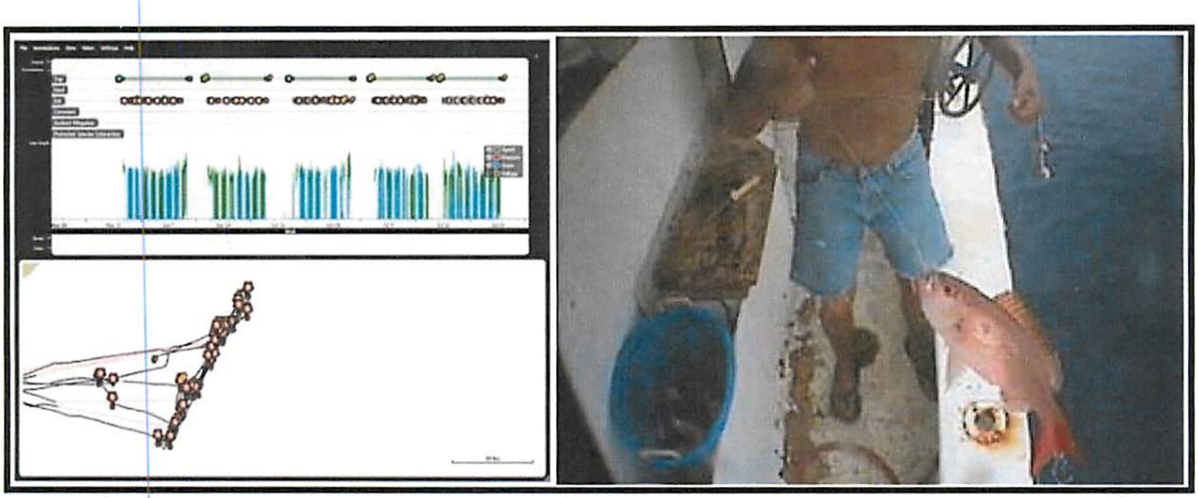
NCU-T-12-003

Characterization of bycatch associated with the South Atlantic snapper-grouper bandit fishery with electronic video monitoring, at-sea observers and biological sampling.



Final report
October 2012

Author:
M. Scott Baker, Jr.
North Carolina Sea Grant
University of North Carolina-Wilmington
Center for Marine Science
5600 Marvin K. Moss Lane
Wilmington, NC 28409, USA

A project funded by NOAA/National Marine Fisheries Service Cooperative Agreement No.NA09NMF4540138 (University of North Carolina Wilmington Grant Number 515650)

The views contained herein are those of the author and do not necessarily reflect the views of the U.S. Department of Commerce or any of its sub-agencies.

Table of Contents

1. Award information

Grant Number: NA09NMF4540138

Amount of Grant: Federal $381,765 Match $0 Total $381,765

Project Title: Characterization of bycatch associated with the South Atlantic snapper-grouper bandit fishery with electronic video monitoring, at-sea observers, and biological sampling.

Grantee: M. Scott Baker Jr., University of North Carolina Wilmington (PI); Amber Von Harten, South Carolina Sea Grant (Co-PI); Eileen Dougherty, Environmental Defense Fund (Co-PI).

Award Period: From 08/01/2009 to 07/31/2012 *includes 1 year no cost extension

Expenditures: Funding Total: $381,765.00

Category	Expenditures
Personnel	$27,355.53
Travel	$6,234.07
Supplies	$2,760.82
Contractual	$162,584.70
Other	$71,198.30
Total Direct	$270,133.42
Indirect	$67,533.33
TOTAL	$337,666.75

Total Cumulative Expenditures (all periods): $337,666.75
Total Remaining Balance: $44,098.25

2. Executive summary

The South Atlantic snapper-grouper Species Management Complex is comprised of 73 species that are managed by the South Atlantic Fishery Management Council (SAFMC) in Charleston, South Carolina. The management of the Snapper-Grouper fishery is complicated because of the large area, the variety of fishing gears and vessel sizes used, and the life history of the species in the fishery. The objectives of this study were (1) to compare data obtained from electronic video monitoring (EM) to data collected simultaneously with fishermen logbooks and fisheries observers, (2) to collect otoliths to assist in determining the age-size structure of frequently discarded species, (3) to present the findings of this study, along with results from similarly completed or ongoing studies in the Southeast, to fishermen, scientists and other stakeholders at a public workshop in conjunction with a SAFMC meeting and (4) conduct a survey to help us understand permit holder perceptions and attitudes about electronic monitoring research specifically and cooperative research in general.

In the spring of 2010, Archipelago Marine Research Ltd. (Archipelago) began working with Sea Grant and several permit holders in the snapper-grouper bandit reel fishing industry to test the effectiveness of electronic monitoring (EM) in the fishery. Electronic monitoring is an onboard system that collects fisheries data using a series of sensors (drum, hydraulic pressure, GPS) installed throughout a fishing vessel along with a user interface in the wheelhouse. Data collection is followed by post-fishing trip data interpretation and analysis. To test the applicability of the EM system within the fishery, EM systems were deployed on 8 vessels from March 2010 to December 2010. EM data were then compared to data collected by fishers and at-sea observers. A total of 93 trips were monitored by EM, 34 by self-reported fishing logbooks, and 5 by observers. A total of 524 sea-days were monitored with EM systems, and complete catch documentation using EM was completed for 139 sea-days. Observer data were available for 26 sea-days or a total of 315 events. Observer count data matched well with EM count data, but species identification with EM was less accurate. Self-reported logbook information collected by fishermen matched well with EM data for some vessels but matched poorly for others. Many species important to the fishery within the families Serranidae, Sparidae and Haemulidae were difficult for the EM reviewer to identify. Vermilion snapper *Rhomboplites aurorubens* and gray triggerfish *Balistes capriscus* collectively comprised a significant portion of the retained and discarded catch, and the EM reviewer correctly identified these species most of the time. The results indicate that EM monitoring has potential to augment existing data collection programs in this and similarly prosecuted fisheries provided that steps are taken to improve overall catch counts and species identification.

Information on frequently discarded species was collected by investigators, fishermen and the observer. Working with fishermen, the investigators obtained otoliths from 102 undersized fish representing six species. The observer reported fate for 381 catch items, with 91% of discards released in excellent condition (category 1 of 1-4). Lengths, location and depth of capture were recorded by the observer for many samples, but EM system used here did not have the capability to record depth.

An EM workshop for the SAFMC snapper-grouper advisory panel members and members of the public was held in April 2011. The workshop provided participants with detailed information on this study and other research project results on both electronic monitoring and traditional fisheries observing approaches for the commercial snapper-grouper hook and line fishery. Eleven of 34 participants provided responses to the exit survey. Attendees were either "Very Satisfied" (50%) or Satisfied (50%) with the overall workshop. The workshop was comprised of 4 presentations (4 presenters) as well as open discussion periods. In order of response scores, our pilot project results were marked as the most useful (90%), followed by the presentations of NOAA / NMFS vessel monitoring systems, the Gulf and South Fisheries Foundation at-sea observer study, and then by the regional electronic monitoring project conducted in the Gulf of Mexico. Only one respondent indicated that electronic monitoring was too intrusive. The NOAA representative who presented on VMS was happy with the workshop as it is often difficult to show the benefits of VMS to fishermen. Overall, fisherman, Council staff and fisheries managers were impressed with the capabilities of EM systems as well as the relatively strong correlation between EM and observers and EM and fishermen's self-reported logbooks.

Finally, a combination outreach mailing and research survey was delivered to all snapper-grouper permit holders (n=773). This survey represents the first attempt to define snapper-grouper permit holders' attitudes towards the concept of electronic monitoring specifically and cooperative research in general. The response rate (15%) was adequate, but could likely have been improved by using a "warm-up letter" prior to the mailing of the survey. Generally speaking, respondents were not supportive of future EM testing in the snapper-grouper fishery, but were supportive of cooperative research in general. Permit holders preferred project types that relied on the use of industry knowledge. When given the opportunity, 54 permit holders (47% of survey respondents) provided names and contact information (address, phone numbers, email, etc.) in order to stay up to date on cooperative research information.

3. Project objectives

1) To compare data obtained from electronic video monitoring (EM) to data collected simultaneously with fishermen logbooks and NOAA fisheries observers;

2) To collect otoliths and other information to assist in determining the age-size structure of frequently discarded species,

3) To present the findings of this study, along with results from similarly completed or ongoing studies in the Southeast, to fishermen, scientists and other stakeholders at a public workshop in conjunction with a SAFMC meeting;

4) Conduct a mailing to all South Atlantic snapper-grouper permit holders which provides (a) a short summary of the research conducted final report and (b) a short voluntary survey to allow permit holders to comment on the outcomes of this specific study as well as identify what, if any, should be the next steps to consider in this line of "electronic monitoring" cooperative research.

4A. Evaluation of electronic video monitoring in the South Atlantic snapper grouper fishery (Final Report from Archipelago Marine Research, Ltd.).

USE OF ELECTRONIC MONITORING FOR CHARACTERIZATION OF BYCATCH ASSOCIATED WITH THE SOUTH ATLANTIC SNAPPER-GROUPER BANDIT FISHERY

By
Adam Batty
María José Pría
Howard McElderry
Jessica Schrader

April 25, 2011

Archipelago Marine Research Ltd.
525 Head St.
Victoria, British Columbia, Canada
V9A 5S1
www.archipelago.ca

ARCHIPELAGO
MARINE RESEARCH LTD.

ABSTRACT

The South Atlantic Snapper-Grouper Species Management Complex is comprised of 73 species that are managed by the South Atlantic Fishery Management Council (SAFMC) in Charleston, South Carolina. The management of the Snapper-Grouper fishery is complicated because of the large area, the variety of fishing gears and vessel sizes used, and the life history of the species in the fishery. The species complex includes inshore and offshore species, which further complicates the management. In the spring of 2010, Archipelago Marine Research Ltd. (Archipelago) began working with Sea Grant and several permit holders in the Snapper-Grouper Bandit Reel fishing industry to test the effectiveness of Electronic Monitoring (EM) in the fishery. EM is an onboard system that collects fisheries data using a series of sensors (drum, hydraulic pressure, GPS) installed throughout a fishing vessel along with a user interface in the wheelhouse. Data collection is followed by post-fishing trip data interpretation and analysis. EM can provide a wide range of information depending on the application within the fishery. The overall objective of this research is to determine if EM technology can be used to fill data gaps within the South Atlantic Snapper-Grouper fishery. To test the applicability of the EM system within the fishery, EM systems were deployed on 8 vessels from March 2010 to December 2010. EM data were then compared to data collected by fishers and at-sea observers. A total of 93 trips were monitored by EM, 34 by self-reported fishing logbooks, and 5 by observers. A total of 524 sea-days were monitored with EM systems, and complete catch documentation using EM was completed for 139 sea-days. Observer data were available for 26 sea-days or a total of 315 events. Comparisons between EM and observer data showed that EM was a reliable source of catch data and was not significantly different from observer data. EM can provide accurate piece count data that could be used for management of the fishery. Several recommendations are made to increase the success of EM including changes to catch handing methods, clarifying how fishing events are defined, and implementing a fisher logbook audit program.

1.0 INTRODUCTION

1.1. BACKGROUND

The South Atlantic Snapper-Grouper Species Management Complex is comprised of 73 species (see Appendix 1) that are managed by the South Atlantic Fishery Management Council (SAFMC) in Charleston, South Carolina. The fishery is geographically widespread, covering the area of the US east coast ranging from Cape Hatteras, North Carolina to Key West, Florida. There are approximately 880 permit holders in the fishery, of which about 600 to 700 are active on a regular basis. Permit holders are widely distributed along the coastline and have highly variable levels of fishing activity (NOAA, 2011).

The management of the Snapper-Grouper fishery is complicated by the large area, the variety of fishing gears and vessel sizes used, and the life history of the species in the fishery. The species complex includes species that are found within both inshore and offshore habitats, which further complicates management. Approximately 80% of the average landings (2001-2005) are caught with vertical lines and electric hook and line gear (called bandits). Recent research related to the fishery has been focused on the species composition and length distribution of discarded catch (Gulf and South Atlantic Fisheries Foundation Inc., 2008) and mortality after discarding (Rudershausen and Buckel, 2007) because of concern about the impact of unaccounted for bycatch in stock assessments.

In the spring of 2010, Archipelago Marine Research Ltd. (Archipelago) began working with Sea Grant and several permit holders in the Snapper-Grouper fishing industry to test the effectiveness of Electronic Monitoring (EM) in the fishery. EM has been used in fisheries around the world to collect fisheries data using a series of onboard sensors and video cameras. EM allows for at-sea data collection followed by post-fishing trip data interpretation and analysis; EM can provide a wide range of information depending on the application within the fishery. The overall objective of this research is to determine if EM technology can be used to fill data gaps within the South Atlantic Snapper-Grouper fishery. EM technology could potentially be used to provide high quality, verifiable, fishery dependent data for stock assessments and management decisions.

1.2. CURRENT MANAGEMENT

Management and monitoring of the Snapper-Grouper fishery is currently done through a series of management protocols that vary by species. Aspects of the management program include size limits, trips limits, annual catch limits (ACLs) (i.e. quota), gear restrictions, species closures, marine protected areas (MPAs), area closures, and individual transferable quotas (ITQ). Changes to the Fisheries Management Plan (FMP) for Snapper-Grouper are made through amendments by the SAFMC as necessary. The stock assessments on which management is based are developed and reviewed by the Southeast Data, Assessment, and Review (SEDAR) Stock Assessment Program. Quota for individual species is allocated by the SAFMC between commercial and recreational (for-hire) fisheries.

Given the complicated management structure of the fishery, monitoring is in place to ensure that species quotas are not exceeded by individuals or the fishery as a whole. Monitoring programs that are currently in place include federally required catch logbooks (Federal logbooks), fisher discard logbooks (discard logbooks), and port sampling. Federal logbooks are required for all fishing trips, and contain information provided by skippers on the fishing location, gear type, and pounds landed by species. Discard logbooks are assigned to 20% of the fleet to estimate bycatch in the Snapper-Grouper commercial fishery (McCarthy, 2009, Poffenberger, 2004). Port sampling is conducted upon landing, but provides no data related to discarded catch. As a result of the monitoring through logbooks, data that are used in SEDAR stock assessments are self-reported data, and are considered to be less desirable than fishery independent data (SEDAR, 2010).

Fisheries managers often rely on independent data sources to confirm self-reported data, and in many cases these data sources are at-sea observers. Observers accompany fishing vessels and record catch data during fishing activities to supply independent data. The Snapper-Grouper monitoring program does not include observers because there is currently no source of funding to cover the cost of observers. Pilot studies to test the use of observers in the fishery are on-going and are funded by the NOAA Cooperative Research Program.

Recent changes to the Magnuson-Stevens Fishery Conservation and Management Act have impacted the fishery management by requiring annual catch limits and accountability measures. National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act requires that fishery management plans must:

> *"establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided."*

As a result of National Standard 9, there is a need to improve the monitoring and data collection programs of the Snapper-Grouper fishery. Specifically, the data types that are required for improved management are total catch-by-species, total discards-by-species, and fleet fishing effort.

Currently, management concerns within the Snapper-Grouper fishery include overfishing (SAFMC Amendment 13C), discard mortality (SAFMC Amendment 17, Overton and Zabaski 2003, Rudershausen and Beckel 2007), and improving accountability (SAFMC Amendments 17A, 17B). Specifically, a major management concern is the fishing mortality of Red Snapper; the SAFMC has taken actions to decrease the mortality of Red Snapper by 70% through the creation of Amendment 17A. This amendment prohibits the harvest and possession of Red Snapper in Federal waters (3 – 200 miles offshore) and created an area closure of 4,800 square-miles. Amendment 17 became effective on December 3, 2010 continuing a prohibition on the harvest of Red Snapper. Implementation of the Snapper-Grouper area closure was delayed until June 1, 2011, to allow for development of Regulatory Amendment 10, which will eliminate the Snapper-Grouper area closure approved in Amendment 17A (SAFMC News Release, 2010). Improvements to the monitoring program may help to alleviate some of the management concerns within the fishery by providing a more complete picture of the fishery.

1.3. ARCHIPELAGO MARINE RESEARCH LTD.

Over the past decade, Archipelago Marine Research Ltd. has pioneered video-based EM technology, conducting several pilot projects and fully implemented EM-based projects around the world. The current capabilities of EM have been reviewed in McElderry (2008). EM systems, consisting of up to four closed circuit television cameras, a GPS receiver, a hydraulic pressure sensor, a drum sensor, and a system control box, can be deployed on fishing vessels to monitor a range of fisheries variables including fishing location, catch, catch handling, fishing methods, protected species interactions, and mitigation measures. Given the advances in EM technology, its use in the South Atlantic Snapper-Grouper fishery may be an economically feasible and advantageous bycatch monitoring strategy for this fishery.

1.4. REGIONAL PROJECT MANAGEMENT

The project was initiated, coordinated, and managed on site by Sea Grant personnel in North Carolina and South Carolina. Sea Grant provides research, education and outreach related to coastal issues and serves as a resource on a broad range of topics, one of which is fisheries science and management. As partners in this project, Scott Baker and Amber Von Harten of Sea Grant were able to connect with local fishermen. Sea Grant personnel also coordinated the project locally and provided all vessel service and logistical arrangements in the area.

1.5. RESEARCH OBJECTIVES

This project was intended to test EM systems for their applicability for filling the current data needs of the South Atlantic Snapper-Grouper fishery. The specific objectives of this pilot project are:

1. to compare EM data to self-reported logbook and at-sea observer data;
2. to determine if the age-size structure of discards can be documented using EM; and
3. to collect data on the number of discards with respect to depth and location of capture.

2.0 METHODS AND MATERIALS

2.1. EM TRIALS ON FISHING VESSELS

EM System Specifications

The EM systems used for this project were custom manufactured by Archipelago in Victoria, BC. A basic EM system, shown schematically in Figure 1, consists of up to four closed circuit television cameras, a GPS receiver, a hydraulic pressure sensor, drum sensor, and a system control box. Technical specifications for the EM system are provided in Figure 2.

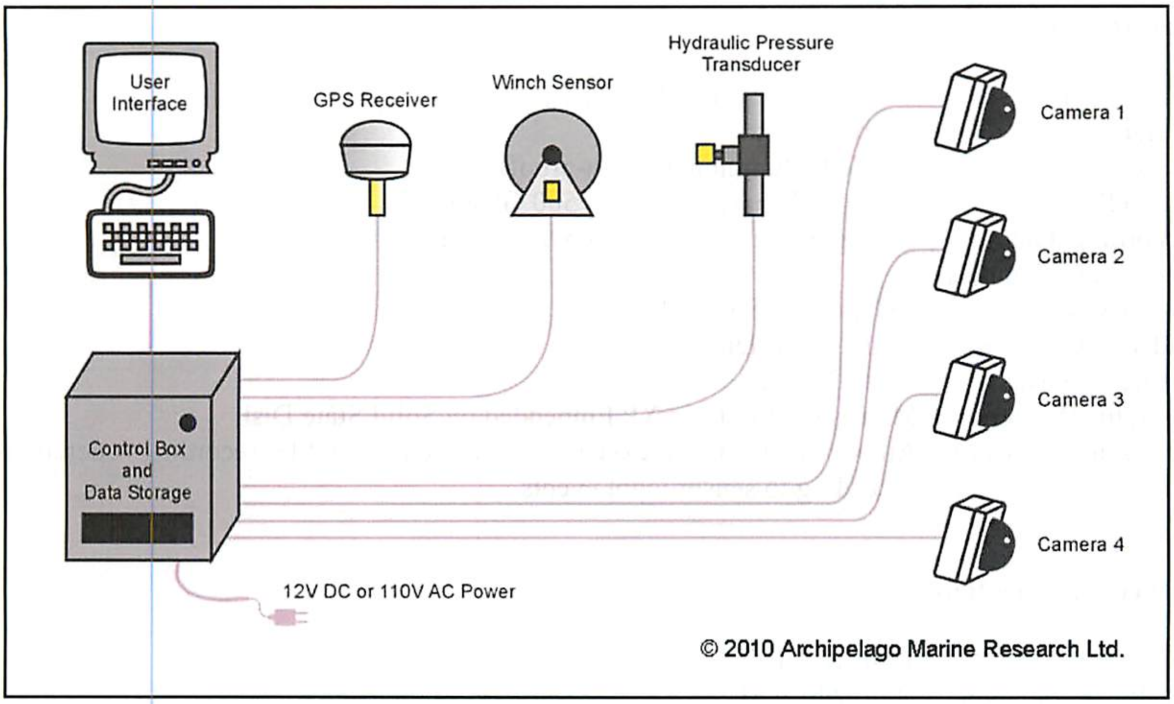


Figure 1. Schematic of a standard EM system.

The EM system software can be set in a variety of ways for data recording. For the purposes of this study, the system was to be powered continuously to record sensor data (e.g. location, time, speed, and drum activity, system events, etc.) at a ten-second frequency. Image data recording was set to record when the drum rotations exceeded a threshold (one rotation) and to continue recording for ten minutes after sensor activity dropped below the threshold. Data were recorded onto a 250 GB or 500 GB hard drive in the control box and were collected periodically.

Control Box	
Dimensions	8" x 8" x 13" (20 x 20 x 31 cm)
Weight	11 lbs, 5.2 kg
Chassis/Container	Welded Aluminum (splash-proof)
Video Storage	Removable hard disk up to 500 Gigabytes
Recording Time	Configuration dependent, up to 1000 hrs
Recording Channels	4
Video Resolution	VGA (640-480 pixels)
Video Compression	Windows or DivX
Frame Rate (fps)	Up to 30 total
Operating System	Microsoft Windows XP Embedded on Solid State Disk
Operating Software	Autonomous at-sea execution, user configurable recording operations according to sensor input events
Power Specifications	
DC Power	12 to 16 VDC
AC Power (adaptor)	90 to 240 VAC
Operating Current	6 Amps
Protection	20 Amp fuse, Battery deep discharge prevention
Protection	Low current (20 mA) Sleep Mode
Available Sensors and Options	
GPS, Radio Frequency ID Tag, pressure, rotation, acoustic receiver, contact closure, power supply monitor, Iridium satellite modem (ship to shore).	
Standard Camera	
Housing	Powder coated cast aluminum, sealed to IP66
Power	12 VDC
Resolution	480 TV lines, analog NTSC signal
Lenses	2.9 (fisheye) to 16 mm (telephoto)
Light rating	1 – Lux
Aiming	Fixed aim, internally adjustable for Pan, Tilt, Rotation.

Figure 2. Technical specifications of an EM system.

2.2. FIELD OPERATIONS

Archipelago sent a field technician to install EM systems (Figure 3) and train Sea Grant personnel on the maintenance, installation, data retrieval and removal of the EM equipment during March 2010. Sea Grant was responsible for selecting participating vessels and scheduling equipment installations on vessels whose owners volunteered to take part in the study. Installation of EM equipment on participating vessels took an average of eight hours per vessel.

EM systems were deployed originally on six vessels throughout the South Atlantic region from April, 2010 to December, 2010. Installations included a briefing of the skipper to explain how the system functions and to discuss the placement of equipment and wire routing to ensure that equipment had minimal impact on vessel and crew operations. EM systems were initially installed on six vessels, however, two vessels (vessels 4 and 8) were voluntarily withdrawn from the study early on and two new vessels (vessels 1 and 5) were added in July and August, 2010 (Table 1).

Table 1. Data collection start and end dates for all vessels that participated in the study.

Vessel	Data Collection Period	
1	08-Jul-10	18-Dec-10
2	30-Apr-10	28-Aug-10
3	29-Apr-10	23-Dec-10
4	06-May-10	31-May-10
5	03-Aug-10	21-Nov-10
6	04-May-10	04-Dec-10
7	05-May-10	27-Nov-10
8	05-May-10	7-June-10

System installation consisted of three to four cameras, a drum sensor, a GPS, and a control box in the wheelhouse (Figure 3). Hydraulic pressure sensors were not used in this study. Cameras were installed on vessels with the objective of capturing at least one bandit reel per camera. Cameras were installed as necessary to cover the entire area where fish were brought on board, handled, then either retained or released. Based on discussions with the skipper, a drum sensor was installed on the bandit reel that the skipper used in all fishing activities (the "primary bandit reel"). This placement was intended to ensure triggering of video recording during all fishing activity. The GPS was installed as high as possible on the vessel to allow for the best satellite coverage.

Data were retrieved periodically to ensure that hard drives were not filled so that all fishing events could be recorded. During data retrievals, the system was checked and any necessary alterations (e.g. camera angles changed, parts replaced) were made to ensure that the system was functioning properly. At the end of the study period, all systems and components were removed and all data retrieved from the vessels.

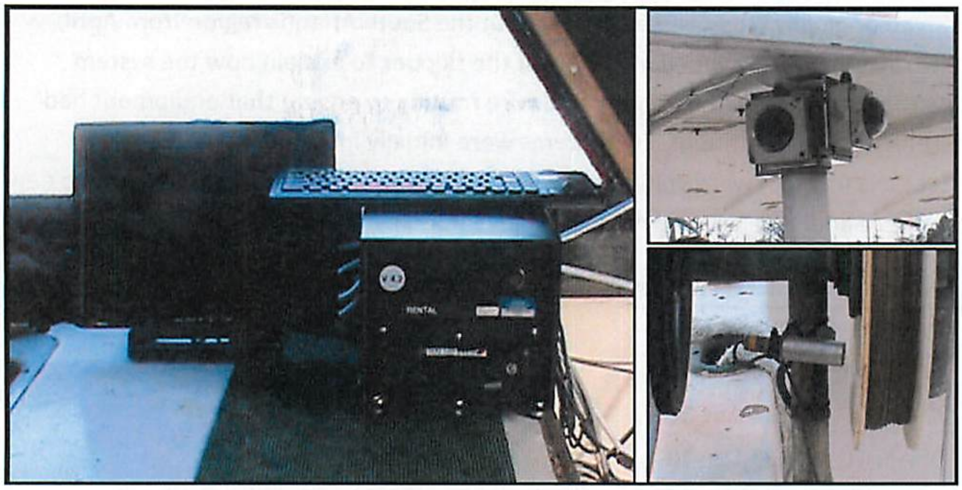


Figure 3. Examples of installed equipment on vessels. Cameras were mounted to record all fishing areas of the vessel. A drum sensor was mounted on the primary bandit reel.

2.3. DATA SOURCES

EM Data

EM data were collected at ten-second intervals while vessels were at-sea and systems were powered on. Data types collected by EM include: location, speed, direction, voltage and drum sensor rotation. Drum sensor rotation on the primary bandit reel triggered the system to record video data, with a run-on time of ten minutes. Skippers were asked to use the primary bandit reel before other reels to ensure that all fishing activities were captured on video.

Fishery Logbooks

Fishing data were recorded by skippers and crew during fishing events. There were three types of logbooks that were kept for this project:

- federal logbooks,
- federal discard logbooks, and
- self-reported logbooks.

The federal logbooks are required to be completed for all fishing trips and are used to track the total catch and effort in the fishery. Skippers record trip dates, gear type, area fished, total catch by weight (gutted and whole), total hours fished, and average depth at which fish were caught for each trip (Appendix 2). Copies of all available federal logbooks were provided to Archipelago electronically (in pdf format) by Sea Grant personnel.

Discard logbooks were provided to Archipelago electronically (in pdf format) when available by Sea Grant personnel. The discard logbooks contain data related to the trip start date, species discarded, total discarded, gear type, and reason for discarding. These data were not available for all trips, and were not used in the data comparisons for this study.

A main source of logbook data used in this study comes from an expanded form of skipper logbooks (hereafter "self-reported logbooks") (Appendix 3). The self-reported logbooks were designed specifically for the pilot project to allow for direct catch comparisons with EM data. Skippers were required to record start/end time, average depth, target species (if any), and total catch and discards for selected species for up to two cameras. For each fishing event, the skipper was required to record total retained and discarded pieces for a group of three species (Group 1: Vermillion Snapper, Gag Grouper, and Red Snapper, or Group 2: Red Porgy, Red Grouper, and Red Snapper). Skippers were initially requested to complete the self-reported logbooks for one bandit reel over a 4 hour block of time for each day of a fishing trip, on the frequency of one trip per month. Most skippers recorded catch for blocks of time that were longer than four hours and some skippers including all species from multiple bandit reels. Self-reported logbook data were compiled into an MS Access database by Sea Grant personnel and then provided to Archipelago for comparison with EM data.

Observer Data

An at-sea fisheries observer was present on a total of 5 trips (26 sea-days). Data types recorded by the observer include date, vessel name, start/end time, location, sea state (height of waves), depth, weather, number of reels set, and camera number observed. When catch was being brought on-board, observers collected the following data: time of retrieval, species, retained or released, length (cm), fate if released (direction of swimming, alive, dead), and other general comments (Appendix 4). The observer was asked to record the catch data for the reels within view of a single camera at a time. By limiting catch documentation to a single camera, the data can be more easily used to compare with data from the EM video imagery data. Although observers are not a component of the fisheries monitoring program, observer data provides a similar level of data collection, against which EM data can be compared. Observer logbook data were compiled into an MS Access database by Sea Grant personnel, and provided to Archipelago for comparison with EM data.

2.4. EM Data Interpretation

Sensor Data Interpretation

EM and logbook data were delivered to Archipelago in Victoria, BC on hard drives and were processed by experienced data processors using Archipelago's software EM Interpret 1.1 (Australia Configuration) (Figure 4). The software allows for quick identification of fishing activity by displaying data in several forms including line graphs, maps, and text. The data processing protocols were developed based on the project objectives and experience with similar EM trials carried out in the past.

