Project Proposal:

Restoring Fishery Habitat on the West Florida Continental Shelf: Phase I, Benthic Habitat Characterization and Assessment

Partners:

University of South Florida:
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United States Geological Survey (USGS):
TBD

National Oceanic and Atmospheric Administration, National Marine Fisheries Service:
TBD

Project Location: West Florida shelf from Pensacola, FL, to north of the Dry Tortugas, in 20-250 m of water. (See the attached map; Fig. 1). We propose to operate in five zones (one each year in the five years of our field campaigns). Each year we will carefully plan our operations to consider areas of high fishing activity (as revealed by catch and effort records) as well as marine protected areas, built infrastructure, and known or presumed high value habitats for reef fishes and other species.

While most activities will be undertaken from St. Petersburg, Pinellas County, Florida, the activities themselves will be concentrated off counties most heavily impacted by the Deepwater Horizon incident in the northeastern Gulf of Mexico.

Project Description:

Summary - This project seeks to provide critical information on the extent and species utilization of offshore fishery habitats along the West Florida Continental Shelf (WFS). These data are generally lacking for this region and as a result, there have been few proposals to restore and conserve critical offshore fish and wildlife habitat as a result of the call for habitat restoration activities. Using state-of-the-art towed camera and multibeam/sidescan sonar technologies, our team will assess habitat characteristics and species associations in five zones extending from off Pensacola, FL to just north of the Dry Tortuga Islands. Products of this effort will be detailed high-resolution maps of the bathymetry and habitat types of about 7,680 square kilometers of additional valuable fish habitat, and detailed video images of about 192 square kilometers at representative locations. Additionally, we will describe the habitat requirement of various species, with special emphasis on bottom-dwelling reef fish species including snappers and groupers. From these data, we will describe the state and condition of bottom habitats in the region, and identify locations where additional conservation protections or active restoration activities will be most beneficial.

Background- Many living marine resources are intimately linked to the benthic environment through utilization of the physical habitat for shelter, feeding and spawning. A lack of understanding of the distribution and abundance of benthic habitats prevents a fuller understanding of how critical ecosystem functions are linked to the health of the habitat and the quantification of living marine resources at various life stages associated with them. For several years, the Florida Fish and Wildlife Research Institute (FWRI), NOAA-National Marine Fisheries Service (NOAA-NMFS), the US Geological Survey (USGS) and the University of South Florida (USF) have been engaged in various studies to address this information gap. Modest-scale mapping projects have produced highly accurate bathymetry of a few areas of high conservation value such as the Florida Middle Grounds Habitat Area of Particular Concern (HAPC; Fig. 2), the Steamboat Lumps and Madison-Swanson fishery closed areas, the “edges” area off of the Florida Panhandle, the “sticky grounds” off of Tampa, and a few small areas to the south. These areas, however, represent only a small fraction of the likely high-value hard bottom habitat areas on the WFS. There are large regions of the area that have had no work done on them with respect to habitat identification. Furthermore, even for those areas already mapped with high resolution sonar, the actual habitat types and species associated with them are poorly understood. Unlike the western Gulf of Mexico, there has been a paucity of acoustic surveys in the eastern Gulf, due to the moratorium on oil and gas exploration and development. Reasons for the lack of a synoptic mapping effort on the WFS to date are several (1) lack of dedicated funding, (2) disparities in the data collected in past surveys and the challenges of integrating them, and (3) lack of ability to merge acoustics with ground trothing technologies that can be used to positively identify significant portions of the area covered by sonar. For this proposal, we believe we can overcome these challenges.

There have been and continue to be many proposals to conserve fish species and their habitats by designating additional HAPCs and higher levels of protection afforded by fully closed marine protected areas (MPASs). To do so, however, requires accurate information on the fish and wildlife habitats contained in various candidate areas and their value relative to alternative areas. Also, we do not have a good set of evaluations of the health of various offshore habitats in relation to a variety of threats including fishing activities, pollution, effects of Deepwater Horizon, climate change and invasive species. The latter issue, especially with respect to the invasion of predatory lionfish, represents a serious threat to the integrity of offshore fish habitats. In order to provide required information to address habitat restoration and conservation in the face of such threats we need a concerted effort to bring existing habitat mapping efforts on the WFS together, to integrate various disparate existing data sets and to mount a credible field effort to systematically improve the amount and relevance of information on habitats for fishes. This effort will address these goals.

