Herring PDT Meeting Summaries

May 26, 2009
April 8, 2010
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NEW ENGLAND FISHERY MANAGEMENT COUNCIL

Final Herring PDT Report

May 26, 2009
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met in Mansfield, MA to review and discuss the development of alternatives for Amendment 4 to the Herring Fishery Management Plan (FMP). Many of the Herring PDT comments have been incorporated directly into the Draft Amendment 4 Discussion Document (dated June 2009) and are not included in this report. This report focuses on the Herring PDT discussion related to proposed measures to address maximized retention and net slippage, as well as issues related to observer coverage, dockside monitoring, and catch monitoring in general.

Maximized Retention/Net Slippage

Maximized retention may be one mechanism for measuring/verifying at-sea catch, but it poses some significant logistical, operational, safety, enforcement, and compliance challenges that must be addressed when designing the system. It is unclear what the goal/expectation of a maximized retention program may be.

- Is the goal of maximized retention to obtain a census of all bycatch in the Atlantic herring fishery or to improve precision and accuracy for estimates of bycatch?
- Is maximized retention being considered because there is uncertainty about the accuracy of sea sampling data? While recognizing that coverage levels should be increased, is there a lack of faith in the sea sampling data that are collected?

  Is maximized retention being considered because of concerns that:
  - Observed trips are not representative of the entire fleet (i.e., trip selection for sampling is biased)?
  - Observed trips are biased by an "observer effect" (ex., frequency and composition of slipped and partially slipped hauls differ between observed and unobserved trips)?
  - Precision around discard estimates is too low (i.e., not enough trips, insufficient geographical/temporal coverage)?
  - A census may provide better estimates of catch than statistical sampling?

If the goal of maximized retention is to fully and accurately sample all catch on herring vessels and estimate bycatch, then there may be other ways to achieve this goal – for example, through increased observer coverage and provisions to better address net slippage and fully sample discarded catch.

Issues to Address/Potential Challenges

Under the assumption of full compliance (no slippage and/or at-sea discarding), maximized retention could provide an opportunity to sample at-sea catch that would have otherwise been discarded. The amount of various species would still be estimated, unless the entire catch was disaggregated into species and fully sampled. Several issues regarding the sampling program would need to be specified/clarified:

- Would vessels separate the target harvest and unwanted catch at-sea?
- Would the unwanted/discarded portion of the catch be fully sampled (high volume) or counted (very low volume)?
- Would all trips or just some trips be sampled at the dock for species composition?
- Would the volume of unwanted/discarded catch be measured for all vessels or only some vessels?

The above questions need careful consideration in order to assess the efficacy of maximized retention compared to other methods for estimating discards in the Atlantic herring fishery. Currently, dockside sampling of landed catch on herring vessels can take 12 hours or more. If the retained portion of unwanted catch is high in volume (for example, feedy herring), then sampling of retained discards will likely take several hours. This will impact the size/design of the dockside monitoring program.

The Herring PDT identified several challenges to a maximized retention approach for the herring fishery, which should be acknowledged and addressed to the extent possible when designing provisions for maximized retention in this amendment.

- Separating the harvest from the unwanted catch may be difficult for some vessels and could reduce vessel capacity.
- With such a large-volume fishery, many boats take trips with the intention of bringing back a specific quantity of herring needed for the market. There may be trips where either the desired market quantity of fish will be reached before a bag is fully pumped. There is also the potential for landing poor quality/unmarketable fish under a maximized retention program.
- How are "test tows" addressed? Fishermen may make a short tow to determine the composition and/or quality of fish they are catching before fully loading the bag. If the fish in the test tow are not desirable, the vessel can release the bag and move elsewhere. Would test tows be prohibited under maximized retention provisions? Would vessels be required to retain fish from test tows even if they are unwanted and/or unmarketable (for example, feedy herring)?
- How will the unwanted/discarded portion of the catch be sampled? For example, will the discarded portion need to be pumped out at the dock, sampled, and then pumped back into the vessel to be dumped at-sea? Will the unwanted fish be handled and sampled at the dealer/processing facilities or on the vessel?
- How to dispose of the unwanted/unmarketable catch? Are vessels or processors/dealers responsible for unwanted catch? Will vessels need to take the unwanted catch back to sea and dump, or are other land-based options available? If the excess catch is sold (even as bait), this could depress the market price for other landings.

- What would prevent non-observed vessels from discarding at sea? Alternative 3 proposes video-based electronic monitoring for this purpose, but are there other alternatives? It seems that maximized retention would only be effective with either an observer or a video camera on the vessel. If this is the case, then can the same goal be achieved just by increasing observer coverage to adequate levels and getting better information about discards and slipped catch?
- Are there safety concerns with requiring maximized retention and putting everything in the hold? For example, slippage events have been noted due to full vessel capacity and gear problems. What about concerns related to compromising the quality of the catch?
- There are additional costs that should be considered, which will include monitoring (video, for example), sampling (dockside), and disposal costs.
- How are carriers addressed under maximized retention provisions? Are carriers required to retain unwanted fish from harvesting vessels, or would harvesting vessels be required to sort the catch prior to pumping fish to a carrier? How would carrier catch be sampled?
- If maximized retention is going to be implemented in this fishery, it will be critical to work in partnership with the industry to address many of the operational and safety challenges associated with this program.

Other Alternatives?

Given the logistic problems and the potential costs of maximized retention, the question arises as to whether the goals of maximized retention (accurately estimating total catch and discards) could be achieved be more efficiently and at a lower cost. The PDT expressed concern about reacting too strongly to the existing information and imposing measures that would have a significant cost for the entire fishery before the nature and extent of the problem is fully assessed. It seems that the first and most appropriate step would be to implement measures to ensure that more and better information is gathered and then developing a more technically-sound solution to any problems that are identified. In this context, the Herring PDT discussed some possible alternatives to maximized retention.

- The discarded portion of the catch on herring vessels could be characterized and estimated more accurately with a well-designed allocation of sea sampling effort (observer coverage).
- Slipped catches must be addressed and should be sampled at-sea for species composition and amounts of discards. It is imperative that observers be provided the opportunity to sample the contents of the entire haul.
- The Observer Program was not designed to collect detailed information about net slippage, but this is something that can be addressed in the sampling protocol, added to observer logs, and addressed through regulations requiring detailed information when slippage events occur. A requirement that all vessels report slippage of catch (with reasons and estimates of discards) could be useful for estimating discards and assessing compliance. Data on slippage events need to be collected in a more consistent manner, and this amendment provides an opportunity to implement the necessary elements of a catch monitoring program to do so.
- If observer coverage levels are increased and regulations mandate detailed reporting of slippage events on *all* trips, then that slippage rates can be compared across observed and

unobserved trips to assess compliance and determine the nature/extent of the problem. An analysis of information generated on observed trips versus unobserved trips could identify any discrepancies and be used to determine whether or not more significant action needs to be taken to address the issue.

- A similar analysis was conducted for the groundfish fishery – the mandatory retention of groundfish in the B-DAS program with the provision of "flipping to A DAS" when groundfish catches exceeded the B-DAS trip limit is informative. In this case, flipping rates of observed trips and unobserved trips were significantly different, suggesting that catches of groundfish exceeding B-DAS limits were discarded on some unobserved trips.

Dockside Monitoring/Sampling

The Herring PDT also discussed dockside monitoring/sampling as part of a catch monitoring program, and as something that would be necessary if maximized retention is mandated in the fishery. It is not clear that dockside monitoring would be necessary if observer coverage is adequate to generate estimates of bycatch, but some questions may remain about the accuracy of sampling similar looking, small-bodied fish at-sea in a high-volume fishery, given current protocols. Regardless, dockside monitoring and sampling may be an appropriate tool for monitoring and confirming landings in the fishery.

- "Dockside monitoring" tends to refer more to the monitoring/confirmation of landings in the herring fishery, while "dockside sampling" tends to refer more to the sampling of catch for the purposes of estimating bycatch or incidental catch.
- Dockside sampling is not necessary for estimating landed bycatch if sea sampling is adequate, but the ability of both dockside and at-sea sampling to generate accurate estimates of bycatch should be tested.
- Dockside monitoring could be constructed differently (and perhaps less costly) if used only for confirming the accuracy of self-reporting (of herring catch).
- Dockside sampling is effective for sampling/estimation of catch of small-bodied species like herring, mackerel, river herring, and shad – may provide an appropriate cross-check with observer sampling for these species, which may be more difficult to distinguish in large quantities;
- Dockside sampling/monitoring may be less expensive than at-sea monitoring, but will not address slippage – at-sea monitoring is still necessary, so dockside sampling could increase costs, depending on the goals of the program;
- Dockside sampling is not subject to the same weather (and other) constraints as at-sea sampling.
- Dockside sampling can provide a mechanism to compare and cross-check at-sea sampling data.
- If a dockside monitoring program is included in this amendment, efforts should be made to be consistent with the groundfish sector dockside monitoring program if possible.

NEW ENGLAND FISHERY MANAGEMENT COUNCIL

FINAL Herring PDT Report

April 8, 2010
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met on April 8, 2010 in Mansfield, MA to review and discuss the development of alternatives for Amendment 4 to the Herring Fishery Management Plan (FMP). The PDT discussed some of the proposed elements of the catch monitoring program as well as information and analyses related to the development of management measures to address the bycatch of river herring in the Atlantic herring fishery.

Amendment 5 Catch Monitoring Alternatives

Ms. Steele briefed the Herring PDT on the Herring Committee's recent two-day meeting and the continuing work on the development of catch monitoring alternatives for consideration in Amendment 5. Discussion focused on specific issues for which the Herring Committee is seeking additional guidance, information, and/or analysis. Herring PDT discussion is summarized below.