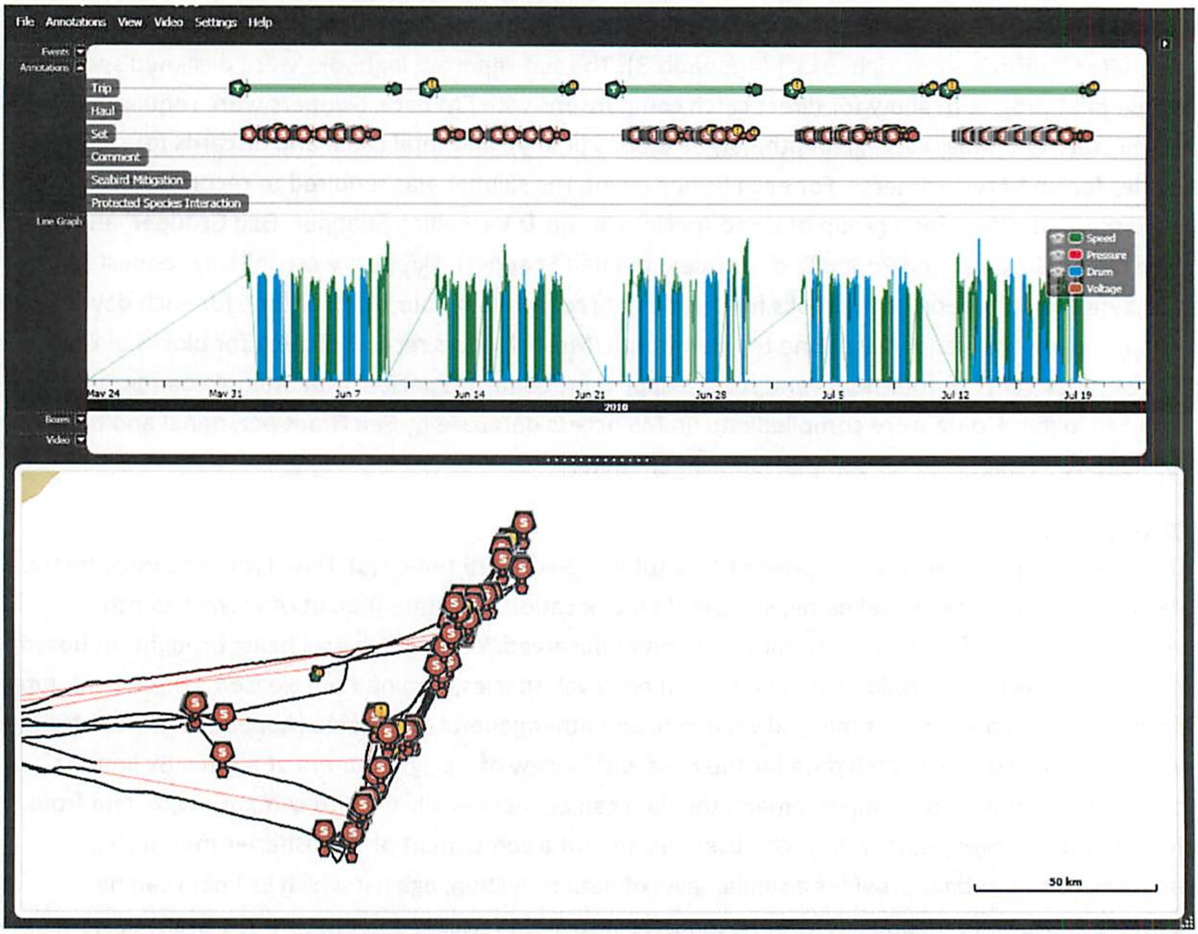


Figure 4. Example of a complete data set as seen in EM Interpret with annotations for trips and fishing events (sets).

EM data interpretation began with an inventory of the data set and an assessment of its quality and completeness. Through this process, a determination was made of missing data and whether the EM system and sensors performed properly. Next, the data set was interpreted to determine details of the fishing trips such as trip start and end, and the location and time for all fishing events (Figure 5 and Figure 6). Trips were defined as the period of time between the vessel departing from the port and returning to the port. Fishing with bandit reels does not require discrete fishing activities (i.e. setting of gear, and retrieval of gear), like other fishing types, so fishing activity was determined from the drum rotation and speed of the vessel.

Archipelago data processors used the self-reported fishing logbook, or observer data, when available, as a guide to define fishing events. Observers recorded individual events as periods of time when the fisher was in the same location. For trips that had observers, events were identified by data processors to match observer events. For non-observed trips, the events were defined by data processors as a period of time with continuous fishing without a break greater than one hour. If fishing stopped for more than one hour, the data processors identified the end of the event, and defined the start of a new event at the next point of fishing. Skippers generally recorded fishing events in self-reported logbooks as an entire day of fishing, so for trips with self-reported logbooks, events identified in EM were combined to the day level for comparison.

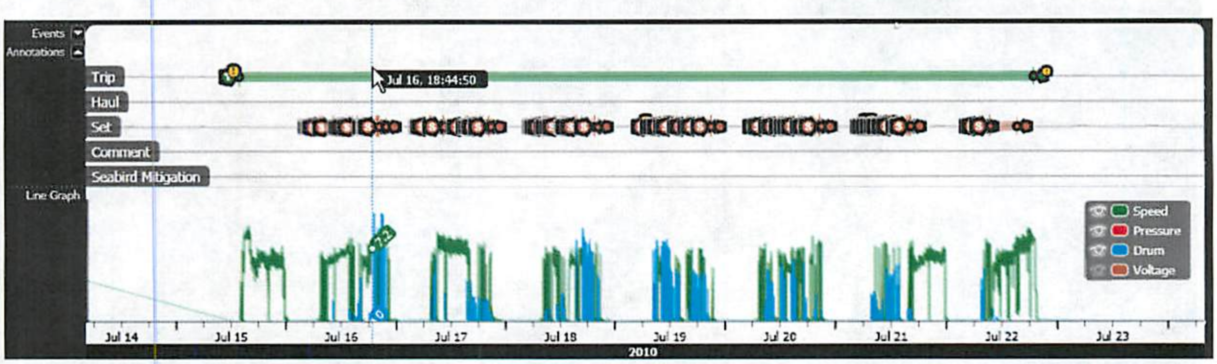


Figure 5. Example of an annotated data set from an entire trip. Data collected include speed and drum rotations.

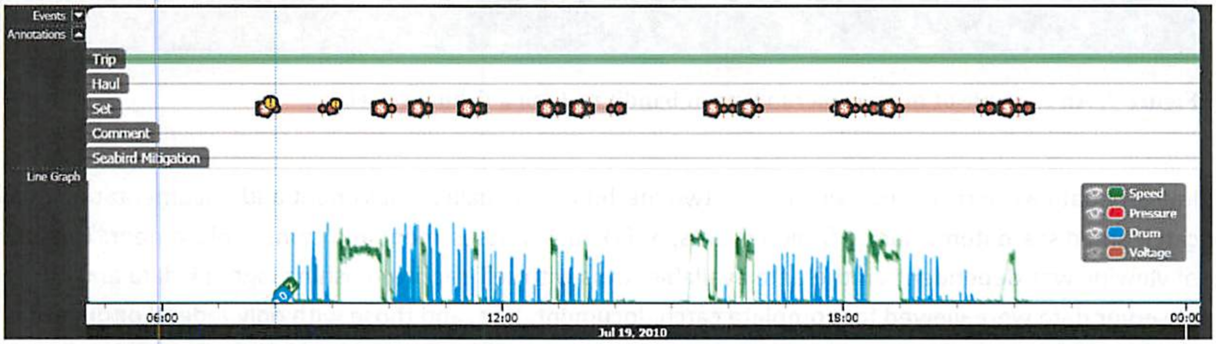


Figure 6. Example of an annotated data set for a single day of fishing. One day of fishing is broken into multiple fishing events, which are indicated by increased drum sensor counts (blue line).

Image Data Interpretation

Viewing of all imagery data was completed by an experienced Archipelago viewer in Victoria, BC using the custom software package Video Analyzer. Video Analyzer provides synchronized playback of all camera imagery and a data entry form for recording catch observations in a sequential manner (Figure 7). This application produces catch data in XML files that are then loaded into a database for catch comparison analysis. Image playback speeds during interpretation varied from about 1.5 to 4 times real time depending on catch density and image quality.

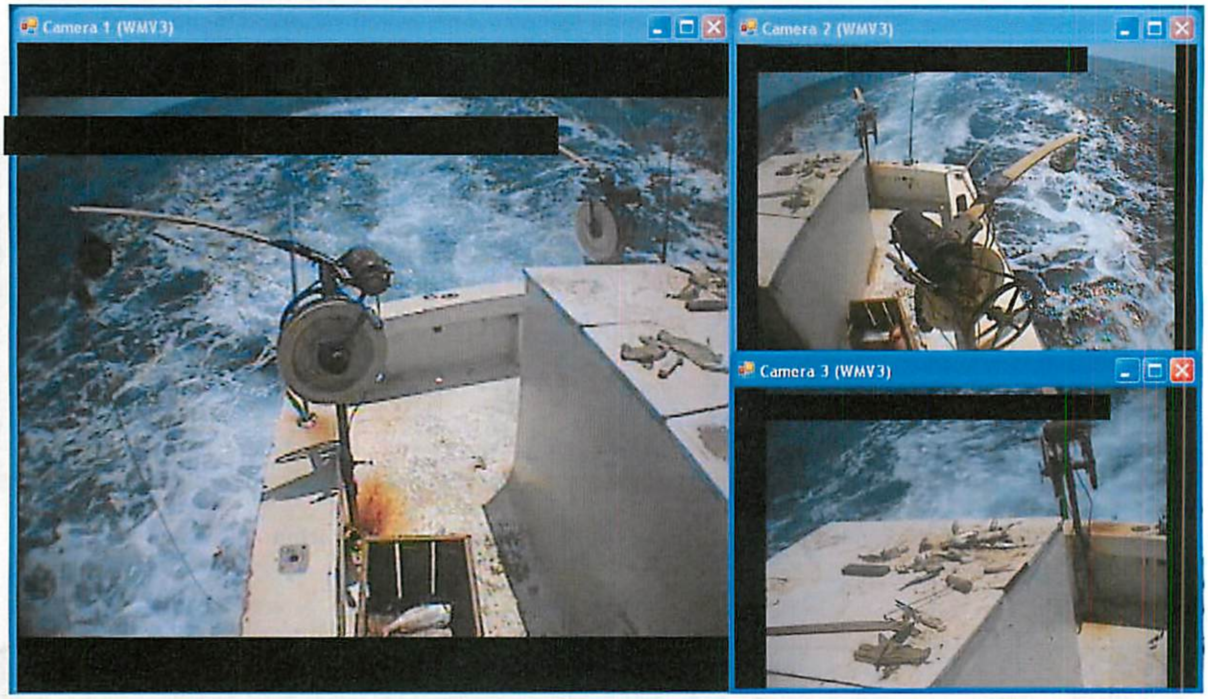


Figure 7. An example of three camera views of bandit reels on a fishing vessel.

Imagery data were reviewed using one of two methods: (1) quality assessment and documentation of all catch and discard items during fishing events, or (2) quality assessment and camera placement. The type of viewing was dependent on the data available; trips with self-reported fishing logbook data and observer data were viewed for complete catch documentation, and those with only federal or discard logbook data were viewed for imagery assessment. Periods of time that corresponded to self-reported fishing logbooks, or observer data were viewed for full catch documentation. Viewing for catch documentation was done only for the camera that had catch documented by the skipper or observer for comparison.

Video imagery for all events was given a rating based on its quality for use in identifying species, and catch use (retained or discarded). Quality of imagery was defined as follows:

- High - imagery was very clear and the viewer had a good view of fishing activities. Focus was good, light levels were high and all activity was easily seen.
- Medium - view was acceptable, but there may have been some difficulty assessing discards. Slight blurring or slightly darker conditions hampered view, but did not impede analysis.
- Low - imagery was difficult to assess. Some camera views may not have been available. Imagery was somewhat blurred or lighting was low.
- Unusable - imagery was available but could not be processed due to extreme lack of focus, low light levels or inadequate views of fishing activities.

Data Inventory

Not all data that were collected were suitable for inclusion in the comparisons due to either human or system error. Fishing events were excluded from analysis if key variables of the fishing event could not be confirmed from EM, self-reported, or observer data. The criteria used for exclusion were:

1. No start time was recorded in the self-reported/observer logbook;
2. No end time was recorded in the self-reported/observer logbook;
3. None of the cameras recorded video; or
4. Drum sensor data was not available (therefore no video triggered).

A fishing event was excluded if it met any one of the above criteria because it would not be possible to identify the fishing event, fishing activity, or catch due to data gaps.

Data collected on vessel 8 were not included in the analysis for this report. This vessel was voluntarily removed from the study after recording 5 days of EM data. The vessel's data was excluded because there was no drum sensor data recorded, which prevents identification of fishing events by data processors. The lack of drum sensor data likely resulted from fishers not using the primary bandit reel during fishing. Despite being excluded from the data summaries, this data does highlight the importance of communication with skippers about the proper operation of the EM system.

Catch data from vessel 4 was not included in the catch comparisons analyses. This vessel was voluntarily removed from the study after recording 25 sea-days. The vessel had a total of 2 trips with the EM system onboard. Neither of the two trips was selected for imagery viewing for catch documentation, consequently vessel 4 is not included in the catch comparisons, but was included in the total sensor data summary.

2.5. DATA ANALYSIS

After data processing and viewing was complete, the data were imported into an MS Access database for further examination, summary, and analysis. An Archipelago data analyst created several summaries of data collected including summaries of total fishing activity, time gaps, and data completeness, which are presented in the results. Also, catch and discard comparisons were made between EM data and self-reported logbook data, and between EM and observer data. These comparisons provide a better understanding of how well EM can capture the data necessary to answer management questions, and what changes could help to improve data collection in potential future EM work in the Snapper-Grouper fishery.

3.0 RESULTS

3.1. FIELD SERVICE AND CHALLENGES

Sea Grant personnel Scott Baker and Amber Von Harten conducted all vessel service throughout the project period. Excluding trips dedicated to installing and removing EM systems, 31 service trips were made to participating vessels (Table 2). Due to the large geographical range of this study, most of these service trips required six to eight hours to complete, including travel time. Seventeen trips included standard data retrievals in which sensor data was initially analyzed on-site. During data retrievals, hard drives were removed and empty hard drives were installed in the EM system. Fifteen of the 31 service trips involved adjusting and/or replacing at least one component of the EM equipment. In order of occurrence, adjustments and repairs were for cameras (n = 7), drum sensors (n = 7), battery / wiring issues (n = 4), replacement of other hardware (monitors, keyboards) (n = 2), and non-initializing hard drives (n = 1). Details related to the service events can be found in Appendix 5.

Table 2. Summary of service events for all vessels, excluding installation and removal. Bold text vessels are those that are owner-operated.

Vessel	Number of service trips	Trips involving adjustment or repair of EM
1	**6**	**1**
2	6	4
3	5	3
4	2	1
5	**2**	**2**
6	**4**	**1**
7	5	2
8	1	1
Total	**31**	**15**

3.2. DATA COLLECTION

EM data collection started in April, 2010, and ended in December, 2010 (Table 3). A total of 93 trips were documented with EM, 38 of which were viewed for complete catch accounting by Archipelago imagery viewers (Table 3 and

Table 5). Vessel 4 was not able to collect data throughout the entire data collection period, however the dataset collected by that vessel is included in the results presented here. Vessel 8 was also not able to collect data for the entire collection period, and was excluded from the analysis.

Data collection success rate was 64% across all vessels (Table 3); the lowest success rate was 46.9% and the highest was a 90.0% success rate on vessel 1 (Table 3). The success rate is generally expected to be low in EM pilot studies, but has been observed to be consistently high (98%) in established EM programs in British Columbia.

Table 3. Summary of data collected and collection success rate per vessel. Note: Vessel 8 is not included in data analysis.

Vessel	Total Trips	Sea-days	Mean Trip Length (days)	Sensor Data Collected (hours)	Data Collection Success (percent)	Total Events
1	16	89	6	1500.5	90.6	220
2	10	66	7	862.1	66.2	106
3	9	108	12	1375.5	58.6	260
4	2	25	13	325.7	60.3	74
5	12	41	3	343.2	46.9	44
6	26	88	3	1261.3	71.6	125
7	18	107	6	1082.5	48.8	195
	93	**524**		**6750.8**	**64.0**	**1024**

3.3. SENSOR DATA

Sensor data were reviewed by data interpreters to assess completeness, and to find any possible errors in the data. Identifying fishing activity was done by identifying patterns in the data that indicate certain equipment was being used or activities were taking place. Data processors identified all fishing events based on drum sensor and vessel speed. High drum rotation count combined with low vessel speed indicated fishing activity (Figure 8). Some fishing events were not recorded because fishers did not use the primary bandit reel, thus video recording was not triggered.

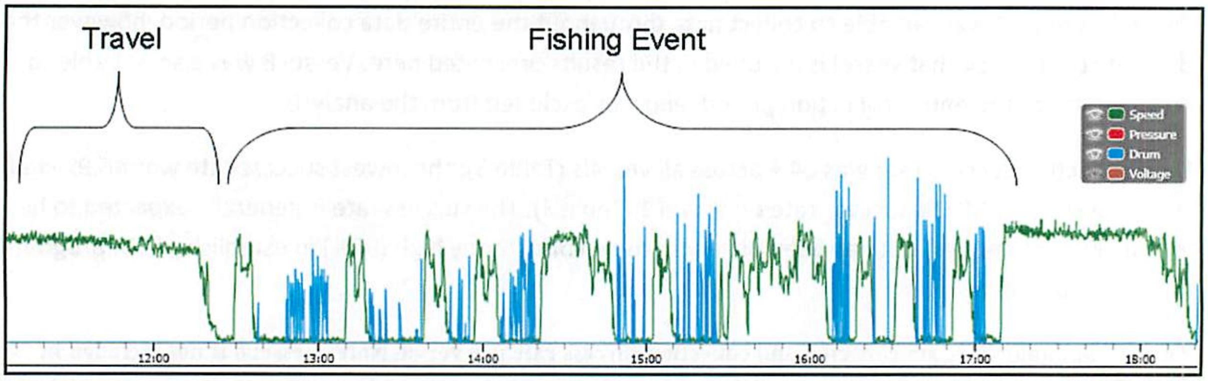


Figure 8. Example of sensor data indicating fishing activity. Any break in drum activity of more than one hour was marked as a new event.

3.4. IMAGERY DATA

A total of 429 events were viewed by an experienced Archipelago imagery viewer, of which 315 were comparable with observer data, and 113 were comparable with self-reported data (Table 5). For all events that were recorded with EM, imagery was assessed based on its quality for viewing as unusable, low, medium, or high. Sixty-three percent of imagery collected by EM for this study was considered to be of medium quality (Table 4). The ability of the viewer to identify the catch item was related to image quality, camera view, and fisher catch handling.

Catch was identified to the species level when possible, but when not possible, it was identified to the species group level (e.g. Snapper - unidentified). If the viewer could not identify the species, or species group, it was recorded as an unidentified catch item. Of all catch items that were recorded by the EM viewer, 18% were classified as an unidentified fish. Within the combined Snapper, Grouper and Porgy categories 19% of catch items were classified as unidentified within their respective category.

Table 4. Summary of imagery quality for all events viewed (n = 435). Note: events are not combined to the day level.

Vessel	High	Medium	Low	Unusable
1	0	70	36	1
2	0	1	6	0
3	2	99	81	0
5	0	5	0	0
6	3	16	15	0
7	1	82	17	0
Total	**6**	**273**	**155**	**1**

A total of 35 trips had self-reported logbook data that met all of the criteria for completeness, and were subsequently used in the analysis and catch comparisons. For self-reported data, events identified in EM were combined to a single event for a given day, and there were a total of 113 comparable self-reported events (Table 5). The same observer was present on four different vessels for a total of five observed trips. There were 315 events in observer data that are comparable with EM data (Table 5). The observer data had events recorded at the hook level, thus there are more fishing events in far fewer trips than in self-reported data.

Table 5. Summary of trips and events for each vessel that were viewed by an EM imagery viewer, had an observer present, and had a self-reported data logbook.

				Observer			Self-reported		
Vessel	Total Trips	Sea-days	Trips Viewed	Trips	Events	Sea-days	Trips	Events	Sea-days
1	16	89	8	2	88	7	7	22	22
2	10	66	2	0	0	0	2	7	7
3	9	108	5	1	160	10	5	28	28
4	2	25	0	0	0	0	0	0	0
5	12	41	5	0	0	0	5	5	5
6	26	88	8	1	11	2	7	22	22
7	18	107	10	1	56	7	9	29	29
Total	**93**	**524**	**38**	**5**	**315**	**26**	**35**	**113**	**113**

We calculated the total view time for each vessel and the viewing ratio of fishing effort to view time (Table 6). View time is used to assess how efficient the process for reviewing video imagery is, the objective being to view fishing activity faster than real time (i.e. ratio <1). View time is affected by several variables including total catch, image quality, frequency of catch, and camera angle. The mean viewing ratio for all vessels and all trips was 0.3, meaning that on average for every one hour of fishing activity video collected, it took approximately 18 minutes to review the imagery and record catch.

Table 6. Imagery view time for all events viewed. The viewing ratio is the total view time (hours) divided by the total fishing effort (hours). Note: events are not combined to the day and one event was excluded because it had unusable data.

Vessel	Viewed Events	Total View Time (hrs)	Total Effort (hrs)	Viewing Ratio
1	106	36.0	118.6	0.3
2	7	13.8	31.7	0.4
3	182	40.0	154.9	0.3
5	5	5.0	29.6	0.2
6	34	39.8	137.4	0.3
7	100	52.0	254.1	0.2
Total	**434**	**186.6**	**726.2**	**0.3**

3.5. CATCH COMPARISONS

By comparing among different data sources, it is possible to examine how well EM and EM imagery viewers are able to document catch during fishing events. Catch comparisons are made between catch data collected by observers, EM, and self-reported logbooks. This comparison can lead to a better understanding of variables that affect the success of EM for catch accounting. A total of 6880 individual fish were identified and recorded using EM and were used for comparison among data sources. Comparisons are made between both EM data and self-reported logbook data, as well as between observer data and EM data. As a result of how we defined events, we were not able to make direct comparisons among all three data sources.

Self-reported Data

The minimum catch reporting requirements for self-reported logbooks were that skippers were required to record three assigned species. Despite the limited reporting requirements, some skippers were able to record more than the required species and attempted to record all catch items. This reporting uncertainty leads to unknown reporting levels in the self-reported logbooks. The EM imagery viewer recorded all catch items regardless of species, consequently we expect that total piece counts for all species will not match well between EM and self-reported data.

For events that had both EM and self-reported data, EM data reports that 4300 total pieces were caught over all trips analyzed, with 3637 pieces being recorded as retained, whereas self-reported data had a total catch of 3129, with 2579 pieces being retained (Table 7). As previously mentioned, this discrepancy is likely attributable to the differences in reporting requirements between EM and self-reported data.

Table 7. Summary of EM and self-reported data catch records for each vessel. Bold text vessels are those that were believed to be recording all catch based on skipper information.

	Total Pieces		Retained		Released	
Vessel	**EM**	**Self-reported**	**EM**	**Self-reported**	**EM**	**Self-reported**
1	1208	740	1049	635	159	105
6	1076	275	826	183	250	92
2	190	114	131	89	59	25
3	**252**	**239**	**240**	**222**	**12**	**17**
5	**303**	**313**	**281**	**265**	**22**	**48**
7	**1271**	**1448**	**1110**	**1185**	**161**	**263**
Total	4300	3129	3637	2579	663	550

Based on Sea Grant personnel discussions with the vessel skippers, we understand that vessels 3, 5, and 7 reported all catch, vessels 1 and 6 recorded only the required species, and it is unknown what the intentions of vessel 2's skipper were. In the following analyses, we divided the vessels into two groups:

total catch recorded, and required species recorded. This division is used to determine whether skippers are able to report all catch and bycatch.

Examination of the catch recorded for all species in EM and self-reported data reveals that some vessels were capable of reliably recording all catch species (Figure 9). As expected, those vessels that only recorded the required catch data consistently have lower total piece counts for all species (Figure 9).

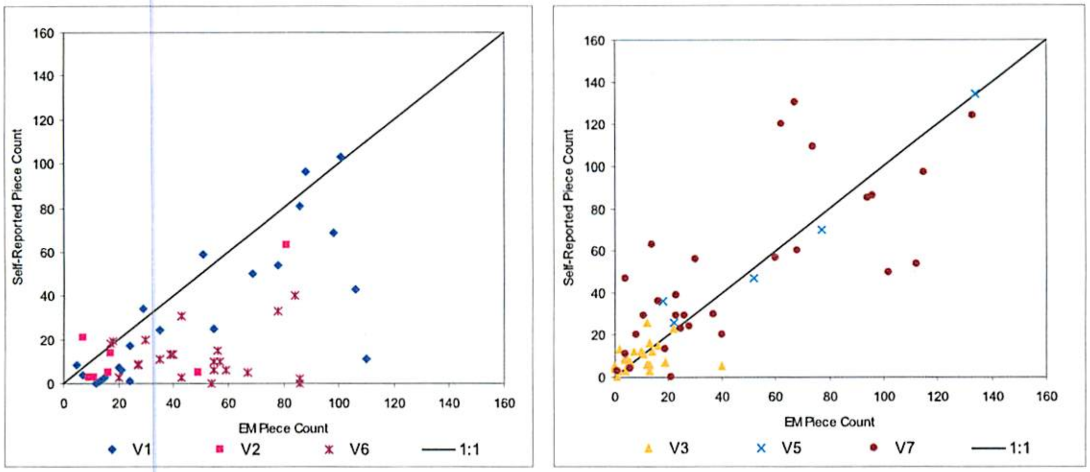


Figure 9. Total catch by event for all species by vessels that did record all catch (left) and, vessels that recorded everything (right).

Boxplots reveal that within the piece count differences between EM and self-reported data for all species there is a tendency towards positive differences (i.e. EM > self-reported) for those vessels that did not record all species, as would be expected (Figure 10). There were too few events recorded for vessel 5 to construct a boxplot. Vessels 3 and 7 have total piece counts that are comparable to EM data because the boxplots overlap with 0 and the median piece count difference is approximately 0 (Figure 10). Vessel 7 had frequent crew and skipper changes during the collection period, which may have resulted in the high variability that is evident in the boxplot.

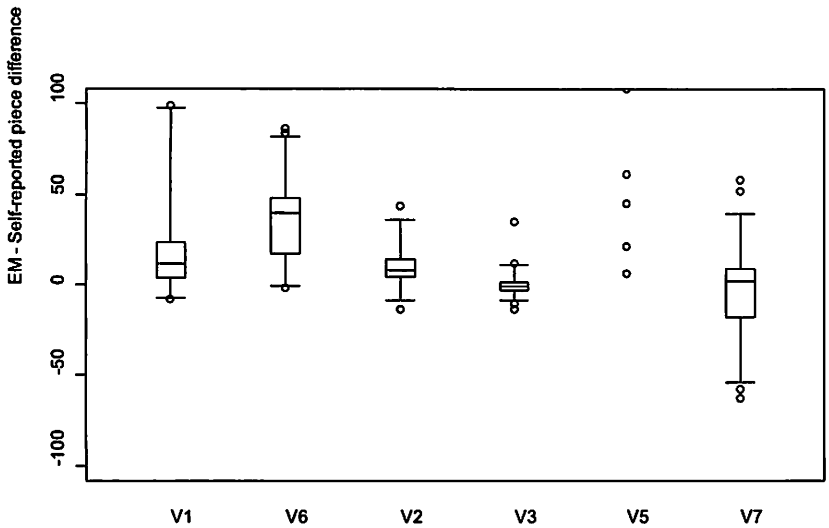


Figure 10. Boxplots for catch difference for all species by event, in order of vessels that did not record all catch (V1, 6, 2) and those that recorded all catch (V3, V5, V7). V5 had too few trips to form a boxplot. The boxes are the 25th and 50th percentiles, the whiskers are the 5th and 95th percentiles. The median is the line in the middle of the box (when present)

A Wilcoxon Sign Rank test on the piece counts for EM and Self-reported data for vessels 3, 5 and 7 shows that there is no significant difference between the data sources ($V = 788$, $n_1 = n_2 = 61$, $P = 0.6$, two-tailed) and median piece count difference is -1 piece (95% CI -4.5 to 2.5). This result means that there is on average one less piece recorded in the self-reported logbooks than in the EM data, but that the data sources are comparable.

When examining data for only those species that were required to be recorded, there does not appear to be a difference between the vessels that recorded all catch and vessels that recorded only required species (Figure 11 and Figure 12) although no statistical analyses were done. This result suggests that reporting on all catch items does not have a negative effect on the skipper's ability to report on the target species in the fishery.

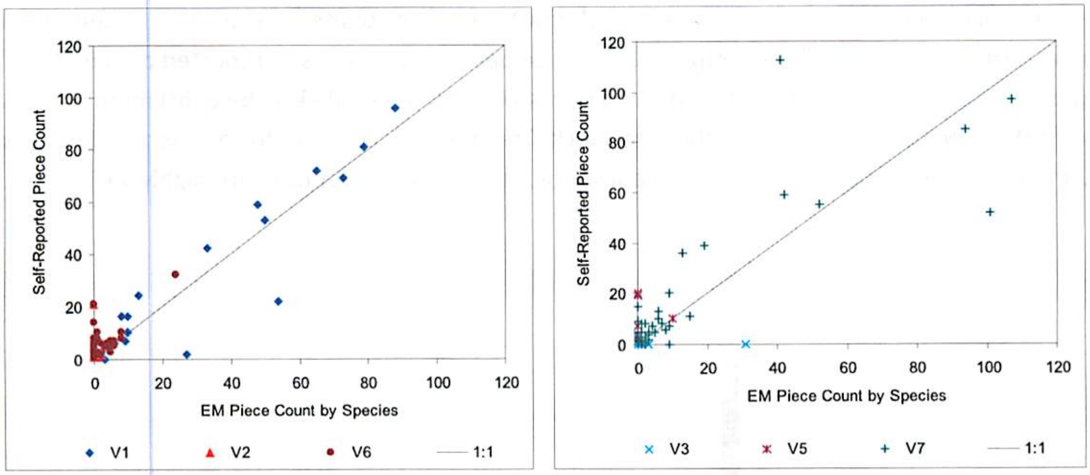


Figure 11. Those that only recorded required species (left) and those that recorded required catch for vessels that tried to record everything (right).