Objectives – The specific objectives of this restoration-related project are as follows:

(1) Assemble existing fish habitat mapping information and related high-resolution bathymetry and ground truth data on habitat features and species occupation. Maintain an accurate and complete map of the West Florida shelf as mapping activities are conducted. Consult with stakeholders, state and federal agencies for priorities for future mapping activities.
(2) Conduct field mapping of priority habitat types, fish species associations and high-resolution bathymetry in each of 5 target zones (Fig. 1)
(3) Assess the species composition and size distribution of fishes and other environmental factors in mapped areas. Develop models to predict habitat types and species associations based on correlating acoustic backscatter patterns and detailed imagery
(4) Develop and share maps, databases and related environmental information to assist conservation planners and managers
(5) Publish detailed reports on the status of fish habitats on the West Florida Shelf and identify potential areas for additional protection and restoration activities.

The goal of this program is to extend previous mapping activities on the WFS in order to facilitate habitat restoration/protection in offshore waters of the Gulf of Mexico. To do so, we will collaborate widely with various science and management entities in state and federal government agencies, academia, and private industry.

Methods- The project relies on two major technologies in order to effectively characterize both habitat types and to assess species abundance and size composition within them. First, we will use the C-BASS (Camera-Based Assessment System) towed imaging system to map both the bottom characteristics and to evaluate species

utilization of various habitat types. C-BASS is a system that is designed to be towed by a research vessel and provide high quality imagery from 5 simultaneous cameras (Fig. 3). From these images we can assess the species identity and the relative sizes of individuals using stereo vision techniques. The C-BASS vehicle also provides a full suite of simultaneous environmental measurements including temperature, depth, and altitude above bottom, turbidity, salinity and chlorophyll. The tow sled is "flown" about 3 meters above the bottom and provides an image width of about 10 meters. Images are provided to the ship in real time to avoid obstacles and assure proper height above the bottom. Second, in addition to the C-BASS towed camera system, we intend to use multibeam and side-scan sonar to provide high resolution bathymetric mapping to accompany the images. In this way, we can build up small to large scale maps of the west Florida shelf to be used in developing habitat mapping and conservation proposals. Both of these technologies are developed and tested and are ideal for our application. All relevant instruments and sensors are calibrated and tested in applications similar to ours. The team will use research vessels supplied by the Florida Institute of Oceanography (R/V *Weatherbird II* and R/V *Bellows*) to conduct these surveys which will allow day and night operations to maximize the use and data collection during deployed days at sea.

Seafloor mapping component

Swath imaging of the seafloor using multibeam and sidescan sonar bathymetry will be conducted in conjunction with video surveys to provide insight on the association between bottom type and benthic community. Most of the west Florida shelf is unmapped territory, thus we will conduct exploratory surveys to identify new areas of seafloor habitat to be further investigated using the C-BASS system. Past mapping efforts have focused on select areas along the shelf break in the NE GOM (Pinnacles-to-Steamboat Lumps), the Florida Middle Grounds, Sticky Grounds, the Pulley Ridge paleo-shoreline and banks in the Tortugas region. Minor additional multibeam mapping has attempted to follow some paleo-shoreline hard bottom along the outer shelf. The FWRI have conducted numerous small-site surveys related to camera stations occupied by the Fishery-Independent Monitoring (FIM) program. Our strategy will be to gather and access existing datasets as a template for new mapping efforts, and to coordinate future surveys with ongoing projects in other organizations. We will focus on linking together the existing patch-work of mapping with delineating the large-scale trends in distribution patterns of important bottom types and species.

