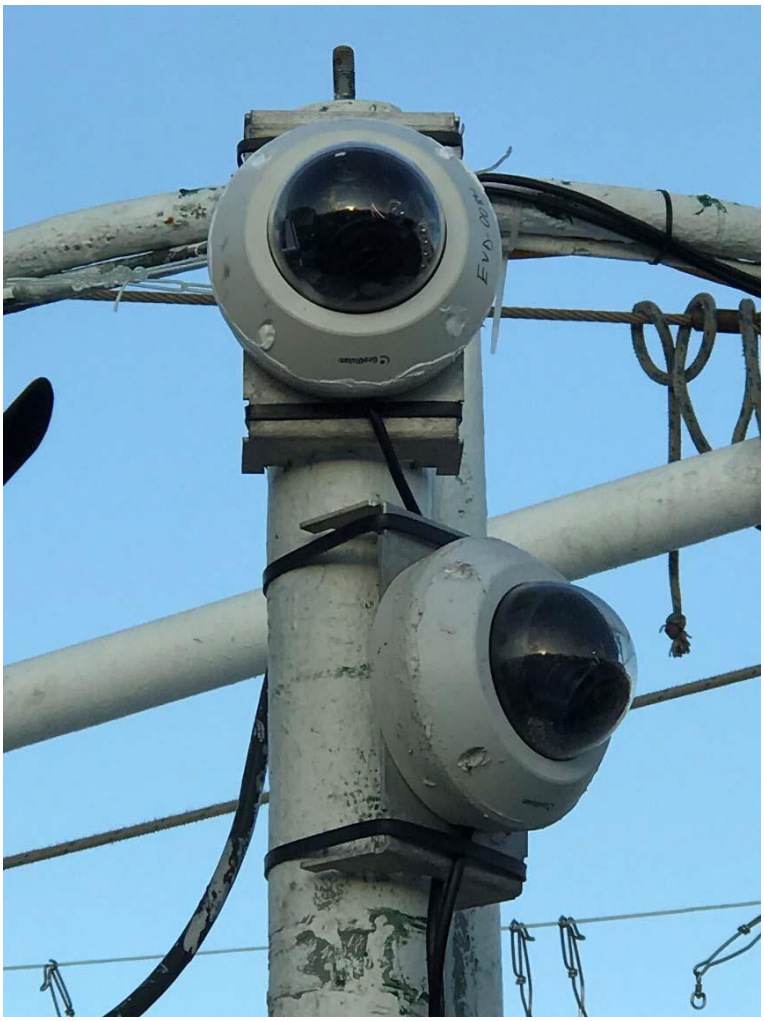
National Electronic Monitoring Workshop



February 12-13, 2020
Renton, WA

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Welcome

Fisheries in the U.S. and around the world are increasingly utilizing electronic monitoring (EM) to improve the timeliness, quality, cost effectiveness, and accessibility of fisheries-dependent data collection by incorporating cameras, gear sensors, and electronic reporting (ER) into commercial fishing operations. NOAA Fisheries and the Pacific States Marine Fisheries Commission are hosting this workshop to raise awareness of EM programs and emerging technologies, provide a platform for collaboration, and provide guidance on developing EM policy and best practices.

The objectives for this workshop include the following:

- Education: Provide participants with a shared frame of reference for the development and implementation of EM in U.S. federal fisheries.
- Regional exchange: Review regional approaches to EM and share experience across regions, roles, and responsibilities.
- Best practices: Share perspectives on best practices and lessons learned that can help guide the design and implementation of existing and future EM programs.
- Looking ahead: Identify the ongoing questions and challenges with EM implementation, and generate ideas and next steps for gaining traction at the regional and national level.

Facilitators: Katie Latanich and Kim Gordon

Workshop organizers: Brett Alger, Laura Keeling, Katherine Wilson, and Lisa Peterson

(NOAA Fisheries)

Workshop coordination support: Dave Colpo, Teresa Fairchild, and Sarah Kirk (PSMFC)

Steering committee:

Name	Affiliation
Bob Dooley	Pacific Fishery Management Council
Dan Falvey	Alaska Longline Fishermen's Association
Melissa Sanderson	Cape Cod Commercial Fishermen's Association
Ben Martens	Maine Coast Fishermen's Association
Justin Kavanaugh	NOAA Fisheries - WCRO
Matthew Carnes	NOAA Fisheries - PIFSC
Claire Fitz-Gerald	NOAA Fisheries - GARFO
Nichole Rossi	NOAA Fisheries - NEFSC
Erika Feller	National Fish and Wildlife Foundation
Chris McGuire	The Nature Conservancy
Melissa Mahoney	Environmental Defense Fund
Shems Jud	Environmental Defense Fund
George LaPointe	Net Gains Alliance
Dorothy Lowman	Net Gains Alliance

National Electronic Monitoring Workshop Agenda

Day 1: Wednesday, February 12th, 2020

Meeting room: Grand Ballroom 8

8:00 – 9:00 am **Registration (coffee provided)**

9:00 – 9:20 am **Welcome and introductions**

- Brett Alger, NOAA Fisheries Electronic Technologies Coordinator
- Bob Dooley, Pacific Fishery Management Council Member
- Sam Rauch, NOAA Fisheries Deputy Assistant Administrator for Regulatory Programs
- Facilitators

9:20 – 10:00 am **National EM Overview: Where have we been and where are we now?**

Objective: Introduce EM; reflect on challenges identified in the 2014, 2016, and 2019 National EM Workshops; provide an overview of US programs and current national policy.

- Brett Alger, NOAA Fisheries
- Q&A/Discussion

PART 1: Regional EM experiences

Objective: Share regional experiences with EM program development, implementation, and costs; reflect on the role of national EM policy; and identify successes, challenges and lessons learned.

Through presentations and panel discussions participants will explore similarities and differences across regions and identify opportunities for sharing best practices.

- What are the keys to success? What are the challenges and plans to resolve them?
- How are national policies affecting program development?
- What are the key technologies and data applications being used?
- How are programs reducing costs?
- How do you see your region's EM program(s) changing over the next 5 years?

10:00 – 10:45 am **Regional EM experience – Pacific Islands**

- Presenter: Keith Bigelow, Pacific Islands Science Center, NOAA Fisheries
- Panelists: Josh Lee, Pacific Islands Regional Office, NOAA Fisheries
  Matthew Carnes, Joint Institute for Marine and Atmospheric Research
  Eric Kingma, Hawaii Longline Association

10:45 – 11:15 am **Break**

11:15 – 12:15 pm **Regional EM experience - Alaska**

- Presenter: Jennifer Ferdinand, Alaska Fisheries Science Center, NOAA Fisheries
- Panelists: Dan Falvey, Alaska Longline Fishermen's Association
  Ruth Christiansen, United Catcher Boats
  Julie Bonney, Alaska Groundfish Data Bank

Abby Turner-Franke, North Pacific Fisheries Association
Beth Stewart, Peninsula Fishermen's Association

12:15 – 1:15 pm **Lunch (provided[1])**
Grand Ballroom 9

1:15 – 2:15 pm **Regional EM experience – West Coast**

- Presenter: Justin Kavanaugh, West Coast Regional Office, NOAA Fisheries
- Panelists: Courtney Paiva, Pacific States Marine Fisheries Commission
  Brent Paine, United Catcher Boats
  Melissa Mahoney, Environmental Defense Fund

2:15 – 2:45 pm **Break**

2:45 – 3:45 pm **Regional EM experience – Northeast – Developing the 3rd party model**
Objective: Share regional experience and examine the 3rd party model groundfish-audit program for lessons learned and remaining challenges.

- Presenters: Niki Rossi, Northeast Fisheries Science Center, NOAA Fisheries
  Brant McAfee, Greater Atlantic Regional Fisheries Office, NOAA Fisheries
- Panelists: Melissa Sanderson, Cape Cod Commercial Fishermen's Alliance
  Chris McGuire, The Nature Conservancy
  Amanda Barney, Teem Fish Monitoring Inc.

3:45 – 4:45 pm **Panel Discussion: Designing a cost-effective industry-funded EM program**
Objective: explore questions and challenges with designing an industry-funded EM program (i.e., 3rd party model) and identify best practices and next steps.

- Presenter: Dan Linden, Greater Atlantic Regional Fisheries Office, NOAA Fisheries
- Panelists: Melissa Hooper, West Coast Regional Office, NOAA Fisheries
  Bob Dooley, Pacific Fishery Management Council Member
  Dan Falvey, Alaska Longline Fishermen's Association
  Julie Bonney, Alaska Groundfish Data Bank
  Niki Rossi, Northeast Fisheries Science Center, NOAA Fisheries
  Melissa Sanderson, Cape Cod Commercial Fishermen's Alliance

Discussion:

- What are key factors in designing a program that meets your goals? How do you avoid "scope creep"?
- How do you minimize video review and storage costs?
- How can we measure "soft" costs (e.g., added catch handling requirements? How do we analyze and share all costs?

4:45 – 5:00 pm **Day 1 wrap up and closing remarks**

[1] Lunch will be provided on both workshop days for all non-federal participants. Lunch will also be available both days for a fee to federal employees who selected this option during the pre-workshop registration process.

5:00 – 7:00 pm **EM vendor expo and networking**
Location: Grand Ballroom 7

EM vendors will be available with their EM equipment or services for demonstrations and questions. Attendees are invited to interact with EM vendors and meet with workshop participants.

Day 2: Thursday, February 13th, 2020

8:00 – 9:00 am **Registration (coffee provided)**

9:00 – 9:10 am **Welcome back and Day 1 recap**
- Workshop facilitators

PART 2: Integrating new technology and AI applications

9:10 – 10:30 am **Vendor panel and discussion**
Objective: Gain additional insight into EM successes and challenges from the perspective of EM service providers and learn about current and upcoming EM system advancements

- Howard McElderry, Archipelago Marine Research Ltd.
- Joshua Wiersma, Integrated Monitoring
- Jared Fuller, Saltwater Inc.
- Amanda Barney, Teem Fish Monitoring Inc.
- Chris Rodley, SnapIT HD
- Tomás Galán, Satlink
- Jacob Isaac-Lowry, Flywire

Discussion:
- What questions do stakeholders, managers, and vendors have for one another? What does each group think is important for others to understand?
- Where do you see your EM systems in the next 5 years?
- What are the trade-offs of a multi-vendor solution for a single program?

10:30 – 11:00 am **Break**

11:00 – 12:00 pm **Artificial Intelligence (AI) and innovative applications of fisheries data**
Objective: Explore how AI applications can support EM and fisheries data systems.

