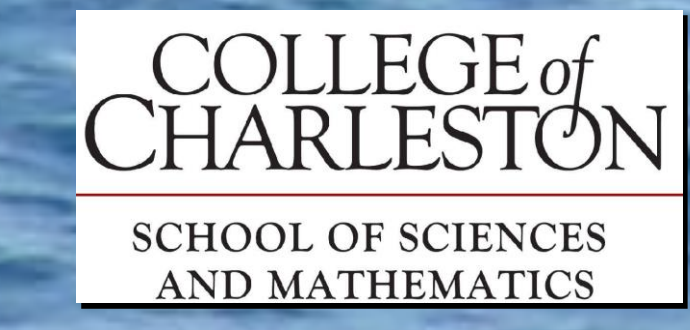
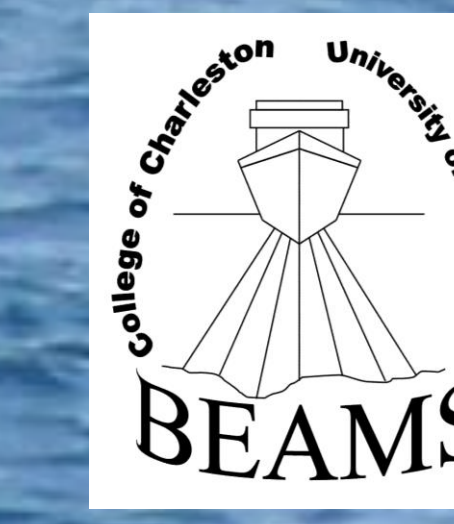
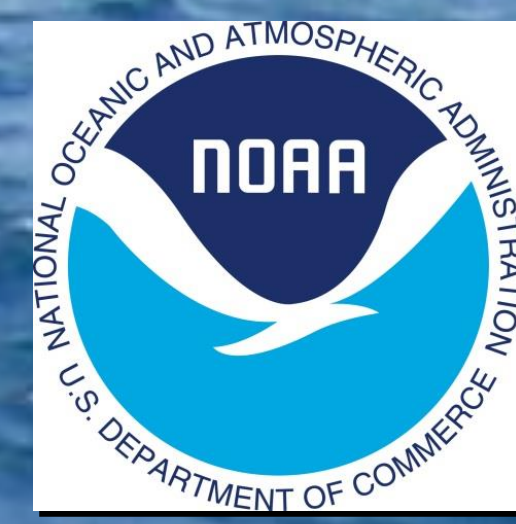


BATHYMETRIC ANALYSIS OF *PTERIOS VOLITANS* SHELF-EDGE HABITATS, ONSLOW BAY N.C.

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Abstract

In 1992 Hurricane Andrew devastated South Florida, killing as many as 15 people and causing billions in structural damage. A lesser known result of this event is that several aquaria and pet shops were destroyed, releasing many non-native species into the wild, including *Pterios volitans*, more commonly known as the Lionfish. Though lionfish have been present since the 1980's The Lionfish inhabits warm tropical waters of the South Pacific and Indian Oceans. They can be found in waters up to 300 m deep (985 ft), but prefer shallow water environments consisting of hard bottom, mangroves, sea grass, corals, and artificial reefs. Since their introduction into the warm waters off Florida they have made their way into the Gulf Stream which has carried them as far north as Long Island, NY. Onslow Bay, NC has seen a dramatic increase in Lionfish populations over the last decade. The concern is the ability to prey on ecologically and economically important native species and have quickly become one of the dominant predators in many of the fisheries habitats throughout the southeastern Atlantic coast. NOAA National Marine Fisheries has deemed their spread worrisome enough to gather bathymetric data to locate and identify current and potential Lionfish habitats. Analysis will be done using bathymetric data collected on board the NOAA Ship *Nancy Foster* from 2008 to 2009 by the NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC. Research will determine the bathymetry of each site and any similarities between them that may help us determine future lionfish habitats.



Fig. 1: This image shows the progression of Lionfish sightings throughout the Caribbean and Southeast Atlantic Coast.