Our methods will include state-of-the-art swath mapping systems and acoustic data analysis. Geological oceanographers at the USF College of Marine Science (CMS) have decades of experience with acoustic seafloor investigations. We have facilities for both deep-tow and ship mounted swath mapping, along with a large inventory of

supporting equipment and software. Some key systems include a Teledyne-Benthos C3D interferometric sidescan sonar, Edgetech analog sidescans, hull-mounted EK60 sonar on the R/V *Weatherbird II*, and a new Reson Seabat 7125 multibeam (this proposal). These systems will be integrated with the CBASS video surveys. Additionally, the interpretation of seafloor imagery will be conducted with an eye toward classification standards being developed by FWRI, NOAA Fisheries, and University of Florida researchers. We plan to show bottom type classification related to community/fish assessments, and to establish semi-quantitative relationships between bottom type and fish populations (diversity and abundance).

Habitat Classification and Species Utilization Component

The C-BASS tow sled and camera system (Fig. 3) were supported by two grants from NOAA/NMFS to the University of South Florida (S. Murawski, PI) for conceptual design and testing of the feasibility of large-scale fish abundance and habitat mapping. It is equipped with high resolution cameras and lighting focused ahead of and below the vehicle so that imagery of the fish is collected at multiple perspectives, increasing the likelihood of positive identification. All video and sensor data is processed and data-based *in situ* onboard the platform. Additional technical improvements to this system are underway and may include computerized automatic species recognition algorithms and software. Although not part of this proposal, if these advancements are made, then they will be implemented in the current project.

As preliminary investigation of the Gulfstream gas pipeline using C-BASS (Fig. 4) have shown, the continuity of seafloor structure provides a pathway and focus for fish congregations extending over long distances, proving direct inter- and intra-regional physical linkages. Naturally-occurring high-relief hard bottom structures on the seafloor also constitute long-distance structure for marine ecosystem connectivity. Many seafloor habitats occupy relic paleo-shorelines formed thousands of years ago during the deglacial rise of sea level during the Holocene. These paleo-shorelines are continuous over great distances and are found at predictable water depths throughout the eastern GOM, as well as other continental shelf margins throughout the world. In addition to relic coastal landforms, other geologic structures are present across the continental shelf and slope, such as sea-level lowstand river deltas (e.g., Madison-Swanson), solution holes/springs, and carbonate banks (Florida Middle Grounds and Tortugas region) that reflect much older pre-Holocene structural accretion and erosional processes that have shaped the Florida continental margin and provide essential habitat for marine resources. Indeed, the monitoring of fish populations by state and federal agencies is increasingly applying acoustic imaging of the seafloor to identify hard bottom habitat favored by fish communities in order to select observing stations for stock assessment (FIM program of FWRI). Our investigations will focus on these

continuous habitat structures since they represent likely high-quality habitats for reef fish populations (Fig. 2).

The C-BASS system provides high quality imagery from which species identification for most individuals is feasible (Fig. 4). Surprisingly, the preliminary surveys along the pipeline west of Tampa revealed numerous invasive lionfish. An important sub-objective of our work will be to document the spatial extent and abundance of this species in relation to the quality and characteristics of such habitats. If additional lionfish control strategies are appropriate, our data can provide a benchmark as to the effectiveness of such efforts.

Habitat classification standards have been developed and tested by partner agencies (USGS, FWRI, NOAA-NMFS) and we will adopt these standards as we classify them based on the imagery we obtain. One of the important sub-projects is to develop a predictive model of the relationship between sonar backscatter patterns and the types of habitats actually visualized. This is important because the swath width of the sonars is approximately 40 times wider than the video swath width obtained from C-BASS. Thus extrapolating the habitat types to the larger sonar mapped area requires such a model. Having this will allow us to classify large areas relatively quickly.

Identification of Survey Priorities and Coordination Strategies –

A key element for the success of this project is to identify the likely regions containing high quality reef fish habitat and to assemble a consensus of those priorities using input from various stakeholders and agencies (state and federal). Part of our budget is allocated in order to develop workshops and outreach to various stakeholder groups. Before launching our field campaigns, we will conduct a series of workshops and public listening sessions to gather such input. In particular, we want input from commercial and recreational fishing groups, regulatory agencies (Florida Fish and Wildlife Commission, NOAA-NMFS), and various science agencies. We envision these public sessions to both provide an opportunity to explain the goals and purposes of these efforts and to use input received to help designate areas for surveys. Additionally, we will form a standing oversight committee comprised of representatives from USGS, NOAA-NMFS, FWRI, USF and other science entities to review progress and help assure that these efforts are fully integrated with other efforts Gulf-wide.