- Jordan Watson, Alaska Fisheries Science Center, NOAA Fisheries (webinar)
- Farron Wallace, Southeast Fisheries Science Center, NOAA Fisheries
- Eric Pennaz, Google
- Mark Hager, New England Marine Monitoring

Discussion:
- How can AI support data processing efficiencies?
- How do today's decisions impact future AI advancements? What can EM practitioners, vendors, managers, and others do to support AI implementation?

- What are the challenges and important principles for including data from AI models (e.g., computer vision applications) for science, management, and enforcement?

12:00 – 1:00 pm **Lunch**

1:00 – 1:30 pm **Wrap-up discussion: Integrating new technology and AI applications**
Objective: Identify challenges, questions, and potential next steps involved in implementing new technology and AI applications for use in fisheries management.

PART 3: EM Data Considerations

1:30 – 2:30 pm **Data mapping exercise and report from 2019 EM Data Sharing Workshop**
Objective: Review the flow of EM data from collection to storage and consider how data flow intersects with question about data sharing, access, security, and privacy.

- Kate Wing, Net Gains Alliance

2:30 – 3:00 pm **Break**

3:00 – 4:15 pm **Panel Discussion: Data access, security, privacy, and enforcement**
Objective: Explore questions commonly asked of NOAA Fisheries relating to data management, access, and enforcement. Identify specific outstanding questions and consider next steps for resolving key issues around EM imagery and summary data.

- Keith Hagg, Office of General Counsel, NOAA Fisheries
- Bob Hogan, Office of Law Enforcement, General Counsel, NOAA Fisheries
- Ben Cheeseman, Office of Law Enforcement, NOAA Fisheries
- Samir Mehta, Office of the Chief Information Officer, NOAA Fisheries
- Brett Alger, Office of Science and Technology, NOAA Fisheries

Discussion:
- When, by whom, and for what purposes can EM video be used?
- What are law enforcement priorities with regard to EM?
- What potential enforcement actions could be taken, who is accountable, and what are the consequences?
- Do vessels have access to their own video footage?

4:15 – 4:30 pm **Closing discussions, Day 2 wrap up, and closing remarks**
Objective: Share highlights from Day 2 including takeaways and potential next steps.

Discussion:
- What are your personal takeaways from this workshop? What have you learned, and how can you apply this knowledge to your own work?
- From your perspective, what aspects of EM implementation are beneficial to continue discussing at a national level? What is best left to the regions?

National Electronic Technology Policies

Policy on Electronic Technologies and Fishery-Dependent Data Collection

This policy provides guidance on the implementation of electronic technology (ET) solutions in fishery-dependent data collection programs. ETs include the use of vessel monitoring systems (VMS), electronic reporting (ER), video cameras, gear sensors, and automated image processing for electronic monitoring (EM), data collection technologies for human observers, and other technologies that can improve the timeliness, quality, integration, cost effectiveness, and accessibility of fishery-dependent data. The policy was originally published in 2013, and recently updated in May 2019; it includes a requirement that each Region and the Highly Migratory Species program publish a Regional Electronic Technology Implementation Plan (Plans).

Regional ET Plans were initially created in early 2015 and subsequently updated bi-annually through 2017. Regional programs are currently updating the Plans by June 30, 2020 looking forward five years (updated annually through the end of 2024) and to establish a Regional vision for developing, integrating, and implementing ETs. The Plans will include Regional priorities, Council actions, and research and development across all forms of ETs including VMS, ER, EM, and human observer technologies. These Plans will be used to prioritize funding from internal and external funding sources. Each Plan will highlight efforts to integrate these technologies through coordination and standardization of fishery-dependent programs within and across Regions. Each Plan should identify challenges with implementing ETs, cost information on ET programs, and a funding transition plan that includes sampling and administrative costs for EM programs.

Procedural Directive on Cost Allocation in Electronic Monitoring Programs for Federally Managed U.S. Fisheries

Constraining budgets and increasing demands for data are driving the need to evaluate and improve existing fishery-dependent data collection programs with respect to cost-effectiveness, economies of scale, and sharing of electronic technology solutions across regions. EM programs provide a potentially cost-effective solution for the data demand. In order to effectively implement the *Policy Directive on Electronic Technologies and Fishery-Dependent Data Collection,* this procedural directive was published to establish a framework for allocating costs for EM programs in federally managed U.S. fisheries between NOAA Fisheries and the fishing industry, and a timeline for implementing the framework.

The ET Policy Directive and the EM Cost Allocation Procedural Directive can be found here:

https://www.fisheries.noaa.gov/national/laws-and-policies/science-and-technology-policy-directives

Draft Procedural Directive for Minimum Data Retention Period for EM Programs

The use of EM is an effective tool for collecting critical fisheries-dependent data for science and management purposes. Unlike traditional means of data collection in fisheries, (e.g. at-sea observer programs and logbooks), EM data—or the "raw" data that is collected as video, imagery, or other metadata during fishing operations, as well as reviewed or processed summary data—can require substantially more storage space, which often drives the costs of EM programs. As such, the fishing industry has raised concerns over the costs associated with storing EM data, including:

- The amount, size, and format of the video being stored;
- The length of time the video is stored, and the storage options utilized (e.g. external hard drives, cloud storage, etc.); and
- The accessibility requirements for accessing EM data from storage.

This procedural directive would establish data retention requirements for data collected by EM systems that are the cost responsibility of the fishing industry, as prescribed in the EM Cost Allocation Procedural Directive. The draft procedural directive was presented to Fishery Management Councils and other stakeholders for review, with the comment period having closed on December 31, 2019. NOAA Fisheries is working to review the comments and revise the procedural directive before finalizing it this spring.

Retention Schedule for Federal Records from EM Programs

Currently, data collected by EM systems and submitted to and/or retained by NOAA Fisheries are treated the same as at-sea observer data for retention purposes under the National Archives and Records Administration (NARA), and are retained permanently. The amount and types of data collected from EM systems, such as video and sensor data, are different from traditional at-sea observer data, and much more costly to store. NOAA Fisheries is proposing a new retention schedule that balances the costs and risks of EM data retention with the need to preserve data to effectively meet monitoring program objectives and enforcement activities. A Federal Register notice will be published in the near future and a 45-day comment period for the public to provide input, prior to finalizing a new retention schedule for EM data under NARA.

For more information or questions on these policies, please contact Brett Alger, NOAA Fisheries Electronic Technologies Coordinator at brett.alger@noaa.gov.

Regional Electronic Monitoring Programs

Alaska

https://www.fisheries.noaa.gov/resource/document/amendment-alaska-region-electronic-technologies-implementation-plan

Program Information	
Geography	Alaska
Program Objectives	Bycatch, Prohibited Species Catch (PSC), and target species accounting; compliance monitoring; observer assistance
Target Species	Groundfish and Pacific Halibut
Gear Type(s)	Pelagic/non-pelagic trawl, demersal longline, pot/trap
Vessel Participation (2019 unless otherwise noted)	**Compliance-only EM:** 39/40 Trawl CP/MS (98%); 23/29 Longline CP's (80%) **Standard EM on fixed gear CV's:** 168/532 Longline and Pot CV's (34%) **Pollock pelagic trawl CV's, tenders, and plants (expected for 2020):** 49/86 CV's (57%); 9/14 tenders (64%); 6/12 plants (50%) **Research EM:** 4 Longline CV's (1%); 1 Trawl CP (3%); 2 plants (3%)
Program Status	**Compliance-only EM**: : Implemented within various sectors in 2000, 2008, 2011, and 2014; required by regulation for Catcher Processors/Motherships and processing plants in certain catch-share fisheries. Cameras ensure compliance with sorting regulations to ensure unbiased observer samples and assist observers in monitoring catch. Video retained aboard the vessel for 120 days and made available to NMFS upon request. **Standard EM on longline and pot CV's:** Piloted 2014-2017, operational as of 2018. Vessels which opt-in are not required to carry an observer. Catch events by species are enumerated by video reviewers; the reviewed data are converted into catch estimations and incorporated into the Catch Accounting System (CAS). **Pollock pelagic trawl:** Feasibility testing in 2020 through an Exempted Fishing Permit testing compliance monitoring for minimal discard with observer sampling at processing plants **Research EM**: 2014-current. Vessels volunteer to carry machine vision prototype systems developed by NMFS, the University of Washington, and the Pacific States Marine Fisheries Commission (PSMFC). Data are annotated and algorithms are being developed to automate species identification, length/weight estimates, event detection, and ultimately catch and bycatch estimation. Not currently used for catch estimation.
Budget/Finances	**Compliance-only EM**: Fully industry-funded; NMFS does not collect cost information. **Standard EM on longline and pot CV's:** In 2018, this program cost $961,131. Costs are adjusted to spread equipment cost over expected life. Fully funded by outside grants until 2020. Eventually will be sourced from the 1.65% observer fee. **Pollock pelagic trawl:** Not yet funded; expected to be fully funded by outside grants; NMFS does not collect cost information. **Research EM**: Variable depending on projects. Funded by NMFS through internal competitive programs. Expected to be ~$700,000 in 2020.
Percent Coverage	**Compliance-only EM**: 100% in required sectors

	Standard EM on longline and pot CV's: Targeting 30%; in 2018, realized coverage was 22.7% on longline and 25.2% for pot vessels. As a reference point, ~10-25% of non-EM trips are selected for observer coverage (variable by sector, see AFSC's 2018 Annual Report for actual realized 2018 coverage rates). **Pollock pelagic trawl CV's:** 100% EM coverage; targeting 30% observer coverage at Gulf of Alaska (GOA) processors receiving EM deliveries and 100% Bering Sea (BSAI) processors to ensure biological data collections. As a reference point, ~10-25% of GOA pollock trawl non-EM trips and 100% of BSAI pollock trawl non-EM trips are selected for observer coverage (see AFSC's 2018 Annual Report for actual realized 2018 coverage rates). **Research EM**: exempt from observer coverage; 100% review for annotation and algorithm development only

Entity	Program Roles
NMFS	• **Review Protocols:** Work with PSMFC to develop/improve • **Data Validation & QA/QC:** AFSC and AKRO approve VMP's and CMCP's, validate reviewed data, and submit feedback to vendors and reviewers • **Analysis/Extrapolation:** Process and compile reviewed data into Catch Accounting System (e.g., average weights are applied to enumerations for catch estimations) • **Video Review:** NMFS only reviews compliance video only; all other video review is completed by PSMFC
Fishermen	• **Catch Handling, Transmission, and Storage:** Fishermen and vendors work together to submit Vessel Monitoring Plans and Catch Monitoring Control Plans. Fishermen mail in hard drives for review; maintain compliance video for 120 days
Vendors	• **Hardware, Data Collection:** Install and maintain cameras, computers, sensors, etc.; troubleshoot systems in the field and work with fishermen to resolve operational issues
Other	• **Video Review, Storage:** PSMFC reviews and stores video used for fixed gear catch estimations, and video for pollock trawl CV EFP no-discard compliance

