

Framework 3 to the Atlantic Herring FMP

DRAFT Appendix II:

Calculating 2014-2015 RH/S Catch Cap Options for the Atlantic Herring Fishery

Prepared by the NEFMC Herring Plan Development Team, September 2013

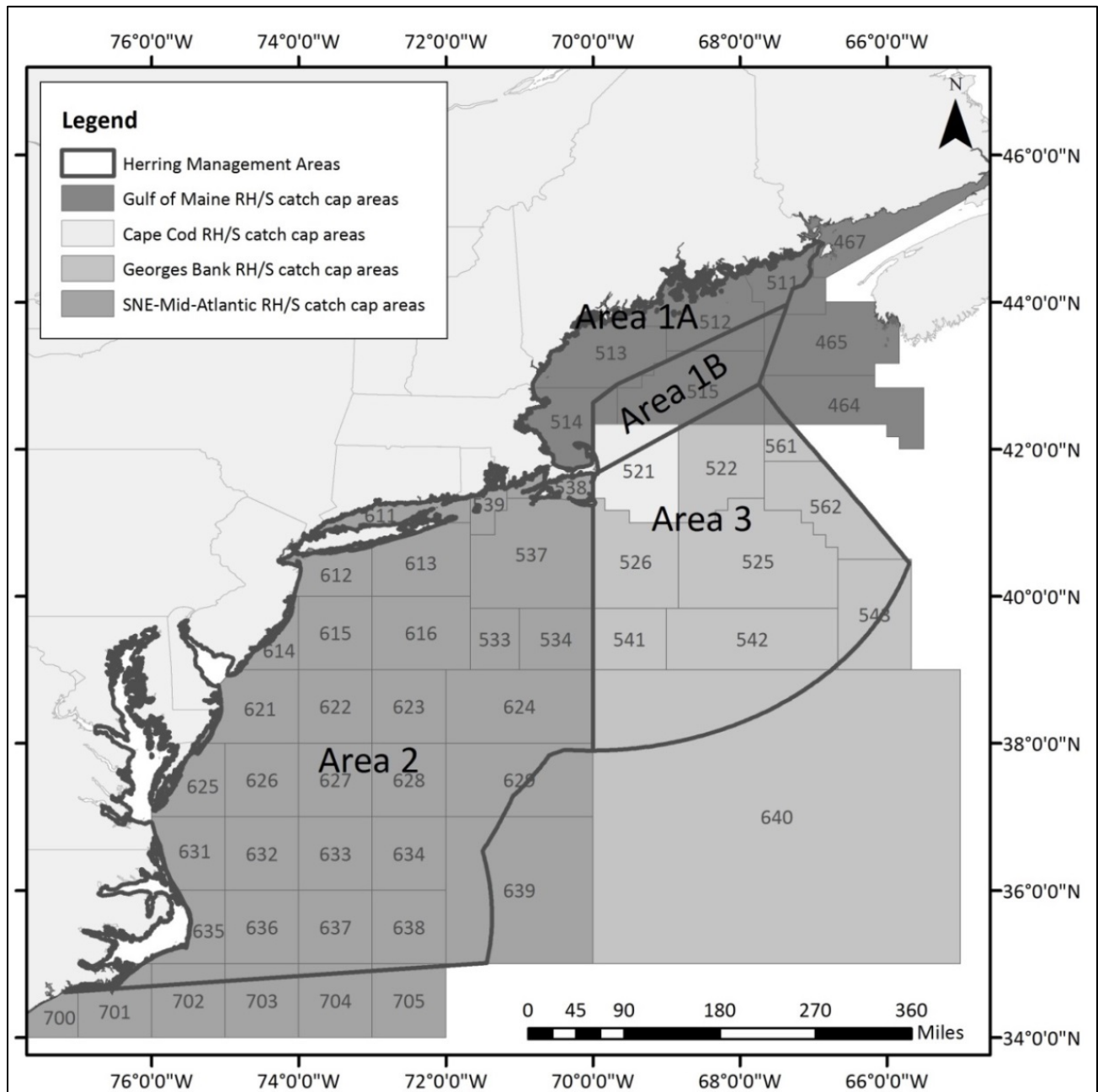
This document describes the Herring PDT's approach to developing a range of options for river herring and shad (RH/S) catch caps in the Atlantic herring fishery during 2014 and 2015. The options under consideration will be implemented in Framework 3 to the Atlantic Herring Fishery Management Plan (FMP). For the purposes of this document, the term "river herring" refers to the species of alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), and the term "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." Catch refers to landings and discards. The Council is proposing to set RH/S catch caps in one or more of the shaded areas shown in Figure 1. Management provisions related to the RH/S catch caps are described in the Draft Framework 3 discussion document.