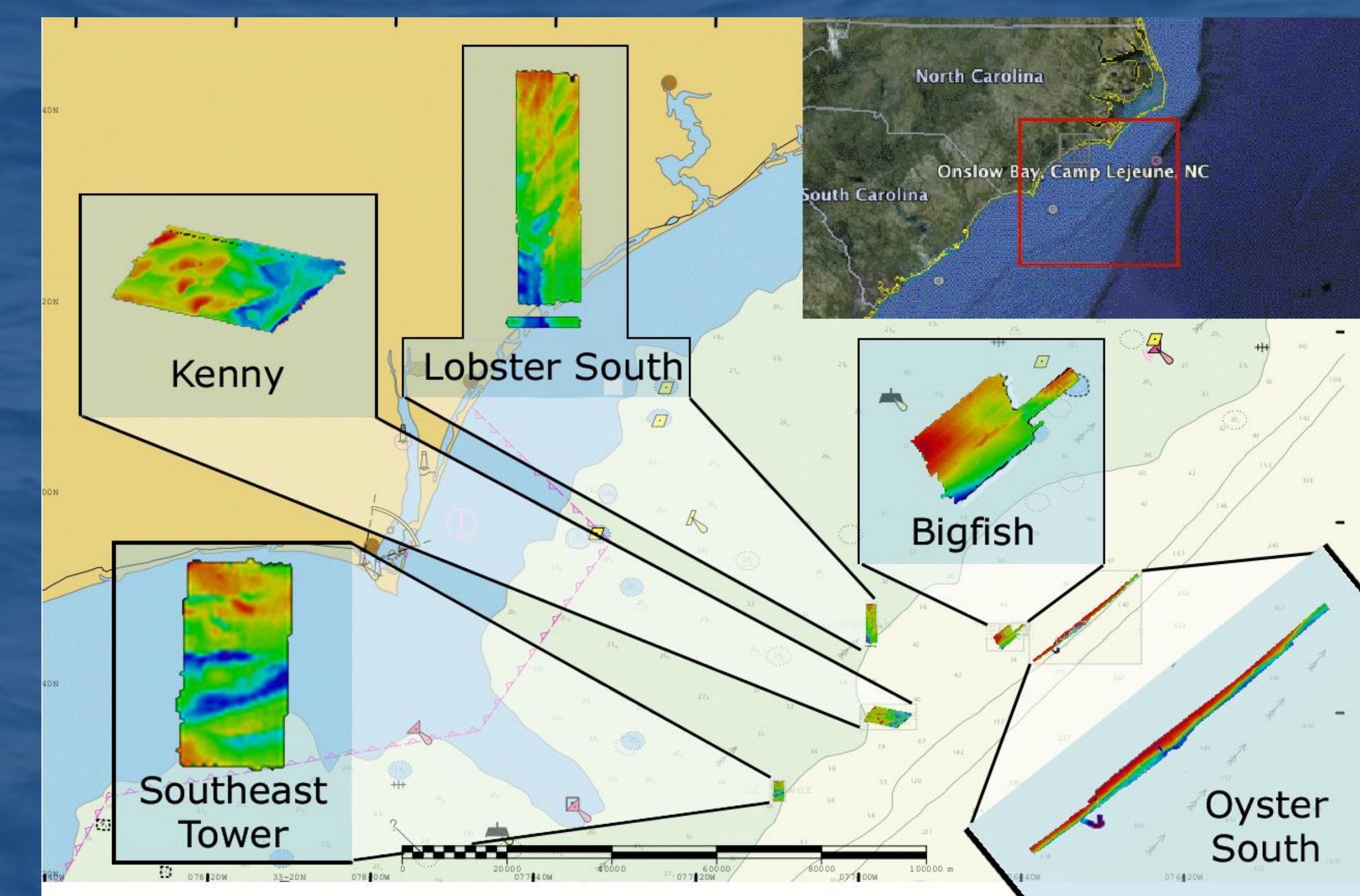


Fig 2. Overview of all the sites reported in this study in the Onslow Bay area. Color scales for the sites vary, see detailed images.

The goal of looking at the bathymetric data was to find similarities and differences in the sites to gain a better understanding of preferred Lionfish Habitats. *Pterios volitans* is usually associated with hard bottom and rocky outcrop locations, which is confirmed by analysis of these sites. Hard bottom is very distinct from sand bottom with relatively low relief, mostly represented by solid blue in these sites. Outcrops were found at Lobster South, Big Fish and Oyster South.

