Final Programmatic Report Narrative

Title: Evaluating the Use of Electronic Monitoring in the U.S. Atlantic Sea Scallop Fishery (MA/NJ)
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Project Highlights

- Through voluntary participation, we met our proposed goals by installing EM systems on six Limited Access sea scallop fishing vessels from Massachusetts and New Jersey.
- During the project period, we received EM footage from 111 fishing trips (821 days-at-sea [DAS]) from these six vessels, exceeding our target DAS (252 total) by 225.8%. Reviewers exceeded our proposed goals by quantifying catch and bycatch from 4,808 hauls from 43 trips (330 DAS), totaling 34,273 baskets of sea scallops.
- Through a partnership with the Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program, we are continuing to collect real-time data on temperature and depth from each vessel that can be paired with catch and bycatch, providing a novel source of fisheries-dependent data and meeting proposed goals.
- Compared to the current federal DAS regulation method that is based on the U.S. demarcation line, we found that monitoring fishing effort with EM footage reduced the average length of a fishing trip from 7.2 to 6.0 DAS/trip, increasing fishing efficiency and profitability by approximately 17.8%
- As a result of data from this pilot project, we have received an Exempted Fishing Permit (EFP) to test the feasibility of EM as a regulatory tool in the sea scallop fishery. All EM systems remain functional and are continuing to be used by the six original vessels for additional NFWF-funded research.

Project Activities & Outcomes

Activities

CFF completed each original activity and there are no discrepancies between activities conducted during the grant and the activities agreed upon in the grant agreement, which are listed below.

I. Develop incentivized agreements with fishing partners and EM reviewer software template.

Prior to the start date of the project (July 1, 2024), we held a kick-off meeting on May 28th, 2024 with the Saltwater team, vessel owners, and captains to discuss objectives, timing, and the first steps for initiating camera installation on our six participating vessels. In addition, CFF and Saltwater met several times in July – August 2024 to draft the reviewer guidance template. This document (provided upon request) established review protocols, identified key species of interest, including bycatch (e.g., yellowtail flounder and Atlantic cod) and sea scallop predators (e.g., large sea stars), and included examples of key behaviors (e.g., deckloading and high-grading).

Vessel agreements that included one-time training stipends ($1,000) for all captains of each of the six vessels were finalized by August 2024. These vessels participated through the end of the project, October 1, 2026, and remain as primary participants during the next stage of the project (see **Project Impact and Next Steps** section below). All vessels agreed to record a minimum of 21 days-at-sea (DAS) of fishing effort. A draft of the EM reviewer software template was completed by September 2024, with periodic edits added to the template throughout the project period.

II. Installation of EM systems and training vessel personnel

The first Saltwater EM systems (see **Figure 1a, b**) were installed on the FV *Kathy Ann*, *Capt John*, and *Grand Larson III* (Barnegat Light, NJ) in June 2024, prior to the project period of performance start date (July 1, 2024) to ensure that data could be collected during the active fishing season. EM systems were installed by Saltwater

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technicians on the FV *Socatean* and *Seafarer* (New Bedford, MA) at the end of June 2024. The final EM system was installed on the FV *Susan L* (Cape May, NJ) in July 2024. At least two vessel personnel (captain and at least one crew) were trained to operate and maintain the EM systems during installation, and further instructions were provided in the Vessel Monitoring Plans (see **Activity III**). Lotek LAT1800L depth and temperature sensors were installed by CFF staff on the vessels by December 2024. CFF also partnered with the Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program, which seeks to outfit commercial fishing vessels with similar sensors, but with the capability to transfer data via Wi-Fi at the dock through a deck data hub (DDH). Due to increased ease of use and reliability, we switched all six vessels to eMOLT sensors between March – August 2025 (**Figure 1c**).

III. Draft Vessel Monitoring Plans and coordination with the observer programs.

Vessel Monitoring Plans (VMPs) were drafted by Saltwater during EM system installation in July – August 2024, with each vessel given an opportunity to provide feedback before all final copies were signed into effect by September 2024. Each VMP included information on the vessel, project objectives, EM system specifications, and an installation summary. The VMPs are available upon request. CFF coordinated with several staff at the NOAA NEFSC Office of Fisheries Monitoring and Operations Branch in June 2024 to plan future quarterly meetings to provide updates on progress and to gain feedback. CFF additionally has coordinated with members of NOAA Northeast Fisheries Science Center (NEFSC) and NOAA Greater Atlantic Regional Fisheries Office (GARFO) and includes staff from both offices in update meetings.

IV. Field deployment of EM systems.

During the project period (July 1, 2024 – October 1, 2026), vessels were tasked to record the EM footage for a minimum of 21 DAS of fishing effort during each fishing year, which is federally defined as April 1 to March 30. Due to project period constraints, Year 1 of this project ran from July 1, 2024 – March 30, 2025 and Year 2 spanned April 1, 2025 - March 1, 2026. During the entire project period, we received EM footage from 111 fishing trips between the six vessels (**Figure 2a**), exceeding our target DAS (252 total) by 225.8%. These trips amounted to a total trip duration of 821 days between the participants (**Figure 2c**). To allow time to complete review and quality control (QA/QC) of the EM footage, we set March 1, 2026 as the review cutoff date for this project, although vessels continued to operate their systems normally after March 2026. From July 1, 2024 – March 1, 2026, we received footage from 75 fishing trips amounting to a total trip duration of 553 days between vessels (**Supplementary Figure 1**). Although vessels were not asked to run the systems during Research-Set-Aside (RSA) compensation trips, many did so voluntarily.

