



**NOAA
FISHERIES**

Office of Science and
Technology's National
Observer Program

Second National Electronic Monitoring Workshop Report

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U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

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George Lapointe

**NOAA Technical Memorandum NMFS-F/SPO-177
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Workshop facilitator George Lapointe, NOAA Contractor—Electronic Technologies

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Executive Summary

Overview

Electronic monitoring (EM)—the use of video cameras, sensors, computers and other technology to monitor fishing operations passively—is increasingly being used as an alternative to some observers for identifying and counting catch, and monitoring and counting bycatch and discards.¹

Potential benefits of EM include:

- Reducing the costs associated with fisheries monitoring.
- Providing an alternative means of data collection on vessels where carrying an observer is problematic due to space limitations or other concerns such as life raft capacity.
- Providing evidence of compliance with monitoring requirements.
- Automating catch and bycatch accounting and monitoring.
- Providing more robust scientific information.
- Improving the timeliness of data collection and processing, as automatic image recognition and speed of review improve in the future.

There are currently five fisheries approved to use EM in the United States, with another eight fisheries in the process of EM implementation. Individual programs have been designed and implemented in order to meet the unique monitoring needs and logistics of specific fisheries.

As EM programs continue to develop, the most successful approaches have been those that incorporate the perspectives of fishermen, managers, scientists, law enforcement, service providers, and other interests. Facilitating discussion among EM program participants across fisheries and regions promotes information sharing and accelerates progress. To foster information sharing, collaboration, and education, the first National Electronic Monitoring Workshop² was held in Seattle, Washington, in January 2014. The workshop focused on building support for the consideration and development of new EM programs, as well as addressing development and implementation challenges in existing EM programs.

¹ EM would not replace all observers on all trips in fisheries in which EM is introduced; observers are needed for certain biological sampling duties.

² <http://eminformation.com/wp-content/uploads/2014/05/2014-NatEMWorkshop-final-summary-report.pdf>

Workshop Goals and Structure

Building on the lessons and information from the first workshop and the subsequent development, pre-implementation, and implementation of EM programs around the United States, the second National Electronic Monitoring Workshop was held in late 2016, in Seattle, Washington. This second workshop convened practitioners and stakeholders from across the country for a discussion of best practices: what was working well, what was not as effective, and the reasons behind those successes and challenges. Participants also discussed common issues facing EM programs, including confidentiality, data retention requirements, and implementation costs. Overarching goals of the workshop included:

- Facilitating a better understanding of the range of EM applications.
- Discussing solutions to current challenges impeding the integration of EM.
- Identifying key program design elements and processes.
- Sharing lessons learned from pilot studies and early EM program design and integration efforts across regions.
- Understanding cost considerations and implications of EM.

The two-day workshop was organized into ten panel discussions. During each panel, moderators invited several



Panelists for the Program Design and Implementation session discuss their perspectives.

panelists to provide their individual viewpoints on EM programs and facilitated discussion among panelists and workshop participants. The panels on the first day, detailed below, focused on EM program development across different regions, species-specific programs, and those in development:

- Alaska Region.
- West Coast Region.
- Greater Atlantic Region.
- Atlantic Highly Migratory Species (AHMS).
- New Kids on the Block: Emerging EM Programs and Technologies.

The panels on the second day, listed below, looked at broader issues, cutting across regions and programs, and also discussed issues that had been raised during the first day's sessions:

- Data Quality, Storage, and Retention.
- Walking the Walk: Exploring EM Program Enforcement and Compliance.
- Program Design and Implementation.
- Program Costs and Stakeholder Buy-In.
- Workshop Wrap-up.

Outcomes

Following the meeting, organizers reviewed and synthesized the presentations and discussions that took place at the workshop. The organizers identified the following three key themes that emerged from the individual viewpoints expressed at the workshop:

- **Successes.** When properly designed and implemented, EM works, and in more ways than may seem apparent at first. In addition to the benefits of monitoring activities in the fisheries, EM can serve as a tool to enhance stakeholder engagement, increase compliance, and build positive relationships with the fishing industry.
- **Best practices.** Numerous participants stated that capturing and sharing best practices is critical to successful electronic program development and implementation. Panelists provided a range of ideas on this front, ranging from technical considerations to strategies for successful implementation.

- **Challenges.** EM is not without its difficulties and pitfalls. Workshop participants identified a series of specific challenges that must be considered to expand existing EM programs or develop new EM programs.