1.0 BACKGROUND

Atlantic herring fishery data from 2008-2012 were provided to the Herring PDT by NERO as a basis for developing the catch cap options for 2014 and 2015. These data appear in Appendix I to Framework 3. The tables in Appendix I are similar to the table considered by the Mid-Atlantic Council for the RH/S catch cap for the Atlantic mackerel fishery in that they summarize RH/S catch on NEFOP-observed trips landing more than 6,600 pounds of herring from 2008-2012. They provide detailed information about RH/S catch on observed "catch cap trips" by gear type, catch cap area, and year. The RH/S catch ratio for each gear type/year/area was expanded to derive a total RH/S catch based on methods similar to those utilized to monitor the butterfish catch cap. Mean, median, 75th percentile, high, and low values were provided (see Appendix I for more information).

The Herring PDT reviewed the data provided in Appendix I and agreed that the RH/S catch information from ME DMR and MA DMF portside sampling programs, as well as additional ME DMR sea sampled trips, should be incorporated into the data used to develop the options for the 2014-2015 RH/S catch caps in the herring fishery. Analyses by the Herring PDT (Amendment 5, also provided in Section 4.0 of this document) and ME DMR (ongoing work) indicate that there is no significant difference between river herring catch estimates derived from sea sampling versus portside sampling on fully-sampled trips. Adding these trips to the database will increase the sample size for some of the strata and should reduce the uncertainty and size of the confidence intervals associated with the expanded RH/S catch estimates. This will lead to catch estimates (and RH/S caps for 2014 and 2015) that are based on the best available fishery information.

Figure 1 Proposed RH/S Catch Cap Areas (Framework 3)



**This figure will be updated for the Final Framework 3 document.*

2.0 SUMMARY OF AVAILABLE DATA

Table 1 summarizes the total number of “RH/S catch cap trips” taken by gear type and management area from 2008-2012, i.e., those trips landing more than 6,600 pounds of Atlantic herring. More detailed information related to these trips can be found in Appendix I of Framework 3. Table 2 summarizes sampling levels for the RH/S catch cap trips from 2008-2012 using the master dataset constructed by the Herring PDT. This table includes catch data from NEFOP (sea sampling), MA DMF portside sampling, ME DMR portside sampling, and ME DMR sea sampling. Data from all sampled trips shown in Table 2 were utilized to derive the catch cap estimates for 2014-2015, based on methods similar to those utilized by NERO to monitor the butterfish catch cap in the Atlantic mackerel fishery (see discussion in the following section). Table 3 provides a comparison between Table 1 and Table 2 and summarizes sampling levels across gear type and catch cap areas.

Table 1 Total Number of Trips Landing Greater Than 6,600 Pounds of Atlantic Herring by Gear Type and Catch Cap Area, 2008-2012

	GOM	CC	GB	SNE/MA	Total
Bottom Trawl	80	0	11	513	604
Midwater Trawl	402	176	581	687	1,846
Purse Seine	1,213	1	4	0	1,218
Total	1,695	177	596	1,200	3,668

Source: NMFS NERO.

Table 2 Sampled RH/S Catch Cap Trips by Strata, 2008-2012 (NEFOP, ME DMR, MA DMF)

