DRAFT
Toward Implementation of Electronic Monitoring in Groundfish Fishery Sectors

White Paper

Electronic Monitoring Working Group

June 6, 2014

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1.0 Introduction

In Amendment 16 (A16) to the Northeast Multispecies Fishery Management Plan, electronic monitoring (EM) is discussed for the sector system specifically for monitoring catch and discards and ensuring compliance with reporting. A16 also identified sector operations/monitoring plans as the vehicle for using EM as a tool, however it was noted that EM was not ready for approved use for monitoring. Furthermore, A16 indicated that NMFS would develop guidelines for approved use of EM.

Since 2010, the NEFSC has been conducting a study with Archipelago Marine Research, Ltd. to test the applicability of EM in the groundfish fishery. More recently, NMFS has issued national and regional policy statements committing to implementing electronic technologies in fishery data collection programs and identifying two promising approaches for EM in the groundfish fishery, which the NEFSC incorporated into its project.

To facilitate discussion on NMFS approved use of EM by sectors in sector monitoring plans and to ensure that all appropriate entities were included in that discussion, the New England Fishery Management Council (Council) passed the following motion at its April 2013 meeting:

> *That the Council convene an electronic monitoring working group consisting of 2 current members of the Council, 2 NERO representatives chosen by the Regional Administrator and 2 NEFSC representatives chosen by the Science Director, 2 members of the Groundfish Advisory panel, NOAA General Counsel, a representative from NOAA enforcement and 2 members of the industry.*
>
> *The objective of this working group would be to identify any existing barriers or necessary steps to NMFS approving sector operations plan(s) that rely on electronic monitoring as a primary mechanism to achieve the Council's identified compliance and catch attribution goals for this program (separate from the biological sampling program).*
>
> *The working group will provide a brief progress update at the June [2013] Council meeting and will present a full overview at the September [2013] Council meeting of existing barriers, identified next steps, respective responsibilities of each participating entity and anticipated timelines to implementation of electronic monitoring.*

Since its inception, the Electronic Monitoring Working Group (EMWG) has approached its work with a spirit of collaboration, respect for different perspectives and a goal-oriented approach to addressing the barriers to EM implementation. The following draft report is a summary of the progress made to date by the EMWG, whose efforts remain ongoing.

Regional Progress on Electronic Monitoring to Date

Well before the expansion of groundfish Sectors through the implementation of Amendment 16 (A16), stakeholders raised concerns regarding how to achieve the catch accountability necessary for the new catch shares management system, and how to ensure that participating groundfish vessels would do so successfully. Many industry members stated concerns about the costs, logistics, and safety of high levels of at-sea monitoring coverage, particularly for the smaller vessels in the fishery. For these reasons, some industry groups began exploring and piloting electronic monitoring (EM) technologies to examine if EM as a tool could achieve some of the goals of the catch monitoring program in Sectors, without exclusive reliance on human observers to monitor the fishery at sea.

In 2010, the Northeast Fisheries Science Center began a three-phase study to evaluate operational application of EM in the context of New England groundfish fisheries. Phase I developed region-specific operational and basic data needs; and Phase II focused on improving methodology to address specific issues of weight estimation and species identification. In April, 2013, a summary of the current shared perspective of the Northeast Fisheries Science Center, the Greater Atlantic Regional Office, the Northeast Enforcement Division and NOAA General Counsel on potential uses of electronic (video) monitoring in the region was provided to the Council. Phase III focused on developing and testing on-board methodologies for two models that held promise for incorporation of EM, which were identified in that summary. Much was learned through these collaborative pilot studies and exchanges with managers, service providers and fishermen utilizing EM technology in other fisheries.

However, some stakeholders felt that efforts to move toward NMFS approving the use of EM as a central component of groundfish Sectors catch monitoring plan appeared to be stalled or proceeding too slowly. Many participants in the fishery argued that accelerated progress, toward Sectors having the option to utilize EM as a tool to achieve stated monitoring goals within their sector operations plan, was necessary, especially given the looming transition towards industry-funded monitoring costs for the fishery.

2.0 Approach

The focus of the EMWG is the incorporation of electronic monitoring (EM) in the groundfish sector monitoring program within operations plans. The EMWG proposed an approach to their work that occurs in three components:

1) Identification of barriers to EM implementation,
2) Development of models for EM application, and
3) Summarization of recommendations.

The EMWG developed a tentative timeline and recognized that elements of the first two components may proceed iteratively. The group anticipates updating the Council on progress at forthcoming Council meetings.

The intent of the group is not to create a parallel process or duplicate national efforts but to focus on issues specific to monitoring programs for groundfish sectors. The EMWG recognizes that other EM endeavors are also underway (e.g., National Workshop in January 2014, scoping efforts from NOAA Headquarters led by George Lapointe, National Strategies for implementation of monitoring; GARFO working group on monitoring costs/cost-sharing, NEFSC studies of utility of EM for the Northeast Multispecies Fishery) and aims to link into those processes as appropriate.

The EMWG also recognized that experts (outside of the EMWG) might be asked to provide information, as necessary. The ongoing NEFOP/NEFSC/industry EM projects will be a valuable source of information in addition to EM examples from other regions.