VMS Issues/Information

The Herring Committee is considering management measures to address the activities of Atlantic herring carrier vessels, including measures to require vessel monitoring systems (VMS) on carriers. A motion was passed to consider a size threshold for smaller carriers that would not be required to use VMS, so the Committee is interested in obtaining more information about the characteristics of carrier vessels currently participating in the fishery.

- Ms. Nordeen suggested that the Committee could consider a "dual" option that would allow carrier vessels to either (a) use VMS for pre-trip declarations, have flexibility to declare activity on a per-trip basis, and not be bound by the seven-day minimum enrollment in the current LOA; or (b) not use VMS and be subject to current LOA restrictions (status quo). She mentioned that the Multispecies FMP applies a similar approach for VMS provisions and agreed to provide the regulatory language.
- Ms. Nordeen agreed to investigate information about carrier vessels currently participating in the fishery – how many vessels per year, size of vessels, herring permits that carrier vessels may possess, etc.

Measures to Address Net Slippage – "Trip Termination Options"

The Herring Committee discussed measures to address net slippage during its March 30-31 meeting and passed the following motion:

> To task the PDT to develop trip termination options for slippage events, applicable to different gear types, vessel sizes, and observer rates

The Herring PDT discussed this issue in some detail. It was generally agreed that trip termination options may be applicable under a maximized retention program and/or on trips with observers/monitors on board,, but they are not really useful as stand-alone options to address net slippage. It is unclear what the objective of a trip termination measure would be if it is a stand-alone measure (i.e., not part of a maximized retention program). Some concerns were also expressed about applying a trip termination measure on trips with observers on board because it is likely to create problems for the observers, who would be required to make a determination that a slippage event has occurred and subsequently mandate that the captain terminate the fishing trip. The measure is essentially punitive. Trip termination determinations could therefore place the observers in an enforcement role and could create an undesirable situation on the fishing vessel and a confrontational atmosphere.

Moreover, for a trip termination measure, the definition of a slippage event would need to be very clearly and specifically defined in the amendment so that determinations as to whether a slippage event has occurred could be made equitably, consistently, and with certainty. The PDT is uncertain how slippage events would be defined based on gear type or vessel size. Numerical values (pounds of fish in bag) and/or percentage-based determinations (x% of the total catch) do not seem to be feasible ways to determine slippage events. If the release of any amount of unsampled/unobserved fish constitutes a slippage event, would test tows be prohibited?

Some PDT members also wondered if this measure could cause captains to pump unwanted fish on board (versus slipping the net) and questioned the benefits of this approach if some fish would have survived by slipping the net. This is a very important consideration. If maximizing sampling is the objective, the Herring PDT believes that there are other approaches that could be considered to achieve this objective. The Herring Committee should consider whether the trip termination measure is intended to be developed as a stand-alone measure, and if so, what the objective(s) of the measure may be.

Analysis of Portside Sampling/At-Sea Observer Data to Determine Coverage Levels

At its March 30-31 meeting, the Herring Committee tasked the Herring PDT to consider at-sea and portside sampling coverage levels and design a combination program intended to meet the priorities identified by the Council (in terms of coefficients of variation, CVs, on bycatch estimates for herring, haddock, and river herring). The Committee is interested in how the at-sea and portside sampling data may relate to each other and how they can be utilized in combination to ensure that the Council's priorities for sampling are met in the most cost-effective manner and that accurate bycatch estimates can be generated for the fishery.

Matt Cieri agreed to develop an analysis of portside sampling and at-sea data to determine the relationship between the data and show where the two datasets overlap and where they may differ. The analysis will ultimately resemble the analysis in the document to demonstrate observer coverage levels based on the SBRM (standardized bycatch reporting methodology) approach. Dr. Cieri will assess the variability in the observer estimates versus the portside sampling estimates as well; if variability is similar and the two datasets are comparable, then portside coverage levels would be similar to at-sea levels. Dr. Cournane suggested that the analysis also examine the relationship of these data to data from vessel trip reports (VTRs) to relate them to estimates of landings.

Dr. Cieri agreed to present some preliminary information to the Committee on May 17 about the overlapping trips in the database (trips with both an at-sea observer and a portside sampler) to give the Committee an idea of the relationship between the two datasets, at least with respect to river herring. He will then develop a more detailed analysis for the Herring PDT to consider in late May when it revisits this issue. The PDT will review the available analyses and develop recommendations regarding coverage levels for at-sea and portside sampling, and comments regarding a combination approach to achieving the desired CVs.

Measures to Address Slippage

At a previous meeting, the Herring Committee passed a motion to include a measure in Amendment 5 that would task the Herring PDT to determine (and the regulations to apply) a minimum portion of a slipped catch that would be required to be pumped ob board a vessel to ensure complete sampling. The PDT discussed this motion/measure and expressed some concerns:

- It is not clear how a percentage could be determined to ensure complete sampling from a slipped catch without further investigation/research. Sampling based on a percentage of the catch implies that the total amount of fish in the net is known.
- Fish may stratify in a net that sits for a period of time, and it is not clear how to maximize sampling without knowing more about stratification. In addition, sampling efforts may vary depending on the size and contents of the bag. To illustrate this point using a somewhat extreme example, a net that may include 10% river herring stratified in the mix would require considerably more sampling to ensure accuracy than a net that may include 80% river herring mixed homogenously throughout.
- Measures have recently been implemented in Closed Area I that require herring vessels to bring all fish across the deck for sampling purposes; it seems that there may be some useful information generated from the Closed Area I regulations that could be considered when developing measures to maximize sampling in Amendment 5. The logistics and practicality of sampling all fish at-sea can be better understood once the Closed Area I regulations have been applied.
- It is unclear how to develop this measure without conducting a study to determine the appropriate percentages. Also, it would be helpful to know what question(s) this measure is intended to address? Is this measure intended to maximize sampling for a particular species or group of species, or is it intended to provide for max sampling across all species that may be encountered while fishing for herring?

General Updates

2009 IVR/Landings Data

Matt Cieri updated the PDT on 2009 landings from the herring interactive voice response (IVR) program. IVR catch for the 2009 fishing year totaled 102,892 metric tons, with the TAC from Area 1A fully utilized (43,588 mt) and catch in Area 3 substantially higher than recent years (see Table 1 below). This information will continue to be updated and will be provided in the Amendment 5 Draft Environmental Impact Statement (EIS).

Table 1 Comparison of IVR Landings (Metric Tons) by Area 2008-2009

Management Area	2008	2009	Difference
1A	41,857	43,588	**1,731**
1B	8,104	1,796	**-6,308**
2	19,256	28,062	**8,806**
3	11,800	29,446	**17,646**
US Total	81,017	102,892	**21,875**
NB Weir	6,448	2,534	**-3,914**
Total	87,465	105,426	**17,960**

Northeast Fisheries Observer Program

Sara Wetmore updated the Herring PDT on observer coverage levels and available data from the Northeast Fisheries Observer Program (NEFOP). Observer coverage rates across the herring fishery during 2009 were considerably higher than recent years. Table 2 summarizes observer coverage levels for 2009 by gear type, based on number of trips and number of sea days corresponding with landings from the VTR, Dealer, and IVR databases. All observed trips for these gear types (SMW = single midwater trawl, PMW = paired midwater trawl, and PS = purse seine) are included in Table 2 regardless of target species. The totals also include trips covered by two or more observers (i.e., pair trawl trips, trips with catcher/carriers). Overall, coverage across the fishery was greater than 20% in 2009 and averaged close to 30% based on landings in the fishery.

Table 2 Summary of NEFOP Observer Coverage Levels by Gear Type, January – December 2009

	# trips				# sea days				Metric tons of herring landed
	SMW	PMW	PS	Total	SMW	PMW	PS	Total	Total
OBS	18	138	53	209	74	473	162	709	28,938
VTR	78	489	222	789	352	1844	591	2787	106,301
Dealer									101,025
IVR									102,617
% coverage	23%	28%	24%	26%	21%	26%	27%	25%	27% (VTR) 29% (Dealer) 28% (IVR)

The NEFOP has also updated its observer training program to address new requirements for herring vessel access to Closed Area I as well as general training for observing high volume fisheries. In 2010, the NEFOP has conducted three high-volume fishery training classes to recertify 70 observers. The program is designed to improve sampling in fisheries that pump fish on board and ensure that only experienced observers who have proven high data quality will be assigned to these fisheries. The program was developed to improve fishery-specific training and focuses on defining gear, understanding bycatch issues, knowing and identifying species of concern, subsampling methodology, common scenarios, safety, and the process of pumping fish on board. The NEFOP also implemented a discard log to obtain more detailed information regarding discards in high-volume fisheries. The new discard log will be completed for every haul during which fish are pumped, and it includes fields to provide information on what kind of discard event may have occurred, whether or not the observer could see the contents of the codend when pumping stopped, why catch may have been discarded, information about the composition of discarded catch, and any challenges the observer may have experienced when observing the haul. Observers are also bringing in samples of fish from every trip to confirm species identification.

For the 2010 year (April 2010-March 2011), coverage is expected to be relatively high again, with funds allocated to support about 500 sea days of coverage for the three gear types in Atlantic herring fishery. An additional 156 sea days are anticipated for Closed Area I coverage. Coverage levels will ultimately depend on available resources and priorities, once the Council(s) have provided input to the proposed sea day schedule based on the SBRM approach.

