A Cost Comparison of At-Sea Observers and Electronic Monitoring for a Hypothetical Midwater Trawl Herring/Mackerel Fishery.

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Executive Summary

The Greater Atlantic Regional Fisheries Office (GARFO) and the Northeast Fisheries Science Center (NEFSC), with input and data from the Gulf of Maine Research Institute, Archipelago Marine Research, Ltd., Saltwater, Inc., and Ecotrust Canada, developed an assessment of the projected costs of EM in a maximized retention program for a hypothetical midwater trawl fleet in the Atlantic herring/mackerel fishery, and compared it to the costs of an at-sea observer program for the same fishery. The objective of this comparison is to provide a better understanding for fishermen, the New England and Mid-Atlantic Fishery Management Councils, and NOAA Fisheries of the potential costs of an operational EM program, and how those costs would compare with an at-sea observer program. This information is intended to better inform the Councils and industry as they design EM applications in the midwater trawl herring/mackerel fisheries for the purpose of monitoring.

This cost comparison demonstrates that EM in the midwater trawl herring/mackerel fishery is substantially less expensive than human observers, in large part, because the video only needs to be viewed for identifying discard events. The herring/mackerel comparison shows that, after the initial EM implementation costs, the hypothetical EM program would cost about one-third as much as the at-sea observer program annually. When complimented with a portside sampling program, the herring/mackerel monitoring program would increase the total program costs however the total program cost would still be about half as much as an at-sea observer program.

This cost comparison represents a starting point for developing future EM program designs, and some caveats to the assumptions contained in the paper must be noted. Costs of an actual program may vary from the costs associated with the EM program design represented in this document depending on the program design characteristics. Some areas where costs could vary include the following program design changes:

- Start-up costs for an At-Sea Observer Program have already been borne by NOAA Fisheries and cannot be compared with start-up costs of future EM programs.

- EM in a maximized program would necessitate a complimentary portside sampling program thus elevating overall monitoring costs.

- Rather than requiring a technician to retrieve hard drives, costs could be reduced if video data could be submitted by mail.

- Video data storage in the "cloud" could be authorized to reduce costs.

- Fixed costs per vessel would decrease as the number of participating vessels increased.

Table 1 (below) contained in this document compares the costs associated with Electronic Monitoring and at-sea observers for a hypothetical midwater trawl fleet in the herring/mackerel fishery. Recall the caveats noted earlier when interpreting the results.

Table 1: Summary of Program Costs of Hypothetical Fleet

At-Sea Observer Annual Costs	**Fleet Total**	**Per Vessel**	**Per Sea-Day**
Industry costs	$1,329,650	$147,739	$917
NOAA Fisheries shore-side costs	$694,344	$77,149	$479
Total At-Sea Observer costs	$2,023,994	$224,888	$1,396

*Assumptions:

- 1450 sea-days
- 500 trips

Electronic Monitoring Annual Costs	**Fleet Total**	**Per Vessel**	**Per Sea-Day**
Industry costs	$472,391	$52,488	$326
NOAA Fisheries shore-side costs	$140,295	$15,588	$97
Total Electronic Monitoring costs	$612,686	$68,076	$423

*Assumptions:

- 1450 sea-days
- 500 trips

Portside Sampling Costs*	**Fleet Total**	**Per Vessel**	**Per Sea-Day**
Industry costs	$520,000	$57,778	$359

*Based on the Massachusetts Division of Marine Fisheries (MA DMF) and the UMass School for Marine and Science Technology (SMAST) per trip cost of $1,040. . See Section 3.0 for details.

- 1450 sea-days
- 500 trips

Electronic Monitoring Start-Up Costs*	**Fleet Total**	**Per Vessel**
Industry costs	$139,168	$15,463
NOAA Fisheries costs	$326,500	$36,278
Total Electronic Monitoring start-up	$465,668	$51,741

*Note that Start-Up Costs for the At-Sea Observer program have already been borne by NOAA Fisheries and therefore are not applicable.

1.0 Introduction

There is considerable interest in using electronic monitoring systems (EM) as an alternative to human observers and at-sea monitors for the collection of data at sea as well as for other objectives in Northeast (NE) fisheries. A primary motivation for considering EM is the hope that it will reduce monitoring costs relative to other data collection tools. However, the true cost of EM relative to observers/at-sea monitors depends on the design and scale of the program and what objectives must be met. To date, early discussions about potential EM programs for NE fisheries have not produced sufficient information about the design of potential programs to generate a cost estimate. Yet the costs of a potential EM program have continually been identified as a key piece of information needed by the fishing industry and the government to transition EM from pilot projects to fully operational programs (Lowman et al., 2014; Taylor Singer, 2014).

The Greater Atlantic Regional Fisheries Office and the Northeast Fisheries Science Center, with input and data from the Gulf of Maine Research Institute, Archipelago Marine Research, Ltd., Saltwater, Inc., and Ecotrust Canada, developed a cost assessment of the potential costs of an EM program for two candidate NE fisheries. The objective of these analyses were to provide a better understanding for fishermen, the Fishery Management Councils, and the government of the expected costs for an operational EM program, and how those costs would compare with an at-sea monitor or observer program for delivery of comparably useful data. The analysis focused on the NE multispecies (groundfish) sector fishery and the Atlantic herring and mackerel midwater trawl fishery. This report presents the analysis for a hypothetical EM program for the Atlantic herring and mackerel midwater trawl fishery.

The New England and Mid-Atlantic Fishery Management Councils have been exploring ways to increase monitoring in the Atlantic herring and mackerel fisheries to better estimate total catch (landings and discards) and track catch against fishery catch caps (haddock, river herring/shad). The midwater trawl fleet may be a good candidate for EM, because the majority of catch (over 95%) is landed. EM could be used to verify retention of catch for portside sampling and monitor compliance with discarding requirements. In this report, we discuss the potential costs of this type of EM model, as well as an industry funded at-sea observer program.

There are currently no operational industry-funded monitoring programs in the groundfish or herring/mackerel fisheries on which to base realistic cost estimates. Therefore, we looked to comparable monitoring programs and pilot projects in the Northeast and elsewhere to generate cost estimates. NOAA Fisheries costs for the existing Northeast Fisheries Observer Program (NEFOP) were used to estimate costs for industry-funded observer coverage. To calculate the potential costs of the EM programs, we asked EM service providers to generate cost estimates based on a hypothetical program description and their experience. In order to generate realistic cost estimates, we had to make assumptions about the design of the monitoring programs and fishing effort, which would drive actual costs. We tried to use educated assumptions informed by fishery data, previous Council management actions, discussions from workshops, and the literature, where possible, but the models used here are a starting point for potential program designs. The monitoring program models used in this analysis are described in detail in the Appendix.

How to Use This Report

This report discusses the estimated costs of an at-sea observer program and a hypothetical EM program in the midwater trawl herring/mackerel fishery. The requirements of the hypothetical EM program were specified in fall 2014 so that the participating vendors could develop cost estimates (detailed requirements are described in the Appendix). The Executive Summary notes some different approaches that may be considered for an operational program, and how they might affect the cost estimates. There are several different combinations of design elements that would meet or exceed the Councils' and industry's monitoring requirements. Determining the "right one" is the subject of continuing analysis and deliberation. Rather than waiting to develop cost estimates until those questions are answered, this document estimates the costs of the hypothetical EM model as it was envisioned in the fall of 2014, and notes where different approaches could affect the cost estimates for the hypothetical program model.

