Project Title: **South Atlantic Oculina Experimental Closed Area and Deep-Water Marine Protected Areas: Characterization of Benthic Habitat and Fauna**

Applicant Organizations: National Marine Fisheries Service (NMFS) / Southeast Fisheries Science Center (SEFSC) and Harbor Branch Oceanographic Institute at Florida Atlantic University (HBOI/FAU)

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Geographic Location of Project: Continental shelf-edge of the south Atlantic Bight between Fort Pierce, FL and Cape Lookout, NC. Inside and adjacent to six marine protected areas (MPAs): North Florida, Georgia, Edisto, Northern South Carolina, Snowy Wreck, and the Charleston Deep Artificial Reef as well as inside the Oculina Experimental Closed Area.

Project Timeframe: October 2014 – September 2017

Scope of the Project:

The South Atlantic Fishery Management Council (SAFMC) established eight deep-water Marine Protected Areas (MPAs) along the outer continental shelf off the southeastern U.S in February 2009 and the Oculina Experimental Closed Area (OECA) in 1994. This project proposes to document and characterize the benthic habitat, macro-fauna, and fish assemblages of these protected areas in the U.S. South Atlantic as part of a long-term sampling program to document changes in these areas before and after fishing restrictions are implemented. Efficacy testing of this management tool will aid the SAFMC in future use of area restrictions for the protection of valuable habitat and fishery resources.

PROJECT SUMMARY:

The Oculina Experimental Closed Area (OECA) was established in 1994 and closed the area to all bottom fishing in order to evaluate the effectiveness of the reserve for management and conservation of snapper grouper populations. The OECA is located within the Oculina Habitat

Area of Particular Concern (OHAPC) which was established in 1984 when the significance and value of *Oculina varicosa* to important fishery species was recognized by the SAFMC. As part of the Oculina Experimental Closed Area Evaluation Plan, a re-evaluation of the area is set to be completed in 2014.

In 2009, the SAFMC established eight MPAs ranging from North Carolina to the Florida Keys. The proposed study is a continuation of a monitoring program of five of these MPAs which began five years prior to the closures. The MPAs were implemented to protect five species of grouper and two species of tilefish, all of which are long-lived, late-maturing species. These life history characteristics suggest it will take several years to detect population-level changes in abundance of these target species. Thus far, four years of pre-closure and four years of post-closure data have been collected (surveys in 2005 and 2011 were not conducted due to weather and funding issues respectively). Funding of the proposed study would extend the surveys to a point at which the first year classes born in the absence of fishing pressure would begin to reach maturity. An unfished population is valuable for determining the natural density of these species in the MPAs. This survey is the most comprehensive, long term and geographically dispersed of any in these MPAs, and as such the Council has placed high emphasis on it to provide the most detailed information on these areas.

This project proposes to continue annual monitoring of five of the eight deepwater MPAs to examine closure effectiveness by conducting remotely operated vehicle (ROV) dives inside and adjacent to the protected areas. ROV dives will also be conducted inside the OECA. Digital video and still images collected with the ROV will result in a full, detailed analysis of fish assemblages, macro-benthos, and habitat inside the protected areas as well as in neighboring areas that are open to fishing. Multibeam mapping has also become a priority over the past couple of years and has proven crucial for locating target habitats to examine with the ROV.

For each year of this study, the abundance and distribution of economically important reef fish species and macro-benthos will be determined both in and around the MPAs as well as inside the OECA in the U.S. South Atlantic. Percent cover of habitat types will be calculated, and habitat and fishery data will be correlated.

Partners:
PIs for this project are from NOAA/NMFS/SEFSC and HBOI/FAU. The ROV and pilots are from the University of North Carolina at Wilmington's Underwater Vehicles Program (UNCW/UVP), and multibeam mapping expertise has come primarily from NOAA's National Ocean Service - National Centers for Coastal Ocean Science (NOS/NCCOS).

