

Multibeam Sonar Analysis of Areas Adjacent to Gray's Reef National Marine Sanctuary

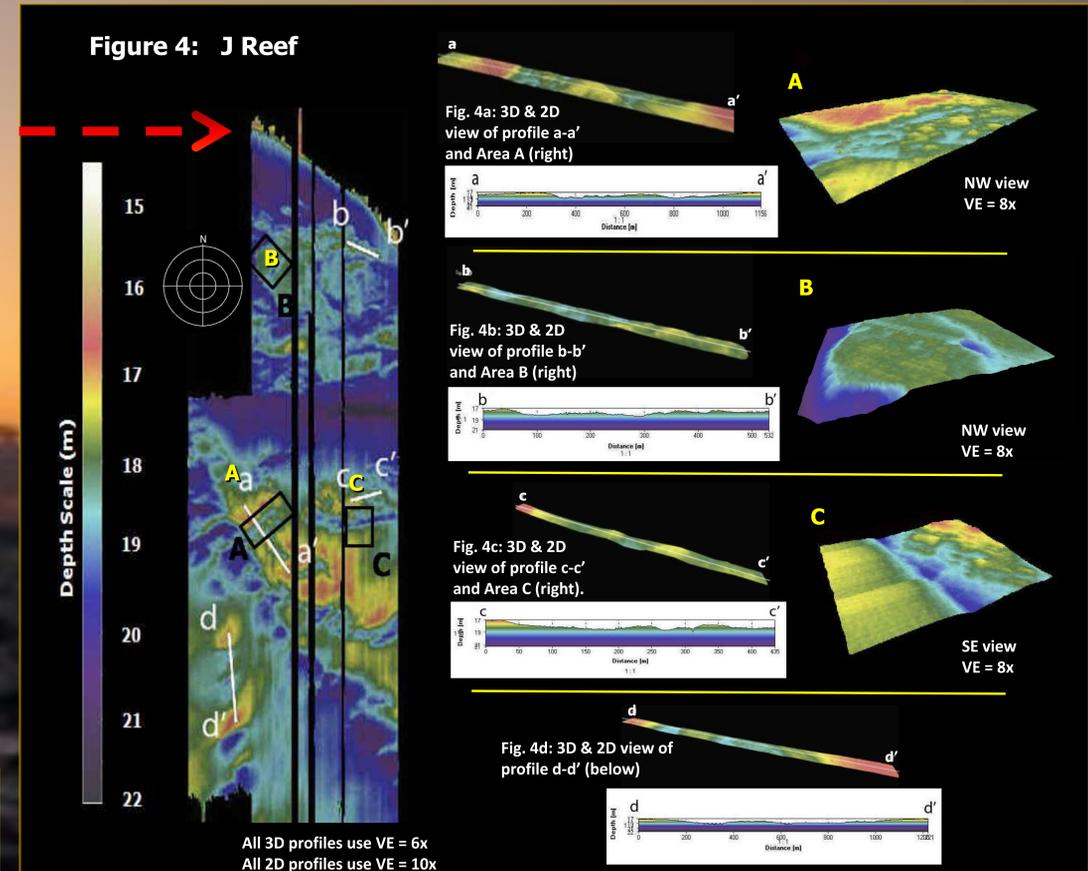
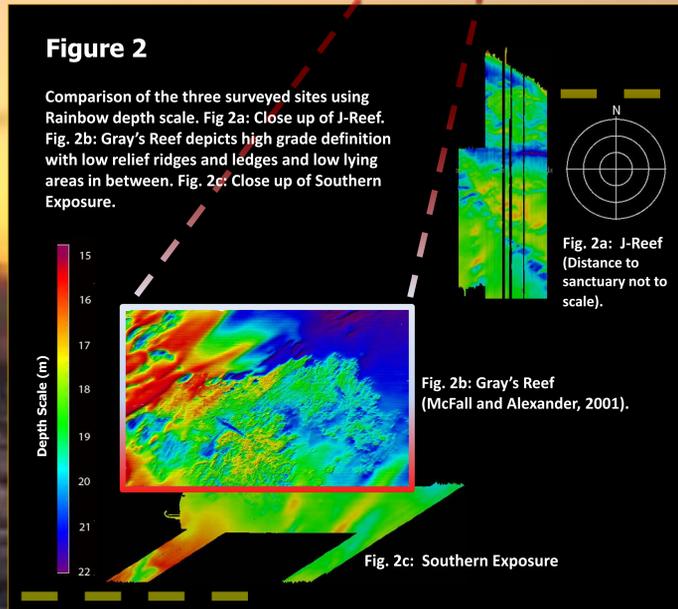
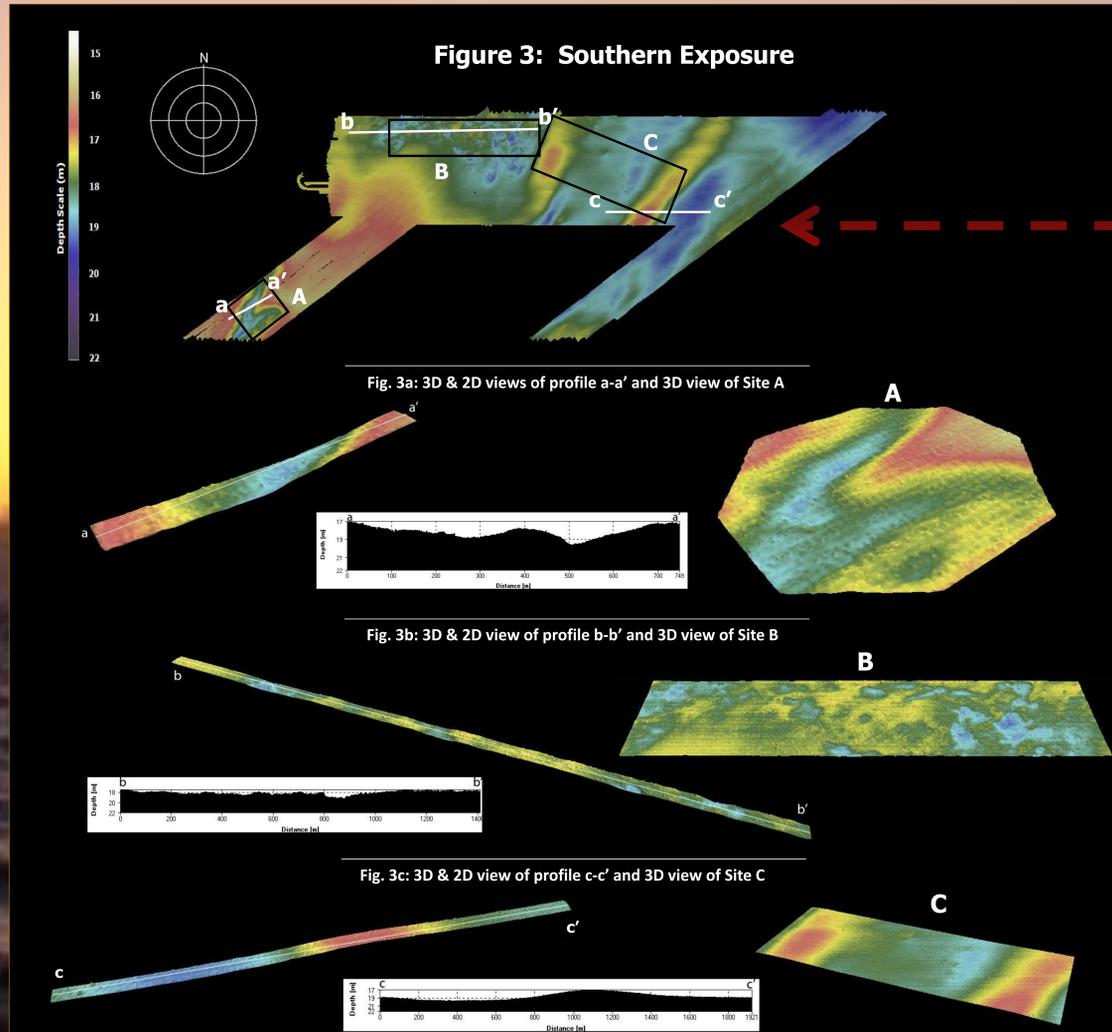
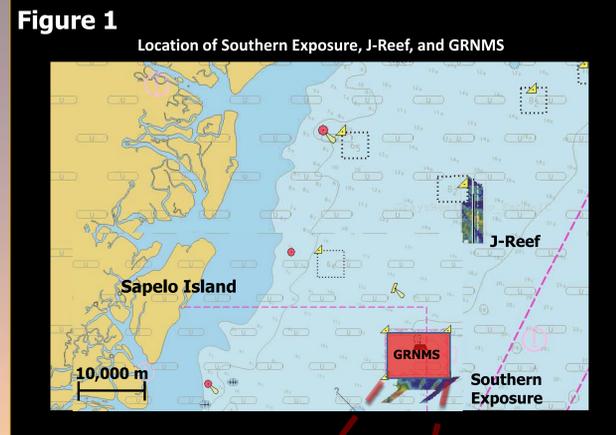
Abstract: Multibeam sonar surveys were conducted along the northeastern and southern borders of Gray's Reef National Marine Sanctuary (GRNMS), ~ 32 km off Sapelo Island, GA as part of a two leg cruise aboard the NOAA Ship *Nancy Foster* in May 2008. Approximately 24 nm² of additional seafloor adjacent to the sanctuary were mapped for the purpose of examining seafloor morphology and geology in comparison to the sanctuary, as well as to help preserve living and non-living resources. Multibeam sonar bathymetric data were processed and refined using CARIS HIPS 6.1 software. Areas mapped in '08 range in water depths from ~14.8 to 22 m and are referred to as "J-Reef" (northeast of GRNMS), and "Southern Exposure" (immediately adjacent to the southern boundary of GRNMS). The purpose of this study is to characterize the seafloor of these nearby reef areas and compare their seafloor morphology to GRNMS. Southern Exposure exhibits signs of low relief ledges along the northernmost edge, low-relief ridges, and an incised channel. In contrast, J-Reef exhibits more patchy karst bathymetry, similar to the GRNMS, with a broad, 22 m deep depression. These results can help contribute to the current knowledge of the physical features of Gray's Reef National Marine Sanctuary, and supplement additional mapping being conducted in 2009.