Approach to Work

Component 1: Identification of barriers to EM implementation

- Identify broad categories of barriers: legal, regulatory, operational (logistical/financial), enforcement, and science/biological (assessment-based)
- Identify specific barriers under each category
- Discuss synergies between barriers
- Summarize findings in tables
- Report on findings to the Council

Component 2: Development of monitoring models that incorporate EM for compliance and/or catch attribution

- Develop at least two models of monitoring system that incorporate EM that could be included in a sector operations/monitoring plan
- Use Component 1 tables to inform discussion of barriers
- Discuss necessary steps by barrier category (or groups of barrier categories) to overcome those barriers for each example
- Summarize findings by example
- Report on findings to the Council

Component 3: Summarize recommendations

- Discuss Component 2 findings and develop list of recommendations
- Categorize recommendations by implementation time frame: short or long term
- Synthesize Components 1-3 findings into a white paper
- Provide final report to the Council

3.0 Perspectives on Barriers to Electronic Monitoring Implementation

This section summarizes three perspectives on barriers to EM implementation. The perspective include: industry, analytical, and overview of laws/logistical. These summaries were developed during the initial brainstorming session by the group. These do not necessarily summarize consensus view on the topics, but rather raise awareness of key issues when thinking about barriers to EM implementation.

These summaries provide three general snapshots of different perspectives, and some overlap of the issues is to be expected but all the main issues are not necessarily reflected within one perspective.

Section 4.0 examines cross-cutting issues for more specific EM models, and was informed by the summaries in this more generalized section.

Industry Perspective

Cost

There is the big unknown of how much EM would cost per vessel. If it is going to be more expensive than a human ASM, it is hard to believe that any sector would consider it as an option.

Understanding that there are various factors that go into to determining the cost of the system/program, there should still be some information that is readily available to start getting an idea of the costs (such as equipment costs & installation costs).

Obviously, the coverage rate will determine review costs, but there should be at least some guidelines to aid in estimating, for example, how much it costs to review an individual trip.

Privacy, Ownership, and Confidentiality

Some fishermen will refuse to put a camera on their vessel. So whatever plan is developed, it must allow for a sector using a combination of EM and human ASMs.

Who will own the data/camera footage if the industry is paying for monitoring? Does the agency maintain 100% ownership or will the industry be part owners? Likewise, clear confidentiality standards should be developed for this type of data/footage.

What happens when a vessel is participating outside of the groundfish fishery (scallop, squid, fluke, etc.)? Does the system stay on and record these events as well and if so, what happens to this information – is it deleted, saved but not used or used to capture effort in other fisheries?

Operational and Functionality

There are concerns with the reliability of the system. Past pilot projects have shown that capturing 100% of activity is impossible due to various factors (intended and unintended) leading to the potential shutdown of the system while at sea. If the system shuts down and cannot be restarted, will the vessel have to return to port? What are the legal implications if 100% of the trips are not captured?

Small vessels may not have adequate power to supply the system. Technical specifications need to be provided to the industry so that they can determine if EM is even feasible for their sector/vessels.

There are concerns that the original pilot project in the NE region was limited in scope. There is a need to know that EM can capture all relevant data needed for sector ACE monitoring before a sector would consider it because the industry should not have to pay for something that is not fully operational or have to pay for further refinement of the system.

Who will be trained for installing, servicing, retrieving and reviewing of EM data? Is there a provider in the Northeast Region that can do EM or will we have to rely on Archipelago Marine?

Is there enough equipment to outfit sectors if they choose this as an option? Sector membership varies in the number of active members with approximately 15-20 active members per sector (for example NEFS 5 had 26 active members in FY 2013.)

The timeline from when a sector submits its operation plan (approximately in September) to when they are approved (approximately in April) is quite a long time frame to wait to determine if the agency will approve EM use in the plan and to get started installing the systems. If EM is included in an operations plan, sooner notification of approval or not on this aspect is necessary.

Analytic Perspective

Objective and Perspective

The objective of a catch monitoring system is to quantify total removals (landings plus discard) by a fishery, over all fisheries. For most assessment analyses, removals are ultimately characterized as stock number at age, to generate estimates of stock size and fishing mortality rates. For management applications, removals are characterized as stock weight for comparison with Annual Catch Limits, and Fishery Management Plan- specific features (e.g., allocations such as sector Annual Catch Entitlements or additional monitoring objectives for management purposes. Typically, electronic (video) monitoring (EM) has been associated with quantification of the discarded component of the catch.

Required Characteristics and Resolution of Raw Data to Characterize Discards for Stock Assessment

- Species identification
- Statistical area to derive stock area
- Gear type/mesh size
- Calendar quarter(month)
- Weight
- Length, age composition

Species identification: Removals must be identified accurately at the species level, e.g., thorny skate, rosette skate, little skate, winter skate; American shad, alewife, blueback herring instead of "skates" or "river herring." Non-target species managed under different FMPs should be included, to account for removals over all fisheries (e.g., yellowtail flounder in the sea scallop fishery; haddock in the Atlantic herring fishery; monkfish, skates and spiny dogfish in the groundfish fishery). Data on non-target species is also consistent with movement toward an ecosystem approach to fisheries management, as well.

Statistical area: Removals must be identified by stock area, a geographic sub-region of total species distribution. Typically stock areas are defined as aggregations of three-digit statistical reporting areas. Thus, data will need to be ascribed to spatial resolution of a three-digit statistical reporting area, because the set of statistical reporting areas differs from stock to stock.

