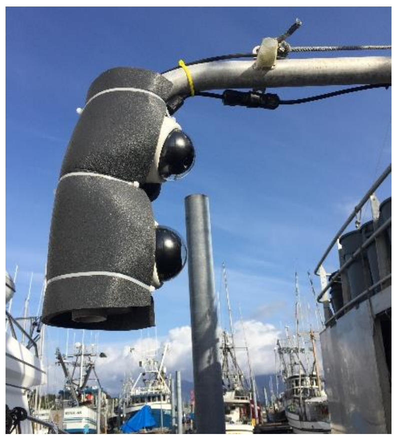
INITIAL REVIEW DRAFT

**Environmental Assessment/ Regulatory Impact Review/
Initial Regulatory Flexibility Analysis**

**for Proposed Amendments to the Fishery Management Plans
for Groundfish of the Bering Sea and Aleutian Islands Management Area and
Groundfish of the Gulf of Alaska,**

and Regulatory Amendments

Analysis to Integrate Electronic Monitoring into the North Pacific Observer Program



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Abstract: This document analyzes a proposed management change to establish electronic monitoring (EM) as a part of the North Pacific Fishery Management Council (Council)'s fisheries research plan for the fixed gear groundfish and halibut fisheries of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). The Council's fisheries research plan is implemented by the North Pacific Observer Program at the National Marine Fisheries Service's Alaska Fisheries Science Center, and its purpose is to collect data necessary for the conservation, management, and scientific understanding of the groundfish and halibut fisheries off Alaska. This document analyzes alternatives that would allow an EM system, which consists of a control center to manage the data collection, connected to an array of peripheral components including digital cameras, gear sensors, and a global positioning system (GPS) receiver, onboard vessels to monitor the harvest and discard of fish and other incidental catch at sea, as a supplement to existing human observer coverage.

List of Acronyms and Abbreviations

ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
AKFIN	Alaska Fisheries Information Network
AMR	Archipelago Marine Research, Inc
BSAI	Bering Sea and Aleutian Islands
CAS	Catch Accounting System
CDQ	Community development quota
CFEC	Commercial Fisheries Entry Commission
CFR	Code of Federal Regulations
Council	North Pacific Fishery Management Council
CP	catcher/processor
CV	catcher vessel
E.O.	Executive Order
EA	Environmental Assessment
elogbook	Electronic logbook
EM	Electronic monitoring
ER	Electronic Reporting
ESA	Endangered Species Act
FMA	AFSC's Fisheries Monitoring and Analysis Division
FMP	fishery management plan
FR	*Federal Register*
ft	foot or feet
FTE	full time equivalent
GOA	Gulf of Alaska
GPS	Global positioning system
IFQ	Individual fishing quota
IPHC	International Pacific Halibut Commission
IRFA	Initial Regulatory Flexibility Analysis

LOA	length overall
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORPAC	AFSC Observer Program database
NPFMC	North Pacific Fishery Management Council
OAC	Council's Observer Advisory Committee
Observer Program	North Pacific Groundfish and Halibut Observer Program
ODDS	Observer Declare and Deploy System
OLE	NOAA Office of Law Enforcement
PSC	prohibited species catch
PSMFC	Pacific States Marine Fisheries Commission
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
SBA	Small Business Act
Secretary	Secretary of Commerce
SWI	Saltwater, Inc.
t	tonne, or metric ton
TAC	total allowable catch
U.S.	United States
USFWS	United States Fish and Wildlife Service
VMP	vessel monitoring plan
VMS	vessel monitoring system

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Executive Summary

This document analyzes a proposed management change to establish electronic monitoring (EM) as a part of the North Pacific Fishery Management Council (Council)'s fisheries research plan for the fixed gear groundfish and halibut fisheries of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). The Council's fisheries research plan is implemented by the North Pacific Observer Program at the National Marine Fisheries Service (NMFS)'s Alaska Fisheries Science Center, and its purpose is to collect data necessary for the conservation, management, and scientific understanding of the groundfish and halibut fisheries off Alaska. This document analyzes alternatives that would allow an EM system, which consists of a control center to manage the data collection, connected to an array of peripheral components including digital cameras, gear sensors, and a global positioning system (GPS) receiver, onboard vessels to monitor the harvest and discard of fish and other incidental catch at sea, as a supplement to existing human observer coverage.

This analysis was developed with input from a Council committee, the fixed gear EM Workgroup. In 2014, the Council appointed the EM Workgroup to develop and refine an EM program for integration into the Observer Program. The EM Workgroup provides a forum for all stakeholders, including the commercial fishing industry, agencies, and EM service providers, to cooperatively and collaboratively design, test, and develop EM systems, and to identify key decision points related to operationalizing and integrating EM systems into the Observer Program in a strategic manner.

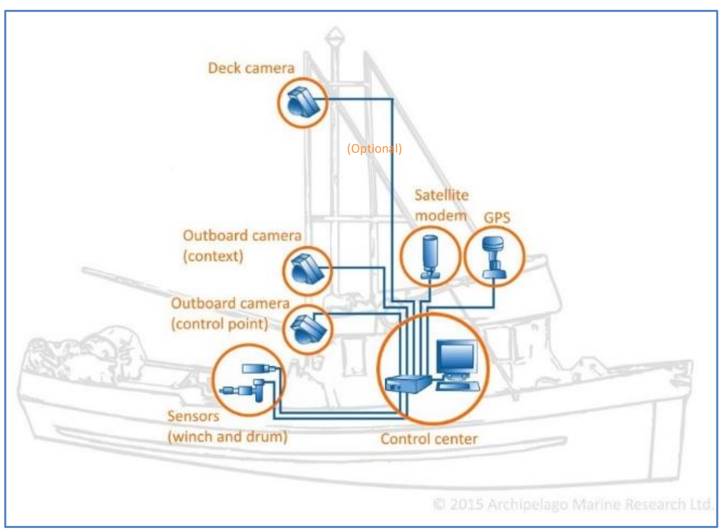
What is electronic monitoring?

For more info, see Section 1.1

In broad terms, electronic monitoring is the use of technology to collect data from fishing vessels. EM can collect a variety of different data, including retained catch, discarded catch, fishing location, and compliance with Federal fisheries regulations. An "EM system" encompasses the spectrum of EM equipment with varying features and capabilities, depending on the specific goal of the monitoring program. An EM system typically consists of a control center to manage the data collection and an array of peripheral sensor components that include: video cameras, GPS receiver, gear sensors, and optionally a communications transceiver (Figure ES-1). The EM system should be a comprehensive data collection platform, designed to record large volumes of sensor and image data, operating autonomously for long periods of time. A typical EM system deployment is shown in Figure ES-2. This analysis anticipates that the EM system will change over time, as technological improvements are made.

Figure ES-1 Example of an electronic monitoring (EM) system

Figure ES-2 Example of an EM system setup



Purpose and Need

For more info, see Section 1.2

In February 2016, the Council adopted the following statement of purpose and need:

> To carry out their responsibilities for conserving and managing groundfish resources, the Council and NMFS must have high quality, timely, and cost-effective data to support management and scientific information needs. In part, this information is collected through a comprehensive fishery monitoring program for the groundfish and halibut fisheries off Alaska, with the goals of verifying catch composition and quantity, including of those species discarded at sea, and collecting biological information on marine resources. While a large component of this monitoring program relies on the use of human observers, the Council and NMFS have been on the path of integrating technology into our fisheries monitoring systems for many years, with electronic reporting systems in place, and operational EM in a compliance capacity in some fisheries. More recently, research and development has focused on being able to use EM as a direct catch estimation tool in fixed gear fisheries.
>
> The fixed gear fisheries are diverse in their fishing practices and vessel and operational characteristics, and they operate over a large and frequently remote geographical distribution. The Council recognizes the benefit of having access to an assorted set of monitoring tools in order to be able to balance the need for high-quality data with the costs of monitoring and the ability of fishery participants, particularly those on small vessels, to accommodate human observers onboard. EM technology has the potential to allow discard estimation of fish, including halibut PSC and mortality of seabirds, onboard vessels that have difficulty carrying an observer or where deploying an observer is impracticable. EM technology may also reduce economic, operational and/or social costs associated with deploying human observers throughout coastal Alaska. Through the use of EM, it may be possible to affordably obtain at-sea data from a broader cross-section of the fixed gear groundfish and halibut fleet.
>
> The integration of EM into the Council's fisheries research plan is not intended to supplant the need for human observers. There is a continuing need for human observers as part of the monitoring suite, and there will continue to be human observer coverage at some level in the fixed gear fisheries, to provide data that cannot be collected via EM (e.g., biological samples).
>
> The Council and NMFS have considerable annual flexibility to provide observer coverage to respond to the scientific and management needs of the fisheries. By integrating EM as a tool in the fisheries monitoring suite, the Council seeks to preserve and increase this flexibility. Regulatory change is needed to specify vessel operator responsibilities for using EM technologies, after which the Council and NMFS will be able to deploy human observer and EM monitoring tools tailored to the needs of different fishery sectors through the Annual Deployment Plan.

Alternatives

For more info, see Chapter 2

In February 2016, the Council adopted the following alternatives to be analyzed as part of the Council's EM Integration analysis.

Alternative 1: No Action - EM is not a tool in the Council's Research Plan

Alternative 2: Allow use of EM for catch estimation on vessels in the EM selection pool

Option: Require full retention of ~~key~~ rockfish[1] species with associated dockside monitoring

Alternative 3: Allow use of EM for compliance monitoring of vessel operator logbooks used for catch estimation

[1] Note, in the Alternative 2 Option, it is the suggestion of the EM Workgroup to replace the word "key" with "rockfish", as it more accurately reflects the intent of the option.

Alternative 1

Under the No Action, or status quo, alternative, at-sea fisheries monitoring in the partial coverage category is accomplished with a human observer pool, through a flexible deployment plan that allows the Council and NMFS to make annual policy choices on which vessels are monitored in different selection pools, and the selection rates assigned to each pool. In 2015 and 2016, the Council has authorized a select number of hook-and-line catcher vessels to be included in the zero selection pool for human observers, while these vessels are testing the feasibility of using EM for at-sea fisheries monitoring. While the at-sea data collected from these vessels have been important for developing the EM program, it has not been used for managing the fishery. Under the status quo, the industry observer fee that is assessed in partial coverage fisheries, 1.25 percent of the ex-vessel value of all landings to support at-sea monitoring, can only be used to fund the human observer program.

Alternative 2

Alternative 2 would integrate EM into the Observer Program to allow EM to be used in addition to human observers for the purpose of monitoring at-sea fixed gear groundfish and halibut fishing activity in the partial coverage category of the Observer Program. The implementation of Alternative 2 would bring EM as an option into the process by which the Council and NMFS make annual policy choices on which vessels are monitored in different selection pools, and the level of monitoring required for each pool. The integration of EM into the Observer Program would mean that NMFS would enfold EM into their Observer Program infrastructure, management, and oversight, including the annual process of developing the Annual Deployment Plan (ADP) and evaluating the monitoring program through the Annual Report. The reviewed EM at-sea data would be used in catch estimation for NMFS' catch accounting and fishery management.

Regulatory changes under this alternative include identifying the process by which fixed gear vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool. The regulations will direct each vessel operator to comply with a Vessel Monitoring Plan that specifically tailors the requirements to the vessel's unique characteristics.

On an annual basis, the Council and NMFS will determine what deployment model is appropriate for the EM selection pool or pools through the ADP. Annual decision points may include whether there is to be an EM selection pool, and if so, the fisheries, gear or operational types, or vessel sizes in the EM selection pool, the EM selection rate and selection mode, and primary service ports for EM. An important part of this annual process would be the allocation of the available budget between human observer deployment and EM deployment.

Under this alternative, NMFS will set up a contract or grant with one or multiple EM service providers to install and service EM equipment, and to collect and review EM data. The contract or grant will specify hardware and field service specifications, and EM data review (both as to timeliness and specificity) and archiving requirements. Because a contract is likely to be for multiple years, and some of the deployment decisions have a significant impact on EM provider costs (for example, the number and location of primary service ports), there may be some deployment decisions that are made on a multi-year cycle consistent with the EM contract, rather than varying annually in the ADP. Similarly, it is anticipated that the EM system will change over time, as technological improvements are made, and these changes will be accommodated in the contract or grant.

Under Alternative 2, the Council would incorporate EM as a monitoring option in the Council's "fisheries research plan", which is how the Magnuson-Stevens Act refers to the Observer Program. The Council's groundfish FMPs would be amended to reflect the inclusion of EM. As a result, the industry observer fee could be used to pay for at-sea monitoring either through EM or human observers.

Alternative 3

Under Alternative 3, all vessel operators in the EM selection pool would be required to complete a logbook of discarded target species and key bycatch species of concern. For rockfish species, where species identification can be challenging, full retention of all species would be required. All other incidental species would be estimated from the EM video audit and/or from the human observer strata. Vessel operators would be required to log and retain the following species:

EM Program Requirements:	Longline	Pot
Require operators to log all discards of:	halibut, sablefish, Pacific cod, and sculpins	Pacific cod, octopus, crab, and sculpins
Require EM vessels to retain for dockside monitoring:	all rockfish	
Other requirements:	logging of all seabird interactions	

All vessels would carry EM systems, and to verify the accuracy of the logbooks, a review of the footage from EM cameras would be used to audit the operator logbooks. The exact amount could be specified annually in the ADP based on available budget, but in keeping with similar programs elsewhere, might begin at a threshold of 10 to 20 percent.

The regulations would prohibit falsifying the logbook data. If the logbook is found to be inaccurate, based on the EM audit, then that may result in a violation. As with Alternative 2, the regulations would identify the process by which vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool, in terms of completing the logbook, installation and maintenance of the EM system, catch handling requirements, and what happens in case of EM system failure. It would be regulated that each vessel operator must comply with a Vessel Monitoring Plan designed specifically for his or her vessel.

On an annual basis, the Council and NMFS would determine whether to allow an EM option in the ADP, and vessel operators would be able to opt into the EM pool. NMFS would set up a contract or grant with an EM service provider to install and service the EM systems, as with Alternative 2, with the additional task of auditing the logbooks against EM data. As the Council and NMFS have not yet tested the logbook model in the Alaska fisheries, some cooperative research would be necessary to develop an appropriate EM logbook. Once it is part of the Council's "fisheries research plan", the logbook/EM system could be funded through the industry observer fee.

Options

Under Alternative 2, the analysis includes an option to require retention of all rockfish species by vessels when using EM. Current regulations require discard over maximum retainable amounts (MRAs) when an allocated species is closed to directed fishing (bycatch status)[2], or discard of any amount of the species once it is placed on prohibited species status. While EM studies to date have shown that in most cases, it is possible to identify fish to the species or species complex required for management, there are some rockfish species groupings that are difficult to distinguish. Under this option, vessels that are using EM would be required to retain all rockfish, so that the rockfish could be speciated dockside once they are landed.

[2] The only exception to this is for incidental catch of demersal shelf rockfish (DSR) species in Southeast Outside waters (NMFS reporting area 650), where full retention of all DSR species in area 650 is required.

The EM Workgroup discussed changing the requirement for full rockfish retention to apply across the board to all fixed gear vessels, rather than limiting it only to fixed gear vessels using EM. Industry representatives on the Workgroup supported extending the retention requirement because it would result in a consistent regulation for rockfish retention across all regulatory areas and species, and would apply regardless of whether a vessel is using EM. Retaining rockfish would also reduce waste if the retained rockfish were donated or otherwise used. If the Council were to change the intent of this option, to apply full retention to all fixed gear vessels, the purpose and need statement would need to be modified, along with the scope of this analysis. Another possibility would be to evaluate a universal rockfish retention requirement in a separate analysis, either on a parallel track or as a trailing action. The Workgroup highlights this issue for the Council, but does not have a specific recommendation.

The EM Workgroup recommends that the Council add an additional regulatory option to this analysis, to allow vessel operators to retain IFQ or halibut CDQ exceeding the amount available in the individual area being fished if they are carrying either an observer or EM. Under the current regulations, vessel operators may *only* fish in multiple areas, and retain IFQ or halibut CDQ in excess of their available quota in the specific area being fished, if they have an observer onboard the vessel. Vessel operators in partial coverage no longer have the option to hire an observer directly from an observer contractor if they wish to fish in multiple regulatory areas on a single trip; their only option is to be randomly selected for observer coverage. A previous Council discussion paper suggested that a solution to this issue could be to allow the use of electronic monitoring instead of observer coverage to monitor IFQ fishing in multiple regulatory areas, rather than using an observer for this compliance monitoring role. The EM Workgroup supports evaluating this regulatory change as part of this analysis.

Implementing EM

For more info, see Section 3.1

The analysis breaks out different components have been identified within the EM program:

1. EM Deployment Design	***Goal:*** *Use best available information to design the EM deployment methods, including the EM selection pool, which meet policy and data collection goals.*
2. Participation	***Goal:*** *A pool of EM participants that are capable and committed to making EM work on their boats.*
3. Equipment and installation	***Goal:*** *Appropriate EM equipment (wiring/sensors, cameras, monitors, hard drives) gets properly installed on each vessel, at the right port, and in a timely fashion, with the least interruption to the fishing plan.*
4. Operation	***Goal:*** *Each vessel operator maintains a functioning EM system throughout the fishing trip and there is a good process for maintaining quality control and addressing equipment failures.*
5. Data and equipment retrieval	***Goal:*** *EM equipment with data returned to NMFS timely and in good condition.*
6. EM data and Catch Accounting	***Goal:*** *Extract information from EM system and integrate it into the Catch Accounting System in a timely manner so that data can be used in management.*
7. EM data retention and storage	***Goal:*** *Retain EM data (video and data derived from video review) in an appropriate format.*
8. Feedback mechanisms	***Goal:*** *All participants have the opportunity to provide timely feedback to address problems and improve the EM Program.*
9. Fees/ Funding/ Costs	***Goal:*** *Use Observer Program fees or other sources of funding to pay for the EM equipment, installation, and maintenance.*

All the EM program components listed above apply under both alternatives. For Alternative 3 only, however, there is an additional program requirement, the catch logbook, which is described below:

10. Catch logbook *Alternative 3 only*	***Goal:*** *Each vessel operator maintains an accurate logbook with discarded catch of key target and bycatch species.*

Each of these components will be implemented through various available implementation vehicles. These include the regulations, the Annual Deployment Plan (and Annual Report), the EM service provider contract (or grant), the Vessel Monitoring Plan (which defines the placement of EM equipment onboard each individual vessel, and sets out operator responsibilities for maintaining EM equipment and for fish handling practices conducive to camera monitoring), and NMFS administration. Figure ES-3 provides a preliminary assessment of how the different pieces of the EM program fit together under each of these implementation vehicles. The numbers in parentheses correspond to the ten EM program components identified above.

Figure ES-3 Preliminary assessment of EM components, organized by implementation vehicle

The numbers in parenthesis correspond to the ten EM program elements identified above.

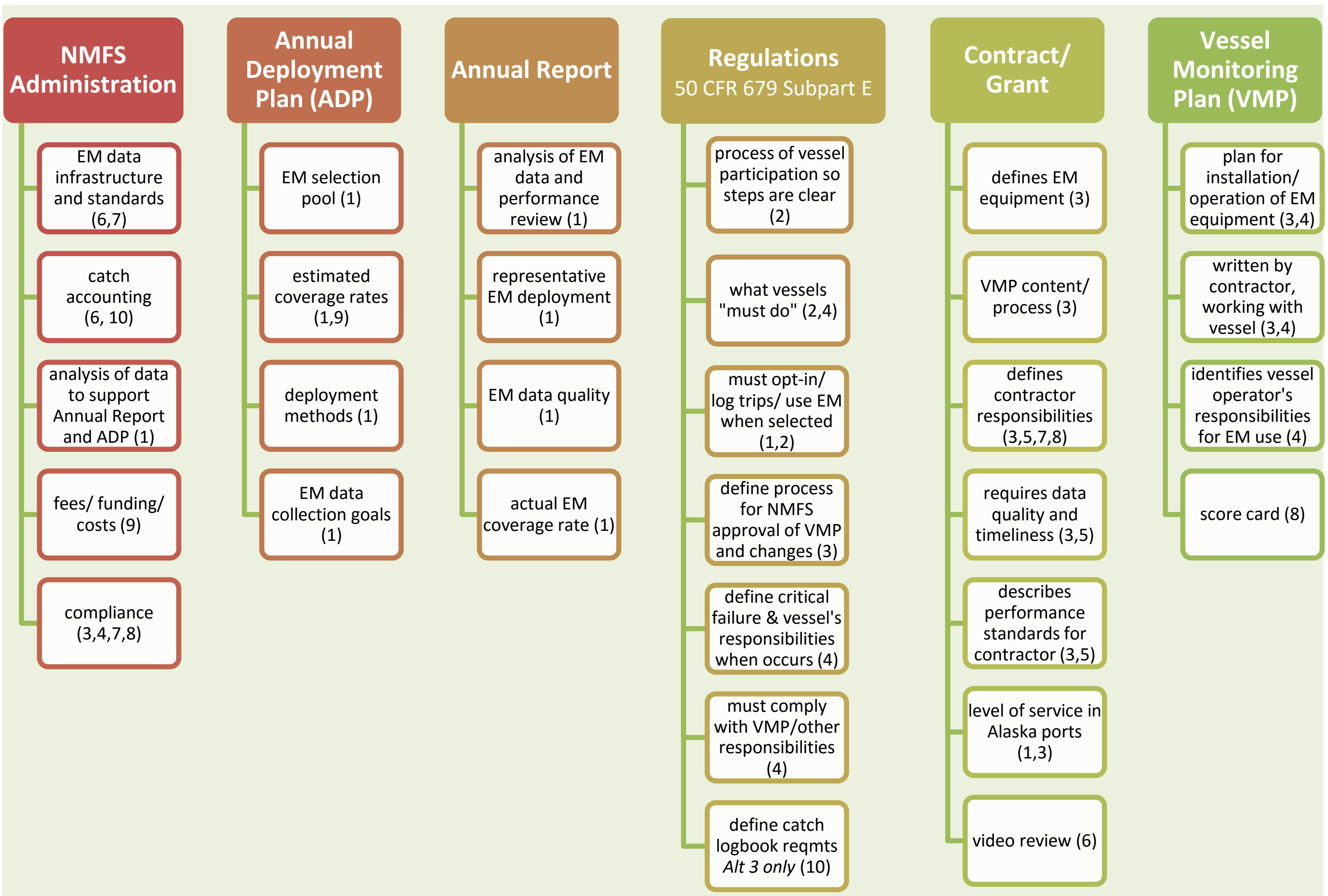
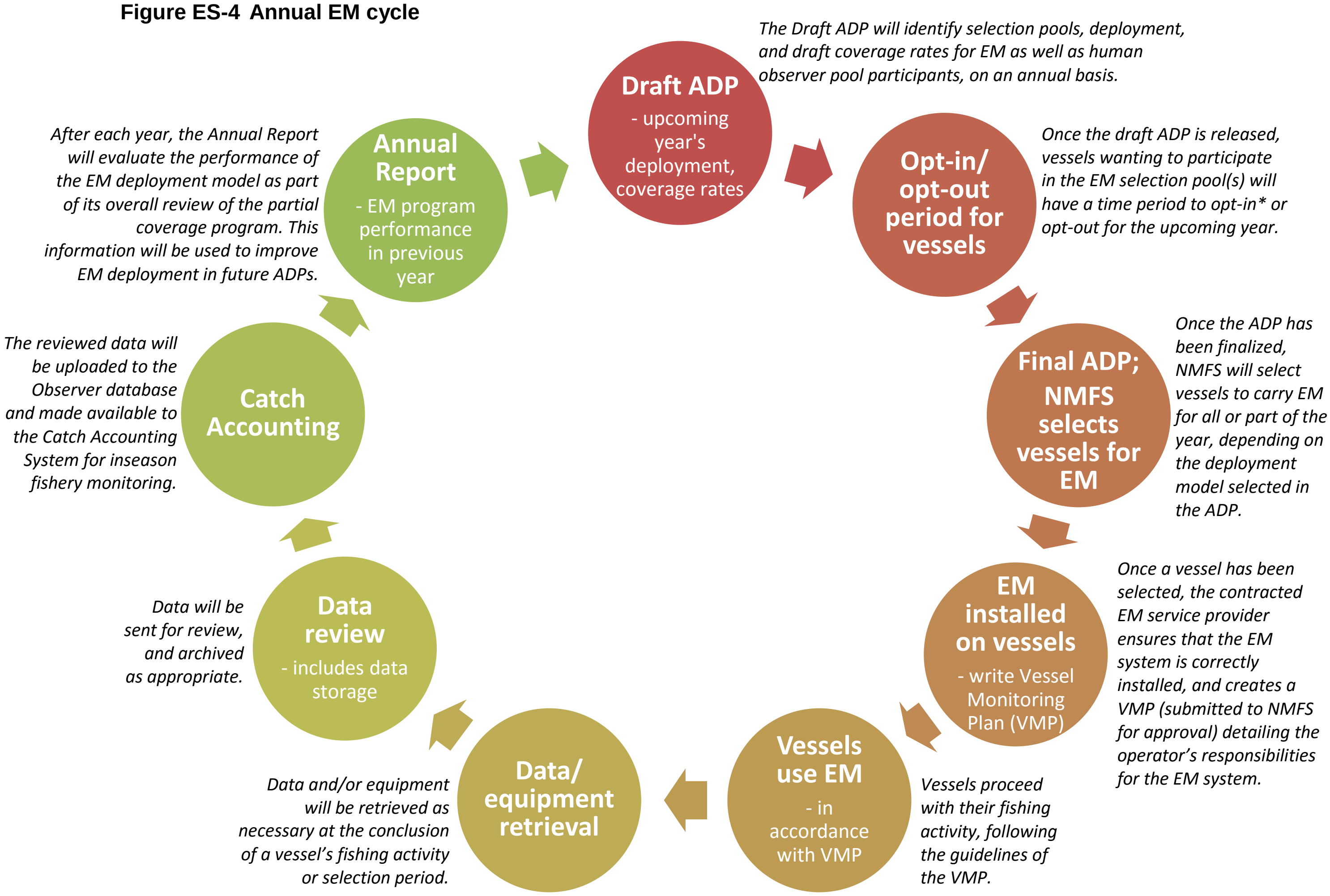


Figure ES-4 illustrates how these pieces fit together in an annual cycle of the EM program, once implemented. The figure applies to both Alternative 2 and Alternative 3, but under Alternative 3 the additional component of catch logbooks is not illustrated. Vessels would complete catch logbooks during fishing activity, and these would be submitted directly to NMFS as a data source for catch accounting.

Figure ES-4 Annual EM cycle



*Once a vessel has initially opted-in, it remains in the EM selection pool for all future years, until either the vessel opts out, or the EM selection pool is changed (through the ADP) such that the vessel is no longer eligible.

Council process for EM development

For more info, see Section 3.5

This analysis evaluates proposed actions that would allow EM to be used for monitoring partial coverage fixed gear groundfish and halibut fisheries. It is anticipated that EM technology will change over time, as improvements are made. Research to date has focused on the hook-and-line and pot vessels over 40 ft length overall, but the Council may want to use EM in other fixed gear sectors in the future also. The Council's EM Workgroup has developed a process for developing EM technology, and applying it to different fixed gear sectors, in order to ensure that EM is continually providing quality monitoring data. As the Council and NMFS consider annually whether to use an EM selection pool as part of the Annual Deployment Plan, they will need to consider what is known about the reliability of the available EM technology, its suitability for the different fishing patterns or vessel configurations of the subject fleet, and the ability of vessel operators to successfully interact with the technology onboard. In the future, EM development may be funded with NMFS funds or through grants, such as from the National Fish and Wildlife Foundation, similar to how the pre-implementation has been funded since 2014.

Figure ES-5 identifies the different stages of EM technology that are currently being developed in the fixed gear sector in Alaska, and how far they are likely to have progressed in 2018. Development work to date has focused on using EM for catch estimation, as described in Alternative 2. If the Council is interested in pursuing development work for Alternative 3, the logbook audit approach, under current planning, it would be at the operational testing stage. The use of the standard cameras as the auditing device would be mature, but no work has yet been done in Alaska to develop appropriate EM logbooks designed to work with an EM audit system.

Figure ES-5 Stages of EM development, and anticipated stage of Alaska fixed gear EM development, in 2018

	Fisheries	Technology
Proof of Concept	• <40 ft hook-and-line catcher vessels	• Automatic species identification through video review
Pilot Program		• Stereo cameras • E-logbooks
Operational Testing		• *Logbooks with EM audit (Alt 3)*
Pre-Implementation	• Pot catcher vessels	• Standard cameras for pot
Mature	• >40 ft hook-and-line catcher vessels	• Standard cameras for hook-and-line

EM data

For more info, see Section 3.7

Under Alternatives 2 and 3, data collected with EM will be integrated into the Observer database and in the Catch Accounting System. This will allow EM data to be used for fishery management and stock assessments[3]. The first step is to review and extract the data from the video. During pre-implementation of EM in the hook-and-line fisheries, video review has been conducted by Pacific States Marine Fisheries Commission (PSMFC). In the future, this work may continue to be conducted by PSMFC or contracted to a video review company, but the methods being utilized by PSMFC provide a model for what is anticipated under a regulated program. Reviewers assessed the completeness of the sensor and video data during each trip, the quality of the imagery, and recorded species to the lowest identifiable taxonomic level possible, by count, damage to fish, disposition (retained or discarded), and whether the discard was intentional or a drop-off from the line. Halibut were assessed to determine the release method and condition for each fish. A review rate was calculated as review minutes divided by sort minutes.

The next step is to use data from video review for catch estimation in the Catch Accounting System. Infrastructure is being developed to move data from the video reviewers into the catch estimation process. An important factor in using EM data for catch estimation is time needed for video review, and the overall turnaround time from when a vessel finishes a trip to when data are available for inseason management.

Video and sensor data: Under Alternative 2, a census of catch will be collected within an EM trip, and expansions will not generally be necessary to complete estimation at the haul and trip-level. In situations where hauls are missing video or sensor data, then the hauls will be considered “unsampled” and estimates will be made using trip level information, which rely on neighboring haul information within an observed EM trip. The highest impact of missing data is when the sensor data is missing, as in these circumstances, the video reviewers have no way to determine how many hauls occurred on the trip and there is no way to determine how much video might be missing. In 2016, the sensor data was complete on about 75 percent of trips. The number of hauls in 2016 with gaps in video data that occurred during catch coming onboard was low,[4] likely at about 1.5 percent of hauls. Video was more likely to be incomplete on the vessel’s first or second trip. These results indicate that there is a learning curve for vessel operators to get used to operating the EM system, and also for the EM service provider to customize the EM system

[3] Under Alternative 3, EM data will be used in conjunction with logbook data for fishery management.
[4] Excluding hauls associated with a software problem on a single longline Pacific cod vessel which was rectified once identified.

for each vessel. The majority of the video was of high quality in 2016 (80 percent). Of the hauls with medium quality (16 percent), poor camera angles and water spots caused the majority of degradation.

Species identification: In 2016, video reviewers identified a high proportion of retained and discarded catch to species level. Exceptions were generally species groups that are known to be problematic, including short and longspine thornyhead rockfish, shortraker and rougheye/blackspotted rockfish, and arrowtooth and Kamchatka flounders. The results of EM species identification in 2015 and 2016 are similar to previous work conducted on EM in the hook-and-line fisheries in Alaska, namely that comparison of species identification of catch between observer estimation and EM showed statistically unbiased and acceptable comparability for almost all species except for some that could not be identified beyond the species grouping levels used in management.

Converting counts to weights: Estimating the weight of species caught will always be required with EM, since weights (or lengths) are not available from the EM systems currently being deployed in pre-implementation. The conversion of count to weight will be done using average weights of fish, collected by at-sea observers from vessels which choose not to opt into the EM pool, being applied to EM counts. Thus, as part of the Annual Deployment Plan process, it will be valuable to evaluate the potential for gaps in the observer data.

Summary of Alternatives by Operational Differences

		Alternative 1 Human observer program only	Alternative 2 EM as tool for catch estimation	Alternative 3 Logbook as tool for catch estimation, with EM verification
Operational Differences	*Observer fee*	1.25% of ex-vessel value for all landings in partial coverage fisheries	No change	No change
	Coverage requirements	Determined annually in ADP (in 2016, all vessels ≥40’ in gear-specific stratum)	EM selection pools determined annually in ADP; vessels may opt in/out of selection pools annually	Same
		Target coverage rates determined annually in ADP (15% in 2016)	EM target coverage rates determined annually in ADP (30% in 2016)	100% coverage of all vessels in selection pool
	Retention requirements	Rockfish over the maximum retainable amount must be discarded*	Option: require rockfish retention for dockside monitoring for vessels when using EM	Require rockfish retention for dockside monitoring for all vessels in EM selection pool
	Source of catch estimation discard data	Observer data	EM video review for all species, and observer data	Vessel logbook for key species (target and incidental species of management concern); EM video review for remaining; observer data
	Amount of data	Observers randomly sample catch on a random selection of trips	EM intended to capture all hauls on EM-selected trips; video review of a random selection of hauls with complete sensor and video data provides a census of catch	Logbook of information on discard of key species required for all vessels; EM audit of a random selection of hauls, smaller proportion than Alt 2
	Timeliness of data	Observer report is transmitted at trip-end	Hard drives mailed at end of trip; EM video review turnaround is high priority	Logbook data is transmitted at end of trip; EM video review for audit/ estimating remaining species is lower priority
	EM system components	None	Sensors, control box, deck cameras, rail cameras	Same as Alt 2, plus catch logbook
	Key enforcement mechanism	Vessel required to comply with observer regulations	Vessel required to comply with Vessel Monitoring Plan (VMP) and regulations	Same as Alt 2, plus vessel required to accurately report catch in logbook**

* except demersal shelf rockfish in Southeast Outside; ** where NOAA Office of Law Enforcement determines the standard of reporting “accuracy”

Enforcement Recommendations

For more info, see Section 3.6

NOAA Office of Law Enforcement (NOAA OLE) recognizes that an EM system to supplement the Observer Program has as its primary objective the management of the fisheries and data collection. However, an effective EM program must also have compliance components to contribute to that goal. With the accelerated timeline for implementation of an EM program, some of the enforcement issues that have been raised may not be fully resolved before the Council's final recommendation on this analysis, or even before initial implementation, however the following recommendations will help to ensure the enforceability and overall success of the program:

- Any components or tools for compliance implemented by this program should be consistent with other regulatory programs (e.g., the Observer Deploy and Declare System (ODDS), Vessel Monitoring System (VMS) transmission requirements, and electronic logbooks, if required).
- NOAA OLE envisions visiting vessels either at sea or while at the dock to verify that the systems are functioning correctly and are in compliance with the vessel's vessel monitoring plan.
- Data reviewers and EM service providers should report substantive potential violations observed aboard the vessels to NOAA OLE.
- Data retention should be sufficient to allow for compliance review and complex investigations, anticipated to be between 3 to 5 years but dependent on national guidelines.
- Strong and clear regulations provide guidance to vessel owners and operators about their responsibilities to maintain a functioning EM system. These will likely include requiring system health checks daily, keeping the cameras clean, and following the specifications of the vessel monitoring plan. NOAA OLE is considering various methods to verify that EM systems are on and functioning correctly, including whether to require real time transmission of system health data.
- Regulations should also clearly define the system failures under which a vessel would not be allowed to operate.

EM will likely provide some support for enforcement of other regulations. During EM video review, the data reviewers would record potential violations and report to NOAA OLE. Thresholds for reporting violations would need to be developed. Additionally, as the program develops, additional compliance-only EM components may be integrated. The use of cameras to verify seabird streamer line use, which is required for hook-and-line vessels under pre-implementation, is one such example. Another is the option, proposed by the EM Workgroup and supported by NMFS, to allow vessels to fish individual fishing quota (IFQ) in multiple areas with the use of an EM system.

Environmental Assessment

For more info, see Section 4.1

Improving data reliability was one of the primary drivers for restructuring the Observer Program in 2013. By allowing the use of EM as part of the Observer Program, NMFS would maintain the ability to provide the unbiased discard information used in the Catch Accounting System and would increase flexibility to adapt monitoring to specific data needs, by collecting data from vessels where observer coverage is not practicable. The coverage rate for human observers is expected to decrease, as the finite fees would be used to fund both deployment of observers and EM. The Council and NMFS would, however, decide annually how to balance EM coverage with observer coverage, relying on analyses to evaluate potential gaps in observer data resulting from EM participation.

Additionally, this document analyzes the impacts of changes to the data collected under the alternatives by comparing the data currently collected by observers with the data that would be collected with EM. In those instances where certain data can only be collected by observers, and not by EM, the impact of implementing either EM alternative would only be to reduce, and not eliminate, the amount and sometimes the timeliness of that data. This is because both EM alternatives contemplate the use of EM (Alternative 2), or of a logbook with EM audit (Alternative 3), as a supplement to human observer deployment, rather than a replacement for it. Observer data will continue to be used to provide estimates for the fishing activities without coverage or where EM does not collect that specific data. A detailed evaluation of how the Catch Accounting System generates estimates from the available observer data, and the impact of gaps in coverage, has been provided in a previous analysis.[5]

Groundfish, halibut, prohibited, and ecosystem component species **For more info, see Sections 4.2-4.4**

Human observers (Alternative 1) collect type, size, sex, length, and weight of all organisms in samples, and collect biological samples such as scales, tissues, age structures (otoliths), and stomachs. Observers may also conduct special research projects that provide scientists with other information. With the current EM camera technology, cameras record the catch as it comes onto the vessel. From the video, we get a census of the species (or species groupings) of fish caught and the number of fish, their disposition and condition. NMFS cannot collect weight data with current EM technology, which NMFS uses to estimate biomass. Weight data would need to be extrapolated from the observer data and applied to the data collected with EM. NMFS also cannot collect sex data with current EM technology. Data on sex ratios are useful to determine which parts of the population are being affected by fisheries. This is particularly true for species (like grenadiers) where there are geographical or depth-related differences in the distribution of males versus females. Additionally, NMFS cannot collect biological samples with EM.

Under Alternatives 2 and 3, an iterative process would be used through the ADP and Annual Report to refine sampling protocols for EM to meet catch accounting and stock assessment needs in the hook-and-line and pot gear fisheries. Alternative 3 uses a logbook to collect data on key target and bycatch species, and all other incidental species would be estimated from EM video audit. As the amount of video review is likely to be reduced under Alternative 3, less EM data would be collected from the vessels selected to use a logbook and EM than from those selected to use EM under Alternative 2. An option under Alternative 2, and a requirement under Alternative 3, would oblige the vessel operator to retain all rockfish while using EM. With full retention, landed rockfish could be differentiated and counted at the processor; this may require additional dockside monitoring.

Marine mammals **For more info, see Section 4.5**

Observers conduct statistically reliable monitoring of fishing operations and to record information on all interactions between fishing operations and marine mammals. The Observer Program reports mammal interactions to Marine Mammal Laboratory staff and estimates are made independent of the Catch Accounting System. Observers record the species, number, and types of interaction (including location, date and time, gear type, catch composition, fishing depth) with marine mammals, and the length, tissue samples, photographs, and disposition (e.g., dead, released alive) of marine mammals caught in the gear.

Under Alternative 1, restructuring has brought vessels into the partial coverage program which operate closer to shore and in areas where there was previously little to no observer information, such as the inside waters of southeast Alaska, and nearshore waters in southeast Alaska and the Kenai Peninsula. As marine mammals occur nearshore, we now have the ability to collect observer data on fishery interactions with marine mammals with a better spatial distribution of sampling relative to the fishery footprint. Under Alternatives 2 and 3, cameras would be able to record dead animals coming on board the vessel, but would be unable to record animals that fell off the gear prior to coming on board or being entangled in gear. No marine mammal interactions with gear have been recorded in the EM data collected during pre-implementation, so there is no data on the ability to identify marine mammal species with EM. Depending

[5] NMFS. 2015. Final Supplement to the Environmental Assessment for Restructuring the Program for Observer Procurement and Deployment in the North Pacific. September 2015. https://alaskafisheries.noaa.gov/sites/default/files/analyses/finalea_restructuring0915.pdf

on the vessels that opt for EM selection, the implementation of EM may decrease the gains made in collecting data on marine mammal interactions in the fishery. Under Alternatives 2 and 3, observer data will continue to be used to provide estimates for the fishing activities without coverage.

Seabirds

For more info, see Section 4.6

The majority of observed seabird bycatch in fisheries occurs in the hook-and-line fisheries. The restructuring of the Observer Program extended partial coverage to the halibut fisheries off Alaska, addressing a long-standing data gap for seabird bycatch estimates. Observers collect the number, species identifications, and tag recoveries of seabirds caught or killed by fishing gear, and report on seabird mitigation measure compliance (e.g., streamer lines) (Alternative 1). These data are used to estimate total bycatch of seabirds, and particularly those birds of conservation concern at risk of interaction with hook-and-line gear, including albatrosses.

Seabird data collection measures have been part of the 2015 and 2016 EM research and pre-implementation plans, with a primary objective for seabird monitoring in 2016 being to record presence/absence of streamer lines (seabird mitigation measures) during setting of hook-and-line gear on EM-observed trips. Fishermen are also required to hold caught seabirds up to a camera for identification purposes. While both observers and EM allow reporting of compliance with streamer lines, the observer can provide context for a particular situation, and can work with vessel operators in real-time to correct any potential issues. The ability to identify seabird species is similar when using observers and EM, as experts found the 2016 protocols for displaying seabirds to the camera and the camera picture quality were sufficient as long as fishermen adhered to catch handling protocols. Observers are able to collect specimens, however, and bring them onshore for identification. This could be a responsibility of the vessel operator with EM, although protocols and procedures for fishermen to collect specimens and bring them onshore for identification would need to be developed. It is likely that new or modified special purpose salvage permits from USFWS would be necessary.

Summary of Environmental Impacts of the Alternatives

		Alternative 1 Human observer program only	Alternatives 2 and 3 EM alternatives
Environmental Assessment Impacts	***Goals achieved with restructuring***	Unbiased discard data	Yes
		Ability to adapt monitoring to specific needs	More flexibility for monitoring on vessels where human observers are not practicable Less human observer coverage as fee is supporting both options
	Data collection		Where EM cannot duplicate an observer function, impact is a reduction in overall data <u>not</u> elimination of that data; observer data will be used to generate estimates, per established procedures.
	Fish	Species ID, count – based on sample	Yes, based on census
		Weight/ sex/ length	No
		Biological samples/ special projects	No
	Marine mammals	Information on interactions (location, date/time, gear, fishing depth, catch composition)	Not unless brought onboard dead No marine mammal interactions recorded to date in pre-implementation
		Information on gear entanglements (length, tissue samples, disposition)	No
	Seabirds	Species ID, count, tag recovery	Yes for species ID and count, if handling protocols adhered to Procedures needed if vessel operators are asked to collect specimens
		Compliance with streamer lines	Yes

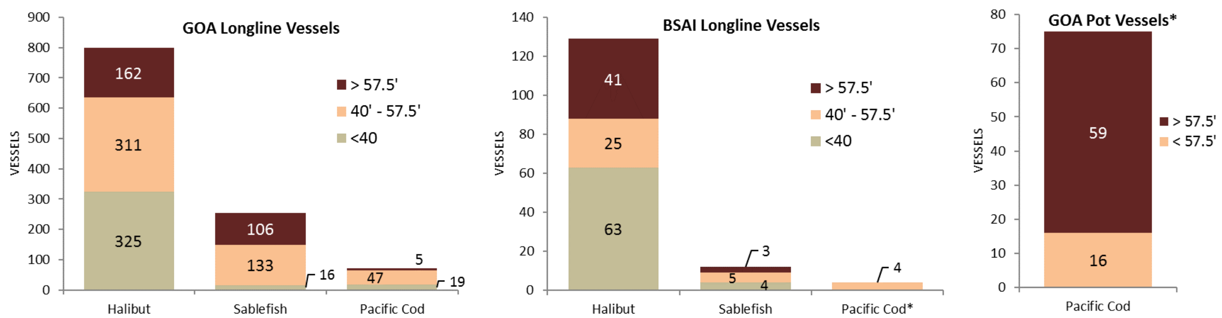
Regulatory Impact Review

Potential EM vessels

For more info, see Section 5.6

This analysis evaluates integrating EM as an option for the fixed gear groundfish and halibut fisheries that are currently in partial coverage under the Observer Program. Hook-and-line participants in these fisheries primarily target halibut, sablefish, and Pacific cod, and pot gear participants target Pacific cod[6]. Figure ES-6 provides an overview of the number of vessels that participated in these target fisheries in 2015, by vessel size category. The majority of participation across all target species occurs in the GOA management area. Participation by vessels of less than 40' LOA primarily occurs in the halibut fishery. Vessels of 57.5' LOA or greater make up less than 20% of the fleet targeting halibut, but account for around 46% of catch. Vessels in that size category make up the majority of the pot gear.

Figure ES-6 Count of longline and pot vessels fishing in 2015, by gear type, target fishery, and size category



Source: Catch Accounting System, provided by NMFS AKRO.

* Vessel size categories <40' and 40-57.5' LOA have been combined, and pot vessels in the BSAI are not shown, in order to preserve confidentiality.

In 2016, the EM Pre-implementation Program was available to longline vessels from 40 to 57.5 ft length overall, with service port locations offered in Sitka and Homer, and limited support in remote ports. Vessels were required to carry EM, if selected, for all trips during a 2 to 4 month selection period[7]. As of July, the 2016 EM selection pool included 51 vessels. Table ES-1 provides summary information on the 2015 fishery participation when using hook-and-line gear of the 51 vessels that are in the 2016 EM selection stratum. This information is used as a basis for modeling the effort patterns of at least one class of vessels that might be part of a fully implemented EM stratum (the EM pool will evolve as large vessels (>57.5'), small vessels (<40'), and pot gear vessels opt into the stratum). The vessels had an average trip length of 3.5 days (1,448 days over 418 trips) over all ports and trip targets when using hook-and-line gear. While this profile does not predict the stratum's demographics in 2017 or under a fully implemented program, it is informative in that this set of vessels represents fixed-gear operators who are motivated to carry EM equipment. Understanding the timing and location of fishing among this subset of the fixed-gear fleet could play into the Council's annual decision as to where and to what extent field support services should be provided, and where efficiencies can be realized.

[6] A small amount of catch was made on trips targeting sablefish with pot gear in 2015 (3 vessels landed 120 mt in the BSAI); draft regulations are pending to allow longline pot gear for sablefish in the GOA. Pot gear is not used to target halibut.

[7] In 2017, the Council is considering a pre-implementation plan that would use a trip selection approach, where vessels log each trip and are randomly selected to use EM on that trip. The pre-implementation pool is also open to all vessels ≥40' fishing either hook-and-line or pot gear.

Table ES-1 2015 hook-and-line effort by landing port for vessels in the 2016 EM pool

Landing Port	Vessels	Trips	Days Fished	Average Trip Length
Sitka	24	187	538	2.9
Seward	10	64	266	4.2
Kodiak	7	37	154	4.2
Homer	8	31	91	2.9
Yakutat	5	31	102	3.3
Juneau	5	16	65	4.1
Petersburg	4	12	49	4.1
Dutch Harbor/Nome/ St Paul*	4	16	98	6.1
Sand Point	C	C	C	3.0
King Cove	C	C	C	5.5
Port Alexander/Wrangell*	3	9	26	2.9
Other Alaska	C	C	C	2.0
Total	**46**	**418**	**1,448**	**3.5**

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT. C= Confidential
* Dutch Harbor, Nome, and St. Paul Island, and Port Alexander and Wrangell, are combined to maintain confidentiality.

Methodology for cost analysis

For more info, see Section 5.4

The EM funding and cost landscape is complex. The expense of EM, whether at the program level or on a per-vessel or per-day basis, is an important factor in the Council's determination regarding net benefits, but it is only part of the equation. In selecting a preferred alternative, the Council will also consider cost effectiveness (i.e., costs in terms of what the program provides) and how well the alternative addresses the management issues identified in the purpose and need statement. In other words, it is possible that the Council could recommend integrating EM even if its near-term monetary cost profile is higher than that of a program that only deploys human observers. As such, this analysis does not seek to assign a dollar cost to an EM program of a given size and scope in any future year. Rather, it uses the best available information on what the Alaska fixed-gear EM program costs, in its present state, to establish a baseline for an ongoing deployment decision-making process over the life of the program.

Acknowledging the limitations to projecting accurate EM costs for a given deployment design in a given future year, the objectives of this RIR as it relates to monetary-cost analysis are to (1) define key cost drivers, and describe how those drivers affect the program's total cost profile, contingent on factors that are expected to vary over time or are contingent on program design choices that are yet to be made (Section 5.7.4); (2) estimate the unit cost of deploying EM in 2016, recognizing that these figures reflect a research-oriented program that does not cover the pot gear sector or the fleet of vessels that is less than 40' LOA, and that these estimates provide a useful baseline to track Alaska hook-and-line EM costs over time (Section 5.8.2.1); and (3) characterize the trade-offs in EM services that can be provided under various budget constraints, where "budget" is defined as the portion of the monitoring fee pool that would otherwise be used to purchase human observer-days for the partial coverage category and link expenditures of the monitoring fee-base on EM to the Observer Program's need for – and ability to purchase – observer-days (Section 5.8.2.2).

Cost factors

For more info, see Section 5.7.4

To evaluate EM costs, the analysis considers four factors: fixed versus variable costs, startup versus ongoing costs, cost trajectory, and uncertainty regarding program design.

- Any given category contains a mix of variable costs and fixed costs. Variable costs scale positively with the amount of activity in the program or the amount of services provided. Fixed costs can be thought of as overhead, and their unit cost might actually decrease as more vessels join the EM fleet or take more trips.

- Cost factors can also be categorized by those that are one-time ("startup") costs, periodic costs, and ongoing costs. Startup costs tend to be overhead costs or fixed costs of management, such as reprogramming aspects of the Catch Accounting System. Once the Alaska EM program transitions to a regulated program, its will have benefitted from the fact that some of those cost-intensive investments in human capital and program infrastructure occurred during pre-implementation, when they were funded by NMFS and other grant monies. For example, planned purchases to support the draft 2017 pre-implementation program would result in potentially 90 EM hardware sets purchased and installed on hook-and-line vessels[8], and another 30 EM systems on pot vessels. Some cost factors are predictably periodic, meaning that costs occur at predictable intervals. For example, hardware will need to be replaced or upgraded on a regular basis.
- The price of EM services and components will change over time ("cost trajectory"). Some cost factors are weighted towards the early years of the program; those costs can be generally categorized as "capacity building" activities. Other cost factors could decrease over time, either as a result of capacity building (e.g., fewer field services required) or of competition and technological development (e.g., the cost of new hardware or video review time decreases). Cost factors that are otherwise similar might have a different trajectory over time, however the analysts generally assume that costs will decrease over time as the program moves past startup costs and as implementation inefficiencies are overcome.
- Finally, the size, scope, and nature of the EM program in any given post-implementation year has not been determined yet, nor is it intended to have been. The analysts refer to these as cost uncertainties. The action alternatives establish a process through which data objectives and deployment strategies that affect costs are made annually. The EM program's annual deployment design will also be dictated by available funding and by the demand for observer-days to meet sampling needs in non-EM strata. The EM stratum is intended to be an option for vessel operators, thus the number of vessels in the stratum, their distribution across delivery ports, and the number of trips they make each year will likely vary on an annual basis. Elements that were thought to have a declining cost trajectory might behave differently as the objectives or design of the program is redefined.

Table ES-2 summarizes monetary cost factors for evaluating an EM program.

The design of field service deployment and the definition of operator responsibilities are also likely to impose costs on vessel operators that are not directly denominated in dollar expenditures.[9] Program design elements that create demands on operators' time, affect trip plans, or alter at-sea operations result in opportunity costs. Though not quantified in this analysis, opportunity costs reflect the value of what a stakeholder could have generated if he or she were not otherwise obligated. The values that could have been generated might be denominated in terms of production (harvest efficiency) or utility (satisfaction with the monitoring program, or time available for non-labor activities). Program designs that result in high non-monetary costs could cause vessel owners on the margin to disengage from the fishery by selling quota shares or allowing their shares to be fished on platforms that are less impacted by the Observer Program's requirements. To the extent that vessel operators disengage from the fishery as a result of the monitoring plan, the program affects the distribution of benefits from the resource and the supply of employment opportunities.

[8] The plan calls for the pre-wiring and installation of camera and sensor systems on 90 vessels, and the purchase of 60 control centers that can be rotated among the fleet.
[9] Non-monetary costs might extend to non-harvesting shoreside stakeholders such as processors depending on whether the design of the EM program creates new responsibilities such as dockside monitoring, and how those responsibilities are apportioned.

Table ES-2 Characterization of selected EM cost factors (viewed as annual costs over the life of the program

Category	Cost Factor	Trajectory	Uncertainty
Hardware	Control Center*	Null or Decreasing	Start-up pool; Size of EM Pool; Depreciation/Breakage rate
	Camera/Sensor Package	Decreasing	Start-up pool; Size of EM Pool; Depreciation/Breakage rate; Undefined required peripherals
	Installation	Decreasing	Start-up pool
	Hard-Drives	Decreasing	New technologies
	Software Licensing	Null or Decreasing	Contract requirements; Competition
Field Support	Re-installation	Unknown	Demographics; Port capacity
	Control Center Rotation	Unknown	Deployment method; Port capacity
	Labor/Travel	Null or Decreasing	Demographics; Deployment method; Port capacity
	Project Mgmt.	Unknown	Contract requirements
	Training	Decreasing	Port capacity
	Data Retrieval	Decreasing	Operator responsibilities; Demographics; Automated data transmission
	Dockside Monitoring**	Null or Increasing	Undefined data objectives
Data Analysis	Video Review Time	Unknown	Data objectives; Size of EM Pool
	Review Labor/Training	Null or Unknown	Data objectives; Labor turnover
	Software Licensing	Null or Decreasing	Contract requirements; "Open-source"
	Project Mgmt.	Unknown	Port capacity; Contract requirements; Competition
Administrative	Data Integration	Decreasing	Pre-Implementation work; Data objectives
	Data Auditing	Unknown	Data objectives; Contract requirements
	Data Storage	Decreasing	New technologies; Undefined requirements
	Deployment Mgmt.	Increasing	Demographics; Size of EM Pool
	Outreach	Decreasing	Size of EM Pool; Port capacity
	Project Mgmt.***	Unknown	Deployment method; Port capacity; Data objectives

* The analysts make no assumptions about the future unit-cost of proprietary hardware, but note that market competition could be a factor.
** Not part of the Pre-Implementation program. Cost could come out of the human observer side of the deployment budget.
*** NMFS/FMA costs would not come out of the Observer Program's deployment budget, as is the case under status quo.

Unit cost exercise

For more info, see Section 5.8.2.1

The cost of EM programs in other regions have typically been assessed in terms of how much the program costs per vessel, per trip, or per monitored sea-day ("unit costs"). Unit costs are a useful metric for tracking the cost of a given EM program at a moment in time, although they fail to capture the trajectory of costs as they tend to conflate fixed and variable costs and are too simplistic to recognize the cost impact of program uncertainties. The analysts express reservation about using unit costs as a tool to compare EM's cost *effectiveness* across regions or against human observer programs.

Only those cost factors that would be paid for through the monitoring fees that are collected from the industry (i.e., the 1.25% ex-vessel fee) have been considered for this cost exercise. The analysts have established a single methodology for estimating unit costs (per vessel, per trip, per sea-day) of the 2016 EM program. That methodology is applied to 12 different scenarios that could, conceivably, describe the 2016 program in retrospect. The need for twelve different scenarios (I – XII) stems from the many unknowns involved in costing out a 2016 program that is in the midst of purchasing and operation. Moreover, the 2016 program is distinct in that it is both an operating pre-implementation monitoring program and an effort to build up capacity for future years. The individual scenarios are not described in detail in this Executive Summary, but they vary based on high and low spending cases, how 2016 partial year data is reflected, how previously spent funds were credited towards 2016 hardware purchases, and how aggressively pre-purchasing of hardware for 2017 will be carried out through the end of 2016.

Table ES-3 summarizes the results of this exercise in costing out the 2016 fixed-gear EM program. The unit cost estimates in the major columns of the table represent three different presumptions about which tasks might be funded through the observer fee, as opposed to being absorbed in NMFS' budget (EM Contractor only; EM Contractor and Video Review; EM Contractor and Video Review and Data Storage). The twelve scenarios provide a range within which to consider the unit costs of the 2016 EM program, and should be understood with the three following caveats. First, the 2016 program was not designed with cost-efficiency as the primary goal. Second, all unit cost estimates would be lower if there were more fishing effort in the EM pool. Third, this basic model is set up in a manner suggesting that non-hardware provider costs are inversely related to hardware purchasing in 2016. That relationship is merely an artifact of the analysts' inability to enumerate the EM provider's field service, travel, and management costs. Hardware purchasing and field service spending levels during the pre-implementation phase are certain to differ from the levels that will be observed in a mature program.

Table ES-3 Unit cost estimates for the 2016 hook-and-line EM program, under three different assumptions of the EM costs that might be paid from the observer fee

		Unit Cost ($)								
Scenario	2016 Prog. Cost	EM Contractor			Contractor + Vid. Review			Contractor + Review + Data Storage		
		Per Vessel	Per Trip	Per Day	Per Vessel	Per Trip	Per Day	Per Vessel	Per Trip	Per Day
I	$453,278	26,663	7,952	1,988	29,396	8,767	2,192	29,730	8,867	2,217
II	$187,140	11,008	3,283	821	13,741	4,098	1,025	14,075	4,198	1,050
III	$424,478	24,969	7,447	1,862	27,702	2,868	2,066	28,036	8,361	2,091
IV	$158,340	9,314	2,778	694	12,047	3,593	898	12,381	3,692	923
V	$651,450	21,715	5,714	1,429	24,446	6,433	1,609	24,779	6,521	1,631
VI	$271,450	9,048	2,381	595	11,779	3,100	775	12,113	3,188	797
VII	$622,650	20,755	5,462	1,365	23,486	6,181	1,545	23,819	6,269	1,567
VIII	$242,650	8,088	2,129	532	10,819	2,848	712	11,153	2,935	734
IX	$508,800	16,960	4,463	1,116	19,691	5,182	1,296	20,024	5,270	1,318
X	$393,600	13,120	3,453	863	15,851	4,172	1,043	16,184	4,259	1,065
XI	$492,000	16,400	4,316	1,079	19,131	5,035	1,259	19,464	5,123	1,281
XII	$376,800	12,560	3,305	826	15,291	4,024	1,006	15,624	4,112	1,028

EM cost tradeoffs under budget constraints

For more info, see Section 5.8.2.2

Estimated unit costs of the 2016 Alaska fixed-gear EM program provide a useful baseline for future program evaluations, but the metric is inherently limited in its ability to capture the evolution of individual program elements' cost profiles over time. Another approach is to consider what is known about the variations in cost of each element, based on cost trajectory or program design, and consider the total of these costs in the context of a range of plausible EM budget scenarios. This exercise allows the reader to conceptualize potential trade-offs between the scope of the EM program and other monitoring needs.

Program elements include hardware/software (costs are profiled at the annual, per-vessel level so that total program costs can be scaled up or down depending on the size of the EM stratum that is being imagined in a given future year), field service (costs are expected to vary across both time (trajectory) and program design choices (uncertainty)), video review and data storage (it is yet to be determined whether these costs will be paid through the monitoring fee or NMFS's budget). Some cost items, such as program management, do not scale with the size of the fleet or the effort in the EM stratum in any manner, but might decrease over time as the program matures and requires fewer hours of management, reporting, and coordination with the regulatory development process. Other cost items, such as the number of ports in which local trained technicians are provided, scale with participation and effort to a degree, but not on a per-vessel or per-trip basis. The service cost items that behave more like variable costs will scale differently depending on the program's deployment model – "vessel selection" or "trip selection." Holding the size of the EM fleet steady over time, it is reasonable to expect that demand for services will trend downward – approaching a steady state – as initial installations convert to re-installations, as service travel demand decreases, or as routine maintenance and software management can be handled remotely or by the vessel operator. Finally, it is also important to recognize that the cost *effectiveness* of dollars spent providing field services may vary depending on the level of effort in the EM stratum and the selection probability for vessels that have received costly installations and technical support.

The manner in which the **annual budget for EM** is determined is a policy choice that is yet to be made, and the basis for the budget could evolve as the Council and the Observer Program gain a sense of the program's scope, true cost, and value. For the purpose of discussion, the analysis considers three ways to scope an EM budget: as a function of the number of vessels in the EM stratum, the amount of effort (trips or sea-days) relative to the non-EM strata, or the proportion of total monitoring fees remitted by the vessels in the EM stratum during the preceding year. The consideration of EM budgets includes options to divide up only the non-trawl proportion of the EM budget, to ensure that the program is "revenue neutral" towards the trawl sector. Based on approximations of those metrics drawn from recent years, the potential EM budget ranges between $287,000 and $957,500, out of a total fee base of $3.83 million. At the largest level, the remaining $2.87 million would afford approximately 2,680 observer-days, which is less than the 4,500 and 5,300 observer-days per year used during 2014 and 2015, but these levels were only achieved with supplementary Federal funds. During those years, monitoring fees were used to purchase 2,600 to 3,000 observer-days. The analysis suggests that the cost of an EM program is likely to exceed the amount of the monitoring fees that would have been generated by the vessels in the EM stratum during the preceding year. However, the existing pre-implementation program, which provided the baseline for some of the cost profiles, was not designed to minimize costs. It is entirely possible that an EM program could be deployed within a given budget constraint, but doing so – at least in the near-term – would likely require cost-conscious design choices.

Impacts of Alternative 2

🔍 **For more info, see Section 5.8.2.3**

EM participants: The EM program is structured as a stratum into that vessels may choose whether or not to opt into. While there are certainly both benefits and costs to participating in EM, one would assume that vessel operators who volunteer for the program perceive an individual net benefit. The main category of costs for EM vessels is the "non-monetary" time and opportunity costs. These costs include the time that operators and crew might spend working with the provider on installation and maintenance, or completing duty-of-care tasks that are defined as operator responsibilities in the ADP (currently outlined in the 2017 Pre-Implementation Plan). Some time and opportunity costs might fall more heavily on vessels that operate out of remote ports, where the program could potentially require them to remain in port until a technician can travel to correct a critical EM system failure or transit to a nearby port with a local EM technician. The potential onus of these operator responsibilities will be defined as the Council, NMFS, and stakeholders on the EM Workgroup balance the trade-offs between providing service in all areas and the cost of the program. While this analysis uses the term "non-monetary" to describe time and opportunity costs, modifications to a vessel's business plan or an individual's labor schedule do impose economic costs. Over the course of the Observer Program and the EM pre-implementation phase, NMFS and EM providers have worked with fishermen to minimize the unintended operational impacts of monitoring, and that practice is expected to continue.

Other partial coverage harvesters: All vessel owners who pay monitoring fees hold a stake in the quantity and quality of the biological and management data that are generated through the combined efforts of the Observer Program. While vessel owners are the direct payers of the fee (along with their processing partners), hired skippers and crew members are affected by the quality of information that is available to fishery managers, as the adequacy and timeliness of data influence catch limits and season closures that, in turn, affect opportunities for labor. The most apparent mechanism for the action alternatives to affect non-EM fishery participants is "competition" for limited monitoring deployment funds across the various partial coverage strata. The potential effect depends on the scope of the program, which will evolve and be analyzed and adjusted annually.

Processors: Alternative 2 is not expected to have a substantial impact on shoreside processors. Though not part of the 2016 Pre-Implementation Plan or the draft 2017 Plan, it is possible that the ADP in some future year could define a dockside monitoring component of the EM program, and if so, a processor might have to make adjustments to its catch monitoring and control plan if it has one. Responsibilities for dockside monitoring costs, should they exist, have not been fully defined, as the need for dockside monitoring under Alternative 2 is thought to be low at the present time.

Observer Program: In terms of how integrating EM might impact the deployment of observers in other partial coverage strata, the direction of the effect is determined largely by the cost of deploying EM. In general, if the cost of EM deployment is disproportionately high relative to the amount of data that the stratum is producing, then it is likely that the budget for purchasing observer-days will be curtailed (absent additional sources of funding). The analysts are limited in their ability to identify a cost tipping-point beyond which EM expenses have a net negative impact on the number of observer-days that can be afforded. The Council is under no obligation to limit the scope of the EM program to a level that has no effect on observer deployment. If the Council selects Alternative 2, it is merely committing to an annual process through which these trade-offs will be analyzed in the fleet and budgetary context that exists at the time.

Impacts of rockfish retention option under Alternative 2

🔍 **For more info, see Section 5.8.3**

Vessel operators might experience an opportunity cost if they are required to retain species that fetch a lower ex-vessel value than what they are targeting on the trip *and* if those retained fish displace stowage capacity for higher value fish. This negative outcome is more likely to occur on smaller vessels with limited hold capacity, though it could occur on any vessel that fills its hold on a given trip. That effect would be exacerbated if the species is on PSC status, and thus cannot be sold after it is landed. Of the three primary target species for fixed gear vessels (halibut, sablefish, and Pacific cod), rockfish are most likely to be encountered on halibut trips due to the similar depths at which the species tend to be found. If any perceived negative impact occurs only when carrying EM, this option might create a disincentive for vessel owners to opt into the EM stratum, reducing engagement in the program and the maximum range of its net benefits to the nation.

The benefits of full retention are primarily centered around improved data quality (rockfish identification) and the simplification of vessel operators' at-sea responsibility for identifying species. Shoreside processors are stakeholders in the overall quality of data collection, but could experience small to moderate negative impacts in the form of additional responsibilities and/or monitoring costs. The two categories of potential processor costs are dockside monitoring and responsibility for disposal of non-marketable catch after delivery. Requiring full retention could also create an avenue for the Observer Program to collect biological samples from the EM stratum, which obviously cannot be collected through video review

Impacts of Alternative 3

🔍 **For more info, see Section 5.8.4**

Alternative 3 anticipates similar EM program requirements to Alternative 2, with the addition of catch logbooks. The alternative requires all vessels in the EM stratum to carry an EM system, which could increase the hardware/software cost profile of the program, especially compared to Alternative 2 where, in pre-implementation, control centers will be rotated among hook-and-line participating vessels. The full retention requirement could also bring with it a need to incorporate dockside monitoring into the program, as in Alternative 2, Option 1. Relative to Alternative 2, the cost of the EM program under Alternative 3 would be driven by the difference in the amount of video that is being reviewed. It is not possible to quantify this marginal difference at this time because the size of the EM stratum, the selection rate for coverage, and the proportion of video that would be reviewed to audit logbook quality (e.g., 10% to 20%) are not defined. Vessel operators might experience moderate time costs related to logbook responsibilities. These costs would be additional to those involved with EM system installation and maintenance, which are described under Alternative 2.

The overall cost profile of the EM program under Alternative 3 will also depend on frequency of logbooks being found out of sync with what reviewers find in the video data; in other words, costs are driven by logbook quality. Logbook quality will be at least partially determined by the fleet's experience with EM logbooks (i.e., the number of vessels that are new to the EM stratum), or the number of vessels that take only a small number of trips per year. The analysts would expect vessels that have, or accrue, less experience filling out EM logbooks to require a greater amount of re-review and logbook correction after the initial audit. If participation in the EM stratum shifts generally towards vessels that take only one or two trips per year, the cost-effectiveness of the program could decrease. As discussed under Alternative 2, these vessels impose higher per-vessel costs on the program in terms of hardware and field services, in addition to higher data analysis costs. The cost of additional review for non-compliant logbooks would be borne by NMFS, and could not be paid through industry monitoring fees.[10] Over time, however, it is reasonable to expect the quality of EM logbooks to increase and the cost of data analysis to stabilize after a period of fleet learning and EM socialization.

As with Alternative 2, it is important to keep in mind that the cost of the EM program – and thus its impact on the Observer Program's overall mission – is limited by the fact that this action merely authorizes a new use of monitoring fees, but does not guarantee that the EM stratum will be part of the monitoring plan in any or all future years. If the economic and non-economic costs of the program outweigh the anticipated benefits, or do not improve the cost-effectiveness of data collection, then the ADP would not recommend an EM stratum.

[10] NMFS Alaska Region has the authority to charge a monitoring fee to industry under Section 313 of the MSA, but those fees may only be derived from a recovery based on landings. In other words, NMFS may use the ex-vessel based monitoring fee to fund the collection and review of video data or logbooks, but would need explicit authority from Congress to charge a separate fee for a particular duty such as re-reviewing video triggered by a non-compliant logbook. Charging a separate fee, in addition to the fee recovered from landings, might implicate the augmentation of appropriations laws that bar agencies from imposing agency costs for agency responsibilities onto industry. NMFS would not use the monitoring fee to cover the cost of typical agency responsibilities, such as routine management and reporting, or the administrative cost of developing a new logbook format for EM. (NOAA GC AK. Personal Communication, 2016.)

Summary of Economic Impacts of EM Alternatives

		Alternative 2 EM as tool for catch estimation	Alternative 3 Logbook as tool for catch estimation, with EM verification
RIR Impacts	***Vessels in the EM selection pool***	• Vessels choose whether to join EM, therefore they have made the net benefit is positive • Main costs are opportunity costs – time on installation, maintenance, at-sea operator responsibilities. May be more onerous for vessels operating in remote ports, where EM service is less frequent.	
	Catch Logbook	Alt 2: Not applicable	Alt 3: additional time cost for completing the catch logbook, and risk of violation if logbook is inaccurate
	Rockfish retention	Alt 2: Council option • simplifies rockfish requirements • Opportunity cost for retaining species that displace higher value fish; more likely to affect smaller vessels with less hold capacity	Alt 3: required
	Vessels in partial coverage but not using EM	• All who pay the fee have a stake in good data • "Competition" for limited deployment funds from the observer fee	Alt 3: 100% EM system requirement increases hardware costs, but logbook audit model means less cost for data review
	Processors	• No substantial impact unless dockside monitoring or full retention is required	
	Rockfish Retention	Alt 2: Council option • Costs from responsibility for disposal of non-marketable catch, and potential changes to accommodate dockside monitoring	Alt 3: required
	Observer Program	• Cost of EM affects Observer Program overall by impacting deployment in other strata • Alternatives regulate a process to allow EM, rather than a specific EM outcome • Council and NMFS will have annual opportunity to consider appropriate budget tradeoff between EM and human observer deployment	
	Rockfish retention	Alt 2: Council option • Rockfish retention would improve data quality for rockfish, provides opportunity to get biological samples, but may increase costs if dockside monitoring is required	Alt 3: required
	Catch Logbook	Alt 2: Not applicable	Alt 3: logbook quality may affect costs, as inaccuracies will drive need for more thorough EM review

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1 Introduction

This document analyzes a proposed management change to establish electronic monitoring (EM) as a part of the North Pacific Fishery Management Council (Council)'s fisheries research plan for the fixed gear groundfish and halibut fisheries of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). The Council's fisheries research plan is implemented by the North Pacific Observer Program at the National Marine Fisheries Service (NMFS)'s Alaska Fisheries Science Center, and its purpose is to collect data necessary for the conservation, management, and scientific understanding of the groundfish and halibut fisheries off Alaska. This document analyzes alternatives that would allow an EM system, which consists of a control center to manage the data collection, connected to an array of peripheral components including digital cameras, gear sensors, and a global positioning system (GPS) receiver, onboard vessels to monitor the harvest and discard of fish and other incidental catch at sea, as a supplement to existing human observer coverage.

This analysis was developed with input from a Council committee, the Fixed Gear EM Workgroup. In 2014, the Council appointed the EM Workgroup to develop and refine an EM program for integration into the Observer Program. The EM Workgroup provides a forum for all stakeholders, including the commercial fishing industry, agencies, and EM service providers, to cooperatively and collaboratively design, test, and develop EM systems, and to identify key decision points related to operationalizing and integrating EM systems into the Observer Program in a strategic manner.

This document is an Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA). An EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). This EA/RIR/IRFA addresses the statutory requirements of the Magnuson Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, Presidential Executive Order 12866, and the Regulatory Flexibility Act. An EA/RIR/IRFA is a standard document produced by the North Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

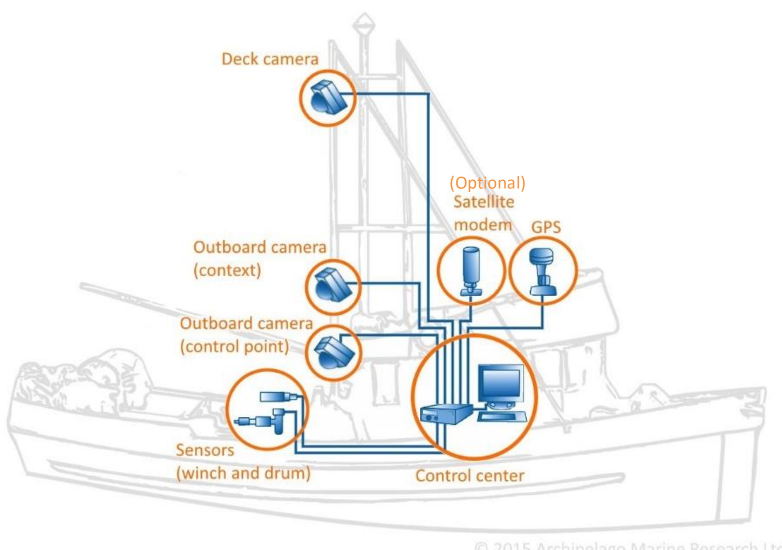
1.1 What is electronic monitoring?

In broad terms, electronic monitoring is the use of technology to collect data from fishing vessels. EM can collect a variety of different data, including retained catch, discarded catch, fishing location, and compliance with Federal fisheries regulations. An "EM system" encompasses the spectrum of EM equipment with varying features and capabilities, depending on the specific goal of the monitoring program. An EM system typically consists of a control center to manage the data collection and an array of peripheral sensor components that include: video cameras, GPS receiver, gear sensors, and optionally a satellite modem (Figure 1-1). The EM system should be a comprehensive data collection platform, designed to record large volumes of sensor and image data, operating autonomously for long periods of time. A typical EM system deployment is shown in Figure 1-2. This analysis anticipates that the EM system will change over time, as technological improvements are made.

Figure 1-1 An electronic monitoring system

Source: Archipelago Marine Research, Inc.

Figure 1-2 Example of a typical EM monitoring system depicting key components



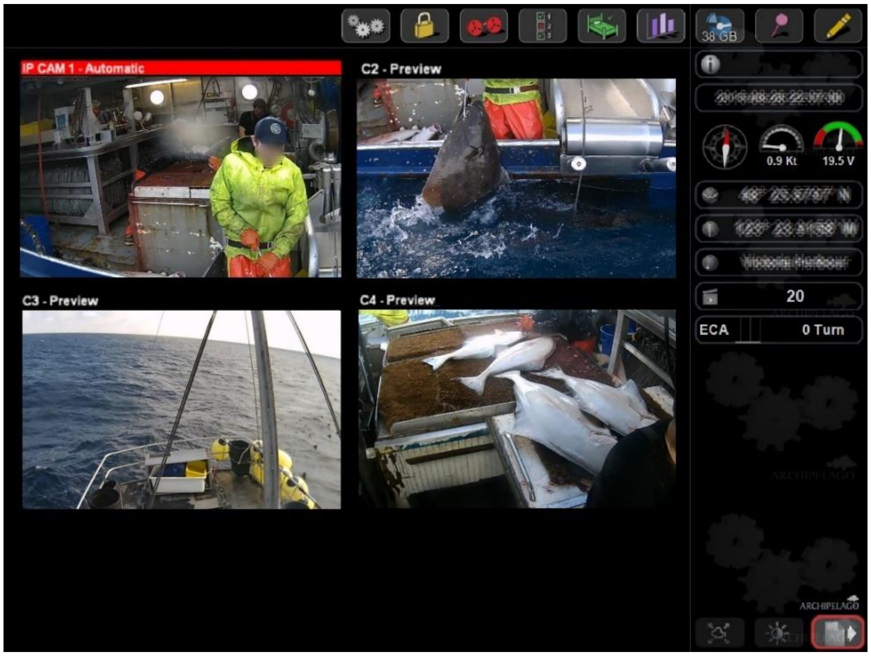
Source: Archipelago Marine Research, Inc.

Control Center and User Interface

The control center should record data reliably and securely, monitoring the status of sensors to trigger image recording from cameras. Based on previous research in the Alaska fixed gear fisheries, the EM system must be able to connect to at least four cameras. In addition, data must be easy to collect, and suitable for storage of several weeks of video and sensor data.

The EM system may also provide a display and user interface for the vessel master where operators can easily monitor the status and performance of each system component (Figure 1-3).

Figure 1-3 Example of EM system user interface showing camera views, sensor activity and status



Source: Archipelago Marine Research, Inc.

Power Management

Stable power is a challenge on many fishing vessels, and essential to ongoing data collection at sea. EM systems should be operable across a voltage range using both DC and AC power. To ensure consistent data collection, EM systems should have the ability to prevent data loss during ‘brown outs’ and short power loss through the use of an internal or external universal power supply, and a controlled shut down with extended power loss or when the vessel engines or generators are off, to reduce drain on vessel battery systems. The systems should automatically resume function when the power restarts.

EM System Data

The EM system should be able to consolidate data inputs from multiple sensors and cameras inputs into an integrated data stream. The EM system should be configurable to start and stop image data recoding using a variety of event triggers such as vessel speed, winch or hydraulic system activity, GPS location and/or time. The system should also allow for configurable video collection settings (triggers, frame rate, resolution) for individual cameras so as to achieve specific data collection goals (e.g., recording only during hauling versus always recording).

Security

The control center should be tamper resistant, and have password protection to limit access to system configuration settings. All data recorded by the EM system should be encrypted using advanced encryption standards, and ensure that encrypted data can only be unencrypted authorized data reviewers. All system settings, function tests, shut downs and malfunctions should be recorded in data logs.

Other requirements

The EM system should also have the capability to allow easy, safe, and reliable hard drive replacements by skippers and assurance that data are intact, and the new drive is initialized properly.

Sensors and Cameras

Video Cameras

Digital cameras used by the EM system should be housed in waterproof, low profile fixtures that are resistant to the extreme environmental conditions encountered on marine fishing vessels. The cameras need multiple installation options for placement on the vessel (rail, deck-view, seabird cameras that monitor setting of streamer lines). The cameras should provide high quality image resolution and frame rates to permit verification of species, catch handling, processing, and discarding.

Figure 5 Example of digital video imagery from EM system

Source: Archipelago Marine Research, Inc.

Sensors

A selection of the following sensors can be utilized to fully monitor vessel activity in the fixed gear fleet:

- A dedicated GPS receiver to deliver time, date, latitude, longitude, heading, vessel speed, and positional accuracy to the control center.
- A hydraulic pressure transducer to determine the vessel's fishing status by monitoring the pressure in the vessel's hydraulic systems. The pressure sensor is capable of monitoring the use of fishing gear.
- On a small number of vessels in the fleet, a drum rotation sensor can be used to determine the vessel's fishing activity by sensing the rotation winches used for hook-and-line, warps, or net drums.
- To enable 'sleep mode' of the system during inactive periods such as at night, use of an engine oil pressure sensor or similar indicator should allow the automatic starting/stopping of the control center along with the engine being powered on or off. This feature is essential to preserve vessel battery power during periods of inactivity.

Satellite modem

EM systems may also include a satellite modem capable of transmitting basic or complex system health data and/or image clips, GPS and sensor logs.

1.2 Purpose and need

In February 2016, the Council adopted the following statement of purpose and need:

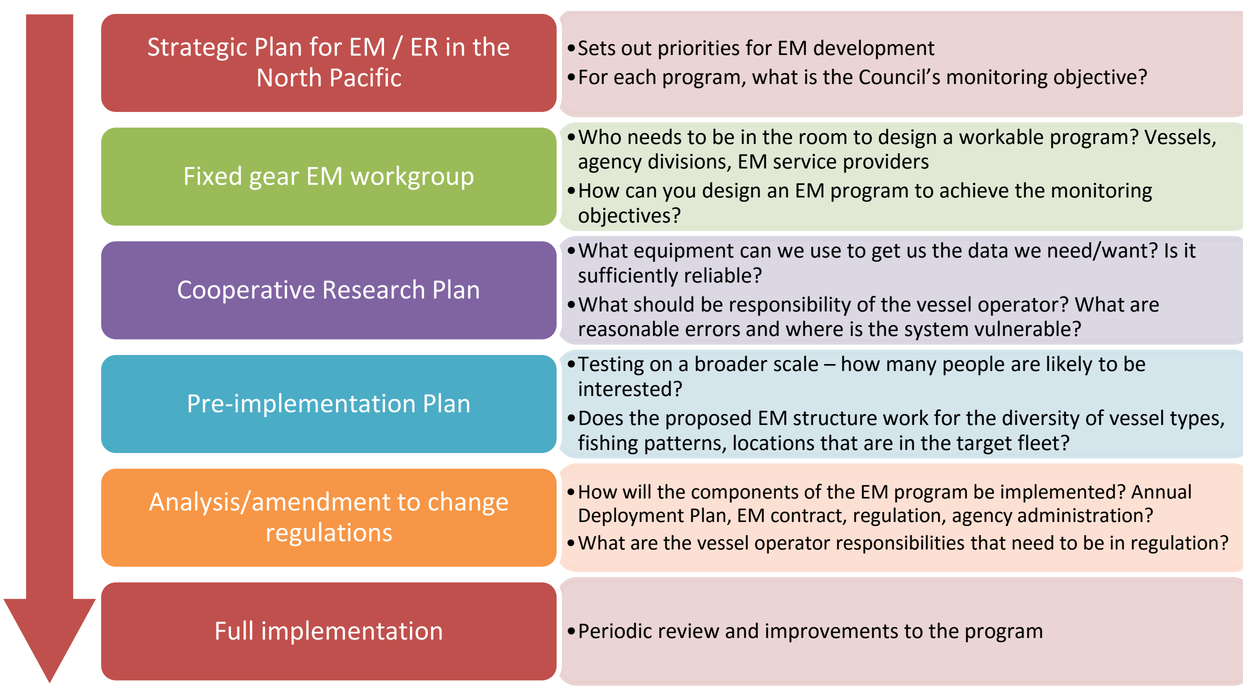
> To carry out their responsibilities for conserving and managing groundfish resources, the Council and NMFS must have high quality, timely, and cost-effective data to support management and scientific information needs. In part, this information is collected through a comprehensive fishery monitoring program for the groundfish and halibut fisheries off Alaska, with the goals of verifying catch composition and quantity, including of those species discarded at sea, and collecting biological information on marine resources. While a large component of this monitoring program relies on the use of human observers, the Council and NMFS have been on the path of integrating technology into our fisheries monitoring systems for many years, with electronic reporting systems in place, and operational EM in a compliance capacity in some fisheries. More recently, research and development has focused on being able to use EM as a direct catch estimation tool in fixed gear fisheries.
>
> The fixed gear fisheries are diverse in their fishing practices and vessel and operational characteristics, and they operate over a large and frequently remote geographical distribution. The Council recognizes the benefit of having access to an assorted set of monitoring tools in order to be able to balance the need for high-quality data with the costs of monitoring and the ability of fishery participants, particularly those on small vessels, to accommodate human observers onboard. EM technology has the potential to allow discard estimation of fish, including halibut PSC and mortality of seabirds, onboard vessels that have difficulty carrying an observer or where deploying an observer is impracticable. EM technology may also reduce economic, operational and/or social costs associated with deploying human observers throughout coastal Alaska. Through the use of EM, it may be possible to affordably obtain at-sea data from a broader cross-section of the fixed gear groundfish and halibut fleet.
>
> The integration of EM into the Council's fisheries research plan is not intended to supplant the need for human observers. There is a continuing need for human observers as part of the monitoring suite, and there will continue to be human observer coverage at some level in the fixed gear fisheries, to provide data that cannot be collected via EM (e.g., biological samples).
>
> The Council and NMFS have considerable annual flexibility to provide observer coverage to respond to the scientific and management needs of the fisheries. By integrating EM as a tool in the fisheries monitoring suite, the Council seeks to preserve and increase this flexibility. Regulatory change is needed to specify vessel operator responsibilities for using EM technologies, after which the Council and NMFS will be able to deploy human observer and EM monitoring tools tailored to the needs of different fishery sectors through the Annual Deployment Plan.

This analysis proposes a management change to integrate EM as an option for monitoring the Council's fixed gear BSAI and GOA groundfish and halibut fisheries that are subject to partial coverage. The action responds to a management need to effectively and efficiently monitor groundfish and halibut fisheries in a way that provides scientific data collection necessary for the conservation, management, and scientific understanding of the fisheries. Electronic monitoring and reporting technologies have been used successfully in other aspects of the Alaska fisheries to improve existing data collection programs, and their exploration is supported both by national policy and the Region's "Strategic Plan for Electronic Monitoring/ Electronic Reporting in the North Pacific" (NMFS 2013). The Council and NMFS have recognized the opportunity for EM to provide high priority fishery information for management and science; is relevant to policy priorities, including providing a monitoring tool that suits the needs of the observed fleet; is available when needed; and is obtained in a cost-effective manner.

1.3 History of action

The Council has been actively considering the use of electronic monitoring as part of the suite of fishery monitoring tools since the development of an analysis to restructure the Observer Program, on which the Council took final action in 2010, and which was implemented in 2013. Since that time, the Council, the agency, and industry members have all been active in the development of EM. Figure 1-4 shows the history of fixed gear EM development in Alaska. The building block of EM development is the "Strategic Plan for EM / ER[11] in the North Pacific" (NMFS 2013), which was reviewed and adopted by the Council in June 2013. The document lays out a plan for integrating monitoring technology into data collection programs for Alaska fisheries. Through that document, the Council identified their initial priority for developing camera systems, targeting a monitoring option for vessels 40-57.5 feet in length, which have difficulty accommodating a human observer onboard. These vessels only became subject to observer coverage under restructuring of the Observer Program in 2013, and many of the vessels are small halibut boats, with limited space onboard for an additional person or limited space in the vessel's life raft. The Council committed to developing EM as a monitoring alternative for collecting data to be used in catch estimation for this fleet. A number of these vessels were granted conditional release from observer coverage in 2013 and 2014, due to insufficient bunk space to accommodate an observer, or temporary exemptions due to insufficient life raft capacity for an additional person onboard. These releases/ exemptions created data quality issues in the small vessel (40-57.5 foot) observer stratum.

Figure 1-4 History of the Council fixed gear EM development



The Council created a Fixed Gear EM Workgroup in April 2014, as a forum for all stakeholders to work together on EM development. Stakeholders include representatives of the commercial fishing industry sectors, agencies (Council, managers, enforcement, the Observer Program), and EM service providers (equipment and service providers as well as video reviewers). The purpose of the Workgroup is to

[11] Electronic reporting

cooperatively and collaboratively design, test, and develop EM systems that are consistent with Council goals to integrate EM into the Observer Program. The time commitment from members is fairly intensive, however; the group met 4-5 times per year in 2014 through 2016. A National Fish and Wildlife Foundation grant has provided some financial support for industry participation. The Workgroup will likely continue to meet actively through full implementation, at which time the group may transition to a different role with reviewing and improving the program.

The Cooperative Research Plan, effective in 2015, was the first effort to bring together various EM pilot testing work that had been done previously, and begin to test systems designed to assess the efficacy of EM for catch accounting of retained and discarded catch. The research plan also helped to identify key decision points related to operationalizing and integrating EM systems into the Observer Program for fixed gear vessels. This morphed into a Pre-implementation Plan for 40-57.5 foot hook-and-line vessels in 2016, which continued to include research elements for other gear types, different EM equipment, and other hook-and-line size classes. In 2017, the Workgroup is recommending a pre-implementation program for any hook-and-line and pot vessels greater than 40 feet. With the creation of a concerted EM development fieldwork program, the Council and NMFS scaled back (2015) and eventually rescinded (2016) the granting of waivers to vessels having trouble accommodating a human observer, as the EM selection pool provided an alternative for those vessels.

The Workgroup established a process whereby new technology or program elements should be first field-tested for workability, and then more broadly operationally-tested in a pre-implementation environment. In this way, the Workgroup can evaluate whether a program element is conducive to deployment on the diversity of fixed gear vessels, by different operators employing individual fishing patterns. This process also allows for continued research and development, both of new technologies, and deploying EM gradually into different sectors of the fixed gear fleet.

The development of an EM analysis and regulatory amendment is linked to the research and pre-implementation plans, as these field efforts help to identify the appropriate questions for informing implementation decisions and Council alternatives for how EM can be used in a comprehensive monitoring plan. Even though the current EM development effort has focused on the Council's initial priority of small hook-and-line vessels that have difficulty in carrying a human observer, the analysis has broadened to address a regulatory change applying to all fixed gear vessels. The EM program design elements and sampling techniques are conceptually similar on all fixed gear vessels, although distinct from those of trawl vessels.

The analysis identifies how each element of the EM program will be implemented. While some aspects of EM require a regulatory change, other components are implemented through the Annual Deployment Plan, through a contract with an EM service provider, or through agency administration. The regulations need to identify operator responsibilities for fixed gear vessel operators using EM. On an annual basis, the Council has the flexibility, through the Annual Deployment Plan, to go through the process (field-testing and operational-testing) to ensure that new sectors can be brought into the EM program. For example, the Workgroup is interested in starting work on developing EM models appropriate to the under 40 foot hook-and-line vessels, which are currently not required to carry observers. New technology can also be tested through pilot implementation programs within the EM pool through the Annual Deployment Plan, and use of specified systems will likely be implemented through the contact to the EM service provider.

The proposed timeline for the development of EM for fixed gear vessels has been an aggressive one, requiring considerable workload by Council and agency staff and the Workgroup, and the Council has prioritized this work above other projects at many stages. Under the current best scenario timeline, regulations would be prepared in 2017, and the integrated program would be implemented for the 2018 fishing year. Table 1-1 lays out concurrent timeframes for EM fieldwork and pre-implementation, beginning in 2014 through eventual implementation in 2018. The EM fieldwork and pre-implementation that occurs before EM is implemented into the monitoring program has to be financed with independent funding sources, currently a combination of Federal funding and National Fish and Wildlife Foundation grants. Once EM is implemented, the partial coverage observer fee will be used for both human observer coverage and EM deployment, with some potential need for Federal startup funds during the transition to industry funding. Table 1-2 provides a more detailed rendering of the milestones between Council final action, scheduled for December 2016 under the best case scenario, and implementation in 2018.

Table 1-1 Best case timelines for EM fieldwork, Council process, and Observer Annual Deployment Plans

Year	Fieldwork / Pre-implementation (Pre-Imp)	Council process, regulations	Observer Program/ Annual Deployment Plan (ADP)
2014	*Fieldwork*	*EMWG develops 2015 Cooperative Research Plan (CRP), discusses alternatives for analysis*	*Oct – 2015 ADP places 10 vessels that are participating in EM research into the no selection pool*
2015	*Feb – SSC reviews CRP* *Jan-Jul – operational longline, stereo camera, pot cod field research*	*Feb – SSC, Council review CRP* *Oct – propose a 2016 Pre-Implementation plan to Council*	*Oct – 2016 ADP proposes all EM Pre-Imp vessels in no selection pool*
2016	Jan-Dec – Pre-implementation on 53 longline vessels 40-57.5'. *Jan-Apr – pot cod field work* *Jan-Jul – Stereo camera research on 3-5 longline and pot vessels*	Oct – initial review for EM analysis to integrate EM into observer program. Dec – final action on EM analysis	Oct – 2017 ADP proposes all EM Pre-Imp vessels in no selection pool
2017	Jan-Dec – Second pre-implementation year for longline vessels >40', and proposed pre-implementation for pot vessels. Potential research on other technology.	Jan-Aug – Develop proposed and final regulations for integrating EM, hold MSA-required hearings in AK, WA, OR	June – Annual Report provides prelim analysis on allocating observer fee between observer and EM deployment Oct – 2018 ADP allocates funding to observers and EM deployment
2018	**Integrated observer/EM monitoring program**		

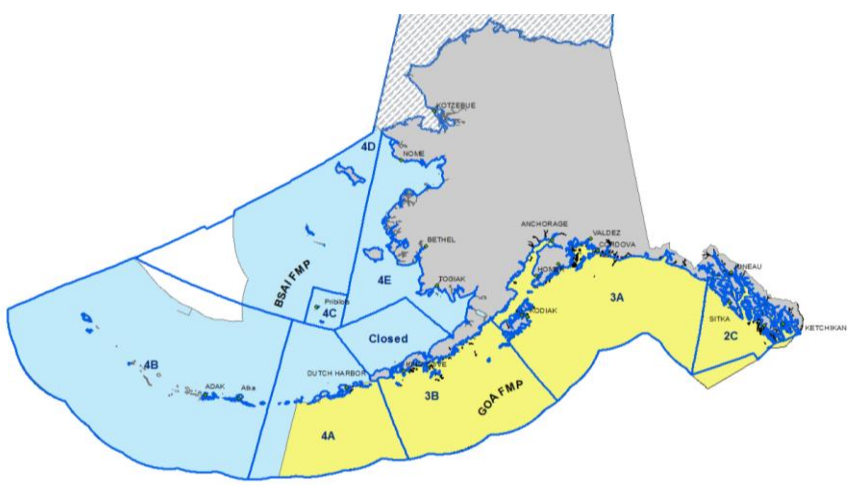
Table 1-2 Detailed implementation timeline and milestones, under a best case scenario

Month	Milestone	Comments
December 2016	**Council final action**	
March 2017	Publish **proposed rule**/notice of availability of **FMP Amendment**	
April - June 2017	Public comment period and hearings	60-day comment period and hearings requirements are in MSA 313(c)
June 2017	**Annual Report** to Council presenting NMFS's recommended EM selection pool for upcoming year (2018).	The EM selection pool is the universe of vessels that can participate in EM based on, for example, vessel size, gear type, area fished, port.
June - August 2017	Write/review **Final rule** Approve **FMP Amendment**	Assumes 1 month GC review, which is less than the average review time.
August - September 2017	Write **ADP**; review by OAC, Plan Teams	
	Final rule publishes before September 1	30 day cooling-off period required before it is effective. Effective October 1, at the latest
	Contract(s) awarded	(estimate)
October 2017	Council reviews draft **ADP**	ADP includes the EM selection pool, an EM selection rate, etc., based on analysis of costs, partial coverage budget, selection pool size, etc.
	NMFS announces EM opt-in period and the defined EM selection pool	May be a challenge for Pacific cod, which opens on January 1.
	Vessel opt-in period	Opt-in using ODDS.
December 2017	Final **ADP**, with EM selection pool, EM selection rate, etc.	
	Start Vessel Monitoring Plan and installation process	
January 2018	NMFS starts selecting vessels for EM coverage	

1.4 Description of Management Area

The proposed action affects fixed gear groundfish and halibut catcher vessels throughout the BSAI and GOA groundfish management areas, and throughout the Alaska halibut management areas (Figure 1-5).

Figure 1-5 BSAI and GOA groundfish management areas
Light blue = BSAI Groundfish FMP area, Yellow = GOA Groundfish FMP area, Blue lines = IPHC halibut management areas (2C, 3A-B, 4A-E)



2 Alternatives

In February 2016, the Council adopted the following alternatives to be analyzed as part of the Council's EM Integration analysis. The alternatives are designed to meet the purpose and need for this action. Note, in the Alternative 2 Option, it is the suggestion of the EM Workgroup to replace the word "key" with "rockfish", as it more accurately reflects the intent of the option. Unless the Council demurs, this change will be made permanent in future versions of this analysis.

Alternative 1: No Action - EM is not a tool in the Council's Research Plan

Alternative 2: Allow use of EM for catch estimation on vessels in the EM selection pool

Option: Require full retention of ~~key~~ rockfish species with associated dockside monitoring

Alternative 3: Allow use of EM for compliance monitoring of vessel operator logbooks used for catch estimation

As part of initial review in October 2016, the EM Workgroup encourages the Council to identify a preliminary preferred alternative. To date, at the Council's direction, EM program development in Alaska has focused primarily on an EM program as captured in Alternative 2. This is in part because in pursuing EM exclusively for catch estimation, the Alaska program is breaking new ground, while an Alternative 3-style logbook program has been successfully implemented in other regions. If the Council chooses to change direction and pursue Alternative 3, additional program development and pre-implementation would be required to fully test how a logbook program would work in the field.