	Successes, Challenges, and Future Development
Successes	• Increased participation since inception • Strong support for EM in affected sectors • Strong regulatory compliance has been achieved in sectors with the aid of compliance cameras
Challenges	• Multiple objective programs like longline and pot EM are complex • Voluntary nature of EM programs increases difficulty in developing a comprehensive monitoring program incorporating technology and observers
Future Development	• Develop operational EM in the 2020 Pollock pelagic trawl catcher vessel fleet • Continue to expand EM into the longline and pot catcher vessel fleet • Refine and improve video review, QA/QC, and catch estimation protocols • Integrate automated machine vision systems (currently in development) into the operational EM suite

Canadian Pacific Groundfish

Program Information	
Geography	Canadian Pacific Region (British Columbia)
Program Objectives	The objective of the program is to provide a verification tool for the fisher's logbook. It is used for resource management, enforcement and scientific purposes.
Target Species	Ground fish (primary species are Halibut, Hake, Rockfish, Sole, Flounder, Cod, etc)
Gear Type(s)	Trawl, trap and Hook and Line
Vessel Participation	Approximately 300 vessels.
Program Status	This program is fully implemented and integrated into the fisheries management regime in the pacific region. There are other pilot programs on the east coast that I will describe in the presentations.
Budget/Finances	Fully paid for by industry.
Percent Coverage	100% coverage of all trips in the Halibut, Sablefish, Rockfish, Lingcod and Dogfish and Hake fisheries.. A random 10% of footage is reviewed unless certain thresholds are reached, in such cases 100% may be reviewed.

Entity	Program Roles
DFO	**Hardware – Selection & specifications:** Conditions of License for each specific fishery specifies the technical requirements for the hardware, but DFO does not qualify any particular hardware. The Integrated Fishery Management Plans (IFMPs) for each fishery describes the services that the Fisher must receive from a service provider. **Review Protocols** – Review procedures were developed collaboratively between DFO, industry and AMR in 2006. Any specific details that are required can be found in the IFMP. **Analysis – Data Validation & QA/QC** – DFO does not currently conduct a formal validation or QA/QC of data received from AMR.
Fishermen	**Hardware – Selection & specifications:** Fishermen purchase hardware that meets the specifications described in the CoL. They also contract, normally through industry associations, with AMR for the provision of EM services to meet their licence conditions. **Catch Handling** – All retained and released catch is handled in view of the cameras.
Vendors	**Collection:** Camera installation and collection of hard drives is done by AMR. **Transmission** – Hard drives are collected by AMR. **Analysis – Data Review** – Review of the data is done by AMR. For each trip, a random 10% of the sets on the video are reviewed. Retained and released catch for key species are recorded and compared to the fishers logbook. If the logbook is found to be within predetermined reporting standards for accuracy then it is used as the official record of catch for management purposes. If the data in the fishing log is below these standards

	then DFO may request AMR to review 100% of the video for that trip. In such cases, the catch information from the video review will be used as the record of catch for that trip. Additional charges for the 100% review are paid by the individual harvester. Approached as an educational opportunity, other options explored before going to 100% review. **Analysis – Data Validation:** Internal QA/QC processes are the purview of AMR. **Storage – Raw Data** – AMR stores original EM hard drives for 2 weeks unless it is a closed area occurrence or DFO requests it be held for enforcement purposes. The original EM hard drive is held until DFO gives approval to scrub it. It is then put back into circulation. **Storage** – **Processed Data** – AMR stores data for 3 years then it is archived. Currently the archived data goes back to 2012.

Successes
● Implementation of 100% EM coverage in the groundfish midwater trawl fishery and ground fish hook and line and trap fleets in the Pacific region.
● Co-developed of the monitoring regime by DFO (management and science), AMR and the fishing sectors resulted in a robust system that was supported by the industry.
Challenges
● Cost to industry.
● Lack of contractual arrangement between DFO and Service Providers results in a lack of control from a regulatory perspective.
● Limited market. AMR is currently the only video/EM service provider for the groundfish fisheries in the Pacific Region. **Note**: There are two other EM system service providers in the Pacific Region for the commercial crab fisheries. They are Ecotrust Canada and Pacific Coast Fisheries Services
Future Development
● Combining EM with traditional at-sea observation – EM system focusing on area of fishing activity, observers monitoring other areas of vessel such as processing.
● Adapting to changes in the fishery.
● East Coast – several pilots currently underway in Gulf Tuna, Gulf Scallop, NL Tuna and NL crab. Proposals in place to conduct more pilots and begin transitioning the Gulf Tuna pilot into a full EM program.

Atlantic Highly Migratory Species (HMS)

Program Information	
Geography	Western Atlantic and Gulf of Mexico
Program Objectives	Verification of vessel reported bluefin (bycatch) info
Target Species	Swordfish, yellowfin and bigeye tunas
Gear Type(s)	Pelagic longline
Vessel Participation	EM systems installed on 113 vessels (76 active vessels)
Program Status	Operational, Implemented in 2015.
Budget/Finances (funding estimates below)	NOAA Funded EM Program - Approximately $1.3M per year, including software development.
Percent Coverage	Approx. 10% of pelagic longline sets audited via EM

Entity	Program Roles
NMFS	Program Oversight Implement regulations (functional requirements), contract with EM vendors Review protocols – Sample design and selection Analysis – Data validation, comparison of EM data to other data sources Enforcement: Coordination with vendors on vessel compliance
Fishermen	Catch handling; Transmission: Mail hard drives; submit VMS reports Hardware maintenance - communicate with vendor as needed
Vendors	Saltwater- Installation and maintenance of EM systems ERT- Hard drive management, data processing and storage, Video review, QA/QC, software development

Successes
Program objectives met: deployment of operational EM systems on 113 vessels, verification of vessel data on bluefin catch
Evolving program, including software development to improve efficiency and data accessibility
Expanded to include verification of shortfin mako shark disposition; EM capabilities of fleet facilitated international negotiating position on retention of makos
Challenges
Future funding (NMFS vs Fleet)
Improvement of discard detection
Refinement of program metrics (what level of matching accuracy is acceptable?)
Implementing advanced software and AI tools.
Future Development (for consideration)
Optimization of video image (e.g., modify requirement for location of rail camera; standardized measuring mat on deck, etc)
Changes to hard drive shipping frequency

Current Annual Funding Estimates	
Atlantic HMS Pelagic Longline	
Program Support - EM installation, training, and maintenance	$570,000
EM Program Performance Monitoring - Reviewing video and data to optimize sampling rates - Analyzing data and integrating into monitoring program	$308,437
Video and Data Storage - Video storage and access - EM database maintenance - EM database enhancements	$740,563
TOTAL	**$1,049,000**

Northeast

Program Information	
Geography	Northeast region: ME, NH, MA, CT, RI, NJ
Program Objectives	Groundfish audit-model program: VTR verification for catch estimation Groundfish MREM program: compliance; Herring: EM will verify catch retention, portside sampling will supply catch composition for quota monitoring
Target Species	Groundfish, Herring (mid-water trawl fleet)
Gear Type(s)	Groundfish: hook, benthic longline, sink gillnet, otter trawl; Herring: midwater trawl
Vessel Participation	Groundfish: ~25 vessels; Herring: ~12 vessels (fleet has yet to select monitoring option)
Program Status	Groundfish audit-model program: Ongoing operational program under an EFP (Fishing Year 2016-Present) Groundfish MREM model: Ongoing operational program under an EFP (Fishing Year 2018-Present) Herring pilot program: Pilot program, Completed (August 2016 - January 2018) (https://www.nefmc.org/library/april-2018-industry-funded-monitoring-ifm) Operational program combined with portside under an exempted fishing permit, expected April 2020
Budget/Finances	Groundfish programs: EFPs are primarily funded via National Fish and Wildlife Foundation grants; the dockside monitoring component of MREM is supported by temporary agency funds. Herring programs: NOAA has secured funding for the first year of the IFM Amendment; these funds will cover the industry's EM costs for the first year. Industry will be responsible for portside monitoring costs.
Percent Coverage	Groundfish audit-model program: 100% EM coverage and 50% video review; NEFOP observers deployed on a subset of trips to collect biological information Groundfish maximized retention electronic monitoring program: 100% EM coverage and 100% video review; At-sea monitoring are deployed on a subset of trips to collect catch information Herring pilot program: EM - 100% coverage and 50% video review; Portside - 50% of total trips (not exclusive to EM vessels); NEFOP - observers deployed on a subset of trips to collect biological information

Entity	Program Roles
NMFS	Groundfish and Herring Programs: Data collection: Dockside monitors (MREM), portside samplers (herring) Review protocols: NMFS develops and trains reviewers in review protocols Analysis - Data validation & QA/QC: NMFS conducts secondary video review on a subset of trips to examine EM service provider's performance Storage-Processed Data: NMFS stores summarized catch data submitted by vendor
Fishermen	Groundfish audit-model program: Catch handling: Holds fish over length strip prior to discarding Transmission: Mail-in hard drives to vendor and logbooks to agency Groundfish MREM program: Catch handling: Retain and land all allocated groundfish catch, including undersized fish Transmission: Submit logbooks to agency Herring program

	No changes to catch handling. Captain must report slippage as normal and abide by slippage requirements. Transmission: Mail-in hard drives to vendor and submit logbooks to agency.
Vendors	Groundfish and Herring Audit-model program vendor: Teem Fish MREM program vendor: Integrated Monitoring Herring pilot program vendor: Saltwater Hardware - selection and specifications: No hardware specifications at this time Data collection: cameras (audit-model) Transmission: Video syncs to cloud when vessel enters wi-fi range (MREM program only) Analysis- Data Review: Vendor reviews video footage of trip Storage- Raw Data: Vendor retains and stores video footage indefinitely Storage- Processed Data: Vendor retains a copy of the summarized catch data submitted to agency indefinitely

Successes
• (Audit) 1) Evaluated third-party video review for catch accounting; 2) Developed audit methodology comparing discards seen on video footage to fishermen's eVTRs; 3) Refined catch handling and standardized video review protocols; and 4) Implemented and evaluated an internal secondary review as a quality control measure to ensure data integrity.
• (MREM) 1) Examined feasibility of discard compliance monitoring in a mixed-species fishery; 2) Tested and implemented maximized retention; 3) Developed a pilot dockside monitoring program to collect catch data and monitor potential changes in size distribution.
• (Mid-water Trawl Herring) In April 2018, the New England Council approved EM, used in conjunction with portside sampling, as a monitoring option for midwater trawl vessels to satisfy the Industry Funded Monitoring (IFM) requirements in the Atlantic herring fishery.
Challenges
• Minimal participation due to low observer coverage in the fishery, continued NMFS funding of the monitoring program, and a lack of incentives to participate.
• Limited NMFS resources and staffing to support EM and ER development. Lack of permanent funding inhibits the agency's ability to scale to full fleet participation or properly support an operational program.
• Industry participation has centered on interested from the day-boat fleet. The absence of participation from the trip-boat fleet or high volume catch vessels limits the region's ability to understand how to properly apply EM to this portion of the fleet.
Future Development
• Further develop business practices necessary to support an operational EM program including; data analysis protocols and design for the audit-model (i.e., percentage of video reviewed, pass/fail criteria, development of subsampling and volumetric sampling approaches).
• The NEFSC is developing the database infrastructure to incorporate EM data into assessments and is working on creating one shared data system that collectively meets management and science needs.
• The NEFMC is currently developing Amendment 23 to the groundfish Fishery Management Plan. The purpose of Amendment 23 is to implement measures to improve reliability and accountability of catch reporting and to improve the accuracy of collected catch data for the groundfish fishery. As part of this amendment, the Council is considering adopting EM as an option to meet monitoring requirements.
• The region is preparing to support EM (under an EFP) in the mid-water trawl herring fishery as a monitoring option under the IFM Amendment in April 2020. Agency funds were secured to cover the industry's costs for the initial year.

