Surveying the Abundance and Biodiversity of Deep Water Species in the Exuma Sound

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Shark Research & Conservation Program

Deep Sea Exploration

Water that is deeper than 200 meters is considered the deep sea. It is the largest ecosystem on the planet; an environment with extremely high pressure, very little light, and low temperature, making it difficult to study.

Unsustainable Fisheries

Recently, fisheries have begun exploiting deep-water resources. Deep-water species are k-selected, meaning they have slow growth rates and low fecundity (Morato et al. 2006). Therefore, deep-sea fishing is unsustainable because deep water species cannot repopulate at the rate in which they are being fished (Norse et al 2012).

Figure 1. This satellite map shows South Eleuthera. The star indicates the location of The Island School in relation to deep water, which is shown by the dark blue surrounding the cape.

Previous Deep Sea Studies

The most efficient solution to the exploitation of the deep-sea is to collect holistic data to provide a baseline and factual evidence for why deep-water ecosystems should be managed. Two previous deep-water studies have been conducted at the Cape Eleuthera Institute and The Island School, which have used research long-lining to survey deep water species in the Exuma Sound. In this study, a significant decline in species richness with an increased distance from the wall, increased depth, and lower temperature was observed.

The Medusa

The Medusa is a deep-water baited remote underwater video survey unit (BRUVS). It is non-invasive because it does not interfere with behavior. It is more holistic because it documents all species that live in deep-water ecosystems, including crustaceans and mollusks that could not be captured with long-lining.

The purpose of this study is to survey the diversity, abundance, and distribution of deep water species within the Northeast Exuma Sound, The Bahamas using baited remote underwater video surveys.

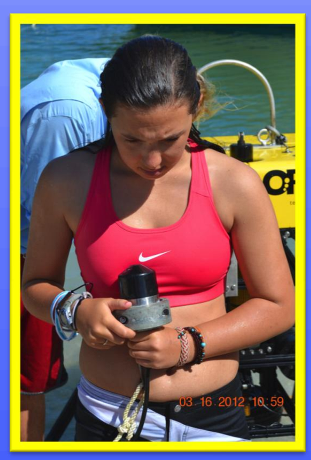


Figure 2A. The Medusa is prepared for deployment. The bait is attached, the camera is turned on using a magnet, and the CTD (the device that records temperature, depth, and salinity) is turned on using the modem (shown in the picture).

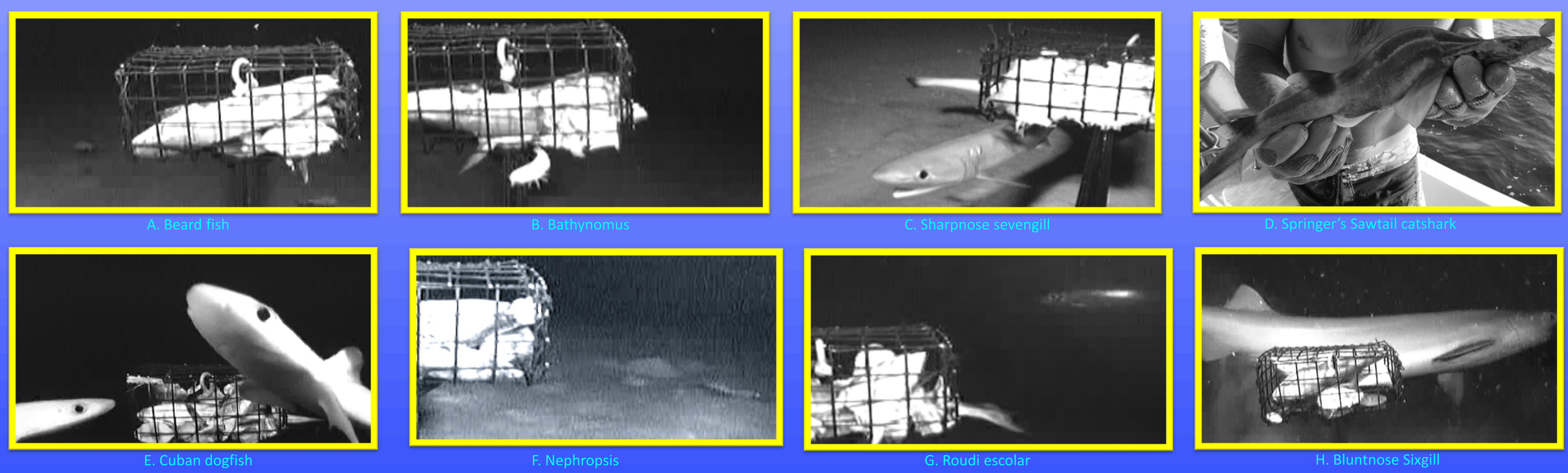


Figure 3. These screenshots show 8 of the shark, bony fish, and crustacean species captured on Medusa film.