An important aspect of this proposal is to assemble the information from all the existing habitat studies. As can be seen in Fig. 2, some areas have had very substantial efforts. However, these areas are generally small and dis-connected. One of our highest priorities is to essentially “fill-in” the missing pieces and areas between the regions already mapped so that a larger more complete map of some of the high quality hard bottom areas will emerge. While we will work in all 5 of the designated mapping zones

(Fig. 1), not all areas contain equal amounts of the hard bottom habitats we seek. Thus, while it is likely that our efforts will be concentrated in the northeast region, we must also be mindful that so much of the region has not been systematically mapped that there are likely important discoveries to be made in many of the zones. Our steering committee will help balance the objectives of completing large blocks with the importance of discovering additional essential fish habitats.

Two key pieces of information will be assessed in order to inform the site selection process. First, working with NOAA-NMFS, we will use the high resolution satellite tracking data from reef fish fishing vessels to visualize where these activities occur. This should provide a highly detailed representation of where reef fish habitats occur and thus guide the selection of new areas for mapping. Second, we will use the SEAMAP trawl survey data (usually conducted over sand bottom areas) to define relatively low priority areas. In this way we should be able to provide useful information informed by data analyses and our outreach efforts.

Fish Density Data –

Using the imagery from the C-BASS video assessment we will be able to produce estimates of the relative and absolute fish density (numbers per square kilometer or numbers per track line interval). Absolute density will require estimates of the "observability function" which is the fraction of fish in the path of the tow sled that are actually imaged. This fraction will be influenced by three important factors (1) the turbidity of the water, (2) the fraction of a fish population that may be at a height above that viewed by the cameras, and (3) the fraction of fish that sense the oncoming presence of the vehicle and avoid detection. All of these factors can be determined by experimentation and continuous monitoring of vehicle environmental conditions. Using several experiments to assess these factors, we will adjust our density values to provide absolute density estimates for use in stock assessment and other applications that require population estimates. This may be of particular interest in assessing the economic consequences of habitat improvements for particular areas and for assessing additional MPAs for the WFS.

Summary - While many environmental restoration projects are being proposed for coastal, estuarine and upland areas of Florida and the other Gulf States, few to date have been specifically applicable to the deeper continental shelf regions. This is ironic because much of the impact of the Deepwater Horizon oil spill and inputs of nutrients have been focused offshore. One of the impediments to greater focus on the offshore regions for fisheries habitat improvements has been the lack of high resolution inventories of the habitat types and species utilization of these areas. Our project will provide high-resolution bathymetry, habitat classification and fish density information to inform habitat restoration and conservation efforts as part of the larger effort to restore

the fish and wildlife habitat and to manage living marine resources on the West Florida Shelf. As well, we will identify potential at-risk habitats for the eventuality of offshore activities such as oil and gas leasing and development, wind turbines and other potential threats. For example BOEM has recently announced pending lease sales in the Eastern Gulf of Mexico including waters off Florida. Proposed lease sales 225 and 226 are scheduled for 2014 and 2016 and are located in the Gulf of Mexico's Eastern Planning Area off Florida's Gulf Coast. We will identify candidate areas for consideration for greater conservation protection and potentially active restoration/rehabilitation activities that can be undertaken in later phases of this offshore restoration effort.

Estimated Project Costs:

We are proposing a 6-year budget for this effort (see attached spreadsheet). In the first year (2013) we will mobilize the necessary personnel, equipment and facilities, and conduct a series of priority-setting workshops. If these funds are granted in 2013, we will complete these activities by the end of the calendar year. Beginning in 2014 we will work for 5 years (2014-2018), surveying for 50 sea days per year. This will be the most intensive and sustained habitat mapping effort ever undertaken in the Gulf of Mexico. In each year, we will process the information from sonar imagery and C-BASS video and environmental data and update the base maps and make products available on our website. At the termination of this project we will publish electronic and paper maps of these habitats.