NEFOP At-Sea Observed Cap Trips*							
<i>* only includes trips with >6,600 lbs herring</i>							
Gear	Cap Area	2008	2009	2010	2011	2012	Total
Bottom Trawl	GOM	0	0	0	0	2	2
	SNE/MA	1	8	7	17	19	52
Midwater Trawl	CC	11	9	23	11	36	90
	GB	12	33	78	77	114	314
	GOM	16	40	40	25	8	129
	SNE/MA	24	26	34	34	22	140
Purse Seine	GOM	24	35	22	51	35	167
	Total	88	151	204	215	236	894
MADMF Portside Observed Cap Trips*							
<i>* only includes trips with >6,600 lbs herring that were not also sampled at-sea by NEFOP</i>							
Gear	Cap Area	2008	2009	2010	2011	2012	Total
Bottom Trawl	SNE/MA	0	0	0	9	52	61
Midwater Trawl	CC	3	0	2	0	6	11
	GB	0	0	0	9	13	22
	GOM	9	3	11	4	4	31
	SNE/MA	0	6	5	5	17	33
Purse Seine	GOM	0	3	0	0	0	3
	Total	12	12	18	27	92	161
MEDMR Portside Observed Cap Trips*							
<i>* only includes trips with >6,600 lbs herring that were not also sampled at-sea by NEFOP</i>							
Gear	Cap Area	2008	2009	2010	2011	2012	Total
Bottom Trawl	SNE/MA	0	0	0	2	3	5
Midwater Trawl	CC	0	0	0	0	1	1
	GB	0	0	0	0	1	1
	SNE/MA	0	1	0	0	0	1
Purse Seine	GOM	0	0	0	2	4	6
	Total	0	1	0	4	9	14
MEDMR At-Sea Observed Cap Trips*							
<i>* only includes trips with >6,600 lbs herring that were not also sampled at-sea by NEFOP</i>							
Gear	Cap Area	2008	2009	2010	2011	2012	Total
Bottom Trawl	GOM	0	0	3	1	2	6

**If a trip occurred in multiple cap areas, it was assigned to the area where the majority of the catch occurred (for portside-sampled trips) or was split into separate sub-trips (for sea-sampled trips).*

Table 3 Summary of Catch Cap Trip Sampling by Area and Gear Type, 2008-2012

	Catch Cap Trips Taken 2008-2012				
	GOM	CC	GB	SNE/MA	Total
Bottom Trawl	80	0	11	513	604
Midwater Trawl	402	176	581	687	1,846
Purse Seine	1,213	1	4	0	1,218
Total	1,695	177	596	1,200	3,668
	Catch Cap Trips Sampled 2008-2012				
	GOM	CC	GB	SNE/MA	Total
Bottom Trawl	8	0	0	118	126
Midwater Trawl	160	102	337	174	773
Purse Seine	176	0	0	0	176
Total	344	102	337	292	1,075

3.0 HERRING PDT METHODS FOR ESTIMATING 2014/2015 RH/S CATCH CAPS

To develop the 2014-2015 RH/S catch cap options, the Herring PDT created a master dataset that includes observed catch cap trips from 2008-2012 from the NEFOP, ME DMR, or MA DMF databases (trip numbers summarized in Table 3 above). Any trip that landed > 6,600 lbs Atlantic herring (AH) where the whole catch was systematically sampled for catch of river herring and shad (RH/S) was included in this analysis (i.e., NEFOP, MADMF, or MEDMR).

For each sampled trip, the amount of RH/S catch (kept and discarded) was divided by the total landed catch of all species (“kept-all”) to derive a RH/S catch ratio. The mean RH/S catch ratio was then calculated for each year, gear, and area combination. These ratios were then multiplied by the total amount of kept-all on all trips that caught >6,600 lbs of Atlantic herring. To account for annual changes in the scale of the fishery, each RH/S amount was further multiplied by an expansion factor, standardized to the 2013-2015 Atlantic herring catch limit (ACL)*. The resulting values represent the estimated amount of RH/S catch that would have occurred in a year, gear, area combination if the fishery operated at the scale of the 2013-2015 Atlantic herring ACL.** Due to the natural variability of RH/S catch estimates and low sample sizes, the confidence intervals for some scaled RH/S catch amounts are quite high (see Figure 2).

