Final Report for Florida Middle Ground Project

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GENERAL OBJECTIVES/LOGISTICS AND SUMMARY OF PROGRESS:

We have completed mapping the entire Florida Middle Ground HAPC (Habitat Area of Particular Concern) using a high-resolution 300 kHz multibeam bathymetry and backscatter system (Figures 1-3) . The survey augmented the existing coverage in the area from previous USF cruises. The main scientific objectives of the cruise are to define the fish habitat areas within the Florida Middle Ground HAPC using multibeam bathymetry, multibeam backscatter, and ground truth data (previous and new sediment grab samples and previous video samples). Second, to eventually produce a Habitat Map that defines area of Sediment, rock, and coral reef. Third, to provide a map of the paleoshoreline during a previous glacial period, when sea level was lower. The first objective has been completed and the data DVD's have been sent to the Gulf of Mexico Fisheries Management Council in March 2007. Drs. Mallinson and Naar have coauthored one paper presented at the international American Geophysical Union Meeting in 2006 (Mallinson et al., 2006) and have another paper submitted to a special volume (Hine et al., 2007) and have a third and final paper summarizing all our work at the Florida Middle Grounds in preparation (Mallinson et al., 2007). In addition a fourth paper, Florea et al. (2007), is in press and makes use of paleoshoreline data resulting from our surveys. The data collected during this project were also used within Dr. Lee Florea's USF Dissertation. Additional ground truth data will be mined from FSU in collaboration with Dr. Coleman and then used by Drs. Mallinson and Naar to make a final habitat map and manuscript anticipated to be submitted later in 2007.

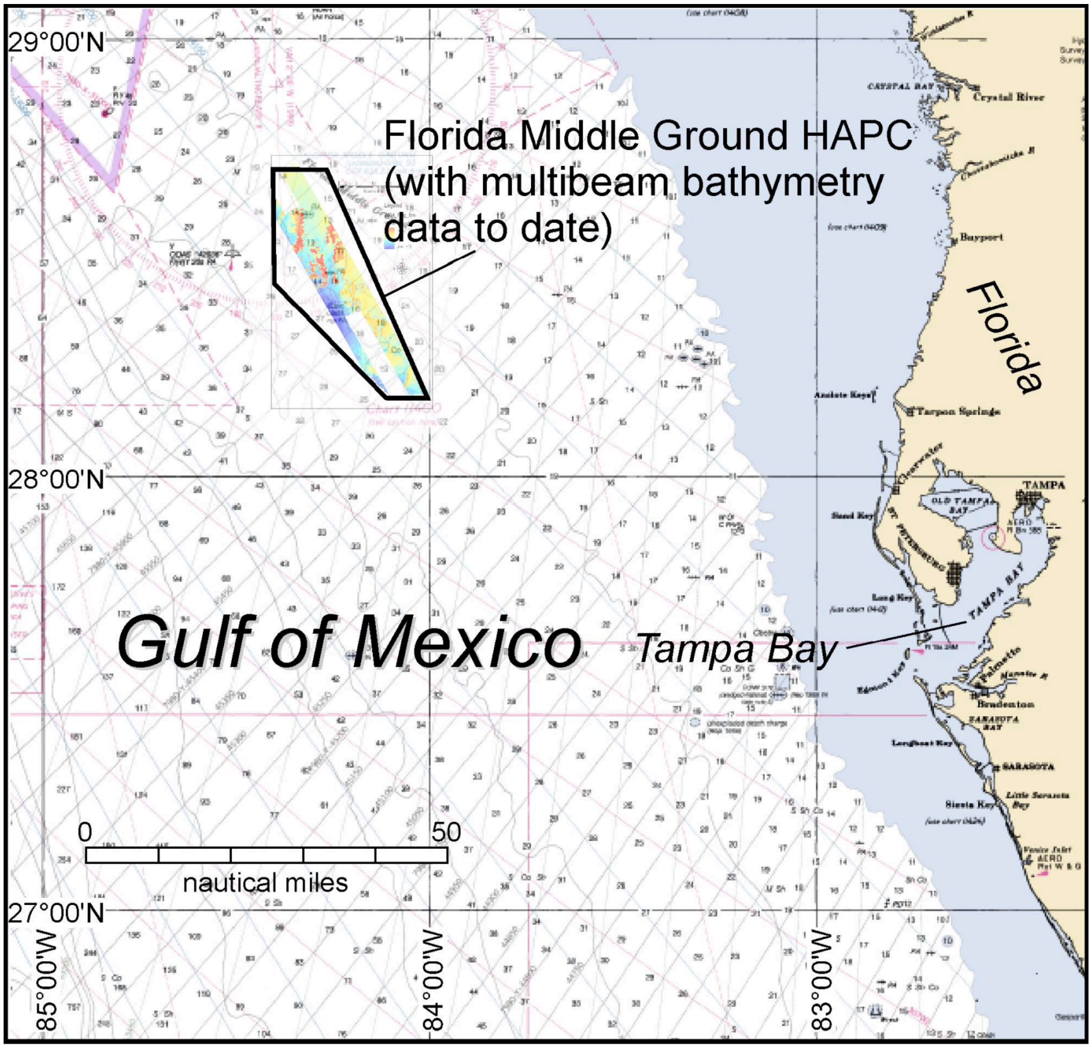


Figure 1. The Florida Middle Ground is located on the carbonate ramp of the West Florida Shelf in the eastern Gulf of Mexico. The area within the polygon (which marks the HAPC boundaries) is now completely filled (Figures 2 and 3).

