



## New England Fishery Management Council

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**To:** Tom Nies, Executive Director

**From:** Scientific and Statistical Committee

**Date:** August 14, 2020

**Subject:** Terms of Reference – Overfishing levels (OFLs) and acceptable biological catch (ABC) recommendations for Atlantic herring for 2021-2023

The Scientific and Statistical Committee (SSC) met on July 29, 2020 via webinar to address the following term of reference (TOR):

Review information provided by the Council's Herring Plan Development Team (PDT), the results of the recent Atlantic herring management track assessment, and using the acceptable biological catch (ABC) control rule selected by the Council in Amendment 8, recommend the overfishing level (OFL) and the ABCs for Atlantic herring for 2021-2023.

To address this TOR, the SSC considered the following information:

1. 2020 Management Track Assessment for Atlantic Herring, Preliminary Report Final report
  - a. 2020 Management Track Assessment for Atlantic Herring, Changes to Projection Methodology
    - b.-i. Several PDFs of assessment model output
    - j. 2020 Management Track Peer Review Committee Report
2. Presentation slides, 2020 Management Track Assessment
3. Herring PDT Report (Draft)
4. Presentation slides, PDT Report
5. SSC Final Report for Atlantic Herring Specifications (2019-2021), November 2018
6. Risk Policy Roadmap and Matrix - July 2020
7. State of the Ecosystems Reports for the Northeast U.S. Shelf (NOAA/NEFSC)

### **SSC Attendance**

A. Birkenbach, M. Carroll, Y. Chen, J. Collie, K. Friedland, A. Jordaan, J. Maguire, J. McNamee, R. Merrick, A. Pershing, F. Serchuk, P. Sullivan, L. Williams

### **SSC Response**

The SSC received a thorough overview of the management track assessment from Dr. Jon Deroba detailing the available fishery dependent and independent data, updated analyses, stock assessment results, calculation of reference points, recommendations regarding the stock status, and stock projections. The SSC also received a report on the PDT analyses from Dierdre Boelke, including the herring PDT recommendations for OFL and ABC for 2021-2023.

The results of the Atlantic herring management track stock assessment indicated that the stock status for Atlantic herring was overfished but overfishing was not occurring. The stock assessment used the Age Structured Assessment Program (ASAP) which was used in previous assessments, with no structural

changes. Short-term projections of future stock status were carried out using ASAP and assumed that age 1 recruitment was derived from the estimated recruitments for 1965 – 2017 for FY2021-2023 and the last five years for initial conditions in 2020 (2015-2019). The key concern for this stock is the relatively poor recruitment in 2013-2019. If the estimated recent low recruitment continues, then the spawning stock biomass (SSB) is likely to remain relatively low in the near term, putting the stock at relatively high risk for continued overfished status in years 2021-2023.

The ABC recommendations made by the PDT were based on the Council-selected ABC control rule which was informed by a management strategy evaluation (MSE) process. The control rule is biomass based, with a maximum fishing mortality of 80%  $F_{MSY}$  proxy when biomass is greater than 50%  $SSB/SSB_{MSY}$ . When biomass falls below this threshold, fishing mortality declines linearly until 10%  $SSB/SSB_{MSY}$ , when fishing mortality is set to zero, or a fishery cutoff at 0.1. The ABC control rule was applied to projected biomass estimates for 2021-2023.

The SSC was prepared to implement the harvest control rule selected through the Amendment 8 MSE process. However, the SSC had reservations about the projections for Atlantic herring and were concerned about the assumptions regarding future recruitment, though noted that previous work indicated that the impact of low recruitment within the window of the short term projections did not have strong impacts on the catch advice generated from the control rule. The SSC noted that age 1 recruitment in projections for 2021-2023 was drawn from 1965-2015 and the resulting projected biomass showed a substantial increase in the third year of the projection relative to the earlier years of the projection. The SSC considered that the projected increase in biomass in 2023 was uncertain and were concerned about setting ABC based on this value. Following a discussion on this topic, the SSC resolved to make ABC recommendations for 2021 and 2022 based on the ABC control rule and ASAP projections, but recommended keeping ABC in 2023 the same as 2022 due to the uncertainty in recruitment assumptions underlying the projections. However, the SSC recommended that the OFL be set to follow the projections for all three years of the advice.

The use of the reduced ABC in 2023 is consistent with the SSC's role in accounting for scientific uncertainty. It acknowledges that the projections are sensitive to the assumptions around recruitment. The SSC discussed that the Gulf of Maine and Georges Bank is considerably warmer than during most of the 1965-2015 period and that there may be other environmental factors that could be controlling herring recruitment. In carrying the 2022 ABC into 2023 instead of using the projections, the SSC is following the practice it developed in 2018. During that meeting, Dr. Deroba reran the projections using a more conservative recruitment assumption. Applying the harvest control rule to the final year of that projection led to an ABC that was similar to carrying the second year value forward. This suggests that the rationale of adding an additional uncertainty buffer onto the third year by holding it static is an appropriate way to handle scientific uncertainty for the herring stock.

The SSC supported the New England Fishery Management Council (NEFMC) and Northeast Fisheries Science Center's (NEFSC) scheduled management track assessment in 2022. This management track assessment should verify the projected trend in biomass and provide information for the 2023 – 2024 specifications based on more informed estimates of recent recruitment. The SSC wanted to emphasize the need for this scheduled management track assessment as it was an important factor in the deliberations.

In response to TOR1, OFL and ABC values (expressed in metric tons) resulting from these deliberations are as follows:

<b>Year</b>	<b>OFL</b>	<b>ABC</b>
2021	23,423	9,483
2022	26,292	8,767
2023	44,600	8,767

The SSC wanted to highlight a couple areas that need additional research. Continuing to investigate the mechanisms that are driving the current low recruitment are important. This could involve things like researching environmental linkages to recruitment such as temperature drivers or predation effects. Additionally, a dedicated acoustic survey for this schooling pelagic species may improve and supplement the existing trawl survey information as a source for abundance information for the stock. Finally, the SSC lauds the NEFSC and the NEFMC PDT for their continued work to incorporate social and economic science into the materials provided for this species. In particular, the risk policy matrix is an important tool to summarize the factors to be considered across scientific disciplines. The SSC recommends continuing to build social, cultural, and economic information out by focusing in on the potential impact of management decisions for Atlantic herring and the impacts on other fisheries and economic activities in the region, including possible distributional effects. Of note in this regard is the fact that there are impacts on other fisheries not managed by the NEFMC that could be folded into this focus, for instance looking at interactions with species such as Atlantic striped bass and the tuna species. Some of these connections are touched on through reference to the role Atlantic herring play in the larger ecosystem and the interactions with habitat and other managed species, but could be built out further to assist decision making about this species in the larger social-ecological context in line with Magnuson-Stevens Act (MSA) National Standards and other requirements.

The SSC recognized that the fixed-net herring fishery necessitated a somewhat ad hoc procedure for specifying biological reference points based on the selectivity of the mobile gear fishery. During the management track assessment, it wasn't possible to resolve this potential inconsistency. However, the ASAP model for herring now incorporates both fleets separately. As the percentage of catch caught by the fixed-gear fleet increases, it will become more important to separately account for the fixed-gear fishery. The herring peer-review panel recommended modifying the approach for estimating reference points by explicitly including the fishing mortality rate for the fixed-gear fleet. The result would be a contour plot of SPR for combinations of  $F_{\text{mobile}}$  and  $F_{\text{fixed}}$ ; one of these contours is  $SSB_{40\%}$ . The equations for making these calculations have been derived in the context of multispecies models, in which predation mortality represents the additional fleet.

### **Summary of recommendations**

1. The SSC recommends an OFL for Atlantic herring of 23,423 mt in 2021, 26,292 mt in 2022, and 44,600 mt in 2023.
2. The SSC recommends the ABC for Atlantic herring should not exceed 9,483 mt in 2021, 8,767 mt in 2022, and 8,767 mt in 2023.
3. The SSC recommends a management track stock assessment for Atlantic herring in 2022 based on the recent benchmark assessment.
4. The SSC recommends further investigation into understanding the recent low recruitment of Atlantic herring and possible drivers.

5. The SSC recommends investing in an acoustic survey for this species to better understand abundance trends.
6. The SSC recommends continued build out of the social science information (social, cultural, economic) for this species to better contextualize its role in the larger social-ecological system. This should include a focus on inter-species interactions, taking into account species not managed by the NEFMC including but not limited to striped bass and tuna.

## **APPENDIX II – Background analyses of herring and mackerel incidental catch limits and seasonal fishing effort**

1.0	Background Information on the Mackerel Resource and Fishery.....	2
1.1	Current regulations related to declaring into the herring and/or mackerel fisheries.....	2
1.2	Atlantic Herring reg text (now that FW6 is implemented): .....	2
1.3	Atlantic Mackerel reg text .....	2
1.4	Current incidental possession limits in the herring and mackerel fisheries, review of in-season actions that have been implemented, and summary of catches to date .....	3
1.5	Summary of the relationship between menhaden and herring .....	8
1.6	Initial input on range of alternatives.....	8
1.6.1	Measures to adjust the herring in-season possession limit.....	8
1.6.2	Measures to adjust the seasonal closure of Area 1B .....	8
2.0	Herring Incidental Trip Limit Analysis .....	9
2.1	Background.....	9
2.2	Herring Trips Remaining After sub-ACL Closure .....	9
2.3	Herring Trip Limit Analysis.....	13
2.3.1	Seasonal Herring Trip Landings by Area .....	13
2.3.2	Herring Landings vs. Total Trip Value.....	15
2.3.3	Additional Herring Incidental Trip Limit Analysis .....	18
3.0	Monthly herring and mackerel revenue.....	20

# 1.0 BACKGROUND INFORMATION ON THE MACKEREL RESOURCE AND FISHERY

## 1.1 CURRENT REGULATIONS RELATED TO DECLARING INTO THE HERRING AND/OR MACKEREL FISHERIES

Vessels participating in the Atlantic herring fishery with a limited access herring permit (Categories A, B, or C) or an Areas 2-3 open access herring permit (Category E) must declare into the herring fishery via the vessel monitoring system (VMS) prior to leaving port. A vessel can declare into the herring fishery with the HER or HMS codes or by indicating that it is retaining herring when participating in the Atlantic mackerel (e.g., MAH, MHS) or squid fisheries (e.g., SLH, LHM, SIH, IHM). The VMS declaration codes for the herring and mackerel fishery are defined in Table 1. If a vessel is declared out of the herring fishery (DOF) prior to leaving port, that vessel may not harvest, possess, or land herring on that trip. Vessels issued Category A, B, C, or E herring permits on a declared herring trip are required to submit a daily catch report and a pre-landing notification via VMS.

Vessels participating in the Atlantic mackerel limited access fishery are required to declare into the fishery via VMS for trips targeting Atlantic mackerel. A vessel can declare into the Atlantic mackerel fishery with the MAC code or by indicating that it is retaining herring when participating in the Atlantic mackerel (e.g., MAH, MHS) or squid fisheries (e.g., HMS, IHM, LHM, MAS). Vessels issued a Tier 1, 2, or 3 Atlantic mackerel permit on a declared mackerel trip are required to submit a daily catch report and a pre-landing notification via VMS.

## 1.2 ATLANTIC HERRING REG TEXT (NOW THAT FW6 IS IMPLEMENTED):

(m) Atlantic herring VMS notification requirements. (1) A vessel issued a limited access herring permit (i.e., Category A, B, or C) or a Category E Herring Permit intending to declare into the herring fishery or a vessel issued a herring permit and intending to declare an Atlantic herring carrier trip via VMS must notify NMFS by declaring a herring trip with the appropriate gear code prior to leaving port at the start of each trip in order to harvest, possess, or land herring on that trip.

(2) A vessel issued a limited access herring permit (i.e., Category A, B, or C) or a Category E Herring Permit or a vessel that declared an Atlantic herring carrier trip via VMS must notify NMFS Office of Law Enforcement through VMS of the time and place of offloading at least 6 hours prior to landing or, if fishing ends less than 6 hours before landing, as soon as the vessel stops catching fish. The Regional Administrator may adjust the prior notification minimum time through publication of a document in the Federal Register consistent with the Administrative Procedure Act.

## 1.3 ATLANTIC MACKEREL REG TEXT

648.10(n) *Limited access Atlantic mackerel VMS notification requirements.* (1) A vessel issued a limited access Atlantic mackerel permit intending to declare into the mackerel fishery must notify NMFS by declaring a mackerel trip prior to leaving port at the start of each trip in order to harvest, possess, or land mackerel on that trip.

(2) A vessel issued a limited access Atlantic mackerel permit intending to land more than 20,000 lb (9.07 mt) of mackerel must notify NMFS of the time and place of offloading at least 6 hr prior to arrival, or, if fishing ends less than 6 hours before arrival, immediately upon leaving the fishing grounds. The Regional Administrator may adjust the prior notification minimum time through publication in the Federal Register consistent with the Administrative Procedure Act.