2.1 Alternative 1 – No Action

Under the No Action, or status quo, alternative, at-sea fisheries monitoring in the partial coverage category is accomplished with a human observer pool, through a flexible deployment plan that allows the Council and NMFS to make annual policy choices on which vessels are monitored in different selection pools, and the selection rates assigned to each pool. Under the status quo, the industry observer fee that is assessed in partial coverage fisheries, 1.25 percent of the ex-vessel value of all landings to support at-sea monitoring, can only be used to fund the human observer program. The preamble to the final rule implementing the restructured Observer Program provides extensive detail on how observers are deployed in the partial coverage category, and the fee system (see 77 FR 700621, November 21, 2012).

In 2015 and 2016, the Council has authorized a select number of hook-and-line catcher vessels to be included in the zero selection pool for human observers, while these vessels are testing the feasibility of using EM for at-sea fisheries monitoring. While the at-sea data collected from these vessels have been important for developing the EM program, it has not been used for managing the fishery.

2.2 Alternative 2 – Allow EM for catch estimation on vessels in the EM selection pool

Alternative 2 would integrate EM into the Observer Program to allow EM to be used in addition to human observers for the purpose of monitoring at-sea fixed gear groundfish and halibut fishing activity in the partial coverage category of the Observer Program. The implementation of Alternative 2 would bring EM as an option into the process by which the Council and NMFS make annual policy choices on which vessels are monitored in different selection pools, and the level of monitoring required for each pool.

The integration of EM into the Observer Program would mean that NMFS would enfold EM into their Observer Program infrastructure, management, and oversight, including the annual process of developing the Annual Deployment Plan (ADP) and evaluating the monitoring program through the Annual Report.

The reviewed EM at-sea data would be used in catch estimation for NMFS' catch accounting and fishery management. Chapter 3 (Integrating EM) provides a detailed discussion of these features of Alternative 2, and how NMFS and the Council would integrate EM into the Observer Program.

Regulatory changes under this alternative include identifying the process by which fixed gear vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool. The regulations will direct each vessel operator to comply with a Vessel Monitoring Plan that specifically tailors the requirements to the vessel's unique characteristics.

On an annual basis, the Council and NMFS will determine what deployment model is appropriate for the EM selection pool or pools through the Annual Deployment Plan (ADP). Annual decision points may include whether there is to be an EM selection pool, and if so, the fisheries, gear or operational types, or vessel sizes in the EM selection pool, the EM selection rate and selection mode, and primary service ports for EM. These annual decisions will be influenced by the stage of EM development in a particular fishery or using a particular EM technology, a process which is discussed in more detail in Section 3.5. As a result, the fishery sectors for which an EM selection pool is available may change over time. For example, pre-implementation to date has focused on hook-and-line and pot catcher vessels greater than 40 feet length overall; EM development has not yet extended to other fixed gear partial coverage sectors. An important part of this annual process would be the allocation of the available budget between human observer deployment and EM deployment.

Under this alternative, NMFS will set up a contract or grant with one or multiple EM service providers to install and service EM equipment, and to collect and review EM data. The contract or grant will specify hardware and field service specifications, and EM data review (both as to timeliness and specificity) and archiving requirements. Because a contract is likely to be for multiple years, and some of the deployment decisions have a significant impact on EM provider costs (for example, the number and location of primary service ports), there may be some deployment decisions that are made on a multi-year cycle consistent with the EM contract, rather than varying annually in the ADP. Similarly, it is anticipated that the EM system will change over time, as technological improvements are made, and these changes will be accommodated in the contract or grant.

Under Alternative 2, the Council would incorporate EM as a monitoring option in the Council's "fisheries research plan", which is how the Magnuson-Stevens Act refers to the Observer Program. The Council's groundfish FMPs would be amended to reflect the inclusion of EM. As a result, the industry observer fee could be used to pay for at-sea monitoring either through EM or human observers.

2.2.1 Option: Require full retention of all rockfish species with associated dockside monitoring

Under Alternative 2, the analysis includes an option to require retention of all rockfish species by vessels when using EM. Current regulations require discard over maximum retainable amounts (MRAs) when an allocated species is closed to directed fishing (bycatch status)[12], or discard of any amount of the species once it is placed on prohibited species status. Under this option, the regulations would be changed to require retention of all rockfish species by vessels using EM, regardless of the management status of rockfish species.

While EM studies to date have shown that in most cases, it is possible to identify fish to the species or species complex required for management, there are some species groupings that are difficult to distinguish. For example, it is difficult to differentiate the individual species among groupings of

[12] The only exception to this is for incidental catch of demersal shelf rockfish (DSR) species in Southeast Outside waters (NMFS reporting area 650), where full retention of all DSR species in area 650 is required.

shortraker and blackspotted/rougheye rockfish, or shortspine and longspine thornyhead rockfish. Under this option, vessels that are using EM would be required to retain all rockfish, so that the rockfish could be speciated dockside once they are landed. The option is intended to implement a simple and consistent policy for all rockfish, rather than requiring fishermen to identify and remember which rockfish species must be retained and which must be discarded. On an annual (or multi-year) basis, the Council and NMFS would determine the requisite level of dockside monitoring, and who would provide it: whether speciation by plant personnel is sufficient, or whether dedicated dockside monitors are needed. If the latter, these could be provided either by the EM service provider, as a requirement of the EM contract, or human observers under the partial coverage contract could be detailed for dockside monitoring through the Annual Deployment Plan.

Regulations would be crafted with regard to the disposal of retained rockfish species. Under current regulations for retained Demersal Shelf Rockfish species (50 CFR 679.20(j)), species that are within the MRA amounts can be sold, but species in excess of that amount cannot enter commerce through sale, barter, or trade. They may, however, be used for personal consumption or donation. Regulations for retained rockfish under this option would likely be similar in character.

The EM Workgroup discussed changing the requirement for full rockfish retention to apply uniformly to all fixed gear vessels, rather than limiting it only to fixed gear vessels using EM. Industry representatives on the Workgroup supported extending the retention requirement because it would result in a consistent regulation for rockfish retention across all regulatory areas and species, and would apply regardless of whether a vessel is using EM. Retaining rockfish would also reduce waste if the retained rockfish were donated or otherwise used. If the Council were to change the intent of this option, to apply full retention to all fixed gear vessels, the purpose and need statement would need to be modified, along with the scope of this EM analysis. Another possibility would be to evaluate a universal rockfish retention requirement in a separate Council analysis, either on a parallel track or as a trailing action. The Workgroup highlights this issue for the Council, but does not have a specific recommendation.

2.3 Alternative 3 – Allow EM for compliance monitoring of operator logbooks used for catch estimation

Under Alternative 3, EM would be used as verification of vessel operator logbooks, which are the data collection tool for key species. The logbooks would be used as a data source for catch estimation. All vessel operators in the EM selection pool would be required to complete a logbook of discarded target species and key bycatch species of concern. For rockfish species, where species identification can be challenging, full retention of all species would be required. All vessels would carry EM systems, and to verify the accuracy of the logbooks, a review of the footage from EM cameras would be used to audit the operator logbooks. The exact amount could be specified annually in the ADP based on available budget, but in keeping with similar programs elsewhere, might begin at a threshold of 10 to 20 percent.

Vessel operators would be required to log and retain the following species:

Longline vessels:

- Require operators to log all discards of halibut, sablefish, Pacific cod, and sculpins
- Require EM vessels to retain all rockfish (for dockside monitoring)
- Require logging of all seabird interactions (including extended presentation to the camera of dead seabirds)

Pot vessels:

- Require operators to log all discards of Pacific cod, octopus, crab, and sculpins

All other incidental species would be estimated from the EM video audit and/or from the human observer strata. As the first priority would be to input data from the logbooks, the timeliness of data from EM video review is likely to be slower than under Alternative 2.

As with Alternative 2, the regulations would identify the process by which vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool, in terms of completing the logbook, installation and maintenance of the EM system, catch handling requirements, and what happens in case of EM system failure. It would be regulated that each vessel operator must comply with a Vessel Monitoring Plan designed specifically for his or her vessel. In a similar manner to the Alternative 2 option, the regulations would also specify the disposition of retained bycatch species.

The regulations would prohibit falsifying the logbook data. If the logbook is found to be inaccurate, based on the EM audit, then that may result in a violation. In other regions that have implemented a similar program, the consequence is that the vessel operator has to pay the cost of a full EM audit, but this is not a legal option in Alaska. Other regions also use information from the EM review, where it differs from the logbook, to adjust IFQ accounts, as well as harvest mortality and prohibited species catch information that is used to manage the status of fisheries where applicable. For Alaska, this is not possible under current regulations, and would require a change in how halibut is debited from IFQ accounts and in how PSC is allocated to the Pacific cod fixed gear fisheries.

On an annual basis, the Council and NMFS would determine whether to allow an EM option in the ADP, and vessel operators would be able to opt into the EM pool. NMFS would set up a contract with an EM service provider to install and service the EM systems, and audit the logbooks against EM data. As the Council and NMFS have not yet tested the logbook model in the Alaska fisheries, some cooperative research would be necessary to develop an appropriate EM logbook. Once it is part of the Council's "fisheries research plan", the logbook/EM system could be funded through the industry observer fee.

2.4 Comparison of Alternatives

Table 2-1, Table 2-2, and Table 2-3 provide a comparison of the alternatives in this analysis, with respect to their operational differences, and impacts.

Table 2-1 Summary of Alternatives, by Operational Differences

		Alternative 1	Alternative 2	Alternative 3
		Human observer program only	**EM as tool for catch estimation**	**Logbook as tool for catch estimation, with EM verification**
Operational Differences	*Observer fee*	1.25% of ex-vessel value for all landings in partial coverage fisheries	No change	No change
	Coverage requirements	Determined annually in ADP (in 2016, all vessels ≥40' in gear-specific stratum)	EM selection pools determined annually in ADP; vessels may opt in/out of selection pools annually	Same
		Target coverage rates determined annually in ADP (15% in 2016)	EM target coverage rates determined annually in ADP (30% in 2016)	100% coverage of all vessels in selection pool
	Retention requirements	Rockfish over the maximum retainable amount must be discarded*	Option: require rockfish retention for dockside monitoring for vessels when using EM	Require rockfish retention for dockside monitoring for all vessels in EM selection pool
	Source of catch estimation discard data	Observer data	EM video review for all species, and observer data	Vessel logbook for key species (target and incidental species of management concern); EM video review for remaining; observer data
	Amount of data	Observers randomly sample catch on a random selection of trips	EM intended to capture all hauls on EM-selected trips; video review of a random selection of hauls with complete sensor and video data provides a census of catch	Logbook of information on discard of key species required for all vessels; EM audit of a random selection of hauls, smaller proportion than Alt 2
	Timeliness of data	Observer report is transmitted at trip-end	Hard drives mailed at end of trip; EM video review turnaround is high priority	Logbook data is transmitted at end of trip; EM video review for audit/ estimating remaining species is lower priority
	EM system components	None	Sensors, control box, deck cameras, rail cameras	Same as Alt 2, plus catch logbook
	Key enforcement mechanism	Vessel required to comply with observer regulations	Vessel required to comply with Vessel Monitoring Plan (VMP) and regulations	Same as Alt 2, plus vessel required to accurately report catch in logbook**

* except demersal shelf rockfish in Southeast Outside; ** where NOAA Office of Law Enforcement determines the standard of reporting "accuracy"

Table 2-2 Environmental Impacts of the Alternatives

		Alternative 1 Human observer program only	Alternatives 2 and 3 EM alternatives
Environmental Assessment Impacts	***Goals achieved with restructuring***	Unbiased discard data	Yes
		Ability to adapt monitoring to specific needs	More flexibility for monitoring on vessels where human observers are not practicable Less human observer coverage as fee is supporting both options
	Data collection		Where EM cannot duplicate an observer function, impact is a reduction in overall data not elimination of that data; observer data will be used to generate estimates, per established procedures.
	Fish	Species ID, count – based on sample	Yes, based on census
		Weight/ sex/ length	No
		Biological samples/ special projects	No
	Marine mammals	Information on interactions (location, date/time, gear, fishing depth, catch composition)	Not unless brought onboard dead No marine mammal interactions recorded to date in pre-implementation
		Information on gear entanglements (length, tissue samples, disposition)	No
	Seabirds	Species ID, count, tag recovery	Yes for species ID and count, if handling protocols adhered to Procedures needed if vessel operators are asked to collect specimens
		Compliance with streamer lines	Yes

Table 2-3 Economic Impacts of the EM Alternatives

		Alternative 2 EM as tool for catch estimation	Alternative 3 Logbook as tool for catch estimation, with EM verification
RIR Impacts	***Vessels in the EM selection pool***	• Vessels choose whether to join EM, so therefore they have made the calculation that the cost/benefit is worthwhile • Main costs are opportunity costs – time on installation, maintenance. May be more onerous for vessels operating in remote ports, where EM service is less frequent.	
	Catch Logbook	Alt 2: Not applicable	Alt 3: additional time cost for completing the catch logbook, and risk of violation if logbook is inaccurate
	Rockfish retention	Alt 2: Council option • simplifies rockfish requirements • Opportunity cost for retaining species that displace higher value fish; more likely to affect smaller vessels with less hold capacity	Alt 3: required
	Vessels in partial coverage but not using EM	• All who pay the fee have a stake in good data • "Competition" for limited deployment funds from the observer fee	Alt 3: 100% EM system requirement means more intensive hardware costs, but audit only means less cost for data review
	Processors	• No substantial impact unless dockside monitoring or full retention is required	
	Rockfish Retention	Alt 2: Council option • Costs from responsibility for disposal of non-marketable catch, and potential changes to accommodate dockside monitoring	Alt 3: required
	Observer Program	• Cost of EM affects Observer Program overall by impacting deployment in other strata • Alternatives regulate a process to allow EM, rather than a specific EM outcome • Council and NMFS will have annual opportunity to consider appropriate budget tradeoff between EM and human observer deployment	
	Rockfish retention	Alt 2: Council option • Rockfish retention would improve data quality for rockfish, provides opportunity to get biological samples, but may increase costs if dockside monitoring is required	Alt 3: required
	Catch Logbook	Alt 2: Not applicable	Alt 3: logbook quality may affect costs, as inaccuracies will drive need for more thorough EM review

2.5 Potential option: allowing EM as a monitoring tool when fishing in multiple IFQ areas

In February 2014, the Council reviewed a discussion paper on a concern raised in public testimony about the ability to fish halibut IFQ, halibut CDQ, and sablefish IFQ in multiple regulatory areas during the same trip, under the restructured Observer Program. Under the current regulations, vessel operators may retain IFQ or halibut CDQ exceeding the amount available in the individual area being fished *only* if they have an observer onboard the vessel (50 CFR 679.7(f)(4)). Having an observer onboard allows vessels with IFQ or CDQ in multiple areas to harvest their fish on a single trip; without an observer, this practice is not allowed.

Since 2013, under current Observer Program regulations, most vessels fishing for IFQ or halibut CDQ are in the partial coverage category, where observers are deployed randomly by NMFS under the ADP. NMFS regulations do not authorize voluntary observer coverage for vessels in the partial coverage category. NMFS is concerned that voluntary observer coverage would create the potential for data quality problems (fishing behavior may change if observers can be taken voluntarily on selected trips) and operational issues (the need to identify these trips separately in observer data, and the need to re-program the catch accounting system to exclude these data for catch estimation). In addition, NMFS requirements for safety, support, and assistance to observers do not apply for observers taken voluntarily. Moreover, NMFS does not support using observer days in the partial coverage category to provide an observer for this strictly compliance monitoring role. For these reasons, vessel operators no longer have the option to hire an observer directly from an observer contractor if they wish to fish in multiple regulatory areas and retain catch in excess of their available IFQ or halibut CDQ for one area. The only option available to conduct fishing in multiple areas is if the vessel is randomly selected for observer coverage. The Council has heard testimony that vessel operators seeking observer coverage to IFQ or halibut CDQ fish in multiple areas may attempt to manipulate trip logging through ODDS by logging and then cancelling a trip until the vessel is selected for coverage.

The February 2014 discussion paper suggested that a solution to this issue could be to allow the use of electronic monitoring instead of observer coverage to monitor IFQ fishing in multiple regulatory areas, rather than using an observer for this compliance monitoring role. The EM systems have been developed and tested, and include sensors to determine when fishing is occurring, GPS units to determine where the vessel is located and how it is moving, and video cameras which can be reviewed in order to monitor how many fish were harvested in each regulatory area.

The EM Workgroup recommends the Council add a regulatory option to this EM Integration Analysis to allow vessel operators to retain IFQ or halibut CDQ exceeding the amount available in the individual area being fished if they are <u>either carrying an observer or EM</u>. In this way, vessels that want to be able to fish in multiple areas may choose to carry and use EM, with the option to have the camera system to monitor compliance as to how many fish were harvested in each regulatory area. Some of the issues that apply to voluntary observer coverage would still need to be addressed for EM in this situation, particularly if, in the EM selection pool, EM is deployed on a trip selection model where each trip is subject to random selection for coverage. At the same time, other issues are not applicable. Once an EM system is installed on a participant boat in the EM selection pool, the same duty of care for the equipment applies regardless of whether the system is operational on a given trip. There is some cost associated with video review of non-selected trips, but the use of the EM system in these circumstances is dissimilar in that it is not directly trading off with the ability to deploy those observer days in another fishery during that time; the capital investment in the EM equipment is already committed to that vessel. If the Council does support allowing this regulatory option as part of this analytical package, some coordination with the IPHC would be required. Because regulations governing halibut IFQ and CDQ fishing in multiple regulatory areas are addressed in both Federal fishery regulations and IPHC regulations, implementation of a regulatory amendment change to this provision may also require a complementary action by the IPHC.

It is uncertain how many IFQ and halibut CDQ vessel owners are facing restrictions due to the current regulations, although testimony by IFQ fishery representatives in June 2013 first identified this issue for the Council, and expressed the importance of being able to fish IFQ in multiple regulatory areas to reduce the costs of fishing, the potential for increased amounts of unfished IFQ if vessel owners cannot combine "clean-up" trips for multiple areas, and the possibility that the situation will become more costly and limiting if halibut and sablefish catch limits decline in future years.

2.6 Alternatives considered but not carried forward

The EM Workgroup recommended that the Council consider a trailing amendment to this analysis, to evaluate the feasibility and potential cost savings associated with EM cooperatives, where a particular group of vessels would contract specifically with an EM provider to meet their monitoring needs over the course of a year. It was represented that this concept shows promise for meeting the goals of the program with respect to providing cost savings, while maintaining a high level of data quality. The complexity of the Federal contracting system, however, is such that fully specifying and analyzing this alternative as part of the initial Council EM Integration analysis would have delayed initial review on that package, and consequently would have delayed the possibility of 2018 implementation. As a result, the Workgroup and the Council recommended that this concept be evaluated as a trailing amendment.

3 Integrating EM into the Observer Program

Integrating EM into the Observer Program is a complex project with many components. This chapter addresses all of the components necessary to integrate EM and to use EM data for fishery management and stock assessment.

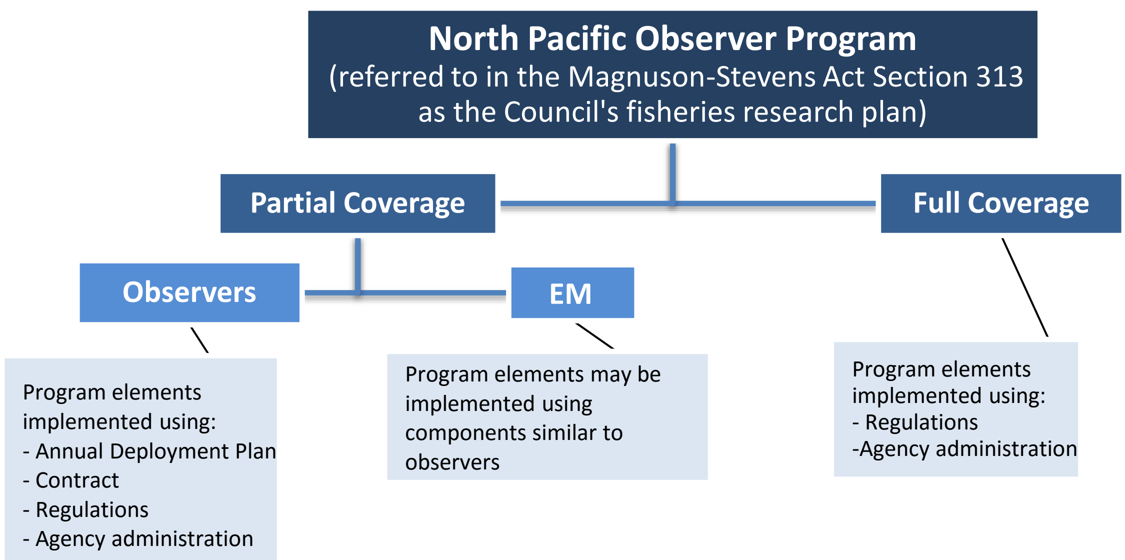
3.1 Implementation vehicles for the EM program

This analysis considers broadly the costs and benefits of a functioning EM pool as part of the Council's fishery monitoring program. To understand how EM would work under either Alternative 2 or 3, it is necessary to understand how the Observer Program is structured, and how EM would be integrated into that program. The following sections describe the current implementation structure for the North Pacific Observer Program (Section 3.1.1), and then describe the various components of an EM program (Section 3.1.2) and a preliminary assessment of how they will be implemented on an annual basis (Section 3.1.3).

3.1.1 Current implementation structure of the North Pacific Observer Program

As EM is integrated into the Observer Program, the different components of the program may be implemented through regulation, the annual deployment plan, contracts, or administration by NMFS (Figure 3-1). Note that the Observer Program has a full coverage category and a partial coverage category, however the Council is only considering integrating EM into the partial coverage category with this action. No changes will be made to the full coverage category.

Figure 3-1 Diagram of the North Pacific Observer Program, with EM added to the partial coverage category



To facilitate the discussion about how to integrate the different elements of EM into the partial coverage program, the following describes how elements of the current partial coverage observer category are implemented. Figure 3-2 provides additional detail about each element.

> The **Annual Deployment Plan (ADP)** documents how NMFS intends to assign at-sea and shoreside observers to vessels and processing plants engaged in groundfish and halibut fishing in the North Pacific. The ADP addresses the changing needs of fisheries management and stock assessment by providing a flexible design that may be adjusted annually.

The **observer provider contract** supplies qualified observers to vessels in a timely fashion and provides logistical and operational support including travel to deployment locations, safety and communications.

The Observer Program **regulations** describe vessel owner or operator responsibilities.

Agency administration of the Observer Program ensures that observers collect high quality data, and that observer data are integrated into the catch accounting system in a timely manner so data can be used for management.

Figure 3-2 Elements included in each of the implementation vehicles for the current human observer program

Annual Deployment Plan (ADP)

- Defines pool of vessels and shoreside processors eligible to be selected for coverage
- Defines strata based on factors that are known prior to vessel departure (e.g. gear type, vessel size). The strata definitions can change on an annual basis.
- Describes the selection rate for the strata based on estimated effort and budget
- May include policy decisions regarding observer development to address scientific and management needs (for example, the Bering Sea Aleutian Islands Pacific cod fleet voluntarily selecting full observer coverage).

Contract

- Defines the qualification requirements for observers to be hired by the contractor
- Defines observer duties and data collection requirements
- Identifies the contractor roll in the ODDS call center
- Describes the contractors responsibilities regarding logistic and operational support for observer deployment
- Requires contractor to describe how the quality and timeliness of observer data will be ensured.
- Describes performance standards contractor must meet to be considered successful and receive a positive past performance rating.

Regulations

Requirements for:

- Logging fishing trips
- Paying fees
- Making vessel available and carrying observers when selected for coverage
- Ensuring observers have a safe environment and are able to collect required data when aboard.

Agency Administration

- Train observers prior to deployment
- Provide inseason support during deployment
- Debrief observers at the end of deployment
- Manage and disseminate data collected by observers
- Maintain and evaluate methods to integrate observer data into catch accounting

3.1.2 EM program components

The analysis breaks out the different components have been identified within an EM program. The components are:

1. EM deployment design
2. Participation
3. Equipment and installation
4. Operation
5. Data and equipment retrieval
6. EM data and Catch Accounting
7. EM data retention and storage
8. Feedback Mechanisms
9. Fees/Funding/Costs

For each of the EM components, the following identifies its goal, and elements that may be included in the component.

1. EM Deployment Design

Goal: *Use best available information to design the EM deployment methods, including the EM selection pool, which meet policy and data collection goals.*

- Use the ***ADP*** process to define the
  - EM deployment methods and coverage rates
  - Allocate budget between EM coverage and observer coverage
  - EM selection pool (the universe of vessels that can participate in EM based on, eg, vessels size, gear type, area, and/or port)
  - EM data collection goals and methods (types of data collected by EM vessels, seabird handling, depredation)
- Use the ***Annual Report*** for performance review and analysis of EM coverage and data
  - Representative deployment
  - Data quality
  - Achieved coverage rate and monitoring rate

2. Participation

Goal: *A pool of EM participants that are capable and committed to making EM work on their boats.*

- Opt-in process - NMFS to notify the universe of vessel owners defined by the selection pool and provide the opportunity for eligible vessels to opt-in.
- Once a vessel has opted in to the EM program, they must remain in during the calendar year, and they will remain in the program until they choose to opt-out during the next opt-in/opt-out period.
- Opt-in/out period - NMFS will define a period when vessels can opt-in -out of EM selection for the following calendar year
- Eligibility to participate contingent on:
  - qualifying for the EM selection pool
  - compliance with the vessel monitoring plan (VMP)
- Selection of vessels to carry EM during selection periods (selection can be by vessel or trip)

3. Equipment and installation

Goal: *Appropriate EM equipment (wiring/sensors, cameras, monitors, hard drives) gets properly installed on each vessel, at the right port, and in a timely fashion, with the least interruption to the fishing plan.*

- NMFS contracts with service provider to provide and install equipment on each vessel
  - Specifications/performance standards for equipment would be in the contract (few, if any, regulations would be needed to specify equipment)
  - Contractor works with a vessel operator to write a VMP, which can be amended between trips working with the contractor.
  - Equipment/installation paid for using observer fees or other funding as available (including vessel owner's)
  - Maintenance/replacement of equipment
  - Vessel operator's responsibilities to ensure contractor has all needed access and assistance (similar to 2016 pre-implementation plan) prior to and during installation.
  - Compliance monitoring and recourse if installation is not successful
- VMP Process – NMFS will define general template for VMPs in the EM provider contract, and will specify the NMFS approval process for initial and amended individual VMPs.

4. Operation

Goal: *Each vessel operator maintains a functioning EM system throughout the fishing trip and there is a good process for maintaining quality control and addressing equipment failures.*

- Vessel operator's responsibilities in the operational plan, part of the VMP
- Types of responsibilities include stable power supply, function tests, breakdown, hard drive capacity, video quality, catch handling, effort logbook – all from 2016 EM pre-implementation plan, others depending on information gathered during pre-implementation.
- Flexibility to address equipment malfunctions while at-sea
- If a critical failure occurs at-sea, then the vessels can remain fishing but the next trip will automatically be selected for EM coverage.
- Critical EM system malfunction, vessel must remain in port for up to 48 hours for repairs, vessel released if repairs can't be fixed within 48 hours. Malfunction must be fixed prior to departing on subsequent trips
- First trip quality control and electronic record - recommended
- Dockside observer to verify EM data or collect data that cannot be obtained from EM (optional)

5. Data and equipment retrieval

Goal: *EM equipment with data returned to NMFS timely and in good condition.*

- Transmit hard drives/data to NMFS/contractor
- Un-install equipment
- Coordination with contractors (schedules, ports, etc.)

6. EM data and Catch Accounting

Goal: *Extract information from EM system and integrate it into the catch accounting system in a timely manner so that data can be used in management.*

- Methods for video review
- Method for integrating data from video review into catch accounting
- Methods for certifying video review entities
- Methods for other types of data (seabird handling, depredation)

7. EM data retention and storage

Goal: *Retain EM data (video and data derived video review) in an appropriate format.*

- Retrieval for compliance
- Data will be retained in accordance with national guidelines
- EM data is stored in such a way as to maintain its confidentiality, akin to observer data

8. Feedback mechanisms	***Goal:*** *All participants have the opportunity to provide feedback to address problems and improve the EM Program.*

- Rapid feedback from video reviewers to vessel operators on video obstructions, quality issues
- Feedback from vessel operators on performance of providers (exit survey)
- Feedback on performance of vessel operators, for example on equipment maintenance, data quality (score card)
- Feedback on NMFS management of EM Program
- Feedback from NOAA Office of Law Enforcement and NOAA General Counsel for Enforcement on compliance/ enforcement actions

9. Fees/ Funding/ Costs	***Goal:*** *Use Observer Program fees or other sources of funding to pay for the EM equipment, installation, and maintenance.*

- Alternative mechanisms to fund EM equipment purchase
- Alternative mechanisms to fund EM equipment installation and maintenance
- Process for how fees are used
- Process for how to achieve efficiencies and cost savings
- Costs include equipment purchase, ongoing installation/maintenance, equipment replacement, NMFS management/infrastructure

All the EM program components listed above apply under both Alternative 2 and Alternative 3. For Alternative 3 only, however, there is an additional program requirement, namely the catch logbook, which is described below as component 10.

10. Catch logbook *(Alternative 3 only)*	***Goal:*** *Each vessel operator maintains an accurate logbook with discarded catch of key target and bycatch species.*

- Specify which species are required to be logged by vessel operators
- Methods for integrating logbook data into the catch accounting system

Figure 3-3 provides draft performance metrics for each component, to evaluate whether goals are met. Some of the identified performance metrics would be included in the Annual Report; while others might be considered as part of a periodic evaluation of the EM program.

Figure 3-3 Examples of periodic or annual EM review metrics for EM components

1. EM deployment design

- The Observer Science Committee annually reviews observer deployment, and will comment on both the EM and human observer deployment plans and develop appropriate metrics.
- Ones that are currently tracked in the 2014 Annual Report include:
  - Deployment rates for each stratum: were target sample rates achieved? Quantification of under- and over-coverage rates, non-response rates.
  - Was sampling representative? Temporally, spatially, and representative of trip characteristics (trip duration, vessel size, number of NMFS reporting areas visited, amount of landed catch, number of species in the landed catch, proportion of total landed catch that was due to the most prevalent species)
  - Adequacy of sample size – probability of selecting a sample and having coverage in each stratum/NMFS reporting area

2. Participation

- Many of the metrics for this goal can be duplicated from the 'Operation' category – i.e., is there a pool of EM participants that are regularly meeting their obligations for a functioning EM system?
- Other metrics could track participation over time, eg EM participants who stay in the EM program from year to year

3. Equipment and installation

- Frequency of equipment or installation-related video image quality issues (e.g. poor camera angles, condensation)
- Number of critical failures
- Locations of EM service and installation ports or outport service compared to start/landing ports of EM vessels, and denied requests for outport services
- Average length of time for installation and repairs

4. Operation

- Frequency and type of EM system failure (overall and after initial trip)
- Frequency of operator-related video image quality issues (e.g. water spots, dirty camera lens)
- Completeness of operator requirements – effort logbook, IPHC logbook, fish ticket
- Completeness of duty of care requirements – function tests, continuous power
- Appropriate catch handling – all discards at control points, handling within camera view
- Consistency with seabird goal requirements – mitigation devices used, extended presentation
- Enforcement/compliance metric examples from the Annual Report include: number of compliance reports and enforcement actions, and non-compliance trends, by category

5. Data/ Equipment Retrieval

- Time lag between last EM trip and equipment retrieval
- Frequency of equipment replacement (by system part – sensors, cameras, CPUs, etc.)

6. EM data and Catch Accounting

- Time lag for when EM trips occur and when data is available to the catch accounting system, by target fishery

7. EM data retention and storage

- Report on data storage times.
- Periodic report about how often and on what duration EM data is consulted after it is stored.

8. Feedback mechanisms

- Incidence of poor quality video that may have been avoidable
- Vessels leaving the EM program for program management issues

9. Feeds/Funding/Costs

- How much of the program is paid for through the observer fee or other funding sources

10. Catch logbook

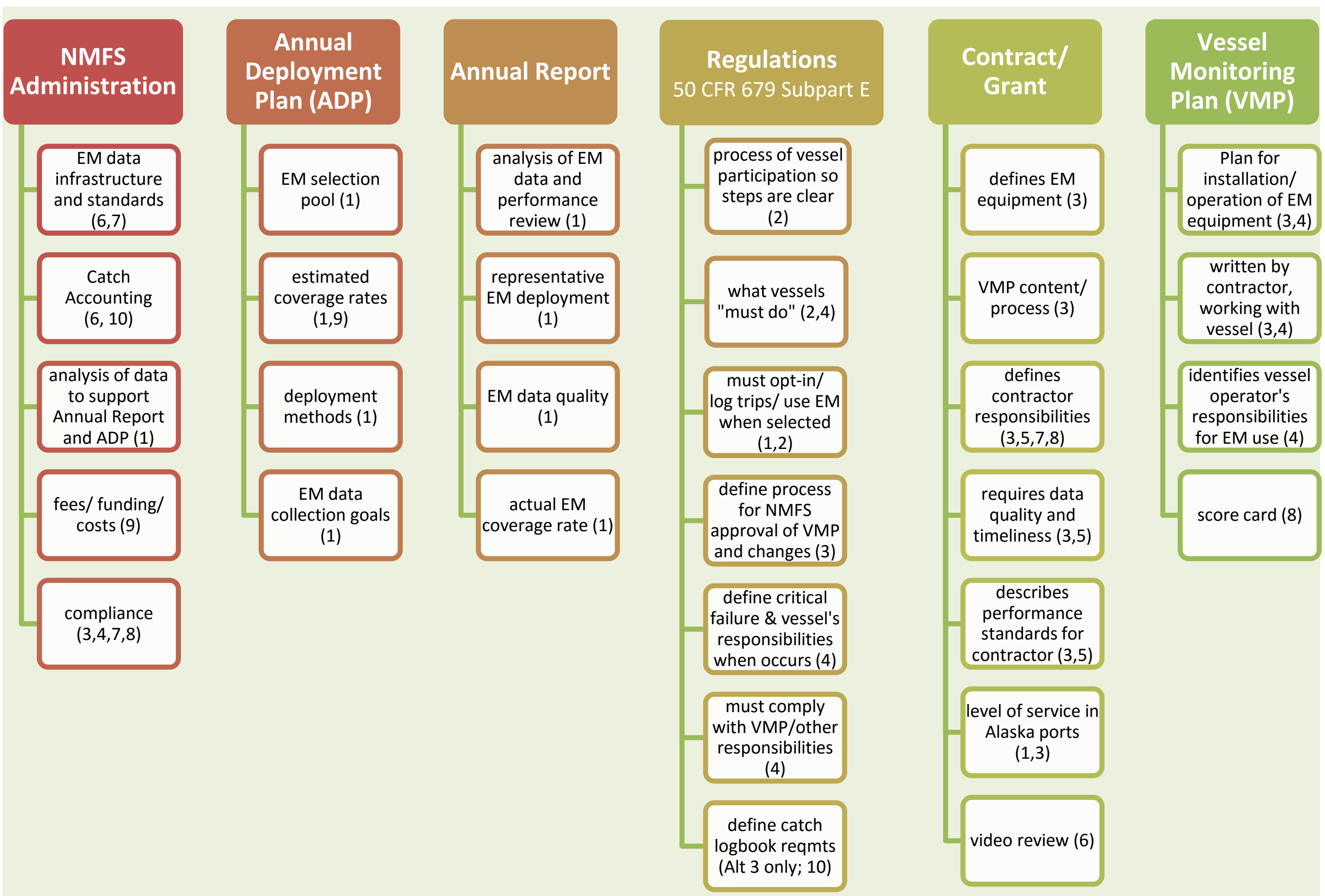
- Consistency of logbook values with audited EM review

3.1.3 Implementation vehicle for EM components, and annual EM cycle

Each of the EM components will be implemented through various available implementation vehicles, as discussed for the human observer program under Section 3.1.1. These include the regulations, the Annual Deployment Plan (and Annual Report), the EM service provider contract (or grant), and agency administration. An additional vehicle for the EM Program is the Vessel Monitoring Plan, which defines the placement of EM equipment onboard each individual vessel, and sets out operator responsibilities for maintaining EM equipment and fish handling practices conducive to camera monitoring. Figure 3-4 provides a preliminary assessment of how the different pieces of the EM program fit together under each of these implementation vehicles. The numbers in parentheses correspond to the ten EM program components identified in Section 3.1.2.

Figure 3-4 Preliminary assessment of EM components, organized by implementation vehicle

The numbers in parentheses correspond to the ten EM program elements in Section 3.1.2.

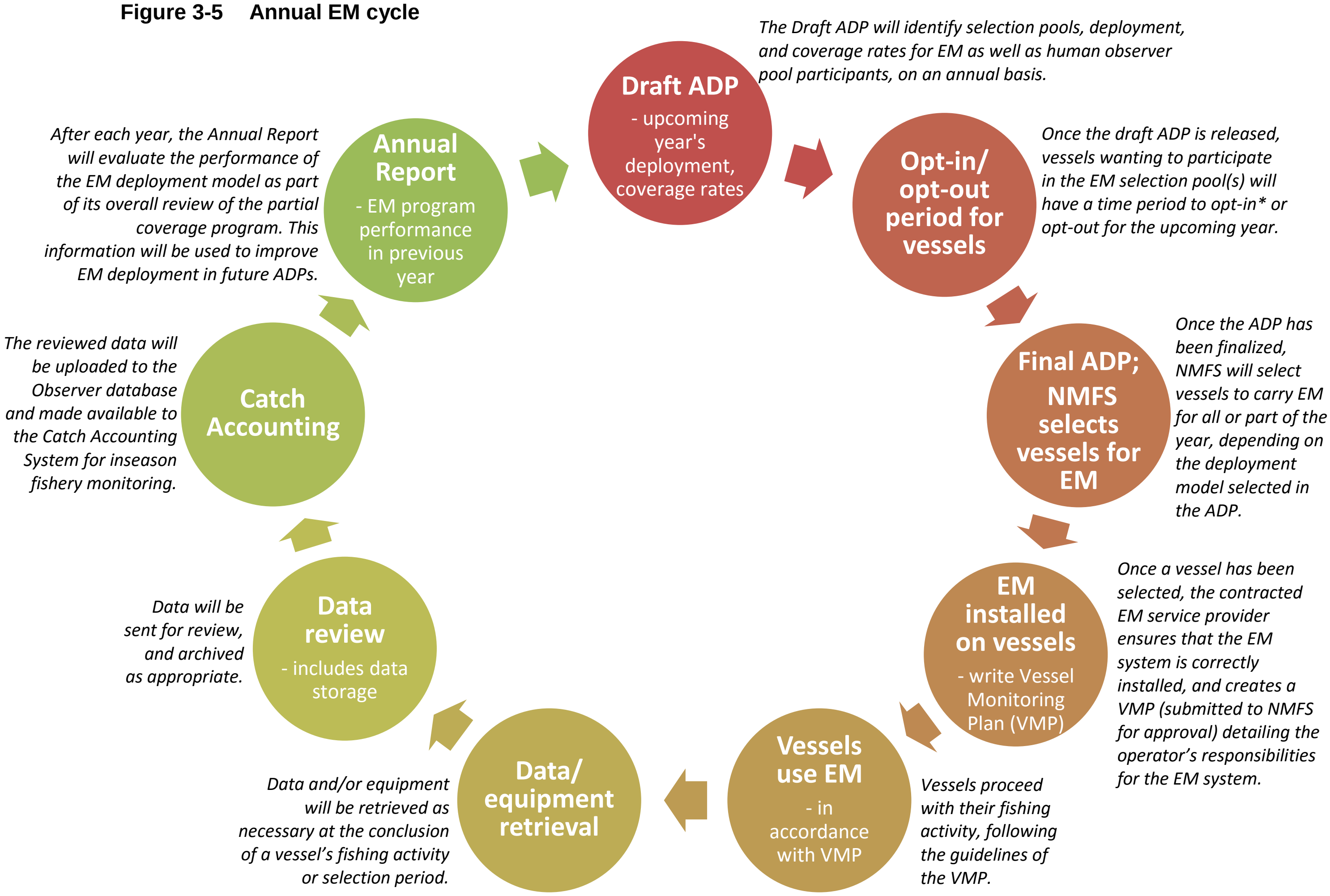


Annual EM Cycle

Figure 3-5 illustrates the annual cycle of the EM program, once implemented. The cycle begins with identifying the EM selection pools in the Draft Annual Deployment Plan, provides an opportunity for vessels to opt-in and opt-out, and once the Final ADP is adopted, for NMFS to select which vessels are carrying EM. The system is installed, and vessels conduct their fishing activity. Data and/or equipment is retrieved at appropriate intervals, the data is reviewed and input in the Catch Accounting System. At the conclusion of the year, EM deployment performance is evaluated in the Annual Report along with other components of the Observer Program, and that information is used to make improvements in future ADPs.

Figure 3-5 applies to both Alternative 2 and Alternative 3, but under Alternative 3 the additional component of catch logbooks is not illustrated in the figure. Vessels would complete catch logbooks during fishing activity, and these would be submitted directly to NMFS as a data source for catch accounting.

Figure 3-5 Annual EM cycle



*Once a vessel has initially opted-in, it remains in the EM selection pool for all future years, until either the vessel opts out, or the EM selection pool is changed (through the ADP) such that the vessel is no longer eligible.

3.1.4 Annual Deployment Plan

The Annual Deployment Plan describes how NMFS plans to deploy observers to vessels and processors in the partial coverage category in the upcoming year. NMFS has produced four ADPs to date. The ADP provides flexibility to improve deployment to meet scientifically based estimation needs while accommodating the realities of a dynamic fiscal environment. NMFS's goal is to achieve a representative sample of fishing events, and to do this without exceeding funds available through the observer fee. This is accomplished by the random deployment of observers in the partial coverage category. NMFS adjusts the ADP each year after a scientific evaluation of data collected under the Observer Program. NMFS evaluates the impact of changes in observer deployment and identifies areas where improvements are needed to collect the data necessary to conserve and manage the groundfish and halibut fisheries.

The most important goal of the ADP is to achieve randomization of observer deployment in the partial coverage category. Sampling that incorporates randomization is desirable at all levels of the sampling design since: 1) sampling theory dictates that randomization at all levels allows for unbiased estimation; and 2) sampling is generally preferential over a census because it is more cost efficient, is less prone to bias than an imperfectly implemented census (one subject to logistical constraints), and can result in greater data quality. Random deployment greatly improves NMFS's ability to evaluate the statistical properties of estimators and improve catch estimation procedures in the future. The sampling methods described in the ADPs were designed to reduce bias in observer data, improve catch estimates, and lay the groundwork for cost-effective improvements to sampling methods implemented in future ADPs.

To summarize the ADP process, each year, NMFS develops a draft ADP that describes how NMFS plans to deploy observers to vessels in the partial observer coverage category in the upcoming year. The draft ADP describes the deployment methods NMFS plans to use to collect observer data on discarded and retained catch, including the information used to estimate catch composition and marine mammal and seabird interactions in the groundfish and halibut fisheries. The draft ADP also describes how NMFS will deploy observers to shoreside processing plants or stationary floating processors in the partial coverage category.

The Council reviews the draft ADP and considers public comment when developing its recommendations about the draft ADP. The Council may recommend adjustments to observer deployment to prioritize data collection based on conservation and management needs. After a scientific evaluation of the Council's recommendations, and adjustments to the draft as appropriate, NMFS finalizes the ADP and releases it prior to the start of the fishing year.

EM and human observer selection pools in future partial coverage Annual Deployment Plans

Under Alternatives 2 and 3, an EM selection pool would be established in the ADP. NMFS would describe how vessels in EM selection pool would be selected to carry EM to achieve a representative sample of fishing events, and to do this without exceeding funds available through the observer fee. In developing an ADP that includes both human and EM selection pools, NMFS and the Council will need to consider the impact of each pool, and possible participation, on the ability to meet the Council and the Observer Program's monitoring goals. An important constraint is budget: the Council and NMFS would annually decide the rate of observer coverage and EM coverage that can be afforded with the budget from fee revenues. The amount of coverage allocated to both deployments would be determined annually in the ADP based on an analysis of the costs, budget, and effort in the partial coverage category. Another important part of this annual analysis will be understanding gaps in observer data when a portion of the partial coverage vessels opt-in to EM. Appendix 1 provides an example of the type of analysis that would be conducted on an annual basis to inform that decision and ensure that sufficient observers are deployed to maintain the representativeness of the data that cannot be collected with EM. During this process, NMFS and the Council can balance EM coverage with maintaining representative observer coverage.

3.2 Use of the Observer Fee

This section addresses several questions about the extent to which the Council and NMFS can recover costs for EM from the fees collected under the terms of the Fisheries Research Plan authority in section 313 of the Magnuson-Stevens Act.

3.2.1 Magnuson-Stevens Act authority for the Fisheries Research Plan and fee collection

Under section 313 of the Magnuson-Stevens Act, the Council may prepare, in consultation with the Secretary of Commerce, a North Pacific Fisheries Research Plan (Research Plan) for all fisheries under the Council's jurisdiction, except salmon. Any such plan would require observers to be stationed on fishing vessels and on fish processors, or shoreside processing facilities as appropriate, to collect data necessary for the conservation, management, and scientific understanding of any fisheries under the Council's jurisdiction, including halibut, but excluding salmon. It would also establish a system of fees to pay for the cost of implementing the plan, which may vary by fishery, management area, or observer coverage level.

Pursuant to the Magnuson-Stevens Act, fees collected may be expressed as a fixed amount, reflecting actual observer costs or a percentage, not to exceed 2 percent, of the unprocessed ex-vessel value of the fish harvested under the jurisdiction of the Council. Moreover, the total amount of fees collected cannot exceed the combined cost of (1) stationing observers, or electronic monitoring systems, on board fishing vessels and fish processors; (2) the actual cost of inputting collected data; and (3) assessments necessary for a risk-sharing pool, less any amount received for such purpose from another source or from an existing surplus in the North Pacific Fishery Observer Fund.[13] Finally, the fees must be fair and equitable to all participants in the fisheries under the jurisdiction of the Council, including the Northern Pacific halibut fishery, and may not be used to pay any costs of administrative overhead or other costs not directly incurred in carrying out the plan.

This section addresses several questions about the extent to which the Council and NMFS can recover costs under the terms of the Research Plan authority in section 313 of the Magnuson-Stevens Act.

Limitations on the use of fee proceeds

Sections 313(b)(2)(C), (H), and (I) of the Magnuson-Stevens Act, provide language directing how fee proceeds can be used, but are not explicit as to what plan implementation costs can be covered by fee proceeds. For example, section 313 (b)(2)(C) states: Any system of fees shall "provide that fees collected not be used to pay any costs of administrative overhead or other costs not directly incurred in carrying out the plan." Although this does not allow for fees collected to be used to pay for administrative overhead, it is implicit that fee proceeds could then be used toward other agency costs associated with implementation.

Section 313(a)(2) states that the Research Plan implemented under the section may establish a system of fees "[t]o pay for the cost of implementing the plan". Although this provision initially grants broad authority to collect costs associated with implementation, section 313(b)(2) defines and appears to limit recoverable costs. According to section 313(b)(2)(A), the total amount of fees cannot exceed the combined cost of "(i) stationing observers, or electronic monitoring systems, on board fishing vessels and United States fish processors, (ii) the actual cost of inputting collected data,…". Further, under Section 313(b)(2)(C), fees may "not be used to pay any costs of administrative overhead or other costs not directly incurred in carrying out the plan." This language raises the question about what specific costs are associated with "stationing observers or electronic monitoring systems" on board fishing vessels and at fish processors, and "inputting collected data". The terms "stationing observers, or electronic monitoring systems" and "inputting collected data" are undefined in the Magnuson-Stevens Act. To add to the issue, there are no regulatory definitions and none were promulgated in the earlier Research Plan.

NMFS, using its expertise and past experience in "stationing observers" and "inputting collected data", developed a reasonable common sense standard describing what costs are captured by these terms. Although there is broad authority to collect fees for costs associated with the Research Plan, NMFS

[13] The risk-sharing pool concept under (3) was not considered as it appears the past insurance issues have been resolved either through the commercial market, or through the use of the Magnuson-Stevens Act 403(c) language, which provides observers Federal employee status for the purposes of compensation under the Federal Employees' Compensation Act.

established a nexus between administrative and implementation costs and their relationship to placing or stationing observers aboard vessels and at processors. NMFS intends to use this same process for stationing electronic monitoring systems.

The remainder of this section describes the general categories of responsibilities under the restructured Observer Program, the general categories of responsibilities from integrating EM into the Research Plan, and NMFS' proposed use of fee proceeds. With the integration of EM, in which the government enters into direct contracts with EM providers for services, responsibilities and associated costs would fall into three categories: (1) those that could be paid by NMFS, (2) those that could be required under a contract to be paid by the EM providers, and (3) those that are new and unique to EM and could be paid for by either NMFS or the EM providers.

NMFS views all of the activities described in Table 3-1, including those that would be additions to the status quo, as essential functions specific to the execution of the Research Plan, should EM be integrated into the Research Plan. In other words, these are the functions necessary to station observers or electronic monitoring systems on fishing vessels or in processor and to input collected data. Some activities may be administrative by nature, but they are essential to Research Plan operations and NMFS would not be conducting them were it not for the Research Plan. Thus, NMFS views all activities noted in Table 3-1 as falling under the fee authority in the MSA. However, NMFS currently does not use fee proceeds to fund observer-related administrative tasks identified as "NMFS" in the last column Table 3-1, and NMFS does not intend to use fee proceeds in the future to fund the similarly noted administrative tasks associated with EM. In addition, as noted above, the MSA does not allow NMFS to use the fee proceeds for "any costs of administrative overhead or other costs not directly incurred in carrying out the plan." For example, NMFS would not consider Alaska Fisheries Science Center (AFSC) leadership salaries or travel to be within the scope of the fee. All funds collected would be used to pay for the direct costs of the Research Plan.

In general, the activities describe in Table 3-1 can be separated shoreside costs and at-sea costs where at-sea costs are conducted by a service provider and will be paid by using fees and shoreside costs are paid by NMFS. Some activities, such as video review (including data processing) and data storage would also be conducted by a service provider. These activities are part of "inputting collected data" and therefore could be paid for using fees. However, since these costs are shoreside costs, they could be paid for by NMFS. Since the source of funding for these activities has not yet been determined, these costs are noted with a question mark.

NMFS recognizes that the ongoing contribution of the Federal government in supporting the existing Research Plan must continue. **NMFS does not intend to use fee proceeds to offset the government's contribution to the Research Plan, because it recognizes that fee proceeds would best be used to procure and optimize the observer coverage or electronic monitoring needed in Alaska.** NMFS intends to continue to fund, and expand to the extent National resources are available, the agency contribution in support of the Research Plan. However, to the extent new activities are required of NMFS in association with integrating EM into the Research Plan, NMFS may use fee proceeds that are available. Depending on the types of activities that must be funded, they could reduce the total number of observer days that NMFS is able to purchase.

Table 3-1 Comparison of the tasks under the partial coverage category and potential tasks under an EM program

	Observer task	EM equivalent task	Intended source of funds to pay for the task
NMFS Tasks	Training and briefing observers (includes instruction, training aids/equipment and fish/crab specimens, manuals and books)	Training and briefing video reviewers	NMFS
	Equipping observers with sampling and safety gear (purchasing, maintaining, issuing, and receiving gear). Replacement of lost or damaged observer gear and safety equipment.	N/A	NMFS
	Debriefing observers (checking data and interviewing observers)	Auditing data collected from video	NMFS
	Managing collected data (editing, storage, retrieval and analysis, as well as on-going database development).	Managing collected data[1] (editing, storage of processed data, retrieval and analysis, as well as on-going database development).	NMFS
	Maintaining Observer Program field office and staff (Dutch Harbor and Kodiak)	N/A	NMFS
	Communications with observers at-sea (maintaining and developing computer software and responding to observer messages)	Communications with video review staff	NMFS
	ODDS: registering trips and selecting vessels for observer coverage	ODDS: registering trips and selecting vessels for EM coverage	NMFS
	N/A	Opt-in process to be in EM Program and approval of Vessel Monitoring Plan	NMFS
	Annual Deployment Plan: identification and designation of appropriate sampling strata; designing sample-size requirements; calculating total sampling effort for the upcoming year, based on expected funding; allocation of 'target-days' (sampling effort) to strata, database design, programming, application development and testing, etc.		NMFS
	Annual Report: Analyze deployment and data collected in the previous year.		NMFS
	Fees: determination (calculating ex-vessel value of catch); fee collection (billing, receiving and monitoring payments); and fee budgeting and accounting		NMFS
	Catch Accounting System: design, programming, application development, and testing.		NMFS
	Government contract development, solicitation, and award for deploying observers	Government contract development, solicitation, and award for deploying EM and reviewing EM data	NMFS
	Oversight and management of the government contract(s)	Oversight and management of the government contract(s)	NMFS
	Modify regulations		NMFS

	Observer task	EM equivalent task	Intended source of funds to pay for the task
Provider Tasks	N/A	Video review and data processing	?
	N/A	Storage of raw video footage [2]	?
	N/A	Dockside monitoring for species with required full retention (species ID, timely reporting)	?
	N/A	EM equipment (camera, wires, sensors). Replacement of EM equipment due to loss, damage, or upgrade.	Fees (plus other funds)
	N/A	Vessel Monitoring Plan (develop and amend)	Fees
	Recruiting and hiring qualified observer candidates	Recruiting and hiring qualified EM technicians and video reviewers. Training EM technicians.	Fees
	Observer deployment logistics (air travel, ground transportation, lodging, per diem)	EM technician logistics (air travel, ground transportation, lodging, per diem)	Fees
	Observer pay, insurance, and benefits	EM technicians and video reviewers pay, insurance, and benefits	Fees
	Housing observers (during training, briefing, and debriefing)	Housing EM technicians (during training, installation, maintenance)	Fees
	Maintaining observer provider Field Coordinators as needed (Dutch Harbor and Kodiak)	Maintaining Contractor Field Coordinators as needed	Fees
	Communication with fishing industry (coordinating observer embarkation and disembarkation)	Communication with fishing industry (coordinating EM installation and maintenance with vessel)	Fees

[1] Includes processed data and may also include raw video footage.
[2] Storage of raw video could either be a NMFS task or an EM service provider task.

3.2.2 Fees and funding for observer coverage and EM

The fee system used in the restructured Observer Program follows the Magnuson-Stevens Act requirements. Section 313(b)(2)(E) states that "any fee system shall be expressed as a fixed amount reflecting actual observer costs as described in subparagraph (A) or a percentage, not to exceed 2 percent, of the unprocessed ex-vessel value of the fish and shellfish harvested under the jurisdiction of the Council…." The fee system allows the observer coverage or electronic monitoring in the partial coverage category to be paid for by industry and provides a consistent source of revenue directly linked to the value of the fishery. Through the fees, owners and operators compensate the Federal Government for some of the costs associated with managing fishery resources.

NMFS assesses a fee equal to 1.25% of the ex-vessel value of the landings of groundfish and halibut subject to the fee. The Council determined that the same fee percentage should apply to all sectors as they all benefit from resulting observer data that is essential for conservation and management of the fisheries in which they participate. The ex-vessel value of the catch is based on a standard measure of the value of the fishery resource harvested or processed by the participants and the fee applies regardless of whether a vessel or processor is selected to carry an observer. An ex-vessel value fee is commensurate both to each operation's ability to pay and the benefits received from the fishery. The ex-vessel value of the catch is expected to fluctuate, as are the catch quotas.

Fee revenues constitute NMFS's budget and determine the level of costs that could be incurred to station electronic monitoring systems in addition to observers. In determining the level of EM coverage needed in each impending year, NMFS would consider the revenue anticipated to be generated from the fisheries subject to the ex-vessel value fee and any surplus in the observer fund from previous years. NMFS would need to adjust observer and EM coverage levels within the fleets subject to the fee revenue to align anticipated costs with available revenue. Section 313(d) allows for the establishment of a Fishery Observer Fund that is available without appropriation or fiscal year limitation, and extra sums may be kept on deposit.

For 2013, NMFS used Federal start-up funds to transition from the industry-funded model to one where NMFS contracts with observer providers to deploy observers in partial coverage category sectors. NMFS also used Federal funds to pay for observer coverage in 2014 and 2015, which allowed NMFS to carry over fee proceeds into 2016. Federal funds are subject to Congressional appropriations and NMFS priorities and may not be available for supplementing the fees in future years. Table 3-2 shows NMFS's budget each year from fees and Federal funds and the number of observer days used each year.

Table 3-2 Budget and observer days from 2013 to 2016

Year	**Budget** $ million (fees + Federal funds)	Observer days
2013	$3.94 (Federal funds)*	3,533 (used)
2014	$6.14 ($4.25 + $1.89)	4,573 (used)
2015	$6.16 ($3.46 + $2.7)	5,318 (used)
2016	$5.02 ($3.78 + $1.24 carry over)	4,937 (projected)

*Only $2.1m was spent in 2013, the remainder was carried over to future years.

If the fee proceeds do not sufficiently align with anticipated costs over a period of time, the Council could initiate a new regulatory amendment to increase the fee percentage up to 2%. In its final motion for the restructuring action, the Council committed to reviewing the fee percentage after the second year of the program based on information in the Annual Report. The Council explained that it may recommend revising the fee assessment percentage in the future through rulemaking after it had an opportunity to evaluate program revenues and costs, observer coverage levels, fishery management objectives, and future sampling and observer deployment plans.

Given the cost uncertainties with integrating EM, the Council could consider increasing the fees up to 2% to ensure that funds are available to maintain observer coverage in the partial coverage category while also funding EM deployment on a portion of the partial coverage vessels.

3.3 EM Contract

NMFS is considering several different options for implementing EM services under an operational and regulated EM program beginning in 2018 or 2019. They include:

Approach 1: Continue the grant between NMFS and PSMFC in which PSMFC contracts for EM services with one or more EM service providers

Approach 2: Standalone federal contract for EM services with one or more EM service providers

Approach 3: Combined federal contract with one or more EM service providers and partial coverage observer providers

Approach 1: Grant between NMFS and PSMFC, in which PSFMC contracts for EM services with one or more EM service providers

Since 2014 the Pacific States Marine Fisheries Commission (PSMFC) has been working with NMFS, EM service providers, and the fishing industry under a NMFS funded, multi-year grant to test and develop cost effective EM/ER technology solutions for the small, fixed gear fleet in Alaska. In 2017 the pool of eligible vessels will be expanded to include pot vessels and fixed gear vessels greater than 57.5 feet in length overall. NMFS provides funding for the PSMFC grant on an annual basis depending on Congressional appropriations and availability of discretionary NMFS EM/ER funds. Annual funding for EM/ER efforts include operational deployments costs (i.e., the contract with EM service provider) as well as providing support for PSMFC staff working on EM research and development projects. Annual funding is estimated at $1.2 million depending on a variety of factors including cost estimates for deployment and research and development cost for EM/ER.

Under the 2016 and 2017 EM Pre-Implementation Plans PSMFC has administered a separate non-federal contract with EM service provider Archipelago Marine Research (AMR) to deploy EM systems, provide field support, and collect data from the fixed gear fleet. Video review has been performed by PSMFC under the federal grant and data are provided to NMFS. In 2017 expansion of EM deployment to the pot fleet will also be administered through a separate non-federal contract between PSMFC and an EM service provider. Although the exact details of this separate non-federal contract are yet to be worked out through a PSMFC Request for Proposals the outcome is envisioned to be similar to the existing contract with AMR.

Since a grant is already in place with PSMFC to collect, review, and process the necessary video data, this option would be readily available in 2018. This would help streamline and simplify the process for implementing a regulated program. Providing additional funds to the PSMFC grant could be accomplished quickly and efficiently through the grant on an annual basis when funds become available[14]. Further, federal contracting deadlines are sometimes difficult to meet because funds are not always available early in the fiscal year[15]. This could be particularly problematic if observer fees are not made available to NMFS until May or June of each year, as has been the case the past few years.

Approach 2: Standalone federal contract for EM with one or more EM service provider(s)

Under this approach, the NOAA Contracting Office would administer a federal contract for an EM service provider similar to the process used to award the existing partial coverage observer contract. Standard federal contracting requirements would apply and a request for proposal would be solicited through FedBizOpps.gov. Due to the substantial lead time required for processing multi-year, multi-million dollar contracts, and in order to have a contract in place by January 1, 2018, work on a standalone contract would need to begin in 2016[16]. An additional consideration for this approach would be the timing on availability of observer fees. Since observer fees are not released to NMFS until approximately May of each year, an EM service provider contract could not be awarded until June at the earliest. NMFS would need to find additional funds and a mechanism to cover EM deployment from January through June 2018. For this reason, NMFS will be requesting startup funds for EM deployment in 2018 and will most likely be using the PSMFC grant to fund EM deployment beginning January 1, 2018.

[14] The PSMFC grant has a period of performance from July 1 through June 30.
[15] Deadline for submitting contracts >$150K to the Acquisition and Grants Office is April 1.
[16] NMFS has not begun work on an EM service provider contract, in part due to uncertainty in funding and because NMFS already has a mechanism in place through the PSMFC grant to continue EM operations and deployment.

Approach 3: Combined federal contract with one or more EM service provider(s) and partial coverage observer provider(s)

A third approach would be similar to approach 2, with the key difference being that this approach would include both EM services and observer services under a single contract. This approach was discussed with NOAA Acquisition and Grants Office staff during the Council's May Observer Advisory Committee (OAC) meeting as a possible approach. The contract could be awarded to multiple EM or observer providers and individual components of the contract such as EM or human observer services would be administered through task orders. This option could potentially reduce the administrative burden of managing two separate contracts by incorporating them into a single contract. The current partial coverage provider contract expires in June 2019 and work on the solicitation would need to begin in late 2017.

At the May 2016 OAC meeting the OAC also requested the Observer Program to work with NOAA Acquisition and Grants Office to determine if the current EM grant with PSMFC can be used in 2018 and 2019 to continue EM implementation work using partial coverage observer fees. While there is still some uncertainty as to when observer fees would be available to fund the grant, there seems to be no disagreement that observer fees could be used for EM implementation work, regardless of the mechanism used to obtain these services. The OAC noted that many details associated with EM deployment strategies, fleet size, field support models, and resulting cost are still evolving. Ability to continue a successful, grant based approach during this adaptive development phase is a viable option to refine a mature deployment model. This process will provide information which informs the public and potential contractors on important program details, which may ultimately result in a more cost effective program. The intent is not to continue the PSMFC grant indefinitely, but to provide greater transparency during the development stage and evaluate the benefits of integrating the EM program with the larger partial coverage contract in 2019.

3.4 Infrastructure for Integrating EM

Infrastructure needs for an EM program will be shared jointly between PSMFC and NMFS or an EM service provider and NMFS depending on the vehicle used to obtain EM services as outlined in the previous section. For example, under the current grant with PSMFC, they are largely responsible for the infrastructure needed to review, store, and retain video files. If NMFS were to contract with an EM service provider, the contract could specify that the EM service provider would be responsible for video review, storage, and retention of all video records. Under both of these scenarios the agency's infrastructure needs might be minimal in comparison to PSMFC or an EM service provider.

For the purposes of this section, infrastructure is defined broadly as including all the shoreside costs needed to support an at-sea EM data collection program, inclusive of personnel to review, process, and make available to the agency the data needed for management. Regardless of the approach used, the infrastructure costs will be funded by NMFS and must be accounted for in one way or another. If NMFS uses a federal contract to obtain EM services, then some or all of the required infrastructure may need to be provided by NMFS with direct funding provided by NMFS. If NMFS continues to use the current grant with PSMFC for EM services, then much of the infrastructure will be provided by PSMFC, with those costs being covered by the grant with PSMFC.

There are several categories of infrastructure, both equipment and staff resources, that need to be taken into account to ensure effective implementation of an EM program. These include:

- Storage space for raw video footage
- Managing collected data (editing, storage of video data, retrieval and analysis, as well as ongoing database development)

- Hardware and software including licenses
- Databases and associated software
- Staff resources
- Video reviewers
- Auditors
- Programmers
- Data processors
- Database managers

Many of these infrastructure needs will be delegated to PSMFC or an EM service provider. EM information that is authorized to be collected under the Magnuson-Stevens Act is a form of observer information under the Act and, as such, subject to the Act's confidentiality requirements, the Freedom of Information Act, and other applicable law. Storage space for raw video footage will depend in large part upon the number of participants in the EM selection pool, the amount of fishing effort and associated trips and/or hauls that are recorded, and ultimately how long the data will need to be retained. The length of time video will need to be retained will depend on Federal record retention policies and guidelines which are currently under development for EM data. Until the new retention policy is developed, raw video footage is required to be retained indefinitely. The statute of limitations, however, for retaining data under the Magnuson-Stevens Act is currently five years after which the data may be discarded. Therefore, it is anticipated that when retention policies are put in place, raw video footage will need to be retained by either PSMFC or an EM service provider for five years.

3.4.1 Startup capital for EM program

Investment in EM infrastructure has already begun, under the Alaska fixed-gear EM cooperative research plan and pre-implementation plans that have been in place since 2014. NOAA, NMFS, PSMFC, grant funders, and industry participants have invested time, money, and human capital in hardware, fleet outreach and education, and training of local service technicians will have put the program in a position to achieve a much smoother integration once a regulatory amendment package is approved. These investments will also reduce the cost of the program by creating an initial stock of EM hardware and several local pools of qualified labor without tapping into the Observer Program's fee-based budget for these items in the initial year or years of the integrated program.

Table 3-3 provides a count of hardware items that are currently "in the program" (i.e., purchased by NMFS) as of July 2016, and planned purchases to support the 2017 Pre-Implementation Plan. This count only includes items that are part of the hook-and-line EM contract with AMR. The right-hand column of the table shows the final sum of hardware units that have been and are planned to be purchased and installed using start-up funds. The installation field work will lower the cost of the program at the point of EM integration. The hook-and-line EM program has acquired 16 control centers and a variety of peripheral components, to date; the odd numbers in Table 3-3 reflect the fact that AMR maintains a stock of back-up components that are distributed across EM service ports. Not all EM vessels will use the same set of peripherals, but this inventory was compiled to support a hook-and-line EM fleet of around 30 vessels in 2016, and a fleet of up to 90 hook-and-line vessels in 2017. The typical set of peripheral hardware items includes: network switch, monitor, keyboard, GPS unit, sleep sensor, and two pressure sensors.

Installation during the pre-implementation phase, or "pre-wiring," also reduces future costs as some vessels will be prepared for EM deployment after only the relatively minor cost of hooking up a control center to the peripheral package and checking camera angles and sensor/software function. Pre-wiring vessels for EM does not guarantee that there will not be future reinstallation time and labor costs, as, for example, some vessels that underwent installation after being selected for EM coverage in the first part of 2016 have had to have the hardware removed as the vessel reconfigured for salmon seining or other activities (this is most often the case for vessels that use a shelter deck in their hook-and-line configuration). The contracted hook-and-line EM service provider reported that 27 hook-and-line vessels were installed and wired with EM systems as of July 2016. During the pre-implementation phase, service providers are combining installation work with fleet outreach and education, to extend technical capacity for some field services to participating vessels. In 2017, the draft Pre-Implementation Plan calls for pre-wiring all of the up to 90 vessels that may participate from the hook-and-line sector; the amount of pre-wiring that will be achieved is not known at this time. Also, as the composition of the EM fleet may vary from year to year, the benefits of pre-wiring may not always be long-term.

The program expects to have an inventory of 60 AMR control centers for 2017. Having a large stock of control centers builds up hardware capacity for a regulated program, and also gives the Council the option to recommend a trip-selection model for EM in 2017 and/or in future years, rather than a model where vessels are selected to carry EM on all trips during the course of several months. Trip-selection is only feasible if the program has a sufficient number of control centers that can be rotated quickly among vessels in the same port.

Table 3-3 Inventory of Archipelago EM equipment for the hook-and-line sector that has been, or is expected to be, available for use in the program (current, end of 2016, 2017)

Components	Total number in project in July 2016	Projected equipment installed at year-end 2016	Projected total inventory for 2017[1]
Control center	16	None (removed at end of fishing)	60
Camera sets	31	30	90
Network switches	43	30	103
Monitors	43	30	102
Keyboards	44	30	104
Pressure sensors[2]	70	40	120
GPS	41	30	99
Sleep sensors[3]	25	18	67

[1] Includes equipment installed in 2016 and equipment budgeted for purchase in 2017.
[2] For vessels that do not have line drums, two pressure sensors will be installed.
[3] Not all vessels have sleep sensors. Several operators declined them, some stating that they do not require a sensor because the engine remains on at night.
Source: AMR, 2016. Personal communication.

The draft 2017 Pre-Implementation plan calls for a pool of 30 pot vessels. The contract for an EM provider to service the pot fleet has not yet been awarded, but assuming full participation is reached, the program would be in possession of up to 30 complete pot EM systems at the beginning of 2018. The draft Pre-Implementation plan for the pot sector does not call for rotating control centers between vessels because scheduling installation during the shorter, competitive limited access seasons in order to install equipment would be a strong disincentive to joining the program.

Aside from hardware purchasing, both sectors of the EM program should benefit from the management and administrative infrastructure that is being developed during the pre-implementation phase. NMFS staff are currently developing the software applications that are required for timely integration of EM data into the Catch Accounting System. Since 2014, NMFS and FMA staff have made EM education part of their routine Observer Program outreach curriculum. Similarly, AMR and Saltwater, Inc, also an EM service provider, have spent a proportion of their field time on training and educating local technicians and skippers than they are likely to be spending under a fully integrated program. Skippers and crew are building familiarity with EM technology, troubleshooting, routine maintenance, operator responsibilities, and filling out EM logbooks. Providers have spent time administering skipper debrief surveys, which feed into the iterative process of refining the hardware to the point where it can be as effective without unnecessary components that entail costs and require additional maintenance.[17]

A caveat to the hardware investment is that the particulars of the EM provider contract for the implemented program are yet to be determined. Investments that have been made in a certain type of proprietary hardware or software might yield lesser benefits if a new provider enters the program and systems are incompatible.

3.5 EM Development

The proposed action would establish EM as part of the observer program, and would allow the Council and NMFS to offer an EM alternative for monitoring as part of the annual observer deployment design. EM technologies are not static, however, and will continue to be developed and modified over the coming years. The observer and integrated EM deployment process can accommodate the changing status of EM technologies and operational testing, as improvements are made. Research to date has focused on the hook-and-line and pot vessels over 40 feet length overall, but the Council may want to use EM in other fixed gear sectors in the future also.

3.5.1 Steps in the EM development process

The Council's EM Workgroup has developed a process for developing EM technology, and applying it to different fixed gear sectors, in order to ensure that EM is continually providing quality monitoring data. As the Council and NMFS consider annually whether to use an EM selection pool as part of the Annual Deployment Plan, they will need to consider what is known about the reliability of the available EM technology, its suitability for the different fishing patterns or vessel configurations of the subject fleet, and the ability of vessel operators to successfully interact with the technology onboard. This development process has been illustrated in Figure 3-6.

[17] To date, skipper feedback has informed camera angles, highlighted power system concerns, and identified sources of superfluous video recording that can drive up data storage and video review costs.

Figure 3-6 Stages of EM development

Programmatic Development	*EM Program Stage*	Logistical Development
• **Scale** - A few volunteer boats • **Data use** - Demonstration • **Management pathway** - undetermined • **Costs** - unknown • **Typical timeline** - 1-2 years	**Proof of Concept** *Goal: Adaptive development of new technologies*	• **EM Hardware** - Custom construction • **Vessel responsibilities** - Limited/informal • **Review software** - Under development • **EM Acceptance** - Unknown • **Data review protocols** - Under development
• **Scale** - a few volunteer boats • **Data Use** - Program design • **Management pathway** - Initial management objectives defined • **Costs** - Gathering cost data • **Typical timeline** - 1-2 years	**Pilot Program** *Goal: Standardized testing*	• **EM Hardware** - System Components defined • **Vessel Responsibilities** - preliminary responsibilities defined • **EM Acceptance** - initially positive • **Review software** - Standardized and ready for initial testing • **Data review protocols** - Preliminarily defined
• **Scale** - A diverse portion of the fleet • **Data Use** - Fishery demographics used to enhance program design • **Management pathway** - Management objectives approved by Council • **Costs** - initially promising, now independently evaluated • **Typical timeline** - 1-2 years	**Operational Testing** *Goal: Independent evaluation under operational conditions*	• **EM Hardware** - Commercially available • **Vessel Responsibilities** - Preliminary Vessel Monitoring Plan (VMP) process • **EM Acceptance** - Mixed • **Review software** - Independent evaluation under operational conditions • **Data review protocols** - Defined
• **Scale** - All EM candidate vessels • **Data Use** - Gap analysis + limited use for fisheries management • **Management pathway** - Protocols for using EM data nearing completion • **Costs** - Start-up costs funded, long term costs-effectiveness deemed sustainable. Refinements to reduce costs being tested. • **Typical timeline** - 1-2 years	**Pre-Implementation** *Goal: Building scale/ finalizing program design*	• **EM Hardware** - cost effective and commercially available • **Vessel Responsibilities** - Defined in VMP • **EM Acceptance** - Growing • **Review software** - Commercially available and cost effective • **Data review protocols** - Defined
• **Scale** - All EM candidate vessels • **Data Use** - Data routinely used to meet management objectives • **Management pathway** - Operational • **Costs** - sustainably funded, cost effective and decreasing • **Typical timeline** - 3-4 years	**Mature** *Goal: Productive use of EM data*	• **EM Hardware** - Cost effective and commercially available • **Vessel Responsibilities** - VMP feedback process operational • **EM Acceptance** - Mostly positive • **Review software** - Commercially available and cost effective • **Data review protocols** - Defined

Figure 3-7 identifies the different stages of EM technology that are currently being developed in the fixed gear sector in Alaska, and how far they are likely to have progressed in 2018. Development work to date has focused on using EM for catch estimation, as described in Alternative 2. If the Council is interested in pursuing development work for Alternative 3, the logbook audit approach, under current planning, it would be at the operational testing stage. The use of the standard cameras as the auditing device would be mature, but no work has yet been done in Alaska to develop appropriate EM logbooks designed to work with an EM audit system.

Figure 3-7 Anticipated stage of fixed gear EM deployment in Alaska, in 2018

	Fisheries	Technology
Proof of Concept	• <40 ft hook-and-line catcher vessels	• Automatic species identification through video review
Pilot Program		• Stereo cameras • E-logbooks
Operational Testing		• *Logbooks with EM audit (Alt 3)*
Pre-Implementation	• Pot catcher vessels	• Standard cameras for pot
Mature	• >40 ft hook-and-line catcher vessels	• Standard cameras for hook-and-line

3.5.2 EM deployment in 2017, under pre-implementation

The EM development work to date has focused on hook-and-line and pot catcher vessels, using EM for catch estimation (as in Alternative 2). A robust pre-implementation program was implemented in 2016 for hook-and-line catcher vessels, and pilot testing for pot vessels. In 2017, further work has been proposed for both these sectors. The EM Workgroup has proposed that the EM selection pools in 2017 will include vessels that meet the Council's criteria for EM, and who opt into the EM pool. Table 3-4 summarizes the main features of the 2017 pre-implementation program as proposed to the Council for review in October 2016. Some details for the EM program for pot vessels remain to be decided, as PSMFC is currently in a proposal process to award a contract for an EM provider for the pot fleet.

Table 3-4 Features of proposed 2017 EM pre-implementation program for hook-and-line and pot vessels

EM program feature		Longline	Pot
EM selection pool	Qualifying Criteria	Vessels > 40 ft length overall First priority to vessels where carrying a human observer is problematic	Same
	Opt-in Process	Vessels must contact NMFS to say they are interested by Sep 20, 2016. Once rules for 2017 pre-implementation are finalized in Oct 2016, NMFS will send out letter; vessels then have until mid-November to opt out of the EM pool.	Same
	Size	Up to 90 vessels	Up to 30 vessels
EM deployment	Pre-installation	Vessels may begin pre-installation in October 2016 upon approval of 2017 plan. All vessels will be pre-wired with sensors and cameras, and some with control centers.	Same
	ODDS Trip selection	Vessels must log each 2017 fishing trip in ODDS, and if selected for coverage, obtain control center (if necessary), and turn EM system on. Vessels will not be able to log trips in ODDS until EM system has been pre-installed.	Same
	Target coverage level	30% of logged trips	Same, 30% of logged trips
Service ports	Primary	Sitka, Homer, Kodiak	To be determined once PSMFC designates an EM provider
	Other ports	Limited to remote support or periodically scheduled visits by primary port technicians.	Same
EM hardware		Equipment designed and supplied by Archipelago Marine Research, Inc.	To be determined once PSMFC designates an EM provider

To define the EM strata within partial coverage for pre-implementation in 2017, NMFS sent a letter to all fixed gear (both hook and line and pot gear) vessels greater than 40 ft LOA. In this letter NMFS requested that vessels indicate their interest in being in the EM selection pool by September 20, 2016. After the October 2016 Council meeting that will include discussion of the EM Pre-implementation Plan, a second letter specifying the rules governing EM deployment for 2017 will be sent by NMFS to vessels that have expressed interest in being in the EM selection pool. If, after receiving this second letter and reviewing the requirements for volunteering, vessels may choose to contact NMFS and "opt out" of the EM program and be returned to the human observer pool. Vessels agreeing to the EM program rules, and accepted by NMFS, will be placed in the EM selection pool for the duration of the 2017 fishing season, with no probability of carrying an observer on any trips for the 2017 fishing season. Additions to the EM pool from vessels not meeting the September 20, 2016 deadline may be considered on a case-by-case basis relative to the qualifying criteria.

Under a regulated EM program, NMFS would allow vessels that were in the EM selection pool the previous year to automatically be in the EM selection pool for the coming year, rather than requesting vessels to opt in each year. Any additional vessels interested in participating in the EM selection pool would have an opportunity to opt in during the fall (exact date to be determined) for the upcoming year. Under the voluntary program in 2017, vessels can opt out of the EM selection pool during the fishing year. Under a regulated program, vessels will not be allowed to opt out of the EM pool during the fishing year. Instead they would be allowed to opt out of EM for the following fishing year. This would be done to ensure that the projected rates and costs for deployment as defined in the ADP are predictable and executable. Any diversion from the strata and deployment rates described in the ADP increases the likelihood of cost over-runs by the observer program.

3.5.3 Future funding for EM development

EM development may be funded with NMFS funds or through grants, such as NFWF, similar to how the pre-implementation has been funded since 2014.

There has been interest in using the observer fee for funding EM development for sectors and for vessels not currently covered under pre-implementation, such as vessels under 40 ft LOA or trawl catcher vessels. As discussed in section 3.2, section 313(a)(2) and (b)(2)(H) of the Magnuson-Stevens Act limit use of fees to only paying for the cost of implementing the research plan. In order to use fees for EM development, the Council would need to explicitly include EM development as a component of its research plan. To support the decision to make EM development part of the research plan, an analysis would need to be conducted to (1) explain how EM development meets the standards in section 313(a) and (b) for the research plan, and (2) understand the impacts of using the finite fee revenues for EM development instead of observer or EM deployment.

3.6 Enforcement Considerations for an EM Program

NOAA OLE recognizes that with the accelerated timeline for implementation of an EM program, some of the enforcement issues that have been raised may not be fully resolved before the Council's final recommendation on this analysis, or even before initial implementation. However, it is still important to raise enforceability concerns early so that the enforcement issues that may affect the enforceability and overall success of the program can be addressed prior to implementation. NOAA OLE looks forward to continuing to work with the EM Workgroup to address additional enforcement concerns, after implementation, as the program matures.

Two broad categories of enforcement considerations are described here. First, Section 3.6.1 provides recommendations for enforcing a functioning EM program. Second, Section 3.6.2 describes the tools an

EM program can provide that will allow OLE to detect violations of other requirements in the fishery, and Section 3.6.3 identifies other uses of EM for compliance monitoring.

3.6.1 Recommendations to be able to enforce an EM Program

NOAA OLE recognizes that an EM system to supplement the Observer Program has as its primary objective the management the fisheries and data collection. However, an effective EM program must also have compliance components to contribute to that goal. This section describes those compliance tools that would be needed to ensure a functioning EM program that meets that primary objective. Any decision points that have multiple avenues for enforcement are described in more detail.

An EM system that meets the enforcement needs would ultimately integrate GPS as a compliance, data, and management tool with these desired functions:

- Tamper resistance and low/no maintenance
- Independent date/time stamp with transmitted position or tagging in EM dataset
- Records of gear type, fishery, and fishing effort; two way communications; data transmission; electronic signatures, etc.
- Data to owner/operator for voluntary compliance.
- Mapping overlay of federal areas, transit restrictions, management units, gear restrictions, and restricted/closed areas 'geo-fencing'.

Any components or tools for compliance implemented by this program should be consistent with other regulatory programs. Examples of tools that should be consistent across regulatory program include the ODDS system, VMS transmission requirements, and electronic logbooks, if required. This minimizes the number of regulatory requirements a vessel owner must comply with which maximizes compliance and minimizes unintentional violations. Having consistent requirements aides in enforcement of those requirements and NOAA OLE can provide better and more informed guidance to fishers.

NOAA OLE will need access to an EM system aboard the vessel. NOAA OLE envisions visiting vessels either at sea or while at the dock to verify that the systems are functioning correctly and are in compliance with the vessel's VMP. Methods will need to be developed to allow enforcement boarding officers the ability to verify that the cameras are in the approved locations and that the handling procedures are being followed.

Data reviewers and EM service providers should report substantive potential violations observed aboard the vessels to NOAA OLE. Vessel owners are encouraged to self-report violations. Data reviewers will be provided a list of potential violations that might be observed during the video review. Procedures should be in place for documenting and transferring this data to NOAA OLE to meet chain of custody requirements. EM service providers and vessel owners should report critical malfunctions or divergence from an approved VMP to NOAA OLE.

Data retention should be sufficient to allow for compliance review and complex investigations. This should be anticipated to be between 3 to 5 years and will depend on what national guidelines are developed. Sound and consistent practices for the transfer and handling of data will be required to maintain evidentiary value of compliance data. This would be similar to other information collected aboard a fishing vessel and required by NMFS, such as raw observer data.

Strong and clear regulations provide guidance to vessel owners and operators about their responsibilities to maintain a functioning EM system. These will likely include requiring system health checks daily, informing NOAA OLE and the EM provider when system failures have occurred, keeping the cameras clean, following the specifications set forth in their VMP and ensuring that the systems are not tampered with (not turning the system off when required, not intentionally obstructing camera views or blocking sensors). To aide enforcement, VMPs should be clear, specific and updated to reflect the most up to date information about a vessel's operations. VMPs should be readily available to NOAA OLE.

Regulations should also have a clear definition of the failures in which a vessel would not be allowed to operate. Regulations should also include a provision to prohibit a vessel from fishing in the case of continual EM equipment failures or extraordinary failure situations. NOAA OLE's criteria for this type of failure of a system would not be the same as the "critical failure" developed in other sections of the document. The regulatory provision to prohibit a vessel from fishing would likely only need to be invoked under the most extreme circumstances when all other methods of bringing a vessel into compliance have failed.

NOAA OLE is considering several methods to verify that EM systems are on and functioning correctly while aboard the vessel. The three methods being considered include:

Method 1: NOAA OLE receives reports from the EM data reviewer of system failures after the EM reviewer has reviewed the data.

Most often, the failure would be reported well after it occurred. This option has many disadvantages. It would be difficult for NOAA OLE to determine if the failure was accidental, intentional, or malicious. Vessel operators and owners may not be aware of the failure or may have difficulty remembering the details of the incident. Enforcement cases may be difficult to prove or delayed by months or years. Vessels that had failures which prevented the collection of usable data might not be addressed until after fishing is complete at which time violations could be more significant. Enforcement would be primarily a reactive tool if the operator did not comply with requirements to stop fishing or repair the system. Enforcement would be of less value for proactive or voluntary compliance.

Method 2: Transmission of basic system health data from vessels at sea in real time to NOAA OLE and EM providers. Transmission of a full system maintenance check along with image clips, GPS and sensor logs when arrive at the dock.

Real time reporting of EM system health has many advantages. These include being able to notify and work with vessel operators immediately when systems fail which may address issues early and keep vessels at sea and fishing with no down time. It would also speed enforcement response to address violations at an earlier stage and help identify vessel operators that may be inclined to repeat violations or intentional tampering with EM system. System health transmissions would aid compliance assistance and allow program technicians to troubleshoot EM systems at sea, potentially keeping vessels on the fishing grounds. This method would help ensure that compliant vessels remained in the EM pool. If a failure was immediately reported and the operator was able to correct the problem, the likelihood of enforcement action (e.g. penalty) would be decreased. Finally, this information may be used in lieu of VMS requirements if the data was detailed and submitted in a timely fashion.

There are some disadvantages to this approach. First, installing equipment to allow vessels to transmit at sea and at the dock may not be feasible for some vessels that would otherwise qualify for the EM pool. Also, installation and transmission would have some additional costs, which are not known at this time. It is unclear if the vessel owner or the agency would be responsible for paying for these costs. Additional OLE technicians would be required to monitor the system health data.

Method 3: Vessel owners and operators report EM system malfunctions directly to NOAA OLE and EM Providers. The malfunctions reported to NOAA OLE would be those that require the vessel to remain in port until repaired.

This option has some of the advantages of the second option as well as some of the disadvantages of the first option. Requiring vessel owners to self-report malfunctions would engage the stakeholders so that they are aware of the problem and actively attempting to repair it. It is possible that not all malfunctions would be reported to NOAA OLE or would be reported later when the EM reviewer noticed the failure.

This would have many of the same challenges of the first option. However, failure to report malfunctions as required would be violation as well. Also, without the ability to transmit, using this in lieu of VMS would not be feasible and would not allow vessels to participate in fishing IFQ in multiple areas, described later in this section. This option may cost less than transmitting at sea and would not require dedicated NOAA OLE technicians to monitor system health checks. NOAA OLE staff time would be required to receive and investigate reports. Investigations would be difficult if NOAA OLE lacked immediate access to system information. Enforcement investigations and troubleshooting systems would likely need to happen more frequently at the dock.

3.6.2 Enforcement Tools provided by an EM program

EM will likely provide some support for enforcement of other regulations, regardless of which components are selected. During EM video review, the data reviewers would record potential violations and report to NOAA OLE. Table 3-5 provides a list of potential violations that could be captured by EM and detected by either human review or by automatic algorithms. Seriousness is based on anticipated violations, but is highly dependent on particulars of each situation. It is likely not all potential violations will be reported to NOAA OLE. Thresholds for reporting violations would need to be developed.

Table 3-5 Potential violations that could be captured by EM and detected by either human review or by automatic algorithms.

Violation	Likelihood of Detection[3]	Seriousness of Violations	Automatic Algorithm Detection
Fail to comply with VMP or components of EM program[1]	Medium	Low-High[2]	Yes
Conduct fishing contrary to inseason action, closure, or adjustment - 679.7(a)(2)[1]	Low	High	Possible?
Steller sea lion no fishing zone or no transit approach - 223.202(a)[1]	Low	High	Possible?
Feed or harass a marine mammal- 216.11(b)	Low	High	
Discharge a firearm within 100 yds of an endangered Steller sea lion 224.103(d)(1)(ii)	Low	High	
Take or lethally take a marine mammal- 229.3(a)	Low	High	
Fail to comply with effort log, logbook, or electronic logbook requirement- 679.5	Medium	Low-High[2]	Possible?
Submit false information on a report - 679.7(a)	Medium	High	
Retain undersize or out of season fish – multiple regulations	Medium	High	Possible
Discard legal sized IFQ halibut – 679.7(f)	Medium	Medium	Possible?
IFQ required retention or discard - 679.7(f)	Medium	Medium	
IRIU -679.27	Medium-High	Medium	
Remove fins of a shark and discard carcass at sea – 600.1203	Low	Medium-High	
Fail to return prohibited species to sea with a minimum of injury -679.21(b)(2)	Medium	Low-Medium	
Fail to release halibut outboard of the rail- 679.7(a)(13)(i)	High	Low-Medium[2]	
Fail to release halibut by cutting ganion, twisting or straightening hook-679.(a)(13)(ii)	Medium	Low-Medium	
Puncture or gaff a halibut - 679.(a)(13)(iii)	Low	Medium	
Crucify or otherwise strip halibut by contact with vessel- 679.(a)(13)(iv)	Medium	Medium	Possible?
Retain or possess prohibited species - 679.7(a)(12)	Low	Medium-High	Possible?
Fail to collect seabirds- 679.51(e)(1)	Medium	High	
Fail to deploy or meet seabird avoidance gear performance standards 679.24(e)(4)	High	Medium-High	
Pursue, take, capture, kill any migratory bird- 16 USC 703(a)	Low	High	
Fail to make a reasonable effort to release seabirds alive - 679.24(e)(2)	Low	High	
Marine pollution	Low	Low-High	Possible

[1]Real time detection capability desired
[2]Seriousness dependent on the particular situation
[3]Likelihood of Detection means able to be detected by an EM reviewer with moderate familiarity with regulations

3.6.3 EM for Compliance Monitoring

As the EM program develops, Council, industry and agency may integrate additional compliance-only EM components. Two elements of the EM program are now being considered that would fulfill a primarily compliance role: use of cameras to verify seabird streamer line use and the use of an EM system to allow vessels to fish IFQ in multiple areas. EM used primarily for compliance will likely have more stringent requirements than those required for EM data collection. However, those requirements will likely vary depending on the compliance use and the likelihood and severity of violations. Potential additional requirements for EM used as a compliance tool may include: electronic logbook requirements, additional reporting requirements, transmission of critical data while at sea, or the requirement to cease fishing if crucial components of the EM system fail.

3.6.3.1 Cameras used to verify streamer line use

The cameras installed as part of the EM system to verify the use of streamer lines is proposed as a compliance tool, but will be a part of the complete EM system. For this camera to verify streamer line use the frame rate recording could be very low. The camera would only need to be on and recording while the gear was being set and the frame rate for the recording could be extremely low, one frame per minute would allow NOAA OLE to verify that the streamer lines were being deployed. At this time NOAA OLE is not envisioning any additional requirements beyond those required for the EM system as a whole while required aboard the vessel.

As part of the normal video review, the reviewer would note the use of streamer line and provide a report to NOAA OLE if streamers were not deployed or if there were obvious violations of performance standards. As with other potential violations detected, there will likely be a threshold for this reporting requirement which has not yet been defined.

3.6.3.2 EM option for vessels IFQ fishing in multiple regulatory areas

Retaining halibut IFQ, halibut CDQ, and sablefish IFQ from multiple regulatory areas on a vessel at the same time is allowed under current regulations if the amount retained does not exceed the total amount of unharvested IFQ or CDQ available in the regulatory area in which the vessel is fishing, and the halibut are identified by regulatory area (by individual marking or storage in separate areas). In addition, halibut IFQ or CDQ fishing in multiple regulatory areas in Area 4 is allowed if an observer is onboard the vessel or the vessel carries either VMS and does not possess at any time more halibut than the IFQ or CDQ available in the area being fished. In both cases for Area 4, the halibut need to be identified by regulatory area (by individual marking or separation).

For all regulatory areas, vessel operators may retain IFQ or halibut CDQ *exceeding* the amount available in the area being fished if they have an observer onboard the vessel (50 CFR 679.7(f)(4)). This allowance was in effect at the time NMFS developed regulations to restructure the Observer Program. Unfortunately, NMFS did not identify at that time that this regulation needed to be revised with implementation of the partial coverage category. **For this reason, and for data quality, cost savings, and monitoring and enforcement reasons described below, NMFS recommends allowing vessels to obtain and use an EM system in lieu of carrying an observer.** The caveat to this recommendation is that NMFS is uncertain how many IFQ and halibut CDQ vessel owners are facing restrictions due to the current regulations. We could spend considerable time developing regulatory amendment alternatives that benefit a small number of people or offer solutions that will not be used by fishermen.

Because regulations governing halibut IFQ and CDQ fishing in multiple regulatory areas are addressed in both Federal fishery regulations and IPHC regulations, implementation of proposed regulatory amendment requires coordination with the IPHC and may also require a complementary adjustment by the IPHC.

In June 2013, representatives of IFQ fishermen identified the conflict between NMFS's regulations that allow IFQ fishing in multiple areas with an observer and the limitations for vessels in the partial coverage category on voluntarily taking an observer. Industry expressed the importance of being able to fish IFQ in multiple regulatory areas **to reduce the costs of fishing**, the potential for increased amounts of unfished IFQ if vessel owners cannot combine "clean-up" trips for multiple areas, and the possibility that the situation will become more costly and limiting if halibut and sablefish catch limits decline in future years.

Under current Observer Program regulations, most vessels fishing for IFQ or halibut CDQ are in the partial coverage category where observers are deployed randomly by NMFS under the ADP. NMFS regulations do not authorize voluntary observer coverage for vessels in the partial coverage category. NMFS is concerned that voluntary observer coverage would create the potential for data quality problems (fishing behavior may change if observers can be taken voluntarily on selected trips) and operational issues (the need to identify these trips separately in observer data, and the need to re-program the catch accounting system to exclude these data for catch estimation). NMFS requirements for safety, support, and assistance to observers do not apply for observers taken voluntarily. In addition, NMFS does not support using observer days in the partial coverage category to provide an observer for this strictly compliance monitoring role. For these reasons, vessel operators no longer have the option to hire an observer directly from an observer contractor if they wish to fish in multiple regulatory areas and retain catch in excess of the available IFQ or halibut CDQ for the area. The only option available is to conduct fishing in multiple areas if the vessel is randomly selected for observer coverage.

VMS alone is a minimally adequate tool to monitor IFQ fishing in multiple areas because the transmission rate of VMS is inadequate to determine where, how much, or how often fishing occurs and VMS currently deployed in Alaska only provides speed and heading on an intermittent basis.
NMFS is concerned that vessel operators seeking observer coverage to IFQ or halibut CDQ fish in multiple areas will attempt to manipulate trip logging through ODDS by logging and then cancelling a trip until the vessel is selected for coverage. This behavior would undermine the goal of random sampling and create **data quality concerns**. NMFS will continue to monitor whether logging of trips in ODDS is being intentionally manipulated to obtain observer coverage.

A potential solution to this program would be to allow vessels that want to fish IFQ in multiple areas to install and use the same EM system envisioned by this action. However, instead of tool to account for catch is would be used to ensure compliance with the requirements for fishing IFQ in multiple areas.
The EM systems have components that include sensors attached to parts of the gear to determine when fishing is occurring and GPS units to determine where the vessel is located and how it is moving. NMFS believes that an EM system could provide the necessary monitoring for IFQ fishing in multiple areas. Vessels that want to fish IFQ in multiple areas would need to have the complete systems installed aboard their vessels prior to registering in ODDS. At this time, only vessels that are in the EM selection pool would be allowed to use an EM system.

When the vessel registered a trip in ODDS, there would be a way to notify NMFS that even if they were not selected for EM coverage for catch accounting, they would be using an EM system for monitoring compliance with the IFQ fishing in multiple areas requirement. This would allow NMFS to remove any data collected from this vessel from database and alleviate any data quality concerns.

The system would require a reliable power source that would be operating 24 hours a day and it would be required to be operating at all times after the vessel left port to conduct IFQ fishing in multiple areas. This may be different than the EM system envisioned for catch accounting which may not need to be recording 24 hours a day.

The data storage device would likely be a computer with a removable hard drive. Depending on what is developed for the transmission method this hard drive may need to have the storage capacity for several weeks of data.

Transmission of sensor and location data: In order to monitor compliance with the IFQ in multiple areas requirement, a vessel with this EM system may need to transmit their location and sensor data to NMFS OLE, similar to what is required for VMS. Since the camera footage would not be a required to be transmitted, it is likely these transmission costs would be lower.

Electronic logbook: NMFS OLE proposes that an electronic logbook (elogbook) could be required, but would not have to transmit at sea and could be transmitted once the vessel returned to port or had access to a wireless modem. It may be possible to modify the elogbook so that the GPS and sensor data could be attached to the elogbook transmission. This data might be sent to NMFS OLE and housed and reviewed by the contracted technicians or OLE staff.