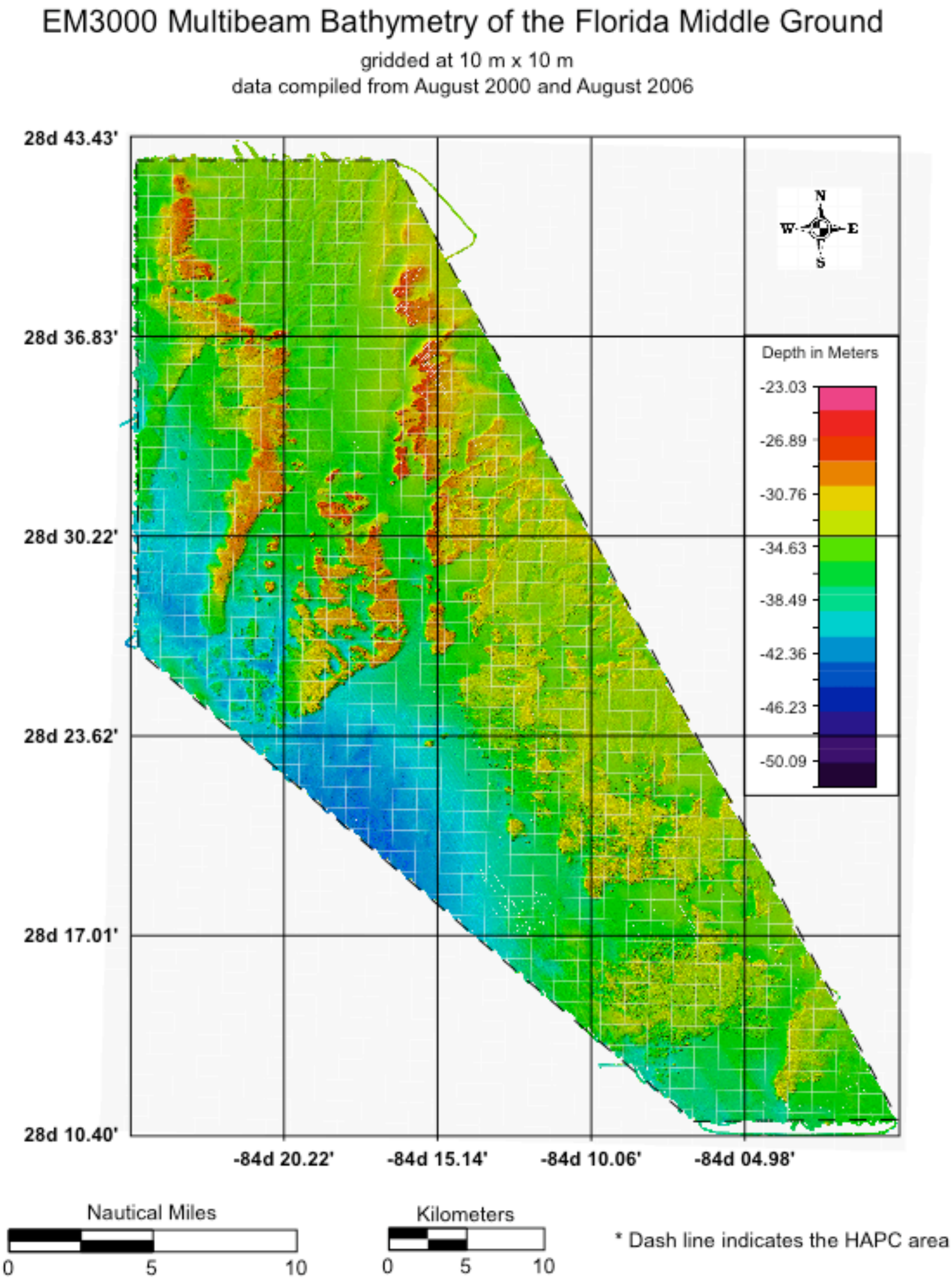


Figure 2. The completed multibeam bathymetry map gridded at a 10 X 10 m cell size. Additional images and data files at different grid cell spacings are available on the distributed DVDs.

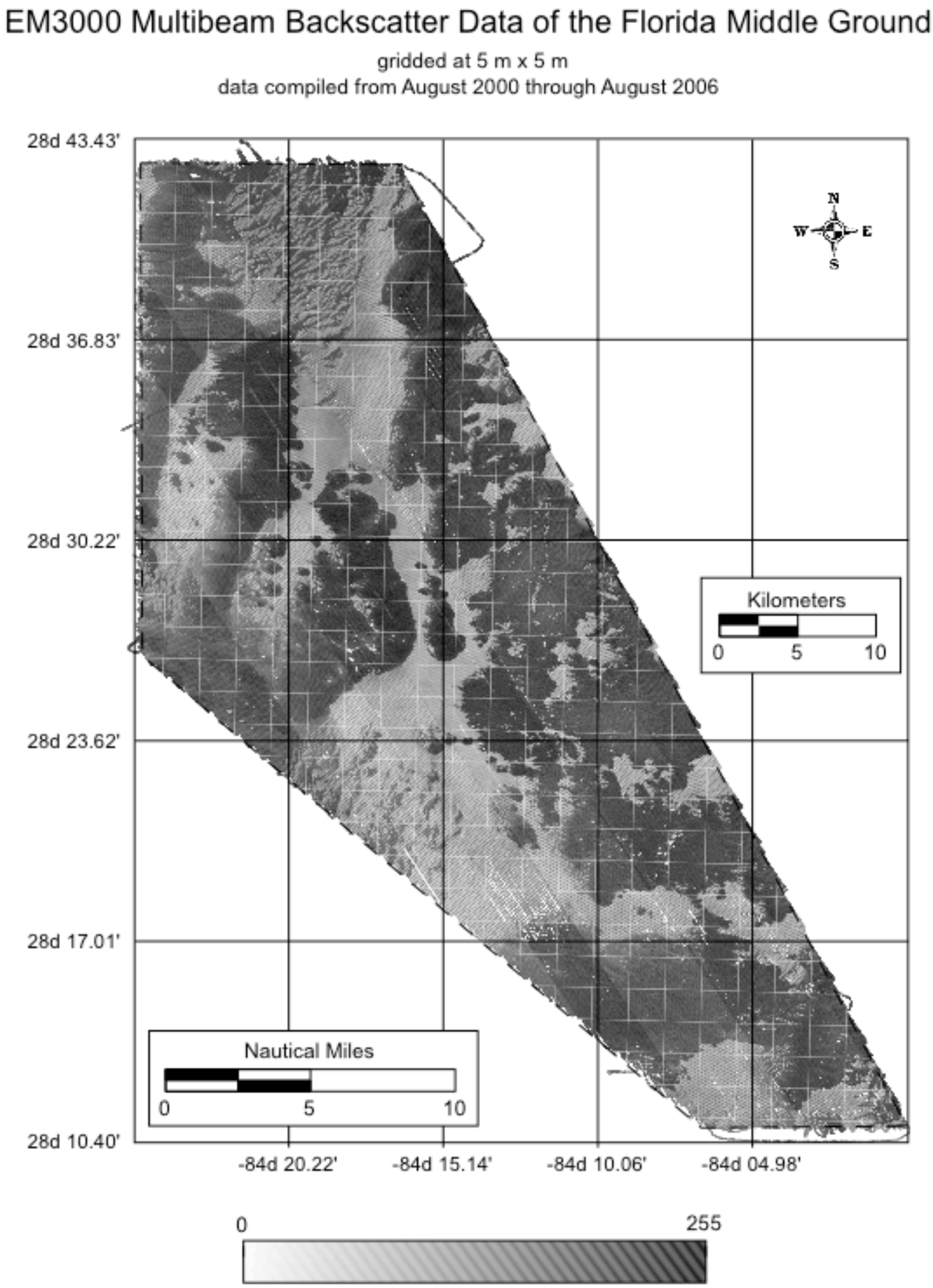


Figure 3. The completed multibeam backscatter map gridded at a 5 X 5m cell size. Dark backscatter represents high (strong) backscatter indicative of exposed limestone, reef, and/or very coarse shell hash. Light backscatter represents low (weak) backscatter, which is indicative of siliclastic sands and carbonate muds. Final Benthic habitat map is pending additional ground truth data and manuscript completion (Mallinson et al., 2007). Additional images and data files at different grid cell spacings are available on the distributed DVDs.

