New England Fishery Management Council

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MEETING SUMMARY

(revised January 15, 2016)[1]

Herring Plan Development Team

Gloucester, MA

December 10, 2015

The Herring Plan Development Team (PDT) met on December 10, 2015 in Gloucester, MA to discuss 2016 Council priorities for Atlantic herring, develop information and analyses for Amendment 8 to the Atlantic Herring Fishery Management Plan (FMP), discuss the potential for using state port-side monitoring data to monitor the river herring/shad catch caps, review/discuss development of industry-funded monitoring (IFM) options for the Atlantic herring fishery in the omnibus IFM amendment, and develop recommendations for 5-year research priorities for Atlantic herring (2017-2022).

MEETING ATTENDANCE: Rachel Feeney (Herring PDT Interim Chairman), Deirdre Boelke (NEFMC staff); Peter Kendall (Herring Committee Chairman); Tim Cardiasmenos (via webinar), Daniel Luers, Brant McAfee, Carrie Nordeen (NMFS GARFO staff); Jon Deroba, Kristen Gustafson, Min-Yang Lee (via webinar), Sara Weeks (NEFSC staff); Matt Cieri (MEDMR); Micah Dean, (MADMF); Renee Zobel (NHFG); Madeline Hall-Arber (MIT Sea Grant); and Jason Didden (via webinar, MAFMC staff). Others in attendance include: Dianne Borggaard (GARFO), Brad Schondelmeier (MADMF), and about five members of the public.

KEY OUTCOMES:

- The PDT will prepare background information regarding the 2016 Council priority on considering revisions to the Georges Bank haddock catch cap accountability measure.
- The PDT discussed preliminary work and plans for developing Amendment 8 and seeks direction from the Herring Committee.
- The PDT recommends future use of state portside sampling data to monitor the river herring/shad catch caps, but identified several issues that would need to be resolved prior to doing so.
- The PDT made recommendations for 2017-2022 research priorities.

[1] Clarifications were made to the discussion of the state portside data collection programs.

OPENING REMARKS AND AGENDA REVIEW

Interim Herring PDT Chairman Rachel Feeney introduced Deirdre Boelke, who will become the Herring PDT Chairman in 2016 as she wraps up her work as the Scallop PDT Chairman. New Herring Committee Chairman Peter Kendall was also introduced.

2016 COUNCIL PRIORITIES FOR ATLANTIC HERRING

The PDT had a brief discussion of the Council's 2016 priorities for Atlantic herring. In addition to developing Amendment 8 to consider revising the ABC control rule and address concerns regarding localized depletion, the Council added an additional priority at its December 2015 meeting, to "initiate an action to amend the accountability measures in the Georges Bank haddock catch cap in the herring fishery." On October 22, 2015, the National Marine Fisheries Service (NMFS) closed the directed herring fishery in the Herring Georges Bank (GB) Haddock Accountability Measure (AM) Area after it was determined that the GB haddock catch cap had been harvested. Midwater trawl vessels were then restricted to a 2,000 lb herring possession limit in the AM Area for the remainder of the groundfish fishing year (through April 30). In December, the Council expressed concerned about this closure and wanted to reconsider the AM.

The PDT briefly discussed the haddock catch caps and associated AMs, revised though Framework 46 to the Northeast Multispecies FMP (2011 implementation). It is uncertain how quickly the Council will want to develop an action to consider revising the AM or what the range of alternatives might be (e.g., revising AM closure area, overage deduction, possession limits, AM trigger). It was noted that increasing the possession limit to 6,600 mt would not be enough to justify directed herring trips on Georges Bank. The PDT expects that work will be needed to provide/update information on the spatial/temporal distribution of haddock.

Follow-up work: The PDT will prepare a brief memo for the Committee meeting in January 2016 with background information about the AM currently in place, and awaits direction from the Herring Committee.

AMENDMENT 8 TO THE ATLANTIC HERRING FISHERY MANAGEMENT PLAN

Action Plan

The PDT reviewed the timeline and Action Plan for Amendment 8. In January 2016, the Herring Advisory Panel (AP) and Committee will review scoping comments, discuss conducting a Management Strategy Evaluation (MSE) of the ABC control rule, and may begin to develop measures. The plans for MSE have not been fully developed. If the ABC control rule implemented through Amendment 8 is to be used for developing the 2019-2021 specifications, it would be best to have Amendment 8 implemented prior to significant work occurring on the specifications (in 2018). However, Amendment 8 does not necessarily need to be complete prior to the next assessment. Timeline details will be fleshed out in the future.

Follow-up work: The PDT will update the Action Plan prior to the January 2016 AP and Committee meetings.

ABC Control Rule

In the spring of 2015, Dr. Deroba conducted a preliminary evaluation of several potential control rules developed by the Ecosystem-Based Fisheries Management (EBFM) PDT, which was presented at the June 2015 meeting of the Science and Statistical Committee (SSC). The SSC

encouraged that this work be peer reviewed and potentially a subject for a Management Strategy Evaluation (MSE). Sarah Gaichas (NEFSC) is leading a Northeast Fisheries Science Center (NEFSC) working group to develop MSEs, and the Council staff is coordinating with this group on a MSE for the Atlantic herring ABC control rule, the details of which have yet to be determined. The Herring PDT discussed the preliminary evaluation and provided input to consider in planning for a more formal MSE.

Dr. Deroba presented an overview of the work to date on evaluating ABC control rule alternatives for Amendment 8. The six control rules developed by the EBFM PDT were each evaluated using the results of the 2012 Atlantic herring assessment. The interim control rule (currently in use) was not evaluated, but the rule that keeps the fishing mortality rate constant at 75% F_{MSY} is a close approximation. Within the framework of a MSE, modeling the interim control rule (a constant catch value that would produce a 50% chance of overfishing in the third year) is difficult. A PDT member asked how annual harvest was set. The model set harvest based on the biomass the year prior, but it could be adjusted to test a constant catch approach, similar to how the fishery is currently managed. The Lenfest control rule was one of the more biologically conservative of those analyzed; it does not allow as high F over the range of SSB. The 75% F_{MSY} approach is one of the less conservative, as it provides for less biomass and higher fishery yield. The SSC made a few suggestions in June 2015: to examine auto-correlated recruitment to approximate environmental variability and time-varying natural mortality (M). Subsequently, Dr. Deroba included these in the analysis, however, neither affected the results appreciably.