Designing a monitoring program is essentially about weighing trade-offs between different program characteristics to find the configuration that best meets the program's objectives. Conversations about goals and objectives, program design, and cost should be iterative throughout the development of a monitoring program, as the costs and benefits of different options are evaluated. We intend for this report to be a starting point for consideration of potential costs in the development of monitoring programs for Northeast fisheries. The cost estimates published here are generated from broad assumptions and generalizations, averages, or otherwise aggregated data and, therefore, should not be considered a quote. Rather, the estimates are intended to give the reader an idea of the potential scale of costs of the programs under consideration, to highlight the design elements that drive costs, and to illustrate the potential trade-offs associated with different options. Although this report focuses on the Atlantic herring and mackerel fisheries, many of the cost drivers and trade-offs discussed have broad applicability and are important considerations for other Northeast fisheries.

Prices and other business information that might affect the competitiveness of a business are confidential and protected under federal law. NMFS cannot publish the actual prices paid for monitoring services. Therefore, cost estimates in this report are averaged over multiple service providers in order to protect the confidentiality of the information.

Whether any of the cost estimates presented in this report are workable for the fleets discussed depends on the individual vessel's portfolio of catch and its profit margins. Estimating the profitability of fishing businesses is an analysis unto itself and is not part of this report. Instead, we provide these cost estimates as a tool for individual vessels to use in considering what monitoring options would work best for them.

2.0 Atlantic Herring and Mackerel

The herring and mackerel fisheries do not currently have any industry-funded monitoring programs. However, the New England and Mid-Atlantic Councils are developing an amendment that would establish monitoring coverage targets for industry-funded monitoring in the herring and mackerel fisheries. If the Councils recommend that at-sea observers be used to meet coverage targets, both industry and NOAA Fisheries would have specific responsibilities outlined in the amendment. The industry would be responsible for contracting with service providers to obtain and pay for observers. NOAA Fisheries would be responsible for ensuring the quality of the data and the program, including approving service providers, training and certifying observers, and processing and performing quality control of the observer data.

Some industry groups are interested in using EM, assuming it will be a cost effective alternative to observers to potentially satisfy any new industry-funded monitoring requirements. For this analysis, we assumed that midwater trawl vessels in the herring and mackerel fisheries would require 100 percent observer coverage, and that the current program requirements established for midwater trawl vessels fishing in groundfish closed areas under Amendment 5 of the Atlantic Herring fishery management plan would be expanded to all midwater trawl trips in any fishing area. Such a program would require midwater trawl vessels to carry a NEFOP observer on 100-percent of trips and would prohibit discarding except in specific cases. Observers would subsample catch that is pumped onboard to characterize the catch, record the presence of discarding events, and estimate the composition of the catch. The vessel operator would be required to report any discard events to NOAA Fisheries within 48 hours of the trip via a Released Catch Affidavit, and the observer data would be compared to the Released Catch Affidavits to verify reporting compliance. We used information from the existing federally-funded Northeast Fishery Observer Program to estimate the potential costs of an industry funded observer program for our hypothetical midwater trawl fleet.

An EM program used in lieu of an observer program would have to meet the same general objectives of an observer program. The EM model evaluated in this report assumes EM would be used to record video on each fishing trip and video footage would be reviewed in its entirety to verify retention of catch for portside sampling and compliance with the Released Catch Affidavit requirements. This type of EM program with maximized retention is suited to fisheries where a significant portion of the total catch is retained and little discarding occurs, as is the case with herring/mackerel midwater trawl vessels. A maximized retention program would also consist of a complimentary portside sampling program whose objective is to sample the landed catch to identify its composition. The maximized retention approach greatly simplifies the role of the EM program in that it is being used to identify the presence of a discard event and is not being used to identify and quantify discarded species. The maximized retention approach also simplifies the assumptions that needed to be made for this cost comparison because the entire video will be reviewed. Assumptions were conservative while remaining realistic, in order to provide useful information about potential costs. As a result, the costs for certain hypothetical program components may be at the upper end of the range for the model described. For example, we assumed that technicians would be deployed to retrieve hard drives instead of captains mailing the hard drives. The latter option is likely to be cheaper and has been implemented in the NOAA Fisheries Highly Migratory Species (HMS) program. More detail about the monitoring program model assumptions used in the analysis is contained in the Appendix.

2.1 At-Sea Observers

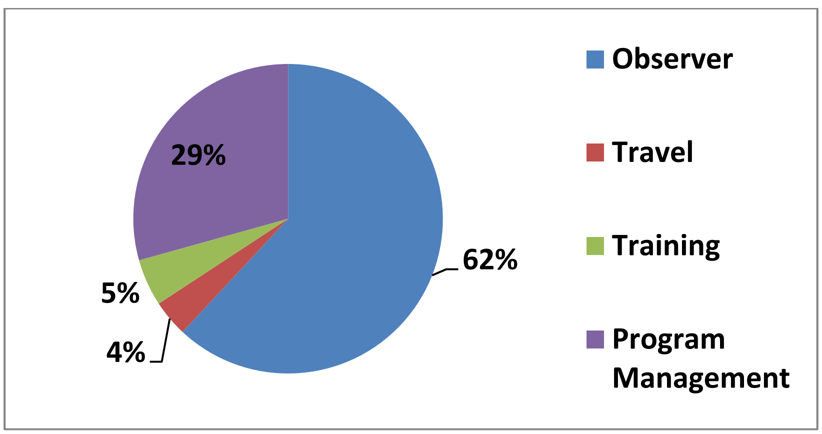
If the Councils recommend that at-sea observers be used for monitoring, the industry would be responsible for contracting with service providers to obtain and pay observers. In this cost comparison, we differentiate the recurring operational costs of a program from the one-time or periodic investments to start and maintain the program, termed “annual” and “implementation” costs, respectively. For the purpose of this cost comparison, it is assumed an industry funded observer program would look and function similarly as the existing NEFOP.

2.1.1 Industry Costs

We used the average cost per sea day for NEFOP observers (Lowman et al., 2013) to generate estimates of projected program costs. The estimated cost per sea day of the different program components were as follows: At-sea data collection ($568 per day), program management costs ($269 per day), training for the observer ($45 per day), and travel to deployments ($35 per day, Table 2)). The Federal contract for this activity may not be a wholly accurate representation of the costs that would exist under an industry-funded program model, but should provide the reader an idea of what the potential costs could be. We expanded these sea day costs to generate the annual cost for a hypothetical herring fleet using fictitious membership and activity of 9 vessels in ports from New Bedford, MA to Rockland, ME, fishing 500 trips per year. A detailed description of the program design and the assumptions made in are described in the Appendix.

The types of costs of an industry-funded at-sea observer program that would need to be borne by industry include at-sea data collection (observers), service provider program management, observer training, and travel to deployments. The largest component of observer costs is the cost of data collection (62 percent), followed by program management costs (29 percent), and training and travel costs (5 percent and 4 percent, respectively; Figure 1).