**Table 1 - VMS Declaration codes for Herring and Atlantic Mackerel**

<b>HER</b>	Herring Trip
<b>HMS</b>	Herring Trip with Mackerel and/or Squid Retention
<b>IHM</b>	Illex Squid Trip with Herring and Mackerel Retention
<b>LHM</b>	Longfin Squid Trip with Herring and Mackerel Retention
<b>MAC</b>	Mackerel Trip
<b>MAH</b>	Mackerel Trip with Herring Retention
<b>MAS</b>	Mackerel Trip with Squid Retention
<b>MHS</b>	Mackerel Trip with Herring and Squid Retention

## **1.4 CURRENT INCIDENTAL POSSESSION LIMITS IN THE HERRING AND MACKEREL FISHERIES, REVIEW OF IN-SEASON ACTIONS THAT HAVE BEEN IMPLEMENTED, AND SUMMARY OF CATCHES TO DATE**

The following tables summarize information about both the herring and mackerel plans. First general background about management programs including permits, accountability measures, and recent allocations is summarized in Table 2. Both fisheries have several permit categories, some with possession limits and some without. Both fisheries account for mortality from the fish caught in Canada, but in slightly different ways. In the Herring FMP, catch from the Canadian weir fishery is taken into account as part of the management uncertainty buffer, after ABC is defined a set amount is set-aside for the weir fishery. If the full set-aside for Canadian catch is not projected to be caught by November of that fishing year, 1,000 mt is allocated back to the US fishery and added to the Area 1A sub-ACL. In the mackerel fishery, Canadian catch is accounted for by reducing the total ABC to get a US ABC. From there, a smaller reduction is taken for management uncertainty as well as recreational catch, and the remaining amount is the commercial ACL.

Both fisheries have in-season accountability measures (AMs) if the commercial catch limits are projected to be harvested. In the herring fishery, when 92% of a sub-ACL, or 95% of the entire ACL is projected to be caught, the directed fishery is closed and a 2,000-pound incidental limit is implemented for that area, or the entire fishery. The mackerel fishery does not have sub-area allocations, and the accountability measure is a two-step process to slow catch down as the fishery approaches the catch limit. When 90% of the mackerel ACL is projected to be caught a possession limit of 40,000 pounds is implemented for all limited access vessels; when 98% of the ACL is projected to be caught a 5,000-pound incidental catch limit is implemented. While these AMs are different, they are both designed to limit directed fishing on the target species to help prevent ACL overages. These percentages consider the current quota and recent trips, so if the quota changed or trips changed substantially the Council may consider modifications to these percentages. Modifying the herring possession limit is one of the measures under consideration in Framework 8.

**Table 2 – Summary of Herring and Mackerel management and recent allocations for fishing years 2019-2020**

	Herring FMP	Mackerel FMP			
Limited Entry	June 2007 (Amendment1)	2011 (Amendment11)			
Permit Categories	A - LA all areas, no limit	Tier 1 - LA, no limit			
	B - LA Areas 2 and 3 only, no limit	Tier 2 - LA, 135,000 lb.			
	C - LA all areas, 55,000 lb.	Tier 3 - LA 100,000 lb.			
	D - OA all areas, 6,600 lb.	Open Access - 20,000 lb. limit			
	E - OA Areas 2 and 3, 20,000 lb.				
2019	Herring	Mackerel	2020	Herring	Mackerel
OFL	30,668 mt	31,764 mt	OFL	41,830 mt	N/A
ABC (also mackerel ACL)	21,266 mt	29,184 mt (US ABC = 19,184)	ABC (also wckerel ACL)	16,131 mt	29,184 mt (US ABC = 19,184)
Canadian deduction	N/A (see MU)	10,000 mt	Canadian deduction	N/A (see MU)	10,000 mt
Management Uncertainty	6,200 mt 10-year avg of CA weir catch (CA catch, discards, state water catch)	539 mt (3% reduction - accounts for imprecisely estimated discards and/or potential quota over-runs)	Management Uncertainty	4,560 mt 10-year avg of CA weir catch (CA catch, discards, state water catch)	537 mt (3% reduced from 10% when in-season AM changed)
ACL or DAH	15,065 mt	17,371 mt	ACL or DAH	11,571 mt	17,312 mt
Recreational catch	N/A	1,209 mt	Recreational catch	N/A	1,270 mt
Directed fishery closure	95% of ACL and 92% of each sub-ACL	Step 1: 90% of ACL Step 2: 98% of ACL	Previously, before Framework 12, when 95% of ACL reached, all have 20,000 lb		
Incidental limit post closure	2,000 lb. when either limit reached	Step 1: 40,000 lb. Step 2: 5,000 lb.	And when 100% of ACL reached, possession limit of 0.		
LA – limited access      OA – open access      OFL – overfishing limit ABC – acceptable biological catch      MU – management uncertainty ACL – annual catch limitDAH – domestic annual harvest CA - Canadian					

The in-season AMs for sub-ACLs have been triggered numerous times in the herring fishery since they were adopted in 2011. Table 3 summarizes the in-season actions related to triggering lower possession limits that



have taken place in both the herring and mackerel fisheries. In some cases, these in-season actions have likely impacted fishing of other species, particularly when they are implemented earlier in the fishing season. The current measures for closing mackerel due to mackerel catches have not been tested (recent closures have been due to the RH/S cap

**Table 3 – Summary of in-season actions implemented in the herring and mackerel (in gray) plans**

<b>Year</b>	<b>Month</b>	<b>FMP</b>	<b>AM triggered</b>
2012	February	Herring	Herring Management Area 2 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	October	Herring	Herring Management Area 3 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	November	Herring	Herring Management Area 1A sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
2013	April	Herring	Herring Management Area 2 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	October	Herring	Herring Management Area 1A sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	October	Herring	Herring Management Area 3 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
2014	May	Herring	Herring Management Area 1B sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	September	Herring	Herring Management Area 3 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	October	Herring	Herring Management Area 1A sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
2015	October	Herring	GB Haddock AM triggered – closure to MWT gear in GB Haddock stock area
	October	Herring	Herring Management Area 1A sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
2016	November	Herring	Herring Management Area 1B sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
2018	February	Mackerel	RH/S catch cap reached for mackerel fishery – mackerel incidental limit at 20,000 pounds.
	March	Herring	RH/S catch cap reached for MWT vessels in MA/SNE catch cap area – herring incidental limit at 2,000 lb. in that area.
	October	Herring	Herring Management Area 1B sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	December	Herring	RH/S catch cap reached for MWT vessels in MA/SNE catch cap area – herring incidental limit at 2,000 lb. in that area.
2019	March	Herring	Herring Management Area 2 sub-ACL reached – herring incidental limit of 2,000 lb. in that area.
	March	Mackerel	RH/S catch cap reached for mackerel fishery – mackerel incidental limit at 20,000 pounds.

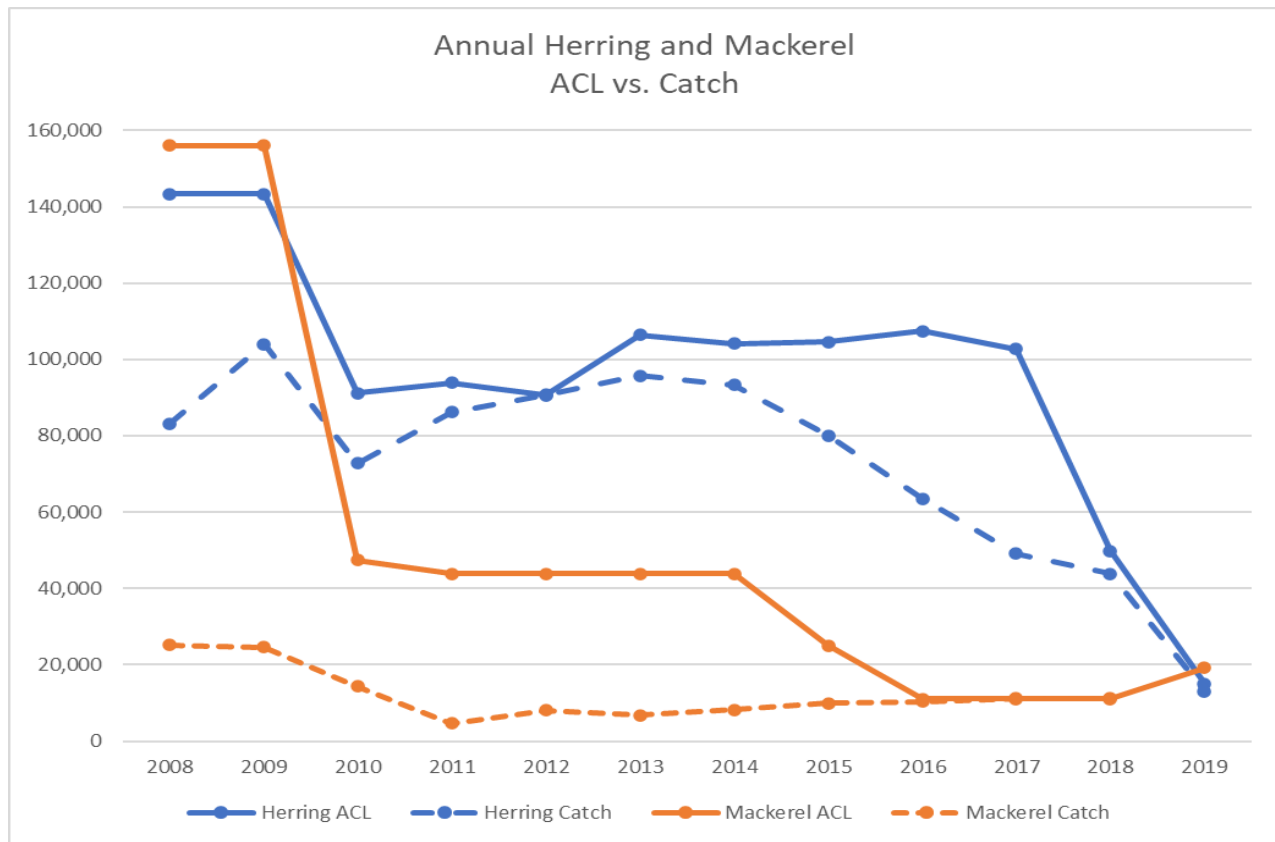
There are numerous reasons why a fishery does not harvest their full ACL. Table 4, Figure 1 and Figure 2 below compare the allocated ACLs and actual catches for both the herring and mackerel fisheries. The in-season actions, and dates they were implemented in these fisheries have been included in Table 4 as well. It is possible that these in-season actions had a role in preventing one fishery or the other from harvesting the full ACL; however, each fishing year is unique with different circumstances influencing fishing effort levels including factors not related to management such as market demand, weather, effort in other fisheries,

resource availability, etc. These analyses have been provided as background, and not to suggest that in-season accountability measures alone are the only reason a fishery has not been able to harvest ACLs. In some cases, both fisheries have been very close to harvesting the full ACL, particularly in more recent years as ACLs have declined.

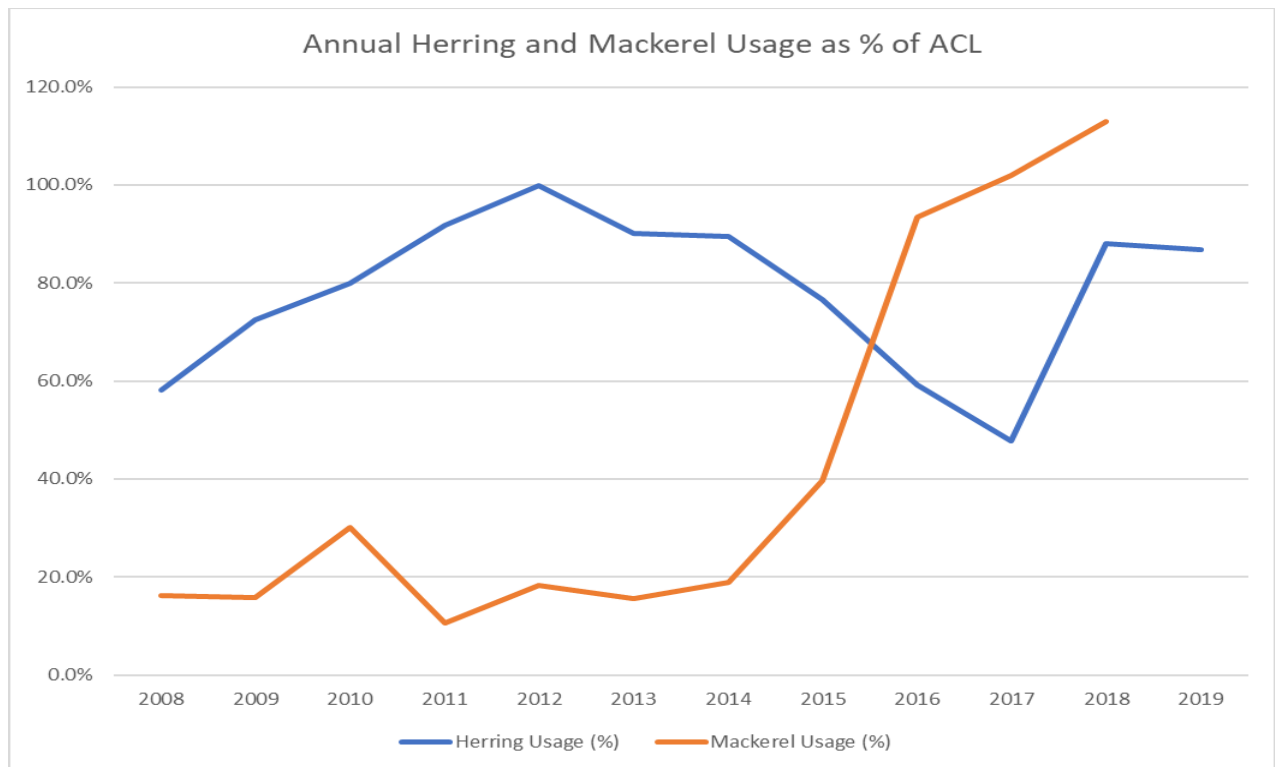
**Table 4 – Summary of herring and mackerel ACL and final catches (2008-2019) as well as in-season actions implemented each year including date of implementation**

