This is a proposal to work cooperatively with fishermen to evaluate electronic video monitoring as a tool to characterize fishing activities of the commercial Snapper Grouper vertical hook and line (bandit) fleet. Although a primary short term objective is to characterize the age-size structure of the frequently encountered discarded species (Priority 1.a.1), the long term objective of this study is to evaluate over a 12 month period, a electronic video monitoring system that may be able to bridge the cost and efficiency gap between human observers and fishermen's logbooks (Priority 1.a.3.). The study design will allow for statistical comparisons among fishermen's logbooks, at-sea-observers and electronic video monitoring systems.

Project Description

Project Title: Characterization of Bycatch Associated with the South Atlantic Snapper Grouper Bandit Fishery with Electronic Video Monitoring, At-Sea Observers, and Biological Sampling.

Project Goals and Objectives: Specific objectives are: 1) To compare data obtained from electronic video monitoring (EM) to data collected simultaneously with fishermen logbooks and NOAA fisheries observers; 2) To determine the age-size structure of frequently encountered discarded snapper grouper species; 3) To collect information on number and disposition of discards with respect to depth and location of capture; and 4) 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 South Atlantic Fishery Management Council (SAFMC) meeting.

Identification of the Problem and Justification:

Management Issues for the Snapper Grouper Fishery

The South Atlantic snapper grouper complex is comprised of more than 73 species that are managed collectively by the SAFMC. Members of the snapper grouper complex are distributed widely throughout the South Atlantic, demonstrating a considerable latitudinal range and occupying both inshore and offshore habitats. This complex has proved challenging to manage, not only because of the broad spatial and temporal patterns of species distribution and abundance, but also because the life history strategies typical of snappers and groupers make them particularly vulnerable to additional mortality upon capture. Many members of the snapper-grouper complex demonstrate slow growth, delayed maturation, long life spans, and predictable aggregative behaviors allowing for efficient harvesting (Coleman et al. 1999). As a result, management of this multi-species fishery requires a complex fishery management plan that addresses all levels of biological, ecological, and anthropogenic interactions, including the impact of commercial and recreational harvest of these species.

Fishermen that target snapper grouper species are located throughout the entire jurisdiction of the SAFMC, from Cape Hatteras, NC to Key West, FL. Vessel size varies greatly throughout the fishery with trips lasting from hours to two weeks. Landings (2001-2005) by North Carolina, South Carolina and Georgia fishermen account for approximately 56% of the landings for this complex (SAFMC, Amendment 13C).

To further complicate management strategies, commercial harvest of snapper grouper species occurs with a variety of gear types (hook and line - hand-powered, electric, pneumatic or

hydraulic), bottom longline, fish traps (for black sea bass) and spearguns (SAFMC 1983). Approximately 80% (2001-2005 average landings) of South Atlantic snapper grouper landings are attributable to vertical lines including electric, vertical hook and line gear (bandits) as this gear can be mounted on both small and large vessels (Figure 1). This gear is efficient at capturing the majority of species in the complex, depending on terminal tackle used, but as a consequence, the gear is also effective at capturing non-targeted species. Catch of non-targeted species (i.e. bycatch) is of significant concern to the management of snapper grouper species.

Traditional management measures, such as size limits and trip limits, can be successful in regulating specific species with these life history traits. However, some of these same management measures that are implemented to prohibit species specific interactions can sometimes create new management issues. One such issue is regulatory discards, which can have unintended consequences, such as increased discard mortality for certain species.

Need to Address Bycatch

NOAA Fisheries and the regional fishery management councils are required to address bycatch. National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act requires that "conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided minimize the mortality of such bycatch." Additionally, 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."

There are a number of different types of bycatch in the snapper grouper fishery and the reasons for those vary. In some cases, bycatch results from prohibitions intended to reduce or eliminate directed fishing pressure on vulnerable species or interactions with threatened and endangered species. This type of bycatch applies to depleted or slow-growing fishes, marine mammals, sea birds, sea turtles, and other species listed under the Endangered Species Act. In other cases, bycatch results from regulations such as size limits and trip limits. Size limits are designed to protect spawning individuals or those too young to spawn. Trip limits are often imposed to spread out fishing opportunity throughout the year or among participants. The varied causes of bycatch and the lack of information available about the composition (age-size structure), abundance and disposition of bycatch species warrants an effective method for collecting data, monitoring and implementing management strategies based upon on-the-ground observations of fishing practices.

There is a need to characterize the entire catch of commercial fishing operations as the extent of bycatch may be impacting current fishery management strategies for snapper grouper species (SAFMC, Amendment 13C). A number of the species in the snapper grouper complex are overfished or experiencing overfishing including gag, vermillion and red snapper (SAFMC, September 2008 briefing book). While the SAFMC is taking measures to address these species, unaccounted for bycatch can decrease manager's ability to accurately manage the fishery and/or require managers to account for higher levels of uncertainty by decrease the annual catch targets for the fishery. As we move towards a multi-species management approach with a higher level of accounting for bycatch, these types of data are essential.

The impacts of bycatch on fish stocks are included in traditional stock assessments whenever information is available. Information needed includes the age and size structure of both retained and discarded fish, as well as any estimate of release mortality. Many reef fishes captured at depths greater than ~ 20 m often have problems submerging when released by fishermen. In addition, fishes caught in water deeper than 40 m may experience anatomical traumas due to decompression that occurs with the rapid ascent during capture (Collins et al. 1999; Rudershausen and Buckel, 2007). Estimates of release mortality are an important component when imposing minimum sizes to rebuild stocks, protecting spawning individuals, or allowing for the survival of smaller, younger fishes that have not had the opportunity to spawn. Without reliable estimates and ages of discard numbers by species, depleted stocks may not be able to be effectively managed.

Bycatch characterization other than reef fish

Many efforts to address bycatch have focused on the Gulf of Mexico and South Atlantic shrimp fishery. Shrimp trawls drag the bottom and scoop up most things in the fishing path, resulting in significant amount of bycatch and mortality of bycatch. Bycatch of sea turtles and juvenile red snapper (Gulf of Mexico) in shrimp trawls have been of particular concern, and so research was done to develop mechanisms to minimize shrimp trawl bycatch of these species. Such programs led to the development of Turtle Excluder Devices, a technology that helps turtles escape shrimp trawl nets and similarly, Bycatch Reduction Devices, to help red snapper and other finfish escape from nets. Both devices have helped reduce bycatch and allow continued shrimp fishing.