Gear type and mesh size: Because size composition of catch (kept and discard) varies with gear type and mesh size, gear information should be adequate to differentiate between gear types with different selectivity patterns.

Calendar quarter (month): Especially if smaller, younger individuals are encountered, observations should allow at least quarterly resolution to track cohorts during their most rapid phases of growth. The fishery may shift spatially or temporally within the year, exploiting different components of the stock over time. Discard and retention patterns may change as quotas for individual stocks are approached or met.

Weight: Accurate weight estimates are required to implement ratio estimators of discard, which are based on the ratio of weight of a species discarded to weight of all species kept. Likewise, accurate weight estimates are required if input directly into discard accounting (see census method below) and auditing.

Length and age composition: Length samples or subsamples are required in order to generate numbers removed at length; age samples are required in order to generate numbers removed at age. Because size selectivity will vary depending on gear type, sampling should be stratified by gear type and mesh size. (Age samples currently are obtained under Standardized Bycatch Reporting Methodology (SBRM)-observed trips or research survey sources. Length samples in addition to those collected under SBRM sampling are often required or desirable: SBRM sampling is designed to meet precision targets for total discard weight, not necessarily discard at length.)

Examples of Raw Data Collection Challenges

Species identification

- Full retention[1]: Species must be in identifiable condition on reaching the dock.
- Audit[2]: Captain/vessel crew must be capable of accurately distinguishing individual species. This may involve supplementary training and certification for data accuracy, especially for species currently commonly aggregated into groups.

Stock area

- Full retention: Removals must be separated by statistical area, e.g., discarded haddock from Georges Bank stock area must be separated from discarded haddock from Gulf of Maine stock area. Captain/vessel crew must be capable of accurately distinguishing statistical areas such that different species can be properly assigned to stock area. This may involve supplementary training and certification for data accuracy. Alternatively, landings and discards could be pro-rated to statistical area using vessel trip report (VTR) data, in the same way that dealer landings data currently are attributed to statistical area.
- Audit: Tow-by-tow data would be required for trips that fished in more than one stock area during the trip. (The definition of stock areas differs from species to species).

Gear type/mesh size

- Full retention: If changes in gear type were made during the trip, removals must further be separated into different gear/mesh strata.
- Audit: VTR information must adequately document gear/mesh used for each trip component, for trips that fished with more than one gear type during the trip.

In summary, data must be collected so that each combination of species – stock area- gear type – kept/discarded disposal type encountered during the trip can be identified. (Each combination is called a stratum.) For full retention applications, VTR information could be used to partition catch by area and gear type, consistent with the current procedures used to partition landings from dealer data.

Analytic Challenges for Stock Assessment and Quota Monitoring

Combining ASM and EM data

The At-Sea Monitor (ASM) program currently provides significant improvements in precision of discard estimates. ASMs in the New England groundfish fishery are deployed in strata that are consistent with those in the Standard Bycatch Reporting Methodology (SBRM) program, key data collection protocols are similar, and discard ratios and length frequency information have generally been shown to be indistinguishable between the two collection programs. This consistency enables incorporation of ASM data into estimates of discards to substantially improve precision of discard estimates. In the case of Gulf

[1] Full retention: EM would be used to monitor compliance with a full retention requirement, which would be accompanied by dockside monitoring.

[2] Audit: Initial quota accounting would be based on industry reports, e.g., electronic vessel trip reports. EM records would be sampled to validate the vessel trip report and disincentives would be structured to motivate vessel operator to fill out the forms correctly and fully.

of Maine haddock, for example, coefficients of variation (CVs) for discard estimates in 2009 (before the implementation of ASMs) were 0.81, 0.34 and 0.27 for longline, trawl and gillnet fleets, respectively. In 2013, the combination of NEFOP and ASM data led to CVs of 0.28, 0.14 and 0.10 for the three gear types, respectively. We would expect precision of discard rates for non-target species to similarly have improved with increased sampling through ASMs.

The statistical challenges of combining data from two different collection methods (SBRM/ASM vs. EM) have yet to be met. A comparison of discard ratios and length frequency information obtained from SBRM/ASM and EM programs will be required to determine if estimates from EM can replace those from ASM, for example.

If EM cannot replace ASM, lower scientific precision will affect stock assessments and management advice. The cost of lowered precision on annual catch limits should be at least qualitatively included in total cost estimates. Management strategy evaluations would quantitatively evaluate these costs.

Execution in the context of quota monitoring and potentially stock assessment

The current method of quantifying discard to monitor sector Annual Catch Entitlement is first to estimate a sector-specific discard rate by stock area, gear type/mesh size, and season for each stock. The total discarded weight of the single stock in the stratum is estimated as the product of the ratio of discard single stock weight to kept (landed) weight of all kept species from observed trips in the stratum, and the total landed weight of all kept species from all trips in the stratum. Those estimates are then summed over all strata to obtain discards by stock. This approach is based on the assumption that the discard rates of observed trips are similar to discard rates of unobserved trips in the same stratum.