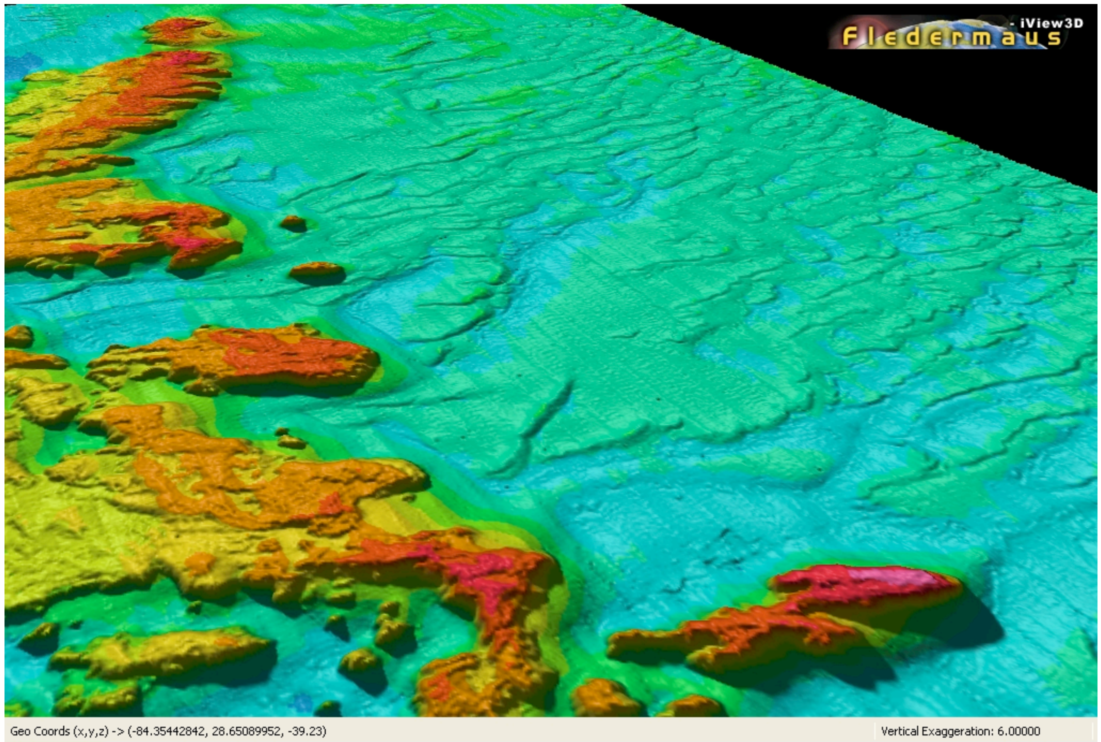
Characterization of the Benthic Environment of the Florida Middle Ground

The Florida Middle Ground is a diverse carbonate benthic environment on the West Florida Shelf (Fig. 1), which is the product of the complex interplay of carbonate production, climate and sea-level change, and physical oceanographic processes. High-resolution geophysical surveys have defined the various benthic environments, and subsurface controls, of the Florida Middle Ground Habitat Area of Particular Concern (FMG-HAPC). The FMG-HAPC has been fully surveyed using a 300 kHz Simrad EM3000 multibeam bathymetry and backscatter sonar (Figs. 2 and 3). Additional geophysical data include side-scan sonar data (acoustic backscatter), acquired with an Edgetech Model 272TD towfish, and high-resolution uniboom seismic data. Sediment grain-size data have been acquired on thirteen bottom grab samples acquired during the 2004 cruise, and are used to aid in "ground-truthing" acoustic facies. Additional historical data collected by FSU will be integrated into the final habitat map and final publication that is under preparation (Mallinson et al., 2007).

The FMG relict reef complex trends north-northwest, parallel to the platform margin, and is some 60 km long by 15 km wide. Water depths range from 45 meters in surrounding shelf areas, to a minimum depth of 24 meters on bank-tops. Diver and ROV observations reveal highly bioeroded margins with abundant cryptic environments, including arches, overhangs, and shallow caverns. Benthic communities are dominated by *Millepora alcicornis*, *Dichocoenia stokesii*, Octocorals, genus Muricea, *Madracis decactis*, *Xestospongia muta*, and tube sponges. Geophysical data reveal a wide variety of geomorphic and acoustic facies that represent a complex geologic framework of relict Pleistocene limestone mantled with Holocene corals and sediment. High-relief hard bottoms occur in the northern study area, stand approximately 12 to 20 meters above the surrounding shelf environment, and include three varieties: 1) semi-continuous (>8 km) margin-parallel banks 2 to 3 km in width; 2) isolated flat-topped banks with no particular orientation or maximum dimension; 3) isolated patch reefs generally <500 m in diameter.

Low-relief hard bottom environments occur in the southern study area, stand approximately 2 to 8 meters above the surrounding shelf environment, and include five varieties: 1) undulatory/crenulated surfaces exhibiting no discernable patterns; 2) elongate, parallel, overlapping biohermal structures; 3) rounded depressions of unknown origin with central patch reefs, ~200 m in diameter; 4) isolated patch reefs; 5) parallel ridges trending NW-SE. Soft-bottom environments include 1) featureless flats; 2) scour depressions surrounding hard-bottom environments; 3) scour depressions with active sediment transport; 4) sand waves ~1 to 2 m in relief and 200 m in wavelength. Bedforms, sediment distribution patterns, and scour patterns indicate an influence of southward-flowing and off-shelf directed currents (Figure 4).

Seismic data reveal that the high-relief carbonate banks are likely developed upon the low-relief environments, and represent zones of maximum early- to mid-Holocene reef recruitment and growth. Low-relief environments appear to be Pleistocene shallow water limestones that were intermittently exposed to subaerial weathering processes during Pleistocene lowstands (e.g., Florea et al., 2007), and subsequently mantled with Holocene corals. Acoustic facies and bathymetry data are being analyzed and digitized using ArcMap (GIS) tools. Slope aspect and rugosity assessments are being performed, which will be part of a final manuscript in preparation (Mallinson et al., 2007).



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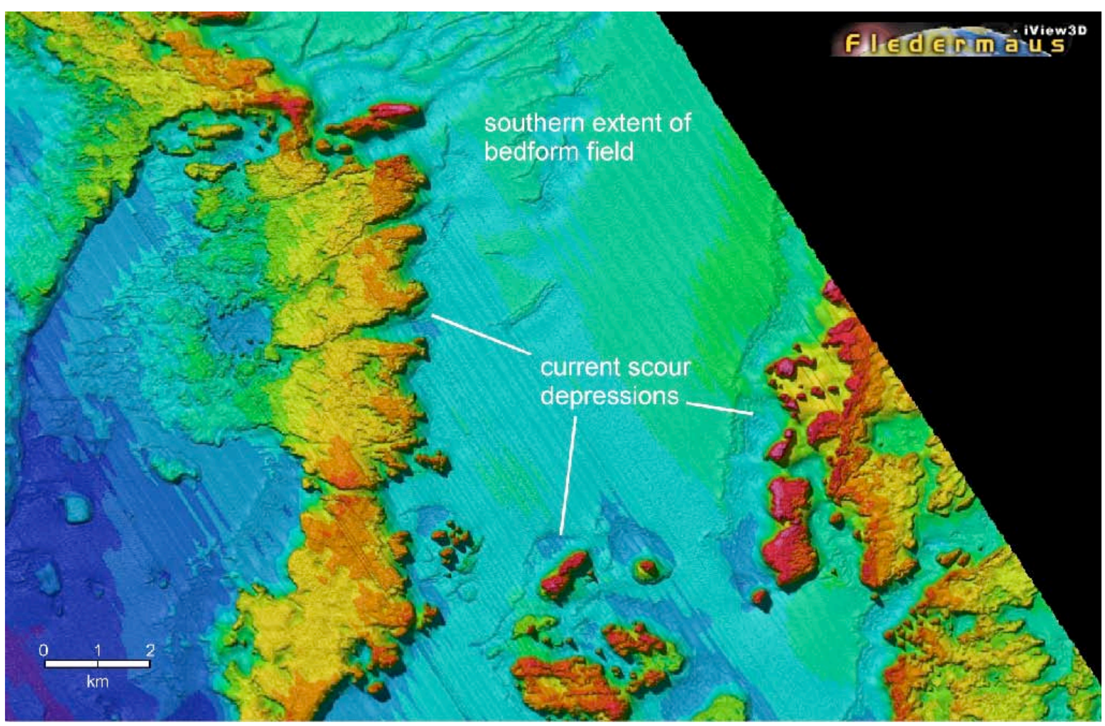