The PDT discussed the general process of MSE. MSE objectives would first be determined by the Council through a public process. Then, potential control rules would be selected and evaluated relative to those objectives. Trade-offs such as yield versus biomass would be considered. Since Amendment 8 focuses on the ABC control rule, the PDT recommends focusing the MSE on potential ABC control rules, and not include evaluation of the Atlantic herring assessment at this time, as it would compound the complexity of analysis. However, the control rule MSE may inform future improvements in the assessment. The PDT discussed that a broad range of ABC control rules could be evaluated, and that some general control rules (e.g., biomass-based) should be selected early in the process through communication with the Council and stakeholders. The PDT noted that the statutory requirements for rebuilding within certain timeframes are not included in the evaluation model currently. PDT members noted other fisheries that have or are undergoing MSE that lessons could be drawn from (e.g., menhaden). The process for public input has yet to be determined, whether that would be through a series of Herring AP, Committee and Council meetings, or whether there would be a separate workshop(s) on the topic.

Public Comment

Ms. Erica Fuller (Earth Justice) asked about the relationship between the stock assessment and the outcome of the MSE. The PDT indicated that the MSE would be of the ABC control rule. The stock assessment produces the abundance estimate, input for whichever control rule is in place. She also asked how other stakeholders besides the Council members would be included in the process. The PDT acknowledged that the public should be included in the MSE, but the specifics of format have not been determined yet.

Public Scoping Comments on Amendment 8

The PDT reviewed the public comments that were submitted in both the initial and supplemental comment periods, as well as the draft summary prepared by Ms. Feeney and Dr. Hall-Arber. Feedback that the PDT provided in August on the summary was incorporated. The PDT reviewed the demographics of commenters, the general support for and concerns with the goals of Amendment 8, what were perceived to be current problems, desired outcomes of Amendment 8, specific ideas for measures, and trade-offs that the Council should consider. The PDT noted that many of the concerns raised by the public are not new. All public comments are available on the Council's Amendment 8 webpage. The format of the summary is similar to the summary of public comment on the groundfish Amendment 18 Draft Environmental Impact Statement. The PDT was supportive of using this format.

Follow-up work: The public scoping comments summary will be finalized for the January 2016 AP and Committee meetings.

Public comment

Ms. Erica Fuller (Earth Justice) expressed support for the summary format and asked about the best way to identify what state people are from, particularly for signers of large form letters. The PDT suggested that a spreadsheet of signers be submitted that could be sorted by state. Mr. Greg Wells (Pew Environment Group) asked if there was a summary of what the 28,000 people who signed a form letter asked for. The PDT pointed out how the demographics of the signers were identified. There were about 2,500 of those signers who wrote individual comments. The themes of those comments were similar to the themes of the form letters, and the form letters are included in the thematic summary of all comments.

Localized Depletion

The PDT discussed potential technical approaches and limitations for identifying localized depletion, and awaits direction from the Herring Committee prior to proceeding further with analyses. Dr. Deroba presented a preliminary analysis of the effect of herring catch on predator catch (Appendix I). The NEFSC gut content data indicate that cod, spiny dogfish, and pollock feed heavily on herring. Using Vessel Trip Report (VTR) data, the change in commercial catch per trip was examined by statistical areas (with areas 513 and 514 presented as examples) for cod, spiny dogfish, and pollock during the week following catches of herring. Catch by gear type and catch per tow were also examined. A negative relationship between the catch of herring followed by catch of predators could be evidence of localized depletion. (i.e., predators leave an area due to lack of herring, and therefore catch per trip declines the following week). A lack of such relationship does not necessarily mean that localized depletion is not occurring, just that there may be other treatments of the data necessary. This preliminary analysis did not identify significant trends or relationships between catches of herring and its predators. Dr. Deroba did not necessarily suggest this analysis as a way forward, but as a starting point for further study.

The PDT brainstormed key questions and considerations for work that could support the development of Amendment 8, and posed questions for the Herring Committee:

Key questions:

1. What additional work should the PDT do at this time, recognizing that measures would need to address a defined problem and at a correct spatial and temporal scale(s)?
2. What spatial and/or temporal scales, geographic areas, and predators are most important in investigating evidence of localized depletion?
3. Is the concern primarily biological/ecological or one of economics/availability of fish to user groups? Is the concern more about fishing effort intensity than resource depletion?

Considerations:

- Herring Area 1A seasonal closure
    - The intent of the 1A seasonal closure, implemented trough Amendment 1 (no mid-water trawl access June-September), was to prevent localized depletion (in addition to 0% sub-ACL January-May). The PDT could investigate whether this closure has had a measurable impact on herring and/or predator resources (e.g., abundance, condition factor).
    - Analysis during the development of Amendment 1 was hampered by the lack of a firm definition of what localized depletion is, the spatial and temporal scale that mattered, which depends on the predator of interest.
    - There may be more data on sequential days or weeks of herring and predator catches prior to 2007, with recent declines in groundfish effort and the seasonal closure of Herring Area 1A since that time.
- Data resolution/constraints
    - If localized depletion is occurring within whatever area is examined (e.g., predators move but stay within area), detection may be difficult.
    - Investigating correlations between catches of herring and predators (e.g., time series, catch per unit effort (CPUE)) is compounded by many factors that influence fishery effort beyond presence/absence of fish (e.g., inter-vessel communication about fish presence/absence, fishery closures).
    - Identifying localized depletion is very difficult, because the rate of herring removal relative to the rate of herring immigration to an area must be identified. It would be difficult to find evidence on a spatial scale that is smaller than the scale that herring can move in a day (about 15 nm/day).
    - Vessel Trip Report (VTR) data is available by statistical area for each trip or sub-trip, and the fisherman identifies a location (lat/lon) where most of the fishing effort occurred.
    - Vessel Monitoring System (VMS) data could be helpful, potentially finer resolution of vessel location, but the data do not natively collect fishing information, rather this would need to be inferred from track lines and other catch information sources.
    - Many concerns expressed through scoping came from recreational fishermen, yet there is very little spatial information about private angler catch. Investigating the data for impacts to those fishermen would be difficult.