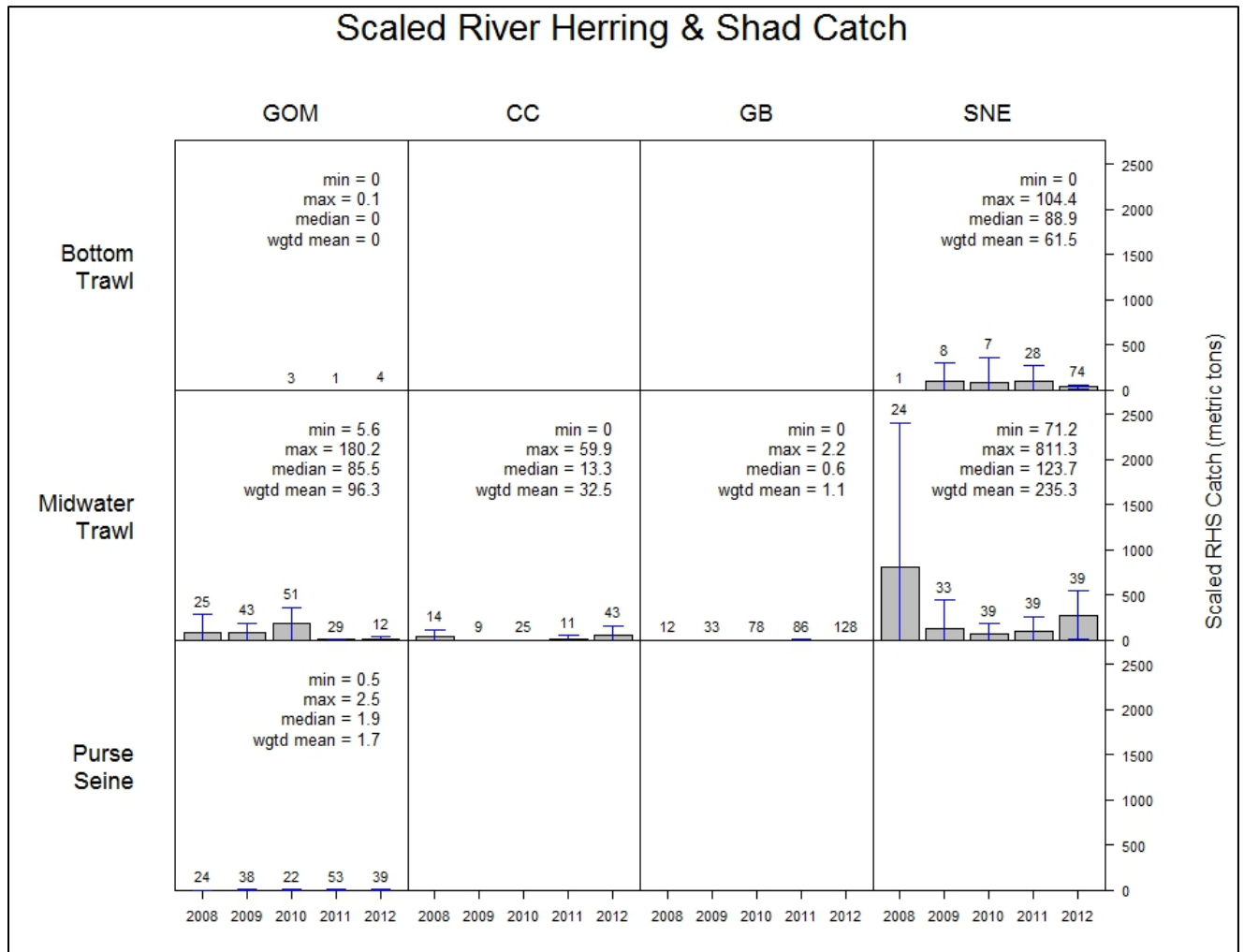
**RH/S cap areas for the GOM, CC, and GB do not coincide with the herring sub-ACL designations; therefore, the expansion factors for these areas were calculated using the ratio of the total ACL in a given year to the total ACL in 2013-2015.*

***Since the RH/S cap area for southern New England/Mid-Atlantic does not coincide with Herring Management Area 2, the expansion factor for SNE/MA was calculated using the ratio of Area 2 herring landings in a given year to the Area 2 sub-ACL for 2013-2015.*

Four options for establishing a 2014/2015 RH/S catch cap were calculated by the Herring PDT, based on the annual scaled catch amounts for each gear and area from 2008-2012:

- 1) *Minimum* – would allow the herring fishery to catch RH/S up to the amount observed in the lowest year, 2008-2012.
- 2) *Maximum* – would allow the herring fishery to catch RH/S up to the amount observed in the highest year, 2008-2012.
- 3) *Median* – would allow the herring fishery to catch RH/S up to the middle annual value, 2008-2012.
- 4) *Mean* – would allow the herring fishery to catch RH/S up to the average annual value, 2008-2012. Because the sampling coverage (and confidence intervals) varied substantially between years, the average value was weighted by the number of samples in each year.

Figure 2 Estimated Annual RH/S Catch (mt) by Gear and Catch Cap Area



*Error bars represent +/- 95% confidence intervals; the values above each error bar represents the number of observed trips.

4.0 2014-2015 RH/S CATCH CAP OPTIONS

The resulting options for the 2014/2015 RH/S catch caps are provided in Table 4 and Table 5 below. Also provided in this document are detailed tables summarizing RH/S catch data and the expanded estimates by year for each strata. A full description of the options and related management measures under consideration can be found in the Draft Framework 3 Discussion Document.