GMRI Herring Stock Structure Pilot Project

Jason Stockwell updated the Herring PDT on morphometric information generated from the recent herring stock structure pilot project conducted by GMRI. GMRI conducted a pilot study during 2009 to evaluate the application of an interdisciplinary approach to stock structure identification using morphometrics and otolith shape and microstructure analyses. Adult herring in pre-spawning or spawning condition were obtained from Scots Bay, German Bank, and Georges Bank via the Canadian Commercial Fishery, DFO, and NMFS. A graduate student conducted a morphometrics analysis similar to Armstrong and Cadrin (2001) and Bolles (2005). Despite relatively small samples sizes, multivariate analyses produced a 72% success rate in stock discrimination, consistent with stock discrimination success rates from the previous morphometric studies. Collectively, these morphometric studies suggest this is a promising method for stock discrimination work in the Gulf of Maine. To date, GMRI has not secured funding to process the otolith samples to compare with the morphometrics approach. Dr. Stockwell noted that the expectation, based on recent interdisciplinary work in Europe, is that combining multiple stock identification methods will prove far more powerful than any single method (i.e., morphometrics alone). Future sampling for a broad-scale study can be done in a very cost-effective manner given collaborative relationships with the commercial herring fishery and government agencies in both the U.S. and Canada.

Measures to Address River Herring Bycatch

The Herring PDT discussed available information related to the development of management measures to address river herring bycatch in the herring fishery.

Estimates of River Herring and American Shad Removals in the Directed Atlantic Herring Fishery: Update with Preliminary Data

Matt Cieri presented an updated (preliminary) analysis of river herring and shad bycatch in the directed herring fishery, following up from an analysis he presented in 2008 focused on river herring bycatch. Observer data and portside sampling data were combined and compiled for trips landing more than 2,000 pounds of Atlantic herring, and then stratified by year, area, gear type, and quarter. A ratio was estimated (pounds of river herring:pounds of Atlantic herring), and estimates of the error (coefficients of variation, CVs) were generated for these ratios.

The general conclusions from the analysis are that river herring bycatch in the directed herring fishery is low in terms of percentage of total catch but may be significant relative to the river herring stock(s). Bycatch of river herring ranged from 0.01%-2% by weight of Atlantic herring landed, and there are many "zero observations" in both data sets. The estimates, however, are quite variable, and CVs are approaching 1+ when the data are disaggregated into gear/area/quarter strata. While coverage is limited in some times/areas/gear sectors, the data suggest that many of the observed bycatch events occurred in Quarters 1 and 4 (winter) around Cape Cod and southern New England. Results are somewhat similar for shad, but CVs on bycatch estimates are even higher and probably not very useful at this time.

Data through the 2009 fishing year should be available relatively soon, and Dr. Cieri agreed that he would update the information and present it to the Herring Committee at the May 17 meeting. He also agreed to add some preliminary analysis looking at data from trips that both had an observer on board and were sampled at the dock by a portside sampler. This information will be presented to the Committee in preliminary form, and the PDT will reconvene in late May to review a more detailed analysis.

The Herring PDT discussed the issue of characterizing a "directed herring trip" for the purposes of analysis in Amendment 5. Currently, most data summaries and analyses have characterized bycatch on trips that land 2,000 pounds or more Atlantic herring, some of which may not necessarily be directed herring trips. While this issue was discussed in detail, no resolution was reached by the Herring PDT. The PDT considered the benefits of characterizing a directed herring trip based on a percentage of total landings and may revisit this in the future. For the most part, however, the PDT felt that landings on midwater trawl, pair trawl, and purse seine trips that landed 2,000 pounds or more herring may be appropriate to characterize the directed herring fishery, and that it may just be a matter of investigating the data associated with the bottom trawl sector of the fishery in more detail. Bottom trawl vessels that land 2,000 pounds or more of herring could be directing on a number of species, including whiting and herring. Summarizing landings from bottom trawl vessels on trips with 2,000 pounds or more Atlantic herring is likely to capture more than just the directed herring fishery, and the PDT agreed to investigate this issue in more detail during the development of the amendment.

During the discussion, several PDT members expressed concern about focusing on the Atlantic herring fishery when trying to develop management strategies to reduce/minimize river herring bycatch. While the Herring PDT agreed that bottom trawl activity should be investigated more closely, one PDT member suggested that if the Council wants to address river herring bycatch, it needs to look beyond just the Atlantic herring fishery and consider the issue on a larger scale, including all of the fisheries in the region that may encounter river herring. Someone else noted that the NEFSC Reference Document examining river herring bycatch has identified the NE small mesh otter trawl sector as the sector with the highest river herring bycatch rates. Another PDT member expressed concern about the Herring Committee's direction to the PDT to develop alternatives for closed areas to reduce river herring bycatch. It was noted that while the PDT could define some areas where river herring bycatch has been observed, there is no way to predict/ensure that fleet effort will not shift to other areas with similar or even higher bycatch rates. It is also not possible to determine what these kinds of management measures may actually do to improve the health of the river herring resource. Nevertheless, the Council is required by law to minimize bycatch, so the Herring PDT agreed to present all available data to the Herring Committee and ask the Committee for guidance regarding the development of specific management alternatives. Some of the PDT's concerns may be addressed in Dr. Cournane's river herring bycatch analysis (summarized below and detailed in the appendix).

Developing Alternatives to Mitigate River Herring Bycatch At-Sea (Jamie Cournane)

Jamie Cournane provided the Herring PDT with an overview of her work to develop a spatial model to evaluate river herring bycatch as well as management strategies intended to minimize bycatch (summarized in the attached appendix). Her project will investigate management alternatives intended to mitigate river herring bycatch under a range of ecological and fishing fleet dynamics scenarios, as well as the potential impact of these management alternatives on fishing fleets and co-occurring pelagic species.

Dr. Cournane presented an overview of her work to date as well as some maps illustrating some of the data that she will be investigating more closely. Maps of 2004-2008 relative weights of alewife and blueback herring, from NMFS bottom-trawl surveys, suggested seasonal differences in fish distribution and aggregations. Similar maps of bycatch events of alewife and blueback herring in fisheries targeting Atlantic herring, Atlantic mackerel, menhaden, whiting, butterfish, and squids, from observer data, were constructed for gear types. The next steps involve developing spatially and temporally explicit statistical models of river herring bycatch events and relative weights using spatial, temporal, and fisheries factors as model predictors. Future work will include fishery-independent (federal and state trawl-surveys) and fishery-dependent (vessel trip reports, dealer data, and observer data) datasets.

Dr. Cournane agreed to provide a presentation and white paper to the Committee on May 17, at which time the Herring PDT hopes to get feedback from the Committee regarding the further development of management alternatives to address river herring bycatch in Amendment 5. The Herring PDT agreed to reconvene in late May to continue developing the analyses to support the alternatives under consideration in Amendment 5.

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APPENDIX

FINAL Herring PDT Report

April 8, 2010
Holiday Inn, Mansfield, MA

Developing Alternatives to Mitigate River Herring Bycatch At-Sea (Jamie Cournane)

Problem Statement

Many river herring runs have declined along the Atlantic coast to a degree such that a collapse of the coast-wide stock is feared to be underway. NOAA has declared both species as "Species of Concern", and ASMFC has passed a default closure of directed fisheries and has joined MAFMC in requested emergency action from the Secretary of Commerce. NEFMC is now joining efforts to reverse the decline of river herring by tasking the Herring PDT with development of alternatives to mitigate bycatch in ocean fisheries.

River herring undertake extensive migrations during which they encounter numerous impacts in riverine, estuarine, and oceanic habitat. All of these impacts need to be monitored, managed, and ultimately mitigated in a comprehensive restoration strategy. Bycatch in ocean fisheries is known to occur. The magnitude of this impact likely varies among spawning populations based on their unique at-sea migration patterns. In some places, it might be the most significant factor driving declines, whereas elsewhere it might be negligible.

We currently lack the information needed to link bycatch impacts with population trends in specific coastal areas. However, it is the one impact on river herring that is unmanaged and unmitigated. Alternatives developed in this project aim to correct that gap, acknowledging that any action taken is unlikely to fully rectify the problem in any particular watershed and certainly not on a coast-wide scale, but will add a missing piece to the multi-dimensional restoration effort nonetheless.

Methodology

This project will evaluate management alternatives to mitigate river herring bycatch at sea under a range of ecological and fishing fleet dynamics scenarios. Additionally, this will involve evaluating the impact of these management alternatives on fishing fleets and co-occurring pelagic species. The overall goal is to identify the management action most likely to produce the largest decrease in bycatch with the smallest impact on the affected fleets.

Three main objectives of this work to meet this goal are to:

- Develop a detailed and dynamic model that captures spatial, seasonal and inter-annual differences in the relative abundance of river herring and Atlantic herring.
- Construct a fleet dynamics model for the Atlantic herring fleet to use in simulations of fleet behavior.

- Evaluate management strategies to mitigate river herring bycatch by linking the ecological model with the fleet model.

There are a range of management options to be tested within this management strategy evaluation framework. For example, the Alaskan pollock fleet and the NPFMC have addressed salmon bycatch using different combinations of fixed spatial closures, rolling hotspot closures, and bycatch quotas. The Commission for the Conservation of Antarctic Living Marine Resources has addressed bycatch of a range of species using so-called "move along rules", whereby vessels are required to move fishing operations a minimum distance if a bycatch threshold is exceeded. This work will examine these and other strategies to determine the approach that is most effective at reducing bycatch while considering the impact on the fleet.

Preliminary analyses revealed that multiple datasets can be used for modeling river herring populations and bycatch in sea fisheries. Maps of 2004-2008 relative weights of alewife and blueback herring, from NMFS bottom-trawl surveys, suggested important seasonal differences in fish distribution and aggregations. Similar maps of bycatch events of alewife and blueback herring in fisheries targeting Atlantic herring, Atlantic mackerel, menhaden, whiting, butterfish, and squids, from observer data, were constructed for gear types. The next steps involve developing spatially and temporally explicit statistical models of river herring bycatch events and relative weights using spatial, temporal, and fisheries factors as model predictors. Future work will include fishery-independent (federal and state trawl-surveys) and fishery-dependent (vessel trip reports, dealer data, and observer data) datasets.