- Other information to examine
    - Dr. Kevin St. Martin's work on identifying fishing locations (maps of VTR data showing clusters of effort) may be helpful to see where fishermen are working within a statistical area.
    - Study Fleet and the tuna catch data would be additional sources of data.
    - The information about herring population dynamics in earlier actions is largely the latest available still.
- The biological traits of the predators could be used to define the area of analysis. What is the distance that swimming to find prey becomes costly for the predator? If herring were unavailable in an area, would a predator opt to seek out herring or just eat other prey in the local area? To what degree do predators rely on herring? Answers to these questions are likely predator-specific and may be available in the literature. Should an analysis try to identify a metabolic cost to the predator?
- Correlation of data does not necessarily mean causality. For example, herring and predators could have different requirements for water temperature. Due to temperature, herring could migrate to an area at the same time that predators leave. NMFS survey or Study Fleet data could help identify whether temperature or herring are more important to predict presence of predators.
- There are seasonal components to consider: how the herring fishery is managed, and whether herring are temporarily residing in or moving through areas. It might be easier to identify localized depletion in times and areas where herring are feeding.
- Herring schools constantly form and reform, so it would be difficult to determine the size of a typical herring school relative to the amount typically removed by a herring trawl.

Public comment

Mr. Steve Weiner indicated that the spatial data on tuna catch is poor, and tuna fishermen are concerned about the tuna leaving the Gulf of Maine for Georges Bank or Canadian waters; that is the scale of concern for his fishery. He expressed concerns that subsequent to herring vessels fishing together in an area, the whales, porpoises and other predators are gone. To him, the term "localized depletion" regards a concern about a high catch of herring by midwater trawl vessel in a small area affecting the local area (e.g., southern Jeffries vs northern). He recommends examining the data from prior to Amendment 1 implementation (i.e., before midwater trawl vessels were excluded from Area 1A January-September). He is not concerned about catching herring in Area 1A, but about the effects that the midwater trawl gear has when it is allowed there (October-December).

The Herring Committee Chairman expressed appreciation for the preliminary PDT work and expects the Herring AP and Committee to give input on better defining the problem and analytical approaches to pursue. The Herring PDT appreciated the public input on the scales of concern (stock area, within stat areas), which can help refine future work, but noted that other stakeholders have different ideas about scale and what the problem is. It would be helpful to have specific direction from the Herring Committee moving forward, noting that many of these issues were considered during Amendment 1.

Ms. Erica Fuller (Earth Justice) expressed support for the preliminary work and requested that the input from stakeholders be broadened beyond the AP. The PDT asked for her input on the

relevant scale to examine. Ms. Fuller concurred with the PDT that the scale is predator-specific and suggested a literature search on connecting localized depletion to a cause.

Potential use of Portside Data to Monitor RH/S Catch Caps

The PDT discussed the Council motion considered at September 2015 Council meeting:

> *"That because River herring/Shad bycatch in the sea herring fishery is monitored by NMFS solely from observer data, the Council requests NMFS include state portside monitoring of RH/S catch to determine that catch relative to the bycatch caps."*

The Council voted to postpone consideration of this motion to a later meeting, as a number of questions arose about the potential for using state portside monitoring data to monitor the river herring/shad (RH/S) catch caps. The PDT discussed what the portside data are, how they have been used to date, how the RH/S catch caps are currently monitored, and issues pertaining to potential use of portside data in monitoring, and made a recommendation.

PDT Discussion

What are the State portside sampling programs?

In an effort to increase the number of trips sampled and to reduce the uncertainty surrounding bycatch estimates for the Atlantic herring and Atlantic mackerel fisheries, voluntary portside sampling has been conducted by Maine and Massachusetts since 1999 and 2008, respectively. The portside sampling programs collect landings data in an inexpensive but efficient and accurate way and collect samples for important biological analyses. Massachusetts Division of Marine Fisheries (MADMF) and Maine Department of Marine Resources (MEDMR) collaborate to implement consistent sampling protocols to enhance the quantity of information and trip sampling frequency. The methods of the two State programs are very similar and consistent with NOAA and ACCSP protocols for subsampling (differences in vessel selection discussed below). Both programs have a random-stratified design for subsampling, where the sampler collects batches of fish, sorts and weighs by species and then extrapolates to the total catch. All subsample weights are actual weights. Hail weights (for both truckloads and fishing vessels) are acquired from the plant managers or vessel's captain and therefore estimated (estimate weight). Some offload locations are not safe and/or accessible for portside sampling, and therefore sampled by neither program.

MEDMR sampling takes place at processing plants and bait dealers in Maine, New Hampshire, Massachusetts, Rhode Island and New Jersey. At each port, random herring samples are collected directly off the incoming vessels. Data are collected on gonad development, age, length, and weight. A sampling level of 5% of the entire herring fishery is targeted.

MADMF conducts portside sampling in Massachusetts and Rhode Island for all midwater trawl and small mesh bottom trawl vessels in the limited access Atlantic herring and mackerel fisheries. The program goals are to document landing activities and record and quantify catch composition, including size and age, of the fish landed by the these fisheries. Sampling design has evolved since the program was initiated in 2008, but since 2012, MADMF has subsampled unsorted offloads.

How have the portside data been used for setting catch caps?

The portside data have been combined with observer data to estimate RH/S catch by the Herring PDT for consideration in the development of Framework 3 (created the RH/S catch caps, implemented in 2015). During the development of Framework 3, the PDT determined that the RH/S catch data from the portside sampling programs, as well as additional MEDMR sea sampled trips, should be incorporated into the data used to develop the options for the RH/S catch caps in the herring fishery. Analyses by the Herring PDT (Amendment 5 and Framework 3) and MEDMR indicate that there is no significant difference between RH catch estimates derived from sea sampling versus portside sampling on fully-sampled trips. More recently, the PDT updated estimates of RH/S with this data for the 2016-2018 Atlantic Herring Specifications. Adding these trips to the database increased the sample size for some of the strata and reduced the uncertainty and size of the confidence intervals associated with the RH/S catch estimates.

How much additional data on RH/S catch has the portside sampling program provided?

Table 1 summarizes the total trips, observer coverage and portside sampling for 2008-2014 in the areas with RH/S catch caps in 2015 (and recommended for 2016-2018). In all, 23% of trips in those areas landing > 6,600 lbs of Atlantic herring were observed, and an additional 16% were sampled portside (that did not also have observer coverage). Table 2 to Table 4 contain the total number of trips, landings, and trips with observer coverage or portside sampling in 2008-2014 for all areas.

How is coverage for observers and portside sampling expected to change in the future?

In 2014, 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. From January – June 2015, preliminary estimates indicate that observer coverage was about 6% on midwater trawl trips, about 7% on declared purse seine trips, and about 31% on small mesh bottom trawl trips targeting Atlantic herring. These dramatic decreases are primarily due to budget restrictions and funding limitations imposed by the omnibus amendment revising the Region's standardized bycatch reporting methodology.