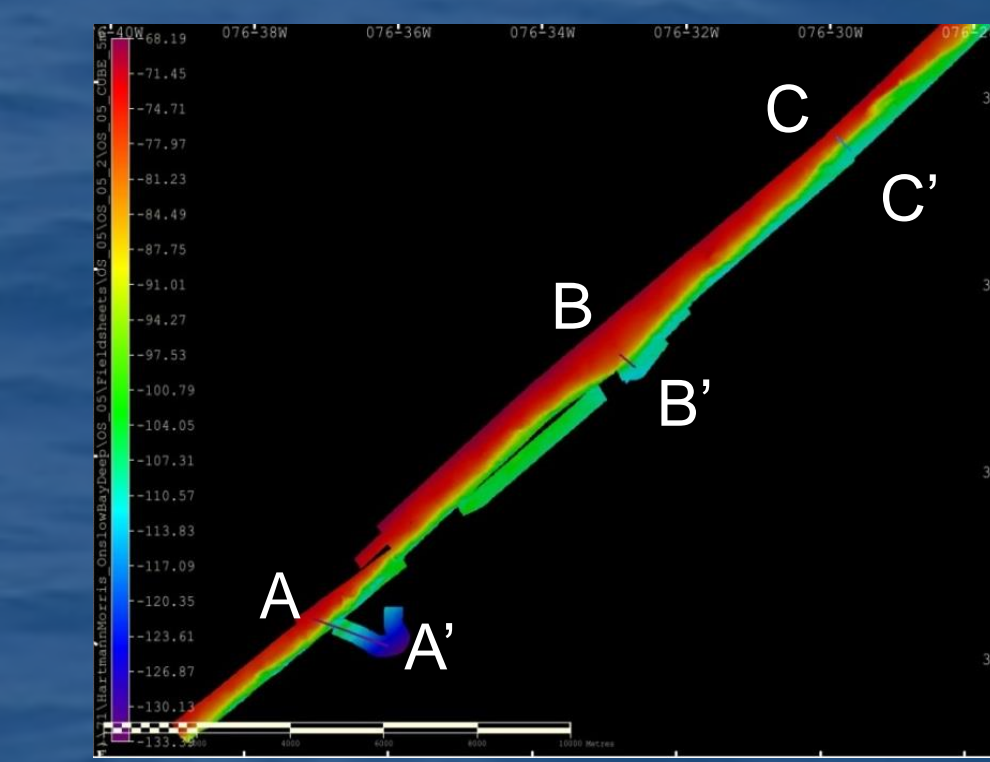
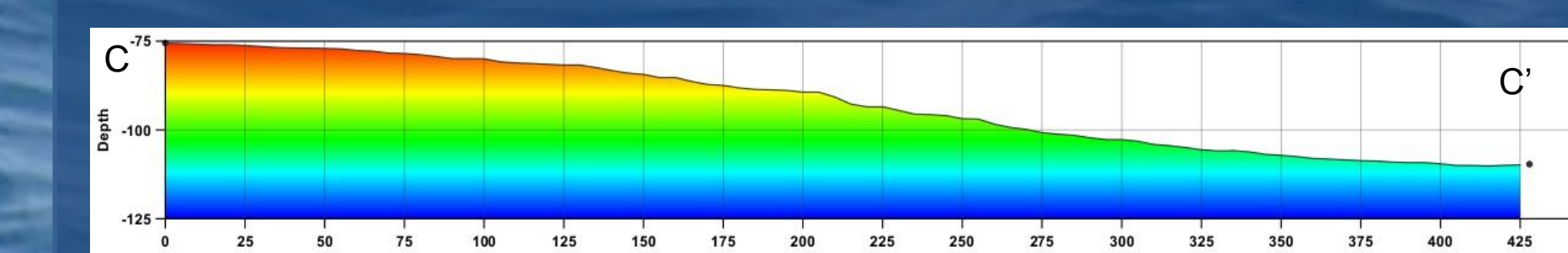
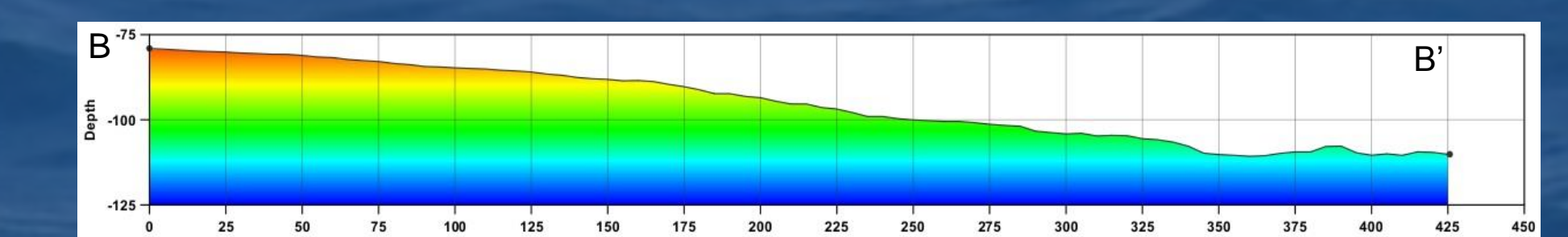
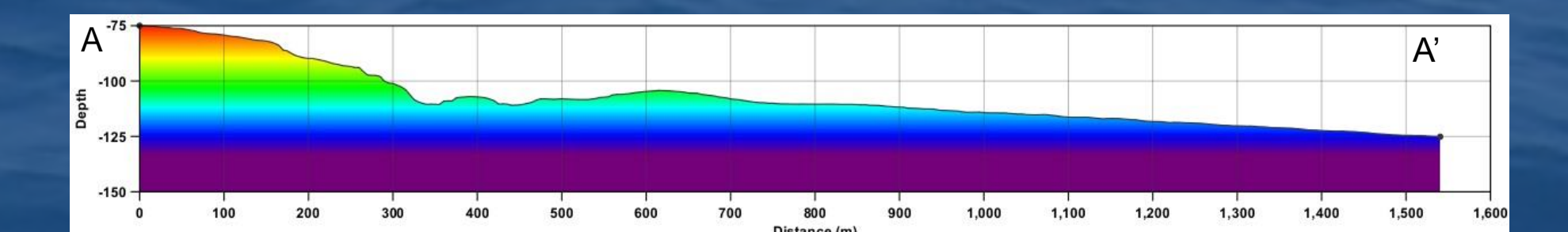
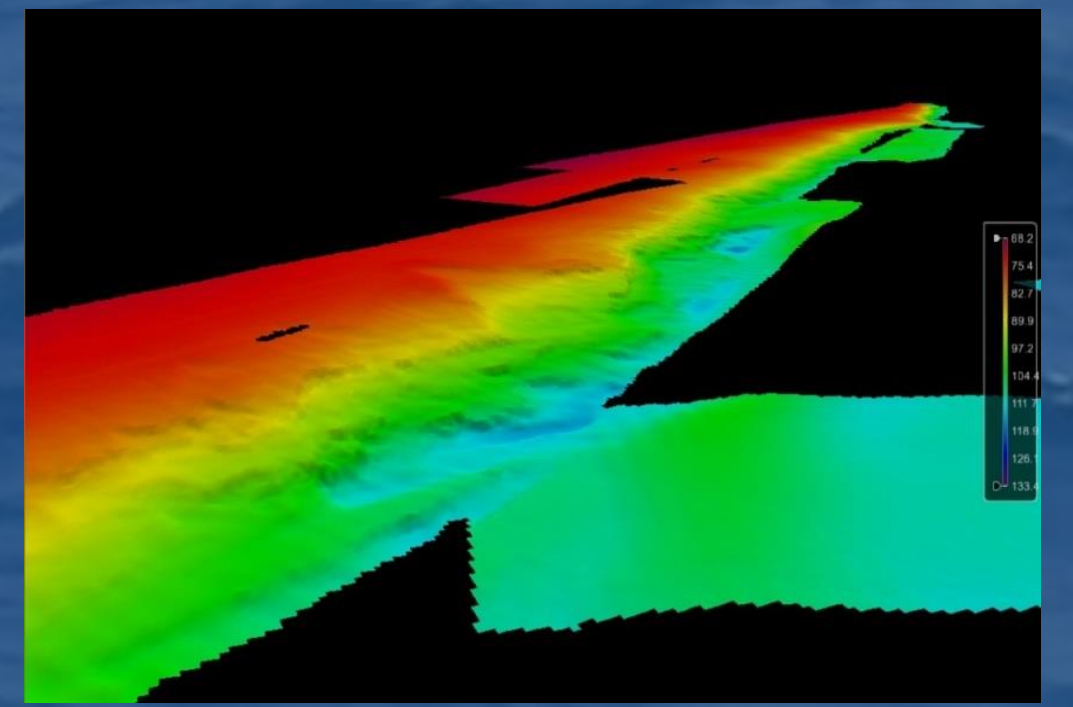


Figure 3a: Oyster South is a shelf-edge site (depth range 68 to 133 m), characterized by long relatively steep-sloping ledge. The slope decreases from SW-NE, and levels out into broad sandy plain.

Oyster South

Figure 3b: shows a 3-D image (1.5x) of the ridge near A-A'. This image shows the full depth range from 68-133m.



These are profiles from different parts of the ridge. At A-A' the ridge has the greatest slope decreasing from SW-NE, and levels out into broad sandy plain. The steepness of the slope increases from northeast to southwest.

Pterios volitans (Lionfish)



Figure 9: Images of Lionfish and their natural habitats

Methods

All of our data was acquired with a Kongsberg EM 1002 Multibeam Sonar System aboard the NOAA Ship *Nancy Foster* over the course of multiple cruises since 2008. The data was analyzed and visualized using the CARIS HIPS & SIPS 7.1 and BASE Editor software. Five hard-bottom sites were analyzed within the mid- to outer-shelf of Onslow Bay.