How would EM data be incorporated into this process? How would auditing of EM data affect the process? Two example l methods are included below, one associated with sector discard rates, and one associated with individual vessel discard rates

1.) EM as observer proxy for sector discard rates – A.) When a trip on a vessel with EM is selected to carry an observer, the vessel instead operates the EM system either in full-retention or audit mode to provide data to generate a discard/kept (all) ratio for the trip. That ratio is applied to that specific trip and is then also included in the sector stratum discard estimation process. If subsequent audit sampling of the video data indicates that either not all catch was retained or that the video of discards is significantly inconsistent with VTR records, then the trip is removed from the sector stratum discard estimate, the sector discard rate is re-estimated, and the discard from the trip is estimated using the sector discard rate. (Vessel also may be barred from future use of EM or incur higher audit rates.) This approach is not preferred because it may be prone to bias. B.) The vessel operates the EM system either in full-retention or audit mode on all trips. A subset of trips from all vessels using EM is randomly selected for processing, and used to generate discard/kept (all) ratios. Ratios are applied to respective specific trips and included in the sector stratum discard estimation process.

2.) EM as census for individual vessel discard rates – A vessel with EM operates the EM system on all trips. A discard census is generated for that that vessel for that trip, and every trip on that vessel. The vessel could still be selected for NEFOP/SBRM coverage through the PTNS system. Otherwise, vessel trips would not contribute to the sector stratum discard estimate process, because trips are not randomly selected. The vessel discard census (total) is added to the rest of the final sector total. If subsequent auditing indicates that either not all catch was retained or that the video of discards is significantly inconsistent with VTR records, then the vessel discard census is removed from the sector total, and the vessel's discards instead are estimated using the sector stratum discard estimator. (Vessel may also be barred from future use of EM or incur higher audit rates.)

Other Related Questions

How will the timing of the delivery of EM information affect the ability to estimate total catch? This includes swings in the discard rate as there will be lags in determination of compliance and changes in the discard rate as data from trips determined to be non-compliant are removed from the estimates.
Will the system be used to assist in the quantification of total catch or only the discarded portion of the catch? This will potentially dictate additional consideration of data checks and requirements.

How will cost-sharing definitions apply (identified under "Legal/logistical perspective")? How many participants are expected? How much infrastructure will be required to support and/or oversee potential additional new data streams? How will that be funded?

Overview of Laws/Logistical Perspective

The following is a list of potential legal and/or logistical barriers to implementation of electronic monitoring in New England fisheries. This list is based on a review of NOAA EM White Papers, NOAA's Discussion Draft on EM/ER Guidance and Best Practices, the National Marine Fisheries Service Policy on Electronic Technologies, and various Agency communications to the NEFMC. It is not intended to be a comprehensive review of potential barriers and should be considered a work in progress.

According to existing FMPs, the primary goal of observers and at-sea monitors for sector monitoring is to verify area fished, catch, and discards by species and gear type. Electronic monitoring may be used in place of actual observers or at sea monitors *if the technology is deemed sufficient for a specific trip based on gear type and area fished.* (FW 48)

Has not been approved by NMFS as an accepted monitoring tool

The recently released Electronic Monitoring White Paper on Existing Technologies noted that "despite numerous past and ongoing video monitoring pilot projects there are currently no operational video monitoring programs in NMFS-managed fisheries where data extracted from video are used for science and management purposes". (EMWP-ET)

Additionally, in a recent letter to the NEFMC regarding implementation of Framework 51, Regional Administrator John Bullard noted that "electronic monitoring has not yet been sufficiently developed to provide a reasonable substitute" for human observers. And that NMFS "understands some are hopeful that electronic monitoring may be a suitable monitoring alternative for consideration at some point in FY 2014. However, we do not expect electronic monitoring and associated data handling protocols to be available any sooner than FY 2015.

In order for electronic monitoring to be incorporated into regional fishery management plans, NMFS must approve it as an acceptable complement to monitoring plans designed around human observers.

Catch Accounting and Compliance Monitoring

Electronic monitoring systems are being considered as a complement to human observer based monitoring programs. A key aspect of these programs is the ability to utilize collected data for catch accounting and compliance monitoring. To date, concerns have been raised regarding the ability of video-based monitoring systems to differentiate between various species (particularly flatfish and skates) and to estimate weights of discarded species.

Data Confidentiality

Another consideration in the approval of electronic monitoring systems is the confidential nature of data collected. According the Magnuson Stevens Act "any information submitted to the Secretary, a state fishery management agency, or a marine fisheries commission by any person in compliance with the requirement if this Act, shall be confidential and shall not be disclosed, except…Observer data is considered confidential, observer information does include information collected by electronic systems".

The issue of data confidentiality is a key issue for NOAA and fishery participants. As noted above, NOAA commissioned six white papers on EM/ER implementation. While five of those white papers were released early in 2013, the legal/data confidentiality white paper has yet to be released. Moreover, NOAA in the process of updating existing rules and regulations regarding data confidentiality. It is not know at this time when the White Paper on legal/data confidentiality issues and the proposed rule will be released, but it is assumed that data collected by electronic monitoring systems will be addressed when they are.