The workshop was an opportunity to discuss best practices for implementing EM programs around the country. NOAA Fisheries, in consultation with stakeholders, intends to address both short-term and long-term funding challenges; tackle policy issues, including data storage and confidentiality; and to share lessons learned. NOAA Fisheries expects to see significant strides in EM technology and video/image review automation over the next few years, and intends to organize a third national EM workshop in the future to assess further lessons learned as new EM programs are implemented in Alaska, the West Coast, and the Northeast.

This report provides a high-level overview of these successes, best practices, and challenges, as identified by individual panelists at the workshop. A summary of those observations is included in [Figure 1](#). A list of workshop participants is included as [Appendix A](#). A summary of EM programs, transcripts of the panel discussions, and links to videos of panel presentations can be found online at https://spo.nmfs.noaa.gov/sites/default/files/TMSPO177_supp.pdf.

This technical memorandum summarizes individual viewpoints expressed at the Second National Electronic Monitoring Workshop. The successes, challenges, and best practices discussed in this technical memorandum do not reflect consensus advice or recommendations to NOAA Fisheries.



A commercial fishing vessel is outfitted with a camera to monitor catch and discards.

2nd National Electronic Monitoring Workshop

BEST PRACTICES, SUCCESSES, AND CHALLENGES OF EM IDENTIFIED AT THE WORKSHOP (WINTER 2016)



WORKSHOP GOALS

- Facilitate a better understanding of the range of EM applications.
- Discuss solutions to current challenges impeding the integration of EM.
- Identify key program design elements and processes.
- Share lessons learned from pilot studies and early EM program design and integration efforts across regions.
- Understand cost considerations and implications of EM.



SUCCESSES

- Strong leadership and vision by fishermen and managers.
- Standing working groups of fishermen, managers, law enforcement, service providers, NGOs, and other stakeholders.
- High level of involvement by many stakeholders.
- Regular involvement and input with Councils.
- Sustained funding mechanism in North Pacific and West Coast after initial investment by NOAA Fisheries.
- Use of EM for catch monitoring.
- Video access provided to fishermen.
- Easing of logistical challenges for small vessels.



CHALLENGES

- Building stakeholder buy-in.
- Providing long-term funding and agency staffing.
- Developing national guidance on data retention, confidentiality, and cost sharing.
- Addressing data concerns: access to data, confidentiality, quality, cost of acquisition, combining multiple data sources, connecting program design to data integration, distinguishing between video and derived data for records retention requirements.
- Making EM cost-effective and providing transparency in identifying program cost information.
- Funding research and development needed for technology development.
- Positioning EM as part of integrated electronic reporting and monitoring systems.
- Implementing in fisheries with less than 100 percent observer coverage, and in complex fisheries (e.g., bottom trawl).
- Addressing volatility in voluntary EM programs.
- Overcoming expectation for low EM review rates when observer coverage is low.
- Incorporating EM data in stock assessments.
- Using EM to validate anecdotal information.
- Balancing between compliance and workability for fishermen.
- Considering incentives for EM participation (i.e., access to closed areas, relaxation of other restrictions).



BEST PRACTICES

- Establish clear goals and objectives.
- Collaborate with all stakeholders for trust-building and consistency.
- Communicate regularly among stakeholders and, ideally, across regions.
- Use shared, specific terminology.
- Give time for programs to develop, including a pre-implementation period.
- Use Exempted Fishing Permits (EFPs) for learning and program adaptation.
- Build in flexibility to adapt to changing conditions and technologies.
- Focus programs regionally as much as possible
- Link data elements to program goals and objectives, and maintain control of data access.
- Invest in research to improve efficiencies.
- Incentivize program improvement.

Figure 1. Summary of workshop goals and inventory of successes, best practices, and challenges as expressed by individual panel members at the Second National Electronic Monitoring Workshop. These successes, best practices, and challenges do not reflect consensus advice or recommendations to NOAA Fisheries.

Successes

Individual workshop participants identified the following factors influencing the success of EM programs which are providing concrete, positive outcomes for fisheries science and management.

Strong leadership and vision by fishermen and managers.

Across all panels, several participants commented that the EM design phase promotes dialogue and collaboration between fishing industry representatives, non-governmental organization (NGO) partners, councils/commissions, and agency staff. This early discussion and collaboration, both within the Council process and outside of it, have been some of the key successes of program development to date.