Some IFQ vessels that may use this exception may not have a NMFS logbook requirement. However, OLE proposes that logbook data is needed as it commits the operator to his or her fishing activity. The NMFS logbook would be a crucial piece of evidence in any multiple area case. Additionally, IPHC does not provide NMFS OLE with the IPHC logbook data. Vessel owners and operators are required to provide the logbook to OLE, if requested.

Several questions regarding implementation of such a program are outstanding that require further discussion, including:

- Could vessels that are not part of the EM selection pool participate?
- Who would be required to pay for the systems if vessels not in the EM selection pool are allowed to participate or if a vessel in the EM pool was not selected to use EM for the trip?
- How and when would they be installed aboard the vessels?
- Would the systems stay onboard the vessels even when not fishing in multiple areas on one trip?
- If the electronic transmission of the data is not possible retrieving or requiring submittal of the data from the vessel could be more complicated and would require more thought before implementation. For example, would it be possible to mail hard drives directly to NMFS OLE? What would the chain of custody requirements be?
- How many vessels would be interested in this option if it became available?
- How would NMFS manage the data from an EM system that was for compliance only?

3.6.4 Enforcement of Alternative 3

The regulations would identify consequences if the logbook is found to be inaccurate, based on the EM audit. In other fisheries, the consequence is that the vessel operator has to pay the cost of a full EM audit, but this may not be a legal option in Alaska. Information from the EM review, where it differs from the logbook, would be used to adjust IFQ accounts, as well as harvest mortality and prohibited species catch information that is used to manage the status of fisheries where applicable. However, enforcement tools to ensure vessel operators report accurate logbooks are not readily available at this time to Alaska OLE. The only tool that may be feasible is to remove a vessel that had inaccurate logbook reports from the EM selection pool.

An electronic logbook would be needed under Alternative 3 so that NOAA OLE does not have to interpret handwriting or other marks made in a paper logbook. Electronic logbooks also increase the timeliness of reporting which would reduce the enforcement response time.

Enforcement costs under Alternative 3 are expected to be higher. OLE officers or agents would need to review cases in which logbook audits did not match the EM reported data. Thresholds for severity as well as patterns of non-compliance would need to be collected and reviewed. This would likely require multiple years of collection of instances and long periods of investigative work.

3.7 Video Review and Catch Estimation Process

Chapter 2 describes how catch estimation occurs under status quo and provides an overview of how catch accounting would be accomplished using the EM data under Alternative 2 and the logbook data under Alternative 3. The pre-implementation of EM 2015 and 2016 has provided experience with aspects of video review and information about the reliability of EM and data quality in the catch estimation approach under Alternative 2. This section provides more detail about how NMFS envisions the implementation of the video review and catch estimation process under Alternative 2 and discusses some data quality and validation considerations associated with using EM data for catch estimation.

3.7.1 Video review and availability of EM data

During the pre-implementation of EM in the hook-and-line fisheries, the video review has been conducted by Pacific States Marine Fisheries Commission (PSMFC). In the future, this work may continue to be conducted by PSMFC or contracted to a video review company, but the methods being utilized by PSMFC provide a model for what is anticipated under a regulated program.

PSMFC worked with the EM workgroup and NMFS to develop the video review protocols and the information that is being recorded during the video review of 2016 pre-implementation is summarized in Appendix 2. All of the video reviewers employed by PSMFC have a bachelor of science degree in a natural resource science. In addition, they have at-sea commercial fishing knowledge and experience and, specifically, past experience as a fisheries observer. Reviewers are trained to use the review software and follow review protocols, and have been tested to ensure review standards are met. Staff reviewed raw video and sensor data using EM Interpret™ Pro software from AMR[18]. This software integrates the hydraulic sensor and GPS data with the synced video output in order to facilitate identification and recording of trip and haul information (such as start and end times). The software also allows the reviewers to record catch information. Metadata such as GPS location information, the date, and time were captured automatically from the sensor data when reviewers recorded point annotation (such as trip/haul start/end, or catch event).

Reviewers assessed the completeness of the sensor and video data during each trip. The quantitative data from the sensor readings and locations helped validate whether the video was complete. Video for a trip was deemed incomplete by a reviewer under several scenarios: the system was not powered for the beginning or end of the trip, the video turned on after the start or before the end of the gear hauling, or there was an unexplained video gap that was long enough to miss a haul or part of the catch. If video was incomplete, the duration of the video failure was noted along with the reason for the gap. Reviewers also categorized the quality of the imagery (high, medium, low) and the reason for medium and low quality imagery.

A PSMFC staffer worked with the North Pacific Observer Program on Alaska species identification and has trained all video reviewers. The reviewers were instructed to record species to the lowest identifiable taxonomic level possible. Reviewers recorded species, count, damage to fish, disposition (retained or discarded), whether the discard was intentional or a drop-off from the line. Halibut were assessed to determine the release method and condition for each fish. For cases where the video stopped recording before catch handling was completed, fish that were onboard at the time of the video ending were reported as retained. Discards were categorized as intentional or unintentional depending on the method of discard. Any fish that dropped off the gear (i.e., without visible shaking or other interaction by a crew member, or without hitting the roller or the vessel) was defined as unintentional. All other discards were categorized as intentional.

[18] An open-source, video review software is also being developed by Saltwater Inc, and Sea State through a National Fish Wildlife Federation (NFWF) grant and may provide an alternative video-review software option in the future.

Video reviewers recorded the number of minutes it took to review each haul. On-deck sort time was calculated from the start and end times of catch handling in the video. Review rate was calculated as review minutes divided by sort minutes.

PSMFC has developed a double-review comparison process to verify data collection. This includes verification that: data are being reviewed in a consistent manner (i.e., protocols are being followed and viewers are using the same review methods); and data outputs (such as number and identification of fish, interpretation of release methods, review time, etc.) are similar regardless of the viewer producing the data. Each quarter, at least one haul per reviewer is randomly selected and is examined by all the reviewers. The information from the all the reviewers is compared to determine differences that are used to identify needs for remedial training, clarification of protocols, and improvements to training methods and/or materials.

Table 3-6 Data being collected in 2016 by PSMFC during video review from the EM selection pool.

Type of Data	Data Elements	Details & notes
Drive Metadata:	ADFG permit number	
	Date drive retrieved	
	Field assessment notes	Saltwater/Archipelago notes when drive was picked up
	Logbook completed: Y/N	
	Vessel Attributes:	• Vessel configuration (covered deck vs deck uncovered); • fishing gear (conventional, snap, auto line); • deck gear; camera location; • EM configuration; • fishing characteristics (day vs night fishing; side-haul vs stern haul)
	Initial review of drive imagery to determine:	Is sensor data complete? Y/N Is imagery/video complete? Y/N
Data for each Trip:	Trip start and end date and time	
	Trip start and end ports (locations)	
	Time gaps	characterize type of time gap, location within trip, and duration / number of missing sets (as possible)
	Target fishery	Trip targets assigned using standard Catch Accounting System protocols based on the predominant retained species.
	Streamer line used (Y/N)	
	Number of fished sets as determined by the sensors	
	Paper logbook data (effort logs, IPHC logs)	Key punch all data. If an IPHC logbook is provided, then enter the same information that is collected on the effort log **plus** the lat/lon of each set.
Data for each retrieval:	Retrieval start and end date and time	
	Retrieval distance:	Derived haul distance from lat/lon from sensors during the retrieval
	Gear type (within hook-and-line, differentiate snap and fixed gear)	
	Time to review imagery for the set	
	Time gaps, GPS gaps, sensor gaps, video gaps	
	Reviewer confidence:	EM reviewers' rating of data confidence (high, medium, low).
	Image quality:	EM reviewers' assessment of image quality (high, medium, low). For low & medium image quality, they assign a reason for the lower image quality.
Effort Data (for 100% of hauls):	Size of each set	Amount of time to retrieve set Use the time & lat/long from the sensors to calculate the length of the set
	Any unusable or missing portions of set	Quantify the portion of set with missing or unusable image data (where catch and disposition cannot be identified).

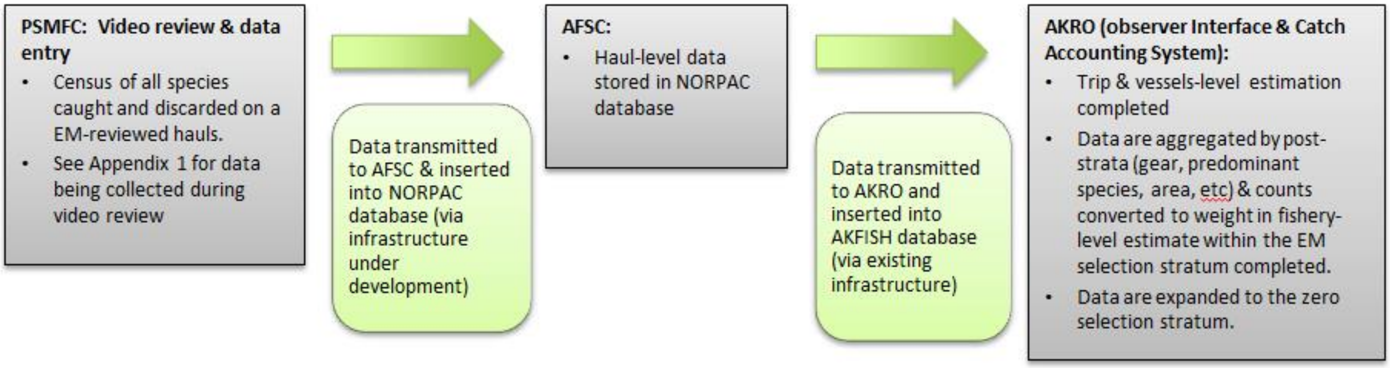
Type of Data	Data Elements	Details & notes
Catch Data (census of haul):	Quantify start/stop times for data gaps.	Reason for low quality image data Reason for missing image data; portions of set retrieval without imagery
	Species IDs to lowest level for fish, inverts, birds, and mammals	When a partial fish is caught (e.g., fish head, lips) and the reviewer can tell what species it is, then the species code will be used with a note designating a partial fish. If the species cannot be determined because too much of the fish is missing, then the "lips or heads" species is used. For halibut, it will be recorded as species halibut with a Discarded-Damaged disposition.
	Counts of each species	If a seabird is caught, then capture a still image for post-hoc species ID confirmation. Record if the bird was not held in front of the camera for enough time for a still image to be captured.
	Disposition of catch:	• Retained – General • Retained – Damaged • Discarded – General • Discarded – Damaged • Drop off below water • Drop off above water • Utilized onboard
	For discarded Halibut:	• Injury key/Release condition • Release method

3.7.2 Moving data from video review into catch estimation

In order for EM data to be incorporated into catch estimation and used for inseason management of fisheries, NMFS needs access to the information that is recorded by video reviewers. Infrastructure is being developed to move data from the video reviewers into the catch estimation process (Figure 3-8). After the video review process, data are exported into a PSMFC database and the raw video and sensor data are uploaded and stored on a server at PSMFC. This raw video and sensor data is backed-up on two more servers to ensure there is no loss of data in the rare event of a server malfunction. Information will be transferred to the Observer Program at the Alaska Fisheries Science Center and then to NMFS Alaska Region's Catch Accounting System (CAS). The output from CAS is available for NMFS inseason management of the fisheries.

Estimates of total catch by fishery will be required for unobserved vessels in the EM pool. Currently CAS does this for unobserved trips using haul information collected by at-sea observers and expanded to the haul-level (as calculated by AFSC). These methods are easily modified to treat EM haul information as an input data using the existing infrastructure and data-stream from AFSC into CAS. Similar to current CAS methods (as described in Cahalan et al. 2015), the EM data will be used to estimate catch on unobserved trips as and average weights collected from at-sea data applied to those count estimates to obtain total weight (see Section 3.7.4 for more detail).

Figure 3-8 Anticipated flow of information from video review to the Alaska Fisheries Science Center (AFSC) through the catch estimation process in the Alaska Regional Office (AKRO) catch accounting system.



3.7.3 Timeliness of EM data

An important factor in using EM data for catch estimation is time needed for video review and the overall turnaround time from when a vessel finishes a trip to when data are available for inseason management.

During the EM pre-implementation in the hook-and-line fishery, PSMFC has been tracking the amount of time necessary for video review. Review rate was similar in the halibut and sablefish target fisheries: approximately half of real time (Table 3-7; e.g., one hour of catch handling time could be reviewed in 30 minutes). The review rate in the Pacific cod fishery was slower and close to real time (e.g., one hour of catch handling could be reviewed in about 1 hour). Pacific cod hauls tended to have more variety of species caught than other fisheries, as well as being the only fishery where stern hauling was conducted. Stern haulers were more difficult to review due to a side view of the line (as opposed to a top down view). In addition, there was more fishing at night in the Pacific cod fishery and poor lighting on the line at night increased the review time.

The availability of EM data for management is affected not only by the video review time, but also the time necessary to mail the hard drives from the vessel to Portland, Oregon, and the amount of time after a hard drive arrives before a reviewer is able to conduct the review. Table 3-8 provides summary information on the number of days for hard drives to arrive at PSMFC and the overall review times that have been seen to date in 2016.

It would be possible to reduce the number of days is takes a hard drive to arrive at PSMFC if hard drives are sent more frequently. Currently, under the 2016 pre-implementation plan, an EM vessel making a landing in Homer or Sitka contacts the local the EM Field Coordinator who pulls the hard drive off the vessel and mails it to PSMFC for review. If landing in another port, and it has been more than 14 days since the last hard drive swap, then the vessel is instructed to mail the hard drive directly to PSMFC. Under the 2017 pre-implementation plan, the EM workgroup has recommended mailing the hard drives within two business days after each selected trip. This would likely improve timeliness of the data review and reduce scenarios where there has been a very long arrival time.

Table 3-7 Average video review rates in 2016 by target fishery. Review included enumerating both retained and discarded catch for the entire length of the haul.

	Longline		
	Halibut	Pacific cod	Sablefish
Number of hauls	123	160	140
Average minutes of sorting per haul	136	117	208
Average minutes of review per haul	59	107	102
Average minutes of review/minutes of sorting	0.47	0.93	0.49

Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

Table 3-8 Average time (in days) for EM hard drives to arrive at PSMFC and average turn-around time for video review under pre-implementation in 2016.

	Arrival Time		Review Time		
	Days from last fishing date on drive	Days from last date on drive	Days from arrival	Days from last fishing date on drive	Days from last date on drive
Average	9.28	6.05	8.80	18.08	14.85
Median	7	6	7	15	12
Mode	6	4	3	15	12
Minimum	3	2	0	4	4
Maximum	63	14	30	65	33

Source: PSMFC; 7/27/2016

3.7.4 Catch estimation process

Alternative 2 would implement an EM program to collect information that will be incorporated in the NMFS Catch Accounting System (CAS) to generate catch and bycatch estimates to be used for management. In this section, we provide an overview of the estimation approaches, necessary data, and tradeoffs that NMFS is considering under Alternative 2.

In the sample design currently used by the Observer Program there are three sampled strata (small-vessel trip selection, large-vessel trip selection, and full coverage) and one unsampled stratum (vessels <40ft LOA). Within each sampled stratum, the sampling and associated catch and bycatch estimation are hierarchical. Catch and bycatch estimation follows the sampling hierarchy by expanding sample data to the haul, haul data to the trip, trip to vessel, and the vessel data to the fishery within each sampling stratum. Strata estimates are combined as appropriate to produce overall estimates that are used in management and for stock assessments.

Under Alternative 2, the EM vessels will be in sampling strata separate from the at-sea observer strata. It is still uncertain what deployment design will ultimately be used to sample within the EM stratum; in 2016 a vessel-selection approach is being used and in 2017 the EM workgroup is recommending trying a trip-selection deployment design. Depending on which of these designs is ultimately implemented, either the vessel (i.e., vessel selection) or trip (i.e., trip-selection) will be the primary sample unit within the EM sampling stratum and all estimation will follow up the sample hierarchy to the individual (monitored) vessel or trip before being extrapolated to the fishery. Within the EM sampling stratum, average weights from the at-sea observer stratum most similar to the EM stratum will be applied, as appropriate, to produce fishery-level estimates of catch for each EM sampling strata. As possible, observer data from vessels in the same area, size class, and gear types will be used to estimate average fish weights. The EM stratum-specific estimates will ultimately be added to catch estimates from the at-sea observer strata to generate overall catch estimates.

The total count of species on a sampled haul will generally be known since all catch is enumerated by species on sampled hauls. There are some situations where the video may be missing for a portion of a sampled haul. However, the amount of missing video within a haul is expected to be low, resulting in catch on nearly all sampled hauls being completely enumerated. Data gaps, or the use of unverified data, are expected to be minimal since counts of hauls will be available (based on sensor data), landings are assumed known at the trip level, and both discarded or retained fish can be censused at the haul level (for sampled hauls). Nearly all variance associated with the fishery-level catch estimates is functionally related to the statistical expansion from sampled trips to unsampled trips, sampled vessels to unsampled vessels, and the use of average weights.

Generally, we anticipate that the count of fish on an EM trip will be known precisely, since it will be derived from a census of all fishing events on the trip and expansion will be unnecessary. There will be situations where portions of the haul data cannot be collected; although, based on preliminary studies, we expect this occurrence to be unusual. If there are hauls with missing data, NMFS will either ignore the partially sampled hauls and treat them as unsampled (and use sampled hauls on an EM trip to estimate total catch), or estimate catch on the partial hauls by using the portion of the haul with imagery.

An issue with treating the partial hauls as if they were unsampled during the estimation process is decreased sample size (assuming multiple hauls are partially observed - i.e., not censused), and information that would otherwise be useful for estimation is ignored. In addition, if factors causing the missing data are not random, ignoring available data and using sampled hauls within a trip for estimation has the potential to introduce bias into the estimated catch. On the other hand, if missing data is a random event, then we can assume that the hauls with complete data are representative of all hauls and treating those hauls as unsampled may not impart bias into final estimates. Estimation for that haul would then occur at the trip level of the hierarchy.

NMFS is continuing to investigate using hauls with some portion of missing data to estimate trip-level species information. Methods that use hauls with only partial video would require expanding the portion of the haul with imagery to the portion of the haul with no imagery. In order to expand the partial sample to the entire haul, it is necessary to have a measure of the portion of the haul that was sampled, as well as a measure of the haul size.

There are several methods for quantifying the size of hauls on EM trips; each method has tradeoffs. The number of hooks sampled is often used as a measure of the size of a haul. In review of the EM data in 2014, we determined that counting hooks per haul from video images is difficult and time consuming. In 2016, vessels are recording effort information into a logbook (length and number of skates, number of hooks per skate, and hook spacing) so this information can be used to determine the size of the haul. A drawback to this approach is that it requires vessels to maintain an effort logbook. In addition, there is no mechanism for validating the self-reported information (i.e., there is no independent measure of these variables). As an alternative, we are considering using the length of the groundline as a measure of haul size. For this approach, haul size will be defined as the length of the groundline as computed from the GPS data collected during haul retrieval[19]. A concern with this approach is that wind and water current may affect how the boat moves during gear retrieval (e.g., if the boat is pulling gear with the current it may drift a longer distance than the length of the groundline). It would be preferable to calculate the length of the groundline during haul setting; however, the EM sensors rely on hydraulics and do not reliably record the haul setting activity.

Given the tradeoffs with the various methods, NMFS plans to look at both the self-reported effort data (skates and hooks) and the length of the groundline, as computed from the GPS data collected during haul

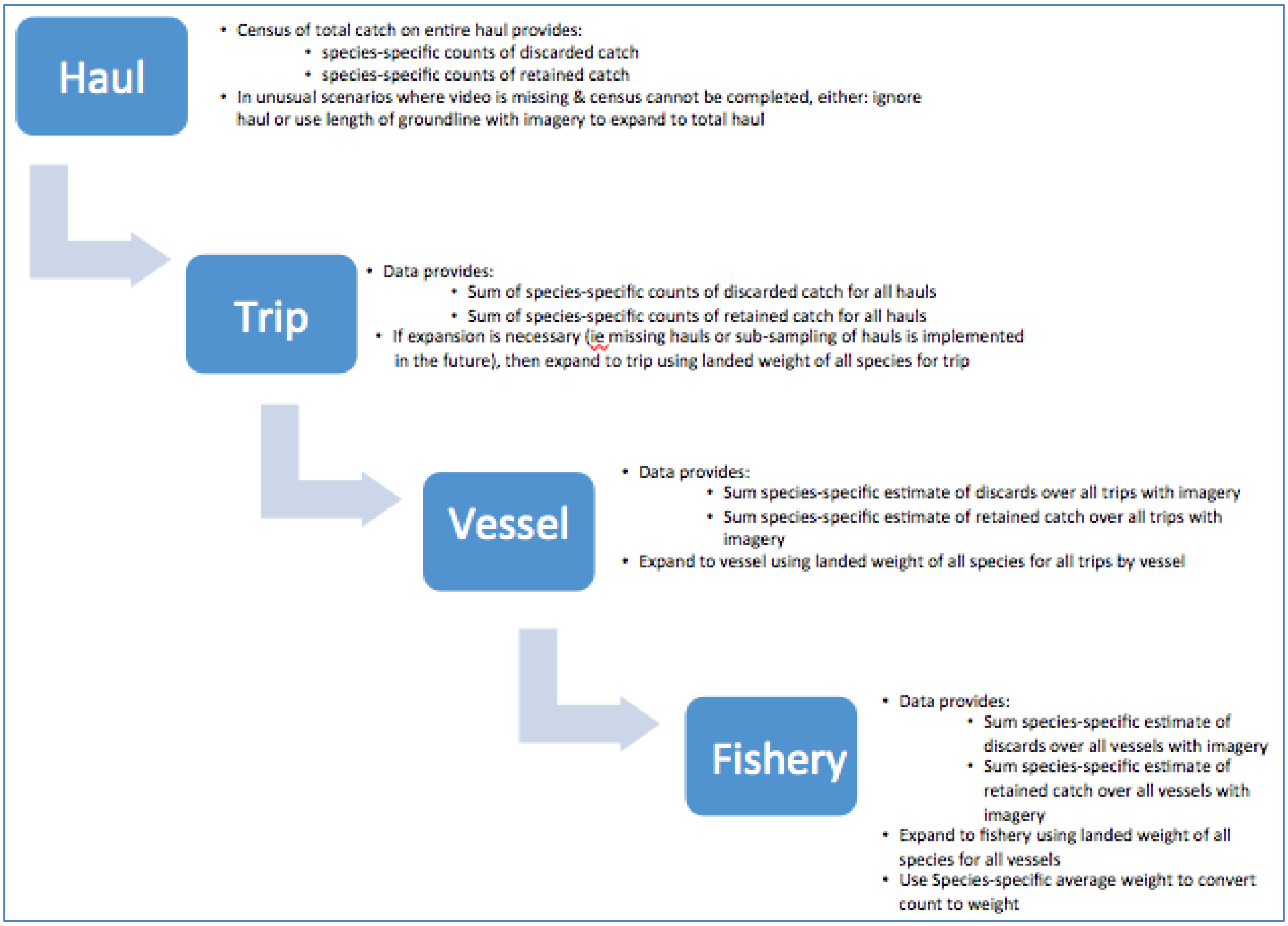
[19] Another option could be to use haul-back time if the length of groundline is not available.

retrieval, to evaluate haul size. If NMFS uses hauls with missing video, then ratio estimators would be used for the haul-level estimate; i.e., the species composition, by number, will be expanded to the total haul based on available imagery and sensor data expanded to the haul size. However, as previously stated, given that most hauls will be censused, the impact of using partially sampled hauls to estimate total catch is likely small since nearly all catch data used is based on a census.

For trip, vessel, and fishery levels of the sampling hierarchy there are two estimation routes available: a mean-based and a ratio-based estimator. A ratio-based approach is currently used to estimate catch using data from the observer program (Cahalan et al. 2015) and in the short-term, this is the approach NMFS will take to estimate catch from EM data from the hook-and-line fisheries (Figure 3-9). However, as EM is expanded to other fisheries, such as the pot gear, the logistics of gathering data necessary for a ratio estimation approach may not be cost effective. For example, gathering data on the number of retained fish in a pot fishery may be costly for video review and require significant changes in catch handling on the pot vessel and therefore using a simple mean-based estimator, or other estimator that does not rely on knowing the weight of the retained catch, may be the most logistically feasible approach. If the underlying sample design changes, the choice of estimator will also be impacted. For example, if video from all hauls within a trip are not reviewed, expansions within the trip will be necessary. This will change the variance assumptions (and variance structure) and therefore change the best choice of estimator. Appendix 3 provides more detail and describes some of the tradeoffs of two estimation approaches at the trip, vessel, and fishery level in the estimation hierarchy.

In summary, census of catch will be collected within an EM trip and expansions will not generally be necessary to complete estimation at the haul and trip-level. In unusual situations where hauls are missing video or sensor data, then the hauls will be considered "unsampled" and estimates made using trip level information, which rely on neighboring haul information within an observed EM trip. NMFS will continue evaluating the potential of using partial haul information to estimate on these hauls, but in the near-term the haul will be assumed unsampled. At the trip and fishery levels in the estimation hierarchy, NMFS will use a ratio estimation approach to estimate catch within the EM stratum.

Figure 3-9 Summary of catch estimation process throughout the estimation hierarchy, using EM data and a ratio estimator.



3.7.5 Data quality/validation considerations

3.7.5.1 Previous EM Studies in Alaska

There has been a long history and numerous studies testing various aspects for deploying EM in both trawl and longline fisheries in Alaska. In the trawl fishery, EM was evaluated for potential use for monitoring discards (Bonney and McGauley 2008, Bonney et. al 2009, Buckley 2005, Heist 2008, McElderry et. al 2005, McElderry et. al 2008). There were two studies that focused on seabirds including one that evaluated EM for seabird compliance monitoring in the longline fishery (Ames et. al 2005) and another that assessed EM for monitoring bird strikes on trawl third wire (McElderry et. al 2004). There have been several studies that have specifically focused on EM in the Halibut longline fishery. In a 2002 study, Ames (2005) noted identification limitations where 7 of the 17 species investigated had discrepancy rates greater than 10 percent, but overall the analysis demonstrated potential benefits of EM technology for monitoring. A follow up study was initiated in 2004 after incorporating recommendations from the 2002 study. In this study, Ames (2007) reported that enhancements improved the video analyst’s accuracy relative to the observer data for most species although declined for some. In 2007, another EM study was initiated in the Halibut longline fleet (Cahalan et. al 2010) to compare species identification of catch between standard observer estimation, complete hook-status observer coverage. This study showed statistically unbiased and acceptable comparability for almost all species and comparisons of total species-specific numbers of fish estimated using EM and hook-status data showed few statistically significant differences. All studies reviewed reported varying degrees of EM reliability resulting in lapses of data collection and/or found species identification of like species difficult or impossible to distinguish.

3.7.5.2 Missing video and sensor data

During an EM trip there can be times when either the sensor or video data are not captured and there are gaps in the EM information. During pre-implementation in 2015 and 2016, the video reviewers at PSMFC have assessed the completeness of the video and sensor data during each trip. If video from a trip was incomplete, the duration of the video failure was noted along with the reason for the gap.

The impact of the missing data varies depending on what is missing (Table 3-9). The highest impact scenario is when the sensor data is missing. In these circumstances, the video reviewers have no way to determine how many hauls occurred on the trip and there is no way to determine how much of the video might be missing. If there are gaps in the video that occur while catch is coming onboard, then there is no way to count catch events during the portion of the haul with missing video. In these circumstances, NMFS will either need to ignore the hauls with missing video or extrapolate the catch to the portion of the haul with missing data (see Section 3.7.4).

There are also circumstances when video is missing before or after all the catch was brought onboard and thus no catch was missed as it came onboard, but some of the catch handling by crew could have been missed. In the EM systems being used during pre-implementation, the video cameras turn on when sensors on the hydraulic gear trigger them. However, there can be times that the gear has started to be retrieved and the video has not yet been triggered to start recording. This can cause gaps in the video before any catch has been brought onboard. When the gear has finished being hauled, the hydraulic-sensor triggers the cameras to record for an additional 1 to 2 hours, depending on the recording setting. However, if all of the catch still has not been sorted after this time and recording stops, video reviewers will be unable to determine if some of the catch was discarded later.

The sensor data was complete on about 75 percent of the trips (Table 3-10), while the video was only complete on about half of the trips so far in 2016. Looking at the information within a trip, however, provides more information about the reliability of the video; about 75 percent of the hauls had video for the entire haul event (Table 3-11). It was very rare (0.5 percent of hauls) for video to be missing for an entire haul, but much more common for video to be missing for some portion of a hauling event (Table 3-11). About 15 percent of the hauls had gaps in the video that occurred while catch was being brought onboard. However, the vast majority of these missing video events occurred on a single hook-and-line Pacific cod vessel where there was a problem with the software on the control box that caused a one minute gap in the video to occur every hour during video recording. The software was updated when this issue was brought to the attention of the EM service provider and did not occur again. **Excluding the hauls with the software problem, the number of hauls with gaps in video data that occurred during catch coming onboard was low and the frequency that was seen in the halibut and sablefish trips occur (4 hauls out of 263 hauls, or 1.5 percent of hauls) is likely more representative of what is expected to occur.**

For catch estimation it is important that any gaps in video coverage that result in missing information are random so that expansion from the remaining imagery will not introduce bias to the estimation process. In 2015, no pattern was evident for the reasons for missing video information. Reasons included power loss, power button being pressed, a system reboot, and unexplained gaps. Video was more likely to be incomplete on the vessels first or second trip (Figure 3-10). Of the vessels that had complete data on the first trip, several were in the EM program the previous year. Gaps in the video after the third trip tended to be short in duration and related to software system errors on the EM control box. These results indicate that there is a learning curve for vessel operators to get used to operating the EM system and also for the EM service provider to customize the EM system for each vessel.

Table 3-9 Varying levels of impact on data quality when EM information is missing.

Available EM data	Impact on Data Quality	Level of Impact
Complete video and sensor data	No impact – all information available	None
Missing video - *before* catch brought onboard	Low impact since all information is available to estimate catch & disposition, but some risk that might have missed species interaction	Low
Missing video - *after* all catch brought onboard but *before* all catch handling ends	Can count all catch, but missing information on disposition of some of the catch so have to make the assumption that catch remained as retained and was not discarded later.	
Missing video - *during* catch being brought onboard	Cannot count catch for portions of haul, therefore either expand catch to remaining portion of haul or ignore the haul	
Missing sensor data	Cannot tell how many hauls occurred, cannot confirm if video is complete or missing	High
No video nor sensor data for trip	No information available from the trip	

Table 3-10 Number of trips and completeness of video and sensor data during 2016 EM pre-implementation in 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Video & sensor completeness (number of trips)	Halibut	Pacific cod	Sablefish	Total
Number of trips with complete video data	7	4	13	24 (46%)
Number of trips with complete sensor data	16	7	16	39 (75%)

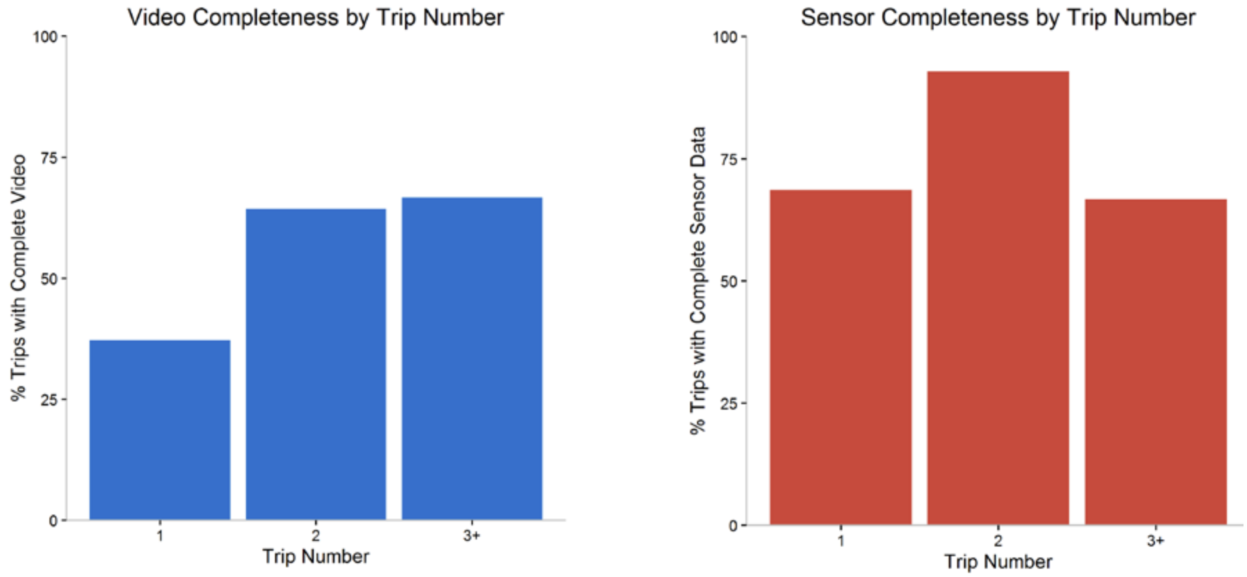
Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

Table 3-11 Number of hauls and completeness of video during 2016 EM pre-implementation in 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Video completeness of hauling events (number of hauls)	Halibut	Pacific cod	Sablefish	Total (percent of hauls)
Video of entire hauling event and catch sorting	98	97	120	**315 (74%)**
Missing video - *before* catch brought onboard	4		6	**10 (2%)**
Missing video - *after* all catch brought onboard but *before* all catch handling ends	19	4	11	**34 (8%)**
Missing video - *during* catch being brought onboard	2	58*	2	**62 (15%)***
No video for entire haul		1	1	**2 (<1%)**
Total hauls	**123**	**160**	**140**	**423**

*Note that the vast majority of these events occurred on a single hook-and-line Pacific cod vessel where there was a problem with the software on the control box. Once the software was updated, this issue did not occur again.
Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

Figure 3-10 Video and sensor completeness in relation to the number of trips since the EM system had been installed on a specific vessel.



Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

3.7.5.3 Image quality

The quality of the video imagery is an important factor in the ability of video reviewers to identify species and count catch events. Poor image quality can be caused by a variety of factors including poor camera angle, glare on the camera, lighting issues (especially during night fishing), and water spots on the lens. During pre-implementation, reviewers categorized the quality of the imagery (high, medium, low) and the reason for medium and low quality imagery. The majority of the video (80 percent) was of high quality (Table 3-12). Of the hauls with medium quality, poor camera angles and water spots caused the majority of the degradation (Table 3-13). Low quality was mostly caused when video from 1 or more camera was missing so video reviewers had to rely on wide-angle deck-camera(s), which does not provide a close-up view of the catch coming up on the line.

Table 3-12 Image quality as assessed by video reviewers at PSMFC while reviewing 2016 EM pre-implementation hauls from 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Image Quality (number of hauls)	**Halibut**	**Pacific cod**	**Sablefish**	**Total (percent of hauls)**
High	111	97	123	331 (78%)
Medium	11	45	13	69 (16%)
Low	1	17	3	21 (5%)
Unusable				
No video		1	1	2 (<1%)
Total	123	160	140	423

Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

Table 3-13 Image quality as assessed by video reviewers at PSMFC while reviewing 2016 EM pre-implementation hauls from 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Cause	Medium Quality				Low Quality			
	Halibut	Pacific cod	Sablefish	Total	Halibut	Pacific cod	Sablefish	Total
Glare			2	2				
Dirty Camera		2		2				
Night Lighting	1	5	1	7				
Poor camera angle	9	27	2	38	1	6		7
Water spots	1	11	8	20				
No data from 1 or more cameras						11	3	14

Source: PSMFC preliminary review of the 2016 season, updated 7/11/2016

3.7.5.4 Species identification from EM data

During the pre-implementation of EM in the hook-and-line fisheries, video reviewers were instructed to record species to the lowest identifiable taxonomic level possible. In 2016, video reviewers identified a high proportion of retained and discarded catch to species level. Exceptions were generally species groups that are known to be problematic, including as short and longspine thornyheads, shortraker and rougheye rockfishes and arrowtooth and Kamchatka flounders (see Table 3-14). There was also 3 rockfish that were recorded as “Rockfish –unidentified”, 1 that were recorded as “Rockfish, Dark unidentified” and 31 that were recorded as “Rockfish –Small Red unidentified” out of the total 445 rockfish that were recorded (which were not part of the shortraker/rougheye or short/longspine thornyhead groups).

As part of the EM cooperative research in 2015, dockside monitors were deployed in multiple ports to collect landed catch data from fishing vessels to enable comparison of rockfish species identification. All vessels were instructed to keep all of their rockfish or report any discarded rockfish to the dockside monitor. Dockside monitors recorded only had access to landed rockfish bycatch, so comparisons of EM data and dockside monitoring were generated for retained rockfish at the trip level. The counts of shortraker and rougheye rockfish from the dockside monitor were aggregated for comparison with the shortraker/rougheye rockfish recorded by the video reviewer. The dockside monitored shortspine and longspine thornyhead counts were treated similarly; they were aggregated and compared to the thornyheads recorded by the video reviewer. The counts of landed rockfish bycatch were generally similar between video reviewers and dockside monitors (Figure 3-11).

Table 3-14 Counts of retained, discarded, and unknown disposition catch from 2016 EM pre-implementation hauls in 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Species	Longline Halibut			Longline Pacific Cod			Longline Sablefish		
	Retain	Discard	Ukwn	Retain	Discard	Ukwn	Retain	Discard	Ukwn
Rockfish and Thornyheads									
Rockfish - unidentified					3				
Rockfish, Black				34	1		1		
Rockfish, Canary	13	1		1				1	
Rockfish, Dark unidentified		1							
Rockfish, Dusky (was Light Dusky)	8	1		4	8		13	1	
Rockfish, Quillback	1				21				
Rockfish, Red Banded	31	1		4	1		3		
Rockfish, Silvergray				13	1				
Rockfish, Small Red unidentified	1	1		10	1		15	3	
Rockfish, Tiger				1	1				
Rockfish, Yelloweye	166	3			7		69		
Rockfish, Shortraker/Rougheye Total	234	21		57	3		1,106	85	
Rockfish, Rougheye	*63*	*4*		*15*			*188*	*9*	
Rockfish, Shortraker	*36*	*2*		*9*	*2*		*364*	*26*	
Rockfish, Shortraker/Rougheye unident.	*135*	*15*		*33*	*1*		*554*	*50*	
Rockfish, Thornyheads Total	318	27		3			3,656	1,341	
Rockfish, Longspine Thornyhead									
Rockfish, Shortspine Thornyhead	*70*	*2*		*2*			*510*	*249*	
Rockfish, Thornyhead unidentified	*248*	*25*		*1*			*3,146*	*1,092*	
Sablefish	1,651	92		10	177	1	26,179	863	
Pacific halibut	1,113	1,129		210	4,210	1	360	555	
Pacific cod	378	16		37,779	651	1	1		
Lingcod	33	8		3	26		10	2	
Flatfish									
Flatfish - unidentified					162	2		1	
Flounder, Kamchatka/Arrowtooth Total		164		12	720		2	125	
Flounder, Arrowtooth		*40*		*5*	*205*			*34*	
Flounder, Kamchatka					*8*		*1*	*2*	
Flounder, Kam/Arrow – unident.		*124*		*7*	*507*		*1*	*89*	
Sole, Dover		1						4	
Sole, Flathead					121	1			
Sole, Rock Sole unidentified					1				
Other Fish									
Pollock (Walleye Pollock)				1,181					
Grenadier (Rattail), Giant		9					2	1,358	
Grenadier, (Rattail) - unidentified		10			1		81	5,671	
Ratfish, Spotted		21			2			6	
Ronquil/Searcher - unidentified					17				
Roundfish - unidentified		1		10	82	1		41	
Sculpin - Myoxocephalus unidentified					43				
Sculpin - unidentified		72		3	2,642	2			
Sculpin, Bigmouth		1			2				
Sculpin, Great				1	100				
Sculpin, Irish Lord - unidentified		5			78				
Sculpin, Red Irish Lord					14				
Sculpin, Yellow Irish Lord		50		3	905				
Fish head / lips or parts		2			7		4	97	
Fish - unidentified				6	59			2	
Shark									
Shark, Pacific Sleeper (Mud)					5				
Shark, Spiny Dogfish		82			241		3	56	

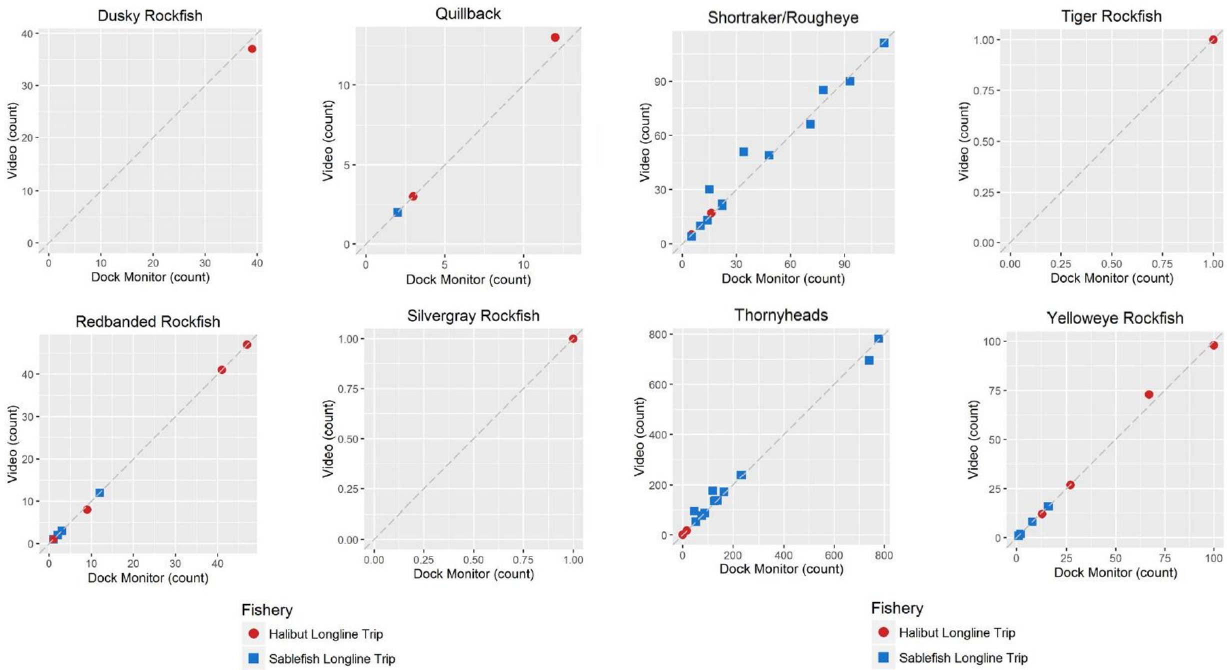
(Table 3-14 continued)

Species	Longline Halibut			Longline Pacific Cod			Longline Sablefish		
	Retain	Discard	Ukwn	Retain	Discard	Ukwn	Retain	Discard	Ukwn
Skate									
Ray, (Skate) - unidentified				1	22				
Skate - Soft Snout unidentified		8		7	289			40	
Skate - Stiff Snout unidentified					6				
Skate, Alaska					45			3	
Skate, Aleutian		3		6	35			3	
Skate, Bering		2			32				
Skate, Big		104		312	716	1		6	
Skate, Longnose		122		263	456			48	
Skate, Roughtail							1	106	
Crab									
Crab - unidentified (Family Unknown)								1	
Crab, King, Couesi								1	
Crab, Tanner - Unidentified								14	
Coral									
Bryozoans/Coral Unid					3		13	32	
Coral, Red Tree					1			2	
Invert									
Invertebrate - unidentified		7			98		1	34	
Sand Dollars, Sea Urchins		47			9				
Sea Anemone - unidentified		3			84			3	
Sea Whip, Sea Pen - unidentified				2	700		2	218	
Snail - unidentified		17			7				
Snail, Empty Shell					4				
Sponge - unidentified					1				
Octopus - unidentified				13	27		1	5	
Starfish - unidentified		11		2	64			3	
Starfish, Basket		13		1	8			2	
Starfish, Brittle		6						511	
Starfish, Sunstar	3	25		4	3,221	4	5	9	
Bird									
Fulmar, Northern					2				
Unknown					38			2	
Miscellaneous (rocks, mud, garbage, etc)		21			175		5	39	

Source: PSMFC preliminary review of the 2016 season, 5/20/2016

Figure 3-11 Comparison of 2015 data from dockside monitoring and counts of retained rockfish counts from video aggregated to the trip level.

The dashed grey line is the video = dockside monitor line. If video and dockside monitor counts agreed, the point would fall on the dashed line. Pacific Cod Longline Data is withheld for confidentiality.



Source: PSMFC Final Report Alaska Track 1: Review of the 2015 Season, May 2016

During 2015, a study was conducted onboard chartered research survey vessels equipped with Archipelago Marine Research (AMR) EM camera systems to compare the accuracy of catch composition data (species identification and counts) collected using EM relative to an observer (see Appendix 4 for more detailed description of the study). An important finding showed that declining video quality (from high to medium) had a significant effect on video counts compared to observer counts, which suggests that lower data quality may bias the results. The study showed good correspondence between video and at-sea counts for many species, but overall the two methods were significantly different and could not be considered the same. However, differences in a rank correlation test between of video and at-sea species counts was not significant, suggesting that the relative order of species counts between the two data collection methods were the same. Percent agreement between video and at-sea observations of skates, a few flatfish, and some rockfish species suggest that additional species groupings should be considered (i.e. group all skates Raja and Bathyraja). In addition, invertebrate counts from video were generally much lower compared to at-sea counts, suggesting that video reviewers may miss small invertebrates.

Many of the results on species identification from the work conducted during EM pre-implementation in 2015 and 2016 are similar to previous work conducted on EM in the longline fishery in Alaska. Cahalan et al. (2010) compared estimates of numbers of fish from dedicated fishery observer documentation with estimates of bycatch based on review of EM. Comparison of species identification of catch between observer estimation and EM showed statistically unbiased and acceptable comparability for almost all species except for some that could not be identified beyond the species grouping levels used in management. Similarly, comparisons of total species-specific numbers of fish estimated using EM collected and hook-status observer-collected data showed few statistically significant differences.

3.7.5.5 Converting counts to weights

Estimating the weight of species caught will always be required with EM since weights (or lengths) are not available from the EM system currently being deployed in pre-implementation. The conversion of count to weight will be done using average weights of fish collected by at-sea observers being applied to EM counts: these methods will likely be done in CAS after counts have been estimated and made available to inseason managers on a per-trip basis. Within the EM sampling stratum, average weights from the at-sea observer stratum most similar to the EM stratum will be applied, as appropriate, to produce fishery-level estimates of catch for each EM sampling strata. As possible, observer data from vessels in the same area, fishery, and gear types will be used to estimate average fish weights. The conversion of counts to weight will rely on observer data from vessels who choose not to opt-into the EM pool. Thus, as part of the ADP process, it will be valuable to evaluate the potential for gaps in the observer data. Appendix 1 provides an example of this type of analysis to evaluate the potential impacts on observer data as the size of the EM pool increases.

3.7.5.6 Estimation of halibut mortality

During 2016, video reviewers have collected data on the release of Pacific halibut, including the method of release and condition of halibut at the time of release. The release methods and conditions collected by video reviewers are the same as those collected by observers, with the addition of three new release methods that were developed in consultation with the observer program and IPHC: “hand release”, “Other careful release’, and “other non-careful release’. The majority (93 percent) of Pacific halibut were released carefully using the “Hook twisting and shaking” method (Table 3-15). It was much more difficult for video reviewers to assess the condition of the halibut as the fish were released; 42 percent of the time the condition of the fish was noted as “unknown” (Table 3-16). Halibut were noted with an unknown release condition if the video reviewer was not able to observe both sides of the fish or the injuries could not be clearly observed at the point of release. Of the fish where video reviewers were able to determine a release condition was able to be determined, the majority were assessed with minor damage.

The current methodology to assess halibut discard mortality relies on assessments of halibut viability. Information derived from video is unlikely to be of fine enough resolution to estimate viability, as the current technique includes opercular stimulation, muscle tone observations, and sand flea intrusion (C. Dykstra, personal communication, 9/7/2016) and the number of unknowns ranges from 24 to 49 percent, as in Table 3-16. EM does seem to get a reasonable profile of release method (Table 3-15). However, the IPHC does not currently have any method to compare the release method to a corresponding mortality signature, and resultant mortality rate. IPHC representatives have discussed the need for some experimental or observer-based data (in conjunction with video-based data from the same trips) which summarizes the suite of viabilities in relation to each release method and relative to the size of the fish. There are practical difficulties with such an experiment, however, with respect to how to recapture released fish outboard the vessel to assess said viability codes, and how to avoid the fisherman biasing release techniques when s/he knows that the release technique is being monitored for the injury it produces. The IPHC continues to discuss the best way to do such fieldwork.

Table 3-15 Pacific halibut discards by release method in 2016 EM pre-implementation hauls, from 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Halibut release method	Halibut		Pacific cod		Sablefish		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Cut the gangion	0	<1%	18	<1%	0	< 1%	18	<1%
Gaff	1	<1%	1	<1%	0	< 1%	2	<1%
Hand release	19	2%	12	<1%	96	17%	127	2%
Hit the roller	7	1%	18	<1%	2	< 1%	27	<1%
Hook straightening	37	3%	0	<1%	0	< 1%	37	1%
Hook twisting and shaking	1,048	93%	4,007	95%	431	78%	5,486	93%
Other careful release	0	<1%	2	<1%	1	< 1%	3	<1%
Unknown	7	1%	126	3%	22	4%	155	3%
Dropped off line without any crew interaction	10	1%	26	1%	3	1%	39	1%
Total	1,129		4,210		555		5,894	

Source: PSMFC preliminary review of the 2016 season, 5/20/2016

Table 3-16 Pacific halibut discards by release condition in 2016 EM pre-implementation hauls, from 3 hook-and-line fisheries (halibut, Pacific cod, and sablefish).

Halibut release condition	Halibut		Pacific cod		Sablefish		Total	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Dead/Sand fleas/Bleeding	29	3%	39	1%	22	4%	90	2%
Minor	774	69%	2,080	49%	398	72%	3,252	55%
Moderate	5	<1%	29	1%	3	1%	37	1%
Severe	3	<1%	4	<1%	0	<1%	7	<1%
Unknown	308	27%	2,031	48%	129	23%	2,468	42%
Dropped off line without any crew interaction	10	1%	27	1%	3	1%	40	<1%
Total	1,129		4,210		555		5,894	

Source: PSMFC preliminary review of the 2016 season, 5/20/2016

4 Environmental Assessment – Probable Environmental Impacts

Integrating electronic monitoring into the Observer Program provides a choice for specific vessels in the partial coverage category to use electronic monitoring instead of carrying an observer. Electronic monitoring is intended to achieve the goals of the Observer Program and improve the ability to collect fishery-dependent data on a wider variety of vessels. To understand the impacts of electronic monitoring on the human environment, we look at how integrating EM, either under Alternative 2 or 3, has the potential to change to impacts of the Observer Program.

The analysis presented in the 2011 EA/RIR/IRFA used the best available information to analyze the potential environmental impacts of the restructured Observer Program and its alternatives (NMFS 2011). The 2011 EA/RIR/IRFA analyzed the effects of the proposed action and its alternatives on the biological, physical, and human environment in Section 4.3. NMFS (2015, chapter 6) provided new analysis of the environmental impacts of the Observer Program using the new information and analysis to build on the analysis of the environmental impacts completed in the 2011 EA/RIR/IRFA (NMFS 2015).

The Observer Program collects data necessary to support the management of the North Pacific fisheries. This includes monitoring harvest amounts relative to specified total allowable catches (TACs) and PSC limits and the collection of data that are incorporated into annual stock assessments. The Observer Program provides information to monitor the effectiveness of, and compliance with, fisheries management decisions made through the annual harvest specifications process.

Note that the annual harvest specifications and PSC limits that are implemented each year through proposed and final rulemaking are separate and distinct actions from the restructured Observer Program. Those actions are informed by an environmental impact statement (EIS) and supplemental reports prepared annually on the TAC specifications and PSC limits, as referenced above. Likewise, parameters under which the North Pacific groundfish and halibut fisheries operate (who, what, where, when), remain in effect. Therefore, the effects of this action, which determine some of the parameters under which those fisheries are monitored, are evaluated based on the assumption that the effects of the fisheries themselves on the marine resources have been evaluated in separate NEPA analyses. It is thus assumed that the action is implemented in conjunction with harvest limits set annually by the harvest specification process and according to current regulations governing fishing within the exclusive economic zone off Alaska (50 CFR 679).

Restructuring observer deployment methods allowed NMFS to redesign observer coverage requirements to reduce bias and improve data quality. Improved observer data and monitoring is anticipated to generate better information to make in-season management and policy decisions, facilitating the attainment of optimum yield, and enhancing the sustained health of the resource, fishing sectors, and dependent communities. The restructured Observer Program achieves these benefits predicted in the 2011 EA/RIR/IRFA at the realized coverage rates and with the deployment methods implemented since 2013. Additionally, due to the implementation of a statistically reliable sampling design and estimation procedures in the catch accounting system (CAS), NMFS expects to realize these benefits at a realistic range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015).

The Observer Program improves the utility of observer data by improving the ability of NMFS to deploy observers when and where necessary to improve the quality of observer data and allow for the deployment of observers and the collection of data on vessels that were not covered under the previous program (less than 60 ft LOA groundfish vessels and halibut vessels).

The Observer Program does not increase fishing activity or change the measures currently in place to protect the physical and biological environment. Overall fishing effort, including the spatial and temporal distribution of fishing effort, in the groundfish and halibut fisheries is not expected to change under the alternatives. None of the alternatives affect how, where, and when fishing is conducted.

The 2011 EA/RIR/IRFA and the 2015 Supplemental EA identified that the Observer Program that the potential to impact the data collected on groundfish, halibut, prohibited species, marine mammals, and seabirds (see Table 4-1). However, no adverse impacts on these resources were anticipated from the Observer Program. Given that Alternatives 2 and 3 would provide an additional data collection tool under the Observer Program, and EM is anticipated to provide data that can be used in the CAS from vessels that currently do not carry observers, these alternatives would not change the Observer Program in a manner that would cause adverse impacts to the physical or biological environment. No potential impacts on habitat or the ecosystem have been identified. This section analyzes whether implementing EM as part of the Observer Program would change any of the potential impacts of the Observer Program.

Table 4-1 Resources potentially affected by the proposed action and alternatives.

Resource component	Potentially Affected?
Groundfish	Yes
Halibut	Yes
Prohibited & Ecosystem Component Species (non-target)	Yes
Marine Mammals	Yes
Seabirds	Yes
Habitat	No
Ecosystem	No
Social and economic	Yes

N = no impact anticipated by each alternative on the component.
Y = an impact is possible if each alternative is implemented.

4.1 Benefits from improved observer data under the restructured Observer Program

Improving data reliability was one of the primary drivers for restructuring the Observer Program. The restructuring of the Observer Program expands observer coverage to fill scientific data gaps, reduce bias in the data, and equitably distribute costs. The 2011 EA/RIR/IRFA identified three types of benefits from the restructured Observer Program—

- Reducing sources of bias.
- Reducing data gaps
- Targeting observer coverage to address data needs.

The restructured Observer Program achieves these benefits predicted in the 2011 EA/RIR/IRFA at the realized coverage rates and with the deployment methods implemented since 2013. Additionally, due to the implementation of a statistically reliable sampling design and estimation procedures in the CAS, NMFS expects to realize these benefits at a range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015). Integrating EM into the Observer Program would maintain these benefits of expanded observer coverage to fill scientific data gaps and reduce bias in the data. Integrating EM would also allow the Council and NMFS to target EM coverage to address data needs.

4.1.1 Reducing sources of bias

The restructured Observer Program uses scientific methods to deploy observers. The random sampling established under the restructured Observer Program addresses sampling biases that federal regulations built into the previous program. The goal of sampling under the restructured program is to randomize the deployment of observers into fisheries to collect representative data used to estimate catch and bycatch, assess stock status, and determine biological parameters used in ecosystem modeling efforts and salmon stock-of-origin analyses (NMFS 2013). Random sampling results in better spatial and temporal distribution of observer coverage across all fisheries. This generates data that is representative of fishing and greatly improves our confidence in catch and bycatch estimation and the quality of data collected in all Federal fisheries.

NMFS Alaska Region requires representative sampling method (e.g., random) to provide the unbiased discard information used in CAS. Providing unbiased at-sea discard information is a critical function of the Observer Program. The random deployment methods described in the annual deployment plans (ADPs) are evaluated using performance metrics described in the Annual Reports. These performance metrics rely on random sampling theory to evaluate whether unobserved events are similar (a basic premise for random sampling and assessment of deployment bias), and the degree to which sampling targets were achieved. The annual review and deployment process will result in continuous improvement in the representativeness of observer data through scientific evaluation of the sampling plan.

Under Alternatives 2 and 3, NMFS would use representative sampling methods to deploy EM on vessels in the EM selection pool. This would maintain the ability to provide the unbiased discard information used in CAS and conduct an annual review using performance metrics.

4.1.2 Reducing data gaps

Under the restructured Observer Program, coverage was expanded to nearly all catcher/processor vessels, the halibut IFQ fishery, and vessels between 40 ft and 60 ft length overall (LOA). In summary, restructuring dramatically reduced the proportion of trips that do not have any coverage (i.e., no observer data) and, compared with the previous program, improved discard estimates by using observer information that better represents the fishing activities across the entire federal fishing fleet. The restructured Observer Program results in better spatial and temporal distribution of observer coverage across all fisheries. Taken together, the improvement in data quality greatly improves our confidence in catch and bycatch estimation and greatly improves the quality of data collected in all Federal fisheries.

Prior to 2013, vessels less than 60 ft LOA and halibut IFQ vessels were unobserved, and the new data from these vessels is providing important information on discards at-sea. Species that currently present catch accounting and management challenges in GOA fixed-gear (hook-and-line and pot) fisheries include: most rockfish species, sharks, skates, Pacific cod, Pacific halibut, and sablefish. Current TACs of some species, including sablefish, in the GOA groundfish fishery are already close to their ABC amounts. In particular, many rockfish and skate species are of management concern because the fixed-gear fisheries catch most of the TAC of these species and the TAC is set equal to ABC. Sculpins and sharks present a management challenge because of the high discards of these species by the hook-and-line fisheries, and life history characteristics that make them sensitive to fishing pressure (e.g., sleeper sharks). In addition, the key element for seabird issues that came along with the restructured Observer Program is that for the first time we have fishery observers on board halibut IFQ vessels and can then monitor seabird interactions and calculate estimates of the seabird bycatch. This is of particular importance for short-tailed albatross.

While the restructured Observer Program expanded observer coverage, there are still many vessels in the partial coverage category that are excused from observer coverage. Vessels less than or equal to 40 ft LOA are in the zero selection pool. Under Alternatives 2 and 3, these types of vessels could be included in the EM selection pool to expand the proportion of trips from which we collect data for better representation the fishing activities across the entire Federal fishing fleet.

Alternatives 2 and 3 are expected to decrease the coverage rate for human observers as the finite fees would be used to fund both the deployment of observers and the deployment of EM. Under Alternative 2, the Council and NMFS would annually decide the rate of observer coverage and EM coverage that can be afforded with the budget from fee revenues. The amount of coverage allocated to both deployments would be determined annually in the ADP based on an analysis of the costs, budget, and effort in the partial coverage category. An important part of this annual analysis will be understanding gaps in observer data when a portion of the partial coverage vessels opt-in to EM. Appendix 1 provides an example of the type of analysis that would be conducted on an annual basis to inform that decision and ensure that sufficient observers are deployed to maintain the representativeness of the data that cannot be collected with EM. During this process, NMFS and the Council can balance EM coverage with maintaining representative observer coverage.

4.1.3 Targeting observer coverage to address data needs

The 2011 EA/RIR/IRFA identified an additional benefit to a restructured program for fisheries with partial coverage, the ability for NMFS to adapt coverage to address specific data needs. For example, the flexibility afforded to NMFS to deploy observers through restructuring has enabled NMFS to explore alternative designs for genetic Chinook salmon bycatch sampling in the GOA pollock fishery that should result in representative data being collected cost-effectively. Through the annual process, the restructured Observer Program allows for iterative adaptation so as to make continuous improvements, rather than rely on fixed regulation for change (Faunce 2015).

Under Alternatives 2 and 3, the Council and NMFS retain this flexibility to adapt observer coverage to address data needs. Alternatives 2 and 3 would add additional flexibility to adapt EM coverage to address specific data needs and collect data from vessels when observer coverage is not practicable, such as on vessels less than 40 ft LOA.

4.2 Impacts on groundfish data and inseason management

In the partial coverage category, most observers are deployed on trawl vessels that harvest groundfish. EM would not be available to trawl vessels in the partial coverage category under this action. Observers are also placed on pot and hook-and-line vessels that harvest Pacific cod and hook-and-line vessels that harvest halibut and sablefish. Vessels that use jig gear to harvest groundfish are in the zero coverage selection pool. Alternatives 2 and 3 would make EM available to fixed-gear vessels, which include pot hook-and-line vessels. The hook-and-line gear and pot catcher vessels who would participate in the EM selection pool participate in the directed Pacific halibut, sablefish, and Pacific cod fisheries.

Alaska groundfish fishery managers use the best scientific information available to determine the status of each stock or stock complex. Total catch accounting for all managed species is mandated by the Magnuson-Stevens Act and necessary to comply with statutory requirements for status determination criteria. NMFS and the Council assess the status of the stocks that comprise the groundfish category in the annual Stock Assessment and Fishery Evaluation Report. The most recent report is available on the Alaska Fisheries Science Center webpage at http://www.afsc.noaa.gov/Publications/assessments.htm. The North Pacific Fishery Management Council (Council) and its Scientific and Statistical Committee then use this information to establish the overfishing levels (OFLs), acceptable biological catch (ABC), and total allowable catch (TAC) for each stock or stock complex. Each year, the Council recommends, and the Secretary of Commerce publishes, harvest specifications for the Bering Sea and Aleutian Islands (BSAI) and the Gulf of Alaska (GOA) groundfish fisheries. Harvest specifications establish specific annual limits on the harvest of groundfish used to manage the groundfish fisheries. Harvest specifications establish the OFL, ABC, and TAC for each stock or stock complex, and PSC limits. NMFS publishes the annual harvest specifications in the *Federal Register* and on the NMFS Alaska Region webpage at https://alaskafisheries.noaa.gov/harvest-specifications/field_harvest_spec_year/2016-2017-751.

The Inseason Management Branch of the NMFS Alaska Region monitors the catch rate of groundfish and prohibited species according to the allocations and the gear, seasonal, and sector apportionments found in the harvest specifications. Further description of the inseason management process is available at: https://alaskafisheries.noaa.gov/sites/default/files/harvestdiscussion.pdf.

Each year, accounts are established in the Alaska Region's CAS that match the annual harvest specification tables; these accounts are monitored by NMFS to limit catch within prescribed limits in the specification tables. The system uses information from multiple data sources to provide an estimate of total groundfish catch, including at-sea discards, as well as estimates of PSC and other non-groundfish bycatch. Currently in the partial coverage hook-and-line fisheries, NMFS uses observer data to generate discard rates to estimate discarded catch. Observer data from the small catcher vessel hook-and-line fleet are transmitted from observers in the field to staff in the observer program office in Seattle where the data are entered into the observer program database. At this point, the data are integrated into the CAS and available for inseason management. The data are usually available for management within days of the trip ending.

The Council and NMFS annually determine the TACs based on the projected biomass of the fish species, and effective monitoring and enforcement would continue to ensure that the overall TACs are not exceeded. Therefore, the alternatives only impact the amount and types of data collected, and the timeliness of the availability of the data to managers.

NMFS needs reliable estimates of catch from all sectors of the GOA and BSAI fishing fleet regardless of vessel size in order to properly assess groundfish stocks (target and non-target). The critical outcome of an observer or an EM system is to get reliable total catch estimates for both target and non-target stocks to ensure overfishing is not occurring. Monitoring requires not only total catch amounts but also obtaining representative biological information needed for stock assessment. Representative individual lengths and weights in addition to otoliths and sex composition data are important to ensure that stock assessment models can track which segment of the population is being impacted by fisheries. The data collection system is continually being refined across all fisheries to ensure representatives samples and adequate sample sizes for stock assessment. NMFS strives to advance groundfish stock assessments to higher tier (greater information) when possible and as technology and fishery information allows such advancement. Risk of unknowingly overfishing a stock is reduced as more information is obtained. Additional documentation on catch reporting needs for stock assessment for the hook-and-line fisheries were addressed in a February 2014 Alaska Fisheries Science Center memo[20].

Table 4-2 and Table 4-3 provide total catch information for fixed gear catcher vessels, by management area, gear type and species. The data are provided for 2013 through 2015 inclusive, for the sum of the three year period. The table also includes the total catch of each species by all gear types, and identifies the proportion of the total that is attributable either to hook and line or pot catcher vessels.

The fixed gear catcher vessels' proportion of total catch of their three target fisheries, sablefish, halibut, and Pacific cod, is understandably high, especially in the GOA. In the GOA, hook-and-line catcher vessels also account for larger proportions of the total catch of various rockfish species. The hook-and-line catcher vessels also account for a high proportion of shark and skate catch, and to a lesser extent, sculpin. Pot catcher vessels are responsible for 84 and 79 percent of octopus catch in the GOA and BSAI, respectively, over the three-year period.

[20] Available: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/AFSCmemo214.pdf

Table 4-2 Total target species catch in the GOA by fixed gear catcher vessels, compared to total target catch in all groundfish and halibut fisheries, for 2013 through 2015 inclusive.

Proportions of 20 percent or higher are highlighted in yellow.

Area	Species		Total catch (t)			Proportion of total from hook and line	Proportion of total from pot
			Hook and line	Pot	Total (all gears)		
GOA	Pollock		422	133	397,052	0.1%	0.0%
	Pacific cod		24,254	57,615	169,227	14%	34%
	Sablefish		28,152	4	32,685	86%	0.0%
	Atka mackerel		2	15	3,547	0.1%	0.4%
	Rockfish	Pacific Ocean perch	3	1	49,582	0.0%	0.0%
		Bocaccio rockfish[2]	0		0	0.0%	
		Canary rockfish[1]	4		6	67%	
		China rockfish[1]	0		1	0.0%	
		Copper rockfish[1]	0		0		0.0%
		Dusky rockfish	49	13	9,001	1%	0.1%
		Greenstripe rockfish[2]	0		0	0.0%	
		Northern rockfish	8	7	13,104	0.1%	0.1%
		Quillback rockfish[1]	39		40	98%	
		Redbanded rockfish[2]	41		129	32%	
		Redstripe rockfish[2]	1		145	1%	
		Rosethorn rockfish[1]	0		1	0.0%	
		Rougheye rockfish	552	0	1,862	30%	0.0%
		Sharpchin rockfish[2]	0		247	0.0%	
		Shortraker rockfish	801	0	1,994	40%	0.0%
		Silvergray rockfish[2]	6		85	7%	
		Tiger rockfish[1]	2		8	25%	
		Vermillion rockfish[2]	0		0	0.0%	
		Widow rockfish[2]	0		67	0.0%	
		Yelloweye rockfish[1]	541	0	780	69%	0.0%
		Yellowtail rockfish[2]	0		5	0.0%	
		Thornyhead rockfish	2,071		3,318	62%	0.0%
	Flatfish	Flathead sole	0	1	6,861	0.0%	0.0%
		Rock sole[3]	0	1	10,120	0.0%	0.0%
		Butter sole[3]	0	0	2,187	0.0%	0.0%
		Dover sole[4]	0		532	0.0%	
		English sole[3]		0	142		0.0%
		Rex sole	0	0	9,240	0.0%	0.0%
		Arrowtooth flounder	762	4	76,955	1%	0.0%
		Starry flounder[3]	0		270	0.0%	
		Flounder (general)[3]	0		3	0.0%	
		Greenland turbot[4]	0		2	0.0%	
	Other species[5]	Squid	0	1	827	0.0%	0.1%
		Sculpin	1,592	675	4,168	38%	16%
		Octopus	233	2,284	2,710	9%	84%
		Pacific sleeper shark	140		237	59%	
		Salmon shark	0		519	0.0%	
		Spiny dogfish	3,668	3	4,352	84%	0.1%
		Shark (other)	16		29	55%	
		Big skate	2,467	0	5,705	43%	0.0%
		Longnose skate	3,243	0	5,017	65%	0.0%
		Alaskan skate	1		6	17%	
		Aleutian skate	2		70	3%	
		Skate (other)	3,650	0	5,498	66%	0.0%
	Halibut[6]	Pacific halibut	44,816		44,836	100%	

[1] In Southeast Alaska, these species are all managed as part of the Demersal Shelf Rockfish complex.
[2] These species are all managed as part of the Other Rockfish complex, in addition to Northern Rockfish in the Eastern GOA, and DSR species when caught outside of Southeast Alaska.
[3] These species are managed as part of the shallow water flatfish complex.
[4] These species are managed as part of the deep water flatfish complex.
[5] All shark species are managed as a single complex, and all skates except big and longnose are managed as a single complex.
[6] Halibut total catch is only for directed halibut fisheries; halibut caught as prohibited species is listed in Table 4-8.

Table 4-3 Total target species catch in the BSAI by fixed gear catcher vessels, compared to total target catch in all groundfish and halibut fisheries, for 2013 through 2015 inclusive.

Proportions of 20 percent or higher are highlighted in yellow.

Area	Species		Total catch (t)			Proportion of total from hook and line	Proportion of total from pot
			Hook and line	Pot	Total (all gears)		
BSAI	Pacific cod		4,850	68,946	716,255	1%	10%
	Sablefish		1,485	883	3,465	43%	25%
	Pollock		13	36	3,897,234	0.0%	0.0%
	Atka mackerel		0	18	107,402	0.0%	0.0%
	Rockfish	Pacific Ocean perch	4	0	95,167	0.0%	0.0%
		Aurora rockfish[1]	0		0		
		Black rockfish[1]	0	0	2	0.0%	0.0%
		Dusky rockfish		4	1,079	0.0%	0.4%
		Northern rockfish	3	1	11,577	0.0%	0.0%
		Rougheye rockfish	12	1	699	2%	0.1%
		Shortraker rockfish	137	0	719	19%	0.0%
		Yelloweye rockfish[1]	2	0	3	67%	0.0%
		Thornyhead rockfish[1]	107	1	1,026	10%	0.1%
	Flatfish	Yellowfin sole	1	10	448,653	0.0%	0.0%
		Flathead sole	0	0	44,728	0.0%	0.0%
		Rock sole	1	2	156,918	0.0%	0.0%
		Butter sole[2]		0	337	0.0%	0.0%
		Arrowtooth flounder	78	55	50,908	0.2%	0.1%
		Kamchatka flounder	60	3	19,218	0.3%	0.0%
		Bering flounder	0		143	0.0%	
		Greenland turbot	106	4	5,601	2%	0.1%
	Other species[3]	Sculpin	182	608	15,648	1%	4%
		Octopus	36	861	1,095	3%	79%
		Pacific sleeper shark	24	1	194	12%	1%
		Spiny dogfish	8		51	16%	
		Big skate	1		219	0.5%	
		Aleutian skate	4		241	2%	
		Skate (other)	1,598	0	74,817	2%	0.0%
	Halibut[4]	Pacific halibut	7,853		7,976	98%	

[1] These species are all managed as part of the Other Rockfish complex.
[2] Butter sole is managed as part of the other flatfish complex.
[3] All shark species are managed as a single complex, and all skates are managed as a single complex.
[4] Halibut total catch is only for directed halibut fisheries; halibut caught as prohibited species is listed in Table 4-8.

4.2.1 Data collected under Alternative 1

The restructured Observer Program improved the reliability of the information used to manage the fisheries and set harvest levels compared to the previous program. The restructured Observer Program provides managers with better estimates of target and incidental harvest and bycatch, increases flexibility in deploying observers, and ensures harvest remain within TAC levels. Also, observer data that reflects the temporal and spatial distribution of fishing effort allows fishery managers to open and close fisheries to more precisely meet, but not exceed, TAC levels.

NMFS manages for total catch accounting. Total catch includes retained catch and discarded catch (also called bycatch). For example, NMFS collects data on rockfish catch and bycatch in the rockfish fishery and rockfish bycatch in the Pacific cod fisheries. NMFS uses all of this information to estimate total rockfish catch by all fisheries. The restructured Observer Program focuses on achieving representative samples of catch in the partial coverage category. Observer data is then used by the CAS to estimate catch and bycatch. The estimation procedures used by the CAS rely on the expansion of available observer data and on catch reports provided by industry. These are combined to obtain estimates of retained catch, at-sea discards of groundfish species, and at-sea discards of nontarget and prohibited species. Additional details are provided in Chapter 3 of NMFS (2015) and Cahalan et al. (2014).

Prior to 2013, the catcher vessels less than 60 ft LOA and halibut IFQ vessels were unobserved, and the new data from these vessels is providing important information on discarded catch, including many groundfish species.

Despite the per-day costs being higher than anticipated in the 2011 EA/RIR/IRFA, inclusion of small catcher vessels and halibut IFQ vessels under the restructure Observer Program improved the representativeness of data compared to the previous program (see NMFS 2015, Section 3.1). These improvements also resulted in more nearshore data and better representation of the small catcher vessels and halibut IFQ fisheries in 2013 and 2014 (see NMFS 2015, Section 3.2.1).

One huge improvement under the new program is that for the first time, NMFS has observer data from which to estimate the bycatch of groundfish (e.g., skates, sharks, rockfish), invertebrates (e.g., crab and coral), and seabird and marine mammal interactions in the halibut fishery. This improves NMFS's ability to assess the status of each stock and estimate total catch in compliance with Magnuson-Stevens Act's requirement for annual catch limits (16 U.S.C. 1853(a)(15)). This improved data in turn allowed estimation to occur when it previously had not under the previous program. These new estimates provided important new information to stock assessment authors and inseason managers on sensitive species such as skates, sharks, and rockfish. This new information raised management concerns for rockfish in the BSAI and skates in the GOA due to catch exceeding ABC limits because inseason mangers did not previously have information from which to manage these species. Species that currently present catch accounting and management challenges in GOA fixed-gear fisheries include most rockfish species, sharks, skates, Pacific cod, Pacific halibut, and sablefish. Current TACs of some species, including sablefish, in the GOA groundfish fishery are already close to their ABC amounts. In particular, many rockfish and skate species are of management concern because the fixed-gear fisheries catch most of the TAC of these species and the TAC is set equal to ABC. Sculpins and sharks present a management challenge because of the high discards of these species by the hook-and-line fisheries.

Implementation of the random sampling methods for the large vessel stratum improved the representativeness of effort for vessels that had had observer coverage under the previous program. This was apparent by observer coverage better tracking actual fishing effort through the year rather than deviating from effort as fishery participants chose when to carry an observer. There were also spatial improvements in the trawl fishery as noted by coverage in the western GOA, which previously had limited coverage.

The data collected since 2013 has improved NMFS's total catch accounting and ability to make effective conservation and management decisions. The restructured Observer Program provides data to managers from more vessels in more fisheries and in more areas, and more data enters the CAS more consistently throughout the season. These facts greatly improve managers' ability to manage catch limits and seasonal apportionments. Additionally, due to the implementation of a statistically reliable sampling design and estimation procedures in the CAS, NMFS expects to realize these benefits at a realistic range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015).

4.2.2 Comparison of groundfish data collected by the observers and EM systems

4.2.2.1 What data on groundfish can we collect with EM?

Under Alternative 2, hook-and-line and pot gear catcher vessels would be able to volunteer to carry EM instead of an observer. With the current camera technology, cameras record the catch as it comes onto the vessel. From the video, we get data on the types of fish caught and the number of fish. During pre-implementation, an iterative process is being used to refine sampling protocols to meet catch accounting and stock assessment needs in the hook-and-line and pot gear fisheries. The results of the research under the pre-implementation enable evaluation of EM program design options and various EM integration approaches that could be used to achieve management needs, including species identification and timelines for data being available for management. With Alternative 2, an iterative process would still be used through the ADP and Annual Report to refine sampling protocols for EM to meet catch accounting and stock assessment needs in the hook-and-line and pot gear fisheries.

4.2.2.2 What groundfish data do observers collect that we cannot collect with current EM technology?

Observers collect size, sex, length, and weight of all organisms in samples and collect, biological samples such as scales, tissues, age structures (otoliths), and stomachs. Observer also may conduct special research projects that provide scientists with other information. NMFS cannot collect weight data with current EM technology. NMFS uses weight data to estimate biomass. Weight data would need to be extrapolated from the observer data and applied to the data collected with EM. NMFS cannot collect sex data with current EM technology. Data on sex ratios are useful to determine which parts of the population are being affected by fisheries. This is particularly true for species (like grenadiers) where there are geographical or depth-related differences in the distribution of males vs. females. Additionally, NMFS cannot collect biological samples with EM.

Table 4-4 provides the combined number of otolith samples collected by observers from BSAI and GOA groundfish and halibut fisheries in the years 2013 through 2015, by species and management area. The table does not include otoliths collected on the groundfish and halibut surveys. Table 4-4 also identifies how many of the total samples were collected from fixed gear catcher vessels that would be eligible to opt in to the EM strata. Note that the Council has already indicated that the scope of EM implementation would not be to replace human observers entirely for these sectors, and there will continue to be deployment of human observers in these sectors. Rather, Table 4-4 is intended to illustrate the species for which the fixed gear catcher vessel sectors currently contribute the majority of otolith samples. The final column in the table identifies the proportion of total samples taken from all gear types that have been aged.

Table 4-4 Number of otolith samples collected from fixed gear catcher vessels, compared to total otoliths collected from the groundfish and halibut fisheries, for 2013 through 2015 inclusive, and proportion of otoliths collected from all gear types that have been aged.

Area	Species	Number of otolith samples					Proportion of total (all gears) that are aged
		Total (all gears)	Hook and line	Proportion of total from hook and line	Pot	Proportion of total from pot	
GOA	Pacific cod	1,280	442	35%	352	28%	0%
	Sablefish	3,524	1,905	54%			18%
	Pollock	2,682	3	0.1%			NA
	Pacific Ocean perch	4,615	17	0.3%			9%
	Northern rockfish	3,149	6	0.2%			15%
	Shortraker rockfish	999	455	46%			0%
	Rougheye rockfish	869	302	35%			14%
	Dusky rockfish	2,326	53	2%			0%
	Dark rockfish	48	6	13%			0%
	Shortspine thornyhead rockfish	1,447	446	31%			0%
	Longspine thornyhead rockfish	1	1	100%			0%
BSAI	Pacific cod	9,482	46	0.5%	181	2%	0%
	Sablefish	1,719	245	14%	95	6%	21%
	Northern rockfish	1,474	1	0.1%			30%
	Shortraker rockfish	725	148	20%			0%
	Rougheye rockfish	697	47	7%			0%
	Dusky rockfish	136	11	8%			0%
	Dark rockfish	3	1	33%			0%
	Shortspine thornyhead rockfish	1,193	170	14%	2	0.2%	0%

Source: NMFS AFSC Observer Program, data compiled by AKFIN, except proportion of total otolith samples that have been aged, which is from http://access.afsc.noaa.gov/al/otolith_inventory/searchform.php.

In the GOA, about 60 percent of Pacific cod otolith samples are currently collected from the fixed gear catcher vessel sectors, and about half of sablefish otolith samples. Since 2013, no Pacific cod otoliths collected from the fisheries have been aged in either the BSAI or the GOA, and about 20 percent of sablefish otoliths from each management area have been aged. Longline catcher vessels account for approximately 46 percent of shortraker rockfish samples, and about a third of shortspine thornyhead otolith samples (as well as the only longspine thornyhead rockfish sample taken in 2013 through 2015), which have not yet been aged. In the GOA, about 35 percent of rougheye rockfish otolith samples derive from hook-and-line catcher vessels, and approximately 14% of samples from all gears have been aged. In the BSAI, fixed gear catcher vessels accounted for approximately 20 percent of Pacific cod and shortraker rockfish otolith samples, as well as one of the three dark rockfish samples collected during the time period.

Table 4-5 provides the number of length samples collected from fixed gear catcher vessels, inclusive over the same time period. Longline vessels represent a fairly modest proportion of length samples for most species, and more so pot vessels.

Table 4-5 Number of length samples collected from fixed gear catcher vessels, compared to total lengths collected from the groundfish and halibut fisheries, for 2013 through 2015 inclusive.

Area	Species	Number of length samples				
		Total (all gears)	Hook and line	Proportion of total from hook and line	Pot	Proportion of total from pot
GOA	Pacific cod	6,638,985	224,677	3%	691,467	16%
	Sablefish	2,055,816	378,214	18%	79	0.0%
	Pollock	3,649,026	9,271	0.3%	3,840	0.2%
	Pacific Ocean perch	2,411,292	157	0.0%	29	0.0%
	Northern rockfish	673,209	278	0.0%	212	0.0%
	Shortraker rockfish	40,614	7,194	18%	1	0.0%
	Rougheye rockfish	63,573	5,595	9%	3	0.0%
	Dusky rockfish	349,617	671	0.2%	421	0.0%
	Dark rockfish	7,221	67	0.9%	19	0.0%
	Shortspine thornyhead rockfish	823,468	97,824	12%		0.0%
	Longspine thornyhead rockfish	352	122	35%		0.0%
BSAI	Pacific cod	143,877,050	20,463	0.0%	702,906	1%
	Sablefish	242,004	11,968	5%	10,350	9%
	Pollock	290,920,196	521	0.0%	894	0.0%
	Pacific Ocean Perch	6,288,912	26	0.0%	5	0.0%
	Northern rockfish	614,568	40	0.0%	36	0.0%
	Shortraker rockfish	38,504	1,734	5%	5	0.0%
	Rougheye rockfish	54,496	342	0.6%	7	0.0%
	Dusky rockfish	70,488	136	0.2%	87	0.0%
	Dark rockfish	385	34	9%	1	0.0%
	Shortspine thornyhead rockfish	272,708	5,321	2%	44	0.0%

Source: NMFS AFSC Observer Program, data compiled by AKFIN, except proportion of total otolith samples that have been aged, which is from http://access.afsc.noaa.gov/al/otolith_inventory/searchform.php.

4.2.2.3 What data is necessary for species with management concerns?

For the fisheries currently being considered for EM, species that currently present catch accounting and management challenges include: most rockfish species, sharks, skates, Pacific cod, Pacific halibut, and sablefish. For species with management concerns, NMFS needs timely fishery data to make inseason management decisions and avoid exceeding applicable limits.

Many of the species that are caught in the Pacific cod fisheries are not open for directed fishing and are on “incidental catch status” and can only be retained up to the maximum retainable amounts (MRAs) listed in Federal regulations at Table 10 to part 679. If an MRA is reached, a vessel is required to discard these species. Groundfish species that are open for directed fishing are: demersal shelf rockfish in the Southeast of the Eastern GOA, dusky rockfish, northern rockfish, Pacific ocean perch (not commonly caught on hook-and-line gear), Pacific cod, and sablefish (for IFQ holders).

The halibut and sablefish IFQ fisheries are prohibited from discarding Pacific cod and rockfish in most federal reporting areas, with the exception of area 640 where discard is allowed once the rockfish MRA is reached. This requirement was intended to prevent the circumstance of discarding these species to save room for higher valued halibut or sablefish IFQ. Discarded Pacific cod and rockfish would be wasteful of these resources because they are unlikely to survive hooking and rapid changes in depth. The only exception to this prohibition occurs when NMFS closes directed fishing for these species or determines that these species should be treated in the same manner as prohibited species to prevent exceeding their TACs.

Pacific cod

Estimates of discarded catch of Pacific cod in these fisheries are critical for management because the TAC of Pacific cod is fully allocated by sector. Pacific cod is open for directed fishing during the A (January 1 – June 10) and B (September 1 – December 31) seasons and all sectors have A and B season allocations. Any catch prior to the B season is usually covered by the B season allocation. However, a management concern occurs in the B season when the catch could exceed the sector allocation or even total TAC by all sectors. Therefore, NMFS needs timely data to monitor the total catch (including discard) of Pacific cod to determine if management action is necessary. Usually, the GOA hook-and-line Pacific cod sectors are open until December 31.

Rockfish and skates

Rockfish and skates present a monitoring challenge since many of the species can be difficult to differentiate and they are managed at either the group level (e.g. Demersal Shelf Rockfish) or the species level (e.g. Shortraker Rockfish). Therefore, identification of the species is important so that fish can be accounted for in the appropriate grouping. In addition, many rockfish and skates species are of management concern because the hook-and-line fisheries catch most of the TAC of these species and the TAC is set equal to ABC. Also, if catch approaches an OFL then NMFS may need to close fisheries in areas that catch the most of the species approaching an OFL. Thus, NMFS needs timely data to be able to monitor the discards of these species in-season relative to the TAC to determine if management action is necessary. Rockfish species that present less of a management challenge in these fisheries are: dusky rockfish, northern rockfish, and Pacific ocean perch.

With Alternatives 2 or 3, the Council is considering an option for full retention requirement for rockfish while using EM. With full retention, landed rockfish would be differentiated and counted at the processors. This may require additional dockside monitoring. The State requires full retention of all rockfish (excluding thornyhead) in some areas of the eastern Gulf of Alaska. All rockfish taken in excess of trip or bycatch limits must be landed, weighed, and reported on an ADF&G fish ticket. Demersal shelf rockfish taken in excess of the trip limit is forfeited to the State. If excess rockfish bycatch is sold, proceeds from the sale are surrendered to the State. The permit holder may retain excess rockfish bycatch for personal use; the pounds must be documented as overage on the fish ticket.

NMFS requires full retention of demersal shelf rockfish in the Southeast Outside District of the GOA at §679.20(j). These regulations require the operator of a catcher vessel that is required to have a Federal fisheries permit, or that harvests IFQ halibut with hook and line or jig gear, must retain and land all demersal shelf rockfish that is caught while fishing for groundfish or IFQ halibut in Southeast Outside. When demersal shelf rockfish is closed to directed fishing, the operator of a catcher vessel that holds a Federal fisheries permit, or the manager of a shoreside processor, may sell, barter, or trade a round weight equivalent amount of demersal shelf rockfish that is less than or equal to 10 percent of the aggregate round weight equivalent of IFQ halibut and groundfish species, other than sablefish, that are landed during the same fishing trip. The operator of a catcher vessel that harvests IFQ halibut or the manager of a shoreside processor may sell, barter, or trade a round weight equivalent amount of demersal shelf rockfish that is less than or equal to 1 percent of the aggregate round weight equivalent of IFQ sablefish that are landed during the same fishing trip. Amounts of demersal shelf rockfish retained by catcher vessels in excess of these limits may be put to any use, including but not limited to personal consumption or donation, but must not enter commerce through sale, barter, or trade.

NMFS moves rockfish to PSC status when the TAC has been reached. NMFS would need to modify the PSC regulations to allow full retention of rockfish in PSC status, similar to the changes made to implement retention of Chinook salmon PSC in the Bering Sea pollock fishery. Additionally, changes to regulations would be required to allow retained rockfish to be donated, similar to the Prohibited Species

Donation Program. Some issues to consider are (1) how would operators dispose of regulatory retentions; (2) what would happen if the fish were not donated; and (3) who would initially take possession of the retained rockfish?

Sablefish

Sablefish are a concern because the TACs are fully allocated under the IFQ Program. Vessels with IFQ permit holders with available sablefish IFQ onboard are required to retain sablefish. The season dates usually change every year for the halibut and sablefish IFQ fisheries, but are usually open around mid-March through November 7. Vessels without IFQ permit holders that have available IFQ onboard are required to discard halibut and sablefish. This also occurs in the Pacific cod fishery. The sablefish discard in the Pacific cod fishery accrues to the sablefish TAC. If catch approaches an OFL then NMFS may need to close fisheries in areas that catch the most of the species approaching an OFL. Thus, NMFS needs timely data to be able to monitor the sablefish discards in-season relative to the catch limits to determine if management action is necessary.

The fixed gear sablefish TACs are fully allocated to the IFQ Program, and none of the TAC is set aside for sablefish caught incidentally in other fixed gear fisheries (i.e., in the Pacific cod and halibut IFQ fisheries). Likewise, for the trawl gear sablefish TACs, most are closed for directed fishing using trawl gear and the full trawl gear sablefish TAC is fully used as there is no incidental catch allowance (ICA) for sablefish for the trawl fisheries. In the Central GOA Rockfish Program, the trawl cooperatives do receive a sablefish allocation that is open for directed fishing. Because there is no ICA for sablefish caught in the other fixed gear fisheries or the trawl fisheries, any incidental catch of sablefish must be discarded and accrues toward the TAC. For incidental catch of sablefish using trawl gear retention is allowed up to the maximum retainable amount. At implementation of the IFQ Program, the Council believed that there would be enough unused TAC in the trawl fisheries to absorb incidental catches without exceeding the overall sablefish TAC.

In the GOA, the sablefish allocations to the fixed gear sectors have been fully harvested in most years since implementation of the IFQ Program. As a result, incidental catches of sablefish by vessels without sablefish IFQ have caused sablefish harvests by the fixed gear sector to exceed the fixed gear TACs in some areas of the GOA in some years. In the SE Outside District, retained catch plus discards has exceeded the TAC in most years.

The combined area TACs for fixed gear and trawl gear have generally not been exceeded since the implementation of the IFQ Program because the trawl allocation has not been fully harvested. However, in recent years trawl harvests plus discards of sablefish in the CGOA and WY districts have been approaching the TAC, leaving little TAC available to absorb overages from the fixed gear sector. As a result, the combined TAC has been exceeded in the CGOA and West Yakutat District. In the CGOA, trawl gear sablefish is a secondary species for the Rockfish Program cooperatives. Although retained plus incidental catches have exceeded the sub-area TACs in some years, NMFS does not consider this a current management issue, because total catch has remained below the area-wide TACs (and ABC).

As discussed in Section 4.5, marine mammal interactions with hook-and-line gear are an important and growing issue in the assessment of sablefish catch. Historically this mortality is poorly accounted for in total catch estimates, with counts only occurring if whale damaged sablefish remains on a hook and is counted within an observers sampling period (i.e., “tally period”). However, depredation often occurs prior to hauling the hook-and-line onboard, with whales feeding on sablefish on a submerged line that cannot be observed. This additional source of unaccounted sablefish mortality reduces catch rates, underestimates mortality, and decreases the accuracy of stock assessments that, in turn, influences management advice.

Review of the Alaska Sablefish Assessment by the Center for Independent Experts (CIE 2016) highlighted whale depredation as an issue, indicating that adjustments for depredation should be applied to catches. Currently, at-sea observer information is the primary source of information available documenting whale interactions with gear. At-sea observers record sets where considerable whale depredation occurs based on visual evidence of whales diving on gear and feeding on catch, and/or there is a sudden drop in catch rates while whales are present (AFSC 2016). In absence of at-sea observer data, logbooks are another source of information on whale depredation; however, this is an unverified source of information for interactions.

Under Alternative 2, EM would provide information on whale interactions only when damaged fish remained on the hook and were visually examined by a video reviewer. Some examples include hooks containing only lips or heads, or fish with whale bite marks. However, this would be an incomplete accounting of depredation since fish are removed from a hook and cannot be viewed. Thus, EM would reduce the amount of information available on this important issue, and depredation data would instead need to be collected from unverified logbooks and from vessels subject to observer coverage. Whale interactions are relatively infrequent and clustered events. The quality of information available to assess depredation would decrease as the size of the EM pool increased, assuming that future EM methods were not developed that allowed assessment of whale interactions. Given the methodology to account for this additional mortality in the sablefish stock assessment model is still underdevelopment, the impact from this action on that effort is uncertain.

Sculpins and Sharks

Sculpins and sharks present a management challenge because of the high discards of these species by the catcher vessel hook-and-line fisheries and because the TAC is specified GOA-wide. Sculpins catch in the GOA and BSAI is provided in Table 4-9. Sharks catch is the GOA and BSAI is provided in Table 4-6 and Table 4-7. These species are always on "incidental catch status". In 2013, in the GOA, sculpins catch was about 33% of the TAC, and sharks catch was about 36% of the TAC. Since most of the sculpins and shark catch occurs in these hook-and-line fisheries, the ability of EM to collect data on sculpins and sharks and identify the catch to species is important to inform the stock assessment.

Both complexes contain a range of species with differing life history vulnerabilities. According to the sculpin stock assessment, vulnerability analyses indicate that the individual species in the sculpin complex have a wide range of vulnerabilities to overfishing (largely as a result of differences in life history and thus productivity), which may suggest that two or more separate sculpin complexes could be considered (http://www.afsc.noaa.gov/REFM/Docs/2015/GOAsculpin.pdf). Concern exists about sleeper sharks, a poorly understood species. Thus, continued assessment of catch for this species is of high importance (https://www.afsc.noaa.gov/REFM/stocks/plan_team/GOAshark.pdf). An ongoing problem with sleeper shark data collection by at-sea observers is determining weights. The animals are large and difficult to sample; current work is underway to evaluate trends in numbers.

Octopus

Octopus are caught in in the Pacific cod pot fishery. NMFS presumes that the catch of octopus in the Pacific cod pot fishery might not be accurately reported on fish tickets/eLanding. Many Pacific cod pot vessels retain octopus on board to use as bait. If the octopus is not landed then there is a possibility that it is not being recorded on the fish ticket/eLandings and therefore, not does not enter into the CAS. Under Alternative 2 or 3, EM on Pacific cod pot vessels may be a solution to account for this potentially under-reported catch.

Table 4-6 Average estimated amount of retained and discarded catch (in metric tons) of species with management concerns in the hook-and-line sablefish, Pacific halibut, and Pacific cod fisheries, and Pacific cod pot fishery from 2013 through 2015 in the GOA.

Species	Hook-and-line						Pot	
	Sablefish		**Halibut**		**Pacific cod**		**Pacific cod**	
	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain
Big skate	5	0	387	4	269	158	0	0
Demersal shelf rockfish	1	10	5	56	-	0		
Dusky Rockfish	1	0	9	1	1	1	4	0
Longnose skate	184	10	506	36	53	292	0	-
Northern rockfish	0	0	2	0	1	0	2	0
Octopus	7	0	58	2	6	4	404	357
Pacific cod	68	20	1,018	155	120	6,701	188	19,017
Pacific ocean perch	1	-	0	0	-	0	0	0
Rougheye/Blackspotted rockfish	64	79	16	24	0	1	0	-
Other rockfish	31	9	91	47	5	22	2	0
Sablefish	379	8,236	129	619	19	1	1	-
Shortraker rockfish	101	73	56	35	0	1	0	-
Thornyhead rockfish	255	398	10	27	0	0		
Other Skates	151	1	501	1	563	0	0	0
Sharks	508	1	600	0	166	0	1	-

Source: NMFS Inseason Management.

Table 4-7 Average estimated amount of retained and discarded catch (in metric tons) of species with management concerns in the hook-and-line sablefish, Pacific halibut, and Pacific cod fisheries, and Pacific cod pot fishery from 2013 through 2015 in the BSAI.

Species	Hook-and-line						Pot	
	Sablefish		Halibut		Pacific cod		Pacific cod	
	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain
Northern rockfish	-	-	1	0	0	-	0	0
Octopus	-	-	-	-	-	-	233	54
Pacific cod	5	0	285	14	13	1,304	95	22,886
Pacific ocean perch	-	2	0	0	0	1	0	-
Blackspotted/Rougheye rockfish	1	0	3	1	0	-	-	-
Other rockfish	15	24	15	12	2	0	4	0
Sablefish	3	391	11	88	0	-	0	-
Shortraker rockfish	4	1	42	1	0	2	-	0
Skates	22	-	488	1	8	2	0	-
Sharks	0	-	10	-	0	-	-	-

4.2.3 Alternative 3

Under Alternative 3, EM would be to be used as verification of the vessel operator logbooks as the data collection tool for key species. The logbooks would be used as a data source for catch estimation. All vessel operators in the EM selection pool would be required, when selected, to complete a logbook of discarded target species and key bycatch species of concern, which may alternatively be retained for dockside monitoring where identification is difficult.