Figure 4. South flowing shelf currents promote active bedform fields (A) and interact with the bathymetry to yield complex scour patterns surrounding the banks (B).

References resulting in part or in full from this project:

Florea, L.J., H.L. Vacher, B.T. Donahue, and D.F. Naar, Quaternary Cave Levels in Peninsular Florida, *Elsevier Editorial System(tm) for Quaternary Science Reviews*, in press for April 2007.

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Mallinson, D., Donahue, B., Naar, D. F., Hine, A., Locker, S., 2006. Pleistocene and Holocene geologic controls on the Florida Middle Ground relict reef complex: A diverse benthic environment on the West Florida Shelf. In, Eos Transactions, AGU Ocean Sciences Meeting.

Mallinson, D., Naar, D. F ., Donahue B., Coleman, F., Florea, L.J., Locker, S., and Hine, A., 2007. Pleistocene and Holocene geologic controls on Multibeam bathymetry and backscatter and benthic habitat map of the Florida Middle Ground relict reef complex, manuscript in preparation.

FINAL REPORT – April 2007

PROJECT TITLE: Spatial and temporal patterns of recruitment to mid- and outer-shelf banks in the NW Gulf of Mexico

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PROJECT SUMMARY

This project is the third year of a multi-year effort to characterize reef fish and benthic (e.g. corals, algae, sponges) communities that overlie topographic highs in the northwestern Gulf of Mexico. In the pilot study, completed in the Fall 2004 (Year 1), we characterized reef fishes and corals on a portion of a Sonnier Bank, and results provided information for evaluating the importance of this natural bank as nursery grounds of important reef-associated species (e.g. snappers, groupers). In Year 2 of the this study (2005), we expanded our current work by including an outer shelf bank (McGrail Bank) to assess the value as essential habitat of fishes and coral. This year we will build on the first two components by examining spatial and temporal patterns of recruitment and habitat use on these banks. Our objectives are three-fold: 1) investigate recruitment patterns through fine-scale surveys of natural habitat and collecting new settlers off experimental settlement structures (ESS), 2) determine what changes are apparent from Hurricane Rita (which passed directly over Sonnier Bank) by replicating last years quantitative point counts of the snapper-grouper-grunt complex and photographic surveys of the benthos, 3) develop a more quantitative understanding of the snapper-grouper-grunt complex in deeper areas with ROV surveys. This continuation of the project will provide new information on reef-fish recruitment to these coral reef habitats and will establish a foundation for assessing adverse impacts that may occur at these sites from fishing or non-fishing activities.

Bathymetric highs punctuate the continental shelf of the northwestern Gulf of Mexico, serving as important naturally occurring habitats for exploited fish species. Until recently, the reef fish assemblages, benthic communities, and fish recruitment patterns at these mid-shelf banks have been described only qualitatively. Consequently, data for monitoring ecological changes are limited. Since 2004, we have been addressing this gap at Sonnier Bank, designated an EFH Habitat Area of Particular Concern (HAPC) by the GMFMC. Surveys with SCUBA and a remotely operated vehicle (ROV) have characterized the snapper-grouper-grunt (SGG) complex as well as benthic composition. Between 2004 and 2005, the SGG complex was similar and dominated by *Lutjanus griseus*, *Rhomboplites aurorubens*, *Epinephelus adscensionis*, *Paranthias furcifer*, and

[†] The views expressed in this paper are those of the authors alone and do not necessarily reflect any position of the US government or NOAA.

Haemulon aurolineatum. In 2006, significant reductions in abundances of *P. furcifer* and *H. aurolineatum* and pronounced increases in *L. griseus* and *R. aurorubens* were observed. Also in 2006, we recorded newly recruited species that included juveniles of *L. buccanella*, *Mycteroperca phenax*, and *E. guttatus*. Though the benthic communities at Sonnier Bank have been previously described as a *Millepora*-sponge community (>20 years ago), more than half of the benthic coverage was a mixture of algae species. Further, algal coverage increased in 2006. In 2006, we also deployed artificial settlement structures to provide information on the composition of newly settled reef-fishes and the importance of predation.

INTRODUCTION

Compared to low-relief soft-sediment environments that dominate the continental shelf of the northwestern Gulf of Mexico, hard banks support diverse fish and coral communities that represent important naturally occurring aggregation areas for species in the families Lutjanidae, Serranidae, and Haemulidae, i.e., the snapper-grouper-grunt (SGG) complex (Rezak et al. 1985, Dennis and Bright 1988). Most of these banks are unmonitored and their importance to critical life stages of fishery resources has not been quantified (Asch and Turgeon 2003, Coleman et al. 2004). We have been developing new information on one such bank, Sonnier Bank (approximate location: 28°20'N, 92°27'W). In our initial surveys of Sonnier Bank (Kraus et al. 2006), we identified that the snapper-grouper-grunt complex was dominated by *Lutjanus griseus*, *Rhomboplites aurorubens*, *Paranthias furcifer*, *Epinephelus adscensionis*, and *Haemulon aurolineatum* at depths <31m. At these same depths, benthic habitats were predominately composed of large patches of mixed algae species that were interspersed by *Millepora alcicornis*, *Neofibularia nolitangere*, *Ircinia strobilina*, and *Agelas clathrodes*. With subsequent surveys in 2005, we observed no significant changes in the fish community (except for a small but significant increase in density of *E. adscensionis*; Rooker et al. 2006). In addition, whereas Rezak et al. (1985) characterized the crest of Sonnier Bank as a "*Millepora*-Sponge Zone", our results indicated that it should be called more appropriately an Algae-*Millepora*-Sponge community.

Here, we report on additional surveys from 2006, where we replicated surveys of the snapper-grouper-grunt complex and the benthos. We also present preliminary information on the use of artificial settlement structures to quantify recruitment of fishes at this site. Finally, after our surveys in 2005, Hurricane Rita passed within 30 km of Sonnier Bank as a category-4 storm on September 23rd; therefore, we consider storm perturbation as a potential factor contributing to the differences in the biological community that we observed in 2006.