Figure 1: Proportion of At-Sea Observer Costs by Program Component



The data collection component represents the costs associated with deploying an at-sea observer. The majority of data collection costs are not derived from the observer's salary, but rather other infrastructure and labor such as equipment and observer coordination and management. It may be possible that industry is able to negotiate lower costs or discounts through direct contracts with service providers, which would not have to comply with Federal contract standards. However, observer service providers have noted that they would still have to comply with state labor and minimum wage requirements and Federal travel standards. In addition, fair wages are necessary to retain experienced monitors that collect high quality data. In the previous midwater trawl observer program, only the most experienced NEFOP observers were selected and specially trained to sample the high volume of catch that is present on midwater trawl trips. The observer program is not certain that observers with less experience or less training would be able to meet the rigors of this more complex sampling protocol to provide adequate data. Vessel owners may also be able to improve coordination and communication with service providers and observers to reduce logistical and travel costs if they have more direct contact. This is more likely in a program with 100-percent coverage, where NOAA Fisheries would not have to act as an intermediary for trip selection. It is difficult to predict the exact efficiencies that vessel owners and service providers may be able to devise in an industry-funded program and how they would impact these cost estimates.

The program management cost category includes service provider business operations, shipping, communication, and deployment logistics (Martins, pers. comm., 2014). Training costs represent the travel and labor costs from sending the observer to training.

We expanded the total sea day cost ($917) by the number of sea days fished by the hypothetical midwater trawl fleet, assuming 100-percent observer coverage to derive a total annual cost of $1,329,650[1]. Divided equally among all 9 vessels, the average annual cost per vessel is $147,739. Divided by the number of trips, the average cost per trip is $2,659. A detailed breakdown of these costs is presented in Table 2 below.

Table 2: Annual At-Sea Observer Costs for Hypothetical Fleet

	Estimated Cost			
Program Component	**Total**	**Per Vessel**	**Per Sea Day**	**Per Trip**
Observer	$823,600	$91,511	$568	$1,647
Travel	$50,750	$5,639	$35	$102
Training	$65,250	$7,250	$45	$131
Program Management	$390,050	$43,339	$269	$780
Total	$1,329,650	$147,739	$917	$2,659

These estimates represent averages across the hypothetical midwater trawl fleet, assuming all vessels fished an equal number of trips totaling 500 trips with an average trip length of 2.9 days.

[1] Assuming 1,450 sea days observed.

In an operational environment, an individual vessel's cost would be driven by its own level of activity throughout the year. In general, the total cost of $1,329,650 is driven by the number of sea days fished (and observed, in our 100-percent coverage scenario). It is important to note that these estimates were derived from the average costs of the NEFOP program as a whole, and not just midwater trawl trips. The limited range of ports used by midwater trawl vessels may result in lower average travel costs per trip. The exact observer travel costs of a particular trip would depend on where the vessel was leaving from and returning to, and the costs of travel (i.e., lodging, mileage, meals, and labor). More centrally-located operations or consistent deployments from the same ports may have lower travel costs than infrequent trips or trips leaving from remote ports. In addition, the travel cost estimates used here are based on rules for travel reimbursement for Federal employees, in which the observer is only reimbursed when travel is 50 miles outside of their home port (Rossi, pers. comm., 2014). Changes to these terms under an industry-funded program would affect travel costs. It may also be possible to find efficiencies in deployments that we could not model here, such as coordinated deployments between vessels in the same or nearby ports.

In addition to ongoing operational costs of the industry-funded observer program, there are one-time or periodic investments to set up the program and maintain it. Given that the infrastructure for the NEFOP observer program is already in place, we do not foresee much implementation required to set up an industry-funded observer program for the midwater trawl fleet. Some consideration will need to be given to potential start-up costs for developing a fleet notification system, observer management system, and observer gear such as baskets, gloves and boots, as well as administrative functions such as processing observer invoices and issuance of payments. The service providers may have some costs to recruit and train observers to support the increased demand.

2.1.2 NOAA Fisheries Costs

Under an industry-funded observer program, NOAA Fisheries would have general oversight of the program, monitoring the performance of the program, observers, and service providers, and ensuring the quality of the data for management. Specific duties would include training and certification of service providers and individual observers; debriefing of observers; processing and quality assurance of data. NOAA Fisheries would have ongoing costs from labor, travel, and contracts generated from these activities, as well as facilities and electronic data collection equipment necessary to provide these services.

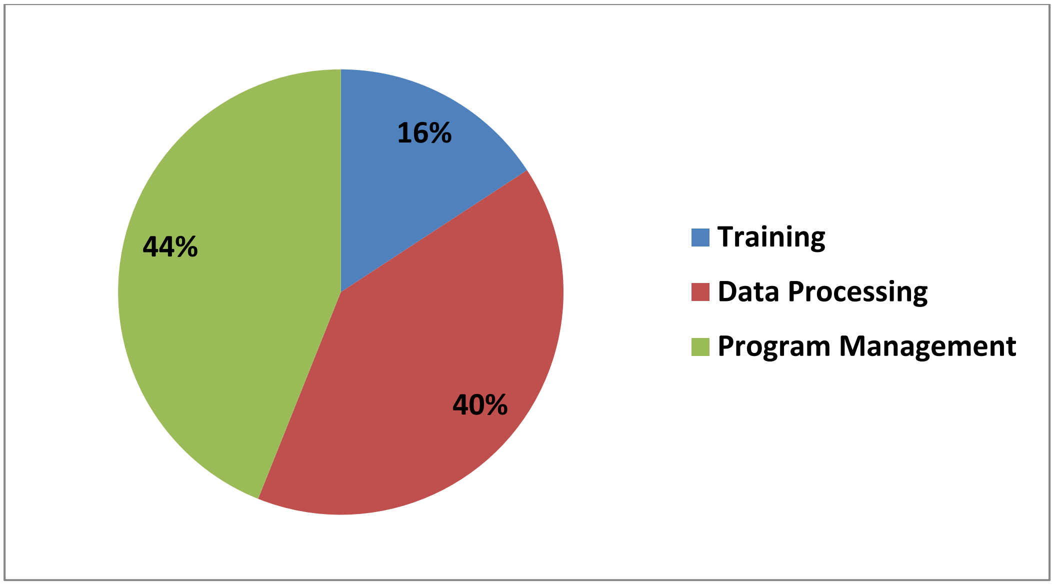
We use estimates of NOAA Fisheries costs for administering NEFOP, including the Scallop Industry-funded Observer Program, from a presentation made by NEFSC staff to the New England and Mid-Atlantic Councils (Gabriel, 2014). It was not possible to isolate NOAA Fisheries costs for administering only observer coverage for midwater trawl trips. Rather, to get a general estimate of NOAA Fisheries potential costs for administering our hypothetical program, we multiplied the estimated administrative cost per sea day shown in Table 3 ($479/day) by the number of observed sea days fished by our hypothetical fleet (1,450 sea days). This resulted in a total estimated cost of approximately $694,000 from training, data processing, and program management.

Table 3: Fiscal Year 2013 At-Sea Observing Costs for NOAA Fisheries

	Estimated Cost	
Program Component	**Total**	**Per Sea Day**
Training	$109,532	$76
Data Processing	$279,655	$193
Program Management	$305,158	$210
Total	$694,344	$479

The majority of NOAA Fisheries costs are from the program management and data processing categories (Figure 2). Program management costs include conducting the observer training and certifications of service providers; liaising with service providers, vessel operators, and enforcement; facilities; materials; communications; and other associated costs. Data processing costs include debriefing of observers and quality checks of the data. These costs do not all scale directly with the number of vessels in the program, but are a general estimate of potential fixed and variable costs. NOAA Fisheries would also have other costs associated with enforcing the program and using the data for management, which were not included here for consistency but would be incremental costs.