The project costs below were provided in the report by Cap Log Group, LLC, commissioned by The Nature Conservancy and presented in April 2019. This report can be found on the em4.fish website in their library of documents. https://em4.fish/our-library/projected-cost-of-providing-electronic-monitoring-to-100-vessels-in-the-new-england-groundfish-fishery/

Projected annual cost of operating an Audit-Based EM program for 100 vessels in New England's Groundfish Fishery with 100% coverage and 50% video review after two years of startup costs (estimates provided by The Nature Conservancy)	
Program Administration and Operations Costs - Program management - Management software and systems - EM submission, review and reporting - EM video/data transmission and storage	$901,148
On-vessel costs - Repair and support of EM systems - EM equipment and software would have an initial cost of $672,000 in the first year for all new participants to the program, would have no cost after that	$162,000
Policy, Regulatory and Program Development Costs - Program planning and development would cost $193,200 over the first two years	$0 after start-up
TOTAL	**$1,063,148**

Additionally, NE EM projects have been supported by the annual FIS/ET/CSP Request for Proposals, below are the names and costs of some of those projects. More details can be found on the NOAA FIS Supported Projects website. https://www.fisheries.noaa.gov/data-tools/fis-supported-projects

FY2020 - Administering Portside Sampling in the Atlantic Herring Fishery (NEFSC), $28,250.00

FY2019 - Building a Comprehensive Electronic Monitoring (EM) and Electronic Reporting (ER) Integrated Database Infrastructure to Support Operational Electronic Monitoring Programs (NEFSC), $490,000

Support for Implementing and Administering Industry-Funded Electronic Monitoring in the Atlantic Herring Midwater Trawl Fishery (NEFSC), $342,118

Capitalizing on a groundfish image library to test automated image classification in the northeast region (NEFSC), $130,000

Continued Funding for Dockside Monitoring Program to support Maximized Retention Electronic Monitoring Pilot in the New England Groundfish Fishery (GARFO), $200,000

Unifying Electronic Monitoring and Vessel Trip Reporting Collection Systems (GARFO), $12,000

FY2018- Building a Library: Image Processing and Machine Learning to Support Electronic Monitoring Programs (NEFSC), $135,000

Leveraging EM Technology to Support Catch Cap Monitoring and Improve Safety----Testing Emerging Echosounder Technology in Combination with Electronic Monitoring to Improve Management of the Atlantic Herring Midwater Trawl Fishery (NEFSC), $376,800

Portside Sampling for the Atlantic Herring Midwater Trawl Fishery (NEFSC), $57,750

FY2017 - Dockside Monitoring Program to support Maximized Retention Electronic Monitoring Pilot in the Groundfish Fishery (GARFO), $180,000

Pacific Islands

Program Information	
Geography	Pacific Islands Region (Hawai'i based)
Program Objectives	Protected species monitoring, quota monitoring
Target Species	Tuna, Swordfish
Gear Type(s)	Pelagic Longline
Vessel Participation	25 systems
Program Status	Pre-implementation: Baseline research has been completed, a steering committee was formed in September 2019 to discuss implementing ER/EM.
Budget/Finances (cost estimates below)	Funded so far by FIS, CSA, and Cooperative Research Grants
Percent Coverage	10% EM coverage, Video reviewed on adhoc basis for research, no set review rate

Entity	Program Roles
NMFS	● **Hardware:** Custom built systems running Chordata software ● **Collection**: Systems are outlined at https://pt.chrdta.com/em/ ● ***Analysis:*** *Data Review*: JIMAR staff have watched the majority of footage and also perform audits on all third party review that was submitted by SWI and Lynker ● **Review Protocols**: Joint Institute staff created review protocols based on existing observer protocols ● **Transmission**: Project staff collect system off vessel when it lands, evaluate functionality of system ● **Analysis – Data Validation & QA/QC** – Data are compared to logbook, observer data, and buyer data to validate the EM data stream. QA/QC is done through automated checks for logical errors (caught dead, released alive, etc.) ● **Storage – Raw Data**: Stored by PIFSC indefinitely on LTO tapes ● **Storage** – **Processed Data**: Stored by PIFSC indefinitely in Database
Fishermen	● **Collection***:* Vessels are volunteer status, can leave the project at any time ● **Hardware**: Vessel keeps lenses clear during the trip, report issues as they happen ● **Catch Handling**: No specific requests for 2017-2019, 2020 vessels are asked to bring sharks closer
Vendors	● **Analysis – Data Review**: Lynker and SWI have provided review at times ● **Hardware:** NMFS bought original systems from SWI. Transitioned to custom build 2020.
Other	● **Funding:** FIS awards have funded project so far.

Successes
● 8x speed review with 720p video is most accurate of other speeds ● SWI and Chordata have been extremely helpful giving support of ● Fishing industry has been extremely supportive of effort, Captains use data for themselves ● **<u>No protected species missed by EM at 8x speed</u>**

Challenges
● Bycatch is difficult to find without catch handling regulations ● Animals are cut before they are able to be identified on camera ● Animal never surfaces or comes into light before it is freed ● 4x speed review resulted in missing protected species, 16x resulted missing catch events ● Reviewers need to be engaged but not over taxed
Future Development
● Regional Electronic Technologies Steering committee formed ● PIFSC investing in centralized AI infrastructure ● Working with Protected Resources on utility of EM ● Continued work with annotation of rare and common events to keep DB up to date

Current Annual Funding Estimates	
PI – Pelagic Longline	
Program Support - Council support, rulemakings, permitting - Staff time to review equipment on vessels and VMPs - Facilitate communications between participants and providers	$35,000
Certification of EM Providers - Purchasing hardware - Examine software, hardware, and data reports	$120,000
EM Program Performance Monitoring - Special Projects - Reviewing video and data to optimize sampling rates - Analyzing data and integrating into monitoring program	$190,000
Video and Data Storage - Video storage and access - EM database maintenance	$2,000
TOTAL	**$347,000**

Southeast Pilot Studies

1) Mote Marine Lab's Center for Fisheries Electronic Monitoring at Mote (CFEMM): CFEMM advances electronic monitoring in partnership with the Gulf of Mexico commercial fishing industry, charters-for-hire, federal and state management organizations, subcontractors, EM equipment and software providers, and other stakeholders.
2) Southeast Shrimp Trawl Observer Program Pilot Electronic Monitoring (Shrimp Trawl EM): In partnership with the shrimp trawl industry, the NMFS Southeast Fisheries Science Center conducted a pilot study to test video monitoring hardware and software to determine the feasibility of developing a cost-effective and reliable system of monitoring smalltooth sawfish bycatch, release mortality, and other shipboard practices aboard shrimp trawl vessels.

Program Information	
Geography	CFEMM: Ports in FL and TX (fishing activity coverage-federal waters-West FL Shelf, SW, NW, W FL) Shrimp Trawl EM: U.S. Gulf of Mexico
Program Objectives	CFEMM: Data on catch, bycatch, and protected species interactions for industry & management Shrimp Trawl EM: Bycatch Estimation
Target Species	CFEMM: Snapper Grouper fishery Shrimp Trawl EM: Shrimp
Gear Type(s)	CFEMM: Bottom longline and vertical lines Shrimp Trawl EM: Otter Trawl
Vessel Participation	CFEMM: 14 (up to 18 have participated) Shrimp Trawl EM: 3
Program Status	CFEMM: Independent pilot projects, funded through NFWF and NOAA/NMFS. Sept 2016 to ongoing (current NFWF). Shrimp Trawl EM: No established programs NOAA is involved with in the GOM shrimp fishery. Manuscripts accepted for publication. Saltwater Final Report.
Budget/Finances	CFEMM: ~$500,000. (current NFWF). NOAA/NMFS BREP & CRP (~$350,000) Shrimp Trawl EM: Estimated budget $490,000.
Percent Coverage	CFEMM: Low coverage (14 of 68 permitted BLL [not all of these fish]); 25% video review of complete events/trip. Shrimp Trawl EM: 2% observer coverage in the GOM shrimp fishery.

