December 5, 2008

New England Fishery Management Council
Attn: John Pappalardo, Chairman
Frank Blount, Herring Committee Chairman
Paul Howard, Executive Director
Lori Steele, Chair, Herring Plan Development Team
50 Water Street, Mill 2
Newburyport, MA 01950

RE: HERRING MONITORING PROPOSAL

Dear John, Frank, Paul and Lori,

Please accept this proposal on behalf of the Herring Alliance. It proposes that the Atlantic Herring fishery in New England could, should, and can have an effective monitoring system for catch and bycatch. We look forward to working with you on further development of Amendment 4 to the Herring Fishery Management Plan, especially as it pertains to this monitoring proposal.

This Proposal

This proposal pertains only to Category 1 All Area & Area 2/3 permits (category A & B). The vast majority of herring landings come from these vessels. As we understand it from the Amendment 4 draft document, this is a total of 45 vessels (though a review of the 2007 SAFE report implies that it is actually only 30 vessels, the proposal continues to assume 45 as data sources seem to contradict one another. The initial investment required for this program would be reduced by 33% if the number of participating vessels is actually 30 instead of the assumed 45).

The *preferred alternative(s)* in this proposal call for:

(1) A catch monitoring program that calls for 100% of hauls being sampled by Federally trained and certified at-sea employed by third party observer providers
(2) A limited Electronic Monitoring program to help verify that all catch is sampled by observers
(3) Provisions to heighten monitoring of midwater trawl vessels operating in Groundfish Closed Areas

Cost of Proposed Program

Since data on the number of trips, landings, revenues, etc associated with specific permit categories was not readily available for the preparation of this document, the proposal relies on estimates and round numbers derived from the best data available to us. The assumptions are as follows for the fleet covered by the proposal: 45 vessels; 1000 sea days annually; 100,000 tons of annual landings; and $20,000,000 in annual gross revenue.

The program, as outlined in the *preferred alternative(s)* anticipates an initial start up cost of approximately $2,000,000 for the fleet to purchase and install electronic monitoring equipment. After the initial investment, the cost is projected to be $600 - $700 per sea day, for an annual total of $600,000 - $700,000. This assumes that Federally trained and certified observers working for third party companies can be paid and that the data can be handled for a cost of $600 - $700 per sea day.

With gross revenues of $20,000,000, we conclude that 3% - 3.5% of gross revenues will be allocated to monitoring under this proposal.

Funding
This proposal promotes industry funding to pay for costs associated with putting observers on vessels. The $600 – $700 per sea day expense is reasonable for an industrial fleet of vessels that spend $6,000 - $30,000 per vessel per day on fuel and has the potential to recognize revenues of $80,000 or more per day (800,000 lbs of herring x $.10 per pound). In the overall economic scope of the operating cost of an industrial midwater trawler, $600 - $700 is a minimal expenditure.

Once the NEFMC and NMFS require a monitoring system that includes Electronic Monitoring, the midwater trawl industry will have incentive to work with other stakeholders to find creative ways to fund the initial cost of purchasing and installing the necessary equipment. Member groups of the Herring Alliance are committed to working with the industry, the Federal government, and State governments to fund this initial investment. Two opportunities we have identified are:

(1) Conservation NGOs/foundations, the midwater trawl industry, and other stakeholders working together to support a $2,000,000 Congressional appropriation to cover the initial investment
(2) A public-private program in which the herring industry, other industry stakeholders, conservation NGO/foundations, State governments, and the Federal government would make matching contributions to cover the initial investment

Conclusion
Everyone, from the conservation community to regulators to the midwater trawl industry agrees that the current monitoring system for the Atlantic herring fishery is unacceptable. This proposal is a reasonable, cost effective approach that will allow all stakeholders to be confident in the data that is produced. We look forward to working with the NEFMC as Amendment 4 is developed.

Sincerely,

Peter Baker, Director
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The Herring Alliance
The Herring Alliance is a coalition of environmental and other public interest organizations dedicated to protecting and restoring marine wildlife populations and Northeastern U.S. marine ecosystems by reforming the Atlantic herring fishery. The mission of the Herring Alliance is three-fold:

- To establish ecosystem-based catch limits which leave sufficient herring in the ecosystem as forage for other marine predators.
- To spatially and temporally apportion herring trawling using buffer zones and time and area closures which both minimize bycatch and avoid localized depletion to ensure sufficient herring is present when and where it is most needed by other predators.
- To fully monitor and minimize bycatch of commercially and recreationally important fish stocks – including juvenile or spawning Atlantic herring and depleted river herring and groundfish – as well as whales, seals, dolphins and porpoises.

More information about the Herring Alliance can be found at **www.herringalliance.org**.

An At-Sea Catch Monitoring Program for the Atlantic Herring Fishery Prepared for the New England Fishery Management Council

Response to the *Call for Stakeholder Recommendations for an Atlantic Herring Fishery Catch Monitoring Program* (16 October 2008)

DRAFT Proposal for Discussion

This document presents a draft proposal for at-sea catch monitoring in the Atlantic herring fishery. The proposal was prepared by the *Herring Alliance* in response to a *Call for Stakeholder Recommendations for an Atlantic Herring Fishery Catch Monitoring Program* (16 October 2008). This document outlines a series of alternatives and options to be considered by the council as it develops Amendment 4 to the Atlantic Herring Fishery Management Plan. The document focuses on achieving critical monitoring goals through trained at-sea observers with support from modern electronic monitoring tools. A selective review of the *status quo* monitoring program is provided, and then three additional alternatives are developed along with a series of options. Any of the alternatives could be used in parallel with existing monitoring systems offered by NEFOP (NMFS). These alternatives are not intended to replace the NEFOP.

Table of Contents

1.0 SUMMARY

The Herring Alliance proposes that the New England Fisheries Management Council (NEFMC) and the herring Industry improve catch monitoring through an at-sea observer program. The proposed program is designed to provide timely, high quality data (i.e., precise and accurate) on all catch, including targeted Atlantic herring, catch that is important in other fisheries (e.g., mackerel, river herring, haddock, striped bass), and all other bycatch and incidental catch (landed or not). The goal of the program is to benefit the fisheries by providing high quality data for managing quota in real-time, accounting for bycatch so it can be minimized, and improving data used in stock assessments. This program is intended to complement the existing NMFS observer program, *Northeast Fisheries Observer Program* (NEFOP), not replace it. The program is based upon the placement of third-party, NMFS-trained, observers on all herring trips (A and B permit category), with standard electronic monitoring equipment for data acquisition and as a backup for observer reporting. Electronic data entered by observers and data collected from electronic data loggers will be transmitted daily to NMFS and analyzed on a continuous basis. Discharging, or transferring, net contents without sampling will not be allowed (i.e., *slippage*). Key elements of this proposal are modeled after several successful observer programs currently in use in other regions of the US (e.g., Alaska Pollock, Pacific whiting). The cost of the program is small relative to the revenues generated by the catch.

2.0 INTRODUCTION

Reliable monitoring of all catch is essential for effective fisheries management, for reliable stock assessments, for quota management, and for sound business planning. It is critically important for understanding the impacts of one fishery on other fisheries and for understanding impacts on ecosystems. Management systems based on Annual Catch Limits (ACLs) and Accountability Measures (AMs) are required under the Magnuson-Stevens Reauthorization Act of 2006 (MSA) but will not work without reliable data on all catch in the Atlantic herring fishery, or any other fishery. Monitoring of the herring fishery is particularly critical since Atlantic herring are not only a harvested, revenue-generating, resource but also a resource that supports other fisheries, marine mammals, and other parts of the ecosystem[1]. High quality data on catch of target species, and bycatch, is required under federal law. It is essential that Amendment 4 to the Atlantic Herring Fishery Management Plan include strong plans for comprehensive monitoring of all catch. The New England Fishery Management Council is to be commended for its efforts to engage the public in the process of crafting quality approaches to monitoring through its request for stakeholder proposals.

2.1 Proposal focus on catch monitoring as an alternative to self-reporting

In the present proposal we focus on improving catch monitoring, as distinct from reporting systems. Reporting encompasses a wide variety of unverified information provided to managers by fishermen. Examples of self-reporting currently used to estimate catch, discards, and landings include Vessel Trip Reports (VTR), hail reporting, Interactive Voice Response (IVR) reports, and Dealer Electronic Reporting (DER). Whereas these honor-systems are currently a major source of catch data, they should become ancillary to independent at-sea observer systems in the future. At present, the only fisheries monitoring data that are suited to the kind of monitoring discussed in this proposal are the data provided by the National Marine Fisheries Service (NEFOP).