Lobster South

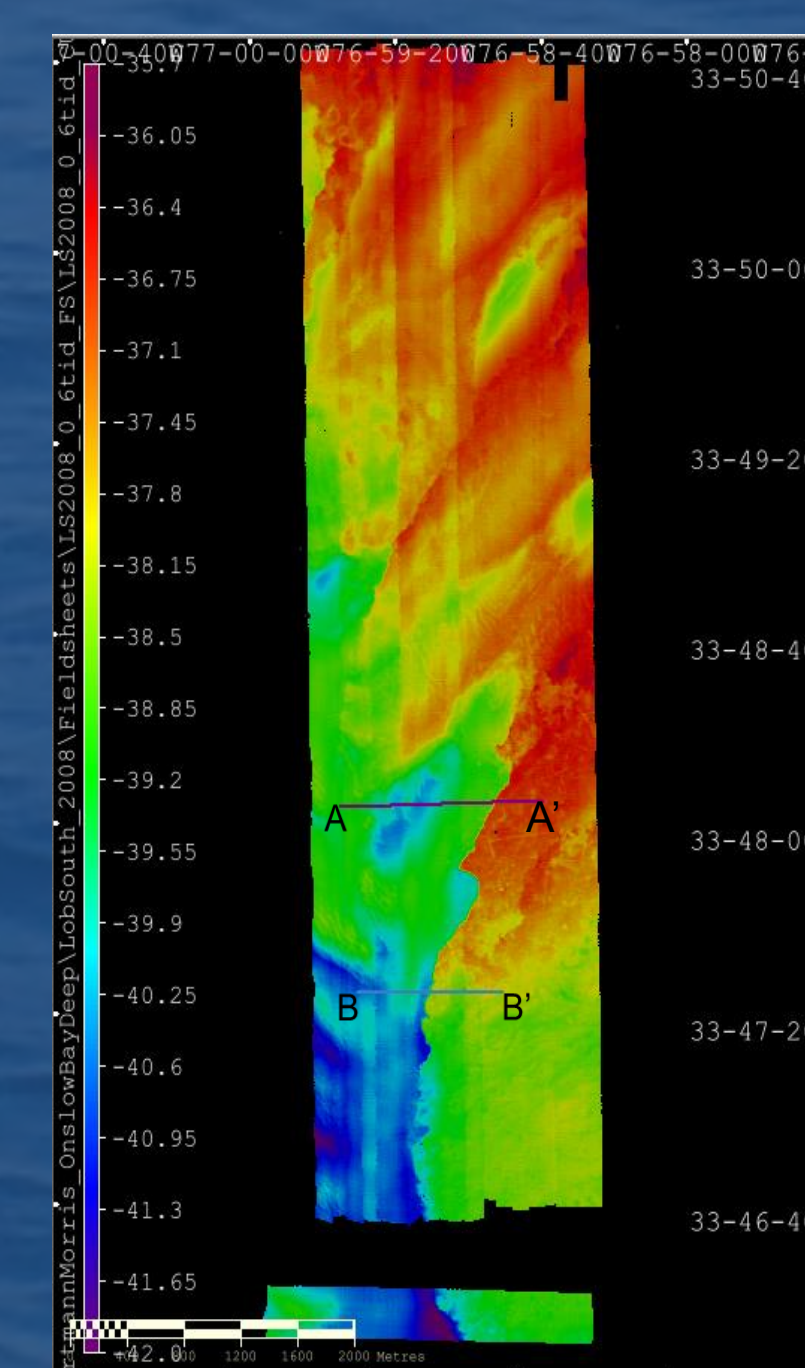
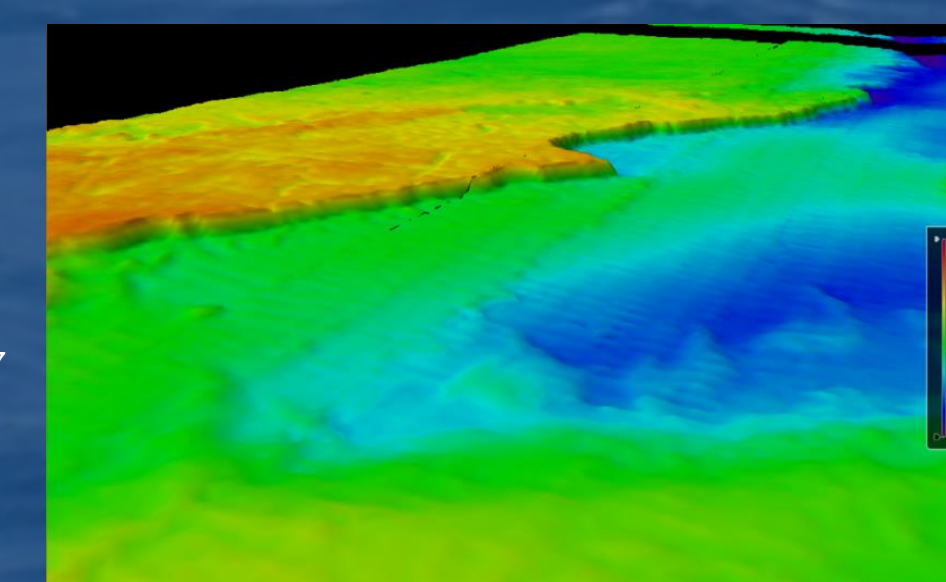
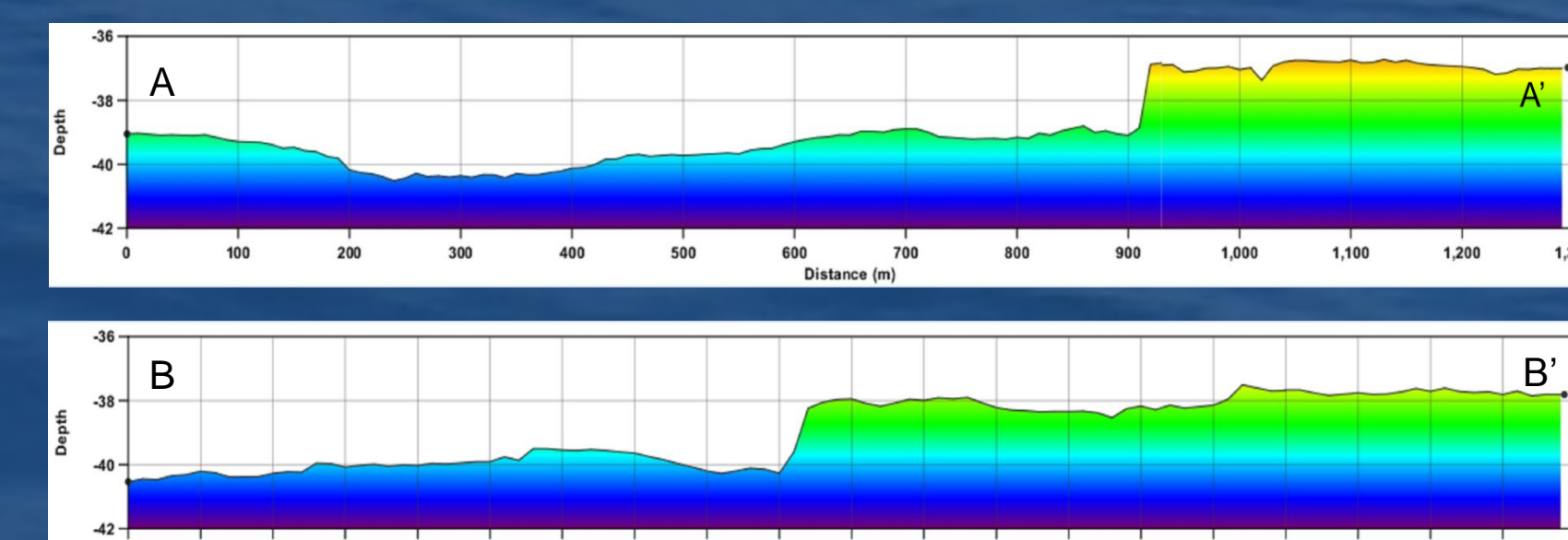