Figure 2: Proportion of NOAA Fisheries Costs by Program Component



2.2 Electronic Monitoring

We assumed that the basic requirements and objectives for a midwater trawl EM program would be to monitor compliance with discard restrictions and verify compliance to requirements to submit a Released Catch Affidavit. Industry would contract with a third-party service provider, approved by NOAA Fisheries, to collect and submit EM data to the agency. The EM data would report the absence or presence of discard events. We developed a detailed program design for the purpose of calculating cost estimates, modeled after the Pacific States Marine Fisheries Commission's Pacific whiting EM project. We assumed that discard would be prohibited, as on closed area trips, and that EM would be used to verify retention of catch for portside sampling and to monitor compliance with discard requirements. The full program design and assumptions are described in the Appendix. Three EM service providers, Archipelago Marine Research, Ltd., Saltwater, Inc., and Ecotrust Canada, were asked to use the program description to generate cost estimates for this report. The individual cost estimates submitted by the providers were then averaged to get one cost estimate for each program component, in order to protect the confidentiality of the service providers' price information.

Observers currently sub-sample the catch that is pumped aboard on closed area trips. If this data collection is to be continued under an EM program, a complimentary portside sampling program would be needed to collect this same information. Portside sampling costs are also discussed in Section 3.1 and can be considered together with or separately from the EM costs.

2.2.1 Industry Costs

Annual Costs

The average estimated annual cost of the EM program for our hypothetical midwater trawl fleet was $472,391(Table 4). This cost represents the ongoing annual operational costs of the EM program that would be expected to recur each year, including equipment, field services, data services and program management. Since we assumed the camera systems would be purchased, instead of leased, annual equipment costs estimated here include spare parts to replace broken or aging equipment, as well as licenses for the use of proprietary software. Field services includes labor, travel, and other costs associated with repairs, technical support, and retrieving hard drives from the vessels and delivering or shipping them to the service provider for analysis. Data services refer to the costs associated with review and analysis of the video, reporting to NOAA Fisheries, and archiving of the data. Program management is composed of the costs of the day-to-day operations of the service provider for running the EM program. Dividing the total annual cost equally among the 9 vessels results in a total per vessel cost of $52,488 (Table 4). The average estimated cost per sea day is $326[2] and the average estimated cost per trip is $945[3] (Table 4).

[2] Sea day cost was calculated by dividing the total program cost by 1,450 sea days.
[3] Cost per trip was calculated by dividing the total program cost by 500 trips.

Table 4: Annual Electronic Monitoring Costs for Hypothetical Fleet

	Average Estimated Cost			
Program Component	**Total**	**Per Vessel**	**Per Sea Day**	**Per Trip**
Equipment	$15,654	$1,739	$11	$31
Field Services	$112,490	$12,499	$78	$225
Data Services	$231,578	$25,731	$160	$463
Program Management	$112,669	$12,519	$78	$225
Total	$472,391	$52,488	$326	$945

Ongoing annual costs are largely generated by data services (49 percent; Figure 4). Data services consist of video review and analysis, reporting and data archiving. Video review and analysis costs are driven by the amount of video being reviewed and the level of complexity of the review and analysis. For this cost exercise, we assumed that 100 percent of the video from each trip would be reviewed in order to identify discard events because discard events are a rare occurrence and low levels of review may miss them. Video review consists of a primary review and a discard compliance review. Primary review is the review of video during haul back and during catch sorting and pumping activities. Discard compliance review is the review of all remaining video not reviewed during primary review. The primary and discard compliance reviews have the same objective and are done in the same manner. Although both types of review can happen at greater than real-time speed, the review rate of the discard compliance review is typically faster than that of the primary review. The primary review observes video during fishing operations where on-board activity is more prevalent, resulting in slower review rates than the compliance review. Because the compliance review is applied to a greater portion of the total video, costs of the discard compliance review are generally greater than that of the primary review. Primary review accounts for 38 percent of data services costs while the discard compliance review accounts for 49 percent of data services costs (Figure 3). Due to the vast amount of footage generated from the hypothetical midwater trawl fleet's 500 trips, at 2.9 days each, the total review costs are substantial. We used review ratios (total video time/video review time) from the Pacific whiting project, which may not be entirely representative of an operational scenario.

The EM service providers suggested other review approaches for consideration, which could reduce costs while potentially still meeting program objectives:

- A level of randomly subsampling of the video may be found that would provide confidence that discard events are being detected in the review and incentivize accurate reporting. If the video is only used to verify submission of affidavits, a lower level of review may be sufficient, combined with the presence of cameras on all trips to encourage accurate reporting (Saltwater, 2014; AMR, 2014; Ecotrust, 2014).
- Review of haul back events could be prioritized and sampled at a higher rate, as this is when discard events would occur (Saltwater, 2014).
- Software solutions may be able to automate review of discard events (Ecotrust, 2014; Saltwater, 2014).

The remaining costs of the data services category consist of reporting (6 percent) and archiving (7 percent; Figure 3). Reporting costs result mainly from the labor associated with compiling and submitting data to NOAA Fisheries. Archiving costs are driven by the amount of data and the length of time it needs to be stored, security requirements, and whether the data needs to be accessed regularly or simply archived. Individual file sizes are driven by the amount of footage, resolution, frame rate, type of codec used, and even the amount of light and movement in the footage (Pria, pers. comm., 2014). These technical specifications are determined by the objectives of the program.

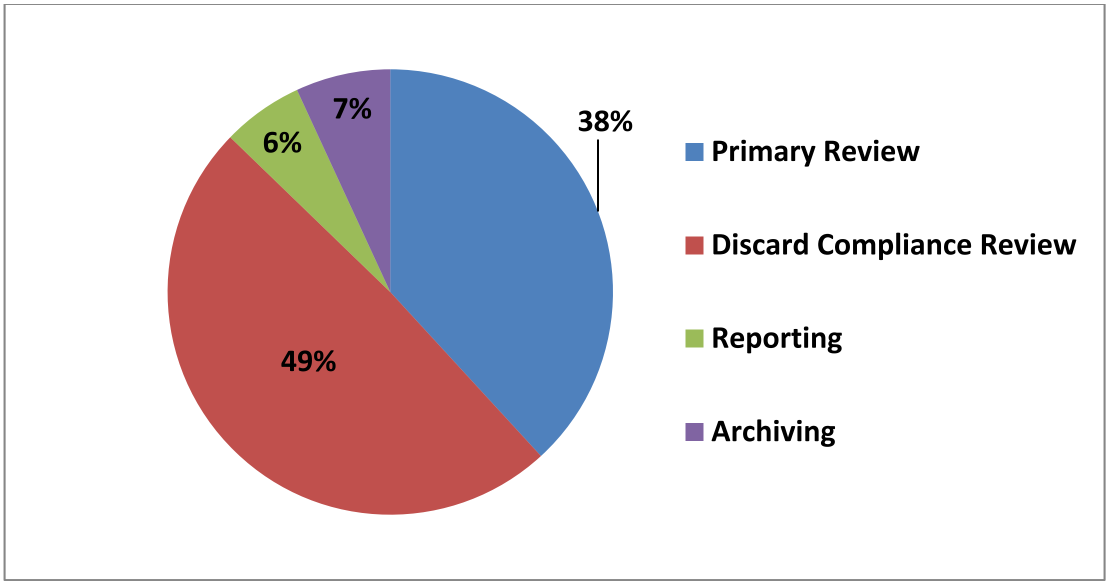
- The objective of the program and the layout of the vessel will determine how many cameras are needed.
- The speed of the activities of interest will determine the necessary frame rate of the video (frames per second, fps).
- The amount of detail desired will determine the image resolution of the video needed to achieve the review objectives (e.g., species identification, length measurements).
- The objective of the review will also determine when video is recorded. If video recording can be targeted to certain periods of interest during the trip, it can reduce data volumes and archive costs (AMR, 2014).