Species that were recorded by the EM viewer to the species group level were not included in total EM counts for required species because they could not be identified. This identification issue is likely the cause of the tendency toward negative piece count differences (i.e. EM < self-reported) (Figure 12).

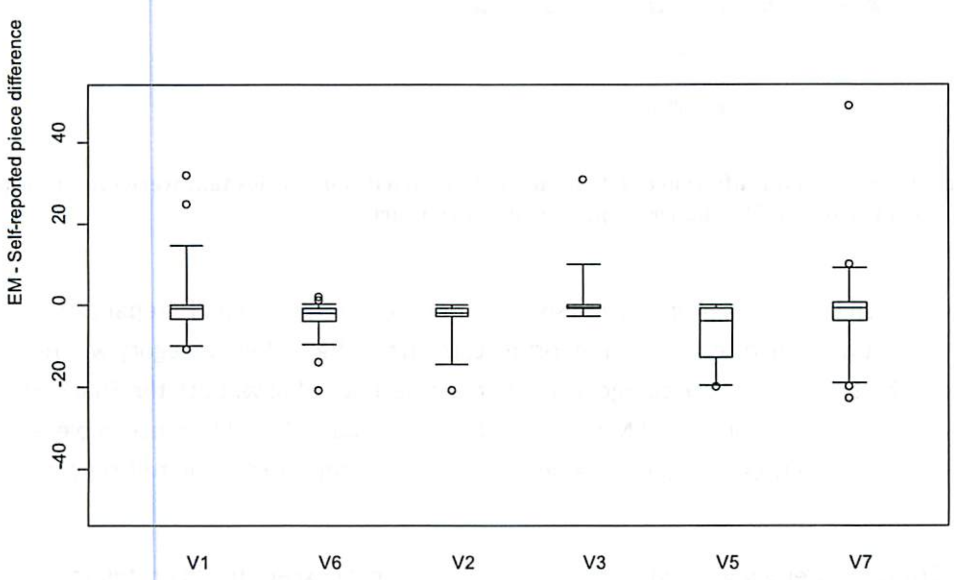


Figure 12. Boxplots of catch differences for required species. Vessels 1, 6 and 2 did not record all species, and vessels 3, 5, and 7 recorded all species caught. The boxes are the 25^{th} and 50^{th} percentiles, the whiskers are the 5^{th} and 95^{th} percentiles. The median is the line in the middle of the box (when present)

A histogram of the differences between EM and self-reported piece counts for required species by event (Figure 13) reveals that 86.5% of records had a mismatch of ≤ 5 pieces. This is small discrepancy when there are large piece counts, however, for events with few total piece counts, 5 pieces would cause total catch estimates to be unreliable. For example, a difference between EM and self-reported data of 2 pieces may be considered minor when the total catch was 100, but it would likely be considered a large discrepancy if there were only 6 pieces in the total catch. The mean piece count from observer data was 12 pieces, and the mean piece count from EM data was about 11 pieces, but both are highly variable.

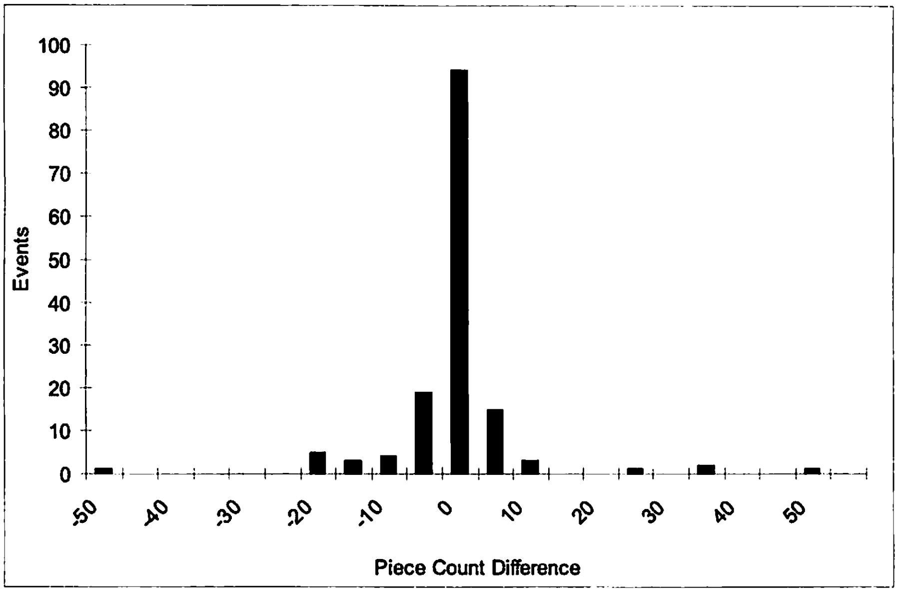


Figure 13. Histogram of the piece count difference (EM minus self-reported) for species that were required to be reported. (n = 148). Most events (86.5%) had +/- 5 piece count difference.

Examination of the total catch by species (Appendix 6) shows differences in the catch discrepancies between species. The largest discrepancies in catch reporting came from the "other" category where there was a difference of 73%, and the Shark category that had a difference of 85%. Both the Shark and "Other" categories had more catch recorded in EM than in self-reported data. This difference in piece count should be expected because these species were not required to be reported in the self-reported logbook data.

All species within the Grouper category were identified to the species level except for the category Sea Bass – unidentified, which accounted for 0.4% (2 pieces) of the total Grouper catch in EM data (Appendix 6). Within the Snapper category, 3.4% (55 pieces) were classified as Snapper – unidentified (Appendix 6). The Porgy category proved to be the most difficult species for the EM viewer to identify to the species level, with 71.5% (446 pieces) being classified as Porgy – unidentified (Appendix 6).

The difficulty identifying Porgy to the species level is one of the main sources of piece count differences, because Red Porgy was one of the required reporting species. It is likely that many of the Porgy –

unidentified may have been Red Porgy because they were reported as such in the self-reported fishing logbooks.

Total piece counts for species groups that had required species matched well. Piece counts documented for the Snapper (0.1%), Grouper (-5.8%), and Porgy (0.5%) categories were generally close. This relationship suggests that when species are required to be recorded, strong agreement between EM and self-reported data is possible.

Observer vs. EM Data

In this study the observer was required to record all species and catch utilization. Comparisons were made at the level of the fishing event as recorded in the observer logbook. A total of 315 comparable events were available, however, in the following comparisons, 226 events are used because 89 of the events had no catch recorded in either EM data or observer data (Table 8). The only vessel that had events with catch recorded by the observer but not by the EM viewer were on vessel 3; Sea Grant personnel informed us that this vessel had very high rails, so the discrepancy for these events may have been due to catch being handled outside of camera view.

Table 8. Summary of all comparable EM and observed events..

Vessel	Catch in EM and Observer Data	Catch in Observer Data only	Catch in EM Data only	No Catch in EM No Catch in Observer Data
1	79	1	0	8
2	0	0	0	0
3	86	10	1	63
5	0	0	0	0
6	11	0	0	0
7	37	0	1	18
Total	**213**	**11**	**2**	**89**

EM data reports that 2580 total pieces were caught over all trips analyzed, of which 2277 were recorded as retained, whereas observer data had a total catch of 2730 with 2292 pieces recorded as retained (Table 9). Overall, the match between EM and observer data is very good, especially when examined at the event level (Figure 14).

Table 9. Summary of observer and EM data catch records for each vessel.

	Total		Retained		Released		Unknown
Vessel	Observer	EM	Observer	EM	Observer	EM	Observer
1	1620	1558	1463	1419	144	139	13
3	310	261	274	246	30	15	6
6	397	422	238	287	140	135	19
7	403	339	317	325	62	14	24
Total	2730	2580	2292	2277	376	303	62

Comparisons between total piece count from observer data and EM catch data were completed. This comparison can be used as a basis for evaluating how well EM imagery viewers were able to document catch. We used observer data as the baseline against which to compare EM data (Figure 14). The results of comparisons between total catch documented in observer data and EM data were quite close. The close relationship between observer data and EM data can be best demonstrated on a scatter plot of observer piece counts vs. EM piece counts for each event (Figure 14). If all points were on the 1:1 line, then the data would be a perfect match, however, in this case they are distributed closely around the 1:1 line, indicating a strong match between observer and EM data.

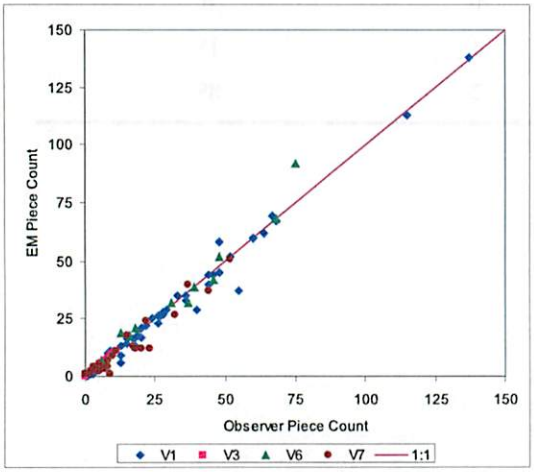


Figure 14. Comparison of total piece counts per event recorded by observers and EM imagery viewers (n = 226).

The objective of the comparisons between observer and EM data is to elucidate any difference between the two data sources. The use of boxplots showing the distribution of the piece count differences between observer and EM data for each vessel reveals that the differences were not significantly different from zero for all vessels (Figure 15). Variability within in each vessel's data is indicated by the length of the whiskers. The first trip that was observed was on vessel 6 (Figure 15) and had the highest variability. The second observed trip was on vessel 7, and the video had to be triggered manually, which may have resulted in catch that was missed by either EM or the observer.

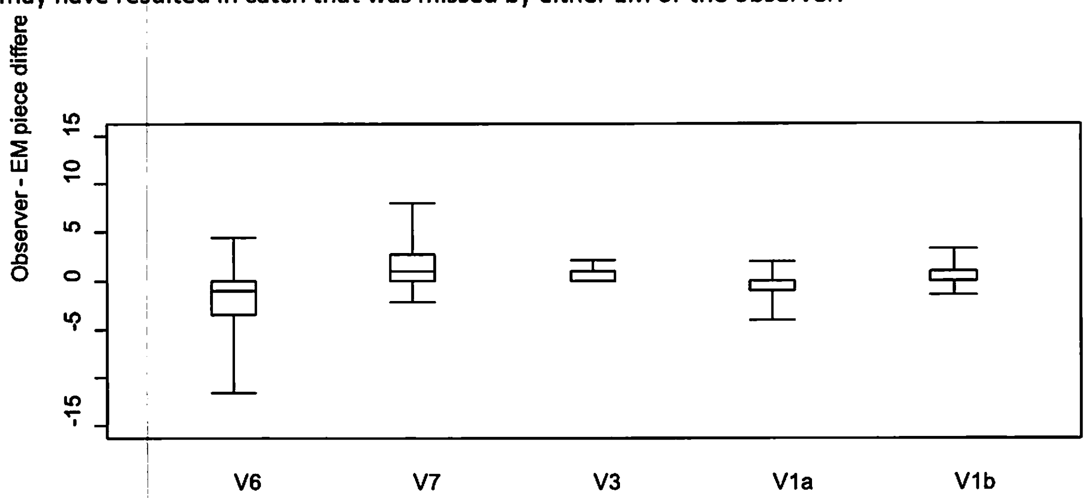


Figure 15. Boxplot showing the piece count difference between observer and EM data for each vessel. Vessels are in order of the date the trips were taken. The boxes are the 25th and 50th percentiles, the whiskers are the 5th and 95th percentiles. The median is the line in the middle of the box (when present).

A Wilcoxon Sign-Rank test on the piece counts for EM and observed data indicates that the data sources are significantly different ($V = 4795$, $P = 1.5\text{x}10^{-6}$, $n_1 = n_2 = 226$), and the median difference is 1.00 pieces (95% CI 1.00 – 1.50). This result means that the piece counts are not statistically equivalent; however, from a management perspective, a median difference of one piece may not be of concern.

A histogram of the piece count differences for each event (Figure 16) reveals that 93.4% of events had a mismatch of ≤ 4 pieces for the required reporting species, however this does not take into account the total catch for each event. The mean catch for events recorded by EM was 9 pieces, and the average that was recorded in the observer data was approximately 11 pieces and both data sets were highly variable. As described above, the impact of these discrepancies on the total catch is relative to the number of pieces that were caught in the event.

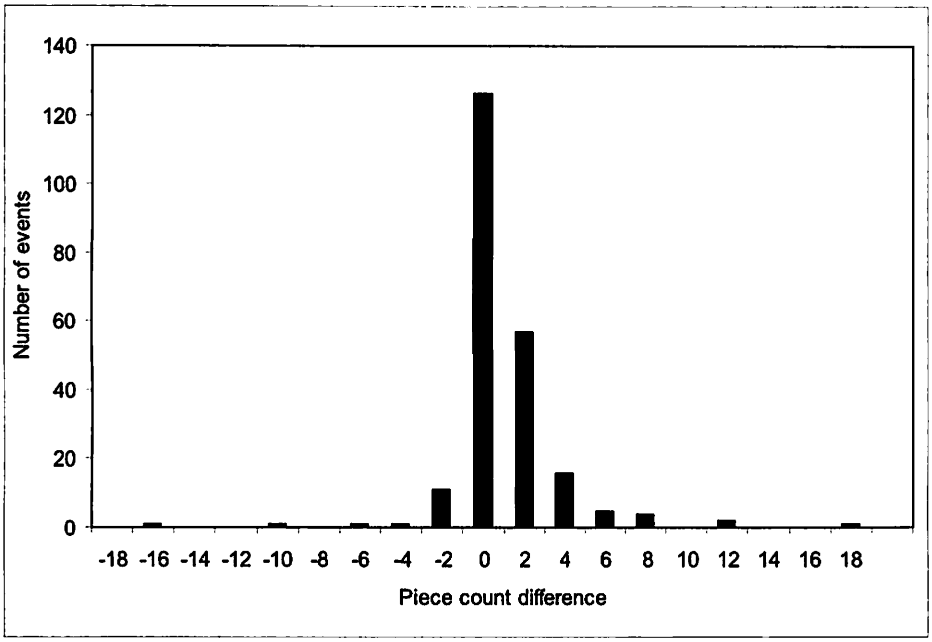


Figure 16. Histogram of the piece count difference (Observer minus EM) for all species. Most events (94.5%) had +/- 4 piece count difference (n = 226).

Examination of the total catch by species (Appendix 6) shows differences in the catch discrepancies between species. Similar to the self-reported data comparison, the total pieces in the "Other" category had a large discrepancy (39.5%). Total counts for Snappers, Porgies, and Sharks matched well and were within 5.8%, 10.5% and 8.7% respectively. Within the Porgy category, EM viewers documented all porgies (n = 307) as Porgy - unidentified, whereas the observer reported to the species level, however the total count is within 10.5%. Across all species, the total difference between EM and observer data is 5.5% for all vessels and events.

For the observed trips, the EM viewer was able to identify 85% fish to the species level, and some groups were more frequently assigned to the unidentified category than others. Within the Snapper category, less than 1% of catch items were identified as Snapper – unidentified. The Porgy group was the hardest for the EM viewer to identify to the species level, with 100% (307 individual fish) that were identified as Porgy – unidentified. Roughly half (52%) of Sharks were identified as Shark – unidentified, and 93% of Grunts were identified as Grunt – unidentified. Total piece count for the Grouper category matched poorly between EM and observer data. Observer data had a total of 531 pieces, and EM data recorded a total of 250 in the Grouper category. The reasons for the large discrepancy within the grouper data are not known.

3.6. FISHING EFFORT

Fishing effort is one of the basic units of fisheries management, and total fishing effort was estimated from EM data, and recorded in the Federal logbook. A comparison of the levels of effort shows that for the 75 trips that had comparable data, the difference between EM and fishing logbook estimates of effort varied greatly among vessels (Table 10 and Figure 17). These discrepancies likely result from the lack of a set definition of fishing effort, and could be reduced if a clear definition is created. Records of sea-days were close for most vessels, however vessels 6 and 7 had large discrepancies between EM and Federal logbook data.

Table 10. Comparison of fishing effort (length of fishing events) recorded by EM and in Federal logbooks across all fishing trips with comparable data.

		EM		Federal Logbooks	
Vessel	Total Trips	Sea-days	Total Effort (hours)	Sea-days	Total Effort (hours)
1	11	58	353	57	276
2	9	62	301	77	605
3	6	71	560	79	668
4	1	13	147	14	100
5	11	38	245	46	625
6	24	81	740	111	776
7	13	79	373	105	735
Total	**75**	**402**	**2718**	**489**	**3785**

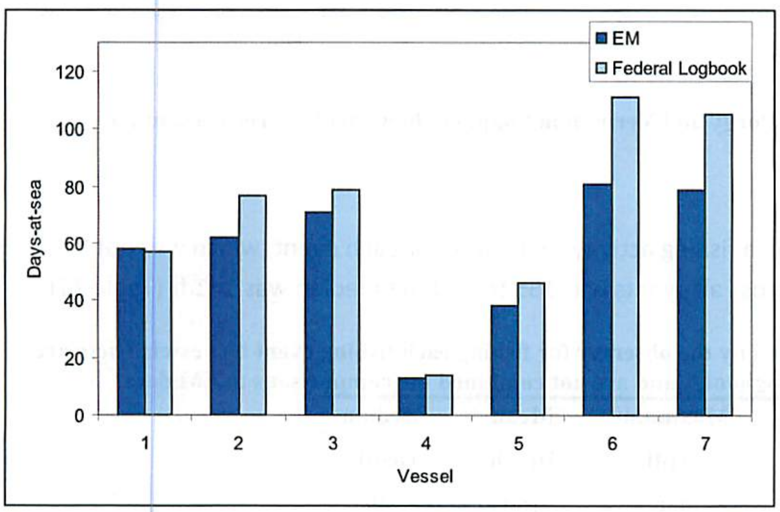


Figure 17. Comparison of sea-days for each vessel from EM and Federal logbooks (for trips that had both data types, n = 75).

3.7. OBSERVER DATA

The observer recorded data types that were not available through EM, including depth of fishing events, and the fork length (mm) of some species. Observers recorded the fork length of several assigned species, as well as the utilization (i.e. retained or released). Red Porgy and Vermillion Snapper were the most commonly recorded species and had sufficient length (mm) and utilization data to produce length histograms of the catch (Figure 18).

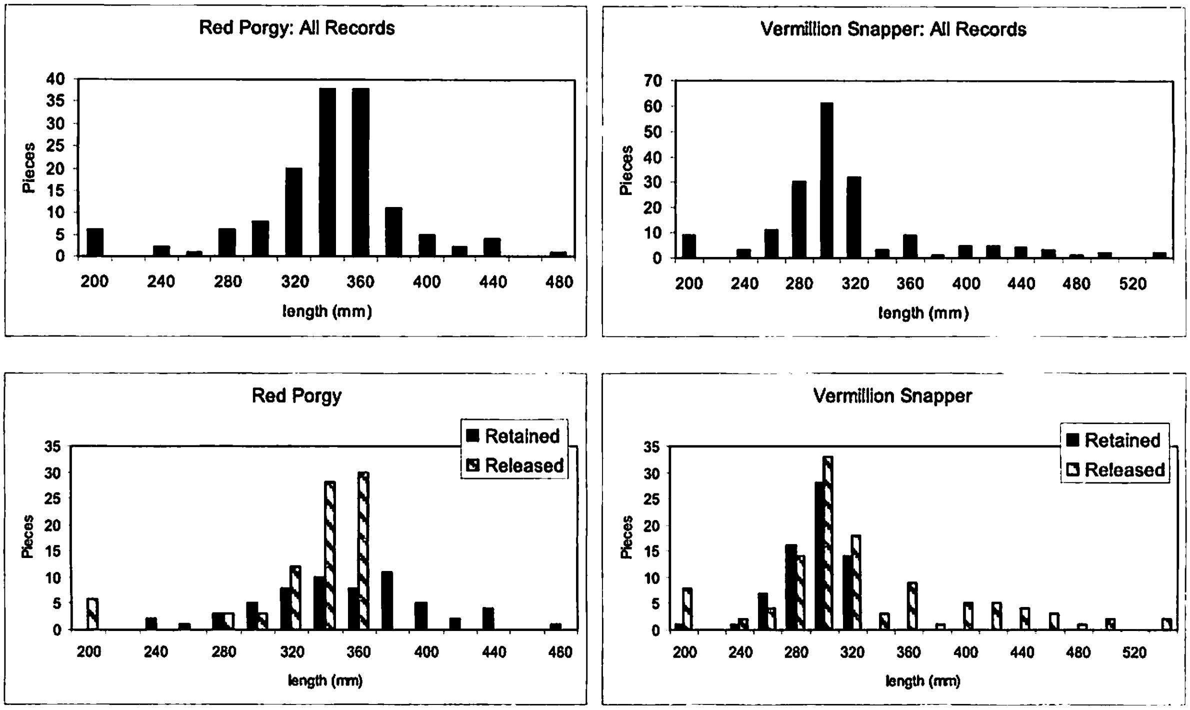


Figure 18. Length distribution of Red Porgy and Vermillion Snapper shown with all records, and by utilization.

Observers recorded the depth at which fishing activity took place for each event, which was not recorded by EM. The mean depth across all events was 155 ft, and the median was 141 ft (Table 11).

Table 11. Depth (feet) of water recorded by the observer for fishing each fishing event by vessel. These are total events recorded in the observer logbooks, and are not combined for comparisons to EM data.

Vessel	Events	Minimum Depth	Maximum Depth	Mean Depth	Median Depth
1	164	1	486	160	149
3	322	1	275	151	137
6	77	14	141	122	125
7	103	103	225	183	181
Total	**666**				
Mean				**155**	
Median					**141**

3.8. CATCH DISCARDING

EM catch records were split into catch items that were retained and those that were discarded. We examined the proportion of total catch per event that was discarded (Figure 19), and excluded events that had a total catch of less than 30 fish. This division is due to the fact that proportions (or percentages) are inflated when there is a low total catch, and are likely less relevant for management.

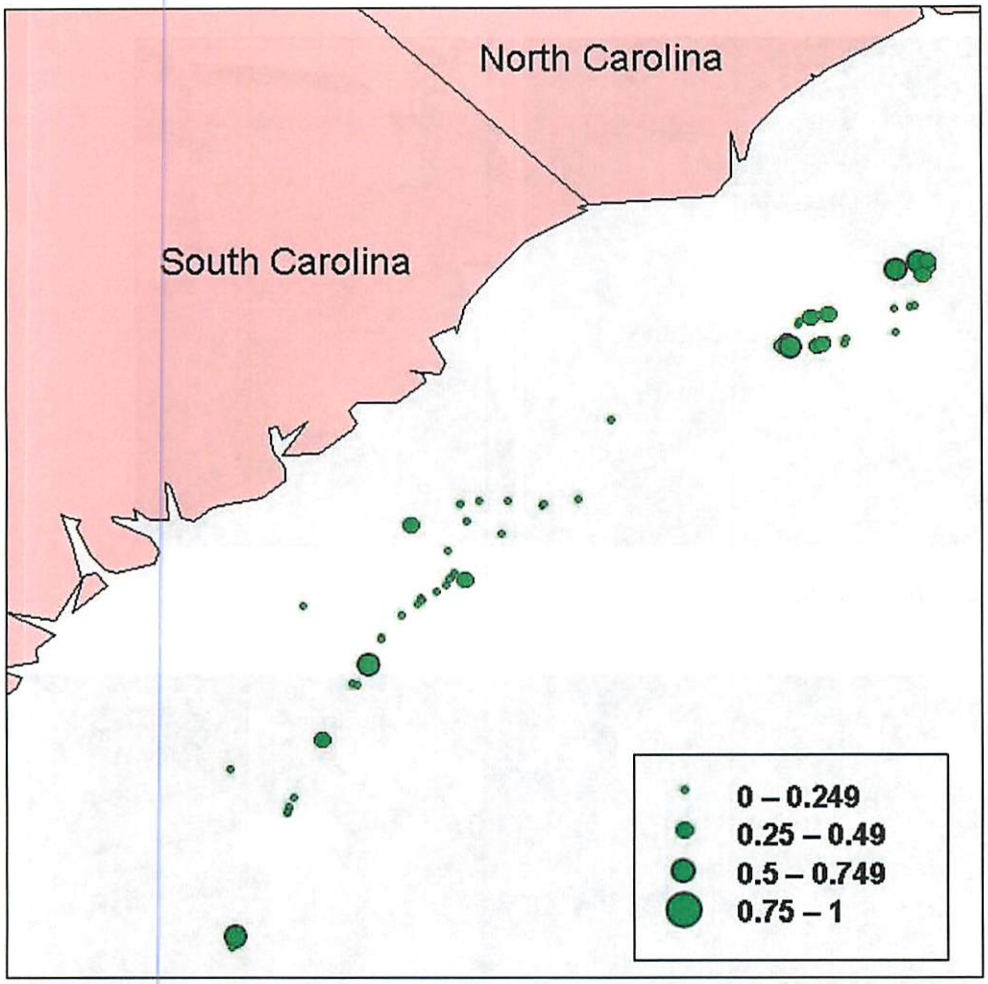


Figure 19. Proportion of total catch that was discarded in EM data. Only events with total catch >30 pieces were included (n = 70).

3.9. DISCARD CHUTE TRIAL

We tested a discard chute on vessel 1 to determine if it improved the viewer's ability to identify catch. The chute was plumbed with running seawater to aid fish sliding down the chute. As the fish box on this vessel is located on the center of the back deck, it was deal to mount the chute on top of the box so that all fishermen (on all sides of the vessel) would have access to the chute. The chute itself had to be rather large to be able to accommodate the large range of species encountered on normal fishing trips.

During the discard trials, only 3 of the 4 bandit reels were used as retained catch from these stations could be observed with the mounted cameras. In the trial, all discards exited the vessel through the chute. Using the discard chute (Figure 20 and Figure 21) modified the catch handling methods, and slowed handling down so that viewers had a chance to see each fish that was discarded. The discard chute had a tape measure and several indicators of length on it, which was intended to be used to help viewers estimate the size of the catch.

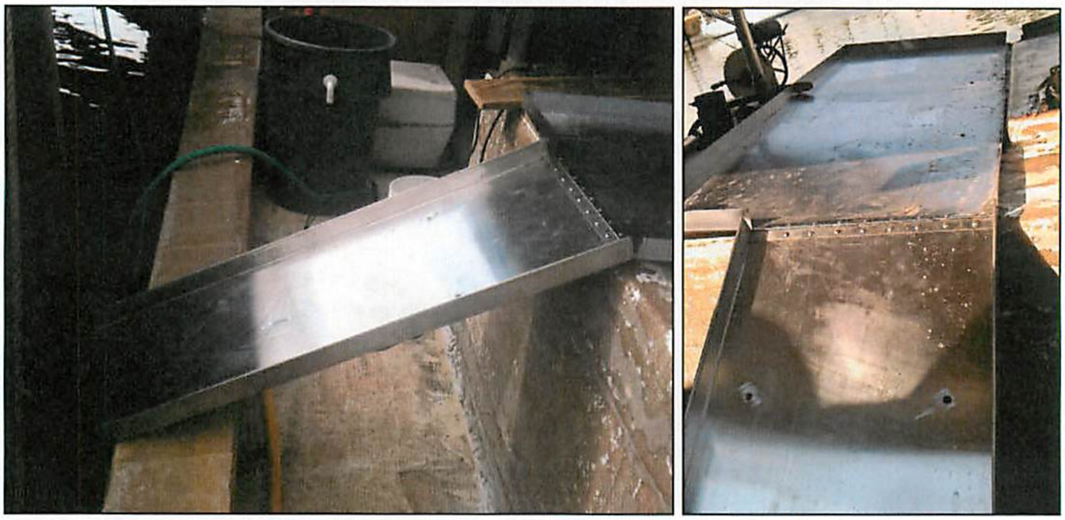


Figure 20. Discard chute trial installation

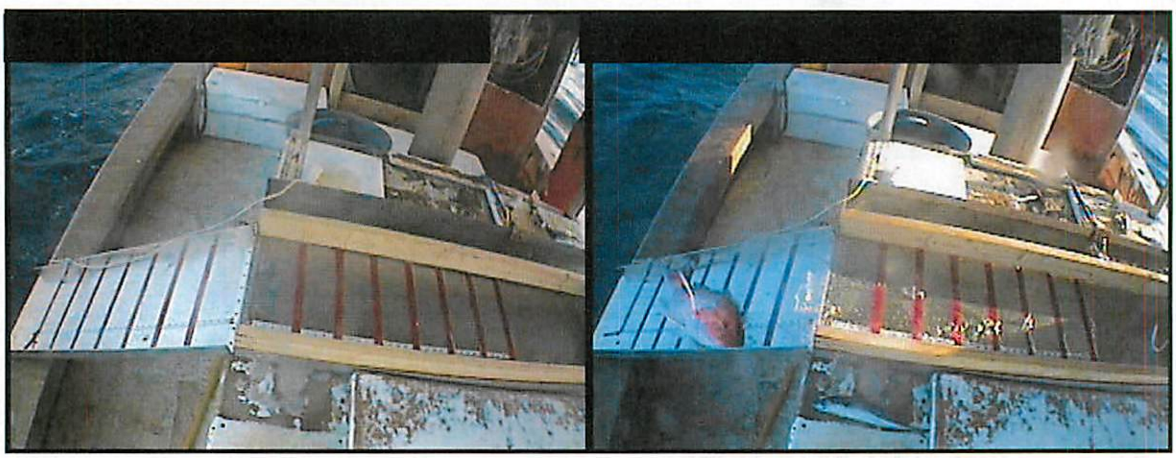


Figure 21. Images of the discard chute captured by the EM system camera. Tape was in place for use as a size reference.