What would need to be resolved to use portside data for in-season catch estimates?

- Requiring participation or portside safety/access standards may resolve any sampling bias issues between the observer and portside programs, but it may not be possible for NMFS to require participation in a state-run program.[2] It would also have to be resolved whether participation would be required for the vessel and/or dealer. Currently, some offload locations cannot be sampled due to safety or logistical reasons. Vessels may opt to offload in ports with no sampling, unless all offload locations become held to certain standards.
- Data transmission time lags and verification methods would need to be improved and minor differences in sampling protocols would need to be resolved. These could be accomplished through closer coordination of the programs and do not require federal rule-making (e.g., through a Council action).

[2] It was later determined that NMFS could require participation, however, NMFS cannot require a state program to exist.

Would incorporating portside data require a Council action?

Using portside data to monitor the RH/S catch caps would not require a Council action. Framework 3 allowed NMFS to determine its approach to monitoring the caps. GARFO could make this change without a Council action. However, requiring the fleet/offload locations to participate in portside reporting (e.g., making it a condition of the landing or dealer permit) would require Council action.

Haddock catch cap monitoring

The catch caps for haddock and RH/S are currently monitored using the same method. As with the RH/S catch cap, the final rule for the haddock caps (*Federal Register* 71(157) p. 46871) did not specify the data that must be used to monitor this cap. The PDT recommends keeping the monitoring of these caps consistent; should portside data be used to monitor RH/S catch, they also be used for the haddock caps. If so, the same issues as noted above would need to be resolved.

PDT Recommendation

At the Herring PDT meeting on October 29, 2014, in preparing for work on the 2016-2018 Atlantic herring specifications, the PDT expressed strong support for moving forward with incorporating portside sampling data into NMFS' monitoring program for RH/S catch caps and urged GARFO staff to continue to explore this issue. The PDT noted at the time that this may be especially important if observer coverage on herring vessels is decreased due to limited funding and the allocation of observer days through the standardized bycatch reporting methodology.

During the December 10, 2015 meeting, the Herring PDT reiterated its support, as the data have already been used to establish and modify the caps. However, there are several issues that would need to be resolved, as outlined above. Thus, the PDT does not recommend using the data immediately.

Public comment

Mr. Gerry O'Neill indicated that he is not concerned about the voluntary nature of the program, but that the sampling would be only of the same subset of vessels, those that land in ports capable of participating in portside sampling. Every time he comes to port, he assumes his vessel will be sampled. However, the vessels landing in other ports could have high bycatch that would never be sampled, unless all ports are required to participate and provide access for sampling.

DEVELOPMENT OF INDUSTRY-FUNDED MONITORING (IFM) OPTIONS FOR THE ATLANTIC HERRING FISHERY IN THE OMNIBUS IFM AMENDMENT

Ms. Carrie Nordeen briefly updated the PDT on the status of the Industry-funded Monitoring (IFM) amendment, particularly the development of alternatives for the Atlantic herring and mackerel fisheries. There has been recent IFM PDT work on revising cost estimates. Ms. Nordeen asked for input on a few tables describing the data that would be provided by various sources of monitoring and the specific alternatives under consideration.

The PDT offered recommendations for improving the format of the tables and a few clarifications to the data currently collected from each sampling program. The PDT indicated that federal observers do not collect data of spawning condition (sex, Gonadosomatic index (GSI), and maturity stage), but the state portside sampling programs do The IFM amendment document will be further developed by the IFM PDT and brought to the Council at a future time.

RESEARCH PRIORITIES FOR ATLANTIC HERRING, 2017-2022

In 2016, the Council will identify five-year (2017-2022) research priorities for all its FMPs. As the initial step in the process, each PDT has been asked to develop recommendations for their respective committee to consider. The Herring PDT examined research priorities and data needs identified by the Council for 2010-2014 and priorities for the Atlantic herring Research Set-Aside program (see 2016-2018 Atlantic Herring Specifications Draft Environmental Assessment). Additionally, the PDT discussed the draft priorities that have been identified related to river herring by the Mid-Atlantic Fishery Management Council (MAFMC) Collaborative Research Committee (November 13, 2015 meeting summary). Table 5 compiles all of these priorities; some are duplicative.

The Herring PDT made recommendations for 2017-2022 Atlantic herring research priorities (Table 5). The PDT reiterated the continued importance of all of the 2010-2014 research priorities related to Atlantic herring, particularly emphasizing the need for improved time series data on herring mortality due to predation, which could be useful in the assessment and for ecosystem-based management. The PDT recommended that the Council research priorities regarding social science be more specific than those identified in the 2010-2014 Council priorities to better predict social and economic impacts of management alternatives (e.g., the potential to enter or exit the fishery). The PDT reiterated the importance of the Research-Set-Aside priorities included in the 2016-2018 Atlantic herring fishery specifications. The PDT supported the research topics on river herring in the draft 2016-2020 research plan of the MAFMC (based on input from the River Herring Technical Expert Working Group). The PDT also recommends improving RH/S catch estimation methods.

OTHER BUSINESS, PLAN NEXT MEETING, ADJOURN

The Herring PDT expects to have a conference call shortly following the January 13, 2016 Herring Committee meeting. The meeting adjourned at approximately 4:10 p.m.

Table 1 - Atlantic herring trips in RH/S Catch Cap Areas with NEFOP observers or portside sampling, 2008-2014

RH/S Catch Cap Area	Total trips*	Total NEFOP**		Total Portside***	
	n	n	%	n	%
GOM - midwater trawl	461	161	35%	47	10%
CC - midwater trawl	288	143	50%	32	11%
SNE/MA - midwater trawl	1,046	165	16%	106	10%
SNE/MA - bottom trawl	897	149	17%	250	28%
Total	**2,692**	**618**	**23%**	**435**	**16%**

* Total trips with Atlantic herring landings > 6,600 lbs.
** Total trips with NEFOP observers.
*** Total trips with portside sampling that were not also observed by NEFOP.
Source: 2016-2018 Atlantic Herring Specifications Environmental Assessment, Appendix I (Tables 2 and 4).