The EM service providers roughly estimated average file sizes per camera at 0.6 GB/hr at 5 fps to 2.1 GB/hr at 15 fps with a resolution of 1280 x 800. Based on these file sizes, a rough estimate of potential data volumes for the midwater trawl is program 334 TB per year (AMR, 2014).

For this analysis, we asked service providers to assume that all video imagery, sensor data, etc., needs to be stored for 5 years after the trip (the statute of limitations under the Magnuson-Stevens Act), to generate a worst-case scenario of storage costs. Options for data storage include purchasing cloud storage services from a third party, centralized storage on servers by the service provider, and storing the video on the original hard drives. The most appropriate option will be influenced by the record-keeping and security requirements for EM data, which have yet to be determined. The service providers suggested that cloud storage would be the most cost effective, if only simple storage is needed. Companies like Amazon have low rates for simple storage ($0.01/GB/month[4]) and take care of all maintenance and data back-ups. Additional fees are charged for access, so if regular data access is needed, a centralized storage option may be more appropriate (AMR, 2014). Centralized storage on servers requires facilities and staff to house and maintain them, which increases costs, but some service providers believed this could be done cost effectively. Storing the data on individual hard drives would require purchasing many hard drives as well as storage space to house them all. In addition, hard drives can degrade over time, threatening the integrity of the data (Rossi, pers. comm., 2014). Storing data on the original hard drives was believed to be the most expensive option as well as being potentially risky to the preservation of data integrity.

[4] https://aws.amazon.com/archive

Figure 3: Annual Data Services Cost Breakout

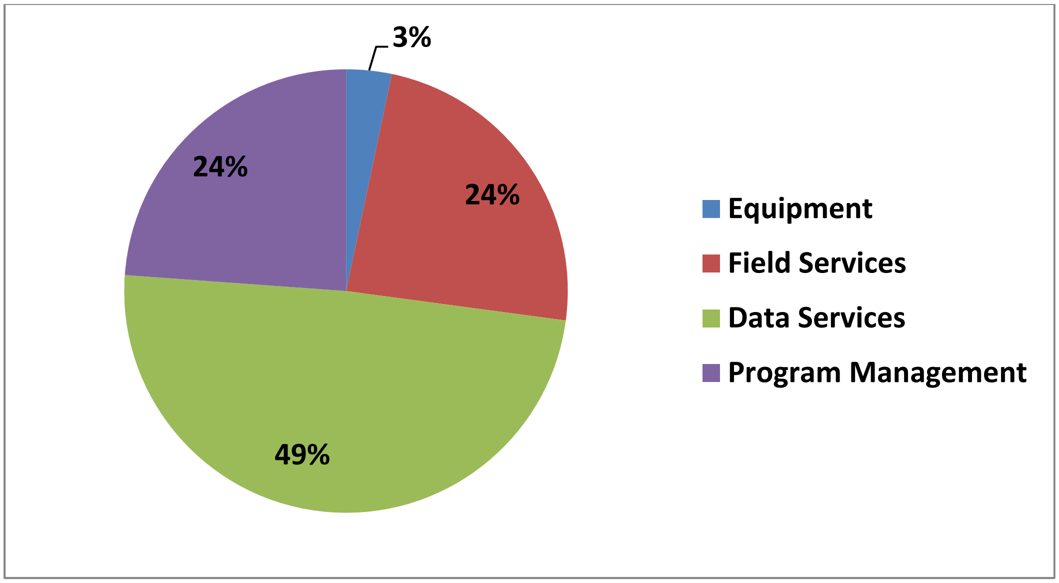


The next two largest cost drivers of ongoing annual costs are field services and program management at 24 percent each (Figure 4). Field services costs are largely driven by the frequency of hard drive retrievals from the vessel, and the associated travel and labor costs. For this analysis, we assumed that a technician would be deployed to retrieve the hard drive from each vessel after each trip to sync with the timeline for submission of Released Catch Affidavits, which are due within 24 hours of landing (Appendix). This generated a conservative estimate of potential field services costs of $112,490 (Table 4). The EM service providers suggested several other alternative approaches that could reduce costs. The hard drives could be retrieved weekly or on some other schedule that would meet needs for data timeliness. Another option could be to have the vessel operator switch out the hard drive after each trip and mail them to the service provider for analysis. The approach has precedent and is the method that has been implemented in the NOAA Fisheries Highly Migratory Species (HMS) EM program. Technological security measures may also be put in place that could otherwise ensure data integrity during transit. However, the cost of security measures to render the data tamper-evident or tamper proof is a trade-off. End-to-end encryption is an effective, but costly way to ensure that data cannot be easily manipulated. The EM service providers indicated that hard drives could be made tamper evident to ensure data security without requiring end-to-end encryption. Digital signatures are currently used in Canadian fisheries monitored with EM and are an effective method to render the EM data tamper evident (Van Oyen, pers. comm., 2014; Pria, pers. comm. 2014). The data can be digitally signed by the EM control box, allowing the service provider to detect if the trip data were changed during transit. Once digitally signed, any change to the underlying data would invalidate the signature. While not physically preventing tampering, digital signatures may be sufficient to dissuade tampering if combined with appropriate penalties or other incentives. As open source algorithms are available, digital signatures may be a cost effective way to ensure the integrity of EM data in transit (Van Oyen, pers. comm., 2015). If it is necessary for the hard drive to be retrieved by a technician, coordinated or centralized visits may help reduce costs (e.g., service multiple vessels on a single visit). If EM is supplemented by a portside sampling program, portside samplers may be trained to retrieve the hard drives to save costs. The most appropriate option will depend on the goals and objectives of the program and whether measures can be put in place to ensure the effectiveness of that approach.

Repair and technical support needs also drive field services costs. The need to resolve software issues or install updates and how well the equipment is maintained by the vessel operator; whether the vessel operator is allowed or able to make simple fixes on his/her own; whether the service is covered under warranty; and the complexity of the problem all drive the frequency and length of technical service visits and costs. A simple issue may be fixed by a data retrieval technician during routine hard drive retrieval. But a more complex problem may require a more highly trained technician, necessitating a dedicated visit (Pria, pers. comm., 2014). For this analysis, the service providers assumed that many minor technical issues with the system could be addressed on the weekly visits to retrieve the hard drive, so estimated costs of exclusive equipment/technical support visits are low. If vessel operators are submitting the hard drives, more dedicated equipment/technical support visits may be necessary, increasing field services costs from those estimated here. The cost of these services for an individual vessel will also depend on how support services are billed – per visit, or amortized over the entire fleet or multiple years of the program.

