Investigating the Vertical Distribution of Deep-Sea Fauna in Exuma Sound

Grace Wetsel, Leighton Graham, Tobias Wynn, Anna Weisel, Jessie Hill, Bella Garfield, Krystynia Pyfrom

Advisors: Brendan Talwar and Nathan Robinson

Cape Eleuthera Institute
The Island School
Shark Research & Conservation Program, Cape Eleuthera Institute, The Bahamas

Introduction

The majority of Earth's surface is covered in water, yet only 5% of our oceans have been explored (National Aquarium, 2018). We know even less about the deep ocean, defined as all marine ecosystems located below 200m deep.

Much research has been conducted in Exuma Sound, The Bahamas from the shallows up to the edge of the wall (0-30m), and some has even been conducted beyond 500m deep. In between, however, previous research has failed to characterize the species and habitats found along the wall itself. Research in these habitats has been unsuccessful due to a lack of equipment available to investigate these depths effectively.

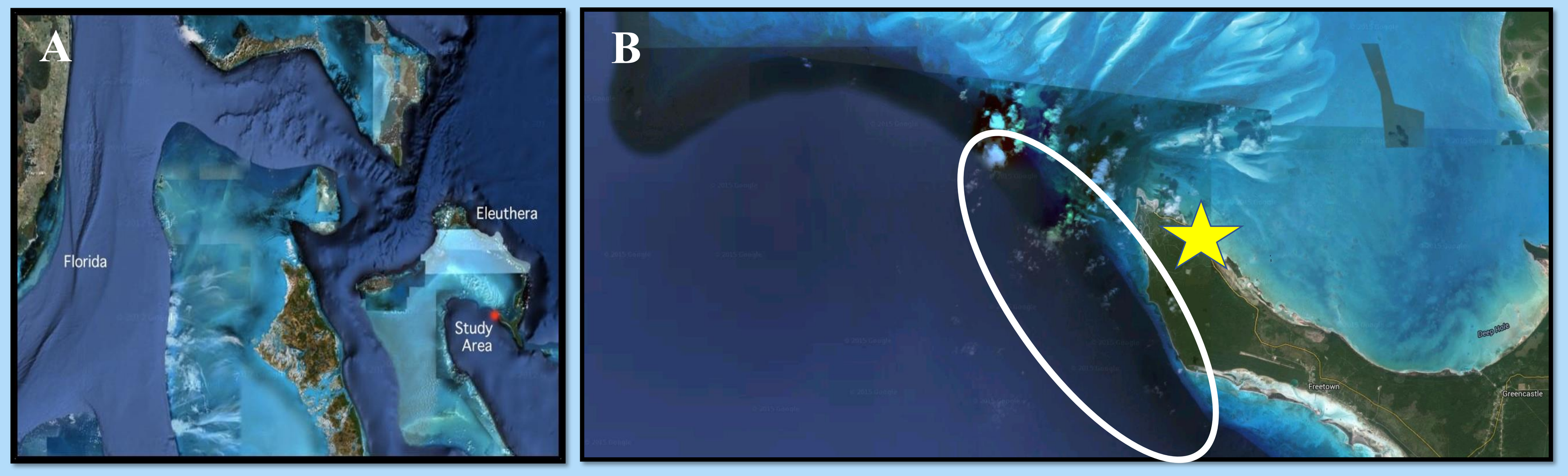

Figure 1: (A) Map of The Bahamas. (B) Map of Cape Eleuthera with study site in white oval and the Cape Eleuthera Institute depicted by a star. Turquoise coloration indicates shallow water (0-50m), and darker blue indicates water that is hundreds of meters deep.

The Cape Eleuthera Institute is uniquely situated 40 minutes from the Exuma Sound wall – a sudden drop-off from 30m to hundreds of meters deep. This exceptional positioning allows for easy access to deep-sea environments where researchers can collect data and specimens while still being able to quickly and easily bring them back to a lab.

Purpose

To characterize the vertical distribution of deep-sea fauna between 30 and 500 meters deep along the Exuma Sound wall.

Methods

We were fortunate this spring to work with the MV Alucia, a luxury research vessel equipped with high-tech equipment such as sonar and deep-sea submersibles. Two researchers from Cape Eleuthera Institute (CEI) were able to place deep-sea baited remote underwater video units (BRUVS) between the depths of 30m and 500m, and conduct opportunistic sampling while aboard the Alucia's submersibles.