Bycatch characterization and reduction research has been conducted for other fisheries in the Southeast Region, though not to the same degree as for the shrimp fishery. Pelagic longline fisheries for tuna, swordfish, and sharks have had mandatory observer programs in place since 1992. The directed shark gillnet fishery developed off the east coast of Florida and Georgia in the late 1980s. It is classified as a Category II fishery under the Marine Mammal Protection Act (MMPA) due to occasional interactions with or capture of marine mammals. There is also a concern about interaction with sea turtles. Marine Finfish Initiative (MARFIN) and Saltonstall-Kennedy (S-K) grants have funded research on bycatch in the menhaden purse-seine fisheries of the Gulf and Atlantic coasts. The menhaden industry has already developed some gear innovations to release bycatch alive during harvest. Bycatch is considered to be minimal in this fishery.

Estimates of fishes caught, but not retained, in recreational fisheries are made through the national Marine Recreational Fisheries Statistics Survey (MRFSS) program for much of the Southeast Region. There have been S-K awards for short-duration projects assessing recreational bycatch in some geographic areas not covered by MRFSS. A number of MARFIN and S-K grants have been awarded to examine mortality of hooked and released fish (NMFS 1998a).

Characterization of Bycatch in the Snapper Grouper Complex: Limitations and Opportunities

Several studies and monitoring programs have been conducted to evaluate bycatch, discard mortality, and generally characterize the snapper-grouper fishery in the South Atlantic.

These activities have been conducted using a variety of methods: paper and electronic logbooks, port sampling (biological sampling), and at-sea observers (SAFMC 2007).

Logbooks are a type of self-reporting used in commercial fisheries that record, either written or electronically, various types of information (location, gear, number of pounds landed by species, etc.) that sometimes includes bycatch data. Discard logbooks are currently being used to estimate bycatch in the snapper grouper commercial fishery in the region. For the snapper grouper fishery, 20% of commercial fleet is required to fill out a discard logbook in addition to the standard logbook (Poffenberger, 2003). Such bycatch data can be biased without additional at-sea observer data to ground truth the logbook data. Logbook data biases can result from fishermen under reporting bycatch species, particularly if fishermen have the perception that reporting such information may result in a restrictive fishery regulation. Fishermen may also catch but not record fish species with little to no economic value. While the quality of bycatch data is largely unknown, low accuracy rates for bycatch reporting may also stem from the additional paperwork burden associated with discard logbooks while offering little incentive for fishermen to accurately complete the logbooks. Despite these biases, logbook programs are usually required for all participants in the fishery, which allows for good estimates (through extrapolation) for total bycatch levels in a fishery. While there may be delays in obtaining logbook data, logbooks currently prove to be one of the most cost-effective mechanisms for collecting bycatch data when compared to other more costly mechanisms (NMFS 2003).

Port sampling is conducted by state or federal fishery management agencies or contract employees that are trained to collect biological samples and fishery information, sometimes including bycatch information, from commercial fishermen or dealers (NMFS 2004). The accuracy of data collected by port sampling relies upon the reporting relationship between the fisherman and the port sampler as well as the accuracy of the information recorded by the port sampler. Additionally, port samplers do not visually observe discards and can only rely on the information obtained from the fisherman in port. Also, biological samples are only obtained for landed catch leaving a gap in biological sampling for discards. Another disadvantage to port sampling is the limited geographical area covered by port samplers – not every port in every state has a port sampler. However, unlike logbook reporting that can often be delayed, port sampling data is often reported very quickly and the timeliness of the reporting allows for immediate response to fishery management issues based on the data collected (NMFS 2004).

At-sea observers are trained biologists deployed on-board commercial fishing vessels and often have multiple objectives with regards to observing and collecting information on fishing activities and practices (NMFS 2004). Typically they collect information on the catch and bycatch as well as information on the disposition of some or all of the bycatch species. Other types of information collected by observers include biological samples, fishing fleet characterizations and economic information. Coupled with logbooks and other data collection mechanisms, observers can estimate the relative abundance of target and bycatch species in some fisheries. Bias in the accuracy of the data can be a concern due to the "observer effect," a term used to describe a change in fishing practices or behavior caused by having an observer on board a vessel. Other limiting factors for using observers in the South Atlantic snapper grouper fishery are the high cost of sending observers to sea and the subsequent lack of funding to implement observer programs as well as the safety and logistical constraints associated with the small vessel size in the fleet.

Although a NOAA funded reef fish observer program exists for the Gulf of Mexico, no such program is authorized for the South Atlantic. Recognizing the need for similar data in the

South Atlantic, in FY06 the NOAA Cooperative Research Program funded a one year pilot at-sea observer program to characterize the fishery, including the number and disposition of discards (http://sero.nmfs.noaa.gov/grants/crp_selected_funding). Data was collected using NOAA certified at-sea observers. The project was highly successful and as a result was funded again in FY08. These projects have and continue to produce a wealth of baseline data for this fishery, but other technologies exist that may be able to achieve the same level and quality of data at a significantly reduced cost, in addition to other benefits.

Electronic video monitoring (EM) is a fairly new technology that has been piloted or recently implemented in over 25 studies spanning diverse geographies, fisheries, fishing vessels and gears, and fishery monitoring issues (McElderry, 2008). The methodology involves mounting one or more tamper-proof digital video cameras in various areas on a fishing vessel's deck or hull, and recording all or a portion of the fishing activities. The data can then be removed from the fishing vessel and analyzed after the completion of the trip. An overview of the technology and the methodology being used by the primary developers of this technology, Archipelago Marine Research Ltd., is described in a recent report (McElderry, 2008). Figure 2 illustrates the typical set up of an EM system.