Figure 4a: 2-D image showing 2008 and 2009 data for Lobster South. This site has a relief of around 5m from 37-42m.



3D image (10x) of the southern section of Lobster South, showing a ledge that ranges from 1-3 m high and extending for approximately 2850 m.



Profiles A-A' and B-B' show the relief of the ledge feature. It averages 2 m in height and would make an ideal habitat for lionfish and their prey.

Bigfish

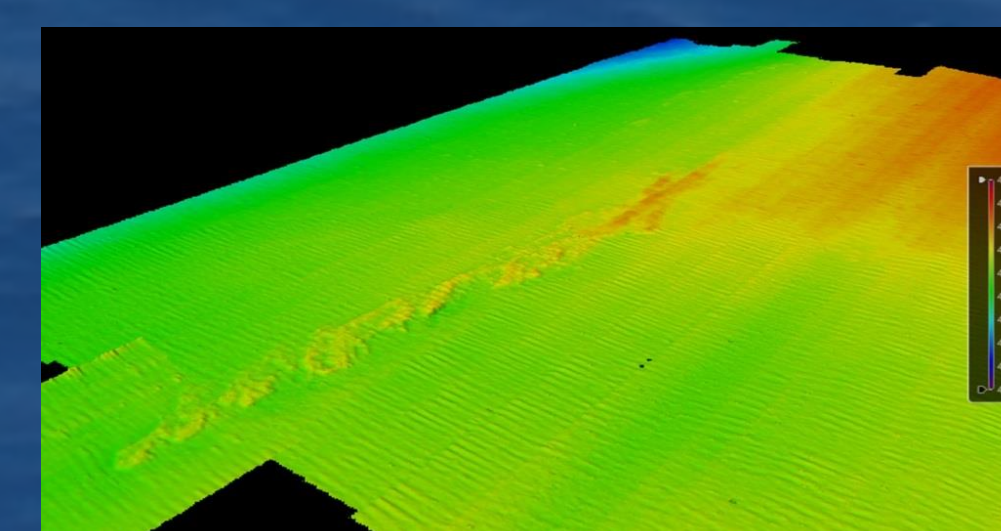
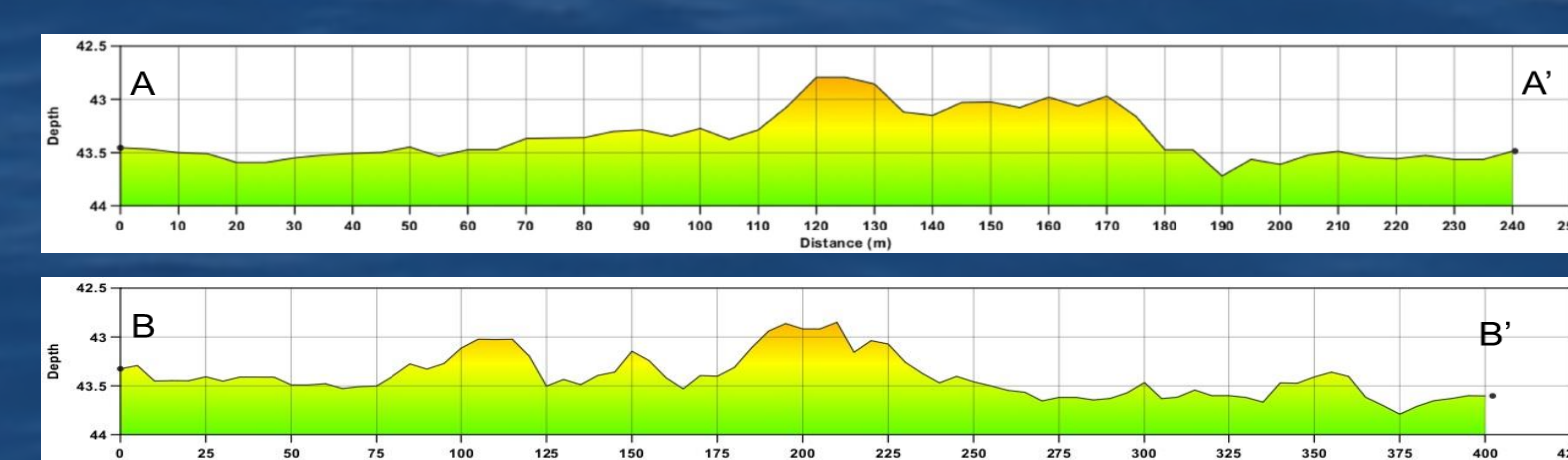


Figure 6a: 3-D image (10x) of the Bigfish site focusing on the central rocky outcrop.