There is a number of other state and federal entities that also collect data that could be used in future real-time fishery monitoring programs to strengthen monitoring overall. These entities include NMFS Office of

[1] *Out Of Balance: Industrial Fishing and The Threat To Our Ocean. The Herring Alliance*, 2008, http://www.herringalliance.org/images/stories/herring_alliance_report_out_of_balance.pdf

Law Enforcement (OLE), state environmental police, and port sampling programs conducted by the states of Maine and Massachusetts. The current barriers to integration of these sources into a robust real-time system appear to include differences in sampling schedules, data collection protocols and data-sharing arrangements. Better coordination among these entities on fisheries management would serve the public interest.

2.2 The alternatives offer important improvements over status quo

The present monitoring of the Atlantic herring fishery is insufficient to meet key goals for management and the requirements of federal law. The deficiencies in the *status quo* system are treated in more detail below. They include low observer coverage rates (often under 5% of trips), well below the target set by the NEFOP and too low to produce reliable data for a complex, high volume fishery. Observer data suggest that fishing practices may be different on the few trips that are observed and thus the trips may not be representative. Large quantities of catch are discarded at sea without being sampled by observers, further undermining the value of the observer data. The herring fishery is a high volume fishery and observers do not currently come close to meeting goals for sampling of catch set out in the observer program's own protocols. Observers on large mid-water trawl vessels are sampling a fraction of one percent of the catch, and the sampling does not appear to be representative of the whole catch which may be over 100 tons in a typical trawl.

The alternatives developed in the present proposal seek to address these deficiencies with protocols that promise more reliable data on the entire catch, for quota monitoring, stock assessments, efforts to reduce bycatch, and compliance with the law. All of the alternatives include the use of state of the art electronic technologies for data acquisition and reporting. These systems will serve to augment observer data, and reduce errors in reporting. All the alternatives proposed include substantial increases in observer coverage over the *status quo*, placing at least one observer on every vessel (100% coverage). The advantages of full observer coverage are many. They include increased reliability of data for quota monitoring and assessments, simplified program logistics, with observer effects effectively eliminated, difficult statistical sampling problems mitigated, and confidence in reported catch data increased. The proposed use of electronic monitoring reduces the need for additional observers thereby containing costs. Additionally, third party observers are available at about half the cost of NMFS observers due to much lower overhead costs.

2.3 The proposal meets ten critical objectives for the Atlantic herring fishery

1. Support of real-time quota monitoring.
2. Provide quality estimates of target catch (i.e., Atlantic herring).
3. Provide quality estimates of catch of other managed stocks for quota monitoring.
4. Quality bycatch data for developing measures to minimize bycatch.
5. Quality estimation and reporting of all mortality associated with fishing activities (i.e., incidental catch).
6. Quality estimates of catch for implementation of annual catch limits and accountability measures.
7. Close monitoring of criteria for access to closed areas.
8. Rapid analysis and dissemination of data – near real time.
9. Observer sampling of all catch – complete accounting for every haul.
10. Improved compliance and enforcement of program requirements.

2.4 The proposed protocols are being used in other fisheries

With increased awareness of the importance of managing fisheries with reliable and timely data on catch for quota management systems and for controlling bycatch, the use of heightened observer coverage and electronic monitoring systems is growing in the US and abroad. Companies are developing more sophisticated electronic devices to assist with catch monitoring (e.g., SIMRAD), and companies that provide technical observer services

are flourishing (e.g., Archipelago Marine Research LTD, East West Technical Services LLC). The alternatives advanced here draw on this important technical infrastructure to offer a better future for catch monitoring in the Atlantic herring fishery[2].

There are many fisheries today where both industry and management have recognized the importance of providing high quality catch data through full observer coverage and electronic monitoring[3]. In Alaska, examples include fisheries for Pollock, groundfish, and rockfish. On the West coast of the US, examples include the Pacific at-sea hake fishery, and the Deep-set longline fishery for tuna, and the Hawaii longline fishery for swordfish. The benefits of learning from these examples in New England are clear.

2.5 High quality monitoring is required by law

High quality data on catch is essential to the Atlantic herring fishery and to the future of all fisheries in New England. The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA) includes national standards mandating that fishery management plans (FMP) and regulations implementing such FMPs include conservation and management measures that minimize bycatch and establish a monitoring and reporting program that assesses the amount and type of bycatch occurring in the fishery in order to accomplish this mandate. The MSA's national standards and related provisions also require that conservation and management measures be based on the best scientific information available and prevent overfishing, rebuild overfished stocks, and protect, restore and promote the long-term health and stability of the fishery.

Recent changes included in the Magnuson-Stevens Reauthorization Act (MSRA) amplify the critical need to revise and improve the Atlantic herring FMP's catch monitoring program. These changes require that annual catch limits and accountability measures be implemented for this fishery in 2011. In enacting these new requirements, Congress recognized that revisions are needed to FMPs throughout the country in order to bring them into compliance with the intent of the Magnuson-Stevens Act to provide for sustainable U.S. fisheries. Even for fisheries that may not be considered overfished, Congress recognized the need to improve management systems for the long-term health of fisheries. The monitoring program for each fishery is the foundation for implementation of these recent changes in law and for effective and sustainable fisheries management. It is the monitoring program which must provide the information necessary to ensure catch limits within, and across, fisheries are meaningful and that accountability delivered.

3.0 CURRENT MONITORING IS NOT SUFFICIENT (*STATUS QUO*)

Catch monitoring of the Atlantic herring fishery is presently conducted by the *Northeast Fisheries Observer Program* (NEFOP), a program of the Fisheries Sampling Branch (FSB) of NOAA Fisheries Northeast Fisheries Science Center (NEFSC), within NMFS. The federal at-sea observers are provided by approved third-party contractors under the management of NEFOP. The program provides valuable training and infrastructure for observers, protocols, and a system for data analysis. Nevertheless, there are a number of ways in which the important work of this observer program needs to be augmented in order to meet requirements under the law, to ensure sustainable fishing, and to provide needed information on the interaction of this fishery with other fisheries and ocean wildlife broadly.

Estimating all the various components of catch, through sampling of trips and tows within multiple strata, is complex, particularly in the herring fishery and other high volume fisheries. Considerable effort has been

[2] MRAG Americas (2004) *Fisheries Monitoring Technologies: A Project Report Submitted to North Pacific Fishery Management Council*. By MRAG Americas, Inc, Tampa, Florida.

[3] Howard McElderry, Archipelago Marine Research Ltd, Victoria BC, July 2008. *Current assessment of the state of video applications in fisheries in the United States and internationally*. http://www.fakr.noaa.gov/npfmc/misc_pub/EMproceedings.pdf

devoted to critical analyses and the development of protocols.[4] Some of the issues of sampling precision, accuracy, bias, and observer effects are essentially eliminated if full observer coverage can be implemented as recommended here for the herring fishery. A great deal of the complexity in developing reliable observer sampling protocols stems directly from striving to obtain quality data while observing a small fraction of total fishing trips. Although complete coverage of trips brings with it the cost of more observer *sea days*, the cost savings brought by simpler protocols and improved data quality must also be considered.

3.1 More trips need to be observed

The NEFOP has a limited number of observer sea days that it may allocate to a particular fishery, with a target of 20% for the herring fishery[5]. Covering only one in five trips is insufficient for attaining a number of the important goals for monitoring because this does not produce a representative random sampling of the population of trips (see *Sampling design for proposed monitoring program*, below). Making matters worse, the current program has failed to come close to this target level of observer coverage. According to NEFOP, the average coverage was only 13% during the 2005-2007 period (i.e., on a per trip basis), with trip coverage in the 2-3% range during some time periods (Table 1). Observer coverage is too low to provide all the data that are needed on catch for the Atlantic herring fishery.

Table 1: Observer coverage on herring vessels; from NEFOP presentation 22 May 2008.