Standing working groups of fishermen, managers, law enforcement, service providers, NGOs, and other stakeholders.

In Alaska, the North Pacific Fishery Management Council (Council) established a Fixed Gear EM Working Group (EMWG) as part of its Observer Advisory Committee³, which consists of managers, scientists, fishermen, law enforcement officers, and service providers, to advise on the development of the fixed gear EM program. The Vice-chair and staff of the Council chaired and facilitated, respectively, the meetings. Operating by consensus, the EMWG provided a standing forum for EM discussions and for the development of recommendations to the Council. Similarly, the New England Fishery Management Council had established an EMWG to explore EM issues, including a comparison between audit-based and maximized retention program types. While the effort stalled because of competing priorities, it demonstrated the Council's interest in EM, and led to a more informal group of fishermen, NGOs, service providers, and agency staff who have been working through EM implementation issues in the groundfish fishery.

High level of involvement by many stakeholders.

Most members of the Alaska panel noted that NOAA Fisheries staff were committed to the process of developing and implementing the Alaska fixed gear EM program. This agency commitment included having staff from the Alaska Fisheries Science Center's North Pacific Observer Program, Sustainable Fisheries Division, NOAA General Counsel, and NOAA Office of Law Enforcement at working group and Council meetings to contribute their respective expertise to EM discussions. This commitment gave participants

confidence that the agency would follow through on implementation of the EM program consistent with Council decisions. It also provided an "early warning system" when proposals might have veered outside agency authority or resources.

Most panel members pointed to the trust built over time among fishermen, managers, and scientists, the accessibility of a venue for discussion and program development that welcomes participation, and the general sense among stakeholders that their voices are being heard in the EM development process. Additionally, stakeholders have been hearing positive reports about EM development and EM use on vessels from those in the field. All of these factors have led to increasing interest in, and support for, EM programs in Alaska.

Regular involvement and input with Councils.

Most Alaska panel members cited the Council's willingness to consider seriously the EM working group's recommendations as a key factor in the group's success. Other panelists noted that the working group also provided a public, structured forum for system design, developing operational capacity, and considering new technology options. Its success streamlined much of the debate that otherwise may have bogged down Council deliberations.

Sustained funding mechanism in North Pacific and West Coast after initial investment by NOAA Fisheries.

Many panelists identified sustained funding for equipment purchase, field support, and video review as a factor in the success of the Alaska EM program. To date, funding for program development has come primarily from NOAA Fisheries and the National Fish and Wildlife Foundation, though funding for program implementation in the future is expected also to come from industry fees that cover observer costs.^{4,5} However, several panelists pointed out that observer fees are allocated among fisheries and will need to be allocated further between observers and EM, with insufficient projected revenues to meet all monitoring needs at current coverage levels.

Some West Coast panel members also stated that funding for EM program development and implementation, and ongoing industry funding for observers or EM, was a factor in the success of EM in the groundfish fishery in the Pacific Fishery Management Council region.

Use of EM for catch monitoring.

In several panels, individual panelists noted that EM can serve as an alternative to or enhancement of observer

³ <https://www.npfmc.org/observer-program/>

⁴ MSA Section 313 (d)

⁵ Final Alaska EM rule: <https://www.federalregister.gov/documents/2017/08/08/2017-16703/fisheries-of-the-exclusive-economic-zone-off-alaska-integrating-electronic-monitoring-into-the-north>

coverage to either increase monitoring of catch, or more easily meet observer coverage requirements. For instance, the 100 percent observer coverage requirement in the West Coast's groundfish individual fishing quota (IFQ) fishery was cited as a success in its EM program. Because of the cost of observers, there is a strong interest in shifting to EM as a potentially more affordable alternative that still allows compliance with catch monitoring requirements.

Video access provided to fishermen.

According to some Atlantic Highly Migratory Species (AHMS) panelists, making EM video available to the fishermen who submitted the data helped improve support for the program, giving fishermen confidence in the program because of the increased transparency.

Similarly, some Greater Atlantic panelists said that third-party review of EM video data was a success for the Maine Coast Community Sector program, because it controlled access to video data, addressing an ongoing concern for fishermen involved in EM programs. Some panelists believed that the third-party review arrangement also provided more operational flexibility than likely would occur with a more federally controlled process, such that short-term operational changes make video review more efficient and less costly.

Easing of logistical challenges for small vessels.