NEW ENGLAND FISHERY MANAGEMENT COUNCIL

Final Herring PDT Report

June 15, 2010
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met on June 15, 2010 in Mansfield, MA to: review and discuss actions from May 17 Herring Committee meeting regarding the development of alternatives for Amendment 5 to the Herring Fishery Management Plan (FMP); review and discuss preliminary analyses of overlapping sea sampling/portside sampling trips; discuss and develop information/analyses related to measures to address river herring bycatch; and discuss other issues related to Amendment 5 development.

Ms. Steele briefed the Herring PDT on the Herring Committee's continuing work on the development of management alternatives for analysis in the Amendment 5 Draft Environmental Impact Statement (EIS). Discussion focused on the May 17, 2010 Herring Committee motions and the management measures under consideration to address river herring bycatch. Ms. Steele also reviewed the Amendment 5 timeline with the PDT. The Council is scheduled to approve the range of alternatives for analysis in the Draft EIS at its September 2010 meeting. Herring PDT discussion is summarized below.

Comparison of Bycatch Estimates from Portside and At-Sea Observer Sampling Programs in the Atlantic Herring Fishery

Steve Correia and Matt Cieri presented preliminary analysis of 52 trips that were sampled by both an at-sea observer and a portside sampler with some additional focus on observations of river herring bycatch from both datasets. Steve summarized an ongoing statistical analysis comparing the two datasets (at-sea and portside), and Matt presented some more detailed analysis of river herring bycatch data and a closer look at the tow-by-tow and basket sample data from the observer program. The Herring PDT discussed the preliminary data and the steps that should be taken to investigate some of the outstanding issues.

- In general, when comparing the portside and at-sea data, the correlation coefficients are poor, and there appears to be relatively low agreement and high variability between the two datasets.
- The PDT discussed differences between sampling approaches by at-sea observers and portside samplers from both ME DMR and MA DMF. The issue of sampling "lots" of fish versus an entire offload is likely to be important for portside sampling because some stratification has been observed, and this could contribute to the variance.
- On average, portside sampling is detecting occurrences of bycatch more often than sea sampling, but the reasons for some of the differences in the datasets are not clear at this time. Correlation coefficients are poor, and none are significantly different from zero other than spiny dogfish.
- Preliminary analysis suggests that there appears to be very low agreement across almost all species between the two datasets. Ranking bycatch species in both datasets produces

relatively consistent results, but the frequency of occurrence between the datasets is quite different.

- The PDT agreed to further investigate sampling and bycatch estimation methods from both the at-sea and portside sampling programs, and to consider the intensity of sampling, to gain a better understanding of how variation in the system may be influencing the analysis.
- The PDT also agreed to further investigate the trips for which a portside sampler observed the entire offload; these trips will be compared to tow-by-tow and basket data from observers that were present at-sea. Some basket data were reviewed during the PDT meeting, and the PDT agreed that these data should be audited prior to moving forward.
- The PDT may consider extrapolating the data from both datasets to generate a bycatch estimate and evaluate/compare resulting CVs.
- It will be important to identify and consider the strengths and weaknesses of both programs in order to determine the best way to combine the programs and generate the most precise estimate of bycatch. As one example, sea sampling will remain the best method for estimating at-sea discards, an important piece of information that cannot be generated at all from a portside sampling program.

The PDT will revisit this analysis at its next meeting.

River Herring Bycatch Analysis and Identification of "Hotspots"

Jamie Cournane updated the Herring PDT regarding her ongoing analysis of river herring bycatch and development of a model to assess management approaches to mitigate bycatch. The PDT worked through some regression trees to get a better understanding of what some of the major factors may be that are contributing to the distribution of the data. Dr. Cournane also summarized some information from the North Pacific Fishery Management Council regarding the management of chum salmon bycatch and the methodology used by the North Pacific Council to identify and rank bycatch "hotspots."

The Herring PDT discussed and generally agreed on an approach to identify river herring bycatch hotspots using observer/catch data and survey data. The results of this analysis will be reviewed/discussed at the next PDT meeting.

Development of Discussion Paper Re. Potential for Scales in the Herring Fishery (Council staff)

Talia Bigelow briefed the Herring PDT on a white paper she is developing regarding the potential applicability of flow scales, hopper scales, and truck scales in the herring fishery. This information will be presented to the Committee at its July 27-28, 2010 meeting.

The Herring PDT will reconvene in July prior to the July 27-28, 2010 Herring Committee meeting. The PDT will review ongoing analyses and develop recommendations and a final report for the Committee meeting.

NEW ENGLAND FISHERY MANAGEMENT COUNCIL

FINAL Herring PDT Report

July 15, 2010
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met on July 15, 2010 in Mansfield, MA to: continue work on analyses of overlapping sea sampling/portside sampling trips; discuss and develop information/analyses related to measures to address river herring bycatch; and discuss other issues related to Amendment 5 development.

Meeting Attendance: Lori Steele, PDT Chairman; Talia Bigelow, NEFMC Staff: Matt Cieri, Jamie Cournane, Jon Deroba, Madeleine Hall-Arber, Carrie Nordeen, Aja Peters-Mason, Sara Wetmore, Debra Duarte (PDT Members); Dave Ellenton (Herring AP Chairman), Jeff Kaelin, Eoin Rochford, Ben Martens, Jud Crawford.

Comparison of Bycatch Estimates from Portside and At-Sea Observer Sampling Programs in the Atlantic Herring Fishery

The Herring PDT reviewed and discussed ongoing analysis comparing observer data with portside sampling data, developed by Steve Correia and Matt Cieri. Overall, the analysis was conducted at the request of the Herring Committee to determine (1) whether the two datasets are comparable/additive and (2) what appropriate coverage levels may be if a combination at-sea/portside monitoring program is developed. The analysis is based on statistical evaluation of catch data from 52 paired trips that were sampled by both an at-sea observer and a portside sampler. The analysis sought to answer the following questions:

1. Is the frequency of detection of bycatch species similar for the portside sampling and observer programs?
2. Does the estimate of percent occurrence differ between sampling methods for each bycatch species?
3. How similar is the occurrence of species by tow?
4. How much does the estimation of bycatch weight differ by method?

Overall, the analysis suggests that there are some significant differences between the at-sea and portside sampling data and that the two datasets are not additive at this time. Statistical evaluation indicates that there is a significant difference between portside sampling and at-sea sampling in terms of the number of observations of a particular bycatch species. Portside sampling data show more occurrences of bycatch than the observer data, and there are relatively low levels of agreement of the occurrences. Moreover, there is no correlation between portside and observer estimates of weight on the paired trips. The data are extremely variable, and it is this variability that is driving the differences between the two data sets. Additional investigation is warranted.

The Herring PDT supports both at-sea and portside sampling in the herring fishery for obtaining more information about catch and bycatch. Both programs have strengths and weaknesses with respect to sampling the herring fishery for data to generate bycatch estimates. Observer sampling will always be able to document at-sea discards and details about fishing activity, released catch, marine mammal interactions, and other details regarding the operation of the fishery. Portside sampling is more cost effective and may provide a better opportunity to sample smaller-sized and similar species. Both programs are beneficial and should be supported; however, the data are not comparable at this time, and further investigation/analysis is required to examine the sources of variation.

The Herring PDT agreed to form a PDT sub-group consisting of representatives from MA DMF, ME DMR, and the observer program (NEFOP) to investigate the sources of variation between portside and at-sea sampling. The sub-group will examine all available data from overlapping trips in detail to investigate differences between the data sets and discuss sampling methodologies. Observer basket data prior to 2008 will also be examined. The sub-group will continue this analysis through the development of the Amendment 5 Draft EIS and may be able to provide additional recommendations for the Amendment 5 document. The PDT acknowledges that bycatch estimates from portside data and at-sea data will never match each other (and are not expected to, based on the way the data are collected), but developing consistent sampling methodologies for the portside program and understanding the reasons for the differences between portside and at-sea estimates will improve the overall understanding of the data and increase the usefulness of future data collected through both programs.

The PDT discussed possible levels of coverage to consider in the amendment for both the portside sampling program and the observer program. Several options are under consideration in the document, some of which focus on methodologies for determining observer coverage levels from the Standardized Bycatch Reporting Methodology (SBRM). The Council has also developed an option that would require observer coverage to be at a level that would allow for catch estimates to be generated for herring and haddock with a 30% coefficient of variation (CV) and river herring with a 20% CV (i.e., more precise).

The PDT revisited the "example approach" to determining coverage levels, which is presented in the Amendment 5 Draft Discussion Document and based on an SBRM approach using 2005 observer data. The example approach suggested that, based on 2005 observer data, a 10% coverage level in the midwater trawl fishery would likely generate river herring bycatch estimates with a 20% CV. In 2009, observers covered about 25% of the midwater trawl fishery. Dr. Cieri used the observer data from 2009 to generate a bycatch estimate for river herring that resulted in a CV over 100%. It is clear that the variability in the observations of river herring are causing the differences; nearly 70% of observed trips don't encounter river herring at all. Variability in the occurrence of river herring bycatch events has increased considerably since the example approach was developed using 2005 observer data. **The PDT agreed that the next step will be to update this analysis examine bycatch estimates in greater detail. The PDT will also examine work completed by the NEFSC regarding river herring discard estimation (Wigley et al, 2009).**

Recent levels of observer coverage are not generating reliable estimates of river herring bycatch due to variability of bycatch events. The SBRM approach to determining coverage levels is based on a normal distribution of encounter rates, and river herring encounters are known to not follow a normal distribution, as they are considered to be more rare events (70% of observations do not encounter river herring). **Because of the inherent variability, it may be very difficult, if not impossible, to generate bycatch estimates for river herring with a CV of 20% on a consistent basis. It is therefore very difficult for the PDT to recommend specific coverage levels to achieve this level of precision in the bycatch estimate.** Some PDT members are concerned that this level of precision may not be achievable even with 100% observer coverage (because of sampling methodology and variability).