Expected outcomes and performance evaluation:
During each year of the project, semi-annual progress reports will be submitted to the SAFMC as well as a final report including a detailed analysis of fish assemblages, macro-benthos, and habitat of each year's ROV dives as well as processed multibeam mapping data. Results from this MPA monitoring survey will be used by the Council to evaluate efficacy of these MPAs as well as aid in decisions made on future sites. Project P.I.'s will also be available for

presentation(s) during Council meetings to ensure project information dissemination occurs during appropriate Council Committee agenda discussions.

PROJECT DESCRIPTION:

The SAFMC also has a mandate through Amendment 13A to the Snapper-Grouper Fishery Management Plan to provide a re-evaluation of the Oculina Experimental Closed Area in order to determine if the regulations have been successful and to decide if any changes are needed in size, configuration, and gear restrictions for the area. A portion of the Oculina Bank known as the Oculina Habitat Area of Particular Concern (OHAPC) first received protection in 1984 when the significance and value of *Oculina varicosa* to important fishery species was recognized by the SAFMC. The Oculina Experimental Closed Area (OECA) was then established in 1994 in response to rapidly diminishing grouper populations (Figure 2). This closed the area to all bottom fishing in order to evaluate the effectiveness of the reserve for management and conservation of snapper grouper populations. Previous ROV dives have been completed in the OECA in 2003, 2005, and most recently in 2011 which will be used to compare past and present fish and macro-benthos populations. Additionally, *Oculina* mounds recently discovered by PIs David and Reed in 2011 lie in the area between the North Florida MPA and the OHAPC which could be incorporated into this project if time allows.

The SAFMC implemented eight Type II MPAs between Cape Hatteras, NC and the Florida Keys to protect seven species of the deepwater snapper-grouper complex in February 2009 (Fig. 1). The closures, however, will provide ecosystem-level benefits to the entire complex as well as protect the shelf-edge reef habitat they utilize. The targeted species consist of five species of grouper: snowy grouper (*Hyporthodus niveatus*), yellowedge grouper (*H. flavolimbatus*), warsaw grouper (*H. nigritus*), speckled hind (*Epinephelus drummondhayi*), and misty grouper (*H. mystacinus*); and two species of tilefish: golden tilefish (*Lopholatilus chamaeleonticeps*) and blueline tilefish (*Caulolatilus microps*). These species are considered to be at risk due to currently low stock densities and/or life history characteristics which make them vulnerable to fishing mortality. Based on the most recent stock assessments, one of these are considered to be overfished, snowy grouper, and two are undergoing overfishing, warsaw grouper and speckled hind (SEDAR 04, 2004). Tilefish (SEDAR 25, 2011) are not considered overfished, and the status of misty grouper, and yellowedge grouper is unknown at this time. A stock assessment for blueline tilefish was recently completed and indicated they are overfished and undergoing overfishing (SEDAR 32, 2013). An updated stock assessment for snowy grouper is currently on-going. Life history characteristics of several of the targeted species make them more vulnerable to overfishing. Many are protogynous hermaphrodites with highly female-skewed sex ratios, even in unfished populations. Aggregate spawning with strong interannual site fidelity is also common, offering knowledgeable fishermen the possibility to harvest large numbers of reproductively active fish in a short period of time. Dominant males aggressively defend these spawning aggregation sites and are more easily caught than during non-spawning periods, leading to further skewing of the sex ratios and localized reproductive failure (Gilmore and Jones, 1992; Coleman et al., 1996). Bottom-tending fishing gear has been shown to have deleterious effects upon reefs and is now prohibited in the MPAs.

These sites are the first MPAs designated by the Council to protect spawning grounds of reef fish. As such, decisions to create future area closures will be based upon the efficacy of these areas and the lessons learned during their implementation. Additionally, the MPAs contain extensive areas infested with the invasive lionfish (*Pterois volitans/miles*), whose population continues to rapidly expand (Whitfield et al, 2007). Future monitoring will assist in evaluating the ecosystem effects of this invasion. Area closures constitute a politically charged issue that is unlikely to retain support without evidence indicating increases in the target species. Knowledge gained and information disseminated by projects such as this one will educate the public and inform managers about the usefulness of closed areas as a management tool. This project will also benefit coral reef ecosystems directly by improving our understanding of the impact of fishing activities on both vertebrate and invertebrate species.