The imagery viewer's qualitative assessment of the discard chute was that it did not drastically improve video review time, however, with some improvements it could provide a clear view of the discarded catch and be used to estimate discard size. The use of a discard chute in this fishery requires further investigation; the EM viewer made several suggestions that could help to improve the effectiveness of the discard chute:

1) Alter camera angle to provide a view from directly above;
2) Use a chute that controls the angle that fish slide down (i.e. remain parallel to sides); and
3) Use more permanent measurement grid.

While the discard chute may be feasible for recording discards, retained catch would still have to be documented from the other camera angles pointed toward the bandit reels. Currently, EM systems are limited to four cameras (although an eight camera system is under development), so the addition of an extra camera to monitor the discard chute would not be possible on some vessels. Clarification of monitoring objectives and possible catch handling modifications may be necessary if EM were to be implemented.

4.0 CONCLUSION

4.1. PROJECT OBJECTIVES

The objectives of the project were:

1. to compare EM data to logbooks and at-sea observer data;
2. to determine if the age-size structure of discards can be documented using EM; and
3. to collect data on the number of discards with respect to depth and location of capture.

We were able to meet both the first and third objectives, and tested some methods that could be used in later work to achieve the second objective.

Objective 1 – Catch Comparisons

We successfully compared EM data with self-reported logbook and observer data. The results of comparisons between observer data and EM data indicate that EM is a reliable source of data for estimating the total catch by piece count. While EM is able to provide adequate estimates of total piece count per trip, it was less reliable for determining catch by species, with 18% of catch items being classified as unidentified. Improved catch handling procedures would greatly increase the ability of the EM viewer to identify catch to the species level. As well, if EM were implemented, a local viewer with experience identifying species in the fishery would likely improve the species identification.

Comparisons between EM and self-reported data reveal that skippers were able to accurately record all catch regardless of species. Some skippers went beyond the reporting requirements and reported all catch items rather than just the three required species. Catch records from these vessels are not significantly different from the EM catch records, indicating that skippers are able to record complete catch.

The pilot project was intended to test EM and help to determine how an EM program could be setup if it were to be fully implemented. The strong relationship between observer and EM data indicates that with some changes in the reporting requirements for self-reported data, EM would likely be a reliable source of data for the fishery.

Objective 2 – Age-Structure

In order to successfully estimate size using EM, several modifications would need to be made in the Snapper-Grouper fishery. The primary requirement when estimating size is to have a clear image of the fish in front of a size reference. Some modifications in catch handling practices would allow for the estimate of catch size from EM imagery. Size estimates from EM were not made in this report, however, we evaluated the application of a discard chute for assisting with size estimation and found that with some modification it would be possible to document discard size.

Objective 3 – Discard Documentation

EM was successfully used to document the number and species of discards for each fishing event. The EM system documents the location of fishing events, so it can be used to create a discard record for individual fishing locations. Although depth is not recorded by the EM system, the location records for fishing events could be used to determine depth based on existing bathymetric studies.

4.2. Cost Structure Considerations for EM Programs

Many factors influence the overall cost of a fisheries monitoring program (Table 12). Some factors are determined by how the fishery operates (external factors) and others are directly related to decisions made around how the program itself operates (internal factors). It is important to note that although the same factors would need to be considered when structuring costs for any monitoring program (observer or EM), different monitoring programs may have different degrees of sensitivity to a particular factor. For example, an EM program would be less affected by highly erratic fishing schedules than an observer program because the EM system is always onboard and ready at any time of day. In contrast, an observer program would be less sensitive to higher requirements for service decentralization than an EM program due to the higher infrastructure requirements needed to service equipment and retrieve data. Most of the internal factors that would influence cost on an operational EM program for the South Atlantic Snapper-Grouper fishery remain to be defined.

The focus of this cost structure breakdown is the cost associated with a Logbook Audit-based monitoring method. The primary principle of this Audit Methodology is that the logbooks are used as the main data source, and a representative sample of EM data is reviewed to confirm the data. In BC Groundfish Fishery, 10% of the fishing activity for each trip is reviewed and logbooks are given a rating based on how well the data sources match. If the logbook data are outside an acceptable range from the EM data, a complete review of the EM data is required. This random review encourages skippers to be rigorous in documenting catch because there are additional costs to them when logbooks do not match well with EM data.

The cost structure of the Snapper-Grouper fishery EM pilot study does not provide an accurate representation of monitoring costs because the pilot study was structured very differently than a mature operational EM program would be. Generally, the cost of a pilot study is much larger than the cost of an operational EM program (on a per sea-day basis) because the costs associated with project start-up such as training, planning, and reporting are not present in an operational program. Additionally, there are high costs associated with determining the best system installation methods, data review methods, and data reporting structure when EM is first tested in the fishery. These costs would be lower in an operational monitoring program after all training has taken place and methods determined.

Table 12. Factors that influence the cost structure of an EM and observer program.

Factors	Examples
External	
Fishery activity/effort	Number of vessels, landing, fishing events and sea-days
Port use patterns	Temporal and spatial distribution of the fishery
Internal	
Analysis and reporting requirements	Data product delivered and frequency of reporting
Overall maturity of data model	Integration of data from different sources and flow of monitoring data to quota system
Degree of program centralization	Management of the program operations centralized vs. replication necessary at various levels or regions
Cost recovery method	Division of cost responsibilities between government and industry as well as within industry
Program responsiveness	Reporting timelines (within 1 week, 1 month, 1 year of fishing activity)
Feedback and outreach processes	Reports, meetings, one-on-one feedback
Performance tolerances	Data quality requirements. If audit-based: additional analysis required based on initial results
Audit method and coverage level *	Amount of data that requires interpretation as well as level of detail within interpreted data

* Only a factor for audit-based programs

Equipment costs are the second reason cost structures would be significantly different between a pilot study and an operational program. This project leased equipment for the duration of the study, whereas in an operational program, equipment is often purchased and, although upfront capital costs are high, the cost of equipment is amortized across the total sea-days for the lifespan of the equipment. The cost to purchase a complete EM equipment ranges from approximately 9500 $CDN to 12000 $CDN depending on the specific requirements of the program and vessel. Another up front cost of the EM program is the installation of the system, which would take about six to eight hours of service technician time, based on the installation time in this study. Given that EM systems have historically lasted for up to 10 years of operation onboard vessels, this amortization period can be significant.

The third reason for differences in cost structure is that reporting requirements were complex including an interim summary and a final report with data analysis and summaries. Once reporting requirements for an operational EM program are defined, reporting is done in a standardized way for all trips. This cost difference has the added benefit of ensuring that trips with high quality data follow a streamlined process with little or no additional time needed for further investigation to provide feedback, whereas trips with fair or poor data quality require more time for investigation or feedback.

- The best insight into cost structure for an EM program comes from analyzing data from existing mature EM programs for which all inputs and outputs have been defined, such as the BC Groundfish hook-and-line catch monitoring program (

Table 13). The BC Groundfish hook-and-line monitoring program is an audit-based EM program that delivers a finished data product for an average cost per vessel of 194 $CDN per sea-day or 3.2% of the landed catch value on average (median 4.7%) (Stanley ., in press). Beyond EM monitoring, this cost also includes hail-in and hail-out, fishing logbooks, dockside monitoring, data consolidation, and comparison of all data sources. The monitoring program includes all data collection, interpretation and reporting to generate a finished data product (i.e. audit report and appropriate quota deductions). Some of the external and internal factors for this fishery are:

External

- 202 active vessels, 1,323 trips, 11,545 sea-days and 23,192 fishing events per year;
- Total landed weight of 11,789 tons with a value of 75 million $CDN; and
- Operates out of six main ports but service is provided for close to 30 ports.

Internal

- EM data must be retrieved after every fishing trip; and
- Finished data product must be available to industry and fisheries managers within five days of landing, unless audit fails to meet standards.

Table 13. Summary of BC Groundfish hook-and-line catch monitoring program costs for the 2009/2010 program year, including funding from both industry and the Department of Fisheries and Oceans Canada (Stanley *et al.*, in press).

Monitoring programme	Average cost vessel^{-1} year^{-1} ($CDN)
Hail programme	$236
Logbooks	$312
Dockside monitoring	$2 890
EM equipment	$1 760
EM field services	$3 889
EM data services	$2 891
EM subtotal	$8 540
Total programme costs	$12 053
Cost per trip	$1 840
Cost per sea-day	$194
Cost per kg landed	$0.21

When all cost factors are equal, independent at-sea monitoring program options in order of increasing cost are: audit-based EM programs, EM census programs, and observer programs. The EM portion of the BC Groundfish hook-and-line program accounts for ~70% or roughly a yearly average cost per vessel of 136 $CDN per sea-day. Stanley *et al.* (2009) estimate that if the audit-based program was substituted with an EM census program (i.e. 100% review of all video), the EM costs would increase to 274 $CDN per sea-day, and new challenges and costs would be introduced to meet the five-day turnaround timeline. Another point of comparison for possible costs is the offshore trawl fishery in BC which is 580 $CDN per sea-days (although the BC offshore trawl fishery operates with 50 vessels and 4,500 sea-days per year). Although these numbers are estimates, they offer valuable insight on the differences that could be expected from considering these different methods.

Estimating costs of a fully implemented EM program requires understanding of many factors that affect the total costs. Both internal and external factors can play a large role in the costs of the program. If EM is to be pursued within the South Atlantic Snapper-Grouper Fishery, the management council would have to evaluate the possible configurations for the monitoring program and how to best achieve the monitoring objectives.

4.3. RECOMMENDATIONS

The results of the pilot study indicate that EM is an effective method to improve monitoring in the Snapper-Grouper fishery in the South Atlantic. EM performed well for documenting total catch and species to the group level, but was less reliable at the species level. The use of EM allows for efficient data collection on a number of variables that are currently not included in the existing monitoring program. The implementation of EM on a fishery-wide scale would require adaptations to ensure that the data collection is to a high standard and provides adequate opportunity for validation. The main challenges related to data collection that would need to be overcome are clearly defining what activities constitute a "fishing event", making changes to the catch handling methods, and compliance with equipment use requirements on vessels.

Define Fishing Events

The purpose of a pilot study is not only to test the equipment, but also the processes used to monitor the fishery. In this study, the biggest challenge was related to matching fishing events at all levels. The definition of "fishing event" was not the same among data sources, therefore we had to modify the EM definition of events based on the other data source. In some fisheries, there are clear fishing events such as setting of gear, and retrieval of gear, but in the bandit fishery, fishing is continuous and may not be distinct even when moving between locations. Managers and fishers would need to clearly define what an individual "fishing event" is so that comparisons can be made among data sources.

Modify Catch Handling

Catch handling affects the imagery viewer's ability to identify catch. Feedback from the EM viewer revealed that the main obstacle to indentifying a fish is a poor view of the fish. Any action by the fisher that places the fish clearly within camera view will have a positive impact on EM identification. In the BC Groundfish Fishery, fishers are required to briefly hold discards in front of a measuring panel. This approach allows viewers to identify catch, and to confirm the final use of the fish.

A discard chute was tested, and with further modifications could aid with identification and size estimation of discards. As a result of the trial, we recommend that future EM work in the fishery continue to evaluate possible configurations for a discard chute. Both physical configuration (placement, materials) and logistical configuration (catch handling) will require further consideration within the constraints of the fishery.

The discard chute may be a solution to identifying discards, but will not directly address identification of retained catch. Centralized control points have been used in other fisheries to improve catch documentation. A control point is a single location where all fish are handled and either obviously retained or discarded. This option would require input from fishers to help develop a standardized approach that allows for smooth fishing operations, but also meets the needs of EM.

Standardize EM System Use

In this study, some trips had incomplete imagery data capture because video was not triggered during fishing activity. If crew did not use the primary bandit reel, then video was not triggered and catch data could not be collected using EM. A second challenge with the EM system use was that the EM systems were not consistently left on for the duration of the fishing trip. Turning off EM systems resulted in EM data processors being unable to confirm that fishing did not occur during some periods, which can be very important closed areas are a part of the fisheries management plan. In addition, often vessel operators were not the owners and the project personnel primarily communicated with the vessel owners about the study. In this situation, which is representative of many of the vessels in this fishery, there is need to ensure that good communication channels exist between vessel owners and vessel operators and between EM service technicians and vessel operators about the details of the system operation. All of these challenges could be solved through clear communication with skippers and increased comfort with the equipment. If an EM program is fully implemented in the fishery, an approach to communicating requirements and ensuring they are met (often through incentives or disincentives) will be necessary for the success of the monitoring program.

Archipelago data processors used a combination of drum sensor and speed as the indicator for fishing activity. Given the uncertain level of reliability with the drum sensor use, using voltage as an indicator may be a feasible alternative to identifying fishing activity. Vessel batteries are charged while vessels are travelling, and the battery is drained when the vessel engine is turned off, and fishing gear is in use. The pattern of charging and draining batteries results in strong agreement between the drum sensor method and the voltage method (Figure 22) for identifying fishing activity for some vessels. However, the voltage signature is vessel dependent because of the varying power sources across the fleet. Vessel 1 did not show the same relationship between drum use and voltage (Figure 23) as described above. Using voltage as the primary indicator may be a reliable method for identifying fishing activity for some vessels but would not be consistent across the fleet. We recommend that if EM were to be implemented, voltage be used as a backup indicator, until the voltage signatures across the entire fleet are better understood.

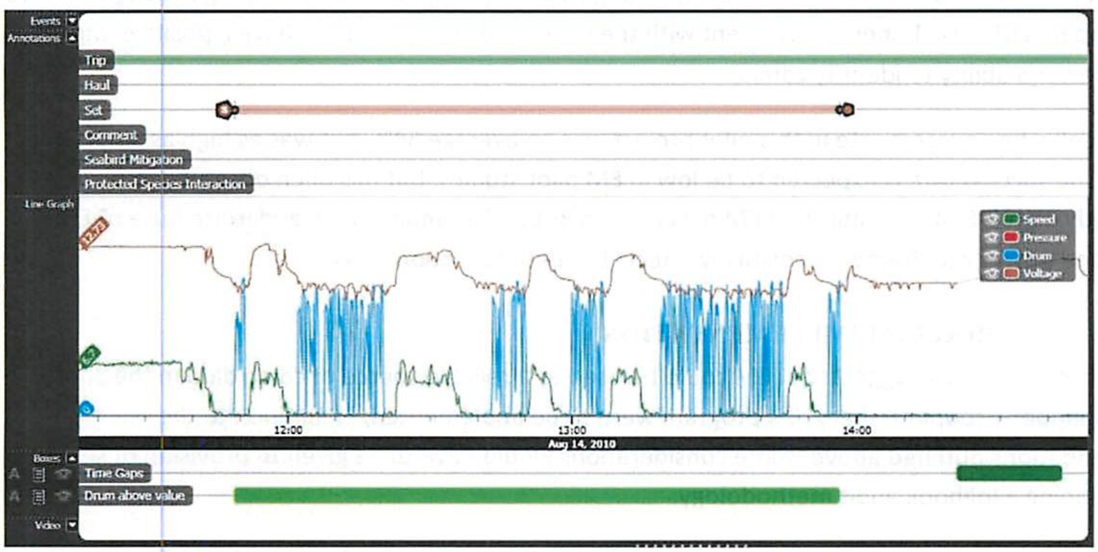


Figure 22. Example of voltage indicating fishing activity. The use of any of the bandit reels lowers the battery voltage, which can be used to identify fishing activity.

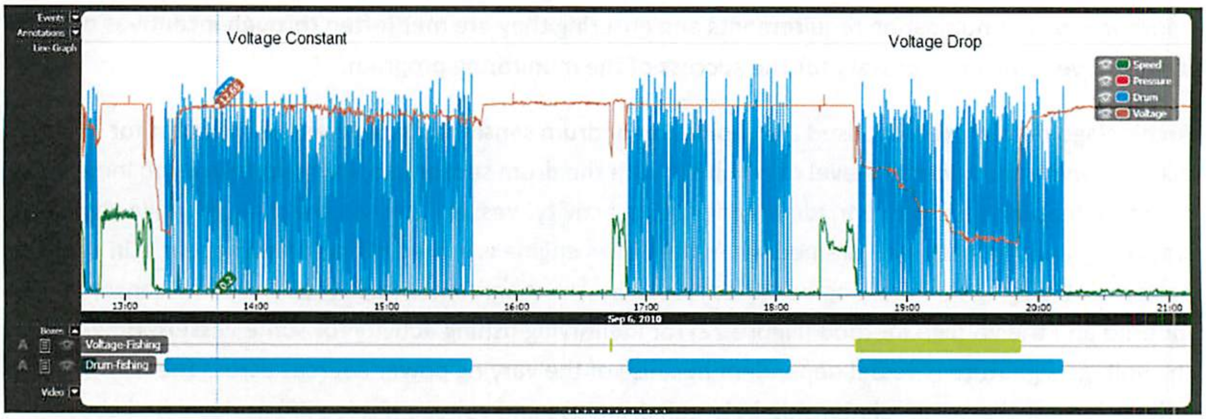


Figure 23. Sensor readings from vessel 1. Cases where voltage is not dependent on drum use can make it difficult to identify fishing using voltage.

A final factor related to the operation of the EM system is the on-going maintenance of the system by skippers and crew. The EM system is equipped with cameras that are able to withstand use for long periods in the marine environment, however, wiping clean the cameras prior to fishing activity can have a large impact EM data. Fisher involvement with the upkeep of the system can have a positive impact on the EM viewer's ability to identify catch.

The data collection success rate in this pilot project was on average 64%, but was as high as 90.6% on vessel 1. The success rate is expected to be low in EM pilot studies, but has been observed to be consistently high (98%) in established EM programs in British Columbia. The standardized use of EM systems and power requirements positively affects the data collection success rate.

4.4. Program Implementation

The results of this study suggest that EM could be used as a reliable source of catch data in the South Atlantic Snapper-Grouper Fishery. If a program were to be implemented, in addition to the recommendations outlined above, some considerations would have to be given to provision of service and developing a logbook audit methodology.

Vessels that participate in this fishery primarily utilize 12v batteries or banks of 12v batteries to start the engine as well as operate the electrical devices onboard the vessel (radio, GPS, lights, etc) including 3 to 4 electrically powered bandit reels. Generators are rare on these small vessels and operators are careful about power consumption on these small vessels. With the increasing price of diesel fuel, operators are more and more frequently turning off the vessel engine while actively fishing – often restarting the engine to move to a new fishing location. This is evident in the sensor data. In a relatively short amount of time during active fishing with electric bandits, vessel batteries are reduced to the point that the threshold (<12.5) to allow the EM control to function is reached, which causes it to automatically shut down regardless of whether fishing is occurring. All but one of the 8 vessels outfitted with EM systems in this study used 8d batteries. Vessel 5 was the only vessel that utilized the lighter and more powerful "gel" batteries. Further evaluation of the EM system function on gel batteries is warranted – considering that many small commercial vessels in the South East U.S. operate in this capacity.

If EM were to be implemented as an ongoing monitoring program the field services provider, and the data processing and analysis provider would need to be identified prior to beginning the start of the program. The cost of equipment service can have a large impact on the overall cost of a monitoring program. In this pilot study, the costs of shipping hard drives and the associated delay in image and sensor analysis were costly in both dollars and time awaiting feedback. Furthermore, to save on minimize the hassles of shipping, hard drives from two to three vessels were often shipped together, which further delayed the possibility of receiving rapid feedback from experiences EM processors. Archipelago's most up-to-date EM software allows skippers to remove and replace full hard drives without a service technician. By giving skippers more autonomy, overall program costs are reduced. Given the wide geographic area and large number of ports in the Snapper-Grouper fishery, decreasing the need for service events could offer large cost savings.

While EM can be used to collect all catch data, it also serves as an effective tool for auditing the fisher logbooks, and creating incentives for fishers to improve logbook data quality. The audit method has been effective at improving fisher logbook data, and providing a low cost monitoring program in British Columbia. Additionally, the method provides a transparent process that is reliable and trusted by both fishers and fisheries managers. A key factor for the planning and implementation of an EM program is how to best create the incentives and disincentives to encourage fishers to comply with reporting requirements. A well communicated incentive program can help to make the data more reliable and decrease the frequency for complete EM data review, thus decreasing program costs.

The results of this study indicate that EM can be used as a reliable source of catch data in the South Atlantic Snapper-Grouper Fishery. With the implementation of an EM program, there would be many variables to consider and questions to answer, but with careful planning EM could provide reliable data to fill some of the current data gaps. Based on Archipelago's experience and the results of this pilot study, if a program were to be implemented in the Snapper-Grouper Fishery, it could make valuable contributions to the current fishery management program.

5.0 REFERENCES

Gulf and South Atlantic Fisheries Foundation, Inc. 2008. Catch Characterization and discards within the snapper grouper vertical hook-and-line fishery of the South Atlantic United States. Final Report October 2008.

McCarthy, K. 2009. Calculated discards of red grouper from commercial vertical line fishing vessels in the US South Atlantic. SEDAR 19-DW-16

McElderry, H. 2008. At sea observing using video-based electronic monitoring. Background paper prepared by Archipelago Marine Research Ltd. for the Electronic Monitoring Workshop July 29-30, 2008, Seattle WA, held by the North Pacific Fishery Management Council, the National Marine

Fisheries Service, and the North Pacific Research Board: The efficacy of video-based monitoring for the halibut fishery. Available: http://www.fakr.noaa.gov/npfmc/misc_pub/EMproceedings.pdf.

NOAA 2011. http://sero.nmfs.noaa.gov/foia/HTML/SG1.htm.

Overton, A. S., and Zabaski J. 2003. Release mortality of undersized fish from the snapper/grouper complex off the North Carolina coast. Final Report to North Carolina Sea Grant Fisheries Resources Grant Program. 03-FEG-21.

Poffenberger, J. 2003. Discard Estimates South Atlantic Region. SEDAR 4-DW-12

Rudershausen, P. J., and Beckel, J. A. 2007. Discard composition and release fate in the snapper and grouper commercial hook-and-line fishery in North Carolina, USA. Fisheries Management and Ecology. Vol 14, pg 103-113

SAFMC Amendment 13C 2006. Amendment 13C to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region. Available: http://www.safmc.net/Portals/6/Library/FMP/SnapGroup/SG20Amend2013C202-23-0620FINAL.pdf

SAFMC Amendment 17A July 2010. Amendment 17A to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region with final Environmental Impact Statement, Initial Regulatory Flexibility Act Analysis, Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement. Available: http://www.safmc.net/Portals/6/Library/FMP/SnapGroup/Amend17Afinal071910.pdf

SAFMC Amendment 17B March 2010. Amendment 17B to the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region with final Environmental Assessment, Initial Regulatory Flexibility Act Analysis, Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement. Available: http://www.safmc.net/LinkClick.aspx?fileticket=9BXhV2vGiyM3d&tabid=415

SAFMC News Release, 2010. NOAA Fisheries Service announces the publication of a final rule intended to end overfishing of Red Snapper in the South Atlantic. FB10-106. Available: http://www.safmc.net/LinkClick.aspx?fileticket=gM6a78W24aE3d&tabid=139

SEDAR 2010. SEDAR 24: SouthEast Data, Assessment, and, Review Stock Assessment Report - South Atlantic Red Snapper. Available: http://www.sefsc.noaa.gov/sedar/download/SEDAR2024_SAR_October202010_26.pdf?id=DOCUMENT

Stanley, R. D., H. McElderry, T. Mameezan, J. Koolman. The advantages of an audit over a census approach to the review of video imagery in fishery monitoring. (In press).

APPENDIX 1 SNAPPER-GROUPER SPECIES LIST

Common Name	Species Name
Sea Basses and Groupers ( )	
Gag	*Mycteroperca microlepis*
Red grouper	*Epinephelus morio*
Scamp	*Mycteroperca phenax*
Black grouper	*Mycteroperca bonaci*
Rock hind	*Epinephelus adcensionis*
Red hind	*Epinephelus guttatus*
Graysby	*Cephalopholis cruentata*
Yellowfin grouper	*Mycteroperca venenosa*
Coney	*Cephalopholis fulva*
Yellowmouth grouper	*Mycteroperca interstitialis*
Tiger grouper	*Mycteroperca tigris*
Goliath grouper	*Epinephelus itajara*
Nassau grouper	*Epinephelus striatus*
Snowy grouper	*Epinephelus niveatus*
Yellowedge grouper	*Epinephelus flavolimbatus*
Warsaw grouper	*Epinephelus nigritus*
Speckled hind	*Epinephelus drummondhayi*
Misty grouper	*Epinephelus mystacinus*
Black sea bass	*Centropristis striata*
Bank sea bass	*Centropristis ocyurus*
Rock sea bass	*Centropristis philadelphica*
Snappers (Lutjanidae)	
Queen snapper	*Etelis oculatus*
Yellowtail snapper	*Ocyurus chrysurus*
Gray snapper	*Lutjanus griseus*
Mutton snapper	*Lutjanus analis*
Lane snapper	*Lutjanus synagris*
Cubera snapper	*Lutjanus cyanopterus*
Dog snapper	*Lutjanus jocu*
Schoolmaster	*Lutjanus apodus*
Mahogany snapper	*Lutjanus mahogoni*
Vermilion snapper	*Rhomboplites aurorubens*
Red snapper	*Lutjanus campechanus*
Silk snapper	*Lutjanus vivanus*
Blackfin snapper	*Lutjanus buccanella*
Black snapper	*Apsilus dentatus*
Porgies (Sparidae)	
Red porgy	*Pagrus pagrus*
Sheepshead	*Archosargus probatocephalus*
Knobbed porgy	*Calamus nodosus*
Jolthead porgy	*Calamus bajonado*
Scup	*Stenotomus chrysops*
Whitebone porgy	*Calamus leucosteus*
Saucereye porgy	*Calamus calamus*
Grass porgy	*Calamus arctifrons*
Longspine porgy	*Stenotomus caprinus*

Common Name	Species Name
Grunts ( )	
White grunt	*Haemulon plumieri*
Black margate	*Anistotremus surinamensis*
Margate	*Haemulon album*
Tomtate	*Haemulon aurolineatum*
Sailor's choice	*Haemulon parra*
Porkfish	*Anisotremus virginicus*
Bluestriped grunt	*Haemulon sciurus*
French grunt	*Haemulon flavolineatum*
Cottonwick	*Haemulon melanurum*
Spanish grunt	*Haemulon macrostomum*
Smallmouth grunt	*Haemulon chrysargeryum*
Jacks ( )	
Greater amberjack	*Seriola dumerili*
Crevalle jack	*Caranx hippos*
Blue runner	*Caranx crysos*
Almaco jack	*Seriola rivoliana*
Banded rudderfish	*Seriola zonanta*
Bar jack	*Caranx ruber*
Lesser amberjack	*Seriola fasciata*
Yellow jack	*Caranx bartholomaei*
Tilefishes ( )	
Tilefish	*Lopholatilus chamaeleonticeps*
Blueline tilefish	*Caulolatilus microps*
Sand tilefish	*Malacanthus plumier*
Triggerfishes ( )	
Gray triggerfish	*Balistes capriscus*
Ocean triggerfish	*Canthidermis sufflamen*
Queen triggerfish	*Balistes vetula*
Wrasses ( )	
Hogfish	*Lachnolaimus maximus*
Puddingwife	*Halichoeres radiates*
Spadefishes ( )	
Atlantic spadefish	*Chaetodipterus faber*

APPENDIX 2 FEDERAL LOGBOOK

2007 LOGBOOK TRIP REPORT FORM   Use Black Ink only !

OMB 00648-0016 Exp 12/31/2009
Version Date 09/06

Signature:	Phone No.: ( ) -	Schedule No. *NMFS Use Only*
Vessel Name:	Start Date: MM DD YY	County or Parish: State:
Vessel No.:	Unload Date:	Dealer Name:
Ooperator Name:	Days at Sea: No of Crew:	Dealer Number: (if known)
Operator Number: (if known)		State Trip Ticket No.: (if known)

GEAR SECTION: See instructions on page 2.   Check gear box and fill in all the boxes below.

Traps (T) ☐ Fish ☐ Other		Longline (L) ☐ Bottom ☐ PLL ☐ other		Gill Net (GN) ☐ Strike ☐ Drift ☐ Other ☐ Anchor		Hook & Line ☐(H) Hand ☐(E) Electric ☐(TR) Trolling		Divers ☐(S) Spear ☐(P) Power		Other Gear (O)	
Total # Hauls		# Sets:		# Sets		# Lines		# of Divers		Type	
# Traps Used		# Hooks per Line		Length (yards)		# Hooks per Line		Total Hrs Fished		Total Hrs Fished	
Trap Soak Time (hrs)		Set Soak Time (hrs)		Depth (yards)		Total Hrs Fished					
Total Soak Time (hrs)		Total Soak Time (hrs)		Set Soak Time (hrs)		Date Received: *NMFS use only*					
Mesh: ☐x☐/☐x☐		Length (Miles)		Mesh:							

CATCH SECTION: See instructions on page 3.

Weight- Record **POUNDS** sold gutted or whole (**DO NOT** include fractions of pounds).
Gear- Record gear used for **MAJORITY** of catch as T, L, GN, H, E, TR, S, P or O. (Do not use multiple gears).
Area- Areas can be found on maps in logbook (Page 5). Do not use state area codes.
Depth- Record depth where the **MAJORITY** of fish were caught in **FEET**.