		By trip			By weight		
		# obs trips	# total trips	% coverage	lbs observed	lbs landed	% coverage
Winter	2005	26	103	25.2427%	4,142,640.00	25,797,931.60	16.0580%
	2006	37	187	19.7861%	4,364,941.00	37,157,651.20	11.7471%
	2007	28	303	9.2409%	1,623,436.00	45,106,116.00	3.5991%
Summer	2005	108	372	29.0323%	16,058,434.00	84,473,217.30	19.0101%
	2006	11	340	3.2353%	2,754,334.00	107,492,107.30	2.5624%
	2007	9	410	2.1951%	1,672,989.00	62,939,588.40	2.6581%
Fall	2005	82	337	24.3323%	16,498,303.00	94,378,705.50	17.4810%
	2006	7	220	3.1818%	2,445,782.00	79,143,596.80	3.0903%
	2007	17	252	6.7460%	4,062,293.00	66,178,785.10	6.1384%
Total 2005		216	812	26.6010%	36,699,377.00	204,649,854.40	17.9328%
Total 2006		55	747	7.3628%	9,565,057.00	223,793,355.30	4.2741%
Total 2007		54	965	5.5959%	7,358,718.00	174,224,489.50	4.2237%
Total 2005-2007		325	2524	12.8764%	53,623,152.00	602,667,699.20	8.8976%

[4] Rago, P.J.; Wigley, S.E.; Fogarty, M.J. 2005. NEFSC bycatch estimation methodology: allocation, precision, and accuracy. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 05-09; 44 pp.
Wigley SE, Rago PJ, Sosebee KA, Palka DL. (2007) The analytic component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: sampling design end estimation of precision and accuracy (2nd edition). U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 07-09; 156 p.
Babcock EA, Pikitch EK, Hudson CG (2003) *How much observer coverage is enough to adequately estimate Bycatch?* http://www.oceana.org/north-america/publications/reports/how-much-observer-coverage-is-enough-to-adwquately-estimate-bycatch/

[5] A. van Atten, Operations Coordinator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 22 May 2008 (www.nefmc.org/herring/index.html).

Historical data reveals that NEFOP has often missed major pulses of effort by the herring fleet and probably over-samples others. For example, in May 2007 herring vessels removed over 8,000 tons of fish from Management Area 1A in approximately 3 weeks, much of it from a groundfish closed area, with no observed tows. In October 2008 observers were unable to maintain coverage on herring vessels fishing in Georges Bank Closed Area I despite detecting a major haddock bycatch event in the first week of the month. As a result, no tows were observed in the second week although the herring fleet removed twice as much herring relative to the first week. As a consequence of this spotty coverage, catch and bycatch rates on observed trips cannot be extrapolated fleet-wide for the purposes of monitoring catch and bycatch limits, as they are in other hard TAC fisheries in the region. Analyses of catch and bycatch done months or years after the fact usually reveal numerous calendar-quarters and/or statistical area gaps that make extrapolation perilous.

Under the current system, herring vessels are required to carry an observer upon request, but there is no minimum coverage requirement specifying how often such a request must be made. Many managers and stakeholders believe minimum coverage rates are required by the Standardized Bycatch Reporting Methodology, or by Framework 43 to the Multispecies FMP. However, the target rates associated with both of those FMP actions are not actually binding and, historically, have not been achieved. The alternatives developed in this proposal will correct this problem by requiring a minimum of one observer per trip to observe and sample all catch.

3.2 Observed trips are not representative of trips as a whole

One of the issues that complicates the interpretation and use of data from a sample of trips is the possibility that the sampled trips are not representative of the fishery (or fleet) as a whole. For instance, sampling bias can result if vessels fish differently due to the presence of an observer. This bias, commonly referred to as "observer effect," has been documented in other monitored fisheries and typically occurs if there are perceived consequences of particular fishing behavior or practices (e.g., observations of substantial bycatch[6]).

There are several indications that NEFOP observed fishing trips are not representative because of observer influences. NEFOP has reported significant observer influences on trip duration.[7] Additional analyses presented by NMFS have also indicated differences between observed and non-observed trips within a given fishery, in fishing locations and trip durations. [8,9]

Data provided by NEFOP for herring (Table 1) also show a systematic difference between the percentage of trips observed (%) and the corresponding percentage of catch observed (observed weight as percentage of total landed weight). In 8 of 9 cases (89%) the observer coverage for weight, relative to landed weight (overall average of 9% covered by weight), was less than the proportion of observed trips (overall average of 13%).

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[6] A. van Atten Operations Coordintator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 1 October 2008 (Hwww.nefmc.org/herring/index.htmlH).
Burns RJ, Kerr GN (2008) Observer effect on fisher bycatch reports in the New Zealand ling (*Genypterus blacodes*) bottom longlining fishery. New Zealand Journal Of Marine and Freshwater Research, **42**(1): 23-32.

[7] A. van Atten Operations Coordintator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 1 October 2008 (Hwww.nefmc.org/herring/index.htmlH).

[8] Wigley SE, Rago PJ, Sosebee KA, Palka DL. 2007. The analytic component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: sampling design end estimation of precision and accuracy (2nd edition). U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 07-09; 156 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. (Hhttp://www.nefsc.noaa.gov/nefsc/publications/crd/crd0709/crd0709.pdfH)

[9] McAllister MK (2007) Review of the Northeast Region Standardized Bycatch Reporting Methodology. Lenfest Ocean Program Report (http://www.lenfestocean.org/publications.html).

Other things being equal, one would expect that the percentage of trips observed would be about the same as the percentage of catch observed (i.e., weight). The probability of seeing 8 of 9 cases with weight observed less than trips observed, by chance, is exceptionally low (binomial probability = 0.018). This raises the concern that there may be a tendency for observed trips to report lower weight because more catch is discarded without record (i.e., slipped nets) compared to trips as a whole (i.e., another form of observer effect). This pattern might also result if observers are simply not observing every tow. Concern is warranted if either explanation for this pattern is correct.

The risks of obtaining catch data that are biased by observers are a particular concern when the rates of observer coverage are very low. For an individual vessel in this situation, the near-term economic consequences of modifying fishing behavior on the occasional trip carrying an observer are small – most trips are not observed so fishing can go on without influence most of the time. Conversely, the consequences of these kinds of biases for estimating all catch for the fishery, and for stock assessments, are very high. With observer coverage rates very low for the Atlantic herring fishery (i.e., as low as 5% of trips), the risk of observer biases would appear to be high.

Unfortunately we do not yet know the extent to which observer effects are influencing our assessment of catch in the herring fishery. However, the potential for biases in observer data is high and must be reduced. The proposed monitoring program will seek to eliminate these biases by placing observers on all trips and using electronic monitoring to augment observer data.

3.3 The data from observed trips are incomplete

According to the NEFOP, approximately 17% of observed tows were at least partially discarded at sea (i.e., *dumped* or *slipped*)[10] without any systematic sampling, and one in ten tows (11%) was completely discarded without sampling. This is significant considering individual tows may contain over 100 metric tons of sea life, including substantial amounts of bycatch mortality.[11]

In addition to these large-scale dumping events, experienced observers report that larger animals are often excluded prior to where observers take their samples of pumped catch. For instance, on most herring vessels, the catch is pumped through a series of de-watering boxes and/or size specific sorting grates (with additional sorting by crew) prior to entering the fish hold. Some observers attempt to sample upstream of such presorting but this is not always possible, and crew cooperation in the retention of bycatch for sampling is often unreliable. Consequently, much of the pre-sorted catch is not sampled or recorded.

Another practice that complicates representative sampling is the tendency of vessels to dump any remaining catch at sea following the pumping process. These *operational discards* are particularly problematic since they are unlikely to be well represented in the observer samples because of the sorting influences of grates and the tendency for stratification of catch in the net.[12] These issues are addressed in the present proposal through the use of video monitoring of pre-sorting activity and by sampling the residual catch in the cod end after pumping.

A further impediment to obtaining complete and representative sampling arises in the pair trawl component of the herring fishery. Pair trawling is the dominant component of the herring fishery, producing by far the largest hauls of herring. It is not uncommon to have only one observer assigned to a given pair of vessels engaged in this form of fishing. This can lead to a significant portion of the catch going without sampling when fish are pumped to the vessel lacking an observer. Recent documentation of this problem showed that 25% of

[10] A. van Atten, Operations Coordinator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 22 May 2008 (Hwww.nefmc.org/herring/index.htmlH).

11 Davis MW (2002) Key principles for understanding fish bycatch discard mortality. Canadian Journal Of Fisheries And Aquatic Sciences. **59** (11): 1834-1843

[12] ibid at note 10

tows on otherwise observed herring trips were not observed due to this loophole.[13] It is a poor assumption that the catch pumped to one member of the pair is identical to that pumped to the other.

Thus, substantial catch goes without sampling, thereby undermining the utility of the data that is recorded by the program. If the discarded catch were a random subset of what was kept, then these issues might not be so serious. However, the discarded catch is not a random sub-set of the overall catch. According to NEFOP, whole tows are discarded based on the captain's assessment of the value of what is in the net, including large amounts of non-target catch (i.e., bycatch).[14] This amounts to a bias in the observer data that is expected to lead to underestimating catch. The importance of this underestimation is expected to be particularly severe for non-target species where the amount of bycatch may be a small percentage of the target catch, but large relative to the abundance of the bycatch species (e.g., river herring, or rare marine mammals).