Entity	**Program Roles**
NMFS	Shrimp Trawl EM: Provided observers to ground truth data.
Fishermen	Shrimp Trawl EM: Contracted shrimp industry owners.
Vendors	CFFEMM: Archipelago Marine Research (Past) & Saltwater Inc. (SI) (Current); Fabrication Companies (welding and boom construction); SeaSucker (underwater camera mount engineering); SubAqua Imaging (underwater camera)

	Shrimp Trawl EM: Saltwater, Inc. for Hardware, Collection, Analysis – Data Review. Data Validation in collaboration with NMFS observer data base.
Other (Mote)	CFEMM: ***1.*** *Hardware - Selection & Specifications* – Chosen by Mote ***2.*** *Collection (Equipment, People)* – Archipelago Marine Research; currently Saltwater Inc. ***3.*** *Catch Handling* – Annotated for each reviewed event ***4.*** *Review Protocols* – Developed by Mote based on NMFS, SI, and Industry feedback. ***5.*** *Transmission* – Imagery reviewed post trip at CFEMM. ***6.*** *Analysis – Data Review* – Mote staff; reviews 25% of complete events/trip; Uses R for aggregation of data; Waterinterface LLC. ***7.*** *Analysis – Data Validation & QA/QC* – Set QA/QC points in process; R data checks; Link EM trips to Dealer trip tickets, Observer Reference No.'s, and Trip Interview Program Reference No.'s. ***8.*** *Storage – Raw Data* – Dedicated server and network attached server ***9.*** *Storage – Processed Data* - Dedicated server and network attached
Successes	
CFFEMM: 1) Advance Data processing, management, review, analysis; 2) Functional process development and protocols; 3) Development of cost-effective technical labor resources	
Shrimp Trawl EM: Per Saltwater final report - Overall the image quality was good, resolution was adequate to allow the reviewer to observe fairly small sharks that were brought on deck. The hardware held up for the duration of the trips with no water ingress to the deck components and there were was only one significant gap that may have been caused by a system component malfunction.	
Challenges	
CFFEMM: Equipment depreciation; Inconsistent fisher protocols vessel to vessel; Unstable funding; Video storage.	
Shrimp Trawl EM: There was very limited interest in participation by vessels in the fleet, which prohibited full project implementation. There were two significant video gaps, with no opportunity to troubleshoot issues while the system was installed.	
Future Development	
CFFEMM: 1) Underwater camera system for cut-offs of larger species (e.g., sharks); 2) Digital ruler to remotely measure fish; 3) EM Data modeling 4) Artificial Intelligence Development	
Shrimp Trawl EM: NMFS proposal funded for 2020 for EM in the GOM shrimp fishery: 1) Outreach to the fishing industry to describe the project and the benefits of video monitoring; 2) Deployment of 7 systems on 7 vessels over a 12-month period; 3) Determine/establish the most appropriate monitoring/sensor system and methods that best meets sampling objectives; 4) Use imagery previously collected and those collected in this study; and 5) Using these annotations, re-train Alaska Fisheries Science Center image analysis machine learning algorithms that estimate volume of catch and discard species identification for the southeastern shrimp fishery.	

West Coast Groundfish

Program Information	
Geography	Washington, Oregon, California
Program Objectives	At-Sea discard accounting for Individual Fishing Quota species (auditing vessel-reported logbook discards)
Target Species	Multispecies groundfish including Pacific whiting, sablefish, rockfish, flatfish
Gear Type(s)	Fixed gear, midwater trawl, bottom trawl
Vessel Participation	Approximately 50
Program Status	Currently operating under Exempted Fishing Permits (EFP). Final rule published July 2019 for whiting and fixed gear fisheries with follow up rule for bottom trawl and non-whiting midwater trawl pending. Full program implementation under regulation: January 2021.
Budget/Finances (cost estimates below)	EFP program funded by NMFS. Transition to EM costs borne by industry (catch share observer coverage costs paid by industry).
Percent Coverage	100% at-sea and dockside monitoring requirements under trawl rationalization. EM: 100%, with potential for less than 100% review.

Entity	Program Roles
NMFS* (*This is under the regulatory model starting in 2021, PSMFC provides under EFP through 2020)	● **Approve EM Service Providers and vessels** ● **Catch Handling:** design catch handling protocols in coordination with PSMFC, approve vessel monitoring plans. ● **Review Protocols**: design review protocols in coordination with PSMFC review ● **Analysis – Data Validation & QA/QC**: verify logbook data initially at trip/haul level. Audit a percentage of 3rd party reviewed data ● **Storage – Raw Data**: Store raw data as requested for NMFS audit purposes. ● **Storage** – **Processed Data**: Intake processed data (EM summary data) for logbook comparison and discard deductions of shorebased vessel accounts and at-sea mothership sector ● **Program monitoring and Enforcement**
Fishermen	● **Hardware - Selection & Specifications:** select a NMFS-approved EM Service provider ● **Collection:** Fill out discards in logbook, report malfunctions and EM system issues ● **Catch Handling:** Follow catch handling protocols as described in vessel monitoring plans. ● **Data Transmission**: submit hard drives and logbook data.
Vendors	● **Hardware**: design and deploy the hardware systems which meet the program's general technical specifications. ● **Collection:** EM systems continuously record and store video and sensor data. ● **Review Protocols** follow review protocols as established by NMFS for accurate accounting of at-sea IFQ discards and verification of catch handling/data quality. ● **Transmission Analysis – Data Review**: process raw EM data submitted by vessels. Annotate and create EM summary data and transmit to NMFS. ● **Analysis – Data Validation & QA/QC:** perform internal QA/QC. Validate hard drive data for completeness (gaps, number of trips and hauls). Use NMFS audit feedback for additional QA/QC as necessary.

	Storage – Raw and processed Data: store raw data for minimum timeframe based on storage procedural directive (12 months after annual data finalization)

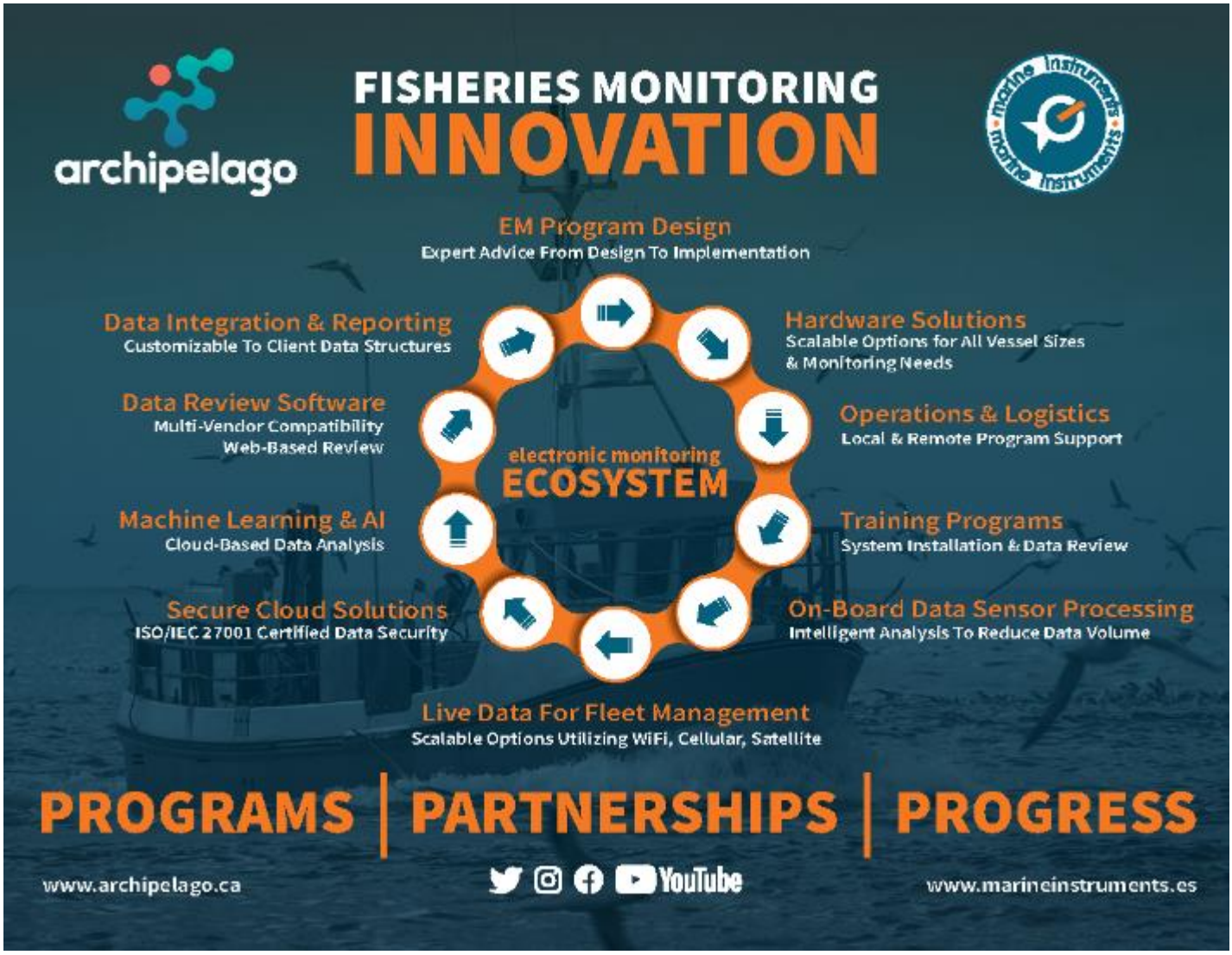
Successes
• Successfully tested EM for effective monitoring of discard debits under EFP over a number of years
• Participation from vessels of all approved gear types (whiting midwater trawl, midwater non-whiting trawl, bottom trawl, fixed gear)
Challenges
• Costs
• Transition to 3rd party model
• Data infrastructure: need to build out components on NMFS side
• Data lag
Future Development
• Update data storage requirements in regulation to align with national storage procedural directives
• Potential for adopting new technologies to increase efficiencies

Annual Estimated Costs for the WC Goundfish EM Program - This table provides the projected estimate of costs once the regulatory program goes into effect in 2021. These estimates were provided in a report to the Pacific Fisheries Management Council in November 2019. More details, including estimated cost recovery fees, can be found in the report[2].	
Administration of EM program [NMFS Cost] - Labor, equipment, licenses, and data storage	$450,000
Equipment [Fleet Cost to provider] - Purchase, lease, and installation of equipment	$90,000
Video Review [Fleet Cost to provider] - Labor (Based on recommended reduced sampling rates)	$126,470
Program Management [Fleet Cost to provider] - Vessel outreach - Generating and submitting reports	$57,220
Data Storage [Fleet Cost to provider] - Based on 4 years of data storage on local servers	$48,754
Service and Maintenance [Fleet Cost to provider] - Routine maintenance, 24-hour technical support - Repair and replacement of EM system components	$300,000
TOTAL	**$1,072,444**

[2] https://www.pcouncil.org/wp-content/uploads/2019/11/H3a_Sup_NMFS_Rpt6_EM_costs_est_NOV2019BB.pdf

Electronic Monitoring Service Providers

Archipelago and Marine Instruments



NOAA FISHERIES

PROGRAMS

Building on a platform of previous EM experience to ensure knowledge transfer and effective program implementation.

PROGRESS

Ensure EM technology continues to evolve with changing needs and becomes adopted where appropriate.