The use of an EM system varies depending upon the monitoring objective. The system can monitor factors such as the compliance to fishing regulations related to gear and on-board handling requirements, catch composition (retained and discarded), disposition of discards and time and area of fishing. When compared to the costs of observers, EM can be a less expensive mechanism for monitoring over the long term and is dependent on the set-up/maintenance costs, amount of days monitored and associated data review. The use of technology to record species, capture position, and disposition of released fishes has the potential to augment the collection of bycatch information and lessen the need for observers. Video technology can be used on vessels that cannot take a human observer for safety reasons or vessel limitations. Previous experience indicates video monitoring is very effective for monitoring catches from hook and line gear due to the size and types of species collected. It is also substantially less expensive than observer coverage for comparable data collection. Given the advances in electronic monitoring technology, piloting this technology in the South Atlantic snapper grouper fishery may be an economically feasible and advantageous bycatch monitoring strategy for this fishery.

Implementing Recommendations for Bycatch Monitoring Methods

On May 16-18, 2006, NMFS Southeast Regional Office hosted the Southeast Bycatch Workshop in St. Petersburg, Florida. Approximately 100 participants representing commercial and recreational fishermen, non-governmental organizations, scientists, and managers attended the workshop. The goal of the workshop was to provide a better understanding of bycatch issues in the Southeast Region and identify potential solutions to reduce bycatch by means of management measures, gear technology, data/monitoring, and research. The workshop stressed the need for more information on bycatch and bycatch mortality, landings, fishing effort, and more timely use of these data within the fishery management system. Workgroups indicated that observer programs are very expensive and suggested greater emphasis be placed on inexpensive means or alternate methods of monitoring bycatch including video monitoring. All four workgroups strongly supported cooperative research programs, building on a common theme - the need to involve industry in identifying solutions to reducing bycatch. Participants agreed that cooperative research between scientists and industry promotes outreach, education, and

acceptance of reasonable ways to reduce bycatch. The workgroups stated that scientists need to be an integral part of the design of cooperative research programs, while relying on industry's expertise. Finally, the workgroups affirmed a need for long-term cooperative research projects.

Study Design: A Departure from Previous Studies

The South Atlantic at-sea observer program funded through CRP and coordinated through the Gulf and South Atlantic Fisheries Foundation (GSAFF) has been shown to provide excellent information for the trips observed, but with the aforementioned limitations of such a program, steps should be taken to evaluate alternative, more cost effective technologies that are equally capable of capturing the data necessary for management purposes. Space issues, safety concerns, and vessel scheduling aside, the primary drawback of current at-sea observer programs is cost. The problem is magnified considering that once underway, observers will be at work for the duration of the trip. With a limited number of observers in operation traveling from port to port, it is almost impossible to characterize the fishery in real time, or allow for cross comparisons between species interactions and regions. With the temporal and spatial variety of species encountered in this fishery, this may not be the best approach to characterize this diverse fishery.

In the snapper grouper fishery, regulations require that permit holders complete logbooks for each trip. In addition, twenty percent of permit holders are required to complete discard logbooks (Poffenberger, 2003). As discussed, this is the most cost-effective bycatch monitoring approach, but also the least credible. Despite the best intentions, scientists are hesitant to use data from the logbook program other than quantification of landed catch and fishing effort. Instead of providing observers for a limited number of trips to record fishing activities, an alternate scenario would be to design a system whereby fishermen's logbooks would be partially validated by an EM system. This is the approach used by the Canadian Department of Fisheries and Oceans with some of the Individual Fishing Quota (IFQ) fisheries (McElderry, 2008). Partial review of EM, compared to data recorded by fishermen in logbooks, could be used to validate the standard and discard logbook programs, thus ensuring that management has access to the best available fisheries-dependent data.

In partnership with industry, North Carolina Sea Grant, South Carolina Sea Grant Consortium, Environmental Defense Fund, and NOAA Fisheries, we propose to evaluate electronic video monitoring as a tool to characterize fishing activities of the commercial Snapper Grouper vertical hook and line (bandit) fleet. Although a primary short term objective is to characterize the age-size structure of the most frequently encountered discarded species (Priority 1.a.1), the long term objective of this study is to evaluate over a 12 month period, a electronic video monitoring system that may be able to bridge the cost and efficiency gap between human observers and fishermen's logbooks (Priority 1.a.3.). The study design will allow for statistical comparisons among fishermen's logbooks, at-sea-observers, and electronic video monitoring systems. The need to provide better bycatch estimates in the South Atlantic commercial snapper grouper fishery is the sixth and seventh action item priority for FY07-FY08 in the Southeast Region's Bycatch Implementation Plan (NMFS 2006).

Sampling Design and Methodology

Overview

To determine the utility and effectiveness of EM use in the bandit fishery, this study will involve multiple of layers of data collection that revolves heavily on expanded data collection by the fishermen collaborators. Unlike at-sea observers which move from vessel to vessel, EM equipment must be installed on the fishing vessel, and as such, is capable of recording information for every trip. Being that it is financially unfeasible and largely unnecessary to review all EM data for every trip during the 12 month period for all six vessels in this study, a tiered sample design will allow for comparisons between characterization methodologies: trips with expanded logbook data collection by fishermen, trips with at-sea observer coverage, and normal fishing trips. Unlike the previous characterization studies of the snapper grouper fishery, our study will focus on discards and will hopefully validate the data collected by fishermen in logbooks, which is by far the most cost effective bycatch monitoring program for this fishery.

Electronic Video Monitoring Analyses

Six vertical hook and line (bandit) commercial fishing vessels located at Southport, NC (n=1), Little River, SC (n=2), Murrell's Inlet, SC (n=1), and Townsend, GA (n=2) will each be outfitted with a stand alone EM system (Figure 3). Once installed by the service provider, the EM system will be configured to run for the duration of the data collection period (12 months). Figure 4 illustrates the typical components of an EM system. The EM systems will be in place to record sensor and image data from an estimated 66 fishing trips, or approximately 528 fishing days. The fishing trips will be of three categories: trips with expanded data collection by fishermen (48 trips or ~ 384 days), trips monitored by observers (4 trips or ~ 32 days), and normal fishing trips (14 trips or ~ 112 days).