FY	Herring ACL	Herring Catch	Usage (%)	Mackerel ACL	Mackerel Catch	Usage (%)	<i>In-season actions that were implemented (with date)</i>
2008	143,350	83,240	58.1%	156,000	25,212	16.2%	
2009	143,350	103,943	72.5%	156,000	24,529	15.7%	
2010	91,200	72,851	79.9%	47,395	14,261	30.1%	
2011	93,905	86,245	91.8%	43,781	4,610	10.5%	
2012	90,683	90,561	99.9%	43,781	8,037	18.4%	<i>Herring Area 2 (2/17), Area 3 (10/3) and Area 1A (11/2) closed early</i>
2013	106,375	95,764	90.0%	43,781	6,799	15.5%	<i>Herring Area 2 (4/14), Area 1A (10/11) and Area 3 (10/21) closed early</i>
2014	104,088	93,247	89.6%	43,781	8,252	18.8%	<i>Herring 1B (5/22), Area 3 (9/18) and Area 1A (10/23) closed early</i>
2015	104,566	80,011	76.5%	25,039	9,905	39.6%	<i>GB haddock catch cap in-season AM (10/20), Herring Area 1A closed early (10/29)</i>
2016	107,360	63,581	59.2%	11,009	10,277	93.4%	<i>Herring Area 1B closed early (11/15)</i>
2017	102,656	49,072	47.8%	11,009	11,230	102.0%	
2018	49,900	43,878	87.9%	11,009	11,261	112.9%	<i>RHS:Mack Closure (2/23); RHS:Herr SNE MW closure (3/12), Herring 1B closure (10/22) and RHS:Herr CC MW closure (12/19)</i>
2019	15,065	13,066	86.7%	19,184	*	*	<i>Herring Area 2 closure (3/6) and RHS:Mack closure (3/8)</i>
* Data not available yet							
Source: APSD end of year catch accounting and <a href="#">Atlantic mackerel 2020 data update</a> .							

**Figure 1 – Herring (in blue) and Mackerel (in orange) ACL compared to final catch (2008-2019)**



**Figure 2 - Herring (in blue) and Mackerel (in orange) catch as percent of ACL (2008-2019)**



## 1.5 SUMMARY OF THE RELATIONSHIP BETWEEN MENHADEN AND HERRING

The PDT discussed two items for this tasking item. First, the ASMFC Ecological Reference Point Working Group developed an ecosystem model for Atlantic menhaden. The group is investigating assumptions about the reliance of striped bass on herring, menhaden, and other predator-prey interactions. Initial results suggest that when menhaden populations are low, striped bass may rely more heavily on Atlantic herring. The PDT plans to investigate whether Atlantic herring may be food limited by reviewing trends of herring food sources available in this region based on the larval dataset. Unfortunately, access to these data have been impacted by office closures due to COVID-19, so the PDT has not been able to make progress on this item to date.

## 1.6 INITIAL INPUT ON RANGE OF ALTERNATIVES

### 1.6.1 Measures to adjust the herring in-season possession limit

The PDT has developed several analyses as tools to support the AP and Committee identify a range of alternatives to consider further. Attachment 1 includes more detailed analyses of: 1) the estimated number of trips available after a herring sub-ACL closure; 2) herring trip landings throughout the year; and 3) the relationship between trip herring landings and overall trip value.

### 1.6.2 Measures to adjust the seasonal closure of Area 1B

The PDT has summarized herring and mackerel fishing by month for years prior to 2014 when Area 1B was closed Jan1-Apr30, compared to more recent years. Attachment 2 includes monthly herring and mackerel revenue maps before Area 1B was closed and the years after Area 1B closed (2014-2018). Please note that the scales are different for the different maps. These analyses can be used as a tool to support AP and Committee identify a range of alternatives to consider further.

During the PDT discussion of restrictions during seasonal closures a question came up about whether vessels can harvest herring under incidental levels during seasonal closures of Area 1A (Jan – May) and Area 1B (Jan – Apr). The PDT would like to take this opportunity to clarify these regulations. Regulations at 646.201(d) and (e) describe the seasonal sub-ACLs and state that zero percent of the harvest in Areas 1A and 1B is available early in the year. The regulations do not define harvest, but the standard language for fishing is -- *fishing for, possessing, catching, transferring, or landing*. Therefore, it is prohibited to land herring from the areas with seasonal closures during those periods of time, even under incidental possession limits.

## 2.0 HERRING INCIDENTAL TRIP LIMIT ANALYSIS

Author: Brant McAfee (GARFO), June 2020

### 2.1 BACKGROUND

As part of the Framework 8 process, the Atlantic Herring Committee tasked the Plan Development Team (PDT) to evaluate increasing the herring incidental trip limit from 2,000 lbs. up to 40,000 lbs. Potential incidental trips limits of 2,000, 5,000, 10,000, 20,000, and 40,000 pounds were arbitrarily selected and evaluated across three factors:

1. The estimated number of trips available after a herring sub-ACL closure;
2. Herring trip landings throughout the year; and
3. The relationship between trip herring landings and overall trip value.

Additionally, the Herring Committee met on June 9, 2020 and requested the PDT complete additional analyses to support development of herring incidental trip limit alternatives. These analyses were completed by a sub-set of the PDT before the June 2020 Council meeting.

1. Count of herring and mackerel trip declarations by year (Table 6)
2. Count of vessels and trips landing both herring and mackerel, and proportion of trip that is herring landings when mackerel was also landed (Table ??? and Figure ??? in EA)
3. Plots of herring trip landings by year (2016-2019) for trips landing  $\geq 20K$  or  $\geq 100K$  of mackerel (Figure 19)
4. Evaluate RSA data for identifying incidental possession limits, to the extent possible

*A sub-group of the PDT investigated this issue further. Due to confidentiality issues the results cannot be included in this memo. The group concluded that the data is very narrow in space and time; therefore, the ability to scale up for the full fishery is limited. It was a useful exercise to look at some individual RSA trips, but the results were not different than the fishery wide data for non-RSA trips (See Figure 18). Some trips still had relatively large amounts of herring catch.*

5. Investigate whether an option could be developed that would impose a herring possession limit potentially based on VMS declaration code.

*A sub-group of the PDT recommends that if this is developed further it should not be based on VMS declaration code. Herring permit type may be a better way to monitor possession limits from the start of the fishing year. Some time was spent developing a spreadsheet that identified possible possession limits. The AP and Committee discussed these ideas very generally at the August 2020 meeting and there was limited interest to pursue a possession limit option that would be in place at the start of the year.*

### 2.2 HERRING TRIPS REMAINING AFTER SUB-ACL CLOSURE

We evaluated the potential number of trips available in an area after the closure of directed herring fishing under different herring incidental trip limits and closure targets of 75%, 80%, 85%, 90%, and 92%. Each of the five tables below shows the estimated trips remaining in an area after applying these closure targets to 2016-2020 ACLs. It is important to remember that these estimates assume each area would be accurately closed at the specified closure target. These tables were updated with potential 2021 and 2022 sub-ACL values to help show the potential number of trips that would remain under various closure targets. Please note these are NOT the final sub-ACLs for 2021-2022 – they are based on alternatives under consideration in Framework 8, but the final catch values may be different than these values used for illustration purposes.

**Table 1. Estimated Remaining Trips by Area, 2016-2022: 75% Closure Target**

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2016	1A	30,524	22,893	7,631	8,412	3,365	1,682	841	421
2016	1B	2,844	2,133	711	784	313	157	78	39
2016	2	31,227	23,420	7,807	8,606	3,442	1,721	861	430
2016	3	42,765	32,074	10,691	11,785	4,714	2,357	1,178	589
2017	1A	32,115	24,086	8,029	8,850	3,540	1,770	885	443
2017	1B	4,825	3,619	1,206	1,329	532	266	133	66
2017	2	31,227	23,420	7,807	8,606	3,442	1,721	861	430
2017	3	43,873	32,905	10,968	12,090	4,836	2,418	1,209	605
2018	1A	28,038	21,028	7,010	7,727	3,091	1,545	773	386
2018	1B	2,639	1,979	660	728	291	146	73	36
2018	2	8,200	6,150	2,050	2,260	904	452	226	113
2018	3	11,318	8,488	2,830	3,120	1,248	624	312	156
2019	1A	5,223	3,917	1,306	1,440	576	288	144	72
2019	1B	628	471	157	173	69	35	17	9
2019	2	4,062	3,046	1,016	1,120	448	224	112	56
2019	3	5,700	4,275	1,425	1,571	628	314	157	79
2020	1A	3,214	2,410	804	886	355	177	89	44
2020	1B	483	362	121	133	53	27	13	7
2020	2	3,120	2,340	780	860	344	172	86	43
2020	3	4,378	3,284	1,094	1,206	482	241	121	60
2021	1A	1,264	948	316	348	139	70	35	17
2021	1B	188	141	47	52	21	10	5	3
2021	2	1,216	912	304	335	134	67	34	17
2021	3	1,705	1,279	426	470	188	94	47	23
2022	1A	1,057	793	264	291	116	58	29	15
2022	1B	157	118	39	43	17	9	4	2
2022	2	1,017	763	254	280	112	56	28	14
2022	3	1,426	1,070	356	392	157	78	39	20

**Table 2. Estimated Remaining Trips by Area, 2016-2022: 80% Closure Target**

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2016	1A	30,524	24,419	6,105	6,730	2,692	1,346	673	336
2016	1B	2,844	2,275	569	627	251	125	63	31
2016	2	31,227	24,982	6,245	6,884	2,754	1,377	688	344
2016	3	42,765	34,212	8,553	9,428	3,771	1,886	943	471
2017	1A	32,115	25,692	6,423	7,080	2,832	1,416	708	354
2017	1B	4,825	3,860	965	1,064	425	213	106	53
2017	2	31,227	24,982	6,245	6,884	2,754	1,377	688	344
2017	3	43,873	35,098	8,775	9,673	3,869	1,935	967	484
2018	1A	28,038	22,430	5,608	6,182	2,473	1,236	618	309
2018	1B	2,639	2,111	528	582	233	116	58	29
2018	2	8,200	6,560	1,640	1,808	723	362	181	90
2018	3	11,318	9,054	2,264	2,496	998	499	250	125
2019	1A	5,223	4,178	1,045	1,152	461	230	115	58
2019	1B	628	502	126	139	56	28	14	7

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2019	2	4,062	3,250	812	895	358	179	90	45
2019	3	5,700	4,560	1,140	1,257	503	251	126	63
2020	1A	3,214	2,571	643	709	284	142	71	35
2020	1B	483	386	97	107	43	21	11	5
2020	2	3,120	2,496	624	688	275	138	69	34
2020	3	4,378	3,502	876	966	386	193	97	48
2021	1A	1,264	1,011	253	279	112	56	28	14
2021	1B	188	150	38	42	17	8	4	2
2021	2	1,216	973	243	268	107	54	27	13
2021	3	1,705	1,364	341	376	150	75	38	19
2022	1A	1,057	846	211	233	93	47	23	12
2022	1B	157	126	31	34	14	7	3	2
2022	2	1,017	814	203	224	90	45	22	11
2022	3	1,426	1,141	285	314	126	63	31	16

**Table 3. Estimated Remaining Trips by Area, 2016-2022: 85% Closure Target**

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2016	1A	30,524	25,945	4,579	5,047	2,019	1,009	505	252
2016	1B	2,844	2,417	427	471	188	94	47	24
2016	2	31,227	26,543	4,684	5,163	2,065	1,033	516	258
2016	3	42,765	36,350	6,415	7,071	2,829	1,414	707	354
2017	1A	32,115	27,298	4,817	5,310	2,124	1,062	531	265
2017	1B	4,825	4,101	724	798	319	160	80	40
2017	2	31,227	26,543	4,684	5,163	2,065	1,033	516	258
2017	3	43,873	37,292	6,581	7,254	2,902	1,451	725	363
2018	1A	28,038	23,832	4,206	4,636	1,855	927	464	232
2018	1B	2,639	2,243	396	437	175	87	44	22
2018	2	8,200	6,970	1,230	1,356	542	271	136	68
2018	3	11,318	9,620	1,698	1,872	749	374	187	94
2019	1A	5,223	4,440	783	863	345	173	86	43
2019	1B	628	534	94	104	41	21	10	5
2019	2	4,062	3,453	609	671	269	134	67	34
2019	3	5,700	4,845	855	942	377	188	94	47
2020	1A	3,214	2,732	482	531	213	106	53	27
2020	1B	483	411	72	79	32	16	8	4
2020	2	3,120	2,652	468	516	206	103	52	26
2020	3	4,378	3,721	657	724	290	145	72	36
2021	1A	1,264	1,074	190	209	84	42	21	10
2021	1B	188	160	28	31	12	6	3	2
2021	2	1,216	1,034	182	201	80	40	20	10
2021	3	1,705	1,449	256	282	113	56	28	14
2022	1A	1,057	898	159	175	70	35	18	9
2022	1B	157	133	24	26	11	5	3	1
2022	2	1,017	864	153	169	67	34	17	8
2022	3	1,426	1,212	214	236	94	47	24	12