Table 2 - Number of trips that landed > 6,600 lbs. of Atlantic herring, 2008-2014

Gear	Cap Area	2008	2009	2010	2011	2012	2013	2014	Total
Bottom Trawl	**GOM**	5	18	24	9	27	3	9	**95**
	CC	0	0	0	0	0	0	0	**0**
	SNE/MA	70	135	103	118	73	223	175	**897**
	GB	1	0	1	0	2	0	0	**4**
Midwater Trawl	**GOM**	88	115	109	65	25	23	36	**461**
	CC	40	16	40	28	50	39	75	**288**
	SNE/MA	152	188	116	77	148	219	146	**1,046**
	GB	36	103	87	183	169	189	154	**921**
Purse Seine	**GOM**	243	225	205	265	275	314	313	**1,840**
	CC	0	0	1	0	0	0	0	**1**
	SNE/MA	0	0	0	0	0	0	2	**2**
	GB	0	0	0	0	0	0	0	**0**
	Total	**635**	**800**	**686**	**745**	**769**	**1010**	**910**	**5,555**

Source: 2016 – 2018 Atlantic Herring Specifications Environmental Assessment, Appendix I (Table 3)

Table 3 - Total landings (mt) from trips that landed > 6,600 lbs. of Atlantic herring, 2008-2014

Gear	Cap Area	2008	2009	2010	2011	2012	2013	2014	Total
Bottom Trawl	**GOM**	32	100	109	40	121	10	39	**451**
	CC	0	0	0	0	0	0	0	**0**
	SNE/MA	3,186	5,952	4,558	4,629	4,935	9,422	5,503	**38,185**
	GB	67	0	66	0	89	0	0	**222**
Midwater Trawl	**GOM**	17,663	22,803	18,628	12,875	4,258	6,563	7,381	**90,171**
	CC	7,280	2,806	5,522	5,769	12,569	6,002	17,199	**57,147**
	SNE/MA	26,460	36,070	22,158	9,799	18,207	16,788	14,230	**143,712**
	GB	7,564	26,669	14,237	32,172	30,355	35,795	27,052	**173,844**
Purse Seine	**GOM**	25,200	21,694	8,272	17,001	19,295	22,981	27,247	**141,690**
	CC	0	0	9	0	0	0	0	**9**
	SNE/MA	0	0	0	0	0	0	58	**58**
	GB	0	0	0	0	0	0	0	**0**
	Total	**87,452**	**116,094**	**73,559**	**82,285**	**89,829**	**97,561**	**98,709**	**645,489**

Source: 2016 – 2018 Atlantic Herring Specifications Environmental Assessment, Appendix I (Table 3).

Table 4 - Sampled RH/S catch cap trips by strata, 2008-2014

NEFOP At-Sea Observed Cap Trips*									
Gear	**Cap Area**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Bottom Trawl	**GOM**	0	0	0	2	2	1	0	**5**
	SNE/MA	1	9	7	20	19	46	47	**149**
Midwater Trawl	**GOM**	17	40	40	25	8	11	20	**161**
	CC	11	9	24	11	38	14	36	**143**
	SNE/MA	26	30	34	34	23	13	5	**165**
	GB	12	33	79	77	114	72	44	**431**
Purse Seine	**GOM**	24	35	22	51	35	31	15	**213**
	Total	**91**	**156**	**206**	**220**	**239**	**188**	**167**	**1,267**
MADMF Portside Observed Cap Trips**									
Gear	**Cap Area**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Bottom Trawl	**SNE/MA**	0	0	0	9	49	112	67	**237**
Midwater Trawl	**GOM**	8	4	9	3	4	6	13	**47**
	CC	2	0	2	0	6	12	9	**31**
	SNE/MA	0	7	4	5	20	31	18	**85**
	GB	0	2	0	9	13	9	22	**55**
Purse Seine	**GOM**	0	2	0	0	0	0	1	**3**
	Total	**10**	**15**	**15**	**26**	**92**	**170**	**130**	**458**
MEDMR Portside Observed Cap Trips*									
Gear	**Cap Area**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Bottom Trawl	**SNE/MA**	0	0	1	1	2	5	4	**13**
Midwater Trawl	**CC**	0	0	0	0	1	0	0	**1**
	SNE/MA	0	2	0	0	1	11	7	**21**
	GB	0	0	0	0	1	0	0	**1**
Purse Seine	**GOM**	0	0	0	0	0	1	1	**2**
	Total	**0**	**2**	**1**	**1**	**5**	**17**	**12**	**38**

Note: If a trip occurred in multiple areas, it was assigned to the area where the majority of catch occurred.

* Only includes trips with >6,600 lbs. herring.

* Only includes trips with >6,600 lbs. herring that were not also sampled at-sea by NEFOP.

Source: 2016 – 2018 Atlantic Herring Specifications Environmental Assessment, Appendix I (Table 4).

Table 5 – Possible 2017-2022 research priorities related to Atlantic herring

Research topic (note some are duplicative)	**2010-2014 NEFMC priority**	**2016-2018 RSA[1]**	**Draft 2016-2020 MAFMC priority[2]**	**PDT input**
Stock assessments				
Further investigations into stock definition, stock movements, mixing, and migration through tagging studies, DNA markers, morphological characteristics and other means for herring.	√			Recommends
Investigate/determine the cause for retrospective patterns in herring assessments, and identify appropriate adjustments (e.g., data or modeling revisions for both) to resolve those patterns.	√			Recommends
Stock structure/spatial management; availability and detectability; fishery acoustic indices; and volume-to-weight conversion.		√		Strongly recommends
Surveys				
Continue development of hydroacoustic surveys and other resource surveys of pelagic species to provide an independent means of estimating stock sizes and/or defining localized depletion (long-term research).	√			Recommends
Fishery performance and monitoring				
Improve sampling of commercial catch at age data, such as through cooperative NMFS/industry programs to supplement port agent activities for Atlantic herring, with an emphasis on bycatch.	√			Recommends
Define localized depletion of spawning components on a spatial and temporal scale for herring.	√			Recommends
Investigate fleet behavior and decision-making with respect to their relationship to population dynamics, closed areas, catch rates, etc.	√			Recommends
Research fishing practices or gear modifications that may change the ratio of component catch species or improve size and species selectivity of gear in herring.	√			Recommends
Portside sampling		√		Strongly recommends
Electronic monitoring		√		Strongly recommends
River herring/Shad (RH/S)				
Collect data on discards of other clupeids in the sea herring fishery.	√			Recommends
River herring bycatch avoidance		√		Strongly recommends
Support data collection standardization efforts and improve methods to develop biological benchmarks used in assessment modeling & management (including catch caps) for RH/S stocks.			√	Strongly recommends
Calculate and/or improve RH/S life stage-specific estimates of range-wide natural and human mortality rates, including fishing.			√	Strongly recommends
Collect information on the marine phases of RH/S specific to: migrations at sea (e.g., determination of river origin of individual catch in coastal/ocean independent surveys, tagging);			√	Strongly recommends