The EM system provides a comprehensive sensor and image data record for the fishing trip. As well, a series of system files are generated to record EM performance data. Raw sensor and image data (Figure 5) are interpreted using specialized analytical tools for generation of fishery data. The goals of sensor data analysis usually include determining overall data quality and distinguishing key vessel activities including transit, gear setting, and gear retrieval, and interpreting the geographic position of vessel operations. The objectives of the image interpretation process include completing an inventory to ensure that all imagery is present, making an assessment of image data quality, and finally, interpreting imagery to make specific fishery observations such as catch events or fishing behavior.

EM data analysis will vary according to the type of fishing trip. Normal fishing trips (no observer or expanded fishermen data collection) will receive less emphasis with analysis to inventory data, assess completeness and overall data quality, essentially to determine if usable fishery data could be derived from the data set. Fishing trips with an observer aboard will receive the most analysis emphasis since observer data are likely to be the most comprehensive and therefore the best for comparison with EM data. EM data from these trips will follow the same procedures as with normal trips, plus detailed review of the imagery to document catch by species (or species group), number of pieces, and disposition (i.e., kept or discarded). EM data from fishing trips with expanded data collection will follow similar analysis procedures as with observer trips but the fisher data are not expected to be as comprehensive, likely limited to a few

key species. The latter will likely be sub-sampled with strata across vessels, month, and possibly fishing area.

A hypothetical depiction of the sampling strategy is shown in Table 1. Note that with future restrictive management measures currently being discussed in Amendment 16 to the South Atlantic Snapper Grouper Fishery Management Plan, it is highly possible that some of the participating vessels may not fish during the months of January through April 2010, as some of the target species (i.e., groupers) may be closed to fishing. Should those vessels participate in other fisheries during that time period (i.e., king mackerel) EM data may be usable if cameras are able to observe fishing activities.

The EM system, which operates on vessel power, must be serviced to maintain the unit and insure data integrity. Data is recorded to hard drives and these will need to be exchanged periodically and sent (mailed) to the service provider for processing. In addition, in order to head off any potential and/or unforeseen technical issues, the service provider has requested that personnel be designated to attend to these types of activities (as the service provider is located in British Columbia and will not be onsite except for initial installation, testing and removal of systems a year later). The PI and Amber von Harten, located at opposite end of the study's range, will be trained in EM operation and basic troubleshooting by the service provider so that they will be able to periodically service the EM equipment.

Data Collection by Fishermen

Fishermen will have numerous responsibilities that are crucial to the success of this project. First, an EM system will be installed on each vessel and this system will collect data for the entire 12 month study period. The captain and crew members therefore have the primary responsibility of monitoring the equipment to ensure that it is indeed collecting data while at sea, and reporting to project personnel if the EM system requires servicing. The EM system provides a simple user interface and functionality self test routine to make it easier for fishermen to accomplish this task. Fishermen will not be required to service equipment. Secondly, fishermen will be responsible for data collection above and beyond what is currently required by NOAA Fisheries. Fishermen will continue to report logbook information (standard and discard) on a trip level for all normal fishing trips and trips monitored by observers. Expanded data collection will be required from one fishing trip per month, where fishermen will be recording the same logbook information on a finer time scale, ideally 4-6 hour time intervals, but minimally daily. Discard totals for each time interval will be tallied for the trip and reported on the standard discard logbook form. This critical process will allow for quantitative and statistical review of the EM data by the service provider. Even though the EM equipment will record data for every trip during the study, it is financially unfeasible and largely unnecessary to validate data from all trips in this pilot study. This sample design is meant to validate fishermen's logbooks as it is the single most cost-effective bycatch monitoring tool for this fishery. Third, fishermen will be asked to retain the first five regulatory discards for up to five pre-selected species on the first trip of each month of the study. The overall goal is to compile up to 300 samples of a selected species throughout the region for the study. With a study of this nature, it is imperative not to overburden the captain and crew with data collection activities far removed from normal operations. For this reason, each vessel will be requested to keep discard totals by day on only a few, pre-selected species. These species (not yet determined) will likely be some of the most discarded species associated with the fishery and/or species which are to be analyzed with the

SEDAR process in the near future. Possible species for inclusion are vermilion snapper, red snapper, red porgy, black sea bass, greater amberjack, scamp, gag grouper, and red grouper. This format will allow for fishermen to collect data without detracting significantly from normal operations and scientists to receive fisheries dependent age samples that would not otherwise be available through port samplers.

Age-Size Structure of Regulatory Discards

Regulatory discard samples (whole fish) will be retained by vessel captains on ice until the vessel returns to port. To minimize unnecessary dock-side sampling trips, samples will be labeled, stored (frozen) at participating fish houses until a time when sampling trips can be arranged. The PI and Amber Von Harten will travel to participating vessels and fish houses to obtain biological samples (lengths, weights, sex, otoliths) from retained regulatory discards as needed over the course of the 12 month data collection period. These trips will likely co-occur with periodically required EM equipment servicing. Because of the unique spatial scale of the study design (6 boats fishing concurrently in 3 states), and a total estimate of discards for each species provided by each vessel per trip, this sampling program represents a unique opportunity to fully characterize the age-size structure of regulatory discards for selected species. Initial discussions with NOAA Fisheries personnel indicate that it will be possible through the Exempted Fishing Permit (EFP) process for fishermen partners to retain adequate numbers of regulatory discards, even if scientists or observers are not present on-board vessels (Kate Michie, NOAA Fisheries, Southeast Regional Office, pers. comm.). Upon sample collection, data sheets and otoliths will be sent to Jennifer Potts (NOAA Fisheries, Beaufort laboratory) for processing, age assignment, and eventual use in fishery management plans.

At-Sea Observers

Unlike previous fisheries characterization studies, at-sea observers will have a smaller, but significant role, in this project. Fishing trips that carry observers will allow for a unique opportunity to provide a three way comparison for same trip data collected with logbooks, EM, and observers. We propose to use NOAA certified observers on 4 trips (~32 days of at-sea data collection). Trips that include observers will employ full EM review of the entire trip to allow for sufficient statistical comparisons. Because one of our primary objectives is to validate catch and discard data reported in logbooks using EM, observer coverage for this study will be limited to the amount suitable for robust statistical comparisons.