**Table 4. Estimated Remaining Trips by Area, 2016-2022: 90% Closure Target**

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2016	1A	30,524	27,472	3,052	3,364	1,346	673	336	168
2016	1B	2,844	2,560	284	313	125	63	31	16
2016	2	31,227	28,104	3,123	3,443	1,377	689	344	172
2016	3	42,765	38,488	4,277	4,715	1,886	943	471	236
2017	1A	32,115	28,904	3,211	3,540	1,416	708	354	177
2017	1B	4,825	4,342	483	532	213	106	53	27
2017	2	31,227	28,104	3,123	3,443	1,377	689	344	172
2017	3	43,873	39,486	4,387	4,836	1,934	967	484	242
2018	1A	28,038	25,234	2,804	3,091	1,236	618	309	155
2018	1B	2,639	2,375	264	291	116	58	29	15
2018	2	8,200	7,380	820	904	362	181	90	45
2018	3	11,318	10,186	1,132	1,248	499	250	125	62
2019	1A	5,223	4,701	522	575	230	115	58	29
2019	1B	628	565	63	69	28	14	7	3
2019	2	4,062	3,656	406	448	179	90	45	22
2019	3	5,700	5,130	570	628	251	126	63	31
2020	1A	3,214	2,893	321	354	142	71	35	18
2020	1B	483	435	48	53	21	11	5	3
2020	2	3,120	2,808	312	344	138	69	34	17
2020	3	4,378	3,940	438	483	193	97	48	24
2021	1A	1,264	1,138	126	139	56	28	14	7
2021	1B	188	169	19	21	8	4	2	1
2021	2	1,216	1,094	122	134	54	27	13	7
2021	3	1,705	1,534	171	188	75	38	19	9
2022	1A	1,057	951	106	117	47	23	12	6
2022	1B	157	141	16	18	7	4	2	1
2022	2	1,017	915	102	112	45	22	11	6
2022	3	1,426	1,283	143	158	63	32	16	8

**Table 5. Estimated Remaining Trips by Area, 2016-2022: 92% Closure Target**

					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2016	1A	30,524	28,082	2,442	2,692	1,077	538	269	135
2016	1B	2,844	2,616	228	251	101	50	25	13
2016	2	31,227	28,729	2,498	2,754	1,101	551	275	138
2016	3	42,765	39,344	3,421	3,771	1,508	754	377	189
2017	1A	32,115	29,546	2,569	2,832	1,133	566	283	142
2017	1B	4,825	4,439	386	425	170	85	43	21
2017	2	31,227	28,729	2,498	2,754	1,101	551	275	138
2017	3	43,873	40,363	3,510	3,869	1,548	774	387	193
2018	1A	28,038	25,795	2,243	2,472	989	494	247	124
2018	1B	2,639	2,428	211	233	93	47	23	12
2018	2	8,200	7,544	656	723	289	145	72	36
2018	3	11,318	10,413	905	998	399	200	100	50
2019	1A	5,223	4,805	418	461	184	92	46	23
2019	1B	628	578	50	55	22	11	6	3
2019	2	4,062	3,737	325	358	143	72	36	18
2019	3	5,700	5,244	456	503	201	101	50	25
2020	1A	3,214	2,957	257	283	113	57	28	14



					Remaining Trips				
Year	Area	Sub-ACL (mt)	Closure Target (mt)	Sub-ACL Remain (mt)	2,000 lbs.	5,000 lbs.	10,000 lbs.	20,000 lbs.	40,000 lbs.
2020	1B	483	444	39	43	17	9	4	2
2020	2	3,120	2,870	250	276	110	55	28	14
2020	3	4,378	4,028	350	386	154	77	39	19
2021	1A	1,264	1,163	101	111	45	22	11	6
2021	1B	188	173	15	17	7	3	2	1
2021	2	1,216	1,119	97	107	43	21	11	5
2021	3	1,705	1,569	136	150	60	30	15	7
2022	1A	1,057	972	85	94	37	19	9	5
2022	1B	157	144	13	14	6	3	1	1
2022	2	1,017	936	81	89	36	18	9	4
2022	3	1,426	1,312	114	126	50	25	13	6

## 2.3 HERRING TRIP LIMIT ANALYSIS

Commercial fishing trips reporting any landings of herring were included in the analysis. Only trips reporting a federal Vessel Trip Report (VTR) were included. Trips were assigned to a Herring Management Area (HMA) according to the HMA reported on the daily herring VMS catch report, in situations where no herring VMS catch report was available, the latitude and longitude position reported on the VTR was used to calculate the HMA. Each trip was assigned to a single HMA. In the minority of situations where a trip spans multiple HMAs, the trip is assigned to the HMA where most herring landings occurred. All landings amounts are in live pounds (whole animal, shell on) and value is in nominal dollars.

### 2.3.1 Seasonal Herring Trip Landings by Area

Figure 3 below plots the weekly average herring trip landings by area from 2016-2019. The color of each data point indicates the average percent of trip landings that was herring for that week, and the size of the point indicates the number of trips within that week (summation of all trips within that week and area from 2016-2019).

**Figure 3 - Weekly average herring trip landings by area from 2016-2020.**



**Figure 3 notes:**

- Area 1A
  - Trip average herring pounds above 40,000 lbs. for all weeks.
  - All trips predominantly herring with variable landings amounts.
  - Trips occur from June - December.
  - Possibly influenced by ASMFC weekly landing limits.
- Area 1B
  - Trip average herring pounds above 40,000 lbs. for all weeks.
  - All trips predominantly herring.

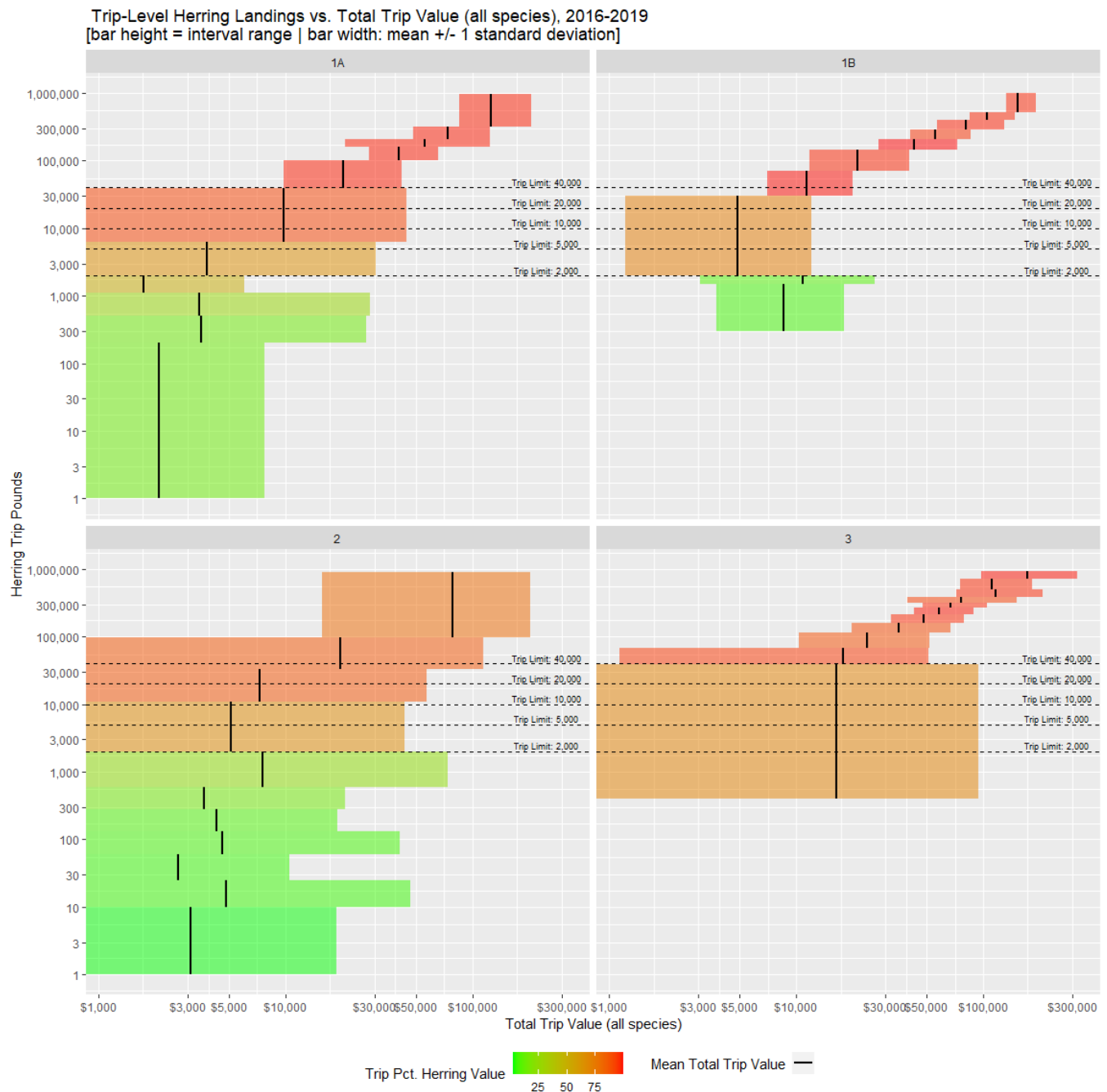
- Trips occur from May - November.
- Total trip effort generally lower than other areas.
- Area 2
  - Trip average herring pounds above 40,000 lbs. during January to April, then drops below 40,000 lbs.
  - Mixed species trips, especially April-December.
  - Herring catch is seasonal and mostly occurs in the winter and early spring.
  - Continuous activity throughout the year.
- Area 3
  - Trip average herring pounds generally above 40,000 lbs.
  - All trips predominantly herring with variable landings amounts.
  - Trips occur throughout the year.
  - Total trip effort generally lower than other areas.

### 2.3.2 Herring Landings vs. Total Trip Value

The relationship between herring landings on a trip and the total value of the trip was analyzed to help identify potential herring incidental trip limits that maximize opportunity to harvest non-herring species while minimizing herring landings and reduce overall risk of exceeding the sub-ACL. The correlation between herring landings and total trip value varies by HMA. HMAs 1B, 1A and 3 had higher coefficient of determination ( $R^2$ ) values of .89, .81, and .64 respectively indicating a stronger relationship between trip herring landings and overall trip value. HMA 2 had a substantially lower  $R^2$  of .38, possibly indicating a more mixed fishery with value coming from other species.

This relationship is visualized by plotting total trip value on the x-axis and trip herring landings on the y-axis, which helps identify (if possible) a herring incidental trip limit between 2,000 and 40,000 lbs. that yields the largest increase in overall trip value by capturing trips farther out on the x-axis. Figure 4 below shows on a log10 scale total herring landings vs. total trip value for all trips between 2016 and 2019 in the 4 HMAs. Trips are binned into ranges based on the herring landings (bar height) where each bin is composed of approximately the same number of trips for each HMA. The vertical black lines within each box represent the mean total trip value for the bar, and the width of the bar indicates +/- 1 standard deviation from the mean. The color of the bar indicates the mean percent of trip value yielded from herring.

