A Biological and Geological Survey of the Florida Middle Ground – HAPC: Assessing Seafloor Impacts of Fishing-Related Activities

R/V Suncoaster Cruise
August 17-23, 2000

Prepared for
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By:

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Plates:
  Plate 1:  100 kHz side-scan sonar mosaic from August, 2000 cruise.
  Plate 2:  300 kHz multibeam sonar bathymetric chart from August, 2000 cruise.
  Plate 3:  Interpreted acoustic facies map.

CD:  Contains all of the above data as JPEG images, PDF files, and MapInfo formats
**Scientific Crew on R/V Suncoaster:**

David Mallinson – USF - diver  
Brian Donahue – USF - diver  
Michelle McIntyre – USF - diver  
Tina Drexler – Eckerd - diver  
Greg Berman – USF - diver  
Beau Suthard - USF  
Lauren Wetzell – USF  
Derek Sawyer – Eckerd  
Michael Barnette – NMFS diver  
David McClellan – NMFS - diver  
Michael Judge – NMFS - diver

**Scientific Crew on M/V Papasan:**

Gene Shinn – diver  
Don Hickey - diver  
Gary Hill - diver
Abstract

Acoustic remote sensing surveys (side-scan sonar and multi-beam sonar) combined with diver observations have been used to evaluate potential large scale adverse impacts by commercial fisherman to the Florida Middle Ground – Habitat Area of Particular Concern (FMG-HAPC). Acoustic data and diver observations have also been used to assess the biological and geological characteristics of the FMG. An interpreted acoustic facies map is derived that may be used to assess the distribution of bottom type and potential fish habitat. On the basis of the side-scan sonar surveys, and diver observations, fishing related impacts to the bottom are deemed minor. Only four potential fishing-related bottom scars are noted on side-scan records within the study area. Of these four, only one is a very strong candidate.
Introduction

Between August 17 and 23, 2000, scientists from the University of South Florida (College of Marine Science – Center for Coastal Ocean Mapping) conducted a remote sensing survey of the Florida Middle Ground (FMG) Habitat Area of Particular Concern (HAPC) (Figure 1). The FMG is a series of carbonate banks and live-bottom areas located on the outer edge of the continental shelf, approximately 90 miles west of Tampa Bay, Florida, on the outer West Florida Shelf in the eastern Gulf of Mexico. This investigation was performed as a response to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) that calls for the characterization of essential fish habitat (EFH), and adverse bottom impacts as a result of fishing practices.

The FMG-HAPC is an important area to both commercial and recreational fisheries. Anecdotal information suggests that habitat damage has occurred from various fishing activities, although the extent of this damage has not been ascertained or quantified to date. Survey data from this investigation allow us to assess fishery impacts, and provide baseline data for future monitoring.

Additional and complementary components of this investigation included the characterization of the biologic, geologic and geomorphic framework of the Florida Middle Ground. The high relief, hard-bottom characteristics of the Florida Middle Ground are responsible for the high diversity and productivity in this area.
Methods

Geophysical surveys of the FMG were conducted during 1999 and 2000 using high-resolution single channel seismic instruments (a Huntec boomer and ITI 10-channel streamer), an EG&G model 272 TD side-scan sonar towfish, and a Simrad EM3000 multibeam bathymetry system. Seismic data were acquired and processed using DelphSeismic software, using a lowpass and highpass filter of 3500 and 500 Hz, respectively (Figure 2). 400 kilometers of side-scan data were acquired at 100 kHz, and processed using Isis and Delphmap software (Triton Elcigs, Inc.) (Figure 3; Plate 1). Multibeam bathymetry data were acquired at 300 kHz and processed using the Simrad Neptune and Merlin software (Figure 4; Plate 2). Bottom samples, photographs, and video were acquired by divers (Figure 5). A short core was acquired using a rotary hydraulic drill on loan from the USGS Center for Coastal Geology in St. Petersburg, FL.

As part of the biological component of this investigation, divers from the National Marine Fisheries Service performed fish counts (McClellan and Judge, 2000; Addendum 1), and underwater photographs were used to assess the benthic biology of sample sites (Table 1). Furthermore, water samples were acquired for Florida Marine Research Institute (FMRI) investigators, in order to evaluate the phytoplankton diversity, especially dinoflagellate concentrations (responsible for red tide).

Table 1. Predominant benthic organisms at dive sites.