In addition to catch that is missed due to discarding, there is also a potential for biasing the estimates of catch composition due to inadequate sampling from the catch stream. Data from the NEFOP show that the catch is non-uniformly distributed within herring hauls, for example, with more river herring detected toward the end of the pump-out period.[15] Further, data on the pattern of basket sampling show that sampling is often uneven. For example, on some tows samples are taken at regular intervals during part of pumping process (e.g., the beginning) but not throughout pumping. This source of bias will be eliminated in the proposed program by ensuring sampling throughout the entire tow.

4.0 SYNOPSIS OF CATCH MONITORING PROGRAM ALTERNATIVES

4.1 Alternative I: status quo

As explained above, NEFOP provides limited observer coverage for the Atlantic herring fishery and does not meet many of the important objectives for reliable monitoring of this fishery. This *status quo* alternative is not acceptable.

4.2 Alternative II: single observer with electronic data logging

Objectives:

- Monitoring of every tow, all trips
- Total weight of haul with at least 10% resolution (i.e., weight of all catch before sorting or pumping)
- Systematic sampling of pumped catch, representative of entire tow
- Complete record of pre-sorted catch
- Complete record of residual catch in cod end after pumping
- Digital record of trip, tow, location of net above sea floor

This alternative will provide substantial improvements over the *status quo*, with a trained observer on each trip, improved sampling protocols, and electronic data acquisition. There are a number of clear benefits to using the elements contained here, including simplifying protocols and logistics by observing each trip, and improved data on all catch.

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[13] Northeast Fisheries Science Center. *A Detailed Look at the Observed Herring Trips from 2005-2007*. Handout for PowerPoint presentation given by Amy Van Atten, Operations Coordinator and Acting Branch Chief, NEFMC Herring Plan Development Team Meeting November 12, 2008.

[14] ibid at notes 10 and 13

[15] A. van Atten, Operations Coordinator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 22 May 2008 (Hwww.nefmc.org/herring/index.htmlH).

Suggested protocols:

a. Single NMFS certified observer on each vessel
    a. Primary real-time observation is basket sampling of catch pumped into hold
    b. Analyzes pre-sorted discards on deck, checks counts against video
    c. Analyzes residual catch within cod-end after pumping is complete
b. Electronic monitoring systems to augment observer data
    a. tow characteristics (total catch, GPS, height of foot-rope)
    b. video record of catch pre-sorted on deck for observer analysis

4.3 Alternative III: two observers with reduced electronic monitoring requirement

Objectives:

- Monitoring of every tow, all trips
- Total weight of haul with at least 10% resolution (i.e., weight of all catch before sorting or pumping)
- Systematic sampling of pumped catch, representative of entire tow
- Complete record of pre-sorted catch
- Complete record of residual catch in cod end after pumping
- Digital record of trip, tow, location of net above sea floor

This alternative requires more investment in human observation and less in electronic monitoring. This may be advantageous in situations where electronic monitoring fails, or under unusual circumstances that are not well covered by electronic systems. The costs associated with this alternative are expected to be higher than those for the preferred alternative (see Table 2, below).

Suggested protocols:

- Two NMFS certified observers on each vessel
    - Real-time basket sampling of catch pumped into hold (one observer)
    - Real-time sampling of pre-sorted catch on deck (one observer)
    - Analyze residual catch within cod-end after pumping is complete (two observers)
- Electronic monitoring systems to augment observer data
    - tow characteristics (total catch, GPS, height of foot-rope)

4.4 Alternative IV: performance-contingent program for reduced observer coverage

Objectives after year 3:

- 25% monitoring of trips with random stratified sampling protocol
- Systematic sampling of pumped catch, representative of entire tow for all observed trips
- Complete record of pre-sorted catch for all observed trips
- Complete record of residual catch in cod end after pumping for all observed trips
- Total weight of haul with at least 10% resolution (i.e., weight of all catch before sorting or pumping) for every trip (%100)
- Digital record of trip, tow, location of net above sea floor for every trip (%100)
- Video record of deck activities with random audit for every trip (%100)

Observer coverage reduced to 25% contingent upon voluntary upgrade of electronic monitoring systems, and compliance with performance standards for a period of three years. Under this alternative, observer coverage begins at 100% with electronic data logging as in Alternative II (i.e., *preferred alternative*) and is changed after 3 years.

4.4.1 Phase 1 (as in Alternative II)

c. Single NMFS certified observer on each vessel
    a. Primary real-time observation is basket sampling of catch pumped into hold
    b. Analyzes pre-sorted discards on deck, checks counts against video
    c. Analyzes residual catch within cod-end after pumping is complete
d. Electronic monitoring systems to augment observer data
    a. tow characteristics (total catch, GPS, height of foot-rope)
    b. video record of catch pre-sorted on deck for observer analysis
e. Performance standards for years 1-3
    a. Full compliance with fisheries regulations
    b. Annual discarding within limits permitted for safety reasons
    c. Record of cooperation with observer program (NEFOP and industry specific)

4.4.2 Phase 2 changes after 3 years

f. NMFS certified observer on 25% of trips according to stratified random trip sampling protocol
g. Electronic monitoring systems upgraded
    a. Two video cameras on all vessels
    b. Other monitoring systems as in alternative II

5.0 MANAGEMENT OPTIONS

5.1 Suggested accountability options

5.1.1 Option 1 Accountability for tows discarded without sampling (i.e., slipped bags).

a. Up to 3 discarded tows (full or partial) allowed per fishing year to mitigate verified safety emergencies.
b. Fishing suspended for 48 hours for any discarded or transferred tow, allowed or not.
c. Full weight of discard will count against the annual herring catch allocation for the management unit; weight assumed to be 200 tons in the absence of the required electronic weight.

5.1.2 Option 2 Accountability for transfer of tows without sampling (e.g., to other vessel)

a. Fishing suspended for 48 hours for any tow transferred without sampling.
b. Full weight of transfer will count against the annual herring catch allocation for the management unit; weight assumed to be 200 tons in the absence of the required electronic weight.

5.1.3 Option 3 Accountability for discarding pre-sorted catch without observation

In the event that crew do not set aside all pre-sorted catch for observer analysis, as detected through the video verification process:

a. Fishing suspended for 48 hours for the vessel
b. Vessels that repeatedly discard pre-sorted catch (6 incidents with discrepancy of 10% or more, by count) will be excluded from the fishery for the season.

5.2 Groundfish closed area monitoring option

Monitoring Requirements and Criteria for Access to Groundfish Closed Areas by Midwater Trawl Vessels

At its November 2008 meeting, the NEFMC directed the herring committee to revisit the monitoring requirements and criteria[16] for access to groundfish closed areas by midwater trawl vessels in a 2009 action. Groundfish closed areas receive special treatment because they have been identified as spawning grounds or areas of high groundfish abundance, important to rebuild depleted groundfish stocks and to prevent overfishing as required by the Magnuson-Stevens Act.[17] As a result, the groundfish FMP and related regulations closed groundfish closed areas to all gear capable of catching groundfish.[18] Herring midwater trawl vessels, were authorized to access groundfish closed areas based on the premise that they caught no or only negligible amounts of groundfish.[19] This premise has proven to be false.[20] Because of the special status of groundfish closed areas, certain separate monitoring requirements and criteria for access that would apply, apart from those that apply throughout the fishery, are justified. Two sub-options are proposed:

Under these two sub-options, access to closed areas by midwater trawl vessels (single or paired) is prohibited except with an experimental fishing permit (EFP) meeting the requirements below. Future access without an EFP along with minimum criteria for access may be reconsidered and established through a framework action after consideration of the data obtained through any EFPs. Note that this option would be an "overlay" that would be included in addition to the selected core catch monitoring alternative.

5.2.1 Sub-Option 1 – Monitoring requirements with criteria for access.

This option includes both the monitoring requirements and the additional requirements and criteria for access.

