Operationalizing Open-Source Electronic Monitoring Systems in New England Groundfish Sectors: Year 1 Summary

Introduction

Recent federal budget cuts and looming industry cost sharing mechanisms have created the need to develop more cost effective and sustainable alternatives to at-sea-monitoring (ASM) in New England's groundfish fishery. While ASM costs for the groundfish fleet have been fully funded by the National Marine Fisheries Service (NMFS) since the sector system was implemented in 2010, there is uncertainty around the continuation of this funding in the future. In 2011, the industry-covered portion of these costs for ASM only ($3.8M, assuming NMFS paid the $1.5M in infrastructure and overhead costs)[1] would have equated to ~4% of the total groundfish sector revenue ($89M). Eventually these costs will be transitioned to the industry, and there are valid concerns that the majority of them will be unable to afford these monitoring costs.

In order to maintain the economic viability of groundfish fishing enterprises, while at the same time delivering the required catch monitoring data to fisheries managers, innovation is required. Electronic Monitoring (EM) systems, either as a replacement for or complement to human At-Sea Monitors, may offer a way to greatly reduce the costs associated with ASM without compromising data quality or integrity. In addition, EM effectively increases the ASM coverage level to 100%[2], which is an improvement from the current combined coverage level of approximately 25%, and opens up multiple opportunities to increase the use of fishery-dependent data for science and management. Realizing that EM is a potential tool to effectively monitor the fleet in a cost-effective manner, The Nature Conservancy (TNC), the Gulf of Maine Research Institute (GMRI), and Maine Coast Community Sector (MCCS) partnered with Ecotrust Canada (EC) to develop and test an open-source EM system on groundfish sector vessels in New England.

Efforts surrounding the implementation of EM have been taking place in the region for over a decade. Prior to this project, two EM pilots were conducted in New England: In 2004 the Cape Cod Commercial Fishermen's Alliance, NMFS and Archipelago Marine Research Ltd. (AMR) tested the suitability of EM in the haddock longline fishery in Cape Cod, later expanding to the gillnet fleet in 2006; NMFS and AMR also worked together on a three-year EM study in the New England trawl and gillnet fleets. To compliment these pilots there have been several national policy efforts, regional initiatives and workshops between key stakeholders and decision-makers. While there has been a considerable amount of EM work in the region, the current project will build on lessons learned and operationally test methods introduced in the previous pilot projects.

One expected outcome of this project is to outfit participating groundfish sector vessels with voluntary EM systems that could be utilized to meet regulatory at-sea monitoring requirements in Fishing Year (FY) 2015 if NMFS approves the use of EM for this fishing year. Upon completion of this project, the vessels will be able to keep the hardware installed on their boats. While NMFS may only

[1] Gabriel, Wendy. Funding Northeast Fishery Science Center Monitoring Programs. Presentation to the NEFMC, April 23, 2014.

[2] While the cameras typically record 100% of fishing activity, and the percentage of the video reviewed is dependent on the design and goals of the EM system, and may range from a random sample of 10% to 100% review.

approve the use of EM for certain gears and types of fishing behavior (i.e., single stock area fishing trips or day trips), we believe this is a significant step towards facilitating the implementation of EM.

A second, longer-term outcome is that the open-source software and affordable hardware developed for the these vessels can be expanded in the future for other vessels in the groundfish fleet, both for different fishing operations and for the varying species catch composition in the broad stocks areas within the fishery. Ecotrust Canada's EM system currently costs between $2,500 - $5,000 depending on the type of sensors involved and number of cameras being used. Annual service provision for data retrieval, analysis and delivery to regulators is not included in initial installation and hardware costs, and the cost varies depending on types of services being delivered.

Methodology

In Year 1, EC developed EM technology with open-source data collection software for boats using gillnet and trawl gear (see Figure 1). In 2013 these systems were installed on two MCCS vessels, one of each gear type, and a server was set up at GMRI for data downloading and analysis.

The two cameras were set up as follows in Year 1: one to capture an overview of deck activities and one focused on the sorting table (gillnetter) or sorting area on deck (trawler) for identifying and estimating weights of discarded groundfish species. In Year 2 a third camera has been added with a view of the side rail where any catch being discarded without coming on board can be captured on film and to give an even more complete deck view.

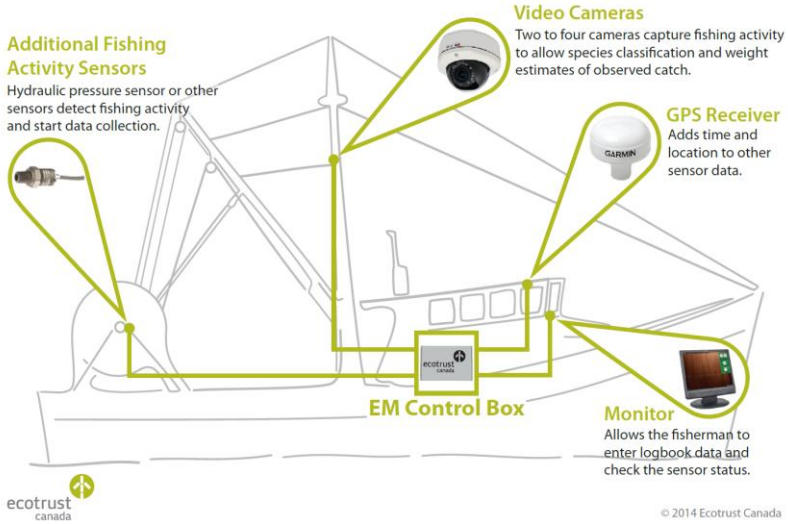

Figure 1: Schematic of hardware included in Ecotrust Canada's EM system

Catch Handling Methodologies and Analysis

In Year 1 two vessels participated, a gillnetter and a trawler. All video hours from both participating vessel were first screened to assess the quality and usability[3] of the video data collected. In Year 1,