- *Millepora alcicornis* - fire coral
- *Dichocoenia stokesii* - eyelet coral
- Octocorals, genus *Muricea*
- *Madracis decactis* - ten ray star coral
- *Xestospongia muta* - barrel sponge
- tube sponges
Seafloor Disturbance Identification Criteria

Side-scan data were reviewed during playback of individual lines. Criteria for identification of possible trawler scars included:

- The occurrence of linear features on the seabed as defined by acoustic backscatter contrast;
- Linear dimensions ranging from widths of 1 to 10 meters and lengths of greater than 50 meters;
- Orientations oblique to the cruise-track, so as to eliminate misinterpretations of acoustic artifacts.

Identification of anthropogenic impacts was complicated by the occurrence of various naturally occurring linear features as well as sampling artifacts in the record. Considerable amounts of the alga, *Sargassum sp.*, were present within the water column and concentrated in wind rows. The wind rows of algae produced lineations within the acoustic record. These lineations were identified as algal-origin based upon the occurrence of the backscatter signal within the water column, and associated temporary loss of bottom tracking due to signal attenuation. Artifacts include cruise-track parallel acoustic shadows that occur as a function of the interaction of the incident acoustic beam with a bottom of irregular relief, and cruise-track orthogonal features caused by displacement of backscatter imagery resulting from small errors in navigation or bottom tracking.
Results

Structural setting and geomorphology

The FMG complex trends north-northwest, parallel to the platform margin, and is some 60 km long by 15 km wide (Figures 1-4). Individual banks are approximately 12 to 15 meters in height, and as much as 2 to 3 km in width (Figure 3). Water depths range from 45 meters in surrounding basinal areas, to a minimum depth of 26 meters on banktops. Seismic and side-scan sonar data reveal the geologic framework in greater detail than any previous investigations (Figures 2 and 3). The basement reflector shows up to 4 meters of karstic relief, and is likely of Miocene age (Figure 2). Several seaward-dipping Quaternary sequences are recognized. An angular unconformity separates dipping sequences from younger aggradational sequences. The banks extend upward from a shallow subsurface reflector and assume several morphologies including very steep-sided, flat-topped banks, and numerous pinnacles. Data suggest that the FMG carbonate banks were originally recruited upon low relief shoal-like structures, possibly paleoshorelines similar to those found on the south Florida margin (Locker et al. 1997).

The southern portion of the FMG is characterized by low relief, with depths ranging from 45 to 35 meters (Figure 4). The northern portion of the FMG is characterized by greater relief, with depths ranging from 45 to 24 meters. The carbonate banks are surrounded by rock rubble and sediment aprons. Diver reconnaissance reveals highly bioeroded margins with abundant cryptic environments, including swim-throughs, overhangs, and shallow caverns. The geologic setting, that of a mid to outer shelf carbonate buildup in a ramp setting, is similar to the reefs of Campeche Bank on Mexico's Yucatan Peninsula (Hine and Mullins, 1983; Logan et al., 1969).
Charts presenting the side-scan sonar data and multibeam bathymetry data are included in this report (Figures 3 and 4; Plates 1 and 2). These charts are also included in the accompanying CD. These data reveal the distribution, bathymetry, and composition of fish habitat over large portions of the study area, including areas where no detailed information previously existed (Figure 6; Plate 3).

Based on these remote sensing data, the FMG appears to be a relict coral-reef complex and has all the morphological similarities to modern patch-reef complexes seen on the Bahama Banks and other areas. On the basis of the seismic and side scan data that we have collected, the only possible geomorphic feature that the Florida Middle Ground can represent is a coral-reef/patch-reef complex. Seismic data reveal that the topography does not result from massive karst activity (either surficial or subterranean), nor is it a lithified carbonate coastal deposit such as a dune field (eolian or submarine). We know of no carbonate shelf deposit that presents this geomorphology other than reefs.

The presence of significant rock rubble and sediment aprons on slopes, and the lack of abundant carbonate producers, indicate a degradational environment. The slopes of the banks are highly bioeroded and undercut, creating significant cryptic environments for a diverse assemblage of organisms. The bioerosion of the margins of the banks produces a coarse gravel to boulder lag of debris, and contributes significant amounts of sediment to the surrounding inter-bank lows.