Research Objectives

1) Characterize patterns of recruitment to Sonnier Bank through fine-scale surveys of natural habitat and collecting new settlers off experimental settlement structures (ESS)

2) Determine the effect of Hurricane Rita on Sonnier Bank by replicating last years quantitative point counts of the snapper-grouper-grunt complex and photographic surveys of the benthos

3) Develop a more quantitative understanding of the snapper-grouper-grunt complex in deeper areas with ROV surveys

METHODOLOGY

Identification of habitat features from side scan sonar data

Sonar images and bathymetry data were collected in 2004-2005 (earlier funding from the GMFMC) to characterize peaks at both Sonnier Bank and McGrail Bank (Figure 1). We invariably observed high reflectivity on the tall peaks consistent with uplifted cap rock and coral. These were surrounded by either aprons of coarse-grained debris, sand patches, and/or fine-grained mud with low sonar reflectivity. Interspersed between the tall peaks were large patches of rubble and coral heads of varying densities. The presence of boulders and rubble encrusted with various corals, sponges, and algae was confirmed with ROV surveys in 2005 and 2006. The more gradually sloping peaks were usually characterized by an apron of coarse grained debris, which most likely represents coral debris. Small isolated patches of coral heads in deep water were also observed. Whereas Sonnier Bank is characterized by isolated pinnacles that were capped with a *Millepora*-sponge community and surrounded by drowned reef habitat with apron of coarse-grained debris, McGrail Bank exhibited expansive coral caps (Figure 1). These caps of hard substrate were dominated by algal fields, including algal nodules, leafy macro algae, *Lobophora*, and *Padina*, and this habitat was punctuated by outcroppings of drowned Pleistocene reef that was characterized by a “pot-hole” or “honey-comb” appearance.

Snapper-Grouper-Grunt (SGG) complex

To quantify density of species in the SGG complex, we modified the stationary point count method of Bohnsack and Bannerot (1986), counting all SGG species within an imaginary cylinder of radius 5m. Divers visualized the cylinder and accuracy was checked against a 5-m length of line placed on the bottom. In 2005, we conducted a total of 63 fish counts at the two main peaks. Samples were distributed among three depth zones which stratified our survey design (20 to 24m, 24 to 28m, and 28 to 32m). In 2006, we used a similar approach and were able to make 57 independent point counts. The surveys were conducted during summer months (June and August) in both years. For analysis, we normalized the count data to number per 100 m^2, and modeled these as a Poisson distribution with year (2005 and 2006), and depth (continuous covariate) as explanatory variables (using SAS/STAT(c) software version 9.0). To account for over dispersion in the data, we scaled the covariance matrix by the deviance (Kleinbaum et al., 1998). Depth effects were either inconsistent between years, influenced by a few observations (e.g., for *L. griseus* and *R. aurorubens*), or depth effects were slight (e.g., there is probably little ecological significance of a decline of 0.02 individuals with each meter increase in depth for *E. adscensionis*). Therefore in this report, we removed depth from the analysis. Significance level of alpha=0.05 was established prior to statistical hypothesis testing.

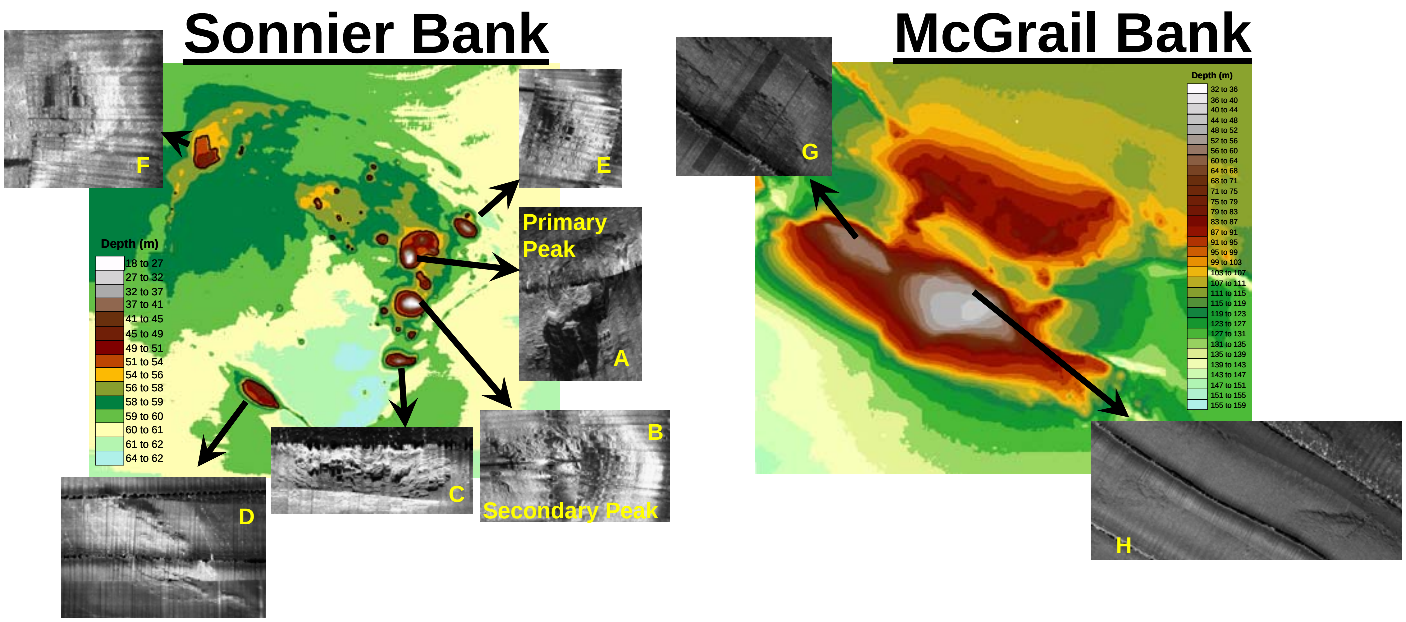

Figure 1. Bathymetry of Sonnier Bank and McGrail Bank. Detail of areas that were surveyed with SCUBA and ROV are presented as inset side scan sonar images that are labeled alphabetically.

Benthic habitat characterization

To quantify benthic habitat characteristics, we collected underwater photographs using quadrats (0.25 x 0.25 m square PVC frame) as a size reference. At each fish count location, a quadrat was placed in the center of the cylinder and photographed so that the PVC frame filled the picture, standardizing distance from the camera. Ideally, the frame was flipped over three times on different sides so that an entire square meter in the middle of the cylinder was recorded, but often fewer than 4 pictures were recorded due to limited dive times. Subsequently, we used image analysis software to outline benthic species and quantify 2-dimensional area. We analyzed a total of 161 and 76 photographs encompassing total areas of 26.8 and 19.2m^2, respectively from trips in 2005 and 2006. We examined two aspects of benthic species coverage in the images: fragment (or patch) size (cm^2) and percent coverage (total within the quadrat).

These variables were analyzed with ANOVA using depth zone (same as defined for the fish counts, above), year, and their interaction as fixed effects.