**Figure 4 – Herring landings compared to total trip value including other species (2016-2019) per herring management area**



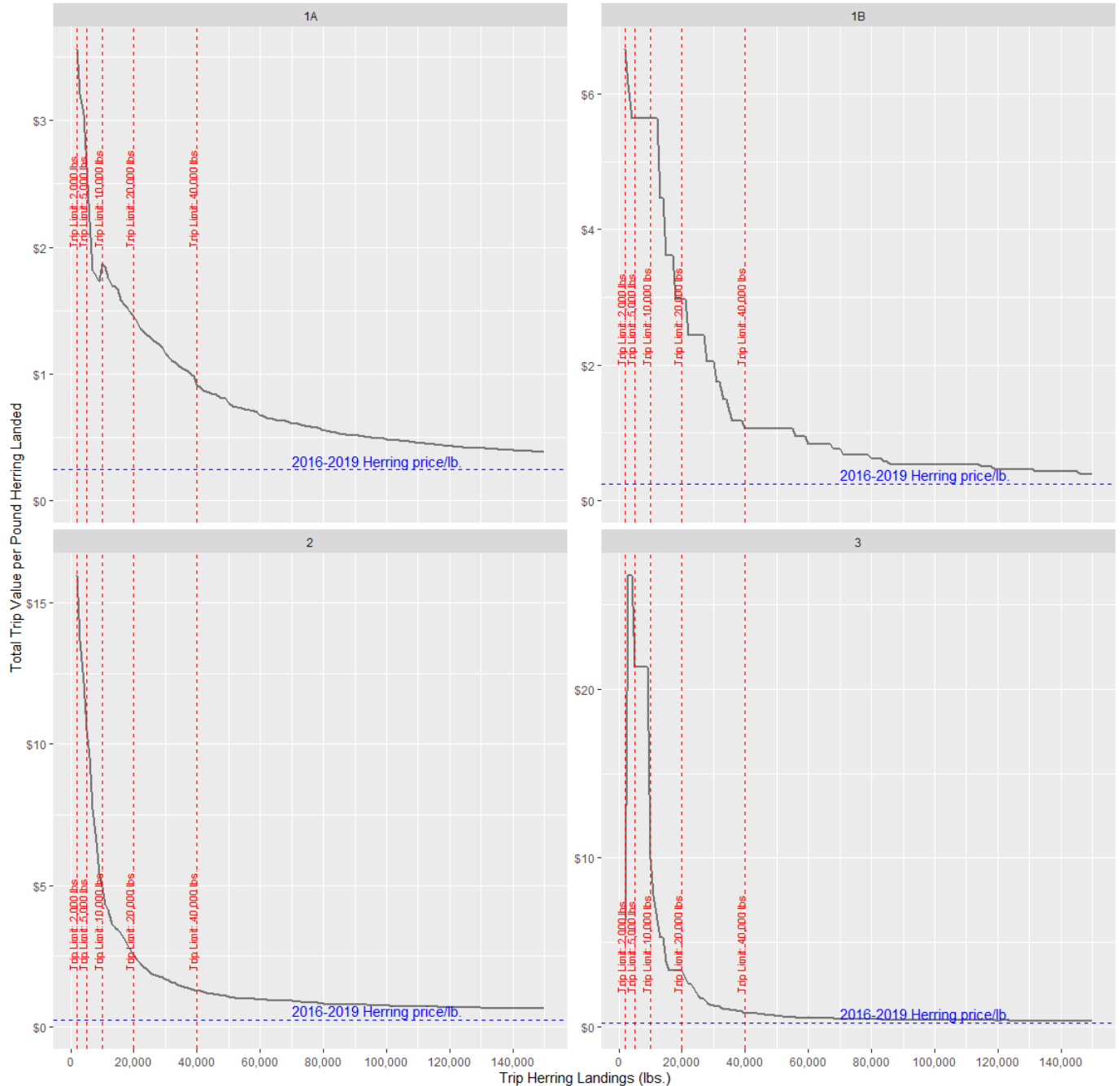
**Figure 4 notes:**

- Area 1A: Mix of larger and smaller herring trips. Relatively more low value trips less than 40,000 lbs. herring.
- Area 1B: Small cluster of trips less than 2,000 lbs. herring, mostly greater than 40,000 lbs. herring trips.
- Area 2: Mix of larger and smaller herring trips. Trips with less than 40,000 lbs. herring were more variable in total value, while relatively more 40,000 lbs. or greater herring trips had lower percent value from herring than other HMAs, which indicates value coming from other species.

- Area 3: Dominated by trips greater than 40,000 lbs. herring.

To further distill the relationship between herring landings and trip value, total trip value per pound of herring was calculated from all trips under a given herring incidental trip limit (Figure 5). Incidental trip limits that yield total trip value per pound of herring well above the 2016-2019 price per herring (\$0.24/lbs) generally capture trips where more value is coming from sources other than herring. Conversely, incidental trip limits with total trip value per pound of herring that is closer to the 2016-2019 herring price are more likely directed herring trips that generate most of their value from herring. By iterating through the range of incidental herring limits, a threshold that captures the steepest drop in total trip value per pound of herring may be a good candidate that maximizes total trip value and minimizes herring landings.

**Figure 5 – Total value per pound of herring caught from all trips landings 2,000 to 150,000 pounds.**



**Figure 5 notes:**

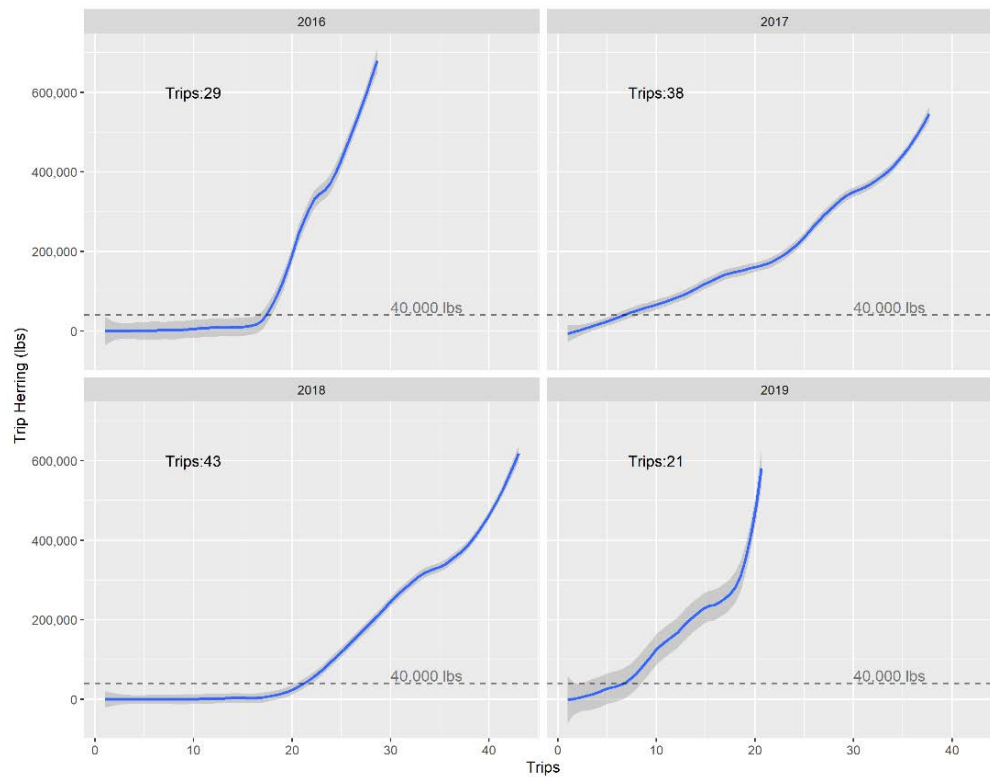
- Total trip value per pound of herring caught drops off steeply as trip herring landings increase.
- Converges towards 2016-2019 herring price per pound as herring trip landings increase.
- Majority of decline captured by proposed herring incidental trip limit range of 2,000 – 40,000 lbs.

### 2.3.3 Additional Herring Incidental Trip Limit Analysis

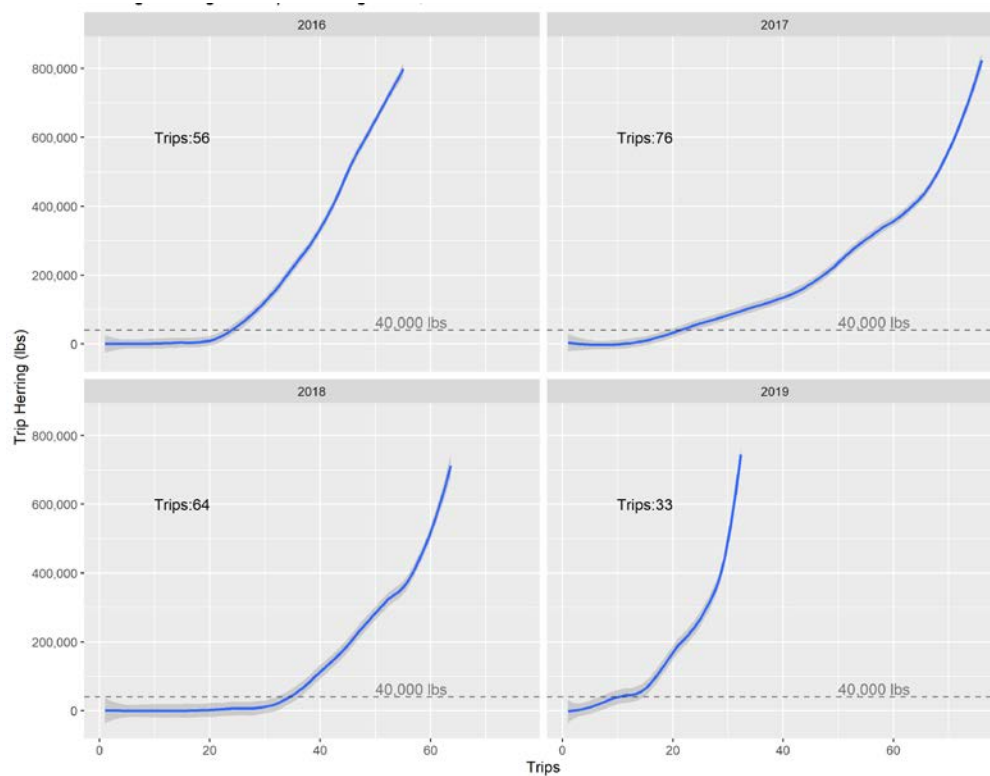
**Table 5 – Declared mackerel and herring trip counts, 2016-2019**

Declaration	2016	2017	2018	2019
HER-HER	266	407	605	271
HER-HMS	639	599	224	94
SMB-LHM		34	128	36
SMB-MAC	97	124	18	75
SMB-SHM, SMB-SQM, or SMB-IHM	1,007	657	13	56
SMB-SIM		46	29	85
SMB-SLM		427	1,053	1,103
SMB-MAH, SMB-MAS, SMB-MHS, or SMB-SCM	6	11	19	115
<i>Source: AMS Database as of 2020-06-22</i>				

**Figure 6 – Herring landings on trips with more than 100,000 lb of mackerel, with 40,000 pound line for reference (2016-2019).**



**Figure 7 – Herring landings on trips with more than 20,000 lb of mackerel, with 40,000 pound line for reference (2016-2019).**

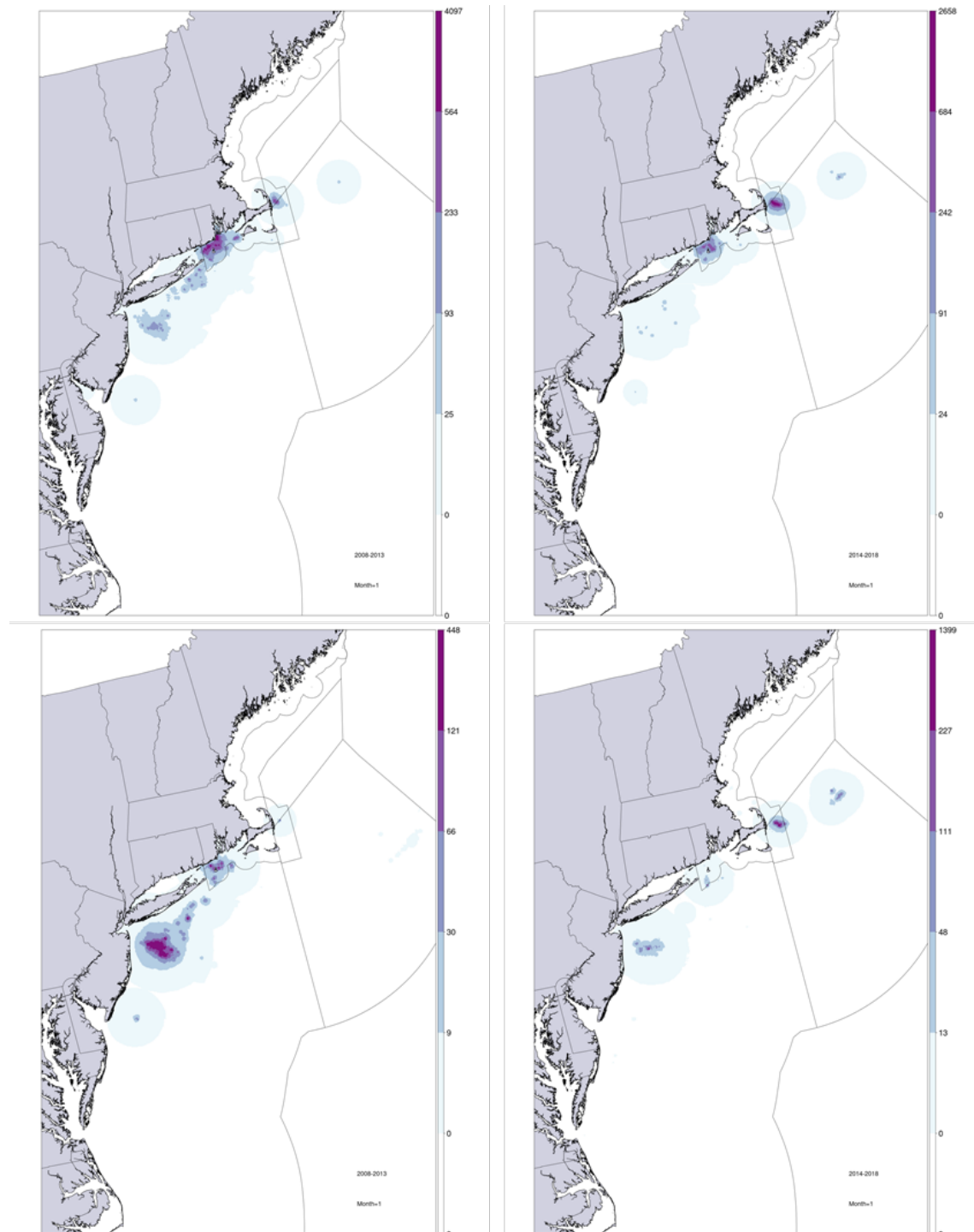


### 3.0 MONTHLY HERRING AND MACKEREL REVENUE

Author: Dr. Min-Yang Lee (NEFSC SSB)