	Species Name	Code	Gutted	Whole	Gear	Area	Depth		Species Name	Code	Gutted	Whole	Gear	Area	Depth
	Amberjack-Great	1812	#	#			'	PORGY	Jolthead	3312	#	#			'
	Amberjack-Lesser	1815	#	#			'		Knobbed	3308	#	#			'
	Almaco	1810	#	#			'		Red	3302	#	#			'
	Banded Rudder	1817	#	#			'		Whitebone	3306	#	#			'
	Crevalle	0870	#	#			'	SHARK	Blacknose	3485	#	#			'
	Cobia	0570	#	#			'		Blacktip	3496	#	#			'
	Dolphin Fish	1050	#	#			'		Bonnethead	3483	#	#			'
GROUPER	Black	1422	#	#			'		Bull	3497	#	#			'
	Gag	1423	#	#			'		Dusky	3514	#	#			'
	Misty	1420	#	#			'		Finetooth	3481	#	#			'
	Red	1416	#	#			'		Lemon	3517	#	#			'
	Scamp	1424	#	#			'		Sandbar	3513	#	#			'
	Snowy	1414	#	#			'		Sharpnose	3518	#	#			'
	Yellowedge	1415	#	#			'	SNAPPER	Blackfin	3757	#	#			'
	Yellowfin	1426	#	#			'		Lane	3761	#	#			'
	Hind, Red	1413	#	#			'		Mangrove	3762	#	#			'
	Hind, Rock	1412	#	#			'		Mutton	3763	#	#			'
	Hind, Speckled	1411	#	#			'		Queen	3770	#	#			'
GRUNT	Bluestriped	1444	#	#			'		Red	3764	#	#			'
	French	1446	#	#			'		Silk/Yelloweye	3758	#	#			'
	White	1441	#	#			'		Vermilion	3765	#	#			'
	Margate	1442	#	#			'		Yellowtail	3767	#	#			'
	Margate, Black	1443	#	#			'		Triggerfish, Gray	4561	#	#			'
	Grunts, Unc.	1440	#	#			'		Triggerfish, Ocean	4562	#	#			'
	Hogfish	1790	#	#			'		Triggerfish,Queen	4563	#	#			'
	King Mackerel	1940	#	#			'		Tilefish, Gray	4474	#	#			'
	Spanish Mackerel	3840	#	#			'		Tilefish, Golden	4470	#	#			'
	Wahoo	4710	#	#			'		Sea trout, White	3455	#	#			'
	Black Sea Bass	3360	#	#			'		Puffers, Blowfish	2760	#	#			'
	Bluefish	0230	#	#			'		Barracuda	0180	#	#			'
	Blue Runner	0270	#	#			'		Hake	1550	#	#			'

TRIP EXPENSE & PAYMENT SECTION: MANDATORY FOR SELECTED VESSELS. See instructions on the bottom of page 3.

Owner Operated? Yes ☐ No ☐	Gal. of Fuel Used This Trip ☐☐☐☐☐	Price per Gallon $ ☐☐.☐☐
Trip Fuel Cost (Approximate) $ ☐☐☐☐☐.0 0	Trip Bait Cost (Approximate) $ ☐☐☐☐.0 0	Total Ice Cost (Approximate) $ ☐☐☐☐.0 0
Trip Grocery Expense (Approximate) $ ☐☐☐☐.0 0	Misc. Expenses For this trip only $ ☐☐☐☐.0 0	Captain & Crew Share Payout $ ☐☐☐☐☐.0 0
Total Trip Revenue $ ☐☐☐☐☐☐.0 0		

APPENDIX 3 SELF-REPORTED LOGBOOK AND INSTRUCTIONS

Date ___/___/2010 Vessel Name___________ Logbook Grid#______ Avg. Depth (ft)____

Starting time________ Ending time________ Target species (if any) ______________________

Bandits (camera # from computer screen) observed during this period. Camera #___ Camera#___

	Species Name	Total # Kept (any reason)	Total # Discarded (any reason)
Vermillion snapper			
Gag grouper			
Red snapper			
O			
T			
H			
E			
R			
S			

Did you record ALL occurrences of the first 3 species listed on this sheet? Yes_____ No ______

ADDITIONAL COMMENTS:

<u>Observer Instructions:</u>

1. Enter the date of the fishing activity recorded. Example May 10, 2010 = 5/10/2010.

2. Vessel Name.

3. NMFS Snapper Grouper Logbook Grid Number(s) in which most of the fishing event occurred.

4. Avg. Depth. Record the average depth of fishing for this time series.

5. Starting time and ending time.

- The starting time and ending time will be used to establish a time period for a fishing event. Starting time is when the bandit(s) dropped baits to the bottom and end time is when the last bait was retrieved for that time period.
- You will be using established time periods that are set up in 4-hour intervals to include: 6-10am, 10am-2pm, 2pm-6pm, and 6pm-10pm. You may not necessarily fish for an entire time period, especially if you are moving around to different fishing locations.
- Please record data on each day of the fishing trip for a minimum of one time period of your choice (4-hours per day). Daylight time periods are preferred unless most of the fishing activity is occurring at night.
- Over the course of the entire fishing trip, please try to record data at least once for each established time period.
- We suggest using the official time that is displayed on the computer screen (use the time displayed in the top right corner of the VDL screen where it says 'Local Time').

6. Target species. Please indicate the target species you are fishing for, if any, during this fishing event. For example, vermillion snapper vs. groupers.

7. Bandit reels observed during this time period. Indicate by camera # (you can get the camera number by looking at the computer display screen) that observes the bandit for which you are recording catch data. Camera#/bandit# should be the same. Only observe those bandits where you can observe and document ALL of the target species requested on the form. In the event that a camera is not working (again, check the computer screen) – please select a different bandit reel / camera # for observation.

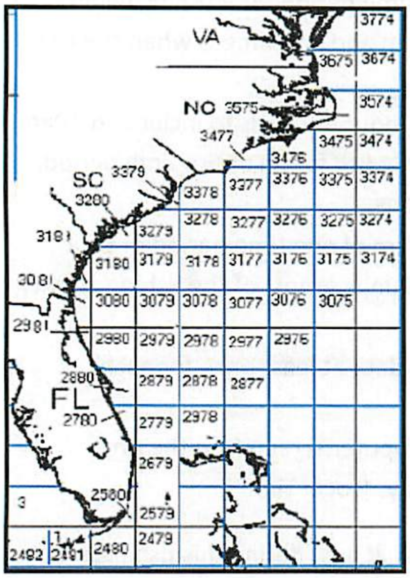
8. Documentation of kept and released species. You are only required to keep track of the species listed on the datasheet during each time period of observation. For example, every vermillion snapper caught by the bandit gear observed should be reported as either <u>kept</u> (for sale, bait, etc.) or <u>discarded</u> (size, season, shark bite, etc.). Use tick marks or any available means to record this information as video reviewers will be trying to match up the numbers that they can see on the recorded video with what you report on the datasheet.

   If you would like to document presence and number of additional species or noteworthy information that occurred during this time period – please use the blank spaces at the end of each section.

9. Please keep this logbook on the vessel at all times. Project coordinators (Scott Baker and Amber Von Harten) will retrieve the data sheets when they visit to download the computer data.

<u>Recommendations</u>

Remember, for this project, we are more concerned with the quality/accuracy of the data than the quantity of data. So, it's more important that you record 100 of the data (species, # kept/discarded) for one bandit than try to record "most but not all" of the data for 2 or more bandits. <u>SO, PLEASE ONLY RECORD DATA FOR THE NUMBER OF BANDITS THAT YOU ARE ABLE TO REPORT 100 OF THE REQUIRED INFORMATION.</u>



South Atlantic Statistical Grids are the same as in your federal logbook. Grids numbers follow lines of latitude and longitude. The first two digits are latitude and the second two digits are longitude.

APPENDIX 4 OBSERVER DATA SHEET

VesselName:		Start Time:		Location:		Sea state:		
Set #:		End Time:		Depth (ft):		Weather:		
# Reels set:		# drops (obs reel only)		FishStyle:		EM record?	Yes No	
Notes:								

Date: _______________ Latitude:________________ Longitude:_________________

Time 24 hr clock	Bandit # ___ (Camera # ___)		Length & Fate		Comments
	Species Kept	Species Released	TL (mm)	Fate (1,2,3,4)	

APPENDIX 5 EM SERVICE AND OBSERVER NOTES

Date: May 14, 2010.   Vessel: F/V V6 Tech: Scott

Performed the first DR of the project today. Two trips were made on this WO with trip #1 from May 4-7 and May 10-13. Self-reported data was collected on the first trip. Fed logbook will be uploaded as soon as received. I swapped out the hard drives but was unable to initialize the new drive (trouble shutting down the VDL user to log into tech account for initialization – EM kept freezing). I left the EM system "OFF" and plan to initialize the drive when they return from their next trip, probably May 20-21. Captain indicated that on the first night of the trip, the EM system repeatedly went to sleep but kept waking up on its own. He was also having issues with his fish finder – which was wired to the same battery. He rewired EM to a standalone battery that evening and system worked well after that. Captain manually put EM to sleep each night. Received an error message "MSCOMM32.OCX or one of its dependences not correctly registered." Kim indicated that was likely caused by the rewiring and a section of code could be placed in the C: folder to fix this error.

Date: May 16, 2010   Vessel: F/V V3 Tech: Scott and Amber

One trip was made on this WO prior to data and hard drive retrieval with approximate dates of April 30 – May 11. Captain reported that EM system kept going to sleep during active fishing. Voltage avged below 11.0 during entire trip. EM is supposedly connected to a new standard deep cycle car battery. Captain says he repeatedly turns off engines while fishing for periods of up to hour or more. There was some thought that the bandit motors were connected to the same battery bank – again, not sure. Voltage displayed on the VDL during DR was usually 3+ volts lower than displayed on the vessel dashboard. Preliminary analysis of the sensor data and function tests revealed that the drum sensor failed early in the trip, but came back on for a little, and then went out again. Function test revealed that it was not working. We spliced a new drum sensor onto bandit and it now works. New hard drive installed with new WO# 300717. Kim provided technical assistance on power issues and drum sensor. No self-reported data collection occurred this trip and fed logbook has not yet been received.

Date: May 18, 2010   Tech: Scott

Three hard drives were shipped to AMR (V6 WO# 300218; V3 WO# 300219; and blank HD that failed to initialize during March 2010 initial instillation). The faulty drum sensor and extra wire from spliced sensor was also returned in a separate box. 2 boxes total FedEx ground.

Date: May 19, 2010   Vessel: F/V V4   Tech: Scott

One trip was made on this WO (thus far) with approximate dates of May 5 – May 18. Sensor data was copied but hard drive and WO was not changed. Approximately 12% of drive was used. Voltage avged below 11.0 during entire trip. Crew reported that camera 4 (port stern) went in and out (picture to darkened black or even blue screen) towards the latter days of the trip. Applying pressure to the large electrical connection between camera circuit board in housing to camera body caused camera to go in and out of operation although connection was tight. Replaced connector from one extra "complete" camera and this appeared to work. Note, we no longer have a complete extra camera. Review of video footage revealed that 2 camera angles were not adequate (those bandits on port and starboard sides near wheelhouse). These were adjusted. Matt and I also determined the best possible location for placement of baskets on the deck for guys to place fish – these locations were marked with a large black arrow on the side of the fish boxes. The vessel also uses (temporarily at least) black non-skid mats on the deck surface to prevent slippage which may possible inhibit video review. In addition, Matt was going to ask the head mate to try and place fish on top of the box prior to placing them in the basket – at least for bandit locations for which self-reported data is being collected. New measuring tapes (stickers) were also to be added to tops of the boxes. The Sensor data revealed that the drum sensor did not appear to function for approximately 2.5 days during the middle of the trip and thus no video was recorded when fishing activity was occurring. During my visit, the drum sensor worked and it may be that the bandit / drum sensor was moved at some point in the trip causing the sensor be out of link with the reflective tape – only to fall back into position days later. This is likely to be a problem on other vessels as well. Suggest duct-taping the sensor on the bandit pole (in addition to the cable ties) to minimize movement. Informed the crew of this potential issue. Self –reported data was collected for this trip and will be uploaded along with a copy of the federal logbook in a few days.

Date: May 21, 2010. Vessel: F/V V6 Tech: Scott

Because I was not able to initialize the new drive last visit (May 14) – the EM was left "off" for the last trip, May 17-20. On this visit I was again unable to initialize the hard drive (Serial# 105212). I initialized a new hard drive and successfully changed the Work Order # to 300716. Note: The captain does not expect to fish again until June 1.

Date: May 21, 2010. Vessel: F/V V2 Tech: Amber

First DR for this vessel. Three trips were made on this WO. Trip # 1 was May 1-7; Trip #2 was May 11 (mechanical failures forced the vessel to return the same day); Trip #3 was May 16-20. Approximately 10% of the hard drive was used. Based on the review of some of the sensor data, there were some video recording issues (no video recorded) on May 19 and 20 and periodically throughout trip #1 and trip #2. The captain reported that the camera system would periodically shut off and not come back on. He was not sure of what to do or what was causing the shut off. The system would come back on once the engine was turned back on (indicating power saver mode or fishing activity had ceased.) However, it is not clear why the system shut off on May 19 and 20. There may have been some issues with the drum sensor not being triggered because it was loose and may not have been in the plane of the reflective tape. When the sensor data was retrieved, there were 256 files processed and 12 unclosed AVI files. Error messages included: No function test performed by captain; No drum sensor detected during portion of trip; No video clips recorded during portion of trip. I spoke with the captain about performing a function test at least once during the trip to test the system. I also spoke with him about being sure to use the reel with the drum sensor attached (or at least trigger the sensor) otherwise the system would not turn out to record video. All the cameras were functioning during DR. The lens on camera #4 (starboard, bow) was changed from a 3.6 to a 6.0 to better capture fish being hauled in this area of the boat. Also, the drum sensor seemed loose and was secured with additional duct tape and zap ties as well as additional reflective tape on the reel spool to ensure that the drum sensor was triggered. The hard drive was swapped out and a new hard drive was initialized (hard drive #105209) under new WO #300720. Last, there was not a padlock on the black box cover and I will need to place one on the box at the next DR. Self –reported data was collected for this trip and will be uploaded along with a copy of the federal logbook. This vessel is expected to return fishing on May 25 or 26.

Date: May 26, 2010. Vessel: F/V V7 Tech: Amber

First DR for this vessel. Captain was not available during the DR. Two trips were made on this WO. Trip # 1 was May 5-12; Trip #2 was May 18-24. Approximately 12% of the hard drive was used on this WO. When the sensor data was retrieved, 424 files were processed and there were 4 unclosed AVI files. Error messages received included: few abnormal startups; system shut down caused by dead battery; system shut down caused by watchdog timeout; system shut down caused by GPS/COM1; check GPS in VDL/hyperterminal; GPS data stream stopped; function test performed at least one time; # of recording triggers in VM file is less than the # of clips in the AVI list. Review of the sensor data revealed that the drum sensor did not appear to function for approximately 2 days during the middle of trip #2 (May 20/21) and thus no video was recorded when fishing activity was occurring. The drum sensor was checked and tested and was working during the DR. Review of the video data revealed several days with only a few video clips when there was obvious fishing activity happening throughout the day and night (May 5, May 12 and May 20). On May 24, camera #4 appeared to lose connection and showed a blue screen on the VDL and the video recording. However, all cameras and drum sensors were tested during the DR (before and after hard drive swap) and all components were operational. The vessel conducted some night fishing and the video resolution and lighting appeared to be adequate. Would like this confirmed by video reviewers in case changes need to be made. Captain needs to be sure to clean camera housing to keep the field of view clean from salt water. The camera housing on camera #4 is scratched pretty badly in the middle of the field of view and may need to be replaced. Had some issues during the hard drive swap and received the error message, "Component MSCOMM32.OCX or one of dependencies not correctly registered. A file is missing of invalid." However, after talking with Scott on the phone about his same experience on the V6, I was able to use the control-alt-delete function to log into the EMtech account and successfully install and quick initialize the new hard drive. After going through the control-alt-delete step and logging on twice, I received the message, "Success: Watchdog disabled." The hard drive was swapped out and a new hard drive was initialized (hard drive #105328) under new WO #300719. Self – reported data was collected for this trip and will be uploaded along with a copy of the federal logbook. This vessel is expected to return fishing around June 1-3.

Date: June 2, 2010. Vessel: F/V V4 Tech: Scott

Two trips occurred this WO, May 5-18 and May 20 – June 1. Self-reported logbooks were also recorded for each trip. Due to family issues, the V4 will no longer be able to participate in the project. The sensor data was downloaded and the EM system was removed from the vessel. Federal logbooks were not available at time of retrieved.

Date: June 4, 2010. Vessel: F/V V6 Tech: Scott

The fisheries observer was introduced to the EM system and was shown how to perform function test if needed. We decided that we would try to perform as many hook-by-hook comparisons as possible.

Date: June 8, 2010 Tech: Amber

Mailed 2 HD's: V7 WO300220 and V2 WO300221

Date: June 19, 2010. Vessel: F/V V6 Tech: Scott

Two trips occurred this WO, May 31-June 2 and June 14-17. The June 14 trip was the first trip as part of the EM-observer comparison.

Notes from the observer:

June 14, 2010. The vessel anchored at 10am. I positioned myself behind the fish box, which allowed me to have excellent visual of both bandit #1 and #2. The position also allowed me to view the computer screen. I could see bandit #3 fairly well but trying to obtain fish for measuring interfered with fishermen. Concentrated my efforts on drop times. Picked red porgy for length measurements – both legal and undersize. Measured vermilion in the afternoon. Established a working routine. Fishermen's behavior in drops was very confusing. Up-down would occur quite often – oftentimes dropping back down when the fishermen could see that bait was still on the hook but before hook was retrieved to the surface. Mahi Mahi through a twist in the works. After rebaiting, Mahi would hit the bait before the drop or while the fishermen was removing fish. This gave the appearance that they caught 3 fish on a 2 hook rig. Two loggerhead turtles came near the vessel while fishing – location and time was recorded.

June 15, 2010. Today's sampling I recorded Bandit #1 from start to 13:00. From 13:00 to the end of the day I recorded bandit #2. I measured only red porgy, red snapper, vermilion snapper and scamp. The fishermen id'ed a fish as an amber jack as a lesser amberjack but we resolved it to be an amberjack. The surgeonfish and blue tang I'm not familiar with, and was unable to ID which of these it could possibly be. It was quickly discarded. Having issues with partial bandit drops. Measuring other bandit discards tends to interfere with time vs. drops recording – concerned about accuracy.

June 16, 2010. Recorded times for bandits #2 and #3. Worked well until catch rate dropped off and I felt like I was wasting paper on #3. On set #16 stopped to process samples for NC DMF. Undersize fish were sampled. The duration of handling undersize fish on my part may have increased the fate rate on a few fish throughout the day. Made attempts to hold fish in front of video, to release them to see if they could observe the fate on video. Fishermen on #2 and #3 put all of his fish in the same box. He may reel both reels up and take the fish off all at the same time. I could see that on video it may be hard to distinguish which reel the fish were caught on.

HD changed, sensor data downloaded. New WO is 300996.

Date: June 22, 2010. Vessel: F/V V8Tech: Scott

Two trips were taken during this one and only WO for this vessel the dates of which are unknown. Due to family issues, the V8 (same owner as V4) will no longer be able to participate in the project. The sensor data was downloaded and the EM system was removed from the vessel. We believe that no video was recorded because the bandit with the sensor attached was not used. We believe that this was not deliberate but that it happened to occur because the 2 fishermen onboard happened to use only 2 of the 4 reels. No self-reported data was recorded. Logbooks were not available at the time of service.

Date: June 25, 2010. Vessel: F/V V7 Tech: Amber

Routine service visit to check equipment and adjust cameras as needed.

Date: July 7, 2010 Vessel: V1 Port: Mt. Pleasant, SC WO#: 300998 Tech: Scott &Amber

Replacement vessel for the V4. Took us many hours to figure out that alligator clips (used to power up the system prior to installing the EM in its permanent place on the vessel) were not sufficient to transfer both AMPERAGE and Volts from the vessel batteries to the EM box. Once this was corrected and the box "hardwired" to the isolated battery – there were no issues. 4 camera system installed.

Date: July 8 2010 Tech: Scott

Mailed 2 HD's via FedEx ground. V4 WO300223 and V6 WO300716 (which contains the first observer trip). Since no video was recorded on V8 WO300222, sensor data was downloaded at last service and the HD was reinitialized for use on another vessel.

Date: July 8, 2010 Vessel: F/V V3 Tech: Amber

The V3 continues to have "powering down" issues and we are certain if the problem is a battery issue or an artifact of how the captain and crew fish (long periods of motor not running, bandits not turning (more than 10min run-on, etc.). Amber assisted the crew in rewiring the EM box to the house bank of batteries (5, 8d batteries) as opposed to the single isolated 12v battery. This appears to have resolved the issue. Also, while on sight it was determined that the drum sensor was not working (result of FT). New sensor was spliced on (I think) and the sensor was relocated to the starboard bandit reel closest to the wheelhouse – the own usually fished by the captain.

Date: July 15, 2010 Vessel: F/V V7 Tech: Observer!

The observer undertook the 2nd trip of the study onboard this vessel from July 15-22. Immediately prior to this trip we learned that one of the cameras had been damaged, the glass dome severely scratched, with water inside the camera – leaving it inoperable. We did not have time to service/repair the camera prior to the trip. In addition, AMR had sent some feedback with regards to current angles and suggestions for adjustment as per the previous WO. Scott provided the observer with tools necessary to make the adjustments and these were made by the observer once onboard the vessel. With the addition of the observer, one crew member was not taken to sea. Consequently, this crew members bandit reel was not used – because, 1, he was not onboard and 2, the reel motor had been damaged on the previous trip. Needless to say, on the first day of the 8 day trip, the observer realized that the EM was not recording when fishing started....because the drum sensor was also on this reel!!...and the crew did not understand that the sensor was required to activate recording of video. Therefore, throughout the entire trip, the observer initiated EM recording by turning the sensor-mounted broken bandit reel by hand. Despite this setback, the observer felt that most of the video was recorded although there may be small lapses in footage.

Notes from observer regarding 2nd trip of study (July 15-22) onboard the V7:

Date: July 26, 2010 Vessel: V7 and V2 Tech: Amber

New HD's were installed. New WO's are V7 WO 300999 and V2 WO 301000

Date: July 27, 2010 Vessel: V3 and V5 Tech: Scott

I met with the captain, crew and owner of the V5 based in Murrells Inlet, SC today. This will be the replacement vessel for V8 and bring all EM systems (6) back online. Installation will occur next week. I also visited the V3 as it had just returned from the first trip since the last service and adjustments. Viewing of the sensor data indicated that everything functioned normally – although there was a slight data gap at the beginning of the July 12-26 trip, WO300717. With the bandit-sensor fiasco that occurred on the second observer trip - we wanted to make sure that the EM was functional prior to the 3rd observer trip of the study in August.

Date: Aug 1, 2010 Vessel: V5 Tech: Scott & Amber

A three camera EM system was installed on the vessel today – similar to the set-up on the V6 – 1 bandit each on port and starboard sides, and a single bandit, fished dead-man style, on the central stern. This will be the replacement vessel for the V8. Starboard and port cameras were removed from their mounting brackets and mounted directly on the outer wheelhouse wall (each 3.6). The camera covering the stern reel was mounted over the fish box, under the canopy to show the reel as well as the entire fish box (large) where all fish go before they are gutting and iced.

Date: August 2, 2010 Tech: Amber

2 HD's were mailed: V7 WO300719 and V2 WO300720

Date: Aug 9, 2010 Vessel: V2/V7 Tech: Amber

Repaired camera housing damaged by water leak by replacing the circuit board of the camera. After review of video, angles of two cameras were adjusted to focus in on stern cameras separately.

Date: Aug 15, 2010 Vessel: V1 Tech: Amber

Four trips occurred on this WO, July 8-15, July 20-27, Aug 1-5 and Aug 9-13. Self-reported data was recorded for portions of each trip. Federal logbooks have not yet been collected and the vessel was not selected for discard reporting this year. Sensor data downloaded and HD removed. New WO is 301003.

Date: Aug 17, 2010 Vessel: V5 Tech: Scott

This is the initial work order for this vessel (begin study in August) and includes 2 trips, Aug 3-7 and Aug 11-14. This vessel typically makes 3-4 day trips, once a week, weather permitting. No self-reported data was included by the captain and crew but will begin with the next WO. Video review during this service indicated that the fishermen operating the port reel was usually in between the wheelhouse mounted camera and the bandit reel – thus obscuring the view. The 3.6 angle also created a wide viewing angle. I installed a 6.0 on this camera. Sensor data was downloaded and HD pulled. New WO is 301004.

Date: Aug 20, 2010 Vessel: V6 Tech: Scott

9 trips occurred on this WO: June 22-26; June 29-July 3; July 5-July 0; July 12-15; July 20-23; July 27-30; Aug 2-4; Aug 8-11; Aug 16-19. Approximately 45% of the 500Gb drive was used. Self-reported data is available for the first and last trips only. However, the fed and discard logbooks as well as the self-reported data associated with the last trip on the WO has not been retrieved from the captain and will be added ASAP. Sensor data was downloaded and HD removed. New WO is 301005.

Date: Aug 25, 2010 Tech: Scott

2 HD's were mailed FedEx ground: V5 WO 301001 and V6 WO 300996.

Date: Aug 30-31, 2010 Vessel: V2 Tech: Scott & Amber

At some point in the recent past (last trip or trip before last), the V2 took a large wave and video monitor was smashed (inoperable). Apparently some damage, or at least loose connections, also resulted from the "jarring" as the EM box, when powered on, did not recognize any of the 4 cameras. We repeated the power-up / down process several times and also tried to physically tighten the wiring and module connections under the lid. Eventually, after 5 or 6 iterations, the cameras were recognized. Also....to fulfill additional tasks associated with the project, Amber and I obtained 108 fish lengths and otoliths from undersize fish retained by the V7 and V2. Fish were stored whole, frozen, in Charlie's freezer.

Date: Sept 8, 2010 Tech: Scott

Mailed 2 hard drives today FedEx ground; V1 (WO300998) and V3 (WO300717 – which contains an observer trip).

Date: Sept 13, 2010 Vessel: V4 and V8 Tech: Scott

I received from NMFS logbook office the fed logbook information for the V4 2 trips before the EM system was removed. This will be uploaded in WO 300223. As of this date, logbook info has not been received by NMFS for the V8 (WO 300222).

Date: September 3, 2010 Vessel: F/V V3 Tech: Scott

This WO has 4 trips – the last being an observed trip. The dates are May 20-June 1, June 18-July 1, July 12-July 26 and Aug 20-Sept 1. On each trip the captain recorded some self-reported data. Note in the previous entry that the first 2 trips on this WO likely have data gaps as these occurred prior to changing the sensor placement and wiring to the house bank of batteries. Sensor data downloaded and HD removed. New WO is 301002.

Date: September 13, 2010 Vessel: V1 Tech: Scott

At some point during this WO one of the stern cameras went to "blue screen." Amber had tried to fix during a previous service the week before and indicated that the camera components were wet (or had been wet) and that there was corrosion on the cable and BNC. I replaced the old camera with a brand new camera that I had received from AMR a few weeks earlier. This fixed the problem as far as I could tell. We made an effort to fix the camera ASAP as the observer will be accompanying this vessel on his next trip and wanting to make sure that everything was functioning – in light of the sensor fiasco with the V7.

Date: Oct 7, 2010 Vessel: F/V V2 Tech: Amber

System was not recognizing all four cameras. Power to/from the EM box, molex connector and all cable were tested and all were receiving power. After reading troubleshooting guide, it was determined that the video capture card might be damaged or out of place. I removed the EM box from the vessel to work on making the repair while I was able to talk on the phone with ARM (since it was too early to call them on this day). I was also informed on this trip that the keyboard for the V7 was not working. I tried cleaning the keyboard and some of the keys still did not respond when typing. So, a new keyboard will be needed.

Date: October 8, 2010 Vessel: F/V V1 Tech: Amber

Retrieved hard drive and installed new hard drive.

Date: Oct 18, 2010 Vessel: F/V V2 Tech: Amber

ARM consulted on the repair by phone at my office and instructed me to re-position and silicone the video capture card. I returned EM box to the vessel after physically resetting the video capture card. It worked! All cameras were recognized and the system was working normally.

Date: October 22, 2010 Vessel: F/V V5 Tech: Scott

There were several trips on this WO and there was an extended time (10-12 days) when the vessel was being repaired in the yard (bow damage). The port camera was moved from the cabin wall to the stern to get views from the other side of the reel (fishermen was constantly between reel and camera in other configuration). Had to splice in additional cable. 2.9 mm lens was used. Changed starboard lens from 2.9 mm to 6.0 mm and left instructions for captain to change/adjust if necessary. He plans to hold up in front of camera all discards.

Date: October 27, 2010 Vessel: F/V V1 Tech: Amber

Met with vessel owner to start planning the fabrication and installation of the discard chute for recording discards. The owner was going to purchase a stainless steel tray at a kitchen supply store and attach an angled chute off the side of the tray.

Date: Oct 27, 2010 Tech: Amber

Mailed 1 hard drive (F/V V1, WO#301004) today via FedEx ground.

Date: November 5, 2010 Vessel: F/V V1 Tech: Amber

Met with vessel owner to review the discard chute prior to his departure. I repositioned the port stern camera to aim over the discard table/chute and still capture the fishing activity on the starboard port reel. He attached a tape measure to estimate fish length as the fish traveled down the chute.