The proposed monitoring program for the MPAs will ensure the Council remains well informed of changes within reef fish populations and coral habitats associated with these MPAs. NOAA Fisheries conducted pre-closure examinations of five of these potential MPA sites in April-May 2004, June 2006, August 2007, and July 2008. Post-closure data were collected in November 2009, May 2010, July 2012, and July 2013. This situation afforded the opportunity to obviate the criticisms of comparing MPAs with concurrent surveys of analogous, adjacent open-to fishing areas by examining the future MPA sites for four years prior to the closures. Since monitoring began in 2004, this project has produced population density estimates of targeted reef fish species within the boundaries of five of the eight MPAs and adjacent control areas, before and after closure. Three of the MPA sites have not been included in this survey thus far, one artificial reef site off Charleston, SC and two natural bottom sites off southern Florida. The artificial reef site was excluded because the project focused on fish-habitat relationships in natural areas and because no structures were placed on the bottom until 2013. The south Florida sites were excluded for logistical reasons related to their remoteness from the remaining five natural habitat sites in the South Atlantic Bight. The artificial reef site off Charleston, SC will have structure on it by the time funding for this proposal would begin, so it will be included in the ROV surveys to examine reef fish and invertebrate colonization. Time series data provided by this project allows detection of trends in reef fish populations in these MPAs and may afford the opportunity to forecast outcomes of new closures across the U.S. South Atlantic specifically and in other shelf-edge reef areas in general. Annually updated population evaluations provide enhanced management opportunities as well as updated information products and new publications. These closures are very recent in comparison to the life cycles of the fish they are designed to protect; therefore it is imperative to continue annual examinations of these areas as population changes may take several years to detect. Also, examination of previously collected data reveals annual fluctuations in population structures of the targeted species which would not have been detected with biannual (or longer) surveys.

This project also examines mesophotic and deep coral habitat linkages due to the location of the MPAs on the outer edge of the continental shelf. During the most recent cruise (July 2013), *Oculina varicosa* (typically considered a mesophotic coral) was discovered to be common off North Carolina at depths of 90-119 m and what appears in the video to be *Lophelia pertusa* (typically known as a deep-water coral) was observed in depths of 110-134 m, also off North

Carolina. Photos of the "*Lophelia*" were sent to several deep-water coral researchers post cruise that unanimously agreed with the *Lophelia* identification, but could not confirm without a sample in hand. Therefore, it appears the depth ranges of the two coral species could possibly overlap. The ROV we propose to utilize is equipped with a five function manipulator which will allow collection of reference samples, and thus positive identification of noteworthy sessile organisms.

At the March 2012 SAFMC meeting, the Council refined the Comprehensive Ecosystem-Based Amendment 3 (CE-BA 3), and included actions to consider expansion or designation of coral Habitat Areas of Particular Concern (HAPCs) and MPAs for speckled hind and warsaw grouper. A MPA Expert Working Group was subsequently formed to provide scientific input on using MPAs to end overfishing for these two species of grouper. PI Harter is a member of this group and presented results from previous cruises, particularly 2012, to the other Working Group members as this survey is one of only a few that is examining the deep-water MPAs and surrounding areas. Two meetings have been held so far, one in May 2012 and the other in February 2013. At the conclusion of these meetings, a total of 29 areas were proposed along the U.S. South Atlantic shelf-edge ranging from North Carolina to the Florida Keys as possible areas to close to protect speckled hind and warsaw grouper. These included both new MPAs and well as re-orienting the existing MPAs. High emphasis was placed on and will continue to be placed on this survey as this process proceeds. During our 2013 cruise, 13 of the proposed areas were visited and even more will be examined in subsequent years of this survey.