At-sea observers utilized in this study will have to make slight procedural modifications in order to provide data that can be validated and statistically compared to EM data. Unlike previous efforts to compare EM data with observer coverage on longline vessels which have one fishing station, bandit vessels have anywhere from 2 to 6 fishing stations (i.e., bandits) per vessel. As it is often impossible to fully characterize all fishing activities from all fishing stations, normal procedures require that at-sea observers randomly select fishing stations each set that they can fully monitor (i.e., 2 of 4 bandits or 50%). Observations are then extrapolated to characterize fishing activity for the entire trip (Liz Scott Denton, NOAA Fisheries, pers. comm.). For this study, at-sea observers will be instructed to randomly select and maintain observational coverage on the same 1 or 2 bandits (or what can be viewed from one camera) for each day of the trip. This will allow for efficient data collection and analysis by all groups. After each

observer trip is completed, raw data from observer forms will be uploaded by the PI into the NOAA Southeast observer database.

Bycatch Monitoring, Research & Outreach Workshop

Upon completion of the 12 month data collection and analysis portion of the study, we request funds to organize and host a half-day workshop focused on relevant research findings on catch and bycatch characterization in the South Atlantic snapper grouper fishery. By the time data collection for this project is complete, results should also be available from the Gulf and South Atlantic Fisheries Foundation studies (FY06 and FY08), as well as from the recently completed Gulf grouper longline EM pilot through NOAA Fisheries (Jack McGovern, NOAA Fisheries, pers. comm..) and the Gulf grouper longline EM study that is currently underway in conjunction with the Gulf Fisherman's Association. Both Gulf of Mexico EM longline studies were developed working in collaboration with Archipelago Marine Research Ltd. The target audience for the workshop is fishery managers, fishermen, scientists, the environmental community and other interested parties.

The specific objectives of the workshop are: 1) Co-present the findings of this study with commercial fishermen involved in this study and also highlight the effectiveness of cooperative research between scientists, fishermen and other stakeholders; 2) Receive a demonstration from project consultants, Archipelago Marine Research Ltd., on the use and operation of EM equipment in the Snapper Grouper bandit and longline fishery sectors; 3) Discuss the supplemental data collection procedures (expanded logbooks) used to make fishermen and at-sea observer data comparable to EM data; 4) Invite other investigators conducting studies dealing with bycatch in the snapper grouper fishery to present their research findings. Topics may include, but are not limited to, information on total catch characterization (catch composition and disposition of discards); bycatch monitoring methods (electronic logbooks, observers, etc.); life history information for bycatch species and any other relevant research project results; and 5) Panel discussion of future research and outreach/training needs to address bycatch monitoring in the snapper grouper fishery in the South Atlantic.

In order to minimize travel costs and workshop expenses as well as increase participation from our target audience, the workshop would be held in conjunction with an ongoing meeting of SAFMC Snapper Grouper Advisory Panel (AP). Initial discussions with SAFMC personnel indicate that such an event would be possible with adequate planning. This workshop would provide a unique opportunity to synthesize and comment on several reef fish bycatch monitoring projects that have recently been funded by the NOAA Cooperative Research Program.

Project Impacts / Expected Results and Benefits

NOAA Fisheries and SAFMC has indicated that there is a clear need to characterize the entire catch (both landed and discards) of commercial fishing vessels participating in the snapper grouper fishery. With 73 species in the management complex, interactions with non-targeted species and undersized individuals are almost unavoidable. The extent of bycatch interaction has not been verified for this fishery at the regional level until recently with the funding of the at-sea observer pilot program via NOAA CRP. For this fishery to remain viable, a primary need is to collect pertinent data using a methodology that will satisfy the scientific community, without adversely impacting the industry.

This proposal represents a unique collaboration between the commercial fishing industry and various fisheries stakeholders to collect data that would otherwise be impossible to collect. The members of this research team have previously worked together while participating in the Limited Access Privilege Program (LAPP) Exploratory Workgroup for the South Atlantic Snapper Grouper fishery. The industry partners involved understand the gravity of the situation with regards to data acquisition for this fishery and have elected to explore the EM as a tool to characterize fishing activities in the South Atlantic snapper grouper fishery.

The industry partners in the study will be responsible for or help in the collection of an enormous amount of data crucial to better fisheries management. The discards retained for biological sampling will enable scientists to quantify the age-size structure of the most discarded species in the management complex. This information will fill much needed gaps in assessment models and improve fishermen's confidence in the data gathering process. Collecting data above and beyond what is required by law through an expanded logbook will also lead to better information on discard interactions.

As fishermen are already required to complete logbooks to characterize fishing activities, we have followed the most logical approach which would be to design a system that could independently provide verification of this data. The EM audits of logbook data will provide several products: a measure of logbook data quality, an independent sample of the fishery, and an avenue for providing feedback on logbook data quality. The observer program has provided good data for the trips observed, but this methodology can not be applied across the entire fleet, nor can it be considered the most cost effective approach without evaluating all methods currently available, including EM. Long term utilization of an EM system as proposed in this study will allow time for both the industry and scientists to determine whether or not this type of monitoring approach should be more fully evaluated in fleet applications. We propose to explore a modest application of EM in terms of the level and degree to which data is collected. The best thing about an EM application is that the level of data gathering can be tailored to the specific objectives determined by management needs. The study design that we have selected will allow for statistical comparisons of data collected between fishermen's logbooks, at-sea-observers, and an EM system as well as provide for cost and feasibility estimates for broader EM system implementation in this fishery.

The work outlined in this proposal represents the first evaluation of video monitoring systems in the South Atlantic for vertical hook and line boats. This commonly used gear is an integral part of South Atlantic fisheries. With the 2006 Magnuson-Stevens Act and other efforts focused on quantifying and reducing bycatch, the need to explore more effective, efficient, and accurate ways to achieve bycatch goals are increasingly important. Through this study and the proposed workshop, important information can be learned and then disseminated to fisheries participants, managers, and others in the South Atlantic region. It is hoped that collaborative efforts such as this between managers, fishermen, scientists, and non-governmental organizations result in monitoring and bycatch reduction solutions that benefits both the fisheries and fishing communities.