Date: November 5, 2010 Vessel: F/V V3 Tech: Scott

After the second trip on this WO, the captain included that there may be problems with the system. Review of video indicated that only 2 days (out of 12) of video were collected on the most recent trip. The first trip on the WO appeared fine. VDL data was downloaded but could not be analyzed on EMI due to a corrupted file (later found to be missing a header). Therefore, the HD was not changed. Function test revealed that the drum sensor was faulty and a new one was spliced in and confirmed to be working upon departure. – Captain also indicated that the EM monitor (when on) caused the satellite radio on the vessel to not work correctly (static??). As a result, the captain usually left the monitor "off."

Date: Nov 9, 2010 Tech: Scott

Mailed 1 hard drive (F/V V5, WO#301004) today via FedEx ground.

Date: Nov 18, 2010 Vessel: F/V V1 Tech: Amber

Met with vessel owner to review the video of the discard chute since the installation. The camera captured a good enough image to identify the fish by species. However, the captain determined the discard table was too large and did not have high enough sides to keep the fish from jumping out. Also, the tape measure was not large enough to read the length of the fish. So, he closed off a portion of the table making the area smaller and placed a 2X4 on the side to give the side more height to contain the fish better. The tape measure was replaced by strips of red electrical tape placed at 4-inch increments along the length of the table and the chute to estimate length of the fish as it entered and exited the chute.

Date: December 2, 2010 Vessel: F/V V1 Tech: Amber

Retrieved the hard drive and installed the new hard drive (#105329) and new WO# (above). Reviewed video data to make sure the view over the discard chute had improved. The vessel owner indicated that the tape would have to be removed because the scales of the fish would get caught on the tape as it slid down the chute. So, he will paint stripes in 4-inch increments on the chute.

APPENDIX 6 CATCH OCCURRENCE AND COMPARISON TABLES

Summary table showing the total catch for each species for all vessels and events from EM and self-reported data, as well as the frequency of species records (occurrence).

Species Name	EM Percent Occurrence	Self-reported Percent Occurrence	EM Pieces	Self-reported Pieces	Total Piece Difference	Percent Difference	EM percent of Category	Self-reported Percent of Category
Groupers								
Black Sea Bass	17.7	3.5	192	20	172		43.1	4.2
Red Grouper	31.9	33.6	126	176	-50		28.3	37.3
Scamp Grouper	22.1	29.2	51	126	-75		11.5	26.7
Red Hind	7.1	2.7	34	0	34		7.6	0.0
Gag Grouper	15.9	19.5	26	64	-38		5.8	13.6
Bank Sea Bass	5.3	0.0	7	0	7		1.6	0.0
Rock Hind	1.8	10.6	2	45	-43		0.4	9.5
Yellowfin Grouper	0.9	4.4	2	17	-15		0.4	3.6
Sea Bass (unidentified)	0.9	0.0	2	0	2		0.4	0.0
Snowy Grouper	0.9	3.5	1	19	-18		0.2	4.0
Yellowmouth Grouper	0.9	2.7	1	0	1		0.2	0.0
Yellowedge Grouper	0.9	0.0	1	0	1		0.2	0.0
Black Grouper	0.0	2.7	0	4	-4		0.0	0.8
Graysby	0.0	0.9	0	1	-1		0.0	0.2
Total Groupers			**445**	**472**	**-27**	**-6.1**		
Snappers								
Vermillion Snapper	53.1	53.1	1485	1485	0		92.4	92.5
Red Snapper	18.6	31.9	64	114	-50		4.0	7.1
Snapper (unidentified)	8.0	0.0	55	0	55		3.4	0.0
Mutton Snapper	0.9	2.7	2	4	-2		0.1	0.2
Blackfin Snapper	0.9	0.0	1	0	1		0.1	0.0
Silk Snapper	0.0	0.9	0	1	-1		0.0	0.1
Yellowtail Snapper	0.0	0.9	0	1	-1		0.0	0.1
Total Snapper			**1607**	**1605**	**2**	**0.1**		
Porgies								
Porgy (unidentified)	50.4	0.0	446	0	446		71.5	0.0
Red Porgy	14.2	44.2	177	613	-436		28.4	99.4
Knobbed Porgy	0.9	1.8	1	0	1		0.2	0.0
Whitebone Porgy	0.0	1.8	0	3	-3		0.0	0.5
Jolthead Porgy	0.0	0.9	0	1	-1		0.0	0.2

Species Name	EM Percent Occurrence	Self-reported Percent Occurrence	EM Pieces	Self-reported Pieces	Total Piece Difference	Percent Difference	EM percent of Category	Self-reported Percent of Category
Total Porgy			**624**	**617**	**7**	**1.1**		
Sharks								
Sharks (unidentified)	13.3	0.0	19	0	19		70.4	0.0
Sharpnose Atlantic Shark	6.2	1.8	8	3	5		29.6	75.0
Blacktip Shark	0.0	0.9	0	1	-1		0.0	25.0
Total Sharks			**27**	**4**	**23**	**85.2**		
Other								
White Grunt	12.4	4.4	32	17	15		4.8	3.9
Grunt (unidentified)	0.9	0.0	3	0	3		0.5	0.0
Almaco Jack	15.9	8.8	73	132	-59		11.0	30.6
Jack (unidentified)	6.2	0.0	21	0	21		3.2	0.0
Gray Triggerfish	37.2	15.0	452	188	264		68.0	43.6
Greater Amberjack	11.5	11.5	35	73	-38		5.3	16.9
Mahi Dolphin	5.3	0.0	11	0	11		1.7	0.0
Sharksucker	5.3	0.0	10	0	10		1.5	0.0
Queen Triggerfish	3.5	0.9	5	0	5		0.8	0.0
Squirrelfish	3.5	0.0	5	0	5		0.8	0.0
Sand Tilefish	2.7	0.0	4	0	4		0.6	0.0
Banded Lionfish	0.9	0.0	2	0	2		0.3	0.0
Tattler	1.8	0.0	2	0	2		0.3	0.0
Tilefish (unidentified)	1.8	0.0	2	0	2		0.3	0.0
Bluefish	0.9	0.0	1	0	1		0.2	0.0
Great Barracuda	0.9	0.0	1	0	1		0.2	0.0
King Mackerel	0.9	0.0	1	0	1		0.2	0.0
Toadfish (unidentified)	0.9	0.0	1	0	1		0.2	0.0
White Spotted Soapfish	0.9	0.0	1	0	1		0.2	0.0
Margate	0.0	2.7	0	4	-4		0.0	0.9
Blueline Tilefish	0.0	0.9	0	1	-1		0.0	0.2
Hogfish (unidentified)	2.7	4.4	3	16	-13		0.5	3.7
Total Other			**665**	**431**	**234**	**35.2**		
Unknown Fish	78.8	0.0	932	0	932		21.7	0.0
Total			**4300**	**3129**	**1171**	**27.2**		

Summary table showing the total catch for each species for all vessels and events from observer and EM data, as well as the frequency of species records (occurrence).

Species Name	Observer Percent Occurrence	EM Percent Occurrence	Observer Pieces	EM Pieces	Total Piece Difference	Percent Difference	EM Percent of Category	Observer Percent of Category
Groupers								
Black Sea Bass	7.5	4.9	224	131	93		52.4	42.2
Scamp Grouper	19.0	10.6	78	31	47		12.4	14.7
Red Grouper	12.8	10.6	43	32	11		12.8	8.1
Snowy Grouper	1.8	0.0	41	0	41		0.0	7.7
Red Hind	10.2	9.7	38	38	0		15.2	7.2
Rock Hind	10.6	0.0	29	0	29		0.0	5.5
Yellowfin Grouper	5.3	2.2	20	7	13		2.8	3.8
Yellowmouth Grouper	4.9	0.0	13	0	13		0.0	2.4
Gag Grouper	4.0	1.8	12	6	6		2.4	2.3
Coney Grouper	4.0	0.0	10	0	10		0.0	1.9
Bank Sea Bass	1.8	0.9	8	3	5		1.2	1.5
Graysby	2.2	0.0	7	0	7		0.0	1.3
Rock Sea Bass	1.8	0.0	5	0	5		0.0	0.9
Black Grouper	0.9	0.0	2	0	2		0.0	0.4
Yellowedge Grouper	0.4	0.4	1	1	0		0.4	0.2
Sea Bass (unidentified)	0.0	0.4	0	1	-1		0.4	0.0
Grouper Total			**531**	**250**	**281**	**52.9**		
Snappers								
Vermillion Snapper	38.5	37.6	1205	1132	73		98.1	98.4
Red Snapper	4.0	4.0	10	11	-1		1.0	0.8
Mutton Snapper	2.7	0.0	6	0	6		0.0	0.5
Silk Snapper	0.4	0.0	2	0	2		0.0	0.2
Dog Snapper	0.4	0.0	1	0	1		0.0	0.1
Gray Snapper	0.4	0.0	1	0	1		0.0	0.1
Snapper (unidentified)	0.0	2.7	0	10	-10		0.9	0.0
Cubera Snapper	0.0	0.4	0	1	-1		0.1	0.0
Snapper Total			**1225**	**1154**	**71**	**5.8**		
Porgies								
Red Porgy	23.5	0.0	321	0	321		0.0	93.6
Knobbed Porgy	4.4	0.0	14	0	14		0.0	4.1
Whitebone Porgy	1.8	0.0	7	0	7		0.0	2.0
Joltthead Porgy	0.4	0.0	1	0	1		0.0	0.3

Species Name	Observer Percent Occurrence	EM Percent Occurrence	Observer Pieces	EM Pieces	Total Piece Difference	Percent Difference	EM Percent of Category	Observer Percent of Category
Porgy (unidentified)	0.0	24.8	0	307	-307		100.0	0.0
Porgy Total			**343**	**307**	**36**	**10.5**		
Sharks								
Sharpnose Atlantic	4.0	2.7	12	10	2		47.6	52.2
Silky Shark	2.7	0.0	6	0	6		0.0	26.1
Sandbar Shark	0.9	0.0	2	0	2		0.0	8.7
Tiger Shark	0.9	0.0	2	0	2		0.0	8.7
Stingray	0.4	0.0	1	0	1		0.0	4.3
Sharks (unidentified)	0.0	4.4	0	11	-11		52.4	0.0
Shark Total			**23**	**21**	**2**	**8.7**		
Other								
Tomtate Grunt	9.3	0.0	70	0	70		0.0	52.2
White Grunt	7.1	1.3	62	3	59		7.0	46.3
Grunt (unidentified)	0.4	6.2	2	40	-38		93.0	1.5
						67.9		
Almaco Jack	7.1	2.2	19	7	12		53.8	100.0
Jack (unidentified)	0.0	2.7	0	6	-6		46.2	0.0
						31.6		
Hogfish (unidentified)	2.2	1.3	5	3	2		75.0	83.3
Hog snapper	0.4	0.0	1	0	1		0.0	16.7
Spotfin Hogfish	0.0	0.4	0	1	-1		25.0	0.0
						33.3		
Gray Triggerfish	23.5	23.0	379	355	24		91.0	87.5
Mahi Dolphin	1.3	1.8	7	10	-3		2.6	1.6
Greater Amberjack	2.7	2.2	7	6	1		1.5	1.6
Little Tunny (False	0.4	0.0	7	0	7		0.0	1.6
Moray Eel	1.8	0.0	6	0	6		0.0	1.4
Squirrelfish	2.2	2.2	5	5	0		1.3	1.2
Blueline Tilefish	2.2	0.0	5	0	5		0.0	1.2
Queen Triggerfish	1.3	1.3	4	4	0		1.0	0.9
Saddlebass	1.8	0.0	4	0	4		0.0	0.9
Remora	0.9	0.0	3	0	3		0.0	0.7
Sharksucker	0.4	1.8	2	5	-3		1.3	0.5
Bullet Mackerel	0.4	0.0	1	0	1		0.0	0.2
Spanish Mackerel	0.4	0.0	1	0	1		0.0	0.2

Species Name	Observer Percent Occurrence	EM Percent Occurrence	Observer Pieces	EM Pieces	Total Piece Difference	Percent Difference	EM Percent of Category	Observer Percent of Category
Spiny Lobster	0.4	0.0	1	0	1		0.0	0.2
White Spotted	0.4	0.0	1	0	1		0.0	0.2
Tilefish (unidentified)	0.0	1.3	0	3	-3		0.8	0.0
Sand Tilefish	0.0	0.4	0	1	-1		0.3	0.0
Spottail Pinfish	0.0	0.4	0	1	-1		0.3	0.0
Other Total			**592**	**450**	**142**	**24.0**		
Unknown Fish	4.9	51.3	16	398	-382		15.4	0.6
Total			**2730**	**2580**	**150**	**5.5**		

4B. Collection and biological sampling of discards

A secondary goal of this project was to collect lengths and biological samples (e.g., otoliths) from species frequently discarded in the snapper-grouper fishery. This data could help National Marine Fisheries Service (NMFS) determine the complete age-size structure of these species for use in future assessments. Prior to the start of the EM component of the project, an Exempted Fishing Permit (EFP) was requested and granted from the NMFS that allowed retention of up to 300 individuals for each of the following species: red snapper, vermilion snapper, gag grouper, red grouper, greater amberjack, black sea bass and red porgy. For each fish, we planned to collect information on lengths, weights, and sex as well as remove otoliths for age determination.

Data collection by investigators

A total of 102 otoliths were obtained from undersized catch of 6 species (71 vermilion snapper; 18 red porgy; 10 black sea bass; 2 greater amberjack, 1 red snapper; 1 scamp). These fish were obtained by one vessel fishing off the coast of Georgia (NMFS grid 3181) in late August 2010. At least a couple dozen other discards were retained by fishermen for inclusion in this study, but these samples were processed by port samplers in Southport, NC for NMFS and the North Carolina Division of Marine Fisheries and therefore are not included in this report.

Collection of discard samples was difficult during this study for a variety of reasons. Our intention was to allow EFP approved fishermen and vessel owners the option to hold retained discards in the freezer at their place of business (with a copy of the EFP) until a time at which the project investigators could visit to both service the EM equipment and collect biological materials. However, after EM installation was completed and vessels were collecting EM and observer data, visits to service EM equipment and visit with partners were sporadic and unpredictable (based on vessel fishing schedules and time required to intercept vessels between some trips) making it more difficult for partners to plan on retaining discards. Second, we attempted to have the observer collect some otoliths while at-sea, but the observer workload for the EM comparison (beyond that of a traditional observer trip) did not allow for this to happen. The observer however was able to record lengths and fate for several frequently discarded species (see below). Finally, we got the impression that many of the captains, owners and crew were not supportive of retaining regulatory discards in any substantial number as this could impact their fishing grounds. Therefore, trips to sample to sample a handful (< 5) of discards were not feasible given that most ports were between one and three hours from either Wilmington, NC or Beaufort, SC.

Future efforts to collect numbers of discards suitable for age-size structure analysis (≥ 200 samples per species per year) should be independent or at least complimentary of other research activities within the project. If, as in this study, fishermen and not scientists are requested to retain discards for later sampling while at sea, investigators should take time to explain exactly what is expected and how many samples are required in order to constitute a representative sample. In retrospect, we should have tried to coordinate discard retention and discard sampling more with state and NMFS port samplers operating the region as they visited the ports more frequently than we were able to.

Data collected by the observer

While the observer was not able to collect otoliths, he was able to provide information on much of the discarded catch. Percent occurrence of retained and discarded catch from this study was similar to the top 20 retained species for all vessels fishing off North Carolina, South Carolina and Georgia in 2010.

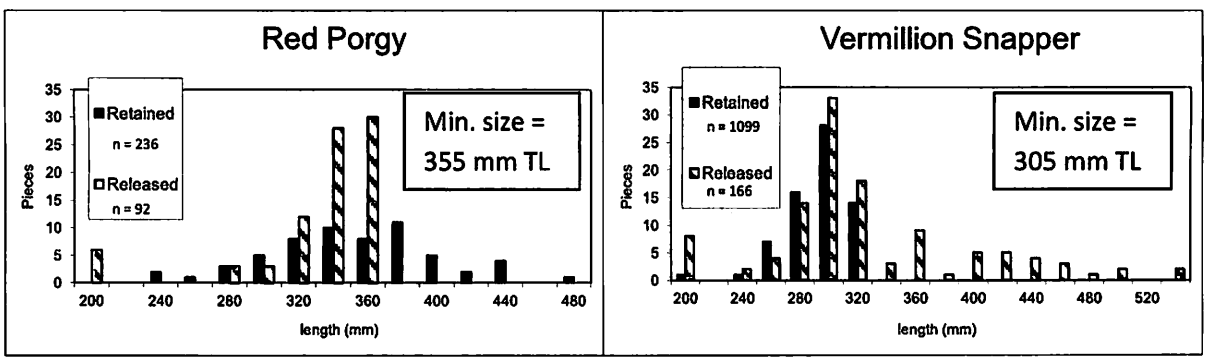
Species	Common name	Percent Retained[a]		Percent Discarded[a]	
		Region[b]	This study	Region[b]	This study
Rhomboplites aurorubens	Vermilion snapper	17%	24%	40%	36%
Caulolatilus microps	Blueline tilefish	9%	1%		
Centropristis striata	Black sea bass	8%	5%	16%	13%
Balistes capriscus	Gray triggerfish	7%	18%	<1%	1%
Mycteroperca microlepis	Gag grouper	7%	5%	1%	<1%
Epinephelus morio	Red grouper	6%	9%	1%	<1%
Scomberomorus	King mackerel	5%			
Seriola dumerili	Greater amberjack	5%	12%	1%	2%
Mycteroperca phenax	Scamp	4%	8%	2%	3%
Pomatomus saltatrix	Bluefish	3%			
Seriola rivoliana	Almaco jack	3%	4%		
Coryphaena hippurus	Dolhphinfish	3%	1%		
Pagrus pagrus	Red porgy	2%	5%	21%	20%
Micropogonias undulatus	Atlantic croaker	2%			
Mustelus canis	Smooth dogfish	1%			
Carcharhinus limbatus	Blacktip shark	1%			
Mycteroperca bonaci	Black grouper	1%	1%		
Epinephelus niveatus	Snowy grouper	1%	3%	1%	<1%
Haemulon plumieri	White grunt	1%	4%	1%	<1%
Euthynnus alletteratus	Little tunny	1%			<1%
Cumulative total		87%	88%	82%	75%

[a]Percent retained is reported in pounds; percent discarded is reported in numbers of fish.
[b]Region values were obtained from the NMFS Southeast logbook program for 2010.

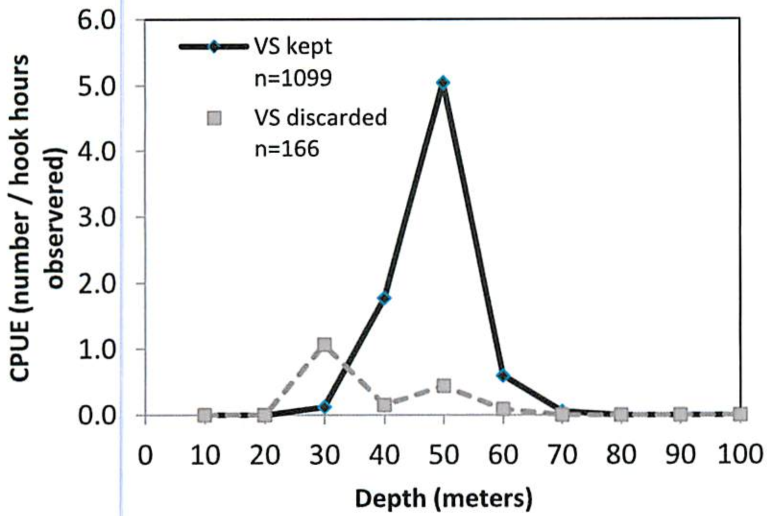
In addition, the observer assigned qualitative fate codes (1 = swam down vigorously; 2 = swam slowly at the surface momentarily before descending quickly; 3 = floating at the surface and not able to resubmerge and 4 = discarded dead) to 381 individuals or 82% of the observed discarded catch. In this table, only species with ≥ 5 observations are shown. Ninety-one percent of discards were released in excellent condition (fate code =1).

		Fate			
Common Name	No. observed	1	2	3	4
Snapper, Vermilion	151	141	3	4	3
Porgy, Red	82	79		1	2
Sea Bass, Black	38	35		1	2
Grunt, Tomtate	20	15		1	4
Grouper, Scamp	13	13			
Shark, Atlantic Sharpnose	10	10			
Snapper, Red	10	7		1	2
Sea Bass, Bank	7	7			
Amberjack, Greater	5	5			
Shark, Silky	5	5			
Total	341	312	3	8	13

Vermilion snapper was by far the most abundant species encountered and represented 46% and 36% of all retained and discarded catch items for this study, respectively. Red porgy (n=326) was the third most abundant species overall and the second most abundantly discarded species overall. The observer was able to record lengths for several discarded species, but vermilion snapper and red porgy comprised most of these observations.



The observer's catch record allowed for calculation of catch per unit effort by depth for vermilion snapper. This could not be calculated for other discarded species because of lack of observations. During five observed trips in the waters offshore of NC, SC and GA from June to September 2010, the vast majority of kept vermilion snapper occurred between 40 and 60 meters depth. Most discards occurred between the 20 and 40 meters.



4C. Electronic monitoring workshop

Workshop announcement and agenda

EM workshop summary

Exit survey results

Workshop announcement and agenda

Workshop Title: At-Sea Monitoring and Observing Approaches for the Snapper Grouper Commercial Fishery

Workshop Goal: Provide Snapper Grouper Advisory Panel members and other stakeholders with detailed information and research project results on both electronic monitoring and traditional fisheries observing approaches for the commercial Snapper Grouper hook and line fishery.

Workshop Objectives: 1) Participants understand the advantages and disadvantages of the different at-sea monitoring and observing approaches (logbooks, VMS, observers, and EM) that have been tested with Snapper Grouper or similar commercial fisheries. 2) Based on future Snapper Grouper management measures, participants will have a better comprehension of what type and level of monitoring is required to maintain or rebuild the fishery. 3) Ideas for new, cooperative research projects involving fisheries observing are discussed.

Time and Place: April 14, 2011. 1pm to 5pm. Town and Country Inn, Charleston, SC. Workshop will take place after the conclusion of the Snapper Grouper AP meeting.

Final Agenda

Time	Topic	Presenter(s)
1:00pm	Welcome, Introductions and Overview	Scott Baker, Amber Von Harten and Eileen Dougherty
1:15pm	Bycatch data needs for the Snapper Grouper fishery and what is on the horizon for SG.	Scott Baker, Amber Von Harten and Eileen Dougherty
1:30pm	South Atlantic Bandit Pilot Project (09CRP013) • Study Design • How EM works • EM v self-reported catch and discards • EM v NMFS logbook location and effort • EM v observers • Costs and Coverage Options • Pros and Cons of EM use in the bandit fishery	Scott Baker, Amber Von Harten
2:00pm	VMS applications in enforcement and management	Pat O'Shaughnessy (NMFS)
2:30pm	Gulf of Mexico EM Longline Pilot Project	Bob Trumble (MRAG Americas)
3:00pm	Q&A period on Electronic monitoring	All
3:15pm	Break	
3:30pm	GSAFF Bandit Observer study results (06CRP005,10CRP005) • Study Design • Results • Costs and Coverage Options	Frank Helies (GSAFF)

	• Pros and Cons of Observer use in the bandit fishery	
4:00pm	Q&A period on Observing study	All
4:15pm	Discussion and possible outcomes to address: • Can one method be selected as "best"? • Acceptance rates of methods by greater industry? • Is additional cooperative research needed to evaluate these approaches and/or collect more data?	Scott Baker, Amber Von Harten
5:30pm	Wrap-up and adjourn	All

Electronic monitoring workshop summary

Introduction

On April 14, 2011 a workshop titled, "At-Sea monitoring and observing approaches for the snapper grouper commercial fishery" was held in conjunction with the South Atlantic Fishery Management Council's Snapper Grouper Advisory Panel. The purpose of this workshop was: 1) to provide Snapper Grouper AP members and other stakeholders with detailed information on a recently concluded South Atlantic Bandit Pilot Project (March 2010 – December 2010) compared electronic monitoring (EM) to at-sea observers in order characterize snapper grouper bycatch and other monitoring technology; and 2) receive input and recommendations from the Snapper Grouper Advisory Panel and other stakeholders.

South Atlantic electronic monitoring bandit pilot project presentation summary:

The South Atlantic Snapper-Grouper Species Management Complex is comprised of 73 species that are managed by the South Atlantic Fishery Management Council (SAFMC) in Charleston, South Carolina. The management of the Snapper-Grouper fishery is complicated because of the large area, the variety of fishing gears and vessel sizes used, and the life history of the species in the fishery. The species complex includes inshore and offshore species, which further complicates the management. In the spring of 2010, Archipelago Marine Research Ltd. (Archipelago) began working with Sea Grant and several permit holders in the Snapper-Grouper Bandit Reel fishing industry to test the effectiveness of Electronic Monitoring (EM) in the fishery. EM is an onboard system that collects fisheries data using a series of sensors (drum, hydraulic pressure, GPS) installed throughout a fishing vessel along with a user interface in the wheelhouse. Data collection is followed by post-fishing trip data interpretation and analysis. EM can provide a wide range of information depending on the application within the fishery. The overall objective of this research is to determine if EM technology can be used to fill data gaps within the South Atlantic Snapper-Grouper fishery. To test the applicability of the EM system within the fishery, EM systems were deployed on 8 vessels from March 2010 to December 2010. EM data were then compared to data collected by fishers and at-sea observers. A total of 93 trips were monitored by EM, 34 by self-reported fishing logbooks, and 5 by observers. A total of 524 sea-days were monitored with EM systems, and complete catch documentation using EM was completed for 139 sea-days. Observer data were available for 26 sea-days or a total of 315 events. Comparisons between EM and observer data showed that EM was a reliable source of catch data and was not significantly different from observer data. EM can provide accurate piece count data that could be used for management of the fishery. Several recommendations are made to increase the success of EM including changes to catch handling methods, clarifying how fishing events are defined, and implementing a fisher logbook audit program.

What is the catch per unit effort?
Why was image quality at 63%?
Is there a link between data collection success rate and image quality?
Could species identification be done by local video viewers?
Is this only applicable for commercial industry, could it be applied to the recreational community?
Can you improve species identification?
What keeps you from going to a higher HD?
What kind of turn around could we have on data with "in house" analysts?
Censor frequency; is there any cost savings with decreasing censor frequency?

Kenneth Fex – "I learned a lot more about what's going on...I was really impressed with that knowledge that you can only construe the science so far."

Vessel Monitoring System (VMS) presentation summary:

VMS is being used effectively in the Southeast and Caribbean. There are approximately 1100-1300 vessels actively monitored at all time in the South Atlantic, Gulf of Mexico and the Caribbean. There are five VMS vendors and four VMS technicians (not including Pat O'Shaughnessy). While some fishermen have old units, new VMS units (Enhanced Mobile Transmitting Units (E-MTU)) are now required. The costs range from $3100 to $3800 with an approximately $30-$45 monthly fee. There is a reimbursement program for VMS of up to $3100. There is currently about $6 million for VMS in the account. The funds are there on a first come first serve basis. There are a number of requirements that can be found in the regulations. If VMS is required, only then can you get reimbursed.

There are many VMS benefits and advanced options, many of which are including below:

Can send and receive email
Can speak with captains
NOAA can send critical fishery information
Can send e-forms
Can get real-time data from units while fishermen are at-sea and can send real-time information to fishermen at-sea
Capability for owners to track their fishing vessels throughout their fishing trip

Can be used as a search and rescue tool (in addition to EBURB)
Can activate a "distress" button
Can use VMS data to improve closures
Can use VMS as a deterrent, detection, and Intel tool
Can be used to show whether fishermen are fishing in state or federal waters

Why has the number of vessels with VMS decreased?
Who has access to VMS information?
Would closed areas increase fishermen's VMS costs in the SA?
Is there enough staff to cover an additional 500 boats?
How does the system work in an emergency situation?
Where do you set a declaration at?
What do you do when you don't have access to power at the dock?
Are any of the new units getting smaller or use less power?
What happens if you don't go to a fish house with your fish?
Can you use VMS in prosecution?
Were the Gulf closed areas violations related to the oil spill?

Don DeMaria: "I am out of charters as a result of VMS". "I think a lot of this stuff works well in BC but not in our areas with small boats and in remote ports".

Gulf of Mexico electronic monitoring longline pilot project presentation summary:

Archipelago Marine Research Ltd. was subcontracted by MRAG to carry out a study to test the feasibility of developing a monitoring system that would use Electronic Monitoring (EM) to satisfy the data needs of the reef longline fishery in the Gulf of Mexico. EM systems consisted of three closed circuit television cameras, a GPS receiver, a hydraulic pressure transducer, a winch rotation sensor, and a system control box. EM systems were placed on six vessels for a total of over 148 days at sea. EM and observer fishing event and catch data were available for comparison for a total of 218 fishing events. EM system at sea data collection on all participating vessels was virtually complete except for data loss occurring when vessel operators manually turned off the EM systems, resulting in 65% overall sensor data completeness. EM sensor data provided accurate vessel position information and enabled identification of setting and hauling events. In terms of catch, both EM and observer methods were numerically within 2.7% of each other and detection of protected species categories was identical. Catch identification comparisons between observer and EM methods were generally good with 80% of catch pairing comparisons having a positive match on a hook-by-hook analysis. Some species showed identification discrepancies between observer and EM, shark species being predominant. These discrepancies were often offset when results from similar species were grouped, usually within the same genus or family. EM was not able to reliably determine catch discarding due to inconsistent catch handling and limitations from camera views. Overall, results of this study suggest that EM shows promise for collecting fishing activity spatial-temporal data and assessing catch composition and further work is needed to determine if the technology could provide reliable catch disposition data.

What was the number #1 cause of the fish that had to be released?
Are the cameras catching the pectoral/dorsal/lower tail fins for identification?