G. Once on land, the Medusa footage is downloaded onto a computer where the video can be analyzed for abundance and species richness.

B. The Medusa is attached to a winch and then is deployed into the water from the boat.

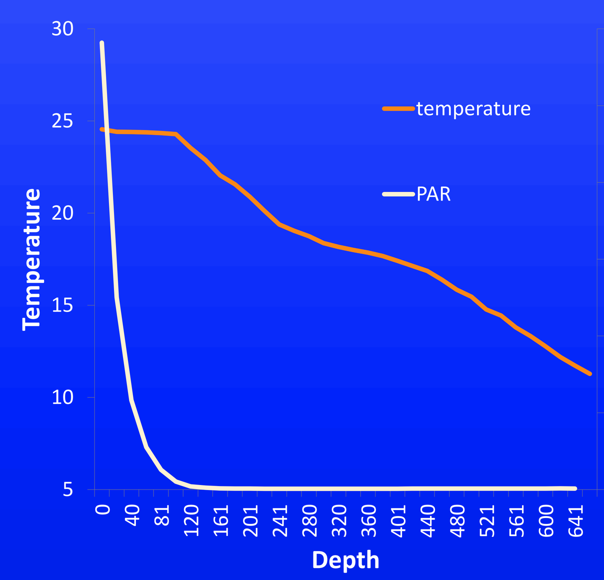


Figure 4. The Medusa provided data about the environment at the bottom of the Exuma Sound. The environment is sandy, flat, and abundant with plankton. PAR is photosynthetic available light, which is measured by the Medusa at different intervals during the descent. Using the CTD, we also studied salinity and temperature in relationship to depth (see Figures 8-10).

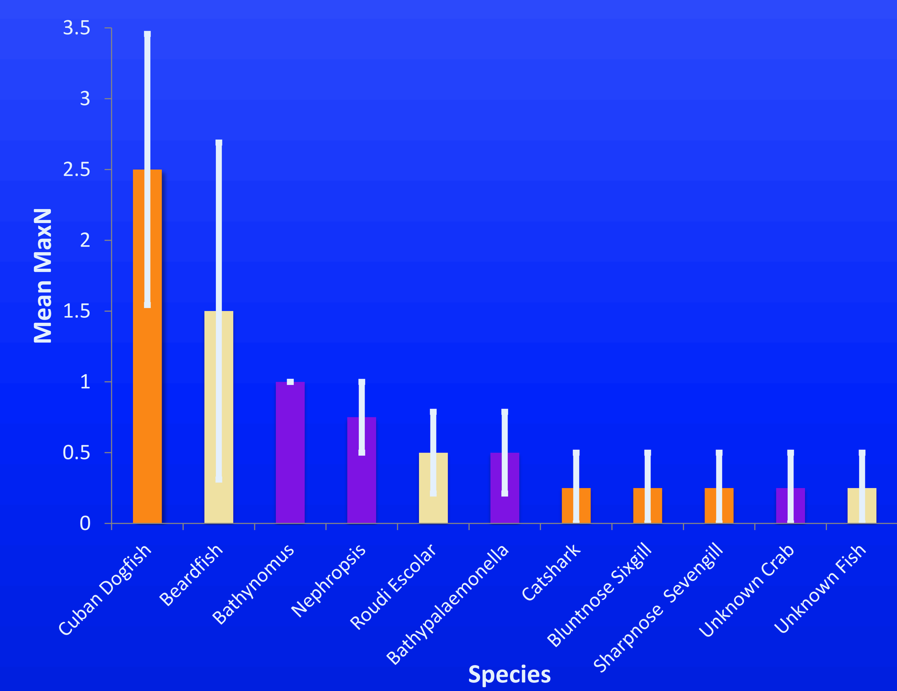


Figure 7. This graph shows the relative abundance of the species caught on footage using the Medusa using MaxN. Eleven species were seen on film as opposed to the nine species captured through long lining.