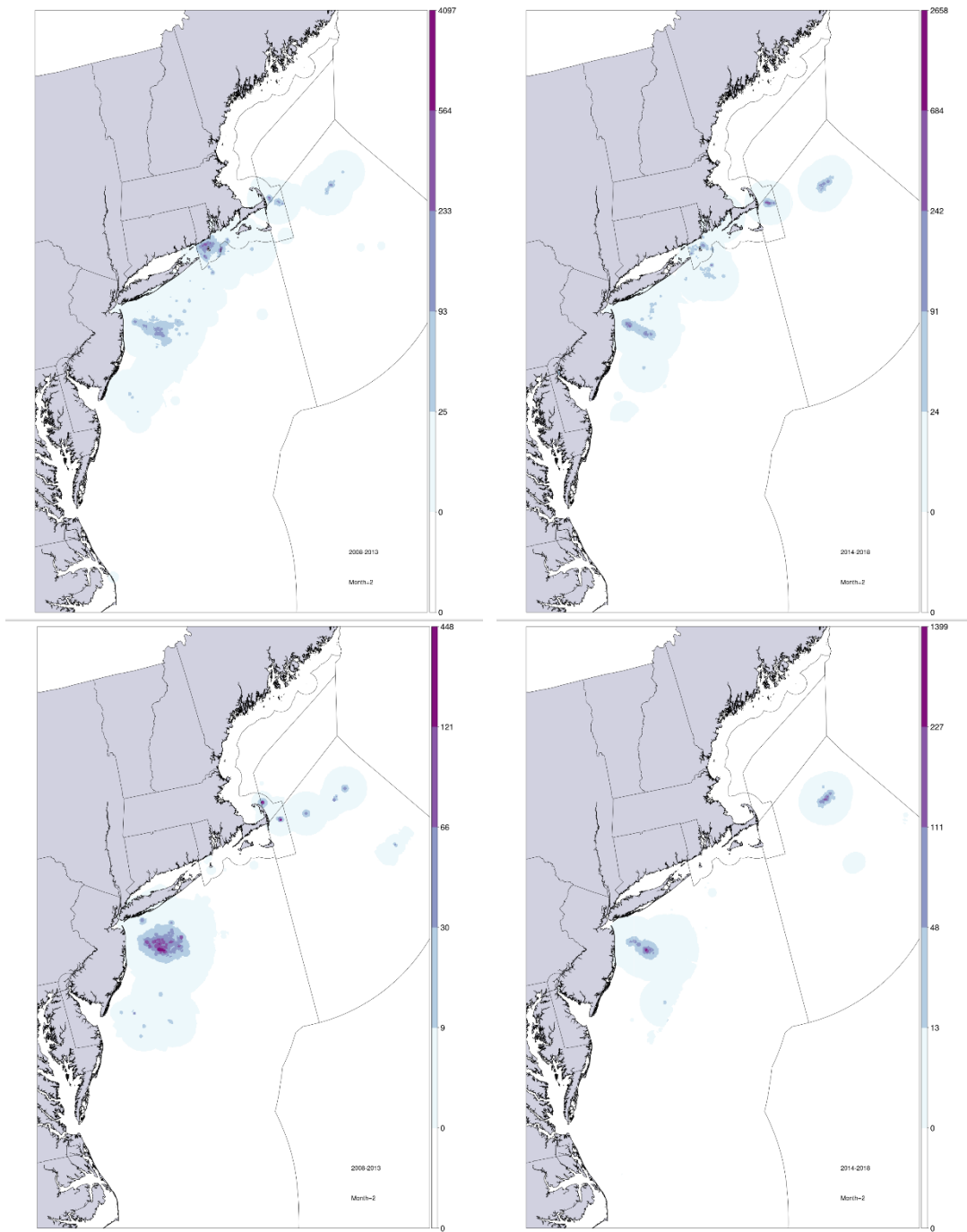
The following maps are of herring and mackerel revenue (Figure 6 - Figure 17). They are aggregated at the monthly level and split into two time periods (2008-2013 and 2014-2018). The units are average revenue (nominal) per square mile. Note that scales are unique for each map.

**Figure 8 - Average herring landings January 2008-2013 (top left) and 2014-2018 (top right). Average mackerel landings January 2008-2013 (bottom left) and 2014-2018 (bottom right).**

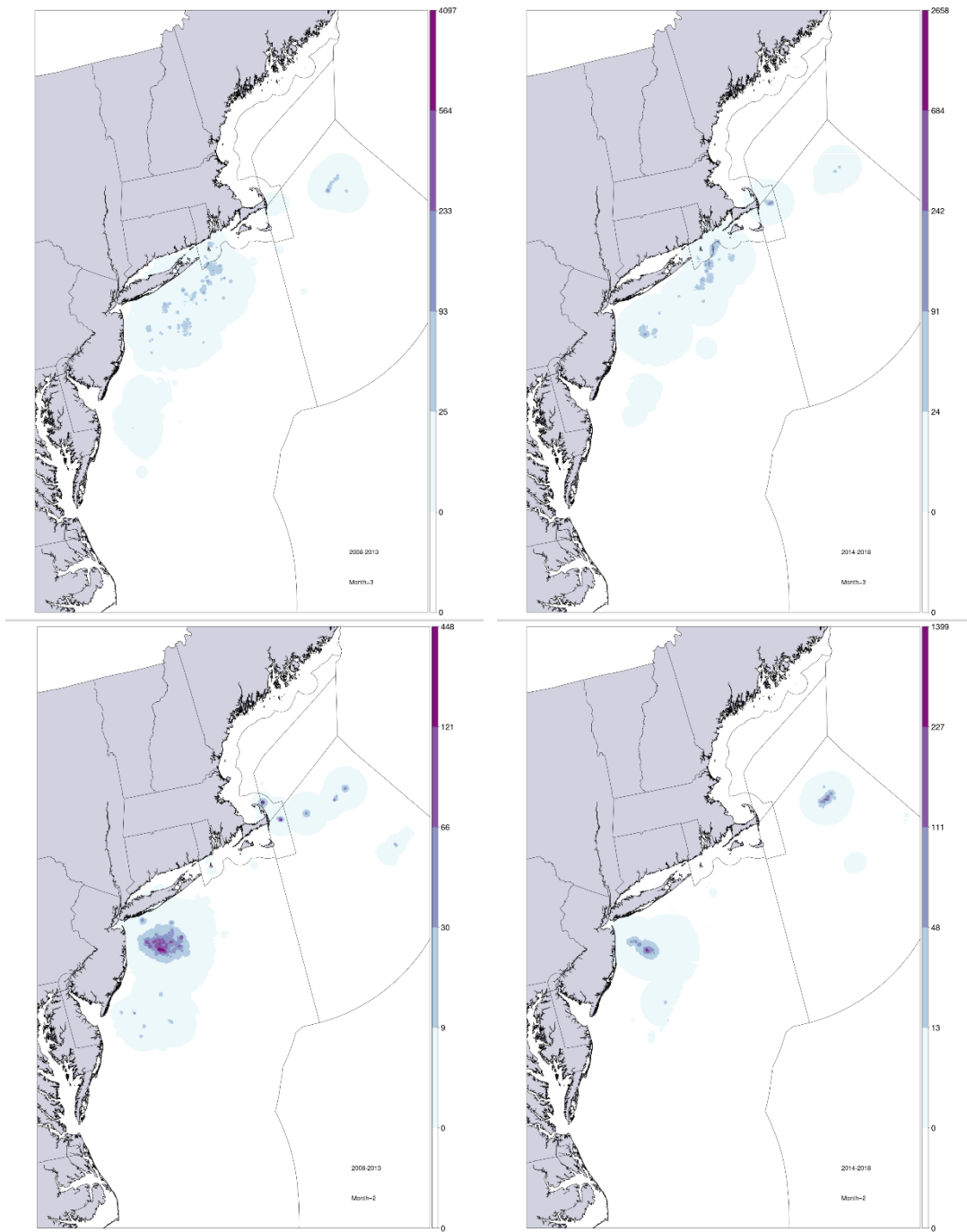




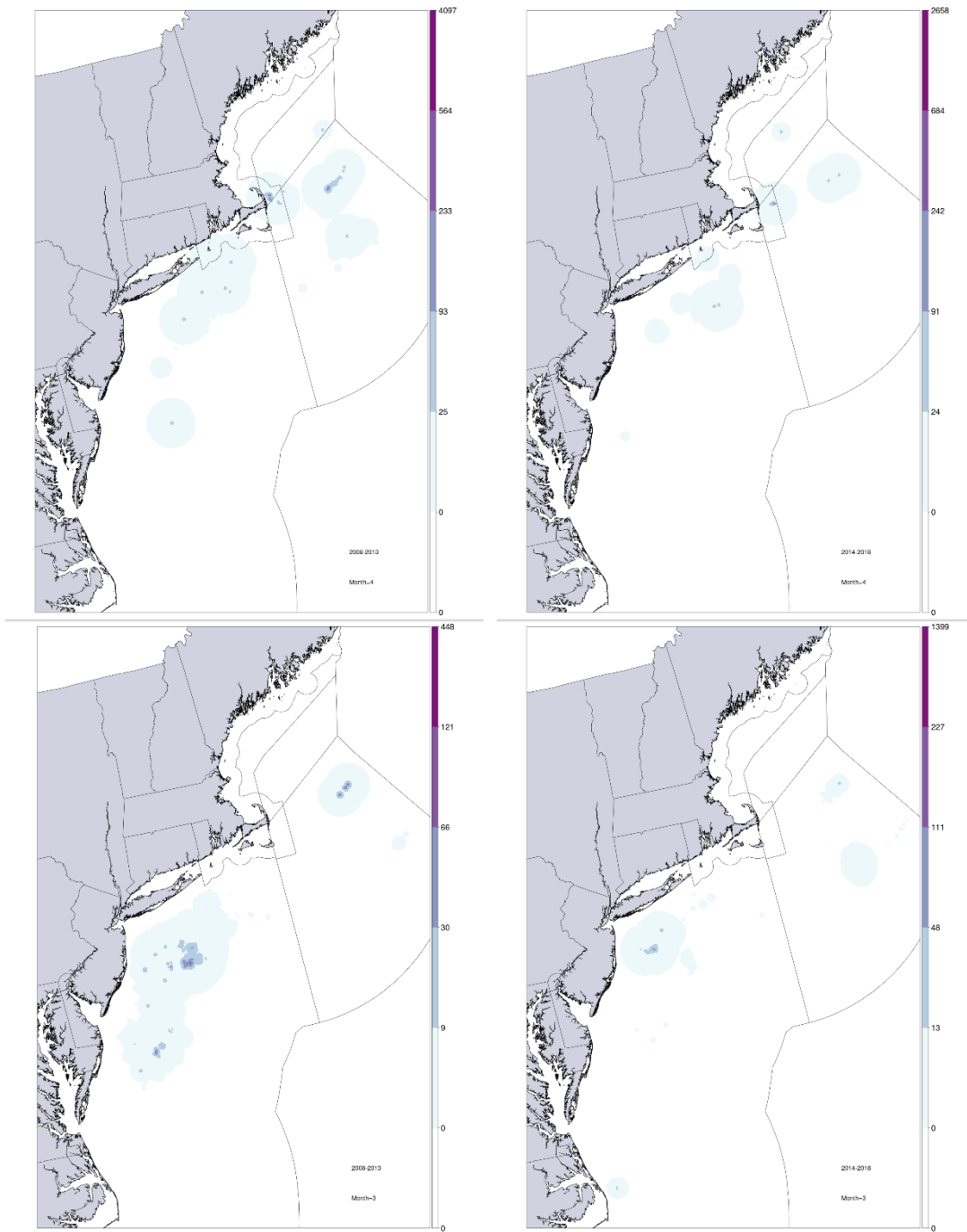
**Figure 9 - Average herring landings February 2008-2013 (top left) and 2014-2018 (top right). Average mackerel landings February 2008-2013 (bottom left) and 2014-2018 (bottom right).**