The 6-year budget for this effort is $10,978,453.91. The largest portion of this funding is allocated to the FIO to support 250 sea days aboard offshore research vessels to undertake this mapping activity. The remainder is allocated to three laboratories at the USF: (1) the Murawski Laboratory (interpretation of C-BASS imagery and support of workshops and outreach activities), (2) the Center for Ocean Technology (technical aspects of maintaining both instruments), and (3) the Locker Lab (high-resolution sonar mapping and analysis). The budget also contains customary overhead to the University of South Florida supporting research infrastructure.

Other Funding:

In addition to these funds, the development of the C-BASS habitat mapping vehicle is being supported by two grants totaling about $650,000 from NOAA-NMFS. As new developments in survey technology are ongoing these will be incorporated into our design. Of particular importance to the project is a series of experiments to evaluate fish avoidance of the towed vehicle and to assess the swath width in relation to water visibility and height above the bottom. These experiments will be incorporated into our calculations.

Technical Feasibility:

Both the multibeam/sidescan technology and the C-BASS towed video system exist and are tested technologies that are available and ready for utilization for this project. As well, the techniques and technologies for interpretation of data and development of appropriate maps are well understood and the USF CMS has decades of experience in interpretation of such data. There are some limitations of hull mounted sonar systems in mapping low-relief coralline habitats and we may rely on alternative technologies if the camera systems identify such regions within our zones of coverage.

Environmental benefits:

The information produced by this project will be used by conservation planners and management authorities to designate essential fish habitat and to upgrade protections for unique habitat features and fish aggregations, as appropriate. As well, we will identify conservation issues such as the distribution and density of invasive species (lionfish) and the habitat requirements of such species. Control efforts for such species need to be informed by data such as those we propose to collect. Additionally, given increasing calls for sale and development of offshore energy resources (both conventional and alternative) a high priority for environmental protection should be the identification of potential at-risk habitats. Our project will provide the most comprehensive effort yet to obtain such data.

Economic and Social Benefits:

According to a new report by the Florida Ocean Alliance, Florida's coastal counties contributed over $584 billion in gross regional product to Florida's economy in 2010, or 79% of the state's economy. More than 228,000 jobs in Florida are directly created by activities that use ocean resources. When indirect effects are taken into account, the number of jobs supported by ocean resources exceeds 440,000. According to a recent report published by NOAA, in 2011 the West Florida Shelf produced commercial fisheries sales valued at $928,929,000 with 10,550 jobs in the state. Recreational fisheries in the WFS supported 47,047 jobs with a total value of sales of $4,881,831,000. Thus, fisheries supported by various habitats in the region account for more than 57,000 jobs and nearly $6 billion in annual economic activity. Preservation of the habitats that generate these enormous benefits to our region thus must be a high priority. We anticipate that conservation efforts supported by our mapping activities will add significantly to these totals.

Community Resilience:

There are many communities along the Florida Gulf coast that are partially to substantially dependent on fisheries (commercial and recreational) as well as wildlife

such as turtles and marine mammals. Conservation of the habitats that support them should be viewed as a high priority. However, without detailed knowledge of these habitats and their significance, we cannot effectively restore and conserve them. Potentially, data from these efforts will be used by conservation planners at the city/town, county, state and federal levels to conserve habitats which will have a commensurate positive outcome for these resource-dependent communities.

Conflicts or Complements to Existing Efforts:

We know of no conflicts between our project and any ongoing or planned effort by state and federal entities. Various agencies have emphasized the importance of more focused habitat mapping efforts such as those we propose and there is strong support among them as well as environmental NGOs to conduct activities such as those we outline.

Complies with Federal, State, Local, and Tribal Laws/Regulations:

There are no Federal or State statutes we are aware of that would prevent or require consultations before proceeding. In fact, relevant State and Federal Agencies would likely welcome more complete information that will be generated from this project.