Vessel operators would be required to log and retain the following species:

Longline vessels:

- Require operators to log all discards of halibut, sablefish, Pacific cod, and sculpins
- Require EM vessels to retain all rockfish (for dockside monitoring)
- Require logging of all seabird interactions (including extended presentation to the camera of dead seabirds)

Pot vessels:

- Require operators to log all discards of Pacific cod, octopus, crab, and sculpins

All other incidental species would be estimated from the EM video audit and/or from the human observer strata. Therefore, less data would be collected from the vessels selected to use the EM and logbook than under Alternative 2 or Alternative 1. When less data is collected, or the data is less representative of fishing practices, then available observer data is expanded to provide estimates for the fishing activities without coverage. NMFS (2015) analyzes the impacts of gaps in coverage and how the CAS generates estimates from the available observer data.

4.3 Impacts on prohibited species catch data and ecosystem component species data in the Pacific cod pot and hook-and-line fisheries

The BSAI and GOA groundfish FMPs establish categories for prohibited species and ecosystem component species. Prohibited species in the groundfish fisheries include Pacific salmon (Chinook, coho, sockeye, chum, and pink), steelhead trout, Pacific halibut, Pacific herring, king crab, and Tanner crab. Ecosystem component species in the groundfish fisheries are forage fish and grenadier species. The effects of the groundfish fisheries in the BSAI and GOA on prohibited species and ecosystem component species are primarily managed by conservation measures developed and recommended by the Council over the history of the FMPs for the BSAI and GOA and implemented by Federal regulation. Information on prohibited species catch (PSC) and catch of ecosystem component species are available on the NMFS Alaska Region webpage at https://alaskafisheries.noaa.gov/fisheries-catch-landings.

NMFS relies on at-sea observer data to estimate PSC, including Pacific halibut and different salmon species, such as Chinook salmon. When a particular PSC limit is reached, NMFS closes those directed fisheries that would otherwise incur additional PSC to that limit. NMFS closes directed fisheries based on attainment of PSC limits per applicable regulatory requirements that detail the specific areas, fisheries, and sectors (i.e., gear type or management program) subject to such closures. These measures can be found at 50 CFR 679.21 and include PSC limits on a year-round and seasonal basis, year-round and seasonal area closures, gear restrictions, and an incentive plan to reduce the incidental catch of prohibited species by individual fishing vessels. Limits regulate the catch of prohibited species in Federal fisheries, and these limits are not affected by the restructured Observer Program or the EM alternatives.

Many of the vessels with PSC limits are in the full coverage category (Catcher/processors and vessels that participate in specific catch share programs). This category was expanded with the restructured Observer Program so more vessels that catch prohibited species are in the full coverage category compared to the previous program, which improves the data collected on PSC. In the partial coverage category, PSC limits apply to trawl vessels that harvest groundfish and hook-and-line vessels that harvest Pacific cod. Halibut and sablefish IFQ vessels and Pacific cod pot vessels are not subject to PSC limits.

NMFS has increased the use of PSC limits for Chinook salmon and halibut. Observer coverage since 2013 resulted in most PSC estimates being made specific to a target and reporting area, which is a result of deployment better representing fishing effort. This means that the PSC estimates are more representative of actual PSC in the fisheries.

In general, harvest information collected by observers, together with information from other sources, is used by NMFS's in-season managers to assess PSC. When harvest information is not timely or accurate, NMFS may inadvertently close fisheries after PSC levels have been reached, resulting in overharvest of PSC species. Or, NMFS may inadvertently close fisheries early, resulting in an underharvest of the target species. The restructured Observer Program minimizes these two cases by providing observer data consistently during the fishery. While this does not necessarily represent a conservation concern for these species, the more observer information available to managers on a near real-time basis, the more closely the closures would approximate the intended PSC limits set by the Council.

The Pacific cod pot and hook-and-line fisheries are required to discard halibut. The halibut discarded in the Pacific cod hook-and-line fishery accrues to a halibut PSC limit that, if reached, NMFS closes directed fishing for Pacific cod with hook-and-line gear. Thus, NMFS needs timely data to be able to monitor the discards of halibut in-season relative to the catch limits to determine if management action is necessary.

Halibut PSC is assessed by NMFS and provided to the IPHC. These numbers form the basis for mortality estimates used in the IPHC assessments. Obtaining data fishery-specific data is important to insuring unbiased data collection. EM is expected to provide accurate counts of halibut for non-IFQ vessels. Another form of halibut bycatch, wastage, is described in the following section.

Table 4-8 provides total PSC data for fixed gear catcher vessels, by management area, gear type and species. The data are provided for 2013 through 2015 inclusive, for the sum of the three year period. The table also includes the total catch of each species by all gear types, and identifies the proportion of the total that is attributable either to hook and line or pot catcher vessels. In the GOA, hook and line catcher vessels are responsible for 30 percent of all halibut mortality, and intercept about 30 percent of all golden king crab and almost all red king crab. Pot catcher vessels are responsible for about two-thirds of all interceptions of bairdi Tanner crab. In the BSAI, pot catcher vessels are responsible for between 21 and 37 percent of king crab PSC, depending on the species, and about a quarter of Tanner crab PSC.

Table 4-8 Total prohibited species catch by fixed gear catcher vessels, compared to total prohibited species catch in all groundfish and halibut fisheries, for 2013 through 2015 inclusive.
Proportions of 20 percent or higher are highlighted in yellow.

Area	Species		Total catch (count or tons)			Proportion of total from hook and line	Proportion of total from pot
			Hook and line	Pot	Total (all gears)		
GOA	Halibut *(tons, catch not mortality)*		3,543	282	11,773	30%	2%
	Herring *(tons)*		0	0	93	0.0%	0.0%
	Crab *(count)*	Red king crab	334	0	346	97%	0%
		Blue king crab	0	0	0	0%	0%
		Golden king crab	163	0	580	28%	0.0%
		Bairdi Tanner crab	1,114	829,274	1,226,068	0.1%	68%
		Other tanner crab	0	0	2	0.0%	0.0%
	Salmon *(count)*	Chinook					
		Non-Chinook					
BSAI	Halibut *(tons, catch not mortality)*		243	99	24,464	1%	0.4%
	Herring *(tons)*		0	0	2,705	0.0%	0.0%
	Crab *(count)*	Red king crab	350	191,512	516,457	0.1%	37%
		Blue king crab	84	1,103	5,240	2%	21%
		Golden king crab	2,010	33,015	104,031	2%	32%
		Bairdi Tanner crab	548	851,871	3,233,525	0.0%	26%
		Other tanner crab	400	149,747	1,942,142	0.0%	8%
	Salmon *(count)*	Chinook	5	0	59,544	0.0%	0.0%
		Non-Chinook	0	0	594,647	0.0%	0.0%

Under Alternative 1, the restructured Observer Program collects timely and accurate bycatch data for use in inseason management to prevent fisheries from exceeding their PSC limit. One of the many improvements from using a scientific deployment method is that observers are deployed steadily throughout the season. This results in a steady input of bycatch data and decreases the variability of data during a season. This improves NMFS's ability to manage fisheries to prevent exceeding PSC limits. Additionally, due to the implementation of a statistically reliable sampling design and estimation procedures in the CAS, NMFS expects to realize these improvements in PSC estimation at a realistic range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015).

Since Alternatives 2 and 3 would provide an EM option to a specific category of fixed-gear catcher vessels, these alternatives would not impact the improvements made by the Observer Program in providing PSC data from the majority of the groundfish fisheries. However, since vessels that target Pacific cod with hook-and-line gear that may volunteer to carry EM are subject to halibut PSC limits, EM could change the timeliness of the PSC data available for these fisheries.

Table 4-9 provides similar information for non-target species intercepted by fixed gear catcher vessels, including the proportion of total catch by all gear types that is attributable to hook and line or pot catcher vessels. Note the scale of catch is much smaller for Table 4-9, provided in kilograms, versus Table 4-8 which lists catch in either count or metric tons. Some of the non-target species are in the ecosystem component category; grenadiers and forage fish. NMFS has implemented management measures to collect data on ecosystem component species caught in the groundfish fisheries. Sablefish IFQ vessels are one of the largest sources of grenadier bycatch and EM systems should be able to collect data on grenadier bycatch.

Table 4-9 Total GOA non-target catch by fixed gear catcher vessels, compared to total non-target catch in all groundfish and halibut fisheries, for 2013 through 2015 inclusive.

Proportions of 20 percent or higher are highlighted in yellow.

Area	Species	Total catch (kg)			Proportion of total from hook and line	Proportion of total from pot
		Hook and line	Pot	Total (all gears)		
GOA	Benthic urochordata	1	0	8	13%	0.0%
	Bivalves	2	0	6	33%	0.0%
	Brittle star unidentified	1	0	2	50%	0.0%
	Corals Bryozoans - Unidentified	7	0	11	64%	0.0%
	Corals Bryozoans - Red Tree Coral	0		1	0.0%	
	Dark Rockfish	4	1	150	3%	1%
	Eelpouts	0		37	0.0%	
	Giant Grenadier	12,549		19,956	63%	
	Greenlings	2	3	28	7%	11%
	Grenadier - Ratail Grenadier Unidentified	2,636		4,647	57%	
	Gunnels	0		5	0.0%	
	Hermit crab unidentified	0	5	6	0.0%	83%
	Invertebrate unidentified	1	0	2	50%	0.0%
	Large Sculpins - Bigmouth Sculpin	48	8	258	19%	3%
	Large Sculpins - Great Sculpin	180	220	639	28%	34%
	Large Sculpins - Hemilepidotus Unidentified	519	204	1,002	52%	20%
	Large Sculpins - Myoxocephalus Unidentified	47	43	139	34%	31%
	Large Sculpins - Plain Sculpin	4	0	9	44%	0%
	Large Sculpins - Red Irish Lord	39	2	47	83%	4%
	Large Sculpins - Warty Sculpin	0		0	0.0%	0.0%
	Large Sculpins - Yellow Irish Lord	392	633	2,182	18%	29%
	Misc crabs	0	7	9	0.0%	78%
	Misc crustaceans	0	0	1	0.0%	0.0%
	Misc fish	957	203	2,493	38%	8%
	Misc inverts (worms etc)	0	0	0	0.0%	0.0%
	Other Sculpins	91	70	271	34%	26%
	Scypho jellies	0	4	264	0.0%	2%
	Sea anemone unidentified	21	1	69	30%	1%
	Sea pens whips	8	0	13	62%	0.0%
	Sea star	1,719	2,203	4,103	42%	54%
	Snails	8	37	50	16%	74%
	Sponge unidentified	2	0	17	12%	0.0%
	Stichaeidae	1		1	100%	
	urchins dollars cucumbers	2	6	16	13%	38%

Table 4-10 Total BSAI non-target catch by fixed gear catcher vessels, compared to total non-target catch in all groundfish and halibut fisheries, for 2013 through 2015 inclusive.

Proportions of 20 percent or higher are highlighted in yellow.

Area	Species	Total catch (kg)			Proportion of total from hook and line	Proportion of total from pot
		Hook and line	Pot	Total (all gears)		
BSAI	Benthic urochordata	4	0	865	0.5%	0.0%
	Bivalves	0	1	35	0.0%	3%
	Brittle star unidentified	0	2	51	0.0%	4%
	Corals Bryozoans - Unidentified	19	0	195	10%	0.0%
	Corals Bryozoans - Red Tree Coral	0		1	0.0%	
	Dark Rockfish	1	0	7	14%	0.0%
	Eelpouts	2	1	532	0.4%	0.2%
	Giant Grenadier	2,339	8	8,673	27%	0.1%
	Greenlings	0	0	2	0.0%	0.0%
	Grenadier - Ratail Grenadier Unidentified	264	3	868	30%	0.3%
	Hermit crab unidentified	0	1	33	0.0%	3%
	Invertebrate unidentified	1	0	319	0.3%	0.0%
	Large Sculpins - Bigmouth Sculpin	8	3	1,445	1%	0.2%
	Large Sculpins - Great Sculpin	34	105	4,301	1%	2%
	Large Sculpins - Hemilepidotus Unidentified	117	167	2,493	5%	7%
	Large Sculpins - Myoxocephalus Unidentified	7	1	335	2%	0.3%
	Large Sculpins - Plain Sculpin	0	1	3,295	0.0%	0.0%
	Large Sculpins - Red Irish Lord	3	0	5	60%	0.0%
	Large Sculpins - Warty Sculpin	0	1	280	0.0%	0.4%
	Large Sculpins - Yellow Irish Lord	132	556	3,041	4%	18%
	Misc crabs	0	13	139	0.0%	9%
	Misc crustaceans	0	0	4	0.0%	0.0%
	Misc deep fish		0	0		0%
	Misc fish	8	45	1,226	1%	4%
	Misc inverts (worms etc)	0	0	0	0%	0%
	Other Sculpins	17	25	734	2%	3%
	Pacific Sandfish		0	0		0%
	Pandalid shrimp	0		9	0.0%	0.0%
	Polychaete unidentified	0	0	3	0.0%	0.0%
	Scypho jellies	2	32	26,444	0.0%	0.1%
	Sea anemone unidentified	7	0	884	1%	0.0%
	Sea pens whips	2	0	206	1%	0.0%
	Sea star	32	22	8,393	0.4%	0.3%
	Snails	13	33	321	4%	10%
	Sponge unidentified	5	2	1,263	0.4%	0.2%
	Stichaeidae	0		2	0.0%	
	urchins dollars cucumbers	7	3	49	14%	6%

4.4 Impacts on Pacific halibut wastage data in the halibut fishery

Halibut are caught and discarded in the directed halibut IFQ fishery. The halibut IFQ fishery discards undersized halibut because there is as a length retention requirement of 32 inches below which fish must be discarded. This halibut bycatch is called "wastage" and is estimated and accounted for by the IPHC. However, there is no limit on the amount of undersized halibut that a vessel can discard in the halibut IFQ fishery. NMFS (2015, Section 3.2.2) provides an analysis of the observer coverage on vessels fishing for halibut IFQ under the restructured Observer Program.

Within the halibut IFQ fishery, there was a large increase in observer coverage after restructuring. Prior to restructuring, observer information from the halibut hook-and-line fisheries was sporadic and an evaluation of this sector showed significant amounts of catch could originate from this sector, leading to a serious data gap. The new Observer Program improved the sampling frame so that the opportunity to sample catcher vessels increased by 51-55 percent. The expanded sampling frame also resulted in better spatial distribution of sampling relative to the fishery footprint. Previous analysis suggested there was poor coverage in nearshore areas, particularly southeastern Alaska and other nearshore areas in the Central and Western Gulf of Alaska. The inclusion of small vessels and halibut IFQ vessels under the restructured Observer Program improved the representativeness of data compared to the previous program and resulted in more nearshore data and better representation of the small vessels and halibut fisheries in 2013 and 2014 (NMFS 2015).

Since 2013, observer data is available on halibut discards in the halibut IFQ fishery. NMFS reports estimated halibut discarded at sea in each Observer Program Annual Report. This is important information for understanding the impacts of the halibut IFQ fishery on the halibut resource. Since 2013, NMFS and the IPHC now have observer data from the directed halibut fishery on wastage from the halibut IFQ fishery. The 2015 Annual Report contains estimates of the at-sea discard of halibut in halibut IFQ fishery. According to Table 4-5 in the 2015 Annual Report, the hook-and-line catcher vessels in the GOA discard approximately half of the halibut they catch (8,648 mt retained and 8,270 mt discarded). In the Bering Sea, roughly a third of the halibut catch is discarded (1,821 mt retained and 614 mt discarded, see Table 4-8 in the 2015 Annual Report). Current observer coverage in the Alaska directed halibut IFQ fishery is low, and therefore estimates of wastage are of unknown accuracy; however, improved monitoring via increased observer coverage and/or electronic monitoring offer potential for improvement in these estimates (NMFS 2015).

EM will enumerate halibut as categorically retained or discarded; however, obtaining average weights for discarded halibut will require additional investigation. The current method for calculating haul-specific estimates of at-sea discards of halibut in the halibut IFQ fishery may be biased because observers collect fish weights from the unsorted (retained and discarded) catch. Because there is a minimum size limit in the halibut IFQ fishery, smaller fish (less than 32 inches) are required to be discarded while larger fish are required to be retained. Hence, basing the mean weight per fish on observer data may overestimate the mean weight of discarded fish and underestimate the weight of retained fish. However, how this bias impacts the final discard estimates is not yet known since its likely fish are not sorted perfectly and vessels may be forced to discard all fish when quota is and hooks are still fishing.

NMFS is preparing a document that describes Observer Program halibut data collections along with the catch/bycatch estimation procedures used to estimate the at-sea discard of halibut in the IFQ halibut fishery. NMFS has modified sampling procedures to better account for discarded halibut and will evaluate solutions to properly account for the sorting behavior under the EM program. These results will also be applicable to estimation under at-sea sampling scenarios.

Under Alternatives 2 and 3, fixed-gear catcher vessels would be able to volunteer to carry EM instead of an observer, including halibut IFQ vessels. Under either Alternative, halibut would be assessed and available for stocks assessment authors as well as inseason managers. Work will continue to address the average weight issue for wastage in both the at-sea and EM programs. More detail on estimation under Alternative 2 is provided in Chapter 3.

4.5 Impacts on marine mammal data collection

Alaska supports one of the richest assemblages of marine mammals in the world. Twenty-two species are present from the orders Pinnipedia (seals and sea lions), Carnivora (sea otters), and Cetacea (whales, dolphins, and porpoises). Some marine mammal species are resident throughout the year, while others migrate into or out of Alaska fisheries management areas. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf.

Marine mammals have been given various levels of protection under the current fishery management plans of the Council, and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts on these species. The most recent status information is available in the Marine Mammal Stock Assessment Reports (SARs), available on the AFSC webpage at http://www.nmfs.noaa.gov/pr/sars/region.htm.

The Observer Program provides better information to managers of marine mammal resources on direct and indirect interactions with fisheries and increased flexibility to meet management objectives. None of the alternatives would change the management of the fisheries, the location of the fisheries, fishing effort, or the marine mammal protection measures in place. Spatial and temporal concentration effects by these fisheries, vessel traffic, gear moving through the water column, or underwater sound production which could affect marine mammal foraging behavior, would not be affected by the proposed action. Significant incentives for compliance with marine mammal protection management measures, such as area closures, would remain in place under all of the alternatives.

Observers are important sources of data for the marine mammal stock assessment reports (Muto et al 2015) and the List of Fisheries (81 FR 20550, April 8, 2016) for compliance with the Marine Mammal Protection Act. Under the restructured Observer Program, NMFS is monitoring the take of all marine mammals in the BSAI and GOA groundfish fisheries and deploys NMFS-trained observers on vessels per the ADP.

NMFS's List of Fisheries annually classifies U.S. commercial fisheries into one of three categories according to the level of incidental mortality or serious injury of marine mammals. The Alaska halibut IFQ fishery and the Pacific cod pot fishery are Category III fisheries in 2016, meaning there is either a remote likelihood of or no known incidental mortality or serious injury of marine mammals in these fisheries. Prior to 2013, when the restructured Observer Program included a requirement for the halibut IFQ vessels to carry observers, the only source of data on incidental injuries to marine mammals from that fishery was self-reports of any injury, incidental mortality, or serious injury of marine mammals.

Vessels have to comply with existing Federal regulations protecting Steller sea lion rookeries and haulouts. As the western distinct population segment of the Steller sea lion is listed as endangered under the Endangered Species Act, current Steller sea lion protection measures close much of the Aleutian Islands region to trawling up to 10 or 20 nautical miles offshore from rookeries and haulouts, with less restrictive no-fishing zones for hook-and-line and pot gear.

In 2014, NMFS published a final EIS, biological opinion, and final rule to implement modified Steller sea lion protection measures (79 FR 70286, November 25, 2014). The 2014 biological opinion included the following Reasonable and Prudent Measure as necessary and appropriate to minimize the impact of incidental take of western distinct population segment of Steller sea lions (NMFS 2014): NMFS will monitor the take of ESA-listed marine mammals in the BSAI groundfish fisheries. In order for any incidental takes to be exempt from the prohibitions of section 9 of the ESA, NMFS must comply with the associated terms and conditions below, which implement the Reasonable and Prudent Measure:

1. NMFS-trained observers will be deployed on vessels in these fisheries per the Observer Program's Annual Deployment Plan.
2. NMFS will use observer data to estimate the minimum mean annual mortality for each fishery.
3. NMFS will evaluate the observer coverage to determine if changes in coverage are warranted to better assess take of listed marine mammals.

4.5.1 Comparison of Alternative 1 with Alternatives 2 and 3

The 2016 Observer Sampling Manual explains that the role of observers under the Marine Mammal Protection Act is to conduct statistically reliable monitoring of fishing operations and to record information on all interactions between fishing operations and marine mammals (AFSC 2016). Observers record –

- number, marine mammal species identifications, and types of interactions with marine mammals;
- number, species identification, length, photographs, tissue samples, and disposition (dead, released alive, etc) of marine mammals caught in the gear; and
- associated marine mammal incidental take or interaction location, date and time, gear type, catch composition, fishing depth.

The Observer Program reports mammal interactions to MML staff and estimates are made independent of the CAS.

Under Alternative 1, NMFS is now placing observers on boats that operate closer to shore and in more areas that under the previous program. As explained in NMFS (2015, Section 3.2), the expanded sampling frame created by the restructured Observer Program resulted in a better special distribution of sampling relative to fishery footprint. Marine mammals occur nearshore and prior to restructuring no observer information was collected in the inside waters of southeast Alaska, and nearshore waters in southeast Alaska and the Kenai Peninsula had limited to no coverage. Now we have the ability to collect observer data of fishery interactions with marine mammals nearshore. Additionally, due to the implementation of a statistically reliable sampling design, NMFS expects to realize these improvements in data on fishery interactions with marine mammals at a realistic range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015).

From 2013 to August, 2016, observers have recorded a total of 134 trips by hook-and-line vessels less than 60 ft LOA with at least one marine mammal record. Two of these records were Steller sea lions (*Eumetopias jubatus*) killed by hook-and-line gear in 2015. One record was a live sperm whale (*Physeter macrocephalus*) entangled in gear, also in 2015. All other records were live animal interactions with gear. For the Pacific cod pot fishery, 4 dead phocid seals (likely a harbor seal) were recorded in pot gear in 2014. Three were on a catcher processor (166 ft LOA) and one was on a catcher vessel (58 ft LOA).

Under Alternatives 2 and 3, specific types of fixed-gear vessels would be able to volunteer to carry EM instead of an observer, including halibut IFQ vessels. EM use may decrease the number of observers deployed on fixed-gear vessels. EM would not provide the same types of data on interactions with marine mammals and may decrease the gains made in collecting data on marine mammal interactions in the fishery. Much of the information collected by observers would no longer be available for vessels that volunteer for EM selection.

Under Alternatives 2 and 3, cameras would be able to record dead animals coming on board the vessel, but would be unable to record animals that fell off the gear prior to coming on board or being entangled in gear (1 in each of the following years: 2013, 2014, 2015, 2016). No marine mammal interactions with gear have been recorded in the EM data collected during pre-implementation. Therefore, there is no data on the ability to identify marine mammal species with EM.

Additionally, marine mammal interactions with hook-and-line gear are an important and growing issue in the assessment of sablefish catch. Killer whales (*Orcinus orca*) and sperm whales are both known to remove sablefish from hook-and-line gear (depredation). Historically this mortality is poorly accounted for in total catch estimates, with counts only occurring if whale damaged sabelfish remains on a hook and is counted within an observers sampling period (i.e., “tally period”). However, depredation often occurs prior to hauling the hook-and-line onboard, with whales feeding on sablefish on a submerged line that cannot be observed. This additional source of unaccounted sablefish mortality reduces catch rates, underestimates mortality, and decreases the accuracy of stock assessments that, in turn, influences management advice.

Review of the Alaska Sablefish Assessment by the Center for Independent Experts (CIE 2016) highlighted whale depredation as an issue, indicating that adjustments for depredation should be applied to catches. Currently, at-sea observer information is the primary source of information available documenting whale interactions with gear. At-sea observers record sets where considerable whale depredation occurs based on visual evidence of whales diving on gear and feeding on catch, and/or there is a sudden drop in catch rates while whales are present (AFSC 2016). In absence of at-sea observer data, logbooks are another source of information on whale depredation; however, this is an unverified source of information for interactions.

Under Alternatives 2 and 3, EM would provide information on whale interactions only when damaged fish remained on the hook and were visually examined by a video reviewer. Some examples include hooks containing only lips or heads, or fish with whale bite marks. However, this would be an incomplete accounting of depredation since fish are removed from a hook and cannot be viewed. **Thus, EM would reduce the amount of information available on this important issue, and depredation data would instead need to be collected from unverified logbooks and from vessels subject to observer coverage.** Whale interactions are relatively infrequent and clustered events. The quality of information available to assess depredation would decrease as the size of the EM pool increased, assuming that future EM methods were not developed that allowed assessment of whale interactions. Given the methodology to account for this additional mortality in the sablefish stock assessment model is still underdevelopment, the impact from this action on that effort is uncertain.

4.6 Impacts on seabird data collection

Alaska’s waters support the greatest concentrations of seabirds in North America. Over 80 million seabirds are estimated to occur in Alaska annually, including three albatross species: black-footed albatross, Laysan albatross, and the endangered short-tailed albatross (USFWS 2009). Seabirds spend approximately 80 percent of their life at sea, and the life history of most seabirds in Alaska is characterized by low reproductive rates, low adult mortality rates, long life spans, and delayed sexual maturity (USFWS 2009). These traits make seabird populations extremely sensitive to at-sea stressors and changes in adult survival. It is difficult to quickly attribute seabird population changes to specific impacts because declines may not become apparent for years or decades.

In Alaska, many hook-and-line fishing vessels use seabird avoidance measures, which minimize seabird bycatch. These measures are required to be used by operators of all vessels greater than 26 ft length overall (LOA) using hook-and-line gear while fishing for (1) Individual Fishing Quota (IFQ) halibut, Community Development Quota (CDQ) halibut, or IFQ sablefish in the EEZ off Alaska or State of Alaska waters (0 to 200 nm combined); or (2) groundfish in the EEZ off Alaska (3 to 200 nm). Also, because seabirds are ecosystem indicators (discussed further in the Ecosystem Considerations Report within the annual Stock Assessment and Fishery Evaluation reports), information about fisheries bycatch of seabirds is collected on an ongoing basis through the Observer Program.

4.6.1 Alternative 1

The restructured Observer Program results in better observer data related to direct and indirect interactions with groundfish fisheries and increased flexibility to meet management objectives. The changes to the Observer Program proposed under Alternatives 2 and 3 are not expected to affect current rates of interaction. No changes in the indirect effects of fisheries on prey (forage fish) abundance and availability, benthic habitat as utilized by seabirds, and processing of waste and offal, all of which could affect seabirds, are expected under the alternatives.

The Observer Program furthers the requirements of a 1998 biological opinion that the U.S. Fish and Wildlife Service (USFWS) prepared on the commercial Pacific halibut hook-and-line fishery in the GOA and BSAI, and its effects on the short-tailed albatross (USFWS 1998). One of the conclusions of the USFWS is that NMFS needs to institute changes to the halibut fishery deemed appropriate based upon the evaluation of the seabird deterrent devices and methods. The biological opinion states that: “Changes may range from requiring minimal observation of the fishery due to the effectiveness of the deterrent devices to requiring extensive observer coverage and expanded or modified use of seabird deterrent devices and methods” (USFWS 1998). The Observer Program helps NMFS assess the effectiveness of seabird deterrent devices and monitor interactions and take of seabirds on observed halibut vessels.

There had only been logbook and some survey data in the past to inform the level of seabird observations and bycatch on halibut vessels. As of 2013, the restructured Observer Program provides data, including seabird takes, on previously unobserved halibut vessels. Information on seabird bycatch (e.g., seabird species) and seabird mitigation measure compliance (e.g., streamer lines) is collected and reported by the observer. Observers collect the number, species identifications, and tag recoveries of seabirds caught or killed by fishing gear. These new data help quantify and describe halibut fisheries interactions with seabirds, which provides a better overall understanding of potential fisheries impacts on seabirds. Observer data are crucial in estimating total bycatch of seabirds, and particularly those birds of conservation concern at risk of interaction with hook-and-line gear including albatrosses. Also, new information has been obtained from tagging additional short-tailed albatrosses. Both of these new sources of information could lead to more effective seabird avoidance measures and fewer interactions in the future.

The majority of observed seabird bycatch in fisheries occur in the hook-and-line fisheries; however, small numbers of seabird bycatch have been observed in trawl and other fisheries. Observer protocols are not set up to monitor trawl fisheries in the same way that hook-and-line are monitored. Trawl bycatch is difficult to quantify (NMFS 2015, Fitzgerald et al. in prep). New observer data recording techniques are likely to lead to better estimates of seabird trawl bycatch takes.

Estimation of seabird bycatch is also a concern in the hook-and-line fisheries. NOAA Fisheries has estimated seabird bycatch using the CAS in the BSAI and GOA groundfish fisheries since 2007 and in the halibut fisheries since 2013 (Fitzgerald et al. 2013; AFSC 2014). Seabird estimates are based on at-sea sampling by observers (AFSC 2015). Seabird takes can also be recorded by observers outside of their sampling period. A record of these takes by observers is opportunistic since they occur outside of the random sampling protocol, thus their inclusion in the total seabird estimate across all fisheries would be inappropriate. Observers generally do not record any information for a seabird outside of their sample, unless it is banded, collected as part of the necropsy program, or is a species of special interest or an ESA-listed species (e.g., the endangered short-tailed albatross). It is important to note that short-tailed albatross takes recorded by observers, whether within or outside of their sampling period, are counted towards the incidental take statement for the fishery in which the bycatch occurred.

Observer coverage improves NMFS's ability to detect endangered short-tailed albatross interactions. NMFS observers on a hook-and-line catcher/processor in the Bering Sea documented the take of two short-tailed albatross in 2014. The world population of the endangered short-tailed albatross is currently estimated at approximately 5,000 individuals (Sievert unpubl. population model). USFWS recently consulted with NOAA Fisheries Alaska Region under section 7 of the ESA on the effects of the groundfish fisheries on the endangered short-tailed albatross. In its Biological Opinion, the USFWS determined that the groundfish fisheries off Alaska are likely to adversely affect short-tailed albatross but that they are not likely to jeopardize its continued existence (USFWS 2015). This Biological Opinion included an incidental take limit of six short-tailed albatross every two years in the groundfish fisheries off Alaska, either by hook-and-line gear or trawl gear. In 1998, the USFWS issued a Biological Opinion for the Pacific halibut hook-and-line fishery off Alaska which includes an incidental take limit of two short-tailed albatross in a two year period (USFWS 1998). In instances where the amount or extent of incidental take is exceeded, reinitiation of formal ESA consultation is required. For over the 26 years NOAA Fisheries has formally consulted with USFWS regarding the short-tailed albatross, and to-date none of the incidental take limits have been reached within the specified time periods.

The addition of observers to many vessels in the GOA contributed important data for our understanding of seabird bycatch patterns and quantities. The key element for seabird issues that came along with the restructured Observer Program is that for the first time we have fishery observers on board halibut vessels that can monitor seabird interactions and calculate estimates of the seabird bycatch.

The 2011 EA/RIR/IRFA concluded that it is expected that the restructured Observer Program would help NMFS assess the effectiveness of seabird deterrent devices (i.e., mitigation measures) and monitor interactions and take of seabirds on observed halibut vessels. NMFS-certified observers have been deployed to about 6% of halibut trips in 2013, 9% in 2014, and 9% in 2015. These deployments have supported NMFS's ability to serve a broad suite of clients interested in seabird/fishery interactions and to further the goals of the 1998 and 2015 short-tailed albatross biological opinions (USFWS 1998, 2015). Our partners and collaborators at the USFWS and various environmental non-governmental organizations have requested monitoring of the halibut fleet since 1993 when seabird duties for observers on the groundfish fisheries were expanded.

The restructured Observer Program, which includes deployments to the halibut fleet, has provided critically important information. Observers submit affidavits to the NOAA Office of Law Enforcement which address failure to properly deploy required seabird mitigation measures. This provides for work with individual vessels to come into compliance with required regulations and also raises awareness throughout the fleet and in fisheries management offices. Data collected by observers are captured in long-standing routines and processes of the FMA and the CAS. These allow for annual estimates of seabird bycatch by species and species groups for the halibut fishery. Data supplied by observers allow managers to understand which vessels in which areas are responsible for the bycatch, it allows for industry groups to internally monitor their own bycatch and take actions to avoid seabird bycatch, and we can now compare seabird bycatch across fisheries and areas to determine where best to place continued efforts to mitigate seabird bycatch.

The restructured Observer Program has addressed a critically important and long-standing information gap. NMFS is now able to include seabird bycatch estimates for the halibut fishery in its annual reports of total estimated seabird bycatch for Alaskan fisheries. This information is provided to a broad suite of interested parties globally, and is especially important for highly migratory species such as the black-footed albatross and for ESA-listed species such as the short-tailed albatross. Observer Program restructuring has been very successful in allowing NMFS to assess the effectiveness of seabird deterrent measures, monitor interactions and takes of seabird on halibut vessels, and begin to take actions to reduce seabird bycatch within this fleet. Additionally, due to the implementation of a statistically reliable sampling design, NMFS expects to realize these improvements in data on fishery interactions with seabirds at a realistic range of coverage levels resulting from variable fee revenues, effort levels, and costs (NMFS 2015).

4.6.2 Alternatives 2 and 3

Under Alternatives 2 and 3, fixed-gear vessels would be able to volunteer to carry EM instead of an observer, including halibut IFQ vessels. As stated previously, the changes to the Observer Program proposed under Alternatives 2 and 3 are not expected to affect current rates of interaction. No changes in the indirect effects of fisheries on prey (forage fish) abundance and availability, benthic habitat as utilized by seabirds, and processing of waste and offal, all of which could affect seabirds, are expected under the alternatives.

NMFS implemented seabird data collection measures in the 2015 pre-implementation plan and then improved upon those measures in the 2016 pre-implementation plan. NMFS established a primary objective for seabird monitoring in 2016 to record presence/absence of streamer lines (seabird mitigation measures) during setting of hook-and-line gear on EM-observed trips. In the 2016 pre-implementation plan, two cameras provide information related to seabirds: 1) seabird camera (aimed at the stern; records streamer line presence/absence when setting gear; on/off trigger is vessel speed) and 2) hauler camera (where fishermen can hold up seabirds for identification purposes). Vessel operators are required to hold incidentally caught seabirds up to the camera for 2-3 seconds and ensure that certain key parts of the animal, such as the beak, are captured by the hauler camera. More specific seabird handling protocols are provided in the participating vessels' vessel monitoring plans. Speed was determined to be an appropriate trigger for the seabird camera so that it is easy to identify when gear is set in the video review. It may also be possible to move beyond streamer line presence/absence to identify when streamer lines are set correctly. Seabird experts have reviewed the screen captures of seabirds in 2015 and 2016, and were mostly able to identify the species using the three-second presentation of the bird to the camera. The seabird experts found the 2016 protocols for displaying seabirds to the camera and the camera picture quality were sufficient as long as fishermen adhered to the protocols.

Observers and EM allow the reporting of streamer line presence/absence. However, the observer can provide context for a particular situation whereas EM cannot. Observers can also work with vessel operators in real-time to correct any potential issues which is not possible with EM.

The ability to identify seabird species is similar when using observers and EM. However, observers collect specimens and bring them onshore for identification and this would/could be a responsibility of the vessel operator with EM. Currently the USFWS issues a permit to NMFS AFSC to collect non-ESA listed seabird species and fisheries observers are listed as sub-permittees on the NMFS permit in order to authorize the collection of specimens. With EM, protocols and procedures for fishermen to collect specimens and bring them onshore for identification would need to be developed. It is likely that new or modified special purpose salvage permits from USFWS would be necessary.

4.7 Cumulative effects

An environmental assessment must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality regulations for implementing NEPA define cumulative effects as:

> *"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).*

The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the Council on Environmental

Quality guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful. As discussed in the proceeding sections, the meaningful effects are those on the amount of observer coverage and the ability to use EM to collected data on vessels currently not included in the observer selection pool. As such, this a cumulative effects analysis focuses on other actions that also change the Observer Program.

Since the restructured Observer Program was implemented in 2013, the Council has recommended and NMFS has implemented additional changes to the Program. The Council is also considering a number of amendments to the regulations governing the Observer Program that may be implemented in the next few years. Some of these amendments would make relatively minor changes in the circumstances under which vessels are placed in the partial versus full observer coverage categories. Other proposals would make more significant or large scale changes to the program. Several of the proposed regulatory amendments were suggested in comments on the proposed rule on Observer Amendments 86/76 (77 FR 23326; April 18, 2012) but were outside of the scope of changes NMFS could make in the final rule. Other proposals were brought to the Council after implementation of Observer Program Restructuring.

The most important aspects of changes to the Observer program are 1) the impacts on observer fee collections, 2) the total number of trips in the partial coverage category, 3) information relative to the cost or efficiency of deploying observers on EM in the partial coverage category, and 4) impacts on data quality. The impact of an action on amount of the observer fee is important because it determines the amount of money available to deploy observers or EM in the partial coverage category. The impact of an action on the total number of trips in the partial coverage category is important because it affects the sampling or deployment rate that can be achieved for a given amount of observer fees or budget. The cost of deploying observers or EM in the partial coverage category is affected by a number of factors that are described in more detail in the 2015 Annual Report. Circumstances that affect travel costs or non-fishing days may affect the average cost of deploying observers in the partial coverage category in a particular year, or may effect bids in future contracts. Therefore, it is of note if a proposal would add or remove fishing trips that may be relatively more expensive to observe.

Implemented changes to the Observer Program described in this section are—

1. Observer coverage requirements for small vessels in the Western Alaska Community Development Quota (CDQ) Program fisheries (Amendment 109 to the BSAI FMP, final rule 81 FR 26738, May 4, 2016)).
2. Observer coverage requirements for small catcher/processors (Amendments 112 to the BSAI FMP and 102 to the GOA FMP, final rule 81 FR 17403, March 29, 2016).

The proposed revisions to the Observer Program described in this section are—

3. Full observer coverage for trawl catcher vessels in the BSAI trawl limited access fisheries (proposed rule 81 FR 44251, July 7, 2016).
4. Observer coverage requirements for trawl catcher vessels harvesting groundfish in the GOA.
5. Observer coverage requirements for vessels delivering to tenders.

Additionally, the other actions under Council consideration that impact the Observer Program described in this section are—

6. Allow Charter Halibut Recreational Quota Entities

The Council has established the priority for analyses of these issues through both individual action to task its staff with preparation of a particular analysis (CDQ small hook-and-line vessels, vessels delivering to tenders, and full coverage GOA trawl catcher vessels) and through action in February 2014 on a discussion paper describing an additional five proposed regulatory amendments to the Observer Program (NMFS 2014). The Council identified analysis of revisions to the allowance for small catcher/processors to be placed in the partial coverage category as its first priority and the allowance for trawl catcher vessels in the BSAI trawl limited access fisheries to request full observer coverage as its second priority. The other three issues described in the discussion paper were 1) develop alternatives to exempt from observer coverage vessels used to harvest small amounts of IFQ under several scenarios; 2) develop alternatives related to observer coverage or other options to monitor vessels used to fish for IFQ in multiple regulatory areas on the same trip, and 3) change the method of observer fee collection for the IFQ fleet to use standardized current year ex-vessel prices, rather than standard prices lagged one year. The Council did not specifically request staff to further analyze these three issues. More information on these issues is in the February 2014 discussion paper (NMFS 2014d). NMFS and Council staff record and report progress and assumed priority to the Council at each meeting.

The highest priority for the regulatory amendments generally has been given to revising regulations to address data quality concerns (vessels delivering to tenders) or to adjust coverage requirements to better balance data quality and cost considerations (CDQ small hook-and-line vessels, small catcher/processors, BSAI trawl CVs). For example, the Council's highest priority for Observer Program related regulatory amendments was to allow small hook-and-line catcher vessels in the CDQ Pacific cod fisheries to be placed in the partial coverage category. The purpose of this action was to facilitate increased participation by small vessels in those fisheries and to provide opportunities for the fishermen in CDQ communities to diversify beyond the halibut fisheries. Another high priority was to refine the allowance for small catcher/processors to be in partial coverage. Priorities for the additional projects have changed over time due to the interaction with other issues and availability of analysts.

Following is a short description of the implemented changes to the Observer Program and proposed regulatory amendments under consideration by the Council and NMFS. Table 4-11 provides a very general overview of the possible magnitude and applicability of the proposed action on the key issues described at the beginning of this section.

Table 4-11 Summary of Observer Program changes with general information about potential impacts.

Observer Program changes	Potential Impacts			
	Observer Fee Collection	**# of Trips in Sampling Frame**	**Cost of Deploying Observers**	**EM Integration**
1. CDQ small hook-and-line catcher vessels	minor increase	minor increase	minimal, if any, trips starting in remote ports may add to the average cost of deploying observers	May be in EM selection pool and vessels may opt-in to EM coverage
2. Small catcher/ processors	increase of $23,000 (0.5% of total observer fee collection in 2013)	67 to 109 additional days subject to observer coverage, relatively small proportion of observed fishing days in 2013	cost slightly more to observe than contribute to observer fee	May be in EM selection pool and vessels may opt-in to EM coverage
3. BSAI Pacific cod trawl catcher vessels	reduction - up to 8% of annual fees	minor change because option has been in place since 2013	no change expected	Not eligible for EM under this action
4. Full coverage for GOA trawl catcher vessels	reduction – up to 25% of annual fees	reduction – about 22% of total days subject to observer coverage in 2014	unknown – will be analyzed	Not eligible for EM under this action
5. Vessels delivering to tenders	no change expected	increase in # of trips due to change in definition of the end of a trip	unknown – will be analyzed	Not eligible for EM under this action
6. Charter Recreational Quota Entity	reduction in annual fees	reduction in observer days	no change expected	N/A

Observer coverage requirements for small vessels in the CDQ Program fisheries

This action implemented a number of regulatory revisions that would apply to catcher vessels less than or equal to 46 ft LOA using hook-and-line gear in the CDQ fisheries (NPFMC 2015). One of those provisions moved these small catcher vessels from full to partial coverage. These vessels were in the full coverage category because the groundfish CDQ fisheries include transferable PSC limits as part of a catch share program. Full coverage for fisheries with transferable PSC limits as part of a catch share program is one of the requirements implemented under Observer Program Restructuring. The Council took final action on this amendment in February 2015 and NMFS implemented it in early 2016 (81 FR 26738, May 4, 2016).

Although analysts were not able to specifically project the number of vessels that may participate in the CDQ small hook-and-line gear fisheries or the number of additional fishing trips that may be added to the partial coverage category, this additional fishing is expected to be small relative to the total number of participants and trips in the partial coverage category. Therefore, the projected increase in observer fees collected as a result of this action also is expected to be small. In addition, some of the vessels affected by this action are less than 40 ft LOA so will be placed in the no selection pool under the current and recent ADPs. If a small CDQ hook-and-line catcher vessel is selected for observer coverage, these vessels likely depart from more remote ports so they may represent some of the more expensive trips to observe based on travel costs and possibly wait time or non-fishing days. However, all of approximately 230 hook-and-line catcher vessels less than 46 ft LOA that participated in the halibut CDQ fisheries already are in the partial coverage category. Those over 40 ft LOA are in the trip selection pool, and any vessels selected for observer coverage likely already are being deployed from remote ports in Western Alaska.

Observer coverage requirements for small catcher/processors

This action revised allowances for small catcher/processors to be placed in the partial coverage category. Previously, all catcher/processors were assigned to the full coverage category unless the vessel met a few limited allowances to be placed in the partial coverage category. These allowances were developed by the Council as part of its final action on Observer Program Restructuring. Three catcher/processors had qualified for partial coverage under these allowances. NMFS received comments on the proposed rule for Observer Program Restructuring requesting revisions and additions to these allowances but determined that such changes were outside of the scope of revisions that could be made to the proposed rule. Starting in early 2013, the Council received requests from industry to modify these allowances and identified this issue as one of its highest priorities for analysis. The objective of the action is to maintain a limited exception to the general requirement for full coverage for catcher/processors, provide an appropriate balance between data quality and the cost of observer coverage, and not be unduly difficult to apply or enforce.

This action established a maximum production threshold that NMFS will apply on an annual basis to identify those catcher/processors that are eligible to request to be placed in partial coverage in the upcoming year. The action is anticipated to increase the number of catcher/processors eligible to be placed in the partial coverage category from three to between six and ten. Newly qualifying small catcher/processors may contribute about $23,000 to the observer fee collection (based on 2013 fishing activity and standard ex-vessel prices). This amount is about 0.5% of the 2013 observer fee collection of $4,251,452. The newly qualified vessels will add more additional days subject to observer coverage in the partial coverage category than they will fund through additional observer fee proceeds. However, this additional number of days (67–109) is small relative to the total number of observer days in partial coverage in 2014 (4,368) or the total number of days fished by vessels in the vessel or trip selection pools 2013 (27,437 total days). The newly qualifying catcher/processors generally have longer fishing trips than the catcher vessels in partial coverage and for those fishing in more remote areas, the trips have a greater proportion of non-fishing days. The Council took final action on this amendment in June 2015 and NMFS implemented it in early 2016 (81 FR 17403, March 29, 2016).

Observer coverage for trawl catcher vessels in the BSAI trawl limited access fisheries

Catcher vessels participating in the BSAI trawl limited access fisheries are in the partial coverage category under the restructured Observer Program. These vessels were placed in the partial coverage category based on NMFS's data needs for this fishery. The BSAI trawl limited access fisheries are not managed under a catch share program with transferable PSC allocations. Therefore, NMFS recommended that full coverage was not needed for catcher vessels participating in these fisheries. In public comment on the proposed rule, owners of some of these vessels requested to be allowed to voluntarily carry full coverage in their BSAI Pacific cod fisheries so that they could use observer data to manage internal allocations of halibut PSC among AFA cooperative members rather than use the halibut PSC rates that would have been generated from partial coverage. NMFS could not make this change in the final rule but has allowed the owner of a trawl catcher vessel to submit a letter of request to NMFS under an interim policy. Under this agreement, vessel owners were required to pay their share of the observer fee liability for landings subject to the observer fee, because the fee assessment is could not be suspended without a regulatory amendment. In addition, owners of vessels complied with full observer coverage requirements and paid the per day cost to procured observer coverage from a permitted observer provider. Not all participants in the BSAI trawl limited access fisheries have or are expected to request full coverage. The Council took final action on this amendment in February 2016 and NMFS published the proposed rule in July 2016.

In general, this action would reduce the observer fees available to deploy observers in the partial coverage category. Analysts estimated that the activity of AFA volunteer CVs generated around $123,000 to $153,000 in fee payments during 2013 and 2014. Based on the daily cost cited above, those fees would have funded the purchase of 115 to 143 observer days per year. Since those volunteer vessels carried full observer coverage independent of the partial coverage category, those observer days were available to be deployed across other sectors of the partial coverage category. In 2013 and 2014, NMFS spent roughly $11.5 million in fee revenues and agency funds to purchase 10,816 observer coverage days. Those partial coverage fee remissions ($123,000 or $153,000 per year) would have made up a relatively small portion (approximately 2.4%) of the Observer Programs total annual budget for purchasing observer coverage days.

Information in the Observer Program 2014 Annual Report provides some information about the maximum amount of the reduction in the observer fee that could result from this action (NMFS 2015a). Table 2-4 in the 2014 Annual Report shows that BSAI trawl catcher vessels contributed $276,454 in observer fees for Pacific cod in 2014. This amount represented about 8% of the $3,458,716 collected overall in 2014. This represents a rough estimate of the maximum amount of reduction in observer fee liability because not all of the trawl catcher vessels in the BSAI Pacific cod fishery will choose to take full coverage. Thirty-one out of a total of 48 participants in the 2015 BSAI Pacific cod fishery opted for full coverage. This is a reduction from prior years (40 out of 53 in 2013 and 37 out of 48 in 2014). Although some vessels will move from partial to full coverage, this will not result in a significant reduction in the number of fishing trips subject to selection in the partial coverage category because many of these fishing trips have been out of the partial coverage sampling frame since 2013 under the interim policy that has allowed vessels to request full observer coverage.

Observer coverage requirements for trawl catcher vessels harvesting groundfish in the GOA

In October 2012, the Council initiated development of the “GOA trawl bycatch management” program, which was a proposed catch share program for trawl vessels that harvest groundfish in the GOA. The objective of the proposed action was to improve incentives for bycatch reduction and management in trawl fisheries, and to increase utilization of groundfish, provide additional flexibility to participants, and increase economic efficiency in the fisheries. Among many of the monitoring and management components of this proposed action was the requirement for 100% or full observer coverage for trawl catcher vessels harvesting groundfish in the GOA. The Council reviewed numerous discussion papers in 2013 and 2014 to further develop the elements and options for the proposed action. However, in December 2014, the Council suspended further analysis of this proposal and stated its intent to take up the issue no earlier than October 2015. In October, 2015, the Council discussed this proposed action and introduced a new alternative. The Council reviewed additional discussion papers in February and June 2016.

In February 2015, the Council tasked its staff to prepare a discussion paper that evaluates the effects of moving all GOA trawl vessels currently in the partial coverage category to the full observer coverage category. The Council requested that the paper address the effects on Observer Program fee revenues, industry costs, and the availability of observers in the full coverage category.

Movement of all trawl catcher vessels that fish in the GOA would create a significant modification to the Observer Program and would impact costs to industry, observer fee liability, and the number and type of fishing trips subject to observer coverage in the partial coverage category. Table 2-3 in the Observer Program 2014 Annual Report shows that GOA trawl catcher vessels contributed $874,919 of the total 2014 observer fee receipts of $3,458,716, which was about 25% of the total. The total days fished by catcher vessels using trawl gear in the GOA in 2014 was about 5,300 days. These days represent about 22% of the total number of days fished by vessels in the trip and vessel selection pools in 2014 (5,300 days/24,575 days, see Table 11 and Figure 29).

The Council reviewed this discussion paper in October 2015 and took no further action to move forward with this proposal independent of the GOA rationalization program. Current regulations are designed to place all catcher vessels in a catch share program with transferable PSC in full coverage. The Council’s proposal for full coverage for GOA trawl catcher vessels as part of a rationalization program is consistent with this approach. However, if the Council were to move forward with full coverage for GOA trawl catcher vessels independent of a rationalization program with transferable PSC, this would represent a change in one of the primary guidelines for placement of vessels in full versus partial coverage. Such an action likely would require examination of whether the rationale that applies to full coverage for GOA trawl catcher vessels should also be considered in analysis if this proposal is further considered in the future.

Observer coverage requirements for vessels delivering to tenders

Tender vessels are vessels that receive catch from catcher vessels and deliver it to a processing plant. NMFS and the Council have identified two potential data quality issues with catcher vessels delivering to tenders: 1) a possible bias in the data, and 2) a decrease in stock-of-origin genetic data for salmon. The potential for data bias was noted by NMFS in June 2013, because it appeared that vessels selected for observer coverage were taking shorter trips than vessels not selected for observer coverage. This could introduce bias if the information collected from observed trips does not represent the fishing activities of all fishing trips. In June 2014, NMFS evaluated a full year of fishing under the restructured Observer Program and analysis of trip length for vessels in the trip selection pool delivering to tenders did not show a systematic difference in trip length between observed and unobserved vessels. However, the small number of observed trips in 2013 for vessels delivering to tenders may be insufficient to clearly capture any differences in trip length. Analysis of observer coverage on vessels delivering to tenders was included in the 2014 and 2015 annual reports presented to the Council at the June meetings in 2015 and 2016. The analysis of 2014 data found no differences in NMFS areas visited during a trip, trip duration, the total weight of landed catch, or the number of species in the landed catch for observed vs. un-observed tendered trips. The analysis did, however, indicate a difference in vessel length and the proportion of the predominant species in the landed catch for observed and unobserved vessels delivering to tenders. Observed vessels delivering to tenders were 8.8% shorter than unobserved vessels delivering to tenders. The landed catch by observed vessels delivering to tenders was 6% less “purely the predominant species” than landed catch by unobserved vessels delivering to tenders. The conclusions presented in 2016 from the analysis of data collected in 2015 identified that there was a difference between tendered and non-tendered trips, and that there was only some evidence on an observer effect within the trips delivered to tenders in 2015. Observed trips in the small vessel trip-selection stratum that delivered to tenders landed catch with 24.7% fewer species than unobserved trips that delivered to tenders. Observed trips in the large vessel trip selection stratum that delivered to tenders were 50.8% shorter than unobserved trips that delivered to tenders.

The second issue of concern with tender deliveries is that observers on catcher vessels must follow different sampling protocols when vessels deliver to a tender, as opposed to when vessels deliver to a shoreside processing plant. The Council has specifically placed a high priority on genetic sampling of salmon intercepted in pollock fisheries. When vessels targeting GOA pollock deliver to a tender, the observer does not have the opportunity to census the offload to account for all the salmon that might have been caught, and then take systematic genetic samples. As pollock deliveries to tenders represent a significant portion of pollock deliveries in some areas of the GOA, this may create a gap in the analysis of the genetic stock composition of GOA salmon bycatch.

Allowing the deployment of observers from or on tenders would add a significant new component to the Observer Program. It would bring tender vessels into the Observer Program for the first time. Deploying observers from tender vessels would require the transfer of observers at sea, which raises safety concerns. It would impose additional costs and restrictions on tender vessels. It might also result in some vessels no longer being able to tender groundfish which could, in turn, affect shoreside processors. These and other logistical and administrative aspects of deployment of observers from or on tenders will need to be addressed in a thorough analysis.

The proposal to deploy observers from or on tenders would not have any effect on the amount of observer fees collected because it would not change which observer coverage category the landings are made in. It would likely impact the number of observer days needed to deploy observers on selected trips. The impact on the cost of deploying observers in the partial coverage category will depend on whether deploying observers on or from tenders increases efficiencies thereby possibly reducing costs or adds new cost components to the program due to more complex deployment logistics. These impacts would need to be to be explored in more detail in the analysis.

The Council reviewed additional analysis of this issue in the 2015 Observer Program annual report presented at its June 2016 meeting and recommended that further analysis of this issue be included in the development of the 2017 Annual Deployment Plan and that future action be evaluated in October 2016. This issue would be impacted by decisions made by the Council on the Gulf Trawl Bycatch Management action. If full observer coverage were required for all trawl vessels in the GOA, the concern about data quality would be addressed, but the issue of less genetic sampling would not be addressed.

Charter Recreational Quota Entity

At its April 2016 meeting, the Council reviewed an initial draft analysis for management measures that would apply exclusively to the guided angler sport (charter) halibut fisheries and commercial halibut setline fisheries in International Pacific Halibut Commission (IPHC) Regulatory Areas 2C and 3A in the Gulf of Alaska (GOA). The measures under consideration would allow a recreational quota entity (RQE) (or entities) to be established to represent the charter sector in the acquisition of commercial halibut quota share (QS), which could augment management measures annually recommended by the Council, approved by the IPHC, and implemented by NMFS through Federal regulations.

Catcher vessels participating in the commercial halibut IFQ fishery are in the partial coverage observer category where landings made by these vessels are subject to the observer fee to fund observer deployment in this coverage category. The proposed RQE raises a two-part question with regard to observer coverage and fees: 1) How much observer fee liability would be foregone if halibut IFQ were used in the halibut charter sector rather than the commercial halibut IFQ sector? 2) How would the proposed RQE change the demand for the number of observer-days in the partial coverage fleet? The Analysis prepared for the April 2016 meeting included several examples of potential impacts on the observer program depending upon the type of QS and the transfer restrictions chosen as part of the preferred alternative. Overall, the various scenarios could result in a negative impact, where more fee liability is removed than demand for observer days, or a positive impact where, more demand for observer days is removed than fee liability.

The RQE committee reviewed the draft analysis and discussion of the potential impacts on the Observer Program and though the committee understands there is no mechanism currently in place to allow for the transfer of observer coverage fees that might be displaced from the program and other administrative costs that may be created. With the intention of the keeping the program cost neutral for other sectors, the committee identified a desire to have an RQE absorb these fees, if there is a way to make the fees collectable. This recommendation was supported in the Council’s motion on the draft Analysis.

5 Regulatory impact review

This Regulatory Impact Review (RIR) examines the benefits and costs of a proposed FMP and regulatory amendment that would establish electronic monitoring (EM) as a part of the North Pacific Fishery Management Council (Council)'s fisheries research plan for the fixed gear groundfish and halibut fisheries of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). The Council's fisheries research plan is implemented by the North Pacific Observer Program at the National Marine Fisheries Service (NMFS)'s Alaska Fisheries Science Center, and its purpose is to collect data necessary for the conservation, management, and scientific understanding of the groundfish and halibut fisheries off Alaska. This document analyzes alternatives that would allow an EM system, which consists of a control center to manage the data collection, connected to an array of peripheral components including digital cameras, gear sensors, and a global positioning system (GPS) receiver, onboard vessels to monitor the harvest and discard of fish and other incidental catch at sea, as a supplement to existing human observer coverage. The alternatives under consideration are further described in Chapter 2.

The preparation of an RIR is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735: October 4, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and Benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nonetheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

E.O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A "significant regulatory action" is one that is likely to:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

5.1 Statutory authority

Under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. 1801, *et seq*.), the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the Council has the responsibility for preparing fishery management plans (FMPs) and FMP amendments for the marine fisheries that require conservation and management, and for submitting its recommendations to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The groundfish fisheries in the EEZ off Alaska are managed under the respective FMPs for Groundfish of the GOA and BSAI, and the halibut fishery is managed under regulations promulgated in accordance with the Northern Pacific Halibut Act. The proposed action under consideration would amend these FMPs and Federal regulations at 50 CFR 679 and 50 CFR 300 Subpart E. Actions taken to amend FMPs or implement other regulations governing these fisheries must meet the requirements of Federal law and regulations.

5.2 Purpose and need for action

In February 2016, the Council adopted the following statement of purpose and need:

> *To carry out their responsibilities for conserving and managing groundfish resources, the Council and NMFS must have high quality, timely, and cost-effective data to support management and scientific information needs. In part, this information is collected through a comprehensive fishery monitoring program for the groundfish and halibut fisheries off Alaska, with the goals of verifying catch composition and quantity, including of those species discarded at sea, and collecting biological information on marine resources. While a large component of this monitoring program relies on the use of human observers, the Council and NMFS have been on the path of integrating technology into our fisheries monitoring systems for many years, with electronic reporting systems in place, and operational EM in a compliance capacity in some fisheries. More recently, research and development has focused on being able to use EM as a direct catch estimation tool in fixed gear fisheries.*
>
> *The fixed gear fisheries are diverse in their fishing practices and vessel and operational characteristics, and they operate over a large and frequently remote geographical distribution. The Council recognizes the benefit of having access to an assorted set of monitoring tools in order to be able to balance the need for high-quality data with the costs of monitoring and the ability of fishery participants, particularly those on small vessels, to accommodate human observers onboard. EM technology has the potential to allow discard estimation of fish, including halibut PSC and mortality of seabirds, onboard vessels that have difficulty carrying an observer or where deploying an observer is impracticable. EM technology may also reduce economic, operational and/or social costs associated with deploying human observers throughout coastal Alaska. Through the use of EM, it may be possible to affordably obtain at-sea data from a broader cross-section of the fixed gear groundfish and halibut fleet.*
>
> *The integration of EM into the Council's fishery research plan is not intended to supplant the need for human observers. There is a continuing need for human observers as part of the monitoring suite, and there will continue to be human observer coverage at some level in the fixed gear fisheries, to provide data that cannot be collected via EM (e.g., biological samples).*
>
> *The Council and NMFS have considerable annual flexibility to provide observer coverage to respond to the scientific and management needs of the fisheries. By integrating EM as a tool in the fisheries monitoring suite, the Council seeks to preserve and increase this flexibility. Regulatory change is needed to specify vessel operator responsibilities for using EM technologies, after which the Council and NMFS will be able to deploy human observer and EM monitoring tools tailored to the needs of different fishery sectors through the Annual Deployment Plan.*

5.3 Alternatives

In February 2016, the Council adopted the following alternatives to be analyzed as part of the Council's EM Integration analysis.

Alternative 1: No Action - EM is not a tool in the Council's Research Plan

Alternative 2: Allow use of EM for catch estimation on vessels in the EM selection pool

Option: Require full retention of ~~key~~ rockfish[21] species with associated dockside monitoring

Alternative 3: Allow use of EM for compliance monitoring of vessel operator logbooks used for catch estimation

Alternative 1

Under the No Action, or status quo, alternative, at-sea fisheries monitoring in the partial coverage category is accomplished with a human observer pool, through a flexible deployment plan that allows the Council and NMFS to make annual policy choices on which vessels are monitored in different selection pools, and the selection rates assigned to each pool. In 2015 and 2016, the Council has authorized a select number of hook-and-line and pot catcher vessels to be included in the zero selection pool for human observers, while these vessels are testing the feasibility of using EM for at-sea fisheries monitoring. While the at-sea data collected from these vessels have been important for developing the EM program, it has not been used for managing the fishery. Under the status quo, the industry observer fee that is assessed in partial coverage fisheries, 1.25 percent of the ex-vessel value of all landings to support at-sea monitoring, can only be used to fund the human observer program.

Alternative 2

Alternative 2 would integrate EM into the Observer Program to allow EM to be used in addition to human observers for the purpose of monitoring at-sea fixed gear groundfish and halibut fishing activity in the partial coverage category of the Observer Program. The implementation of Alternative 2 would bring EM as an option into the process by which the Council and NMFS make annual policy choices on which vessels are monitored in different selection pools, and the level of monitoring required for each pool.

The integration of EM into the Observer Program would mean that NMFS would enfold EM into their Observer Program infrastructure, management, and oversight, including the annual process of developing the Annual Deployment Plan (ADP) and evaluating the monitoring program through the Annual Report. The reviewed EM at-sea data would be used in catch estimation for NMFS' catch accounting and fishery management.

Regulatory changes under this alternative include identifying the process by which fixed gear vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool. The regulations will direct each vessel operator to comply with a Vessel Monitoring Plan that specifically tailors the requirements to the vessel's unique characteristics.

On an annual basis, the Council and NMFS will determine what deployment model is appropriate for the EM selection pool or pools through the Annual Deployment Plan (ADP). Annual decision points may include whether there is to be an EM selection pool, and if so, the fisheries, gear or operational types, or vessel sizes in the EM selection pool, the EM selection rate and selection mode, and primary service ports for EM. An important part of this annual process would be the allocation of the available budget between human observer deployment and EM deployment.

[21] Note, in the Alternative 2 Option, it is the suggestion of the EM Workgroup to replace the word "key" with "rockfish", as it more accurately reflects the intent of the option.

Under this alternative, NMFS will set up a contract or grant with one or multiple EM service providers to install and service EM equipment, and to collect and review EM data. The contract or grant will specify hardware and field service specifications, and EM data review (both as to timeliness and specificity) and archiving requirements. Because a contract is likely to be for multiple years, and some of the deployment decisions have a significant impact on EM provider costs (for example, the number and location of primary service ports), there may be some deployment decisions that are made on a multi-year cycle consistent with the EM contract, rather than varying annually in the ADP. This analysis anticipates that the EM system will change over time, as technological improvements are made.

Under Alternative 2, the Council would incorporate EM as a monitoring option in the Council's "fisheries research plan", which is how the Magnuson-Stevens Act refers to the Observer Program. The Council's groundfish FMPs would be amended to reflect the inclusion of EM. As a result, the industry observer fee could be used to pay for at-sea monitoring either through EM or human observers.

Alternative 3

Under Alternative 3, all vessel operators in the EM selection pool would be required to complete a logbook of discarded target species and key bycatch species of concern. For rockfish species, where species identification can be challenging, full retention of all species would be required. All other incidental species would be estimated from the EM video audit and/or from the human observer strata. Vessel operators would be required to log and retain the following species:

EM Program Requirements:	Longline	Pot
Require operators to log all discards of:	halibut, sablefish, Pacific cod, and sculpins	Pacific cod, octopus, crab, and sculpins
Require EM vessels to retain for dockside monitoring:	all rockfish	
Other requirements:	logging of all seabird interactions	

All vessels would carry EM systems, and to verify the accuracy of the logbooks, a review of the footage from EM cameras would be used to audit the operator logbooks. The exact amount could be specified annually in the ADP based on available budget, but in keeping with similar programs elsewhere, might begin at a threshold of 10 to 20 percent.

The regulations would prohibit falsifying the logbook data. If the logbook is found to be inaccurate, based on the EM audit, then that may result in a violation. As with Alternative 2, the regulations would identify the process by which vessels could opt to be in the EM selection pool versus the human observer pool. The regulations would also specify the responsibilities of vessel operators while participating in the EM selection pool, in terms of completing the logbook, installation and maintenance of the EM system, catch handling requirements, and what happens in case of EM system failure. It would be regulated that each vessel operator must comply with a Vessel Monitoring Plan designed specifically for his or her vessel.

On an annual basis, the Council and NMFS would determine whether to allow an EM option in the ADP, and vessel operators would be able to opt into the EM pool. NMFS would set up a contract with an EM service provider to install and service the EM systems, and audit the logbooks against EM data. As the Council and NMFS have not yet tested the logbook model in the Alaska fisheries, some cooperative research would be necessary to develop an appropriate EM logbook. Once it is part of the Council's "fisheries research plan", the logbook/EM system could be funded through the industry observer fee.

Options

Under Alternative 2, the analysis includes an option to require retention of all rockfish species by vessels when using EM. Current regulations require discard over maximum retainable amounts (MRAs) when an allocated species is closed to directed fishing (bycatch status)[22], or discard of any amount of the species once it is placed on prohibited species status. While EM studies to date have shown that in most cases, it is possible to identify fish to the species or species complex required for management, there are some rockfish species groupings that are difficult to distinguish. Under this option, vessels that are using EM would be required to retain all rockfish, so that the rockfish could be speciated dockside once they are landed.

The EM Workgroup is also recommending that the Council add an additional regulatory option to this analysis, to allow vessel operators to retain IFQ or halibut CDQ exceeding the amount available in the individual area being fished if they are carrying *either* an observer *or EM* (see Section 2.5). As the Council has not yet taken action on this recommendation, it is not considered in the RIR.

5.4 Methodology for analysis of impacts

The evaluation of impacts in this analysis is designed to meet the requirement of E.O. 12866, which dictates that an RIR evaluate the costs and benefits of the alternatives, to include both quantifiable and qualitative considerations. Additionally, the analysis should provide information for decision makers "to maximize net benefits (including potential economic, environment, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach." The costs and benefits of this action with respect to these attributes are described in the sections that follow, comparing the No Action Alternative (Alternative 1) with the action alternatives. The analysts then provide a qualitative assessment of the net benefit to the Nation of each action alternative, as compared to Alternative 1.

This analysis was prepared using data from the NMFS catch accounting system (CAS) and from the Observer Program. CAS is the best available data to estimate total catch in the groundfish fisheries off Alaska. Total catch estimates are generated from information provided through a variety of required industry reports on harvest and at-sea discards, and data collected through an extensive fishery observer program. In 2003, NMFS changed the methodologies used to determine catch estimates from the NMFS blend database (1995 through 2002) to the CAS (2003 through present). Debriefed Observer Program data is entered into a database dataset that was developed for evaluation of observer deployment. This database combines data from the CAS, the AFSC Observer Program Database (NORPAC), and eLandings information to associate observer deployment strata and coverage with past fishing trips. That dataset includes data corresponding to the most recent full year of fishing (2015) in the partial-coverage strata of the 2016 ADP (broadly speaking these include: trawl, hook-and-line, and pot gear on vessels greater than 40 feet LOA). The Observer Program dataset is used in Section 5.6 of this document to describe patterns and geographical distribution of fixed-gear effort, and in Section 5.8 as the basis of trips and sea-days used to model the potential scope of an implemented EM stratum.

The CAS was implemented to better meet the increasing information needs of fisheries scientists and managers. Currently, CAS relies on data derived from a mixture of production and observer reports as the basis of the total catch estimates. The 2003 modifications in catch estimation included providing more frequent data summaries at finer spatial and fleet resolution, and the increased use of observer data. Redesigned observer program data collections were implemented in 2008, and include the recording of sample-specific information in lieu of pooled information, increased use of systematic sampling over

[22] The only exception to this is for incidental catch of demersal shelf rockfish (DSR) species in Southeast Outside waters (NMFS reporting area 650), where full retention of all DSR species in area 650 is required.

simple random and opportunistic sampling, and decreased reliance on observer computations. As a result of these modifications, NMFS is unable to recreate blend database estimates for total catch and retained catch after 2002. Therefore, NMFS is not able to reliably compare historical data from the blend database to the current catch accounting system. That limitation does not impact this analysis because, where fishery data is informative, this analysis focuses on the years under the restructured Observer Program (2013 through 2015). CAS data is provided through the Alaska Fisheries Information Network (AKFIN), which pulls together CAS data, Commercial Fisheries Entry Commission Fish Ticket data, and Commercial Operators Annual Report data to supply catch and discard records, as well as estimates of gross ex-vessel revenues.

Data on historical monitoring fee remittances by vessel gear/size category and by fishery are sourced from the Observer Program's 2014 and 2015 Annual Reports (NMFS 2015b, and NMFS 2016). These reports also provide information on observer-days purchased, observer-days deployed, and spending on other essential program functions.

5.4.1 State of EM development for fixed-gear fisheries

The EM development work to date has focused on hook-and-line and pot catcher vessels over 40 feet length overall, using EM for catch estimation (as in Alternative 2). A robust pre-implementation program was implemented in 2016 for hook-and-line catcher vessels, and pilot testing for pot vessels. In 2017, further work has been proposed for both these sectors. Figure 3-7 identifies the different stages of EM technology that are currently being developed in the fixed gear sector in Alaska, and how far they are likely to have progressed in 2018. As a result, we can make more objective statements about the effect of operator responsibilities and the cost of running a program based on known EM fleet demographic characteristics for these fishery sectors. Also, because the over 40 foot vessels have been carrying observers, we can speak more clearly to the issue of vessels having difficult accommodating human observers, and to the potential impact on the Observer Program.

For vessels under 40 feet length overall, we are limited to discussing theoretical benefits and cost of getting more fishery data from these vessels from EM. Ex-vessel-based observer fees for the under 40 ft vessel category would not change under the proposed alternatives.

Development work to date has not focused on Alternative 3, the logbook audit approach, although EM systems would operate in a similar manner under this alternative. No work has yet been done in Alaska to develop appropriate EM logbooks designed to work with an EM audit system.

Figure 5-1 Anticipated stage of fixed gear EM deployment in Alaska, in 2018

	Fisheries	Technology
Proof of Concept	• <40 ft hook-and-line catcher vessels	• Automatic species identification through video review
Pilot Program		• Stereo cameras • E-logbooks
Operational Testing		• *Logbooks with EM audit (Alt 3)*
Pre-Implementation	• Pot catcher vessels	• Standard cameras for pot
Mature	• >40 ft hook-and-line catcher vessels	• Standard cameras for hook-and-line

5.4.2 Approach to Electronic Monitoring Cost Analysis

The purpose of an RIR, as defined by E.O. 12866, is to assess and describe the overall net benefits of a set of policy alternatives. This task requires the analysts to consider cost of all types. The full cost of integrating EM into the monitoring research plan is not limited to the dollar cost of purchasing and installing hardware, providing field services, training and employing video data reviewers, and administering the program. Non-monetary costs include impacts on vessels' and processors' business practices, and are generally denominated in time and satisfaction rather than in dollars. Those non-monetary costs are described in Section 5.7.4.2, and are considered when assessing stakeholder impacts and National net benefits at the programmatic level (Sections 5.8.2.3 and 5.8.5). The expense of EM, whether at the program level or on a per-vessel or per day basis, is an important factor in the Council's determination regarding net benefits, but it is only part of the equation. In selecting a preferred alternative, the Council will also consider cost effectiveness (i.e., costs in terms of what the program provides) and how well the alternative addresses the management issues identified in the purpose and need statement (Section 5.2). In other words, it is possible that the Council could recommend integrating EM even if its near-term monetary cost profile is higher than that of a program that only deploys human observers.

Having established that the monetary cost of using EM to collect fishery data is not the sole factor to be weighed against the benefits of an integrated monitoring strategy, it is still important to develop a framework for understanding EM's expense. The EM funding and cost landscape is complex, and the track record of such cost analyses is relatively short. The purpose of this section is to (1) identify those complexities, (2) characterize the limited extent to which results from previous EM cost studies inform decisions about Alaska's fixed-gear sector, and (3) outline the complementary approaches used in this analysis. This analysis does not seek to assign a dollar cost to an EM program of a given size and scope in any future year. Rather, it uses the best available information on what the Alaska fixed-gear EM program costs, in its present state, to establish a baseline for the ongoing deployment decision-making process over the life of the program. Building off of that exercise, the analysis describes how each cost factor is likely to evolve, or "behave," as a function of time and of program design choices.

One level of complexity in describing the cost of EM stems from budget, and whether expenditures deploying EM are viewed as a constraint (i.e., the program's scope is confined by a spending limit) or as a measure of the program's impact on other monitoring capabilities (i.e., high EM costs could affect monitoring in the non-EM strata). The likely answer is both – that the EM program's annual deployment design will be dictated by available funding and by the demand for observer-days to meet sampling needs in other strata. Moreover, some program functions are funded by monitoring fees levied on fishery participants, while others are funded through NMFS's operating budget.[23] Funds are a scarce resource, so expenditures on EM deployment have downstream effects regardless of the funding source. However, the specific impact of spending on a given EM component is determined by the source of funding. Use of the monitoring fees can affect the available budget to purchase human observer-days. Use of NMFS funds affects the agency's ability to carry out other essential management functions.

A second level of complexity in costs stems from the fact that the price of EM services and components will change over time ("cost trajectory"). Some cost factors are weighted towards the early years of the program. Those costs can be generally categorized as "capacity building" activities. In terms of the provider's activity, capacity building is usually in the form of increased travel and labor costs spent working with the fleet and training local technicians.[24] Those costs fall into the category of tasks funded through the observer fee. At the moment of EM integration, the program's cost profile will have benefitted from the fact that some of those cost-intensive investments in human capital and program

[23] Table 3-1 in Section 3.2 lists the intended source of funds for each EM function, though the source of several cost-driving components (video review, data storage, and dockside monitoring) are listed as "to be determined."

[24] This analysis amortizes the price of EM hardware components down to an annual cost. Building capacity during the pre-implementation phase by purchasing hardware components enhances the program by getting vessels ready to deploy, but the trajectory of hardware costs over time should be relatively stable (aside from the effect of competition on price levels) and should mainly scale according to the number of vessels in the EM stratum.

infrastructure occurred prior to the point when field services begin being debited against the Observer Program's fee-based budget for monitoring. Other cost factors could decrease over time, either as a result of capacity building (e.g., fewer field services required) or of competition and technological development (e.g. the cost of new hardware or video review time decreases). In terms of the agency's work, capacity building could include fleet outreach and database redevelopment to translate EM data into the management stream. Those costs are, and will continue to be, funded through NMFS operating budget.

A third level of complexity in costs stems from the fact that the size, scope, and nature of the EM program in any given post-implementation year has not been determined yet, nor is it meant to have been ("cost uncertainty"). The action alternatives would establish a process under which deployment decisions that affect costs are made annually. The EM stratum is intended to be an option for vessel operators, thus the number of vessels in the stratum, their distribution across delivery ports, and the number of trips they make each year will likely vary on an annual basis. The scope of the program could vary in terms of how many ports are staffed with local technicians, and how many rely on either fly-out service or require vessels to commute to service hubs. The provision of port service infrastructure is a function of available EM funds and the demographics of the EM stratum, and is also a determinant of program costs. The nature of the program could vary over a range of policy decisions regarding data objectives, deployment models (e.g., vessel vs. trip selection; selection rates), and operator responsibilities, to name only a few. The cost of the program would be different depending on how much video from each selected trip must be reviewed, or how often control centers need to be rotated between vessels (again citing only a few examples). These decisions will be based on both scientific standards and budget constraints. Section 5.7.4 goes into greater detail on the uncertainty and trajectory aspects of each major cost-driving category (hardware, field service, data analysis, and program administration).

The cost of EM programs in other regions have typically been assessed in terms of how much the program costs per vessel, per trip, or per monitored sea-day ("unit costs"). Unit costs are a useful metric for tracking the cost of a given EM program over the course of time. By distilling a complex program with multiple cost drivers and funding sources down to a single number, unit cost estimates tend to conflate fixed and variable costs (thus failing to capture the trajectory of cost over time) and are inherently a function of regional- or program-specific design features. For these reasons, the analysts are hesitant to rely on them as a tool to compare EM's cost *effectiveness* across regions or against human observer programs.[25] This document cites other unitized program costs in Section 5.8.2.1, but notes that those programs operate in very different geographical contexts, serve gear sectors that call for different video review protocols (e.g., trawl versus pot or hook-and-line), and have data objectives that could differ from the selected approach for the Alaska fixed-gear program (e.g., logbook audit vs. catch estimation).

Acknowledging the limitations to projecting accurate EM costs for a given deployment design in a given future year, the objectives of this RIR as it relates to monetary-cost analysis include the following:

- Define key cost drivers; describe how those drivers affect the program's total cost profile, contingent on factors that are expected to vary over time or are contingent on program design choices that are yet to be made (Section 5.7.4);
- Estimate the unit cost of deploying EM in 2016, recognizing (1) that these figures reflect a research-oriented program that does not cover the pot gear sector or the fleet of vessels that is less than 40' LOA, and (2) that these estimates provide a useful baseline to track Alaska hook-and-line EM costs over time, but have limited value for comparison to EM unit costs in other regions (Section 5.8.2.1);
- Characterize the trade-offs in EM services that can be provided under various budget constraints, where "budget" is defined as the portion of the monitoring fee pool that would otherwise be used

[25] In the language of the program evaluation field of economics, one might say that unitized costs of an entire EM program have low "external validity."

to purchase human observer-days for the partial coverage category and link expenditures of the monitoring fee-base on EM to the Observer Program's need for – and ability to purchase – observer-days (Section 5.8.2.2);

5.5 Description of fisheries

Vessels that possess a Federal Fisheries Permit (FFP) must comply with Observer Program regulations when fishing in Federal waters off Alaska or in state-waters when prosecuting fisheries that are under parallel management. The Observer Program complies with the Magnuson-Stevens Act requirement that the program gather reliable data by stationing observers on all or a statistically reliable sample of fishing vessels and processors necessary for conservation, management, and scientific understanding of the fisheries covered by the fisheries research plan (16 U.S.C. 1862(b)(1)(A)).

The current Observer Program structure was implemented in 2013 when the previous Observer Program was restructured to address sampling issues associated with non-random observer deployment on some vessels and fisheries.[26] The restructured program has reduced statistical bias and increased the reliability of catch and bycatch data, reduced data gaps in certain sectors and geographical areas, allowed NMFS to collect data from groundfish and halibut vessels of between 40' and 60' LOA, provided mechanisms to target observer coverage annually to address data needs, and distributed the cost of monitoring more equally across vessel operators (also discussed in Section 4.1). These improvements underline the importance of maintaining monitoring coverage in all statistical areas. If EM is integrated into the overall monitoring plan, it will remain important to have human observers deployed across all areas where biological samples that cannot be collected by video can be obtained.

5.5.1 Definitions, Processes, and NMFS Management Activities

All vessels and processors in the groundfish and halibut fisheries off Alaska are assigned for observer coverage to either the full coverage category, or the partial coverage category. Catcher/processors, motherships, and catcher vessels that are participating in a catch share program that has transferable prohibited species catch (PSC) allocations are placed in the full coverage category by definition.[27] While it is a catch share program, catcher vessels participating in the halibut and sablefish program are not in the full coverage category because they are not issued transferrable PSC allocations. The partial coverage category for groundfish is defined in regulation as all fisheries that are not in full coverage. All of the vessels that could opt into the EM strata that is defined by this action are in the partial coverage category.

In the partial coverage category, NMFS has the flexibility to deploy observers when and where they are needed based on an annual deployment plan (ADP) developed in consultation with the Council. The draft ADP for the upcoming year is typically presented to the Council at the October meeting, and describes how NMFS plans to deploy observers to vessels in order to meet scientifically based catch estimation needs, while accommodating the realities of a dynamic fiscal environment; the ADP is finalized in December of each year. NMFS's goal is to achieve a representative sample of fishing events. The annual planning and reporting process is described in Section 1.2 of the 2015 Observer Program Annual Report (NMFS 2016).

At-sea monitoring within the partial coverage category is governed by random selection of fishing trips. The probability of a trip being selected for at-sea monitoring depends on the selection pool (stratum) to which a vessel is assigned. Vessels log their planned fishing trips into the Observer Declare and Deploy System (ODDS) prior to embarking. If selected, the trip must carry an observer. The 2016 ADP defines

[26] The final rule for BSAI/GOA FMP Amendments 86/76 was published in the Federal Register on November 21, 2012 (77 FR 70062).
[27] The Council recently took action to recommend that BSAI trawl catcher vessels may voluntarily opt into the full coverage category for all of their BSAI trawl activity.

selection strata by gear type (NMFS 2015). There are different strata for trawl, hook-and-line, and pot gear. The 2016 selection probabilities are 28% for trawl vessels, 15% for hook-and-line vessels, and 15% for pot vessels. Prior to 2016, strata were defined according to a combination of factors including both vessel size and gear. Any vessel of less than 40' LOA is in the "No Selection Pool", meaning that it will not be selected to carry an observer but will pay the required monitoring fees. By virtue of their participation in the EM Pre-Implementation program, fixed-gear vessels that have opted into the EM pool are also in the "No Selection Pool" for 2016.

The 2016 ADP lists the *anticipated* number of trips that will be observed in each strata based on the budget available to purchase observer days, projected fishing effort in each strata, and the need to capture adequate data from all fisheries and areas in the partial coverage category. Table 1 (p.13) of the 2016 ADP states that the 2016 program expects to place observers on 644 trawl trips, 428 hook-and-line trips, and 191 pot trips (NMFS 2015). The projected budget for 2016 observer deployment was set at approximately $4.5 million, of which $3.9 million was projected revenue from fees collected from the 2015 fishing year; the balance of funds would be a combination of budget carried over from the 2015 year and NMFS Federal funds. According to the 2015 Observer Program Annual Report, the amount of fees collected from the 2015 fishing year came in at $3,775,956, slightly below the estimate of $3.9 million. Further information on fees collected is provided in Section 5.5.2.

Table 5-1 summarizes fishing activity and observer selection in the 2015 partial coverage category. The information is broken out by gear type, vessel size, and management area (GOA/BSAI). The vessel size categories are defined to match the Council's current priority for EM development (40' to 57.5' LOA), and size categories that could potentially enter the EM pool under future ADPs after the EM stratum is fully integrated into the partial coverage category (<40' LOA).

Table 5-1 2015 partial coverage category vessel count, trips, and observer coverage, by gear type and FMP area

Gear	Area	Vessel Size	# Vessels	# Trips	# Observed Trips	% Observed
LL	GOA	< 40'	333	1,431	0	0%
		40' - 57.5'	337	1,854	202	11%
		> 57.5'	167	1,040	238	23%
	BSAI	< 40'	64	476	0	0%
		40' - 57.5'	25	128	9	7%
		> 57.5'	44	154	30	19%
POT	GOA	< 40'	1	C	0	0%
		40' - 57.5'	15	150	27	18%
		> 57.5'	59	587	139	24%
	BSAI	40' - 57.5'	3	28	4	14%
		> 57.5'	43	450	99	22%
TRAWL	GOA	> 57.5'	68	2,239	538	24%
	BSAI	> 57.5'	22	228	57	25%

Source: Observer Program Annual Report, 2015 (NMFS, 2016)

Table 5-2 and Table 5-3 show the distribution of hook-and-line and pot trips in the partial coverage category across landing ports, and the percentage of those trips that carried an observer. The communities at the bottom of each table are ports where a small number of trips occurred in at least one year (three or fewer in all cases), but none carried an observer. This information is useful for understanding the geographic distribution of the Observer Program's deployment effort, which is a key component of program costs. These tables are limited to the 40’ to 57.5’ LOA vessel size category, as that is the focus of the developing EM program that needs a basis for comparison. Vessels less than 40’ LOA did not have any trips selected for coverage. Information on the geographic distribution of other size categories’ effort is provided in Section 5.6.1. These tables identify the key ports for each gear sector, and provide a basis for the decision to focus EM field services in selected locations.

Table 5-2 Shoreside hook-and-line CVs (40’ – 57.5’ LOA): percentage of trips observed, by port (2013 through 2015)

	2013		2014		2015	
	Total Trips	% Observed	Total Trips	% Observed	Total Trips	% Observed
Kodiak	411	12.9%	428	20.6%	454	12.1%
Sitka	354	4.5%	336	12.2%	359	13.1%
Seward	255	10.6%	195	10.8%	311	9.0%
Homer	206	4.4%	174	13.2%	154	5.8%
Juneau	137	3.6%	125	13.6%	142	9.2%
Dutch Harb.	133	3.8%	125	12.8%	65	6.2%
Petersburg	110	14.5%	110	11.8%	102	13.7%
Sand Point	117	5.1%	85	9.4%	62	9.7%
Wrangell	45	0.0%	49	12.2%	61	11.5%
Cordova	44	0.0%	42	2.4%	32	6.3%
Whittier	20	5.0%	22	4.5%	65	15.4%
Adak	56	1.8%	25	32.0%	25	8.0%
Yakutat	38	2.6%	31	19.4%	36	8.3%
Hoonah	30	0.0%	26	11.5%	24	4.2%
King Cove	32	3.1%	16	0.0%	24	4.2%
Ketchikan	21	4.8%	21	4.8%	20	5.0%
Akutan	18	27.8%	16	50.0%	18	0.0%
Atka	14	0.0%	23	47.8%	14	7.1%
Craig	18	0.0%	15	20.0%	17	0.0%
Alitak Bay	21	0.0%	20	50.0%	8	0.0%
St. Paul	20	0.0%	6	0.0%	9	11.1%
False Pass	8	0.0%	11	18.2%	9	11.1%
Port Alexander	3	0.0%	6	50.0%	3	66.7%
Other AK	2	50.0%	3	66.7%	4	25.0%
Valdez	3	0.0%	1	100.0%	2	0.0%
Bellingham Elfin Cove Kenai Nome Port Protection Port Armstrong	No observed trips					

Source: NMFS Observer Program

Table 5-3 Shoreside pot gear CVs (40' – 57.5' LOA): percentage of trips observed, by port (2013 through 2015)

	2013		2014		2015	
	Total Trips	% Observed	Total Trips	% Observed	Total Trips	% Observed
King Cove	68	0.0%	87	13.8%	68	10.3%
Kodiak	21	0.0%	12	33.3%	30	43.3%
Sand Point	7	0.0%	17	35.3%	29	10.3%
Dutch Harb.	2	0.0%	22	0.0%	21	4.8%
Homer	8	0.0%	15	0.0%	20	20.0%
Akutan			9	100.0%	7	42.9%
IFP	4	100.0%				
False Pass	No observed trips					

Source: NMFS Observer Program
IFP = Inshore Floating Processor

NMFS staff provides essential services that support the Observer Program. These services are not funded through industry monitoring fees, and are not invoiced by the contracted observer provider. In addition to funding and labor that supports the developing EM program, NMFS Fisheries Monitoring and Analysis division (FMA) spends its budget on data analysis, application development (e.g., ODDS), observer training and curriculum development, observer briefing, debriefing and quality control, observer gear inventories, divisions leadership and coordination, and field offices in Anchorage, Kodiak, and Dutch Harbor. These programmatic costs are detailed in Section 2.3 of the 2015 Annual Report (NMFS 2016, p.23). As noted above, FMA has also supplied supplementary funds for observer deployment in the partial coverage category ($2,700,232 in 2015).

Table 5-4 summarizes the FMA division's inflow and outflow of funds for the 2014 and 2015 Observer Program, and what the program purchased in terms of observer-days and other support activities. The division's total annual budget covers operations, observer training, equipment, personnel, and, in recent years, support for the development of EM.[28] Observer-days for the partial coverage category are purchased with a combination of industry monitoring fees collected in the previous year and NMFS Federal funds, though nothing guarantees that supplemental Federal funds will be available in future years. Those Federal funds are not coming out of the FMA division operating budget. The lower panel of Table 5-4 provides a sense of the scope support services that FMA provides, including training programs in Seattle, WA, and briefing/debriefing in Anchorage, Seattle, and Dutch Harbor. New observers complete a 120 hour training course, and returning observers complete a four day refresher course. Prior to deployments, observers attend one, two, or four day briefings depending on their individual needs. After each deployment, observers are debriefed by FMA staff to review sampling and data recording methods and to finalize the data from that deployment. FMA staff also conducts mid-cruise debriefings during an observer's first two deployments of the year. The mid-cruise debrief provides an opportunity to assess and improve data collection methods and to resolve challenges encountered in the field. No count of mid-cruise debriefings was tracked in 2014, but in 2015 FMA staff completed a total of 312 in Dutch Harbor, Kodiak, Anchorage, and Seattle.

[28] FMA and NOAA's National Observer Program did expend funds on EM development in 2014. The table lists that data point as "Not Provided" because no amount was identified in the 2014 Annual Report for spending in the calendar year. Internal budget documents, which could not be included in this document, show proposals to receive funds for EM and related activities on a fiscal year basis, but the analysts are not able to determine how much was spent in 2014 and whether those funds were channeled through FMA or through another source.

Table 5-4 FMA division funds, fees, purchases, and other activities supporting the Observer Program in 2014 and 2015

		2014	2015
Budget	Annual FMA Budget	$7,181,607	$9,099,327
	Monitoring Fees Collected*	$3,775,956	$3,458,715
	Amt. Spent on Observer-Days	$4,937,414	$5,758,268
	Monitoring Fees	*$3,044,606*	*$3,058,036*
	Federal Funds	*$1,892,808*	*$2,700,232*
	Avg. Cost/Observer-Day	$1,067	$1,083
	Amt. Spent on EM	Not Provided	$1,153,618
Observer-Days (Partial Coverage Category)	Observer-Days Purchased	4,368	5,330
	Monitoring Fees	*2,596*	*2,976*
	Federal Funds	*1,772*	*2,354*
	Days Used**	4,573	5,318
	Days Carried to the Next Year	2,710	2,708
Other FMA Activities	# Observers Deployed (vessels & processors)	436	478
	# Observer Days (vessels & processors)***	44,178	46,640
	New Observers Trained	164	192
	Debriefings	669	802
	# FMA Debriefing Staff	24	25
	Mid-Cruise Debriefings	Not Provided	312

Source: 2014 and 2015 Observer Program Annual Reports and Annual Deployment Plans

* Monitoring fees collected in one year are applied to the budget for purchasing observer-days in the *following* year.
** Total budget of observer-days to deploy included both days purchased in that year and days carried over from the previous year.
*** Includes full coverage category.

5.5.2 Collection/Use of Fees for Monitoring

The first part of this section is an overview of the fees collected from industry to fund monitoring (observer coverage and, potentially, EM). The analysts provide summary information on fee collection in recent years, as well as spending on partial coverage observer-days. The second part summarizes how NMFS is authorized to collect monitoring fees and how the fee may be used, including recover costs for EM. The question of how fees may and will be used is critical to this analysis, because EM items and tasks that are funded by the fee are analogous to those covered under the contract with the partial coverage observer provider.

Fees and funding for observer coverage and EM

The fee system used in the restructured Observer Program follows MSA requirements. MSA Section 313(b)(2)(E) states that “any fee system shall be expressed as a fixed amount reflecting actual observer costs as described in subparagraph (A) or a percentage, not to exceed 2 percent, of the unprocessed ex-vessel value of the fish and shellfish harvested under the jurisdiction of the Council…” The fee system allows the observer coverage or electronic monitoring in the partial coverage category to be paid for by industry, and provides a consistent source of revenue directly linked to the value of the fishery. Through the fees, owners and operators compensate the Federal Government for some of the costs associated with managing fishery resources.

NMFS assesses a fee equal to 1.25% of the ex-vessel value of the landings of groundfish and halibut subject to the fee (§679.55). The fee applies regardless of whether a vessel or processor is selected to carry an observer. An ex-vessel-based fee is commensurate to each operator's ability to pay, and to the benefits he or she received from the fishery. Ex-vessel values are expected to fluctuate, as are annual harvest limits. The fee liability is intended to be split evenly between the harvesting vessel (0.625 percent) and the processor that receives the landing (0.625 percent).[29] The Council determined that the same fee percentage should apply to all sectors, as they all benefit from resulting observer data that is essential for conservation and management of the fisheries in which they participate.

The ex-vessel value of a vessel's catch, and thus the fee liability, is based on a standard measure. The value subject to the fee is determined by multiplying a standard price for groundfish by the round weight equivalent for each species and gear combination. Ex-vessel value is based on standard prices from prior years. The standard prices that will be used to determine 2016 liabilities are based on volume and value from 2012 through 2014. NMFS is not able to use a basis of actual ex-vessel prices at the time of the landing because (1) they are not always known or accurately reported on landings reports, (2) some prices are adjusted later in the season, (3) some processors and CVs do not have an independent relationship, and (4) it would be costly for NMFS to audit or investigate incidences of suspected inaccurate price reporting. In order to apply the most appropriate price to a landing, NMFS uses the standard price that reflects the location of the landing with the highest degree of precision. NMFS collects data at the port-level (e.g., Kodiak, Homer, or King Cove) and aggregates up to regulatory area, BSAI/GOA, state-level, or all ports including those outside Alaska, as is necessary to comply with confidentiality regulations. The standard groundfish prices for 2015 are listed on the Region's website, by species, gear type, and port/area group.[30]

Fee revenues constitute NMFS's monitoring budget, and determine the level of costs that could be incurred to deploy electronic monitoring systems in addition to observers. When determining the level of EM coverage needed in each impending year, NMFS will consider anticipated fee revenues and any surplus in the observer fund from previous years. NMFS will adjust observer and EM coverage levels to align anticipated costs with available revenue. Section 313(d) allows for the establishment of a Fishery Observer Fund that is available without appropriation or fiscal year limitation, and extra sums may be kept on deposit.

In 2013, NMFS used Federal start-up funds to transition from the model where industry contracted directly with observer providers to a model where NMFS contracts with an observer provider to deploy observers in partial coverage category sectors. The fact that NMFS has contributed Federal funds to pay for observer coverage in 2014 and 2015 allowed NMFS to carry over fee proceeds into 2016. However, Federal funds are subject to both Congressional appropriations and to NMFS's budget priorities; thus, Federal funds might not be available to supplementing industry fees in future years. Table 5-5 shows NMFS's annual budget for purchasing observer-days since the partial coverage category was implemented in 2013. The Observer Program faces future uncertainties when planning the budget for each year due to natural fluctuations in standard ex-vessel prices, and sequestration of a portion of the previous year's fee proceeds.[31]

[29] While this analysis assumes a 50/50 split of the partial coverage fee liability between harvesters and the processor, that arrangement cannot be confirmed through publicly available data. One might assume that processors are in a position to impose a greater share of the cost on harvesters, either through negotiated direct payment or through reduced ex-vessel payments, due to the inelastic nature of groundfish supply. On the other hand, one must also consider the fact that harvesters and processors develop relationships that span multiple years, and that onerous deals could drive deliveries to another plant.

[30] http://alaskafisheries.noaa.gov/sustainablefisheries/observers/2015standardprices.xlsx. Those standard prices are also noticed in the Federal Register at 78 FR 73842.

[31] The Office of Management and Budget sequesters a portion of fee proceeds each year, under the authority of the Budget Control Act of 2011. This introduces some uncertainty into the program's annual process, as roughly 7% of the previous year's fees are not disbursed to the program until some time in the summer ($306,000 in 2014, and $360,000 in 2015).

Table 5-5 Partial coverage category budget for purchasing observer-days, 2013 through 2016

Year	Budget $ million (fees + Federal funds)	Observer days
2013	$3.94 (Federal funds)*	3,533 (used)
2014	$6.14 ($4.25 + $1.89)	4,573 (used)
2015	$6.16 ($3.46 + $2.7)	5,318 (used)
2016	$5.02 ($3.78 + $1.28 carry over)	4,937 (projected)

*Only $2.1m was spent in 2013, the remainder was carried over to future years.