Figure 6a: Bigfish has the lowest relief (42.75-43.75 m deep) and is the least complex bathymetrically. There is a rocky outcrop in the central section striking northeast with an average relief of about 1 m.



Profiles A-A' and B-B' both cross the only feature at this site. The feature has a relief of about 0.5-1 m and is roughly 50m across.

Kenny

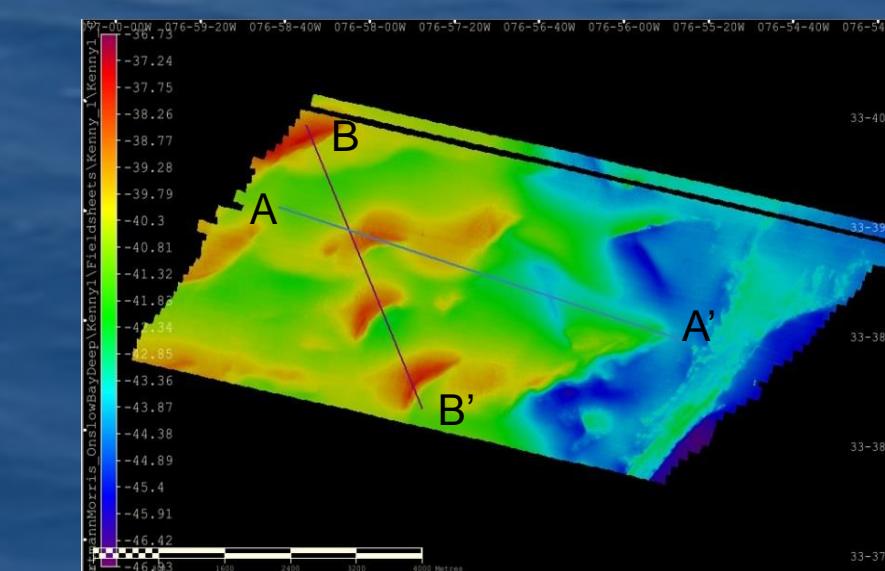


Figure 5a: 2-D image of the Kenny site showing the profile lines and depth scale. Note this site has about 10 m of relief from 37-47 meters.

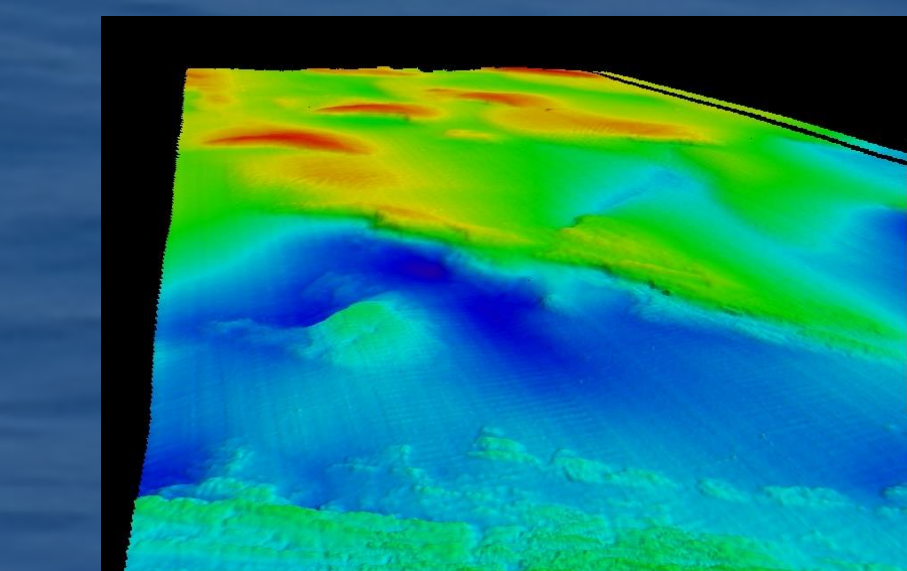
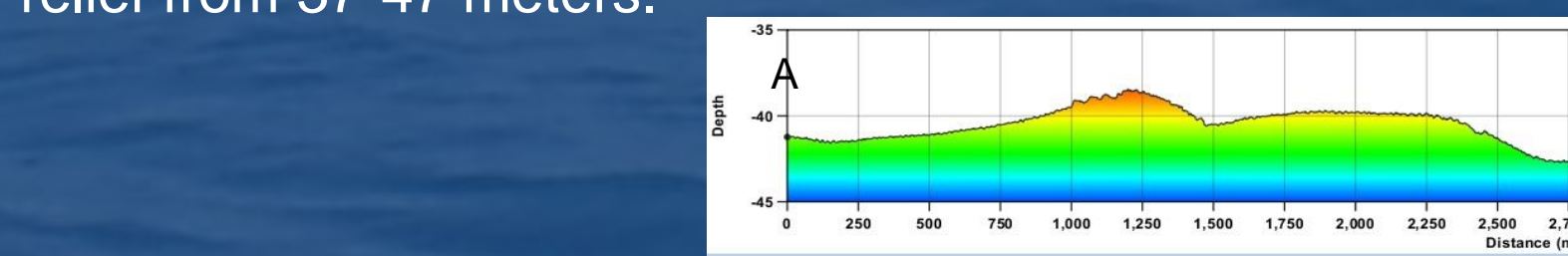


Figure 5b: 3-D Image (10x) showing the hard bottom in the foreground and sand wave features in the background



A-A' bisects the site crossing from hard bottom to sand

B-B' shows the relief of the sandwave features.