Data transmission and chain of custody (security vs. privacy)

Video data is typically stored on an onboard hard drive computer and collected by technicians that subsequently transmit the data to the Agency or third party reviewers. Appropriate systems must be established to ensure a proper chain of custody and prevent tampering. Data must have a clear and secure chain of custody from the collection point to the final user to confirm the authenticity and reliability of the data for prosecution and for evidentiary needs (EM/ER Guidance and Best Practices)

Long-term ownership of data and disposition of video imagery

It is assumed that data collected through EM systems will need to be archived for enforcement, management or regulatory purposes. Records collected by the Agency are subject to records retention requirements, and appropriate steps must be taken to ensure the security, accessibility, and viability of data (EM/ER Guidelines and Best Practices)

Short-term concerns include sufficient hard drive space on board vessel. Long-term concerns include cost of storage and potential loss of data. Data should be kept for a minimum of five years (civil statute of limitations) for enforcement purposes, and possibly longer for science and management needs (EM/ER Guidelines and Best Practices). Often times data collected for fisheries management is required to be stored, archived, and accessible for further review and/or used in the prosecution of violations, potentially requiring a significant investment in data storage infrastructure (up to 5 years minimum).

Law Enforcement

Data and other information collected by human observers have been used in prosecution cases in the past. Questions have been raised regarding image quality and the ability of video footage to meet evidentiary standards. Questions have also been raised regarding whether video footage can be used for prosecuting non-fishing violations, i.e., one fisherman assaulting another, workers comp claims, etc.

Full retention

Full retention or maximized retention approaches in FMPs have been recognized as a potentially viable application for video technology. Under these approaches, information on species composition and weights is collected by dockside monitors and/or dealers and cameras are used to ensure no discarding at sea is occurring. Full retention approaches have been considered by the NEFMC (FW-51) and were specifically called out in NOAA's Policy on Electronic Technologies. Legal/regulatory changes needed to implement such an approach include changes to minimum fish sizes, trip limits, and etc.

Cost-sharing

As industry groups contemplate design and implementation of monitoring programs, whether with human observers or video technology, some have considered the possibility of cost-sharing with the Agency to pay for these services. In fact, cost sharing for observer coverage was approved by the NEFMC in Amendment 5 Herring FMP, but disapproved by NMFS. In its' September 20, 2013 letter to the NEFMC, NMFS stated that under existing law, NMFS and industry cannot share responsibility for observer monitoring costs in the regulations, noting that sharing costs between the Agency and industry is prohibited by the Antideficiency Act.

GARFO has created a Working Group to explore the legal issues surrounding industry-funded observer coverage and has identified a potential administrative mechanism to allow for industry funding for observer monitoring costs. It is assumed this mechanism would be applicable for cost sharing for electronic monitoring technologies as well.

Agency cost perspectives

As industry is concerned about the costs of electronic monitoring that they will have to bear, NMFS is concerned about how to pay for electronic monitoring costs that will be borne by the agency such as agency staff and infrastructure, possible agency funding of 3rd party providers. Other agency cost concerns include (1) the cost of maintaining electronic monitoring and human observers systems if vessels are given a choice if the systems are run concurrently, (2) funding and staffing for video review, (3) funding and staffing for EM system upkeep and data retrieval, and (4) video storage costs.

Other Laws

In addition to the issues raised above, the requirement of several other federal laws must also be considered. These laws include, but are not limited to: Endangered Species Act, the Marine Mammal Protection Act, the Data Quality Act, the Paperwork Reduction Action, the Freedom of Information Act, the National Environmental Policy Act, and the Privacy Act.

4.0 Models

In this section, two specific models (maximized retention and audit of self-reported data) are examined from the different barrier perspectives: legal, regulatory, operational (logistical/financial), enforcement, and science/biological (assessment-based). The information provided is within this sections is a work in progress and is the product of group discussions that remains ongoing.

4.1 Model 1: Maximized Retention

4.1.1 Model Overview

In this model, EM is used to verify that species that are required to be retained are not discarded so that primary accounting for species of interest occurs at the dock from dealer reports and dockside monitoring, rather than at sea. For this program to be successful the purpose for the program and roles of all user groups must be clear, including that of the third party provider and data custodian. The dockside component needs to be integrated into the program. The treatment of video information for enforcement purposes needs to be outlined clearly.

Participation

Amendment 16 allows a sector to propose a monitoring program to monitor its landings and discards, which may include using EM. Under this voluntary model, an individual sector may choose to incorporate EM into its monitoring program, while another sector may choose to continue to use at-sea monitors. A sector that elects to use EM may only require certain gear types in the sector to use EM, while other gear types continue to be monitored with at-sea monitors. Gear types may include handgear, longline, fish pots, gillnets, and otter trawl. Vessels using EM would be observed on 100% of sector trips. Trips on which EM is used could be restricted to single area or include multi-area trips.

Onboard System Set-up

In general, the EM system set-up on board the vessel consists of a configuration of cameras that provide 1) a wide-angle view of the deck to monitor for discards outside the control point (analog camera); 2) a view of catch being brought on board; and 3) a view of discards at the control point (e.g., of discard chute) (digital camera). Hydraulic or motion sensors are used to trigger the video recording when fishing gear is engaged and to monitor the presence/absence of fishing activity. A GPS records the location of fishing events. This set-up and catch handling requirements are typically documented in a vessel's individualized Vessel Monitoring Plan.

Catch Handling

Under current regulations sectors are required to retain all legal-sized fish of allocated ACE stocks. In this maximized retention model, additional species are retained in order to reduce the amount of video review that is necessary. The burden of validation is instead at the dock through dealer reports and dockside monitoring. This may be especially desirable for fish species that are difficult or impossible to differentiate on video (e.g., red and white hake, some flounders) and would otherwise require extensive, detailed review. However, it may not be possible or desirable to retain all species for management or operational reasons. Sector vessels may not be able to land species they don't have a permit for or that are in excess of possession limits under that species' FMP. Vessel operators may not want to retain large amounts of dogfish or skates because there is not enough room on the vessel or because the weight could

present safety concerns. There may be concerns about increased mortality of juvenile groundfish or other species if all catch is retained.