Absent the updated analysis (work in progress), it is difficult to recommend any specific levels of observer coverage at this time. Current levels are likely not sufficient to generate precise river herring bycatch estimates. There is not agreement across scientific literature about what sufficient levels of coverage may be. More observer coverage is clearly favored to increase precision and capture rare events. 100% observer coverage is usually regarded as ideal to accurately report bycatch and determine discard rates, but is financially challenging and may not be feasible for a variety of reasons. At minimum, "adequate" levels of observer coverage should be un-biased (taking into account non-random sampling and fishermen's behavior in the presence of observers).

One method to reduce bias in observer estimates of bycatch suggested in Babcock et al. (2003) is to establish sufficiently high coverage levels. Babcock et al. (2003) suggest that observer programs adopt coverage levels of at least 20 percent for common species and 50 percent for rare species. This alternative was considered in the Omnibus SBRM Amendment. Babcock et al. (2003) distinguish rare species as those for which the weight of the discards is 0.1 percent or less of the total catch (landings plus discards) in the fishery. This alternative was considered to address concerns regarding the potential for bias in the bycatch data and to ensure sufficient sampling levels to provide more precise and accurate bycatch data (Babcock et al. 2003). However, several concerns regarding this approach were identified (Methot 2005; Rago et al. 2005). One specific criticism of the approach proposed in Babcock et al. (2003) is that the particular recommendation for a default level of coverage is not linked to any particular management need, performance evaluation, or set of funding or logistical constraints. During the development of the SBRM amendment, there was a strong concern that the use of default minimum percent observer coverage levels may mask the great diversity of requirements and logistical constraints faced by fisheries observer programs, and fails to recognize the great cost of achieving high levels of coverage.

The Herring PDT will investigate available literature further (Babcock et al. 2003, Rago et al. 2005, Wigley et al. 2009).

One approach to improving river herring bycatch estimates may be to expand observer coverage in the "hotspot" areas, i.e., areas where river herring are known to occur and overlap with the fishery. However, increasing coverage in some areas may compromise the statistical validity of the overall program design, so care must be taken when analyzing the data and generating bycatch estimates. If coverage is expanded in certain times/areas, the bycatch estimates should only be expanded for those times/areas. This may be an important consideration, depending on the program that is ultimately implemented in Amendment 5.

NEFOP Presentation on Slippage and Discussion of Measures to Address Slippage

Debra Duarte and Sara Wetmore from the Northeast Fisheries Science Center Observer Program (NEFOP) presented some detailed information about released catch in the herring fishery based on observed trips during 2008 and 2009. In general, released catch includes operational discards (fish sill in gear after pumping is completed), partial slippage (some fish pumped), full slippage (no fish pumped), and gear damage. Partial/full slippage accounted for about 1.5% of total observed catch.

When operational discards were observed, comments indicated fish "were left in net after pumping" or "fell out of gear when pumps were switched." Operational discarding events represent the smallest amounts of released catch (see Figure 1). Partial slippage events included comments like "vessel capacity filled," "too many dogfish," "poor quality haul," "pump jammed by dogfish," and "captain did not like the mackerel:herring ratio." Full slippage events included comments like "herring too small," "too many dogfish," "not enough to be worth pumping," and "undesired catch, thought he set on herring."

Table 1 Frequency of Released Catch Events 2008/2009

year	month	# hauls covered	kept lbs observed	# hauls w/ released catch	estimated lbs released
2008	Jan	18	822,447	0	
2008	Feb	13	2,621,846	0	
2008	Mar	17	2,184,187	5	17,000
2008	Apr	7	1,890,207	0	
2008	May	21	4,884,872	1	20,000
2008	Jun	27	2,560,004	2	280
2008	Jul	34	3,712,098	5	250,600
2008	Aug	14	2,626,778	0	
2008	Sep	5	110,020	1	200
2008	Oct	40	6,617,020	6	18,740
2008	Nov	24	5,181,209	2	130
2008	Dec	18	4,794,028	4	25,400
2009	Jan	38	7,432,979	2	10,201
2009	Feb	28	2,782,767	6	175,950
2009	Mar	16	1,958,569	2	226,000
2009	Apr	17	3,585,031	3	300
2009	May	33	3,711,450	10	107,675
2009	Jun	35	2,339,028	22	28,595
2009	Jul	43	5,773,521	23	181,580
2009	Aug	36	3,040,099	15	81,650
2009	Sep	85	17,204,553	27	402,117
2009	Oct	64	10,046,838	20	214,400
2009	Nov	67	11,730,652	34	938,215
2009	Dec	11	131,920	2	6,025

Figure 1 Analysis of Comments Regarding Released Catch

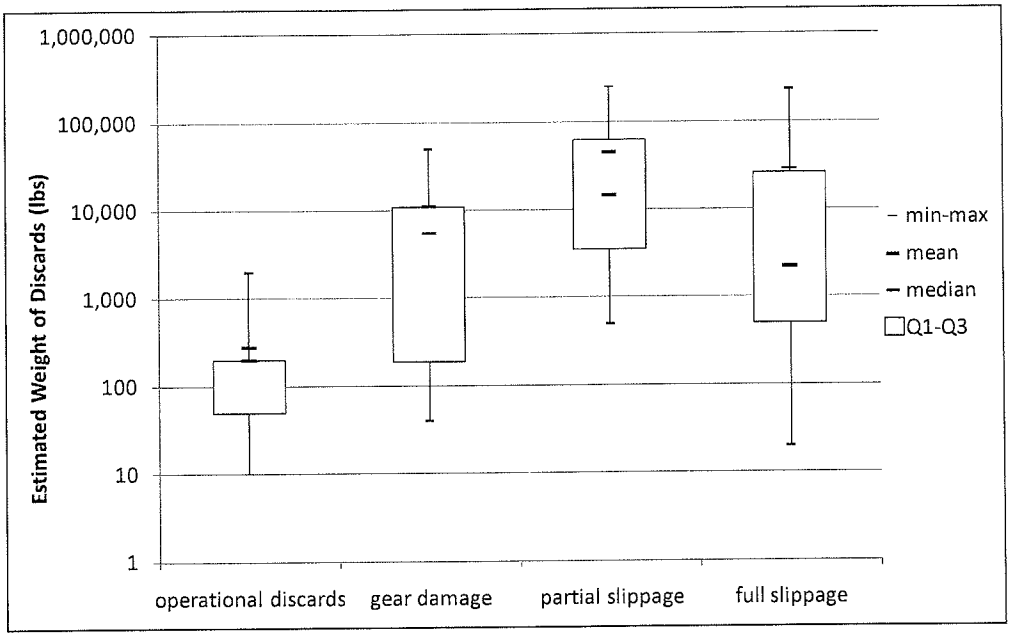


Figure 2 Analysis of Comments Regarding Released Catch (continued)

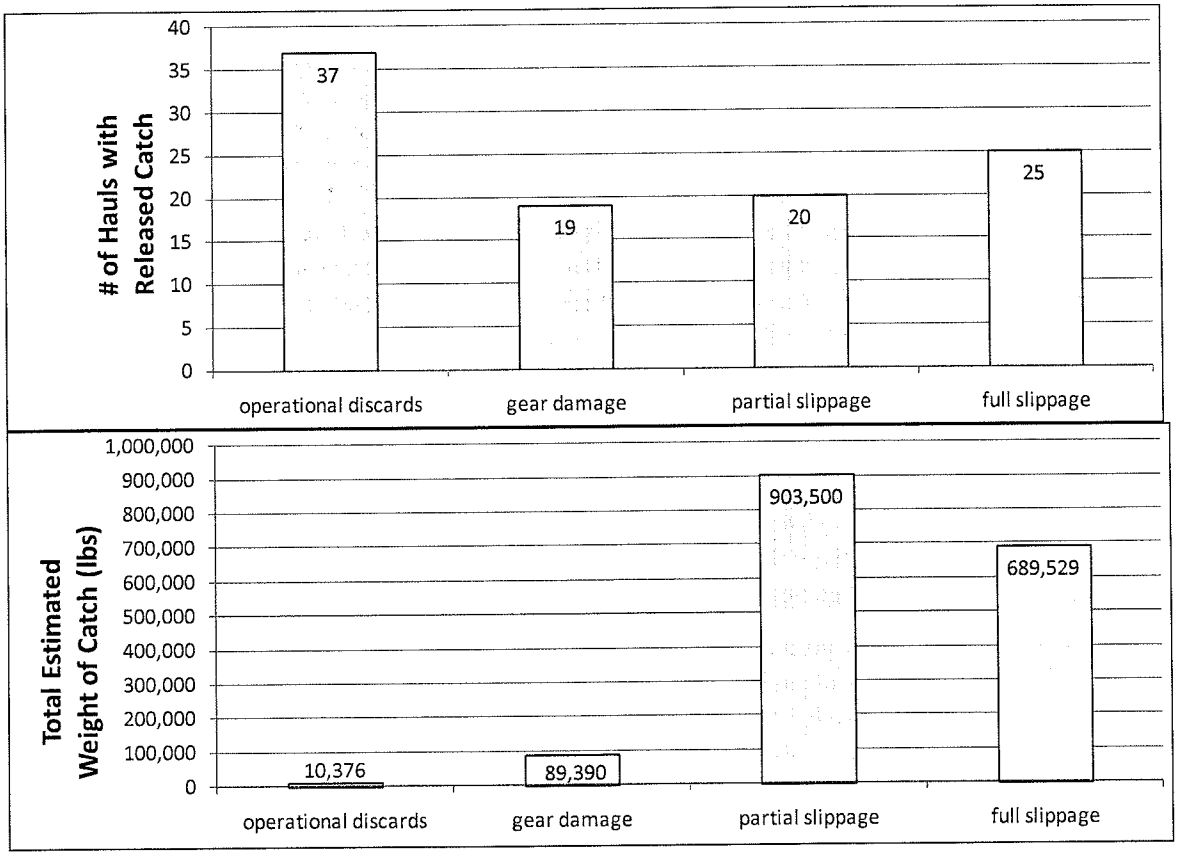
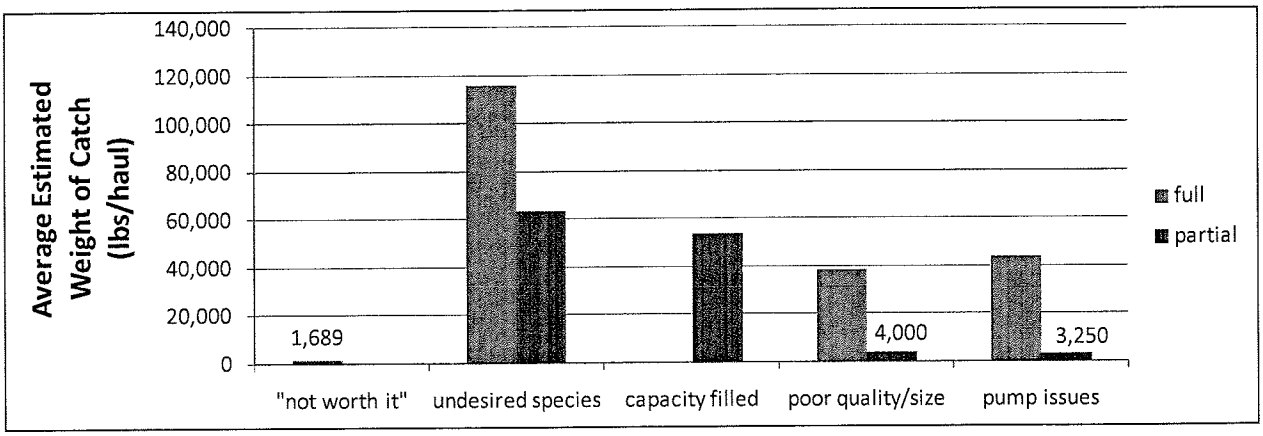