V. Data Management.

All data collected by EM systems remained encrypted, password-protected, and secure during the project. Hard disk drives (HDDs) were mailed from vessels to Saltwater staff, where they were copied to a local server and logged in to a workflow tracker. Saltwater staff promptly returned HDDs with return mailers for vessels to ensure data collection could adequately continue without significant delays. Saltwater technicians performed SPCs (System Performance Checks) on all incoming datasets to ensure EM system integrity, functioning status and identify any required service as necessary before a vessel makes a new trip.

VI. Data analysis.

Reviewers at Saltwater utilized O2Review software to analyze 49 trips, with QA/QC confirmed for 43 trips. The O2Review template was modeled after the U.S. Northeast multispecies (i.e., groundfish) fishery NOAA EM Reviewer Guidance Document. A selection of review template variables includes port of sail, haul number, time to review, dredge type, visibility of catch sorting, catch sorting method, composition of bycatch, abundance of sea scallop predators (e.g., sea stars, moon snails, etc.), and sorting container type. The template can be provided upon request.

Review time for trips varied widely from 52 to 2,465 minutes (mean of 676.9 ± 573 min/trip), with an average time to review each haul ranging from 1.00 to 26.0 minutes, mean of 4.93 ± 2.24 min/haul (**Figure 3**). Based on reviewer feedback, the primary factors influencing review time included high catch/bycatch volumes, camera lens clarity (e.g., water spots or glare), and EM related issues, which are elaborated below. In our proposal, we planned for a 100% review rate in Year 1, followed by a reduction to 50% in Year 2. However, review was faster than expected and we were able to remain at 100% for the duration of the project.

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Reviewers quantified catch from 4,808 hauls totaling 34,273 containers, or baskets, of sea scallops (**Figure 4a, b**). Catch composition varied between reviewed trips, with baskets of sea scallops per haul ranging from zero to 104. Three extreme basket counts (104, 60, and 49) were anomalous, with the remaining baskets counts all under 42 (**Figure 4c**). The container type used for catch sorting was also variable, with crew using rectangular milk crates (49.3%), round bushel baskets (47.6%), or a combination of containers (3.1%; **Figure4 a, b)**. While we refer to both containers as "baskets", reviewers tracked the shape and style during each haul to improve estimates of sea scallop meat weights (see **Outcomes** section below). Through the review cutoff, we logged eMOLT data from 2,645 hauls across the six vessels (**Figure 5a**), with bottom temperatures ranging from 2.1 to 21.3 °C (mean of 6.8 °C) and bottom depth ranging from 13.0 to 174.3 meters (mean of 66.8 m). We plotted these data against catch and bycatch (**Figure 5b**), and plan to model relationships in a peer-reviewed manuscript summarizing the results of this project.

In Year 1, fishermen were not asked to modify their catch sorting behavior and reviewers were tasked with attempting to locate and identify bycatch in normal fishing operations. As each dredge was unloaded on deck, it was challenging to identify bycatch to species level as many fishes were often buried or obscured. Additionally, the proximity of bycatch to each camera impacted reviewers' ability to identify it, especially at night. Thus, reviewers focused on grouping catch composition into five broad categories during Year 1: roundfish, flatfish, clappers, elasmobranchs, protected species, and rare species. Elasmobranchs, which were exclusively comprised of skates (e.g., barndoor [*Dipturus laevis*]), were the dominant bycatch, with at least one skate present in 42.8 – 48.0% of hauls (**Figure 6**). Roundfishes, such as red hake (*Urophycis chuss*), were also quite abundant, with one fish in 27.3 – 41.3% of hauls, followed by flatfishes, such as summer flounder (*Paralichthys dentatus*) and yellowtail flounder (*Limanda ferruginea*), in 14.5 – 26.3% of hauls. While clappers are commonly weighted at the haul level by observers, this catch item was challenging to identify routinely, and present within 0.3 – 1.1% of hauls. Torpedo rays (*Tetronarce nobiliana*) were the primary rare species that was observed, which were separated out from the elasmobranch category, and present in hauls across seven trips (**Figure 6**).

In Year 2, we requested participants to trial bycatch identification areas during at least one trip. We painted two 1-m^2 on either side of the deck, and as close to the cameras as possible with various colors of spray paint, including yellow, red, green, white, and blue (**Figure 7**). During each haul, participants were asked to place priority bycatch species within the squares to allow the best opportunity for reviewers to identify to species level. Priority bycatch species were defined following the 2020 NOAA NEFSC Observer On-Deck Reference Guide, which lists summer flounder, windowpane flounder (*Scophthalmus aquosus*), winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder, and monkfish (*Lophius americanus*) as Priority 1 species. Priority 2 species include Atlantic cod (*Gadus morhua*) and barndoor skate, and Priority 3 include ocean pout (*Zoarces americanus*) and other skate species. Fishermen, who were participating in this bycatch identification voluntarily, requested to avoid sorting skates during this initial trial and that request was granted.

Five of the six vessels participated in bycatch sorting over eight trips. However, one vessel abandoned bycatch sorting during a trip when they encountered unusually high densities of sea scallops. Reviewers were asked to identify all fishes in the bycatch areas, including non-priority species (**Figures 7, 8**). Fifteen different fishes or were identified, with high variability between trips and seasons (**Figure 8**). Despite the squares, reviewers still occasionally found it challenging to identify all fishes to species-level due to poor conditions or orientation, with unknown flatfish, roundfish, and right-eyed flatfish, or left-eyed flatfish periodically reported (**Figure 8**). Of paint colors tested, reviewers found white and blue were the easiest to see during both night and day, though vessel deck background coloration did have an impact as some varied from a worn patina finish, wooden boards or newly painted (**Figure 7**). Higher contrast from fish mottled coloration made for better specimen outline and distinct identification. All paint lasted multiple trips until fading with some lasting upwards to 5 to 6 months (see **Figure 7d**).