PARTNERSHIPS

Actively engaging with all stakeholders to ensure that monitoring programs are more successful. Leveraging our collaboration to ensure we offer the highest quality, cutting edge EM technologies to our clients around the world.

marine instruments

archipelago

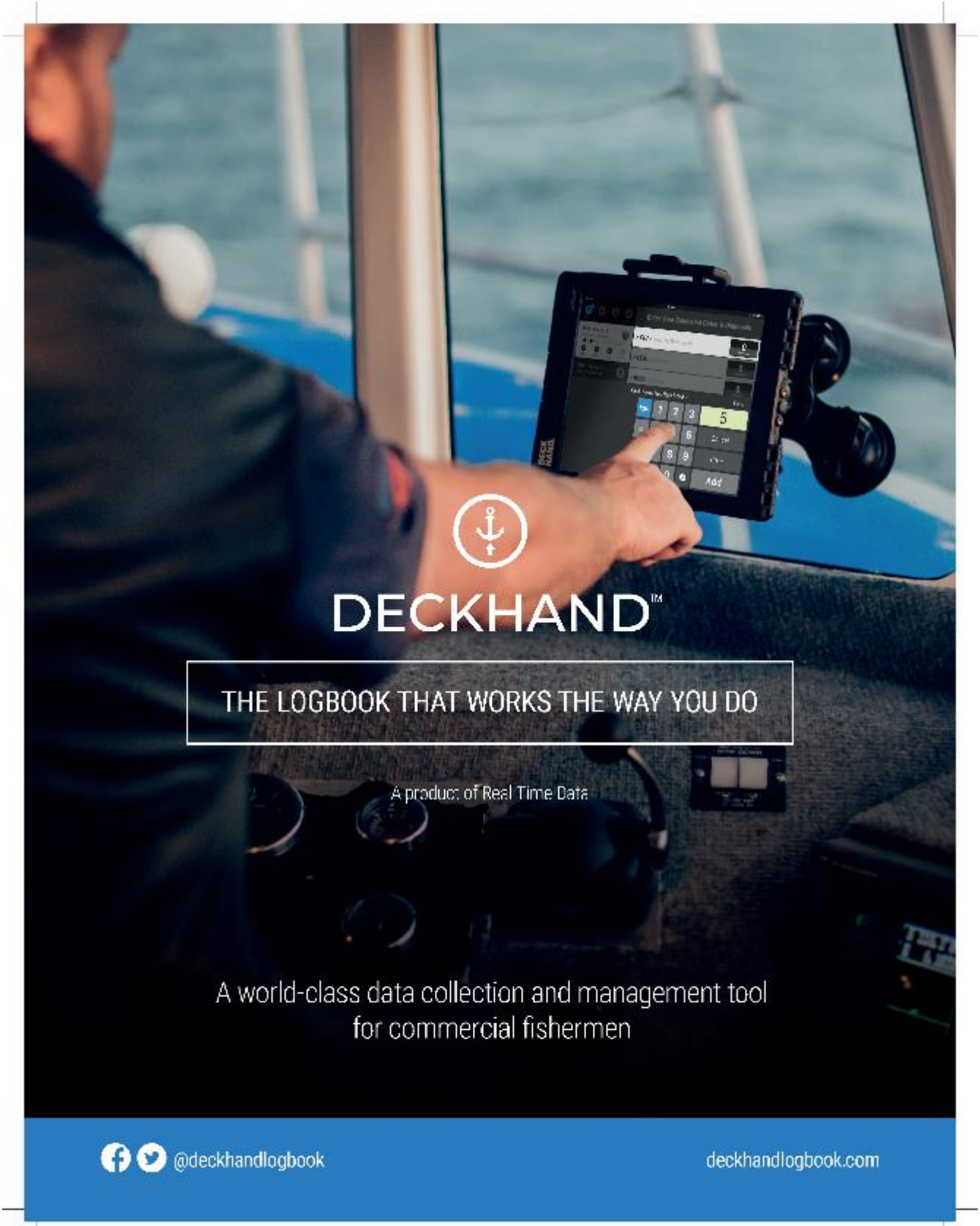
In 2017, Archipelago and Marine Instruments partnered to enable the advancement and implementation of EM technology around the world. Marine Instruments brings a strong worldwide presence in the marine industry and years of technical innovation in marine electronics, satellite communications with significant experience in R&D and manufacturing. Archipelago pioneered the use of EM technology for commercial fisheries in 1999 and currently delivers EM products and services throughout North America, Europe, Australasia, and the Antarctic.

With over 600 EM systems installed across the globe, Archipelago is the largest provider of EM products and services in the world.

SCAN FOR MORE INFO

Bluefin Data

Deckhand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NOAA FISHERIES

DECKHAND™

ENTER DATA WHILE FISHING

THE REST IS AUTOMATIC

KEY FEATURES

EASE OF USE
Enter data as it occurs on deck

RECORD EVERYTHING
Automatically record spatial data

ANY VESSEL SIZE
Designed for open decks or full wheelhouses

SEND REPORTS
Uploaded data gets delivered

ANY GEAR TYPE
Pots, traps, nets, diving, seining, etc.

VIEW COLLECTED DATA
All the data on an interactive map

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HIGH SPEED ANALYSIS

Cloud storage, AI, and expert reviewers deliver the data you need when you need it.

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Being monitored shouldn't slow you down. We keep your deck running the way it should.

STRESS-FREE REPORTING

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Harbor Light produces software to support fisheries management

Founded in 2012, Harbor Light Software (HLS) was commissioned by the Rhode Island Party and Charter Boat Association to build a tablet-based software system to track fishermen in the proposed Block Island Wind Farm area. The data collected in this project was successfully used by the fishermen to push for the relocation of the turbines.

>> Fast forward to 2019. Building upon that first project and working together with the Atlantic Coastal Cooperative Statistics Program (ACCSP), Harbor Light built the industry standard, **eTrips mobile2,** for catch and effort electronic reporting. Next, HLS developed **eDR mobile** for dealer reporting and **Dockside, an electronic APAIS tool.** HLS is currently working on innovative projects with the ACCSP and its partners to incorporate data from various VMS vendors into eTRIPS mobile2 and to expand Dockside to allow voice input.

Today, there are many EM companies focusing on the next best thing and the latest in innovations to accurately capture catch/effort and location data from vessels out at sea. Captains use various electronics that each collect data in a different way.

Our vision is to have one system to use as a single point of data input.

HLS designs custom software that integrates with electronic monitoring systems to provide standards-based reporting and data collection. From sea to plate, HLS envisions an easy to use "Mobile Hub" that allows captains to collect information from different vendors into a single reporting system. This strategy removes redundancy not only for fishermen, but also for dealers, sector managers and enforcement. Data should flow seamlessly through this interface to the end goal, without additional effort from the captains, letting them concentrate on catching fish, not data.

Harbor Light's help desk is available for support 24 x 7/ 365 days a year, so anything built for fishermen is supported around their working hours. We also have on-the-ground support teams to ensure the best experience for the end user.

Partner with Harbor Light to help your company move forward in the world of Electronic Monitoring. We have built successful data collection software that is used by these agencies, and others.

"If you can think it, we can build it."

Integrated Monitoring

NOAA FISHERIES

Lynker

Authenticity. Passion. Success.

Lynker is a growing, HUBZone-certified, water-focused small business delivering innovative high-value scientific, engineering and management solutions with offices in Leesburg, VA, Boulder, CO, and Honolulu, HI. We are Scientists, Engineers, Developers and Conservationists – mission-focused and highly passionate.

Marine, Ocean & Coastal Science & Information

- Electronic Data Collection, Reporting, & Analysis
- Marine, Ocean & Coastal Resource Management
- Scientific Information Systems
- Geospatial Analysis, Modeling, and Visualization
- Policy and Regulatory Compliance
- Communications, Outreach and Education
- Fisheries and Protected Species Observers
- Conservation and Resilience Planning & Management

Water & Environmental Resources

- Hydrologic Modeling & Analysis
- Water Resources Planning
- Climate Hazard, Risk, Impacts & Adaptation
- Flood Modeling, Forecasting & Warning
- HydroInformatics
- Environmental Assessment & Restoration
- Watershed, River & Coastal Management
- Science Data Mining
- Environmentally-Focused AI & Machine Learning

Integrated Technology Services

- Program and Project Management
- Data Management and Analytics
- Full Life Cycle Agile Development
- Legacy System Modernization
- Help Desk Support and Consolidation

Business Highlights

Established 2007

NOAA ProTech Awardee

Fisheries, Oceans & Weather

Awards

- #1 ranked HUBZone company at NOAA
- Recipient of 20+ NOAA Team Member of the Year Awards
- WBJ Fastest Growing Companies 2019, 2018
- Inc 5000 Fastest Growing Companies, 4 yrs in a row
- Rated one of the Best Companies for Millennials by Comparably
- Comparably's Best Companies for Work-Life Balance
- 2015 NOAA Small Business Success Story

Certifications

- CMMI-Dev Level 3
- HUBZone Certified
- ISO 9001:2015
- ISO 20000
- ISO 27001

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NOAA National Marine Fisheries Service (NMFS)

Lynker supports a comprehensive 5-year contract covering 5 NMFS regions. We support a wide range of marine resource management, coral reef conservation, field and laboratory research, spatial tool development, and communications and outreach needs. Our cross-disciplinary team numbers over 90 marine biologists, ecologists, resource specialists, social scientists, economists, bio-technicians, molecular geneticists, field researchers, aquaculturists, habitat restorers, scientist scuba divers, information technology (IT) and geospatial (GIS) data specialists, technical writers and illustrators, and outreach and education specialists.

We integrate scientific disciplines into ecosystem-based management and restoration information and products that help NOAA and stakeholders understand, for example, toxic chemical threats to estuarine ecosystems, species and coastal habitat (i.e. coral and sponges) interactions and associations, and socioeconomic impacts of proposed regulations on the fishing industry and other stakeholders. NOAA recognized Lynker's exceptional work through several employee recognitions and Team Member of the Year awards.

NOAA Professional and Technical (ProTech) Fisheries & Oceans

Lynker is a Small Business and HUBZone-certified awardee on the ProTech Fisheries and ProTech Oceans Domain vehicles. These Indefinite Delivery, Indefinite Quantity (IDIQ) multiple award contracts are designed to provide a full range of scientific, technical, and professional services across NOAA.

ProTech Fisheries primarily serves the needs of NOAA's National Marine Fisheries Service (NMFS) which ensures that the US maintains, protects, and sustains productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems. The scope of contract includes biological, ecological and environmental studies, analyses, and reports; applied research, engineering, and operations; field sampling, data collection and surveys; and consulting. Under the ProTech Oceans contract, Lynker is eligible to compete for task orders supporting primarily NOAA's National Ocean Service (NOS). Services offered range from marine and coastal studies, analyses and reports; applied research, engineering, consulting and operations; field sampling, data collection and surveys; consulting, program and project management; and capacity building.