Figure 3 Information about Full and Partial Slippage Events 2008/2009



The Herring PDT briefly discussed the options in Amendment 5 to develop slippage caps for the herring fishery and the general approaches proposed in the document for setting the slippage caps. **In general, the Herring PDT does not support the establishment of slippage caps in the herring fishery in Amendment 5 and recommends that this measure be added to the list of items that can be implemented through a framework adjustment in the future.**

- Information about slippage events from observer data suggests that when breaking out observed "released catch" events into *full slippage, partial slippage, operational discards*, and *gear damage*, full/partial slippage only represents about 1.5% of the observed catch in 2008 and 2009, which are years during which observer coverage was relatively high (greater than 20%). The observer program reported that there are very few instances of slippage events where the captains report that they are slipping nets because they are not satisfied with the contents of the bag. Consequently, a slippage cap would only address a small proportion of "released catch" events and may be relatively ineffectual at motivating the herring fishery to take greater care to avoid non-target species. The PDT believes that that there are additional measures under consideration in Amendment 5 to continue to encourage the minimization of slippage in the fishery and to improve documentation of any slippage that may occur (see below for examples).
- No statistically-valid approach currently exists for estimating slippage or a slippage cap. Any method to address this topic, however, would likely have to be applied in a gear- and area-specific manner because the frequency and amount of slippage likely changes with these variables. Furthermore, a slippage cap would likely have to be adjusted on an annual basis to allow for changes in fishing effort in response to inter-annual quota (i.e., ACL/sub-ACL) variation. Developing a statistically valid method that addresses these issues may require months or years and involve resources beyond those immediately available to the Herring PDT.
- Given that any estimate of total slippage in the herring fishery would likely have to expand from sampled slippage events collected by observers to the entire fishery, the resulting estimates will have some amount of error associated with them. The extent of this error is currently unknown, but, given current rates of observer coverage and the frequency of slippage events, could be large. Some medium- to long-term analyses are likely required to determine adequate rates of observer coverage and sampling protocols to ensure an estimate of total slippage is accurate and

precise enough for management purposes. Furthermore, defining adequately precise will require further input from managers.

- The population level effects of slippage events are currently unknown. As a result, the measure would have an unknown relationship to total mortality for the herring complex at this time and may not promote conservation and/or ensure that predators have sufficient herring prey. Without such information, quantifying the issue of slippage and measuring the success or failure of management measures aimed at addressing slippage would have a high level of uncertainty. Similarly, the absence of such information prevents the comparison of the outcomes of management measures to some specific and measurable objective. Below, the PDT suggests a cooperative study to begin to quantify the extent of slippage in the herring fishery and partially address this issue.
- The Herring PDT supports ongoing efforts by the observer program (development of detailed discard log, high-volume fishery training, species identification sampling, etc.) as steps to obtain information necessary to determine (1) if slippage caps should be developed and (2) if so, the appropriate method for setting slippage caps. Additionally, Amendment 5 contains measures to encourage the minimization of slippage in the fishery and to improve documentation of any slippage that may occur, such as requirements for Released Catch affidavits and several measures proposed to maximize sampling by observers. Recent and ongoing changes to sampling and documenting released catch may improve the quality of information that is collected, making a slippage cap a more feasible management approach in the future.
- The Herring PDT recognizes the importance of accurately documenting catch in the fishery and ensuring that observers are able to obtain statistically-valid estimates of catch and bycatch for every haul that is observed. The PDT strongly supports the development of a cooperative research project investigating released catch and slippage on herring vessels (all gear types) to obtain better information including: methods to better identify the contents of released catch, mortality of released fish, ways to determine whether stratification occurs in the net, and methods to adequately sample released catch. Furthermore, such a study may inform the development and testing of methods for estimating total slippage and a slippage cap.

River Herring Bycatch Analysis and Identification of "Hotspots"

Jamie Cournane presented updated analysis of river herring data and identification of river herring "hotspots," as directed by the Herring Committee on May 17. The methodology used to identify river herring hotspots was reviewed and agreed upon by the PDT members present at the meeting. Ranking of hotspots will be based on bottom trawl survey data, overlaid with fishery information (observer data) and evaluated based on statistical area and quarter degree square, if possible. After reviewing the methodology, the PDT agreed that using standardized survey median data is adequate, and that all approaches that were examined (mean, median, standardized, etc.) yielded similar results. The following additions/changes will be made to the analysis:

- The observer data will be re-examined to ensure completeness.
- NMFS bottom trawl survey data will be pared down to the most recent 15-year time period to more closely reflect the current distribution of the resource.
- Observed river herring bycatch events will be overlaid with the survey data to provide some perspective on how fishery bycatch may relate to the distribution of the resource. Vessel trip

report (VTR) data will also be overlaid, and the information will be shown on maps with quarter degree squares.

- Fall bottom trawl survey data will be examined as well.

In general, identifying river herring hotspots based on statistical area may be appropriate if the Committee/Council's intent is to increase monitoring and/or monitor the fishery differently in those areas. A finer scale like quarter degree blocks or ten minute squares would be more appropriate, however, if the intent is to develop management measures that may impact the operation of fisheries in the area.

The Herring PDT supports the approach used to identify river herring hotspots and agreed to review the final information one more time through a conference call prior to the July 27-28 Herring Committee meeting. The conference call will occur after the "hotspot white paper" is completed and made available for the Committee meeting. During this call, the PDT will develop some recommendations regarding the identification of specific hotspots, which will be reported to the Herring Committee through a presentation at the meeting.

NEW ENGLAND FISHERY MANAGEMENT COUNCIL

FINAL Herring PDT Report

August 19, 2010
Holiday Inn, Mansfield, MA

The Herring Plan Development Team (PDT) met on August 19, 2010 in Mansfield, MA to: continue work on analyses of overlapping sea sampling/portside sampling trips; discuss and develop information/analyses related to measures to address river herring bycatch; and discuss other issues related to Amendment 5 development.

Meeting Attendance: Lori Steele, PDT Chairman; Talia Bigelow, NEFMC Staff: Matt Cieri, Jamie Cournane, Jon Deroba, Carrie Nordeen, Aja Peters-Mason, Steve Correia, Mike Armstrong, Min-Yang Lee, Sara Wetmore, (PDT Members); Eoin Rochford.

Review of Updated SBRM Analysis

Matt Cieri presented a preliminary update of the Herring PDT's analysis of the levels of observer coverage that may be necessary to meet certain **precision** targets, expressed as coefficients of variation (CV). The updated analysis focuses on river herring, since those are species of concern in Amendment 5 and one that is likely to require higher levels of observer coverage to meet the target identified by the Council (20% CV). For the preliminary analysis, observer data from 2005-2009 was considered. The preliminary results suggest that, based on the SBRM approach, observer coverage should be increased in strata (gear type/area – purse seine, midwater trawl, otter trawl/GOM, GB, SNE) with high variability to reduce the CVs around catch/bycatch estimates. These are generally the strata with very limited observer coverage, but these may not be strata that managers or interested stakeholders would expect. There are a few important caveats to consider when applying the SBRM approach to river herring – the assumptions about linearity and normality in the SBRM analysis may not hold for river herring because the distribution of the data is not normal (there is a high proportion of zeros), and there is a high degree of variability associated with the data. Seasonality (of the fishery and of river herring migrations/encounters) is also very important to consider. The SBRM approach considers variability associated with observed trips, but does not consider variability associated with any strata where coverage has been limited or absent. It also does not consider the variability associated with sub-sampling and extrapolation, and portside versus at-sea coverage, all of which are important especially with respect to river herring.