Project Management and Monitoring of Project Performance

M. Scott Baker, Jr., Fisheries Specialist with the North Carolina Sea Grant Extension Program will serve as Principal Investigator and will oversee all aspects of the project, including personnel management, sampling decisions, observer coordination, biological sampling of discards, EM equipment servicing, data acquisition and storage, budget decisions, and the

communication of findings in the form of meeting presentations and peer-reviewed publications. He will also serve as the project liaison with the service provider, Archipelago Marine Research Ltd. **Lisa Humphrey**, part-time Administrative Associate with Sea Grant, will assist with the these duties, partially budget management within the university system.

Amber Von Harten, Fisheries Specialist with the South Carolina Sea Grant Consortium will serve as Co-Principal Investigator and will assist with biological sampling of discards, EM equipment serving in the southern region of the study and communication of the results via the outreach workshop.

Eileen Dougherty, Fisheries Policy Specialist, Environmental Defense Fund, will serve as Co-Principal Investigator and will be lead in organizing and communicating the results via the outreach workshop.

Industry Collaborators:

Kenneth Fex, Southport, NC. Kenny is full time snapper grouper fishermen and is currently participating in an on-going NOAA CRP with the PI investigating the reproductive biology of black sea bass and red porgy. He is the top-producer of 10-12 boats that pack out at Tatum's Seafood in Southport, NC.

Matt Ruby, Little River, SC. Matt fishes for snapper grouper out of Little River, SC. He owns three boats and has been fishing for 12 years. In addition to managing three boats of his own, he helps run the Little River Fish House that manages ten boats. In August 2008, Matt applied to serve on the South Atlantic Council Snapper Grouper Advisory Panel.

Phil Conklin, Murrells Inlet, SC. Phil is both a fish house owner and snapper grouper permit holder. He owns Seven Seas Seafood in Murrells Inlet, SC. He offers a wide variety of fish for sale at Seven Seas Seafood and sells for about five snapper grouper boats. He serves on the Snapper Grouper Advisory Panel and served on the Snapper Grouper LAPP Workgroup.

Charlie Phillips, Townsend, GA. Charlie has worked the seafood industry for about 35 years. In those years shrimping was his main focus but wreckfish, snapper/grouper, royal red shrimp, and sea scallops were part of his landings as the boat worked from Texas to New Jersey. His work now includes managing a clam farm, a packing house that packs shrimp and fish and two snapper grouper boats. He serves on the Snapper Grouper and MPA Advisory Panels and has been active with advisory panels for over 10 years. Charlie also served on the Snapper Grouper LAPP Workgroup.

NMFS Partner:

Dr. Jack McGovern, NMFS Fisheries Biologist with the Southeast Regional Office in St. Petersburg, FL will be our NMFS partner for this study. Jack has experience working the EM technology and will assist the project team with sampling design to ensure that data collected will be suitable for management purposes.

Milestone Schedule:

Activities	2009						2010												2011					
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Install EM equipment	x	x																						
Collect EM data			x	x	x	x	x	x	x	x	x	x	x	x										
Service EM equipment				x		x		x		x		x		x										
Pick-up biological samples				x		x		x		x		x		x										
Analyze data				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Progress report						x						x						x						
Remove EM equipment															x									
Prepare final report																			x	x				
Plan outreach workshop																					x	x	x	
Host workshop																								x
Submit final report																								x

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Table 1. Hypothetical tiered sampling approach for the South Atlantic Snapper Grouper EM project. At least 66 trips or 528 days at sea (avg. 8 days per trip based on participating fishing vessel history) are expected to occur during the 12 month sampling period. The fishing trips will be of three categories: trips with expanded data collection by fishermen ("E", 48 trips or ~ 384 days), trips monitored by observers ("O", 4 trips or ~ 30 days), and normal fishing trips ("N", 14 trips or ~ 112 days). Each letter indicates a single trip. All 66 trips will be subjected to varying degrees of EM review and analysis. Note that few, if any trips are expected January – April 2010 should significant fisheries closures arise from proposed Amendment 16 (and Amendment 17) regulations. The sampling design can be easily changed to adjust to pending regulations.

	Month											
Vessel	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
1-NC	N	E	E	E	-	-	-	E	E,N	O	E	E
2-SC	E	N	O	E	E	-	E	-	E	E	N	E
3-SC	E	E	E,N	E	-	E	N	-	E	E,N	E	O
4-SC	E	E	E	N	-	-	E	-	E	E	E	E,N
5-GA	E	E	E	E,N	E	-	-	E	O	E	E,N	E
6-GA	E	E	E	E	-	E,N	-	N	E	E,N	E	E

Figure 1. Commercial snapper grouper vessel outfitted with electric reels (bandits).

Figure 2. Illustration depicting the typical set up of an Electronic Video Monitoring system.

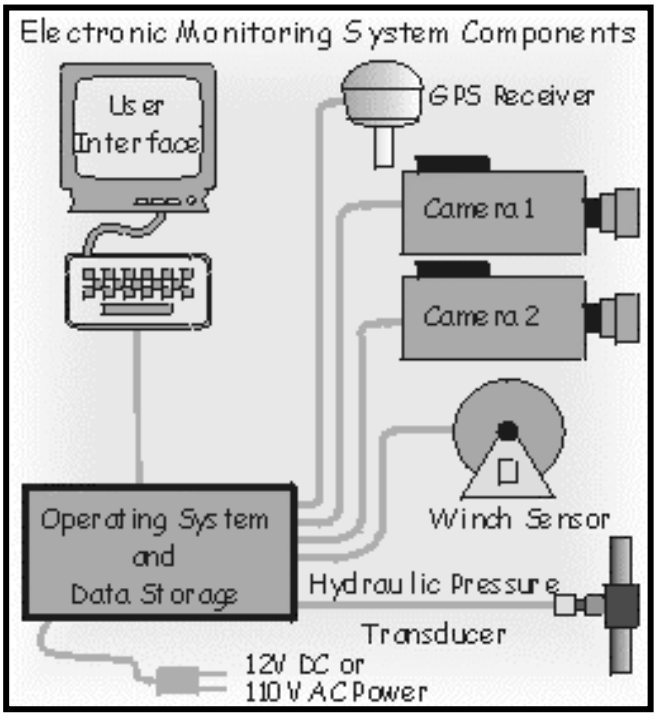


Figure 3. Locations of fishing vessels (white diamonds) to be monitored with EM equipment. The 6 vessels are located in 4 ports. Sites in NC and SC are separated by approximately 80 miles. The Georgia site is approximately 240 miles (4.5 hour drive) to the Southwest of Murrells Inlet, SC. The location of the investigators (SB and AVH) who will be assisting with equipment servicing and biological sampling are indicated by red ovals.