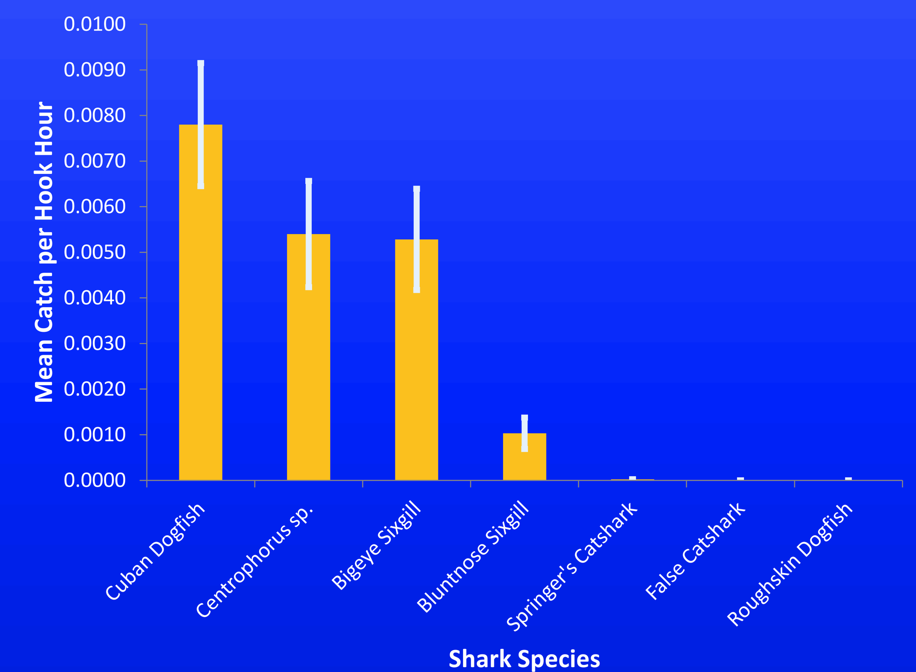


Figure 8. This graph shows the relative abundance of the sharks caught on long lines in the two past semesters of deep water studies. This graph uses CPUE, where the catch is the number of individuals and the effort is Hook Hour, the number of hooks deployed for a certain number of hours.

F. Using, CABO, the Medusa's GPS system, the coordinates of the surfaced Medusa are identified. The winch is then attached to the Medusa and it is brought onto the boat.

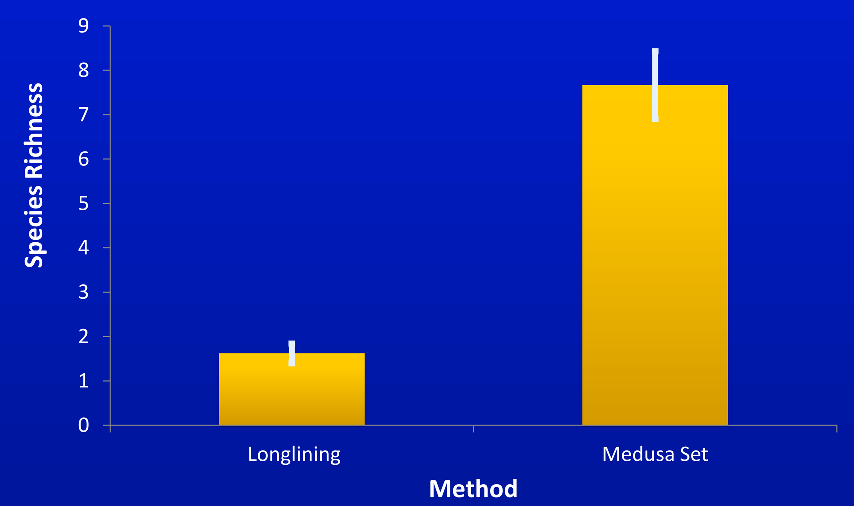


Figure 5. The average species is compared between Medusa and long lining footage. One of the advantages of the Medusa is that it records bony fish and crustaceans as well as shark species. This is shown in the higher species richness seen in Medusa footage as opposed to long lining.