If fee proceeds do not sufficiently align with anticipated costs over a period of time, the Council could initiate a new regulatory amendment to increase the fee percentage up to a ceiling of 2% of ex-vessel value (again, based on the standard pricing methodology). In its final motion for the program restructuring action, the Council committed to reviewing the fee percentage after the second year of the program, based on information in the Annual Report. The Council explained that it may recommend revising the fee assessment percentage in the future through rulemaking after it had an opportunity to evaluate program revenues and costs, observer coverage levels, fishery management objectives, and future sampling and observer deployment plans.

Given the cost uncertainties association with integrating EM, the Council could consider increasing the fees up to 2% to ensure that funds are available to maintain observer coverage in the partial coverage category while also funding EM deployment on a portion of the partial coverage vessels. If, over time, EM proves to be extremely cost-effective and data collection objectives do not increase relative to the current monitoring plan, it is also possible that the Council could initiate an amendment to decrease the industry fee. The Council is scheduled to conduct a 5-year review of the restructured Observer Program, including the amount of the fee assessment, in 2018.

The Observer Program Annual Reports estimate the cost per day of placing an observer onboard a partial coverage vessel. According to the most recent Annual Report, NMFS spent $5,758,268 in 2015 to procure 5,318 observer days, yielding an average cost per sea-day of $1,083. Since 2013, the average cost has been $1,071 per day. That cost is a combination of a daily rate for the days that an observer is on a boat or at a shoreside processing plant, and reimbursable travel costs. The contractor must also recoup their total costs and profit through the daily rate, which includes the costs to the provider of days that observers are not deployed on a boat or at a plant. Those days include training, travel, debriefing, and days that an observer is deployed but not stationed on a boat or at a plant. The detailed cost breakdown between the daily rate and travel (or other costs) is confidential. NMFS notes that the average daily cost for partial coverage is on par with government-contracted rates in other regions, and that the average cost per day is likely to be stable over the next five years.

NMFS lists several factors that impact the cost of partial coverage as compared to the daily cost of full coverage, which is contracted directly between a vessel owner and the provider and tends to be lower. Those factors, also listed in Section 2.4.3 of the 2015 Annual Report (NMFS 2016, p.30), include the following: Federal contracts are subject to regulations that dictate wages, benefits, and overtime for observers; partial coverage observers deploy out of many remote port locations with higher travel and lodging costs; average trip duration in the partial coverage category is shorter and requires more travel in between vessel deployments; expenses incurred between deployments are subject to government travel regulations that include per diem rates that are paid regardless of actual expenses; and that partial coverage is inherently less efficient than full coverage, because the days on which observers are not deployed are expected but difficult to predict, thus, increasing uncertainty in the number of undeployed days for which the partial coverage provider has to recoup costs. NMFS has sought ways to achieve cost efficiencies in the partial coverage program; those are listed in Section 2.4.1 of the 2015 Annual Report (NMFS 2016, p.29).

As noted in Table 5-5, NMFS collected fees totaling $3.46 million in 2014 and $3.78 million across all partial coverage gear sectors and vessel size categories. Table 2-2 in both the 2014 and 2015 Annual Reports break this figure down by sector, size category, and catch species (NMFS 2015b, p.26; NMFS 2016, p.20). Table 5-6 summarizes those tables across all landed species groups. Drawing vessels counts from Table 5-11 and Table 5-12 in Section 5.6.1, the average annual fee liability on a per-vessel basis was around $2,000 to $2,400 for hook-and-line vessels and around $3,300 to $3,600 for pot vessels (again, noting that responsibility for the fee is shared between the vessel and the processor). This is obviously a rough measure, and differs greatly across vessel size categories due to the number of vessels in the fleet and their annual ex-vessel revenues. For hook-and-line gear, the Under-40' category remitted roughly $500 per vessel, the 40' to 57.5' category remitted around $2,000 per vessel, and the 58'+ category remitted around $6,200 per vessel. For pot gear, the 40' to 57.5' category remitted around $1,600 per vessel, and the 58'+ category remitted around $3,500 per vessel.[32]

Table 5-6 Monitoring fees collected in 2014 and 2015, by gear type and vessel size category (all areas)

Gear	Vessel Cat.	2014	2015
LL	< 40'	$229,767	$264,436
	40' - 57.5'	$636,828	$818,751
	> 57.5'	$1,014,575	$1,180,874
	LL subtotal	$1,881,171	$2,264,061
Pot	< 40'	$134	$165
	40' - 57.5'	$28,221	$31,151
	> 57.5'	$384,193	$337,558
	Pot subtotal	$412,548	$368,874
Jig		$7,545	$4,030
Trawl		$1,157,452	$1,138,991
Total		**$3,458,716**	**$3,775,956**

Source: 2014 and 2015 Observer Program Annual Reports

MSA authority for the Fisheries Research Plan and fee collection

Section 3.2 provides a detailed description of the limitations, under the Magnuson-Stevens Act, on the use of the fee, as well as the scope of tasks in partial coverage which are currently supported by the fee. Although there is broad authority under the Magnuson-Stevens Act to collect fees for costs associated with the Council's Fisheries Research Plan (as implemented through the Observer Program), NMFS does not intend to use fee proceeds to offset the government's contribution to the Research Plan, because it recognizes that fee proceeds are best used to procure and optimize the observer coverage or electronic monitoring needed in Alaska. In general, the activities that are essential functions, necessary to stationing EM systems and inputting collected data, can be separated into shoreside costs and at-sea costs. At-sea costs are conducted by a service provider and will be paid for using fees. These include providing, installing, and servicing EM equipment. Shoreside costs are paid by NMFS, or will be, and include development of an EM deployment plan and managing collected data. Some activities, such as video review (including data processing) and data storage would also be conducted by a service provider. These activities are part of "inputting collected data," and therefore *could* be paid for using fees. However, since

[32] Only one pot vessel of less than 40' LOA made landings in 2014 and 2015.

these costs are shoreside costs, they *could also* be paid for by NMFS. The source of funding for these activities has not yet been determined. These activities are described in detail in Table 3-1 in Section 3.2.

5.5.3 Observer Release Policy

Since the 2013 restructuring of the Observer Program, NMFS has worked with vessel operators to mitigate the impact of the program on vessels that were challenged to accommodate observers in terms of bunk space and life raft capacity. Prior to 2015, when the program shifted to a trip selection model for all strata, vessels could be released from observer selection if carrying an observer would displace a crew member or an IFQ holder. The 2015 Supplemental EA (NMFS 2015c) noted that some data quality issues arose in 2013 and 2014, at least partially due to the conditional release policy that resulted in some differences in the spatial distribution of observer coverage in what was then the vessel selection stratum.

The 2015 ADP shifted to a trip-selection model across all strata, allowing for a release from observer coverage on a vessel’s third consecutively-selected trip, and the bunk space conditional release policy was discontinued. The rationale was that in addition to the change to trip selection, the ADP included a new option for vessels to opt into the EM pool (zero observer selection probability). Vessels in the partial coverage category that had insufficient life raft capacity could still request a temporary exemption from the observer requirement. Beginning in 2016, the option of a life raft capacity exemption was removed as the size of the EM opt-in pool expanded. Currently, hook-and-line vessels between 40’ and 57.5’ LOA must either participate in the EM pool or be subject to trip selection, but can receive a conditional release on their third consecutively selected trip.

Understanding the history of observer release requests provides a baseline for the analysis of vessels that could be adversely impacted by selecting the status quo alternative (Alternative 1). Integrating EM into the Observer Program should, in theory, provide these vessels with an avenue to participate in the monitoring plan without displacing crew members. FMA staff report that the top six delivery ports for vessels that indicated difficulty in carrying an observer were Kodiak, Sitka, Seward, Dutch Harbor, Homer, and King Cove. These are, not surprisingly, among the top ports for the fixed-gear fleet.

Table 5-7 shows the number of vessels in each port that requested conditional releases or were granted temporary exemptions from 2013 through 2015. In 2013 and 2014, 137 vessels were released from taking observers in the vessel selection strata of the partial coverage category based on limited bunk space or life raft capacity. The majority of vessels requesting conditional releases were located in Southeast Alaska (62) with the largest number of requests coming from vessels in Sitka (38). Vessels in Homer and Seward requested 47 conditional releases.

In 2015, all vessels in the partial coverage category were moved into the trip selection model and required to log their fishing trips into ODDS. Conditional releases based on bunk space limitations were no longer granted with the option of opting into the EM strata or request a temporary exemption due to limited life raft capacity. At that time, 179 vessels in the 40’ to 57.5’ LOA size category were identified as eligible for either the EM cooperative research program or a temporary exemption based on the vessels’ previous crew history in 2013 and 2014. That year twelve vessels in the 40’ to 57.5’ LOA fleet participated in EM cooperative research (seven from Sitka, four from Homer, and one from Juneau), while five temporary exemptions were granted due to limited life raft capacity (Table 5-7).

In 2016, temporary exemptions were no longer granted, and vessels with life raft limitations were encouraged to volunteer for the EM stratum. Overall, only 25 of the 179 vessels that have requested a conditional release or a temporary exemption have participated in the EM program to date, indicating that most affected vessels either found a way to accommodate observers, or absorbed the impact of carrying an observer given the smaller expected proportion of a given vessel's fishing trips that would be selected for coverage under the trip selection model.

Table 5-7 Location of vessels granted conditional releases (CR), temporary exemptions (TE), or volunteering for electronic monitoring, 2013 through 2015

Port	CR/TE 2013 & 2014	TE 2015	EM 2015
Sitka	38	2	7
Ketchikan, Petersburg, Wrangell	15		
Haines, Juneau, Pelican	9		1
SE AK subtotal	*62*	*2*	*8*
Homer, Seward	47	1	4
Kodiak	9	1	
King Cove, Sand Point	7	1	
Dutch Harbor, Unalaska	6		
Anchorage, Whittier	3		
Adak	2		
Nome	1		
Total	**137**	**5**	**12**

5.6 Description of Fixed-Gear Fisheries

5.6.1 Fleet demographics and fishing activity

This section describes the demographics and recent fishing patterns of the fixed-gear shoreside catcher vessel fleet that would be eligible to participate in the EM stratum. Appropriate monitoring approaches should be developed in the context of the fisheries that the program will serve. The number of vessels, distribution of landing ports, and timing of fishing activity will have a direct bearing on program costs, and thus could affect the design of the program's infrastructure. The data do not include catcher/processors or catch on CVs when operating in state fisheries. Due to the sequential prioritization of different vessel length groups for EM participation, and the different stages of development of EM testing for the hook-and-line and pot gear sectors, information is broken out by gear and length category where possible. To date, vessels less than 40' LOA (no selection pool) have not carried observers, so observer data is not available to describe activity in terms of metrics such as hauls per trip.

Table 5-8 summarizes the Alaska fixed-gear fleet that was subject to partial coverage observer regulations while targeting halibut and sablefish IFQ and limited access Pacific cod in 2014 and 2015. The fleet consists of 1,090 hook-and-line vessels and 143 pot vessels (1,178 unique vessels). Almost half of the hook-and-line vessels active during these years are less than 40' LOA, and roughly one-third are between 40' and 57.5' LOA. Three-quarters of the pot vessels are greater than 57.5' LOA, while only three are less than 40'. Only 55 of 1,178 active fixed-gear vessels deployed both hook-and-line and pot gear, and the majority of those vessels were in the largest size category. Table 5-9 shows 2015 hook-and-line and pot vessel participation by area fished (GOA/BSAI). This break-out provides context for decision points relating to where EM field support services should be provided if the Council considers restricting the EM pool to concentrated areas in early years of the program in order to achieve cost efficiencies. Such decisions could be made and revised on an annual basis through the ADP process after regulations are amended to integrate EM into the monitoring program. The vessel counts in Table 5-9 are lower because the data do not include vessels that only fished in state-waters while participating in Federally managed fisheries.[33] The vessels that are not counted in Table 5-9 would still be subject to Observer Program regulations when participating in parallel fisheries. Figure 5-2 also shows relative participation across management areas, and breaks out target fisheries. Vessels in the under 40' LOA size category are relatively more engaged in the halibut fishery.

Table 5-8 Fixed-gear vessel count by gear type and vessel size category, 2014 and 2015

Gear	Category	2014	2015	Total
All Vessels		1,061	981	1,178
LL	< 40'	438	378	508
	40'-57.5'	365	351	393
	> 57.5	180	176	189
	Total	983	905	1,090
POT	< 40'	2	2	3
	40'-57.5'	24	30	33
	> 57.5	92	92	107
	Total	118	124	143
BOTH	< 40'	1	1	2
	40'-57.5'	6	10	10
	> 57.5	33	37	43
	Total	40	48	55

Source: Fish Ticket data, provided by AKFIN.

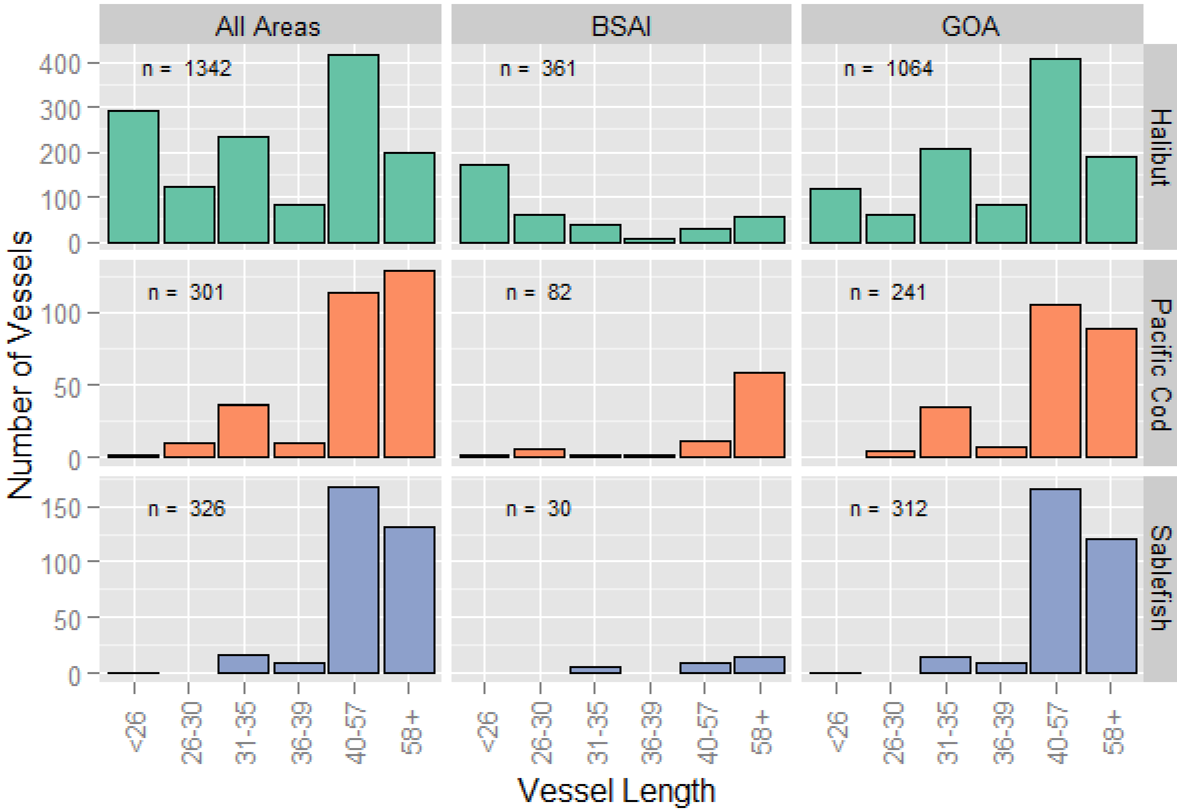
Table 5-9 Fixed-gear vessel count by gear type, vessel size category, and area fished, 2015

GOA			BSAI			Both		
Gear	Category	2015	Gear	Category	2015	Gear	Category	2015
LL	< 40'	177	**LL**	< 40'	53	**LL**	< 40'	9
	40'-57.5'	257		40'-57.5'	26		40'-57.5'	19
	> 57.5	157		> 57.5	42		> 57.5	34
	Total	591		Total	121		Total	62
POT	< 40'	2	**POT**	< 40'	0	**POT**	< 40'	0
	40'-57.5'	27		40'-57.5'	3		40'-57.5'	0
	> 57.5	61		> 57.5	40		> 57.5	9
	Total	90		Total	43		Total	9

Source: Fish Ticket data, provided by AKFIN.
Note, table does not include vessels that possess an FFP but fish only in State waters.

[33] For instance, 905 hook-and-line vessels were active in 2015 (Table 5-8), but only 650 were active in waters outside of the three-mile EEZ boundary line (Table 5-9: sum 591 and 121, then net out 62 vessels that would have been counted twice by virtue of fishing in both areas during 2015).

Figure 5-2 Fixed-gear vessels by area, target fishery, and vessel size (2013 through 2015)



Source: Catch Accounting System, provided by NMFS AKRO.

Table 5-10 describes 2015 fixed-gear activity in terms of target fisheries. The majority of participation and catch across all target species occurs in the GOA management area. Participation by vessels of less than 40' LOA primarily occurs in the halibut and Pacific cod fisheries. Vessels of 58' LOA or greater make up less than 20% of the fleet targeting halibut, but account for around 46% of catch. Vessels in that size category make up the majority of the pot gear.

Table 5-10 2015 Vessel count and percentage of catch by gear type, target fishery, and size category

		Longline Gear						Pot Gear**	
		Halibut		Sablefish		Pacific Cod		Pacific Cod	
Area	Category	# Vessels	Catch	# Vessels	Catch	# Vessels	Catch	# Vessels	Catch
GOA	< 40'	325	16.7%	16	2.2%	19	22.5%	16*	13.3%
	40' - 57.5'	311	39.1%	133	32.3%	47	70.5%		
	> 57.5'	162	44.3%	106	65.5%	5	7.0%	59	86.8%
	Total	798	8,806	255	9,230 mt	71	6,947 mt	75	18,265 mt
BSAI	< 40'	63	18.5%	4	9.2%	-	-	-	-
	40' - 57.5'	25	28.8%	5	40.0%	4*	100.0%	3	5.5%
	> 57.5'	41	52.7%	3	50.8%			40	94.5%
	Total	129	1,874	12	352 mt	4	625 mt	43	21,550 mt
All Areas	< 40'	380	16.9%	16	2.4%	19	20.6%	19*	9.0%
	40' - 57.5'	320	37.3%	135	32.6%	56*	79.4%		
	> 57.5'	168	45.8%	109	64.9%			89	91.0%
	Total	868	10,680	260	9,582 mt	75	7,571 mt	108	39,816 mt

Source: Catch Accounting System, provided by NMFS AKRO.

* Data combined to preserve confidentiality

** A small amount of catch was made on trips targeting sablefish with pot gear in 2015 (3 vessels landed 120 mt in the BSAI); draft regulations are pending to allow hook-and-line pot gear for sablefish in the GOA. Pot gear is not used to target halibut.

The following tables focus on the number of trips that certain classes of vessels made in each recent year, and the length of those trips. These tables only include data from trips that delivered to shoreside processors, as vessels delivering to motherships are not operating within the partial coverage category. The vessel counts found in Table 5-11 through Table 5-16 should not be summed, as vessels may appear in multiple rows when making landings in several ports or management areas in a given year. The definitive annual vessel counts by gear type and vessel size are found in Table 5-8 and Table 5-9.

The length of fishing trips is highly variable due to individual fishing plans, catch rates, market/processor demands, weather, and a range of other factors. Estimating a representative trip length for subunits of the Alaska fixed-gear fleet is a necessary exercise in order to understand the extent to which demand for observer-days might be reduced as more or fewer vessels opt into the EM selection stratum. Due to the known variability mentioned above, average trip length (days per trip) is sufficient for a general discussion of impacts. The best available information on trip length is derived by taking the difference between the date when fish are landed and the date on which gear was first set in the water; this is presented as “Days Fished” in the tables that follow. Days Fished is a close approximation of trip length, but not a precise measurement. Days Fished does not capture time out of port prior to the setting of gear, to say nothing of invoiced observer-days spend traveling or in port; thus, Days Fished likely underestimates the total number of days invoiced by an observer provider company for the trip. This underestimation will be greater for trips that fish farther from port. One might broadly assume that trips farther afield are more likely to occur in the Western GOA and BSAI areas, or on larger vessels with greater hold capacity, though the analysts do not possess the data necessary to test this assumption. As part of the ADP process, NMFS FMA staff develops internal methods to project the total number of observer-days required to provide adequate coverage within its budget constraints. Those methods are too complex to be grafted onto the data available on Days Fished. However, a coarse adjustment could be made by adding between zero and one day to the Days Fished for each trip record.[34] Because that adjustment factor would not be constant across vessels of different sizes fishing in different areas, this

[34] The adjustment factor would be less than one day because some number of trips commences fishing on the same day that the vessel left port.

analysis will proceed with estimating trip length using Days Fished, and note the caveat regarding slight underestimation of trip length.

Days Fished is not the preferred metric for estimating the amount of video data that would be collected and reviewed on a fixed gear trip. Days Fished overestimates the amount of fishing activity that occurs on a given trip for two reasons: the metric captures the unknown and variable time spent returning to port after filling the hold, and the number of gear hauls per day varies across trips and vessels. Rather, estimates of the amount of video review required for a typical trip can be derived from stratified estimates of hauls per trip[35] (Table 5-20), or can be taken directly from PSMFC's reports on review rates in the research phase of the Alaska EM program (refer to Table 5-24 in Section 5.7.4.1.3). When the information is available, the analysts use stratified estimates of hauls per trip when considering the video review and reporting components of EM program costs.

Table 5-11 and Table 5-12 use Catch Accounting System and debriefed Observer Program data to characterize average trip length using the Days Fished metric. Larger vessels size categories recorded longer trips on average across both years and gear types (hook-and-line and pot). The middle range of Days/Trip estimates in Table 5-11 compares well with the trip length statistics in PSMFC's 2015 Alaska EM season review (Al-Humaidhi 2016). PSMFC's data on 2015 EM fixed-gear activity drew on 12 hook-and-line vessels in the 40' to 57.5' length category; the average trip length was 4.1 days for trips targeting halibut, 4.5 days for trips targeting sablefish, and 3.6 days for trips targeting Pacific cod. The middle range in Table 5-12 compares well with the trip length statistics in Saltwater, Inc.'s technical report on pot gear EM testing during the period from November 2013 through March 2015 (Buckelew 2015). That report placed average trip length for EM pot vessels targeting Pacific cod at 2.8 days per trip.

Table 5-11 Hook-and-line (LL) gear participation and activity by CV size category, 2013 through 2015

YEAR	CATEGORY	# Vessels	# Trips	Days Fished*	Days/Trip
2013	LL Vessels < 40'	489	2,535	6,494	2.6
	LL Vessels 40'-57.5'	378	2,138	9,151	4.3
	LL Vessels > 57.5'	186	1,492	9,272	6.2
2013 Total		1,053	6,165	24,917	
2014	LL Vessels < 40'	447	2,088	5,725	2.7
	LL Vessels 40'-57.5'	362	1,931	7,769	4.0
	LL Vessels > 57.5'	175	1,125	6,583	5.9
2014 Total		984	5,144	20,077	
2015	LL Vessels < 40'	388	1,909	5,451	2.9
	LL Vessels 40'-57.5'	349	2,037	8,480	4.2
	LL Vessels > 57.5'	174	1,152	6,672	5.8
2015 Total		911	5,098	20,603	

* "Days Fished" allows for a close approximation of trip length, but not a precise measurement. Refer to a more detailed explanation above Table 5-11 in this document.

Source: NMFS Catch Accounting data, provided by AKRO SF. Observer Program data captures all activity by vessels participating in fisheries that are subject to observer regulations; this includes some fisheries that occur in state waters.

35 Haul data is not available from the Observer Program for vessels of less than 40' LOA, as those vessels are currently in the zero-selection pool (i.e., they do not carry observers).

Table 5-12 Pot gear participation and activity by CV size category, 2013 through 2015

YEAR	CATEGORY	# Vessels	# Trips	Days Fished*	Days/Trip
2013	Pot Vessels < 40'	2	C	C	2.8
	Pot Vessels 40'-57.5'	22	110	278	2.5
	Pot Vessels > 57.5'	96	883	3,414	3.9
2014	Pot Vessels < 40'	1	C	C	2.3
	Pot Vessels 40'-57.5'	18	162	397	2.5
	Pot Vessels > 57.5'	93	1,092	3,928	3.6
2015	Pot Vessels < 40'	1	C	C	2.8
	Pot Vessels 40'-57.5'	18	178	461	2.6
	Pot Vessels > 57.5'	91	1,044	3,535	3.4

C = confidential (annual subtotals excluded in order to maintain confidentiality).

* "Days Fished" allows for a close approximation of trip length, but not a precise measurement. Refer to a more detailed explanation above Table 5-11 in this document.

Source: NMFS Catch Accounting data, provided by AKRO SF. Observer Program data captures all activity by vessels participating in fisheries that are subject to observer regulations; this includes some fisheries that occur in state waters.

Table 5-13 through Table 5-16 provide a snapshot of the geographical distribution of fixed gear activity and trip length across landing ports in 2015. In general, trip length scales upward with vessel size category, and trips deploying pot gear tend to be shorter than those deploying hook-and-line gear. These tables will help the Council, NMFS, and EM providers identify key fixed-gear landing ports as they craft annual deployment strategies that provide cost-effective field support services on an iterative basis. As noted above, the vessel counts in each of these tables are useful for describing the fleet operating out of each port, but summing the vessel column would result in double-counting as many vessels deliver to more than one port in a given year.

Table 5-13 Hook-and-line gear CV participation and activity by landing port, 2015

Port	#Vessels	#Trips	Days Fished	Days/Trip
Kodiak	186	1,050	4,251	4.0
Sitka	168	619	2,068	3.3
Homer	133	362	1,466	4.0
Seward	129	582	2,817	4.8
Petersburg	110	329	1,102	3.3
Juneau	90	259	1,136	4.4
Wrangell	64	153	577	3.8
Yakutat	61	265	852	3.2
Dutch Harb.	57	198	1,320	6.7
Sand Point	55	143	769	5.4
Hoonah	49	107	369	3.4
Cordova	46	112	423	3.8
Ketchikan	31	54	211	3.9
Akutan	28	72	495	6.9
King Cove	26	57	341	6.0
Bellingham	24	25	212	8.5
St. Paul	22	189	335	1.8
Craig	17	24	91	3.8
Whittier	15	79	342	4.3
Togiak	13	44	138	3.1
Savoonga	13	90	178	2.0
Alitak Bay	12	19	59	3.1
Atka	11	70	407	5.8
False Pass	8	15	102	6.8
Adak	8	32	228	7.1
Haines	6	14	35	2.5
St. George	5	68	68	1.0
Nome	5	20	57	2.9
Valdez	4	8	38	4.8
Pt. Protect.	4	5	9	1.8
Kenai	4	4	15	3.8
Dillingham	3	12	34	2.8
Elfin Cove	3	4	9	2.3
Other Alaska	3	4	12	3.0
Port Alex.	2	C	C	2.7
Tenakee Sp.	1	C	C	5.8
Hyder	1	C	C	2.0
TOTAL		**5,098**	**20,603**	**4.0**

Source: NMFS Catch Accounting data, provided by AKRO SF. C = confidential.

Note: Ports listed in descending order of #vessels that made a landing in 2015. Vessel count total is not displayed because vessels that made landings in multiple ports would be duplicated.

Table 5-14 Hook-and-line gear CV participation and activity by landing port and vessel size category, 2015

	LL Vessels < 40'				LL Vessels 40'-57.5'				LL Vessels > 57.5'			
Port	**#Vessels**	**#Trips**	**Days Fished**	**Days/Trip**	**#Vessels**	**#Trips**	**Days Fished**	**Days/Trip**	**#Vessels**	**#Trips**	**Days Fished**	**Days/Trip**
Kodiak	52	336	1,138	3.4	67	454	1,620	3.6	67	260	1,493	5.7
Sitka	50	164	422	2.6	83	359	1,273	3.5	35	96	373	3.9
Homer	44	135	415	3.1	54	154	597	3.9	35	73	454	6.2
Seward	8	40	156	3.9	55	311	1,315	4.2	66	231	1,346	5.8
Petersburg	40	163	409	2.5	43	102	401	3.9	27	64	292	4.6
Juneau	27	79	273	3.5	42	142	671	4.7	21	38	192	5.1
Wrangell	28	79	223	2.8	27	61	284	4.7	9	13	70	5.4
Yakutat	17	164	393	2.4	11	36	140	3.9	33	65	319	4.9
Dutch Harb.	8	32	161	5.0	17	65	439	6.8	32	101	720	7.1
Sand Point	9	27	111	4.1	24	62	294	4.7	22	54	364	6.7
Hoonah	29	66	193	2.9	13	24	104	4.3	7	17	72	4.2
Cordova	19	50	155	3.1	12	32	130	4.1	15	30	138	4.6
Ketchikan	11	22	71	3.2	12	20	78	3.9	8	12	62	5.2
Akutan	9	34	183	5.4	7	18	132	7.3	12	20	180	9.0
King Cove	6	11	41	3.7	8	24	144	6.0	12	22	156	7.1
Bellingham					2	C	C	3.5	22	23	205	8.9
St. Paul	13	174	244	1.4	3	9	37	4.1	6	6	54	9.0
Craig	7	7	26	3.7	10	17	65	3.8				
Whittier	5	14	56	4.0	10	65	286	4.4				
Togiak	13	44	138	3.1								
Savoonga	13	90	178	2.0								
Alitak Bay	4	5	14	2.8	4	8	20	2.5	4	6	25	4.2
Atka	5	49	213	4.3	4	14	128	9.1	2	C	C	9.4
False Pass					5	9	66	7.3	3	6	36	6.0
Adak					5	25	177	7.1	3	7	51	7.3
Haines	6	14	35	2.5								
St. George	5	68	68	1.0								
Nome	2	C	C	3.2	3	14	38	2.7				
Valdez	2	C	C	4.6	1	C	C	5.5	1	C	C	4.0
Pt. Protect.	4	5	9	1.8								
Kenai	3	3	12	4.0	1	C	C	3.0				
Dillingham	3	12	34	2.8								
Elfin Cove	3	4	9	2.3								
Other Alaska					3	4	12	3.0				
Port Alex.					2	C	C	2.7				
Tenakee Sp.	1	C	C	5.8								
Hyder	1	C	C	2.0								
TOTAL		**1,909**	**5,451**	**2.9**		**2,037**	**8,480**	**4.2**		**1,152**	**6,672**	**5.8**

Source: NMFS Catch Accounting data, provided by AKRO SF. C = confidential.

Note: Ports listed in descending order of #vessels that made a landing in 2015. Vessel count total is not displayed because vessels that made landings in multiple ports would be duplicated.

Table 5-15 Pot gear CV participation and activity by landing port, 2015

Port	#Vessels	#Trips	Days Fished	Days/Trip
Dutch Harb.	33	297	1,135	3.8
Kodiak	31	390	1,222	3.1
Akutan	25	166	594	3.6
King Cove	18	115	282	2.5
Sand Point	16	142	403	2.8
IFP**	13	58	180	3.1
Homer	6	43	142	3.3
False Pass	5	*	*	2.8
Atka	1	C	C	6.5
TOTAL		**1,227**	**4,010**	**3.3**

Source: NMFS Catch Accounting data, provided by AKRO SF. C = confidential. * = data excluded in order to maintain confidentiality.
Note: Ports listed in descending order of #vessels that made a landing in 2015. Vessel count total is not displayed because vessels that made landings in multiple ports would be duplicated.
** IFP = Inshore Floating Processor (processes in State of Alaska waters only).

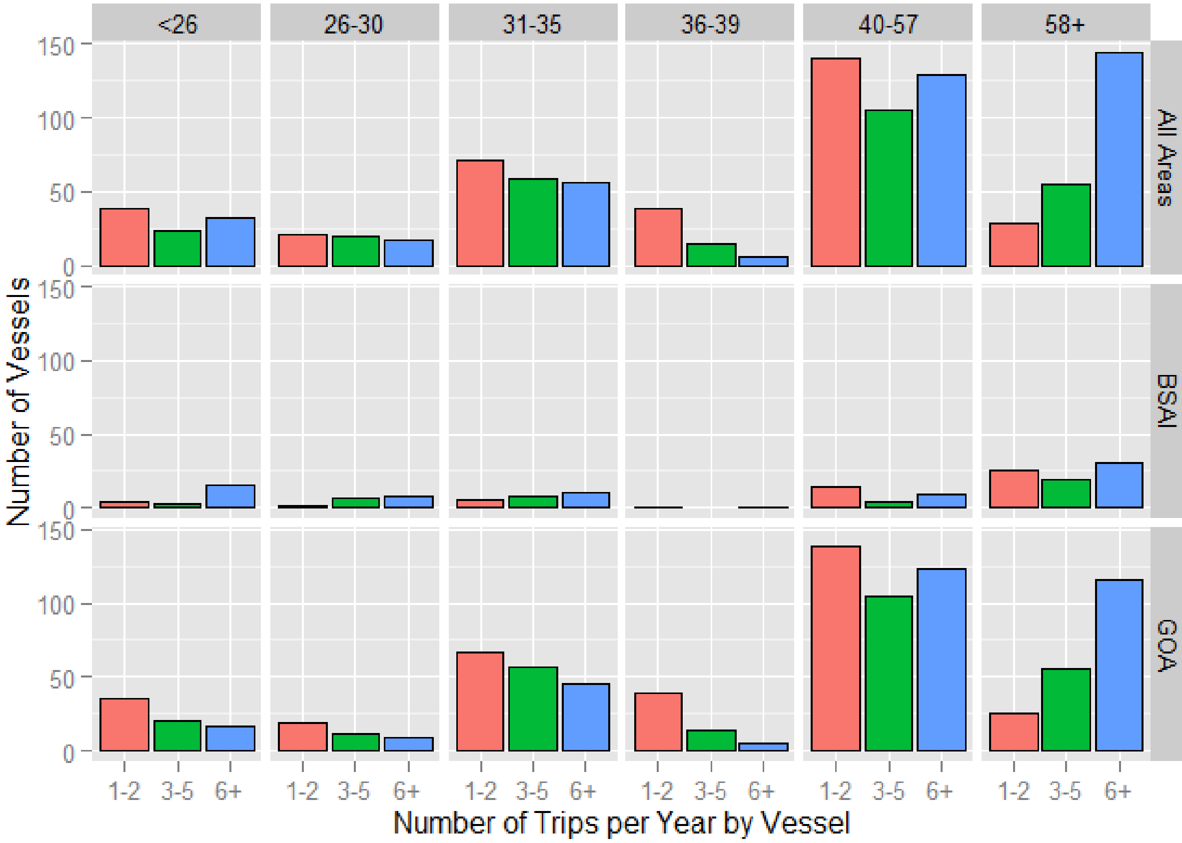
Table 5-16 Pot gear CV participation and activity by landing port and vessel size category, 2015

	Pot Vessels	Pot Vessels 40'-57.5'				Pot Vessels > 57.5'			
Port	< 40'	#Vessels	#Trips	Days Fished	Days/Trip	#Vessels	#Trips	Days Fished	Days/Trip
Dutch Harb.	Conf.***	3	21	67	3.2	30	276	1,068	3.9
Kodiak		3	30	84	2.8	28	360	1,138	3.2
Akutan		1	C	C	3.7	24	159	568	3.6
King Cove		7	68	154	2.3	11	47	128	2.7
Sand Point		3	29	62	2.1	13	113	341	3.0
IFP**						13	58	180	3.1
Homer		2	C	C	3.0	3	18	68	3.8
False Pass		1	C	C	2.7	4	*	*	2.8
Atka						1	C	C	6.5
TOTAL		**20**	**178**	**461**	**2.6**	**127**	**1,044**	**3,535**	**3.4**

Source: NMFS Catch Accounting data, provided by AKRO SF. C = confidential. * = data excluded in order to maintain confidentiality.
Note: Ports listed in descending order of #vessels that made a landing in 2015. Vessel count total is not displayed because vessels that made landings in multiple ports would be duplicated.
** IFP = Inshore Floating Processor (processes in State of Alaska waters only).
*** Only 1 vessel <40' LOA fished pot gear in 2015, landing its catch in Homer, AK with an average trip length of 2.8 days/trip.

The Council will likely be interested in the number of trips that a particular vessel makes in a year, and how that figure varies across vessel size classes and area (Figure 5-3 and Table 5-17). Placing EM equipment on vessels that make a small number of trips is relatively more expensive, as the hardware and field service costs are the same (or greater) than those for more active vessels but the amount of data produced is less. Moreover, pre-implementation research suggests that data quality is sometimes poorer on vessels that make fewer trips, as those operators have less experience with the equipment initially, and less opportunity to improve their performance through feedback mechanisms such as the vessel score card. Vessels that make a small number of trips and operate out of more remote ports would represent some of the most expensive vessels to incorporate in the EM program. While not all "remote" ports are in the BSAI area, the analysts have broken out trips-per-vessel data by vessels that fish in GOA and BSAI as a proxy for ports that might be more expensive to provide with field support service.

Figure 5-3 Individual fixed-gear vessel trips per year, by vessel size category and fishing area in 2015



Source: Catch Accounting System, provided by NMFS AKRO.

Table 5-17 Top 10 ports for trips-per-year-per vessel (all fixed-gear), 2013 through 2015

Years	Trips per Year per Vessel	Port	Landing Count	Vessel Count
2013-2015	1-2	Sitka	112	51
2013-2015	1-2	Petersburg	83	35
2013-2015	1-2	Wrangell	70	28
2013-2015	1-2	Kodiak	65	31
2013-2015	1-2	Hoonah	61	24
2013-2015	1-2	Homer	60	26
2013-2015	1-2	Juneau Borough	53	23
2013-2015	1-2	Cordova	48	20
2013-2015	1-2	Ketchikan	39	14
2013-2015	1-2	Other Alaska	33	21
2013-2015	3-5	Sitka	223	41
2013-2015	3-5	Kodiak	171	37
2013-2015	3-5	Juneau Borough	134	24
2013-2015	3-5	Wrangell	117	18
2013-2015	3-5	Homer	111	22
2013-2015	3-5	Other Alaska	87	22
2013-2015	3-5	Petersburg	87	18
2013-2015	3-5	Hoonah	85	18
2013-2015	3-5	Togiak	78	12
2013-2015	3-5	Yakutat	64	13
2013-2015	6+	St. Paul	891	21
2013-2015	6+	Kodiak	839	36
2013-2015	6+	Yakutat	393	13
2013-2015	6+	Savoonga	389	18
2013-2015	6+	Homer	259	25
2013-2015	6+	Petersburg	255	14
2013-2015	6+	Other Alaska	194	27
2013-2015	6+	Sitka	176	15
2013-2015	6+	Atka	123	5
2013-2015	6+	Tununak	105	16

Source: Catch Accounting System, provided by NMFS AKRO.

Note: “Other Alaska” reflects landing locations that do not have a location code or port code, or are a tender delivery outside of a port with an existing port code.

Table 5-18 and Table 5-19 illustrate the distribution of fishing effort by vessels in the 40’ to 57.5’ LOA category over the calendar year for trips delivering to certain ports or regions. Across regions, the effort of vessels in the Under-40’ category was seasonally concentrated from June to August. Each table identifies the ports that are preliminarily designated as EM service ports under the 2017 EM Pre-Implementation Plan. Other ports are listed in descending groups according to overall effort (# of trips) and geographical region. To make this information presentable, the tables include average monthly trips across the three year period since the Observer Program restructuring (2013 through 2015). Where demand for observer-days and for video review are concerned, average trip lengths from the previous tables can be layered over the trip counts presented in these tables. Applying average trip lengths to the data in these tables removes the information in the document one step farther from actual fishery data, but makes the document more accessible and avoids some instances of confidentiality restrictions. Furthermore, given the small number of years for which post-restructuring data is available, relying on observed trip length data for each port and vessel size category is of dubious value. Table 5-18 and Table 5-19 do not speak to the number of vessels delivering to each port, but that information is available in the middle columns of Table 5-14 (hook-and-line) and Table 5-16 (pot).

Table 5-18 Hook-and-line gear CV average trips per month by port, 40' to 57.5' LOA category, 2013 through 2015

Port			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Avg.
2017 EM Service Ports		Kodiak	59	77	56	14	26	13	12	12	35	55	31	42	431
		Sitka			53	64	84	39	23	24	35	26	2		350
		Homer	< 1	3	14	16	28	37	7	28	19	22	3	1	178
> 100 trips (area total 2013-15)	SE Alaska	Juneau			16	24	28	14	5	15	11	19	2		135
		Petersburg			15	19	20	13	3	11	16	8	2		107
		Seward	13	33	68	25	25	18	4	9	25	29	4		254
		Wrangell			6	14	12	6	4	9	1	1			52
		Yakutat			3	8	9	4	4	5	2	< 1			35
	Southcentral	Cordova		< 1	6	10	7	3	3	6	3				39
		Whittier	7	4	4	2	2	1	1	3	1	1	5	5	36
	WGOA/BSAI	Dutch Harb.	13	10	12	10	8	8	11	14	12	7	2	2	108
		Sand Point	1	4	6	3	9	7	9	14	17	15	4		88
		Adak			1	3	3	5	9	7	5	3			35
< 100 trips (area total 2013-15)	SE Alaska[a]				3	8	13	13	8	8	9	5	2		69
	Southcentral[b]					< 1	13	4	2	1	1				20
	WGOA/BSAI[c]				< 1	1	4	6	15	28	30	7			92
	Other[d]					< 1		< 1	1	2	1	< 1			5
TOTAL			93	131	262	222	291	190	121	196	224	198	56	50	2,034

Source: NMFS Observer Program data, provided by AKFIN.

Landing ports (by area) that received fewer than 100 cumulative landings from 2013-2015 are condensed to maintain confidentiality: [a] SE Alaska: Hoonah, Ketchikan, Craig, Port Alexander, Elfin Cove, Port Armstrong, Port Protection; [b] Southcentral: Alitak Bay, Valdez, Kenai; [c] WGOA/BSAI: King Cove, Akutan, Atka, Nome, St. Paul, False Pass; [d] Other: Other AK, Bellingham (WA).

Table 5-19 Pot gear CV average trips per month by port, 40' to 57.5' LOA category, 2013 through 2015

Port	JAN	FEB	SEP	OCT	NOV	DEC	Annual Avg.
King Cove	33	7	25	9			74
Kodiak*	12	6	< 1	< 1	1	< 1	21
Sand Point	12	4	2				18
Dutch Harbor*	7	1	1	2	2	2	15
Other**	8	3		1	2	8	22
TOTAL	72	22	28	13	5	11	150

Source: NMFS Observer Program data, provided by AKFIN.
* Kodiak and Dutch Harbor are identified as primary service ports for the 2017 Pre-Implementation program; Sand Point might be designated as a service port depending on available funding.
** Other (in descending order of landings received): Homer, Akutan, Inshore Floating Processor, False Pass. Ports aggregated to maintain confidentiality.

Table 5-20 summarizes hauls per trip, which could be indicative of the amount of video review time required to monitor the fishery. This data is drawn from debriefings of observed fixed-gear trips. The data in Table 5-20 comes from observers' post-deployment debriefings. The analysts interpret a "haul" unit for pot gear as a string of single pots. The number of pots in a string is unspecified, as is the number of hooks retrieved on a hook-and-line haul. For reference, SWI produced a technical report on its 2015 EM work in the Pacific cod pot fishery (Buckelew 2015). That report noted that the average number of individual pots hauled on a trip was 305 (+/-199), on a sample size of six vessels operating between November 2013 and

March 2015. SWI performed a modeling exercise in that report, and assumed 360 individual pot hauls per trip, suggesting that the trips that SWI observed during their EM field testing had atypically low effort, which could have been the case for any number of reasons.

For comparison, PSMFC's 2015 summary of the 2015 hook-and-line EM fishery covers 67 trips (24 halibut, 27 sablefish, and 16 Pacific cod), and reported an average of 7.8 hauls per trip (Al-Humaidhi 2016). Halibut and sablefish trips averaged 5.5 and 6.7 hauls per trip, respectively, while Pacific cod trips averaged 11.9 hauls per trip. Across all species, the average number of hauls per day was 1.9. Halibut and sablefish trips recorded similar averages of 1.4 and 1.5 hauls per day, while Pacific cod trips recorded an average of 3.4 hauls per day.

Table 5-20 Average number of line hauls per observed fishing trip for fixed-gear CVs, by vessel category, gear type, target species, and fishing area (2014 through July 2016)

Vessel Length	Gear	Target	Area	Avg. Hauls/Trip
40' - 57.5'	LL	Halibut	GOA	4.7
	LL	Halibut	BSAI	3.6
	LL	Sablefish	GOA	5.1
	LL	Pacific Cod	GOA	5.2
	LL	Pacific Cod	BSAI	2.0
	POT	Pacific Cod	GOA	2.2
58' +	LL	Halibut	GOA	9.7
	LL	Halibut	BSAI	8.3
	LL	Sablefish	GOA	8.9
	LL	Pacific Cod	GOA	4.3
	LL	Pacific Cod	BSAI	8.0
	POT	Sablefish	BSAI	16.3
	POT	Pacific Cod	GOA	4.0
	POT	Pacific Cod	BSAI	4.7

Source: NMFS AFSC Observer Program, data compiled by AKFIN in Comprehensive_NORPAC.

Notes: No observer data is available for the <40' vessel length category. Targeting of sablefish with longline pot gear will be permitted in the GOA beginning in 2017, and shorter trips with fewer hauls might be observed in the future due to the geographic and oceanographic nature of GOA fishing grounds.

5.6.2 2015 Activity of Vessels Participating in the 2016 EM Pre-Implementation Program

This section provides summary information on the 2015 fishery participation of the 51 vessels that were in the 2016 EM selection stratum as of July. While this profile does not predict the stratum's demographics in 2017 or under a fully implemented program, it is informative in that this set of vessels represents fixed-gear operators who are motivated to carry EM equipment. Understanding the timing and location of fishing among this subset of the fixed-gear fleet could play into the Council's annual decision as to where and to what extent field support services should be provided, and where efficiencies can be realized. As noted in Section 5.7.4.1.2, the demographics of the EM pool could evolve as large vessels (>57.5'), small vessels (≥40'), and pot gear vessels opt into the stratum. To provide a snapshot of the pre-implementation pool, this section focuses on vessel counts, trips, trip length, landing ports, and the timing of effort. That information gives the analysts a basis for modeling the effort patterns of at least one class of vessels that might be part of a fully implemented EM stratum (40' to 57.5' hook-and-line vessels).

Forty-eight of these 51 vessels were active in 2015. Forty-six used hook-and-line gear, and their activity *when using hook-and-line gear* is reflected in Table 5-21. One vessel used both hook-and-line and pot gear, while another used both hook-and-line and jig gear. Two vessels that opted into the EM stratum in 2016 did not use hook-and-line gear in 2015 (one used only pot gear and one only jig gear). Two of the 48 vessels were greater than 57.5' LOA; those vessels were allowed into the 2016 EM pool because they agreed to field test "stereo cameras," which is a parallel but different track of research than the technology that would likely be implemented in the early years of the EM program. The hook-and-line activity of these vessels is included in Table 5-21 because their participation still reflects an interest in carrying EM, and because the action alternatives would make EM an available option for larger vessels as well.

Table 5-21 shows that this set of vessels had an average trip length of 3.5 days (1448 days over 418 trips) over all ports and trip targets when using hook-and-line gear. The median vessel's average trip length was 3.3 days, with vessel-averages ranging from 1.6 to 7 days. A standard deviation of 1.3 days per trip indicates that most vessels averaged between 2 and 4.5 days per trip. A vessel's general level of fishing activity did not correlate to average trip length, as vessels taking less than five trips and vessels taking more than 20 trips both averaged around 4.0 days per trip, while vessels taking five to 20 trips averaged 3.2 days per trip.

Table 5-21 also lists the ports that received landings from this set of vessels in 2015 when they were using hook-and-line gear. The several vessels that used pot or jig gear also made deliveries to Haines, Skagway, and Alitak Bay (Kodiak Island). The draft 2017 Pre-Implementation Plan calls for the EM service provider to establish in-port technical support in Sitka, Homer, and Kodiak (and potentially Sand Point, depending on available funds). Of the 48 vessels in the 2016 EM pool vessels that were active in 2015, only 11 did not make a landing in one of the three planned service ports. Eight of those 11 fished predominantly in SE – e.g., Juneau, Petersburg, or Wrangell – and would have reasonable access to services provided in Sitka. The other three vessels that did not deliver to a 2017 EM service port were making a small number of landings in Nome, Seward, or Sand Point, respectively.

Table 5-21 2015 hook-and-line effort by landing port for vessels in the 2016 EM pool

Landing Port	Vessels	Trips	Days Fished	Avg. Trip Length
Sitka	24	187	538	2.9
Seward	10	64	266	4.2
Kodiak	7	37	154	4.2
Homer	8	31	91	2.9
Yakutat	5	31	102	3.3
Juneau	5	16	65	4.1
Petersburg	4	12	49	4.1
Dutch Harbor/Nome/ St. Paul*	4	16	98	6.1
Sand Point	C	C	C	3.0
King Cove	C	C	C	5.5
Port Alexander/ Wrangell**	3	9	26	2.9
Other Alaska	C	C	C	2.0
Total	46	418	1448	3.5

Source: ADFG/CFEC Fish Tickets, data compiled by AKFIN in Comprehensive_FT
* Dutch Harbor, Nome, and St. Paul Island are combined to maintain confidentiality. Of the three, Nome is the outlier with an average trip length of 2.4 days.
** Port Alexander and Wrangell are combined to maintain confidentiality.

Figure 5-4 and Figure 5-5 illustrate this set of vessels' level and distribution of fishing effort over the 2015 calendar year, broken out by the area fished. Figure 5-4 shows trips that were designated in the CAS as halibut target trips, and Figure 5-5 shows sablefish target trips. Trips targeting Pacific cod are not illustrated, but are easily summarized by the statement that hook-and-line cod trips only occurred in the Central GOA area, and largely took place from January to March (between seven and 12 trips per month). One trip occurred in April and 2 trips occurred in October. Figure 5-6 aggregates all trip targets, and shows that effort was generally higher in the early part of the halibut/sablefish season, and that SE and the Central GOA were the most active fishing areas (Sitka, Homer, and Kodiak). Landings that occurred in January and February reflect Pacific cod targets.

Figure 5-4 2015 halibut trips by month and by fishing area for the hook-and-line vessels in the 2016 EM pool

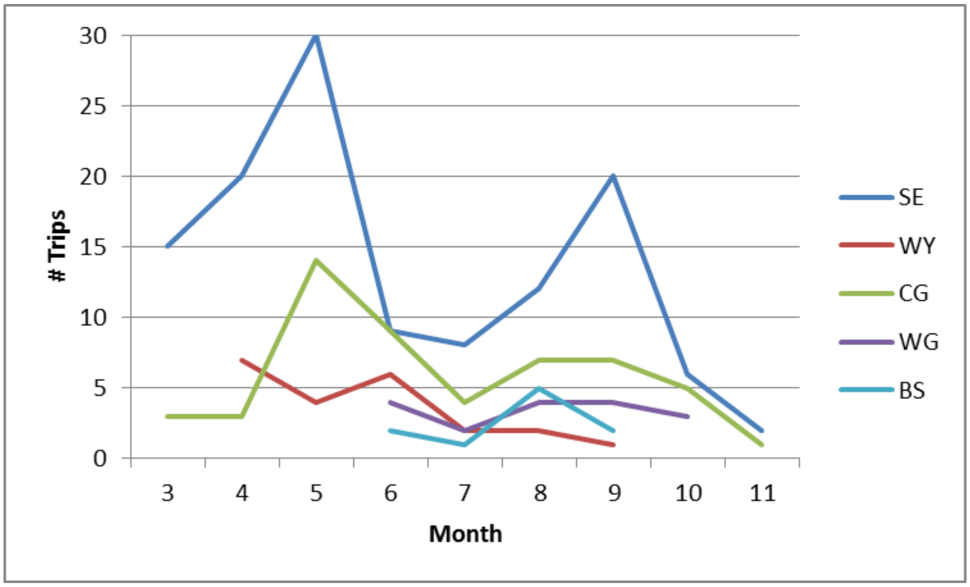


Figure 5-5 2015 sablefish trips by month and by fishing area for the hook-and-line vessels in the 2016 EM pool

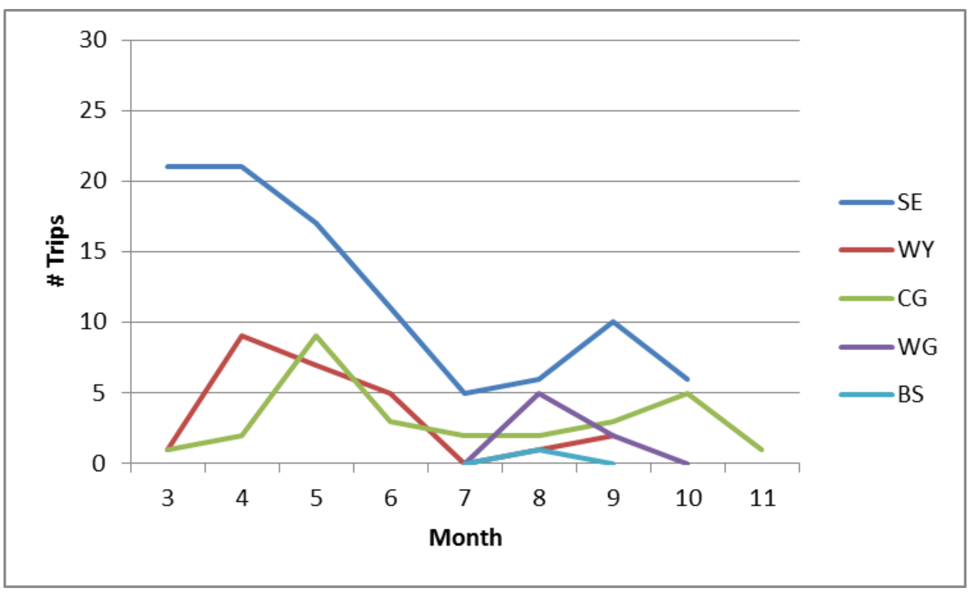
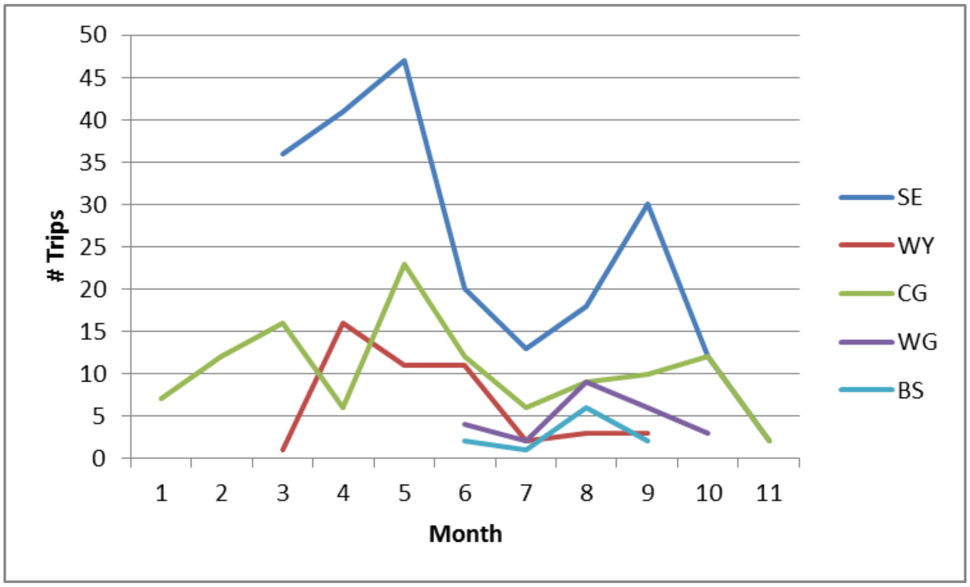


Figure 5-6 2015 hook-and-line trips (all targets) by month and by fishing area for vessels in the 2016 EM pool



The analysts also considered the 2016 EM pool's timing of hook-and-line effort across landing ports in 2015. The analysts focused only on halibut and sablefish trips, as the timing of effort in the fixed-gear cod fishery is well known to occur from January to March with a smaller amount of effort in the fall.[36] The top seven landing ports for this set of vessels accounted for 90% of trips in 2015 (334 of 373). Those ports break down into the Eastern GOA/Southeast Alaska (Sitka, Yakutat, Juneau, and Petersburg), and Southcentral (Seward, Homer, and Kodiak). Sitka accounted for over 50% of deliveries in 2015 (187 of 373). Monthly deliveries to Sitka where relatively high throughout the year, though they were higher from March to June (24 to 29 deliveries per month) than from July to October (11 to 17 deliveries per month). Only Seward and Homer registered months with more than 10 deliveries (May and June).

In the rest of the Eastern GOA/ Southeast Alaska, deliveries to Yakutat were higher in the beginning of the year relative to Juneau and Petersburg, and no landings were made in Yakutat after August. August and September were the most active months in Juneau and Petersburg. Minor ports in SE (Port Alexander and Wrangell) only received deliveries in August and September.

In Southcentral, Seward received the greatest amount of landings from this set of vessels, was active throughout the entire season (March to November), and displayed the expected peaks in April/May and September/October. Deliveries to Homer were largely focused around May/June, with lesser amounts in August, September, and October. Deliveries to Kodiak displayed the opposite pattern, with only two deliveries in the spring, and the balance occurring from July to early October.

Activity in the western areas did not begin until June, and was generally concluded by August aside from three deliveries to Sand Point in October. King cove received landings in August and September. In the Bering Sea, a small number of deliveries were made to Nome and St. Paul Island during July, August, and September.

[36] Kodiak, Seward, and Homer each received a similar number of landings from Pacific cod trips, with 80% occurring from January to March. Kodiak and Seward received landings only from longline trips, while deliveries to Homer were predominantly made by vessels using pot gear.

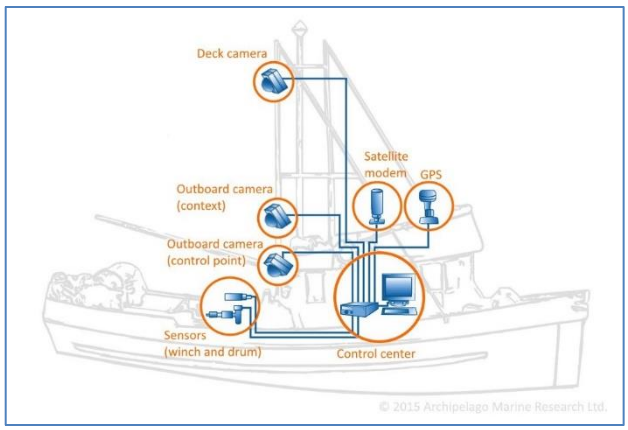
5.7 Background on EM for Alaska fixed-gear fisheries

5.7.1 EM technology in Alaska

In broad terms, electronic monitoring is the use of technology to collect data from fishing vessels. EM can collect a variety of different data, including retained catch, discarded catch, fishing location, and compliance with Federal fisheries regulations. An "EM system" encompasses the spectrum of EM equipment with varying features and capabilities, depending on the specific goal of the monitoring program. An EM system typically consists of a control center to manage the data collection and an array of peripheral sensor components that include: video cameras, GPS receiver, gear sensors, and optionally a communications transceiver (Figure 5-7). The EM system should be a comprehensive data collection platform, designed to record large volumes of sensor and image data, operating autonomously for long periods of time. A typical EM system deployment is shown in Figure 5-8. This analysis anticipates that the EM system will change over time, as technological improvements are made.

Figure 5-7 Example of an electronic monitoring (EM) system

Figure 5-8 Example of an EM system setup



Standard camera EM systems

Pre-implementation EM work in Alaska has focused on testing the "standard camera" EM system for hook-and-line and pot vessels. Section 1.1 provides an overview of the different components of an EM system. Appendix 2 specifies the EM hardware, software, and video review standards that are proposed for 2017 pre-implementation in greater detail.

Video review in 2017 for the hook-and-line fisheries will be undertaken by PSMFC employees using software provided by the EM service provider which integrates the hydraulic sensor and GPS data with the synced video output in order to facilitate identification and recording of trip and haul information (such as start and end times). The software also allows the reviewers to record catch information. Metadata such as GPS location data, dates and times are automatically recorded along with the haul and catch annotations from the reviewers. Video review for the pot fisheries is still to be determined, once an EM contract for the pot fleet has been awarded.

EM technology under development

Stereo cameras with automated image processing

Research and development of new technologies has been in progress within AFSC Observer Program since 2014. The Observer Program is developing a stereo camera EM system that can provide image data sets which develop machine vision algorithms to automate catch event detection, length measurement, and species identification. The EM Team has made significant progress in developing several hardware systems that support automation, including a chute and rail camera system. Machine vision algorithms now support automated processing for catch event detection, length measurement and species identification extracted from camera chute image data. Much progress has also been made for development of machine vision algorithms for the rail camera system, indicating that these systems could greatly improve our ability to monitor fisheries and reduce costs associated with field services, data review, and data storage.

EM lite

The EM Workgroup is considering the utility of deploying sensor systems on vessels that are not deploying cameras, in order to collect positional data about where vessels are fishing. The utility of this information is for catch estimation, when data from EM vessels is applied either to non-selected vessels in the EM pool, or potentially to the broader zero selection pool. In 2017, the Workgroup is also considering testing EM sensor packages (without video components) that could be combined with satellite transmission capacity. The goal would be to determine if this EM configuration could meet a compliance monitoring objective for vessels that want to fish IFQ in multiple areas.

Open source video review software

A NFWF grant is currently supporting a project to develop a suite of complementary software applications that will support EM data acquisition, review, summarization and archival. This software platform will be open source and freely available, allowing any EM implementer to adapt it to their specific needs and requirements. As the number of EM implementations grows, enhancements will be shared with the broader community, lowering the development costs for new implementations.

The software will be designed to be compatible with an array of video formats, and specifications for sensor data formats will be published to encourage interoperability between onboard systems. It is intended to work with hardware ranging from laptop based EM systems with one camera, up to systems with six or more cameras, GPS and VMS integration, hydraulic pressure and reel rotation sensors and sophisticated data encryption protocols. A key constraint to implementation of electronic monitoring in many fisheries is the cost of data review. The use of commodity hardware and open source software will not only significantly reduce the upfront cost of EM implementations, but will also make it less likely for fisheries to become “locked in” to a particular vendor.

5.7.2 EM service providers

This section provides brief summaries of the EM providers currently operating in the U.S.: Archipelago Marine Research, Saltwater Inc., Pacific States Marine Fisheries Commission (PSMFC), EcoTrust Canada, Anchor Lab, and Advanced Fishing Monitoring and Observation Solutions (AFMOS). This information is provided in order to give the reader a sense of the existing marketplace for EM technology and services, and potential for future competition in Alaska. Summaries include a description of each EM provider, examples of previous EM experience, and the type of equipment and technologies utilized, where available. Most of the information below is drawn from the companies’ published materials online.[37] Links to additional EM vendors can be found at www.eminformation.com/vendor-resources. Archipelago, Saltwater, and PSMFC have all participated in EM development work in Alaska for the fixed gear fisheries under the Cooperative Research Plan and the Pre-Implementation Plans in 2014 through 2016, and are represented as service providers on the Council’s Fixed Gear EM Workgroup.

[37] Sources: EcoTrust Canada (http://ecotrust.ca/project/electronic-monitoring);
Archipelago (http://www.archipelago.ca/fisheries-monitoring/electronic-monitoring);
Saltwater (http://www.saltwaterinc.com/electronic-monitoring-overview.html);
Anchor Lab (http://www.anchorlab.dk/EFM.aspx?tab=About);
AFMOS (Letter from member companies to the EM Workgroup).

Archipelago Marine Research provides a complete at-sea electronic monitoring system that is suitable for small inshore fishing boats up to large pelagic vessels. The Archipelago EM system includes a GPS receiver, multiple equipment sensors that are placed on winches, pumps, and lifts, and up to eight digital video cameras linked to an onboard control center. The system includes Archipelago's own EM data logging software which manages and logs fishing activity data while providing wheelhouse crew with a real-time view of key fishing activities on deck. All video, sensor, and GPS data are recorded securely to a portable hard drive, where it can be retrieved once the vessel reaches port and reviewed using proprietary software. Users can encrypt fishing activity data.

Below are two examples of Archipelago's EM work:

1) In the west coast Pacific whiting fishery, Archipelago designed, developed, and managed a program to monitor the shore-based component of the Pacific whiting fishery from 2004 through 2010. The whiting fishery is a high-volume midwater trawl fishery operating off the coast of Washington, Oregon, and northern California. The seven-year EM program was discontinued in 2011 when the groundfish IFQ catch share quota system was implemented along with a requirement for 100% observer-based monitoring of the entire groundfish fleet. In an effort to enable more cost-effective monitoring, the whiting industry requested that NMFS and the Pacific Fishery Management Council restore electronic monitoring within the fleet. In September 2014, PFMC approved an application for an experimental fishing permit (EFP) for the whiting fleet. The EFP provides for a two-year trial EM program with the at-sea and shore-based whiting sectors. Participation in the program is voluntary, and vessels carrying EM systems are exempt from the 100% observer requirement. Archipelago was selected to lead this initiative. Today, Archipelago is working with United Catcher Boats and the Midwater Trawlers Cooperative to provide a cost-effective monitoring program that will inform federal regulators and support EM as a viable monitoring alternative for this fishery in the near future.
2) In the Alaska hook-and-line halibut and sablefish fishery and Pacific cod fishery, Archipelago has contracted with Pacific States Marine Fisheries Commission to provide and install EM systems on volunteer fishing vessels, collect data drives from the vessels, collect dockside monitoring data, collect logbooks, and provide logistical support. Track 1 began in spring of 2014 with deployment of EM systems on nine vessels in two home ports. In 2015, the field work continued, with the deployment of EM systems on 12 volunteer vessels. Activities in 2016 are described elsewhere in this document. In 2014, 36 trips were monitored by Archipelago system components and in 2015, 58 trips were monitored by Archipelago system components.

Saltwater Inc. has provided EM services for a variety of fisheries and gear types. Services have included program design, EM equipment, software, training, field services, and data review. System components include digital cameras that are triggered by hydraulic pressure and magnetic drum sensors. Data is logged and notated with GPS coordinates. Location, time and date stamps appear on every frame. The EM system also includes a secure control box that encrypts data and saves it to removable hard drives. Saltwater Inc. utilizes open source review software that integrates the video and sensor data, and is adaptable to the specific data needs of a particular fishery.

Below are some examples of Saltwater Inc.'s EM projects:

1) In 2014, NMFS finalized new management measures to end overfishing and rebuild bluefin tuna stocks in the western Atlantic. The measures included the introduction of individual bycatch quotas and electronic monitoring of the pelagic hook-and-line fleet targeting tuna and swordfish off the U.S. East Coast, Gulf of Mexico, and Caribbean. NMFS's Highly Migratory Species division selected Saltwater to provide the EM systems and services for this program, including training of technicians and vessel operators, custom equipment and software, and field services. Saltwater installed over 100 EM systems in 2015.

2) Saltwater started working with the North Pacific Fishermen's Association (NPFA) in 2011 to develop an EM solution for small hook-and-line boats fishing for halibut in Alaska. With the input of local fishermen, Saltwater developed and tested an EM system capable of providing video images adequate for catch estimation. The project established local infrastructure, trained technicians, and tested the utility of free, open-license data review software.
3) Since 2013, Saltwater has worked with the North Pacific Fishermen's Association (NPFA) and the NPFMC to develop and field test an EM system for pot gear boats in this GOA Pacific cod fishery. Saltwater has provided stakeholder training, customized EM systems, and data review.

The **Pacific States Marine Fisheries Commission** (PSMFC) is a non-profit interstate compact agency that helps resource agencies and the fishing industry sustainably manage Pacific Ocean resources. PSMFC has no management or regulatory authority, and works as a neutral party. PSMFC's mission statement is "to promote the better utilization of fisheries – marine, shell, and anadromous, which are of mutual concern, and to develop a joint program of protection and prevention of physical waste of such fisheries in all of those areas of the Pacific Ocean over which the compacting states jointly or separately now have or may hereafter acquire jurisdiction," and the Commission works in California, Oregon, Washington, Idaho and Alaska. PSMFC coordinates research activities, monitors fishing activities, collects data and maintains databases for fishery managers and the fishing industry, and facilitates a variety of projects. PSFMC also acts as a primary contractor on grants and projects for states and other organizations, and disperses monetary assets from a variety of federal, state, and other resources.[38]

PSMFC launched an EM program in 2012, and has been involved in projects on the West Coast and in Alaska. PSMFC's responsibilities in these EM projects include: video and sensor data review, data analysis, logbook data entry, and transfer of total catch accounting data to NMFS for IFQ account debiting and in-season management. The EM group at PSMFC includes four video reviewers, a data analyst, a logbook data entry technician, and a program manager.

Below are two examples of PSMFC's EM projects:

1) In anticipation of the Pacific Fishery Management Council's consideration of EM as a compliance monitoring tool in the newly implemented Pacific Trawl Rationalization Program, PSMFC began its EM program in 2012. Exempted Fishing Permits (EFPs) allowed the use of EM in-lieu of an onboard human compliance monitor in the West Coast whiting, fixed gear, and bottom trawl fleets beginning in 2015, and EM is expected to go into regulation beginning in 2017 for compliance monitoring of the West Coast whiting and fixed gear fleets, while testing continues for the bottom trawl fleet.
2) Since 2014, PSMFC has been working with NMFS in Alaska to test EM on small hook-and-line vessels. Under grants from NMFS and NFWF, PSMFC manages the EM service provider contract for Alaska cooperative research and pre-implementation, and conducts all data review.

EcoTrust Canada is a designated service provider in Canada, delivering electronic monitoring, at-sea and dockside observer monitoring, and observer training programs. EcoTrust Canada developed a system that can be adapted for most fisheries, with the goal of improving communities' ability to pursue environmentally and economically sustainable livelihoods. As noted on the company website, EcoTrust Canada EM systems collect high quality data, support collaborative fisheries management, engages fishermen in reporting fishing activity and stock status, and promotes socially, economically, and environmentally sustainable fishing communities. EM equipment utilized by EcoTrust Canada includes two to four camera systems to capture fishing activity, allow species classification, and capture weight estimates of observed catch. EcoTrust Canada utilizes additional fishing activity sensors, including

[38] http://www.psmfc.org/psmfc-info

hydraulic pressure sensors or other sensors that begin data collection when fishing activity is detected. GPS receivers add time and location to other sensor data. The EM control box and a monitor allows fishermen to enter logbook data and check the sensors' status.

EcoTrust Canada has provided EM systems for several fisheries. Below are two examples:

1) In 2012, EcoTrust Canada began working with the Gulf of Maine Research Institute, The Nature Conservancy, and the Maine Coast Fishermen's Association to adapt EcoTrust Canada's existing EM equipment and services for the New England groundfish fishery. The goal of this project is to operationalize and refine EcoTrust Canada's EM system to either support or replace the NMFS At-Sea Monitor program. In Year 1, EcoTrust Canada adapted their EM software and hardware to use on gillnetters and trawlers, and sent the system out for trial runs on two Maine Coast Fishermen's Association vessels. In Year 2, EcoTrust Canada expanded their trial to seven vessels, collecting information on the fleet's technical needs. For Year 3, EcoTrust Canada plans to explore further system adaptations based on proposed regulatory changes and to pursue NMFS approval as a designated service provider.
2) EcoTrust Canada is also working with the Quinault Indian Nation's Dungeness crab fleet in the State of Washington to help track crab pot deployment numbers and locations, limit illegal activity, and gain more information about crab population trends and movements. As strings of traps are set and retrieved, an onboard scanner reads an RFID chip that has been embedded in marker buoys. With each scan, an EcoTrust Canada computer records time, location, and gear data giving fisheries managers data on crab fishing locations, effort, regulatory compliance, and biology. Three Quinault vessels piloted the program in 2014. One year later, the whole Quinault fleet is sporting Ecotrust Canada's EM boxes.

Anchor Lab is a software company based in Copenhagen, Denmark that specializes in data collection and analysis tools for scientific and monitoring applications. Anchor Lab supplies EM systems for a number of fisheries. Their systems are customized and configured to meet the varying requirements of monitoring different fisheries. They provide automated data collection tailored to individual vessels, and tools for analysis of fishing activities and onboard procedures to include catch handling and processing procedures, gear setting and retrieval, and discard activities. Anchor Lab's EM system includes IP cameras with a Power over Ethernet (PoE) switch, removable hard-drives, communication modules for 4G/LTE & WIFI, and built in GPS. The communication system can be set up to automatically transfer completed video files to land-based servers.

One of Anchor Lab's EM projects system is the common mussel fishery in Denmark. Vessels in this fishery are required to be fitted with a sensor system. The fishery has approximately 51 dredge vessels. The EM system has been installed on vessels in the fishery since April 2012. The system is designed to monitor where and when fishing takes place, since the mussel fishery is conducted in sensitive marine areas. Data is recorded every 10 seconds and is downloaded in near-real time through the Global System of Mobile Communications (GSM) network.

Advanced Fishing Monitoring and Observation Solutions (AFMOS) is composed of three separate companies: Olrac SPS, Marine Instruments, and A.I.S. Inc. AFMOS was formed to provide electronic monitoring and reporting services for commercial fishing fleets. AFMOS can provide an EM system that links high definition images with activities in a fisherman's electronic logbook for compliance monitoring. The EM system uses high definition, automatic rapid frame photography instead of video to reduce data volume. The system includes a partially automated audit system to review the photographs and flag potential violations. The system can be configured wirelessly, potentially reducing installation time and cost while also minimizing modifications to the vessel.

Olrac SPS is an international company that provides analytical and technical support to the commercial fishing industry to utilize electronic logbook software. Olrac SPS is represented in the U.S. by Olrac North America East, an operating division of the Atlantic Offshore Lobstermen's Association. Olrac is a NMFS GARFO certified eVTR provider. OLRAC has consulted on most of the major fishing groups in South Africa and has, in the past, consulted in Namibia.

Marine Instruments is a Spanish firm that develops and manufactures marine electronic systems including tracking and remote monitoring products for marine environments. One of Marine Instrument's products is the Electronic Eye system, which utilizes high definition still photography to capture detailed images and reduces data loads. These still images can be automatically linked to e-logbook data collected using the Olrac software system in an EM/ER configuration, or can be used as a standalone EM system.

A.I.S. Inc. is based in Marion, Massachusetts with offices in Seattle, Washington, and Anchorage, Alaska. The company has over 25 years of experience providing project management, logistics support, and fisheries data collection services to government agencies and the commercial fishing industry. They are contracted by NMFS AFSC FMA to provide observer services. As part of AFMOS, A.I.S., Inc. will provide local project management services for deployment of EM systems in the U.S. This includes coordination with industry and managers, monitoring plan development, system installation and servicing, image processing, and data storage.

5.7.3 Cooperative research and pre-implementation

5.7.3.1 Summary of Alaska Fixed Gear EM development

The Council has been actively considering the use of electronic monitoring as part of the suite of fishery monitoring tools since the development of an analysis to restructure the Observer Program, on which the Council took final action in 2010, and which was implemented in 2013. Since that time, the Council, the agency, and industry members have all been active in the development of EM. The Council identified their initial priority for developing camera systems, targeting a monitoring option for vessels 40-57.5 feet in length, which have difficulty accommodating a human observer onboard.

The Council created a Fixed Gear EM Workgroup in April 2014, as a forum for all stakeholders to work together on EM development. The purpose of the Workgroup is to cooperatively and collaboratively design, test, and develop EM systems that are consistent with Council goals to integrate EM into the Observer Program. The Workgroup's Cooperative Research Plan, effective in 2015, was the first effort to bring together various EM pilot testing work that had been done previously, and begin to test systems designed to assess the efficacy of EM for catch accounting of retained and discarded catch. The research plan also helped to identify key decision points related to operationalizing and integrating EM systems into the Observer Program for fixed gear vessels. This morphed into a Pre-implementation Plan for 40-57.5 foot hook-and-line vessels in 2016, which continued to include research elements for other gear types, different EM equipment, and other hook-and-line size classes. In 2017, the Workgroup is recommending a pre-implementation program for any hook-and-line and pot vessels greater than 40 feet. With the creation of a concerted EM development fieldwork program, the Council and NMFS scaled back (2015) and eventually rescinded (2016) the granting of conditional release waivers to vessels having trouble accommodating a human observer, as the EM selection pool provided an alternative for those vessels.

The Workgroup established a process whereby new technology or program elements should be first field-tested for workability, and then more broadly operationally-tested in a pre-implementation environment. In this way, the Workgroup can evaluate whether a program element is conducive to deployment on the diversity of fixed gear vessels, by different operators employing individual fishing patterns. This process also allows for continued research and development, both of new technologies, and deploying EM gradually into different sectors of the fixed gear fleet.

The development of an EM analysis and regulatory amendment is linked to the research and pre-implementation plans, as these field efforts help to identify the appropriate questions for informing implementation decisions and Council alternatives for how EM can be used in a comprehensive monitoring plan. Even though the current EM development effort has focused on the Council's initial priority of small hook-and-line vessels that have difficulty in carrying a human observer, the analysis has broadened to address a regulatory change applying to all fixed gear vessels. The EM program design elements and sampling techniques are conceptually similar on all fixed gear vessels, although distinct from those of trawl vessels.

5.7.3.2 Existing Program Capacity

Since the Alaska fixed-gear EM cooperative research plan was put into place in 2014, NOAA, NMFS, PSMFC, grant funders, and industry participants have invested time, money, and human capital in the development of EM infrastructure. Investments in hardware, fleet outreach and education, and training of local service technicians will have put the program in a position to achieve a much smoother integration once a regulatory amendment package is approved. These investments will also reduce the cost of the program by creating an initial stock of EM hardware and several local pools of qualified labor without tapping into the Observer Program's fee-based budget for these items in the initial year or years of the integrated program.

As detailed in later sections of this document, some costs of the integrated program will be paid through the EM service contract. Those costs include hardware and field support services, and could include video review and data storage depending on decisions yet to be made by the Council (refer to Section 3.2). Costs that are paid through the service contract accrue to the estimates of the program's unit costs (per vessel, per trip, and per sea-day) that can be used for a coarse comparison to the cost of deploying human observers. Other cost factors that are paid for out of NMFS's overhead budget do not accrue to the estimated daily cost of EM coverage, but are nonetheless important because additional costs to support EM draw down the agency's limited resources to complete the overall mission of collecting and integrating data for management.

Table 5-22 provides a count of hardware items that are currently "in the program" (i.e., purchased by NMFS) as of July 2016, and planned purchases to support the 2017 Pre-Implementation Plan. This count only includes items that are part of the hook-and-line EM contract with AMR. The right-hand column of the table shows the sum of hardware units that have been purchased and are planned to be purchased and installed using start-up funds. The installation field work will lower the cost of the program at the point of EM integration. The most current information available indicates that the hook-and-line EM program has acquired 16 control centers and a variety of peripheral components, to date; the odd numbers in Table 5-22 reflect the fact that AMR maintains a stock of back-up components that are distributed across EM service ports. Not all EM vessels will use the same set of peripherals, but the analysts understand that this inventory was compiled to support a hook-and-line EM fleet of around 30 vessels in 2016, and a fleet of up to 90 hook-and-line vessels in 2017. The typical set of peripheral hardware items includes: network switch, monitor, keyboard, GPS unit, sleep sensor, and two pressure sensors.

In addition to purchasing hardware inventory, the AMR contract for 2015 and 2016 included travel and labor costs that went towards installing EM systems on vessels. Installation during the pre-implementation phase, or "pre-wiring," reduces future costs as some vessels will be prepared for EM deployment after only the relatively minor cost of hooking up a control center to the peripheral package and checking camera angles and sensor/software function. Even in the limit, pre-wiring vessels for EM does not guarantee that future reinstallation time and labor costs are minimized to the same degree across the fleet. Some vessels that underwent installation or re-installation after being selected for EM coverage in the first part of 2016 have had to have the hardware removed as the vessel reconfigured for salmon seining or other activities (this is most often the case for vessels that use a shelter deck in their hook-and-line configuration). The contracted hook-and-line EM service provider reported that 27 hook-and-line vessels were installed and wired with EM systems as of July 2016, though whether a portion of that group will have equipment removed at some point during the fishing year remains to be seen.[39] Field services to install and re-install equipment will be required throughout the life of the program, and the actual cost will vary across vessels on a case-by-case basis. The costliness of that field service, however, will be lower than it otherwise would have been due to the technical capacity gained during the pre-implementation years. During the pre-implementation phase, service providers are combining installation work with fleet outreach and education. The analysts presume that field service costs will decline over time before reaching some floor, as fewer of the service providers technicians are required to fly out to remote or hub EM service ports to perform what will become routine operations. The program will have a running start on that cost-saving path by the time full EM integration arrives.

Looking ahead, the program expects to have an inventory of 60 AMR control centers for 2017, when the size of the hook-and-line EM pool is anticipated to be 90 vessels. Having a large stock of control centers is both an investment in capacity for a potentially growing EM fleet, and a move that uses pre-implementation funds to pay into future costs that would be a draw on the budget for purchasing EM service and observer-days if the hardware was not acquired under existing grants. Building up hardware capacity also gives the Council the option to recommend a trip-selection model for EM in 2017 or in future years, rather than a model where vessels are selected to carry EM on all trips during the course of several months. Trip-selection would only be feasible if the program has a sufficient number of control centers that can be rotated quickly among vessels in the same port.

Throughout the remainder of 2016 and during the 2017 pre-implementation year, the EM provider plans to use its available budget to pre-wire vessels to the extent that time and vessel cooperation allows. Building up a fleet of vessels that is ready to carry EM systems upon selection without undergoing a day or more of installation and testing will smooth the deployment model and reduce costs in terms of travel, labor, and vessel operators’ time. The amount of pre-wiring that will be achieved is not known at this time.

While purchasing hardware inventory during the grant-funded pre-implementation years is unequivocally beneficial for the integrated program’s operating cost profile, one must also consider that equipment begins to depreciate as soon as it is deployed. Using start-up funds to purchase and deploy hardware as the program develops means that individual units will be at different points in their lifespan when the program is implemented and hardware costs are shifted to the Observer Program budget. For this reason, the cost estimation exercises that appear later in this analysis rely on annualized hardware costs (purchase price divided by expected lifespan).

[39] The 2016 Pre-Implementation plan calls for 30 longline vessels to be selected over the full course of the year, which is ongoing.

Table 5-22 Inventory of Archipelago EM equipment for hook-and-line sector that has been, or is expected to be, available for use in the program (current, end of 2016, 2017)

Components	Total # In Project for 2016	Projected Equipment Installed at Year End 2016	Projected Total Inventory for 2017*
Control Center	16	n/a (removed end fishing)	60
Camera Sets	31	30	90
Network Switches	43	30	103
Monitors	42	30	102
Keyboards	44	30	104
Pressure Sensors**	70	40	120
GPS	41	30	99
Sleep sensors***	25	18	67

Source: AMR, 2016. Personal communication.

* Includes equipment installed in 2016 and equipment budgeted for purchase in 2017.
** For vessels that do not have line drums, two pressure sensors will be installed.
** Not all vessels have sleep sensors. Several operators declined them, some stating that they do not require a sensor because the engine remains on at night.

The number of systems installed on pot vessels throughout 2016 and in 2017 depends on the release of grant funds, the timing and amount of which is unknown at this time. SWI deployed EM systems on three pot vessels during the 2016 Pacific cod A season, testing methods to determine the weights of fish via video; that field work was completed in April. The draft 2017 Pre-Implementation plan calls for a pool of 30 pot vessels. If that goal is met, the analysts presume that the program will be in possession of up to 30 complete pot EM systems. The Pre-Implementation plan for the pot sector does not call for the rotation of control centers between vessels upon selection because taking vessels off the water during the shorter, competitive limited access seasons in order to install equipment would be a strong disincentive to joining the program.

Aside from hardware purchasing, both sectors of the EM program should benefit from the management and administrative infrastructure that is being developed during the pre-implementation phase. NMFS staff is currently developing the software applications that are required for timely integration EM data into the Catch Accounting System.

Since 2014, NMFS and FMA staff have made EM education part of their routine Observer Program outreach curriculum. Similarly, AMR and SWI have spent a proportion of their field time on training and educating local technicians and skippers than they are likely to be spending under a fully integrated program. Skippers and crew are building familiarity with EM technology, troubleshooting, routine maintenance, operator responsibilities, and filling out EM logbooks. Providers have spent time administering skipper debrief surveys, which feed into the iterative process of refining the hardware to the point where it can be as effective without unnecessary components that entail costs and require additional maintenance.[40] While time and travel incurred by AMR are the only pre-implementation costs that would have accrued to the cost estimates if the existing program in this analysis, all capacity-building efforts are cost-saving for the integrated program in the medium- to long-term.

The ultimate impact of investment and capacity building during the pre-implementation phase is subject to some uncertainty. The composition of the EM fleet will vary from year to year, and could include a larger or smaller number of vessels and a varying proportion of vessels that do not capture the full benefit of pre-wiring because their deck configurations change throughout the year (e.g., vessels that switch to

[40] To date, skipper feedback has informed camera angles, highlighted power system concerns, and identified sources of superfluous video recording that can drive up data storage and video review costs.

salmon seining, or that participate in both pot and hook-and-line fisheries). Also, the particulars of the EM provider contract for the implemented program are yet to be determined. Investments that have been made in a certain type of proprietary hardware or software might yield lesser benefits if a new provider enters the program and systems are incompatible.

5.7.4 Description of cost factors for EM

The Alaska Region Electronic Technologies Implementation Plan underlines the importance of defining a program's goals and objectives, and the means by which they will be accomplished, before the required cost and infrastructure can be fully understood (NMFS/FMA 2015, p.18). The cost profile of an EM program is determined by five broad categories of program design elements: technology, field services, data services, administration, and vessel responsibilities. This analysis groups the first four categories as "monetary costs" and defines the fifth as a set of largely "non-monetary" costs, though the latter is likely a misnomer, as described in Section 5.7.4.2. The following paragraphs introduce some vocabulary for how the analysts have conceptualized EM cost factors: Fixed vs. Variable costs, Startup vs. Ongoing costs, cost trajectory, and uncertainty regarding program design.

Any given category contains a mix of variable costs and fixed costs. Variable costs scale positively with the amount of activity in the program or the amount of services provided. For example, increasing the size of the EM fleet or the selection rate increases the need for hardware and service. Similarly, a greater amount of fishing effort (trips) would increase the shipping cost associated with submission of removable hard drives to the video reviewer. Fixed costs can be thought of as overhead, and their unit cost might actually decrease as more vessels or join the EM fleet or take more trips. For example, implementation of the EM program will create new tasks for NMFS administrative and management staff, but the work involved in those tasks does not vary according to the size of, or effort in, the stratum. Some variable costs can be treated like fixed costs in the specific context of this program. Those are costs that scale positively, but not linearly, with EM activity. For example, the cost of providing field services increases alongside the number of vessels in the EM fleet, but does not do so in a linear manner. Establishing in-port services is costly on a marginal basis (a new technician must be hired and trained), but that cost is not substantially altered if 12 EM vessels operate out of that port as opposed to 11. Following similar logic, reviewing and extra hour of video data should have a specific marginal cost based on the hourly rate of labor compensation, and video review *would* be treated as a variable cost if this analysis estimated review cost in terms of hours spent reviewing video. However, in reality, the organization that has been responsible for video review to-date (PSMFC) deploys its labor capital in a manner that is better characterized as a fixed-cost.[41]

Cost factors can also be categorized by those that are one-time ("startup") costs, periodic costs, and ongoing costs. Startup costs tend to be overhead costs or fixed costs of management, such as reprogramming aspects of the Catch Accounting System. A large proportion of startup costs will be absorbed during the pre-implementation years of the program, and thus should not factor into the annual program operating costs that make for a coarse comparison to the cost of human observers. Other startup costs might include investments in capacity building, such as hiring and training field service or video review staff. As is often the case, building human capacity does not fit neatly into a start-up or ongoing cost category; while hiring and training costs will be greatest at the outset of the program, labor turnover will necessitate periodic but unpredictable waves of spending. Some cost factors are predictably periodic,

[41] PSMFC maintains a professional staff of video reviewers who service multiple EM programs (Alaska fixed-gear, and other). Those staff also complete non-EM tasks that are essential to PSMFC's mission. The required amount of video review varies throughout the year, but constantly adding and subtracting staff is a costly and inefficient way to manage labor capacity. Rather, PSMFC determines how many video reviewers it needs to employ in order to service the Alaska EM program with the appropriate timeliness, and counts that labor cost in full-time equivalents (FTE). Were the Alaska EM program to increase in size and effort beyond a certain threshold, the cost of video review would display a quantum leap in terms of a 0.5 or 1.0 FTE. See further discussion in Section 5.7.4.1.3.

meaning that costs occur at predictable intervals. Hardware will need to be replaced or upgraded on a regular basis. Using assumed depreciation rates, periodic costs can be translated into ongoing (annual) costs. Finally, ongoing costs are the simplest form of variable costs that scale with the amount of activity in the EM program. Field service costs such as the rotation of EM control centers among vessels or the shipping of hard drives are constantly occurred, though the amount of the cost depends on the fleet's level of activity and on program design choices such as the selection rate for EM coverage in each year's ADP.

Cost factors that are otherwise similar might have a different trajectory over time. For example, field support services and video review could both be described as ongoing and semi-variable program costs. Factors that fall under the field support category might be assumed to decrease as the program matures because knowledge and technical capacity will improve with experience; as a result, the EM service provider could achieve the same results with fewer fly-out trips to train individuals or perform installation and maintenance. Video review costs might decrease with time as software improves, or as reviewers gain experience identifying the mix of species in Alaska fixed-gear fisheries. The cost of these program elements are almost certain to change over time, and the rates of change are likely to be different. In general, the analysts assume that costs will decrease over time as the program moves past startup costs and as implementation inefficiencies are overcome.

Finally, there are many program design choices that will affect the implemented program's cost profile, but are yet to be made or will be constantly reevaluated over the life of the program. The analysts refer to these as cost uncertainties. These uncertainties are noted throughout the following subsections, and they exist at all levels. Some uncertainties relate to the program's data objectives (counting discards, estimating discard weight, or auditing vessel logbooks for compliance); others relate to the service delivery model (number of EM service providers, number of EM service ports); other relate to deployment strategies (vessel selection vs. trip selection, or rates of video review); while others might occur at a finer scale (responsibility for retrieving hard drives, data storage requirements, or requirement to cease fishing in poor lighting conditions or in the case of equipment failure). Elements that were thought to having a declining cost trajectory over time might behave differently as the objectives or design of the program is redefined.

For all the reasons described above, the analysts express great reservation about estimating the cost of the EM program in terms of annual costs per vessel, per trip, or per sea-day. Such unit cost estimates conflate fixed/variable costs and one-time/ongoing costs, ignore the trajectory of cost factors over time and program maturity, and are too simplistic to recognize the cost impact of program design choices that are yet to be made (uncertainties).

The following sections describe each category of cost factors in turn, and a table that summarizes the trajectory of, and uncertainty surrounding, key monetary cost items (Table 5-26).

5.7.4.1 Monetary Costs

5.7.4.1.1 Hardware/Software

A subgroup within the EM Workgroup has convened to define the requirements for EM hardware and software in the Alaska fixed-gear program (Appendix 2). Those definitions will be part of the 2017 Pre-Implementation plan moving forward. The group of vessel operators, EM service providers, and NMFS staff set minimum hardware standards for control centers, video monitors, rail/deck cameras, sea bird cameras, hydraulic pressure sensors, drum rotation sensors, engine operation sensors, GPS. Providers must also supply at least one removable hard drive and a backup hard drive. Minimum EM system software requirements address the user interface, function test, independent camera activation, geo-fencing, sensor configurations, engine sleep sensors, system security, and data encryption. EM review software requirements are defined to ensure that PSMFC or another reviewer can accomplish certain protocols efficiently, and that data can be exported and archived securely.

The analysts are unable to provide an itemized price list for EM hardware components and per-vessel software licenses, due to business confidentiality restrictions. The cost estimation exercises included in Section 5.8 rely heavily on a published table[42] developed by NMFS as an update to the 2015 Alaska Region Electronic Technologies Implementation Plan (NMFS/FMA 2015). That table places the cost of an EM control center around $6,000 to $6,500 per unit, and the cost of a camera/sensor/peripheral package around $3,200 to $4,500. In sum, the total price of an EM system in 2016 is around $9,000 to $11,000. To estimate the cost of the EM program in 2016, the analysts are using the lower-end estimates, but noting the range. The actual cost of an EM system varies not only according to price points for required core components, but by the addition and subtraction of peripheral components. Some components that are presumably priced into the published package costs might not be necessary on all vessels.[43] Additional components might be developed, or added to the data collection protocols in the future. One such component that has been discussed at the workgroup level but is not part of the pre-implementation package is a data-logger; that device would record fishing effort using sensor data (no video) on vessels that are wired but are not selected for coverage on that trip. Another such component is a set of radio frequency identification (RFID) tags and scanners, which are being tested on pot gear vessels as a means to help video reviewers decrease review time by identifying catch events.

The total cost of software licenses will scale with the number of EM vessels that operate in a given year. The best information available on license costs come from the table mentioned above; licenses plus hard drives and "other supplies" are estimated at $24,700 for a fleet of 90 hook-and-line vessels. This figure is difficult to pull apart, because it combines annual license costs with semi-durable capital costs that would be amortized over several years (hard drives and supplies). The analysts presume that the individual license cost must be somewhat higher than simply dividing $24,700 (or some portion thereof) by 90, because licenses would only be required for the subset of the EM fleet that is actually selected to carry a system. The number of control centers used in the program (30 to 60) would provide a better denominator, placing the unconfirmed annual license cost in the range of $500 to $700 per vessel.

Over time, and potentially through competition, it is likely that these costs will either be marginally reduced or remain steady while providing greater performance. The influence of competition will greatly depend on how the EM provider contracting process is defined. Even if multiple EM systems are available within the program, the benefit in terms of competition and cost savings might be slow to develop because EM systems run on proprietary software. New alternatives might not be compatible with the existing hardware in which the program has already invested.

The Council's existing plan for EM is set up such that NMFS is effectively purchasing EM hardware, as opposed to leasing it on an annual basis. NMFS would be paying for the cost of depreciation in either case, but a purchase model allows for cost-saving opportunities such as leaving equipment installed on vessels between periods or trips where the vessel is selected for EM coverage.[44] Under the advice of industry, the lifespan of EM systems and components is assumed to be five years. While some systems could last longer, this term accounts for breakage and the need to phase in newer technologies. Whether these assumptions reflect reality is a source of uncertainty when estimating the annual cost of the program.

[42] Available at http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Revised_EM_ImplementationPlan_Budget.pdf.
[43] Several pre-implementation vessels have declined engine sleep sensors, which are intended to shut down the control center when the engine is off in order to avoid battery drain, because the operator does not shut off the engine while at sea.
[44] The west coast's EM program for the Pacific whiting fishery experimented with a hardware lease model during the program development stage, and a 2014 analysis concluded that leasing drove up overall program costs by as much as 20% (AMR 2014).

Hardware and software licensing costs are variable costs, meaning that expenditures would increase as the number of vessels in the stratum increases. A large increase in the size of the EM pool is possible, though not a certainty, if the EM stratum is opened up to vessels smaller than 40' LOA. Purchasing additional components and licenses would increase the cost of the EM program, though the amount that total costs would rise depends on the actual rate of hardware depreciation (which determines the annualized hardware cost). Whether or not larger expenditures on EM hardware increase the total cost of the partial coverage category (including EM and human observers) depends on the extent to which integrating the EM program reduces demand for observer-days, and whether EM is a more cost effective method of collecting data. These issues are discussed further in Section 5.8.

Finally, the general discussion of impacts on vessel operators in Section 5.8 considers the fact that some monetary hardware costs fall outside of the components that NMFS will purchase through the EM provider contract using industry monitoring fees. Individual operators might need to purchase ancillary hardware items to comply with their individual vessel monitoring plan (VMP). Operators who have participated in the cooperative research and pre-implementation phases of the Alaska EM program have expressed the most concern with needing to upgrade their vessel's power supply to accommodate additional electronic systems. New technologies, some of which are already in development, could be based on wireless technologies. Among the other benefits of these systems, technicians might need to install fewer peripherals, and might not need to make as many physical alterations to the vessel.