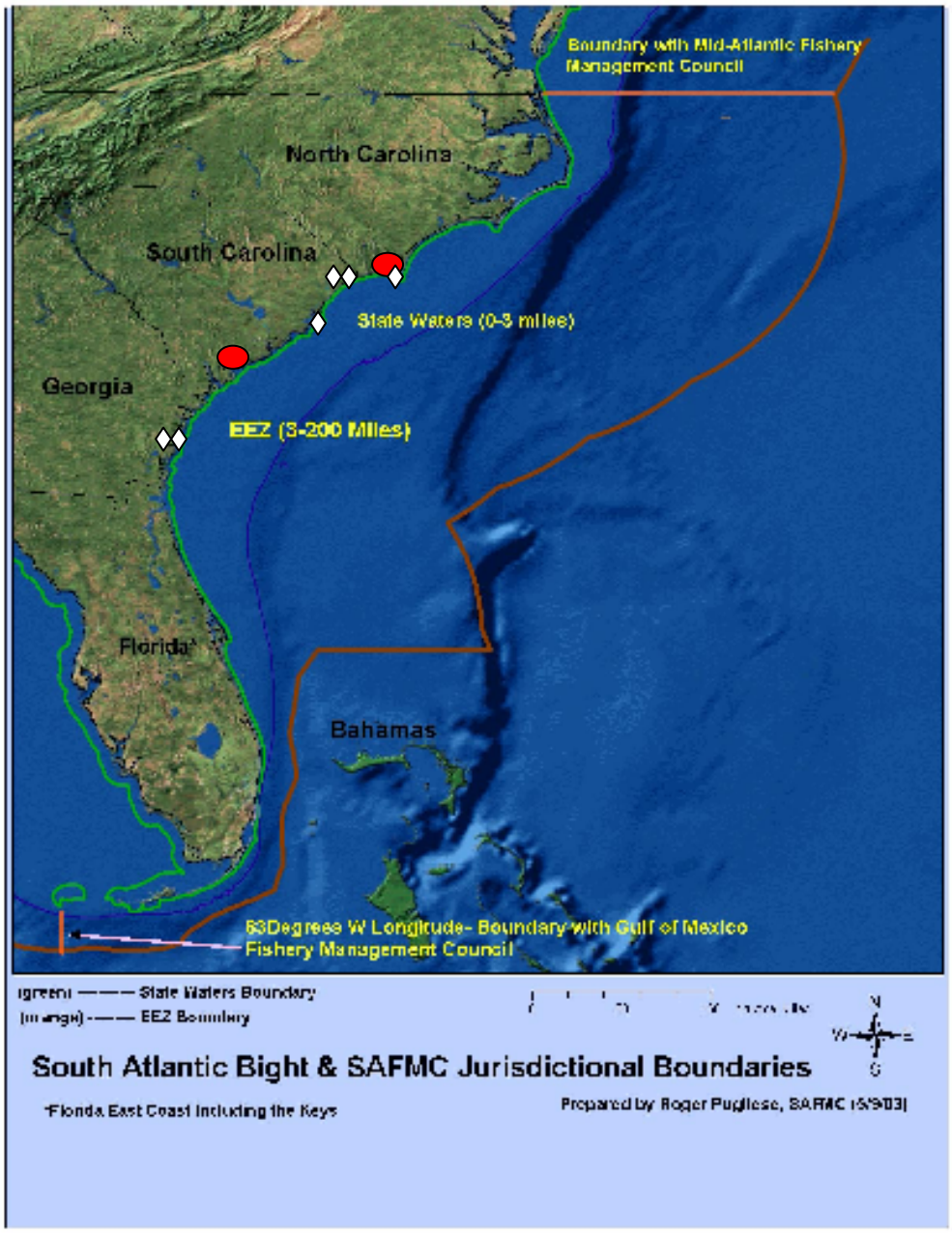


Figure 4. Actual pictures of typical components used in a haddock longline pilot project. Items shown are (a) the control box mounted in the cabin; (b) the pressure sensor located in line with line hauler motor; (c) camera mounts in deployed position; and (d) close-up view of two CCTV camera units. Pictures courtesy of Archipelago Marine Research Ltd.