1. Baited remote underwater video surveys consist of two cages: a bait cage filled with bonito tuna, and a camera rig with a deep-sea camera and light. A deep-sea submersible deployed the BRUVs at 130, 229, 402, and 485m deep along a single transect.
2. The Deep Rover submersible collected various specimens along the Exuma Wall, which were brought back to the CEI labs for further identification and research.

Figure 2: (A) Island School students approaching the Alucia. (B) The Deep Rover submersible being deployed off of the Alucia deck.

Results

Opportunistic Sampling by Deep-Sea Submersible:

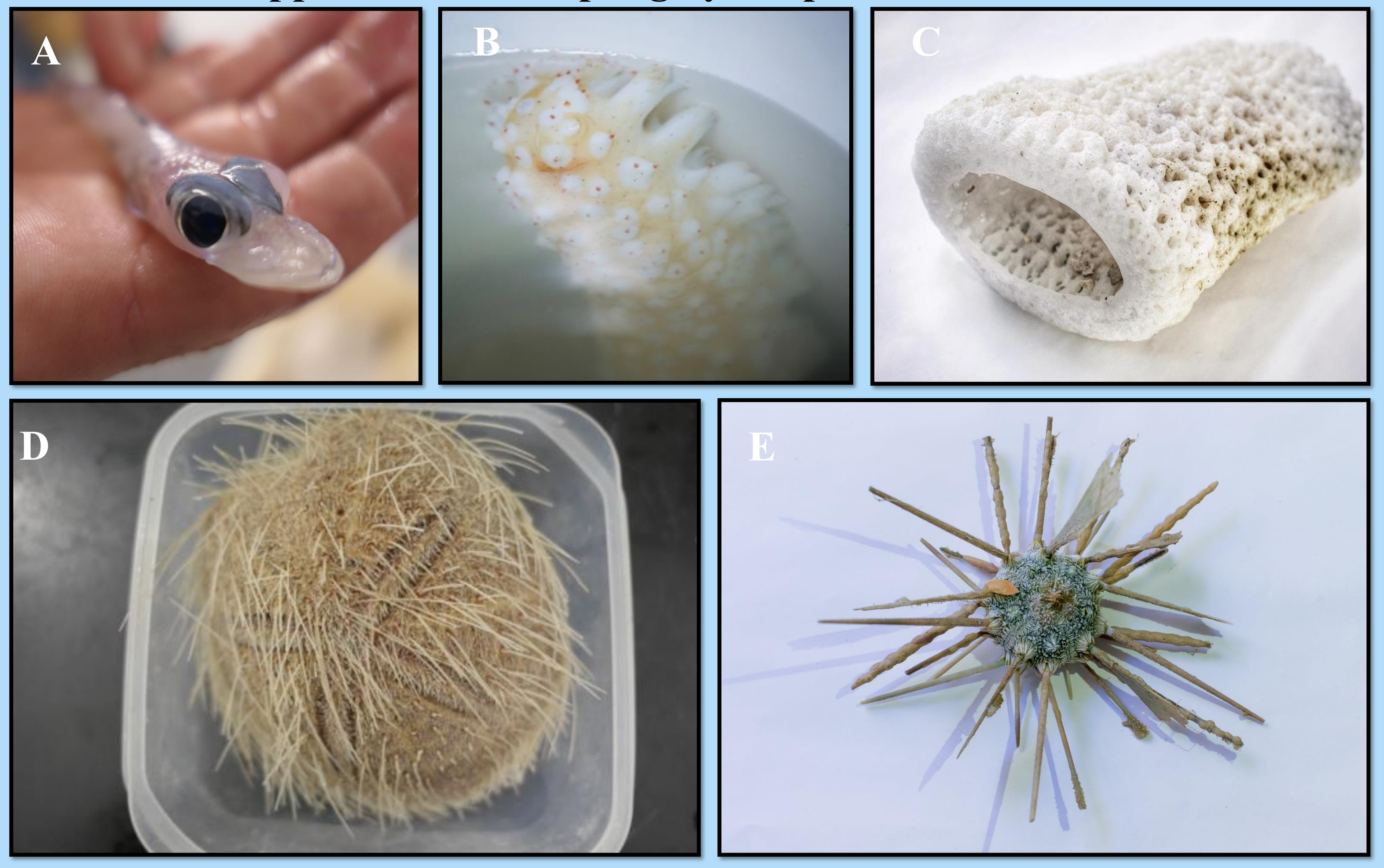

Figure 3: Five of the species pulled up by the Alucia submersible: (A) Shortnose greeneye (*Chloropthalmus agassizi*) (B) Royal sea cucumber (*Parastichopus regalis*) (C) Hexactinellid sponge (D) Heart urchin (*Linopneustes longispinus*) (E) Fan spined urchin (*Cidaris blakei*)

This research project was the first time that CEI has documented any of these species, and to our knowledge the first time that any of them have been documented in Exuma Sound or The Bahamas.