This project is in direct support of Fishery Management Council activities associated with the characterization of protected deep-water coral ecosystems and the efficacy testing of existing protected areas. It addresses the following objectives identified in the 2005 Oculina Experimental Closed Area Evaluation Plan: 1. Identify OECA fish population demographics, 2. Characterize major fishery species within the OECA compared to reference sites, 3. Complete high definition bathymetric mapping within the OECA, and 4. Complete habitat characterization within the OECA. The project also addresses the following CRCP National Goals and Objectives: 1. Obtain ecological information for coral reef fishes and spawning aggregations: Activities may include: a) Studies that identify, map and characterize fisheries habitat (including essential fish habitat, habitat areas of particular concern, and spawning aggregation sites) in U.S. coral reef ecosystems, and assess the condition of the habitat; b) Studies associated with coral reef areas that are currently, permanently, or seasonally closed to fishing, or that may merit inclusion in an expanded network of no-take ecological reserves; and c) Multi-beam or sidescan sonar mapping and ground truthing, habitat characterization, and monitoring of such areas, including deeper coral reefs, bands and beds.

Project Objectives:
1. Perform a re-evaluation of the OECA by conducting ROV dives inside the protected area to complete a species and habitat characterization of the area .
2. Complete multibeam mapping of the OECA

3. Continue annual monitoring of five of the eight deepwater MPAs to examine closure effectiveness by conducting remotely operated vehicle (ROV) dives inside and outside the protected areas.
4. Continue multibeam mapping inside and in the areas surrounding the MPAs. Maps produced have been and will continue to be crucial for locating areas to dive on with the ROV. They also provide an estimate of what percentage of the MPAs contain habitat suitable for the target species.
5. Begin monitoring of reef fishes and invertebrate colonization of artificial structures in the Charleston MPA.

Task Description and Methodology:
The following tasks will be completed each year of the project;
1. Determine the abundance and distribution of economically important reef fish species and macro-benthos in and around the MPAs and inside the OECA in the U.S. South Atlantic;
2. Evaluate the habitat of the areas with respect to species composition and abundance as well as geomorphology; and
3. Correlate fishery and habitat data to detect trends in fish and invertebrate populations as the protected areas mature.

The methodology is straightforward: conduct fishery independent, non-destructive surveys and evaluate trends in fishery abundance and distribution as well as habitat correlations over time. Proposed research for the deepwater MPAs and OECA will follow the protocol established during the self-funded pilot study for the MPAs in FY 04, the Coral Reef Conservation Program (CRCP) funded surveys in FY 06-10, and the CRCP Fishery Management Council Coral Reef Conservation Cooperative funded surveys in FY 11-13 projects. During the cruises, nighttime operations will consist of multibeam mapping and transiting between study areas and daytime operations will consist of ROV dives. During the course of this study, a couple of significant additions have been made to the field work in order to maximize the scientific value of the survey. PI Reed began collaborating on this project in 2010 to provide a detailed habitat and macro-benthos analysis and multibeam mapping was added when we started getting regular ship time on the NOAA R/V *Pisces*.

A stratified random design in its purest form is not possible at this point because we do not have complete maps of the deepwater MPAs from which the areas can be stratified by habitat type. However, with each year more areas are mapped allowing an increase in the ability to stratify and randomly select sites within strata. Therefore, site selection for the deepwater MPAs is a combination of random selection within previously mapped strata, purposeful selection based upon near real-time mapping conducted the night before each dive, and return visits to previously surveyed sites to produce repeated measures in a time series. During the site selection process, contacts will be made with South Carolina DNR – MARMAP (Marcel Riechart) and Beaufort Lab – SEFIS (Todd Kellison and Nate Bachelor), two other monitoring programs that sample in or near the MPAs. Discussions will be used to learn where each program is sampling so that overlap does not occur and that we may all be efficient with limited resources. Site selection for the OECA will be based primarily on existing multibeam data of the area.

Ship time for this project has been allotted on the NOAA Ship *Pisces* for the past three years and we anticipate this to continue in the future. Data collected from the *Pisces* mapping system will consist of both bathymetry from the ME70 multibeam system and fisheries data from the EK60 split-beam system. Data will be processed as it is collected using both CARIS and Fledermaus and then put into ArcGIS so survey sites can be selected for the next day's dives. The *Pisces* is the first vessel used for this project with multibeam mapping capabilities and has greatly improved the success of our cruises. In 2012, 145 km² was mapped and 218 km² was mapped in 2013. These maps have been and will continue to be crucial for selecting hardbottom areas to dive on with the ROV. They also allow the percentage of each MPA containing suitable habitat for the target species to be calculated.