determination of river origin of incidental catch in non-targeted ocean fisheries; and marine survival.				
Develop and/or evaluate innovative approaches for avoidance or monitoring RH/S catch in small mesh fisheries (e.g., environmental cues and bycatch avoidance, electronic monitoring and portside sampling).			√	Strongly recommends
Develop improvements to RH/S catch estimation methods in the Atlantic herring fishery.				Strongly recommends
Expanded ecosystem studies				
Synthesize predator/prey information on herring and other forage fishes and conduct investigations to address information gaps; investigate the role of herring and other forage fishes in the Northwest Atlantic ecosystem and the importance of herring and other species as a forage for other commercial fish stocks; assess the importance of herring as forage relative to other forage species in the region.	√			Strongly recommends
Investigate relationships between stocks, including predator/prey relationships and evaluate whether stock status of some species is slowing the rebuilding of groundfish stocks.	√			Recommends
Investigate effectiveness and economic impacts of closed areas and special access areas to achieve desired goals (e.g., bycatch avoidance/reduction, mortality reduction, yield benefits, ecosystem improvement).	√			Recommends
Endangered, threatened and protected species				
Develop gear modifications or fishing techniques that may be used to reduce or eliminate the threat of sea turtle interactions without unacceptable reductions in target retention in all fisheries.	√			Recommends
Investigate protected species bycatch/discards in the directed herring fishery.	√			Recommends
Socioeconomics				
Initiate or expand appropriate programs to collect information required for improved social and economic impact analyses.	√			Recommends
Characterize the individuals, families, firms, organizations, and communities involved in the Atlantic herring fishery.				Strongly recommends
Identify capacity use and fixed costs of Atlantic herring vessels.				Strongly recommends
Characterize Atlantic herring stakeholders besides those of the commercial herring fishery (e.g., whale watching, tuna, groundfish, lobster fisheries).				Strongly recommends
Characterize Atlantic herring dealers and processors (e.g., dependence on herring, location, costs, earnings, employment).				Strongly recommends
Characterize market dynamics (e.g., relationships between fishermen, buyers, and processors; endusers in bait and fresh markets).				Strongly recommends
Notes: [1] Research-Set-Aside priorities included in the 2016-2018 Atlantic herring fishery specifications. [2] Partial list; includes only topics on river herring.				

APPENDIX I

A preliminary analysis attempting to inform localized depletion of Atlantic herring…using data

By Jonathan J. Deroba

Introduction

This analysis is intended to generate ideas as to how existing datasets might be used to evaluate the extent of localized depletion. The work is not intended to be definitive and should likely be amended (e.g., applied at different spatial and temporal scales) or expanded (e.g., use different datasets) before being used to inform management.

Localized depletion has been of concern to management since at least the mid-2000s, at the time of Amendment 1 (AM1). As part of AM1, midwater trawl (MWT) gears were excluded from management area 1A from June-September out of concern that this gear type was particularly responsible for localized depletion. No evidence or data, however, was used to support these assertions or the management actions, and the actions were described in AM1 as purposefully precautionary. As localized depletion remains an area of concern to management, this analysis suggests some ways that data might be used to look for the effects of localized depletion.

Methods

The occurrence of localized depletion suggests that the removal of prey from a given area would either leave relatively immobile predators (e.g., monkfish) with insufficient prey for some time, or that relatively mobile predators (e.g., cod, tuna) would leave the area in search of alternative prey. This analysis focused on the latter mechanism. Vessel Tracking and Reporting System (VTR) data were used to compare the catch per trip (CPT) of Atlantic cod, pollock, and spiny dogfish the week of reported herring catch to the CPT the week after reported herring catch:

$$D_{y,s,p,w} = \frac{C}{T}_{y,s,p,w+1} - \frac{C}{T}_{y,s,p,w}$$

where C is the catch and T is the number of trips that caught any of the predators (p) in each year (y), statistical area (s), and week (w). These three predators were included because they are of commercial interest and gut contents data from National Marine Fisheries Service bottom trawl surveys suggest that these species prey heavily on herring. A linear regression was conducted with $D_{y,s,p,w}$ as the dependent variable and the catch of herring (h), $C_{y,s,h,w}$, as the independent variable. A consistent negative relationship would support localized depletion, while any other relationship would provide no evidence for localized depletion. This method assumes that CPT is an index of predator abundance between weeks.

Results among statistical areas were similar. Consequently, results from one statistical area from Herring Management Areas 1A, 2, and 3 were provided. More specifically, Statistical Areas 513, 522, and 537. Analyses were also restricted to the years 2006-2013 just to keep the number of comparisons manageable and because each of these years has an adequate number of observations for the chosen statistical areas.

The analysis described above was also repeated: 1) for only predator trawl gears with the number of trips in the CPT estimate replaced with the number of tows, 2) using predator catch per tow from only bottom otter trawls, 3) using predator catch per trip from only bottom otter trawls, 4) using predator catch per trip from only sink gill-nets, and 5) using predator catch per trip from only longlines. These additional analyses were intended to serve as a test of whether the effects of herring catches on the predators may vary depending on the gear type used to catch the predators. For example, if harvesting herring serves to scatter predators over a broader area then a mobile trawl gear may maintain CPT (tow or trip) by towing longer over a broader area, whereas the fixed gill-nets and longlines would require the predators to reaggregate in a given location in order to maintain CPT. The fixed gears might also increase soak times, but that is not accounted for here. The results for all of these analyses, however, were generally similar to those from using CPT from all predator gears combined, and so results for these sensitivities were not presented.

Results

None of the regressions were statistically significant except for statistical area 537 in 2012, which had relatively few observations (Figures). The direction of the relationship between $D_{y,s,p,w}$ and $C_{y,s,h,w}$ was inconsistent (i.e., positive in some years and negative in others; Figures). These results provide no evidence of localized depletion for these predators at the scale of statistical area and one week time intervals.