Depending on these considerations, there are a few possible scenarios:

1. All species are retained, except for large pelagics and protected species **OR**
2. Only groundfish species are retained **OR**
3. Only allocated species are retained.

Under any scenario, sorting and discarding would occur in camera view only and discards would be done at a control point.

Supporting Requirements

If catch handling rules require that some species be retained and disposed of, but not sold, it may be necessary to have a dockside monitoring component to document these dockside discards that would not otherwise we verified by the dealer or video. Trip start and end hails or other declaration may be necessary to facilitate retrieval and replacement of the hard drive after the trip and/or dockside monitoring. Vessel trip reports/logbooks would be used for comparison with video. Haul-level logbook reporting may be necessary to allow for a single haul to be selected for initial comparison, rather than an entire trip.

Data Review

Some individual hauls or trips would be randomly selected for review, depending on the objectives of the video review. If the reviewer must verify the species discarded, a haul-level review and comparison with logbooks may be necessary. If the reviewer must only verify that no fish were discarded, an accelerated review of an entire trip may be sufficient, or some combination of haul and trip-level review. The appropriate level of video review would need to be determined. In general, if an illegal discarding event is detected, then the entire trip's data is reviewed. The comparison may be based on piece counts, weight estimates, or presence/absence of discards. The NEFSC has tested methods to estimate weight of discards through video review and compared these estimates to vessel-reported weights with mixed results. It may not be reasonable to expect a vessel operator to match video-generated weight estimates. But, for the same reason, piece counts may not be robust comparison. If the trip fails the secondary review, the logbook may not be used for catch accounting. It is not clear what would be used in its place – EM-generated estimates? It is also not clear to what extent these estimates would be required to be held to the 30-percent CV performance standard for at-sea monitoring.

4.1.2 Barriers and Potential Solutions

Barriers identified here are a sample rather than a complete listing, and are not necessarily the most problematic or top priority to address.

4.1.2.1 Legal

Barriers: Legal barriers that were identified included data confidentiality/liability/ownership, multiple jurisdictions, and liability/data as evidence.

Solutions: Data collected and reviewed by a third-party, but not submitted to the government might not be considered a government record under certain conditions, though data submitted to the government would be. For government records, compliance with data storage and record disposal requirements and their attendant costs would need to be addressed. Federal Records Act requirements and evidentiary needs for enforcement will govern how long records must be retained and when they may be disposed of. Most records are not required to be retained by the government in perpetuity. Civil enforcement under the Magnuson-Stevens Act has a five year statute of limitations, and Federal Records Act time limits vary. The issue of multiple jurisdictions could be addressed by engaging state agencies (e.g. ASMFC) early in the process, especially if this may require changes in the state's regulations. The development of standards or exemptions may help engagement of all agencies. To address liability issues caused by using the data as evidence, standards for video auditors for reporting violations/illegal activity should be established and could use NEFOP/ASM requirements as a guideline.

4.1.2.2 Regulatory

Barriers: Regulatory barriers that were identified included safety considerations (NS9), coverage level (A16 states that not 100% at sea coverage sectors), and fish sizes (minimum). Non-allocated stocks remain a barrier for EM; however, a potential solution could be to allocate them.

Solutions: More work is needed to fully address the less than 100% at sea coverage established in A16 but this could be addressed on a sector by sector basis. Minimum fish sizes could be removed or exemptions to minimum fish size requirements could be developed for vessels operating with EM. Sector exemptions could be done but not necessarily through Sector Operations Plan.

4.1.2.3 Operational (logistical/financial)

Barriers: Operational barriers that were identified included data storage (and associated costs), hardware (system failures, VMS interference), and accurate ACE quota monitoring. Non-allocated stocks remain a barrier for EM, as management relies on zero retention. In addition, vessel power may be an issue with smaller sized vessels.

Solutions: Cost reduction strategies could include system auditing at reduced cost (as opposed to 100% review on a regular basis) and a tiered approach to paying for costs based on performance (i.e., lower costs on an individual basis for adhering to agreed upon performance standards), however, this might perform better for fish counts rather than weight. A major barrier remains the timing of information and availability; data auditing time has implications at multiple levels - assessments, catch reporting, enforcement, etc. In the case of system failure, a clear protocol needs to be established for effective treatment of these occurrences. Further development on the placement of cameras for reviewer efficiency, and crew efficiency should be conducted. A benefit to 100% dockside monitoring/EM coverage would be improved estimation of total catch, presuming all assumptions above could be met. .

4.1.2.4 Enforcement

Barriers: To effectively support fisheries management, regulations implementing EM technical standards and EM reporting requirements must be enforceable. Three broad barriers were identified to effectively enforcing EM technical standards and EM reporting requirements: (1) Ensuring data gathered from EM technologies can be used as evidence in an enforcement proceeding; (2) Promoting voluntary compliance with EM technical standards and EM reporting requirements; and (3) Ensuring appropriate deterrents are in place when compliance with EM technical standards and EM reporting requirements is not achieved.

