

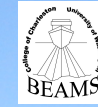


Pterois sp. (image courtesy of NOAA)

# Shallow Marine Lionfish Habitat Characterization of Onslow Bay, NC

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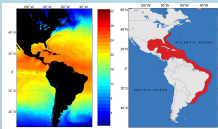
## ABSTRACT

The genus *Pterois* is a group of venomous fish, collectively known as lionfish, that is presently a prominent invasive species found along the eastern coast of North America. Several studies have been conducted to determine the northern most extent that these organisms can inhabit in an attempt to identify the ideal lionfish habitat. A large number of lionfish sightings have been documented in the Onslow Bay area and it is therefore an ideal region of study to identify preferential lionfish habitats. Onslow Bay is a broad crescent-shaped embayment located along the central North Carolina coast and is bordered by two cape promontories. Seven hydrographic surveys were conducted between water depths of 20-40 meters between the years of 2007-2009, using a Kongsberg EM1002 multibeam system aboard the NOAA Ship *Nancy Foster*. Bathymetric surveys were conducted in order to characterize rocky outcrops and ledges where lionfish have been sighted. Hydrographic data were collected by the NOAA Center for Coastal Fisheries and Habitat Research (CCFHRA) Beaufort Lab in North Carolina led by Dr. Paula Whitfield. There are two quasi transect lines across the continental shelf in the northern and southern regions of the bay and one inner shelf site between the two transect lines. Both CARIS HIPS & SIPS 7.1 and CARIS BASE Editor were used to process the multibeam sonar data. These bathymetric surfaces will be used to geologically characterize substrates and to determine the suitability of Onslow Bay for lionfish.

## INTRODUCTION



Invasive lionfish populations have become a serious concern along the eastern coast of the United States extending from the Gulf of Mexico to as far north as New York. The venomous fish, *Pterois* sp., is native to the Indo-Pacific and was introduced to Atlantic waters some time during the 1980's. With few natural predators in the Atlantic, lionfish populations appear to experience little to no population control. The above figure shows the progression of US lionfish populations from 2006-2009.



USGS National Geospatial Database, NOAA

(Morris & Whitfield, 2009)

Scientific studies have concluded that lionfish habitats are likely restricted by their thermal tolerance of no less than 10°C within a 20-90 meters water depth. The threat of climate change may develop a greater suitable living space for lionfish to inhabit therefore it is important to examine all characteristics of lionfish habitat preferences in order to locate and quickly eradicate them.



(Morris & Whitfield, 2009)



Dr. Paula Whitfield and the NOAA CCFHRA Beaufort Lab have been conducting research on lionfish in the NC area for over a decade. Above (left) is a map of the study area in the Three Capes region. The red dots represent known lionfish populations. (Morris and Whitfield, 2009)

Studies have shown that while lionfish are aggressive nocturnal predators, they generally prefer to hide in dark crevices or coral during the day (Whitfield et al., 2002). Based on this observation, an important outcome of this study is to classify the hydrographic surveys sites in order to identify potential lionfish refuges.

Figure 1. Base surfaces for each study area. (Note that depth scales are inverted.)

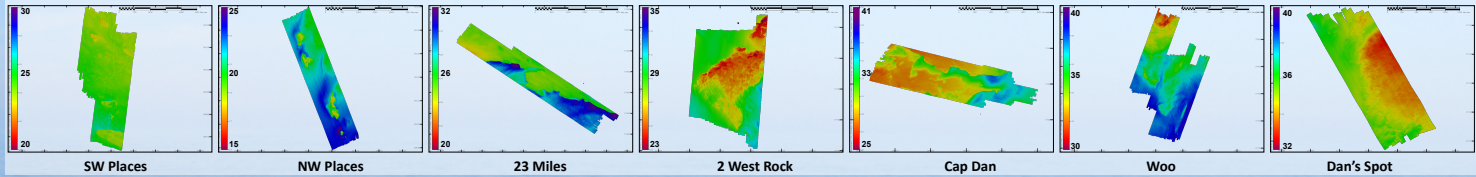


Figure 4. 2 West Rock bathymetry ranges from 31 to 25 m depth. It contains a large feature with approximately 4 m of relief that could be a rocky outcrop.

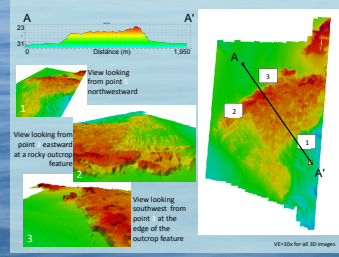


Figure 2. Site map showing geographic location of each of the study sites showing all 3 years of hydrographic data. Depth scale is the same throughout, illustrating the inner and mid-shelf water depths.

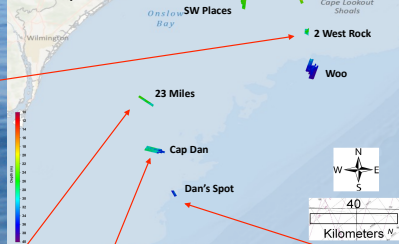


Figure 3. NW Places exhibits scattered high relief features that are likely rocky outcrops. The majority of the region is dominated by low-relief soft bottom.