**Benthic Habitats**

Acoustic backscatter facies are defined and related to bottom type (Figure 6; Plate 3). Live-bottom communities are recruited upon hard-bottom highs, so it is evident that
there is a correlation between bottom type and bathymetry. Live-bottoms and hard-bottom highs are characterized by a high acoustic backscatter signature with a patchy, crenulated texture. Bottom types were ground truthed by divers at five locations (Figure 4). Diver and ROV reconnaissance reveal that live-bottom communities are dominated by various sponges, gorgonian corals, hydrozoans, small (<0.5 m diameter) head corals, and tunicates (Figure 5; Table 2). The tops of the banks exhibit variable degrees of live-bottom coverage, interspersed with depressions filled with sediment.

**Potential Seafloor Disturbance**

- **Our survey data (including diver surveys), suggest that fishing-related impacts to the bottom are minimal.**

  Within the surveyed area, only one feature was identified that was a strong candidate for a fishing-related bottom scar, based upon the criteria used for identifying possible trawler scars (Figure 7; Table 3). Several other faint linear features were identified, but their classification as bottom scars is much less certain (Table 3). Our data should be able to resolve the linear characteristics of bottom scars larger than 1 meter in width. If fishery-related damage does exist, it must be small in scale, and spatially infrequent (i.e., not concentrated in any particular area). Even in the area where a trawler was reported on the bank, there was no clear evidence of damage. Diver observations also failed to discover any damage to live-bottom communities.

  The location and orientation of scars suggest that fishing vessels with gear deployed typically traverse the banks in an east-west direction. Upon encountering the
banks, fishermen are likely to reel in nets or lines to avoid loss of gear. This accounts for the limited length of seafloor scars (<200 m).

Table 3. Locations and characteristics of possible fishing-related seafloor damage.

<table>
<thead>
<tr>
<th>Lat/Lon</th>
<th>Length x Width (meters)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>28°23.9354’N</td>
<td>100 x 2</td>
<td>Trending E-W; begins on western edge of 35 m depth bank. Confidence = 9 (Figure 7)</td>
</tr>
<tr>
<td>84°13.8996’W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28°23.6473’N</td>
<td>50 x 2</td>
<td>Trending E-W.</td>
</tr>
<tr>
<td>84°13.2321’W</td>
<td></td>
<td>Confidence = 5</td>
</tr>
<tr>
<td>28°25.5929’N</td>
<td>50 x 2</td>
<td>Trending E-W.</td>
</tr>
<tr>
<td>84°13.8392’W</td>
<td></td>
<td>Confidence = 5</td>
</tr>
<tr>
<td>28°23.2227’N</td>
<td>200 x 2</td>
<td>Trending E-W.</td>
</tr>
<tr>
<td>84°15.2008’W</td>
<td></td>
<td>Confidence = 5</td>
</tr>
</tbody>
</table>

Summary

♦ Four hundred kilometers of side-scan sonar and multibeam bathymetry data were acquired over the Florida Middle Ground.

♦ Acoustic data were used to evaluate fishing-related impacts and to construct a benthic habitat map.

♦ Minimal fishing impacts were identified on the Florida Middle Ground, based upon acoustic data and diver observations.
Suggestions for Future Work

- Further ground-truth side-scan sonar data using divers and remotely operated vehicles (ROVs).
- Perform a towed-ROV survey of the entire western margin of the FMG.

References Cited


Figure 1. Map showing the location of the Florida Middle Ground on the West Florida Shelf.
Figure 2. Single-channel analog UNIBOOM seismic data across several of the carbonate banks that comprise the Florida Middle Ground. See Figure 1 for the profile location.
Florida Middle Ground
100 kHz side-scan sonar mosaic

Figure 3. 100 kHz side-scan sonar mosaics of the Florida Middle Ground - Habitat Area of Particular Concern. Dark areas represent low acoustic backscatter and correspond to fine quartz and carbonate sands deposited in lows. Light areas represent high acoustic backscatter and correspond to coarse carbonate sands, rock, and live-bottom areas.

Center for Coastal Ocean Mapping
Department of Marine Science
University of South Florida

Universal Transverse Mercator Projection
WGS 84
Side-scan data processed at 2 meter pixel resolution
Figure 4. Multibeam bathymetry mosaic of the Florida Middle Ground, acquired with the 300 kHz Simrad EM3000 system. Dive sites (red dots 1-8) are also shown.
Figure 5. Selected photographs of various dive sites illustrating the predominance of hydrozoans (H), soft corals (G), and sponges (S).
Figure 6. Acoustic facies map and interpretations based upon acoustic backscatter character of the 100 kHz side-scan sonar data.
Figure 7. Side-scan sonar image of a bottom scar on the top of a live-bottom bank. A scar such as this is possibly the result of fishing gear or an anchor dragging across the banktop.