Discussion

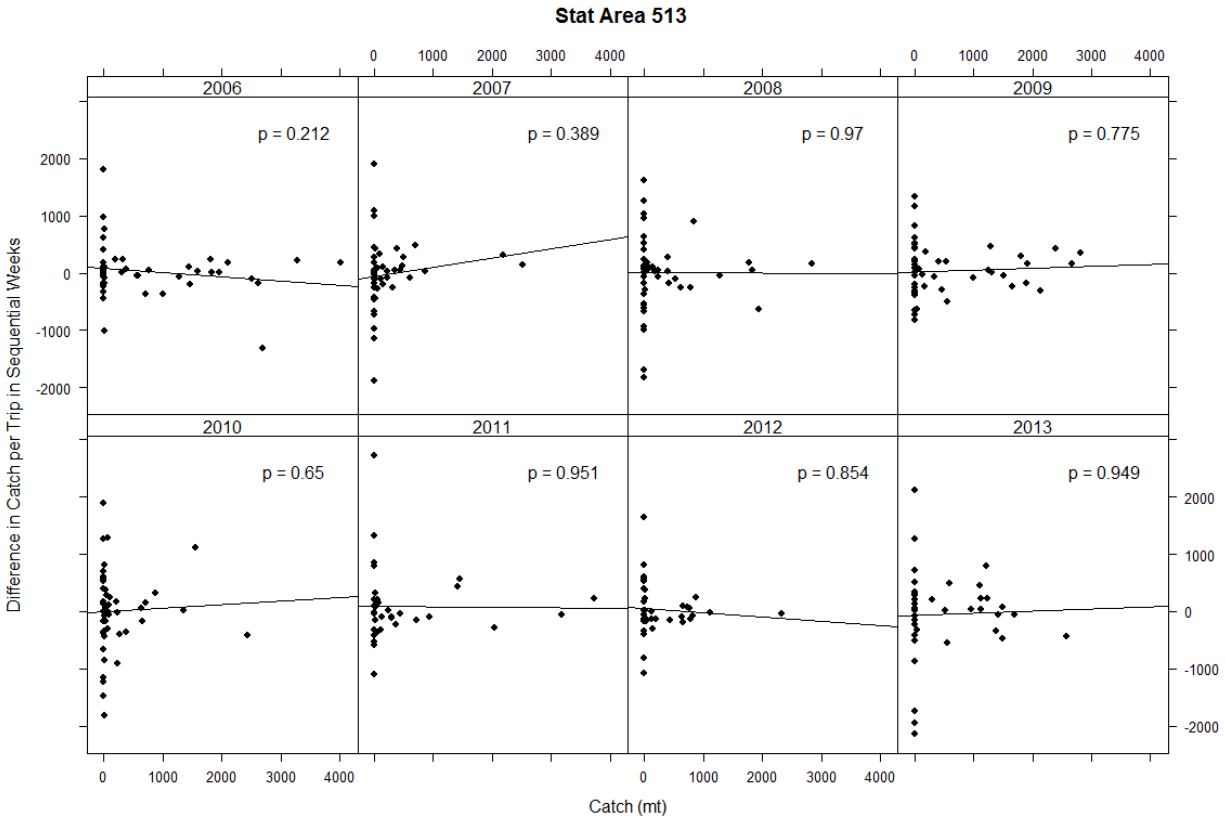
This analysis has several caveats. The spatial and temporal scale at which localized depletion operates has no general definition and may depend on predator. Here, localized depletion was defined to be of interest on the scale of statistical area and week. So, if conditions within a statistical area were unchanged after one week then no evidence of localized depletion would be found. This analysis also focused on three predators and combined them for analysis, but different predators may respond differently to the removal of herring. Conducting analysis by individual predator or groups of predators thought to react similarly to herring removals should likely be considered in the future. Likewise, varying the temporal and spatial scale of analysis by predator might also be considered, but perhaps the predators of greatest interest could be defined ahead of time. This analysis also used VTR data, which is self- reported and may contain errors (e.g., incorrect spatial assignments). Alternative data sources might be considered in the future.

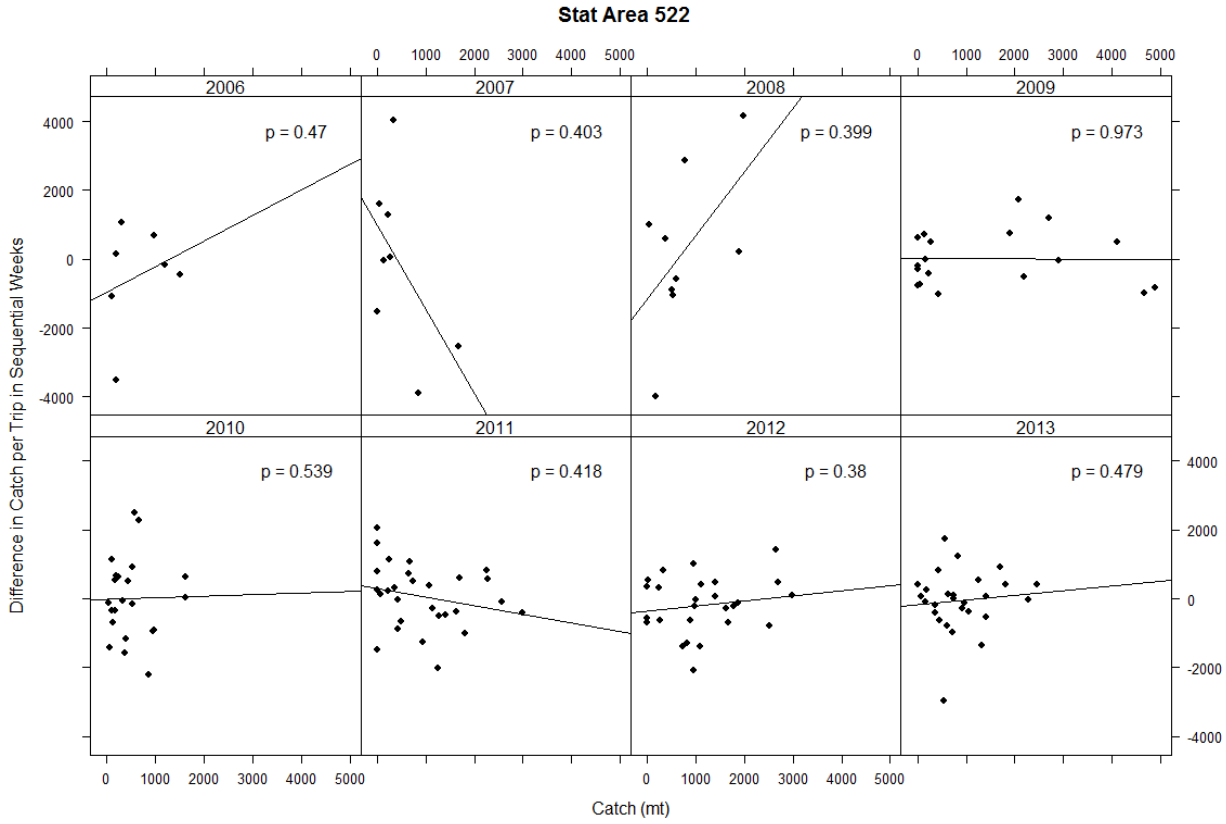
Data from all times of year were combined in this analysis, but perhaps analysis by season should be considered. Herring migrate during certain times of year and so localized depletion is unlikely to occur during these times because the herring will be in a different location in the near future regardless of catches. Conducting analysis during a time of year when herring are likely to be confined in a single region might be more appropriate (summer feeding grounds or fall spawning). (Note, having included data from all times of year in this analysis would only increase the chances of finding a negative relationship in support of localized depletion).