Table 4 Options for 2014/2015 RH/S Catch Caps by Gear Type in the Atlantic Herring Fishery (mt)

Gear	Metric/Option	2014/2015 RH/S Catch Cap Options (MT)			
		GOM	CC	GB	SNE/MA
BOTTOM TRAWL	LOW	0.0	NA	NA	0.0
BOTTOM TRAWL	HIGH	0.1	NA	NA	104.4
BOTTOM TRAWL	MEDIAN	0.0	NA	NA	88.9
BOTTOM TRAWL	WEIGHTED MEAN	0.0	NA	NA	61.5
MIDWATER TRAWL	LOW	5.6	0.0	0.0	71.2
MIDWATER TRAWL	HIGH	180.2	59.9	2.2	811.3
MIDWATER TRAWL	MEDIAN	85.5	13.3	0.6	123.7
MIDWATER TRAWL	WEIGHTED MEAN	96.3	32.5	1.1	235.3
PURSE SEINE	LOW	0.5	NA	NA	NA
PURSE SEINE	HIGH	2.5	NA	NA	NA
PURSE SEINE	MEDIAN	1.9	NA	NA	NA
PURSE SEINE	WEIGHTED MEAN	1.7	NA	NA	NA

**Note that the Herring PDT does not recommend establishing a RH/S catch cap in the Georges Bank Cap Area during 2014 and 2015.*

Table 5 Options for 2014/2015 RH/S Catch Caps by Area (All Gears) in the Atlantic Herring Fishery (mt)

Metric/Option	2014/2015 RH/S Catch Cap Options (MT, All Gears)			
	GOM	CC	GB	SNE/MA
LOW	6.8	0.0	0.0	160.1
HIGH	182.7	59.9	2.2	811.3
MEDIAN	87.7	13.3	0.6	228.1
WEIGHTED MEAN	77.4	32.5	1.1	295.2

**Note that the Herring PDT does not recommend establishing a RH/S catch cap in the Georges Bank Cap Area during 2014 and 2015.*

5.0 ADDITIONAL/SUPPORTING ANALYSIS

5.1 EFFECTS OF ADDITIONAL SAMPLING DATA

Table 6 and Table 7 illustrate the effect of including additional data provided by ME DMR and MA DMF to develop the 2014-2015 RH/S catch cap options. The Herring PDT has noted several times that variability associated with river herring catch estimates is high, particularly as the estimates are disaggregated by stratum (gear type, area, see Figure 2). The addition of portside sampling data increased the sample size in many strata enough to substantially decrease the variability associated with the catch estimates.

Table 6 Changes to the Scaled RH/S Catch Estimates with Additional ME DMR/MADMF Sampling Data

Changes to the Scaled RHS Catch Estimates by including MADMF/MEDMR Data						
Gear	Area	2008	2009	2010	2011	2012
Bottom Trawl	CC					
	GB					
	GOM					-36%
	SNE		0%	0%	-22%	84%
Midwater Trawl	CC	78%		2%	0%	-12%
	GB			0%	-9%	12%
	GOM	1%	-5%	21%	-4%	-22%
	SNE	0%	-16%	-8%	-4%	-16%
Purse Seine	CC					
	GB					
	GOM	0%	44%	0%	-4%	-10%
	SNE					

Table 7 Changes to the CVs Associated with the Scaled RH/S Catch Estimates with Additional ME DMR/MADMF Sampling Data

Changes to the CV of Scaled RHS Catch Estimates by including MADMF/MEDMR Data						
Gear	Area	2008	2009	2010	2011	2012
Bottom Trawl	CC					
	GB					
	GOM					-27%
	SNE		0%	0%	-22%	-65%
Midwater Trawl	CC	-37%		-9%	0%	-4%
	GB			0%	-2%	-5%
	GOM	-33%	-1%	-10%	-10%	-15%
	SNE	0%	-6%	-4%	-9%	-28%
Purse Seine	CC					
	GB					
	GOM	0%	-4%	0%	0%	0%
	SNE					

5.2 SUMMARY DATA BY YEAR/GEAR/AREA

Table 8 – Table 11 provide summary data by year, gear type, and area (based on the RH/S catch cap areas proposed in Framework 3 and shown in Figure 1 on p.2 of this document). These tables include all available sea sampling and portside sampling data from 2008-2012 and form the basis for the catch cap options under consideration for 2014 and 2015.