The Herring PDT agreed to mirror the analysis to the SBRM approach, to the extent possible, and to include this in the amendment as an example of how coverage levels would be determined (annually) under the alternative to target a 20% CV for river herring catch/bycatch. This includes re-running the analysis using only data from the most current fishing year (2009). The PDT also discussed the differences between precision and accuracy in great detail and felt that the Herring Committee could benefit from a better understanding of these concepts (see **Appendix**).

Variability can be addressed by either increasing coverage into highly variable strata based on an SBRM approach, or possibly by seasonally stratifying the data and determining ways to distribute coverage to increase accuracy. As a result, the Herring PDT recommends that the Committee consider adding an alternative that would determine observer coverage levels based on a seasonal stratification. This *could* be an approach that is applied to improve the accuracy of (river herring) bycatch estimates, overlaid on the SBRM approach to determine levels of coverage across all fisheries, including the herring fishery. For example, managers could choose strata with high river herring bycatch to have a higher level of coverage (beyond SBRM rates) to increase the accuracy of resulting bycatch estimates. This approach would require an annual evaluation of coverage levels in the fishery to determine the best way to improve CVs for river herring bycatch in the following year. The feasibility of this approach remains to be seen, but it may be worthwhile to explore; further investigation can be incorporated into the Draft EIS if the Committee/Council is interested in exploring this alternative.

Updated River Herring Hotspot Analysis

Jamie Cournane presented the updated/revised PDT analysis to identify river herring hotspots based on percent occurrence in the NMFS bottom trawl survey, combined with fishery data (vessel trip reports and observer data). At its July 27-28, 2010 meeting, the Herring Committee suggested that the Herring PDT consider revising the analysis based on the following:

Fishery Dependent Data (Trips in VTRs)

- Temporal Stratification: monthly or bi-monthly blocks
- Gear Stratification: gear category

Fishery Dependent Data (River Herring Bycatch Events in NEFOP)

- Temporal Stratification: monthly or bi-monthly blocks
- Gear Stratification: gear category
- Events: frequency distribution/table of river herring bycatch

Fishery Independent Data (Percent Occurrence of River Herring in NMFS BTS):

- Spatial Stratification: quarter degree squares
- Temporal Stratification: months or bi-monthly blocks, include all years (1963-2008)
- Percent Occurrence: threshold number of individuals using catch frequency distribution (e.g. include tows with zeros and those tows with > or = 5 individuals per tow)
- Hotspot Identification: areas with 75% occurrence or more

Other Recommendations:

- Incorporate other fisheries with river herring bycatch
- Calculate a length-based index to identify hotspots
- Timing of runs/spawning (e.g. Rory Saunders et al. 2006, ASMFC- Kate Taylor)
- Juveniles versus adults
- Include the shads (American and hickory)
- Measure of relative exploitation: river herring bycatch/relative abundance- spatial weighting to combine the datasets

- Frequency of occurrence in NMFS BTS tables (threshold)
- Frequency of weight of bycatch events- threshold for move-along in candidate areas (Trip level)
- Using permit categories or gear type for analysis

Dr. Cournane and Dr. Correia updated the analysis to reflect a spatial stratification of quarter degree squares and consider percent occurrence based on a threshold level (versus presence/absence), as suggested by the Herring Committee. Some of the Other Recommendations (listed above) will be addressed through further analysis in the Draft EIS. The new analysis identifies candidate areas for river herring hotspots at the quarter-degree square level. Each quarter-degree square is assigned two measures of river herring bycatch. The first is the probability of river herring occurrence in that square. The second is a catch intensity measure, which is based on the mean, median, or 75th percentile of survey catch in that square. A square is identified as a candidate hotspot if both measures are greater than the 75th percentiles for the entire fishery. In general, quarterly (or bi-monthly) river herring bycatch events overlap with quarterly fishing effort concentrations. Similar patterns are seen with river herring hotspots using percent occurrence per statistical area. The Herring PDT agreed that river herring hotspots should be considered in the context of fishing patterns and observed bycatch events, so the analysis will include maps that overlay the observer data and VTR data on the candidate areas.

Since none of the approaches for identifying candidate river herring hotspots are clearly technically superior to the others, the selection of the approach(es) and hotspots should incorporate consideration of the management objectives. In other words, the definition of a hotspot may depend on how hotspots will be treated as part of the management of the fishery. With respect to the new approach (versus the original percent occurrence approach developed for the July 27-28, 2010 Herring Committee meeting), the Herring PDT discussed the differences between the mean, median, and 75th percentile options and the "risk" associated with selecting one over another for identifying candidate hotspots. Risk is considered relative to minimizing river herring bycatch; depending on the management action, the Herring Committee may want to choose a percentile that will cover a broad range of areas or a percentile that will cover a very narrow range. An approach using the mean will be very sensitive towards a large tow occurring, so the PDT recommends eliminating this approach and considering the median or 75th percentile (or other percentile) approach. The higher the percentile that is chosen, the fewer candidate areas will emerge, hence the possibility of considering different approaches for different management alternatives. A 75th percentile approach will result in fewer hotspot areas (versus a median approach), but those areas have a higher expectation to encounter river herring. However, while the mean, median, and 75th percentile methods produce different sets of squares (candidate hotspots), there is substantial overlap among the methods.

Variability is an important consideration. Areas not defined as hotspots may have a high probability of river herring bycatch events; but are currently undetected due to sampling variability. Timing/seasonality is also a very important consideration, so the Committee/Council should incorporate/eliminate candidate blocks as it deems appropriate based on knowledge about the operation of the herring fishery and the biology (migration patterns, spawning) of the river herring stock complex.

The Herring PDT agreed to:

- Present a straight percent occurrence approach (similar to the one presented at the July Committee meeting) by quarter degree squares (instead of statistical areas) with breakpoint of 25% intervals;
- Present the median and 75th percentile approaches;
- Overlay VTR and observer data bi-monthly in separate maps;
- Present the approaches side by side for the Committee to evaluate, while considering the following advice:

  Seasonal candidate hotspots based on an approach using percent occurrence and catch in numbers from the bottom trawl survey form the baseline configuration for the Committee to explore management options. Candidate areas may be added or subtracted by the Committee based on:

  1. Explicit spatial management objectives (special management areas, monitoring areas, time/area closures);
  2. The fishery – using fishery dependent data (a) to add or subtract candidate areas (for example, based on observed river herring bycatch events) and (b) to assess the impact on the fleet (VTR data); and/or
  3. Biological and practical considerations – discrete areas versus continuous areas.

Herring PDT Report

APPENDIX

August 19, 2010

Precision Versus Accuracy

Accuracy is a measure of how close the estimate or computed value is to the true value. In most cases where calibration is not available, the accuracy of an estimate is unknown. Systematic differences between the true value and estimate represent **bias**. Bias could result from poorly calibrated measuring devices or poor sampling design (non-random sampling).

Precision is the measure of how close repeated measures are to each other. In general, the true value is unknown. Unless a bias exists, higher precision will lead to better accuracy.

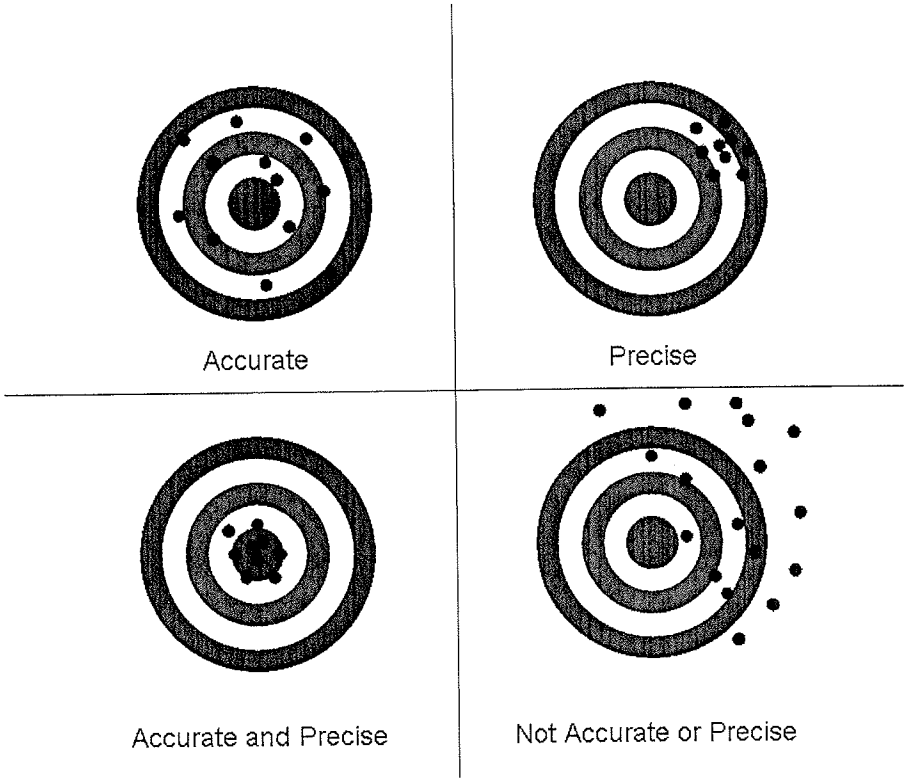


Figure 1. The upper-left bull's eye demonstrates accuracy, where the shots have been fired close to the center of the bulls eye. The upper-right bull's eye demonstrates precision, where a quantity of shots were fired very close to each other, but with a bias towards the upper-right corner. The lower-left bulls eye demonstrates accuracy and precision, where a number of shots were fired close to each other and close to the center of the bulls eye. The lower-right bulls eye has had shots fired at it and beyond, and the shots were not fired close to each other; therefore the lower-right does not demonstrate accuracy or precision.