Reviewers recorded all EM specific events, as well as crew specific events, and unique fishing events (e.g., weather or gear damage). Between the six vessels, a total of 1,113 EM specific issues were identified (**Figure 9**), which included system failure, camera failure, sensor gaps, video gaps, imagery impaired, full or failing hard drive, and other. Of these, video gaps represented 1,010 of the total issues (90.8%), see further discussion in **Project Impact and Next Steps** Section below. Most issues did not result in a loss of data, though, with only 237 (4.9%) of the total issues impacting review of the 4,808 total hauls. The bulk of EM specific events also occurred during the first year of the project as the team worked through various start-up challenges with the systems.

Reviewers also monitored for the presence of deckloading and high-grading behaviors. At the beginning of our project, we consulted with NOAA NEFSC, GARFO, and the NEFMC to determine operational definitions for

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deckloading and high-grading to incorporate into our review protocol. We found deckloading to be a straightforward behavior to objectionably quantify, which we defined as unsorted catch that remains on deck when the proceeding haul or consecutive hauls are unloaded on top. Reviewers clearly identified 21 instances of deckloading that occurred on three separate vessels across four different trips (**Supplementary Figure 2**). High-grading was significantly more challenging to define. The NOAA NEFSC Fisheries Monitoring and Research Division defines high-grading, or upgrading, when, "a previously kept fish or shark is discarded and replaced with one that is larger (or of higher quality/value) previously kept fish that is discarded and replaced with one that is larger or of higher quality/value". However, there is no accepted high-grading definition specific to the sea scallop fishery. Based on the NEFSC definition, we struggled to objectively classify examples of high-grading relative to sea scallop discards. As a result of this project, we believe there are additional parameters that surround high-grading in the fishery to consider during review and expand further on this distinction in the **Outcome Section** below.

VII. Final recommendations and long-term storage.

CFF interviewed fishermen from the participating vessels after Years 1 and 2 to qualify their ongoing experiences and opinions regarding EM. During recorded interviews (available upon request), participants were asked the same nine questions (**Table 1**) during both mid-term and final interviews. Responses were fairly consistent across vessels, with some participants highlighting ease of use and expanding existing survey coverage with data from the fishery. A participant from one vessel said, "*Yes, the cameras are very simple to use: The system check confirms storage space available on the hard drive cartridge, the cameras are easy to clean when needed. Sometimes the only difficult part is finding a drop box to mail completed trips in when we are not returning to home port to offload*". During another interview, a participant from another vessel said, "*I would like to see this technology used for stock assessments. The fishery is only surveyed in the spring and summer but if there was a way to open it up and allow EM data to be used scientists would have so much more data and bottom area to evaluate while tracking and monitoring the resource a different times of year as boats are working. Managers would get a better bead on what's happening, where larger, preferable scallops are located, where smaller ones are in higher abundance, and I imagine a lot of this information can be deciphered from estimating shell sizes while scallops are on deck*". Another participant from a third vessel stated, "*Once this program has gained momentum in the fleet, I think it will have a positive impact on the fishery; any well-designed data collection platform for fisheries is good for everyone*".

All video and sensor data generated by the project has been transferred from Saltwater to CFF, where it will be stored indefinitely on HDDs that are backed up to a secure remote server. The combined size of footage and review files for the 43 trips is 12.8 terabytes, with footage from individual trips ranging in size from 39 gigabytes (GB) to 809 GB, with a mean of 305 GB. These data remain confidential and are owned by the respective participants, who will be able to freely access their data upon request.

Outcomes

In our grant agreement, we described several anticipated project outcomes including: 1) recording and quantifying deck loading and high grading, 2) pairing bycatch abundances with environmental data, 3) filling existing fishery-independent survey gaps with fishery-dependent data (FDD), and 4) developing a system to refine DAS calculation with EM data. We proposed 11 metrics to work towards these outcomes (see **Metric Table** in Easygrants). For Metric 1, we address two activities in the NEFSC Electronic Technologies 2021 – 2025 Implementation Plan, including Activity 4.1) the developing and streamlining commercial FDD systems and Activity 4.3.1) electronic reporting in commercial fisheries. Through our partnership with the eMOLT program and EM catch tracking, we have created an additional source of FDD that can augment federal resource surveys moving forward (**Figure 5**). Furthermore, through a combination of winch-activated sensors and cameras, we have created a novel form of trip tracking to augment electronic reporting that we are currently testing with these six partner vessels under an Exempted Fishing Permit (EFP; DA26-037). We are continuing to expand on these efforts in our next NFWF-funded project, "Advancing the Use of Electronic Monitoring in the U.S. Atlantic Sea Scallop Fishery (MA/NJ/NC)" (Award #89580) and in collaboration with several NOAA employees.

Through a combination of outreach, informational sessions, and presentations we estimate that we have reached approximately 500 stakeholders in relation to Metric 5. Three highlights of these efforts include a presentations by Andrew Corso to the NEFMC Sea Scallop Advisory Panel (June 2026), which is made up of leaders in the fishery, at the International Pectinid Workshop in New Bedford, MA, which was attended by both scientists and fishermen

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(April 2026), and at the International Council for Exploration of the Sea (ICES) Annual Science Conference with roughly 100 international scientists and managers in attendance (September 2026).