Program management costs are the most difficult to estimate, because they vary depending upon the scale and complexity of the program; the level of cooperation from participants; the service delivery model desired by industry and the government; and the amount of efficiency in the program. For this analysis, some of the service providers developed itemized estimates of program management costs, while others estimated program costs as a fixed percentage of direct costs. This resulted in a wide range of cost estimates, which were incorporated into the average cost in Table 4. In general, the service providers would expect there to be higher total program management costs for a large or complex program with many, or uncooperative, vessels. However, per vessel program management costs would decline with more vessels in a program due to the ability to achieve economies of scale. Whether there are one or more service providers in the fishery would also affect program management costs; multiple providers may limit each provider's ability to achieve economies of scale. Some changes to other program components to reduce costs could also reduce costs for program management by simplifying or reducing the scale of the program. For example, training for technicians is included in program management costs. If vessel operators were allowed to submit their own hard drives for analysis, fewer technicians would be employed, reducing training and logistical costs. Another alternative is to reduce the frequency of data retrieval thus reducing technicians' travel and labor costs. Finding the proper balance of data retrieval frequency while still meeting required data timelines will be an important consideration in the program design. Lower levels of video review would similarly reduce program management costs, by reducing labor and training costs (Pria, 2014), though the consequences to the data quality requirements would have to be made clear.

Figure 4: Proportion of Annual Costs by Program Component



Implementation Costs

In addition to the ongoing annual operational EM program costs, there are one-time or periodic investments to implement and maintain the program. We asked the EM service providers to characterize these start-up costs and then binned them into the same broad categories: equipment, field services, and program management. Data services costs represent the costs associated with video review but because our hypothetical EM program for the midwater trawl fleet assumes 100 percent of the video from each trip is being reviewed, there are no additional data services costs associated with implementation. Implementation costs in the categories of equipment, field services, and program management represent different activities than under annual ongoing costs. Here, equipment costs include initial purchase and installation of the cameras, associated sensors, integrated GPS, control box, and hard drives[5], at an average cost of $9,018 per vessel (Table 5). This represents 58 percent (Figure 5) of the total implementation costs. There may be additional costs, not estimated here, to make modifications to the vessels to accommodate the EM system, however because of the significant size of midwater trawl vessels, it is unlikely that many or expensive modifications would be needed. Additionally, individual vessel start-up costs will be impacted by the complexity of the system installation as well as the amount of time required of the technician to ensure camera views are proper and vessel crews are following established protocols.

Following equipment costs, program management is the second largest component of implementation costs at 23 percent (Figure 5). Program management includes all the one-time labor, equipment, facilities, and administrative costs associated with getting the new EM program operational. Program management costs are the most difficult to estimate because they vary greatly depending on the scale and complexity of the program, the level of engagement by

[5] For this analysis it was assumed that equipment was purchased rather than leased and therefore would represent an initial investment to be repeated periodically when the equipment needs to be replaced.

participants, the desirable service delivery model, and the amount of efficiency that can be designed in the program. A simple program or program with fewer vessels would be expected to have lower program management costs than a more complex or larger program. A scenario in which the vessel operators require frequent technical assistance or training may require more coordination and communication with the service provider than a scenario in which the vessel operators are relatively independent or able to rely on other resources for assistance. The service providers took different approaches to estimating program management costs of implementation which resulted in a wide range of estimates. The average program management cost across the three estimates was $31,439 (Table 5).

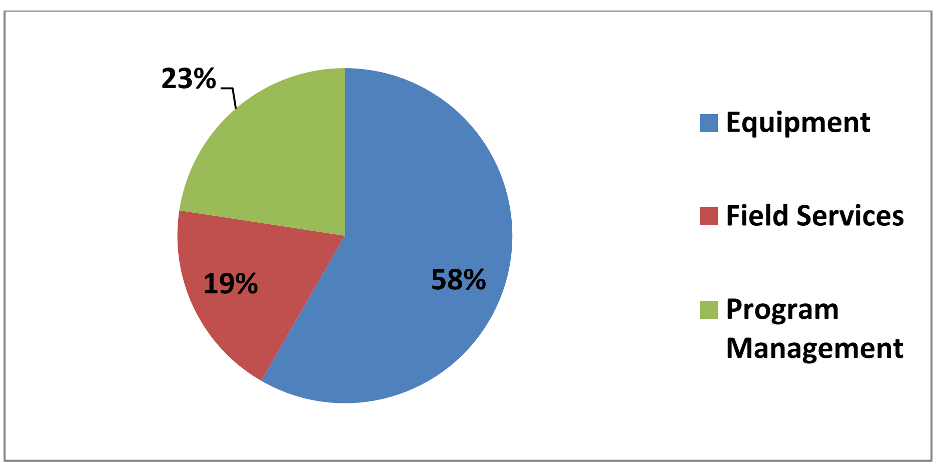
The field services costs of implementation are comprised of the technician's labor and travel associated with the installation of equipment, estimated here at $2,952 per vessel (Table 5). As with data retrieval services, the exact installation costs would depend on where the vessel was located relative to the technician's base of operations and the complexity of the installation.

The total estimated one-time investment of equipment, field services, and program management was $139,168. Divided equally among the 9 vessels, the total cost per vessel was $15,463 (Table 5).

Table 5: Electronic Monitoring Implementation Costs

	Average Estimated Cost	
Program Component	**Total**	**Per Vessel**
Equipment	$81,165	$9,018
Field Services	$26,564	$2,952
Program Management	$31,439	$3,493
Total	$139,168	$15,463

Figure 5: Proportion of Implementation Costs by Program Component



2.2.2 NOAA Fisheries Costs

As with an industry-funded observer program, NOAA Fisheries would have ongoing oversight of the midwater trawl EM program and costs associated with those activities. NOAA Fisheries would approve and monitor the performance of service providers, as with current at-sea monitoring and observer service providers. NOAA Fisheries may implement a training and certification program for EM video reviewers to ensure adequate and consistent performance across service providers. Alternately, the service provider may be required to provide appropriate training to reviewers and technicians, with NOAA Fisheries reviewing or testing the training program or individual reviewers. NOAA Fisheries may continue to operate a call-in system for midwater trawl vessels in order to deploy SBRM observer coverage on selected trips. NOAA Fisheries may also conduct periodic audits of the video review, to ensure service provider compliance with performance standards. NOAA Fisheries would have the responsibility to store any data submitted by the service providers consistent with federal record-keeping requirements. NOAA Fisheries has not tried administering an operational EM program in the Greater Atlantic Region, so we estimated NOAA Fisheries costs for these activities using the costs that NEFOP has accrued for administering programs with similar roles and responsibilities.

The estimated ongoing costs to NOAA Fisheries from the hypothetical EM program would be $152,795 annually (Table 6). Assuming NOAA Fisheries would conduct training for EM reviewers, NOAA Fisheries would have $25,000 in training costs, including labor and costs of licenses for any proprietary EM review software. The number of annual trainings and NOAA Fisheries staffing needs would be driven by the number of EM reviewers employed by the service providers, which would depend on the number and activity levels of vessels and the amount of video review. Although there are only 9 midwater trawlers, there is a large amount of video footage to be reviewed, due to the number of trips (500) and the assumed rate of video review (100 percent). This much video footage may require a larger cadre of EM reviewers than the number of vessels might indicate, also increasing demand for training and certifications and NOAA Fisheries training costs. As was discussed in the previous section, reducing the amount of video reviewed by using a randomized sampling method rather than census would reduce costs for the industry, but also NOAA Fisheries.