- Full observer coverage (one or more observers per vessel, as necessary to ensure that every haul is observed) as in Catch Monitoring Alternative II
- Electronic monitoring systems to augment observer data as in Catch Monitoring Alternative II
  - tow characteristics (i.e., total catch, GPS, height of foot-rope)
  - video record of catch pre-sorted on deck for observer analysis
- Additional requirements and criteria for access to groundfish closed areas.
  - Pair-Trawling in closed areas prohibited
  - No more than 20 mid-water trawl trips per closed area per fishing year
  - Fishing with net foot-rope less than 20 feet off the bottom prohibited
  - Monitoring protocols including mandatory reporting of vessel electronics information and shoreside gear inspections to determine the depth fished by midwater trawl gear and whether contact with the bottom has occurred
  - Groundfish bycatch triggers exclude vessels from access to the closed areas
    - Groundfish bycatch is detected in an amount greater than 100 pounds for any vessel trip - all midwater trawling in such closed area suspended for a minimum of 48 hours
    - Overfished stock - regional administrator determines bycatch to be 0.1% of TAC for stock – one year exclusion

[16] *See* 50 C.F.R. §648.81(a)(2)(iii).
[17] *See, e.g.*, 59 Fed. Reg. 63,926, 63,928 (Dec. 12, 1994); 63 Fed. Reg. 15,326, 15,327 (Mar. 31, 1998); 64 Fed. Reg. 2601, 2601 (Jan. 15, 1999).
[18] *See id.*
[19] *See* 63 Fed. Reg. 7727, 7728-29 (February 17, 1998).
[20] *See, e.g.*, Northeast Fisheries Science Center. *A Detailed Look at the Observed Herring Trips from 2005-2007*. Handout for PowerPoint presentation given by Amy Van Atten, Operations Coordinator and Acting Branch Chief, NEFMC Herring Plan Development Team Meeting November 12, 2008.

- Other groundfish - regional administrator determines bycatch to be 0.5% of TAC for stock – one year exclusion

5.2.2 Sub-Option 2 – Monitoring requirements with criteria for access developed in another section of this amendment or herring action.

This option includes the minimum monitoring requirements and additional requirements and criteria for access will be considered in another section of Amendment 4 or another herring action.

- Full observer coverage (one or more observers per vessel, as necessary to ensure that every haul is observed) as in Catch Monitoring Alternative II
- Electronic monitoring systems to augment observer data as in Catch Monitoring Alternative II
  - tow characteristics (total catch, GPS, height of foot-rope)
  - video record of catch pre-sorted on deck for observer analysis
- Monitoring protocols including mandatory reporting of vessel electronics information and shoreside gear inspections to determine depth fished by midwater trawl gear and whether contact with the bottom has occurred.

5.3 Compliance and enforcement option

This option is intended to facilitate an observer's ability to carry out his or her responsibilities and to improve compliance and enforcement of the catch monitoring program. Note that this option would be included in addition to the selected core catch monitoring alternative.

- The failure by an operator or any other person aboard a midwater trawl vessel to comply with the monitoring and reporting system requirements, including but not limited to the interference with or failure to facilitate an observer's completion of observer protocols and other monitoring system requirements, would be unlawful and subject to penalty as referenced in 50 C.F.R. § 600.735. Such unlawful actions would be included in the list of general prohibitions under 50 C.F.R. § 600.725 in the form necessary to make clear they are consider unlawful. Specific examples of such unlawful actions would include, but not be limited to, failing to bring the cod end on board the vessel for sampling, tampering with electronic monitoring equipment, pumping to an unobserved vessel, refusal to allow a pumping rate to be measured, or the failure to allow collection of electronic data from a vessel's onboard sensors or other electronics.

- In addition to the actions referenced above being unlawful acts subject to existing penalties referenced in 50 C.F.R. § 600.735, when any such violation occurs during a fishing trip that trip shall be ended immediately and the vessel shall return to port.

- Whenever an observer is unable to sample catch on an otherwise observed trip due to at-sea dumping (slippage), pre-sorting, operational discards, the pumping or hauling of fish to an unobserved vessel in a pair trawl team, or any other action by an operator or any other person aboard a midwater trawl vessel, the observer shall make an estimate of the unobserved tonnage using available information from the vessel and their professional judgment which shall be applied against *each* catch limit, bycatch cap, and any other regulatory threshold measured as an amount or percentage of catch.

- When an observer is unable to make such an estimate, then the Regional Administrator shall make an estimate of the maximum amount that could have been unobserved given the information available and that estimate shall be applied against *each* catch limit, bycatch cap, and any other regulatory threshold measured as an amount or percentage of catch.

6.0 FUNDING OPTIONS

6.1 Funding option 1 - federal funding for NEFOP

This option would allow herring vessels to fish only when a Federal observer was provided by NEFOP. Because Federal funding for observers is unpredictable from year to year, this could lead to very low fishing effort due to limited availability of observers.

6.2 Funding option 2 – industry funding augmenting federal funding of NEFOP (Preferred Option)

This option would allow the industry to self-fund trained data collectors to observe their fishing operations and sample their catch under the same protocols employed by NEFOP observers. This would allow individual vessels the option to fish when a NEFOP observer is not available to them.

6.2.1 Sub-option A

Individual vessel owners would decide whether or not to participate in the program. Those choosing not to participate would fish only when a NEFOP observer was available to their vessel. Vessel owners that choose to participate would pay the cost of carrying Federally trained data collectors on a trip-per-trip basis.

6.2.2 Sub-option B (Preferred Sub-option)

All vessels with Category A & B permits participate in the program and pay the cost of carrying Federally trained data collectors on a trip-per-trip basis

6.2.3 Sub-option C

Development of a system that employs a quota set-aside so that the cost of the program is incorporated into landings on a percentage basis. A set percentage of all landings would be sold to pay for the program. The challenge would be to project landings and price in a manner that would ensure that the program was fully funded.

7.0 COMPONENTS OF THE PROPOSED MONITORING ALTERNATIVES

7.1 Improvements to current monitoring

The program seeks to provide high quality data (i.e., precise and accurate) on all catch, including targeted Atlantic herring, catch that is important in other fisheries (e.g., river herring or haddock), and all other bycatch, whether it is landed or not. The program will improve on the current monitoring program in the following ways:

1. Certified observers will be present on all herring trips (i.e., minimum of one observer per trip).
2. The weight of the entire tow, prior to pumping, will be estimated from a calibrated net sensor system, or comparable system.
3. Video records will record the pre-sorting of catch (i.e., removal of catch before it reaches the hold) as an aid to observers as they assess the pre-sorted catch after completion of basket sampling of pumped catch.
4. Protocols will ensure that observers systematically sample catch throughout the process of transferring fish from the net to the hold.

5. The weight of catch placed in the hold will be measured from holding tanks that are certified as calibrated or other reliable method approved by NMFS.
6. The weight and composition of any catch remaining in the net will be ascertained after pumping has been completed, by bringing the residual catch on deck for observation and sampling.
7. No tows will be discarded without sampling (i.e., slipped bags, transfers to other vessels).

The program is based upon third-party, NMFS trained and certified, observers on all herring trips, with standard electronic monitoring equipment for data acquisition and as a backup for observer reporting. Electronic data entered by observers, and directly from electronic data loggers, will be transmitted to NMFS during each trip, and analyzed by NMFS on a continuous basis. Key elements of this proposal are modeled after several successful observer programs currently in use in other regions of the US (e.g., Alaska Pollock, Pacific whiting). The components of this program are developed below. Objectives are presented with suitable methods when they are known. In some cases methods may need to be developed to meet the proposed objectives.

7.2 Vessels to be included in the program

The monitoring program presented in this proposal will include all vessels conducting directed fishing for Atlantic herring, with category A or B permits. The proposal is limited to Category A & B permits as they make up the vast majority of herring landings (95%),[21] represent the largest and most efficient vessels in the fleet, and, in short can be effectively monitored in a contained program. There are 45 A and B permitted vessels (41 A and 4 B).[22] Limiting the monitoring program to these 45 vessels will contain costs and limit the scope of the program while providing data corresponding with the vast majority of herring landings. These vessels account for approximately 1,000 trips.[23]

7.3 Observers

Observers will be recruited and paid by a third party contracted by a given management unit of the industry. All observers will meet screening criteria set forth by NMFS, and will be trained and certified by NMFS. Observers will function as independent, objective recorders of fishing operations and catch information, logging observations as electronic data records.

7.4 Proportion of herring trips observed

Under our preferred alternative (II), and several others, all vessels will be required to carry a minimum of one certified observer. Under some circumstances two observers may work together on a vessel, for example on trips that are also observed by the NEFOP. In fisheries that involve multiple vessels, such as pair trawling, each vessel will have at least one observer.

Obtaining high quality catch data through representative sampling is complex but essential for stock assessments and successful fisheries management. By placing observers on all trips, a number of difficult issues are resolved, better data are obtained, and the playing field is level with respect to any imposition on members of the fleet.