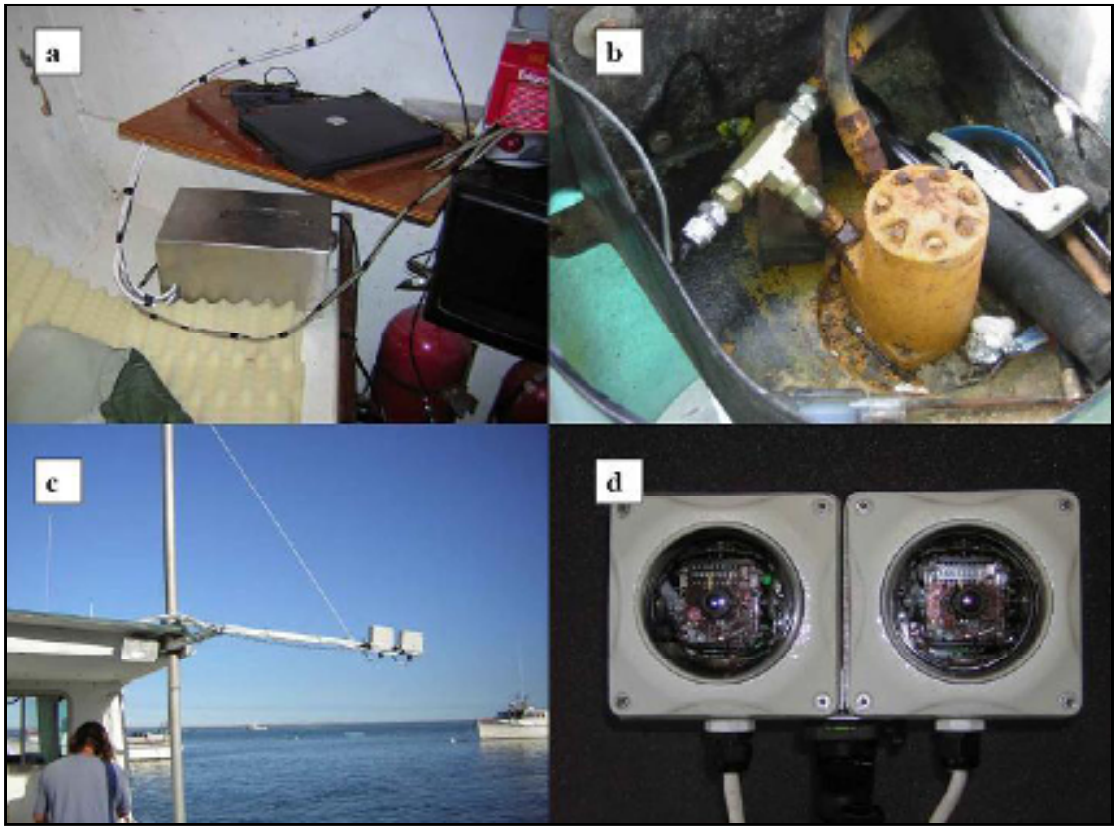
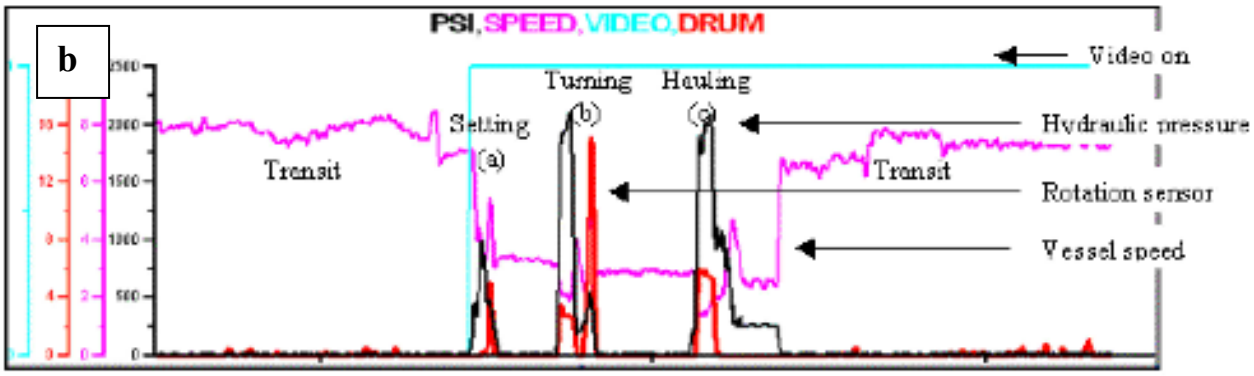


Figure 5. Example pictures showing (a) wide angle and close-up views of hauling station and (b) sensor data for a complete longline fishing trip. Pictures courtesy of Archipelago Marine Research Ltd.



NOAA must analyze the potential environmental impacts, as required by the National Environmental Policy Act (NEPA). Consequently, as part of an applicant's package, applicants are required to answer the following questions:

1. Has any National Environmental Policy Act (NEPA) or other environmental compliance documentation been completed? **No.**

2. Would the proposed activity or environmental impacts of the activity be subject to public controversy? **No.**

3. Would the proposed activity have potential environmental impacts that are highly uncertain or involve unique or unknown risks? **No.**

4. Is the proposed activity related to other activities (both NOAA and non-NOAA that together may cumulatively adversely impact the environment? **No.**

5. Would the proposed activity involve a non-native species? **No.**

6. Would the proposed activity occur within a unique geographic area of notable recreational, ecological, scientific, cultural, historical, scenic or aesthetic importance? **No.**

7. Would the proposed activity affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or cause loss or destruction of significant scientific, cultural, or historical resources? **No.**

8. Would the proposed activity affect public health or safety? The effects may be adverse or beneficial and temporary, long-term, or permanent. **No.**

9. Would the proposed activity affect directly or indirectly, in an adverse or beneficial manner, any listed endangered, threatened, or otherwise protected species or their critical habitat under federal and state laws including the Endangered Species Act and the Marine Mammal Protection Act? **No.**

Budget

	Year 1	Year 2	Total
a. Personnel			
Scott Baker (PI) @ $3,995 per month	$7,990	$4,195	$12,185
Admin. Assoc. @ $1,301 per month	$3,903	$1,366	$5,269
b. Fringe Benefits			
PI @ 29%	$2,317	$1,217	$3,534
AA @ 9%	$351	$123	$474
c. Travel			
Six 3-day trips to service equipment / sample fish	$2,100	$0	$2,100
PI to attend scientific meeting to present results	$2,000	$0	$2,000
Invited quests to attend workshop (12 people x 1 trip)	$0	$14,400	$14,400
d. Equipment	n/a	n/a	n/a
e. Supplies			
Misc. EM supplies and fisheries sampling supplies	$2,500	$0	$2,500
f. Contractual			
Archipelago Marine Research Ltd. (4 line items)	$144,725	$0	$144,725
Fishermen sampling fees (6 boats x 12 mo x $800)	$57,600	$0	$57,600
At-sea observer coverage (32 days x $1,300 day)	$41,600		$41,600
SC Sea Grant (AVH) (1.5 mo salary + travel)	$10,279	$2,246	$12,525
g. Construction	n/a	n/a	n/a
h. Other			
Mailing, copies, office supplies, publication charges	$1,500	$0	$1,500
Workshop expenses (room rental, audiovisual, etc.)	$0	$5,000	$5,000
i. Total Direct Charges (sum of a – h)	$276,865	$28,547	$305,412
j. Indirect Charges 25% of TDC as per NOAA funding restrictions	$69,216	$7,137	$76,353
k. Totals (sum of i – j)	$346,081	$35,684	$381,765

10. NMFS partner (separate from Federal funds requested)
Dr. Jack McGovern