NOAA Fisheries may also have some costs for reviewing and approving, or inspecting, vessel monitoring plans (VMPs) and configuration of the EM system on the vessel. Labor and travel associated with this activity is expected to cost $15,500 for all nine vessels (Table 6). This analysis assumes that NOAA Fisheries would conduct periodic video reviews to audit the service providers, the staff time and equipment costs are estimated at $26,295 (assuming 5 percent of trips are audited). If open source EM review software is available, some of the equipment cost for software licenses may be eliminated. A program manager would be needed to administer the program, liaise with service providers, vessels, and enforcement, and coordinate staff. Program management cost is estimated at $86,000 annually (Table 6). Not included in these cost estimates are NOAA Fisheries costs for storing any data submitted by the service providers for the audit. This cost is driven by record-keeping and security requirements that NOAA Fisheries must comply with, which will determine the length of time the data will be stored and the cost. NOAA Fisheries would also have incremental costs for enforcement of the program and use of the data for management, but these costs were not included here to be consistent with the at-sea observer estimates.

Table 6: Annual Electronic Monitoring Costs for NOAA Fisheries

Program Component	Estimated Cost 9 vessels
EM Reviewer Training	$25,000
VMP Approval, Inspections	$15,500
EM Review Audit	$26,295
Program Management	$86,000
Total	$152,795

In addition to the ongoing annual costs for overseeing the program, NOAA Fisheries would have implementation and periodic costs associated with setting up and maintaining its infrastructure and training and audit programs. These items would include equipment, training for NOAA Fisheries staff, development and modification of databases to accommodate EM data, and initial approval of VMPs. Analysis costs include additional auditing of the provider in the first year to establish a baseline performance standard for the service providers.[6] Audit and training costs increase with the number of vessels and number of trips in the program. However, modifications to databases to receive and house EM data are largely fixed costs. NOAA Fisheries total potential implementation cost is $326,500 (Table 7).
It is important to note that these estimates were made separately from the groundfish program cost estimates so that complete costs could be estimated for each fishery. However, some of this activity would be applicable to both fisheries (or any other EM fishery). These costs are not directly comparable to the at-sea observer program for which the infrastructure is largely already in place.

Table 7: Electronic Monitoring Implementation Costs for NOAA Fisheries

Program Component	Estimated Cost 9 vessels
Equipment	$2,500
Training	$1,000
Database Development	$260,000
VMP Development and Approval	$31,000
Analysis	$32,000
Total	$326,500

[6] We assumed that NMFS would review 10-15 percent of trips during the first year, and 5 percent in future years.

3.0 Other Considerations

In addition to the costs, drivers, and program elements discussed in the previous sections, there may be other cost considerations that need to be taken into account for different program designs. Specifically, a portside sampling program has been discussed as a necessary supplement to EM in a full or maximized retention scenario. A portside sampling program will have additional costs and cost drivers that need to be considered by the industry and managers in the design process. Full or maximized retention protocols also raise issues of what to do with the unmarketable fish that would be landed but could not be sold and any costs associated with handling these fish. GMRI explored these topics and their potential costs and summarized their findings in the sections that follow.

3.1 Portside Sampling

EM systems may be used in conjunction with portside sampling to allow for catch sampling at the dock rather than at-sea. The cameras are used to encourage and monitor compliance with full or maximized retention requirements[7] to improve confidence in dockside subsampling of the catch. A full or maximized retention program relies on dealer-recorded data for landed catch in place of observer data. However, dealers do not necessarily record the same type of information about catch that observers do. For example, a dealer does not record sex or length of the fish, take biological samples, or even sort to the species level in some cases. Dealers may also not record the fish that is landed but not sold ("unmarketable fish"). Some of this information is important for management and can be an objective of the monitoring program. In these cases, portside sampling would be needed to collect biological data not otherwise recorded by a dealer, and enumerate the unmarketable catch.

Key cost drivers of portside monitoring costs are the quantity of the landings and location of the landing, which drive the length of the offload and the amount of travel involved. Costs may also be impacted by the terms of the contract negotiated between the vessel and the service provider - whether the services will be charged at an hourly rate and, if so, how partial hours will be charged, how and when travel time is charged, and whether discounts are given for coordinated landings between vessels or other efficiencies. State and Federal labor laws would also affect the wage component of the costs.

The most relevant cost estimate for this report is the voluntary program developed by the Massachusetts Division of Marine Fisheries (MA DMF) and the UMass School for Marine and Science Technology (SMAST). That program conducts portside sampling of vessels targeting Atlantic herring and mackerel as part of the River Herring Bycatch Avoidance Program. With funding from the National Fish and Wildlife Foundation and The Nature Conservancy, since 2001 MA DMF has been sampling 31 percent of small-mesh bottom trawl trips landed in Rhode Island, and since 2008 50 percent of midwater trawl trips landed in Massachusetts. Biologists sample the entire offload and calculate the amount of river herring bycatch from the trips. These

[7] For reference, Archipelgo Marine Research provides the following definitions: full retention is the retention of all fish catch; maximized retention is the intent to retain all fish catch with some operational discarding (Archipelago, 2012).

estimates are then used by the fleet to denote areas where higher concentrations of river herring have recently occurred and areas to avoid on future trips (Schondelmeier, pers. comm., 2014).

From 2010 through 2013, a total of 301 midwater trawl trips (and 61,759 mt) have been sampled for a total cost of $288,906. These costs include contracted port samplers, one full-time field coordinator, administration, supplies and support to SMAST and represents the majority of total program costs. An additional 5 percent of program costs were covered by in-kind services and supplies donated by MA DMF. The average cost per metric ton of herring sampled in the midwater trawl fleet from 2010 through 2013 was $5.12. The average cost per trip was $1,040.

From 2012 through 2014, 230 small-mesh bottom trawl trips (and 5,106 mt) were sampled for a total cost of $101,297. The average cost of sampling small-mesh bottom trawl trips was $198.40 per metric ton and $440 per trip (Armstrong et al., 2014).

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Noldus Technical Specifications for the Observer XT 12

5.0 Appendix

Monitoring Program Models

This section describes the program models used in the analysis, including the assumptions that were made about program design and context for the purpose of the analysis. This section does not necessarily reflect a detailed proposed model for the fishery, but rather explains only those assumptions that are necessary to calculate cost estimates. Assumptions were made based upon the goals and objectives or other regulatory requirements described in previous management actions and the regulations, as well as examples from programs with similar objectives in other regions.

Atlantic Herring and Mackerel Fishery

At-sea Observer Program

The Atlantic herring and mackerel midwater fishery does not currently have an industry-funded monitoring program on which to base cost estimates. However, there are provisions for 100% observer coverage on midwater trawl vessels fishing for herring in groundfish closed areas that were used as an example on which to base a model. When fishing in a groundfish closed area, a herring vessel fishing with midwater trawl gear is required to retain all catch and carry an observer. Fish that cannot be pumped from the midwater trawl into the hold and that remain in the net at the end of pumping operations are considered to be operational discards and not prohibited discards. . The herring fishery observer protocols include documenting fish that remain in the net in a discard log before they are released, and existing regulations require vessel operators to assist the observer in this process. Specific exceptions to the discard prohibition are made for discarding for safety reasons, for a mechanical failure which precludes bringing fish onboard for inspection, and for spiny dogfish clogging the intake. If any fish are released under these exceptions, the vessel operator must exit the closed area and submit a Released Catch Affidavit to NOAA Fisheries within 48 hours of the trip, explaining the reason for the release, the total weight of fish on the tow, and the weight of fish released. Observers record a visual approximation of fish released from the net on the surface of the water where possible. Observers also subsample retained catch that is pumped onboard the vessel.