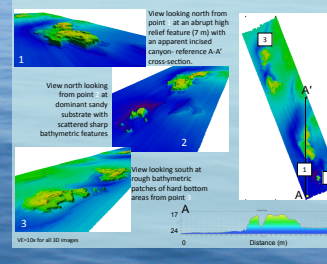


Figure 5. 23 Miles is located on the edge of the continental shelf and has a relief of approximately 7 m with depths between 31 and 24 m.

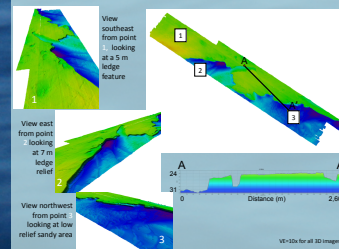


Figure 6. Cap Dan contains a possible ancient river channel that exhibits significant relief of approximately 5 m along each of its edges.

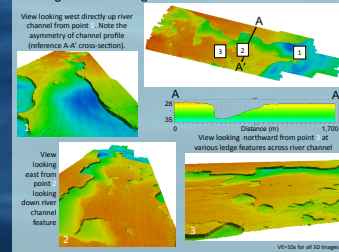
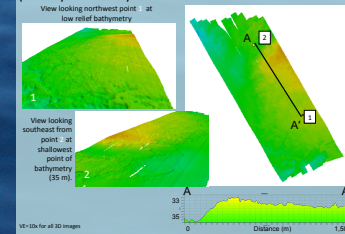


Figure 6. Dan's Spot has very low relief of approximately 2 m and little bathymetric complexity. The substrate is likely dominated by low-lying rocky outcrops possibly covered by sand.



## DISCUSSION AND CONCLUSIONS

Invasive species are capable of competing with native organisms, altering habitats, reducing biodiversity and even causing extinctions of indigenous plants and animals (Morris & Whitfield, 2009). The lionfish's native habitat is in alcoves of coral reefs and rocky crevices in the Indo-Pacific. Without ROV imagery, habitat characterization of the study sites is based solely on general relief and bathymetry seen in base surfaces at profiles generated. Although lionfish have been sighted at each of the study areas the purpose of this study is to assess the level of suitability of the various habitats seen in Onslow Bay.

- Features found at NW Places exhibit a good amount of relief and complexity and therefore could be ideal habitat for lionfish. The feature found at NW Places is likely a high relief rocky outcrop with steeply sloping sides and incised features that would be an ideal lionfish habitat (fig. 3).
- Based on the shape and relatively low relief (4 m) of 2 West Rock it is possible that this area is a low relief rocky outcrop feature that would be a suitable lionfish habitat (fig. 4).
- Due to high topographic relief (7 m), the 23 Mile site could most likely be an ideal habitat for lionfish as the ledge likely houses crevices that would be ideal for lionfish to dwell in (fig. 5).
- Cap Dan's bathymetry shows a possible old stream channel with two high relief (5 m) ledges that would likely provide ample habitat for lionfish to reside (fig. 6). If the feature is in fact a stream channel, it was likely formed during a period of sea level rise during the last deglaciation period within the last 10-15 thousand years.
- The low relief and bathymetry seen at Dan's Spot is likely a low outcrop covered by scattered sand (fig. 7). The bathymetry here is very similar to that of Woo and SW Places.

Based on the analysis of the bathymetry and the complexity of hard bottom features, 23 Miles and NW Places are the best suited lionfish habitat sites due to presence of high-relief incised hard-rock features. 2 West Rock and Cap Dan are both suitable habitats that provide moderate relief hard bottom substrates while Dan's Spot, Woo and SW Places are not highly ideal due a general lack of relief in their bathymetry.

## FUTURE WORK

Since Onslow Bay is a region where there has been high volume of documented lionfish sightings and there are documented long-term ecological studies within the area it is an excellent region to continue to pursue lionfish studies. Additional hydrographic surveys and ROV dives would be beneficial in the characterization of lionfish habitats. It would be interesting to couple a detailed record of geographically referenced lionfish sightings with existing study sites in order to quantify lionfish presence at various habitat types.

## REFERENCES

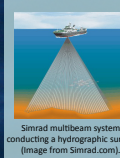
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## METHODS

- Hydrographic surveys were conducted in the Onslow Bay study area in 2007, 2008 & 2009.
- An EM1002 Kongsberg (Simrad) multibeam system was used aboard the NOAA Ship *Nancy Foster*.
- The multibeam data were collected by the NOAA Center for Coastal Fisheries and Habitat Research Beaufort Lab.
- CARIS HIPS & SIPS 7.1 and Bath DataBASE 3.2 geospatial software were used to clean and produce bathymetric surfaces at 7 shallow water sites ranging from 20 to 40 meters water depth.
- Cross-sections were created in CARIS HIPS & SIPS 7.1 at select sites to show bathymetric features found in the bay.
- 2007 survey sites: SW Places, NW Places, 23 Miles, 2 West Rock, Cap Dan, Woo & Dan's Spot
- 2008 survey sites: Cap Dan & Woo
- 2009 survey sites: SW Places, 23 Miles, 2 West Rock, Cap Dan, Woo & Dan's Spot



Simrad multibeam system conducting a hydrographic survey (image from Simrad.com).