5.7.4.1.2 Field Support Services

The same EM Workgroup subgroup that defined hardware and software standards has also defined a minimum standard of field services that a contracted EM provider would need to offer. These standards address the number of primary EM ports in which trained technicians would be stationed[45], length of time after notice in which installation services must be provided, provision of remote and on-site technical support, and the provider's role in developing and approving individual VMPs in a timely manner. Field service technicians will also participate in the information feedback loop, correcting operators' technical and duty-of-care responsibilities that affect data quality and compliance (recording times, sensor performance, and catch handling procedures, to name a few).

The primary factors that drive field service costs include the EM service contract holder's time and travel to train local EM technicians, the labor of in-port service technicians, and travel to "remote" ports to provide all manner of service (installation, re-installation, and maintenance/repair). Depending on how the Council defines vessel operator responsibilities, service costs could also include the collection of hard drives containing EM video data. The service cost profile for an EM program varies along three dimensions: time (capacity-building; fleet learning), program design choices (extent of service provided; where investments in local EM service capacity are made), and the demographics, effort levels, and distribution of fishing over the calendar year for the vessels that opt into the EM stratum. The table referenced in footnote 42 provides the only publicly available information on the present scale of those operational costs, which are summarized below in Table 5-23. The original table was developed while looking forward to an EM fleet of 90 hook-and-line vessels and 30 pot vessels in the 2017 pre-implementation year. It bears repeating that the pre-implementation plans are designed with a primary focus on capacity building rather than cost control. In summarizing, the analysts had to make assumptions about whether "labor" costs for installation, maintenance, and repair include travel on the pot side, and whether travel costs on the hook-and-line side include fly-out service for installation by AMR's Victoria,

[45] The offering of EM service ports might evolve or grow as the program matures. The 2017 Pre-Implementation Plan calls for AMR longline technicians in Sitka, Homer, and Kodiak, with Kodiak being a new addition to the 2016 plan. It also calls for SWI pot technicians in Kodiak and Dutch Harbor. The number and location of service ports on an annual basis will be driven by the demographics of the EM fleet and by budget constraints.

BC-based professionals. In regards to FTE labor salaries, it appears that the pot sector's estimate was built off of the hook-and-line estimate of $106,000 ($106,000 * 2.25 FTE = $238,500). Moving forward, this analysis uses the benchmark of $106,000 per year for a full-time program manager position, and $70,000 per year for a full-time in-port service technician ($210,000 / 3 FTE = $70,000). Presuming that these FTE cost levels include both salary and benefits, it is possible that the figures in the table underestimate manager-level compensation ($106,000). The cost analysis exercise in Section 5.8.2.2 of this document models field service costs at both this reported level and at a higher level.

Table 5-23 Estimated field support costs for 2017 EM pre-implementation program

	LL	Pot
# Vessels	90	30
Labor - Mgmt.	$106,201 (1 FTE)	$238,500 (2.25 FTE combined)
Labor - Port Service	$210,000 (3 FTE)	
Travel (Mgmt./Service/ Installation)	$35,000	$52,500 (termed as "labor")*
Technician Training (Labor, Travel, Materials)	$25,000	$55,000
Equipment Shipping	$20,000	$12,000

Source: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Revised_EM_ImplementationPlan_Budget.pdf
* Assumed to include travel costs

A developing EM program has a higher service cost profile than one that has been in operation for several years. New programs require a greater amount of travel by the EM service provider's core professional staff. Over time, travel costs should decline as service capabilities are developed in hub ports, and as vessel operators advance their own knowledge of EM hardware and software. However, reductions in travel costs might be mitigated if the demographic profile of the EM stratum in a particular year includes relatively more vessels operating out of remote ports. New programs also require more labor time and, potentially, travel to perform initial hardware installations. Mature programs should feature a larger portion of the fleet that is pre-wired, albeit to varying degrees, and would not require a full installation upon being selected for coverage.

To provide a sense of the level of field service required for a developing program, AMR employees and in-port service technicians completed the following tasks over the first six months of the 2016 hook-and-line EM pre-implementation program: new system installations, re-installations, system removals, control center removals, camera service, camera view changes/troubleshooting, software updates/adjustments, and data retrieval. These tasks took place in Sitka, Homer, Kodiak, Seward, Juneau, Petersburg, and Sand Point. Sitka and Homer were EM service ports in 2016, and Kodiak will be staffed with an in-port technician in 2017. Eight of 44 total service events occurred during the first vessel selection period (January/February), and 36 occurred in the second period (March through June). Thirty-four of the 44 events took place in ports that will have locally trained technicians in 2017. Overall, 285 hours of labor were performed, 62% of which occurred in 2016 EM service ports (Sitka and Homer). The total amount of technician travel time logged was 161.5 hours, all of which were related to new system installations, re-installations in non-service ports, and troubleshooting cameras in non-service ports (two service events required AMR staff to travel from British Columbia to non-service ports). Three of the 11 service events that required technicians to log travel hours occurred in Kodiak (52 travel hours), which will be an EM service port beginning in 2017. The analysts do not recommend extrapolating pre-implementation service time data by vessel count to estimate the demands of a certain fleet size, as 2015 and 2016 include a great deal of learning on the part of the provider and the vessel operators. Working with a new fleet in a research-focused program involves many idiosyncrasies; for example, a vessel that pulled out of the EM stratum part-way through an install when the operator realized that he did not plan to participate in fisheries that would be subject to observer selection.

AMR has compiled data on the amount of labor time spent on different field service tasks during the 2015 and 2016 pre-implementation years. This information provides valuable context, but one should also note that this experience reflects a new program under development. Over the course of time, operator and technician experience could reduce the amount of time required for major service events, and the number of service orders is likely to decline on a per-vessel basis (though the total number of service calls will remain a function of EM fleet size). Time costs do not necessarily capture the budget cost of service, as events taking place in non-hub ports will require a technician to travel.

- The average system installation time over 27 events was 16.5 hours (median: 18, minimum: 8.5, maximum: 22).
- Three re-installations on vessels that had participated in 2015 took 4 to 10 hours. Wiring, GPS, and sensors were already in place. The two events that were "routine" re-installations were similar in time (4 to 5.5 hours).
- Comprehensive equipment removals took roughly 2.5 hours. This service event includes the removal of the control center, all cameras, and the monitor/keyboard. This type of removal might occur less frequently as the program matures, but could still occur on vessels that reconfigure their decks mid-year to participate in other fisheries. Simple control center removals – typically paired with data retrieval – took 0.25 to 0.5 hours. Control center removals will remain a key feature of the service cost profile. The number of such events will scale with the size of the EM stratum and the selection rate, and will depend on the deployment model (trip vs. vessel selection).
- Simple data retrieval usually took 0.25 to 1 hour, though most retrieval service orders during the research phase of the program (small number of vessels, all of which were new to the program) were combined with other service events such as camera adjustments or software updates.
- Camera service and troubleshooting events displayed a wider range of labor times. Service events typically involved view adjustments, fixing cable connections, and draining moisture from the hauler camera. Most events required 1 to 2.5 hours. Simple camera view adjustments required 0.5 hours or less. On the high end, an event that involved a custom built telescoping boom mount on a vessel with a shelter deck required 9 hours. Over time, one would expect these events to take less time as the provider gains experience with the particulars of the Alaska fixed-gear fleet, but some vessels will always be outliers.
- Software updates and adjustments to sensor settings (recording triggers) typically took 0.5 to 1 hour.

Due to the smaller scale of its pot vessel EM research to date, SWI has not published or shared extensive records of service events. However, SWI's 2015 technical report (Buckelew 2015) includes a program cost model that presumes certain types and frequencies of service events. Their own characterization of the need for service in a hypothetical EM pot gear sector consisting of 55 vessels across seven ports includes the following:

- 10 hours per installation (includes scheduling, vessel assessment/VMP, equipment installation, and skipper/crew training)
- 1.5 hours per data retrieval and routine service (includes retrieval by in-port technician, system function test, basic maintenance, shipping, uploading data and scrubbing hard drives for reuse; SWI notes that this service cost would be lower if skippers remove and mail hard drives, but that doing so removes an opportunity for feedback on data quality and technical support).

- 4 hours of technical support/service by in-port technicians per vessel for 25% of the fleet (56 hours total)
- 2 to 4 days "fly-out" service labor/travel per vessel for 10% of the fleet (~11 to 22 days total)

The costs of several field service elements are likely to decrease as the fleet gains experience and as technological developments occur. In the broadest sense, field service costs are driven by the amount of human "touch time" that is required. Those costs are exacerbated when in-person service requires travel. Investing in local technical capacity costs money (FTE compensation), but can be cost-saving if it reduces travel; the proper level of investment will only be apparent once the size and demographics of the EM fleet comes into focus. Automation of technical diagnostics and the ability to update or configure software remotely should reduce the amount and complexity of service calls. Automating data transmission would eliminate one field service task, though likely not enough to affect the total annual field service cost profile if it is mainly denominated in terms of FTEs. One can presume with certainty – aside from any technological development that may or may not occur – that the field service costs associated with hardware installations will decrease over time, though that trajectory might not turn downwards until several years into the program when a "base" EM fleet has established itself and been pre-wired to the point where a selected vessel only needs to hook up a control center and check camera placements before deploying. Beginning in 2016, the program is moving away from the practice of completely stripping EM hardware from vessels at the end of the selection period, which had been the case in the earliest cooperative research years.

The field service cost profile will depend to a great extent on program design choices that are yet to be made or are subject to change through future ADPs. The following four points are examples of field service cost drivers that could be large or small depending on the structure and scope of the program:

- **Hardware installation/re-installation** – Post-implementation costs depend on the investment in pre-wiring and the ultimate composition of the EM stratum, which itself is influenced by the Council's stated goals and by NMFS's investment in outreach efforts. The costliness of installation/re-installation efforts could also depend on how the Council defines the period of time in which vessels must opt into the EM stratum. Earlier opt-in periods could negatively affect recruitment, but also allow the provider to cluster installation schedules in a cost-saving manner. Allowing last-minute opt-ins can be costly for the provider, particularly if installations require travel to remote ports. The analysts assume that inefficiencies in scheduling installation service will decrease as the program matures.
- **Provider responsibilities** – The contracted provider(s) costs will depend on staffing levels and travel demand. Staffing levels will depend on the number of hub ports where trained technicians are stationed. Providers would have to increase staffing or investment in training local technicians if they are required to offer maintenance/repair service within a certain amount of time (e.g., within 12 to 24 hours of a service call). Provider costs might increase if the contracted agreement requires especially fast service during peak times in the limited access Pacific cod season. Provider costs would be marginally higher if service technicians are required to participate in the removal and shipping of EM data drives, as opposed to making that part of the vessel operators' responsibilities. Provider costs could also increase if the program includes a dockside monitoring component (as under Alternative 3, or Alternative 2 Option 1), depending on whether the cost of that monitor is invoiced by the EM provider or is the responsibility of the shoreside processor.
- **Travel demand** – Travel costs depend on the range of tasks that the provider must supply (e.g., hard drive removal and data transmission), and the scope of the program. To the latter point, costs could be limited if the EM stratum is restricted to vessels that are willing to commute to hub ports for installation and service; costs could balloon unpredictably if the provider is committed to servicing vessels that operate out of remote ports. Depending on investment in local service

training, the deployment model (trip vs. vessel selection) could also drive up travel demand as technicians are required to travel to support fishing effort in remote ports.[46]

- **Provider contract structure** – Costs might be influenced by the number of EM service providers that are active in the Alaska fixed-gear program, and whether providers are able to work across gear types (hook-and-line and pot). Employing local service technicians is a major cost driver, and cross-training a technician to work on the equipment of multiple providers would reduce the required number of FTEs. Allowing multiple providers to participate in the program could spur competition and reduce hardware and service price levels in the long term, though introducing a diverse set of proprietary EM hardware/software into the fleet could create issues with compatibility. Service costs might be duplicated if a vessel has to work with one provider during its hook-and-line activity and another during its pot activity. The service delivery model could also affect total program costs. A provider that is only involved in the field service component of the program might not be able to justify their participation without invoicing a minimum amount to cover overhead. A provider that is also contracted to perform video review could potentially charge less for field service management. Service delivery models are further discussed in Section 3.3.

Finally, some of the factors that will influence field service costs are outside of the Council's control in regards to program design, and do not vary predictably over time. Some contingency costs, such as equipment breakage, are truly unpredictable. The size of the EM stratum will determine the labor and travel required to service the fleet. The proportion of the fleet that is new to EM in a given year is also unpredictable, and drives costs in the form of more initial installations and potentially more service calls. Similarly, the proportion of the fleet that needs to have EM equipment stripped from the vessel in order to participate in other fisheries (e.g., seining) is difficult to forecast. The demographic makeup of the fleet will affect travel costs in terms of geographical distribution and, to the extent that vessel size correlates with selection rates, could affect the required number of equipment rotations and adjustments. It is possible that the demographics of the EM fleet will display some endogeneity with the number and location of investments made in field services: NMFS and the provider(s) will be more motivated to provide local technicians in ports where many EM vessels deliver, and more vessels are likely to opt into the stratum if there are technicians in their ports. Ultimately, the Council could design a program that is "cost conscious" by catering to the relatively more active vessels that have experience with EM and tend to operate out of hub service ports, but that objective is not expressed in the purpose and need for this action.

5.7.4.1.3 Data Analysis

Video data is currently reviewed by trained PSMFC staff, who receive hard drives directly from vessel operators and EM port coordinators. In the hook-and-line pre-implementation program, PSMFC reviews the video using proprietary AMR software and sends annotated catch and metadata to NMFS for integration into the management data stream. The EM hardware and field service subgroup has defined a working list of review software requirements (Appendix 2). Once fully developed, this list will set standards for improved or competing software that might be developed by provider companies or built collaboratively on an open-source platform in the future.

Under the pre-implementation program, the cost of video review is covered under the PSMFC's EM budget (Row 1 in Table 5-28 in Section 5.8.2.1), which also covers the Commission's program management overhead and data storage. If EM is integrated into the monitoring plan, regulations would allow video review to be funded by the industry monitoring fee, but the Council could also recommend

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[46] The analysts are operating under the assumption that the Pacific cod pot sector of the EM stratum will feature a 1:1 control center to vessel ratio, meaning that the provider would not have to send a technician to rotate control centers quickly between selected vessels during the limited access season. That program design choice would represent a trade-off between field service costs and hardware costs.

that it is funded as part of NMFS's operating budget. This uncertainty is reflected in Section 3.2. For reference, the existing Observer Program funds the cost of deploying observers on vessels with, primarily, industry fees, but funds the cost of training and debriefing observers out of NMFS's budget. The Council and the agency have a policy choice on how to characterize, and thus pay for, video review costs. That choice determines whether or not video review (and/or data storage) is folded into the estimated unit cost (per vessel/trip/day) of the EM program in its current form. Section 5.8.2.1 estimates current unit costs under both decision outcomes.

As described in more detail in Section 5.8.2.1, one could estimate the cost of data analysis (video review) in two ways. Under the first approach, one might presume that the cost of review is a direct function of (1) the hours spent reviewing video (and packaging results into a format that flows into the management stream), and (2) the hourly cost of review labor[47]. Depending on the precision with which fishing effort in the EM stratum could be predicted, the cost of review is a variable cost that is relatively easy to forecast. That forecast would be a function of the number of vessels in the stratum, selection rates, and the amount of fishing activity that occurs on each vessel. However, that approach fails to consider some realities of how the EM fisheries operate and how a qualified data analysis labor force is optimally managed. Therefore, the analysts tend to rely instead on a work-force full-time equivalent (FTE) approach. This second approach is better aligned with the fact that demand for video review ebbs and flows throughout the calendar year, and that the size of the review staff cannot be constantly optimized through hiring and dismissal. Demand varies with fleet activity. Demand is also driven by program design; the required data turnaround time could be a major cost-driver for the analysis element of the program. NMFS might request that video data is processed more quickly during the Pacific cod season when in-season managers use catch estimation data to open and close fisheries, thus requiring more reviewers than at times when the active vessels in the EM stratum are all fishing IFQ. Constant tinkering with the review staff to match demand will reduce the quality of the data product through the loss of experienced reviewers, and imposes large management costs (hiring, training).

Thinking about the cost of data analysis in terms of FTEs rather than hours of video review allows the analysts to consider the broader array of activities that PSMFC or another vendor would provide for an implemented program. The program's data analytics partner will also have to spend time training reviewers and providing feedback on data quality to vessels and the EM provider (vessel score cards). These costs get lost when the scope of data analysis is limited to watching video. The FTE approach also acknowledges that PSFMC achieves economies of scale in labor by cross-training reviewers to work on Alaska fixed-gear EM data and on west coast EM fisheries. This model smooths out variation in review demand throughout the year, because reviewers remain productive during a larger proportion of the season and because the dedication workers' time to the Alaska program can be adjusted to fit with data demands (turnaround time). Having considered its experience with Alaska fixed-gear EM to date, and expected growth to a fleet of 90 hook-and-line vessels and 30 pot vessels in 2017, PSMFC estimates that it can service the program with acceptable data turnaround times using 1.5 to 2.0 FTEs (personal communication, 2016). Given the ability to balance review labor across both Alaska and west coast EM programs, PSMFC expects that FTE labor demand is not particularly sensitive to small changes in EM fleet size and activity. In that sense, data analysis costs behave more like fixed costs than variable costs when viewed as FTEs.

Table 5-24 summarizes PSMFC's activity in the 2016 Pre-Implementation program from January through July. The table shows the diversity in review speed across vessels. The variation actually occurs at the trip

[47] PSMFC estimates this cost at $50/hour including salary and benefits, and notes that that estimate is conservatively high in order to leave room for compensation to grow as high quality labor needs to be retained in order to provide the best data product. If the hourly approach to data analysis costs is used, PSMFC advises the analysts to assume that a reviewer spends approximately 75% of his or her time reviewing video and 25% of time on other job-related tasks (training, reporting, and administrative tasks). (Personal communication, 2016.)

level – not show in the table – as the speed of review is more a function of the weather/lighting conditions and the mix of target and bycatch species than it is of a given vessel's catch handling and deck configuration. PSMFC's final report on 2015 Alaska fixed-gear EM research[48] summarizes review speed by target fishery, as does a mid-season report on 2016 research was published in July 2016[49]. Halibut and sablefish trips are reviewed at roughly 2.0x to 2.3x speed (e.g., a reviewer can work through a haul in roughly half the length of the video's run-time if played at normal speed). Due to the wider mix of species brought onboard when targeting Pacific cod, those trips are reviewed at around 1.1x to 1.4x speed.[50]

Table 5-25 summarizes the length of time that it has taken for removable hard drives to arrive at PSMFC for review, and for that review to be completed. It is important to note that the 2016 experience is only reflective of a research program, where review speed and data turnaround time were prioritized below testing the reliability of catch data and species identification, testing the time-cost of collecting effort data, and providing feedback on data quality to operators and the EM service provider. Because NMFS is not using 2016 EM data for catch estimation, vessel operators and AMR field service staff were not asked to go out of their way to submit hard drives within a limited amount of time, and PSMFC reviewers were not asked to turn focus away from other programs that were using EM data for management. The lower priority on turnaround time means that the "average" and "maximum" rows in the table can be discounted. The reader should look to median and mode as a reflection of normal 2016 operations, and should consider "minimum" as an indication of what could be achieved if timeliness of review is made a priority.

[48] http://npfmc.legistar.com/gateway.aspx?M=F&ID=d3b3f404-991f-4e65-9512-f2c9dc5522f2.pdf
[49] http://npfmc.legistar.com/gateway.aspx?M=F&ID=a7cd6a23-3e69-46ee-adb6-31664484b125.pdf
[50] The cited PSMFC reports denominate review speed as "review rate," which is the inverse of the way it is listed in this document. Review rate would be the length of time (minutes) that a reviewer looks at the video divided by the video's normal run-time. The analysts flipped this ratio to avoid using the term "review rate," which is easily confused with the proportion of a trip or haul that must be reviewed. For example, reviewing 30% of the hauls on a trip would be a 30% trip review rate; reviewing 100% of the video from a haul would be a 100% haul review rate. (The draft 2017 Pre-Implementation Plan calls for 100% trip and haul review rates on trips that are selected for EM coverage.)

Table 5-24 2016 Longline EM Pre-Implementation video review data (January through July)

Vessel	Trips	Hauls	Video (mins)	Review (mins)	Review Speed*	Avg. Haul Review Time (mins)
A	5	14	2,751	906	3.04	65
B	2	23	4,110	1,412	2.91	61
C	4	11	5,067	1,934	2.62	176
D	4	18	3,469	1,327	2.61	74
E	1	16	2,020	811	2.49	51
F	2	7	1,553	667	2.33	95
G	1	4	454	210	2.16	53
H	8	125	20,814	9,940	2.09	80
I	2	15	2,944	1,460	2.02	97
J	7	20	3,686	1,846	2.00	92
K	1	2	717	370	1.94	185
L	2	30	3,735	1,953	1.91	65
M	2	14	844	478	1.77	34
N	1	2	201	115	1.75	58
O	4	15	3,527	2,233	1.58	149
P	6	79	9,348	9,082	1.03	115
Q	5	64	7,000	7,048	0.99	110
Total	57	459	72,238	41,792	1.73	91

Source: PSMFC, July 2016. Personal Communication.
* Rate = Video run-time (mins) divided by Review time (mins).

Table 5-25 Data turnaround time for 2016 hook-and-line EM pre-implementation program (through July 26)

	Arrival Time: Days from last date of fishing on drive	**Arrival Time:** Days from last date on drive	**Review Time:** Days from arrival	**Review Time:** Days from last fishing date on drive	**Review Time:** Days from last date on drive
Average	9.28	6.05	8.8	18.08	14.85
Median	7	6	7	15	12
Mode	6	4	3	15	12
Min	3	2	0	4	4
Max	63	14	30	65	33

Source: PSMFC, July 2016. Personal Communication.

PSMFC is also responsible for storing EM video data under the current program design. Whether storage costs will be paid through the monitoring fee or NMFS's budget after integration remains to be determined. Data storage is similar to video review in that it would seem to be a variable cost (scaling with effort in the EM stratum), but – absent a geometric increase in the amount of data flowing from Alaska fixed-gear EM vessels – the realities of the data management strategy mean that it behave like a fixed cost. The data management strategy and its impact on program costs are described in more detail in Section 5.8.2.1. In short, PSMFC uses the same set of data servers to house EM data (and a full set of backup files) for Alaska and west coast EM.[51] PSMFC staff projects that its current server capacity is sufficient up to the point of a four-year storage requirement. Storing data for five or more years would likely result in the purchase of an additional server, the cost of which would be shared with the west coast program. Storage requirements have not yet been defined, and are further discussed in Section 3.6. The cost-sharing arrangement between the Alaska and west coast programs is not well defined at this point, and will likely be clarified through the contracting process as the integrated EM program comes into focus. The analysts outline their assumptions about the storage costs that are likely to accrue to the Alaska EM program budget (again, paid either through fees or by NMFS) in Section 5.8.2.1.

Like the other cost factors, the cost of data analysis and storage will change as a function of time (cost trajectory). Holding program design choices equal, data analysis costs are more likely to decrease over time (medium- to long-term) than to increase. Technologies that could increase the speed at which analysts review EM video data are under development. For example, review software could achieve some level of automated species identification, and radio frequency identification tags (RFID) could help reviewers skip quickly to actual catch events rather than scanning though minutes of empty hauling video. Storage costs could decrease as video data compression improves, or if EM technology moves towards the use of rapid still images rather than video. The productivity of review labor should increase in the short-term, but remain relatively constant in the long-term as experienced reviewers are naturally replaced through attrition. The extent to which these developments reduce review costs is less obvious if one characterizes costs based on reviewer FTEs, because review automation would have to reach a very high level before having a discernible effect on the size of PSMFC's EM work force. Even if the effect of the aforementioned developments on the cost of reviewing/storing EM data is relatively small, they could still have a positive effect on the program by maintaining current staffing and storage capacity levels while the size of the stratum or the data objectives of the program grow.

One other data analysis cost driver that has not been mentioned is the quality of video data received. Review speed slows down when video quality is low due to poor duty of care, or when hard drives have gaps or cut-offs that analysts have to resolve, catalogue, or provide vessels with feedback through the EM service provider. One would expect video quality to increase as the fleet gains experience, or as the program proves itself and gains buy-in from larger vessels that take more trips in a given year (PSMFC has reported that data quality is lowest on vessels that are taking their first or only trips of the year). Whether or not fleet-learning reduces or stabilizes total costs in the context of a growing EM fleet depends on the type and activity level of new EM vessels. Small vessels (< 40' LOA) are no less capable of improving data quality through years of experience with EM, but they tend to take fewer trips per year meaning that a greater proportion of their trips could be subject to early-season "bugs" that increase costs.

The cost of data analysis depends to a great extent on program design choices that are yet to be made (cost uncertainty). At the aggregate level, the time required for analysis and the associated storage capacity is directly related to the size of the EM fleet, the deployment strategy (selection rates), and the timing of fishing activity (spikes in effort or overlap with EM effort on the west coast would require more reviewers if data turnaround time is a defined performance metric). Costs increase marginally in step with the number of trips and hauls that are selected for review, but they also vary according to the distribution of EM effort across gear type (hook-and-line versus pot) and target fisheries.[52] At the unit level, each

[51] PSMFC investigated the use of cloud storage options, but they were found to be less cost effective because the need for constant access (uploading and downloading) would incur large fees

[52] Given the disparity in experience reviewing video from the pot gear fleet and the longline fleet, it is difficult to make a direct comparison of review-time per fish. The analysts operate under the assumption that pot hauls require more time to review. Pot trips target Pacific cod, which brings in a greater diversity of species and thus requires more time for identification. Moreover, as a rough means of comparison, PSMFC's data on review speed during the first half of the 2016 hook-and-line EM program shows an average of 700 review minutes per trip, while SWI's model of pot EM costs (Buckelew 2015) specifies parameters of 360 pot-hauls per trip at nine minutes of review for each (3,240 review minutes per trip).

review-event's time and data cost depends on the program's data objectives. Costs scale along with decisions about how much of a haul to review or the proportion of hauls that are reviewed on each selected trip (e.g., 100% review vs. logbook audit). Costs also scale depending on whether the reviewer is simply enumerating discards, or is assessing discard viability or accounting for PSC species. The Council may or may not decide to require that vessel operators take on additional responsibilities that could speed up the review process. One such example is the use of electronic logbooks, which could eventually allow the program to achieve similar overall data quality with lower review selection rates by collecting effort data on unobserved vessels.

The cost of data review could also depend on the overall service delivery model that the program evolves. The service delivery model describes the roles of different vendors (private companies, PSMFC) and NMFS in administering EM. The current model involves a mix of entities: AMR and SWI provide hardware, software, and field service; PSMFC reviews and stores video data; and NMFS manages deployment, audits data, and assimilates data into the management stream. A vertically integrated model might contract a single entity to administer the entire program up to the point where NMFS uses the data to manage fisheries and tweak deployment (definition of strata, selection rates, etc.). The cost impact of vertically integrating services is untested in this fishery. The net effect would depend on the balance of efficiencies gained versus any additional cost from shifting data analysis/storage from the non-profit to the for-profit sector.

Having consulted with NOAA GC and NMFS West Coast Region, which has experience developing EM regulations, it does not appear that contracting with one or more vertically-integrated providers would require NMFS to contract separately with a third-party such as PSMFC to audit the data product for quality assurance. When NMFS contracts directly with a provider, as it would in Alaska, that provider is effectively working as an agent of NMFS. Quality assurance and chain of custody issues can be handled through detailed directive contract language. Auditing has come into play in other EM programs because industry participants (vessel owner and processor cooperatives) were contracting directly with providers; the responsible agencies in those regions needed to guard against the possibility of collusion between participants and the data reviewer. In summary, awarding a contract to a provider that supplies hardware/software, services the fleet, and reviews the data would not create duplicative review costs for third-party data auditing.

The design of the EM contracting process could affect the amount of competition in providing EM services and review software. The pre-implementation program relies on a single provider for hook-and-line EM, and PSMFC uses the provider's proprietary software. Allowing for competition in the field services space could affect costs in either direction, depending on whether EM video data from different providers is compatible with the prevailing review software. The compatibility challenge could be solved with the development of open-source review software, but the net effect would only be positive if that software performs to the same standard as proprietary software, or better. At present, not all EM hardware/software packages provide the same ability for reviewers to speed up the video or scan for catch events. It is reasonable to expect open-source software to improve in the long-term, but the incentive to make those improvements will depend on the opportunity for competition that the contracting process allows.

If the program prioritizes the speed of data review and integration into the management stream, PSMFC (or a field service provider operating in a vertically integrated manner) might incur additional costs to provide in-port video review. While not part of the existing implementation plan, this structure could be considered in the future. PSMFC has not tested the feasibility, cost, or benefit of providing in-port review due to the large amount of effort and overhead that would be required to develop infrastructure that might never be utilized. Based on the fastest realized turnaround times achieved in 2016 ("Minimum" row in Table 5-25), it seems unlikely that in-port review would provide cost-effective improvement in data processing speed. This program element is only likely to provide a management benefit during the peak of the limited access Pacific cod seasons, and would presumably do so at a high cost.

5.7.4.1.4 Management and Administration

Aside from funding a significant portion of the EM research and pre-implementation phase, NMFS has devoted significant human capital to the project. The staff time and labor devoted to the project carries an opportunity cost that is not reflected in the spending records reported in the EM Cooperative Research and Pre-implementation Plans[53]. In the context of scarce staff and budget resources, NMFS's investment in EM development could affect its ability to accomplish other aspects of its mission. As with most new programs, the expectation is that workloads will be concentrated in the years directly before and after implementation, and that the ongoing "costs" of managing the program will be limited to discrete new tasks as described in Section 3.2.

During the pre-implementation phase, NMFS staff and FMA division staff have managed the research and pre-implementation budget, worked with industry and EM providers to craft pre-implementation deployment plans, provided analysis to inform revised pre-implementation plans, performed fleet outreach and education on EM, and begun building and/or augmenting the data management infrastructure that will be necessary to utilize reviewed and audited EM data for catch estimation (and other purposes, such as compliance with seabird avoidance regulations).[54] As the Council's decision-making process moves forward, NMFS and FMA staff will continue to analyze the effect of the EM program on the Observer Program's ADP, and will begin to draft regulatory amendment language as the details and scope of the action are refined.

After implementation, NMFS and FMA will continue to play a large role in the function of the EM program, as it currently does for the Observer Program. In a report produced for the Pacific Fishery Management Council, AMR drew on its 20 years of experience with the British Columbia groundfish trawl observer program to conclude that management overhead costs can account for "30% or more of [a] program's total cost" (AMR 2014). Ongoing EM tasks will include contract supervision, deployment management, auditing data for quality assurance of reviewer performance, data processing and reporting, evaluating and approving VMPs, vessel visits to verify proper installation, continued application development to support the Interagency Electronic Reporting System (IERS)[55], and continued fleet outreach. These costs are generally driven by the scale of the EM program, though they do not necessarily scale linearly with the amount of sea-days deployed under EM. On net, these duties represent additional demands on agency resources, though the increase relative to the status quo and the potential need to hire additional staff cannot be known until the program is fully defined. Some ongoing tasks will be assimilated into existing annual responsibilities, such as deployment analysis in the form of drafting and revising the ADP. Others, such as handling VMPs and auditing EM data, are wholly new. None of the management and administrative costs identified in this section would be paid for using the industry monitoring fee (Section 3.2).

Overall, in terms of NMFS budget, EM costs should decline after implementation because some of the program elements that are currently being funded with Federal dollars (hardware/software purchase, field service contract) will be shifted to the funding through the industry monitoring fee. The downstream

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[53] Available at http://www.npfmc.org/observer-program/

[54] Some of the data management tasks that are in progress include developing infrastructure to transmit video review data from PSMFC to the Alaska Fisheries Science Center's NORPAC database, and modifying existing infrastructure to transmit management-quality data to the NMFS Alaska Region AKFISH database.

[55] IERS requires ongoing application development to ensure that the system can be adapted to the evolving requirements of NMFS, ADF&G, and IPHC. Costs associated with this work are shared amongst the three concerned agencies, and would not be funded through industry monitoring fees under any circumstances.

effect of this shift falls on the Observer Program's ability to purchase human observer-days, rather than NMFS's annual administrative operations.

NMFS' ongoing research related to fishery monitoring could have long-term, albeit indirect, impacts on the availability of funds to support EM or the observer side of the program. For example, NMFS Office of Science and Technology invested $120,000 in fiscal year 2016 in the automation of observer training materials. If investments such as this result in lower administrative costs across the monitoring program as a whole, cost savings could be applied to any number of monitoring budget shortfalls that might occur in the future.

5.7.4.1.5 Summary of Monetary Cost Factors

Table 5-26 summarizes monetary cost factors for evaluating an EM program.

Table 5-26 Characterization of selected EM cost factors (viewed as annual costs over the life of the program

Category	Cost Factor	Trajectory	Uncertainty
Hardware	Control Center*	Null or Decreasing	Start-up pool; Size of EM Pool; Depreciation/Breakage rate
	Camera/Sensor Package	Decreasing	Start-up pool; Size of EM Pool; Depreciation/Breakage rate; Undefined required peripherals
	Installation	Decreasing	Start-up pool
	Hard-Drives	Decreasing	New technologies
	Software Licensing	Null or Decreasing	Contract requirements; Competition
Field Support	Re-installation	Unknown	Demographics; Port capacity
	Control Center Rotation	Unknown	Deployment method; Port capacity
	Labor/Travel	Null or Decreasing	Demographics; Deployment method; Port capacity
	Project Mgmt.	Unknown	Contract requirements
	Training	Decreasing	Port capacity
	Data Retrieval	Decreasing	Operator responsibilities; Demographics; Automated data transmission
	Dockside Monitoring**	Null or Increasing	Undefined data objectives
Data Analysis	Video Review Time	Unknown	Data objectives; Size of EM Pool
	Review Labor/Training	Null or Unknown	Data objectives; Labor turnover
	Software Licensing	Null or Decreasing	Contract requirements; "Open-source"
	Project Mgmt.	Unknown	Port capacity; Contract requirements; Competition
Administrative	Data Integration	Decreasing	Pre-Implementation work; Data objectives
	Data Auditing	Unknown	Data objectives; Contract requirements
	Data Storage	Decreasing	New technologies; Undefined requirements
	Deployment Mgmt.	Increasing	Demographics; Size of EM Pool
	Outreach	Decreasing	Size of EM Pool; Port capacity
	Project Mgmt.***	Unknown	Deployment method; Port capacity; Data objectives

* The analysts make no assumptions about the future unit-cost of proprietary hardware, but note that market competition could be a factor.
** Not part of the Pre-Implementation program. Cost could come out of the human observer side of the deployment budget.
*** NMFS/FMA costs would not come out of the Observer Program's deployment budget, as is the case under status quo.

5.7.4.2 Non-Monetary Costs

The design of field service deployment and the definition of operator responsibilities are likely to impose costs on vessel operators that are not directly denominated in dollar expenditures.[56] Program design elements that create demands on operators' time, affect trip plans, or alter at-sea operations result in opportunity costs. Though not quantified in this report, opportunity costs reflect the value of what a stakeholder could have generated if he or she were not otherwise obligated. The values that could have been generated might be denominated in terms of production (harvest efficiency) or utility (satisfaction with the monitoring program, or time available for non-labor activities). Program designs that result in high non-monetary costs could cause vessel owners on the margin to disengage from the fishery by selling quota shares or allowing their shares to be fished on platforms that are less impacted by the Observer Program's requirements. To the extent that vessel operators disengage from the fishery as a result of the monitoring plan, the program affects the distribution of benefits from the resource and the supply of employment opportunities.

EM operator responsibilities for the current program design are defined in the pre-implementation plans[57]. The eventual implemented program could require operators to:

- Coordinate with providers for EM equipment installation/service; participate in installation, and potentially commute to service ports;[58]
- Participate in the development and approval of individual vessel monitoring plans (VMP);
- Pre-register fishing trips and notify NMFS of altered trip plans;[59]
- Complete EM logbooks (potentially in addition to existing logbook requirements);
- Observe new catch handling and/or stowage procedures;
- Alter the timing of fishing activity on an EM-observed trip if data quality requirements – as expressed through the vessel score card feedback process – disincentivize operators from fishing in certain weather/lighting conditions;
- Remove and ship EM hard drives for video review;[60]
- Maintain EM hardware, and coordinate remotely with service providers to undertake basic maintenance/repair; and
- Remain in port until service can be provided in the case of critical EM hardware or software failures.

The extent of opportunity costs associated with vessels' time and travel for EM service cannot be gauged based on experience, because the pre-implementation program has been designed to accommodate participating vessels' schedules and because vessels are not required to alter a planned trip if EM hardware or software fails. After the program is integrated as a stratum in the partial coverage category, the extent of these costs will depend on the geographic density of the EM fleet, the number of ports that

[56] Non-monetary costs might extend to non-harvesting shoreside stakeholders such as processors depending on whether the design of the EM program creates new responsibilities such as dockside monitoring, and how those responsibilities are apportioned.
[57] Available at http://www.npfmc.org/observer-program/
[58] Vessel operators may or may not be required to be present for installation work that involves the vessel's power system that feeds the EM equipment, but it is reasonable to assume that they will often want to be present to monitor work that could affect critical onboard systems. The same is likely true for work on engine hydraulics, such as the installation of oil pressure sensors. Coordinating the logistics of an installation becomes more complicated when the operator, and potentially an engine mechanic, need to be present for EM work to occur.
[59] Requirements to pre-register fishing trips or notify NMFS of altered plans are largely similar to those under the human observer strata, and thus do not represent a significant impact relative to the status quo.
[60] Costs associated with data retrieval would be marginally higher if the program requires operators to submit hard drives after the first or second trip of the year, before the hard drive is full, in order to check for quality assurance. This practice has been employed during the research phase of the program due to the EM learning curve; waiting to collect the hard drive increases the risk of losing a vessel's entire period of video data if a technical or duty-of-care problem is allowed to go undiagnosed.

provide local EM service, and actual system failure rates. The analysts do not foresee a point in time where local EM service is available in every port where fixed-gear deliveries occur, but over time the supply of qualified technicians should increase. The time required for service calls and software updates is likely to decrease as vessel operators gain experience with EM technology and can address issues without in-person support, and as providers develop new tools such as remote system software maintenance.

Technological development could also reduce the time costs associated with requiring operators to ship data drives to the contracted video reviewer. EM providers and NMFS's own staff are currently researching improvements that would automate data transmission without the need for mailing hardware.

Future decisions regarding data objectives and data quality could alter onboard fishing procedures, and thus could affect harvest efficiency. Deciding to use EM video to identify the species of incidentally taken seabirds might have a relatively small impact compared to simply monitoring the fact that a vessel has deployed the appropriate seabird deterrence streamers. On the other end of the spectrum, vessels might experience greater impacts if the operator responsibilities evolve to the point where all discards have to be run over a measuring board. These requirements can be defined and redefined throughout the life of the program through the ADP process.

5.8 Analysis of Impacts

This section discusses the potential impacts of integrating EM into the Observer Program partial coverage category as a new deployment selection stratum. Relative to the "no action" alternative, integrating EM would change the way that the monitoring fees collected from industry participants (harvesters and processors) are utilized to gather management and biological data. If the Council recommends one of the action alternatives, the hardware and field service components of the EM program would be funded through fee revenues, whereas the pre-implementation program funds them through Federal grants. Integrating EM into the partial coverage category has the potential to both reduce the funds available for purchasing observer-days to deploy on non-EM vessels, and to reduce the number of observer-days that are required to meet monitoring objectives within the non-EM strata.

The scope of the EM program and its data objectives are still being defined by the Council. The action alternatives described in Chapter 2 of this document vary in the amount of EM video data that would be reviewed (full catch estimation vs. logbook auditing), and the changes that would be made to at-sea and shoreside business practices (full retention and dockside monitoring). The cost and, more importantly, cost effectiveness of the EM program depends greatly on the program's ambition. Cost effectiveness is different from cost in that it includes not only gross expenditures, but what additional data are produced through the use of EM and what other management missions could have been achieved with those funds. Said another way, considering the cost effectiveness of EM requires the Council to determine whether or not a monitoring program that combines EM with human observers is a better use of limited budget resources than the existing Observer Program. A program may be cost effective while requiring a larger expenditure per vessel or per sea-day if the program is yielding better data, data that could not otherwise be collected, or collecting the same data while imposing fewer non-monetary costs on fishermen. Though not discussed extensively in this document, the Council might also consider whether developing an EM program affects the likelihood of raising or lowering the 1.25% monitoring fee levied on fishery participants in the future.[61]

[61] Changing the fee would require a separate action. Analysis of the effects of a fee change would only be provided if the Council or NMFS indicated that such a change is proposed for consideration.

In addition to framing the Council's consideration of cost effectiveness, this document must provide a foundation for decision makers to assess whether or not the region's monitoring plan, as a whole, will be able to collect adequate and reliable data in the case that the cost of monitoring (EM or human observers) increases.[62] This analysis does not purport to neatly conclude at a threshold of EM costs or program design that would jeopardize the region's monitoring plan if it were exceeded; there are simply too many outstanding decisions that will affect the program's cost profile. Moreover, the action alternatives under consideration do not declare or promise that an EM program of a particular design will be deployed (and thus paid for) in a given future year. The Council and the agency will annually assess data needs, available budget, and projected fishing effort for the upcoming year, and will use the EM cost/benefit descriptions in this document to determine the best use of resources at that time.

The cost side of the EM cost/benefit description in this section is largely based on Alaska's pre-implementation program. The analysts recognize that the 2015 and 2016 fixed-gear EM research work was focused on testing the capability of EM technology and building experience in how to reach and service the fleet, and it does not reflect the cost profile of a mature program. Previous observer and EM analyses in Alaska and in other regions have relied on "unit costs" (per vessel, per trip, or per sea-day) as a primary metric for comparing monitoring programs to each other, and for comparing the various alternatives within a proposed action. Throughout the following discussion of impacts, the analysts note the impossibility of forecasting precise unit costs for deploying EM on fixed-gear vessels. As noted above, the costs of critical program elements are highly dependent on program design choices that are either yet to be made, or are designed to be changed from year to year through the ADP process. Moreover, the cost profiles of elements that are directly funded through industry monitoring fees (hardware, field support services, and potentially data review/storage) are expected to vary over time as a function of technological advancement, competition, improved knowledge and capacity within the fleet and in-port technical labor pool, and the evolution of the program's data objectives. (These uncertainties and cost trajectories are discussed in Section 5.7.4.1 of this document.) While recognizing the inherent fallibility of using unit costs as the centerpiece of a program-level benefit-cost analysis, the analysts have employed that popular approach as a way to characterize the cost of the 2016 pre-implementation version of EM. That exercise – included in Section 5.8.2.1 – provides a baseline for ongoing program evaluation through the Observer Program's annual reporting process. Because the analysts are acknowledging a level of uncertainty about how cost drivers will evolve as the program matures, and because so many cost and spending decisions are yet to be made even for 2016, this document uses a "bookend" approach where a range of scenarios are presented. The scenario that best reflected 2016 will become obvious over the course of the next year, but cannot be pinpointed at this time.

Analyses of EM programs on the U.S. west coast, New England, and British Columbia are informative in terms of understanding key cost drivers and how design choices affect program costs. However, for several reasons this document does not utilize dollar cost estimates from other programs as frames of reference or data points that can be plugged into an Alaska EM cost model. First, Alaska's geography and the associated travel demands (for both service providers and vessel operators) create a unique cost profile for field support services. The analysts think it more appropriate to rely on EM experiences in Alaska, however imperfect. Second, fleet size and effort differs across programs, and has a direct impact on how fixed and variable costs are amortized to the level of cost per day. Third, other known EM programs serve a variety of gear types and have different data objectives than those being considered for Alaska. For example, monitoring for whether a trawl vessel discarded fish after dumping a codend on deck requires less video review per catch event than enumerating and speciating catch on a mixed species longline or pot haul. Fourth, the participants who are directly impacted by this action pay for monitoring through a fee that funds NMFS's monitoring research plan, whereas vessels in other regions with EM

[62] The question of whether the monitoring program can achieve its core mission in the presence of higher than expected costs was the subject of a 2014 US District Court decision (US District Court for the District of Alaska. *The Boat Company v. Pritzker*, No. 3:12-cv-250-HRH).

programs contract directly with a provider to cover their individual services. Regional differences in who pays, and which components of the overall monitoring plan their payments do or do not fund, affect the mix of costs that are being expressed in terms of dollars per day.

5.8.1 Alternative 1 – No Action

If the Council recommends the "no action" alternative, regulations would not be amended to allow monitoring fees to be used to deploy EM systems on fixed-gear vessels. Since the Observer Program was restructured in 2013, the monitoring research plan has achieve improved catch estimation and biological sampling by deploying human observers on a wider array of vessels with reduced systematic sampling bias. The benefits of the Observer program are described in Section 4.1 of this document, and the most recent review of sampling methods is available in the 2015 Supplemental EA completed by NMFS staff (NMFS 2015). Nevertheless, the current monitoring plan is limited in its ability to collect at-sea discards data from vessels that are challenged to accommodate an observer onboard. This gap in data collection affects NMFS's ability to estimate total catch with the greatest possible precision.

Harvesters less than 40' LOA

One set of harvesters that is challenged to accommodate human observers is the category of vessels less than 40' LOA. Vessels less than 40' LOA have participated in the Observer Program since 2013 by remitting monitoring fees (1.25% of ex-vessel value), but have not been subject to selection to carry an observer. Presuming that the under-40' vessel category would remain in the "zero selection" deployment stratum, Alternative 1 would not directly affect those vessels' business or fishing operations; they would continue to pay monitoring fees but would not be subject to observer coverage. However, relative to the action alternatives, Alternative 1 represents a lost opportunity to collect discard data from this unsampled sector of the fleet. That outcome could have a negative impact on all stakeholders who would benefit from enhanced biological resource management, including the under-40' vessel category.

Fixed-gear harvesters greater than 40' LOA

The other harvesters that are challenged to accommodate observers are larger fixed-gear vessels that might have to reduce their crew size in order to carry an observer without exceeding life raft capacity or altering normal bunk space arrangements. Under Alternative 1, these vessels would be subject to selection to carry an observer each time they log a trip in ODDS. As of 2016, the selection probability for these vessels is 15% for each trip. NMFS no longer grants releases for bunk space or life raft capacity limitations. The amount of monitoring fees paid by these vessels would remain at 1.25% of ex-vessel value, which is not a change relative to either the status quo or the action alternatives. The primary impact on these vessels under Alternative 1 is that they would not gain the benefit of a path to participating in the monitoring program without carrying a human observer.

All vessels that are selected to carry an observer for a trip, regardless of size or capacity limitations, experience a degree of monetary and non-monetary costs. In terms of expenditure, vessels pay to feed observers while they are onboard and – while not required – the analysts are told that some vessels insure themselves to cover liability for the additional person onboard in the event that the observer provider's insurance contests a claim. Vessels that carry observers also experience operational costs, which are a form of economic costs insofar as they require time, can alter a vessel's trip plan, and can reduce the operator's satisfaction with the monitoring program. If selected for coverage but no observer is readily available, the Observer Program may require a vessel to delay the trip for a reasonable amount of time to allow an observer to arrive.[63] This circumstance might cause a vessel to miss a preferred weather window,

[63] Regulations allow the Observer Program to release vessels selected for observer coverage on a case-by-case basis (679.51(a)(1)(iii)). There is no cap set on the amount of time that a vessel could be required to wait for an observer, but NMFS works with vessels to address delays and prevent the cancellation of a selected trip. The 72 hour pre-trip notification period for trips logged into ODDS has recently served as the default

could affect the vessel's most profitable timing of fish to market, or could result in a competitive disadvantage during a limited access fishery opening (e.g., Pacific cod). Participants also report that carrying an observer can impose a social cost in some cases, as might be expected when temporarily introducing a new individual to a crew that lives and works in close quarters.

Vessel operators make private decisions about whether the perceived onus of carrying an observer outweighs the benefit of remaining active in the fishery. That calculation is a function of both the deployment model (recently transitioned from "vessel selection" to trip selection) and the probability of being selected to carry an observer on a given trip (currently set at 15%, but revised each year in the ADP). In the status quo fishery, operators in this size category who determine that they cannot accommodate an observer have three options: disengage from the fishery (halibut IFQ, sablefish IFQ, and Pacific cod), lease or "walk on" to fish their quota on another vessel (halibut IFQ, and sablefish IFQ), or participate in the EM pre-implementation program. The latter option, which is the only option of the three that does not eliminate or displace crew jobs, would not be available under Alternative 1.

The subset of vessels in this gear/size category that is most likely to be impacted under Alternative 1 – where no alternative to observer selection is provided – has identified itself (to a rough degree of estimation) by requesting observer coverage releases from NMFS since the program was restructured to include smaller vessels in the selection pool. As described in Section 5.5.3 of this document 179 vessels have made such a request since 2013, though releases are no longer available with the shift to a trip selection observer deployment model and the expansion of the EM pre-implementation pool. Some vessels that requested releases that were not granted continued to participate in the partial coverage category and did not opt into the EM program, indicating that the benefits of fishing under the possibility of observer trip selection outweighed the cost. Perhaps a better indicator of the number of vessels that feel they would benefit under an action alternative relative to Alternative 1 is the number of vessels that did participate in EM pre-implementation. Of 60 available slots for longline vessels, 51 were filled as of July 2016 (three additional vessels have dropped out of the EM stratum between July and mid-September). The fact that not all slots were taken indicates that – at this stage – there were no vessels that preferred EM to the partial coverage but were forced to remain in the trip selection pool. Those 51 vessels are described in Section 5.6.2. Fifty-one vessels might overstate the number of over-40' fixed-gear vessels that truly prefer EM, as some vessels in the 2016 pool have not been selected for EM coverage, and might drop out of the program if selected. On the other hand, 51 might underestimate the number of vessels that would feel more impacted under Alternative 1 because awareness and understanding of the EM option is still infiltrating the fleet. In addition to those longline vessels, three pot vessels participated in EM research during 2016 (to date).

Trawl harvesters and vessels in the full observer coverage category

The impacts of selecting Alternative 1 on vessels that would not be eligible to participate in the EM stratum are similar to those experienced by vessels less than 40' LOA. The monitoring costs paid by these vessels would not change relative to the status quo, but they would receive no potential benefit from expanding monitoring to historically unsampled sectors of the fleet.

Shore-based processors

Alternative 1 would have no direct impact on the processing sector relative to the status quo. Processors would continue to be responsible for collecting, contributing to, and remitting ex-vessel-based monitoring fees to NMFS each year. The analysts assume that the aggregate amount of catch being delivered to processors in the affected fisheries (halibut and sablefish IFQ, and fixed-gear Pacific cod) is determined

"waiting period" before a trip is released in the event that an observer cannot be made available. This guideline is addressed on the NMFS AKRO website under Observer Program Frequently Asked Questions (https://alaskafisheries.noaa.gov/sites/default/files/2016-observer-prog-faq.pdf).

more by annual harvest limits than by the number of vessels in the fleet. To the extent that vessels disengage from the fisheries – perhaps because their participation was contingent on having the option to participate in the "zero selection" EM pre-implementation program – it is assumed that their harvest potential will flow to other fixed-gear vessels; this could occur through IFQ "leasing" or by virtue of the vessels that remain in the Pacific cod fishery each harvesting a larger proportion of the TAC. Minor distributional effects could occur if the set of vessels that disengages from the fishery were locally concentrated around a particular processor. The analysts do not have sufficient information to predict which vessels might disengage and, thus, where local deliveries might shift elsewhere. If one takes the EM pre-implementation vessel pool as an indicator of vessels that are counting on an alternative to observer coverage that would not be available under Alternative 1, this distributional effect should be small because most pre-implementation vessels deliver to ports with relatively large, stable fixed-gear fleets (see Table 5-21 in Section 5.6.2).

Depending on the ultimate design of the proposed EM program, Alternative 1 could represent a small operational benefit for processors relative to the action alternatives. The EM program could, at some point, include processor responsibilities for the collection and shipping of hard drives or the provision of plant observers to administer dockside monitoring. The EM program is more likely to include dockside monitoring if the Council recommends Alternative 2 Option 1, or Alternative 3.

Observer Program

The Observer Program currently provides adequate fishery data through the deployment of human observers at sea and at shore-based processing plants. Relative to the action alternatives, Alternative 1 is less likely to cause the program to differ from the status quo, where observer deployment and coverage rates are determined annually through the ADP process as a function of projected effort, sampling design, and available budget. Alternative 1 would not create the possibility that a portion of monitoring fee revenues is diverted to support EM.

Chapter 3 and Section 5.5 of this document describe the partial coverage category as it currently exists, including the ADP process, historical fee remittances, coverage rates, the number of observer-days purchased, and the number of days deployed. Section 5.5.2 reflects the fact that NMFS has contributed Federal funds to the budget for purchasing observer-days in the years since the program was restructured in 2013. The availability of those funds is not guaranteed in future years, and the amount of monitoring fees collected will vary annually according to harvest levels and ex-vessel prices. As a result it is not possible to forecast coverage rates and observer-days; however NMFS analyzed the effect of higher observer costs and/or lower fee revenues on data collection in the 2015 Supplemental EA (NMFS 2015). The Supplemental EA used historical data on fishing revenues and the average daily cost of an observer to estimate the number of observer-days that could have been purchased with the monitoring fee from 2009 through 2012, and actual purchases from 2013 through 2015 (projected). With the fee set at 1.25% of ex-vessel value, fees alone would have afforded between roughly 3,100 and 5,200 observer-days, depending on the year. While effort and price levels are expected to vary annually, NMFS expects the average cost of a partial coverage observer day to remain stable around $1,070 over the length of the current 5-year provider contract. The Supplemental EA also provides a range of potential observer coverage rates – expressed as the ratio of observed days to total days fished – based on historical fishing effort, fee revenues, and observer-day prices from 2010 through 2014. That exercise orients the reader to the general levels of coverage that were possible in those years, depending on whether the ADP prioritized coverage in one strata versus another (e.g., larger vs. smaller vessels). If coverage rates were set equal across strata, between 13.7% and 19.4% of fishing days could be observed in a given year. Increasing coverage in one stratum would reduce coverage in the other stratum. The selection strata were redefined in 2016, and coverage rates now vary across gear types (trawl, pot, hook-and-line) rather than vessel size. Pot and hook-and-line vessels in the partial coverage category are now selected on a trip-basis at a 15% probability. Whether those rates increase or decrease under Alternative 1 depends on projected effort and available funds in each future year.

Because Alternative 1 does not provide an alternative path for vessels that are challenged to accommodate an observer to comply with monitoring requirements, selecting "No Action" could contribute to the frequency of trip cancellations. The EM Workgroup has received anecdotal reports that some vessels cancel trips that are selected for coverage. While this practice is not pervasive and is not necessarily affecting data quality, cancellations can complicate the logistics of getting observers to selected vessels in an efficient and timely manner. Time and money that an observer spends getting to a deployment that is cancelled consumes scarce resources and marginally reduces available program resources.

5.8.2 Alternative 2 – EM for Catch Estimation

This section includes a two-part analysis of EM costs, followed by a qualitative discussion of impacts on affected stakeholder groups. The first part of the cost analysis (Section 5.8.2.1) addresses the cost of deploying the 2016 pre-implementation version of Alaska's EM program. The second part (Section 5.8.2.2) uses cost information from 2016 as a starting point for a broader look at the cost profile of the EM program as it grows in scope and matures over time.

5.8.2.1 Unit Cost Estimates for the EM Program in its Current Form (2016 Pre-implementation)

Many readers will be interested in making a direct per-day, per-trip, or per-vessel cost comparison between the Alaska EM program, the partial coverage observer category, and other monitoring programs. As noted in Sections 5.4.2 and 5.7.4 of this document, such comparisons are certain to fall short in terms of their ability to recognize structural differences in the various monitoring programs, as well as the different levels of progress along the continuum of EM program maturity (see Section 5.7.1). However, recognizing that one purpose of this document is to establish a foundation upon which to reevaluate the cost and cost-effectiveness of the EM program after implementation, sketching out unit cost estimates of the 2016 EM program (per sea-day, per trip, or per vessel) does serve a purpose. At a basic level, the following exercise seeks to answer the question: *What does today's Pre-Implementation Alaska fixed-gear EM program cost?*

In estimating unit costs for the purpose of a comparison, the analysts have attempted to include only those cost factors that would be paid for through the monitoring fees that are collected from the industry (i.e., the 1.25% ex-vessel fee). Limiting the cost factors in such a way makes for the most adequate comparison to the partial coverage category of the observer program, which reported a per-day cost of $1,083 in 2015. The analysts have had to make some assumptions as to which EM program costs will be funded through the fee and which will be paid out of NMFS funds or other sources (Section 3.2).

Among the many caveats that will follow, the most important is to recognize that the 2016 Pre-Implementation EM program was not designed with the primary objective of minimizing unit costs, optimize monitoring coverage "per dollar spent," or seeking cost efficiencies where available. Rather, the 2016 program was designed as part of an iterative field-testing initiative in order to establish the "realm of the possible" in terms of data collection, to identify data gaps, and to build capacity in ports and within the longline fleet to work with EM technology and to create momentum for the moment when EM is fully integrated into the Alaska Region monitoring plan. Another key caveat to the following exercise is that the 2016 program focuses exclusively on the longline gear category of the fixed-gear sector. Cost estimates for EM on pot gear vessels will be incorporated into the more speculative cost exercises that appear in Section 5.8.2.2.

The cost accounting for the 2016 longline Pre-Implementation EM program breaks down into three parts:

1. Monies spent through the contracted EM provider, Archipelago Marine Research, Ltd. (AMR);
2. Monies spent through Pacific States Marine Fisheries Commission (PSMFC);
3. Administrative and management costs incurred by NFMS AKRO and NMFS FMA division.

This sketch is limited to the activities of AMR and PSMFC, and is primarily focused on the former. The supporting activities performed by NMFS staff are similar to those described in Section 3.6 of this document, though they are likely heavier on planning, development, and organizational tasks than on operational tasks such as data auditing/debriefing, application programming, and the like. Costs paid directly by NMFS and the labor of individuals under the agency's direct employ do not figure into the estimated unit costs of the 2016 program. Holding out NMFS's costs fits with the goal of making a comparison to the observer program, where the agency puts in a great deal of management and analytical work that is not reflected in the average observer cost per day that is reported each year.

The monies that flow through PSMFC pay for video review labor, review software/licenses, and management. PSMFC currently stores Alaska EM video data on the same servers that are already being used for the west coast EM program. Due to the small amount of data that is being produced at this stage, it is not clear that any dedicated Alaska EM funds have been used to "pay for" data storage in 2016. Whether or not PSMFC will be responsible for data storage costs once the EM program is implemented remains an open question. Video review labor makes up a significant portion of PSMFC's expenditure on Alaska EM. While the exact cost of video review in the future is uncertain – for a variety of factors discussed in Section 5.7.4.1.3 – the analysts are able to provide estimates for 2016 year-to-date (through July) and for 2016 projected to the end of the calendar year. Whether or not video review labor should ultimately be included in the EM unit cost estimate depends on how the Council and NMFS determine that industry funds should be used (Section 3.2). For now, the analysts have provided unit cost estimates both with and without video review labor included.

All of the monies that flow through the AMR contract for the 2016 EM program accrue to the unit cost estimates. The EM service provider's costs can be broken down into many distinct items, as described in Sections 5.7.4.1.1 and 5.7.4.1.2. However, due to the proprietary nature of the provider's service, service line items cannot be reported individually or with much precision. Instead, the analysts have divided the provider's cost items into two categories: hardware and related items with costs that can be estimated, and "other" items that must be lumped together. The latter category includes installation and service labor, travel, training, outreach, project management, reporting, contingency items, and the provider's operating margin. The hardware category includes the EM control centers that are rotated onto EM vessels when they are selected for coverage, an installed package of peripheral components that will vary slightly across vessels as each platform has different requirements (cameras, hydraulic sensors, a GPS unit, monitor/keyboard), removable hard drives, and a program-wide annual software license.

As a starting point for this exercise, the analysts reference a 2016 EM budget table that was updated on July 26, 2016 (Table 5-27).[64] That table shows the total amount budgeted for the PSMFC and AMR contracts, and the percentage of funds that have been spent or marked for disbursement ("encumbered") from January 1 through that date. The row labeled "EM Infrastructure Support" shows describes funds flowing through PSMFC, and the row labeled "EM Pre-Implementation Deployment" refers to funds flowing through the AMR contract. Two of the issues that complicate this exercise are the realities that (1) one cannot presume that the entire 2016 budget will be spent, and (2) funds are not expended uniformly across the calendar year. At present, the program is not on pace to spend the entire budget,

[64] For the full original table, refer to page 1 at: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/BudgetStatusFunding2016-2017.pdf

which means that unit cost estimates for the entire 2016 year are likely overestimated when assuming that all $780,000 will be spent. To the second point, some of AMR's expenditures are more heavily loaded towards the beginning of the year; unit cost estimates that are based on the period from January 1 through July 26 will include some costs that will continue to be amortized over additional vessels, trips, and sea-days that occur after July.

Table 5-27 2016 EM budget for video review and field services, and funds spent through July 26, 2016

Funds for use by…	2016 Budgeted Amount	% Spent or encumbered (7/26/16)	Amount spent (7/26/16)	Amount encumbered but not spent (7/26/16)	Subtotal: Amount spent or encumbered (7/26/16)	Amount Remaining
PSMFC	$355,000	23.89%	$84,826	-	$84,826	$270,174
AMR	$780,000	70.04%	$184,921	$361,377*	$546,298	$233,702

* For the second row (AMR), note that not all of the funds that are currently available have actually been disbursed (spent). Around $361,000 has been marked for various purposes, but one cannot say with certainty that those monies will be entirely used. For this reason, the analysts have worked through "high" and "low" unit cost estimates for the EM activities that are conducted by the contracted provider.

The remainder of this subsection has three components. First, the analysts use two different methods to tease apart video review labor from the PSMFC budget and expenditures. This information will allow the analysts to present unit cost estimates with and without review costs included. Second, data storage costs will be estimated at the unit level as if they had been billed to the 2016 program's funding sources. The results table at the end of this section will similarly show cost estimates with and without storage costs being paid through industry fees. Third, the analysts separate estimated hardware costs from other provider costs, and annualize the hardware costs to account for the fact that durable goods will not need to be purchased anew every year. The resulting annual provider expenditures are translated into unit cost estimates, to which video review and/or data storage can be added. Those final unit cost estimates will serve as the most adequate comparison to the unit costs of the observer program, noting of course that the 2016 EM program is not necessarily a reflection of the cost structure of the eventual implemented program.

PSMFC: Video Review Labor and Project Management

The simplest way to isolate video review costs from the funds budgeted for PSMFC in 2016 is to think in terms of full-time equivalent (FTE) workers. PSMFC estimates that the total cost of a full-time video reviewer is around $100,000 per year (salary plus benefits). This is conservatively high, which is preferable because it allows room for compensation growth over the near-to-medium term to account for inflation and retention without substantially altering the validity of the present analysis. PSMFC has a strong interest in retaining review staff, as experienced staff carry lower training costs and generate higher quality data. Under its current model, PSMFC has a team of reviewers who service both the Alaska and west coast EM programs, and who are cross-trained to work on tasks relating to the Commission's other projects.

Modeling in terms of FTEs is relatively more stable than costing out video review on an hourly basis. The volume and timing of video data that will be generated by a fully implemented Alaska EM program is uncertain, and will vary according to pool size, effort levels, and required review rates. Small upswings and downswings in the volume of data coming out of the Alaska EM program do not directly translate into the need to hire or eliminate reviewers, especially considering that bringing on untrained short-term labor is costly and a drain on project management capacity. Moreover, thinking in terms of FTEs allows the Council – in its program-design role – to think about review costs along the dimension of data turnaround time. A single full-time, or even part-time, reviewer could process all of the data coming out of the fishery, but those savings in labor would come at the cost of expediency; in-season managers might not receive the information that they require to open and close limited access fisheries. When using the FTE approach in this analysis, the analysts are operating under the assumption that a fully implemented

Alaska EM program could produce adequate data turnaround times with, at most, two FTE reviewers (PSMFC, 2016. Personal communication). The 2016 pre-implementation program obviously produces much less data, and requires less review labor. For that reason, results from the FTE approach are presented with a range of 1.0 to 2.0 FTEs.

Table 5-28 FTE method for estimating 2016 video review labor costs

Jan 1 - July 26		2016 Total (projected)	
Unit	**Unit Cost**	**Unit**	**Unit Cost**
1.0 FTE = $56,712		1.0 FTE = $100,000	
17 vessels	$3,336 / vessel	30 vessels	$3,333 / vessel
57 trips	$995 / trip	114 trips	$877 / trip
228 sea-days	$249 / sea-day	456 sea-days	$219 / sea-day
1.5 FTE = $85,068		1.5 FTE = $150,000	
17 vessels	$5,004 / vessel	30 vessels	$5,000 / vessel
57 trips	$1,492 / trip	114 trips	$1,316 / trip
228 sea-days	$373 / sea-day	456 sea-days	$329 / sea-day
2.0 FTE = $113,425		2.0 FTE = $200,000	
17 vessels	$6,672 / vessel	30 vessels	$6,667 / vessel
57 trips	$1,990 / trip	114 trips	$1,754 / trip
228 sea-days	$497 / sea-day	456 sea-days	$439 / sea-day

The other approach to estimating review labor costs is to work from hourly review labor rates. PSMFC estimates that the hourly cost of review labor is $50 (salary plus benefits). Furthermore, a reviewer is assumed to spend 75% of his or her time processing video data (six hours out of eight). The balance of the reviewer's time is spent on training and other routine office functions; that non-review time would include setting up video for review. For the big picture view of this analysis, the analysts submit that the "hourly" approach provides a more accurate picture of review costs in the 2016 program as it currently exists, but the "FTE" approach is a better fit for understanding the program's cost structure in the medium-to-long term if the program continues to grow.

PSMFC data indicate that its staff had spent 697 hours (41,792 minutes) reviewing 2016 Alaska longline EM video data through July (Table 5-24). Assuming that reviewers spend only 75% of their work hours reviewing data, that amount of video review translates to 929 hours of invoiced labor at $50 per hour, or $46,467 in total labor costs year-to-date. The same PSMFC data set that supplied the review time figure (697 hours) also tracks the number of vessels that carried EM equipment (17) and the number of trips that those vessels took (57). An average trip-length of four days[65] is applied to the 57 trips to yield a sea-day cost for the hourly method (Table 5-29). Unit costs for the entire year are estimated by assuming that effort in the period after July 26 is the same as effort prior to that date. This is likely an overestimate, as vessel selection to date in Period 3 (July through October) is currently below pace to meet the budgeted goal of 13 vessels. It should be noted that review time (labor per minute of video data) varies across target species; PSMFC's reports on the 2015 season and on 2016 to-day show that video review of trips targeting Pacific cod take longer than those targeting halibut or sablefish due to the diversity of species that are brought onboard (Al-Humaidhi 2016). The costs for 2016 are only reflective of the distribution of trip targets that occurred in the first portion of the 2016 EM pool's season.

[65] PSMFC's 2015 field summary reports average trip lengths of 4.08, 3.56, and 4.52 days for halibut, Pacific cod, and sablefish target fisheries, respectively. NMFS catch accounting data shows average trip lengths (using the "days fished" method) between 4.0 and 4.3 days for hook-and-line vessels between 40' and 57.5' LOA over the 2013 through 2015 period (Table 5-11 in Section 5.6.1).

Table 5-29 Hourly method for estimating 2016 video review labor costs

Jan 1 – July 26		2016 Total (projected)	
Unit	**Unit Cost**	**Unit**	**Unit Cost**
$46,467 YTD		$81,938*	
17 vessels	$2,733/vessel	30 vessels	$2,731/vessel
57 trips	$815/trip	114 trips	$719/trip
228 sea-days	$204/sea-day	456 sea-days	$180/sea-day

* Total projected review costs are the result of expanding the Jan 1 – July 26 expenditure over a 365 day calendar.

Thus far in 2016, based on the labor rate of $50/hour, the results in Table 5-29 indicate that the video generated by a generic sea-day has taken around four hours to review ($204/$50). The higher sea-day review cost estimates in Table 5-28 are the result of paying for labor irrespective of the amount of video data being generated in the program. That discrepancy illustrates one of the problems with unit cost estimates. In reality, the party that is providing video review cannot continually add and subtract from its labor force in order to optimize costs. While the hourly method is useful for understanding data points like review-hours per sea-day, it is not as appropriate for modeling the cost of a fully operational EM program with a larger fleet. Also, the analysts expect the unit cost estimates of review to decrease substantially once participation and effort in the EM pool increase; the number of vessels, trips, and sea-days will grow while the number of reviewers will likely remain at or below 2.0 FTEs.

PSMFC's other 2016 costs can be estimated by subtracting the hour-based estimate of the amount spent on video review from either expenditures during the January through July 26 period or from the total annual budget. That calculation places PSMFC's project management and overhead costs at $38,360 for the first part of the year ($84,826 - $46,467), and at $273,062 for the entire year ($355,000 - $81,938). Given the fact that PSMFC had spent only 23.9% of its 2016 budget through July 26, the analysts do not believe the latter estimate to be an accurate reflection of management costs. Projecting the year-to-date project management cost estimate of $38,360 over a 365 day year would suggest that PSMFC's total annual management costs are around $68,000. If one assumes that this is our best possible estimate of PSMFC's EM overhead, then total PSMFC costs for a fully implemented program can be described as:

Annual Budget = $68,000 + (Reviewer FTEs$100,000).*

Presuming that the Alaska EM program requires 2 FTEs to produce quality data with acceptable turnaround times, PSMFC's annual budget could be in the neighborhood of $268,000.

<u>Data Storage</u>

Several issues relating to data storage costs are yet to be determined. First, the funding source for data storage could be NMFS Federal funds, or it could be the monitoring fees collected from the industry (Section 3.2). If the latter is the case, then data storage costs should be included in the unit cost estimates that are often compared to the observer program and other EM programs. Second, the number of years for which EM video data must be retained is not yet defined in regulation. In other EM programs, the required storage time is related to law enforcement statutes of limitation, as video data could serve as evidence in the case of a violation. Storage requirements are further discussed in Section 3.6.

While the funding remains unclear, there appears to be consensus that the data will be housed by PSMFC, as is currently the case under the 2016 pre-implementation program. PSMFC maintains two servers, each capable of storing 480 terabytes (TB) of data.[66] At present, this 960 TB capacity is sufficient to store four

[66] PSMFC investigated the option of using cloud data storage solutions for its EM work. While the cost per gigabyte of storage is very low on the cloud, the fees for accessing the data (uploading and down) would quickly accumulate to a level that is not competitive with local servers. The cloud account would be accessed on a nearly continual basis, as newly received video data must be uploaded throughout the fishing year. Moreover, while the analysts have nothing to say about how PSMFC manages its funds internally, making periodic investments in durable

years of Alaska and west coast EM video data with complete backup redundancy. Annualized data storage costs would increase if PSMFC needed to purchase a third server. A third server could become necessary under two circumstances: if data were required to be stored for more than four years (for legal reasons), or if average annual data volume exceeds 120 TB. Table 5-30 shows the relative and total data usage for the Alaska and west coast EM programs, dating back to 2014. PSMFC staff does not anticipate west coast data usage to increase substantially in the near-to-medium term, as most of the vessels in the sectors that produce the vast majority of the video data (whiting trawl) are already captured in these statistics. Fixed-gear vessels produce a relatively small amount of the west coast data (14.6 TB in 2015), and the number of fixed-gear vessels participating in EM has not increased since 2014. The amount of data generated in the Alaska fixed-gear EM program will depend on the size of the pool and the review selection rate (currently, 30% of vessels in the EM pool are selected for coverage, and 100% of the usable video from those trips is reviewed). Given those unknown factors, the analysts cannot project future data usage. However, at the current selection rate of 30%, doubling the two most recent years (2015 and 2016_projected) could serve as a high-end estimate. That would equate to 15 to 20 TB of data. Over the first seven months of 2016, the average Alaska fixed-gear EM trip has produced 0.086 TB of data (57 trips). At that rate, 15 TB of data could contain 175 generic fishing trips, and 20 TB of data could contain 233 generic trips. This bracketed analysis should be relatively stable, when and if the Alaska EM pool reaches a size in line with the 2017 Pre-Implementation Plan (90 hook-and-line vessels and 30 pot vessels), as the marginal data impact of an additional fixed-gear vessel is small.

Table 5-30 Alaska and west coast EM video data usage (TB), 2014 through 2016

	Alaska	West Coast	Total
2014	3.71	27.81	31.52
2015	8.05	111.40	119.45
2016 (Jan-June)	4.56	48.74	53.30
2016 (projected)	9.12	97.48	106.60

Source: PSMFC, August 2016. Personal communication.

Each server costs $125,000, and is supported by the manufacturer for five years. The annualized cost of each server is, then, $25,000.[67] Maintenance and electricity costs are assumed to be either covered under warranty or negligible relative to total program costs. Presumably, annual server costs would be split between the Alaska and west coast EM programs, though a cost-sharing arrangement has not been defined. If the Alaska EM program were responsible for half of the cost, $12,500 would need to be budgeted for each server annually. The Alaska program’s data demand is almost certainly less than half because the program does not include trawl vessels, which generate greater amounts of data. To create a range, Table 5-31 considers making the Alaska EM program responsible for 10% of costs at the low-end (based on the 8.5% of 2016 YTD usage shown in Table 5-30), and 20% of costs (based on the 16.7% that one gets from the reasonable hypothetical scenario of using 20 TB out of the 120 TB for both programs combined).

If data storage will be paid for using industry fees, it should be included in the unit cost estimates for the 2016 EM program. Given the many unknowns related to data storage and the responsibility for its costs, it makes sense to consider a reasonable range.[68] The lowest figures in Table 5-31 are less likely, because

storage hardware could be advantageous as it allows inflowing funds to be used as-needed for any critical EM activity, so long as it manages to keep funds on hand for the periodic replacement of depreciated capital.

67 Simple division is sufficient to translate the purchase price of a durable good into an annual cost. Presumably these goods were purchased with cash, thus there is no interest to amortize over the life of a loan.

68 Including high-end ranges is also appropriate because the analysts have little or no information on the amount of video data that a pot vessel will require, and the fully integrated EM program will be open to pot vessels as well as longline vessels. The analysts presume that pot vessels

PSMFC already requires two servers in to provide data backup and to keep data for three or more years. The highest figures in that table are equally unlikely, because if PSMFC needs to purchase a third server, it is unlikely that the Alaska program will be driving that need; thus, it is unlikely that the Alaska program will be paying for a full half of the three-server storage costs. The analysts propose $10,000 to $20,000 per year as a range that likely captures the amount of data storage demand in a mature Alaska fixed-gear EM program. The low end of that range, $10,000, is a conservatively high estimate of the Alaska program's 2016 data storage cost responsibility.

Table 5-31 Range of potential EM storage costs

# Servers	Annual server cost	Alaska cost-share	Alaska storage cost
1	$25,000	10%	$2,500
		20%	$5,000
		50%	$12,500
2	$50,000	10%	$5,000
		20%	$10,000
		50%	$25,000
3	$75,000	10%	$7,500
		20%	$15,000
		50%	$37,500

EM Provider Costs

As mentioned earlier in this subsection, the 2016 budget for the EM provider (AMR) is reported as $780,000, and 70% of that amount ($546,298) is listed as spent or marked for spending as of July 26 (Table 5-27). The $780,000 budget should be thought of as a maximum amount of available funds for all provider activities and purchasing that could occur in 2016, and not necessarily as a projection of how much the 2016 program would or should cost. In fact, the Council's Pre-Implementation Plan for 2016 directed AMR, PSMFC, and participating industry groups to spend 2016 grant and Federal funds opportunistically in cases where those expenditures would build the capacity of the EM program moving forward. For example, 2016 funds might be spent to acquire durable hardware (EM control centers), to pre-wire vessels that will return to the EM pool in subsequent years, or to perform outreach and on-site training with fishermen and local technicians.

The analysts have broken down the service provider's costs into two categories: hardware (and related items), and "all other" program elements that can be identified but cannot be costed out individually without utilizing confidential business information. The latter category includes labor for installation, service and training, travel, reporting, project management, unpurchased hardware inventory that is held in reserve, to name a few. The only way to estimate those costs, in aggregate, is to start with a total 2016 "EM provider budget" and deduct hardware expenditures in the present year (total purchase price, not annualized cost). For that reason, the analysts are not comfortable relying solely on $780,000 as a starting point from which the cost or 2016 EM services can be deduced. This analysis presents a variety of scenarios that are used to generate unit cost estimates, and each scenario is run off of both high and low 2016 "actual budget" starting points. The $780,000 figure serves as the high annual budget, and the analysts have chosen $400,000 as the low budget; both are merely for illustration. Referring back to Table 5-27, Row 2 (AMR) shows that only $184,921 had been spent as of July 27, but that $361,377 had been

will generate relatively more video data because table-sorting takes more time, and because pot vessels target the Pacific cod fishery where vessels bring onboard a greater variety of species that must be identified.

"encumbered." The analysts do not strictly assume that all of the encumbered funds will be expended before the end of the year, and in fact the EM provider is running under budget to this point, year-to-date. The low budget ($400,000) represents the case where only $215,000 of the encumbered funds is spent by December 31, 2016. While the low budget figure serves only for illustration, the analysts believe it to be within the realistic range, as analysts working on the west coast EM project are using a similarly rough estimate of $300,000 per year in EM provider service costs. It is reasonable to presume that costs in Alaska would be higher, as field service in this region involves significantly higher travel costs. Conveniently, $400,000 is very close to the listed "total cost" for the Field Support category as reported in the updated table for hook-and-line EM implementation in 2017 (see footnote 69, below).

Table 5-32 "High" and "Low" budget starting points for 2016 longline EM unit cost exercise

Budget Period	% of Annual Budget	High Budget	Low Budget
2016 (all)	100%	$780,000	$400,000
2016 (year-to-date, July 27)	70%	$546,298	$280,160

The analysts have identified four components of hardware costs: EM control centers, camera/sensor packages (including wiring and peripheral components), removable hard drives, and EM software licenses. Unit prices and depreciation timelines for each component are derived from a table published in 2016 as an addendum to the 2015 Alaska Region Electronic Technology Implementation Plan[69], as well as from consultation with PSMFC and EM service providers. Control centers and camera/sensor packages are assumed to depreciate linearly over a five-year time period. Hard drives are assumed to depreciate over a four year period; this shorter period a modeling decision meant to account for some amount of breakage and loss, as hard drives are subject to more human handling and shipping. Software license costs are a hardware-related fee that the provider would charge each year, so no adjustment is required to arrive at an annual cost.

Table 5-33 shows *estimated* costs and depreciation periods for the hardware components that can be identified. The depreciation period of the three hardware components is an important modeling assumption, but one should expect that the life-span of individual units will vary. The assumed purchase prices of the EM Control Center and camera/sensor packages are drawn from the updated Alaska Region Electronic Technology Implementation Plan[70]. The precise cost of a control center is proprietary business information; moreover, internal budget documents for the 2016 program are difficult to interpret, because some amount of equipment lease fees paid by the program in 2015 were credited toward 2016 purchases. Nevertheless, this estimate is consistent with figures reported in other programs. The analysts are not making assumptions about the future cost of control centers, noting that the price could decrease through competition or it could increase as new capabilities are developed and layered onto the existing platforms. Pricing a camera sensor package is more difficult, as different vessel configurations will require different numbers of cameras and more or fewer peripheral components. AMR staff has informed the analysts that a "standard" package includes four cameras, engine and oil pressure sensors, a GPS receiver, wiring cable, a monitor, and a keyboard. Some platforms might require only three cameras, while others might decline an engine "sleep" sensor due to the way that the vessel is operated. Noting the variability across EM vessel set-ups, the analysts find the cited price estimate of $3,200 to be in line with confidential itemized invoices. The estimate price for a removable hard drive is lower than what is reported in the cited Technology Implementation Plan table, but follow the advice of PSMFC and reflects the generally

[69] The plan document is available at https://alaskafisheries.noaa.gov/sites/default/files/akremerimplementationplan.pdf; the updated table is available at http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Revised_EM_ImplementationPlan_Budget.pdf.
[70] Same source reference as mentioned in footnote 69. The analysts are relying on the hook-and-line portion of that table. The cost estimates for hook-and-line were developed in cooperation with an EM service provider, while the estimates in the pot gear portion of the table were drawn from previous NMFS reports.

declining cost of data storage hardware. Finally, the annual cost to license the EM provider's technology is estimated based on the cited table, where "software licenses/hard drives/other supplies" are listed at $24,700. The analysts do not know how many units were licensed or how much each license costs, but $20,000 provides a starting point for analysis of 2016 as a "program year." The analysts attributed most of the cost in that line item to the licenses because hard drives are relatively inexpensive and "other supplies" are undefined.

Table 5-33 Estimated hardware unit costs for 2016 longline EM program

Component	Purchase Price	Life Span (yrs)	Annual Cost
Control Center	$6,000	5	$1,200
Camera/Sensor Package	$3,200	5	$640
Hard Drive	$100	4	$25
Software Licenses	$20,000	1	$20,000

<u>Methods: Unit Cost Estimates for 2016 Fixed Gear EM Program</u>

The analysts have established a single methodology for estimating unit costs (per vessel, per trip, per sea-day) of the 2016 EM program. That methodology is applied to 12 different scenarios that could, conceivably, describe the 2016 program in retrospect (Table 5-34). For each scenario, the analysts follow these steps:

1. Sum the purchase prices of all hardware
2. Define "Annual EM Service Budget"
    - 2016 Year (High) = $780,000
    - 2016 Year (Low) = $400,000
    - Year-to-date (High) = $546,298 ($780,000*70.04%)
    - Year-to-date (Low) = $280,160 ($400,000*70.04%)
3. Subtract total 2016 hardware purchases (**Step 1**) from EM Service Budget (**Step 2**); result is the estimated annual cost of "other provider services"
4. Sum annualized costs of the hardware purchased in 2016 (refer to assumed hardware life-span in Table 5-33)
5. Add annualized hardware costs to annual cost of "other provider services"; result is the estimated EM program cost for 2016 or 2016 YTD through July 27
6. Convert to unit costs based on participation and effort 2016 YTD through July 27, or based on an expansion of those vessel, trip, and sea-day counts over a full calendar year
7. To the results of **Step 6**, add either/both marginal cost of video review and marginal cost of data storage in the appropriate units

The need for twelve different scenarios (I – XII) stems from the many unknowns involved in costing out a 2016 program that is in the midst of purchasing and operation. Moreover, the 2016 program is distinct in that it is both an operating pre-implementation monitoring program and an effort to build up capacity for future years. Scenarios are useful, because each embodies a set of unknowns. A reader can develop his or her own range of reasonable cost estimates by comparing the scenarios that bookend his or her interpretation of the 2016 program, and the extent to which it reflects the program's cost profile in future years. The following bullets list complexities and unknowns that are reflected in the cost scenarios:

- Is the level of participation and effort in the first part of 2016 (Jan. 1 through July 26) reflective of effort in the latter part of the year?
- What is the service provider's true budget for 2016 EM field services?
- When describing the "cost of the 2016 program," how does one account for previous expenditures that were credited towards 2016 costs via confidential purchase arrangements?

- How many removable hard drives will the program require (per vessel)?
- What amount of labor, time, and budget is available for opportunistic "pre-wiring" on fixed-gear vessels using 2016 EM funds?
- How should one treat the depreciation of hardware if 2016 funds are used to purchase EM control centers or hard drives for use in 2017 (and beyond)?

Table 5-34 Budget, assumptions, and hardware purchasing for the 12 scenarios analyzed in the 2016 longline EM unit cost exercise

	Scenario			Amount of Hardware Purchased in 2016			
	Period	**Assumptions**	**EM Service Budget**	**Control Centers**	**Cam/Sensor Packs**	**Hard Drives**	**Licensing**
I	Year-to-date (7/26/16)	6 control centers were pre-paid in 2015	High ($546k)	10	17	20	1
II	Year-to-date (7/26/16)	6 control centers were pre-paid in 2015	Low ($280k)	10	17	20	1
III	2016 Year	All control centers purchased in 2016	High ($780k)	16	17	20	1
IV	2016 Year	All control centers purchased in 2016	Low ($400k)	16	17	20	1
V	2016 Year	6 control centers were pre-paid in 2015	High ($780k)	10	30	50	1
VI	2016 Year	6 control centers were pre-paid in 2015	Low ($400k)	10	30	50	1
VII	2016 Year	All control centers purchased in 2016	High ($780k)	16	30	50	1
VIII	2016 Year	All control centers purchased in 2016	Low ($400k)	16	30	50	1
IX	2016 Year	"Moderate" pre-purchase/pre-wiring for 2017; All control centers purchased in 2016	High ($780k)	30	45	160	1
X	2016 Year	"Aggressive" pre-purchase/pre-wiring for 2017; All control centers purchased in 2016	High ($780k)	30	90	160	1
XI	2016 Year	"Moderate" pre-purchase/pre-wiring for 2017; All control centers purchased in 2016; Zero depreciation on pre-purchased control centers	High ($780k)	30	45	160	1
XII	2016 Year	"Aggressive" pre-purchase/pre-wiring for 2017; All control centers purchased in 2016; Zero depreciation on pre-purchased control centers	High ($780k)	30	90	160	1

The construction of each scenario is best described by walking through each of the columns in Table 5-34:

- **Scenario – Period**: Each scenario is designed to yield unit cost estimates, which are essentially rates. "YTD" or "2016 Year" defines the period over which expenditures are laid over EM participation and effort (vessels, trips, days). YTD uses real data from PSMFC, but is only reflective of the first part of the 2016 year. This can be problematic because it relies on data from a single partial year, because effort historically trails off in the latter part of the calendar year, and because EM provider costs might not be uniform throughout the year. Expanding YTD costs over the 12 month period provides a better fit for scenarios that include "year-end spending" to purchase and to pre-install additional hardware, but "2016 Year" projections are built on the assumption that EM participation and effort are roughly equivalent over the pre- and post-July 26 date when the mid-year budget update was submitted. That assumption is unlikely to be precisely accurate, but could be adequate for generating a range of unit cost estimates.

- **Scenario – Assumptions**: The scenarios cover a range of uncertainties regarding factors that are unknown (e.g., how previous funds were credited towards 2016 purchases from the contracted provider), and factors that will not be known until the end of the present year (e.g., what amount of funds was expended over the entirety of 2016, and for which purposes). The EM program currently owns 16 control centers, which is enough to cover planned deployments for all of 2016. The analysts understand that the cost of up to six of these was credited from previous lease payments during the cooperative research phase of the program (2015). Scenarios IX through XII consider the possibility that 14 additional control center units will be purchased for future years, using 2016 funds. Scenarios XI and XII represent the likely possibility that none of those additional units are deployed in 2016, and thus their "depreciation clock" will not begin until 2017.
- **Scenario – EM Service Budget**: The only available method for imputing non-hardware EM costs is to subtract 2016 hardware expenditures from the annual EM service budget (**Step 3**). As noted above, the analysts can only make assumptions at this point about 2016 annual expenditures. High and Low spending cases are set at $780,000 and $400,000. Scenarios I and II are set at 70% of those figures, based on the monies spent YTD (as of July 26, 2016). Scenarios that include pre-purchasing or pre-installation of hardware are only evaluated under the High budget case.
- **Hardware – Control Centers**: The EM program currently owns 16 control center units (Table 3-3). Depending on how past expenditures are accounted, either 10 or 16 units were purchased in 2016. Scenarios that include pre-purchasing assume 30 units, which would be the target for a 2017 EM pool of 90 hook-and-line vessels. For simplicity, the analysts do not include scenarios for 24 control center units (six funded through pre-2016 expenditures), but the upper range of the results could be adjusted downward to get a sense of unit costs under that omitted scenario.
- **Hardware – Camera/Sensor Packages**: AMR staff reports that roughly 17 vessels are currently installed with camera/sensor packages, and notes that each is somewhat unique. Since the vast majority of equipment was uninstalled at the end of 2015, and because the program was moving from a lease model to a purchase model, the analysts assume that all 17 peripheral sets were purchased in 2016. The 12 scenarios range from 17 to 90 packages purchased in 2016, with the top-end representing the high end of pre-purchasing in preparation for a 2017 Pre-Implementation target of 90 vessels in the longline EM pool.
- **Hardware – Hard Drives**: According to PSMFC's video review data for January through July of 2016, 17 vessels have used 40 removable hard drives. Individual vessels have used between one and four hard drives. The analysts assume that a vessel selected for EM coverage will need at least two hard drives, and potentially three. The analysts also assume that the program owned at least 20 hard drives entering 2016, because 12 vessels participated in EM during 2015. The low end of 2016 purchasing is set at 20 hard drives, which brings the 2015 stock (20) up to the amount that are currently in use. The high end of 2016 purchasing is 160 hard drives, bringing the 2015 stock up to 180, or enough for each of the 90 hook-and-line vessels in the 2017 EM pool to have two hard drives.
- **Hardware – Licensing**: Given the lack of public information on license costs, the analysts are applying a flat $20,000 annual cost to each of the 12 scenarios. The marginal effect of this cost on total unit cost estimates is proportional to the assumed amount of vessels, trips, and sea-days. $20,000 represents between 3% to 13% of total 2016 program costs, depending on the scenario (refer to the "2016 Program Cost" column in either Table 5-38 or Table 5-39)

Table 5-35 through Table 5-37 provide values for the remaining pieces that are needed to convert an assumed annual budget and an EM hardware purchase list into unit cost estimates for the 2016 EM program. Table 5-35 summarizes the purchase price and annualized cost for hardware items in the amounts prescribed by Table 5-34. Table 5-36 summarizes the participation and effort levels that are applied to the model (YTD for Scenarios I and II, and YTD expanded to a full calendar year for Scenarios III through XII). YTD figures are drawn directly from PSMFC video review data. For "2016 Year," the number of EM vessels is set according to the 2016 Pre-Implementation Plan (30), and the effort levels are set by doubling YTD. Doubling YTD is likely overstates the trips and sea-days that will occur throughout the rest of the year, but no more intricate method would have a better chance of accurately predicting effort for these purposes. Moreover, the analysts note that the 2015 EM fleet of only 12 vessels logged more trips (67) than the 2016 EM fleet is on pace to reach, though the number of monitored sea-days was lower than what is projected based on 2016 effort year-to-date. In short, the pay-off for perfectly predicting total 2016 effort is low because the true amount will eventually be known, and because the effect of increasing effort on unit costs is well understood (unit costs decline as they are amortized over greater effort levels). Table 5-37 summarizes the marginal unit cost of data storage based on the participation and effort levels in Table 5-36, and an assumed annual storage cost of $10,000 for the entire program. For the YTD data storage cost, $10,000 was prorated over a 365 day year. For the marginal unit cost of video review, refer back to Table 5-29 from earlier in this section.

Table 5-35 Total purchase price and annualized 2016 cost for hardware/software purchases in the unit cost exercise scenarios

Item	Amt. Purchased	Purchase Price	2016 Cost
Contol Centers	10	$60,000	$12,000
	16	$96,000	$19,200
	30	$180,000	$36,000
	30*	$180,000	$19,200
Cam/Sensor Pkgs.	17	$54,000	$10,880
	30	$96,000	$19,200
	45	$144,000	$28,800
	90	$288,000	$57,600
Hard Drives	20	$2,000	$500
	50	$5,000	$1,250
	160	$16,000	$4,000
Licenses		$20,000	$20,000

* 14 of 30 control center units pre-purchased for 2017; purchase price is deducted from 2016 budget, but annualized cost does not accrue to 2016 program operating cost.

Table 5-36 Participation and effort levels applied to modeled cost estimates: 2016 year-to-date through July 26 and projection for full 2016 year

	EM Vessels	EM Trips	EM Sea-Days
2016 YTD (7/26/16)	17	57	228
2016 Year	30	114	456

Table 5-37 Marginal cost of data storage, based on participation and effort in Table 5-36

	Annual Cost Basis	Per Vessel	Per Trip	Per Sea-Day
2016 YTD (7/26/16)	$5,671	$334	$99	$25
2016 Year	$10,000	$333	$88	$22

Results: Unit Cost Estimates for 2016 Fixed-Gear EM Program

Table 5-38 and Table 5-39 summarize the results of this exercise in costing out the 2016 fixed-gear EM program. The reader should consider the columns in Table 5-38 as a series of steps culminating in a total 2016 program cost. Those program cost estimates should *not* be compared to one another until they are unitized (divided by the participation and effort levels shown in Table 5-36). Those unit costs are provided in Table 5-39. The unit cost estimates in the major columns of Table 5-39 (EM Contractor; Contractor + Vid. Review; Contractor + Review + Data Storage) grow from left to right as one presumes that more of the tasks currently performed by PSMFC are funded through monitoring fees as opposed to NMFS's overhead budget. For example, the middle column ("Contractor + Vid. Review") is equal to the left-hand column plus the unit costs of review that were calculated using the "hourly method" shown in Table 5-29 (e.g., $204 per sea-day). The right-hand column is equal to the middle column plus the unit costs shown in Table 5-37.

The following list contrasts the 12 scenarios used to bookend this analysis of the 2016 EM program. The reader should be aware of the three following caveats. First, the 2016 program was not designed with cost-efficiency as the primary goal. Second, all unit cost estimates would be lower if there were more fishing effort in the EM pool. Finally, this basic model is set up in a manner suggesting that non-hardware provider costs are inversely related to hardware purchasing in 2016. That relationship is merely an artifact of the analysts' inability to enumerate the EM provider's field service, travel, and management costs. This report does include qualitative information on 2016 field services and other provider activities described in Section 5.7.4.1.2; that information is meant to inform costs analyses of the mature program, but not necessarily to predict future service costs based on the pre-implementation years.

Scenarios:

I & II: Unit costs based on expenditures and participation/effort over the first part of 2016 (through July 26). Monies spent on fixed costs drive up the unit cost results, as they are amortized over fewer vessels/trips/sea-days.

III & IV: Lower unit costs than Scenarios I and II because some monies spent in 2015 are credited towards 2016 hardware purchases. Greater spending on hardware purchasing means that a larger portion of the annual service budget is amortized over the life-span of EM hardware, and a greater portion is identified as the provider's 2016 operating/management costs.

V – VIII: These scenarios mirror Scenarios I – IV, but with greater expenditures on "pre-wiring" vessels with camera/sensor/peripheral packages. As described above, increasing hardware investment lowers the estimated program cost in the present year.

IX & X: Pre-purchasing scenarios do not consider lower annual service budget cases. Increased investment in hardware leads to lower estimates of 2016 non-hardware provider costs and unit costs, relative to Scenarios V and VII.

XI & XII: Pre-purchasing scenarios do not consider lower annual service budget cases. Differs from Scenarios IX and X by excluding the annualized cost of control centers purchased for future years from 2016 Program Costs.