Readiness for Implementation:

We are poised to begin mobilizing the necessary resources for this project within a matter of weeks following approval. The rest of 2013 will be devoted to hiring postdoctoral researchers, students and project staff, as well as developing the detailed plan for year-one activities in consultation with federal and state scientists, regulators and the public. As well, 2013 activities will include assembling and training the project team and project equipment. We have consulted with the Florida Institute of Oceanography and they stand ready beginning in 2014 to allocate 50 sea days per year to this effort. There are no permitting issues associated with this project, and we anticipate no delays in getting the project up and running.

Public Acceptance:

We anticipate considerable public support for our project. For years, commercial and recreational fishers, environmental groups and regulators have been emphasizing the importance of better understanding the quality and characteristics of fish habitat in offshore waters, and the development of better methods to index the health of fish populations. In particular, fishing groups (and especially recreational fishers) will be highly supportive of our project. Often, proposals for the development of new marine protected areas (MPAs) are not based on sound science emphasizing how additional protections may affect target species. Using the high-resolution data supplied by this

project, we anticipate that restoration planners will have a significantly better information base upon which to base any such additional protections. We anticipate that there will be strong support from FWRI, NOAA/NMFS, the Gulf of Mexico Fishery Management Council and the Gulf States Marine Fisheries Commission. Additionally, we have sought and received strong support from environmental non-governmental organizations including the Ocean Conservancy. In fact, as a result of a series of workshops on priorities for science supporting living marine resource management of the Gulf of Mexico, the Ocean Conservancy and other NGOs identified this type of habitat mapping as one of their highest priorities.