To date, we have collaborated and met with three government agencies (NOAA GARFO, NEFSC, OLE), the NEFMC, and at least three non-governmental agencies (NFWF, The Nature Conservancy, and the Commercial Fisheries Research Foundation) and at least three stakeholder groups (including the Cape Cod Commercial Fishermen's Alliance, the Fisheries Survival Fund, and the Sustainable Scalloping Fund) in relation to Metric 1. Prior to deployment of EM systems, we developed VMPs in collaboration with all six vessels, and at the close of the project period had an additional three vessels (Metric 7). Each EM system consisted of two high-definition cameras, two winch-mounted sensors to activate cameras, a wheelhouse video display, and a central processing unit. We evaluated two different winch sensors, activated by either hydraulic or winch rotation, in addition to two different dredge-mounted temperature and depth sensors, initially Lotek then eMOLT sensors. Additionally, to better determine bycatch, we also developed a sorting technique, resulting in a combined total of at least **29 tools** and techniques implemented (Metric 3). The captain and a minimum of two crew members from each of the six vessels were trained in the electronic technologies associated with our EM systems, with two vessels introducing new captains during the project. In addition, three full-time CFF employees and five full-time Saltwater employees were trained, resulting in 30 total FTEs (Metric 4). The six original partner vessels participated in the project for the entire project period and have voluntarily agreed to continue working together on our next NFWF project, resulting in 75 fishing trips recorded and 43 reviewed (Metric 8). Participants were eager to help provide additional trip data when possible, which improved our ability to fine tune the EM system configurations.

Through participation in this project, the captain of each vessel (six original captains with two new captains joining) changed their behavior to maintain the EM system. Captains also informed us that they were able to more effectively monitor safety and fishing operations with the EM display unit in the wheelhouse. A minimum of six crew of each vessel changed their bycatch processing behavior in Year 2, resulting in a total of at least 44 fishermen implementing behavioral changes (Metric 6). Also, each of the six vessels have now changed their fishing schedule and operations because of the modified DAS accounting system and EFP associated with the new NFWF project. In the following section Project Impact and Next Steps, we outline recommended actions for NOAA and NEFMC to develop an effective EM program in the sea scallop fishery (Metric 9).

We compared the DAS totals from 36 reviewed trips across all six vessels determined through three differing methods: 1) the electronic Vessel Trip Report (eVTR) filled out by the captain during a trip based on when they leave and return to port, 2) the legal determination based on when the vessel crosses the demarcation line, and 3) our EM method using sensor and camera data to track the start of the first haul through the end of the last haul. The eVTR method was the most conservative at 269.4 DAS total (mean of 7.5 DAS/trip) for all six vessels, the demarcation line, which is the current policy, resulted in 259.8 DAS total (mean of 7.2 DAS/trip), and the EM method resulted in 217.3 DAS (mean of 6.0 DAS/trip; **Figure 10**). These six vessels spent 42.5 DAS transiting while they were legally classified as fishing. Through an EM-based DAS accounting system, vessels would increase their fishing efficiency by approximately 17.8% (Metrics 10 and 11).

The primary discrepancy between our proposed and realized Outcomes is the quantity and quality of bycatch data. It was more challenging than we expected to count and identify bycatch during normal fishing operations, even with the dedicated bycatch sorting areas. Fishermen noted that large piles of bycatch on the deck could become a slipping safety hazard, some priority species, such as small flatfishes, were still exceptionally challenging to identify depending on their orientation and time of day. Additionally, some crew would forget to sort bycatch entirely during their watch. This initial pilot was entirely based on voluntary effort, so we expect participation would increase with structured incentives. However, we recommend developing another catch processing system with realistic goals to reliably quantify bycatch. Additionally, observers record weights and lengths of bycatch which are important data for stock assessments. Future efforts to quantify bycatch utilizing EM must work towards incorporating at least weights of bycatch, but ideally also lengths.

To improve estimates of catch, we propose either a standardized catch sorting container or improved conversion estimates of bushels to meat weight. The existing NOAA conversion is one bushel of in-shell sea scallops equals approximately eight pounds of sea scallop meats. However, this conversion is obviously dependent on the size and shape of the bushel and areas fished. With a split between slightly larger round baskets and rectangular milk crates (**Figure 4a, b**), estimates of catch from EM footage become more challenging. Furthermore, we observed seasonal

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and regional variability in the conversions from in-shell bushels to estimated sea scallop meat weights as well. Thus, a more rigid catch-sorting or conversion process would be necessary for EM to proceed as a management tool.

Finally, we believe the most urgent policy need facing this fishery is a thorough revaluation and definition of high-grading. Currently, high-grading and deckloading are regarded as negative practices, but are not illegal nor are they regulated. However, we have consistently received feedback during outreach from industry and fishery managers for this project that high-grading is one of the greatest issues impacting sea scallop mortality and EM could help to reduce the practice. As mentioned above, observers only record high-grading when previously retained sea scallops are replaced by larger and/or more valuable individuals. While several of our participants were fishing in high-density areas of sea scallops, we repeatedly observed another behavior that, while technically recorded as discards, we believe to negatively impact the population in a similar way. Often co-occurring with deckloading, fishermen would load up the deck with several hauls and delay processing catch piles for up to 15 hours as they continued to make additional hauls (**Supplementary Figure 2**). As they progressively worked their way through the massive pile on deck, they would appear to selectively discard smaller or damaged sea scallops, while retaining more profitable sizes (**Supplementary Figure 2**). Depending on the air temperature and amount of time sea scallops were on deck, we postulate that most of the discarded sea scallops are dead by the time they are thrown back, or will likely perish from thermal stress. Even though these discarded sea scallops were not shucked and retained, we still view this behavior as high-grading. However, some circumstances prevented straightforward monitoring of this behavior, especially when vessels were fishing in small areas of exception sea scallop density. High fishing effort in these confined regions would result in an abnormal amount of shucked sea scallop shells, not clappers, mixed in with the pile (**Supplementary Figure 3**). Deckloading was often necessary to process these large piles, but the abundance of shells create challenges in determining if selective discards were occurring (**Supplementary Figure 3**).