The proposed RH/S cap areas for the GOM, CC, and GB do not coincide with the herring sub-ACL management areas; therefore, the expansion factors for these areas are calculated using the ratio of the total ACL in a given year to the total ACL in 2013-2015 (107,800 mt). Since the RH/S cap area for southern New England/Mid-Atlantic does coincide with Herring Management Area 2, the expansion factor for SNE/MA was calculated using the ratio of Area 2 herring landings in a given year to the Area 2 sub-ACL for 2013-2015 (30,000 mt). Expansion factors are shown in the following tables.

Table 8 Summary Data by Year and Gear Type for Trips in the GOM Catch Cap Area, 2008-2012

		A	B	C	D	E	F	G	H	I
Year	Gear	Total Atlantic Herring Landings (mt) on Cap Trips (>6,600 lb)	Total Landings (mt) All Species on Cap Trips	Total # Cap Trips	# of Obs Cap Trips	% of Obs Cap Trips (D/C)	RH/S Catch Ratio: Obs vs. Kept Catch on Obs Cap Trips	Estimated RH/S Catch (mt) Butterfish Method (B x F in mt)	Expansion Factor (107,800/ACL)	RH/S Catch (mt) Scaled for 2013-2015 ACL (GxH)
2008	BOTTOM TRAWL	32.3	32.3	5	0	0%				
2009	BOTTOM TRAWL	94.4	98.5	18	0	0%				
2010	BOTTOM TRAWL	104.3	108.8	24	3	13%	0.0001	0.0	1.18	0.0
2011	BOTTOM TRAWL	27.4	31.2	7	1	14%	0.0000	0.0	1.15	0.0
2012	BOTTOM TRAWL	110.1	116.1	26	4	15%	0.0006	0.1	1.19	0.1
2008	MIDWATER TRAWL	17,413.7	17,422.0	87	25	29%	0.0069	121.1	0.75	91.0
2009	MIDWATER TRAWL	22,715.8	22,721.1	115	43	37%	0.0050	113.6	0.75	85.5
2010	MIDWATER TRAWL	18,587.6	18,628.1	109	51	47%	0.0082	152.4	1.18	180.2
2011	MIDWATER TRAWL	13,002.2	13,002.2	66	29	44%	0.0004	4.9	1.15	5.6
2012	MIDWATER TRAWL	4,257.9	4,258.4	25	12	48%	0.0017	7.2	1.19	8.6
2008	PURSE SEINE	24,985.9	25,200.0	243	24	10%	0.0000	0.7	0.75	0.5
2009	PURSE SEINE	21,680.6	21,694.2	225	38	17%	0.0001	3.0	0.75	2.3
2010	PURSE SEINE	8,271.7	8,271.7	205	22	11%	0.0003	2.2	1.18	2.5
2011	PURSE SEINE	17,001.2	17,001.3	265	53	20%	0.0001	1.1	1.15	1.2
2012	PURSE SEINE	19,270.4	19,270.6	275	39	14%	0.0001	1.6	1.19	1.9

Table 9 Summary Data by Year and Gear Type for Trips in the Cape Cod Catch Cap Area, 2008-2012

		A	B	C	D	E	F	G	H	I
Year	Gear	Total Atlantic Herring Landings (mt) on Cap Trips (>6,600 lb)	Total Landings (mt) All Species on Cap trips	Total # Cap Trips	# of Obs Cap Trips	% of Obs Cap Trips (D/C)	RH/S Catch Ratio: Obs vs. Kept Catch on Obs Cap Trips	Estimated RH/S catch (mt) Butterfish Method (B x F in mt)	Expansion Factor (107,800/ACL)	RH/S Catch (mt) Scaled for 2013-2015 ACL (GxH)
2008	BOTTOM TRAWL	0.0	0.0	0						
2009	BOTTOM TRAWL	0.0	0.0	0						
2010	BOTTOM TRAWL	0.0	0.0	0						
2011	BOTTOM TRAWL	0.0	0.0	0						
2012	BOTTOM TRAWL	0.0	0.0	0						
2008	MIDWATER TRAWL	7,214.0	7,215.9	39	14	36%	0.0073	52.7	0.75	39.6
2009	MIDWATER TRAWL	2,804.3	2,805.6	16	9	56%	0.0000	0.0	0.75	0.0
2010	MIDWATER TRAWL	5,466.3	5,517.7	41	25	61%	0.0002	1.2	1.18	1.4
2011	MIDWATER TRAWL	5,745.5	5,769.4	28	11	39%	0.0020	11.6	1.15	13.3
2012	MIDWATER TRAWL	12,319.4	12,391.0	52	43	83%	0.0041	50.4	1.19	59.9
2008	PURSE SEINE	0.0	0.0	0						
2009	PURSE SEINE	0.0	0.0	0						
2010	PURSE SEINE	9.1	9.1	1	0	0%				
2011	PURSE SEINE	0.0	0.0	0						
2012	PURSE SEINE	0.0	0.0	0						