Additional Information: see attachments

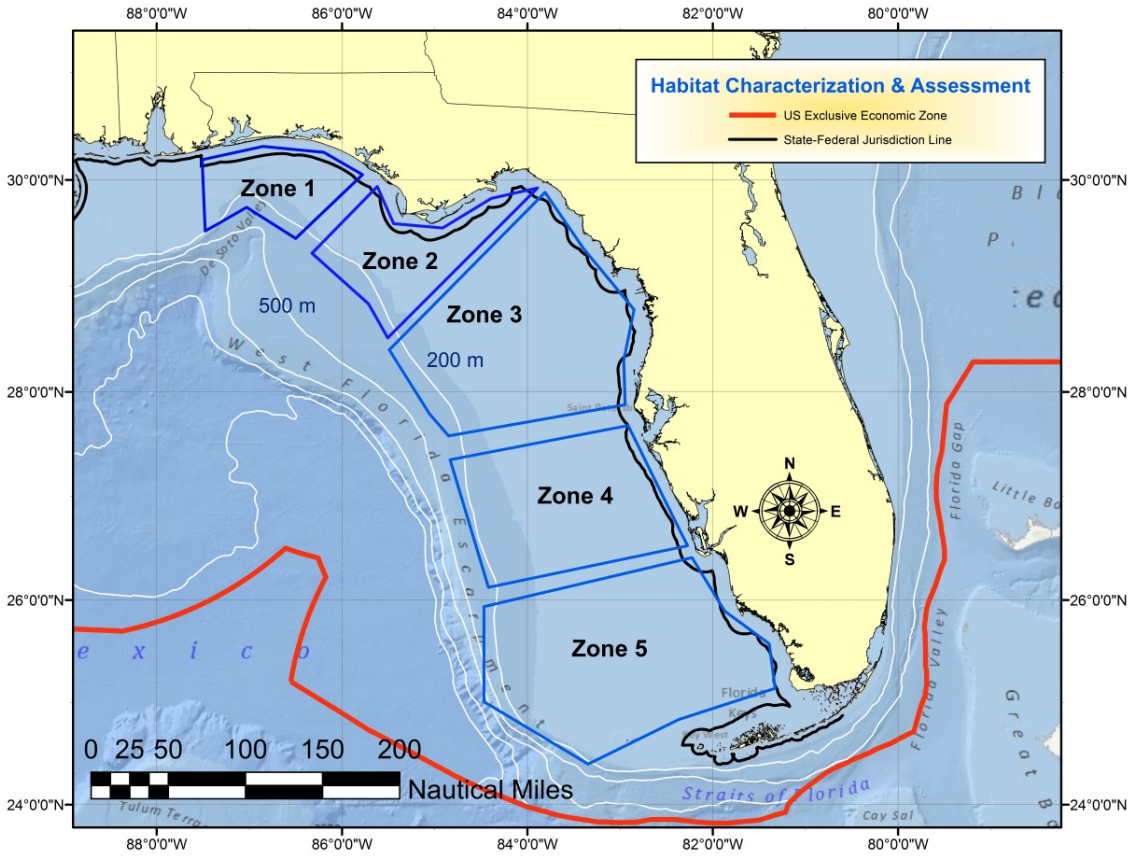

Figure 1. Proposed areas of operation (Zones 1-5) for habitat mapping and related activities on the West Florida Shelf

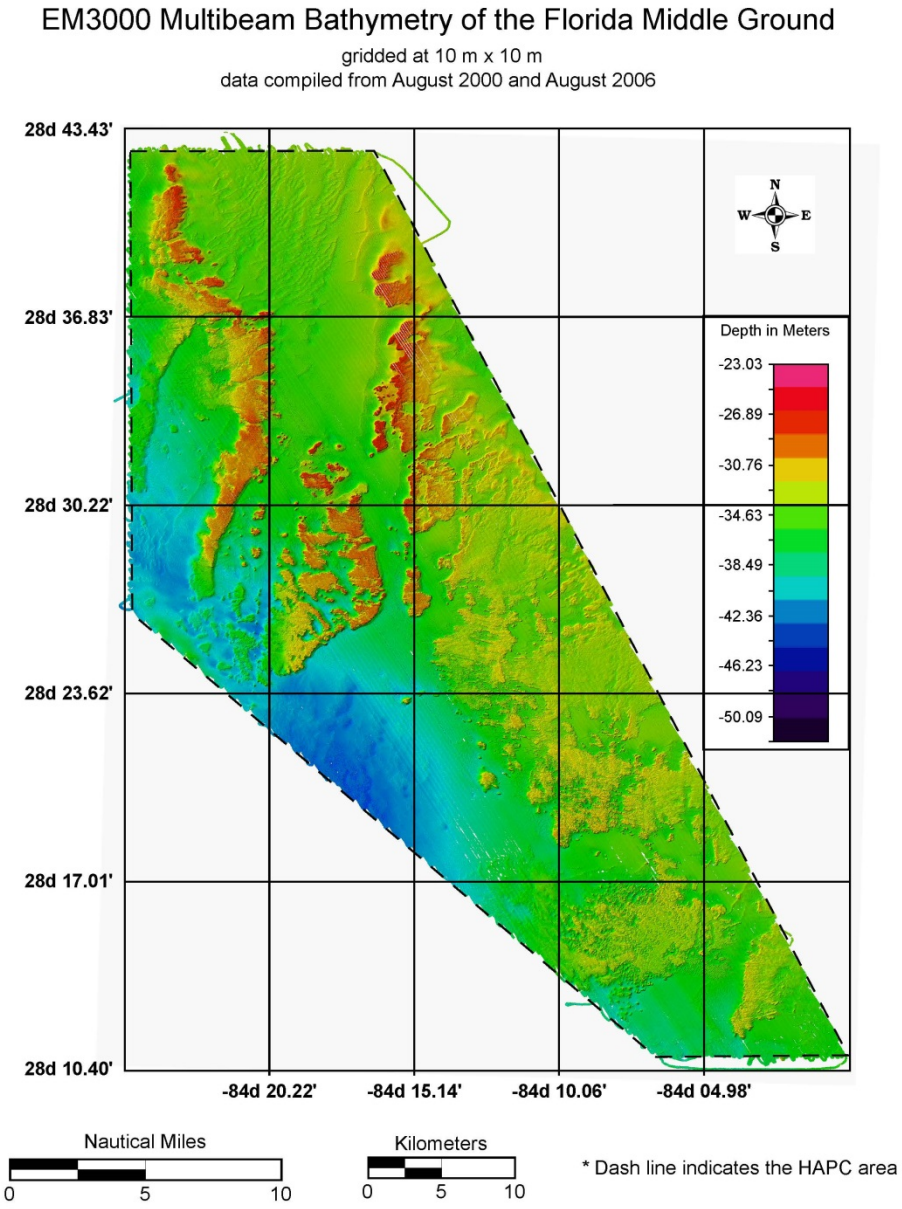

Figure 2. Example high resolution bathymetric map of the Florida Middle Grounds using multibeam sonar technology