Coefficient of Variation

The coefficient of variation (CV) of the mean is one metric of precision and is constructed as the standard error divided by the mean. The standard error is a function of the standard deviation in the population and sample size. Because confidence intervals are a function of the standard error of the mean, the width of the confidence interval is proportional to the coefficient of variation. Higher coefficients of variation result in wider confidence intervals.

These concepts are illustrated by simulating sampling at various sample sizes from a population with known parameters (mean=45.5, standard deviation=3.92, coefficient of variation= 8.6% and the distribution of the items is approximately normal). Results are shown in Figure 2, Figure 3, and Figure 4. Figure 2 shows the result of 100 sampling experiments for sample sizes of 5, 10, 25, 50, 100 of housefly wing lengths. For each sample size, the mean and 95% confidence interval were calculated for 100 samples. Results are shown in Figure 2. Precision is measured by the width of the confidence intervals.

Two features are prominent in Figure 2: the intervals get smaller as sample size increases and the confidence intervals have good coverage of the true mean of 45.1 (Table 1). How much precision is needed is a function of how wide an interval around estimate is needed and the overall cost per sample. For example, a sample size of 5 would be appropriate if you cared if you wanted to be fairly confident that your estimate was between 40 and 55. A sample size of 5 would not suffice if you were interested of having estimates between 43-48. Boxplots of the distribution of 95% interval width for various sample sizes is shown in Figure 3.

An example of precision but biased estimates is shown in Figure 4. Precision increases as sample size increases, but the considerable bias is visible. None of the 95% confidence intervals cover the true mean for sample sizes 25, 50 and 100 and only 2 intervals cover the true mean for sample size of 10. This illustrates highly precise but inaccurate estimates.

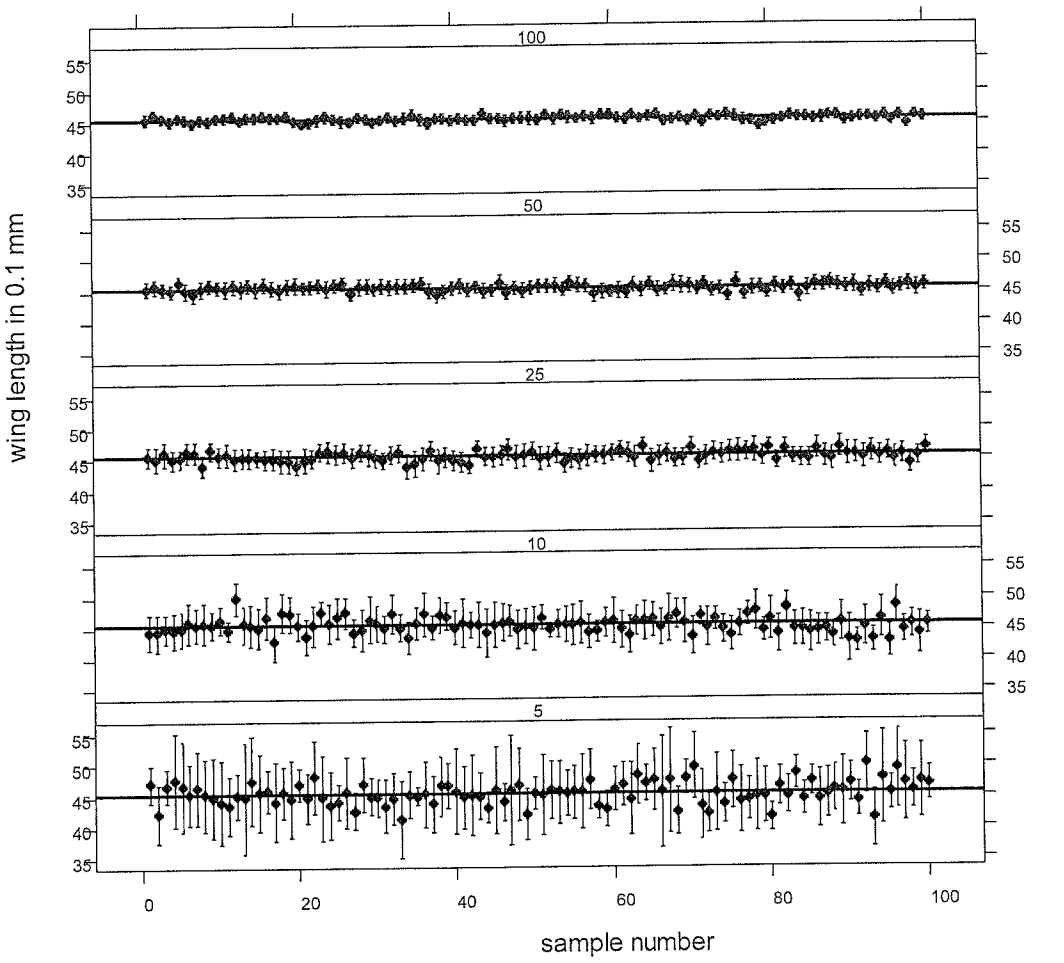


Figure 2. Example of how sample size impacts precision of the mean estimate. Red line is true mean (66.3). Blue dots are sample means and error bars are 95% confidence intervals. Each panel has 100 sampling events for a given sample size. Note how estimates of the mean become more precise as sample size increases.

sample size	5	10	25	50	100
Number of confidence intervals not covering true mean	4	7	2	4	5

Table 1. Number of samples where 95% confidence interval did not cover the true mean. The expected number is 5 per 100 samples with a 95% confidence interval of 1 to 10.

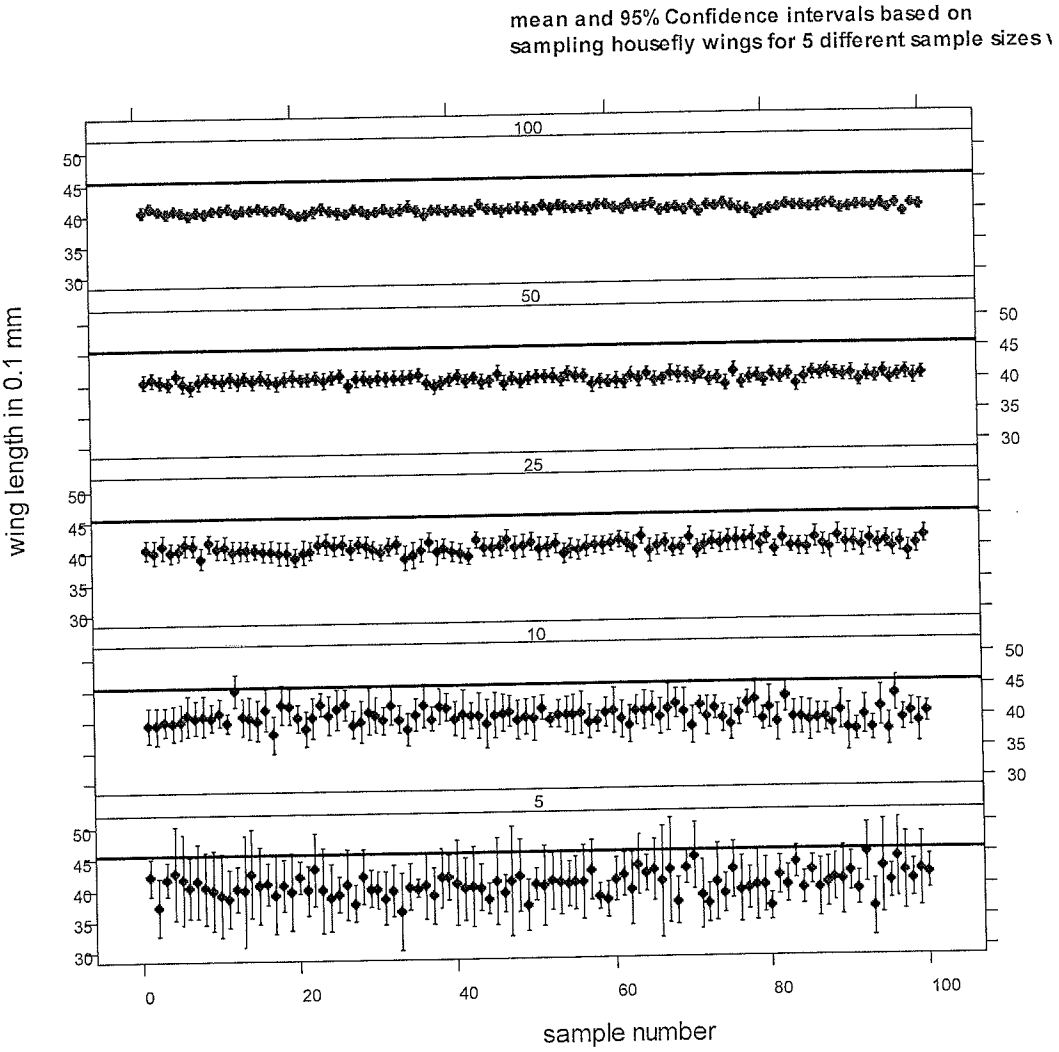


Figure 4. Accuracy and precision for an example with substantial bias in the estimate of the mean estimate. Red line is true mean (66.3). Blue dots are sample means and error bars are 95% confidence intervals. Each panel has 100 sampling events for a given sample size. Note how the estimates of mean are highly precise for the large sample sizes, but inaccurate (biased).