We explored possible associations between benthic species composition and fish density using principle components analysis (PCA). Some pictures were poor quality and unusable for image analysis; therefore, matched records for fish density and benthic species composition represented a reduced data set for the PCA; only 91 of 120 total cases were included (note that multiple pictures characterize a single fish count - thus the difference between fish counts and pictures analyzed). We included 11 variables in the analysis (densities of the 5 most abundance fishes and % coverage of 6 categories of benthos), and examined the first three principal components. Standardized variables were used for the analysis.

We were also interested in the dynamics of fish recruitment at our study sites, which are unique in that they harbor a combination of sub-tropical species in the middle of their range and tropical species at the northern edge of their range. Therefore in 2006, we developed some initial density information on the recruitment of juveniles in the snapper-grouper-grunt (families, Lutjanidae, Serranidae, and Haemulidae, respectively) complex and juvenile pomacentrids (damselfishes) using visual surveys of $0.25m^2$ quadrats. In addition, we deployed artificial settlement structures that were designed to attract settling fishes by providing unoccupied space and which could be retrieved to collect fishes that colonized the structures (Figure 2). These structures were constructed from artificial coral heads (commercially available and made from polyester resin) that were fastened to a block of concrete. We enclosed some of the structures in a plastic mesh to exclude predators, and as a positive control treatment we cut large holes in the mesh of some structures to allow access to predators. We are currently processing the fish that we collected to determine daily ages from otoliths. As we have only conducted a single deployment of the structures, we present only the densities of pomacentrids (damselfishes) that colonized the structures as determined visually prior to retrieval, and we provide some comments on the feasibility of use of these structures.

Figure 2. Artificial settlement structures used to collect recruits at Sonnier Bank. Open and cage (predator exclusion) treatment shown.

RESULTS: CHARACTERIZATION OF BANK COMMUNITIES

In both 2005 and 2006, the five most abundant species in the snapper-grouper-grunt complex were *Lutjanus griseus*, *Rhomboplites aurorubens*, *Paranthias furcifer*, *Epinephelus adscensionis*, and *Haemulon aurolineatum*. The incidence and density of *E. adscensionis* remained similar between years with an average density between 1 and 2 individuals per 100 m^2 observed at almost every count location (incidence = 89 to 95%; Figure 3). By comparison, the other four most abundant species showed considerable differences between years. Incidence declined 2 and 3-fold for *P. furcifer* and *H. aurolineatum*, respectively (Figure 3). Whereas the density of *P. furcifer* also declined significantly, indicating that abundance changed between years at our survey sites, the density of *H. aurolineatum* did not change significantly (Figure 3), indicating that *H. aurolineatum* were simply more aggregated in 2006. The dominant Lutjanidae were more abundant in 2006, with 2 to 3-fold higher incidence and density for *L. griseus* and *R. aurorubens*, respectively (Figure 3). We also noted the occurrence of juveniles (<10 cm standard length) of several species in the snapper-grouper-grunt complex that were only present in 2006. These juveniles were *L. buccanella*, *Cephalopholis cruentata*, *E. guttatus*, *Mycteroperca phenax*, *M. interstitialis*.

The benthic species composition was dominated by algal species that together typically made up between 35 and 45% of the total area of a quadrat. The parts of the pictures (called fragments in this report) that contained a mixture of algae species ranged in size on average between 20 and 230 cm^2 (Figure 4), and were comprised of crustose coralline algae, red filamentous algae, *Lobophora* sp., Y-branching algae, and green macro-algae. We have not yet identified each species of algae; therefore, each of these common name descriptors may include multiple species. Whereas the fragments of mixed algae were significantly larger in 2006 (especially at the shallowest depth zone), the total coverage was similar between years at all three depth zones (Figure 4).

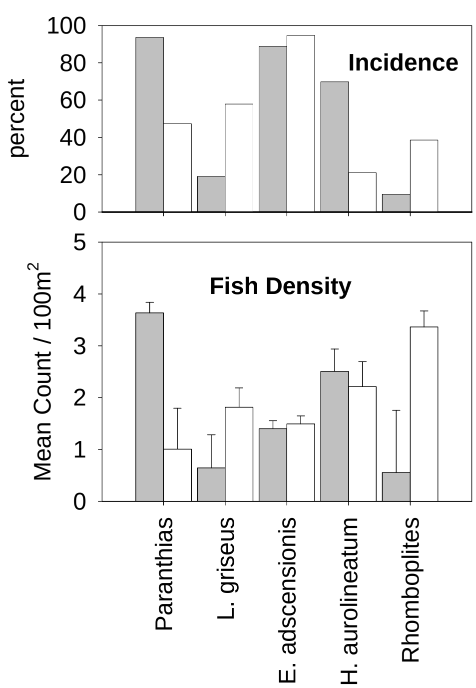

Figure 3. Density and incidence of the 5 most abundant species in the snapper-grouper-grunt complex at Sonnier Bank in 2005 (gray bars) and 2006 (open bars). Counts were made visually by SCUBA divers, and incidence is defined here as the proportion of counts where at least one of the species was observed. Error bars show the upper 95% confidence limit of the mean.

The next most abundant benthic category was *Millepora alcicornis* in which fragment size also increased significantly in 2006. The areal coverage did not change significantly between years for *M. alcicornis*, but there was a significant trend of increasing areal coverage with depth (Figure 4). The third most important benthic category in terms of areal coverage were the sponges, primarily *Neofibularia nolitangere* (mean = 0.6 to 12%), *Agelas clathrodes* (mean = 0.2 to 1.2%), and *Ircinia strobilina* (mean = 0.2 to 2%). For *N. nolitangere*, there was a significant reduction in percent coverage in 2006 with no corresponding change in mean fragment size (Figure 4), indicating a decline in abundance of this sponge in 2006. For the other two sponges, the only significant inter-annual change was an increase in mean fragment size of *A. clathrodes*, especially at the shallow and intermediate depth zones (Figure 4). Finally, the area classified as bare or rubble comprised between 0.3 and 3.9% on average of the quadrat. Although increases in areal coverage of bare/rubble substrate in 2006 were not significant, we estimated large and significant increases (between 712 and 1181 cm^2 differences) in the average size of the fragments in this category (Figure 4).

