IFOMC Electronic Monitoring Workshop Summary
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Introduction

Electronic Monitoring (EM) refers to an integrated array of sensors, usually including still or video imagery, deployed on fishing vessels for the purposes of providing independent, verifiable fisheries information. There is growing interest to deploy EM technologies in commercial fisheries where its efficacy, operational feasibility, and cost effectiveness can be demonstrated. There are few operational monitoring programs and EM is relatively new as practitioners are gaining experience with how best to implement EM for fisheries science and management. Unlike human-based monitoring, EM has more technological and operational complexity, as well as stronger dependencies on various stakeholders. Moreover, technology is advancing rapidly and there are diverse views on what direction, and how quickly, EM will advance.

EM technologies have been a consistent conference theme for IFOMC since 2004 but presented mostly as plenary sessions. The organizers for this conference decided to include an EM workshop session in addition to the dedicated plenary session on operationalizing EM. Indeed, EM was a frequent topic of discussion in many of the plenary sessions although the workshop was structured to facilitate more focused small group discussions, guided by challenge topics provided by workshop facilitators. Attendance at the workshop involved about 140 conference delegates from 27 countries. The workshop involved two discussion sessions held over a six-hour period. Each session included brief introduction to the topic, small group discussion, and summary remarks by delegates to the larger group. Workshop objectives were:

- Build a shared understanding of the current state of EM technology
- Discuss use cases to identify successes and challenges of EM technology
- Expand networks among participants
- Help participants visualize use cases for EM in the fisheries they work with
- Help participants gain a better understanding of the functional elements of an EM program

Session 1 - "EM Basics"

The first session was aimed at exploring the specific capabilities of EM to solve current monitoring issues. Delegates were seated in tables of nine, with each table mixed by area of expertise, geography, and type of fishery. To facilitate discussions, there were three brief presentations:

- Brett Alger (US) – Current State of EM Technology in US Programs
- Dave Colpo (US) – West Coast/Alaska EM Programs-Successes and Failures
- Jon Ruiz (Spain) –Successes and Failures with Tuna Fisheries

Delegates were provided with four challenge questions to facilitate table discussion. A representative from each table then reported back to the broader workshop at the conclusion of Session 1. The challenge questions and a summary of the small group discussion follows.

Challenge Question 1: How do you see EM being used in your fisheries?

The groups agreed EM could be a useful tool for getting estimates of fisheries catch, discards, protected species, fishing effort, and catch accounting, depending on the fishery. For example, EM could probably be used for catch accounting for fisheries where the catch is coming up one-by-one, but it would be more difficult for high volume fisheries. However, EM in those high-volume fisheries could probably be used for bycatch and discards. EM could also be used for other forms of compliance, such as making sure fishermen are doing what they said they would, that they are fishing in a legal location, and are accurately self-reporting data. No matter which fishery EM was used for and for whatever purpose, it could also allow observers to have time to collect additional data or perform tasks that may be more complicated. It could also allow for additional data to be captured by the EM system, such as environmental data (e.g., meteorological, hydrography, hydro acoustic data, etc.). A potentially beneficial use of EM for the fishermen themselves would be for marketing purposes, it could be a way to catch provenance, demonstrate sustainability and support product traceability. In general, the group agreed EM needs to be thought about step-by-step, especially as the technology and costs change.

Challenge Question 2: What type of management and science objectives do you have where you see EM being useful?

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The group could see EM being most useful for compliance requirements, checking discrepancies between data streams, and better traceability. EM could also be used for collecting new data streams, complementing observer data, and improving safety for both observers and for captains to see what their employees are doing. EM could also be used to expand monitoring coverage without having to physically add observers to the program. The group also discussed the need for the monitoring objectives to also address industry objectives for monitoring, such as those that improve safety and promote operational efficiencies. These initiatives help to incentivize EM for the industry.

Challenge Question 3: What questions do you have about how EM could or couldn't work in your fisheries?

The most common questions were related to the data that EM collects. How do we use it? How do we review it? Can fishermen review data in real-time? The group also discussed how it would be interesting to see how observer attitudes change after EM implementation. The group also touched on more broad questions, such as, what is the relationship between the industry, the service providers, and the government? Or, where is the technology headed and how fast is it getting there?

Challenge Question 4: What are the challenges? Are there possible improvements (efficiency, logistical, cost)?

The discussion on challenges was the most expansive, but each table's feedback tended to fall in one of five categories:

1. Perceptions and incentives for EM was discussed the most;
2. Fishermen privacy and security, and their perception that EM was a form of 'big brother', all challenge the participation of vessels in EM programs;
3. The group agreed that a major trial to EM was that you were trying to manage people, not fish. A champion of the technology needs to be found who can build the trust needed for buy-in;
4. Challenges related to costs was also common, such as determining who is and who should be paying for; and
5. Standards for EM was brought up frequently, including data management standards, privacy and security, how to deal with the constant changing of technology, and evaluating service providers.