Table 5-38 Estimates of total 2016 longline EM program costs

Scenario	Service Budget	Hardware Mix (CC/C-S/HD)	Hardware Purchases	2016 Hardware Cost	2016 Other Provider Cost*	2016 Program Cost**
I	$546,298	10/17/20	$136,400	$43,380	$409,898	$453,278
II	$280,160	10/17/20	$136,400	$43,380	$143,760	$187,140
III	$780,000	16/17/20	$172,400	$50,580	$373,898	$424,478
IV	$400,000	16/17/20	$172,400	$50,580	$107,760	$158,340
V	$780,000	10/30/50	$181,000	$52,450	$599,000	$651,450
VI	$400,000	10/30/50	$181,000	$52,450	$219,000	$271,450
VII	$780,000	16/30/50	$217,000	$59,650	$563,000	$622,650
VIII	$400,000	16/30/50	$217,000	$59,650	$183,000	$242,650
IX	$780,000	30/45/160	$360,000	$88,800	$420,000	$508,800
X	$780,000	30/90/160	$504,000	$117,600	$276,000	$393,600
XI	$780,000	30/45/160	$360,000	$72,000	$420,000	$492,000
XII	$780,000	30/90/160	$504,000	$100,800	$276,000	$376,800

CC = control center; C-S = camera/sensor package; HD = hard drive

* "Service Budget" minus "Hardware Purchases"

** "2016 Hardware Cost" plus "2016 Other Provider Cost"

Table 5-39 Unit cost estimates for 2016 longline EM program

		Unit Cost ($)								
Scenario	2016 Prog. Cost	EM Contractor			Contractor + Vid. Review			Contractor + Review + Data Storage		
		Per Vessel	Per Trip	Per Day	Per Vessel	Per Trip	Per Day	Per Vessel	Per Trip	Per Day
I	$453,278	26,663	7,952	1,988	29,396	8,767	2,192	29,730	8,867	2,217
II	$187,140	11,008	3,283	821	13,741	4,098	1,025	14,075	4,198	1,050
III	$424,478	24,969	7,447	1,862	27,702	2,868	2,066	28,036	8,361	2,091
IV	$158,340	9,314	2,778	694	12,047	3,593	898	12,381	3,692	923
V	$651,450	21,715	5,714	1,429	24,446	6,433	1,609	24,779	6,521	1,631
VI	$271,450	9,048	2,381	595	11,779	3,100	775	12,113	3,188	797
VII	$622,650	20,755	5,462	1,365	23,486	6,181	1,545	23,819	6,269	1,567
VIII	$242,650	8,088	2,129	532	10,819	2,848	712	11,153	2,935	734
IX	$508,800	16,960	4,463	1,116	19,691	5,182	1,296	20,024	5,270	1,318
X	$393,600	13,120	3,453	863	15,851	4,172	1,043	16,184	4,259	1,065
XI	$492,000	16,400	4,316	1,079	19,131	5,035	1,259	19,464	5,123	1,281
XII	$376,800	12,560	3,305	826	15,291	4,024	1,006	15,624	4,112	1,028

The "Per Day" columns in Table 5-39 provides the available comparison to the average daily cost that NMFS pays for a human observer – $1,083 in 2015, or $1,071 across all years dating back to 2014 – though it is a tenuous one. The most relevant of the three highlighted columns depends on whether or not the Council and NMFS recommend that industry monitoring fees should be applied to the cost of video review and/or data storage.

For completeness, the analysts include publicly reported estimates of cost per sea-day in other EM programs below. The reader should note that these programs are heterogeneous in their structure, data objectives, stage of maturity, and the range of cost factors that are included in the sea-day cost. Lower unit costs might be realized in programs where the fleet takes longer trips (lower costs that are driven by selection rates and in-port field service), where fleet demographics make it possible for a single in-port technician to service a larger number of vessels, or where vessels tend to be based in ports that require lower travel costs (i.e. road-accessible). EM review costs also vary widely depending on the type of data that is being extracted from the video. Compliance-oriented programs in trawl fisheries with full retention requirements are often reviewing video only to confirm whether or not at-sea discards occurred, meaning that review can be completed quickly and at a lower unit cost.

- New England multispecies groundfish trawl sector program; hypothetical[71] EM program using cameras to estimate discards and retained catch through a logbook audit approach: estimated at $357 in 2015 report (NMFS GARFO 2015a)
- New England/Mid-Atlantic herring/mackerel midwater trawl fishery; hypothetical[72] EM program using cameras to estimate discards and retained catch through a logbook audit approach: estimated at $326 in 2015 report (NMFS GARFO 2015b)
- 2010 West Coast shoreside whiting EFP trawl fishery; cameras used to ensure that salmon and overfished rockfish species are retained: $350 (Lowman et al., 2013)
- 2009-2010 British Columbia (Canada) hook-and-line groundfish fishery; cameras used to audit logbooks for documentation of discarded and retained catch: $149 (Lowman et al., 2013)

5.8.2.2 Assessing EM Program Design Options Under Possible Budget Constraints

This section complements and builds off of the previous section. As noted above, estimated unit costs of the 2016 Alaska fixed-gear EM program provide a useful baseline for future program evaluations, but the metric is inherently limited in its ability to capture the evolution of individual program elements' cost profiles over time. Perhaps more importantly, the 2016 estimates do not reflect the fact that costs are both a driver and a function of program design choices. Hardware purchasing and field service spending levels during the pre-implementation phase are certain to differ from the levels that will be observed in a mature program. The characteristics of a mature EM program will include: a more or less stable EM fleet size with a predictable annual distribution of effort across seasons and delivery ports; a pool of qualified local EM technicians in selected hub ports; and a knowledge-base within the EM fleet that reduces the need for field service and can assimilate technological advancements and additional data logging tasks that enhance overall data quality per dollar spent. Moreover, once the picture of the mature EM fleet and infrastructure comes into focus, costs may still differ as the Council and NMFS periodically redefine the program's data objectives through the ADP process. One might expect data objectives to evolve as EM technology improves and the range of achievable data elements expands, or as the overall monitoring program changes in response to the evolving composition of the partial category[73] or future monitoring budget environments.

The four parts of this exercise are:

1. Define cost profiles for each program element that will be, or might be, funded through the use of industry monitoring fees. Include variations on each element that reflect possible cost trajectories (changes over time) and program design choices.
2. Construct hypothetical total program costs (hardware/software, field service, video review, and data storage) for several program designs of differing scope. For this exercise, "total program costs" do not include NMFS management and administrative overhead (described in Section 5.7.4.1.4). These estimates will be conservatively high if it turns out to be the case that data analysis and storage are not ultimately funded through the monitoring fee.
3. Define a range of "EM budget scenarios." The so-called EM budget is the portion of the total monitoring fee pool that is available to support EM, as opposed to being used to purchase

[71] NMFS Greater Atlantic Regional Fisheries Office enlisted service providers and Gulf of Maine Research Institute to cost out an imagined EM program based on certain program requirements and objectives.
[72] Same as footnote 71.
[73] For example, the Council, NMFS, and FMA division might make wholesale changes to deployment in the partial coverage category if all GOA trawl vessels are moved to full coverage, depending on how that action impacts fee revenues and demand for human observer-days.

observer-days for the non-EM strata in the partial coverage category. Drawing up potential EM budget constraints should help the reader conceptualize potential trade-offs between the scope of the EM program and other monitoring needs. *It is important to recognize that the Council has not signaled any intent to tie the amount of funds available for EM to any specific metric, such as the number of vessels in the EM stratum or the proportion of monitoring fees paid by those vessels in the previous year.*

4. Discuss results. Consider potential scope of EM program design in light of recent historical funding for the partial coverage category, and how to relate EM spending to NMFS's ability to purchase observer-days for the non-EM strata.

5.8.2.2.1 Cost profiles for elements that use monitoring fees

Hardware/Software – Hardware and software costs are profiled at the annual, per-vessel level so that total program costs can be scaled up or down depending on the size of the EM stratum that is being imagined in a given future year. Most of what the analysts have to cite regarding hardware/software costs is summarized in Table 5-33 in the previous section (2016 unit cost estimates). That table only reflects experience with the hook-and-line EM program serviced by AMR. As noted in the previous section, the analysts have little knowledge about how AMR structures the cost of licenses to use its onboard EM software. The total cost of licenses in 2016 was estimated at $20,000 based on the analysts' assumptions about a single line item in the Alaska Region Electronic Technologies Implementation Plan Update Table: "Software Licenses/Hard Drives/Other Supplies" were invoiced at $24,700 for a fleet of 90 vessels.[74] Aside from disentangling the cost of licenses from hard drives and "other supplies," it is not clear whether AMR is charging for a blanket programmatic license, or whether it is charging for one license per control center. For the purpose of this analysis, it is assumed that the cost of an annual software license is $667 *per control center* ($20,000 divided by 30 control centers in 2016).

SWI's 2015 technical report on Pacific cod pot gear EM research (Buckelew 2015) uses the estimated control center and camera/sensor package costs from the Alaska Region Electronic Technologies Implementation Plan Update: $6,500 for control centers, $4,500 for camera/sensor packages.[75] Neither the SWI report nor the AK Tech. Plan reveal any information about cost of software licenses in the pot sector, so the same estimate of $667 per control center per year is applied.

Table 5-40 and Table 5-41 summarize the annual cost of hardware and software for each hook-and-line and pot vessel in the EM stratum, based on reported prices and the assumptions described above. Table 5-40 includes three scenarios for the longline sector, reflecting the uncertainty regarding the total number of control centers that the program would need to purchase in order to service a fleet a certain size. A 1:1 Unit/Vessel Ratio would mean that every vessel has a dedicated control center, and no equipment rotation occurs during the season. A 2:3 ratio would mean that 60 control centers are purchased for a longline fleet of 90 vessels; a 1:2 ration would mean that half of the longline vessels could have a control center installed at any given time. The ratio that is put into practice will depend on the program's budget for field staff to do in-season equipment rotation, and the demographics of the fleet. For example, the agency or the EM provider might conclude that it makes more sense to purchase additional control center units and leave them on vessels in the stratum that are spread around remote non-service ports. The desired ratio might also depend on how the ADP sets selection rates and deployment periods (trip vs. vessel selection) in a given year; a trip selection model would likely require a Unit/Vessel Ratio that is closer to

[74] http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Revised_EM_ImplementationPlan_Budget.pdf.
[75] SWI's report included a 15% per year "annual replacement and upgrade" cost, bringing the total annualized cost of $11,000 worth of equipment to $3,520. The authors of this report have chosen instead to assume that equipment is fully depreciated and replaced every five years, meaning that the annualized cost of $11,000 is $2,200. Given that the analysts have observed the same hook-and-line EM systems being deployed in 2015 and again in 2016, it seems unlikely that a provider would spend $1,650 each year to upgrade $11,000 worth of equipment.

1:1. It is assumed that each pot vessel in the program would have its own control center, because the high-intensity peaks in the limited access season do not allow time for technicians to rotate units between vessels upon selection.

Table 5-40 Annual hardware and software cost per hook-and-line vessel

Component	Price	Life Span (yrs)	Annual Cost	Unit/Vessel Ratio	Vessel Cost
Control Center	$6,000	5	$1,200	1:1	$1,200
				2:3	$800
				1:2	$600
Software License	$667	1	$667	1:1	$667
				2:3	$445
				1:2	$334
Cam/Sensor Pack.	$3,200	5	$640	1:1	$640
Hard Drives (2)	$200	4	$50	1:1	$50
Total Vessel Cost				**1:1**	**$2,557**
				2:3	**$1,935**
				1:2	**$1,624**

Table 5-41 Annual hardware and software cost per pot vessel

Component	Price	Life Span (yrs)	Annual Cost	Vessel Cost
Control Center	$6,500	5	$1,300	$1,300
Software License	$667	1	$667	$667
Cam/Sensor Pack.	$4,500	5	$900	$900
Hard Drives (2)	$200	4	$50	$50
Total Vessel Cost				**$2,917**

Table 5-42 summarizes hardware and software cost estimates for a range of EM fleet sizes, and shows how total costs scale down by roughly 25% to 30% when shifting the hook-and-line sector from a 1:1 to a 1:2 Unit/Vessel Ratio. Though not shown in the table, AMR reports that it budgets an 11% contingency fund across its entire annual spending plan to deal with unexpected events, which could include equipment breakage. The analysts assume that the true hardware/software cost, include breakage and replacement, is contained somewhere in the range of Table 5-42.[76]

[76] For reference, AMR budgeted $175,000 for "EM Products" prior to the 2016 hook-and-line Pre-Implementation year, in which the company planned to support a fleet of 30 vessels (Personal communication, 2016). While it merits reporting, that figure does not fit well with this analytical strategy because AMR was "buying" EM systems that are expected to last five or more years; these tables a built around annualized costs. Also, AMR's 2016 budget was drawn up with the open-ended possibility to purchase additional inventory depending on the direction of development of the 2017 Pre-Implementation Plan.

Table 5-42 Total annual hardware and software costs for the fixed-gear EM stratum, by control center (CC) unit/vessel ratio

Fleet Composition		Total Annual Hardware/Software Cost		
LL	Pot	All CCs 1:1	LL CCs 2:3	LL CCs 1:2
60	15	$197,175	$159,832	$141,165
60	30	$240,930	$203,587	$184,920
90	15	$273,885	$217,871	$189,870
90	30	$317,640	$261,626	$233,625
130	30	$419,920	$339,011	$298,565
130	50	$478,260	$397,351	$356,905

The three preceding tables do not reflect a trajectory in hardware/software costs over time. It is often assumed that technology costs tend to decrease. Whether that occurs here depends on the extent to which competition and choice is part of the eventual program design, and whether the trend in EM technology will be to enhance performance or to lower prices. The incentive for EM providers to compete on price will be lower in the Alaska program than it is in other EM programs, because the users (fishermen) will continue to pay ex-vessel-based monitoring fees rather than directly paying the cost of the systems.

Field Services – This analysis profiles field services at the annual programmatic level. Field service is the program element that varies across the greatest number of dimensions; costs are expected to vary across both time (trajectory) and program design choices (uncertainty). Some cost items, such as program management, do not scale with the size of the fleet or the effort in the EM stratum in any manner, but might decrease over time as the program matures and requires fewer hours of management, reporting, and coordination with the regulatory development process. Other cost items, such as the number of ports in which local trained technicians are provided, scale with participation and effort to a degree, but not on a per-vessel or per-trip basis. Each in-port service technician adds an expense to the program, but can reduce other cost drivers such as travel (for both the EM provider and participating vessels). On the other hand, cost items such as system installation, reinstallation, control center rotation, camera service, software technical support, and data retrieval do tend to scale with fleet size. In ports where those services are provided by local technicians, the cost is absorbed by the annual salary of the labor. When those services occur outside of EM hub ports, those costs manifest in terms of travel cost, or in terms of both travel and additional labor costs if the contracted provider is required to fly out professionals from a company base (e.g., Anchorage, AK or Victoria, BC).

Aside from fleet size, the service cost items that behave more like variable costs will scale differently depending on the program's deployment model – "vessel selection" or "trip selection." The trip selection model is likely to require more service touch-time, and could exacerbate travel costs if vessels in remote ports are routinely selected. Under either deployment model, the actual cost of field service will be somewhat unpredictable, as the probabilistic selection process (ODDS) could select a small number of vessels repeatedly, or could select many vessels for one deployment each. A lower number of "repeat" selections will generally increase service costs; a higher number of repeats means that fewer vessels need EM equipment (re)installed and serviced.

Holding the size of the EM fleet steady over time, it is reasonable to expect that demand for services will trend downward – approaching a steady state – as initial installations convert to re-installations, as service travel demand decreases, or as routine maintenance and software management can be handled remotely or by the vessel operator. However, the cost profile of the service element might jump again if a cohort of new vessels joins the EM stratum and must be built up again from a low baseline of hardware readiness and technical capacity. Such a jump might also occur if the demographics of the EM fleet shift, even on the margin, to include vessels in remote ports with no reasonable expectation of being able to commute to a hub port for service.

Finally, it is also important to recognize that the cost *effectiveness* of dollars spent providing field services may vary depending on the level of effort in the EM stratum and the selection probability for vessels that have received costly installations and technical support. It may be the case that the vessels which require the highest field services cost (distance to hub ports) also take fewer trips and produce a low amount of data for the monitoring program. Whether or not future ADPs make the EM program a monitoring option for these vessels will influence the cost profile of the program and conclusions about its net benefit.

Table 5-23 provided estimates for the cost of field service elements in the context of an immature EM program of 90 hook-and-line vessels and 30 pot vessels that is still primarily focused on research, field testing, and deployment modeling.[77] Summing the hook-and-line and pot columns of that table yields a total cost of $754,000 ($396,000 for hook-and-line, and $358,000 for pot), which is *not* a reasonable expectation for the cost of an integrated program. Summing across that table ignores the trajectory of costs over time and the gains from investing in local service capacity, and picks up the inflated travel, labor, and shipping costs associated with making a high number of initial installations.

Moving forward, the exercise in this section relies on the book-ended cost profile in Table 5-43, which draws on the information in Table 5-23 and modifies it to reflect the preceding discussion. The analysts also drew on a summarized Statement of Work for the 2016 hook-and-line EM pre-implementation program, which was provided by AMR through personal communication.[78] The analysts acknowledge that the spread between "high" and "low" is large, and necessarily so as it is capturing variation in both cost trajectory and program design choices. At the present stage in EM development, the analysts did not find additional value in developing a model laden with parameters built on assumptions in order to arrive at high and low cost estimates that that are no less based on conjecture. The figures in Table 5-43 warrant some justification, which is provided below. The analysts caution that "high" and "low" should *not* be read as "maximum" and "minimum."

Table 5-43 Range of annual field service costs for the fixed-gear EM stratum

	Two Provider Program						Single Provider	
	LL		Pot		Two-Provider Total			
	High	Low	High	Low	High	Low	High	Low
Project Mgmt.	$150,000	$75,000	$150,000	$75,000	$300,000	$150,000	$150,000	$100,000
Port Service Labor	$280,000	$210,000	$210,000	$140,000	$350,000*	$280,000	$350,000	$280,000
Travel/Fly-out Labor	$77,000	$20,000	$40,000	$15,000	$117,000	$35,000	$50,000	$20,000
Shipping & Materials	$20,000	$5,000	$12,000	$5,000	$32,000	$10,000	$25,000	$7,500
Total Service Cost	**$527,000**	**$310,000**	**$412,000**	**$235,000**	**$799,000**	**$475,000**	**$575,000**	**$407,500**

* This cell does not simply sum the high-cost scenarios for the hook-and-line and Pot providers to reach a total cost for in-port technicians (estimated $70,000 per port) in a two-provider program. This cost profile is based on the assumption that up to five ports would be staffed with a local EM technician (as suggested by the 2017 draft Pre-Implementation Plan). Summing would suggest that seven FTE technicians would be hired. The analysts presume that even in a two-provider program there would not be a case where providers contract different individuals with the same skill set to do essentially the same job; rather, the analysts expect service technicians to be cross-trained to work on both types of EM systems.

[77] Those cost estimates were based on a publicly released table that was an update to the 2015 Alaska Region Electronic Technologies Implementation Plan, and is available at: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Revised_EM_ImplementationPlan_Budget.pdf.

[78] The 2016 hook-and-line statement of work was drafted prior to the 2016 season and budgeted room for contingencies and for investment of money and labor in pre-wiring vessels to build fleet capacity. "Program Labor" was budgeted at $438,000, and "Travel" was budgeted at $77,500. The analysts note that these figures conflate project development oversight and actual field services, but greater detail cannot be provided due to confidentiality.

The left-hand portion of Table 5-43 costs out high and low scenarios for a program design in which the field services for the hook-and-line and pot sectors of the EM program are contracted out to separate entities. That design, by definition, includes redundancies that could increase total costs. The right-hand portion imagines a single provider that services both sectors.

- **Project Management** is profiled as one FTE per provider. The higher cost estimate of $150,000 is adjusted upwards of what is reported in the AK Region Electronic Technologies Implementation Plan based on the advice of EM Workgroup members. The low-end estimate represents a more mature program that takes less of a manager's time, and does not indicate any change in the value or productivity of labor. The low-end estimate for a single provider system is held up at $100,000 per year, based on the presumption that managing services for two gear sectors would require more time.
- **Port Service Labor** is denominated in terms of FTEs costing $70,000 per year. The high cost for a single provider system represents five service ports with a dedicated technician in each. The low end for a hook-and-line provider (three technicians, or $210,000) and a pot provider (two technicians, or $140,000) represents the number of service ports for each sector that are defined in the draft 2017 Pre-Implementation Plan. The two-provider total adjusts for the expectation that if both sector providers made the same location a hub service port then a single technician in that location could be cross-trained to work on each system. These estimates are conservatively high because they assume that a full FTE is required in each port. It is possible that an FTE could be eliminated if servicing the EM fleet in a port does not translate to a full-time job; this is more likely to be the case in the pot sector, where effort is concentrated around two peak seasons.
- **Travel** and the cost of labor than cannot be supplied by technicians stationed in hub service ports is the cost item that will vary the most based on capacity building, program design choices (e.g., number of service ports provided, or choosing a trip-selection model), and the uncontrolled possibility that vessels operating out of remote ports will opt into the EM stratum and be selected for coverage. In general, one can imagine a give-and-take between investment in port-services and travel costs. As noted above, travel costs should decline as the fleet gains experience and remote software service technologies are developed. The high end cost for a hook-and-line provider is drawn from AMR's statement of work for the 2016 hook-and-line pre-implementation program. Given the high-service nature of that effort, that figure ($77,000) serves as a top-end reference. The high-end cost for a pot provider is adjusted downward because the pot fleet is smaller and is distributed across a smaller number of ports (Table 5-15). The cost estimates for a single provider system tend towards the middle of the range because the analysts assume some travel efficiency when coordinating service calls with a holistic view of the fleet and its needs.
- **Shipping & Materials** captures the cost of moving new systems to hub and remote ports for initial installations as the fleet size grows. It also builds in budget room for ancillary items related to service and training that are separate from the cost of the actual hardware that is placed onboard a vessel. The cost of shipping equipment should dissipate as fewer vessels are entering the program as new, but those costs will never be reduced to zero because systems will periodically wear out and need replacement. The source materials for this profile describe a pre-implementation program where local technicians are removing data drives as part of high-intensity, trip-to-trip contact with the vessel operators who are participating in EM research, and as a result the provider is taking on the task of mailing hard drives to the video reviewer. It is likely that the provider will not continue shipping drives once the program is fully integrated. The high and low cost estimates for a single provider system are slightly lower as some efficiency in bulk shipping of both pot and hook-and-line EM equipment should be achieved.

Video Review – Review costs are profiled at the annual programmatic level (as opposed to the per vessel, trip, or sea-day level). Whether the cost of video review will be paid through the monitoring fee or

NMFS's budget remains to be determined. This exercise considers the feasible scope of the EM program under various budget constraints both with and without storage costs accruing to the fee-based budget.

Section 5.8.2.1 concludes that, when looking forward to a mature EM program, video review costs are best characterized by the number of FTE labor positions required to service the program. In the context of unknown future participation/effort levels, counting costs in terms of FTEs is a more stable approach than projecting future demand for reviewer-hours and multiplying by an hourly labor rate. Thinking in terms of FTEs also fits best with PSMFC's management strategy of maintaining a stable workforce of reviewers who are cross-trained for several duties, and who can shift their focus to reviewing Alaska EM video as activity in the fisheries and the urgency of data turnaround time ebbs and flows during the course of a calendar year. PSMFC reports that approximately two FTE reviewers could adequately service the Alaska EM program at its projected size in 2017, and that the total cost of one FTE is estimated at $100,000 per year. For this exercise, the analysts use high-cost and low-cost bookends set at 1.5 and 3.0 FTEs, respectively. Including a scenario with three FTE reviewers accounts for the potential increase in the size of the EM fleet over time, the inclusion of pot vessels (expected to require more review time per catch event), or evolving objectives that require reviewers to log more data from each catch event or complete reviews more quickly.

Section 5.8.2.1 also estimated the cost of management for the data analysis element of the 2016 Alaska program. Management costs not only represent labor, but also serve as a stand-in for non-review costs that are difficult to itemize. The 2016 estimate, $68,000 for the year, would represent only a partial FTE for a management-level professional; this seems reasonable, as PSMFC works across a number of EM and non-EM data analysis projects. The authors of this document conjecture that $68,000 per year for management represents the low end for a bookend approach to future program costs. Management costs (i.e., time) would increase with the scope and complexity of the program. Management costs also might increase if the data analysis component of the program is eventually contracted to a for-profit company. This is not to say that a non-profit manager bills labor at a lower rate; rather, a company's management costs might soak up some of the profit margin that is not explicitly invoiced in any line item. Table 5-44 summarizes a rough cost profile for video review, including a range of one to three FTE reviewers and low/high management costs at $68,000 and $100,000 per year, respectively.

Table 5-44 Total annual data analysis cost scenarios

Vid. Review	Review	Project Mgmt.*		**Total Cost**	
FTE	Labor	Low	High	**Low**	**High**
1.0	$100,000	$68,000	$100,000	**$168,000**	**$200,000**
1.5	$150,000	$68,000	$100,000	**$218,000**	**$250,000**
2.0	$200,000	$68,000	$100,000	**$268,000**	**$300,000**
2.5	$250,000	$68,000	$100,000	**$318,000**	**$350,000**
3.0	$300,000	$68,000	$100,000	**$368,000**	**$400,000**

* Includes partial FTE and other non-itemized costs

Data Storage – Data storage costs are also profiled at the annual programmatic level. Whether storage costs will be paid through the monitoring fee or NMFS's budget remains to be determined. As with video review costs, this exercise considers the feasible scope of the EM program under various budget constraints both with and without storage costs accruing to the fee-based budget.

EM video data is housed on servers at PSMFC where storage capacity is shared with data from the west coast EM program, which presently takes up the vast majority of stored capacity due to the program's relative maturity and the fact that it involves trawl fisheries that require longer recording times. Section

5.7.4.1.3 concludes that while storage costs seem to fit the definition of a variable cost, they are more likely to behave like fixed costs in the context of this program. That fixed cost would increase in a step-wise manner as additional servers are required to house Alaska's EM data. Additional servers might be required if the amount of observed effort increases, or if NMFS determines that data needs to be stored for a longer period of time in order to meet law enforcement needs. The growth of storage demand as the program matures might be mitigated by advancements in data compression, a shift from video recording to rapid photo imaging, or the development of applications that slice video to store only catch events. Because the Alaska EM program shares server space with the west coast program, the analysts make assumptions about how server depreciation and replacement costs are shared. The current annual cost of a single server is $25,000. At present, two servers are sufficient to store EM data (and backups) for Alaska and the west coast for four years.

Table 5-31 summarizes the Alaska EM program's theoretical annual storage costs under several scenarios, depending on how many servers PSMFC requires and what proportion of those annual costs are invoiced to the Alaska program. The analysts placed the estimated storage cost for the 2016 cost exercise in Section 5.8.2.1 at $10,000. That estimate represents a two-server system with a five-year depreciation schedule, where the Alaska program is responsible for 20% of total storage costs – a conservatively high estimate considering the amount of data currently flowing from the Alaska program. An appropriately high upper bound could be set at $25,000 per year, which represents growth in the Alaska program that requires a third server and raises Alaska's cost-share to around 30%.[79] Given the large uncertainty around actual data usage, adjusting this $10,000 to $25,000 range to reflect time-trends in data storage costs adds little or no value to the analysis at this time.

5.8.2.2.2 Examples of annual program costs

Specific cost estimates from the preceding profiles of the four key elements (hardware/software, field service, data analysis, and data storage) can be mixed and matched to imagine defensible total program costs that fit with a given concept of the EM program. This subsection provides six illustrations of how the preceding cost profiles might be used. The reader should *not* consider these examples as encompassing the full range of potential program costs; the examples do not include cost-conscious measures such as lower ratios of control centers to vessels, employing only part-time local service technicians, or minimized review labor staff, to name a few. As more clarity on the true scope of the Council's preferred program emerges, the analysts may be able to hone in on a "most likely" program-level cost estimate. At the least, this information could serve as a guideline for iterative analysis of the EM deployment costs as part of the ADP process.

Table 5-45 draws on Table 5-42, Table 5-43, and Table 5-44 to summarize the program cost estimate for each of the following illustrative programs, both with and without video review and data storage included:

1. Fleet size and deployment model similar to 2017 draft Pre-Implementation Plan (90 hook-and-line, 30 pot); two service providers; technical capacity still developing.
2. Same characteristics as Example 1, but with a control centers installed on all hook-and-line vessels (1:1 ratio), experienced fleet with well-established in-port services, and an additional video reviewer FTE to increase the timeliness of data processing.
3. Same characteristics as Example 1, but with a single field service provider and well-established technical capacity.

[79] The analysts think it likely that PSMFC will need to invest in a third server in the near- to medium-term. Table 5-30 shows that annual data accumulation across both Alaska and the west coast programs has been around 100 to 120 TB in 2015 and 2016 (projected). Collecting more than 120 TB per year would push a two-server system to its capacity if data must be stored for four years. The need for a third server could be triggered by either longer required storage periods or a moderate increase in data accumulation. The latter seems likely, given that the Alaska program plans to increase in size, moving from ~50 hook-and-line vessels in 2016 to 90 hook-and-line vessels and 30 pot vessels under the draft 2017 Pre-Implementation Plan with no planned change to the selection rate in the EM stratum (30%).

4. Larger fleet size (130 hook-and-line, 30 pot) with two field service providers and well-established technical capacity.
5. Same characteristics as Example 4, but with a single field service provider and control centers installed on only half hook-and-line vessels.
6. High-end fleet size (130 hook-and-line, 50 pot), with one provider and a large proportion of vessels that are either in remote ports or take only a few trips per year.

Table 5-45 Annual program cost estimates for example EM programs including both hook-and-line and pot sectors (with and without data analysis/storage costs included)

	Hardware	Field Service	Data Analysis	Data Storage	Total Cost	Cost Excl. Data Review/Storage
1	$261,500	$600,000	$250,000	$10,000	$1,121,500	$861,500
2	$317,500	$475,000	$318,000	$10,000	$1,120,500	$792,500
3	$261,500	$415,000	$218,000	$10,000	$904,500	$676,500
4	$339,000	$550,000	$250,000	$15,000	$1,154,000	$889,000
5	$298,500	$425,000	$250,000	$15,000	$988,500	$723,500
6	$397,500	$575,000	$318,000	$25,000	$1,315,500	$972,500

5.8.2.2.3 EM budget scenarios

The manner in which the annual budget for EM is determined is a policy choice that is yet to be made, and the basis for the budget could evolve as the Council and the Observer Program gain a sense of the program's scope, true cost, and value. The ideal way to formulate an EM budget – and perhaps the way it will be done if EM is part of the ADP process – would be to determine the number of observer-days required to meet sampling targets in the non-EM strata, then to apply the average cost of an observer-day to that number; what remains of the fee-base (and any budget carryovers or supplementary Federal funds) would be the available budget for EM. However, FMA staff cannot project the required number of observer-days in a future year because the number is not a simple function of the selection rate. For example, a 15% selection rate for fixed-gear vessels could translate into a different number of observer-days in different years, depending on the amount and distribution of projected effort across seasons, areas, and fisheries. The selection rate itself is determined by the available budget and the minimum number of observer samples needed to arrive at an unbiased catch estimate. The minimum number of samples is a function of the number of vessels in each stratum, the variance of catch estimation in each stratum, and the cost of providing coverage in that year.

Nevertheless, this analysis requires a "straw man" budget in order to discuss what program scope is feasible and, based on the monitoring budgets from previous years, how many observer-days could be afforded for the non-EM strata. For the purpose of discussion, the EM budget could be defined as a function of the number of vessels in the EM stratum, the amount of effort (sea-days) relative to the non-EM strata, or the proportion of total monitoring fees remitted by the vessels in the EM stratum during the preceding year. Table 5-46 provides a range of potential EM budgets based on approximations of those metrics drawn from recent years. The considered EM fleet sizes, in terms of vessels, start at the planned level of the 2017 pre-implementation program (90 hook-and-line and 30 pot) are also adjusted upwards to consider future growth (up to 130 hook-and-line and 50 pot). The rationale for each straw man budget scenario and the calculations behind them are described below. Ultimately, the appropriate way to view the budget constraint must be determined by the Council.

It is important to acknowledge that the fee and participation/effort metrics that underlie the following tables are retrospective. While these metrics have been relatively stable since the implementation of the restructured Observer Program in 2013, they are subject to exogenous forces such as harvest limits (TAC) and market prices, among others. Whether or not any of the budgets in Table 5-46 are precise reflections of the money available to implement the elements of the EM program that accrue to the monitoring fee-base is somewhat beside the point. The purpose of this exercise is to provide the reader with a defensible conceptualization of how much money might be dedicated to EM if the program is limited by certain Council objectives or funding constraints (e.g., not drawing on the portion of the typical fee-base that is contributed by the trawl sector, or not relying on continued direct support from the Federal government). Table 5-47 puts those budgets into the context of the average fee-base as observed over the 2014 through 2016 period.

Table 5-46 Range of potential annual "budgets" for EM program elements that accrue to the industry monitoring fee

Category	Budget Approach	EM Fleet Size	EM Budget
1	*Assigned Percentage*		
1.a	10% - 25% of total fees ($3.83M)	Any	$383,000 - $957,500
1.b	10% - 25% of non-trawl fees ($2.61M)	Any	$261,000 - $652,500
2	*Non-trawl fees ($2.61M) apportioned by…*		
2.a	% of total vessels in EM stratum	90 LL, 30 pot	$287,000
2.b	% of total vessels in EM stratum	130 LL, 30 pot	$378,500
2.c	% of total trips in EM stratum	90 LL, 30 pot	$360,000
2.d	% of total trips in EM stratum	130 LL, 30 pot	$404,500
2.e	% of total sea-days in EM stratum	90 LL, 30 pot	$317,500
2.f	% of total sea-days in EM stratum	130 LL, 30 pot	$412,000
3	*Non-trawl fees ($2.47M) appportioned by…*		
3.a	Sea-Days/Vessel (all vessels)	90 LL, 30 pot	$387,000
3.b	Sea-Days/Vessel (vessels > 40')	90 LL, 30 pot	$489,000
3.c	Sea-Days/Vessel (all vessels)	130 LL, 30 pot	$515,000
3.d	Sea-Days/Vessel (vessels > 40')	130 LL, 30 pot	$662,000
3.e	Sea-Days/Vessel (all vessels)	130 LL, 50 pot	$581,500
3.f	Sea-Days/Vessel (vessels > 40')	130 LL, 50 pot	$729,000

Table 5-47 Proportion of monitoring fee-base that is attributed to the EM program under the budget scenarios (Categories 2 and 3) in Table 5-46

	2.a	2.b	2.c	2.d	2.e	2.f	3.a	3.b	3.c	3.d	3.e	3.f
% "Avg. Non-Trawl Fees"	11	15	14	16	12	16	16	20	21	27	24	30
% "Avg. Total Fees"	7	10	9	11	8	11	10	13	13	17	15	19

"Avg. Total Fees" = $3.83 million; "Avg. Non-Trawl Fees" = $2.61 million for 2.a through 2.f, and $2.47 million for 3.a through 3.f

Taking the period since restructuring as a representative snapshot of the Alaska fixed-gear groundfish and halibut fisheries, the analysts base straw man budget scenarios on activity and revenues in those years. Each of the three categories in Table 5-46 are built off of the average annual monitoring fee receipts over the 2013 through 2015 period (Table 5-5).

- **Category 1** is the simplest of the budget scenario categories. Scenarios 1.a and 1.b represent a Council decision to put a given percentage (10% to 25%) of monitoring fees towards EM.

- **Scenario 1.a** is based on the fact that the average annual fee revenue from all vessels subject to partial observer coverage was $3.83 million over the 2013 through 2015 period.[80]
- **Scenario 1.b** is based on the fact that trawl activity was responsible for an average of 31.9% of annual fee revenues in 2014 and 2015. If the Council wanted to base its concept of an EM budget on an amount that would have less of a direct effect on the budget for deploying observers on trawl vessels, it might start with a straw man budget for all fixed-gear coverage (EM and observers) of $2.61 million (68.1% of $3.83 million).

- **Category 2** builds off of the assumption that dividing $2.61 million between the EM and human observer deployment budgets would ensure that the program is "revenue neutral" towards the trawl sector. From that starting point, Scenarios 2.a through 2.f illustrate three different methods for determining how much of the average annual "non-trawl" fee-base should be used to support EM: (1) the number of vessels in the EM stratum relative to the total fixed-gear fleet, (2) the proportion of total fixed-gear trips that occur in the EM stratum, and (3) the relative number of fishing days in the EM stratum. Similar to how the trawl sector is being treated, this approach attempts to set a budget constraint that minimizes the likelihood of allowing EM to use a disproportionate share of funds and leaving the Observer Program with too few observer-days to meet sampling targets in the non-EM fixed gear strata. *It is important to recognize that the Council has not articulated such a goal, but the EM Workgroup highlighted impacts on coverage in the non-EM strata as a potential source of concern.*
    - **Scenarios 2.a & 2.b** rely on the fixed-gear fleet sizes for 2014 and 2015 that are reported in Table 5-8. Across all size categories, the fleet was made up of roughly 950 hook-and-line vessels and roughly 150 pot vessels in a given year (total of 1,100 vessels). An EM fleet of 90 hook-and-line vessels and 30 pot vessels (120 total) would make up 11% of the fixed-gear fleet. The Scenario 2.a budget is 11% of $2.61 million. An EM fleet of 130 hook-and-line vessels and 30 pot vessels (160 total) would make up 14.5% of the fixed-gear fleet. The Scenario 2.b budget is 14.5% of $2.61 million.
    - **Scenarios 2.c & 2.d** rely on total trips and trips/vessel calculated from Table 5-11 and Table 5-12. Hook-and-line vessels averaged roughly 5 trips per year across all size categories, and pot vessels averaged roughly 11 trips. At these levels, an EM fleet of 90 hook-and-line vessels and 30 pot vessels would log 870 trips in a year, or 13.8% of the fixed-gear 6,320 trips taken in 2015. The Scenario 2.c budget is 13.8% of $2.61 million. An EM fleet of 130 hook-and-line vessels and 30 pot vessels would log 980 trips in a year, or 15.5% of the fixed-gear 6,320 trips taken in 2015. The Scenario 2.d budget is 15.5% of $2.61 million. These figure would be higher if the average number of trips per hook-and-line vessel were calculated based on data from only vessels greater than 40' LOA (roughly 6 trips/year), and greater still if one assumes that the 2015 activity of the vessels that volunteered for EM in 2016 (9 trips/year, according to Table 5-21).[81]
    - **Scenarios 2.e & 2.f** rely on total days fished and sea-days/vessel calculated from Table 5-11 and Table 5-12. Across all size categories, hook-and-line vessels fished approximately 22 days/year on average, and pot vessels fished 33 days/year. Based on those estimates, an EM fleet of 90 hook-and-line vessels and 30 pot vessels would fish 2,970 days/year, or 12.2% of the total ~24,400 days (20,300 for hook-and-line; 4,100 for pot) between the entire hook-and-line and pot fleets. The Scenario 2.e budget is 12.2% of $2.61 million. An EM fleet of 130 hook-and-line vessels and 30 pot vessels would fish

[80] Table 5-5 shows that fee revenues in 2013 through 2015 were $4.24 M, $3.46 M, and $3.78 M respectively.
[81] If hook-and-line vessels were assumed to take 9 trips/year on average, the budget scenarios for 2.c and 2.d would rise to $472,500 and $621,000, respectively. The analysts note this to underscore the imprecision of basing a budget "forecast" on metrics that can vary widely across subsets of a fleet or gear sector.

3,850 days/year, or 15.8% of total days fished. The Scenario 2.f budget is 15.8% of $2.61 million. If the EM stratum were only open to vessels of 40' LOA or greater, the same calculations could be made with the average hook-and-line vessel's days/year set at 29 (average pot effort would not change, as the fleet is almost exclusively made up of larger vessels). Changing that parameter would result in an EM budget of $385,000 for Scenario 2.e, and $509,000 for 2.f (roughly 22% higher than the budgets reported in Table 5-46, and representing 15% and 20% of the non-trawl fee-base rather than the 12% and 16% noted in Table 5-47).

- **Category 3** also attempts to contain the EM budget to a level that does not affect the trawl sector and minimizes effects on the budget to deploy observers in non-EM fixed gear strata. Scenarios 3.a through 3.f each start from an estimate of $2.47 million[82] in average total annual fees generated in the fixed-gear sectors during the 2014 and 2015 period ($2.08 million generated by hook-and-line and $391,000 generated by pot[83]). A percentage of those fee pools may be apportioned to EM according to the relative amount of total fixed-gear sea-days that one would expect from an EM fleet of a given size and composition. This approach is similar to the Category 2 scenarios, but differs in two ways: (1) sea-days per hook-and-line EM vessel are estimated based on the 2015 activity of the vessels that volunteered for the 2016 EM pre-implementation program, and (2) sea-days per vessel are calculated separately by vessel size category. Apportioning the fixed-gear monitoring budget according to sea-days makes intuitive sense because demand for, and the cost of, observer-days is a key metric that is used to set selection rates in the ADP.

  Each pair of scenarios in Category 3 (3.a/b; 3.c/d; 3.e/f) includes two ways to think about the total amount of funds that is being apportioned between EM and non-EM, and the way to count the total number of sea-days in the fixed-gear fleet. The first scenario of each pair (a, c, and e) include all sea-days and all fixed-gear vessels. These scenarios tend to apportion fewer funds to EM because the Under-40' hook-and-line fleet contributes a large number of sea-days to the denominator (total fixed-gear sea-days), but a relatively small portion of the fee pool that is being apportioned.[84] The second scenario in each pair (b, d, and f) only considers sea-days from vessels greater than 40'. These represent scenarios where EM is not being deployed on smaller vessels. Presuming that vessels under 40' LOA remain in the "no selection stratum," excluding sea-days from the smallest vessels means that the denominator is a more accurate reflection of the vessels whose activity drives demand for some sort of monitoring (EM or observer-days).

  - **Scenarios 3.a & 3.b** draw on Table 5-21 for average annual sea-days per hook-and-line EM vessel (31.5 days/year). The analysts chose to use this figure based on the supposition that vessels that have shown an active interest in EM are the best available proxy for per-vessel effort in the hook-and-line sector of the EM stratum in the near-term.[85] It is important to note that all of those vessels are all greater than 40' LOA. Smaller vessels that tend to fish fewer days per year could opt into EM in the future, and would likely carry higher per-vessel EM costs (for reasons discussed below under

[82] Actual fee revenues by gear sector are only available for 2014 and 2015 (Table 5-6). This accounts for the difference between the $2.47 million estimate of average annual fixed-gear fees used for Category 3 and the $2.61 million used for Category 2. The latter was based on total average annual fee revenues dating back to the first year of the partial coverage category goes ($3.83 million). Given that fee revenues will vary each year due to exogenous forces, and because these budget estimates are not meant as forecast, the use of $2.47 million versus $2.61 million as the basis of non-trawl fees should greatly alter the general message of the exercise.

[83] Within the recent annual average of total hook-and-line fees, 53% were generated by vessels 58' LOA or greater, 35% were generated by vessels between 40' and 57.5', and 12% were generated by vessels less than 40'. For the pot sector, 92% of fees were generated by vessels 58' LOA or greater and 8% were generated by vessels less than 58' (Table 5-6).

[84] In 2014 and 2015 the Under-40' hook-and-line fleet accounted for 27% of hook-and-line sea-days but only 12% of fees.

[85] Across all size categories during the 2013 through 2015 time period, hook-and-line vessels averaged around 22 days/year. That figure is dragged down by the Under-40' fleet, which averaged 13.5 days/year compared to 29.5 days per year for all hook-and-line vessels 40' or greater.

"Constraints and Trade-offs"). At 31.5 days/year, a hook-and-line EM fleet of 90 vessels would fish 2,835 days, or 13.8% of total hook-and-line sea-days in 2015 (20,603 days). Assuming that average annual hook-and-line fees are $2.08 million, 13.8% represents a hook-and-line EM budget contribution of $287,000. If the total number of hook-and-line sea-days (the denominator) is restricted to the activity by vessels of 40' LOA or greater (15,152 days), an EM fleet of 90 vessels would represent 18.7% of total hook-and-line sea-days in 2015 and a hook-and-line EM budget contribution of $389,000.

Since there is no pot Pre-Implementation pool to draw on, these scenarios refer to Table 5-12 for average annual sea-days per pot EM vessel. Pot vessels, which are all basically 40' LOA or greater, fished an average of 35.5 days/year from 2013 through 2015. That estimate is weighted by vessels size. Larger pot vessels (58' and greater) fished twice as many days as pot vessels less than 58' (39 days/year versus 19.5 days/year), and the larger class of pot vessels made up 83% of the pot fleet by vessel count. At 35.5 days/year, a pot EM fleet of 30 vessels (with the expected distribution of vessels that are over/under 58' LOA) would fish 1,068 days, or 25.6% of the roughly 4,100 days that the pot sector has fished in recent years. Assuming that average annual pot fees are $391,000, that proportion equates to a pot EM budget contribution of $100,000.

To get to the final budget scenario estimates for 3.a and 3.b, add $100,000 (pot) to both $287,000 (all hook-and-line vessels) and $389,000 (hook-and-line vessels 40' or greater)

- **Scenarios 3.c & 3.d** follow the same procedure, but for a larger hook-and-line EM fleet of 130 vessels. Using the same assumptions about average sea-days per vessel per year, a 130 vessel hook-and-line fleet would account for 19.9% of total hook-and-line sea-days instead of 13.8%. A 130 vessel hook-and-line fleet would account for 27.0% of hook-and-line sea-days among vessels 40' LOA and greater instead of 18.7%. The hook-and-line EM budget contribution for Scenario 3.c, then, is 19.9% of $2.08 million ($414,500), and the hook-and-line EM contribution for 3.d is 27.0% of $2.08 million ($562,000). The totals in Table 5-46 are reached by adding $100,000 to each of these to represent a 30 vessel EM pot sector.
- **Scenarios 3.e & 3.f** differ from Scenarios 3.c and 3.d only in that the number of pot vessels in the EM stratum increases from 30 to 50. Assuming that each pot vessel fishes an average of 36 days/year, the total amount of effort in the EM pot fleet would increase from 1,068 days (25.6%) to 1,780 days (42.7%) of the 4,172 average annual sea-days that the pot sector recorded in 2014 and 2015. Increasing EM pot effort from 25.6% to 42.7% of total pot effort raises the EM portion of fee revenues from $100,000 to $167,000 out of the total annual average pot sector fees ($391,000). As a result, Scenarios 3.e and 3.f are $67,000 higher than Scenarios 3.c and 3.d.[86]

5.8.2.2.4 Discussion

Thus far, this section has provided the reader with an understanding of what drives EM program costs, and illustrated a selection of the many possible program design combinations. The calculations in the preceding cost and budget exercises are heavily caveated, particularly in regards to the cost of field services. The estimated field service costs are built off of publicly available information, but are inherently limited due to both the confidentiality of true costs and the extremely wide range of possibilities for how the program will be deployed.

[86] This analysis does not account for the fact that pot effort might increase as regulations are implemented in 2017 to permit the use of pot gear for sablefish fishing in the GOA. The analysts do not have the data necessary to conjecture about the scale of the potential effort shift from hook-and-line to pot gear in the GOA, or whether vessels shifting their sablefish activity from hook-and-line to pot gear will fish a different number of days than they previously had. The number of vessels using pot gear to target GOA sablefish is expected to be low in the first years of implementation.

Taking the preceding cost and budget exercises at face value, focusing particularly on Table 5-42 through Table 5-46, the analysis suggests that the cost of an EM program is likely to exceed the amount of the monitoring fees that would have been generated by the vessels in the EM stratum during the preceding year. This is not surprising, as the Observer Program to date has relied on supplementary Federal funds to afford enough observer-days to meet deployment goals (the partial coverage category received $1.89 million in 2014 and $2.70 million in 2014; refer to Table 5-5). The discussion provided while working through the cost exercises underscored the fact that the existing pre-implementation program, which provided the baseline for some of the cost profiles, was not designed in a cost-minimizing fashion. It is entirely possible that an EM program could be deployed within a given budget constraint, but doing so – at least in the near-term – would likely require cost-conscious design choices. The program might be able to reduce hardware costs by maintaining a lower ratio of control centers to the number of vessels in the stratum. Field service costs could be reduced by restricting the EM stratum to vessels that are able to commute to service hubs, or that have a record of fishing a minimum number of trips per year (trips are the appropriate metric for this restriction because the program would be interested in increasing the chance that a vessel selected for EM coverage will be re-selected, and thus would require fewer services as an experienced EM operator with existing systems onboard). Data analysis and storage offer less obvious opportunities for cost minimization, but they make up a relatively smaller proportion of "total" program costs; moreover, it is possible that those costs would not accrue to the monitoring fee budget in any event.

In short, any program scope is achievable with unlimited funding. The trade-off that is made when increasing the size of the stratum, which in turn increases the likelihood of including vessels that are more costly to service, is the amount of funds left over to purchase human observer-days. Identifying a minimum acceptable amount of observer-days is not possible, as deployment models are determined by a complex interaction that is both driven by and responsive to available funds. To provide at least some baseline, one could take the difference in the average annual supply of monitoring fees – $3.83 million across all gear sectors, or $2.61 million for fixed-gear – and subtract the "EM budgets" defined in Table 5-46. That amount can then be divided by the average daily cost of deploying a partial coverage observer ($1,071 over the period dating back to 2013) and have an idea of an observer-day budget.

To provide one example, the largest EM budget identified in Table 5-46 is $957,500 out of a total fee base of $3.83 million. The remaining $2.87 million would afford approximately 2,680 observer-days. Table 5-4 shows that the partial coverage category used between 4,500 and 5,300 observer-days per year during 2014 and 2015 *in total*, but only 2,600 to 3,000 were purchased using monitoring fees (the balance was purchased using carryovers and Federal funds). This simple calculation provides some comfort that implementing even a relatively expensive EM program would not be certain to handicap coverage in the non-EM strata. However, deployment for both arms of the partial coverage category is greatly exposed by the possible loss of Federal funds.

5.8.2.3 Impacts

5.8.2.3.1 Impacts on Vessels in the EM Stratum

The EM program would be structured as a stratum into which willing vessels may opt. While there are certainly both benefits and costs to participating in EM, one would assume that vessel operators who volunteer for the program perceive an individual net benefit. Operators would not pay any additional direct financial cost to participate in EM, as the considered action does not change the structure of monitoring fee collection. No change to the level of the 1.25% ex-vessel monitoring fee is expected in the near term as a result of this action.

Operators' motivation for participating in EM may vary. Vessels that are large enough to be selected for observer coverage but small enough to have their onboard operations disrupted by the addition of an observer (e.g., 40' to 57.5' LOA) might select EM as a way to avoid operational and logistical inconveniences. In some cases, carrying EM instead of an observer might mean that a vessel does not leave a crew member in port for a selected trip. The EM Workgroup heard anecdotal reports about IFQ holders who had tied up their vessel and fished their quota on someone else's platform; at least one of those vessels volunteered for the 2016 Pre-Implementation program. An operator that re-enters his or her vessel into the active fleet recovers more value from their quota, and creates crew employment opportunities that have a positive downstream economic effect. Other vessels might view EM as a means to get the benefits of carrying an observer more reliably – especially if EM selection rates in ODDS remain higher than those for human observers (currently 30% for EM versus 15% for observers). Vessels fishing IFQ that are carrying an observer can fish in multiple areas on a single trip without having to return to port if crossing into a new area would mean that the vessel has more fish onboard than the quota it possesses for the management area it has entered. This option is especially appealing to vessels that fish IFQ in the BSAI areas, where fishing grounds are farther from port and the cost of running to deliver is high.[87] (The option to amend regulations to extend this exemption to vessels carrying EM is not currently part of the considered action, but is offered for the Council's consideration in Section 2.5 of this document.) Other benefits of EM are referenced in the discussion of impacts under Alternative 1 (no action), framed as benefits that would *not* accrue to vessel operators if EM is not integrated into the monitoring plan (Section 5.8.1). In addition to the benefits described above, that section mentions the possibility for vessel owners to reduce the cost of optional insurance coverage that they may carry to cover liability for an extra person onboard.

Vessel owners might incur small monetary costs associated with EM if, for example, they choose to modify their power supply to prevent battery drain or make other small hardware purchases. In general, though, the monetary cost of installation will be paid through the budget of industry monitoring fees. The likelihood of vessel owners needing to make such purchases and the extent of the cost cannot be predicted until the program has more clearly defined vessel requirements and the fleet has gone through the process of developing approved Vessel Monitoring Plans with the EM provider.

The main category of costs for EM vessels is the "non-monetary" time and opportunity costs described in Section 5.7.4.2. These costs include the time that operators and crew might spend working with the provider on installation and maintenance, or completing duty-of-care tasks that are defined as operator responsibilities in the ADP (currently outlined in the 2017 Pre-Implementation Plan). If the contracting process for the program results in different EM service providers for each fixed-gear sector, vessels that deploy both LL and pot gear might spend a relatively larger amount of time working with technicians to achieve quality video data with two different systems and potentially changing out incompatible hardware components. Over time, this cost might be reduced if EM technology moves toward a core set of hardware and software that is compatible across providers so that switching from LL to pot gear might only require the realignment of camera angles. If the contract bidding process results in a single EM provider for all of Alaska or for either gear sector, a vessel owner who participates in both Alaska and non-Alaska EM programs with different providers might experience some additional cost in coordinating hardware and software change-overs when moving between fisheries.

Some time and opportunity costs might fall more heavily on vessels that operate out of remote ports, where the program could potentially require them to remain in port until a technician can travel to correct

[87] Allowing vessel operators who desire monitoring coverage for this reason to increase their chance of selection by opting into the EM stratum might also benefit the Observer Program. Anecdotal reports to the EM Workgroup stated that some vessels will log trips in ODDS then cancel the trip and log another on if the first trip was not selected for coverage, repeating the practice until the vessel is selected. This practice could have a negative impact on the statistically unbiased sample design that is crafted in the ADP.

a critical EM system failure, or transit to a nearby port with a local EM technician. The potential onus of these operator responsibilities will be defined as the Council, NMFS, and stakeholders on the EM Workgroup balance the trade-offs between providing service in all areas and the cost of the program. While this analysis uses the term "non-monetary" to describe time and opportunity costs, modifications to a vessel's business plan or an individual's labor schedule do impose economic costs. EM participants in the competitive limited access Pacific cod fisheries could lose out on harvest opportunities if they are held in port. In the IFQ fisheries, a quota holder's catch might not be at risk, but an altered fishing plan could affect profitability by changing the timing of fish to market conditions, or opportunities to participate in other fisheries. A vessel that misses a favorable weather window could face increased safety risks. Finally, altered fishing plans affect individuals' work and leisure schedule, which also factors into socioeconomic net benefits. Over the course of the Observer Program and the EM pre-implementation phase, NMFS and EM providers have worked with fishermen to minimize the unintended operational impacts of monitoring, and that effort is expected to continue. Nevertheless, the monitoring plan requires some adherence to the sampling strategy in order to collect unbiased data, so the program will likely expect some amount of accommodation for time to fix technical issues prior to a trip being released from coverage.

Operators may be required to complete an "effort logbook" under Alternative 2. In that case, the skipper would be responsible for recording the hook size, spacing, skate length, and the number of skates on each LL set. Skippers on pot vessels would record the date and time of each pot set or haul event. (Operators would not be required to record catch or discard information, aside from what is already required by IPHC or other logbooks that the operator fills out.) Effort logs could improve the precision of catch estimation at the fleet level, but they also create another demand on the vessel operator's time.

Integrating EM into the partial coverage category for fixed-gear vessels is not likely to drive fleet consolidation. Vessel owners that do not prefer to carry EM would remain in an observer selection stratum. If EM has any effect on fleet size, it is more likely to be positive as vessels that had become inactive due to the real or perceived costs of carrying an observer would gain an avenue to reenter the fishery.

5.8.2.3.2 Impacts on Other (Non-EM) Harvest Stakeholders in the Partial Coverage Category

All vessel owners who pay monitoring fees hold a stake in the quantity and quality of the biological and management data that are generated through the combined efforts of the Observer Program. Fees are paid by vessel owners who hold FFPs and participate in Federal fisheries or state-waters fisheries where catch is deducted from a Federal TAC. While vessel owners are the direct payers of the fee (along with their processing partners), hired skippers and crew members are affected by the quality of information that is available to fishery managers, as the adequacy and timeliness of data influence catch limits and season closures that, in turn, affect opportunities for labor. Potential impacts of this action on data collection (i.e., the supply of funds to deploy observer-days in the partial coverage category) are addressed in Section 5.8.2.3.4.

The most apparent mechanism for the action alternatives to affect non-EM fishery participants is "competition" for limited monitoring deployment funds across the various partial coverage strata. The potential effect depends on the scope of the program, which will evolve and be analyzed and adjusted annually. Implementing an EM program that features extensive field services in a larger number of ports might benefit EM participants by reducing the time and travel costs required of them to comply with their operator responsibilities, but that added program expense depletes the budget for purchasing observer-days. Conversely, the EM program could mature to a point where fleet and in-port technical capacity is high, reducing the cost profile of major EM elements and allowing the Observer Program to collect adequate data at a lower cost per vessel, per trip, or per sea-day.

Monitoring fees affect the gross income of both vessel owners and onboard workers, who are paid a share of the ex-vessel revenues from which monitoring fees are deducted. To the extent that the considered action has a downstream effect on the level of the 1.25% fee, the incomes of those stakeholders could be marginally affected in the long-term. This analysis does not predict any change to the monitoring fee as a result of this action, nor does it state whether the fee is more likely to increase or decrease in the long-term. Each year, the ADP will be drafted by AFSC FMA staff and approved by the Council, and that exercise will continually seek to achieve the best possible fishery monitoring with the available budget. Should internal or external forces result in an inability to provide adequate coverage, a change to the monitoring fee level would require an amendment to Federal regulations and the attendant opportunities for analysis and public comment.

The small class of CPs that falls under the partial coverage category pays into the monitoring fee-base that would be affected by this action, but those vessels would not be considered eligible to opt into the EM stratum in the near-future. Use of EM technology for catch estimation on CPs would require new research and field testing efforts. The effect of this action alternative on small CPs is similar to those experienced by CVs that choose not to participate in the EM stratum, but the CPs would not have the benefit of choice.

5.8.2.3.3 Impacts on the Processing Sector

Alternative 2 is not expected to have a substantial impact on shoreside processors. The proposed regulatory amendment could alter the manner in which monitoring fees are used, but would not increase or decrease the amount of the fee. As under the status quo, processors would remain responsible for a portion – assumed to be 50% – of the 1.25% ex-vessel fee. Processors collect the other portion of that fee from each vessel that is subject to partial coverage category regulations, and remit the entire amount to NMFS at the end of the calendar year. The considered action is not expected to directly affect the amount of fish that are delivered for commercial processing, the timing of fish to market, or the dock price.

Alternative 2 might create additional duties for processors in assisting vessel operators with shipping data drives to the organization or company that is contracted to review EM video. This type of task is likely to take a negligible amount of time and labor capacity relative to the processors usual administrative operations. Should technology be developed that allows encrypted data to be transmitted to the viewer directly from the vessel's EM control center, this small administrative cost to the processor would be reduced or eliminated.

Though not part of the 2016 Pre-Implementation Plan or the draft 2017 Plan, it is possible that the ADP in some future year could define a dockside monitoring component of the EM program. Dockside monitoring was a component of earlier research phases of the Alaska fixed-gear EM program. Its purpose was to collect better species identifications between pairs of rockfish species that can be difficult to discern on video. Dockside monitors are not currently being deployed because the quality of identification has been better than expected during testing. In the future, monitors could be deployed to capture data that are found to be unreliable when taken from video review. If dockside monitoring is part of the program, a processor might have to make adjustments to its catch monitoring and control plan if it has one. An observer stationed at a processor – and paid by the plant as part of the full coverage category – might take on the additional duty of monitoring EM offloads. A processor might be required to share the cost of an additional observer if a separate catch monitor has to be deployed. As noted in Table 3-1, responsibilities for dockside monitoring costs, should they exist, have not been fully defined as the need for dockside monitoring under Alternative 2 is felt to be low at the present time.

5.8.2.3.4 Impacts on NMFS Observer Program

The potential effects of Alternative 2 on the Observer Program are mainly discussed in terms of how adding an EM stratum to the partial coverage category might affect the deployment of observers in the non-EM strata, and the adequacy of biological data and catch estimation across the entire monitoring plan. Aside from that, Section 5.7.4.1.4 of this document makes note of additional management tasks that NMFS would take on as part of the EM start-up phase and tasks that will be ongoing after integration (e.g., application development for data management infrastructure, and data auditing).

Appendix 1 provides an overview of how observer deployment in the partial coverage category has been affected as vessels are moved into the EM stratum. This synopsis makes the important distinction that EM that the data collected from EM vessels has not been used for catch estimation during the cooperative research and pre-implementation phases, but it will be contributing to fishery management after implementation. Section 3.7 of this document describes what data is collected in the partial coverage category, and the current state of data quality. The reader should refer to the EA (Chapter 4) for discussion and analysis of the extent to which data quality might be improved under Alternative 2.

In addition to the potential benefits described in the EA, integration of EM could have a positive effect on the Observer Program by allowing certain harvesters to modify behaviors that complicate the monitoring deployment process or threaten to bias the data that is collected. To the first point, it has been reported that some harvesters attempt to “game” the observer selection system (ODDS) in order to intentionally draw an observer on a trip or to avoid carrying an observer. Vessels that cancel trips after they are assigned an observer complicate the statistically driven deployment scheme, and could potentially create logistical issues and costs if an observer travels to a port for a trip that will not occur. Conversely, vessels targeting IFQ species sometimes want to draw an observer so that they can fish in multiple management areas without returning to port to offload catch from the first area if having that catch in the fish hold while in the second area will put the vessel in violation of IFQ regulations. Some vessels are said to log, cancel, and re-log trips in ODDS until they are selected; this behavior does not befit a random deployment selection strategy. To the second point, vessels that are currently required to carry observers, but perceive a negative business, operational, or social impact when selected, might conduct fishing differently when observed. This “observer effect” could introduce bias into the discard data from which total catch is estimated for the unobserved portions of that vessel’s stratum. The option to carry EM rather than an observer would present these vessels with a pathway to monitoring compliance without introducing a situation where their behavior affects the precision of management.

In terms of how integrating EM might impact the deployment of observers in other partial coverage strata, the direction of the effect is determined largely by the cost of deploying EM. In general, if the cost of EM deployment is disproportionately high relative to the amount of data that the stratum is producing, then it is likely that the budget for purchasing observer-days will be curtailed (absent additional sources of funding). As discussed extensively in this RIR, the realized cost of the EM program will be determined by a number of program design choices that are yet to be made, and the cost of key program elements is likely to evolve over time. The following is a non-exhaustive list of program design choices or uncontrolled outcomes that could increase the EM cost profile:

- Allowing fixed-gear vessels of less than 40’ – which are unobserved in the existing monitoring plan – to join the EM stratum will create a new stream of data and could improve catch estimation for that sector of the fleet. On the other hand, those vessels currently pay into the monitoring fee (albeit roughly only 12% of total fixed-gear fees) and they do not require any monitoring expenditures. These smaller vessels shift from fee-payers to fee-users when they are selected for EM coverage or when they are pre-wired with EM hardware.
- Allowing any fixed-gear vessel to opt into the EM stratum opens the program to vessels that take a small number of trips per year and vessels that operate out of remote ports. Vessels that operate

out of remote ports will cost more to provide with EM service. Vessels that carry EM systems but take a small number of trips produce less data per dollar spent deploying cameras, and are likely to produce lower quality data and require more technical service as they have less experience with the systems. This low cost effectiveness might be exacerbated if the selection rate for vessels that are carrying EM systems declines from its current level of 30% (twice the 2016 fixed-gear observer selection rate of 15%)

- Contracting with an EM provider company in addition to an observer provider, increases the proportion of total deployment funds that are, in effect, paying for a business's overhead and profit margin.
- Vessels that drop out of the EM stratum after being selected for coverage could increase program costs if the provider has already put resources toward preparing the vessel with hardware. Vessels do not directly experience this cost, because they are paying a 1.25% annual monitoring fee regardless of whether they carry the system or not. According to AMR's 2016 mid-season field report, nine of the first 25 vessels in the EM pool that were selected for coverage decided to drop out and re-enter the observer strata.[88] (These vessels were replaced with alternates from within the EM pool.) Under a fully integrated program, it would be possible to control this cost driver by prohibiting vessels from dropping out of the stratum upon selection.

The analysts are limited in their ability to identify a cost tipping-point beyond which EM expenses have a net negative impact on the number of observer-days that can be afforded. Identifying a tipping-point would require knowledge of (1) future fixed-gear fleet size, demographics, and effort; (2) the target observer selection rate necessary to achieve sampling goals in the non-EM partial coverage strata; (3) the cost per day of deploying an observer; and (4) the total amount of funds available (monitoring fees and otherwise). The latter point depends on future ex-vessel price levels, which are a function of external forces (markets, currencies, etc.), and on the supply of Federal funds, which are not guaranteed in the future. Ultimately, the Council could make a policy decision to prioritize human observer coverage through its approval role in the ADP process. The Council might limit the budget for EM to a level that keeps the observer strata fully funded to meet their sampling targets. In other words, if EM is not situated to provide a cost effective means to generate previously unavailable data, or to generate data without deploying observers on vessels that struggle to accommodate them, then the ADP could theoretically omit the EM stratum until the program's cost profile or the calculation of net benefits changes.

The Council is under no obligation to limit the scope of the EM program to a level that has no effect on observer deployment. Given the fact that the partial coverage category relies on Federal funds to deploy at its current level, one could take the view that observer coverage might be limiting the budget for EM in future years. If the Council selects Alternative 2, it is merely committing to an annual process in which these trade-offs will be analyzed within the fleet and budgetary context that exists at the time.

Chapter 5 of the 2015 Supplementary EA for the Observer Program characterizes the "risk" of fee revenues being insufficient to purchase an adequate number of observer-days (NMFS 2015c). The agency's analysis concluded that "there is not a specific amount of coverage at which NMFS is unable to manage the groundfish fisheries in the BSAI or GOA, rather there are levels of observer coverage at which NMFS may not have data in specific strata or fisheries" (p.108). The Supplementary EA notes that NMFS could address that concern by modifying the level of data aggregation at which NMFS estimates discards (e.g., by combining target fisheries within a management area). The ADP authors identify minimum coverage levels based on the monitoring goal, and if the discards need only to be estimated at the FMP-level, that goal could be achieved at selection rates that are lower than the 15% at which observers are currently deployed in the fixed-gear sector.

[88] http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/ArchipelagoFieldProgramReport25July2016-final.pdf

A different source of potential impact on the Observer Program is the timeliness of turning EM video data into catch estimates that can be used for management. Section 5.7.4.1.3 of this document speaks to the fact that data turnaround times are reasonable for management of an IFQ fishery, even in the pre-implementation phase where PSMFC reviewers are not solely focused on processing speed. That section goes on to note that the cost of increasing processing speed – perhaps at peak times in the Pacific cod fisheries – would be relatively low if the Council and NMFS identify that as a priority.

Insofar as the cost of the EM program is likely to evolve as the program matures, the potential for impact on the Observer Program will change as well. Holding program design choices steady, technological improvements and fleet learning are likely to reduce field service costs, which are a major driver of EM's demand for monitoring fees. The limit – or asymptote – of cost-savings is not known, but the analysts caution against assuming that EM will become highly automated or extremely low-cost in the near-term, as the technology is still working to overcome relatively basic hurdles such as sensor reliability and water drops on camera lenses.

5.8.3 Analysis of Impacts: Alternative 2, Option 1 – Require Full Retention of Key Species

The option under Alternative 2 might increase the accuracy in species identification among certain pairs of rockfish species that are difficult to distinguish on EM video. Implementing a blanket policy of rockfish retention could benefit vessel operators by alleviating their responsibility for identifying and retaining only certain hard-to-differentiate species as specific data quality threats arise over the course of the program. The Council and NMFS would assess whether an EM program with a full retention rockfish identification component requires a dockside monitoring element on an iterative basis via the ADP process. The responsibility for providing, and funding, dockside monitors could fall to existing processor personnel or to the Observer Program. Regulations guiding the disposal of retained rockfish that cannot be marketed would have to be crafted if the Council recommends this option.[89] Disposal of landed fish in the ocean must occur in compliance with the Clean Water Act and the National Pollutant Discharge Elimination System permit that covers seafood processors in Alaska. The option is fully described in Section 2.2.1 of this document.

<u>Effects on Harvesters</u>

Vessel operators might experience an opportunity cost if they are required to retain species that fetch a lower ex-vessel value than what they are targeting on the trip *and* if those retained fish displace stowage capacity for higher value fish. This negative outcome is more likely to occur on smaller vessels with limited hold capacity, though it could occur on any vessel that fills its hold on a given trip. That effect would be exacerbated if the species is on PSC status, and thus cannot be sold after it is landed. Of the three primary target species for fixed gear vessels (halibut, sablefish, and Pacific cod), rockfish are most likely to be encountered on halibut trips due to the similar depths at which the species tend to be found.

While the 2016 pre-implementation program and the draft 2017 Pre-Implementation Plan do not include a dockside monitoring component, one could be included in the future. It is possible, though not necessarily probable, that vessel operators might be required to handle certain fish differently onboard. For example, operators might be asked to store rockfish species in separate totes in order to speed up the offload monitoring process. Such changes to fish handling procedures and use of deck space carry small time and operational costs, similar to the disruption of normal fishing procedures that causes some operators to express dissatisfaction with carrying a human observer.

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[89] Section 2.2.1 notes that under current regulations for retained Demersal Shelf Rockfish species (50 CFR 679.20(j)), species that are within the MRA amounts can be sold, but species in excess of that amount cannot enter commerce through sale, barter, or trade. They may, however, be used for personal consumption or donation. Regulations for retained rockfish under this option would likely be similar in character.

Each vessel operator would experience the impact of full rockfish retention differently. As stated above, full retention might be more disruptive on smaller vessels – depending on fish handling requirements – and would be more likely to alter ex-vessel revenues on vessels that are displacing target species with rockfish. Again, these effects will not be uniform on all trips, even for a given vessel. Retained rockfish can still be marketed, albeit for a lower price, until a species is placed on PSC status. The point in the year at which a rockfish species or species complex reaches PSC status is likely unpredictable.

As written, this option would require full retention only on vessels that are selected to carry EM, although there has been some EM Workgroup discussion about extending the requirement to all fixed-gear vessels (see Section 2.2.1). If any perceived negative impact occurs only when carrying EM, this option might create a disincentive for vessel owners to opt into the EM stratum, reducing engagement in the program and the maximum range of its net benefits to the nation. Should dockside monitoring be part of the program, the Council might also wish to consider whether a vessel would be precluded from making a delivery to a processor that does not have a dockside monitor available.

Effects on Processors

The benefits of full retention are primarily centered around improved data quality (rockfish identification) and the simplification of vessel operators' at-sea responsibility for identifying species. Shoreside processors are stakeholders in the overall quality of data collection, but could experience small to moderate negative impacts in the form of additional responsibilities and/or monitoring costs. The two categories of potential processor costs are dockside monitoring and responsibility for disposal of non-marketable catch after delivery.

As stated above, the responsibility for the cost of a dockside monitor is yet to be determined. In the case that processors are either sharing in the cost of a catch monitor or making their plant observer available for offload monitoring, this option could result in either a time cost or a financial impact. If plant observers are used, managers would gain the additional responsibility of figuring out when to move the observer from the processing line, and whether that affects the plant's ability to continue bringing fish in to the plant. Contracting additional observer-days for offload monitoring would not affect any single plant more than another, because those deployments would be funded through the industry monitoring fee that is expected to remain at the 1.25% status quo level in the near-term. Contracting additional days could affect the Observer Program's overall deployment budget, and could potentially drive up the average cost per observer-day if dockside monitors are needed in a large number of remote ports with higher travel costs. The staff responsible for developing the ADP would likely have to anticipate the additional demand for observer-days based on delivery patterns to higher-cost ports, which are illustrated in Table 5-18 and Table 5-19. If full retention and dockside monitoring are only required for vessels carrying EM, the additional cost of deploying additional observers to monitor offloads is likely to scale upwards as smaller vessels opt into the EM stratum.

Presuming that regulations are amended to allow retention of species that are on PSC status, and thus cannot be marketed, processors will have to dispose of some portion of catch in a manner that does not enter the revenue stream. This could preclude the option of sending unmarketable rockfish to a meal plant, which would otherwise be an appealing option in ports where meal plants exist (e.g., Kodiak). Even if the meal plant is an option, not all Alaska ports process fish into meal. Alternative solutions that create at least some net national benefit – such as food donation programs – would still create extra coordination and tracking work for the processor. It should be noted that donating fish that were caught while on PSC status would require additional regulatory changes.

Options for disposing of additional retained fish that are marketable but unwanted by the processor (due to fish size, quality, or line capacity) are limited in Alaska relative to other regions, particularly in ports that are not road-connected. Alaskan processors do not necessarily have the option of trucking undesired fish to fertilizer or pet food producers, which is a common solution in the Lower 48 regions. To the extent that this option increases the amount of landed fish that are not processed for human consumption, time and coordination spent legally discharging waste-fish at sea is likely to increase.

Other Effects

Requiring full retention could create an avenue for the Observer Program to collect biological samples from the EM stratum, which obviously cannot be collected through video review.

Adding a retention requirement is not likely to increase the time or associated cost of reviewing EM video data for compliance, as reviewers are already watching for discards under Alternative 2. The Council might wish to consider whether a vessel operator is exposed to an enforcement action in the case of an EM recording failure or gap, meaning that it is not possible for reviewers to verify that the vessel complied with the full retention requirement. Any additional exposure to enforcement actions is likely to reduce the number of vessels that opt into the EM stratum.

Finally, contingent on regulatory amendments that might occur outside of (or alongside) this action, a full retention requirement could result in more protein products flowing into food donation programs. This outcome would benefit stakeholders outside of the harvester/processor categories.

5.8.4 Analysis of Impacts: Alternative 3 – EM for Logbook Compliance Monitoring

Under Alternative 3, EM would be used to verify vessel operator logbooks, which would be used as a data source for catch estimation. The operator of every vessel in the EM stratum would be required to complete a logbook of discarded target species and key bycatch species; hook-and-line operators would also log interactions with seabirds. Video reviewers (PSMFC, or another contracted entity) would verify the accuracy of operators' logbooks by auditing a subset of the video data from each selected trip. The proportion of video that would be audited is yet to be determined, and could be adjusted annually through the ADP process based on data objectives and available budget; logbook audit EM programs in other regions have reviewed around 10% to 20% of video from a trip for the initial compliance check.

Alternative 3 would also include a full retention requirement for hook-and-line vessels to retain all rockfish species in order to improve the accuracy with which difficult species to identify are accounted, and to lessen the burden on the vessel operator to speciate rockfish while at-sea. The full retention requirement could bring with it a need to incorporate dockside monitoring into the program. The potential impact of adding dockside monitoring to the program – relative to harvesters, processors, and other entities – is discussed under Alternative 2 Option 1 (Section 5.8.3).

Section 5.3 notes that under Alternative 3, all vessels in the EM stratum would carry an EM system, which could increase the hardware/software cost profile of the program. Under this alternative, hardware costs per hook-and-line vessel would profile like the 1:1 control center to vessel ratio in Table 5-40, as opposed to having a smaller set of control centers that are rotated between hook-and-line vessels upon selection (e.g., a 2:3 or a 1:2 ratio). Per-vessel hardware costs for the pot sector would not profile any differently under Alternative 3 than under Alternative 2, because control centers are planned to be deployed at a 1:1 ratio in both cases.

Effects on the Observer Program

As with Alternative 2, the potential impact on the Observer Program is framed around the competing uses of scarce monitoring fee resources, and the creation of new tasks and cost items that must be funded through NMFS's overhead budget. Both sources of potential impact are driven by the scope and cost of the EM program, which could be defined differently from year to year. As with Alternative 2, it is important to keep in mind that the cost of the EM program – and thus its impact on the Observer Program's overall mission – is limited by the fact that this action merely authorizes a new use of monitoring fees, but does not guarantee that the EM stratum will be part of the monitoring plan in any or all future years. If the economic and non-economic costs of the program outweigh the anticipated benefits, or do not improve the cost-effectiveness of data collection, then the ADP would not recommend an EM stratum. The Council and NMFS would view cost-effectiveness in terms of not only how much data a logbook audit program is generating, but whether the program is reaching vessels that were previously unobserved (Under-40' vessels) or vessels that were receiving conditional releases or temporary exemptions from observer coverage (refer to Section 5.5.3).

Relative to Alternative 2, the cost of the EM program under Alternative 3 would be driven by the difference in the amount of video that is being reviewed. It is not possible to quantify this marginal difference at this time because the size of the EM stratum, the selection rate for coverage, and the proportion of video that would be reviewed to audit logbook quality (e.g., 10% to 20%) are not defined. The analysts can state with confidence that less video would be reviewed under Alternative 3 and under Alternative 2, but the marginal difference in the annual cost of data analysis might not scale linearly with review time. As described in Section 5.8.2.2, data analysis costs are best profiled in terms of FTE reviewer and manager compensation. It is possible, for example, that a 50% reduction in video review hours might only reduce labor costs by 0.5 to 1.0 FTEs ($50,000 to $100,000), out of what is already a small number of FTEs required under Alternative 2 (e.g., 1.5 to 2.0 FTEs). Whether any such savings accrue to NMFS's budget or to the budget of available monitoring fees remains to be determined, and thus the analysts cannot draw a direct line between selection of Alternative 3 and an increase in funds available for the purchase of observer-days, relative to Alternative 2.

As noted in Section 5.7.4.1.3, the speed with which PSMFC or another contractor reviews and processes data could drive costs. However, based on PSFMC's flexible staffing structure that allows additional reviewers to switch their focus to Alaska EM data at peak times, shortening data turnaround times is not expected to raise analysis costs substantially. Data analysis costs are more likely to be driven by the number of vessels in the EM stratum and the selection rate defined in the ADP. Nevertheless, it is conceivable that the logbook approach will mean that video data is translated into the CAS more slowly. Under Alternative 3, NMFS inseason managers would be relying on logbook data for immediate management, and adjustments would be made through audit and extended review in a manner similar to how human observer data is revised after observers are debriefed at the end of their deployment periods. As the accuracy of logbooks increases with experience over time, the urgency to process video data could decrease and ultimately decrease data analysis costs by a modest amount.

The overall cost profile of the EM program under Alternative 3 will also depend on frequency of logbooks being found out of sync with what reviewers find in the video data; in other words, costs are driven by logbook quality. Logbook quality will be at least partially determined by the fleet's experience with EM logbooks (i.e., the number of vessels that are new to the EM stratum), or the number of vessels that take only a small number of trips per year. The analysts would expect vessels that have, or accrue, less experience filling out EM logbooks to require a greater amount of re-review and logbook correction after the initial audit. If participation in the EM stratum shifts generally towards vessels that take only one or two trips per year, the cost-effectiveness of the program could decrease. As discussed under Alternative 2, these vessels impose higher per-vessel costs on the program in terms of hardware and field services, in addition to higher data analysis costs. The cost of additional review for non-compliant logbooks would be borne by NMFS, and could not be paid through industry monitoring fees.[90] Over time,

[90] NMFS Alaska Region has the authority to charge a monitoring fee to industry under Section 313 of the MSA, but those fees may only be derived from a recovery based on landings. In other words, NMFS may use the ex-vessel based monitoring fee to fund the collection and review of video data or logbooks, but would need explicit authority from Congress to charge a separate fee for a particular duty such as re-

however, it is reasonable to expect the quality of EM logbooks to increase and the cost of data analysis to stabilize after a period of fleet learning and EM socialization.

Effects on Harvesters

Vessel operators might experience moderate time costs related to logbook responsibilities. These costs would be additional to those involved with EM system installation and maintenance, which are described under Alternative 2. Operators targeting halibut are already filling out IPHC logbooks, and operators of larger vessels are filling out NMFS logbooks. Alternative 3 would increase the amount of recordkeeping and reporting that is required of harvesters. The burden of identifying non-target species while at-sea is somewhat mitigated by the fact that Alternative 3 would require full retention of rockfish, meaning that difficult-to-identify species could be accounted for by a dockside monitor or through fish ticket records. The potential adverse impacts of full retention and dockside monitoring on harvesters is previously described in Section 5.8.3.

The full effect of Alternative 3 on harvesters depends on whether accountability measures are defined that modify the behavior of operators whose logbooks require further video review after the initial audit. This section previously established that the Alaska program is not likely to charge additional monitoring fees for extended data review. The analysts do not speculate on the full range of accountability measures that might be defined, but note that excluding vessels with historically poor logbook quality from the program might result in similar impacts as those described under Alternative 1 (Section 5.8.1). Those impacts are most negative for harvesters that prefer EM to human observer coverage due to limited bunk space or a general disinclination to carry an observer.

5.8.5 Vessel safety

The implementation of the proposed action is not likely to have any effect on the safety of human life at sea. The Council and NMFS have taken into consideration the operating requirements of the fisheries and the safety of observers and fishermen in developing Alternatives 2 and 3 to integrate EM into the Observer Program.

5.9 Summation of Alternatives with Respect to National Net Benefits

This section focuses on the net benefits of an EM program at the broadest level. It will be further developed to distinguish between various program design choices (e.g., full retention, logbook audit model, budget priorities) once the Council has identified a preliminary preferred alternative.

Ideally, establishing an EM program should benefit the management of North Pacific groundfish and halibut fishery resources by opening up pathways to data that was not previously collected, such as discard information on vessels that were previously in the "no selection" observer coverage stratum.

Participation in the program is framed as a choice that harvesting stakeholders can make on an annual or periodic basis. Framed as a choice, one must assume that harvesters on vessels greater than 40' LOA who opt into the EM stratum are realizing a benefit relative to the alternative of remaining in the observer trip selection stratum. The proposed action alternatives would not directly impose additional costs on harvesters relative to the status quo, as they would continue to pay into the monitoring research plan via the 1.25% ex-vessel based fee. As a result, one assumes that their individual net benefit calculation is

reviewing video triggered by a non-compliant logbook. Charging a separate fee, in addition to the fee recovered from landings, might implicate the augmentation of appropriations laws that bar agencies from imposing agency costs for agency responsibilities onto industry. NMFS would not use the monitoring fee to cover the cost of typical agency responsibilities, such as routine management and reporting, or the administrative cost of developing a new logbook format for EM. (NOAA GC AK. Personal Communication, 2016.)

based on a combination of operational impacts (carrying an observer versus an EM system) and the potential for the monitoring program to collect better management data on the whole. This analysis does not find a direct link between the establishment of an EM monitoring option and fleet consolidation, or any other distributional impacts that adversely affect the business prospects of one sector of the fixed-gear fleet at the expense of another.

While it is possible that integrating EM into the monitoring plan *could* reduce the availability of funds for deploying human observers on vessels, the action is stated such that a negative impact is never assured. The action alternatives merely establish an annual process by which the Council will weigh the benefits and costs of monitoring deployment options and approve a plan that best achieves management goals under a budget constraint.

6 Initial Regulatory Flexibility Analysis

6.1 Introduction

This Initial Regulatory Flexibility Analysis (IRFA) addresses the statutory requirements of the Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (5 U.S.C. 601-612). This IRFA evaluates the potential adverse economic impacts on small entities directly regulated by the proposed action.

The RFA, first enacted in 1980, was designed to place the burden on the government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA recognizes that the size of a business, unit of government, or nonprofit organization frequently has a bearing on its ability to comply with a Federal regulation. Major goals of the RFA are 1) to increase agency awareness and understanding of the impact of their regulations on small business, 2) to require that agencies communicate and explain their findings to the public, and 3) to encourage agencies to use flexibility and to provide regulatory relief to small entities.

The RFA emphasizes predicting significant adverse economic impacts on small entities as a group distinct from other entities, and on the consideration of alternatives that may minimize adverse economic impacts, while still achieving the stated objective of the action. When an agency publishes a proposed rule, it must either ‘certify’ that the action will not have a significant adverse economic impact on a substantial number of small entities, and support that certification with the ‘factual basis’ upon which the decision is based; or it must prepare and make available for public review an IRFA. When an agency publishes a final rule, it must prepare a Final Regulatory Flexibility Analysis, unless, based on public comment, it chooses to certify the action.

In determining the scope, or ‘universe’, of the entities to be considered in an IRFA, NMFS generally includes only those entities that are directly regulated by the proposed action. If the effects of the rule fall primarily on a distinct segment, or portion thereof, of the industry (e.g., user group, gear type, geographic area), that segment would be considered the universe for the purpose of this analysis.

6.2 IRFA Requirements

Until the North Pacific Fishery Management Council (Council) makes a final decision on a preferred alternative, a definitive assessment of the proposed management alternatives cannot be conducted. In order to allow the agency to make a certification decision, or to satisfy the requirements of an IRFA of the preferred alternative, this section addresses the requirements for an IRFA. Under 5 U.S.C., section 603(b) of the RFA, each IRFA is required to contain:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;
- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap, or conflict with the proposed rule;
- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the proposed action, consistent with applicable statutes, and that would minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:
    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

In preparing an IRFA, an agency may provide either a quantifiable or numerical description of the effects of a proposed action (and alternatives to the proposed action), or more general descriptive statements, if quantification is not practicable or reliable.

6.3 Definition of a Small Entity

The RFA recognizes and defines three kinds of small entities: 1) small businesses, 2) small non-profit organizations, and 3) small government jurisdictions.

Small businesses. Section 601(3) of the RFA defines a 'small business' as having the same meaning as 'small business concern', which is defined under section 3 of the Small Business Act (SBA). 'Small business' or 'small business concern' includes any firm that is independently owned and operated and not dominant in its field of operation. The SBA has further defined a "small business concern" as one "organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor…A small business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the firm is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture."

Section 601(3) of the RFA provides that an agency, after consultation with SBA's Office of Advocacy and after an opportunity for public comment, may establish one or more definitions of ''small business'' which are appropriate to the activities of the agency. In accordance with this provision, NMFS has established a small business size standard for all businesses in the commercial fishing industry, for the purpose of compliance with the Regulatory Flexibility Act only. A business is considered to be a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual gross receipts not in excess of $11.0 million for all its affiliated operations worldwide. The $11.0 million standard applies to all businesses classified under the North American Industry Classification System (NAICS) code 11411 for commercial fishing, including all businesses classified as commercial finfish fishing (NAICS 114111), commercial shellfish fishing (NAICS 114112), and other commercial marine fishing (NAICS 114119) businesses.

For fish processing businesses, the agency relies on the SBA size criteria. A seafood processor (NAICS 311710) is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 750 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business that both harvests and processes fish (i.e., a catcher/processor) is a small business if it meets the criteria for the applicable fish harvesting operation (i.e., the $11.0 million standard described above). A wholesale business servicing the fishing industry is a small business if it employs 100 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established “principles of affiliation” to determine whether a business concern is “independently owned and operated.” In general, business concerns are affiliates of each other when one concern controls or has the power to control the other, or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern’s size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when 1) a person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock; or 2) if two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors, or general partners, controls the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor and subcontractor are treated as joint venturers if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

Small organizations. The RFA defines “small organizations” as any not-for-profit enterprise that is independently owned and operated, and is not dominant in its field.

Small governmental jurisdictions. The RFA defines "small governmental jurisdictions" as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of fewer than 50,000.

6.4 Reason for Considering the Proposed Action

In February 2016, the Council adopted the following statement of purpose and need:

> To carry out their responsibilities for conserving and managing groundfish resources, the Council and NMFS must have high quality, timely, and cost-effective data to support management and scientific information needs. In part, this information is collected through a comprehensive fishery monitoring program for the groundfish and halibut fisheries off Alaska, with the goals of verifying catch composition and quantity, including of those species discarded at sea, and collecting biological information on marine resources. While a large component of this monitoring program relies on the use of human observers, the Council and NMFS have been on the path of integrating technology into our fisheries monitoring systems for many years, with electronic reporting systems in place, and operational EM in a compliance capacity in some fisheries. More recently, research and development has focused on being able to use EM as a direct catch estimation tool in fixed gear fisheries.
>
> The fixed gear fisheries are diverse in their fishing practices and vessel and operational characteristics, and they operate over a large and frequently remote geographical distribution. The Council recognizes the benefit of having access to an assorted set of monitoring tools in order to be able to balance the need for high-quality data with the costs of monitoring and the ability of fishery participants, particularly those on small vessels, to accommodate human observers onboard. EM technology has the potential to allow discard estimation of fish, including halibut PSC and mortality of seabirds, onboard vessels that have difficulty carrying an observer or where deploying an observer is impracticable. EM technology may also reduce economic, operational and/or social costs associated with deploying human observers throughout coastal Alaska. Through the use of EM, it may be possible to affordably obtain at-sea data from a broader cross-section of the fixed gear groundfish and halibut fleet.
>
> The integration of EM into the Council's fisheries research plan is not intended to supplant the need for human observers. There is a continuing need for human observers as part of the monitoring suite, and there will continue to be human observer coverage at some level in the fixed gear fisheries, to provide data that cannot be collected via EM (e.g., biological samples).
>
> The Council and NMFS have considerable annual flexibility to provide observer coverage to respond to the scientific and management needs of the fisheries. By integrating EM as a tool in the fisheries monitoring suite, the Council seeks to preserve and increase this flexibility. Regulatory change is needed to specify vessel operator responsibilities for using EM technologies, after which the Council and NMFS will be able to deploy human observer and EM monitoring tools tailored to the needs of different fishery sectors through the Annual Deployment Plan.

6.5 Objectives of Proposed Action and its Legal Basis

Under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Secretary of Commerce (NMFS Alaska Regional Office) and the North Pacific Fishery Management Council have the responsibility to prepare fishery management plans and associated regulations for the marine resources found to require conservation and management. NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine fish, including the publication of Federal regulations. The Alaska Regional Office of NMFS, and Alaska

Fisheries Science Center, research, draft, and support the management actions recommended by the Council. The Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI) groundfish fisheries are managed under the Fishery Management Plans for Groundfish of the GOA and BSAI Management Areas, respectively, and the halibut fishery is managed through regulations promulgated in accordance with the Northern Pacific Halibut Act. The proposed action represents amendments to the fishery management plan, as well as amendments to Federal regulations.

The principal objective of the FMP amendments and proposed regulations is to allow the use of electronic monitoring as a management tool to monitor groundfish and halibut fishing activity in the BSAI and GOA fisheries.

6.6 Number and Description of Directly Regulated Small Entities

The entities directly regulated by this action are those entities that harvest groundfish and halibut from the Federal or parallel fisheries off Alaska (GOA and BSAI) with fixed gear, and are subject to observer coverage in the partial coverage category. This analysis includes vessels that only fished with fixed gear in State waters if those vessels had an FFP, which makes them subject to Federal observer regulations. To be considered in the IRFA, an entity must be both directly regulated and adversely affected.

At present, the analysts are considering only fixed gear vessels in the partial coverage category as entities that might be directly regulated. If the Council considers full retention requirements as an element of its preliminary preferred alternative, staff could provide estimates of directly regulated small processors in a future version of this analysis.

The estimated number of fixed-gear vessels in the partial observer coverage category that are small entities might be overstated. Conversely, the number of non-small entities might be understated. The RFA requires a consideration of affiliations between entities for the purpose of assessing whether an entity is classified as small. The estimate below does not take into account all affiliations between entities. There is not a strict one-to-one correlation between vessels and entities; many persons and firms are known to have ownership interests in more than one vessel, and many of these vessels with different ownership, are otherwise affiliated with each other. For example, vessels in the American Fisheries Act (AFA) catcher vessel sectors are frequently categorized as “large entities” for the purpose of the RFA under the principles of affiliation, due to their being part of the AFA pollock cooperatives. However, vessels that have other types of affiliation that are not tracked in available data (i.e., ownership of multiple vessels or affiliation with processors) may be misclassified as a small entity.

In 2015, 981 harvesting entities participated in the groundfish and halibut fisheries directly regulated by the proposed action. Those 981 inshore catcher vessels include 255 that only operated in state waters but did possess an FFP; all of those 255 vessels are classified as small entities. According to Fish Ticket data provided by AKFIN, the analysts estimate that 950 of those are classified as small entities according to SBA guidelines. Fishing vessels are considered small entities if their total annual gross receipts are less than $11.0 million, after considering all of the vessel’s activities and those of its known affiliates. All of the 31 vessels that are classified as non-small entities met the SBA threshold by virtue of membership in a cooperative whose *combined* gross receipts were greater than $11.0 million in 2015. In other words, no vessel earned more than $11.0 million solely through its activity in the groundfish and halibut fixed-gear fisheries. Each of the 31 vessels classified as non-small entities is affiliated with a crab cooperative, six are affiliated with a Central GOA Rockfish Program cooperative, two are affiliated with an AFA cooperative, and one is affiliated through ownership with the “Freezer Longline” cooperative (some entities are affiliated with more than one cooperative across different North Pacific fisheries).

Table 6-1 provides a count of small and non-small entities. The first row includes all vessels with FFPs that fished with fixed-gear in 2015. The second row is limited to vessels that fished in Federal waters. The bottom rows break out entity counts by gear type and area fished. Those rows should not be summed vertically because vessels that fished with both gear types or in both management areas would be double-counted. No vessel of less than 40’ LOA is classified as a non-small entity, and only one vessel of less than 58’ LOA is classified as a non-small entity.

Table 6-1 Count of small and non-small entities in the universe of directly regulated vessels

		Small Entity	Non-Small Entity	Total
AK Fixed-Gear CVs (Fed. & State Waters)		950	31	981
AK Fixed-Gear CVs (Fed. Waters only)		695	31	726
Longline CVs in Fed. Waters	GOA	584	7	591
	BSAI	114	7	121
Pot CVs in Fed. Waters	GOA	86	4	90
	BSAI	22	21	43

Source: AKFIN Gross Revenue Procedure

6.7 Recordkeeping, Reporting, and Other Compliance Requirements

The projected reporting, recordkeeping and other compliance requirements of the alternatives are identified in Chapters 2 and 3.

No unique professional skills are needed for the vessel operators to comply with the reporting and recordkeeping requirements associated with the proposed action. If they choose to opt into the EM selection pool in partial coverage, vessel operators are required to assist with the installation of the EM system, and conduct basic maintenance to ensure the EM equipment remains functional. Operators will meet with an EM service technician to develop a Vessel Monitoring Plan for their vessel, in which the operator’s responsibilities will be clearly defined. These responsibilities can generally be fulfilled by a crewmember of the vessel who already is fulfilling similar functions during fishing activity.

Under either Alternative 2 or Alternative 3, vessel operators may be required to keep a logbook, that may be in addition to existing reporting requirements. Under Alternative 2, this logbook tracks the vessel’s fishing effort, such as hook size, spacing, skate length, and the number of skates on each set, or for pot vessels, date and time information for each pot set/haul event. Vessels will not be required to record catch information, other than what is already required in IPHC or other logbooks. Under Alternative 3, vessel operators will be required to keep a catch logbook for key target and bycatch species, and, for hook-and-line vessels, seabird interactions.

More detail will be added to this section once the Council has identified a preferred alternative.

6.8 Federal Rules that may Duplicate, Overlap, or Conflict with Proposed Action

An IRFA is required to identify whether relevant Federal rules have been identified that would duplicate or overlap with the proposed action. This section will be completed once the Council has identified a preferred alternative.

6.9 Description of Significant Alternatives to the Proposed Action that Minimize Economic Impacts on Small Entities

An IRFA also requires a description of any significant alternatives to the proposed action(s) that accomplish the stated objectives, are consistent with applicable statutes, and that would minimize any significant economic impact of the proposed rule on small entities. This section will be completed once the Council has identified a preferred alternative.

7 Magnuson-Stevens Act and FMP Considerations

7.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), and a brief discussion of how each alternative is consistent with the National Standards, where applicable. In recommending a preferred alternative, the Council must consider how to balance the national standards.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The implementation of this action will not affect the ability of the fishery management plan to prevent overfishing while achieving optimum yield. The proposed action evaluates the implementation of an alternative monitoring option for fixed gear vessels, to use electronic monitoring (EM) in lieu of a human observer. Because human observer data collection and EM data collection are not identical, there will be impacts of the change in data collection. The implementation of an EM alternative would not eliminate the availability of any source of data, however, as EM will be used as a supplement to human observer coverage, rather than a replacement for it. The use of EM may also allow data collection from vessels where observer coverage is not practicable. Observer data will continue to be used to provide estimates for the fishing activities without coverage or where EM does not collect that specific data, using established procedures. This information will continue to be available to fishery managers and stock assessment authors in order to monitor and prevent overfishing. (Section 4.2)

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

An essential component of the best scientific information to support management and scientific information needs is collected through a comprehensive fishery monitoring program for the groundfish and halibut fisheries off Alaska, with the goals of verifying catch composition and quantity, including of those species discarded at sea, and collecting biological information on marine resources. Extensive field testing of EM in Alaska has demonstrated that EM data can reliably provide species identification and species counts for use in fishery management (Section 3.7), making it a viable tool to supplement human observer coverage. While the EM alternatives in this proposed action accommodate improvements to EM technology over time, the Council has identified a process to ensure that new technology is evaluated for data quality before it is fully operationalized in the fisheries (Section 3.5).