An ROV will be used for habitat delineation, percent coverage estimates, fish identification and abundances, estimating fish size, determining the location of spawning aggregation sites, and the collection of biological samples. Transects for the ROV are generally 1.5-3.0 km in length and topography and currents are factored into dive planning. Sites with similar habitat types will be examined both inside the MPAs and areas adjacent to the closed areas for comparison purposes. Every effort is made to survey all five MPAs each year.

The ROV we will contract for the proposed work is the Sub-Atlantic MOHAWK owned and operated by the University of North Carolina at Wilmington (UNCW) Undersea Vehicle Program. This is a new vehicle with significant improvements over the vehicle previously used for this project. Upgrades include fiber optic cable, high definition video, significantly higher resolution digital still camera, more paired lasers for scaling measurements, and a five function manipulator and suction system for sample collection. If funding becomes available through the FGNMS, HBOI CIOERT will build a collection skid with various buckets for sample collections. The new vehicle also has the ability to go to 1000m, even though it is limited to 350m in its current configuration. High currents in the area require the use of a downweight (~145 kg) to keep the ROV umbilical cable near the bottom throughout the dives as we want the ROV to operate within two meters of the seafloor to make fish and invertebrate identifications possible. This downweight is tethered to the ROV umbilical and the ROV operates on a 30 m leash which provides sufficient freedom of movement to investigate habitat features within visual range of the transect line. The downweight configuration allows the ROV to drift just above the bottom at a controlled over-the-ground speed of approximately 1.4 km/hr (range 0.9 to 2.8 km/hr). The geographic position of the ROV (± 3m) is constantly recorded throughout each dive with a tracking system linked to the ship's DGPS system.

Hydrographic data will also be acquired at all survey sites. A Seabird SBE–19+ CTD will be deployed at the beginning and end of each day and will collect a suite of environmental variables (temperature, depth, conductivity, dissolved oxygen, and transmissivity). In addition, a smaller Seabird SBE-39 will be mounted on the ROV and will measure temperature and depth throughout each dive.

Post cruise, video footage will be used to evaluate fish species presence and abundance within each habitat type inside and outside the MPAs as well as inside the OECA. ROV dives are

typically 1.5-2.5 hr. in length. Each dive will be divided into transects delineated by commonality of habitat type and/or time. All fish within a 5 m radius of the transect line on the video tapes will be identified to the lowest discernable taxonomic level and counted (5 m was determined as the maximum distance that fish could reasonably be identified). Highly mobile fish such as amberjack (*Seriola* sp.) will be conservatively counted as the maximum number seen at any one time in the field of view to prevent overestimating their abundances, since they have a tendency to circle the ROV. For habitat and benthic biota analysis, a digital still camera mounted on the ROV will be tilted perpendicular to the seafloor and an image taken every two minutes. These images will be used to determine percent cover of all habitat types and sessile benthic biota using Coral Point Count with Excel extensions (CPCE) for each dive. The habitat types and biota will be compared inside and outside of the MPAs. Average abundances of fish species inside versus outside each MPA will be compared for the seven target species as well as the more common species in the grouper-snapper complex and lionfish. The fish populations will also be compared by habitat type for the MPAs and OECA.

The SAFMC has also asked for data on size and age structure and sex ratios for the major fishery species within the OECA. This would require collecting specimens with traps, but because this gear type would be destructive to the *Oculina* coral and other macro-benthos, only visual surveys with the ROV will be conducted. The new ROV that will be contracted for this work, however, has more paired lasers allowing for better measuring capabilities. Size measurements of all major fishery species from inside the OECA will then be compared to fish caught in the area surrounding the OECA by the Southeast Fishery Independent Survey (SEFIS) trapping project led by Nate Bachelor and Todd Kellison (NMFS Beaufort Lab) to estimate size and age structure and sex ratios.