Lynker is well positioned to perform ProTech Ocean and Fisheries work in all U.S. coastal regions including territories in the Pacific and Caribbean.

NOAA Office of National Marine Sanctuaries (ONMS)

Lynker supports the management, administrative, education and outreach, capacity building, scientific research, information technology, and facilities maintenance requirements for the Papahānaumokuākea NMS and Monument, International MPA Capacity Building Program, and the Humpback Whale, American Samoa, and Monterey Bay NMS. We help implement the NMS Act by developing strategies for both short and long-range planning, cooperative agreements, policies, budgets, and work plans. We advise on marine and coastal conservation initiatives, coordinate research operational planning and execution, generate geospatial information and tools, and participate in fieldwork and research. Our education, outreach, and training experts coordinate citizen water quality monitoring networks, train docent and other volunteers, plan local education and outreach events, and effectively utilize print, social media, and networking tools.

Our work extends to developing mobile collection applications to enhance data entry and GIS databases and web interfaces to facilitate information access. Our efforts advance ecosystem and habitat research, conservation, and custodianship across one third of the California coastline and expansive areas of the Pacific Islands.

Saltwater Inc.

Saltwater Inc. was founded in 1988 on the belief that the health of our fisheries and oceans is one of the critical issues of our time. We collect high quality data for government agencies, research organizations, and fishermen.

Saltwater's EM program builds on over 25 years of fishery monitoring experience and offers a full range of EM services including: *program design, ongoing R&D, specialized onboard EM equipment & data acquisition software, open-source data review software, training, remote & in-field technical support, and data management, review & analysis services.* Our EM clients include NOAA, Mote Marine Laboratories, The Nature Conservancy, The Environmental Defense Fund, and multiple individual vessel owners.

WHERE SALTWATER WORKS

- Alaska Fixed Gear, Pot & Longline (Cod & Halibut): 2010-Present
- Gulf of Mexico Trawl (Shrimp): 2014-2018
- Atlantic Pelagic Longline (Highly Migratory Tuna): 2014-Present
- Gulf of Mexico Bandit & Bottom Longline (Reef Fishery): 2015-Present
- New England Midwater Trawl (Herring & Mackerel) 2016-Present
- West Coast Midwater Trawl (Whiting): 2016-Present
- Hawaii Deep & Shallow-set Pelagic Longline (Tuna & Swordfish): 2016-2018
- Antarctic Longline (Toothfish): 2017-Present
- Western Gulf of Alaska Trawl (Pollock): 2018-Present
- New England For-Hire Vessels (Mixed Fishery): 2019-Present
- Puerto Rican Small-Boat Fleet (Reef Fishery):2019-Present

ONGOING R&D ACTIVITIES

We are currently working on a variety of innovations involving computer vision (CV) that aim to increase the efficiency of the review process. This work includes:

- *Pot Detector*: Using CV to create annotations in review software for every pot that is brought on board, reducing time spent by the reviewer to find and mark each pot.
- *Human Activity Detection*: Using CV to flag human activity on deck to be used in discard compliance programs to find potential discard events.
- *Onboard Fish Identification*: Integrating fish ID algorithms developed by NOAA scientists into our onboard EM system.
- *Bycatch Detection, ID and Enumeration:* As part of the EDF Smart-Boat Initiative we are training algorithms to find, ID, and count fish as they are discarded.

For more information, please go to www.saltwaterinc.com or contact Morgan Wealti at morgan.wealti@saltwaterinc.com

Satlink

Electronic Monitoring (EM) Workshop
Renton, WA
12-13 February 2020

Meet Satlink
With headquarters in Spain, Satlink has more than 25-years' experience working with commercial fisheries, governments and NGO's around the world. To provide services and support to customers, Satlink has representatives in North America while maintaining offices in the Seychelles, Fiji, South Korea, Taiwan and Ecuador.

Products and Services
Satlink remains committed to research, innovation and development. Our portfolio of solutions include in-house designed satellite communications, oceanographic buoys, vessel monitoring systems (VMS), electronic reporting (ERS) and video monitoring. Satlink's electronic monitoring (EM) solution, called SeaTube, is an extension of our constant interest to contribute to seafood traceability, transparency and effective resource management.

EM Expertise
Satlink has extensive experience in managing EM projects, operating in more than 16 countries in the Pacific, Atlantic and Indian Ocean regions. Through our partnership with Digital Observer Services, a company devoted to EM data analysis, projects include fisheries consultancy, building local capacity and integrating fishery databases. Satlink is following closely EM efforts in the USA and Canada and is actively seeking EM projects where we can contribute, apply technology and knowledge.

Future Innovations
Satlink is committed to improving technology and reducing costs of on-board systems and video analysis routines. We are currently developing artificial intelligence and machine learning algorithms that promise to reduce analysis time. Satlink is committed to cross sectorial collaboration with all stake holders, especially the fishing community. We continue to make improvements in EM educational programs that further help fishermen and other stakeholders understand and apply EM systems in their region.

Contact
For more information on Satlink and Electronic Monitoring, visit us at www.satlink.es
Please stop by our stand and share with us your ideas.

Chris Wilson, North America EM Coordinator
Tel. (703) 447-5287 Email. clw@satlink.es

Teem Fish

Teem Fish is a federally designated fisheries monitoring service provider that delivers advanced electronic monitoring solutions to make it easy and efficient to capture and report reliable, unbiased and verifiable fisheries data. Allowing fish harvesters, who need a cost effective and convenient solution, to meet their regulatory requirements. Teem Fish is recognized for its deep ecosystem understanding and technical expertise. OUr team has been trusted to deliver electronic monitoring solutions to meet the unique needs of fisheries around the world since 2011.

Teem Fish is in a strategic partnership with Snap Information Technology (SnapIT) which means our delivery and development team now include their staff of highly skilled, dedicated specialist software developers and electrical engineers. We combine best-in-class technology with deep fisheries expertise to deliver reliable electronic monitoring systems, round-the-clock service and accurate, verifiable data.

With robust hardware that works in the toughest conditions and remote data transmission capabilities, that remove the hassle of in-person dockside video transfer, we simply make electronic monitoring easier. We equip fishing vessels with custom hardware, software and storage technology needed to capture, analyze, deliver and store fisheries data. This can range from small solar-powered wireless satellite vessel tracking units to complete image capture systems that include cameras with 360 degree pan, tilt, and zoom capabilities that take high-definition video and on-board systems that can remotely transmit data to shore. Our technology also includes the integration of Artificial Intelligence in both data capture and analysis software that can reduce data review and storage costs.

Teem Fish's EM system is designed to help fish harvesters conveniently collect the data needed to meet all regulatory requirements and just get on with their fishing. Along with our technology offerings, we also provide complete program design and delivery services that are focused on creating data access for fishermen as well as regulatory data delivery to fisheries managers. We design our programs so that the value of fisheries data can be realized by not just regulators but also by individual fishermen for business and marketing, by fishing fleets for improved dialogue with fisheries managers and by scientists for better ecosystem knowledge.

For more information on our programs and delivery staff please visit: https://teem.fish/

For more information on our technology offerings please visit: https://www.snapit.group/

SUPPORTING SUSTAINABLE FISHERIES

SUSTAINABLE FISHERIES MANAGEMENT

Woods Hole Group equips fishermen and authorities with integrated satellite technology for tracking & monitoring, catch & data management, and ocean intelligence. With over 25 years of consulting experience, we combine global marine expertise and technical solutions to provide high quality real-time data for sustainable marine resource management.

CORE SERVICES

Our commercial and small-scale fisheries Vessel Monitoring Solutions (VMS), sensors, and cameras cover all regulatory and operational monitoring needs. Our fishermen seamlessly report catch data through our mobile application and dedicated web interface. In addition, we support sustainable fishing operations with real-time ocean analytics and recommendations.

ENHANCED SERVICES

We facilitate real-time quota management and, fishing effort tracking, and fish habitat modeling with the best oceanographic data and forecasts. Additionally, we manage and support digital migrations from paper forms to integrate with any platform. Our fisheries intelligence solutions allow us to identify fishing hotspots through catch performance, oceanographic, data and machine learning.

PHOTO: JAY FLEMING

Tracking & Monitoring

VESSEL TRACKING

- Ruggedized industrial fishing beacon
- Hybrid small-scale fisheries tracking solution
- Affordable satellite service
- Comprehensive vessel management service
- Type-approved in US and Canada

ELECTRONIC MONITORING

- Partnership with leading edge EM provider Anchor Labs
- Wireless data transfer and live view
- Advanced catch analysis
- Robust and encrypted data

FISHERIES MANAGEMENT SOLUTIONS

- Complete Fishing Monitoring Center solution
- Quota management and catch analytics
- Detect and deter illegal, unreported, and unregulated fishing activities
- Habitat management with integrated ocean modeling

Ocean Intelligence

OCEAN ANALYTICS & RECOMMENDATIONS

- Best oceanographic data service to reduce search time and operating costs
- Near real time data for surface and subsurface conditions
- Weather forecast, catch module, buoy tracking
- Unique multi-criteria and gradient tools
- Dedicated fishing grounds analytics tools
- Personalized support from oceanographers
- Weekly fishing recommendations

FLEET DEPLOYMENT, CAMPAIGN ANALYSIS & FORECASTING

- Generate business insights by pairing catch data and oceanographic information
- Improve today's catches by understanding historic performance
- Identify dynamically best fishing zones for target species
- Understand underlying links and impact of catch hot spots

Catch & Data Reporting

CATCH REPORTING

- US and worldwide regulatory forms
- Updated via satellite in real time
- User-friendly Android application

VESSEL OPERATIONS REPORTING

- Ensure management of maintenance, safety and logistics events
- Receive alerts for vessel activities
- Customized operations reporting

CUSTOMIZED DATA SOLUTIONS & INTEGRATION

- Full paper-to-electronic workflow migration
- Full platform integration
- Advanced data visualization

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National Electronic Monitoring Workshop – East Coast Breakout Discussion Session Summary (Working Draft)

National Electronic Monitoring Workshop - East Coast
November 13-14, 2019 ● Wentworth by the Sea ● New Castle, NH

Hosted by NOAA Fisheries and the New England Fishery Management Council

Breakout Discussion Summary (Working Draft) - February 2020

Introduction

The Third National Electronic Monitoring Workshop – East Coast was hosted by NOAA Fisheries and the New England Fishery Management Council on November 13th and 14th, 2019 in New Castle, NH. The workshop convened stakeholders, managers, and EM service providers to explore the following objectives.