Through interviews with participants, we have also received feedback indicating that instances of "true" high-grading may occur while individual sea scallops are being shucked by the crew. In these cases, crew members may discard small in-shell scallops which have significantly less market value than larger sea scallops. Currently, the largest size of sea scallop meats, (i.e., U-10s, or ≤ 10 meats per pound), can fetch a wholesale price that is 50-75% greater than U20 – 30 sized meats. However, this behavior can be influenced by several factors, including prolonged tows when the chain bag becomes clogged preventing smaller sea scallops from escaping through ring openings; a captain's preference for shoveling catch into baskets rather than picking through the pile by hand, or crew fatigue at the end of multi-day trips. While we are interested in adding cameras to the shucking box in the future, participants have reservations on installation due to privacy concerns. Additionally, testing has shown that the confined and crowded shucking box region would be exceedingly challenging to monitor but will be trialed with vessels during our next project

Project Impact and Next Steps

Based on the results of this project and ongoing discussions with stakeholders, NOAA, and NEFMC, we envision two potential pathways for an EM program in the sea scallop fishery. As one option, EM could function purely as a DAS management tool, increasing efficiency, profitability, and equity in the fleet by reducing the loss in DAS from transit. In a second option, EM could augment observer coverage similar to the groundfish fishery. NOAA NEFSC establishes target amount of observer coverage each year based on how many sea days are needed to achieve a precision-based performance standard (30% coefficient of variation [COV] of the discard estimate) for fish and invertebrate species groups across several fisheries in accordance with the Standardized Bycatch Reporting Methodology (SBRM). While EM data could help achieve the minimum amount of data required for certain species groups, such as monkfish or large mesh groundfish (GFL), it would be more challenging to monitor the skate complex requirement given the feedback we received from participants. It is important to note that we do not conclude that EM could ever fully replace observers in the U.S. sea scallop fishery.

The pathway that is best for managing the fishery will depend on a few factors that still need to be addressed. It remains unclear whether the entire fleet would be willing to commit crew time to facilitate collecting observer-level data on catch and bycatch of certain species. Essentially, how much data are the vessels willing to collect themselves before it becomes logistically and/or financially preferable to continue relying exclusively on observers? A more detailed financial analysis is also necessary to compare operational costs, for vessels and managers, to analyze these possible management options. After this pilot project, we have a good estimate for costs to install, record, and review fishing trips. However, we do not yet know the full cost breakdown of the observer program for comparison, because

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of the varying business models of observer provider companies, nor are we aware of the cost-benefit balance of sacrificing fishing crew time for data collection.

Another important caveat of the results of this project is our exclusive focus on Limited Access (LA) permit holders as participants, which are usually larger vessels that fish two dredges simultaneously over multi-day trips. In future efforts, we plan to expand trials to smaller Limited Access General Category (LAGC) vessels as well, which are commonly smaller, single-dredge operations that fish for < 48 hours at a time. The logistical and financial constraints—and benefits—for these smaller vessels introduce several additional factors for analysis to determine the feasibility of this program.

We gained several important takeaways from the EM related system issues. First, we initially programmed cameras to activate with winch activity, record the haul, and then power off after ~45 minutes of processing on deck to save storage space. However, with larger catches or rough weather, crews would continue processing catch after the cameras powered off, partially leading to the high quantity of video gaps we initially experienced. We also found that most vessels were incredibly efficient in fishing operations, often immediately setting the dredges back out after their catch was unloaded. Within the first six months of the project, we found the ideal setup was with a post sensor trigger run-on-time of 30 minutes for high-resolution footage and transitioned the camera systems to record continuously at a low-resolution to best capture areas of excessive deckloading or other events. Second, most vessels in our project would fish consistently for 1 to 2 months, then sit idle at the dock for 1 to 6 months at a time given the current management scheme. As a result, many of the EM system issues came after these long periods of non-usage. As permit stacking is currently not allowed in this fishery, most multi-vessel owners, including at least four in this project, will shift captain and crews across several vessels to continue fishing throughout the year. If possible, we believe a form of hybrid mobile camera system would be the most efficient EM protocol for much of this fishery. For example, a company with three vessels would be able to purchase one central processing system and only need to install cameras and winch sensors on each of their three vessels. After one vessel is done fishing for the year, they could move the processing system to the next vessel to reduce costs and increase maintenance frequency.

To immediately build on the results of this project, CFF and Saltwater received an additional grant from NFWF (Award #89580) to expand the deployment of EM systems in the fishery by installing camera systems on three new boats in North Carolina and Point Pleasant, New Jersey; trial a hybrid mobile camera system; improve bycatch monitoring with novel fish measurement boards and smart scales; trial a regulatory framework for monitoring fishing effort with EM systems; conduct a more detailed financial analysis; test systems on LAGC vessels; improve conversions of bushels to landings, and convene stakeholders to provide feedback on fleet-wide implementation. As an outcome of this continued investment, NFWF can expect a realistic and vetted roadmap outlining the steps towards cost-shared, adoption of EM at cross-regional scales that is supported by both fishermen and federal managers.