Solutions: Clear performance standard are necessary to ensure data gathered from EM technologies can be used to enforce EM technical standards and associated EM reporting requirements. These performance standards should ensure that:

(a)Original video data is available to NOAA OLE and GCES;
(a)The process used to collect, catalogue, and review video data is documented precisely to ensure a strong chain of custody;
(b) Video data is tamper evident;
(d) Video data clearly captures all relevant fishing activity;
(e)Any enhancement to video data occurs on a copy;
(f) Any video enhancement techniques and any techniques used to calculate or discern additional data from the raw video data must be scientifically reliable.

Promoting voluntary compliance with EM technical standards and reporting requirements will be critical to the successful implementation of EM as a sector monitoring tool. The following strategies may help to promote compliance and deter violations:

(a)Additional compliance assistance should be provided to vessels during the initial period of EM implementation.
(b) Self-enforcing mechanisms exist within groundfish sectors and should be utilized to promote voluntary compliance with EM technical standards and reporting requirements.
(c) If a vessel violates EM technical standards and reporting requirements and it prevents the flow of timely and accurate data to NOAA, a vessel's EM data should be subject to further review. If third party EM providers are utilized by sectors to synthesize EM data and report to NOAA, these entities should be required to initiate a more thorough review of EM data when agreed upon performance standards are not met. Allowing a third party provider to charge a sector or individual vessel for the cost of any additional review would promote compliance.
(d) Third party EM providers should be accountable to NOAA for the reports they provide, just as vessel owners and operators are. To the extent authorized by law, third party providers should be subject to appropriate enforcement actions if performance standards are not met.
(e) Third party EM provides should receive training on when to notify law enforcement of potential violations.

4.1.2.5 Science/biological (assessment-based)

Barriers: Science/biological barriers that were identified included non-allocated groundfish stocks, species identification of discards, and treatment of unmarketable fish.

Solutions: Clear guidelines are necessary for handling of non-allocated stocks, e.g. wolffish and windowpane AMs are tied to weight of catch. A potential solution could involve the combination of approaches (maximum retention and audit), e.g., treatment of skates in GF industry/NEFOP EM study. Discards could be counted as individuals with a sub-sample providing a weight estimate on a modified VTR log. On-deck operations would need to be modified with handling protocols, fish chutes, (skates, flounders, hakes difficult), holding up fish to camera to improve species identification of discards. Catch could be sorted by species to validate identification. For species such as hakes and flounders, where distinguishing between species is difficult, full retention could be implemented. The training required for auditors to identify species characteristics on video recordings is different than for at-sea observers who observe the fish directly. Likewise, creating visual markers of species characteristics for the video recording could make auditing more efficient, e.g., data quality standards requiring two primary identification characteristics for identification of fish via video. For currently unmarketable fish, new markets could be developed. If markets cannot be developed, investigation into the feasibility of protocols

for unloading at sea on a subsequent trip may be necessary The NEFSC study provides options for disposal.

4.1.2.6 Additional barriers

Attribution of discards to appropriate stock/species may be problematic without timely and accurate VTR data or complex catch handling and storage procedures. Inputs to the discard to kept ratio will change if only discards are quantified at sea and kept at the dock. Additional protocols are required for estimating weight of catch; presence/absence of species is less problematic. A length/weight regression key could be used to estimate length for a relative size. Other potential barriers include changes in mortality, assumptions for mortality rate in assessments and improved selectivity, i.e., mortality rates of previously discarded fish will now increase to 100% in assessments, but selectivity will become less problematic in terms of determining discard rates

- Solutions: haul by haul reporting using eVTR
- Fishing in a single statistical area
- Linking with VMS to identify fishing activity
- EM technology can be programed for haul by haul recording
- Landings already in VTRs
- Fish attributed to stock area by video

4.2 Model 2: Audit of Self-Reported Data

4.2.1 Model Overview

In this model, EM is used to verify the piece counts or weights of species reported by the vessel operator in a logbook.

Participation

As in the Maximized Retention model described in Section 4.1.1, all or some vessels in interested sectors may be monitored using EM, based on gear type or area fished. Other sectors/vessels would continue to use at-sea monitors. Gear types used may include handgear, longline, gillnets, fish pots, and otter trawls. Vessels using EM would be observed on 100% of sector trips. Trips on which EM is used could be restricted to single area or include multi-area trips.

Onboard System Set-up:

In general, the EM system set-up on board the vessel consists of a configuration of cameras that provide 1) a wide-angle view of the deck to monitor for discards outside the control point (analog),; 2) a view of catch being brought on board; and 3) a view of discards at the control point (e.g., of discard chute) (digital). Hydraulic or motion sensors are used to trigger the video recording when fishing gear is engaged and to monitor the presence/absence of fishing activity. A GPS records the location of fishing events. This set-up and catch handling requirements is documented in a vessel's individualized Vessel Monitoring Plan.

Catch Handling

This model assumes that status quo possession limits remain the same. Allocated stocks of legal size are retained, non-groundfish species are retained under trip limits or discarded, sub-legal size fish are discarded. Sorting and discarding occurs in camera view only and discards are done at the control point.

Supporting Requirements

Trip start or end hails or other declaration may be necessary to facilitate retrieval and replacement of the hard drive after the trip. Discards would be recorded on a vessel trip report/logbook for comparison with the video. Haul-level logbook reporting may be necessary to allow for a single haul to be selected for comparison with EM, rather than an entire trip and if trips occur in multiple statistical areas.