GSAFF Bandit Observer Study:

In 2006, the Foundation was funded to conduct a pilot study to characterize the catch and fate of discards within the Snapper Grouper vertical hook-and-line fishery of the South Atlantic (NA06NMF4540059). The project was highly successful with cooperation of the snapper grouper fleet throughout the South Atlantic with a total of 200 sea days logged with 1698 sets on board 24 different vessels from North Carolina, South Carolina, Georgia and Florida's east coast. Analysis of catch and discard fate began in the Fall of 2007 and a presentation was made to the South Atlantic Fishery Management Council at their June 2008 meeting. In addition, data from the project were reviewed during the latest SEDAR 17 (SEDAR 2008). Catch characterization trips were completed in all four South Atlantic states with eight (8) trips in NC, ten (10) in SC, six (6) in GA and four (4) in FL. Trip lengths ranged from 2 to 13 days with an average of 7 days per trip overall. The number of sets per trip ranged from 14 to 142 with an overall average of 61 sets per trip. Trip length varied with vessels from North Carolina making shorter day trips averaging 4 days in length, while vessels in the three other South Atlantic states averaging longer trips closer to the overall average of 7 days. The dataset created during the performance of this award was not intended to be considered a standalone, but meant to augment the existing datasets and assist scientists in the development of formal stock assessments for the snapper-grouper complex. As a result, the majority of data analyses for this project will be descriptive and include, but are not limited to: number of trips sampled, number of vessels sampled, average number of sets per station, species specific CPUE, species specific length-frequency distribution, mean depth per trip and station, the ratio of retained vs. discarded catch and distribution of effort. Data collected for this project will likely be included in vermilion snapper update as well as other assessments.

What is the discard percentage?
Have you ever considered this into the for-hire sector?

Kenny Fex, "this shows that a lot of our fish are of legal size."

Discussion/Recommendations:

Several of the workshop participants could see the use of VMS in the for-hire sector especially when compared to at-sea observers.
Several of the workshop participants wanted mandatory electronic reporting/online for the for-hire sector and felt that: 1) random reporting needs to be replaced by detailed information; and 2) everyone who has a stake in the fishery needs to be reporting. Several participants pointed out that with electronic reporting, the data could go directly into the system.

There is a pilot program through MRIP that is going on in the N. Gulf – electronic reporting for for-hire industry after the fact on a weekly interval and dockside validation.
In Morehead City, NC – headboat (Capt. Stacy) is reporting via electronic.
Suggestion: cell phone application for electronic reporting.
Scott Baker mentioned that electronic logbooks will not validate the data.
Robert Johnson felt that there is always going to be a problem with validation, but current data is not well validated.
There were a number of participants that felt that, "we need to get a handle on recreational sector, because there are a ton of for-hire boats."

Kenny Fex was very impressed with the pilot program. He felt it really helps validate the data. However, he was concerned that video monitoring might be lead to catch shares. Scott Baker pointed out that the SA snapper grouper fishery could not afford 100% video monitoring at this time, but that it could be set up in a statistical survey design. Kenny Fex felt that some people in the Gulf want as much monitoring as possible to limit the fishery as much as possible. He feels that it is a trap and doesn't want to turn the fishery over to big businesses. Kenny mentioned he was criticized for having the video monitoring on his boat.

Mac Currin felt that video monitoring is "not the end all be all" – but the study is a good argument for repeating a study over a number of years. Some merit to considering repeating it...

Don DeMaria mentioned he would like a mechanism where fishermen who have been in the fishery for 20-30 years without a violation don't have to have a VMS.
Several other participants were concerned about how VMS would work on small boats.
Other participants felt that with closures, there needs to be an accurate count of fish.
Increased monitoring can be good if there is a good reason for it.

Workshop presenters:

Scott Baker
NC Sea Grant

Eileen Dougherty
Environmental Defense Fund

Frank Helies
Gulf and South Atlantic Fisheries Foundation

Patrick O'Shaughnessy
SE OLE VMS Program Manager

Bob Trumble
MRAG Americas

Amber Von Harten
SC Sea Grant

Exit Survey Results for SG Monitoring Workshop (April 14, 2011)

Number of in-person participants (including SAFMC staff) = 25
Number of remote connections via www.safmc.net = 9
Total number of attendees = 34
Number of exit surveys received = 11

This survey will help evaluate the usefulness of topics and information offered at this workshop.

1. How satisfied were you with the information provided on At-Sea Monitoring approaches for the Snapper Grouper Commercial Bandit Fishery?

5 (50%) Very Satisfied 5 (50%) Satisfied 0 Neutral 0 Dissatisfied 0 Very Dissatisfied

2. Please rate the usefulness of each of the seven presentation or discussion periods, from "Very Useful" to "Of No Use."

	Very Useful	Useful	Somewhat Useful	Minimally Useful	Of No Use
SA EM Bandit Pilot Results	7	2	1		
VMS Applications in the SE US	5	3	2		
GOM EM Longline Pilot Results	3	5	1		
Q and A on EM	2	5	1		
Bandit Fishery Monitoring with At-Sea Observers	5	3	2		
Q and A on At-Sea Observers	4	3	2		
Discussing / Brainstorming on what additional monitoring research should address	4	2	1		

3. Please indicate your primary occupation (please choose only one).

4 Fishermen 2 Fishing Industry (other) 5 Other: headboat operator; fisheries consultant,; media; fisheries managers (x2)

4. What was the most beneficial part of this workshop?

-VMS information (headboat operator)

-To help people understand more what is going on in the research side (fisherman)
-I missed part of the workshop, but the parts I saw were good to know (fisheries consultant)
-The fact that recreational fishermen want to count their fish (dealer / wholesaler)
-Total package of options and approaches was very interesting (fishing industry)
-Understanding how "VMS" works (fishing industry)
-Keeping updated on results of EM vs. observer efforts and relative costs (fisheries manager)
-Very informative (fisheries manager)

5. Anything else that you would like to add?

-I strongly feel much of this is too intrusive – should be reserved for those with a history of resource violations (fisherman)
-This information can help scientists understand what is going on offshore on the vessels. Can help with CPUE and discard rates. (fisherman)
-Eric Sander (cell-386-852-8588) teaches shark ID for shark dealers and NMFS law enforcement agents (could be useful for future training of video reviewers) (fisheries consultant)
-This would greatly help the % of recreational (caught) fish going against (The quota) and how many fish recreational anglers are actually catching (dealer / wholesaler)

Thank You for Participating! Your feedback is appreciated!

4D. Cooperative research and EM attitude survey

Welcome letter

EM research results "flyer" included with survey

Survey instrument

Results summary

M. Scott Baker, Jr.
NC Sea Grant Program
UNC-W Center for Marine Science
5600 Marvin Moss Lane
Wilmington, NC 28409

April 9, 2012

Dear South Atlantic Snapper Grouper permit holder:

In 2010, NC Sea Grant, in cooperation with SC Sea Grant and the snapper grouper industry, conducted a research study to test electronic video monitoring as a possible tool to characterize the South Atlantic snapper grouper vertical line bandit fishery. The study was supported through a NOAA Cooperative Research Program.

The purpose of this packet is to provide the snapper grouper industry information about the study and to get feedback about the study design and cooperative research needs in general.

Enclosed in this packet are the following items:

- Brief overview about the study, **"Evaluation of electronic monitoring (EM) as a tool to characterize the snapper grouper bandit fishery."** We welcome your comments and questions about this research study.
- **Cooperative Research Feedback Survey**:
  The purpose of the survey is to help us understand your attitudes about cooperative research, the research needs of your fishery and to help you stay better informed about cooperative research opportunities. Participation in this survey is voluntary and you may stop at any time or refuse to answer any question and will not be treated any differently. Answers to all questions will remain anonymous. At the end of the survey, you will have the option of providing your contact information so that we might be able to contact you about ongoing cooperative research projects and future opportunities. If you would like to complete the survey online instead of the paper version, please visit this website (https://www.surveymonkey.com/s/P3HRG38). The survey should take about 10 minutes of your time.
- **Postage-paid envelope:** Please use this envelope to return the survey if you use the paper option.

Please complete the survey by mail or online by May 31, 2012.

There are several on-line resources for information about fisheries management and cooperative research. We encourage you to check out the following resources:

- "A Guide to Fisheries Stock Assessment: From Data to Recommendations" (New Hampshire Sea Grant and Northeast Consortium): http://www.seagrant.unh.edu/stockassessmentguide.pdf
- "Working Together: Developing a Cooperative Research Project and Proposal" : http://www.nefsc.noaa.gov/coopresearch/guidelines/Cooperative%20Research%20Guide.pdf

Feel free to contact me with any questions regarding the research project or the survey. We appreciate your time in completing the survey!
Best,

M Scott Baker Jr *Amber E. Von Harten*

M. Scott Baker, Jr.
Fisheries Specialist
North Carolina Sea Grant Program
bakers@uncw.edu
910.962.2492

Sea Grant
North Carolina

Amber Von Harten
Fisheries Specialist
South Carolina Sea Grant Program
ambervh@clemson.edu
843.255.6060 ext 112

Sea Grant
S.C. Sea Grant Consortium

Cooperative Research Project Results

Evaluation of electronic monitoring (EM) as a tool to characterize the snapper grouper bandit fishery

M. Scott Baker, Jr., North Carolina Sea Grant Extension Program, UNCW Center for Marine Science, 5600 Marvin Moss Lane, Wilmington, North Carolina, 28409, USA, bakers@uncw.edu
Amber Von Harten, South Carolina Sea Grant Extension Program, P.O Box 189, Beaufort, South Carolina, 29901, USA, ambervh@clemson.edu
Adam Batty and Howard McElderry, Archipelago Marine Research, Ltd., 525 Head Street, Victoria, British Columbia, V9A 5S1, Canada.

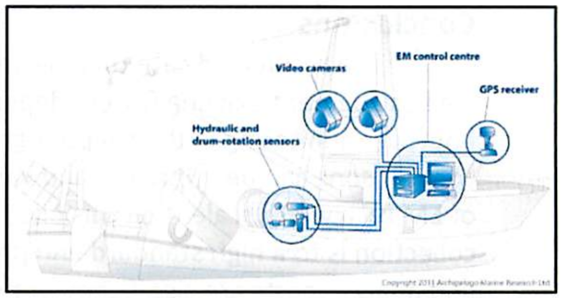
Introduction

Perhaps the biggest challenge affecting management of the South Atlantic snapper grouper fishery is the difficulty in determining the number and fate of regulatory discards (NMFS 2011). Despite this challenge, there is the desire by industry and managers to provide more accountability to self-reported logbook data that is the primary data source for the fishery. Observers have occasionally been used to characterize the fishery (GSAFFI 2010), but electronic video monitoring (EM) may provide a more comprehensive and cost effective approach to monitor fishing activity on a continuing basis.

The overall goal of this research effort is to determine if EM technology can be used as a tool to characterize the South Atlantic snapper grouper vertical line bandit fishery.

Methods

EM systems consisting of three to four cameras, a rotational drum sensor, a GPS and a control box were installed on 6 bandit vessels from NC to GA in March 2010. Cameras were installed as necessary to cover the entire area where fish were brought on board, handled, then either retained or released. EM systems were active on participating vessels from May through December 2010.



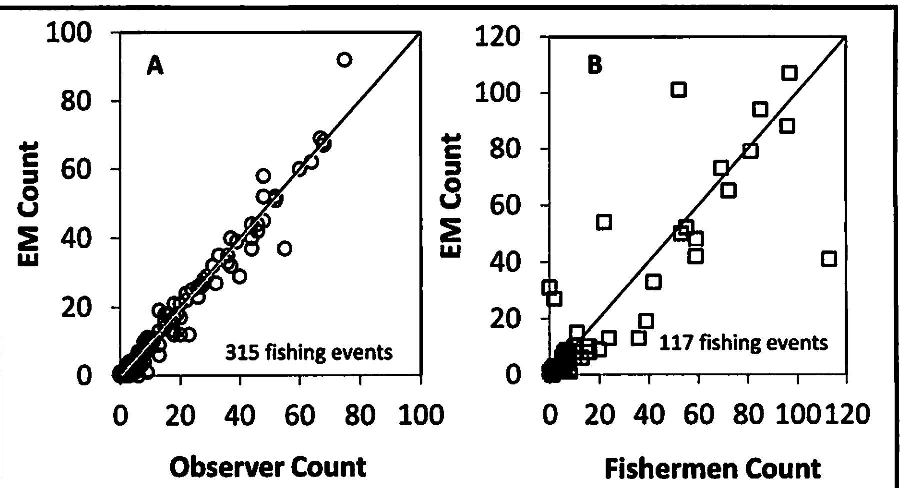
While studies have shown that it is possible to rely solely on EM to monitor a fishery (Stanley et al. 2011), this is a cost prohibitive approach given the characteristics of the Snapper Grouper fishery. Because EM has never been used to characterize bandit gear, data collected by at-sea observer on 5 trips (32 sea days) served as the standard to which to compare EM data. EM data was then compared to catch and effort data recorded by fishermen in a logbook developed specifically for this project in which fish were accounted for by blocks of time (to facilitate EM review at a later date).

Results and Discussion

A total of 93 trips were monitored by EM, 34 by fishing logbooks, and 5 by observers. A total of 524 sea-days were monitored with EM systems, and complete catch documentation using EM was completed for 139 sea-days. The overall EM data collection success rate for the 8 month study period was 64% (range: 46%-91%). Sixty-three percent of image quality was of medium quality and 36% was of low quality.

Fishing effort documented with EM was on average lower than both days and hours fished reported in NMFS logbooks by fishermen. A comparison between EM and observer counts of fish resulted in a high level agreement (Figure A). The comparison of EM to fishermen counts for assigned species common to all vessels (Figure B) also showed good agreement overall, but not as high as with the observer data. Species identification with EM was less accurate than catch recorded in logbooks for most species.

If EM fish counts were equal to those recorded by observers (A) or fishermen (B), there would be no deviation of data points from the 1:1 line. Each symbol represents one observed fishing location.



Conclusions

The results indicate that EM monitoring could be used as a tool to audit logbook data as well as augment existing fishery dependent data collection programs. There is potential to improve monitoring in the snapper grouper fishery if agreement in the catch accounting comparisons can be improved and variation minimized at the vessel level. The implementation of EM on a wider scale than this pilot study would require adaptations to ensure that the data collection is to a high standard and provides adequate opportunity for validation. EM hardware and analysis costs are significant, yet scale of EM implementation could be based on the desired monitoring objective (small study fleet versus fleetwide implementation). The main challenges related to data collection that would need to be overcome are clearly defining what activities constitute a "fishing event", making changes to the catch handling methods to facilitate EM imagery review, and compliance with equipment use requirements on vessels.

References

GSAFFI (Gulf and South Atlantic Fisheries Foundation, Inc.). 2010. A continuation of catch characterization and discards within the Snapper-Grouper vertical hook-and-line fishery of the South Atlantic United States. NOAA/NMFS Award NA08NMF4540399. Tampa, Florida.

NMFS (National Marine Fisheries Service). 2011. U.S. National Bycatch Report. W.A. Karp, L.L. Desfosse, S.G. Brooke, Editors. U.S. Dep. Comm., NOAA Tech. Mem. NMFS-F/SPO-117C, 508 p.

Stanley, R. D., H. McElderry, T. Mawani, and J. Koolman. 2011. The advantages of an audit over a census approach to the review of video imagery in fishery monitoring. ICES Journal of Marine Science, doi:10.1093/icesjms/fsr058.

Snapper Grouper Fishery Cooperative Research Survey

The purpose of this survey is to collect feedback from Snapper Grouper commercial fishery participants specifically on the topic of electronic monitoring (our research study) and cooperative research in general. In 2010, NC and SC Sea Grant conducted a cooperative research study with six commercial snapper grouper boats in NC, SC and GA to test the use of electronic video monitoring (EM). The main purpose of the study was to determine if this type of monitoring device would logistically work in this fishery and more specifically be able to accurately record catch and discards. The research study gained the interest of industry members and fishermen expressed an interest in pursuing additional types of cooperative research projects. Therefore, this survey would like to learn more about the cooperative research interests of the snapper grouper industry.

Participation in this survey is voluntary and you may stop at any time or refuse to answer any question and will not be treated any differently by the researcher(s). Answers to all questions will remain anonymous. At the end of the survey, you will have the option of providing your contact information so that we might be able to contact you about ongoing cooperative research projects and future opportunities. If you provide contact information, it will not be associated with your survey responses. If you would like to complete the survey online instead of the paper form here, please visit this website (https://www.surveymonkey.com/s/P3HRG38). **Please complete the survey by May 31, 2012.**

Section I. Describe your business

The following questions relate to your specific business. This information will help categorize your comments to this survey without identifying you.

1. Please indicate the South Atlantic Snapper Grouper permit type(s) that you currently possess.

- ◯ SG unlimited
- ◯ SG 225 pound
- ◯ SG dealer

2. If you selected "SG unlimited" permit in the previous question, please indicate the number of these permits associated with your business.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 or more

3. What state is your business licensed and located in?

- ◯ NC
- ◯ SC
- ◯ GA
- ◯ FL
- ◯ Other

4. In addition to Snapper Grouper, what other fisheries do you participate in? Check all that apply.

- ◯ Atlantic Dolphin / Wahoo
- ◯ Spanish Mackerel
- ◯ Atl Charter/Headboat for Dolphin Wahoo
- ◯ Spiny Lobster Tailing
- ◯ Shark Directed
- ◯ Other
- ◯ King Mackerel
- ◯ South Atlantic Charter for Snapper Grouper
- ◯ Gulf of Mexico reef fish
- ◯ Commercial Spiny Lobster
- ◯ Shark Incidental

5. How many years have you been involved in the Snapper Grouper commercial fishery?

- ◯ 0
- ◯ 1-5
- ◯ 6-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21 or more years

Section II. Electronic monitoring pilot study with snapper grouper fishermen

Cooperative research is a process by which fishermen and researchers work together to develop and conduct projects that require the specialized knowledge of each partner. Results can promote better science and management for fisheries, as well as increase communication and collaboration among fishermen in the region. This series of questions relates specifically to the results of our cooperative research project involving an electronic monitoring (EM) service provider and 6 Snapper Grouper bandit fishing vessels from NC, SC and GA that tested the technology over an 8 month period in 2010. See handout enclosed with this survey for more information.

6. Would you like to see additional cooperative research done testing and evaluating at-sea EM systems?

◯ Yes ◯ No

Comments:______________________________

7. While EM can be used to collect all catch data, the study found that it can also be an effective tool for auditing self-reporting logbooks. Do you support the <u>concept</u> of using a third-party data review method like EM to validate logbook records?

◯ Yes ◯ No

Comments:______________________________

8. The video processing company we used suggested adopting standardized guidelines for handling fish while fishing (keeping and discarding fish) to make video review quicker and more cost effective. Examples of guidelines could be briefly holding all fish up to the camera for 3 seconds or placing discarded fish on a centrally located discard chute (sloped platform hanging over side of boat) on the back deck to release all discards within camera view. If EM is continued to be tested and considered for a monitoring tool, do you support the adoption of standardized handling guidelines to improve the video review process?

◯ Yes ◯ No

Comments:______________________________

9. While actively bottom fishing (i.e., making more than a few test drops), do you <u>typically</u> turn off the engine or do you keep the engine running?

◯ Usually turn engine off ◯ Usually leave engine on ◯ Combination of on/off ◯ Other

Comments:______________________________

10. On your vessel, what type of batteries do you use for your "house" bank? This bank of batteries would power auxiliary equipment like electric bandits, plotters, radios, lights, etc.

◯ Lead-acid batteries ◯ Gel batteries ◯ Other

Comments:______________________________

Section III. Research topics

The following questions want to understand your attitude about cooperative research in general.

11 & 12. The National Marine Fisheries Service Cooperative Research Program priorities for the snapper grouper fishery are listed below. Please pick 2 topics under Finfish and 2 topics under Economics which you feel are the most important data needs from this list. You will have the opportunity to add topics later in the survey.

Finfish	Place an X in 2 boxes below to indicate priorities
Efforts to characterize the total catch of the commercial fishery	
Efforts to characterize discards and determine discard mortality rates for important species	
Efforts to evaluate electronic log books (ELBs) for fishermen to record data at sea	
Use of observers or electronic monitoring to obtain life history information on important species	
Determination of fish age through collection of hard parts (otoliths, spines, etc.)	
Evaluation of genetic methods for use in tag and recapture studies	
Develop consistent sampling methodologies to document relative abundance over time	
Marine ecosystem modeling of food webs, trophic structure and recruitment in the GOM	
Document and utilize the knowledge of fishermen to identify spawning aggregations	

Economics	Place an X in 2 boxes below to indicate priorities
Document changes in fishing costs when other factors change (regulations, quotas, etc.)	
Development of economic incentives to reduce bycatch	
Fishing capacity investigations: Fleet size vs. productivity of regional stocks	
Social and Economic Impacts of MPAs and area closures	

13. Do you have research recommendations that you would like to add to the above list?

◯ Yes ◯ No

If yes, please list:____

____

____

14. The following species have been identified as in need of additional data to help in stock assessments. Please indicate only those species you are most knowledgeable about.

Greater amberjack	
Red snapper	
Grunts (all)	
Scamp	
Wreckfish	
Snowy grouper	
Hogfish	
Red porgy	
Dolphin	
Wahoo	
Vermilion snapper	
Gag grouper	
Goliath grouper	

Section IV. Personal experience and attitude

The following questions want to understand your experiences with and attitude towards the topic of cooperative research.

15. Have you ever participated in a cooperative research project dealing with a fisheries related topic?

○ Yes ○ No

If yes, please provide a brief description of the project(s) in one or two sentences.:

____

____

____

____

16. Are you interested in participating in future cooperative research projects?

○ Yes ○ No

17. How important is it to you that the data collected during cooperative research projects is used in management decisions (stock assessments, etc.)?

○ Very Important ○ Important ○ Neutral ○ Not Important ○ Not Important At All

18. In order for data generated from cooperative research programs to be used in management, scientists require fishermen to follow formal rigorous scientific data collection protocols. This ensures that everyone involved in the research is collecting data the same way. If you were participating in a cooperative research study, would you be willing to follow this type of protocol?

○ Yes ○ No

19. Stock assessment scientists rely heavily on fisheries-independent surveys when possible. An emerging trend is to use recreational and commercial fishermen to carry out these standardized surveys from private vessels. In most instances, fishermen are compensated and scientists or observers would be onboard and dictate when, where and how to fish (specific gear, hook types, etc.). Do you support this concept?

◯ Yes ◯ No

Section V. Research costs

The following questions want to understand your attitude towards the topic of cooperative research costs.

20. On average, from 2007 to 2011, $1.6 million dollars annually has been used to fund NOAA Cooperative Research Program (CRP) projects from NC to Texas including the Caribbean. On average, 8 projects per year are funded through this program. Please respond to the following statement: "More funding should be devoted to cooperative research in the Southeast US."

◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

21. Cooperative research, particularly at-sea data collection, is expensive. Do you support the concept of the fishing industry cost-sharing in the research process? An example of cost-sharing would be some donation by the fisherman of vessel time (sea-days) or goods (fuel, bait, etc.) to ensure that a research project is successful.

◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

22. In some fisheries, the fishing industry will pay for their own cooperative research and/or marketing activities. This is often through an industry wide membership fee or self-imposed tax. Assuming there was a mechanism to collect and utilize these funds for research, how do you feel about this concept?

◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

23. The Mid-Atlantic region allocates a small portion of selected fishery's annual quota (0 to 3%) as a vehicle to fund research projects. Participants conducting the research are allowed to sell the landings to "fund" the project. This system, termed Research Set Asides (RSA) is not currently used in the Southeast. Is this concept something that the Southeast should explore?

◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

Section VI . Communication

The following questions want to understand your attitude towards the topic of cooperative research outreach and information transfer.

24. Did you know that SAFMC staff with assistance from Sea Grant and others developed a guide for cooperative research in the South Atlantic region and that this free publication can be obtained by contacting the SAFMC office?

◯ Yes ◯ No

25. Did you know that the NMFS Northeast Fisheries Science Center developed a comprehensive guide for fishermen on the ins-and-outs of cooperative research, including how to get involved with the process?

◯ Yes ◯ No

26. Which communication tools do you use to receive information about fisheries management issues?

- ◯ Cell phone
- ◯ Email
- ◯ Fax
- ◯ Websites
- ◯ Mail
- ◯ Newspaper
- ◯ Talk with other fishermen
- ◯ Other ____________________

27. What is the best way to notify fishermen about cooperative research opportunities and research results? Direct mailings to individuals are not typically an option because of time and expense involved.

Answer: ____________________

28. Would you consider providing an email address to a university based organization such as Sea Grant so that we could more easily disseminate research findings?

◯ Yes ◯ No

29. Do you think that results of completed projects should be accessible to the public? For example, posted on the internet after completion, similar to what the Gulf and South Atlantic Foundation does with its project reports)?

◯ Yes ◯ No

Section VII. Connect with researchers and Sea Grant staff

30. Every year, researchers team up with fishermen in the South Atlantic to collaborate on cooperative research projects involving Snapper Grouper species. The purpose of these projects is generally to gather basic information on the fishery or test new concepts, like for example, electronic monitoring. Researchers are always looking for more fishermen to be a part of the process. Likewise, Sea Grant is looking for easier ways to share this type of information with the fishing industry. If you would like to provide your contact information, please do so here and we can begin to assemble a list of Snapper Grouper permit holders, fishermen and dealers interested in cooperative research. <u>We will not associate your contact information with your survey responses.</u> This list will be provided to individuals and organizations that are actively involved in cooperative research in the South Atlantic region.

Name:	
Street Address:	
City:	
State:	
Zipcode:	
Phone:	
Email:	
Vessel Name:	
Home port:	
USCG Doc #:	

31. Would you like to be emailed the results of this survey when it is complete?

◯ Yes ◯ No

If Yes, please provide email address:____________________

We thank you in advance for taking the time to complete this survey.

Snapper-grouper permit holders' attitude and perceptions towards cooperative research in the U.S. South Atlantic: Survey results.

Introduction

The purpose of the survey is to help us understand your attitudes about cooperative research, the research needs of your fishery and to help you stay better informed about cooperative research opportunities.

Methods

A survey was designed to be administered to all participants of the commercial snapper-grouper fishery in the U.S. South Atlantic region that operates off the coasts of Cape Hatteras, NC south to Key West, FL. The addresses of snapper-grouper unlimited permit holders (n=573), snapper-grouper 225 pound permit holders (n=123) and snapper-grouper dealer permit holders (n=199) were obtained from the NMFS Southeast Regional Office Permits webpage (http://sero.nmfs.noaa.gov/foia/readingrm.htm, accessed March 29, 2012). Of the 895 addresses obtained, 109 duplicate addresses were removed as were 13 bad addresses, resulting in 773 possible participants for the survey. An envelope containing a welcome letter, a two page summary of a cooperative research study evaluating electronic monitoring, the survey itself, as well as a postage paid envelope, were mailed to 773 permit holders on April 10, 2012. Recipients wishing to complete the survey were given the option of completing and returning the paper survey via the enclosed self-addressed, postage-paid envelope or responding to the survey via an online portal (www.surveymonkey.com). Approximately three weeks after the initial mailing, a reminder / thank you postcard was mailed to all permit holders.

Results and Discussion

General

One hundred and eighteen permit holders participated in the survey which provided an overall response rate of 15%. The vast majority of permit holders (N=101, 86%) elected to respond to the survey using the paper survey option via the postage paid envelope. Analysis of the responses by permit type revealed that dealer permit holders and 225 pound permit holders responded at a slightly higher rate than expected, while unlimited permit holders responded at a slightly lower rate than expected. The geographical distribution of permit holders' response did not differ from expected, with the largest subset of respondents coming from Florida (N=79, 68%), followed by North Carolina (N=24, 21%). Two-thirds of respondents indicated twenty-one or more years of experience in the fishery (N=76, 66%) while only 14 (12%) indicated less than or equal to 10 years of experience in the fishery. Analyses revealed that owners of multiple snapper-grouper unlimited permits responded at a much higher rate than that would be expected by proportions in the NMFS permit database.

Cooperative research priorities

Respondents were given two separate lists of existing research priorities (Finfish and Economics) as listed in the NMFS Cooperative Research Program Request for Proposals produced annually and asked to select the two most important topics of each list that should be addressed in future cooperative research efforts. The most important research priority from the list of nine finfish topics as deemed by respondents was to "Document and utilize the knowledge of fishermen to identify spawning aggregations", with 51% of respondents including this selection. Of the remaining choices, efforts to gather basic biological information (total catch characterization, discards, life history information) were selected at a rate three times more frequently than efforts to conduct more experimental or applied research such as modeling, genetics, and electronic monitoring evaluation. Two topics in the Economics list were each selected as one of two options by approximately 60% of respondents: "Document changes in fishing costs as other factors change" (N=56) and "Social and economic impacts of Marine Protected Areas and area closures" (N=57). The two remaining topics "Development of economic incentives to reduce bycatch" and "Fishing capacity investigations: Fleet size vs. productivity of regional stocks" were selected half as often as the aforementioned topics.

When provided a listing of 13 species identified as in need of additional data to help in the stock assessment process and asked only to select those species of which permit holders were most knowledgeable, respondents selected gag grouper (68%), dolphin (56%), greater amberjack (53%), red snapper (48%) and vermilion snapper (46%) most frequently. Not surprising considering the specialized nature of the fishery, wreckfish received by far the lowest response rate with 10% of respondents including this species.

Attitudes and interest in cooperative research

The majority of respondents have not participated in any form of fisheries cooperative research project in the past (61%) and currently have no interest in participating in future cooperative research projects (56%). Regardless of past experience or future interest in cooperative research, respondents were asked to rate how important it should be that data collected during cooperative research projects be used in management decisions such as stock assessments. Sixty-two percent of respondents indicated "very important" or "important" while only 14% indicated "not important" or "not important at all." Twenty-four percent of respondents were "neutral."