Acknowledgements

We are incredibly appreciative of the voluntary efforts from the owners, captains, and crew of the six participating vessels in this pilot project, who we have left anonymously in this final report. We are also thankful for the support and helpful feedback from many staff at NOAA GARFO, NEFSC, OLE, and the NEFMC.

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Tables

Table 1. Nine questions used for vessel participant interviews.

1) Can you say something positive about EM?
2) Can you say something negative about EM?
3) Can you say something positive about the observer program?
4) Can you say something negative about the observer program?
5) Are you generally for or against the use of EM within the sea scallop fishery?
6) If EM gave the right to transit through closed areas, can you describe the benefits to your fishing operations and estimate savings related to time and/or fuel?
7) If EM offered an increase in days-at-sea as an incentive, what impacts would it have on your annual vessel operations plan?
8) Would you require an additional incentive or compensation to throw bycatch in a designated area on deck?
9) Do you have any additional comments you'd like on record?

Figures



Figure 1. Examples of EM system components, including a) camera mounted near the winch facing backwards, b) camera mounted near the stern facing forwards, and c) Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) sensor mounted on a sea scallop dredge.

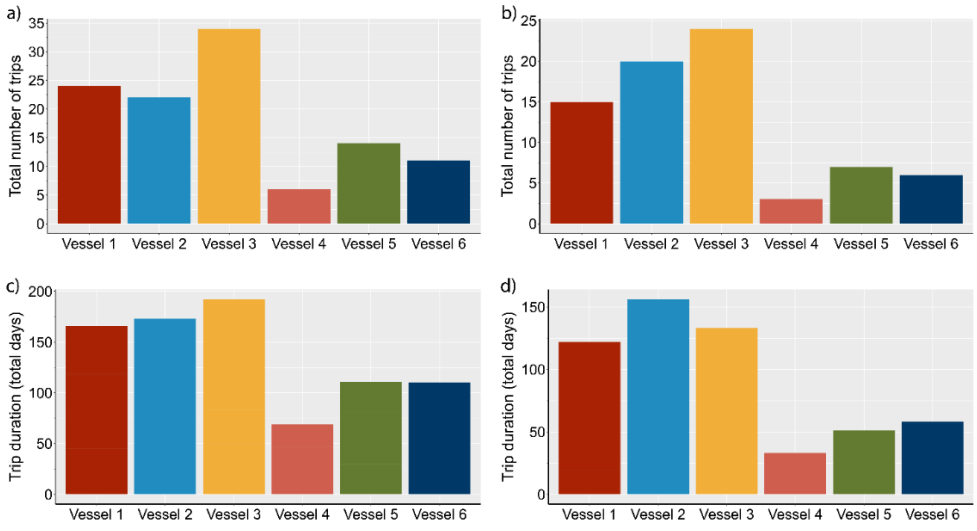


Figure 2. Summarized data from the six EM participants, including a) total number of recorded trips for each vessel during the project period (July 1, 2024 – October 1, 2026), b) total number of recorded trips through the review cutoff for the project (March 1, 2026), c) total duration in days-at-sea (DAS) for each vessel during the project period, and d) total DAS through the review cutoff.

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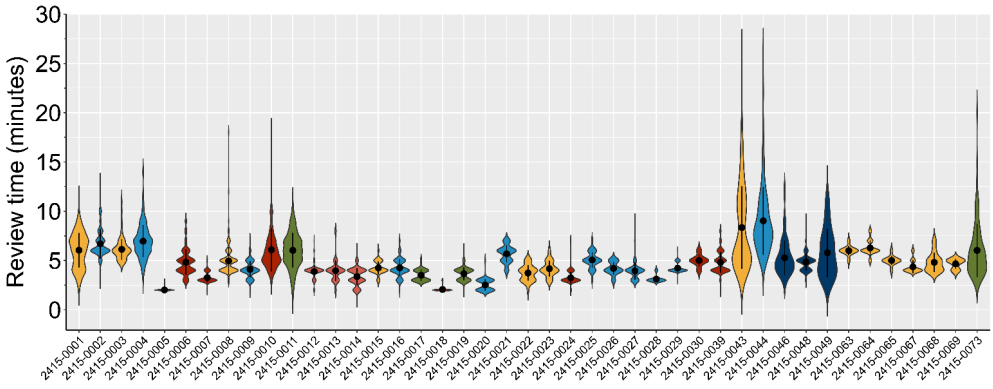


Figure 3. Review time in minutes per individual haul for each of the 43 trips that have been reviewed and checked for quality control, with hauls per trip displayed along the x-axis. Violins are color coded by vessel, with mean review time (black circles) and ± 1 standard deviation (black lines).