Several panelists mentioned the 2013 decision by the Council to place observers on small vessels (between 40 and 57 feet) in Alaska. The restructured observer program resulted in logistical challenges associated with limited bunk space, conditional releases from observer coverage, and the relative remoteness of many Alaskan ports. The implementation of EM is of particular benefit in these cases, serving as a potentially less costly and logistically-constraining alternative to observers.

Best Practices

Individual workshop participants identified examples of effective strategies to ensure the successful expansion of existing EM programs or implementation of new ones.

Establish clear goals and objectives.

NOAA Fisheries' HMS staff stated that the single clearly defined objective—using EM to track individual bluefin tuna quotas—of the mandatory NOAA Fisheries-supported AHMS EM program was a factor that allowed relatively quick program development. This was partly because there was no need to devote time to deliberating the program's scope or cost-sharing. This narrow scope, however, was

cited by some panelists as a possible longer-term challenge, as potential changes could require stakeholders to re-open discussion on key features.

Some Design and Implementation panelists also emphasized the importance of clear program goals and objectives that allow programs to meet monitoring or compliance needs without adding extraneous tasks or components. Panelists cautioned against “mission creep” that could come from adding tasks, workload, and costs not related to program objectives, and suggested that periodically revisiting program goals and objectives would help maintain focus.

Within the workshop wrap-up panel, individual panelists repeatedly emphasized the need to define clearly program terms, goals, objectives and requirements. Specifically, it was noted that many program issues, including data concerns, would be resolved or prevented through clarity of policies and program design.

Collaborate with all stakeholders for trust-building and consistency.

Collaboration among program partners was widely cited as an essential best practice. Panelists from the West Coast said that the cooperation and trust fostered by a collaborative approach allowed a range of stakeholders to weigh in on issues during design and implementation. They also pointed out that while agency staff needed to be present and engaged, it was important that industry have the opportunities to propose solutions. In the Alaska discussion, panelists pointed to the North Pacific Council's EMWG as a strong example of how a standing working group with broad stakeholder representation could play a key role in moving EM programs forward. Ultimately, however, final program development and rulemaking occurs through the Council process.

Communicate regularly among stakeholders and, ideally, across regions.

Numerous panelists expressed that open lines of communication among managers, fishermen, and service providers helped to facilitate relatively smooth development and implementation processes across programs and regions. In the AHMS program, for instance, its Advisory Panel represents a forum for regular interaction between industry and AHMS staff, while the North Pacific Council's EMWG is another example of an avenue for consistent communications, collaborative problem solving and trust building.

The Emerging Programs panel highlighted the importance of opportunities to learn from other EM programs to leverage successes and challenges, which was echoed by the Design and Implementation panel. National and regional workshops

such as this one were cited as useful communications tools, though the events should be held at least annually to be most effective for information-sharing, and could be supplemented by smaller interchanges on a program-to-program or cross-regional basis.

Use shared, specific terminology.

The importance of shared vocabulary in EM discussions was mentioned by several panelists. Terms can be defined differently across fisheries and regions, which can cause confusion unless there is a common understanding of terms among all program stakeholders. For instance, an Alaska panelist pointed to the West Coast whiting fishery, where fishermen refer to “slippage” (the intentional discarding of the cod end without bringing it on board toward the end of the haul), a term that is not used throughout different regions. Similarly, during the Enforcement and Compliance panel, it was noted that EM imagery is a digital file, but is not traditional fishery data consisting of a numerical file. However, the terms were often not clearly defined, sometimes leading to confusion in discussions.

Give time for programs to develop, including a pre-implementation period.

In the case of the AHMS EM program, there was a 6-month delay between approval and effective date of EM requirements. Some panelists believed that this flexibility allowed managers, fishermen, and service providers to work through program and logistical issues that emerged during program development. Panelists also noted that moving to the pre-implementation phase relatively early in the overall design phase allowed for earlier improvements to the system. However, one panelist noted that a more formalized pre-implementation process would have given fishermen a better opportunity to understand more fully how the equipment worked, how it was installed, and the overall program expectations. In general, the pre-implementation period was seen as an important step, giving a chance to work out issues prior to setting regulations.

Use Exempted Fishing Permits for learning and program adaptation.