The closed area observer coverage has historically been provided by NOAA Fisheries through the Northeast Fishery Observer Program, so the Federal contract for this activity may not be an accurate representation of the roles and responsibilities that would exist under an industry-funded model. Industry-funded monitoring requirements are under consideration for the midwater trawl fishery at this time, and can offer an indication of the roles and responsibilities that may be likely in an industry-funded program. We assume that individual vessels would contract directly with the provider for at-sea data collection services. NOAA Fisheries would be responsible for ensuring the quality of the data and the program, training and certifying observers and service providers, processing and QA/QC the observer data. Similar to the current program, observers would transmit data directly to NOAA Fisheries, where it would be processed and audited. NOAA Fisheries would debrief observers as needed to clarify any questions or concerns about the data and liaise with observer service providers. Since this hypothetical model would call for 100% observer coverage, we'll assume that vessels would contact service providers directly to obtain an observer for every trip. As with the current program, NOAA Fisheries would compare the observer data to Released Catch Affidavits to determine compliance.

Fishing activity, port distribution, and gear type, among other things, can all be cost drivers for a monitoring program. In order to calculate a cost estimate, we will use a hypothetical midwater trawl fleet with fictitious fishing activity. Table 8 below contains the assumptions made about the hypothetical fleet for the cost analysis.

Electronic Monitoring Program

The Atlantic herring and mackerel midwater trawl fishery does not currently have an operational EM program or any pilot programs on which to base this analysis. The current program requirements for the midwater trawl vessels fishing in groundfish closed areas were, therefore, used as the model for EM program requirements. The Atlantic midwater trawl fishery has similar fishing practices to the Pacific shoreside whiting fishery, which has had EM pilots for several years and can be used as an example for the Atlantic midwater trawl fishery model.

Similar to the closed area requirements, we assume that an EM system would be used to monitor compliance with retention requirements and to verify that affidavits are being submitted for released catch. . The Pacific States Marine Fisheries Commission (PSMFC) has been testing the ability to quantify discards from video in the hake fishery, including small and large volumes of operational discards. In early phases of the PSMFC study, discard events were binned into categories (e.g., < 2,000 lb). During later phases, reviewers made visual estimates of the actual weight of discards. Although observers in the herring fishery currently subsample retained catch, it is assumed that EM would not be used for this purpose. Instead, a portside sampling program would be implemented to subsample retained catch at the dock, with the EM system providing the verification that the majority of catch is retained.

It is assumed that all midwater trawl vessels would be monitored with EM on all declared fishery trips. In the case of pair trawl trips, an EM system would be operational on each vessel that is pumping catch onboard. Based on the PSMFC report, the EM system set-up on board the vessel consists of a configuration of cameras that provide 1) a wide-angle view of the deck to monitor for discard events; 2) a view of catch the codend being pumped; and 3) a close up view of areas of the deck where catch sorting or discarding occurs. Hydraulic or motion sensors are used to trigger the video recording when fishing gear is engaged and to monitor the presence/absence of fishing activity. A GPS records the location of fishing events. This set-up and catch handling requirements would be documented in a vessel's individualized Vessel Monitoring Plan (VMP), which would be maintained onboard the vessel as an aid to crew, technicians, and enforcement personnel.

In this hypothetical EM program, midwater trawl vessels would be required to retain all catch, with the current exceptions for safety, mechanical, and operational reasons. Any discarding would have to be reported on a released catch affidavit to be verified by the video review. Because released catch is a rare event, it is likely that a high percentage of the video from each trip would have to be reviewed to detect this event. For the purpose of this analysis, it is assumed that 100% of the video from each trip would be reviewed. Video would be reviewed to determine whether a discarding event occurred, whether there was a report submitted for this discarding event, and to determine the reason for the event and amount of discards by species, if possible. It is assumed that the video would be triggered by the first haul and would remain on during catch sorting. One camera with a wide-angle view of the deck would remain on for the duration of the trip to ensure sorted catch is not later discarded. At the end of the trip, an EM technician would meet the vessel at the dock to retrieve the hard drive, replace it with a clean hard drive, and configure the system for the next trip. The timing of hard drive retrieval would depend upon the needs of management. Currently, preliminary observer data is available 5-7 days after the trip. Fully audited observer data is available within 90 days. Affidavits must be submitted within 48 hours of the trip. For the purpose of this analysis, it is assumed that the hard drive would be retrieved at the end of every trip to coincide with the submission of the affidavit. It may be possible that the vessel operator could replace the hard drive, but in order to generate a conservative estimate of costs, it is assumed that a technician will retrieve the hard drive. It is assumed that some sort of trip-start and trip-end hails would be needed to coordinate these services. Additional appointments with a technician between trips may be needed to maintain or repair the system. The provider must be available 24/7, with a telephone system monitored at a minimum of four times daily.

After review of the video, the compliance and catch information would be transmitted to NOAA Fisheries for review and comparison with the affidavits. This process would be expected to be completed within 10 days after the trip lands. The provider would also provide feedback in some sort of report to the technician or vessel operator after each trip to adjust equipment or catch handling practices. Under this program model it is assumed that a vessel would contract directly with a third-party provider for the field and data services described above. In addition, it would be necessary to maintain and archive a database of raw video footage and sensor data for comparison and for later auditing. For the purpose of this analysis, it is assumed that providers would archive the video and associated data for the vessel for a minimum of five years after a fishing trip, consistent with the statute of limitations for fisheries violations under the Magnuson-Stevens Act. The provider may also be required to archive selected trips indefinitely, if requested by NOAA Fisheries. Once data is archived, hard drives may be scrubbed and returned to the field.

NOAA Fisheries would have the responsibility to check EM reports against catch release affidavits for compliance. NOAA Fisheries would also have the responsibility to ensure data quality and compliance with approved performance standards. Therefore, it is assumed that NOAA Fisheries would periodically audit the EM provider's trip reviews. This may involve submission of video and other EM data from selected trips to NOAA Fisheries for review. Any information submitted to NOAA Fisheries would be maintained according to requirements of the Federal Records Act and Magnuson-Stevens Act.

Fishing activity, port distribution, program goals and data review, and gear type, among other things, can all be cost drivers for an EM program. In order to calculate a cost estimate, we used a hypothetical midwater trawl fleet with fictitious fishing activity. Table 8 below contains the assumptions made about the hypothetical fleet for the cost analysis.

Table 8: Key assumptions about the hypothetical midwater trawl fleet.

Characteristic	Assumption
Number of active vessels	9
Distribution of vessels by port	
Gloucester, MA	4
Portland, ME	1
Rockland, ME	2
New Bedford, MA	2
Number and duration of trips	500 trips/2.9 days
Frequency of trips by season	
Spring	2 trips/week
Summer	2 trips/week
Fall	2 trips/week
Winter	1 trip/week
Number and duration of fishing events (haul back) per trip	4 events/3.5hr
Review ratio (review time/imagery duration) per fishing event for reviewing catch handling	0.25
Review ratio (review time/imagery duration) per trip for reviewing discard compliance	0.05
% of video reviewed per trip	100%
Frequency of video retrieval	After every trip
Mean time for video retrieval	0.87hr
Frequency of reporting	Validation and reporting complete 10 days after end of fishing trip

[a] Number of trips based on 2013-2014 annual average for paired and single midwater trawl from Vessel Trip Reports as of January 26, 2015.
[b] Duration of trips and number and duration of fishing events based on combined average for paired and single midwater trawl from 2008-2014 observer data as of September 30, 2014.
[c] Review ratios were based on results from the Pacific whiting EM project for similar review objectives (McElderry et. al., 2014).
[d] Time for video retrieval taken from New England EM Project (Pria et al., 2014).