Elsewhere, the shortnose greeneye can be found between 50m and 1,000m, while the royal sea cucumber can be found between 100m and 300m. Overall, very little is known about these organisms or the deep-sea urchins pictured above (Fig. 4D&E), but past research expeditions have documented them in the Gulf of Mexico and Caribbean.

Researchers at CEI are working to determine if the glass sponge shown in Fig. 3C is a new species – samples currently await analysis at a lab in Canada.

Baited Remote Underwater Video Surveys (BRUVS):

Table 1: Results from 20 hours of BRUVS footage at four different depths.

Species	130 m	229 m	402 m	485 m
Blackfin snapper	■			
Yellow goatfish	■			
Yellowtail snapper	■			
Dog snapper	■			
Wenchman		■	■	■
Red snapper		■		
Deepwater moray			■	
Atlantic sixgill			■	■
Misty grouper			■	■

We documented a shift in fish assemblages with increasing depth. At 130m, four reef associated species were observed (Table 1). At 229m, those species were not seen, although deeper species of reef-associated fish were present. Around 170m deeper at 402m, the red snapper was not documented but a handful of deepwater fishes were identified. Many of these same species were seen on BRUVS at 485m as well.

Discussion

We have now discovered some of the species that occur between the depths of 30m and 500m along the Exuma Sound wall. It is crucial to document the depths at which these species occur because as humans continue to deplete shallow water environments of fish and food, commercial fisheries are moving deeper. In the 1950's the mean depth of fishing was 200m, whereas by the mid 2000s, the mean depth of fishing had dropped to below 500m (Watson & Morato, 2013). This poses a threat to many deep-sea organisms because they are categorized by long gestation periods, long life spans, and a late age at maturity (Koslow et al. 2000). Therefore, these organisms are very susceptible to rapid population declines.

Despite this vulnerability, there is little to no consideration of deep-sea environments and the deep-sea organisms that live there in habitat protection plans. For example, The Bahamas has decided to protect 20% of its near shore marine environments by 2020. Currently all of these potential areas in the Bahamas National Plan for Protected Areas are shallow-water environments (Fig. 4). Deepwater habitats are entirely absent from this proposal.

This project, and projects like it, help shed light on deep-sea habitats and provide data that are necessary in order to effectively site deepwater protected areas in the future.

Figure 4: Proposed Bahamas National Trust (BNT) marine park expansion as denoted by the proposed areas marked in yellow. Only shallow water environments are currently being considered in this plan.

Future Research:

We now know a little bit about the habitats and organisms occurring between 50-500m deep in Exuma Sound from just a 3 day expedition. There is much research that remains to be done in the area. Future research can build on our current sample size and help with understanding which organisms exist at these depths and how they interact. Future research could test new data collection methods, such as the use of environmental DNA, which hopefully will be possible with the return of the MV Alucia to Cape Eleuthera in August 2018.

References

Brooks, E.J., & Sloman, K.A. (2011) Validating the use of baited remote underwater video surveys for assessing the diversity, distribution and abundance of sharks in the Bahamas, *Endangered Species Research* 231-243

Brooks, E.J., Brooks, A.M., Williams, S., Jordan, L.K., Abercrombie, D., Chapman, D.D., Howey-Jordan, L.A. and Grubbs, R.D. (2015). First description of deep-water elasmobranch assemblages in the Exuma Sound, The Bahamas. *Deep Sea Research Part II: Topical Studies in Oceanography*, *115*, pp.81-91.

Koslow, J.A., Boehlert, G.W., Gordon, J.D.M., Haedrich, R.L., Lorance, P., Parin, N. 2000. Continental slope and deep-sea fisheries: implications for a fragile ecosystem. ICES Journal of Marine Science 57: 548-557.

Murphy, H. M., & Jenkins, G. P. (2010). Observational methods used in marine spatial monitoring of fishes and associated habitats: a review. *Marine and Freshwater Research*, *61*(2), 236-252.

Watson, R.A., & Morato, T. (2013) Fishing down the deep: Accounting for within-species changes in depth of fishing. *Fisheries Research* 140: 63-5

Acknowledgements

We thank the following for their numerous contributions -
CEI researchers: Jack, Candace, Michelle, Megan, and Edd
Media Director: Luke Madden
The entire Alucia team for making this possible.

ALUCIA POWERED BY OCEANX