Southeast Tower

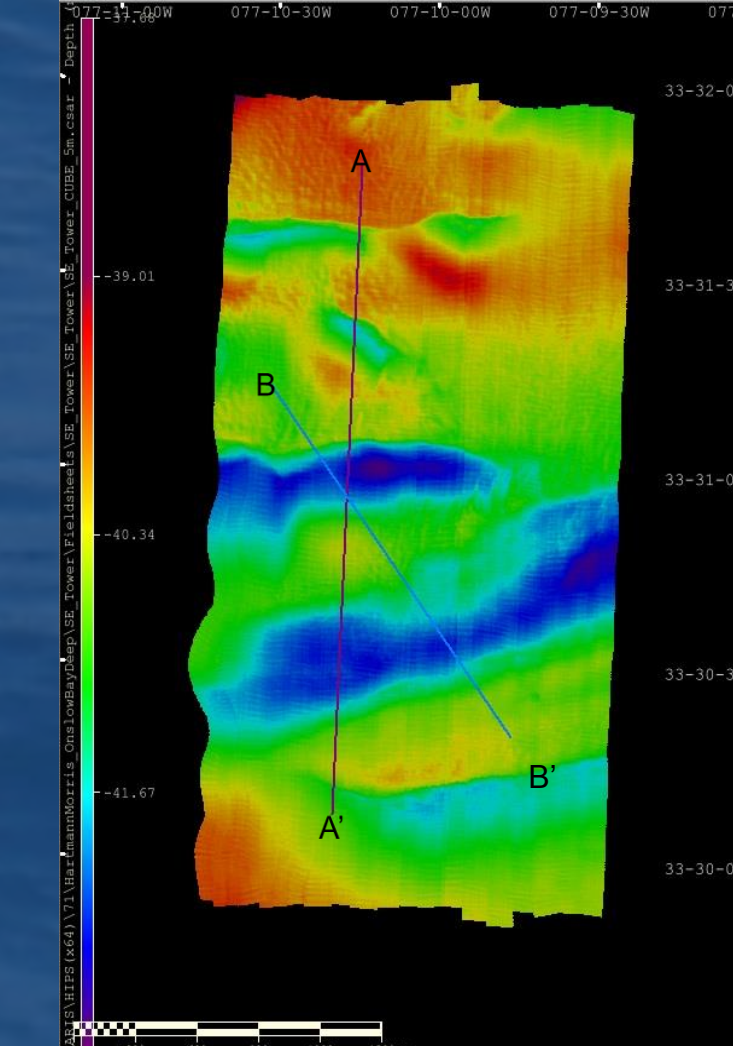


Figure 7a: 2-D map view of SE Tower. Site ranges from 39-42.5 m deep. Two prominent sand waves occur in the southern section and a hard bottom surface exists in the north.

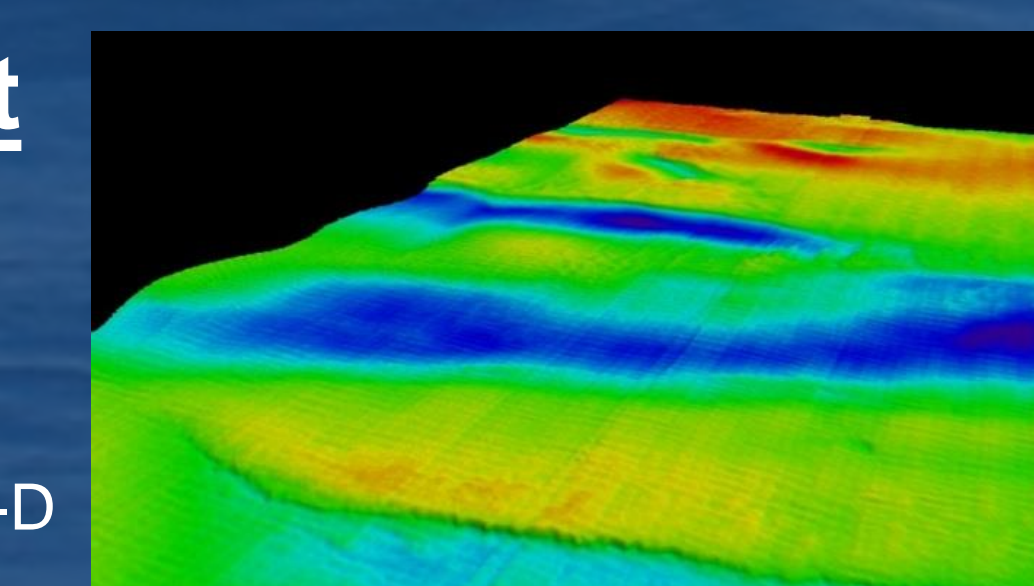
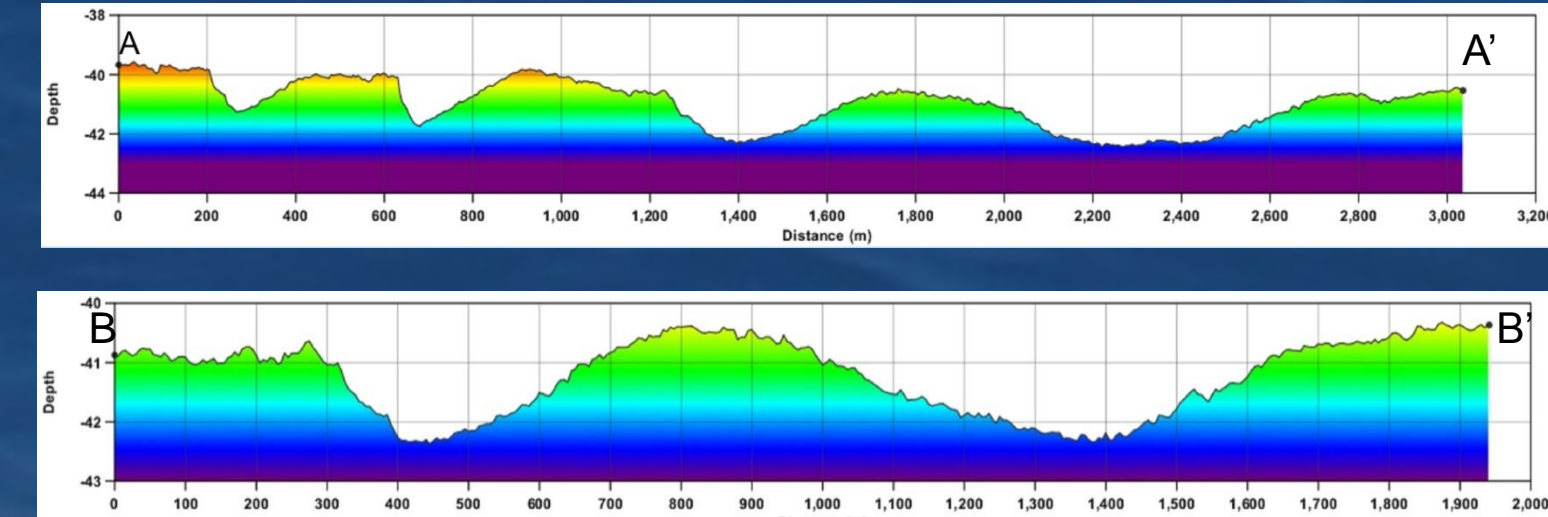


Figure 7b: 3-D Image (10x) showing the relief and unique geomorphology of the site, consisting of hard bottom mixed with sandy bottom.