Other challenges focused on the technology itself and that there are differences between fisheries that make it harder to identify general benefits that apply to all fishermen.

Session 2 - "Putting EM to Work"

The second session was aimed at exploring some of the broader issues with EM, moving from the specific capabilities of the technology to practical issues of monitoring at scale. To facilitate discussions, there were two brief presentations:

- Jennifer Mondragon (US) – Implementation Experiences in Alaska
- Shawn Stebbins (Canada) – EM Implementation Experiences with BC Groundfish Fisheries

Unlike seating arrangements in the first session, delegates self sorted into seven groups to align with discussion topics nominated by the delegates. The topics are identified below, along with rational for their importance. No attempt was made to capture the discussion from these small group sessions as the main objective of this activity was to get delegates exchanging with those of similar interests.

Topic 1: Landings Obligation

The EU will soon be implementing regulations that will prohibit discarding and require all catches of quota species to landed and documented. Many see EM as the only tool available to successfully enforce these new catch retention regulations, yet there are many challenges to apply this methodology across such a large fleet and geographic expanse. Further, there is a general lack of support for monitoring among fishing groups that to date have experienced little or no monitoring. Many of the workshop participants were specifically interested in learning more about EM to better understand its efficacy to enforce these new discard prohibitions.

Topic 2: Data Sharing

EM creates unique data challenges. Raw sensor and image data files are very large, and it is difficult or costly to transfer data from vessel to analysis location without physically shipping hard drives. Vessels hosting EM systems have concerns that the data created may be used for purposes far broader than the original monitoring objectives, hence ownership, rights of access, and clarity on the permitted uses of

the data are important stakeholder concerns. Meanwhile, regulators are charged with responsibilities and associated costs of meeting their legislated data requirements which include protection of privacy and data archiving.

Topic 3: Trawl and Bottomfish

Demersal fisheries often have mixed species catches, only some of which may be of commercial value. Catch quantification is often an important monitoring objective, keeping track of species composition and catch disposition (retained or discarded). Demersal fisheries with mobile gear such as trawl create unique challenges with the entire catch contents presented on deck in a single instance, as opposed to fixed gear where catch general comes aboard in singular fashion. Independent monitoring is increasing in demersal fisheries and the work from many existing EM programs is translatable to these new monitoring challenges.

Topic 4: Incentives and Collaboration

Successful deployment of EM requires well-organized programs where the data needs of the regulators are aligned with the logistical needs of the fishing vessels. Multi-stakeholder workgroups have been very effective in the design and development of new EM programs. Moreover, EM programs generally benefit from the support and cooperation of all stakeholder groups any many programs start with some sort of incentive structure to encourage participation. Finding ways to encourage support, or at the very least acceptance of EM, is essential.

Topic 5: Tuna Fisheries

The world's tuna fisheries present some very unique challenges for independent monitoring. Among seine fleets observer programs are well established and there is increased interest in use of EM to augment observers, and in some cases replace observers where it is impractical for their deployment. Among surface longline fisheries regulators are very interested in EM because of the difficulty achieving current coverage targets on such a vast fleet that operates across such a broad geographic range. As well, the extended duration at sea and difficult working conditions make it challenging for observers. Coupled with these issues, tuna fisheries generally lie within multi-national management structures where a single fishery monitoring program must be coordinated among several host nations.

Topic 6: Small-Scale Fisheries

The challenges of monitoring small scale fisheries are very unique. Typically, vessels are small, catch quantities low, activity levels high, and fleet sizes enormous. The standard monitoring approaches used for larger industrial fisheries are not easily transferable to these fleets. EM is seen as a possible option, yet successful deployment will require low cost, autonomous (solar powered?), simple, ruggedized technology, applied at a very large scale. Most practitioners feel there is no 'one size fits all' solution and that a range of monitoring tools, and management approaches are needed. There is also no universal definition of 'small scale' which complicates the discussion on monitoring solutions.

Topic 7: Machine Learning

Applying EM at the scale necessary for many fisheries will result in the creation of vast amounts of image and sensor data. The large data volumes, the time-sensitivity for data processing and the enormous cost for manual data processing will necessitate some form of data processing automation if EM is to provide significant benefit. Machine learning is developing in other fields where image processing requirements are large, and practitioners feel that it can be successfully applied to routine catch quantification among other monitoring needs. The challenges seem to lie with establishing significant image libraries for learning data sets, aligning technical feasibility of automation with operational benefit among the range of monitoring issues in a fishery, and finding ways to implement automation into emerging technologies and operational programs.

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