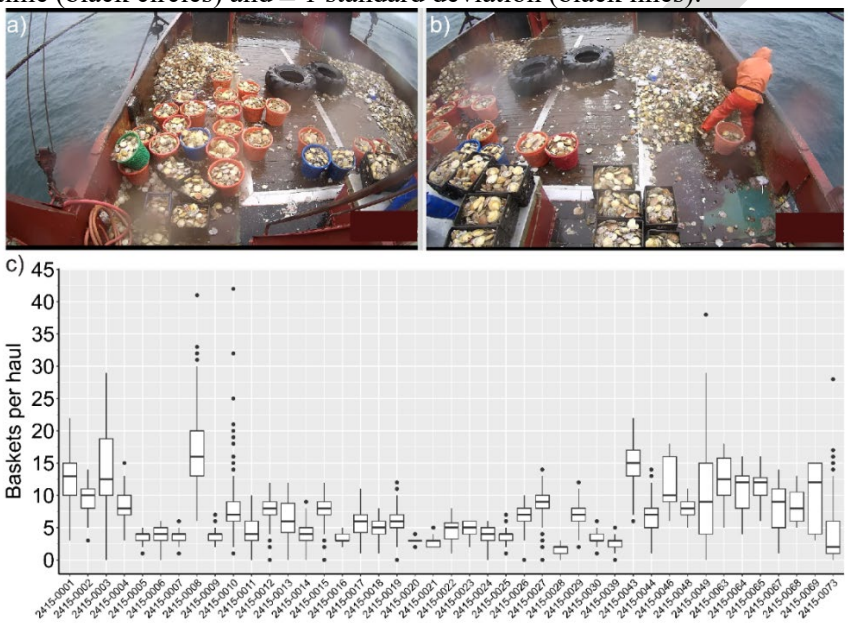


Figure 4. a) and b) Simultaneous photographs from two EM camaras showing sea scallops being sorted into rectangular milk crates and round bushel baskets. c) Box plot of baskets per haul, including all basket shapes combined, from each of the 43 reviewed trips. Three extreme basket counts (104, 60, and 49) have been removed from this plot to improve visibility.

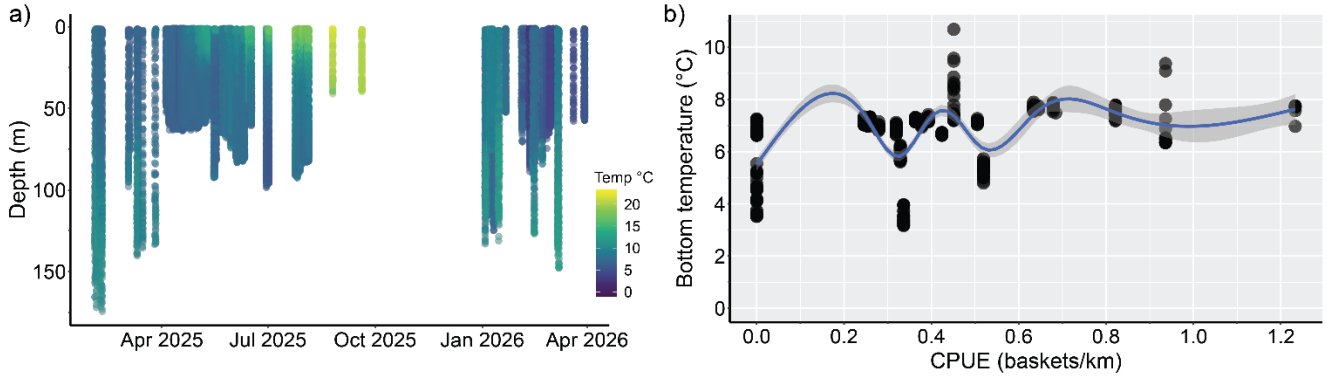


Figure 5. a) Water column profiles from Environmental Monitors on Lobster Traps and Large Trawlers (eMOLT) program sensors attached to a dredge on each of the six participants. b) Catch per unit effort (CPUE) of baskets of sea scallops per kilometer traveled (baskets/km) plotted against bottom temperature logged by eMOLT sensors.

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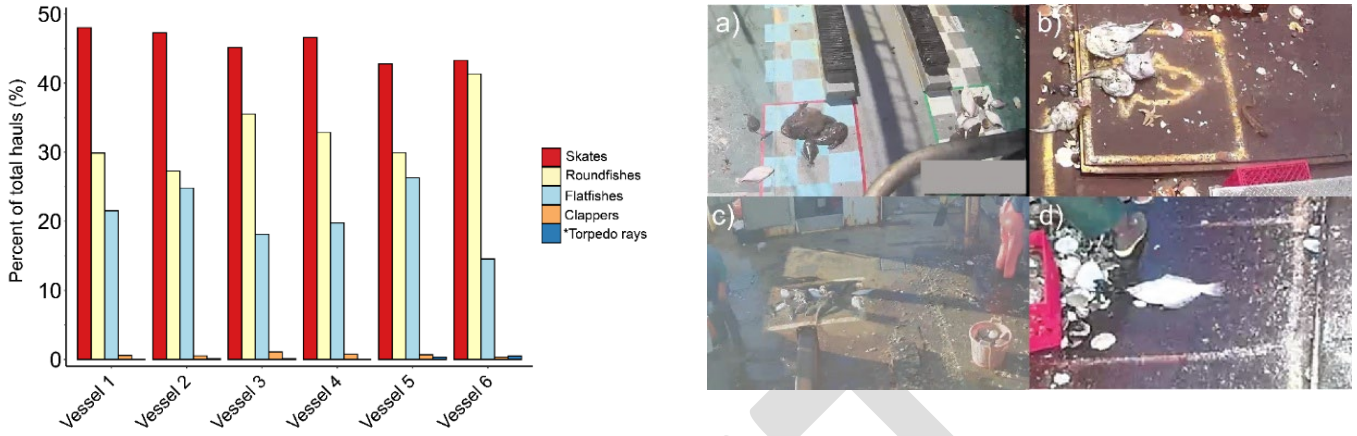


Figure 6 (left). Percent of total hauls from each vessel participant containing different bycatch categories that reviewers identified through March 1, 2026. General categories include 1) skates, such as winter (*Leucoraja ocellata*), little (*Leucoraja erinacea*), and barndoor, 2) roundfish, such as red hake, monkfish, and sea robin (*Prionotus carolinus*), 3) flatfishes, such as windowpane and summer flounder, 4) clappers, or dead sea scallops with an intact hinge, and 4) torpedo rays. **Figure 7 (right).** Examples of bycatch identification areas including a) comparison of red and green paint colors with checkerboard pattern for scale, b) yellow square with several monkfish and an ocean pout that blends with the deck, c) an obscured pile of bycatch that is difficult to identify, and d) fading of paint starting to occur.