[3] Usability means that video from all cameras captured an entire haul event without obstruction and where all discards happen in frame. If video from any camera is missing due to a system malfunction or if the video captured

22% of the usable video was reviewed in order to record: a visual weight estimate for each retained species using accepted weight to length ratio by species; the species, life status and treatment of each incidental take of a marine mammal or protected species; and for all discarded Annual Catch Entitlement (ACE) managed species a length per fish.

Reviewer lengths were converted to weights using peer-reviewed NEFSC length-weight relationships from Wigley *et al*. (2003). In Year 1 the systems proved to be able to capture video at a high enough frame rate and with high enough quality to identify by species marine mammals, protected species, and ACE managed species (see Photo 1).

Photo 1: Video still of images simultaneously captured on two cameras in Year 1

On the gillnet vessels, length-weight ratios were used to determine weight, and the total estimated weights of all discarded species were compared to fisherman's log and, where applicable, to data collected by both Northeast Fishery Observer Program observers and at-sea monitors. On the gillnetter only slight adjustments to fish handling technique were required in order to ensure that fish are moved across the table in view of the camera. The measuring device used in Year 1 proved inadequate and therefore lengths had to be determined by measuring the length of the fish on-screen and converting that to an estimated actual length using a conversion factor.

For the trawl vessel, it was originally planned to use the volume of fish being discarded (based on number of baskets full) to estimate total discard weight by species using density conversions. This methodology could not be used due to lack of known basket weights per species. In place of this method, length measurements extracted from the camera focused on the trawl deck and length estimates were used to determine discard weights on the trawl vessel, calculating true length measurements using a conversion factor as done with the gillnet video footage.

Video reviewers estimated lengths of individual fish by measuring the fish in centimeters on the computer screen with a ruler. Computer screen measurements were scaled against known measurements of the sorting table (on the gillnetter) or the trawl alley (on the trawler). A conversion factor was calculated by measuring the length and width of the sorting table or trawl alley on the screen and comparing it with the given measurements using the following equation where x is the conversion factor: (actual length of trawl alley)(x) = measured computer screen length of trawl alley

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does not clearly show deck activity (either from water/slime on camera lens or a person or object blocking the camera) for any part of the hauling when sorting is occurring then that video cannot be used for species ID, length estimates or determining discards.

For both trawl and the gillnet vessels, pertinent information regarding ACE species, marine mammals, and protected species were recorded on an Excel spreadsheet. This spreadsheet included data fields for the unique video identifying number, haul number, retained/discarded, species name, quantity, species code, length, weight, ACE y/n, protected y/n, life status of incidentals, and treatment of incidentals.

In Year 1 we also developed and began testing an electronic logbook (eLog) system in order to be able to test the feasibility of integrating EM data with haul-by-haul fishing log data in Year 2. This eLog is currently being integrated into the EM system and we are working together with our partners at GMRI and NMFS to get the software certified for use for the participating vessels in FY 2014.

Year 2 Modifications to Pilot

In Year 2 seven vessels are participating: five gillnetters and two trawlers. Modifications to the data collection system in Year 2 include an extra camera, improvements to the measuring devices on both gear types and to the protocol for weight estimations on trawl vessel. In Year 2 trawlers have been outfitted with measuring length strips in view of the camera and crew members will pass discarded fish over the grid as they are being sorted. After a successful trial period in Year 1 we have taken the lessons learned in order to maximize data capture on all vessels in Year 2. Data pulls every week, with timely feedback to captains and GMRI technicians should ensure any software or users errors are corrected prior to next data collection period, and complete analysis of randomly selected hauls from each vessel's data pull throughout the season will result in a more timely reporting at the end of FY 2014. 10% of each vessel's total number of hauls will be completely analyzed in Year 2. Technicians from EC and GMRI worked closely with captains during system installations and measuring devices were placed in such a way as to minimize changes to regular fish handling techniques and work flow on deck. Individual vessel monitoring plans were created for each vessel and shared with the captains prior to the start of FY 2014; these plans can be used as reference.

By the end of Year 2, we hope to have developed and tested an EM system that can be operationalized as part of a comprehensive monitoring system on the gear types being used in the New England groundfishery and that will meet the regulatory requirements for groundfish sector vessels.

For more information about this project or about the EM technology please contact Amanda Barney at Ecotrust Canada (amanda@ecotrust.ca), Rachel Long at the Gulf of Maine Research Institute (rlong@gmri.org), Geoff Smith at The Nature Conservancy (geoffery_smith@tnc.org) or Lucy Van Hook (lucy@mainecoastfishermen.org).

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