Specific activities to be accomplished each year from FY-14 through FY-16 will be a research cruise, data analysis, and submission of reports and data to the South Atlantic Fishery Management Council. The reports to the Council will include information on the presence/absence of all reef fish inside and outside each MPA and inside the OECA, percentage of all habitat types observed inside and outside the MPAs and inside the OECA, a comparison of the abundance of all target and other economically important species inside and outside each MPA and inside the OECA by habitat type, a benthic invertebrate species list with percent cover of sessile biota including sponges and corals, and electronic copies of all multibeam map data. Cruise dates will be targeted for early-summer, to match the majority of the previous effort, remove variability induced by seasonal changes in fish movements, and avoid hurricanes. An average of 14 days of ship time will be requested. Analysis of videotaped and photographic data is time consumptive and will take approximately four to six months to accomplish. Preparation of a final report to the Council will require an additional month. The ROV we will use, operated by UNCW/UVP, has proven to be quite effective for this work and is very cost effective compared to other systems.

<u>Preliminary Conclusions from Previous Years</u>

A presentation was given to the SAFMC in December 2013 reporting what has been accomplished with this project thus far. Changes in abundance of species from the

snapper-grouper complex were examined and compared using a BACI design (inside MPA/before closure, outside MPA/before closure, inside MPA/after closure, outside MPA/after closure). Results varied by species and by MPA, but overall, there are a few general conclusions that have been made.

1. Snowy grouper and speckled hind may show an increase in density inside some of the MPAs.
2. Red porgy, vermilion snapper, and tomtate densities appear to have increased inside most of the MPAs.
3. Gag grouper densities appear to have increased in all MPAs with the exception of Georgia.

Note that these conclusions are based solely on comparisons of densities. Formal statistical analyses have not been completed yet. If funded, a total of 8 years of post-closure data will have been collected. Since the target species are long-lived, it will take some time before changes due to protection are detected, however, we are hoping that 8 years is long enough and that changes will start to be detected. At this point, a formal statistical analysis will be conducted to look for significant changes as a result of protection from fishing.

Outcomes and Deliverables:

For each year that the proposed project is funded, semi-annual progress reports will be submitted to the SAFMC as well as a final cruise report including a full detailed analysis of fish assemblages, macro-benthos, and habitat of each year's ROV dives along with multibeam map data which will be distributed to both the SAFMC and NOAA National Geophysical Data Center (NGDC). Results from the MPA and OECA monitoring survey will be used by the Council to evaluate efficacy of these areas as well as aid in decisions made on future ones. Because our time series of data on the MPAs will surpass a decade during the proposed funding period, data provided by this project should allow forecasting of trends in reef fish populations in these MPAs specifically and along the U.S. South Atlantic in general. We will continue to coordinate activities with other researchers working in the area (e.g. MARMAP and SEFIS) and conduct public outreach through a variety of venues including the NOAA Teacher-at-Sea Program. These data dissemination efforts provide information gathered during this long term monitoring program to managers not directly associated with the U.S. South Atlantic, which may be useful in creating effective MPAs elsewhere.

Literature Cited:
Coleman, F.C., C.C. Koenig, and L.A. Collins. 1996. Reproductive styles of shallow-water grouper (Pisces: Serranidae) in the eastern Gulf of Mexico and the consequences of fishing spawning aggregations. *Environmental Biology of Fishes* 47: 129-141.

Gilmore, R.G. and R.S. Jones. 1992. Color variation and associated behavior in the Epinepheline groupers, *Mycteroperca microlepis* (Goode and Bean) and *M. phenax* (Jordan and Swain). *Bulletin of Marine Science* 51(1): 83-103.

SEDAR 04. 2004. Stock assessment of the deep-water snapper-grouper complex in the South
Atlantic. SEDAR 4 Stock Assessment Report 1. 594p.

SEDAR 25. 2011. Stock assessment of the South Atlantic tilefish. 330p.

SEDARD 32. 2013. Stock assessment of the South Atlantic Gray Triggerfish and Blueline
Tilefish.