- Education: Provide participants with a shared frame of reference for the development and implementation of EM in U.S. federal fisheries.
- Regional exchange: Review regional approaches to EM and share experience across regions, roles, and responsibilities.
- Best practices: Share perspectives on best practices and lessons learned that can help guide the design and implementation of existing and future EM programs.
- Looking ahead: Identify the ongoing questions and challenges with EM implementation, and generate ideas and next steps for gaining traction at the regional and national level.

NOAA Fisheries is hosting a second Third National EM Workshop in partnership with the Pacific States Marine Fisheries Commission on February 12th and 13th, 2020 in Renton, WA. The ideas and themes of discussion from the East Coast workshop helped inform the agenda for the West Coast workshop.

This document summarizes themes of discussion from the final breakout session held on the second day of the East Coast workshop. This summary is a working draft provided as briefing material for the West Coast workshop. A final East Coast workshop report, including summaries of presentations and links to videos and presentations, will be available in spring 2020.

Breakout discussions: EM program design best practices and next steps

The National Electronic Monitoring Workshop – East Coast culminated in a facilitated breakout discussion on the afternoon of Day 2. Participants divided into two groups to explore the following questions.

1) Challenges: What are the remaining challenges to EM implementation? What steps can be taken to address these challenges? What challenges can be prioritized and communicated to NOAA Fisheries as an outcome of this meeting?
2) Best practices: What's working well? What successes and regional experiences can be considered "best practices" to document and share?

Each group generated an initial list of high-priority challenges and discussed where progress has—and has not—been made. Participants considered the roles and responsibilities of NOAA Fisheries, councils, stakeholders, service providers, and other partners in addressing each issue; identified specific questions and concerns, and suggested ideas and next steps.

Discussions demonstrated that challenges and best practices are closely linked. The following sections summarize themes of breakout discussions by topic, including 1) focus areas, 2) additional priorities, and 3) general successes and best practices. This summary captures the range of ideas that were discussed and is not intended to imply consensus or recommendations on behalf of meeting participants.

Focus areas

The following three topics emerged as high priorities for both breakout groups.

Data security, privacy, and enforcement

Participants shared concerns regarding the use of EM video for purposes beyond EM program objectives. These purposes could include opportunistic data collection about fishing activity, as well as monitoring of protected species interactions and investigation of behavior including regulatory violations and illegal activity (such as pollution or drug use) that could have management or enforcement consequences. Participants felt that questions around data security and privacy can undermine trust and buy-in, and that it's important to distinguish valid concerns from perceived threats. In addition, the use of EM data for purposes beyond the program objectives constitutes "mission creep" and has consequences for data storage, program costs, and other considerations.

Participants raised the following questions.

- When, by whom, and for what purposes can EM video be used? Specifically:
    - Under what circumstances does law enforcement have access to video, and for how long? What is the statute of limitations?
    - Can NOAA Fisheries utilize video for other purposes, such as monitoring protected species interactions?
    - Can video be requested under the Freedom of Information Act (FOIA)?
    - Are video reviewers obligated to report observations that fall outside the scope of their review, and if so, what must be reported?
    - Do vessels have access to their own footage?
- What are law enforcement priorities with regard to EM? What potential enforcement actions could be taken, who is accountable, and what are the consequences? Participants shared concerns ranging from minor compliance issues that may be addressed in EM program design such as corrupted data, or damaging or failing to return a hard drive, to violations that may be subject to investigation by law enforcement.
- Do the capabilities of EM technology hold fishing operations to higher standards? Participants cited specific concerns including operational discards, and questioned how to address discrepancies between captain, observer, and camera points of view.

Participants noted that NOAA Fisheries has made progress and provided clarity on some aspects of privacy and data management through developments in national EM policy.[3] These clarifications are important to communicate. The groups emphasized their desire for further clarity, transparency, and open discussion of these concerns, and suggested that NOAA Fisheries address these topics further, for example through a guidance document or white paper. Other suggestions

[3] At the time of the workshop, NOAA Fisheries had provided a Draft Procedural Directive for Minimum Data Retention Period for EM Programs to the regional fishery management councils and stakeholders, with comments due by December 31, 2019. NOAA Fisheries is also proposing a retention schedule for data from EM programs under the National Archives and Records Administration, with the intent of balancing the costs and risks of EM data retention with the need to preserve data to effectively meet monitoring program objectives and enforcement activities.

included early and proactive engagement by law enforcement and looking to other business sectors for examples of how video footage can and can't be used for enforcement purposes.

EM program objectives and opportunity costs
Participants emphasized the need to focus on EM program goals and objectives, avoid mission creep, and achieve progress toward implementation. Maintaining focus on goals and objectives can be challenging for several reasons including the enhanced capabilities ("bells and whistles") provided by EM technology, the perception that more data is better, and the slow pace of EM implementation through the council and regulatory processes. Identifying clear goals and objectives was identified as a theme and best practice at the 2014 and 2016 National EM Workshops. The groups felt that clear program goals and objectives continue to be a best practice and an ongoing challenge, as well as an area where some felt their programs, such as the Atlantic Highly Migratory Species fishery, have been successful. Participants emphasized the need to engage stakeholders in identifying goals and objectives, stay focused, and weigh tradeoffs associated with additional data such as additional cost, workload, and other considerations.

The group also discussed a number of considerations relating to right-sizing data collection. Defining data collection, review, and retention needs relative to EM program goals and objectives is critical to managing program costs. The scope of data collected, and the duration of retention also relates to the privacy and security concerns identified above. However, participants cautioned that minimizing the amount of data collected and retained can also create opportunity costs. Data discarded in the short term could have value in the future. It's important to consider data collection and data management needs to support future capabilities, particularly artificial intelligence.

Estimating and managing EM costs
While the EM community has gained experience estimating and managing EM costs, participants identified ongoing challenges related to video review and data storage, particularly the level of video review needed to achieve EM program objectives. The groups also identified questions and communication needs regarding data retention and national policy guidance, including what data need to be retained, for how long, and for what purposes (for example, short-term quota monitoring or long-term storage). These outstanding questions impact program costs no matter who pays, but also provide clarity on specific costs as prescribed in the EM Cost Allocation Procedural Directive that NMFS published in 2019.

Sustainable long-term funding for EM program is also challenging. Many EM programs are initially funded as pilots and Exempted Fishing Permits (EFPs) with funding through NOAA Fisheries and the National Fish and Wildlife Foundation (NFWF). The group suggested exploring a range of financing options as EM programs transition toward long-term implementation. Some felt that EM funding could be viewed from a food production standpoint, and that supply chain and public financing options should be considered. Participants also shared concerns about the transition toward industry-funded monitoring, including the difficulty of estimating costs, the ability of the fishing industry and individual vessels (especially smaller vessels) to support monitoring costs, the potential for industry-funded monitoring to lead to financial tipping points and consolidation, and changing dynamics between observers, crew, and vessel owners. They also noted the need to characterize "soft costs" such as the additional time and effort required for catch handling to support EM. One specific suggestion was to take a comprehensive perspective on EM program costs by convening a national-level team of NOAA Fisheries and other experts to provide cost analysis support to councils and stakeholders.

Additional priorities

Participants discussed the following ideas and suggestions for addressing EM challenges.

- *Evaluate EM program performance*. Consider conducting periodic reviews of EM programs, similar to the reviews conducted for catch share programs. Reviews could convene NOAA Fisheries, council, stakeholders and other experts to revisit goals and objectives and assess whether they are being met, consider adjustments, and communicate about how EM data is being used for management and science.

- *Develop system-level capacity and support regional exchange*. Participants felt that achieving progress toward EM scaling and implementation is a system-level challenge that depends on the capacity of all stakeholders to leverage

experience and accommodate EM among competing priorities. Participants felt that EM development and innovation are focused at the regional level, that EM models are not transferred between regions despite similarities between programs, and that it is not clear what NOAA Fisheries will or will not approve in a region. Some suggested a more comprehensive and consistent approach to aligning monitoring needs with EM strategies.

- *Articulate and pursue the full value proposition of EM.* Participants felt that many of the proposed benefits of EM have not yet been well articulated or fully realized, including the use of EM data for stock assessments, the market benefits of traceability and accountability, and other potential benefits and return on investment for industry.

- *Encourage and plan for innovation.* EM technology continues to improve and evolve. Participants suggested continuing to invest nationally in emerging technology including artificial intelligence, automation and robust data management practices including labeling, organization, and annotation to lay the groundwork for future data uses and applications. The group also suggested designing EM programs and policies that are flexible to accommodate changing technology, learning from innovation in other natural resource sectors, and facilitating innovation by opening requests for proposals (RFPs) to multiple service providers. An important aspect of planning for innovation is also considering the potential for unintended consequences.

- *Apply consistent program management practices.* Participants emphasized documenting program evolution, policies, and business rules; sharing consistent protocols and definitions among NOAA Fisheries, vendors, and stakeholders; and clearly defining roles and responsibilities.

- *Improve transparency and communication*. Participants suggested enhancing communication between NOAA Fisheries, councils, and stakeholders to set expectations and work through challenges. In particular, participants noted the need for communication about national EM policy, regional developments, and program-specific determinations such as required video review rates.

- *Continue to invest in education.* Ongoing outreach and education are important to support the continued development, implementation and financing of EM programs, as well as address specific challenges such as the articulation of clear objectives. Participants felt that industry stakeholders, decisionmakers and other audiences including elected officials, funders and the public would all benefit from a better understanding of EM. Industry stakeholders can collaborate with NOAA Fisheries to help identify critical audiences and develop effective communication strategies.

- *Engage at-sea observers in EM development.* EM and human observers can be viewed as complementary components of a fishery monitoring program, and while the balance of EM and human observer coverage may change there will continue to be a need for at-sea observers to collect biological data. Participants felt that observers can contribute valuable insight and perspectives, and that more of an effort can be made to support exchange between the EM and observer communities. Participants also noted the potential for observers to transition between at-sea observing and related EM roles such as video review. Benefits could include career diversification and stability for observers, and cost benefits through workforce retention and reduced training costs.

General best practices

Participants also commented on general strategies for supporting EM implementation, many of which were also recognized as successes and best practices at the 2016 National EM Workshop.

- Invest in education, outreach, and communication with all stakeholders regarding the costs, benefits, and objectives of EM; including those directly involved in EM and the broader public.
- Engage all parties early and regularly, including industry stakeholders, NOAA Fisheries, decision makers, law enforcement, service providers, and others.

- Convene working groups and other bodies (e.g. council committees and advisory bodies) to provider diverse perspectives, enlist targeted expertise and explore specific issues.
- Learn and share experience between regions and internationally and consider opportunities to learn from other industries and natural resource management sectors.
- Recognize linkages between challenges; in particular, those related to EM program objectives, design, and cost.
- Communicate developments in national EM policy.

Workshop sponsors

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