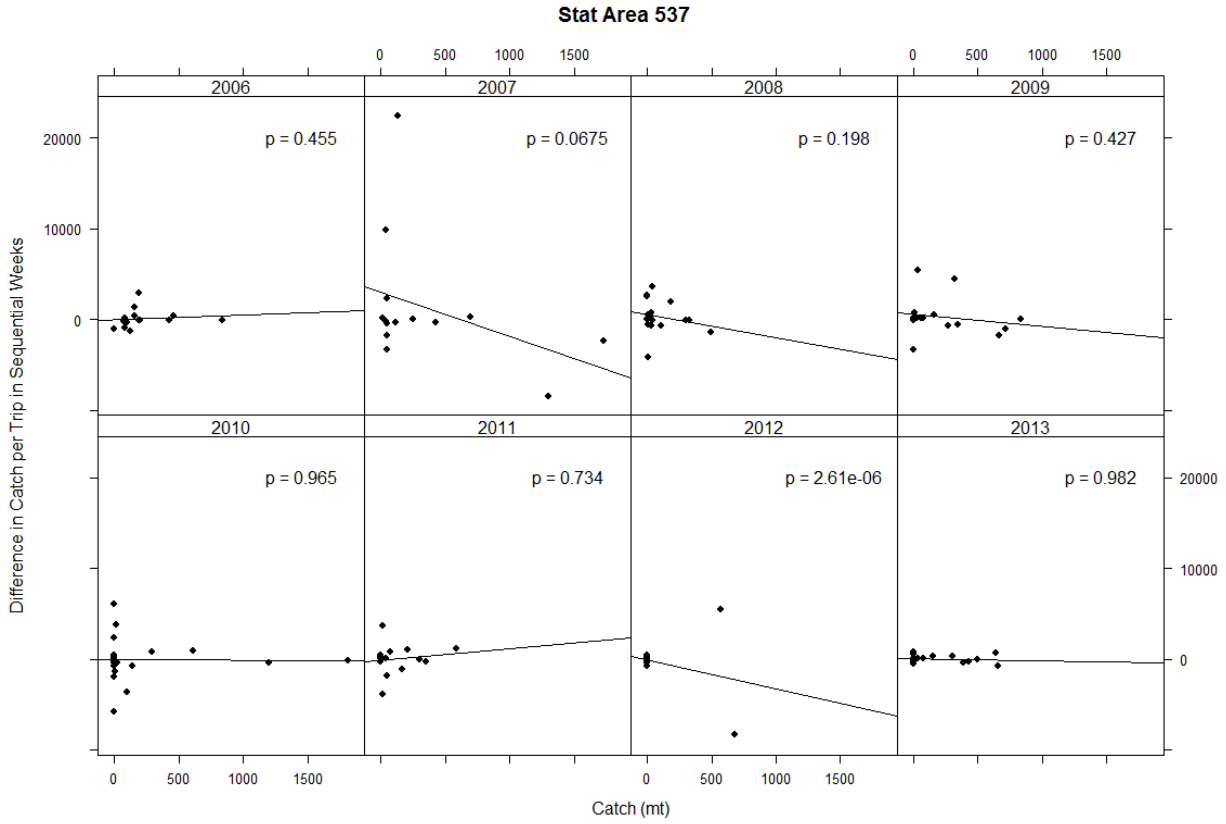
In AM1 and more recently, much attention has been given to MWTs as the gear type responsible for causing localized depletion. The method of removal, however, should not be relevant to the evaluation of localized depletion. If predators are responding only to herring abundance in an area, then given the same amount of catch, the same level of depletion occurs regardless of gear

type and would subsequently have the same effect on predators. That said, as a relatively large and mobile gear, MWTs are likely to have different effects on predators than other gears commonly used to harvest similar amounts of herring (e.g., purse seines). For example, as MWTs pass through an area they may push predators to other regions or disaggregate the predators, making the predators harder to catch for operations targeting those species, and this would occur regardless of the amount of herring caught (i.e., the predators are responding to the MWT passing through and not to a reduction in herring). This decrease in predatory catch may be perceived as a consequence of localized depletion of herring, when in fact may be unrelated to herring catches/depletion. Purse seines that do not cover the same linear distance while in operation as MWTs would not affect predators in this way, and so would be perceived as not causing localized depletion. This scenario is entirely speculative, but these issues of gear conflict should be kept distinct from issues of localized depletion. Are herring predators responding to depletion of herring (which should not depend on the gear used to remove herring), or are the predators responding to a trawl gear passing through an area (and would respond the same way regardless of herring depletion)? The former is localized depletion while the latter is not. These issues are also not mutually exclusive.

Figures




Stat Area 522
2006
2007
2008
2009
2010
2011
2012
2013
p = 0.47
p = 0.403
p = 0.399
p = 0.973
p = 0.539
p = 0.418
p = 0.38
p = 0.479
Difference in Catch per Trip in Sequential Weeks
Catch (mt)


Stat Area 537
2006
2007
2008
2009
2010
2011
2012
2013
p = 0.455
p = 0.0675
p = 0.198
p = 0.427
p = 0.965
p = 0.734
p = 2.61e-06
p = 0.982
Difference in Catch per Trip in Sequential Weeks
Catch (mt)