On the West Coast, developing the EM program through the Exempted Fishing Permit (EFP) process allowed industry, service providers, and agency staff to incorporate lessons learned and other needed changes more easily. The EFP process saved time because changes could be made relatively easily as compared with time needed to amend regulations. The flexibility also gave confidence to industry participants that they would not be locked into unworkable or inefficient measures in the EM program.

In Alaska, the Council’s EMWG opted for an EM pre-implementation phase analogous in some respects to the EFP process used in other regions. This allowed vessels to

participate voluntarily in a program that had not yet been implemented through regulations.

In the Greater Atlantic, the EFP process allowed program partners to move past the pilot project phase while continuing with development of various program elements. This meant that EM data could be used for auditing logbooks, demonstrating to fisherman that EM was useful, and that NOAA Fisheries was committed to the EM development process.

Members of the Data Quality, Storage, and Retention panel concurred with the experience of the regions, noting that the use of EFPs allows a flexible, iterative, and timelier program implementation process, as contrasted with a more bureaucratic system.

Build in flexibility to adapt to changing conditions and technologies.

Members of both the Emerging Programs and Design and Implementation panels highlighted flexibility as a critical component in program planning and development for all stakeholders. Experimentation in early stages enables adaptation to changing conditions in a fishery or in the EM program. EFPs are ideal for providing this flexibility, as are vessel monitoring plans that can be changed by agreement between the vessel operators and the agency, rather than regulatory changes that require more time.

However, in some cases, certain restrictions have been useful. For instance, because the AHMS EM program *required* use of EM and 100 percent coverage, development was accelerated as some of the usual discussions about effective coverage levels and other factors were bypassed. On the West Coast, the 100 percent observer coverage requirement in the groundfish IFQ fishery (a program paid for by industry) also was a factor in the successful transition to the EM program. This allowed the design phase to concentrate on obtaining needed monitoring data instead of debating other program elements.

In the wrap-up session, individual panelists pointed to a common conundrum in fisheries management: how to balance regional flexibility against national guidance. Panelists reiterated the importance of tailoring programs to specific needs while also pointing to an interest in national guidelines. They also noted that enforceability should be balanced with regional flexibility to meet specific program objectives.

Focus programs regionally as much as possible.

Most panelists said that as much program design and implementation as possible should be addressed regionally, as it allows focus and participation based on local knowledge and experience.

Link data elements to program goals and objectives, and maintain control of data access.

Vessel feedback and data access after video review are critical components of EM programs. For example, catch handling or camera placement may need to be adjusted on subsequent trips to ensure adequate EM data quality. In the pilot New England groundfish EM programs, some vessels collect data beyond the data elements and records that are required to be submitted as part of the fishery management program. It is important to ensure that vessels are aware of what is required and being sent to NOAA Fisheries, and what they can choose to retain for their own separate data collection.

Some panelists preferred third-party video reviews for several reasons. The independent reviews represent an important opportunity to reduce costs through private negotiation on fees. There is also a desire to prevent NOAA Fisheries from accessing non-fishing images or videos due to privacy concerns.

Invest in research to improve efficiencies.

Currently, the Alaska Fisheries Science Center, along with other entities, is developing advanced EM machine vision systems that automate image capture, species identification, and length estimation to meet monitoring objectives, thus significantly reducing review costs and potentially decreasing the time needed for review.

Incentivize program improvement.

Across panels, numerous panelists suggested that EM design should incorporate strong incentives for fishermen in order for programs to improve and expand. In some cases, the inherent nature of EM can be an incentive—some Enforcement and Compliance panelists noted that participation in EM meant cost savings for fishermen, which could be incentive enough. Others noted that freeing up space onboard smaller vessels was a positive outcome. The Emerging Technologies panel mentioned several incentives either under consideration (e.g., quota allocation adjustments for EM participants), or being used in the Greater Atlantic Region, such as closed area access for EM vessels or financial support from external partners to lease quota.

Challenges

Individual workshop participants identified several challenges that they believe should be addressed as EM programs continue to evolve and expand.

Building stakeholder buy-in.

In Alaska, unrealistic expectations about what EM can accomplish in terms of monitoring data, the cost and performance of EM systems, and the logistics of developing

and implementing EM systems are an ongoing challenge for industry members and managers. These issues have impeded buy-in, going back to early discussions in 2013.

Panelists in the Emerging Technologies session mentioned low levels of stakeholder participation in program planning and development. In some cases, there may be a lack of interest, because stakeholders do not believe more monitoring is needed, or may believe that implementation of EM technologies might lead to new program and equipment requirements, or increased (unwanted) scrutiny in a given fishery.