With anything less than full observer coverage one faces the task of choosing a subset of trips for observation, as a representative sample from which extrapolation to the entire fleet may be made. This is difficult for a number of reasons. Among these, is the fact that the fleet of vessels and fishing gears is diverse. Additionally, the distribution of fish in the fished region is uneven (i.e., in space and time) due to the

[21] Safe Report 2007, Pg 24
[22] Amendment 4 Discussion Document, 7-9 October, 2008: Table 12
[23] Note: this is an approximate number that needs to be updated data are assembled for Amendment 4

heterogeneous distribution of habitats and the biology of fishes. The mix of fishes encountered is itself diverse, with some species forming dense schools and migrating both locally and in and out of the region. These factors make obtaining statistically representative information, by observing a fraction of the trips, problematic. Layered on top of these issues is the influence of the observers on fishing behavior, or *observer effects*, that can further undermine the value of data obtained from a sampling of trips (see discussion of observer effects above, under Current Monitoring).

The issues raised here point to the need for a robust sampling of herring trips. The current practices of NEFOP, with low and variable rates of coverage (2005-2007 average 13%), are not statistically adequate, nor sufficient to inspire confidence among the impacted stakeholders. Here we propose that all herring trips carry a minimum of one observer and electronic monitoring systems. This practice will make the observer program simpler, obviate most of the sampling issues discussed here, and yield better data.

For all of the reasons discussed here, the practice of placing a minimum of one observer on each vessel is now being used in a growing number of fisheries, including several fisheries in Alaska and Canada,[24] and the catcher-processor vessels in the Pacific at-sea hake fishery.[25]

7.5 Ensuring observation of all catch

Complete coverage of all catch is not possible if some tows are discharged to the water without sampling (i.e., *slipped*). According to the NEFOP, in the current program approximately 17% of tows are partially or completely discharged without systematic sampling by observers.[26] In proposed program, coverage of all catch will be ensured. All tows will be weighed electronically when the net is hauled back, and after pumping. If the net is dumped, the amount dumped (i.e., in pounds) will be deducted from the annual herring allocation for the vessel's management unit. The dumped weight will be assumed to be 200 tons in the absence of an electronic weight. Each vessel will be granted an allowance of three dumping events per year for instances where dumping is necessary for safety reasons. Allowance determinations will require corroborating electronic data and observer reporting.

8.0 MONITORING THE CATCH TOW BY TOW

Observers will carry out approved catch sampling for the purpose of estimating the nature and quantity of all catch, including catch taken into the vessel's hold and catch that is excluded in any way (e.g., excluded by grates or left behind in the net). Observers are also expected to record observations that are pertinent to evaluating the influence of fishing operations on marine life but which may not be classified as catch (e.g., interactions of fishing gear with marine mammals, sea turtles and seabirds).

An effective monitoring program will require monitoring at three points for each tow. These include (1) sampling of the pumped catch *en route* to the fish hold, (2) sampling of pre-sorted (i.e., excluded) catch before it reaches the hold, and (3) sampling of catch remaining in the net whenever pumping is terminated while catch remains in the net.

The bulk of the observer's effort will be devoted to systematically sampling throughout pumping process (i.e., point 3 above) to ensure robust sampling of hauls that may be stratified by catch type. It is not always practical for a single observer to monitor the pre-sorting of catch (i.e., point 2 above) while engaged in sampling the main catch stream. In this program any pre-sorting by crew is recorded on video, for later analysis by the observer between tows as time allows, and on shore. When the captain indicates that the transfer of fish to the

[24] Hhttp://alaskafisheries.noaa.gov/sustainablefisheries/default.htm

[25] Hhttp://www.fakr.noaa.gov/npfmc/misc_pub/EMproceedings.pdf

[26] A. van Atten, Operations Coordinator, Northeast Fisheries Observer Program. Presentation to Herring Oversight Committee of New England Fisheries Management Council, Portland, ME, 22 May 2008 (www.nefmc.org/herring/index.html).

hold has been completed, the weight of the pumped net will be recorded by the observer, and any catch remaining in the net will brought on deck for sampling by the observer (i.e., point 1 above).

Obtaining representative samples from net tows at sea is a formidable task, requiring protocols that are robust to a number of factors. Many of the tows are enormous (e.g., 100 tons of sea life), and the catch is not evenly distributed within the volume of the hauled back net (e.g., some species may occur at the bottom of the net, others near the surface, etc.). This demands that sampling is conducted so as to adequately sample from all of the strata represented within the tow. Sampling must be carried out throughout the pumping process (see discussion above under Current Monitoring).

8.1 Initial description of each tow

The observer will watch the haul-back of the net and provide a brief description of the tow prior to pumping. This will include tow duration, the presence of any bycatch that can be visually observed in the net, and any other observations of interactions with marine life.

8.2 Establishing total catch weight for each tow

The observer will record the fish weight in the net at the time of hauling in to within at least 10% of net capacity. Net sensor technology for estimating catch is available and is based on tension sensors placed within the mesh.[27] Measurement resolution increases with the number of sensors used. Ten sensors placed appropriately will yield the required 10% resolution. All vessels in the herring fleet will be required to provide electronic monitoring of catch during the tow to at least this level of resolution. NMFS will certify placement of sensors and implement periodic inspections to ensure compliance with this part of the monitoring program.

8.3 Electronic monitoring and accounting of pre-sorted catch

The crew on herring vessels typically removes unwanted catch from the catch stream while the observer is engaged in the basket sampling process. Crew will retain all excluded catch (i.e., *pre-sorted*) in baskets for later analysis by the observer. This process will be recorded on video for review by observers. Video review will allow observers to verify that their counts of fish, and other excluded catch, match that recorded on video. These audits will be carried out according to a NMFS approved random schedule. If there is concern about a specific tow, video review may be undertaken at the discretion of the observer.

Video monitoring systems have been developed and implemented for a number of fisheries observer programs.[28] This will require installation of a minimum of one camera per vessel. As time allows on board, or after the trip is over, observers will quantify excluded catch according to standardized protocols, and review video records as dictated by protocol. The priorities for accounting for pre-sorted catch will be:

- Correct species identification, and counts, for all species excluded
- Size estimate for each excluded animal
- Weight of catch for each species estimated from individual lengths and standard length-weight functions
- Random verification of pre-sorted catch from video records

8.4 Systematic sampling of the catch pumped into to the hold

Sampling protocols for the catch stream (i.e., *basket sampling*) have been implemented for NEFOP, and many other fisheries observer programs,[29] and should be applied here with some modification as warranted by additional research on sampling large volume tows with stratification (discussed below).

[27] SIMRAD PI System (www.simrad.com)
[28] Evaluation of Monitoring and Reporting Needs for Groundfish Sectors in New England (Phase I and II Reports), Archipelago Marine Research, LTD, May 2008.
[29] Hhttp://www.st.nmfs.noaa.gov/st4/nop/Observer_training_resources.html

After the net is hauled back, the total catch weight for the tow is recorded (see above), and preparations for pumping are complete, the observer will initiate sampling protocol for fish pumped into the hold.

Typically a fixed number of samples is taken at regular intervals during pumping (e.g., NEOP uses 10 basket samples, approximately 50 pounds each) during the pumping process. The observer will estimate the inter-sample interval based on the number of samples required, the total weight, and the estimated pumping rate. For a high volume fishery like the Atlantic herring fishery, the number of samples per tow should be increased in order to come close to meeting protocols (i.e., minimum of 20% of catch taken in samples). We recommend that the number of samples be set at 16 baskets until additional sampling research has been completed as a basis for further modifying protocols.

If an example tow weight were 100 tons (200,000 lbs) and the pumping rate was 100,000 pounds per hour (or 1,667 lbs/minute), the pumping process would last about 120 minutes (i.e., 2 hours). For 16 samples, with a sample taken at the start and another at the end, the sampling interval will be 8 minutes - the expected pumping duration divided by one less than the number of baskets (i.e., 16-1 = 15 intervals, 8 minutes each). Once pumping has been initiated, sampling must be continued until the pumping is completed even if this means that more than 16 samples are required. It is essential to ensure that basket sampling be initiated when the pumping begins, and be continued systematically throughout the entire pumping procedure to minimize biases that can result when the distribution of catch within the net is not uniform.

8.5 Calibration of pumping rate

Observer sampling protocols require that the pumping rate is known. At least once per trip, the pumping rate must be checked by pumping by filling a calibrated bin, and then interrupting the pumping process long enough for the observer to adjust the sampling schedule. For example, the time required to fill a bin certified to hold 10,000 pounds of herring could be measured (about 200 cubic feet, or roughly 5 x 5 x 8 ft). If it took 8 minutes, the pump rate would be taken as 75,000 pounds/hr. The bin used could be a small calibrated storage bin within the hold.