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The data collection changes that may result from the implementation of the proposed action will not affect the ability of the Council and NMFS to manage individual fish stocks throughout their range, as the implementation of an EM alternative will not eliminate the availability of any source of data, and observer data will continue to be used to provide estimates for the fishing activities without coverage or where EM does not collect that specific data, using established procedures. (Section 4.2)

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be; (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The proposed action would allow the Council and NMFS to establish an EM option for fixed gear vessels. The eligibility provisions for vessels to participate in the EM selection pools are fair and equitable, as any fisherman that meets the deployment criteria may choose to opt in or out of the EM selection pool as described in the Annual Deployment Plan on an annual basis, if they are willing to adhere to the provisions of the program. (Section 3.1.2)

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

One purpose of establishing an EM option as part of the integrated Observer Program is to allow for the possibility of using EM to more efficiently monitor vessels where taking a human observer is impracticable. While costs during pre-implementation of the program have generally been similar to the cost of monitoring in the human observer program, trends of EM implementation in other regions have shown that costs decrease as the program matures. (Section 5.8.2.1)

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The integration of an EM option for fishery monitoring increases the ability for fishery managers to adapt to varying fishery data needs through the Annual Deployment Plan process. (Section 3.1.4)

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The proposed action integrates EM into the Observer Program, and utilizes the existing Observer Program infrastructure to the extent possible. The Council and NMFS have spent several years engaging in cooperative research and pre-implementation in order to identify and control cost drivers for the program. As part of the Annual Deployment Plan process, the Council and NMFS will have a yearly discussion about how best to most effectively allocate monitoring costs between the EM and human observer programs. (Chapter 3)

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirements of National Standard 2, in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The proposed action provides an alternative monitoring option that has been requested by small vessel owners in order to reduce social costs associated with deploying human observers on vessels where carrying an additional person is impracticable (Section 1.3). To the extent that small vessel owners are also members of Alaska fishing communities, if the availability of an EM option encourages them to stay active in the fishery, it is helpful for ensuring sustained participation of coastal communities.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The Council's fisheries research plan, as implemented by the Observer Program, provides the standardized reporting methodology to assess the type and amount of bycatch occurring in the groundfish and halibut fisheries. Integrating EM into the Observer Program maintains this standardized reporting methodology because EM would be deployed using scientific sampling and data from EM would be used in the Catch Accounting System. By integrating EM into the Observer Program, under the proposed action, the Council and NMFS will have an additional tool to respond to bycatch data needs in the fisheries. Observer and EM data on bycatch would be used to inform the Council's and NMFS' development of conservation and management measures that, to the extent practicable, minimize bycatch and minimize mortality of bycatch that cannot be avoided. (Chapter 4)

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The implementation of the proposed action is not likely to have any effect on the safety of human life at sea. Per section 313(b)(D) of the Magnuson-Stevens Act, the Council and NMFS have taken into consideration the operating requirements of the fisheries and the safety of observers and fishermen in developing the proposed action to integrate EM into the Observer Program. (Section 5.8.5)

7.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR/IRFA prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR/IRFA. The effects on participants in the fisheries and fishing communities are analyzed in the RIR/IRFA chapters of the analysis (Chapters 5 and 0). The effects of the proposed action on safety of human life at sea are evaluated above under National Standard 10, in Section 7.1. Based on the information reported in this section, there is no need to update the Fishery Impact Statement included in the FMP.

The proposed action affects the groundfish and halibut fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. Impacts on participants in fisheries conducted in adjacent areas under the jurisdiction of other Councils are not anticipated as a result of this action.

7.3 Alaska Region EM / ER Strategic Plan

In June 2013, NMFS developed and the Council adopted a Strategic Plan for Electronic Monitoring/Electronic Reporting in the North Pacific. The document provided a vision for integrating electronic technologies into the North Pacific fisheries-dependent data collection program:

> ***Vision:*** A future where electronic monitoring and reporting technologies are integrated into NMFS North Pacific fisheries-dependent data collection program, where applicable, to ensure that scientists, managers, policy makers, and industry are informed with fishery-dependent information that is relevant to policy priorities, of high quality, available when needed, and obtained in a cost-effective manner.

Cooperative research that has led to the development of this EM integration analysis addresses the following components of the Council and NMFS' EM Strategic Plan:

- Goal II, Objective 1: Conduct scientific research to advance the science of monitoring and data integration.
    - Strategy C: Evaluate EM technologies in the 2013-14 EM project on volunteer vessels in the <57.5 ft hook-and-line and pot vessels.
        - Action: Evaluate species identification issues.
        - Action: Identify data gaps and potential solutions for species weight estimates, biological samples and rare species interactions.
        - Action**:** Assess the efficacy of using technology for capturing information that would quantify discard and provide spatial and temporal distribution of effort.

Analyses of the results from the cooperative study and follow-on work were used to develop the alternatives that are currently included in this analysis, to address:

- Goal III, Objective 1: Implement EM/ER technology where appropriate and cost effective to improve catch estimation and better inform stock assessments.
    - Strategy A: Implement EM as appropriate based on scientific research from goal II.
        - Action: Select EM approach.
        - Action: Analyze EM approach, impacts, cost, and benefits.
        - Action: Write implementing regulations,
        - Action: Implementation, roll out, outreach.

- Goal I, Objective 3: Continue to develop the regulatory framework to implement EM/ER requirements.
    - Strategy A: Develop requirements to use EM for catch estimation.
        - Action: Identify agency/industry responsibilities
        - Action: Identify performance-based standards for regulations.
        - Action: Assign and prioritize staff for regulation development.
        - Action: Develop vessel monitoring

7.4 Council's Ecosystem Vision Statement

In February 2014, the Council adopted, as Council policy, the following:

Ecosystem Approach for the North Pacific Fishery Management Council

> ***Value Statement***
>
> The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant

populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.

Vision Statement

The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.

Implementation Strategy

The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.

The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

In considering this action, the Council is being consistent with its ecosystem approach policy. This action expands the tools available for appropriate and conservative monitoring of fishing activities, especially species caught incidentally and discarded at sea. This is directly supportive of the Council's intention to provide best data possible for scientists, managers, and the public in order to ensure sustainable fisheries for managed species and their effects on associated ecosystem components.

8 Preparers and Persons Consulted

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Appendix 1 How the partial coverage pool changes as vessels are moved to the EM stratum

Adapted from:
C. Faunce, "How the partial coverage pool (subject to human observation) changes as vessels are removed to implement electronic observation in the North Pacific. Presented to the EM Workgroup on July 27, 2016 and available online at:
http://www.npfmc.org/wpcontent/PDFdocuments/conservation_issues/Observer/EM/FaunceHowhumanpoolchangeswEM2016.pdf

Introduction

The action being considered by the Council will integrate EM into the North Pacific Observer Program and under Alternative 2, deployment of both EM and observers will be incorporated in the Annual Deployment Plan (ADP) process. Each year, NMFS will evaluate the rate of observer coverage and EM coverage that can be afforded with the budget from fee revenues. An important part of this annual analysis will be an evaluation of potential gaps in observer data when a portion of the partial coverage vessels opt-in to EM. During this annual process, NMFS and the Council can evaluate and balance EM coverage with maintaining representative observer coverage.

The analysis in this section was originally presented to the Council's EM Workgroup at their July 2016 meeting. The purpose was to inform the workgroup of the potential implications of expanding the pool of vessels eligible for EM in 2017, since those vessels would no longer be subject to human observation. The paper is included here as an example of the type of analysis that would be conducted on an annual basis to inform the decision of how many vessels will be eligible to be in the EM pool while also ensuring that sufficient observers are deployed to estimate catch in the observer coverage strata and maintain the representativeness of data, such as biological samples and average weights, that cannot be collected with EM.

Methods

Database

A special database for the evaluation of observer deployment resulting from past Annual Deployment Plans was utilized for this exercise. Briefly, this database combines data from the AKRO's CAS and the AFSC Observer Program Database NORPAC and elandings information to associate observer deployment strata and coverage with past fishing trips. Data corresponding to the most recent full year of fishing (2015) for hook-and-line and pot vessels in the partial-coverage strata of the 2016 ADP was used in this analysis[91]. An EM vessel list was generated that included all the vessels that had volunteered to be in the EM pool in 2015 and January 1 - July 25, 2016, *except* those that indicated to NMFS that they would not be participating in EM during 2017. Fishing trips undertaken by vessels in the EM list were labelled as EM trips. Trips were aggregated into "cells" defined by observer deployment strata, NMFS Area, and trip target code. Trip target codes are defined by CAS by the predominant species landed after fishing has occurred, and so not necessarily reflect what the fishermen intended to catch.

Scenarios

Three scenarios were evaluated. In the first, called the Control scenario, there were no EM trips and the entire stratum was subject to human observer coverage. In the second, called the Experimental scenario, all trips undertaken by the EM vessels were subject to EM coverage and the rest were subject to human observer coverage. In this second scenario, it was assumed that EM data was used in catch accounting (i.e. the expected case for 2018). The third scenario, called the Experimental No EM scenario, was

[91] Trawl data were not included in the analysis.

identical to the second scenario except none of EM data was used for catch estimation. This scenario was the case for 2015-2017 under pre-implementation and also reflects the expected scenario for 2018 for information that cannot be collected from EM, such as average weights and biological samples, that will come from observer data.

<u>Metrics</u>

In each scenario, the metric of interest was a measure of resulting data gaps for catch accounting. Specifically, following similar analysis in Observer Program Annual Reports, the probability associated with having at least *X* trips observed with a human in a cell was calculated since in all scenarios it was assumed that where no EM-derived data exist, estimates resulting from human-derived data were used in catch estimation, which has been the case to date. The probability estimated was derived from the hypergeometric distribution and depends upon the total number of trips in the strata, the total number of human observed trips in the strata, the number of trips in a cell, and the number of human observed trips in a cell. This last metric was calculated from the product of the stratum-specific deployment rate in the 2016 ADP and the number of trips in a cell, rounded to the nearest whole number. This method is a simplification since it assumes perfect deployment of observers into all cells, but should reflect the mean expected condition had simulations of observer deployment been conducted. Unlike Observer Program Annual Reports where the focus has been on catch and associated variance, here *X* is defined as zero trips, and is denoted as p0, since it represents the true impact (no human observer coverage) and its inverse represents the minimum needed to generate catch estimates (human observed trips greater than zero).

Data were summarized to highlight three aspects of impact to the human observer pool through EM participation: 1) potential magnitude of impact, 2) susceptibility to impact, and 3) relative risk of impact.

The potential magnitude of change was evaluated in three ways. First, the p0 resulting from the Control scenario was compared to that of the Experimental scenario for each cell and expressed as a percent change; [(Experimental - Control) / Control] * 100. Second, the expected proportion of cells subject to human observer coverage in each cell was compared for each scenario. Finally, the cumulative distributions of p0 was plotted as a function of the total number of trips in a cell. These cumulative distributions were used to determine how the distribution of cell size changes and to determine the overall proportion of total cells in Control and Experimental scenarios that had p0 values greater than 0.5. This threshold value of 0.5 represents an equal chance of having zero or at least one human observed trip in a cell. Cells with p0 values > 0.5 were deemed particularly susceptible to changes in their composition as a consequence of implementing EM since the total number of trips in that cell can only be reduced thereby increasing the p0 for the remaining trips subject to the chance of human observation.

The metric p0 represents a likelihood of no observer coverage in a cell, whereas the potential magnitude of impact by having no observer coverage is represented by the total number of trips in a cell. The product of p0 and the total number of trips in a cell were used to generate a metric of risk of impact since risk is comprised not only of the severity of impact but also of its likelihood of happening. Cells with risk values in the top third of all non-zero risk values for each stratum were labelled as “risk prone”.

<u>Simulations</u>

The impact to the human observer pool of vessels with expanded number of EM vessels was investigated through simulated sampling. The Experimental scenario described so far was used as the base scenario from which further expansions the EM pool were made. Simulations were performed for nine increasing increments in sample size to the EM workgroups considered expansions to 90 Hook and line vessels and 30 Pot vessels. In each simulation, the number of EM vessels was expanded from the base condition by an increment number of vessels in each stratum, and a random selection of vessels remaining in the human observer pool was made. All trips associated with these additional vessels were labelled as EM, and removed from the human observer pool. Metrics and summaries follow those described already.

Results

There were 76 unique vessels that participated in EM research and pre-implementation during 2015 and 2016 or indicated they would do so in 2017. Partial coverage rates in 2016 for human observation were set at 15.24% for Pot, 15.41% for Hook and Line gear. The number of EM boats in this list represented 12.4% and 2.8% of the Hook and Line and Pot gear vessels that fished in 2015 respectively (note that EM was not deployed on Pot gear during EM pre-implementation in 2015 and 2016, so these are likely underestimates for 2017).

The p0 declines sharply for cell sizes between one and 20 trips at the sampling rates present in 2015 (Figure A-1). Changes to the distribution of cell sizes between no-EM (Control) and EM (Experimental) scenarios are evident in Hook and Line in cells as small as ten trips but are not observed in Pot gear at cell sizes < 25 (Figure A-1). Cells with p0 values > 0.5 were confined to those with total trips less than 7 for Hook and Line and 5 for Pot (Figure A-1, Table A-1). Roughly 13 and 20% of cells were identified as "vulnerable" in the Hook and Line and Pot gears respectively, however no EM vessels fished in these areas during 2015 (Table A-1, Table A-2).

The relative changes between p0 values of the no-EM (Control) and EM (Experimental) scenarios is depicted in Figure 2. While large changes in the percent difference in p0 were evident, with only one exception - the Hook and line halibut 514 (BSAI Western Alaska) - these resulted from relatively large changes in very small values of p0 (Figure A-2).

The relative risk to changes in human observer coverage is illustrated for each cell in Figure A-3. Ten of 47 unique cells were either susceptible cells or had mean risk values in the top third. All but one of these ten cells - (i. e. hook and line Cod in 610 (E. GOA) - had fewer than ten trips in them resulting in relatively high p0 values. Sablefish fishing in NMFS area 519 (Unalaska BSAI) was the most risk prone cell.
The Experimental no EM data scenario had greater risk values than the Control or Experimental scenarios with only one exception (Figure A-3, Table A-3). This is because the total number of trips for which estimates are needed are smallest for the Experimental scenario and are the same for the Control and Experimental No EM scenario while as the same time the number of observed trips expected is greatest for the Control scenario and the same between both Experimental scenarios. Consequently, the proportion of the total cells expected to carry observer coverage is lowest for the Experimental no EM scenario, since in this scenario the amount of trips subject to human coverage is diminished by implementing EM, although estimates for all trips in the cell (human and EM) are still required to be made (from the remaining human observed vessels). The relative differences in cell-specific coverage values is demonstrated in Figure A-4.

The number of EM vessels included in simulations was steadily increased at three vessel increments from baseline levels until 92 hook and line and 30 Pot vessels were included (Table A-4). What these vessels represent in terms of the proportion of the total number of vessels that fish in each gear type differ substantially between gear types (Figure A-5). For example, having 16 EM vessels in Pot gear is roughly equivalent to 78 vessels in Hook and Line gear.

The distribution of cell sizes change as more vessels are added to EM and removed from human observation. The changes are less evident among iterations in Hook and line than they are for Pot gear since the removal of three vessels represents a larger proportion of the total for the latter 2016 strata (Figure A-6). For the same reason changes in the cell coverage rate associated with removing vessels from human observation is more dramatic among iterations for the Pot gear than for Hook and line gear (Figure A-7). While the median coverage rate remained close to the expected coverage rate in the Control and Experimental scenarios, substantial drops in this metric were observed in the Experimental no EM scenario. For example, the interquartile ranges for the Experimental no EM scenario stop overlapping the other scenarios when > 80 Hook and line EM vessels are included and > 9 Pot vessels are included.

Discussion

The analysis assumed that fishing effort in 2017 will be identical to fishing effort in 2015 and that coverage rates in 2017 and beyond will be at least as high as in the hook and line and pot strata under the 2016 ADP. Without any expansion of the EM pool from current levels, human observer coverage rates without EM dropped to 12-13%. The expansion of the EM pool will reduce the amount of observer information for the data elements, such as biological samples and average weights, which cannot be collected with EM. This impact was more evident as the EM pool expanded beyond 80 hook and line vessels and 6 pot vessels.

The majority of susceptible or risk-prone cells were in the BSAI due to small NMFS Areas and relatively sparse fishing activities. If EM is implemented in the BASI, there will be a greater potential for be gaps at the NMFS-reporting area in the information that cannot be collected with EM, especially for the cells listed in Table A-2. However, for both pot and hook and line, it is important to note that the definition of cells that are considered vulnerable can be changed and will change in time. For example, observer data on average weights and biological samples could be pooled across NMFS reporting areas. As the EM pool expands, it will be important for NMFS to evaluate alternative post-stratifications to reduce the number of vulnerable cells.

Figure A-1 Both views: How the p-value associated with having no observed trips subject to human observation (p0) changes with the total number of trips in a cell (black lines) plotted with the cumulative proportion of all cells represented by cells below a certain size.

The red and blue step lines represent the cumulative number of "cells" without EM ("Control") and with EM ("Experimental"). Note how the red line is shifted to the left from the blue line. These deviations are the impacts of the EM strata on the human observer pool. A shift to the left means that there is a decrease in the number of trips in a cell subject to human observation, thereby increasing p0 (black lines). Detail views (Right panels) illustrate the size of cells and their representation of the total that have p0 values > 0.5 (shaded area). For actual values the reader should refer to Table A-2.

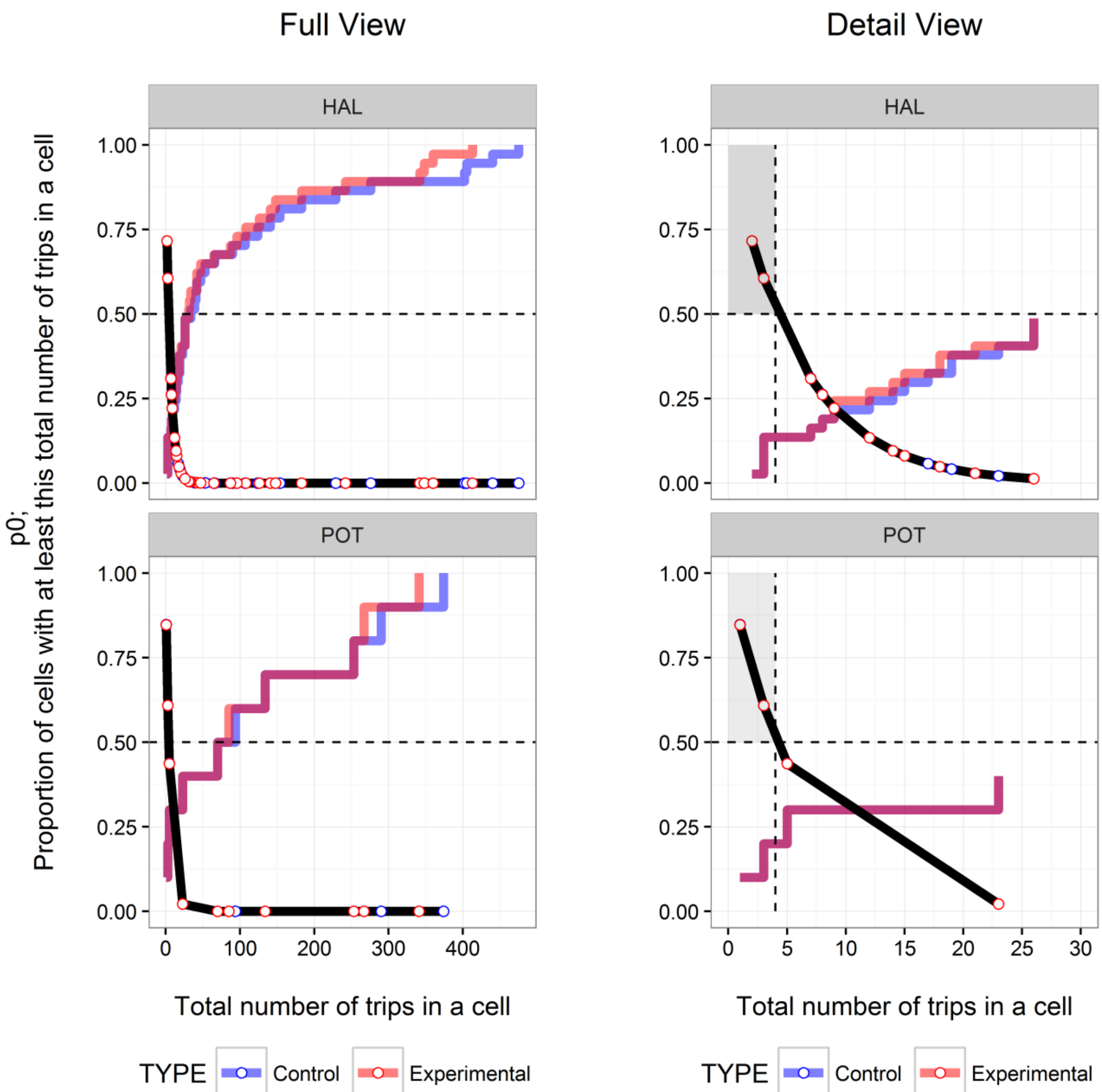


Table A-1 Summary of the cell size (measured in number of trips) below which the p0 estimated by the hypergeometric distribution is greater than 0.5 (i.e., minimum size cell).

The cumulative proportion of all cells in a fishing year with sizes below the min. cell size is also depicted. Exclusion of EM vessels from the population of trips subject to human observer coverage did not result in changes in the minimum size cell or the cumulative proportion of cells with trips up to the minimum size (It is desirable to have this proportion as low as possible).

Strata	Hook and Line	Pot
Minimum size cell	7	5
Proportion of all cells containing fewer than the "minimum cell size"	0.13	0.2

Table A-2 Cells with p0 values > 0.5 that are particularly susceptible to changes in their composition as a result of EM implementation.

None of these areas would be affected by implementing EM from the list of 65 prior EM vessels in this analysis given fishing activities in 2015. p0 values assume selection rates from the 2016 ADP. HAL = Hook and Line, POT = Pot gear.

#	Strata	NMFS Area	Target Code	Trips		Trips in EM (%)	p0	
				Control	Experimental		Control	Experimental
1	POT	518	Cod	1	1	0	0.847	0.847
2	HAL	640	Cod	2	2	0	0.715	0.715
3	POT	541	Sablefish	3	3	0	0.609	0.608
4	HAL	518	Cod	3	3	0	0.605	0.605
5	HAL	543	Halibut	3	3	0	0.605	0.605
6	HAL	543	Sablefish	3	3	0	0.605	0.605
7	HAL	659	Cod	3	0	0	0.605	0.605

Figure A-2 Comparison between the p-values associated with having no observer coverage between control and experimental scenarios.

Each data point depicts the NMFS area colored by the trip target code and sized according to the percent difference in p-values between scenarios. Large percent differences associated with low p-values result from changes in very small values and can be safely ignored.

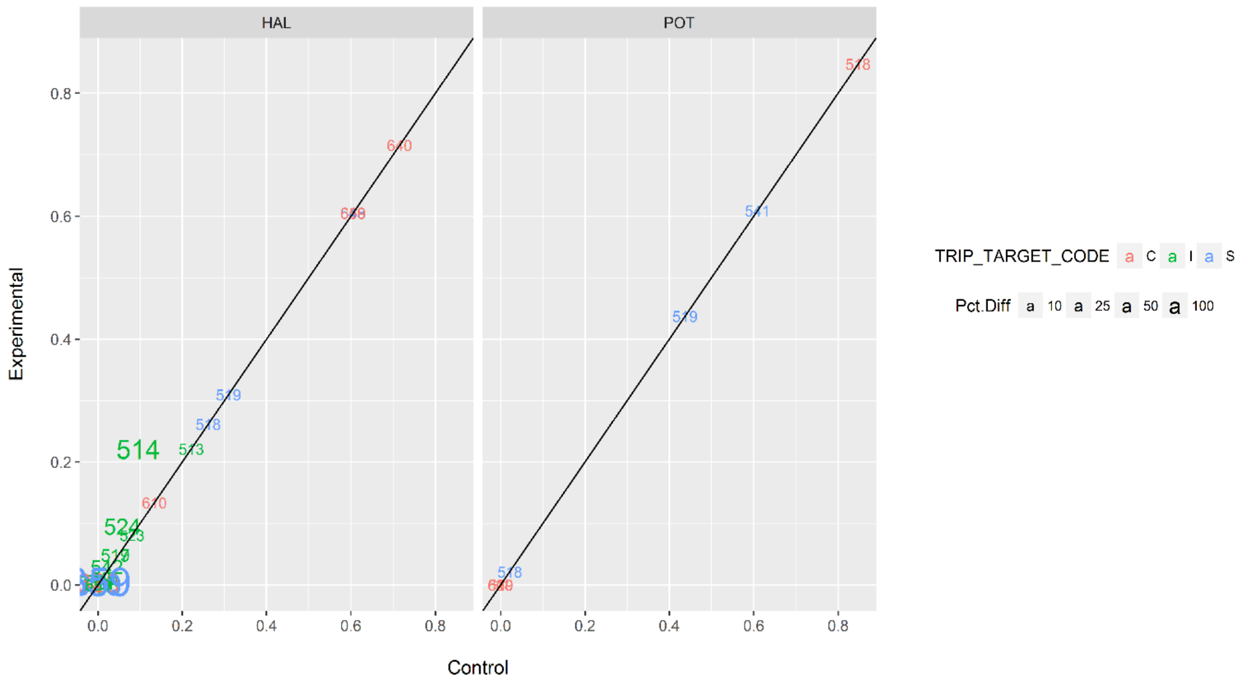


Figure A-3 Non-zero risk scores for each cell and scenario ranked in descending order of the mean among scenarios.

The horizontal reference line represents the 67th quantile of mean non-zero values. Points to the right of this dashed line are in the top third of non-zero risk values. Cells containing scenarios with p-values > 0.05 (Table A-3) are denoted by points with black colored fill.

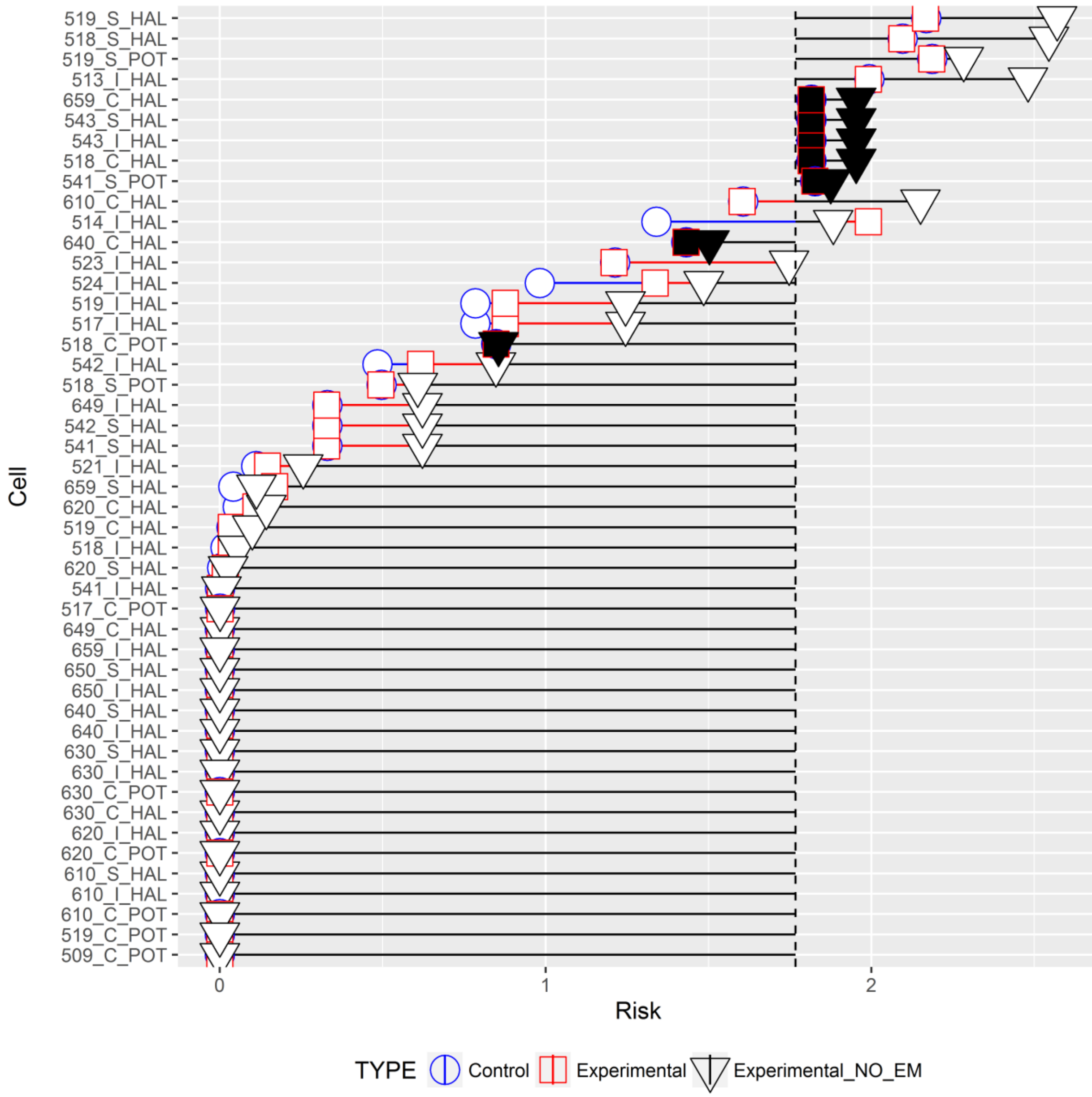


Table A-3 Summary of vulnerable or risk prone cells.

Cells are coded as a combination of NMFS Area, Trip Target Code, and 2016 ADP Strata, where I = Halibut, S = Sablefish, HAL = Hook and Line, POT = Pot. *p*Observed = proportion of trips in a cell expected to carry human observer coverage.

Row #	Cell	Scenario	Total in cell	Observed in cell	*p*Observed	*p*0	Risk	Mean Risk
1	519_S_HAL	Control	7	1	0.143	0.310	2.168	2.301
2	519_S_HAL	Experimental	7	1	0.143	0.309	2.166	2.301
3	519_S_HAL	Experimental_NO_EM	7	1	0.143	0.367	2.570	2.301
4	518_S_HAL	Control	8	1	0.125	0.262	2.096	2.244
5	518_S_HAL	Experimental	8	1	0.125	0.262	2.093	2.244
6	518_S_HAL	Experimental_NO_EM	8	1	0.125	0.318	2.545	2.244
7	519_S_POT	Control	5	1	0.200	0.437	2.187	2.218
8	519_S_POT	Experimental	5	1	0.200	0.437	2.185	2.218
9	519_S_POT	Experimental_NO_EM	5	1	0.200	0.457	2.283	2.218
10	513_I_HAL	Control	9	1	0.111	0.222	1.994	2.155
11	513_I_HAL	Experimental	9	1	0.111	0.221	1.991	2.155
12	513_I_HAL	Experimental_NO_EM	9	1	0.111	0.276	2.480	2.155
13	518_C_HAL	Control	3	0	0.000	0.605	1.816	1.862
14	518_C_HAL	Experimental	3	0	0.000	0.605	1.815	1.862
15	518_C_HAL	Experimental_NO_EM	3	0	0.000	0.651	1.953	1.862
16	543_I_HAL	Control	3	0	0.000	0.605	1.816	1.862
17	543_I_HAL	Experimental	3	0	0.000	0.605	1.815	1.862
18	543_I_HAL	Experimental_NO_EM	3	0	0.000	0.651	1.953	1.862
19	543_S_HAL	Control	3	0	0.000	0.605	1.816	1.862
20	543_S_HAL	Experimental	3	0	0.000	0.605	1.815	1.862
21	543_S_HAL	Experimental_NO_EM	3	0	0.000	0.651	1.953	1.862
22	659_C_HAL	Control	3	0	0.000	0.605	1.816	1.862
23	659_C_HAL	Experimental	3	0	0.000	0.605	1.815	1.862
24	659_C_HAL	Experimental_NO_EM	3	0	0.000	0.651	1.953	1.862
25	541_S_POT	Control	3	0	0.000	0.609	1.827	1.843
26	541_S_POT	Experimental	3	0	0.000	0.609	1.826	1.843
27	541_S_POT	Experimental_NO_EM	3	0	0.000	0.625	1.875	1.843
28	610_C_HAL	Control	12	2	0.167	0.134	1.607	1.787
29	610_C_HAL	Experimental	12	2	0.167	0.134	1.603	1.787
30	610_C_HAL	Experimental_NO_EM	12	2	0.167	0.179	2.150	1.787

Figure A-4 The amount of expected observer coverage in a cell expected to result given the 2016 stratum specific deployment rates (dashed lines) and perfect deployment proportional to the number of trips in each cell in each scenario:

No EM trips (Control), EM trips removed from human observation but EM data used in catch accounting (Experimental), and EM trips removed from human observation but no data for catch accounting derived from EM (Experimental_NO_EM). In this last scenario, there are fewer observed trips with data relative to the total number of trips in each cell that require estimates.

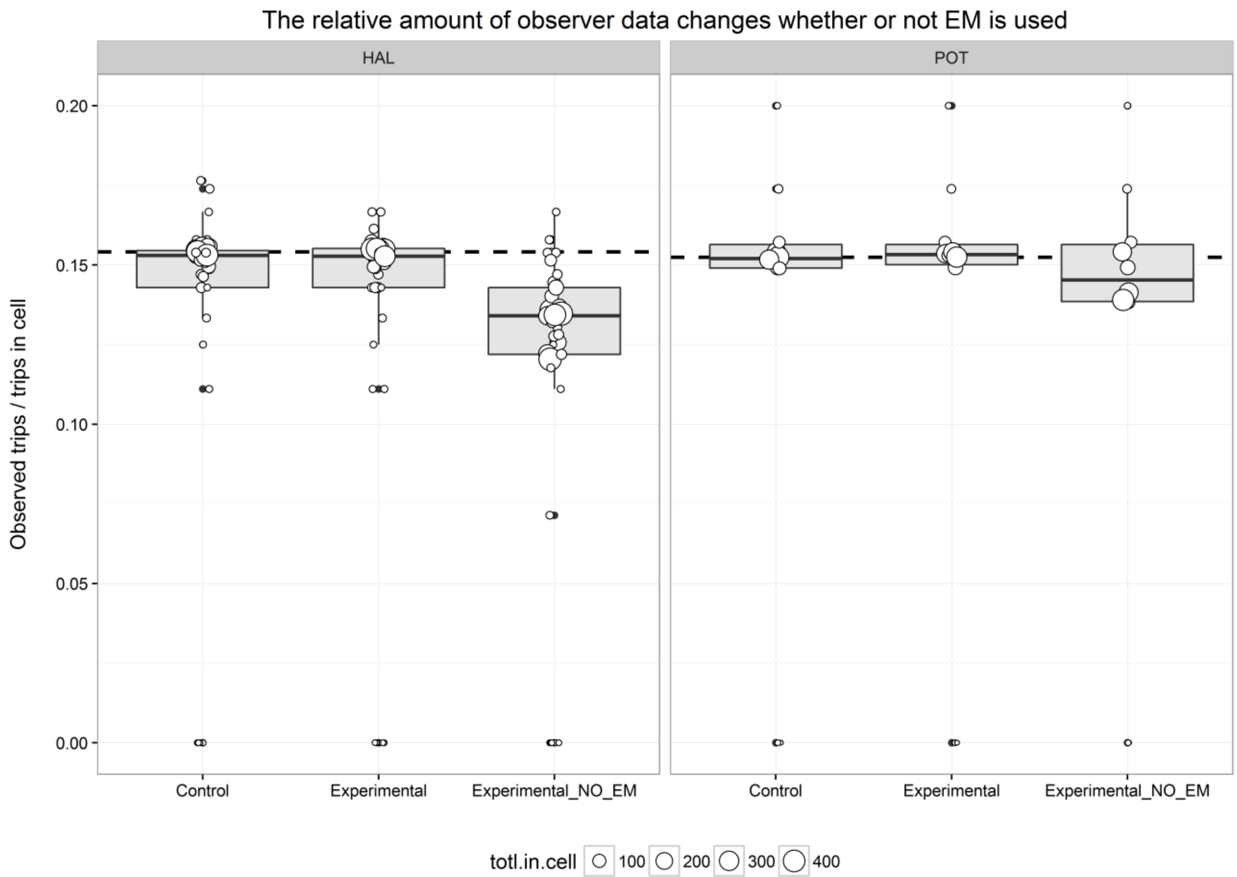


Table A-4 Iteration number (j) and the corresponding number of vessels in EM for Hook and Line and Pot vessels.

A j = 0 denotes the “baseline” condition where there is no expansion of former EM vessels.

j	Total Vessels in EM	
	Hook and Line	Pot
0	65	3
1	68	6
2	71	9
3	74	12
4	77	15
5	80	18
6	83	21
7	86	24
8	89	27
9	92	30

Figure A-5 Visual depiction of the number of vessels in EM as a proportion of the total number of vessels that fished in 2015 by iteration number.

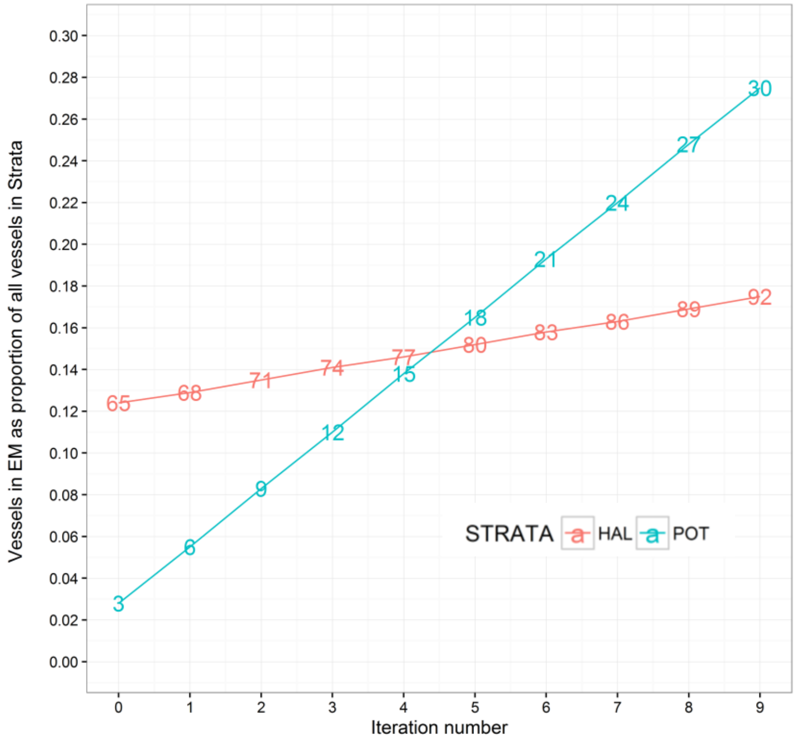


Figure A-6 Comparison of how the cumulative distribution of cell sizes changes as more vessels are removed from the human observer pool and into EM pre-implementation.

j = simulation iteration number. For number of vessels associated with each j, see Table A-5.

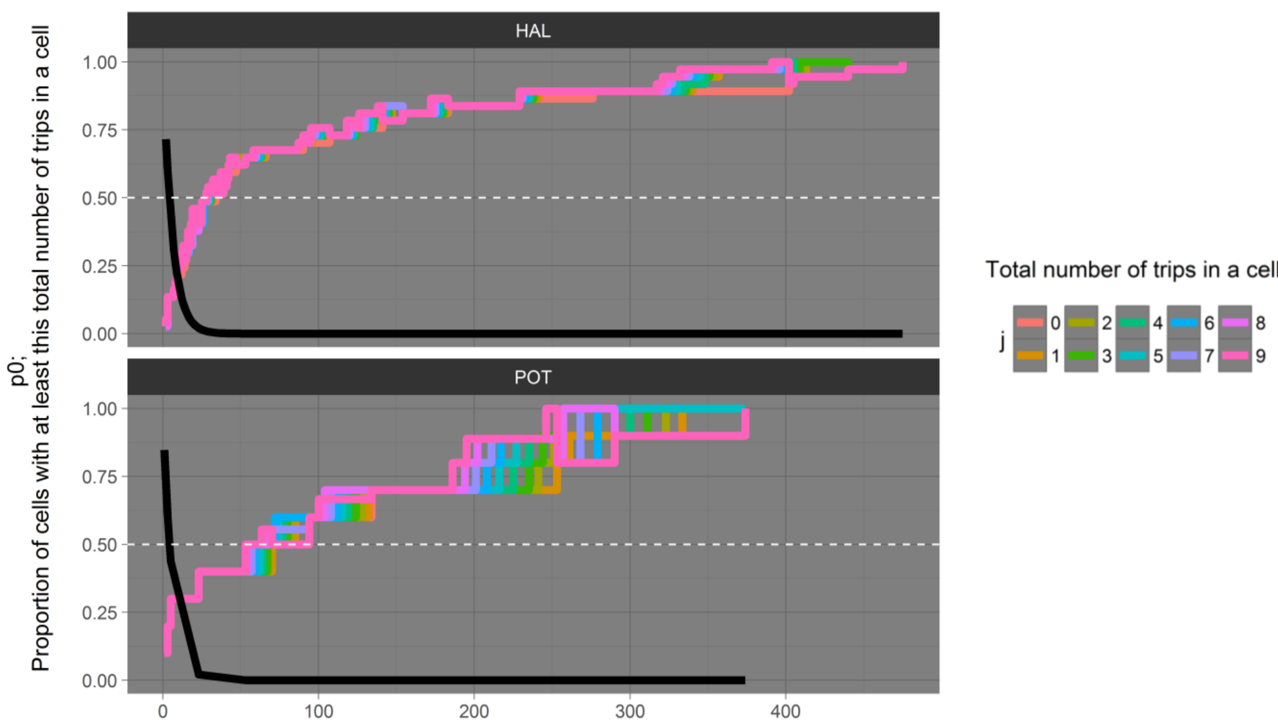
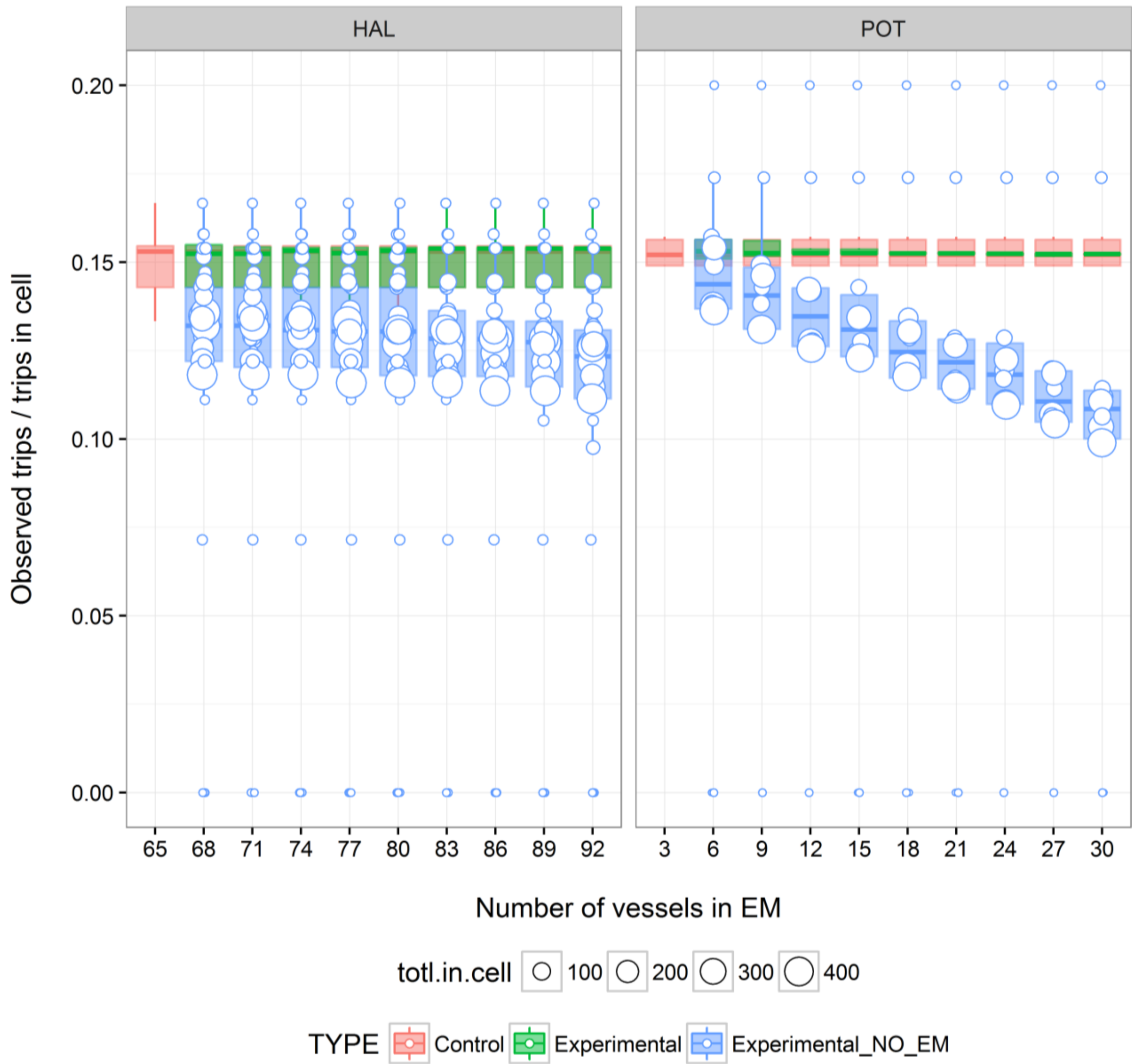


Figure A-7 How increases in the number of EM vessels impact cell-specific coverage rates when the underlying selection rate for human observers is set at 2016 levels (roughly 15%) depends on whether the EM data is used (Experimental) or not used (Experimental No EM).

Individual dots represent individual cells in the Experimental No EM (2017) scenario. Dots are sized according to the number of trips in the cell.



Appendix 2 EM hardware, software, and support elements for 2017

Introduction

The management objective for the 2017 EM program for hook-and-line and pot vessels is to estimate discards by documenting species composition and disposition (fate) of catch. For hook-and-line vessels, validating the presence/absence of seabird mitigation devices (streamer lines) when setting gear is also a management objective. The 2017 EM program will be based on current EM technologies with video and sensor data reviewed by human reviews.

The purpose of the document is to describe functional requirements for EM hardware, software, and support services necessary to integrate with the 2017 EM program design. The intent is to also capture lessons learned through field work, identify methods and features which have demonstrated the ability to provide necessary data, and provide a reference point for evaluating the capabilities of future EM hardware and services. It is not intended to limit innovation. This document is envisioned to be updated annually as pilot testing of new approaches provides additional information, and to reflect the evolution of management objectives, EM technologies, and program design over time.

EM Hardware

- **Overall—**All components if the EM system must be:
    - Able to withstand a marine environment.
    - Capable of accommodating vessel input power voltages from 10V – 32V DC and 110V AC.
    - Capable of accommodating reasonable variations in power quality common to small fishing vessels.
    - Utilize an uninterruptable power supply or other system to allow data to continually be logged during short power fluctuations or temporary brown outs in order to minimize data loss.
    - Designed so the vessel's power state (engines or generators on/off) govern the EM system's power state to prevent draining vessel batteries. EM systems may power down to minimize battery drain when the main engine is off, but should automatically re-start when engine activity resumes.
    - Designed for a bridge environment to standards that minimize radio frequency interference with other electronics and instrumentation. (e.g. BS EN 60945);
- **Control Center**-- The control center should be an independent, fully enclosed, device containing the operating software and data storage components of the EM System. It must be:
    - Capable of receiving and processing digital video inputs from a sufficient number of cameras to fully support species identification and fate determination of catch (hook-and-line and pot gear vessels); and determine presence/absence of seabird deterrent devices the wake area when setting gear (hook-and-line vessels only). Typically, this requires three to four cameras on vessels fishing hook-and-line gear and two cameras on vessels fishing pot gear.
    - Capable of receiving and recording the following sensor data elements based on a configurable interval (typically 10 seconds):
        - Vessel position and speed from GPS
        - Hydraulic pressure
        - Deck equipment rotation (hook-and-line only)
    - Contain a hard drive for data storage capable of being easily removed/replaced by the vessel operator and mailed in for EM review. Hard drives should have sufficient capacity to store approximately 1 month of fishing activity (typically 1 TB);

  - Have "quick disconnect" connections to allow easy removal and installation on multiple vessels/year (hook-and-line vessels only)

- **Video Monitor—**A compact video monitor, powered by the control center, capable of displaying video images to allow vessel operators to evaluate system operation, (recording vs. not recording), system health, and video image quality in order to conduct maintenance as needed.
- **Rail Camera(s) (hook-and-line vessels only)**—Digital camera(s) housed in a waterproof (minimum IP66 rating,) low profile fixture, capable of providing color images of the hauling and discard areas at sufficient resolution and frame rate to support species identification and fate determination (typically 5 -10 unique FPS). Rail camera(s) are activated only during hauling events to avoid constant recording. The rail camera field of view (FOV) must monitor the entire area from where catch breaks the surface of the water to where it is brought onboard the vessel. Previous experienced has identified a 20 degree outboard view angle of the hauling station as an optimal camera view.
- **Deck Camera--**Digital camera(s) housed in a waterproof (minimum IP66 rating) low profile fixture, capable of providing color images of the deck area at a sufficient resolution and frame rate (typically 5 to 10 unique FPS) to validate the fate of fish that pass from view of the rail cameras (hook-and-line vessels) or species identification and fate determination (pot gear vessels). Deck camera(s) are activated only during hauling events to avoid constant recording, and have adjustable run-on times to accommodate final deck sorting after the haul.
- **Sea Bird Camera (hook-and-line vessels only)**— Digital camera, housed in a waterproof (minimum IP66 rating) low profile fixture, capable of providing color images of the vessels wake area at a sufficient resolution and frame rate to validate presence/absence of seabird streamer lines (typically 1-5 unique FPS). Seabird cameras are typically activated by deck equipment rotation, hydraulic pressure, or vessel speed to avoid constant recording.
- **Hydraulic pressure sensors**—Pressure transducers appropriate for the deck equipment on the vessel (typically 0-3000 PSI) which can transmit gradations of hydraulic pressure as changes in base line voltage to activate camera recording during hauling events.
- **Rotation sensors**—Sensors capable of monitoring the rotation of deck equipment, such as a hook-and-line drum, and transmitting a signal to the control center to activate camera recording during hauling or setting events.
- **GPS**— Must provide a digital data stream of time, vessel location (lat/lon), speed, heading, and position accuracy to the control center for recording – time and location must be available on a per frame basis.

EM System Operating Software

- **User interface--** Operating software must provide a "fisherman friendly" user interface to support vessel operator responsibilities and display video images and system operation status at all times when powered. Operating software should provide a separate user interface for EM service technicians to aid in on-site diagnostic and repair work.
- **Function test**—Operating software must provide a system health check capable of being executed by vessel operator to document EM system functionality prior to departing in a trip.
- **Independent camera activation**— Operating software must enable event based activation of camera recording based on a variety of sensor inputs such as vessel speed, rotation of deck equipment, and/or hydraulic pressure. Each camera should be independently activated with configurable "run-on" times after sensor trigger ceases to record final deck activity.

- **Sensor configuration—**Operating software must enable setting of vessel-specific, sensor threshold values which trigger activation of camera recording.
- **System security**— Operating software must provide system diagnostic files (i.e. system operation status, error detection, input voltage, operator commands etc.) of sufficient detail to support forensic determination of system malfunctions. These files should be password protected to prohibit access or tampering by vessel crew.
- **Data Encryption**—All sensor and video data must be encrypted using industry-standard encryption.

EM Review Software

EM reviewing software must allow human reviewers to efficiently time synchronize all sensor and video data streams, view sensor data, identify fishing events, review camera footage, and log species identification and disposition. It must include:

- A timeline that displays all information collected by the sensors to aid in detecting fishing events;
- A map showing vessel position and track line time synched with sensor data to aid in identifying fishing events;
- A means to display and time synchronize video files from individual cameras to support determination of species identification and disposition;
- The ability to start, stop, fast forward or reverse video images, view video images frame-by-frame, and jump between different date and time periods;
- The ability to capture reviewer annotation on:
    - Metadata: Data/vessel name, target fishery, gear used, start and end of a trip (date/time/location/port, set date/time/location, haul date/time/location/sensor and video gaps (or missing video), effort (number of hooks or skates)
    - Haul-specific catch data (ability to link to a specific haul): Species identification/ disposition/ quantification, halibut release method and condition, seabird streamer line presence/ absence, seabird extended presentation, trip-level sensor gaps (identify and classify), post-haul-review data (data confidence, image quality, reviewer name, etc.), etc.
- The ability to support pre-loaded species and port lists
- The ability for reviewers to use custom assigned 'hot keys' on their keyboard for species data entry and video playback control
- A means of clipping and exporting video and sensor data for seabird identification, archiving, or enforcement purposes; exported data must be in formats suitable for use with other software (XML, CSV, JSON, MP4, AVI, etc.)
- Customizable data quality and control alerts for data reviewers (ex. messages appear in the program when certain required fields aren't filled in by a reviewer).
- Data decryption keys to couple with encryption features of EM system operating software.
- Box graphs along the timeline that enable reviewers to quickly identify events of interest based on defined sensor data values or intervals (ex. time gaps).

Technical Support

EM equipment and software providers active in the 2017 EM pre-implementation program must:

- Provide technical assistance to vessels, upon request, in EM system operation, the diagnosis of the cause of malfunctions, and assistance in resolving any malfunctions. Technical support must be available by phone 24-hours per day, seven days per week, and year-round. Technical support must also be available by email.
- Submit critical failure notices and requests for technical assistance from vessels to PSMFC, including when the call or visit was made, the nature of the issue, and how it was resolved.
- Provide technical and litigation support to NMFS or its agent including:
  - Assistance in EM system operation, diagnosing and resolving technical issues, and recovering corrupted or lost data.
  - Support for inquiries related to data summaries, analyses, reports, and operational issues with vessel representatives.
  - Litigation support to NMFS if the EM system/data is being admitted as evidence in a court of law. All technical aspects of a NMFS-approved EM system are subject to being admitted as evidence in a court of law, if needed. The reliability of all technologies utilized in the EM system may be analyzed in court for, inter alia, testing procedures, error rates, peer review, technical processes and general industry acceptance. The EM service provider must, as a requirement of the provider's permit, provide technical and expert support for litigation to substantiate the EM system capabilities or other relevant information to investigate or establish potential violations of this chapter or other applicable law, as needed, including:
    - If the technologies have previously been subject to such scrutiny in a court of law, the EM service provider must provide NMFS with a brief summary of the litigation and any court findings on the reliability of the technology.
    - Sign a non-disclosure agreement limiting the release of certain information that might compromise the effectiveness of the EM system operations.
  - Supply all software necessary for accessing, viewing, and interpreting the data generated by the EM system, including maintenance releases to correct errors in the software or enhance the functionality of the software.
  - Notify NMFS within 24 hours after the EM service provider becomes aware of the following:
    - Any information regarding possible harassment of EM provider staff;
    - Any information regarding possible EM system tampering; (iii) Any information regarding a prohibited action; and,
    - Any information, allegations or reports regarding EM service provider staff conflicts of interest.
  - Notify NMFS of any change of management or contact information or a change to insurance coverage.
- Provide field technician training and support in 3 primary ports <u>for hook-and-line vessels</u> (Sitka, Homer, Kodiak)

Installation and field services

EM system installation and field service providers active in the 2017 EM pre-implementation program must provide installation, maintenance and support services, including maintaining an EM equipment inventory, such that all deployed EM systems perform according to the performance standards. In performing these services EM field service providers must:

- Provide installation services within 2 weeks of notice in primary ports (hook-and-line vessels).
- Provide limited installation services based on scheduled travel to remote ports (hook-and-line vessels).
- Provide on-site maintenance and repair services within 48 hours of receiving a call in primary ports.
- Ensure that field service events are scheduled and carried out with minimal delays or disruptions to fishing activities.
- Develop a VMP for each vessel and submit it to PSMFC for approval within 24 hrs. of installation.
- Comply with data integrity and security requirements, including requirements pertaining to hard drives containing EM data.
- Provide standardized programmatic communication including vessel operator feedback forms, vessel service reports, and critical failure notices.
- Submit critical failure notices and requests for technical assistance from vessels to PSMFC, including when the call or visit was made, the nature of the issue, and how it was resolved.
- Provide technical and litigation support to NMFS or its agent including:
    - Support for inquiries related to data summaries, analyses, reports, and operational issues with vessel representatives.
    - Notify NMFS within 24 hours after the EM field service provider becomes aware of the following: (i) Any information regarding possible harassment of EM provider staff; (ii) Any information regarding possible EM system tampering; (iii) Any information regarding a prohibited action; and, (iv) Any information, allegations or reports regarding EM service provider staff conflicts of interest.
    - Notify NMFS of any change of management or contact information or a change to insurance coverage.

Appendix 3 Further detail on catch estimation process

Chapter 3 provides an overview of how catch would be accomplished using the EM data under Alternative 2. For trip, vessel, and fishery levels of the sampling hierarchy there are two estimation routes being considered: a mean-based and a ratio-based estimator. Note that as data become available from the EM stratum, additional estimation methods may be developed that do not use ratios or simple means at their core. Regardless, estimation will rely on data that arise from a simple random sample design. This section provides more detail on the potential estimation methods currently under consideration and outlines tradeoffs that NMFS is considering between the different estimation approaches.

Trip-Level Estimates

In the near-term we anticipate that nearly all EM trips and hauls will have complete enumeration (a census) of catch, negating impacts of expansion. The census approach for an entire sampled trip may change in the future, particularly if future cost considerations reduce trip-specific review time, resulting in some hauls not being sampled (video not being reviewed). To accommodate sampling of hauls, NMFS will use standard estimating procedures to estimate catch for the sampled trip.

For trips where one or more hauls are marked as not-sampled, discarded and retained amounts will be estimated based on data collected from the sampled hauls. Either a ratio or simple mean-based estimator could be used depending on available data (Table A-5) and the variability between hauls in both discards and amount of gear set. If there is large variability, ratio estimators may provide better estimates, but these benefits are small since data for most trips will be based on a census of all hauls.

Table A-5 Summary of basic data needs for simple mean-based and ratio-based estimators at different levels of the sampling hierarchy.

	Data needs	
	Simple mean-based estimator	**Ratio-based estimator**
Haul-Level	• Full enumeration of species-specific discarded catch – thus expansion not necessary	• Full enumeration of species-specific discarded catch and at-sea retained catch – thus expansion not necessary
Trip-Level	• Species-specific counts of discarded catch • Total number of hauls (derived from sensor data)	• Species-specific counts of discarded catch • Species-specific counts of at-sea retained catch • Total landed catch for trip (from landing reports)
Vessel-level	• Sum of species-specific discards over all trips • Number of trips	• Species-specific counts of discarded catch for all trips by the vessel • Species-specific counts of at-sea retained catch for all trips by the vessel • Total landed catch for all trips by the vessel
Fishery-Level	• Sum of species-specific counts of discarded catch over all vessels • Total number of vessels	• Species-specific counts of discarded catch for all vessels • Species-specific counts of at-sea retained catch for all vessels • Total landed catch for all vessels (from landing reports)

In simple mean-based estimation, the mean discard of a given species will be expanded against the total number of hauls fished on trip. Note that if estimates of mean length per fish are available from the trip (i.e., from hauls within the trip), it would be incorporated into the estimation process at this level. The minimum data requirements for simple mean-based estimation at the trip level are estimates of discard (*weight or number*) for at least one haul on the trip and the total number of hauls fished for that trip (independently known based on sensor data). Covariate information for post-stratification of all hauls within the trip (e.g. NMFS area, etc.) will also be necessary if post-stratification will be used in the estimation process.

In estimating discards using a ratio estimator, the ratio of at-sea species-specific discard to retained catch for all sampled hauls is expanded against total landings (all groundfish species and halibut) for the monitored trip. The ratio-based estimator has potential for lower variance if the at-sea discard number of fish (weight, if available) is correlated to landed weight or if there are large haul-to-haul differences in size of haul or size of discard. This estimator cannot be post-stratified within the trip due to its reliance on total landings, which cannot be post-stratified within the trip. However, this ratio estimator assumes that the ratio of the number of discards for a given species to the total number of groundfish retained is the same as the ratio of the weight of discards of that species to the total weight of groundfish retained. In other words, it assumes that the ratio based on numbers is the same as the ratio based on weight. For some species this assumption will not be valid (e.g. sleeper sharks). For this reason, it would be better to convert the number of fish of each species to weight at this level in the estimation process if possible (e.g., if length data are available for discarded and retained fish from the trip). Alternatively, if mean weight per fish is not available at a lower level in the hierarchy, then estimates would be adjusted by the species-specific mean weight per fish when expanded from the vessel to the fishery.

In the short-term, NMFS anticipates implementing a ratio estimation approach since that is the method currently used under status quo. The assumptions associated with this estimator would need to be evaluated. However, as previously stated, given that most hauls will be censused, the impact of using partially sampled hauls to estimate total catch is likely small since nearly all catch data used is based on a census. The choice of estimator would become more of an issue than under current configurations if the frequency of partially sampled hauls increases (e.g., reduced imagery review or increase in poor video quality).

Vessel-Level Estimates

In 2016, a vessel-selection deployment design was implemented in the EM selection pool and all trips within a time period (2 months or 4 months) were monitored. Since randomization occurred at the vessel level, estimates of discard would be computed for each vessel before combining estimates across the selected vessels and applying those rates to the un-monitored vessels within the EM stratum. Under the 2016 sampling design, it is expected that on selected vessels there will be few trips where no EM data are collected and thus expansion won’t be necessary from the monitored trips to the unmonitored trips on individual selected vessels for a given time period. However, in the situation where fishing occurs for a trip and none of the video imagery is sufficient to allow collection of species composition data, expansions would be required. In addition, the EM Workgroup is discussing implementation of a trip-selection sampling design in 2017. If a different sampling approach was implemented, then expansions to the vessel might not be required, depending on the implemented design.

Using a simple mean-based estimator, the total discards for a vessel will be computed by multiplying the post-stratified discard per trip by the total post-stratified number of trips made by that vessel. Any post-stratification covariates must be available for the entire trip (resolution of the landings data) for both monitored and unmonitored trips. This estimator has potential for high variance if trips are of differing duration, post-stratified sample sizes are small or vary greatly between post-strata, or discard amount varies between trips. At a minimum, use of this estimator will require post-stratified estimates of discard number (or weight) for at least one trip for the vessel and the total number of trips made by the vessel in a post-strata.

Alternatively, a ratio estimator can be used to expand the ratio of post-stratified discard number (or weight) per trip, to landed weight for post-stratified monitored trips against the post-stratified weight of all landings by that vessel. Similar to the simple mean-based estimator, any post-stratification covariates must be available for the entire trip (resolution of the landings data) for both monitored and unmonitored trips. The ratio estimator has potential for lower variance if trip discard weight is correlated with landings or if there is a lot of variation in the size of the trips made by a vessel. The ratio estimator requires, at a minimum, post-stratified estimates of the ratio of discard to landings for at least one trip for the vessel as well as the total post-stratified landings for unmonitored trips made by that vessel.

Note that this ratio estimator, similar to the ratio used at the trip level, assumes that ratio based on numbers is the same as the ratio based on weight. And, as mentioned in above, this assumption will not be valid for all species (e.g. sleeper sharks). Thus, if length data were available from the vessel, the conversion to weight would be applied at this level. Alternatively, estimates would be adjusted by the species-specific mean weight per fish when expanded from the vessel to the fishery. For both estimators, the conversion from numbers of fish to weight of fish would be made using post-stratified observer data from the same post-strata on similar vessels.

Fishery-level Estimates

Lastly, at-sea discards for a fishery will be estimated by expanding from the monitored vessels in the EM stratum to the unmonitored vessels. Using the simple mean-based estimator, the mean catch per vessel for the time period is multiplied by the total number of vessels in the EM stratum that fished in the time period. To use the simple mean-based estimator, at a minimum, post-stratified estimates of discard weight or number for at least one vessel and the known number of vessels that fished in a post-strata must be available.

The ratio estimator expands the ratio of weight discarded per trip to landings expanded to total landings for both unmonitored and monitored vessels. The minimum data required to use this estimation method are post-stratified estimates of the ratio of discard to landings for at least one vessel and total post-stratified landings unmonitored vessels.

For both estimators, conversion from estimated number to estimated weight within the post-strata will be based on mean weight per fish from monitored (human or EM) trips within the same post-strata. **In cases where the ratio estimator was used at the trip or vessel level, the mean weight per fish will be applied to adjust the estimates. Where the mean weight per fish is used, we assume that this mean weight per fish is representative of the true mean weight per fish at that level in the hierarchy.**

Assumptions

We will assume that the disposition (retained or discarded) of all catch is known at the haul level when catch is recorded. In situations where video imagery is not available for the entire time that fish are handled, we will assume that no fish are discarded during the time period after gear retrieval and before all fish are stored below deck. Estimates will assume that imagery for trips and vessels are representative of trips and vessels where data are not available. At the fishery level, we need to assume that post-strata assignments are accurate (data can be assigned to post-strata unambiguously).

Appendix 4 Evaluation of catch composition information from video and observer monitoring in the halibut and sablefish longline fisheries in Alaska

Introduction

Observers collect a wide variety of data to meet diverse management objectives that include the recording of the identity, quantity, and disposition of catch, collecting biological samples, and monitoring for regulatory compliance. Although Electronic Monitoring (EM) is perceived by many as an alternative to at-sea observer programs, it is important to evaluate whether EM can meet the quality and diversity of information collected by human observers. Having a full understanding of the differences in the types of and quality of data collected using EM versus an observer is essential before committing to the use of EM as a replacement for or a supplement to observers and embarking on a large scale EM program. An accurate EM system will provide fishery managers with additional options for monitoring vessel catches and discards.

The National Marine Fisheries Service (NMFS), in collaboration with the International Pacific Halibut Commission (IPHC) and the Alaska Department of Fish and Game (ADFG), conducted this study to examine the efficacy of employing EM technologies using standard camera technology in the Alaskan halibut and sablefish longline fisheries. The purpose of this study was to compare the accuracy of catch composition data (species identification and counts) collected using EM relative to an observer.

Materials and Methods

Fieldwork was conducted during the summer of 2015 aboard two survey vessels contracted by the IPHC to conduct the annual stock assessment halibut survey in the Gulf of Alaska and one vessel contracted by ADFG to conduct the annual stock assessment sablefish survey in Chatham Strait located in SE Alaska (Figure A-8).

The three vessels (F/V Bold Pursuit, F/V LaPorsche and F/V Magia) were selected for the study since each vessel had bunk and/or deck space to accommodate a third sampler and were already equipped with Archipelago Marine Research AMR EM camera systems. These camera systems were deployed in both the 2015 and 2016 EM volunteer longline fleet such that the image quality between the volunteer fleet and survey vessels should be similar such that results could be extended to the current EM monitored fleet operating in Alaskan waters. The EM system consisted of several components including: 1) a dedicated GPS receiver that collected positional information; 2) a magnetic rotation sensor that triggered video recording during setting or hauling gear; 3) a electronic hydraulic pressure transducer; and 4) a computer system and hard drive. Sensors provided data on vessel position, confirmed when fishing activity was taking place, and triggered recording. This information aided the video review technician to quickly identify video segments associated with catch being hauled onboard and provided key information to link the at-sea and video monitoring datasets.

Each vessel carried a hook-status observer to sequentially record both the catch for each hook in the set and the status of that catch (landed, removed intentionally from the line, dropped off the hook before or after the line left the water). This allowed for complete enumeration of species-specific catch for the entire set (haul) throughout the vessel survey area. Hook-status observers were also required to record the vessel information, date, set number, location, skate number and disposition of catch (retained or discarded). The methods used by hook-status observers followed IPHC sampling methods and species identification protocols including species-specific identification codes. In rare cases, the observer would group species.

Video reviewers received species identification training for species encountered in the Alaskan longline fishery from staff in the North Pacific Observer Program (observer program). The video reviewers provided the lowest taxonomic level for each catch piece if video quality was sufficient and reviewers believed a positive ID was possible. If image quality did not support species identification video reviewers followed species grouping methods detailed in the observer program's sampling manual[92] for longline composition sampling. These methods outline which species are allowed to be identified to species level visually and which similar looking species are required to be summed into a group species code for visual composition sampling in the longline fishery (Table 1). In typical sampling situations, observers would sub-sample the catch group for positive species identification to determine the ratio of each species in the catch. The idea for providing the lowest taxonomic level for all species encountered was to provide information to evaluate which, if any, species groups could potentially be identified to their species specific component using video.

Species-specific counts derived from video review were compared to at-sea counts. All statistical analyses used species counts based on species-specific designation or species grouping rules described in the Observer sampling manual for on-board observers using visual identification rules (Table A-6). The video reviewers also recorded meta-data on the video completeness and image quality.

Differences between at-sea and video data can be unequal for reasons that include failure to detect a species or misidentification. To test for differences, a table of the numerical count of fish for a given species was derived from data collected using video and that collected by an at-sea sampler across all hauls. A Wilcoxon sum rank test was employed to test the null hypothesis (H_o: No difference in population mean ranks).

Species-specific video counts can potentially be influenced by video quality such that a video reviewer's ability to identify to a species degrades as video quality degrades. Here, a linear model was used to explore the relationship between at-sea counts, video counts and image quality to determine if image quality had a significant effect on video counts compared to at-sea counts. Haul-specific counts were plotted and linear regression fit was displayed for a given species to assess correspondence of video and at-sea counts. Box plots of differences (at-sea minus video) were also constructed to explore the distribution of differences for a given species. To analyze mean differences between counts (at-sea – video counts) t-statistics and associated p-values were calculated for a given species across all hauls to test the null hypothesis (H_o: at-sea – video counts = 0). The expectation is that the distribution of resulting p-values should be uniform (i.e. only 5% of p-values to be below a value of 0.05, only 10% of the values to be below 0.1, etc.). A large deviation from a uniform distribution was used as criteria to broadly reject the null hypothesis (Murdoch et al., 2008).

Results and Discussion

Hook-status observers collected information on a total of 197 hauls and of these 194 were paired to video information. Video information was not available for four of the hook-status observed hauls since no video was collected from three of hauls and one haul reviewed by video reviewers did have sufficient information to be paired to an observed haul. Video quality was rated high on the majority (80%) of hauls and the F/V LaPorsche had the lowest video quality compare to the other two vessels where 35% of the hauls were rated as "medium" (Table A-7). At-sea observers recorded a total 43,581 individual catch events from 194 paired hauls. At a species group level overall count totals compared well between data collection methods (Table A-8).

Comparison of species-specific count between data collection methods without using Observer visual identification rules allows for an evaluation of video reviewers ability to identify species for visibly

[92] Available at http://www.afsc.noaa.gov/FMA/Manual_pages/MANUAL_pdfs/manual2015.pdf

similar species. Species comparisons were not possible if either the at-sea or video data were absent or for "unidentified" species groups. For example, at-sea counts identified corals to a "Bryozoans/Coral Unidentified" and video counts included species detail for red tree coral that may have been present but not recorded separately in the at-sea counts. The percent agreement between at-sea and video counts was low for a number of species potentially indicating difficulty using video for identification for some species including dover and flathead sole (Figure A-9). Percent agreement was low for a number of skate species including Bering, Alaskan and Aleutian indicating the identification to species level using video is not possible for any of the Bathyraja species (Table A-9; Figure A-10). Percent agreement was high for most rockfish species, however video reviewers recorded several species (redstripe, yellowmouth and yellowtail rockfish) that were not identified by at-sea observer (Table A-10; Figure A-11). Video counts for most invertebrates were low compared to at-sea counts and consequently percent agreement for invertebrates was generally low for most species of invertebrates (Table A-11). These results suggest that video reviewers may miss small invertebrates.

The Wilcox sum rank correlation between of video and at-sea species counts was not significant (W = 1712.5, p-value = 0.4491); thus the null hypothesis of no difference was not rejected. This suggests that the rank sum of species counts between the two data collection methods were similar. A total of 61 species/species groups were identified across all hauls and of these sample sizes were sufficient for 39 species to estimate variance and p-values (Table A-11). However, histograms of p-values from t-tests were highly skewed with greater than expected frequencies of values less than 0.05, which suggests that there are more differences than expected between species-specific obtained by from the two methods and the null hypothesis of no difference was rejected (Figure A-12).

Results from the linear model (lm formula: Observer Count ~Video Count + Image Quality + Video Count:Image) testing the relationship between count information and image quality indicated that image quality had a significant (p=0.038) effect on video counts compared to observer counts. Declining video quality may impacted video counts, especially for some species such as skates (Figures A-13 and A-14) and invertebrates (Figures A-15 and A-16). This suggests that use of lower quality video should be carefully considered before it to estimate species composition for some species (or species groups).

Table A-6 Observer visual identification grouping rules for similar looking species, which were applied across all species recorded in both data sets (at-sea and video counts) before statistical analysis.

Species Identification Grouping Rules

Flatfish
- arrowtooth and Kamchatka flounder (arrowtooth/Kamchatka group)
- northern and southern rock sole (rock sole unidentified group)
- Flathead sole - spot check for petrale sole and Bering flounder

Sculpin
- Bigmouth sculpin
- Irish Lord unidentified
- Myoxocephalus unidentified
- Sculpin unidentified (Cottidae spp.)

Skates
- *Stiff-snout skates (Raja)*
  - Longnose skate
  - Big Skate
- *Soft-snout skates (Bathyraja)*
  - Bathyraja spp

Rockfish
- shortraker and rougheye rockfish (shortraker/rougheye group)
- Shortspine thornyhead - spot check for longspine thornyhead.

Grenadier
- Giant grenadier - spot check for grenadier unidentified.

Crab
- Bairdi and Opilio Tanner crabs (Unidentified Tanner crabs group)
- red, blue and brown king crab (unidentified king crab group)

Others
- tally sample periods, even non-prohibited miscellaneous invertebrates, rocks, and trash
- tally miscellaneous invertebrates to group code or to species as appropriate.

Corals
- Corals on the line must be tallied as coral unidentified (except for sea pens/sea whips).
- Hydrocorals, Stony corals, Gorgonians, Black corals, Soft corals, and Sea pens and sea whips.

Birds
- NMFS requires the crew to retain all seabirds retrieved during an observer's tally period for the purposes of species identification. Remind the rollerman to keep any seabirds during the tally period.

Table A-7 Comparison of the number of hauls, designated image quality and reason for image quality by vessel.

Image Quality Designation	Image Quality Reason	Bold Pursuit	LaPorsche	Magia
High	-	106	37	12
Medium	Dirty Camera(s)	0	3	0
Medium	Glare	3	0	0
Medium	Night Lighting	1	2	0
Medium	No Data Recorded	1	23	0
Medium	Water Spots	2	1	3
Total Number of Hauls		113	66	15

Table A-8 Comparison of video and at-sea species group count for all paired hauls.

Species Group	Video Count	At-Sea Count
Halibut	20422	20446
Sablefish	6138	6145
Shark	4247	4270
Rockfish	3371	3342
Skate	3170	3183
Cod	2534	2482
Flatfish	1227	1246
Ling	601	602
Star	571	583
Invert	260	362
Grenadier	196	201
Coral	40	104

Species Group	Video Count	At-Sea Count
Octopus	76	95
Sculpin	85	84
Ratfish	57	59
Pollock	27	30
Shellfish	10	13
Wolfeel	18	12
Bird	5	5
Salmon	3	3
Unid Fish	26	3
Crab	4	2
Hagfish	2	1

Table A-9 Percent Agreement between video and at-sea count for skate species as recorded by the video reviewer.

Species Group	Common Name	% Agreement
Skate	Skate, Longnose	99.5
Skate	Skate, Big	84.5
Skate	Skate - Stiff Snout Unid.	5.0
Skate	Skate, Aleutian	45.7
Skate	Skate - Soft Snout Unid.	Video Only
Skate	Skate, Alaska	4.4
Skate	Skate, Bering	66.7
Skate	Ray, (Skate) - Unid.	Video Only
Ratfish	Ratfish, Spotted	96.6

Table A-10 Percent Agreement between video and at-sea species count for all rockfish species as recorded by the video reviewer.

Species Group	Common Name	% Agreement
Rockfish	Rockfish - Unid.	Video Only
Rockfish	Rockfish, Black	90.0
Rockfish	Rockfish, Canary	94.4
Rockfish	Rockfish, China	100.0
Rockfish	Rockfish, Dark Unid.	Video Only
Rockfish	Rockfish, Dusky	87.5
Rockfish	Rockfish, Greenstriped	50.0
Rockfish	Rockfish, Quillback	95.9
Rockfish	Rockfish, Red Banded	97.7
Rockfish	Rockfish, Redstripe	Video Only
Rockfish	Rockfish, Rosethorn	50.0
Rockfish	Rockfish, Shortraker/Rougheye	99.3
Rockfish	Rockfish, Silvergray	95.6
Rockfish	Rockfish, Small red Unid.	Video Only
Rockfish	Rockfish, Splitnose	Video Only
Rockfish	Rockfish, Thornyhead Unid.	100.3
Rockfish	Rockfish, Tiger	100.0
Rockfish	Rockfish, Yelloweye	99.6
Rockfish	Rockfish, Yellowmouth	Video Only
Rockfish	Rockfish, Yellowtail	Video Only
Rockfish	Rockfish, Darkblotched	At-Sea Only

Table A-11 Student's t test statistic, p value and estimate from species-specific pairwise comparison between at-sea and video observation of counts.

Common Name	Hauls	statistic	p.value	estimate
Bryozoans/Coral Unid	41	-2.928	0.006	-1.561
Cod, Pacific	125	1.746	0.083	0.384
Flatfish - Unid.	25	-2.333	0.028	-1.840
Flounder, Kam/Arrow Unid.	145	-2.289	0.024	-0.255
Grenadier, (Rattail) - Unid.	4	-1.464	0.239	-1.250
Halibut, Pacific	192	-0.542	0.588	-0.125
Invertebrate - Unid.	83	-2.762	0.007	-2.129
Lingcod	82	-0.191	0.849	-0.012
Octopus - Unid.	36	-2.733	0.010	-0.528
Pollock (Walleye Pollock)	20	-0.497	0.625	-0.150
Ratfish, Spotted	20	-1.453	0.163	-0.100
Rockfish, Black	6	-1.000	0.363	-0.167
Rockfish, Canary	8	0.424	0.685	0.125
Rockfish, Dusky	6	-0.542	0.611	-0.333
Rockfish, Quillback	17	2.219	0.041	0.235
Rockfish, Red Banded	62	-1.508	0.137	-0.226
Rockfish, Shortraker/Rougheye Unid.	48	0.305	0.762	0.063
Rockfish, Silvergray	26	1.690	0.103	0.154
Rockfish, Thornyhead Unid.	52	0.477	0.636	0.058
Rockfish, Yelloweye	76	1.000	0.321	0.053
Sablefish (Black Cod)	117	-0.178	0.859	-0.060
Sculpin, Irish Lord - Unid.	11	1.456	0.176	0.455
Sea Whip, Sea Pen - Unid.	16	1.546	0.143	4.813
Shark, Blue	8	0.683	0.516	0.250
Shark, Pacific Sleeper (Mud)	25	-2.521	0.019	-0.600
Shark, Spiny Dogfish	135	-0.140	0.889	-0.074
Skate - Soft Snout Unid.	97	3.746	0.000	4.175
Skate - Stiff Snout Unid.	45	-3.749	0.001	-8.400
Skate, Big	79	-2.179	0.032	-0.759
Skate, Longnose	179	0.404	0.687	0.067
Sole, Dover	13	4.571	0.001	4.615
Sole, Flathead	7	0.812	0.448	0.429
Sole, Petrale	2	0.000	1.000	0.000
Starfish - Unid.	48	-1.566	0.124	-0.208
Starfish, Basket	9	1.754	0.117	1.111
Starfish, Sunstar	46	-0.503	0.617	-0.130
Turbot, Greenland	4	0.000	1.000	0.000
Wolf-eel	9	2.000	0.081	0.667
Wrymouth Unid.	8	-0.272	0.791	-0.364

Figure A-8 Haul location by trip for each survey vessel with color separating each individual vessel trip.

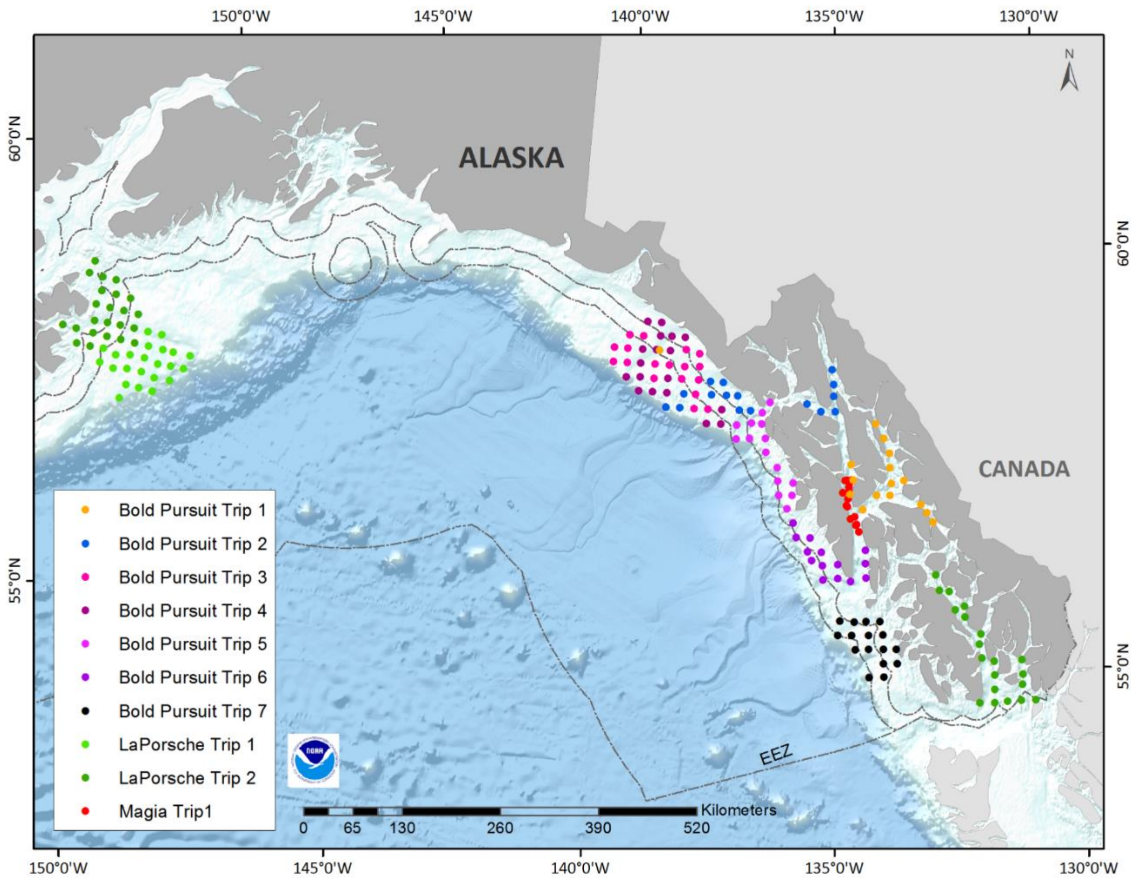


Figure A-9 Box Plots showing the median, 25th and 75th percentiles and the red dot indicating the mean of the distribution of differences between at-sea and video counts for flatfish species.

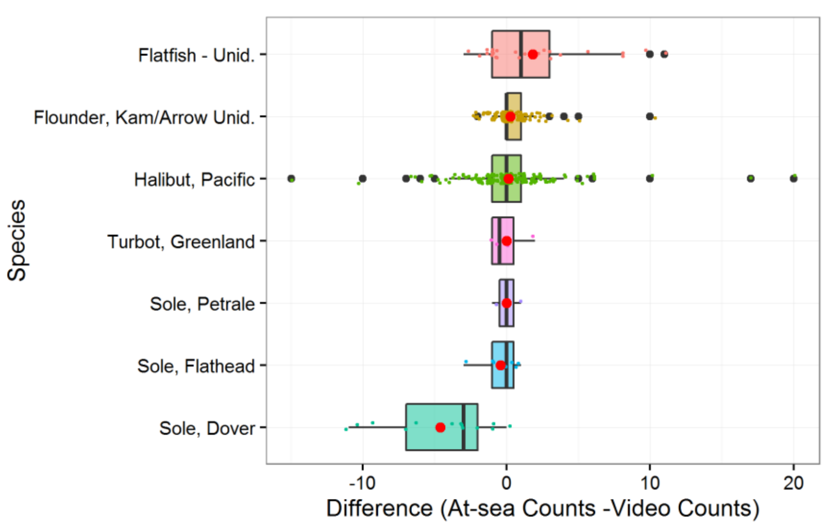


Figure A-10 Box Plots showing the median, 25th and 75th percentiles and the red dot indicating the mean of the distribution of differences between at-sea and video counts for skate species.

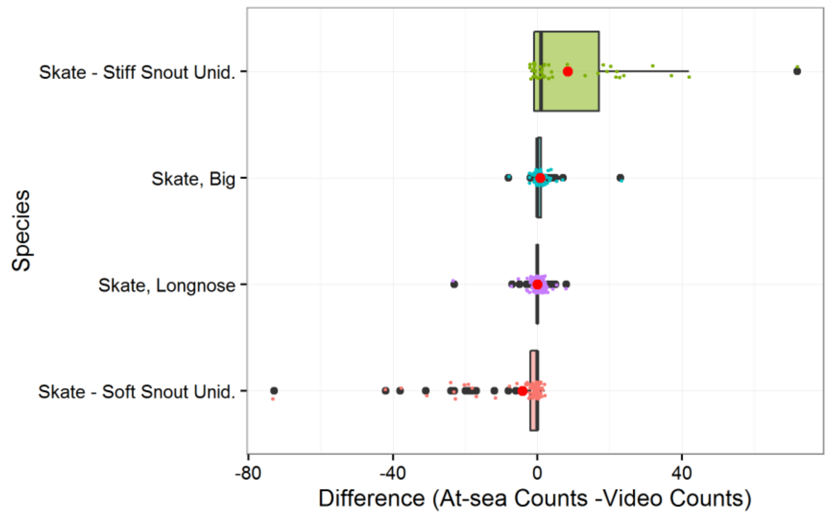


Figure A-11 Box Plots showing the median, 25th and 75th percentiles and the red dot indicating the mean of the distribution of differences between at-sea and video counts for rockfish species.

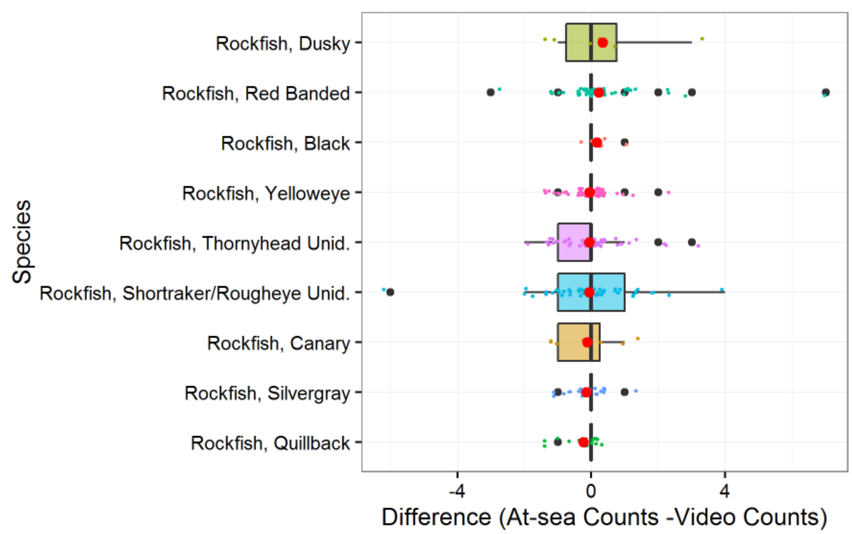


Figure A-12 Distribution of student's t-test probability values for mean differences in at-sea and video counts.

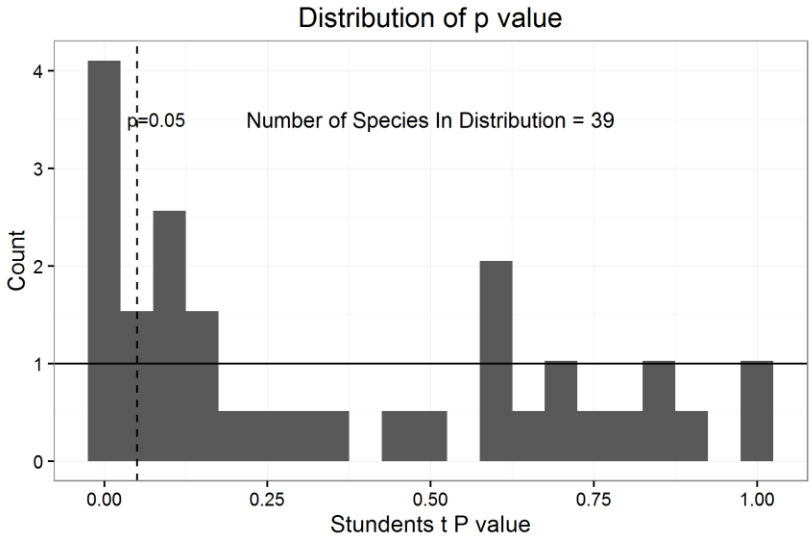


Figure A-13 Linear regression fit to video and at-sea counts for skate species.

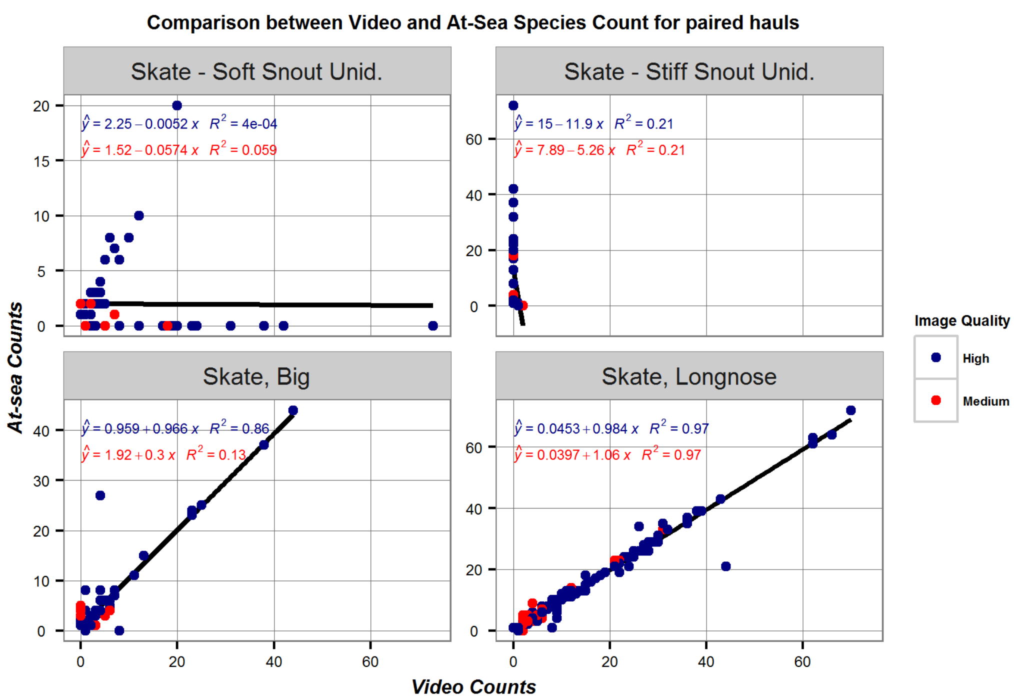


Figure A-14 Plot of percent agreement between at-sea and video counts by haul size for skate species.

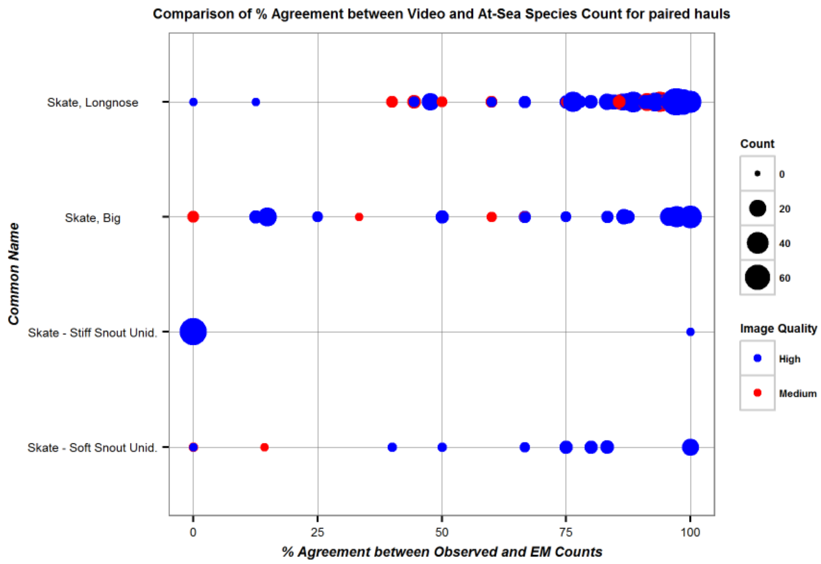


Figure A-15 Comparison of video and at-sea counts by invertebrate species.

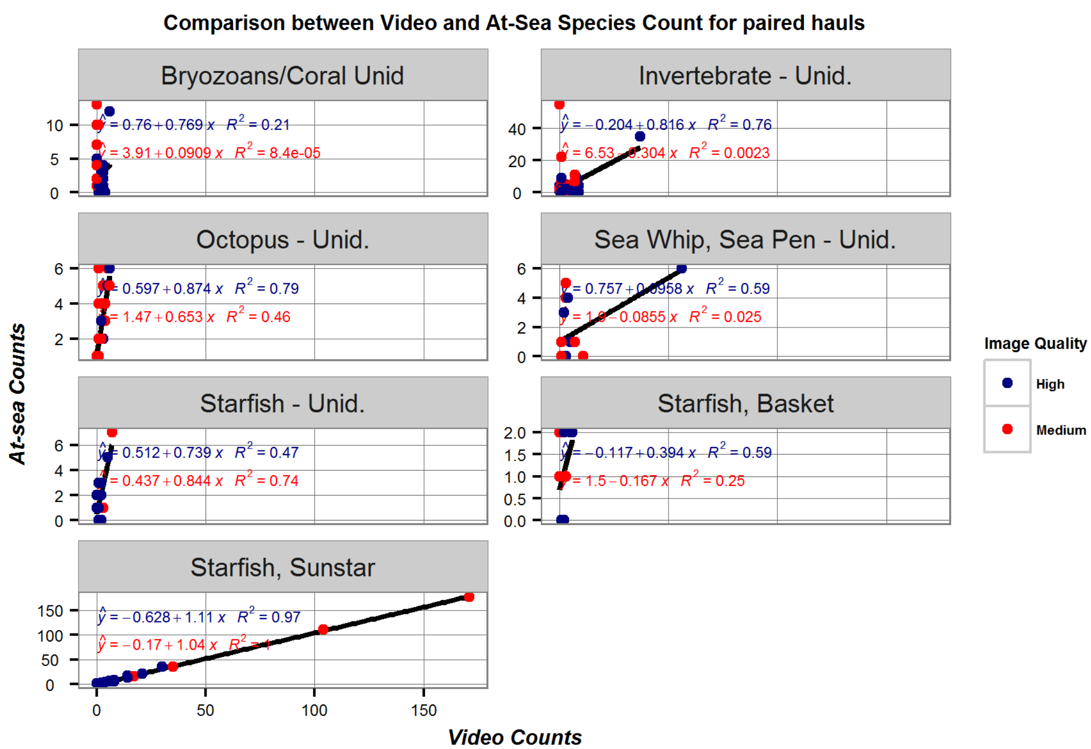


Figure A-16 Plot of percent agreement between at-sea and video counts by haul size for invertebrate species.