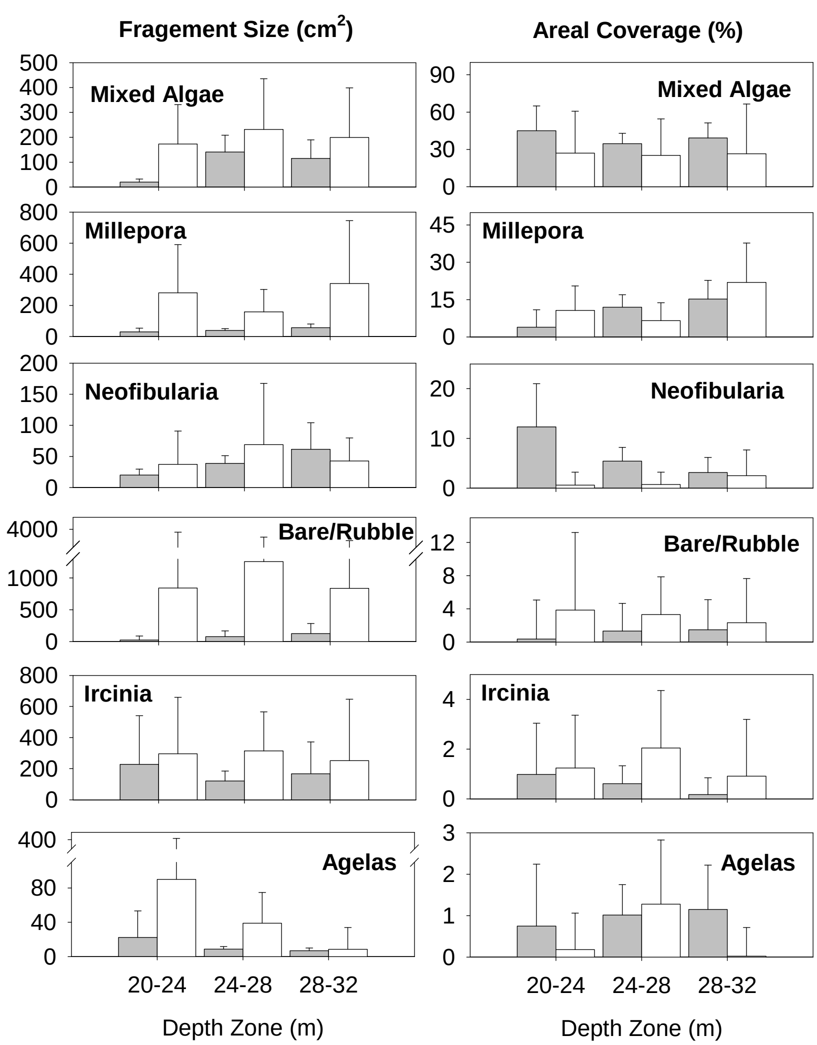

Figure 4. Inter-annual comparison (2005 shaded bars, 2006 open bars) of fragment size and percent coverage at Sonnier Bank. The 6 most abundant categories of benthos, as determined from photographic surveys and image analysis are shown. Error bars show the upper 95% confidence limit of the mean.

The principal components analysis emphasized inter-annual trends and revealed associations between the benthos and the fish density data that were not immediately apparent in other analyses. The variability explained by the first three principal components was relatively modest – only 45% of the total variance in these data. Still, the component scores showed separation between years that was indicative of the differences observed for individual fish species or categories of benthos. For example, opposite inter-annual trends were observed between *P. furcifer* and the two lutjanids; therefore, the vectors for these variables are in opposite directions corresponding to the years in which they had the highest densities (2006 for *R. aurorubens* and *L. griseus*, and 2005 for *P. furcifer*; Figure 5). In addition, the vectors for *E. adscensionis* and *I. strobilina*, for which point counts and image analysis showed no significant inter-annual changes, were oriented perpendicular to the inter-annual axis of separation between *P. furcifer* and the lutjanids. Further, the vectors for *E. adscensionis* and *I. strobilina* were oriented very close together showing positive correlation between density and % coverage in these two species, respectively.

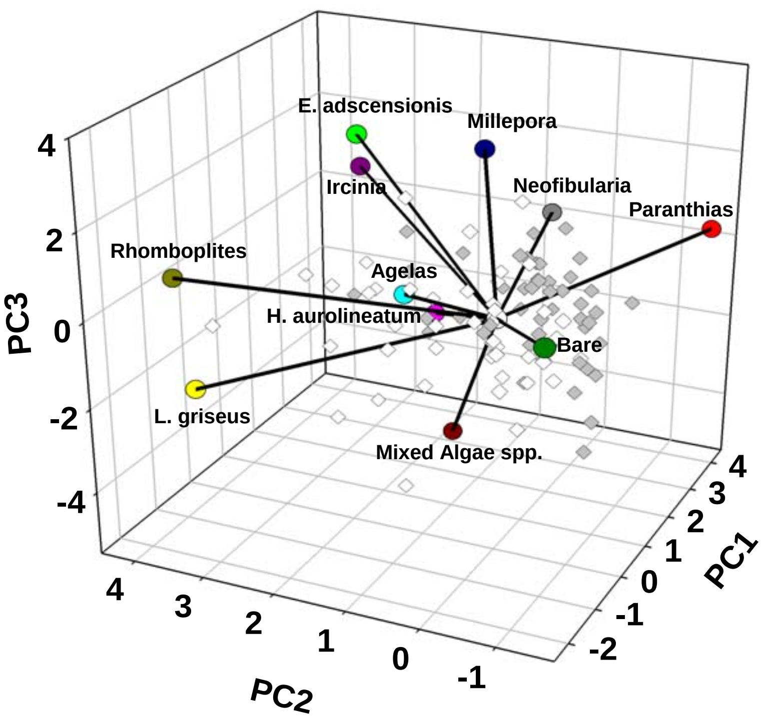

Figure 5. Principal components analysis of fish density and percent coverage of benthos. Only 45% of the variance in the data was explained by the first 3 principal components. Diamonds represent individual observations for 2005 (gray) and 2006 (open). Eigenvectors (black lines w/ circle endpoints) for each of

the 11 variables included in the analysis have been multiplied 7-times in order to view them on the same plot with the component scores.

The juvenile fishes collected from the artificial settlement structures are currently being analyzed in the laboratory. The visual survey results suggest that the fish community that becomes established on the artificial structures differs in composition and density from the natural substrate. For example, the densities of the four most abundant pomacentrids were significantly higher in the quadrat surveys of natural areas compared to the densities on the artificial structures (Figure 6). The most abundant species were *Stegastes variabilis* and *S. leucostictus*, and density in natural areas was significantly higher than on the artificial structures (difference = 0.6 to 0.8 individuals per 0.25 m^2, respectively). Whereas mean density of *Chromis cyanea* observed in quadrat surveys of natural areas was 0.4 per 0.25 m^2, they were not recorded from the artificial structures. Slightly higher densities were also observed in natural areas for *C. scotti*, but the density was not significantly different from the artificial structures (0.3 per 0.25 m^2, pooled mean).

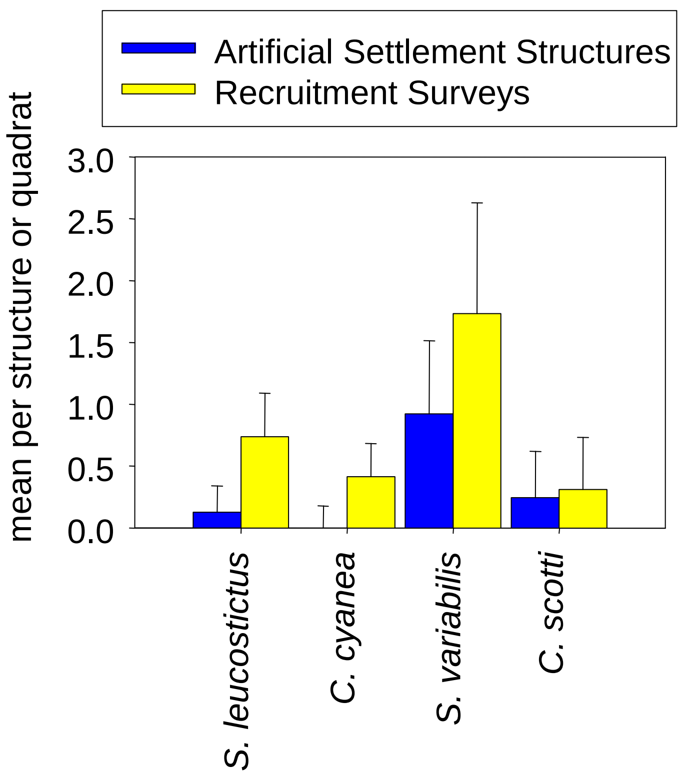

Figure 6. Mean number of reef fish recruits per quadrat (natural habitat) or settlement structure natural habitat.