Whitfield, P.E., J.A. Hare, A.W. David, S.L. Harter, R.C. Muñoz, and C.M. Addison. 2007.
Abundance estimates of the Indo-Pacific lionfish *Pterois volitans/miles* complex in the
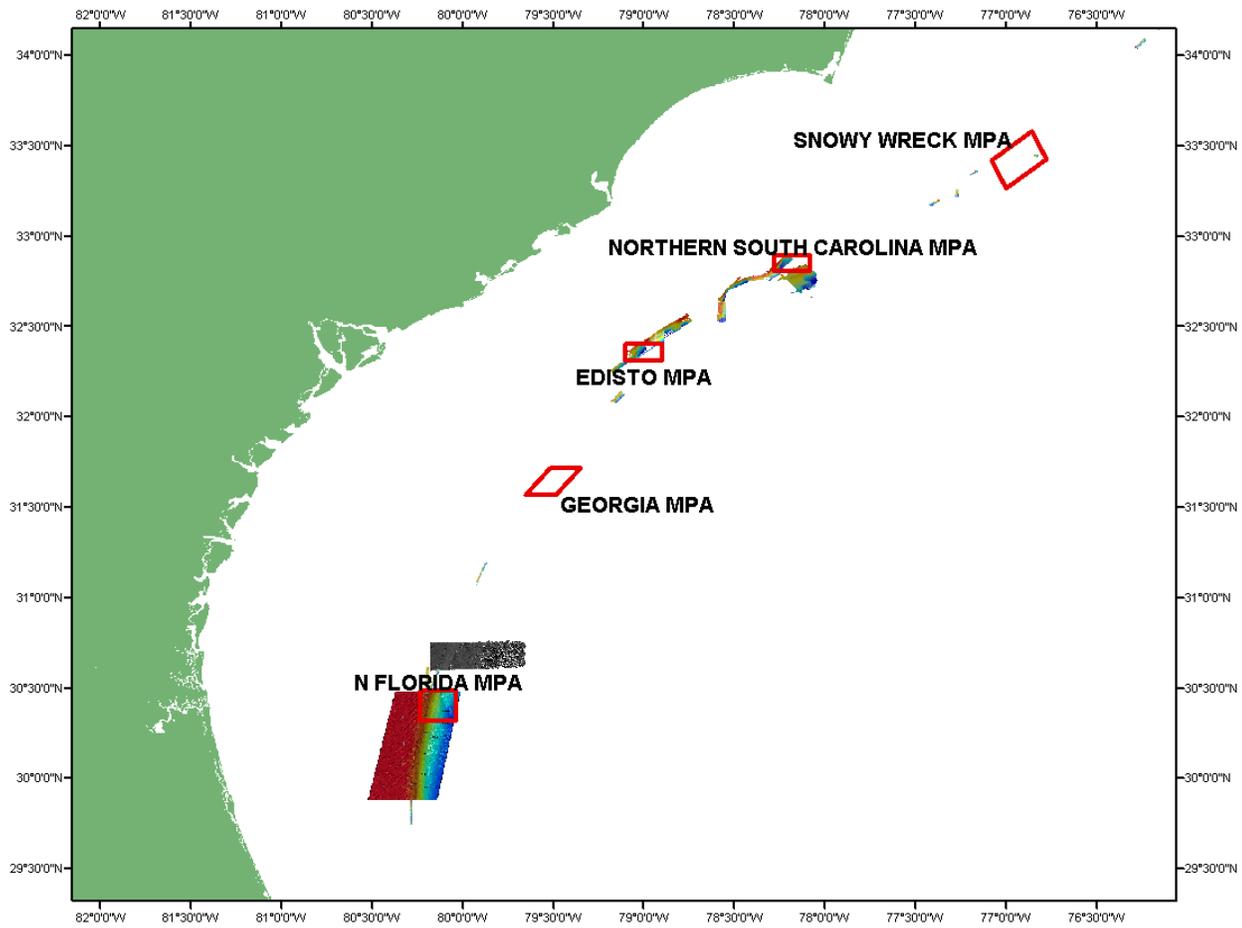Western North Atlantic. *Biological Invasions* 9(1):53-64