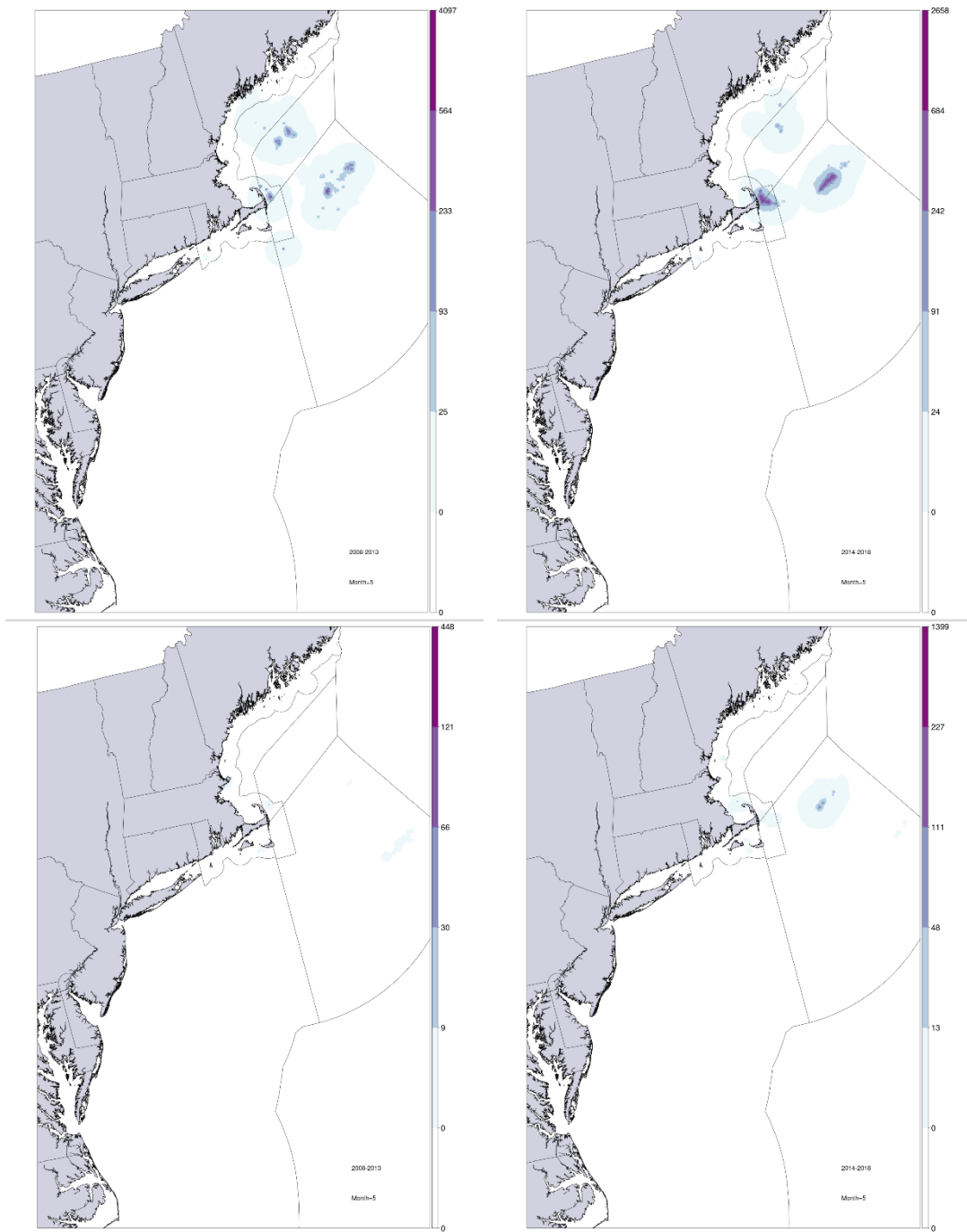
**Figure 10 - Average herring landings March 2008-2013 (top left) and 2014-2018 (top right). Average mackerel landings March 2008-2013 (bottom left) and 2014-2018 (bottom right).**



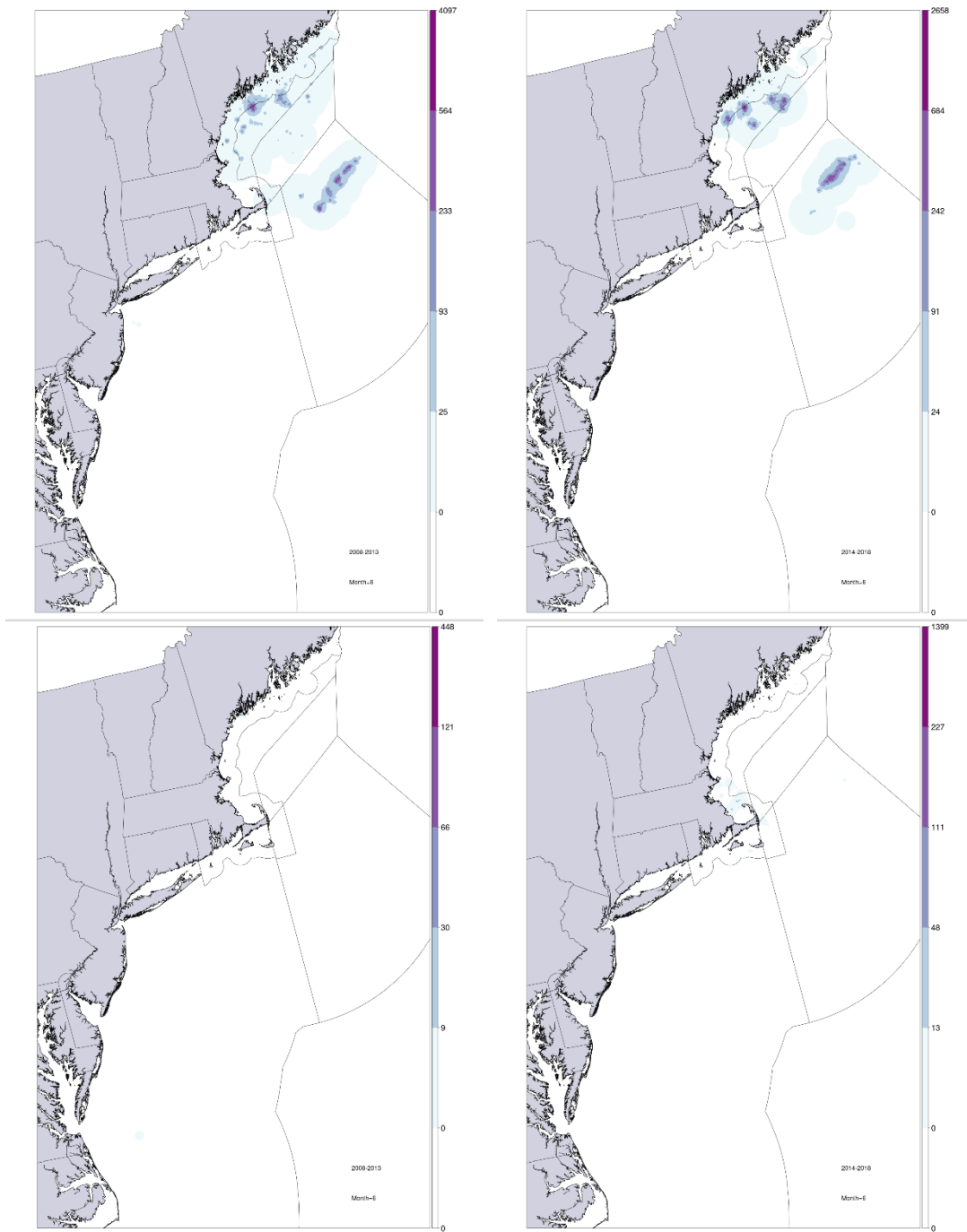
**Figure 11 - Average Herring Landings April 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings April 2008-2013 (bottom left) and 2014-2018 (bottom right).**



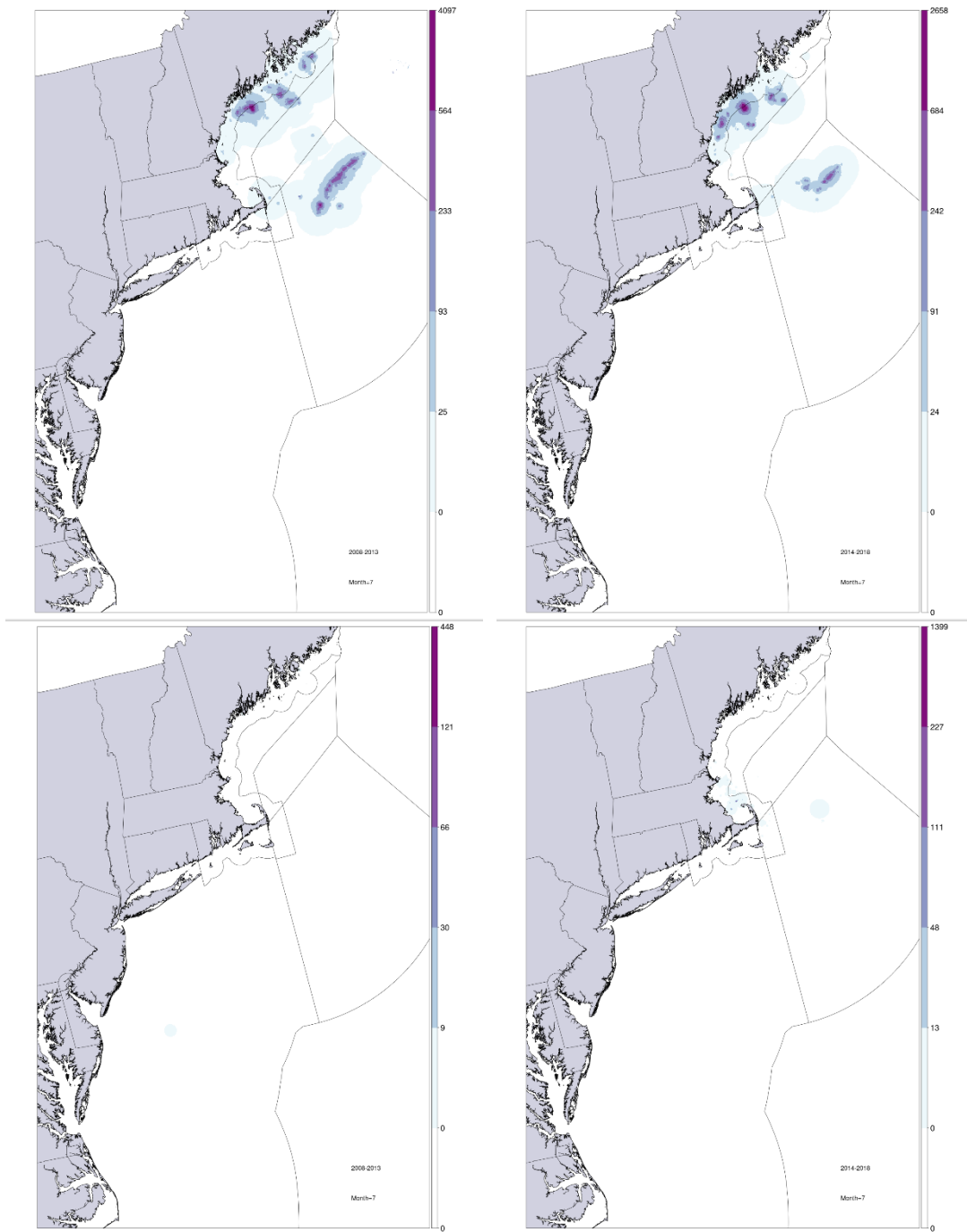
**Figure 12 - Average Herring Landings May 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings May 2008-2013 (bottom left) and 2014-2018 (bottom right).**



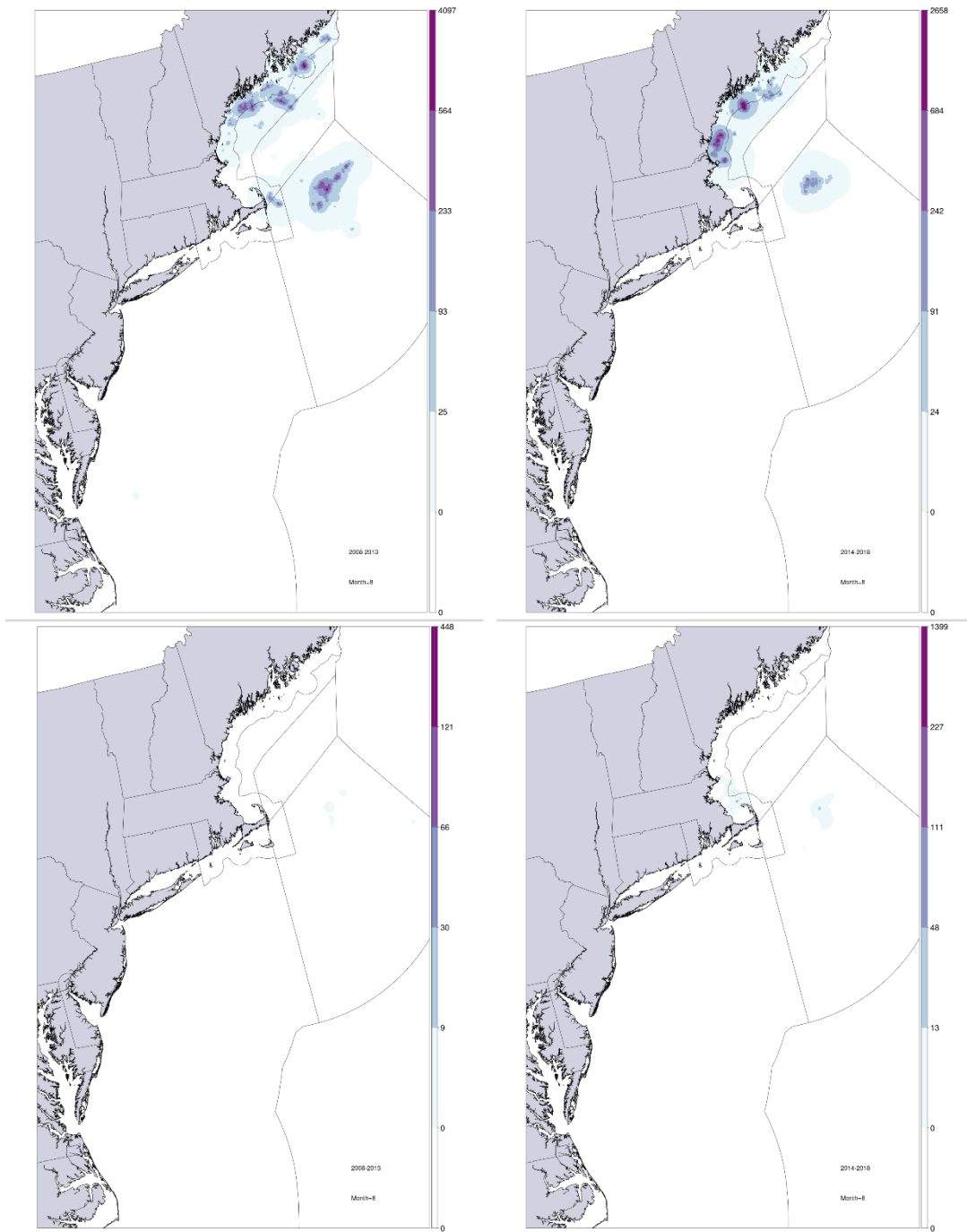
**Figure 13 - Average Herring Landings June 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings June 2008-2013 (bottom left) and 2014-2018 (bottom right).**