8.6 Additional research on sampling protocols

If the distribution of fish species and sizes within a hauled up net were uniform (or randomly distributed), sampling would be more straightforward, since samples taken at different times during pumping would be similar. However, data from the NEFOP show that the catch is non-uniformly distributed in herring hauls, for example, with more river herring detected toward the end of the pump-out period (see discussion above under *Current Monitoring of Herring Fishery Does Not Meet Future Needs*). To the best of our knowledge, detailed studies of the stratification of fish within herring hauls, and the appropriate protocols for sampling from stratified catch, have not been conducted for the Atlantic herring fishery. Such studies would provide valuable information for sampling protocols. In the absence of additional research it seems appropriate to sample the catch stream regularly (i.e., as above) with inter-sample intervals as short as can be managed by observers.

Additional research should also examine the sampling protocols as they relate to the high volume tows typical of today's herring fishery. The sampling protocols currently employed by the NEFOP (10 baskets per tow) amount to sampling only about ¼ of one percent of the catch from an average paired mid-water trawl (approximately 100 tons). Ten basket samples is probably not sufficient sampling, particularly given the uneven nature of the catch stream. Note that the NEFOP Biological Sampling Manual places the minimum sample at 20% of the catch, dictating an increase of at least 80 times above present practice.[30]

[30] ibid

8.7 Analysis of basket samples

NEFOP has developed excellent protocols for training observers on fish identification and the analysis of basket samples, and these will be used by observers in the proposed program.[12] The priorities for analysis of samples will be as follows:

- Correct species identification, and counts, for all species catch
- Weight of catch for each species
- Count of any ripe, running females for each species
- Specimens labeled and retained for shore-side identification as necessary

8.8 Determination of final weight of catch in hold

Observers will be required to record the total weight of catch pumped from a tow into the hold, to at least the nearest 1,000 lbs. This must be done using protocols that have been certified by NMFS, including a schedule for periodic calibration checks.

A volumetric method could be used, based on calibrated fish-hold compartments. Volumetric weight determination would require appropriate calibrations and certification by NMFS. Calibrated hoppers that dispense their contents to the hold each time they are filled offer another measurement approach (i.e., calibrated hopper scale). A calibrated hopper scale could also serve a dual function of calibrating the pumping rate (see *Calibration of pumping rate).*

8.9 Determination of residual catch weight and contents of pumped net

When the pumping process is completed, the weight of any marine life remaining in the pumped net must be estimated (*residual catch*). This will be done by bringing the net on deck for examination by the observer. If feasible, the net contents should be emptied into a calibrated hold for a volumetric determination of total weight. The observer must be allowed sufficient time to document the catch remaining in the net with the following priorities:

- Correct species identification, and counts, for all species common in Atlantic herring catch.
- Weight of catch for each species (length measured for large animals)
- Count of any ripe, running females for each species
- Specimens labeled and retained for shore-side identification as necessary

9.0 ELECTRONIC MONITORING SYSTEMS AND DATA ACQUISITION

Standard electronic monitoring methods will be used to augment the observer data. In certain applications, Electronic Monitoring (EM) may be used to directly replace at-sea observers. However, in this proposal EM is presented as an option to buttress the at-sea observers. The use of EM makes it possible to obtain the needed data with a single observer, providing some substantial cost-savings. Below we provide a description of the components of the electronic monitoring system data acquisition needs.

9.1 Specific objectives for electronic monitoring

The objectives for electronic monitoring are:

- Data logger - Use electronic data loggers to acquire digital data to complement observer data and reduce reporting errors.
- Video camera - Employ video monitoring to estimate composition and weight of that portion of the catch that is excluded during pre-sorting, and to provide backup monitoring of on deck protocols as necessary
- VMS - For each tow, record date, start and end time, and geographic coordinates of the tow

- Net sensors - Estimate total weight of catch in each tow, prior to pumping or pre-sorting; record height of foot-rope above bottom during tow

9.2 Data loggers

Each vessel will be equipped with a secured data logger, including interfaces for all electronic sensors, a secured hard drive, and R/W DVD drive for data backup. The data logger will provide all of the digital records, including video records, time-stamps, and geographic records. Observers will use the DVD copies for any shipboard analysis, and will retain the DVDs for further analysis at the completion of the trip.

9.3 Video cameras

Video-based EM can be used to provide a backup to at-sea observers. While traditional video-based EM cannot provide reliable catch and discard data in trawl fisheries of this nature, it could potentially be used in lieu of a second observer to verify the absence of pre-sorting upstream of the main sampling station.

9.4 Vessel monitoring systems (vms)

The existing VMS system in the herring fishery (required on all vessels) with an integrated Global Positioning System (GPS) and time-date stamps will form an integral part of the proposed system. Under this proposal, VMS data will become an official part of the observer dataset and will be used to provide high-quality, real-time position reports which can be associated with observer data and used to verify fishing location relative to management boundaries. Currently NOAA Office of Law Enforcement (OLE) does not have efficient and useful data-sharing arrangement with NEFOP, which makes it difficult for NEFOP to maximize the usefulness of the existing observer data.

9.5 Net sensors

In the proposed program, standard electronic sensors will be used for data acquisition. Data will be logged by the data logger (i.e., recorded on a secure hard drive) and included as part of the observer dataset for the trip. Net sensors will be used as follows:

- To estimate the total catch for each tow in the net prior to pumping (see above *Establishing the total catch weight for each tow*). This determination of total catch is essential to any system that seeks to provide a complete accounting of the disposition of catch (i.e., total should be approximately equal to the sum of landed catch, pre-sorted catch, and residual catch in the net after pumping). Strain-sensitive net sensors (e.g., SIMRAD PI Catch sensors) are placed at a minimum of ten locations along the cod end of the net, from the far end to the trawl opening, such that catch weight is reported out in increments of 10% of net capacity (NMFS certification of sensor placement required). Each sensor reports when it is triggered by an emitted acoustic signal, received by a hydrophone, and data are logged electronically by the data logger.
- To provide a record of the height of the foot rope above the bottom (e.g., SIMRAD Systems *Simrad PI Height*) during each tow. Data from the footrope height sensor will be logged by the data logger as above, becoming part of the observer dataset.
- To provide a time-stamped record of fishing activity. The output of standard winch rotation sensors, and hydraulic pressure sensors, will be recorded by the data logger and become part of the observer dataset.

10.0 HIGH QUALITY MONITORING IS REQUIRED BY LAW

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA) includes national standards mandating that fishery management plans (FMP) and regulations implementing such FMPs

include conservation and management measures that minimize bycatch.[31] In addition, the MSA requires that FMPs include a monitoring and reporting program that assesses the amount and type of bycatch occurring in the fishery in order to accomplish this mandate.[32] The MSA's national standards and related provisions also require that conservation and management measures be based on the best scientific information available and prevent overfishing, rebuild overfished stocks, and protect, restore and promote the long-term health and stability of the fishery.[33]

Recent changes included in Magnuson-Stevens Reauthorization Act (MSRA)[34] amplify the critical need to revise and improve the Atlantic herring FMP's catch monitoring program. These changes require that annual catch limits and accountability measures be implemented for this fishery in 2011.[35] In enacting these new requirements, Congress recognized that revisions are needed to FMPs throughout the country in order to bring them into compliance with the original intent of the Magnuson-Stevens Act to provide for sustainable U.S. fisheries. Congress recognized that even fisheries that in themselves may not currently be considered overfished need to improve their management systems for the long-term health of our fisheries. The foundation for effective and sustainable fisheries management and implementation of these recent changes in law is each fisheries monitoring program, which must provide the data and information necessary to ensure catch limits within fisheries and across fisheries are meaningful and that accountability is brought to management.

It is the Herring Alliance's view that the current Atlantic Herring FMP fails to comply with these existing and new legal mandates. The cause of these failures begins with the FMP's lack of required monitoring and reporting provisions necessary to assess the amount and type of catch, including bycatch, actually occurring in the fishery. This in turn prevents managers from developing and implementing the necessary conservation and management measures that would minimize bycatch and prevent overfishing in all New England fisheries affected by the Atlantic herring fishery. Improved monitoring requirements will be necessary to effectively implement annual catch limits and ensure accountability in the fishery.