Table 10 Summary Data by Year and Gear Type for Trips in the Southern New England/Mid-Atlantic Catch Cap Area, 2008-2012

		A	B	C	D	E	F	G	H	I	J
Year	Gear	Total Atlantic Herring Landings (mt) on Cap Trips (>6,600 lb)	Total Landings (mt) All Species on Cap Trips	Total # Cap Trips	# of Obs Cap Trips	% of Obs Cap Trips (D/C)	RH/S Catch Ratio: Obs vs. Kept Catch on Obs Cap Trips	Estimated RH/S Catch (mt) Butterfish Method (B x F mt)	Total Herring Landings (mt) on All Cap Trips All Gears	Expansion Factor (30,000/H)	RH/S Catch (mt) Scaled for 2013-2015 ACL (HxI)
2008	BOTTOM TRAWL	1,994.2	3,738.6	71	1	1%	0.0000	0.0	22,089	1.36	0.0
2009	BOTTOM TRAWL	4,158.4	6,026.1	134	8	6%	0.0163	98.4	28,272	1.06	104.4
2010	BOTTOM TRAWL	3,749.1	4,672.9	98	7	7%	0.0122	56.9	19,189	1.56	88.9
2011	BOTTOM TRAWL	4,159.6	4,845.3	120	28	23%	0.0097	47.0	13,804	2.17	102.1
2012	BOTTOM TRAWL	4,520.2	5,588.4	90	74	82%	0.0050	28.2	21,305	1.41	39.7
2008	MIDWATER TRAWL	20,094.4	28,598.1	154	24	16%	0.0209	597.4	22,089	1.36	811.3
2009	MIDWATER TRAWL	24,113.4	36,879.1	189	33	17%	0.0032	116.6	28,272	1.06	123.7
2010	MIDWATER TRAWL	15,439.8	22,157.9	116	39	34%	0.0021	45.5	19,189	1.56	71.2
2011	MIDWATER TRAWL	9,644.7	9,798.7	77	39	51%	0.0046	44.9	13,804	2.17	97.6
2012	MIDWATER TRAWL	16,785.1	18,416.2	151	39	26%	0.0107	196.9	21,305	1.41	277.2
2008	PURSE SEINE	0.0	759.7	0							
2009	PURSE SEINE	0.0	0.0	0							
2010	PURSE SEINE	0.0	0.0	0							
2011	PURSE SEINE	0.0	0.0	0							
2012	PURSE SEINE	0.0	0.0	0							

Table 11 Summary Data by Year and Gear Type for Trips in the Georges Bank Catch Cap Area, 2008-2012

		A	B	C	D	E	F	G	H	I
Year	Gear	Total Atlantic Herring Landings (mt) on Cap Trips (>6,600 lb)	Total Landings (mt) All Species on Cap Trips	Total # Cap Trips	# of Obs Cap Trips	% of Obs Cap Trips (D/C)	RH/S Catch Ratio: Obs vs. Kept Catch on Obs Cap Trips	Estimated RH/S catch (mt) Butterfish Method (B x F in mt)	Expansion Factor (107,800/ACL)	RH/S Catch (mt) Scaled for 2013-2015 ACL (GxH)
2008	BOTTOM TRAWL	0.0	119.3	2	0	0%				
2009	BOTTOM TRAWL	89.3	191.5	5	0	0%				
2010	BOTTOM TRAWL	0.0	1.4	1	0	0%				
2011	BOTTOM TRAWL	22.1	53.1	3	0	0%				
2012	BOTTOM TRAWL	0.0	0.0	0						
2008	MIDWATER TRAWL	7,072.4	7,563.5	36	12	33%	0.0000	0.0	0.75	0.0
2009	MIDWATER TRAWL	25,911.1	26,704.7	104	33	32%	0.0000	0.0	0.75	0.0
2010	MIDWATER TRAWL	14,143.5	14,242.0	89	78	88%	0.0001	1.1	1.18	1.3
2011	MIDWATER TRAWL	31,938.1	32,043.6	183	86	47%	0.0001	1.9	1.15	2.2
2012	MIDWATER TRAWL	30,495.5	30,614.9	169	128	76%	0.0000	0.5	1.19	0.6
2008	PURSE SEINE	66.7	66.7	1	0	0%				
2009	PURSE SEINE	0.0	0.0	0						
2010	PURSE SEINE	65.9	65.9	1	0	0%				
2011	PURSE SEINE	0.0	0.0	0						
2012	PURSE SEINE	89.3	89.3	2	0	0%				