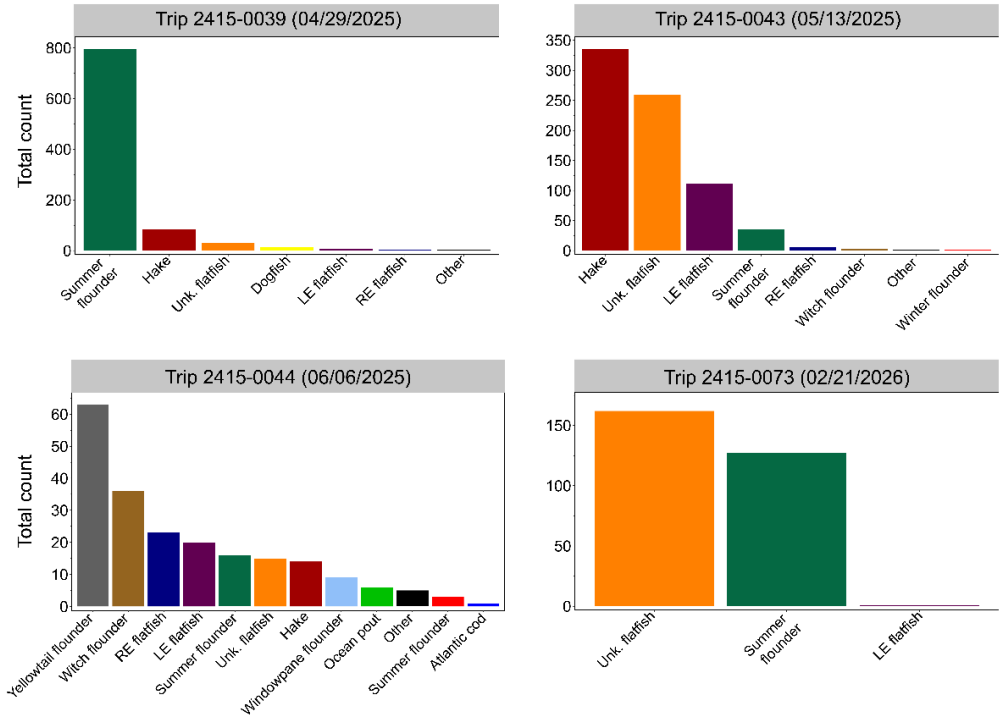


Figure 8. Bycatch composition from four separate trips where the crew sorted bycatch into identification areas. In addition to species identifications, some fishes were grouped broadly due to obscured imagery, with groups including Unknown Unk.) flatfish, left-eyed (LE) flatfish, and right-eyed (RE) flatfish.

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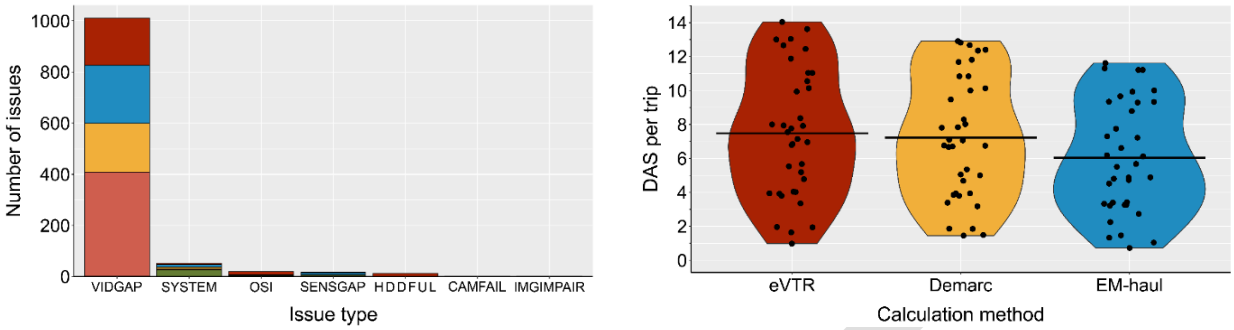


Figure 9 (left). EM specific issues (1,113 total) through the review cutoff (March 1, 2026). Issues include system failure (SYSTEM), camera failure (CAMFAIL), sensor gaps (SENSGAP), video gaps (VIDGAP), imagery impaired (IMGIMPAIR), full or failing hard drive (HDDFULL), and other (OSI). The issues are colored by vessel number.
Figure 10 (right). Days-at-sea (DAS) per trip according to three different calculation methods. Electronic Vessel Trip Reporting (eVTR), the demarcation (demarc) line, and the start of the first haul through the completion of the last haul through EM system data (EM-haul). Black circles are individual trips (36 total) and the black lines are the mean DAS/trip for each method, eVTR (7.5 DAS), demarc (7.2 DAS), and EM-haul (6.0 DAS).

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