Many of the core problems with the current monitoring and reporting system are described below and the Herring Alliance proposes several solutions that would help bring this FMP into compliance with the law. The system proposed here is based on at-sea monitoring by at-sea fishery observers, building upon the strengths of the NEFOP while increasing coverage and closing loopholes which undermine the data currently collected. Electronic Monitoring (EM) is also presented as an option to buttress or backstop the proposed at-sea observers, or to potentially replace a second observer, or to otherwise provide efficiency or cost-savings or critical data. While other comprehensive approaches could also be developed and implemented to provide the type of data and information required to effectively meet the MSA's legal mandates, the use of at-sea observers in a well-designed monitoring and reporting system have a track-record for successful fisheries management.

In addition, the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA) limit the incidental catch of protected species in this fishery. A biological opinion completed in 1998 established limits on the incidental take of endangered species in this fishery.[36] Unfortunately, current limitations on at-sea observer coverage and loopholes in the monitoring system prevent these fundamental protections for some of our most important ocean life from being effectively implemented. This catch monitoring program would improve compliance with the ESA and MMPA and the biological opinion for this fishery.

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[31] 16 U.S.C. § 1851(a)(9).
[32] 16 U.S.C. § 1853 (a)(11).
[33] 16 U.S.C. § 1851(a)(1)(2); § 1853(a)(1).
[34] Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006.
[35] 16 U.S.C. § 1853 note((1)(B).
[36] *See* National Marine Fisheries Service, Endangered Species Act Section 7 Consultation: Biological Opinion, 48-50 (September 19, 1999). The Herring Alliance is currently reviewing this biological opinion in view of changes that have occurred in the fishery and recent scientific information in order to determine whether a full consultation should be reinitiated by the National Marine Fishery Service.

11.0 ESTIMATED COSTS FOR PROPOSED MONITORING PLAN

Here we have estimated the approximate equipment and personnel costs based on the information that is currently available to us. These estimates will provide a reasonable starting point for evaluation of the alternatives in the proposal but should be updated as additional information becomes available. It should also be considered that some of the equipment required under our alternatives is in place on at least a portion of the herring vessels. VMS with GPS, and at least some part of a system for estimating catch or net height, are in place on many of the vessels. In the cost estimation, we have assumed that vessels are already outfitted with a minimal SIMRAD system (or comparable system) with just two sensors. The tabulated SIMRAD equipment costs manufacturer list prices and further cost savings may stem from bulk retail purchases (e.g., by a management unit). Thus, the costs estimated per seaday here are likely high (i.e., conservative).

The costs for observers and for video-based electronic monitoring are taken from an analysis done by Archipelago Marine Research LTD for New England Groundfish, and is based on experience with similar monitoring systems in BC, Canada. Not all of the components included in the Archipelago system (option 3b) are called for in this proposal. Specifically, the Archipelago system is based on multiple cameras (most of our alternatives call for a single camera), and includes two additional transducers not used in our alternatives. Some cost adjustments may therefore be appropriate for the herring fleet.

Table 2 shows the cost estimates pertinent to each of the proposed alternatives on a per seaday basis. Table 3 provides an accounting of the costs for Alternative II, and includes all the components that enter into the other alternatives. For Alternative IV, the costs for observers, per seaday, are slightly higher because coverage is less than 100%. For this last alternative, the estimated cost does not reflect the added administrative burden that comes with partial sampling of trips (e.g., protocols for random selection of trips with stratification, coping with observer effects, the need to extrapolate to the whole fleet, and the costs associated with poorer stock assessments). These costs should be examined further.

Table 2

	per seaday*		**Comments**
Alternatives	Years 1-3	After 3 yrs	
Alternative I	$1,200	$1,200	NEFOP *status quo*
Alternative II	$948	$0	Preferred alternative
Alternative III	$1,573	$625	Added observer
Alternative IV**	$948	$473	Plan change after 3 years
* assumes minimal sensor systems in place at start			
** increased sampling complexity and need for extrapolation			

Table 3

Observers	Costs per seaday			Information Source
	Salary	Overhead	Total	
Third party observers	$200	$500	$700	Archipelago 2008; costs based on program in BC for groundfish
Electronic Monitoring				
Archipelago Package			$150	Archipelago 2008; conservative estimate - program includes more than present proposal
SIMRAD PI Catch System			$98	Estimated cost/seaday for net sensor systems
Total per seaday			**$948**	Cost per seaday with full coverage

Table 4

SIMRAD PI Catch System		**Costs**	
Receiver w/ monitor and hydrophone		$9,900	List estimate from manufacturer
Net sensors (n=10)		$38,000	Sensors required for 10% resolution
SIMRAD PI Height Sensor (n=1)		$3,500	List estimate from manufacturer
Total per vessel with no equipment		$47,900	Initial investment for vessel not currently equipped
Total per vessel with basic system already on board		**$30,400**	**Assumes minimum system with 2 sensors, receivers, hydrophone, in place**
n vessels (A+B permits)	45	$1,820,200	Total cost to equip whole fleet
Approximate sea days/year	2800		From NEFOP Summary data
Approximate trips /year	1000		From NEFOP Summary data
Approximate days/trip	2.8		
Approximate sea days/vessel/year	62.22		
System life 5 years	5		Estimated life of system in years
Approximate cost/sea day		**$98**	Cost per vessel per SD w/ 5 yr life

12 ECONOMICS OF THE FISHERY & BENEFITS OF MONITORING

This section is derived from rounded assumptions based on data sources that do not consistently break down data by permit categories. Since data on the number of trips, landings, revenues, etc., associated with specific permit categories is not readily available for the preparation of this document, the proposal relies on estimates and round numbers derived from the best data available.

The assumptions are as follows for the fleet covered by the proposal: 45 vessels; 1000 sea days annually; 100,000 tons of annual landings; and $20,000,000 in annual gross revenue.

The program, as outlined in the preferred alternative(s) anticipates an initial start up cost of approximately $2,000,000 for the fleet to purchase and install electronic monitoring equipment. After the initial investment, the cost is projected to be $600 - $700 per sea day, for an annual total of $600,000 - $700,000. This assumes that Federally trained and certified observers working for third party companies can be paid and that the data can be handled for a cost of $600 - $700 per sea day.

With gross revenues of $20,000,000, we conclude that 3% - 3.5% of gross revenues will be allocated to monitoring under this proposal. It is reasonable to expect a fleet with so little previous monitoring data and the largest, most efficient gear in the region, to commit up to 5% of revenues to a monitoring program.

By implementing an effective monitoring system that all stakeholders have confidence in, the regulatory uncertainty surrounding the herring fishery will be diminished. This can lead to a more stable and rational herring fishery in which bycatch caps are allocated, monitored and enforced. In addition, this will allow the FMP to institute a true Total Allowable Catch, rather than the current landings cap, and to operate successfully within the required Annual Catch Limits system. Having these tools in place will allow the industry to explore its desire to rationalize the fishery through an allocation amendment. Thus, implementing a strong monitoring program will ultimately lead to higher profitability for the fleet.

In addition, an effective monitoring program will lead to better data going in to stock assessments and other scientific processes, thus ensuring the long term health of the stock. Ensuring the long term health of the target species is paramount to a successful long term business model. This is another economic advantage that a strong monitoring program provides the herring fleet.

Furthermore, by implementing a strong monitoring program, individual vessels will be able to differentiate their activities from those of their peers. This will lead to a system in which the vessels that can be most effective at avoiding bycatch will not be put in jeopardy by the potential impacts of those vessels that are less effective.

Once realized, these economic benefits will far outweigh the cost of the proposed program.

13.0 ORGANIZATIONS AND INDIVIDUALS SUPPORTING THE PROPOSAL

13.1 Organizations

The Herring Alliance

This proposal is submitted on behalf of the Herring Alliance. The Herring Alliance is a coalition of environmental and other public interest organizations dedicated to protecting and restoring marine wildlife populations and Northeastern U.S. marine ecosystems by reforming the Atlantic herring fishery. The mission of the Herring Alliance is three-fold:

- To establish ecosystem-based catch limits which leave sufficient herring in the ecosystem as forage for other marine predators.
- To spatially and temporally apportion herring trawling using buffer zones and time and area closures which both minimize bycatch and avoid localized depletion to ensure sufficient herring is present when and where it is most needed by other predators.
- To fully monitor and minimize bycatch of commercially and recreationally important fish stocks – including juvenile or spawning Atlantic herring and depleted river herring and groundfish – as well as whales, seals, dolphins and porpoises.

More information about the Herring Alliance can be found at www.herringalliance.org.

The Herring Alliance stands willing to assist the NEFMC in its development of Amendment 4. We can provide legal, scientific, and practical advice and expertise. In addition, we would be interested in providing technical support and bringing in outside technical experts as warranted to meet the goals of the Amendment.

13.2 Individuals

The following individuals compiled this proposal and are available to discuss the various components as they pertain to development of Amendment 4

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