DISCUSSION

Previously, Rezak et al. (1985) characterized the crest habitats at Sonnier Bank as a "*Millepora*-sponge zone" remarking that crustose coralline algae are “rare” in this zone, but our more recent surveys show that the dominant category of the benthos is patches of mixed algae species that often included crustose coralline algae. It is not clear whether this difference indicates a change in the biological community because the surveys by Rezak et al. (1985) were expansive in scope (covering numerous sites and characterizing all aspects hydrological, geological and biological) and only qualitative in their assessment of the biological communities at these banks. We propose to amend Rezak et al.’s designation of the crest environment at Sonnier Bank, describing it instead as an Algae-*Millepora*-sponge zone. The high abundance of algae species in addition to the classification of other important benthic species as either *M. alcicornis* or sponges supports our proposition. The condition of Sonnier Bank as an Algae-*Millepora*-sponge zone does not match any another category (other than the *Millepora*-sponge zone) in the Rezak et al. typology of zone classification for banks in the Gulf of Mexico; therefore, Sonnier Bank may very well be fundamentally different from what Rezak et al. described more than 20 years ago. The quantitative results that we have presented will allow better assessment of long-term changes, as monitoring of Sonnier Bank and similar banks seems to occur infrequently or is infrequently recorded in scientific literature. Finally, the changes in the benthos that we observed are consistent with perturbation due to storm action and may in part have been caused by Hurricane Rita in 2005. Still, the changes were minor and included predictable increases in algae and exposed bedrock and rubble and what appeared to be reduction of the sponge, *N. nolitangere*. This confirms Rezak et al.’s conclusion that although Sonnier Bank is subject to relatively high variability in physical conditions (compared to shelf-edge banks) and the occasional storm event, the benthic community is stable over long (geologic) time-scales.

On the other hand, the fish community is more dynamic, and differences that we observed in 2006 in the 5 major species of the snapper-grouper-grunt complex are not clearly linked to potential impacts from Hurricane Rita. Work by Patterson et al. (2001) has confirmed that storm events can play a major role in the redistribution of individuals across continental shelf habitats in the Gulf of Mexico. Highlighting the differences in 2006, our previous work indicated that the abundances of the five dominant species in the snapper-grouper-grunt complex were similar between 2004 and 2005, but the sample size in 2004 was only half as large as in 2005 (Rooker et al. 2006). As there are many other factors influencing the abundances of these species (e.g., fishing, natural predation, physical habitat changes not related to Rita), it is not yet possible to suggest that the changes are due to storm perturbation. In addition in 2006, we noted the appearance of newly recruited juveniles of several species in the snapper-grouper-grunt complex. Although for these species local information on spawning is not available, spawning periods for most of these would be expected to occur earlier in 2006 after the episodic effects of Hurricane Rita (for *E. adscensionis*, *C. cruentata*, *C. cephalopholis, C. guttaus, M. phenax,* and *M. interstitialis* see Bullock & Smith 1991, and for *L. buccanella* see Allen 1985). Sizes of these individuals also indicated that they were young-of-the-year, and we have ongoing work to age some of these individuals from otoliths to examine hatch dates.

A better understanding of aspects of fish recruitment at Sonnier Bank and other banks in the Gulf of Mexico is greatly needed. Some of the most important endeavors should include investigations of the role of larval supply and identification of source populations (from either genetics or otolith microchemistry) to understand the dynamics and structure of fish communities at these banks. In addition, Almany and Webster (2006) provided evidence that the early settlement phase of reef fish life can be a period of significant mortality (55% over the first few days). To better understand processes during this phase of recruitment, we developed artificial settlement structures designed to allow us to quantitatively sample new recruits and develop information on growth and survival during this phase. We will also be able to examine questions about source populations (from genetic markers), and additional standard ichthyoplankton surveys at the bank would address questions of larval supply. With the collection of several early juveniles of some important serranids, the results from the settlement structures are promising. In the near term, we have identified some design and logistical issues that should be straight-forward to correct. Primarily, with the current design we had to bag the structures from the top and then use a second bag that was carefully slid underneath the structure and first bag in order to retrieve the structure. We intend to modify the structures so that only one bag is necessary (reducing handling time and dive time), perhaps such that the first bag attaches to a skirt that is integrated into the structure.

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GULF OF MEXICO FISHERY MANAGEMENT COUNCIL

2005-CORAL COOPERATIVE AGREEMENT NO. NA05NMF4411045
as of JUNE 2007
(Dollars in Thousands)

ACCOUNT	OBLIGATIONS INCURRED	CY 2005-Coral	BALANCE REMAINING $ Normal:	% 0.00%
Personnel Compensation:				
Council Members	0.0	0.0	0.0	100.0%
Staff - Permanents	19.2	18.4	-0.8	-4.4%
Temporaries	0.0	0.0	0.0	100.0%
Premium Pay	0.0	0.0	0.0	100.0%
	19.2	18.4	-0.8	-4.4%
	19.2	18.4	-0.8	-4.4%
Benefits - Council's Share:				
FICA/Medicare	1.5	1.4	-0.1	-5.1%
Health Insurance	2.5	2.0	-0.5	-25.8%
Life Insurance/Disability	0.2	0.5	0.3	66.1%
Retirement	1.9	1.8	-0.1	-6.8%
	5.7	5.7	0.0	0.0%
Travel:		0.0		
Council Members	0.0	0.0	0.0	100.0%
Staff	0.0	0.0	0.0	100.0%
Advisory Panels	0.0	0.0	0.0	100.0%
S&S Committees	0.0	0.0	0.0	100.0%
Other	0.0	0.0	0.0	100.0%
	0.0	0.0	0.0	100.0%
Rents:				
Office Space	0.0	0.0	0.0	100.0%
Office Equipment	0.0	0.0	0.0	100.0%
Meeting Rooms	0.0	0.0	0.0	100.0%
	0.0	0.0	0.0	100.0%
Other Expenses:				
Communications-Phone	0.0	0.0	0.0	100.0%
Communications-Other	0.0	0.0	0.0	100.0%
Transportation & Shipping	0.0	0.0	0.0	100.0%
Printing	0.0	0.0	0.0	100.0%
Contractual Services	149.7	150.9	1.2	0.8%
Supplies	0.0	0.0	0.0	100.0%
Capital Equipment	0.0	0.0	0.0	100.0%
Non-Capital Equipment	0.0	0.0	0.0	100.0%
	149.7	150.9	1.2	0.8%
TOTAL ADMINISTRATIVE GRAN	175.0	175.0	0.0	0.0%