Stakeholder reluctance is particularly an issue in testing or developing new EM technologies, as the testing often requires new equipment, vessel and fish handling procedures, and increased time commitment by vessel crew members to understand, install, use, and test a new technology or piece of equipment. Other stakeholders are hesitant to support new technology programs because of the perceived costs associated with program planning and development, technology system initial costs, and ongoing operating expenses. Finally, the question of who pays for new monitoring programs was mentioned as a challenge by a number of panelists.

Providing long-term funding and agency staffing.

With a current funding outlook influenced by a constrained federal budget, many panelists acknowledged that further development of EM programs could be limited by agency staffing levels and funding, given the time and support required to build and maintain EM programs. These limits also impact internal and external research and development efforts.

To provide further clarity around funding questions and staffing issues, NOAA Fisheries is developing a cost allocation policy that will outline which program costs are the responsibility of the agency and which should be covered by non-federal program partners.

Developing national guidance on data retention, confidentiality, and cost sharing.

The need to develop national guidance in a range of areas, including data retention, confidentiality, and cost sharing, was a common theme. Participants noted that costs and stakeholder buy-in were closely related, and that, as fishermen pay more program costs, it is important to understand how costs are shared.

Greater Atlantic panelists spoke to the importance of establishing national performance standards covering equipment and data. Some Data Quality, Storage, and Retention panelists cited the further need to clarify EM confidentiality rules and data retention requirements.

Addressing data concerns: access to data, confidentiality, quality, cost of acquisition, combining multiple data sources, connecting program design to data integration, distinguishing between video and derived data for records retention requirements.

As already noted, because national guidance on EM program standards and requirements, such as data retention, is under development, this can cause uncertainty regarding logistical and cost implications for EM program participants.

Some workshop participants suggested that the raw video footage from EM systems could be discarded after the EM video had been reviewed and relevant program information obtained, mainly due to the cost of storage. Others believed the video should be retained, recognizing its potential value in enforcement cases, with the five-year statute of limitations for enforcement cases under the Magnuson-Stevens Act (MSA) as a reasonable standard. One panelist pointed out the retention of the original EM data also would be in the best interest of fishermen in the event of an enforcement action or investigation. There was also discussion that data retention could be important for management and science, particularly during early years after implementation.

The Enforcement and Compliance panel also discussed confidentiality of EM information, particularly images and aggregation. A panelist from the fishing industry noted this was a major concern, because images can be readily used in ways that do not reflect what is occurring during fishing operations. Most panel members expressed that national guidance on confidentiality would help EM program development and implementation. Most panel members stated that video or still images should be confidential because there is no way to aggregate images in a way that masks individual identification, as is done with numerical data.

Making EM cost-effective and providing transparency in identifying program cost information.

Some Alaska panelists discussed the ongoing challenge of making the EM program cost effective, which, in turn, can impact participation rates and funding for observers and monitoring in other fisheries. Panelists mentioned both opportunities for cost reductions (such as careful on-camera fish handling that could expedite video review), and barriers to controlling costs, including small fleet sizes that do not benefit from economies of scale. Program flexibility that allows consideration of cost-saving changes was cited as a key component of implementation.

Greater Atlantic panelists emphasized the difficulty of comparing costs to fishermen between observers and using EM systems, partly because the costs associated with EM design and pre-implementation do not necessarily predict what an implemented program will cost. In fact, economic

analyses attempting to estimate annual program costs do not account for initial costs of designing, implementing, and purchasing and installing equipment.

Some Cost and Stakeholder Buy-in panelists noted that program equipment and other design elements should be balanced with their associated costs (e.g., what percentage of video is reviewed, or how much and for how long video data records should be retained), while cautioning that data quality should not be compromised to achieve lower costs.

Greater Atlantic panelists pointed to the groundfish EM programs in New England as improving cost effectiveness for fishermen. Through deliberate deck space use and careful fish handling procedures, fishermen can make video review faster and more efficient, and therefore less expensive.

On the West Coast, some panelists noted the groundfish fishery faces several financial factors that may make it difficult to build a robust EM program to meet the fishery's monitoring needs, similar to challenges faced by fisheries in Alaska and the Greater Atlantic. The fishery, which is subject to a 100 percent observer requirement in the IFQ fishery, includes small fleets in communities that are often a great distance from service providers, making it expensive and logistically difficult to provide EM and observer services to the vessels. The fleet must also consider the costs and logistical coordination of dockside monitoring as part of the fishery management program. While EM or observer costs have been paid for by NOAA Fisheries in the past, the federal contribution has ended, placing full responsibility on the fleet.