Profile A-A' runs the length of the site north to south and exhibits the diverse topography of the site. Profile B-B' runs northwest to southeast over a symmetrical sand wave.

Acknowledgments

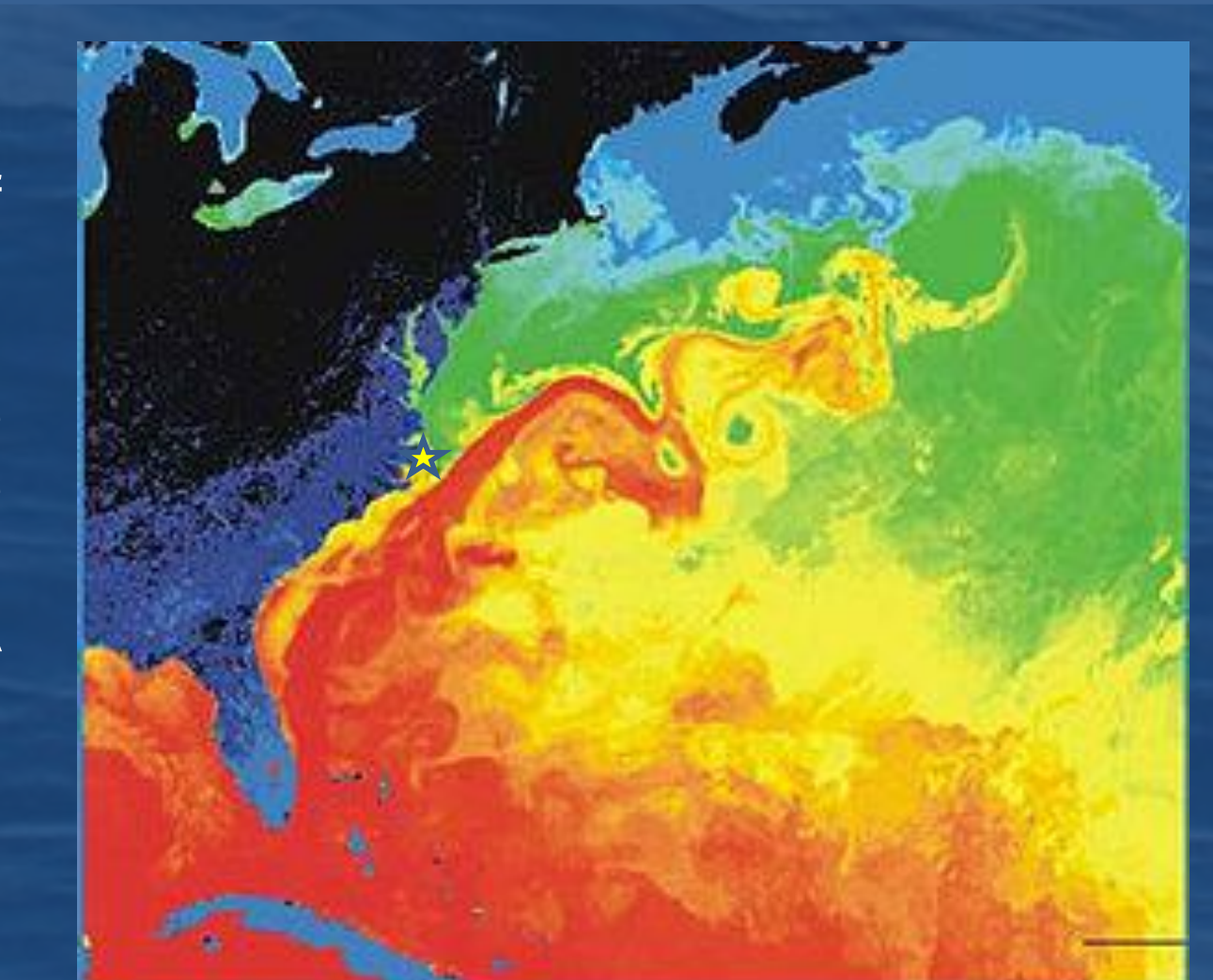
- National Oceanic and Atmospheric Administration
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Discussion

As Lionfish continue to invade the Southeastern Atlantic coastal waters the importance of understanding their preferred habitats has never been greater. In just under a decade we have seen unprecedented range increase of *Pterios volitans*. Though Lionfish have been sighted off U.S. waters as early as 1980, an impressive period of expansion has been in progress since 2000 (Figure 6). *P. volitans* have now been sighted as far North as Long Island, NY. Lionfish can travel farther than most reef fish due to an expanding stomach. They are mainly piscivores and can feed on more than 40 species of prey fish. Prey fish represent an important level in the food chain and it is logical that the expansion of *P. Volitans* will continue to cause damage to reef ecology. (Dornfeld, 2009).

Lionfish have displayed a unique talent for survival in water foreign to them. Even so, they would not be spreading northwards at this rate without the input of warm water and nutrients from the western Gulf Stream system. As shown in Figure 7, the Gulf Stream funnels warm, nutrient rich water up the eastern seaboard largely dissipating just North of Onslow Bay. This, combined with the provided sea floor relief make an ideal habitat for lionfish. Soon the continuation of our recent global sea surface temperature warming trend will allow lionfish to travel farther North than ever before. History tells us that invasive species are impossible to intentionally remove so in all likelihood Lionfish are here to stay. A potential silver lining is the possibility I for a lionfish seafood market. This would be ideal as both a check on the lionfish population and a boon to our economy.

Figure 8: Surface temperatures of the Southeastern Atlantic Coast, showing the movement of the Gulf Stream. Source: NASA



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