**Note that the Herring PDT does not recommend establishing a RH/S catch cap in the Georges Bank Cap Area during 2014 and 2015.*

5.3 PORTSIDE SAMPLING VS. SEA SAMPLING DATA COMPARISON (AMENDMENT 5)

In May 2011, the Herring PDT conducted a study of the comparability of portside sampling and sea sampling methods to estimate the catch of non-target species in the Atlantic herring fishery. To increase sampling coverage and reduce uncertainty, portside sampling programs were initiated in Massachusetts and Maine. The comparability of each sampling program was estimated by two methods – a simulation model as well as empirical data. Furthermore, four different sampling protocols were evaluated: **1) at-sea sampling (AS), 2) portside unsorted sampling (PU), 3) portside sorted sampling (PS), 4) portside lot sampling (PL)**. The comparison focused on midwater trawl vessels because they present a greater challenge in sampling at-sea, thus benefitting the most from additional portside sampled trips.

The simulation method used the R software package to assemble an array of individual fish caught from the three tows, totaling 150 mt in weight. For the purposes of this analysis, the term *bycatch* refers to *retained non-target catch* (i.e., observed/sampled kept catch). To evaluate the sensitivity of each sampling protocol to non-randomly distributed bycatch, two different scenarios were evaluated: 1) similar bycatch per tow and 2) dissimilar bycatch per tow. The simulated hold contained three species: Atlantic herring (target species), river herring (higher abundance bycatch species), and whiting (lower abundance bycatch species). Table 12 presents the hold under each scenario that contained a similar amount of each species and differed only in the concentration of bycatch species in each tow.

Table 12 Percent of Target and Bycatch Species by Weight in Each Tow Under Each Simulation Scenario

Similar Tows Scenario			
	Atlantic herring	river herring	whiting
Tow 1	98.9%	1.0%	0.1%
Tow 2	98.9%	1.0%	0.1%
Tow 3	98.9%	1.0%	0.1%
Total	98.9%	1.0%	0.1%
Dissimilar Tows Scenario			
	Atlantic herring	river herring	whiting
Tow 1	99.89%	0.10%	0.01%
Tow 2	97.40%	2.40%	0.24%
Tow 3	99.41%	0.50%	0.05%
Total	98.9%	1.0%	0.1%

The empirical dataset included a total of 30 midwater trawl trips from 2010-2011 that were identified as being sampled by both at-sea and portside methods. Twenty-four trips were sampled by the portside unsorted sampling method (PU) and six trips were sampled by portside sampling method (PS) methods; five trips were sampled by more than one portside method (PU and PL). In total, the catch of six common species was estimated for each trip and compared across sampling methods (river herring, whiting, American shad, butterfish, haddock and spiny dogfish).

In summary, both the empirical data and the simulation experiment show little disagreement between the PU and AS sampling protocols. The other two portside methods (PS and PL) had inherent biases and were not recommended for use in estimating bycatch. Presently, bycatch estimates in the Atlantic herring fishery are derived from AS sampling alone, and this analysis provides evidence that portside sampling (PU) can be used to effectively increase the sampling coverage of this fishery. Furthermore, these data illustrate that the PU protocol is a far more efficient use of limited resources to achieve an equivalent estimate of bycatch (landed). For example a four to six day trip with 150mt would cost approximately \$350 (two samplers at around \$35/hour for 5 hours) to sample portside, while the AS cost would average around \$5,000 to \$7,000 (one sampler at around \$1200/day). Overall, the portside unsorted sampling protocol presents a useful and cost-effective alternative to estimate the amount of retained bycatch in this fishery.

Additional analysis (ME DMR) will be provided in the final Framework 3 document, if available.