Figure 3. C-BASS (Camera-Based Assessment System) towed imaging vehicle used to classify habitat types and determine the abundance of fish species

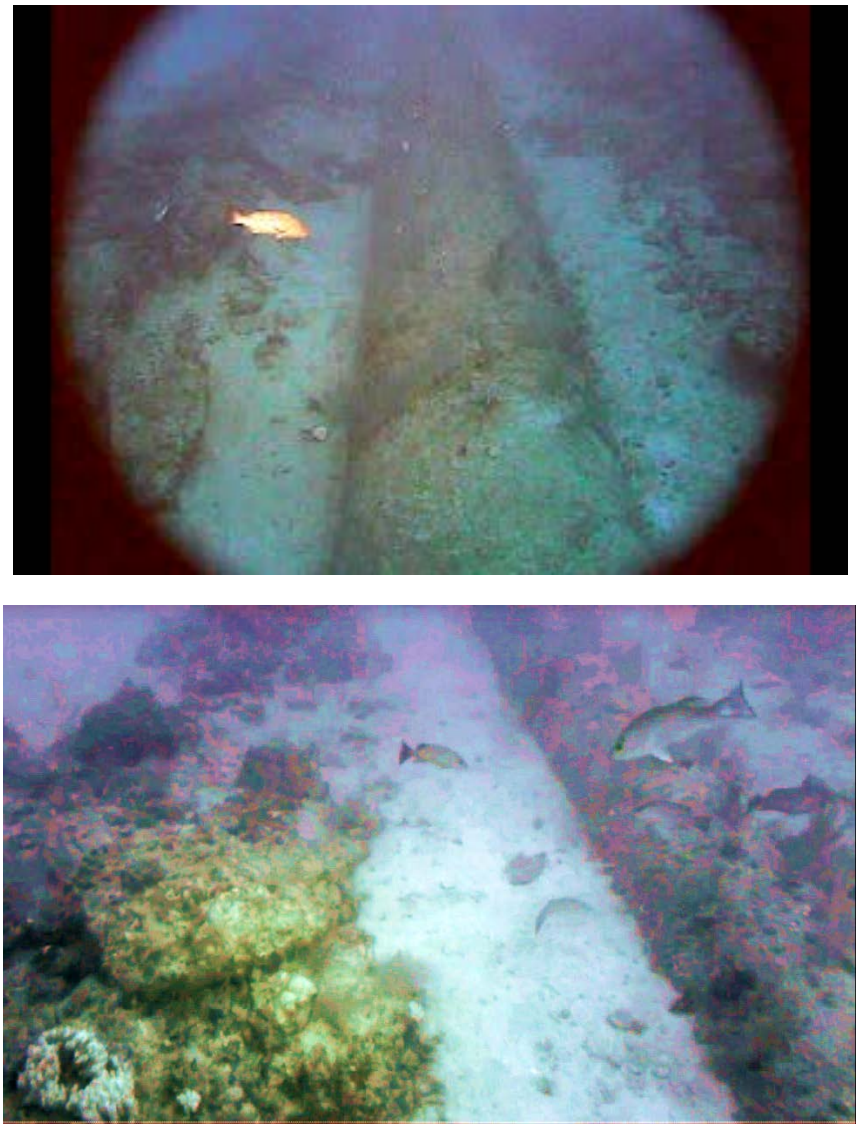

Figure 4. Images taken with a low resolution camera from the C-BASS towed camera system vehicle. Top mage shows a scamp and lower image gag groupers swimming above the Gulfstream gas pipeline in 40 meters of water off Tampa Florida. For scale, the pipeline is 36 inches in diameter.