Figure 1. Map showing the deepwater shelf-edge MPAs (red polygons) and multibeam mapping accumlated over the past couple of years.
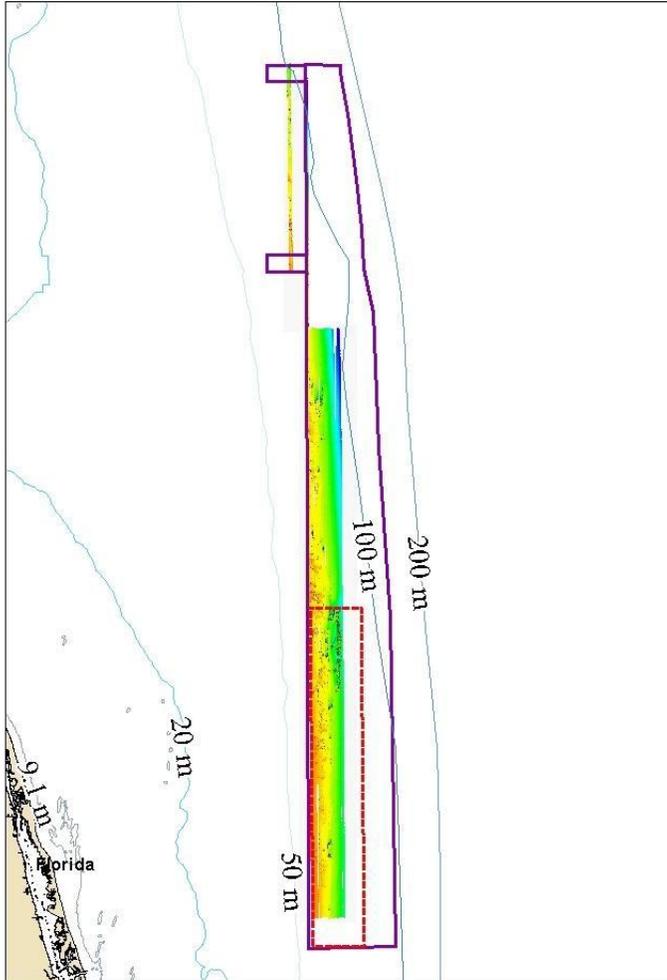
Figure 2. Map displaying the Oculina area and the multibeam mapping that has been completed there. The entire Habitat Area of Particular Concern (HAPC) is outlined in purple while the Oculina Experimental Closed Area (OECA) is outlined in red.

Schedule and Milestones:
It will require approximately six months from the time data is collected to complete analysis of ROV dive video and digital still photos and an additional month to prepare the report for SAFMC.

Year 1
Collect ROV and multibeam data:	July 2015
Analyze and process data:	February 2016
Prepare Final Report for SAFMC:	March 2016

Year 2
Collect ROV and multibeam data:	July 2016
Analyze and process data:	February 2017
Prepare Final Report for SAFMC:	March 2017

Year 3
Collect ROV and multibeam data:	July 2017
Analyze and process data:	February 2018
Prepare Final Report for SAFMC:	March 2018

Project Management:
PIs Harter and David have been examining mesophotic and deepwater ecosystems for over ten years and have been working together since 2004 on the U.S. South Atlantic MPAs. Harter is a member of the South Atlantic Council's MPA Expert Working Group and David was the lead PI for NOAA's Deep Sea Coral Research and Technology Program for the Southeast. PI Reed has been studying deep coral ecosystems for 37 years and was integral in the implementation of the *Oculina* HAPC and examination of the deep coral HAPC implemented by the SAFMC in 2009. He joined this project in 2010, enhancing it to include macro-benthos and a more detailed habitat analysis. Harter and David will be responsible for conducting fish analysis of the MPAs and OECA while Reed will be responsible for conducting the habitat characterization and sessile benthic invertebrate analysis. Collaborators with NOS Charleston and the College of Charleston will collect and process multibeam mapping data and fisheries acoustic data. Harter will be in charge of all cruise planning and will write the semi-annual reports and all three PIs will contribute to the final report.