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Background: Gray's Reef was designated as a National Marine Sanctuary in 1981 (Kendall et al., 2008). The 58 km² area is made up of low relief ridges and ledges up to 3 m high and sandy plains (Kracker et al., 2008). Bathymetric data for the sanctuary were obtained in 2001 using a Reson Seabat 8101 multibeam echosounder aboard the NOAA Ship *Whiting*. The collected multibeam data were processed using CARIS 4.3.2 (Kendall et al. 2005). In 2008, areas adjacent to the sanctuary boundaries were mapped: Southern Exposure (immediately south) and J-Reef (northeast). Here we investigate the seascape surrounding Gray's Reef. The multibeam analysis will allow for better understanding of the geological features present within the areas.

Methods:

- May 5- 19, 2008 data collection aboard the NOAA Ship *Nancy Foster*
- Multibeam bathymetry data acquired using a *Simrad EM 1002* multibeam sonar system.
- Surveying was conducted at a speed of 5 - 7 knots on areas adjacent to Gray's Reef in E-W, SW-NE, and N-S directions, and along parallel track lines.
- Bathymetric data were processed using CARIS HIPS 6.1 software.



Discussion:
Out of the three surveyed sites, Gray's Reef shows the greatest variation in bathymetry with clear depth definition (14.8 to 22.0 m) within its features. The majority of Gray's Reef consists of unconsolidated sediment with distinct regions of patchy hard bottom reef and sandy plains ("Gray's Reef"). The presence of unique geological structures such as ledges, caves, and troughs prove to be the ideal habitat for fish and sessile invertebrates (Kendall et al., 2008). Southern Exposure (Fig. 3c), J-Reef (Fig. 4b), and Gray's Reef (Fig. 2b) all exhibit low relief ledges separated by shallow depressions. Ledges scattered across the northwestern part of Southern Exposure (Fig. 3b) are an extension of a field of low relief ledges seen in Gray's Reef. The adjacent boundaries also show similar SW-NE trending parallel low-relief ridges separated by gradual depressions, comparable to the sanctuary. The ridges of Southern Exposure and J-Reef (Fig. 3c, Fig. 4a) differ, however, being separated by low relief ledges and a featureless plain, respectively. Exclusive to Southern Exposure is evidence of an incised channel (Fig. 3a) with ~2 m relief. Similar depth as well as geological and morphological bottom features, such as ledges, ridges, and shallow depressions found in the three sites, suggest that they will all have the same bottom sediment composition and marine ecology. Further understanding of these benthic habitats is necessary for proper marine ecosystem management (i.e. identifying and protecting habitats), education, and research. Monitoring the temporal changes of Southern Exposure and J-Reef is necessary to understand the dynamic nature of the continental shelf and properly assess the habitat within and around Gray's Reef.

Figure 4: J Reef: a) Profile a-a' shows two parallel ridges separated by a shallow depression abundant with shelf ledges. Area A shows the parallel ridges are separated by a low lying area with ample shelf ledges. b) Profile b-b' and 3D image B show multiple shelf ledges disassociated by low lying areas. Area B also displays assorted shelf ledges extending to a 4 m drop in relief. c) Profile c-c' depicts shelf ledges located in low lying areas with ridges on opposing sides, and nearby 3D area C shows two ridges bisected by a steep depression with shelf ledges present adjacent to the northeast ridge. d) Profile d-d' illustrates parallel ridges separated by a shallow depression.

Results for J Reef

- Multibeam data analysis show shelf ledges and ridges with 2 m relief along with shallow depressions reaching depths of 22 m (Fig 4)
- SW-NE trending ridges extend along profiles a-a' and c-c' and are exemplified in A and C. Located parallel to each other, the ridges are separated by shallow depressions abundant with shelf ledges and gradual slopes.
- Shelf ledges scatter the northern part of the surveyed area and are separated by depressions reaching 19 m in depth.
- Ridges running parallel to each other are seen along d-d' and are separated by shallow depressions with no apparent shelf edges.

•All 3D Profiles use VE = 10x
•All 2D Profiles use VE = 20x
•All 3D Images Viewed Looking N VE = 6x

Fig. 3: Southern Exposure. a) Profile a-a' and the 3D image A show a low relief incised channel in the southwestern portion of the area. b) Profile b-b' and the 3D image of B show multiple ledges disassociated by low lying areas. c) Profile c-c' shows a low relief ridge, the shallowest and deepest points of Southern Exposure. 3D image C shows two low relief ridges bisected by a low lying area.

Results for Southern Exposure

- Multibeam data analysis show ledges with 2 m relief and ridges with 3 m relief along with shallow depressions reaching depths of 20 m (Fig. 3)
- An incised channel, unique to Southern Exposure, exhibits a 2 m relief along the south western part (Fig. 3a).
- Ledges scatter the northern western part of surveyed area and are separated by depressions reaching 2 m in depth (Fig 3b).
- SW-NE trending ridges extend along Fig. 3c. Ridges run parallel to each other are seen in area C and are separated by shallow depressions with no apparent ledges.

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