Funding research and development needed for technology development.

NOAA Fisheries staff and stakeholders in the Alaska region are leaders in developing new technologies to improve EM programs and in understanding the long-term benefits of considering and incorporating new technologies in EM programs. Some examples of new technologies include stereo camera systems, chute camera systems, multispectral imaging, automatic image recognition, and computer analysis of EM video data. Continued research and development across the country will address concerns about how new technologies will function, the extra resources required for testing them, and the risk that new technologies could lead to increased costs and program requirements.

Positioning EM as part of integrated electronic reporting and monitoring systems.

Integrating EM data into the suite of data used to monitor fisheries is an ongoing challenge. Direct comparison can be difficult, since observer data summarizes an entire trip, while EM data is based on reviewing video of a certain percentage of the trip (or, in the case of 100 percent video review, of a

selected set of trips). Because EM represents a relatively new data source, integrating these data requires calibration.

On the West Coast, the fact that fisheries-dependent data are submitted to one organization—the Pacific States Marine Fisheries Commission—has made data integration more timely and efficient, since discussions on integration are centered at one location, rather than requiring coordination among multiple organizations.

Implementing in fisheries with less than 100 percent observer coverage, and in complex fisheries (e.g., bottom trawl).

West Coast panelists discussed the challenges associated with adding a trawl component to the EM program, an action that is currently in development under an EFP in 2017. These challenges include a wider diversity of species, a more complex deck sorting process, and distinguishing between similar species, some of which are subject to annual catch limits, which requires species identification and weight estimation from the video data.

In the Northeast groundfish fishery, EM has proven difficult to implement and expand because of limited human monitoring coverage levels (14 percent in fishing year 2016), alternative fisheries (such as lobster) that are typically more profitable, and lack of incentives to participate. This results in low numbers of both participants and trips per participant, making program evaluation difficult.

Low monitoring coverage levels also provide incentives to alter behavior, depending on whether a trip is observed (observer or EM) or unobserved. Low individual catch levels of some species (e.g., Gulf of Maine cod, Southern New England yellowtail flounder) potentially can shut down fisheries while other, more abundant species still can be caught. In some cases, fishermen on unmonitored vessels may try to maximize catch of more abundant species by discarding the limited quota species.

Addressing volatility in voluntary EM programs.

In Alaska, the fixed gear (longline and pot) EM program will be voluntary, allowing fishermen to opt in or out from year to year. Panelists mentioned two challenges resulting from the voluntary nature of any EM program. First, if it is perceived as not performing well, fishermen then can opt out of the program, increasing program volatility that can influence program costs, participation, and the stability of other EM and observer programs. Second, if fishermen do opt out, the time and resources spent on purchasing and installing equipment and in training their crew could have been better utilized elsewhere.

Overcoming expectation for low EM review rates when observer coverage is low.

Certain Emerging Technologies panelists mentioned that because the tendency is to develop EM programs to provide coverage levels similar to observer levels, fisheries with low observer or monitoring levels have little incentive to develop monitoring programs. With low or no observer coverage, there is a reluctance to consider the costs and burdens of EM or electronic reporting (ER) programs.

Incorporating EM data in stock assessments.

In addition to addressing the challenge of ensuring that EM data is integrated in a way that ensures comparability to observer data, there continues to be extensive deliberation regarding the push to modify EM systems to provide additional data for science and management purposes. In the Greater Atlantic, fishermen have asked about the possibility of EM video data providing supporting information for assessing fishery populations or other purposes. This possibility should be addressed by fishermen, scientists, and managers, as the process for providing additional data likely would be a slow, deliberative, and iterative process, similar to the EM system design process.

Using EM to validate anecdotal information.

Participants on both the AHMS and Enforcement and Compliance panels noted that EM can be used in validating information that is currently viewed as anecdotal. This can give more weight to the observations of fishermen, and can help improve assessment and management in a fishery.

Balancing between compliance and workability for fishermen.

In the AHMS EM program, panelists cited the remaining challenge of developing standards for enforcement of violations, particularly in maintaining a balance in constructively improving program participants' performance with addressing any significant, willful violations.