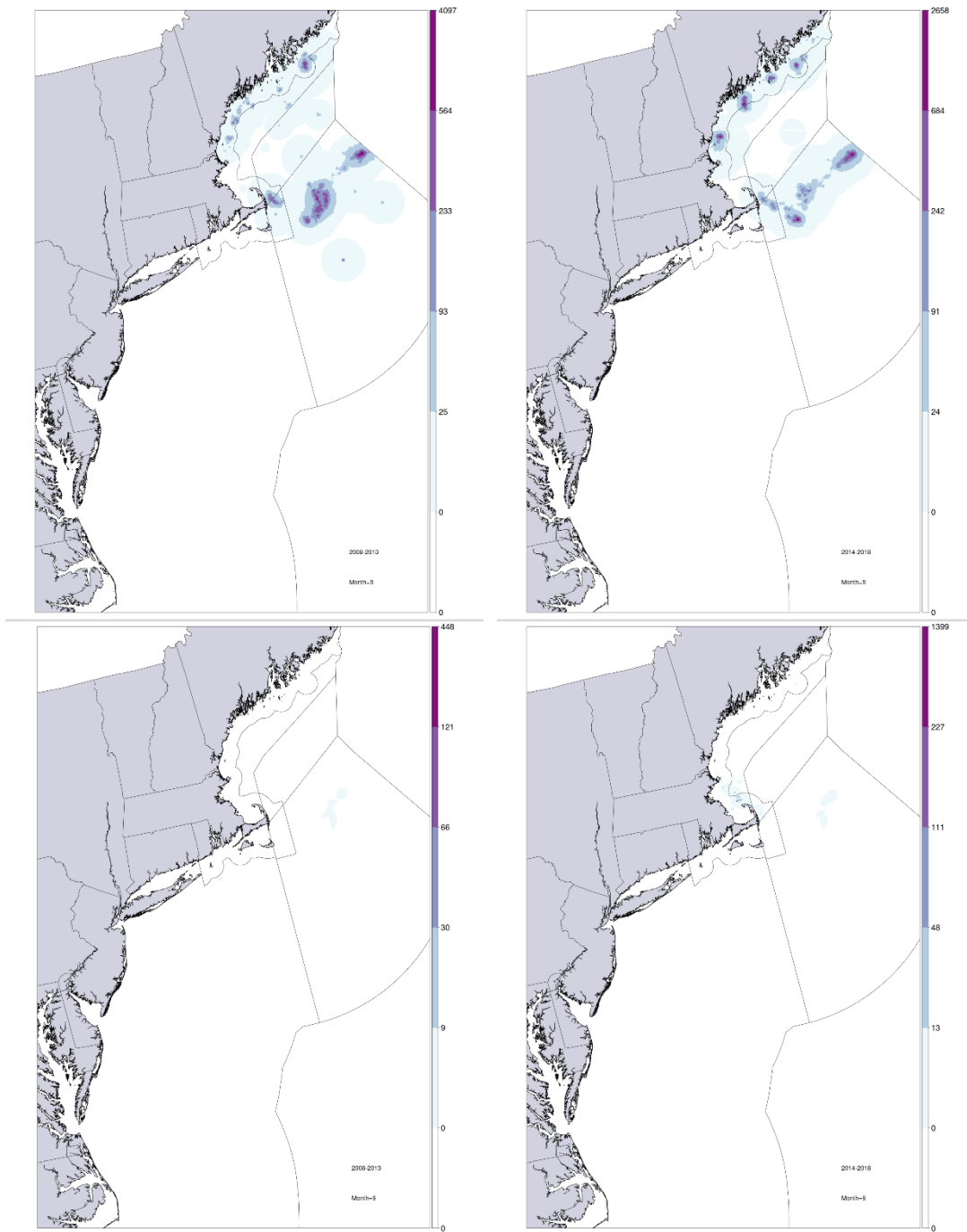
**Figure 14 - Average Herring Landings July 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings July 2008-2013 (bottom left) and 2014-2018 (bottom right).**



**Figure 15 - Average Herring Landings August 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings August 2008-2013 (bottom left) and 2014-2018 (bottom right).**

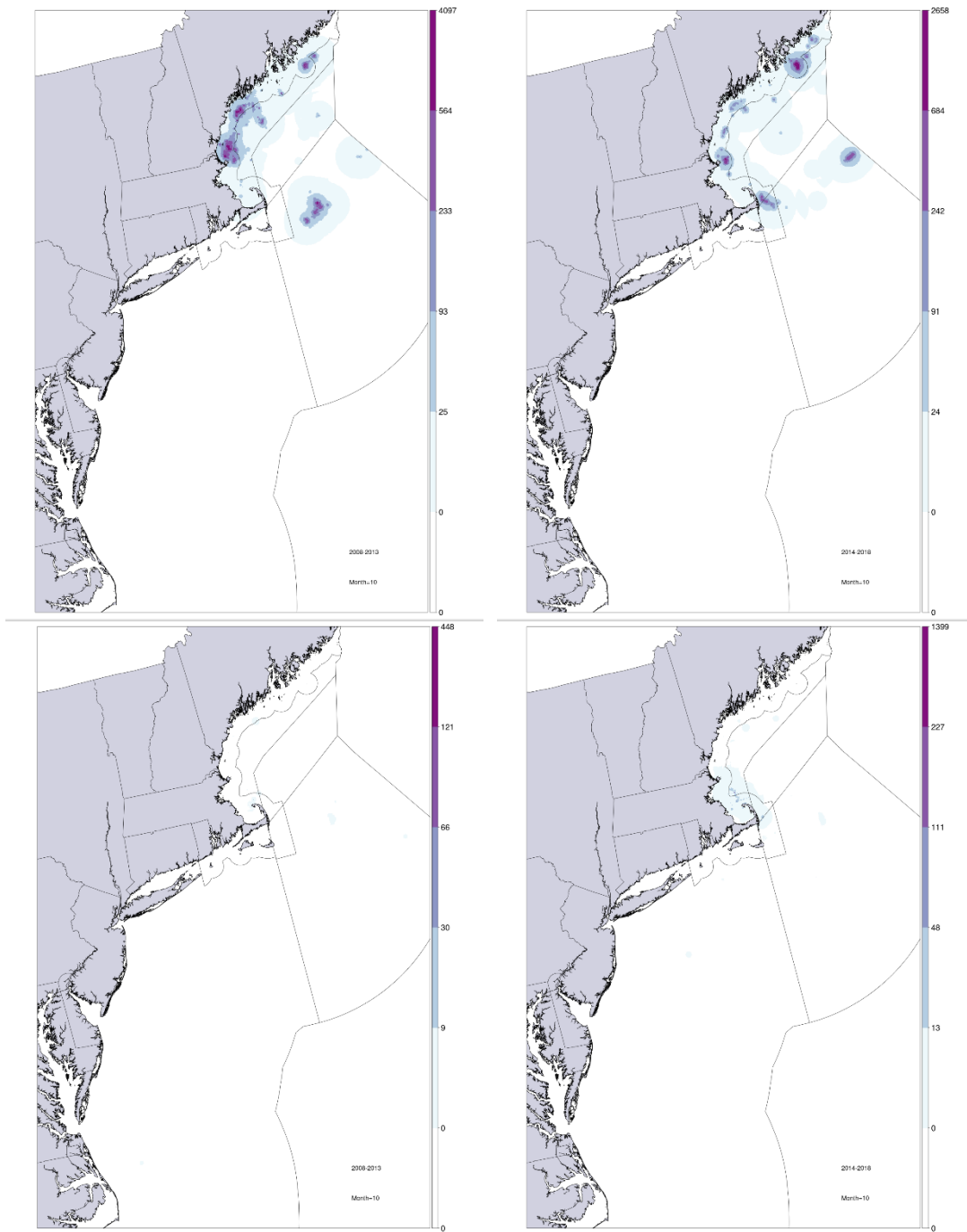


**Figure 16 - Average Herring Landings September 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings September 2008-2013 (bottom left) and 2014-2018 (bottom right).**

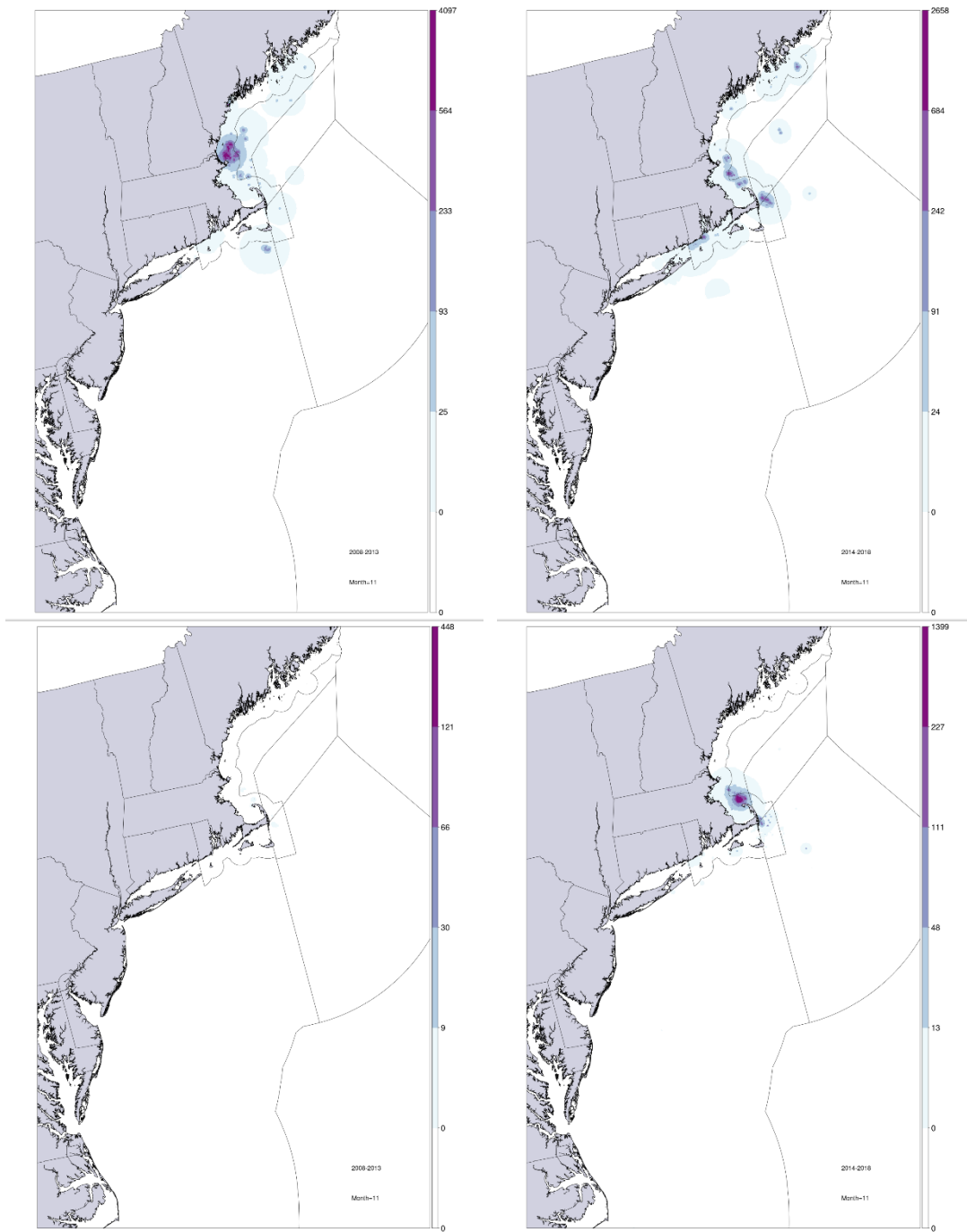




**Figure 17 - Average Herring Landings October 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings October 2008-2013 (bottom left) and 2014-2018 (bottom right).**



**Figure 18 - Average Herring Landings November 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings November 2008-2013 (bottom left) and 2014-2018 (bottom right).**



**Figure 19 - Average Herring Landings December 2008-2013 (top left) and 2014-2018 (top right). Average Mackerel Landings December 2008-2013 (bottom left) and 2014-2018 (bottom right).**