Data Review

A random percentage of hauls from an individual trip would be randomly selected for review. The appropriate level of video review would need to be determined. Reviewers would record piece counts or calculated weights for discarded fish and compare these to the vessel logbook at the haul-level. Comparisons could be made for only allocated stocks or species of interest, or for all discards. Matched weights may provide greater confidence in the validation method and the catch estimates. However, the NEFSC has tested methods to estimate weight of discards through video review and compared these estimates to vessel-reported weights with mixed results. It may not be reasonable to expect a vessel operator to match video-generated weight estimates. But, for the same reason, piece counts may not be robust comparison. If the trip fails the secondary review, the logbook may not be used for catch accounting. It is not clear what would be used in its place – EM-generated estimates? It is also not clear to what extent these estimates would be required to be held to the 30-percent CV performance standard

for at-sea monitoring. If the vessel's reported weights/piece counts are outside some acceptable tolerance level from the EM-generated weight/counts, the entire trip's data is reviewed. The acceptable tolerance level would also have to be determined. If the trip fails the secondary review, the logbook may not be used for catch accounting. It is not clear what would be used in its place – EM-generated estimates? It is also not clear to what extent these estimates would be required to be held to the 30-percent CV performance standard for at-sea monitoring.

4.2.2 Barriers and Potential Solutions

In most cases, the barriers and solutions discussed for Model 1 apply to Model 2. Here, only additional barriers and solutions specific to Model 2 are further examined.

4.2.2.1 Legal

Barrier: A legal barrier was identified was cost-sharing and raises the same issues about cost-sharing as mentioned in section 3.0 above.

Solution: Costs could be delineated by program, e.g., VMS. This could be under the authority of the sector manager.

4.2.2.2 Regulatory

Barriers: Three regulatory barriers identified were the need for Council action, treatment of EM trip, and CV requirement/random coverage.

Solutions: If approved by NOAA General Counsel, this model could be implemented in a sector operations plan instead of requiring Council action. Industry and Council staff could identify consequences of poor performance or reporting. To allow for industry to adjust to EM, a 1 year compliance assistance period could be allowed until penalties would take effect. A transition period could also be utilized to allow for incremental improvements on performance. Enforcement measures could be taken to improve compliance in advance. All vessels in sector (or all vessels using a gear type) could be required to adopt EM. The discard rate could be treated on an individual basis. The EM coverage rate could be lowered to meet the minimum CV requirement. The auditing system could be designed to create a randomized process.

4.2.2.3 Operational (logistical/financial)

Barriers: Operational barriers that were identified include need for haul level reporting for trips that fished in more than one statistical area during a trip, additional time on deck, fish shorting/counting (i.e., volume of discards). These are in addition to the previous barriers, including problematic species identification and difficulty in estimating weight from fish lengths.

Solutions: To reduce impacts of trip level reporting, changes to VTRs could be made to allow haul by haul reporting and video reviews with captains could be conducted. Haul by haul VTR reporting would necessitate the use of electronic VTRs. Aspects of study fleet data collection methodology could be adopted. The transition period would allow for improved self- reporting as users become more familiar with the technology. A standardized length-weight multiplier could be used to convert piece count to discards by species. Data integration across systems would reduce time spent filling out electronic forms. Iterative process could be established in the Sectors Operations Plan.

4.2.2.4 Enforcement

No additional barriers to enforcement were identified at this time.

4.2.2.5 Science/biological (assessment-based)

Barriers: Science/biological barriers that were identified included change from weight to piece count, stratification of EM vessels, and uncertainties in video estimates/measurement error.

4.3 List of Assumptions to Further Discuss within the EM Models

These assumptions are a working list of ideas to be included within the two EM models and currently warrant further discussion by the EMWG. They are documented here, are currently considered placeholder, and will be further incorporated throughout the white paper in its final format. Please note that these are subject to change, expansion, and/or removal.

- System is on from time vessel leaves port to vessel's return to port and offloading.
- 100% coverage of all trips by all participating vessels
- Biological sampling is possible, which may be incorporated through dockside monitors.
- VTR data or catch storage/handling systems are in place to identify stock area of catch components by species. ,
- Appropriate coverage/review rates of video (subsampling) can be objectively determined North Pacific doc see Appendix
- Is EM data observer data? (See discussion of "Legal/logistical perspectives")
- Role of the non-allocated stocks and regulatory requirements can be determined.
- Possession limits can be dealt with through regulatory adjustments
- Fish that is landed but not-sold can be disposed of legally and cost-effectively
- Dockside monitoring is re-implemented (after elimination in FW48)
- Depending on species retained, loss of information (precision) for non-retained species leads to acceptable degradation in quality for those species. Adequate resources and protocols are available to develop vessel monitoring plans
- Monitoring program should improve or maintain documentation of catch
- Programs align with current goals/objectives for the groundfish FMP?
- Statistical methodology can be developed to evaluate precision for comparison with existing 30% CV standard.
- Cost-sharing details are favorable to adoption of EM Resources are available to support increased costs in the near-term including creation of the infrastructure to process the data (in addition to hardware and retrofitting)
- An interim method for dealing with uncertain EM data (e.g., double coverage) can be implemented while data quality is improved. Access to complete video records is possible in order to evaluate sampling adequacy and monitor performance of video reviewers.