The Enforcement and Compliance panel discussed the differences between using EM to enforce overall program requirements, and enforcing compliance with the EM regulations themselves. Current EM programs encourage compliance by working closely with vessels to remedy potential violations prior to initiating formal enforcement actions. The panel discussed performance standards as a means of allowing a non-regulatory approach to compliance, which would necessitate flexibility to adapt to changing conditions and experience gained through EM program implementation.

Considering incentives for EM participation (i.e., access to closed areas, relaxation of other restrictions).

Greater Atlantic panelists pointed to the lack of incentives—and even the presence of disincentives—to participate in the

groundfish EM program as a significant challenge, despite the benefits that increasing monitoring by EM could bring to preventing (or at least accounting for) bycatch. Disincentives include, for example, the possible competitive disadvantage faced by vessels running EM on all trips compared to vessels with human observers on a fraction of trips, some of which may discard fish species with limited quota when unobserved; this could allow them to fish for a longer period of time before reaching annual catch limits for some species. Additionally, any differences in funding for human at-sea monitors and EM could affect participation in an EM program.

Panelists mentioned the need to provide incentives for EM use, such as access to areas closed as part of groundfish management, or using the EM system to implement integrated reporting. Integrated data reporting would allow participating fishermen to report their catch efficiently rather than filling out multiple catch and effort reports.

Some AHMS panelists commented that the 100 percent requirement for EM in this fishery could eliminate duplicative reporting requirements and provide ER functions that satisfy the reporting requirements of other federal, international, and state fisheries programs. The Costs and Stakeholder Buy-In panel suggested that increased monitoring under a 100 percent EM requirement could increase precision of catch (and bycatch) estimates and reduce uncertainty buffers that councils use when setting catch limits. This greater catch estimation precision and reduction in scientific and management uncertainties could allow fishermen to keep more fish or could be used to give regulatory relief from other restrictions, such as closed areas.

Action Items and Next Steps

The Second National EM Workshop represented an important opportunity for reflection and information-sharing as a growing number of EM programs are being implemented and technologies continue to advance. The best practices and lessons learned (see Figure 1), as identified by individual workshop participants, provide useful information for the ongoing evolution of programs in all stages of development, while concerted efforts to address the data, cost, design, and other identified challenges also will benefit programs across the board. NOAA Fisheries has taken action on a number of commitments identified during the workshop to continue the successes to date in advancing EM technologies and in implementing EM with its external partners.

In an effort to improve the implementation of EM, NOAA Fisheries has hired a national Electronic Technologies (ET) Coordinator. The ET Coordinator will serve as the main point of contact for all national (and in some cases international) efforts to coordinate implementation of both EM and ER in U.S. commercial and recreational fisheries. The Coordinator will facilitate the work of agency and stakeholder working groups to develop policy directives and guidance on video retention requirements, EM program cost allocations between NOAA Fisheries and the fishing industry, data confidentiality, and possibly minimum participation best practices for new EM programs, among other duties supporting development and implementation of electronic technologies in U.S. fisheries.

External partners have continued to work with fishery management councils, interstate marine fishery commissions, and the fishing industry to support EM implementation. In addition to the support from the National Fish and Wildlife Foundation, NGOs have provided significant funding to industry toward purchasing hardware and software, video review and storage costs, and other program costs. The commercial fishing industry also has provided significant in-kind donations of vessels and experience to support EM implementation. At the same time, there have been several efforts toward reducing costs, including the development of video review automation and the promotion of innovative methods to decrease storage costs. For example, The Nature Conservancy is helping develop the second-ever fish image recognition competition worldwide, and was among the first to use video and focus on U.S. fisheries.

NOAA Fisheries also will host or participate in a number of EM workshops and meetings over the next year. In August 2017, NOAA Fisheries coordinated a symposium titled “Emerging Technologies in Fisheries Dependent Science and Catch Monitoring” at the American Fisheries Society meeting in Tampa, FL, which is summarized at <http://eminformation.com/2047/presentations-2017-afs-symposium-emerging-technologies-catch-monitoring>. In June 2018, NOAA Fisheries will facilitate a session on EM at the 9th Annual International Fisheries Observer and Monitoring Conference in Vigo, Spain. Additional internal staff meetings will continue to advance both technology and policy for EM implementation. Planning for a third National EM Workshop will start in 2018.

Appendix A: Workshop Participants

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