When asked if they would be willing to follow scientist's direction with regards to sampling protocols (so that data could be collected systematically by several different fishermen), 62% of respondents thought that they could be able to comply with this requirement. Stock assessment scientists rely heavily on fisheries-independent surveys when possible. An emerging trend by research scientists is to use recreational and commercial fishermen to carry out standardized, fisheries-independent surveys from private vessels. In most instances, fishermen are compensated and scientists or observers would be onboard and dictate when, where and how to fish (specific gear, hook types, etc.) for the purpose of the survey. When asked if they could support such a partnership, 59% of respondents said "yes."

Cooperative Research Funding

On average, from 2007 to 2011, $1.6 million dollars annually has been used to fund NOAA Cooperative Research Program (CRP) projects in the Southeast United States from North Carolina to Texas including the Caribbean. This region includes a multitude of commercial fisheries and is the jurisdiction of three of the eight fisheries management councils. On average, eight projects per year are funded through this program. When asked to respond to the following statement: "More funding should be devoted to cooperative research in the Southeast US," 47% of respondents strongly agreed or agreed with the statement, whereas 23% disagreed or strongly disagreed. Roughly one-third of respondents were neutral (30%).

Three questions asked of respondents were devoted to the discussion of non-government related funding mechanisms for cooperative research, and in general terms, these concepts were negatively viewed by respondents. For example, given that at-sea data collection is expensive, the survey asked if there was support for the fishing industry participants to cost-share in the research process. Fifty-seven percent disagreed or strongly disagreed with the statement while only 19% were in favor to some degree. Roughly one quarter of respondents were neutral (23%).

When asked if an industry wide membership fee or self-imposed tax could be considered as a mechanism to assist with cooperative research funding, 54% percent were opposed to the concept and 11% were in favor, while a significant number of respondents remained neutral (35%). The final question on research funding mechanisms asked for opinions about the concept of research set-asides. The pre-text to the questions explained that the Mid-

Atlantic region allocates a small portion of a selected fishery's annual quota (0 to 3%) as a vehicle to fund research projects. Participants conducting the research are then allowed to sell the landings to "fund" the project. The research set aside funding mechanism has only been marginally considered in Southeast fisheries (Gregg Waugh, SAFMC, personal communication), so the question was posed: Is this concept (of RSAs) something that the Southeast should explore? Similar to the previous questions on funding, more respondents were not supportive (40%) than supportive (30%) with a large number of neutral responses (29%).

Despite the rather large percentage of respondents that disagreed or strongly disagreed with these new types of funding mechanisms, roughly one-third of respondents were neutral on the subject, indicating that stronger impressions could be generated if these topics were explained further or explored more comprehensively.

Available Resources

More than three-quarters of respondents were not aware of previously developed outreach publications developed specifically for fishermen interested in cooperative research. For example, when asked if respondents were aware that SAFMC, Sea Grant and others had developed a guide for cooperative research in the South Atlantic region, 77% percent of people responded "no". This was not surprising as the document was freely available, but not publically posted on the SAFMC website. When asked if they were aware that the NMFS Northeast Fisheries Science Center had developed a comprehensive guide for fishermen on the ins-and-outs of cooperative research, including how to get involved with the process, a similar number of respondents (80%) said "no".

Communication Tools

In today's society, there are numerous ways for members of the fishing industry to receive information about fisheries management issues. When permit holders were asked to indicate all of the methods that they currently use to receive information about fisheries management issues, more traditional delivery methods (direct mail (77%) and talking with other fishermen (57%)) were favored over newer electronic delivery approaches (email (38%), websites (35%) and cell phones (17%). Newspaper (18%) and fax (6%) received the lowest responses. The majority of respondents currently receive information through a variety of communication tools rather than one single method.

Building on the previous question, permit holders were simply asked "What is the best way to notify fishermen about cooperative research opportunities and research results?" The pre-text to this question indicated that direct mail to individuals is not typically an option because of the time and growing expense involved in direct mailings. This open-ended question prompted a variety of responses; however, some trends emerged. Forty-five percent of respondents reported email as the best information delivery method for this user group, followed by direct mail (22%), phone based communication methods (15%) and delivery of information through fish houses and fish dealers (12%).

Direct Involvement

When asked if they would consider providing an email address to a university based organization such as Sea Grant so that research findings could be delivered more readily, almost two-thirds of permit holders (64%) responded favorably. When asked if results of completed research projects should be accessible to the public, 83% of permit holders responded "yes." Permit holders were given the opportunity to provide contact information so that Sea Grant staff could begin to assemble a list of snapper-grouper permit holders interested in learning more about cooperative research and/or when funding opportunities become available. Fifty-four permit holders (47% of survey respondents) provided names and contact information (Address, phone numbers, email, etc.). Fifty-nine percent of respondents, when given the opportunity, were interested in being emailed the results of this survey once it is complete.

Electronic Monitoring Research

The survey administered to permit holders contained three questions related to the electronic monitoring research conducted by Sea Grant personnel and funded by NMFS in 2010. Overall, most respondents were opposed to electronic monitoring research. Specifically, when asked if respondents would like to see additional cooperative research done to test and evaluate at-sea electronic monitoring systems, 64% of respondents (N=70) were opposed to the suggestion. Likewise, when asked if a third-party data review method like EM might be considered as a tool to validate self-reported logbook records, 76% of respondents (N=84) stood opposed. Finally, when asked if they would support adoption of standardized fish handling guidelines to improve the video review process if EM was to be further evaluated, more than three-quarters of respondents (76%, N=80) were not supportive of the idea.

The EM systems used in our pilot study are designed to be used on vessels with either continuous AC or DC power. This was sometimes problematic for the snapper-grouper fishery as vessels are typically small and do not have access to continuous, uninterrupted power supplies or generators. When actively bottom fishing, 50% (N=54) of respondents indicated that they routinely turn off their engines and 20% (N=22) indicated that a combination of engine on and off were used while fishing. When asked what type of batteries are used to power the vessel's house bank of batteries (typically used to power auxiliary equipment like electric bandit reels, plotters, radios, lights, etc.), 85% of respondents (N=91) indicated traditional lead-acid batteries while only 8% (N=7) indicated use of newer, lighter and more expensive gel batteries.

Conclusions

This survey represents the first attempt to define snapper-grouper permit holders' attitudes towards the concept of electronic monitoring specifically and cooperative research in general. The response rate (15%) was adequate, but could likely have been improved by using a "warm-up letter" prior to the mailing of the survey. Generally speaking, respondents were not supportive of future EM testing in the snapper-grouper fishery but were supportive of cooperative research in general. Permit holders preferred project types that relied on the use of industry knowledge. Fifty-four permit holders (47% of survey respondents) provided names and contact information (Address, phone numbers, email, etc.) in order to stay up to date on cooperative research information.

Outreach to industry

A shortened, but detailed summary of the survey findings is currently being developed and will be emailed to those survey participants that expressed an interest in the results. This "results summary" will also be available publically and responses will not be linked to individual respondents.

5. Publications, presentations and outreach conducted

Peer reviewed journal articles:

Baker, M. Scott, Jr., Amber Von Harten, Adam Batty and Howard McElderry. *Submitted.* Evaluation of electronic monitoring as a tool to characterize a multispecies, vertical line reef fish fishery. *North American Journal of Fisheries Management.*

Baker, M. Scott, Jr., Ben Sciance and Joanne Halls. In prep. Description of effort in a vertical line reef fish fishery using observer and electronic monitoring data. *Fisheries Management and Ecology.*

Professional and technical presentations:

2011, Oral presentation entitled "Validation of self-reported logbook data from the Snapper Grouper vertical line fishery using Electronic Monitoring." American Fisheries Society Annual Meeting, Seattle, WA. Sept 7, 2011. 45 people.

2010, Poster presentation entitled ""The role of fisheries extension in stakeholder driven, multi-state / multi-agency research projects: A case study to improve data collection in the South Atlantic snapper grouper fishery." Association of Natural Resource Extension Professionals 2010 Conference, Fairbanks, AK, 200 attendees.

2010, Oral Presentation entitled "Project Overview: South Atlantic Snapper Grouper Electronic Monitoring Pilot Project." Tidewater Chapter, AFS. Maryland. 40 people.

Public presentations or documents:

2012. "Counting Fish: Testing Shipboard Video Monitoring." CoastWatch, Autumn issue. http://www.ncseagrant.org/home/coastwatch?task=showArticle&view=listarticles&id=751

2012. "Commercial fishermen participate in electronic video monitoring study." South Atlantic Fisheries Management Council Newsletter, Spring issue. http://www.safmc.net/LinkClick.aspx?fileticket=C6ufpdsETyY%3d&tabid=179

2011, Apr., "Use of Electronic Monitoring for Characterization of Bycatch Associated with the South Atlantic Snapper-Grouper Bandit Fishery. " SAFMC Snapper Grouper AP meeting (EM workshop). Charleston, SC. 44 people.

2009, Sept., "Project Overview: Characterization of Bycatch Associated with the South Atlantic Snapper Grouper Bandit Fishery with Electronic Video Monitoring, At-Sea Observers, and Biological Sampling." South Atlantic Fisheries Management Council Catch Shares Committee, Charleston, SC. 50 people.

COUNTING FISH: TESTING SHIPBOARD VIDEO MONITORING

BY E-CHING LEE

"THE OCEAN IS JUST LIKE THE SERENGETI," says Reece Hair, a snapper grouper fisherman based in South Carolina. "Just got water over the top of it."

But that water can obscure a lot of data. Just ask the South Atlantic Fishery Management Council. It is working to collect sufficient information on the snapper grouper fishery in the region to set and update fishing regulations.

"We just don't have the resources to have that accurate picture of what's actually happening on the water," acknowledges Brian Cheuvront, the council's fisheries economist.

"Having more accurate estimates of catch and bycatch could actually help fishermen in the long run," he continues.

Currently, the SAFMC requires fishermen in the snapper grouper fishery to self-report information in logbooks. Human observers are occasionally placed on a handful of boats to record data, but there are no dedicated funds for an observer program for the fishery.

Some snapper grouper permit holders, including Phil Conklin from South Carolina and Charlie Phillips from Georgia, asked Sea Grant fisheries specialists Scott Baker from North Carolina and Amber Von Harten from South Carolina to conduct a study to determine if electronic video monitoring could be a cost-effective and efficient alternative to those two methods.

"In theory, it doesn't seem to be as intrusive as having an observer on your boat, and management could essentially turn it on and off when needed," Baker notes. "It collects a wealth of information that hopefully could be used to benefit the industry."

Kenny Fex from North Carolina and Mark Mahefka from South Carolina joined Hair, Conklin and Phillips on the project. For logistical purposes, this study involved vessels in the northern half of the SAFMC jurisdiction and did not include Florida.

Their work was supported by a National Oceanic and Atmospheric Administration Cooperative Research Program Grant. This program encourages collaboration in research between scientists and fishermen, requiring that anglers be part of the data-collection process.

JUST ANOTHER TOOL

SNAPPER GROUPER PERMIT HOLDERS ARE required to keep logbooks for each trip. The information is used to document fishing effort and the catch that is landed, which can be verified when the vessel unloads.

However, there currently is no way to validate the number of discarded fish reported in logbooks because this happens at sea. Furthermore, the data can be inaccurate if the records are completed at the end of a trip, long after fishing is complete. According to Baker, for these reasons, scientists are sometimes hesitant to use the data other than to determine fishing effort and landed catch.

Funding from the same cooperative research program allows scientists to put observers on a handful of boats, providing a wealth of information.

"Human observers are considered the gold standard in terms of what's happening out there because it's an independent voice," Baker says. But at a cost of more than $1,300 per day at sea per observer, it quickly adds up to a "crazy amount of money." At that price, the observer program is not scalable to the entire fleet.

Still, funding for observers is very limited and is not guaranteed from year to year. Also, adding another person to these small fishing boats is often a challenge.

Enter electronic video monitoring, or EM.

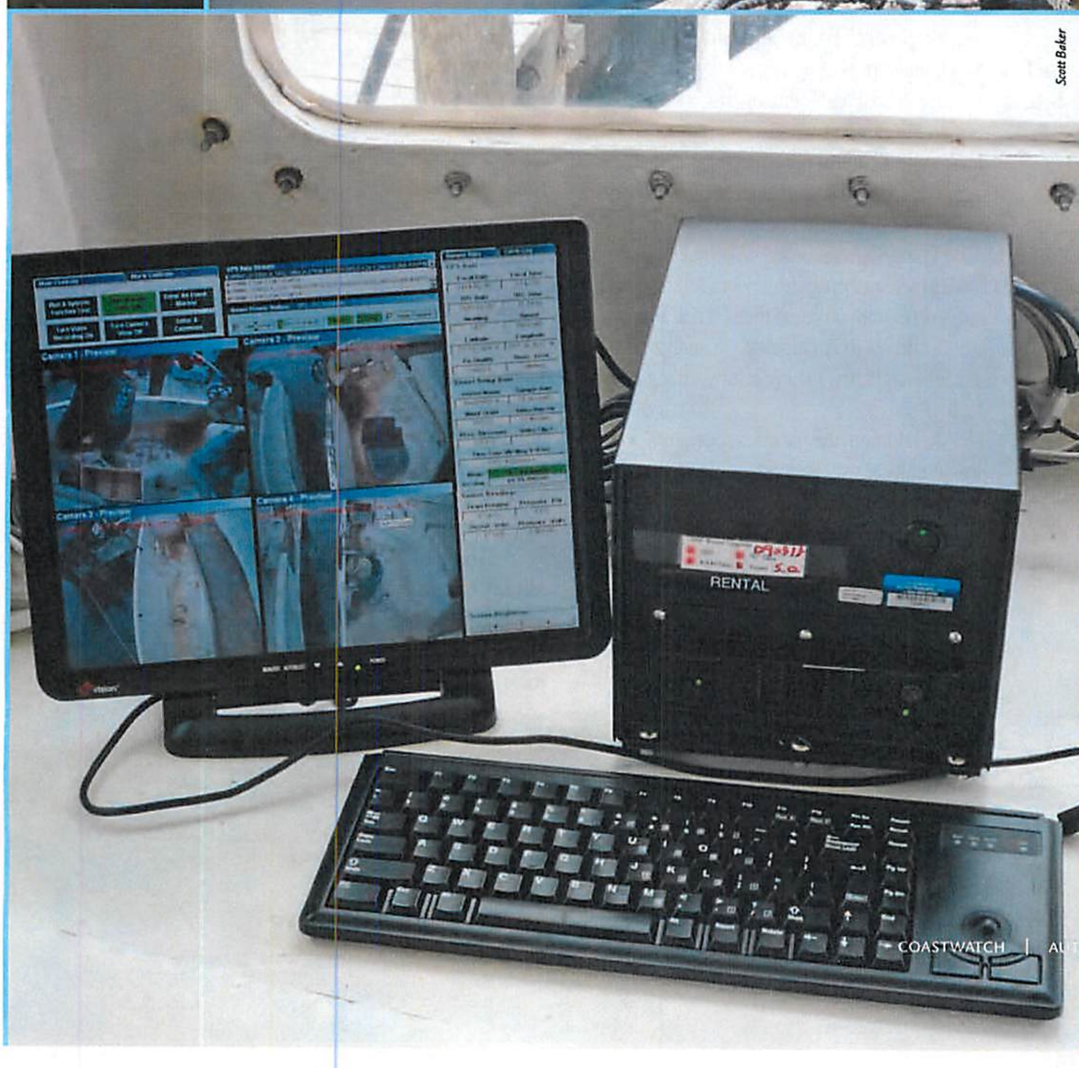
Continued

Clockwise from top left: *The electronic video monitoring control box, screen and keyboard are installed in the wheelhouse.* ○ *Boats from the snapper grouper fleet dock in Southport.* ○ *Scott Baker installs EM wiring in a vessel wheelhouse.* ○ *Amber Von Harten, Kim Astle and Kenneth Fex prepare cameras for installation.* ○ *The system shows live images from four cameras.* ○ *EM cameras are mounted on the vessel so that the reels are in view.* ○ *Bandit reels are named for their resemblance to casinos' one-armed slot machines.*

Scott Baker

Scott Baker

Scott Baker



Scott Baker

Amber Von Harten

Scott Baker

"EM has the potential to improve the existing knowledge of the snapper grouper complex since it records not only fish that are landed, but also species that are released due to regulations or because they do not have marketable value," explains Jack McGovern, project monitor and NOAA fisheries biologist.

Baker and Von Harten theorized that EM would cost less than observers, be more reliable than self-reported logbooks, and not place an additional burden on the fishermen. The Canadian Department of Fisheries and Oceans currently uses this method to validate self-reported data from fishermen. Also, EM can be deployed in instances where safety or space limitations prevent a human observer from being present.

McGovern notes that EM could fill in critical missing information about discards within the fishery. "There is a need to characterize the entire catch of commercial fishermen, not just what is landed. The magnitude and composition of bycatch is not well known. Information from EM has the potential to enhance that knowledge," he says.

The Sea Grant specialists wanted to assess EM's price tag. "We couldn't really understand that until we figured out how these boats fished, how the cameras worked on the boats, how much of the data can be analyzed accurately, and how to hone down the handling practices of the fish on board to capture that data that you need," Von Harten notes.

Another goal was to determine if EM could bridge the informational quality and quantity gap between observers' data and fishermen's logbooks.

"From a larger perspective, this study is: Can we collect the same level of information that they're collecting but at a reduced cost and reduced hassle to human observers?" Baker explains. Available research states that this is possible, depending on the fishery, he adds.

SETTING UP

FOR THE STUDY, BAKER AND VON HARTEN worked with boats that use vertical hook-and-line reels, known as bandit gear. These electric or hydraulic reels are so nicknamed because of their resemblance to casinos' one-armed bandit slot machines.

"They are fast, mobile vessels that can quickly traverse to the fishing grounds and have large enough fish holds to stay out for an extended period of time," Von Harten explains. These boats are configured so that the reels are positioned to fish off the port, starboard and stern of the vessel, allowing fishermen to use three or more reels at once.

The team contracted with Archipelago Marine Research Ltd. for equipment and services to carry out a pilot study on six boats.

"It's a complex fishery to monitor," recalls Howard McElderry, Archipelago's head of fishery monitoring technologies. "We had done some work with the vertical longline fishery before but not a lot, and certainly not as complicated as the South Atlantic."

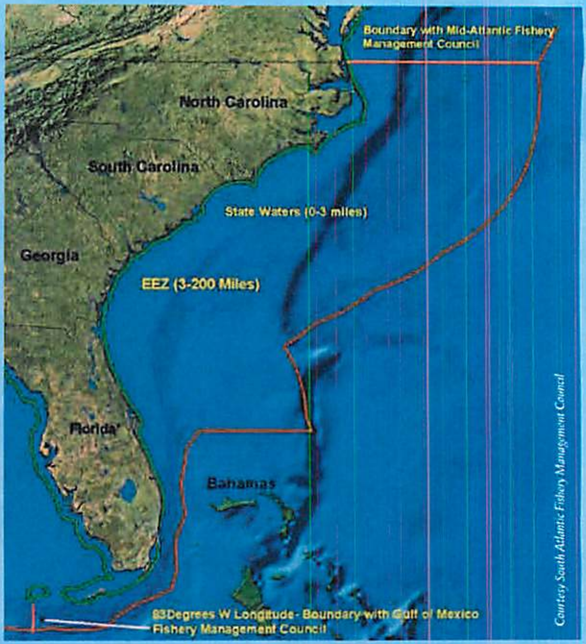
However, these very issues made the work interesting. "Just the vast number of species and the speed at which the fish are coming up from a variety of points on the boat — that presented quite a unique challenge for us in terms of being able to capture all this fishing activity accurately and completely," points out Adam Batty, the Archipelago project manager.

Each boat had four cameras, a sensor to turn on the cameras when a reel moved, a GPS device and a control box. The fixed cameras were pre-focused such that all fishing activity on the back deck could be recorded.

The system recorded video streams on hard drives, and once those were full, Baker and Von Harten replaced them. Then Baker sent the drives to Archipelago to analyze for species caught and fishing effort, among other details.

In addition, the fisheries specialists provided local tech support, going to service the equipment after trips or when there were problems. They did a lot of tweaking to adjust the EM devices for the individual boats and for how the anglers fished — fast, in tight spaces, on long trips that could last up to two weeks, and often in rough seas.

By the close of the study, the pair had picked up some new skills. "We really felt like we were handymen by the end of the project after troubleshooting problems with the equipment and using our toolboxes to fix and tweak adjustments on camera lenses and hardware," Von Harten jokes.



Above: *The SAFMC is responsible for fish stocks within federal waters from Cape Hatteras to Key West, Fla., including the snapper grouper complex.* Right, top: *Fish caught during the study included, clockwise from top left, red grouper, red snapper, vermilion snapper and red porgy.* Right, bottom: *The camera views show a stationary vessel that is not fishing.*

ANALYZING THE DATA

THE FISHERMEN TOOK 93 TRIPS DURING THE eight-month study with EM systems onboard. An independent observer went out on five of those trips, and his records were compared with the data that were collected by the EM systems. Baker and Von Harten also created a special project logbook for fishermen to record catch and effort details to compare with the EM data.

The researchers found that EM and observer data matched well for overall fish count, but fish counts recorded by fishermen varied in levels of agreement to EM. Some fishermen were better at data collection than others.

"The project also demonstrated that there was the potential to obtain information on species identification and length of discarded fish," McGovern says.

"The hard part was breaking down the identity of those species that may come across the camera, including the ones that are discarded," Baker says. "As you can imagine, a lot of them look very similar." For example, some common species such as vermilion snapper were easily identified, while others such as black sea bass were harder to distinguish.

Furthermore, reviewers had to contend with the different fishing styles and the speed at which the anglers fished. Often, very little time

Courtesy Archipelago Marine Research Ltd.

Courtesy Archipelago Marine Research Ltd.

elapsed between the end of one fishing event and the beginning of another. That made it difficult to come to a consensus on how to define a single fishing event, which would be necessary if EM is to be further explored for this fishery.

"Time is money to them," Von Harten explains. "The faster they can discard the fish that they're not going to keep or get the fish on board that they are going to keep, it makes all the difference."

Data analysis — mainly the time spent identifying and counting fish — turned out to be the most expensive part of the project.

"A lot of the costs are actually going to be in coming up with a plan to figure out how you're going to analyze and use that information," Baker says. "You've got to figure out which information is important for you to use."

Without that plan in place, the EM system "could just be an expensive piece of equipment on your boat," he adds.

"Nonetheless, the data will be there," counters the council's Cheuvront, "which is something we've never had before."

LOOKING AHEAD

FEX, THE SOLE NORTH CAROLINA FISHERMAN in the project, has praise for the pilot study. "The good thing about it is that it's true science," he explains. "And it made me realize the amount of discards and things like that." However, he has reservations about deploying the system across the entire snapper grouper fleet, mostly because of cost.

In fact, Baker and Von Harten recommend that with tweaking, EM has the potential to augment, rather than replace, existing data collection programs. One possible use of EM is as an audit system to verify a portion of the fishermen's logbook data.

And even though EM was effective in collecting data, "there's certainly a big learning curve that needs to be incorporated for this to be effective," Baker acknowledges.

"Putting technology on a boat isn't something you just do and forget about. You have to actively work with it," Archipelago's Batty concurs. "Very often it affects the way catch is handled, places where discarding occurs, all those sort of things. So it becomes a bigger method."

However, others are learning from these lessons. When the Ocean Conservancy started a similar pilot study in the Gulf of Mexico for reef fish, Baker was invited to share advice and lessons learned.

"Scott's knowledge of the challenges in maintaining equipment and traveling to multiple sites helped us prepare for the amount of work that would realistically be needed to successfully complete the tasks. Scott also shared guidance on the qualifications we should look for in an observer," says Kristy Tavano, the coordinator for the Gulf project.

"The work that we did with Sea Grant really helped us to know what we were up against and plan a little bit better for the installations," adds Batty, who also is managing the Gulf project for Archipelago. In addition, he used some of the video feed from Baker's study to familiarize his technicians with the type of fishery they would encounter.

Although Von Harten doesn't see the EM system being deployed on all boats in the fleet, she suggests there could be a potential follow-on project in the snapper grouper fishery.

"If there was a small segment of the fleet that wanted to do more pilot testing of the equipment to really hone down on how this could effectively work on their boats, I think that would probably be the next step," she suggests.

But even though he agrees that the EM technology is very useful, Cheuvront has several caveats.

"For this to work, we need to get the buy-in from the fishermen and we need to get the resources from management to actually deploy the technology," he cautions, citing the need to have funding to support the EM work.

"The link between deploying the gear and its use in management has to happen very rapidly or it's going to lose whatever support it has from the fishermen," Cheuvront advises. ■

To learn more about the snapper grouper complex and its related management plan, go to: www.safmc.net *and click on Fishery Management Plans in the Quick Links box. Then search for snapper grouper.*

Electronic Video Monitoring Survey

Scott Baker and Amber Von Harten recently surveyed 773 snapper grouper permit holders on electronic video monitoring research. Fifteen percent, or 116 people, responded.

Responses were grouped according to coastal region. Fifty-four percent of permit holders responding from North and South Carolina, and Georgia were supportive of additional testing of EM systems. However, 75 percent of the Florida respondents were opposed.

When asked if a third-party data review method such as EM might be considered as a tool to validate self-reported logbook records, more than 60 percent in each group were opposed to the concept.

Likewise, when asked if they would support the adoption of standardized fish-handling guidelines to improve the video-review process if EM was to be further evaluated, more than 75 percent of respondents were not in favor.

Commercial Fishermen Participate in Electronic Video Monitoring Study

Researchers partner with vessels from NC to GA to evaluate technology; document catches and bycatch

by Scott Baker and Amber Von Harten

Commercial bandit reel vessels in Southport, NC.

Fisheries managers have struggled with ways to characterize the total catch of the multi-species snapper grouper fishery. After learning about the benefits of electronic video monitoring during discussions at the Council's Limited Access Privilege Program (LAPP) exploratory workgroup meetings in 2007-2008, several fishermen expressed interest in evaluating electronic monitoring firsthand. "Fishermen asked Sea Grant if we could help develop and administer a research project to test video monitoring on bandit boats (commercial hook-and-line vessels targeting snapper grouper species)," explained Scott Baker, fisheries specialist with North Carolina Sea Grant. "So we put together a cooperative research proposal that was funded by NOAA in 2009." Baker served as a member of the LAPP workgroup and later as co-investigator of the NOAA-funded Cooperative Research Program study.

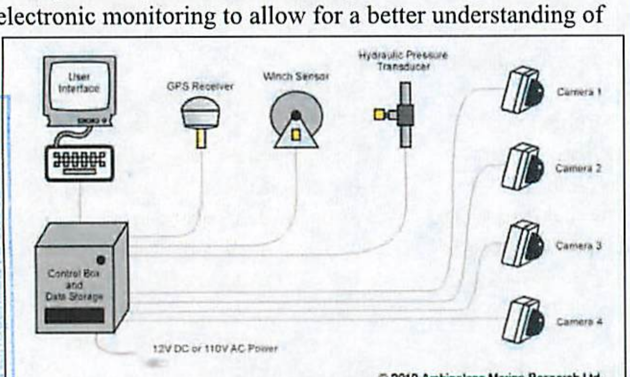
From May through December 2010, six commercial bandit vessels from NC, SC and GA took a total of 93 trips (524 sea days) with electronic video monitoring systems onboard. The systems, developed by Archipelago Marine Research, Ltd. and used in several fisheries around the world, consisted of three to four cameras, a rotational drum sensor (attached to a bandit reel), a GPS, and a control box (computer). Because the system had never been used to monitor a fishing vessel using bandit gear, data was also collected by at-sea observers from five trips (32 sea days) onboard four different vessels, serving as the standard to which to compare the electronic video monitoring data.

"Cooperative research between scientists and the fishing industry is critical in testing methodologies such as electronic monitoring to allow for a better understanding of the ecosystem and the type and magnitude of bycatch," said Dr. Jack McGovern, project monitor and fisheries biologist with NOAA Fisheries Service. "Results from this type of research are important in identifying effective measures to promote sustainability of fishery resources."

The initial results indicate that video monitoring has potential to be used as a tool to validate logbook data as well as augment existing fishery dependent data collection programs, such as at-sea observers. "Our goal was to evaluate the potential for electronic monitoring's use in this fishery – which we did. Whether or not the entire industry is interested in using video monitoring, or if the technology is immediately affordable for the desired objective remains to be determined," said Amber Von Harten, fisheries specialist with South Carolina Sea Grant and project co-investigator.

Courtesy of Sea Grant Consortium

Onboard cameras are strategically mounted around the fishing vessel's deck to record all fishing activity, including fish that are harvested and those that are discarded. This type of electronic video monitoring has the potential to supplement logbook reporting and aid in documentation of the number and disposition of discarded species on fishing trips.



A diagram of the electronic video monitoring system shows the connections between the control box (computer), GPS, fishing reel, transducer, and onboard video cameras.

Mark Marheffka, a commercial fishermen and project partner based in Charleston, S.C., agrees. "Having the equipment on board all boats in the fishery is probably not feasible," said Marhefka. "All the way around though, if there were a handful of boats that had the technology on their boats year-round to do some pilot studies to get much needed data — that would work."

The final report for the research project will be available later this fall. In the meantime, surveys have been mailed by Sea Grant to all federal commercial snapper grouper permit holders to get feedback on the EM pilot study as well as to document attitudes about cooperative research in general.

For more information, contact: Scott Baker, fisheries specialist, North Carolina Sea Grant, bakers@uncw.edu, 910-962-2492; or Amber Von Harten, fisheries specialist, South Carolina Sea Grant, ambervh@clemson.edu, 843-470-3655 ext 112.

National Sea Grant Library
APR 30 2013
URI Bay Campus, GSO, 15 Pier Rd
Narragansett RI 02882 USA