Eye In The Sea

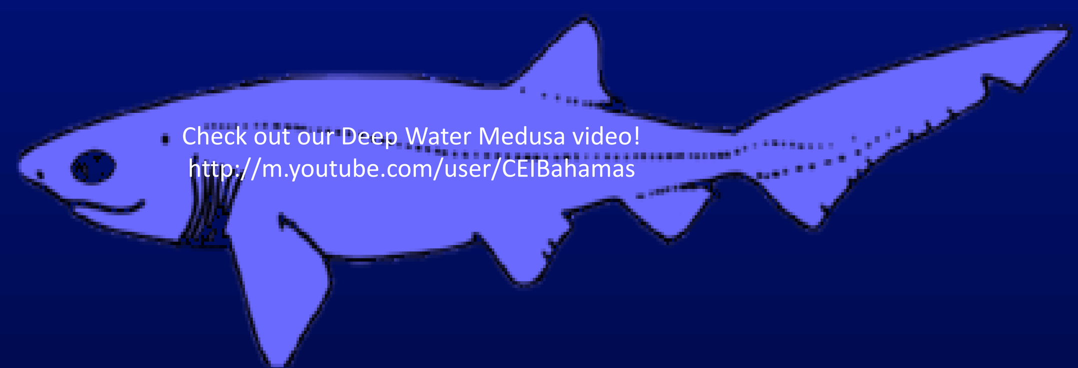
The results of this study are promising because in only 4 Medusa deployments 11 species were recorded, where as in 71 sets of long-lining only 9 species were seen. There were many new discoveries made because of the holistic and noninvasive techniques of the Medusa. The Springer's sawtail catshark, which has rarely been caught long-lining, was seen on the first deployment. The Sharpnose sevengill was also seen, a shark that has never before been recorded in The Bahamas. The Medusa allowed a glimpse at 4 crustacean and 3 fish species in the Exuma Sound that were not previously captured by long-lining surveys because they are not susceptible to capture on baited hooks.

Future Deep Water Studies

Though only 4 deployments were conducted, there was valuable information gained about the deep sea ecosystem and biodiversity of the Exuma Sound. In future deep water studies, the Medusa should be deployed more times and for longer periods to allow researchers a better understanding of the relative abundance of species, the depths they typically inhabit, and the deep-sea environment.

Setting Baselines

Studies such as this one provide information about the largest and least studied ecosystem on Earth: the deep sea. Surveying relative abundance sets baselines for deep water species. With these baselines management of deep water fisheries and conservation of deep water species is possible.



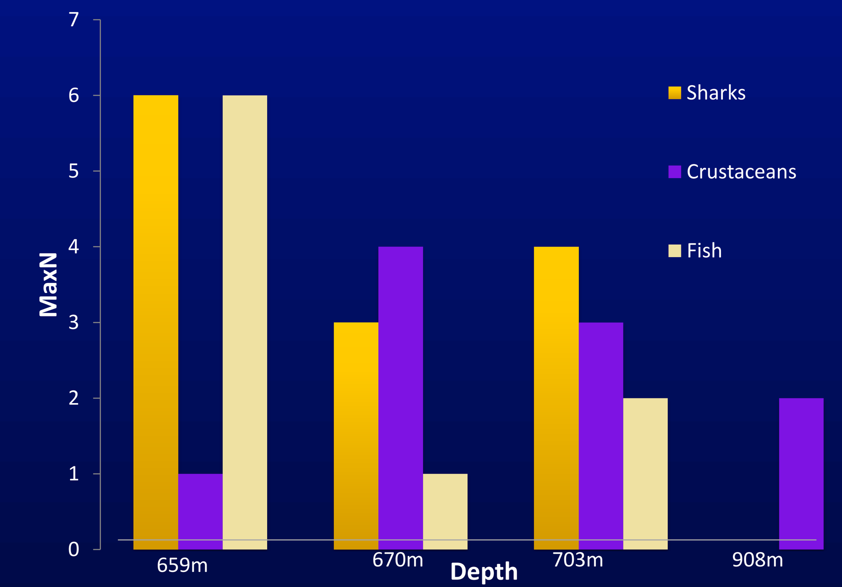


Figure 6. This shows the relative abundance of sharks, bony fish, and crustaceans at the different depths where the Medusa was deployed. Each depth only shows one deployment, so the while this graph shows possible trends, more data would need to be collected to make claims about this data.

C. The Medusa then sinks to the sea floor due to its negative buoyancy achieved by the two biodegradable weights attached underneath the camera.

Literature Cited:
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Morato T., Watson R., Pitcher T. (2006) Fishing down the Deep. Fish and fisheries, 7: 24-34.
Norse E., Brook S., Cheung W., Clark M., Ekeland I., Froese R., Gjerde K., Haesrich R., Heppell S., Morato T., Morgan L., Pauly D., Sumailia R., Watson R. (2012) Sustainability of deep sea fisheries: Marine Policy 36: 307-320

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D. When it is time to retrieve the Medusa, an acoustic signal is sent from the deck box commanding the Medusa to begin rising to the surface.

E. Once the Medusa receives the signal, it drops its sandbag weight to establish positive buoyancy and rises to the surface. Using the deck box, the position of the rising Medusa can be identified.