Species diversity, distribution, and abundance of deepwater sharks In the Exuma Sound, The Bahamas.

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Deepwater Fisheries

Background

The deep water ecosystem is the largest ecosystem on the planet, which makes up about 98% of the bodies of water on Earth. This ecosystem has been minimally explored and little research has been conducted in it. Fishermen moved from shallow waters that were overly exploited, offshore to deeper waters for a larger abundance of fish. Koslow (2000) conducted research showing that deepwater populations began depleting due to overfishing. Deepwater fisheries often catch non-target species of elasmobranchs (sharks and rays) as bycatch (Barker 2004).

Commercial Shark Fisheries:

Sharks were also caught directly for valuable products such as shark fins and liver oil (McLaughlin et al, 2004). Barker (2004) conducted an evaluation of shark species for the Food and Agriculture Organization that showed there had been severe population declines for almost all of the 26 targeted species. The demand for these products has resulted in a more direct commercial shark fishing industry, which has shown to have reduced shark populations to extremely low levels and commercial extinction (Norse et al, 2011).

Methods

Study Location

This study took place in northeast Exuma Sound, The Bahamas, in six different zones (Figure 1 & 2).

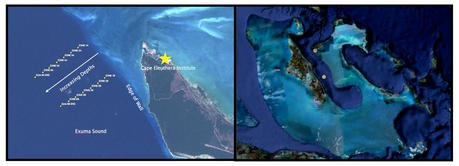


Figure 1&2. Zones in the Exuma Sound, The Bahamas. And the Exuma Sound, The Bahamas.

Data Collection

Once a shark is caught length measurements, DNA samples, and tagging of the sharks are recorded (Figure 3).

Figure 3. Measuring, Tagging, and DNA samples

Deepwater survey lines

The deepwater survey lines are 1700 meters in length. They are anchored on the sea bottom of the Exuma Sound. The bottom 300 meters of this line lays on the ocean floor with 30-baited circle hooks; gauges 10, 12, 14 & 16. The depth and temperature recorder is also attached at the last 300-meter mark. The survey runs for four hours before being hauled to the surface. (Figure 4)

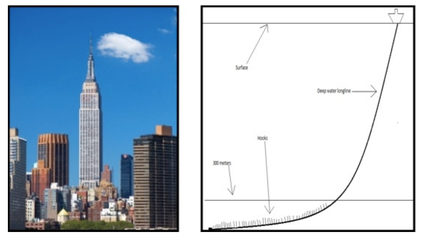


Figure 4. To put in perspective of how long the deepwater survey line is, it would be like fishing from the top of the Empire State Building.

For 95% of deepwater sharks, extremely limited information is available. The remaining 5% of deepwater sharks have one of the lowest species productivity rates of all vertebrates on the planet.

Discussion

Conclusions

A significant trend throughout the survey was seen in species richness which declined with increasing depth. This may be caused to harsher life conditions at deeper depths. These harsher conditions are potentially caused by upwelling, as supported by a study conducted on the mid Atlantic ridge in which less species were found in deeper waters because of lack of nutrients (Fossen et al, 2007). It is also concluded that there is possible prey competition and predator avoidance among the sharks due to the minimal abundance overlap. This was seen most most prevalent in the gulper and Cuban dogfish which were found most abundant in different zones although, similar in size. It was also concluded from our findings that there may be sexual segregation among gulper sharks due to the fact that 76% caught were females.

Directions for Future Research

- Satellite tags for tracking
- Deepwater light traps
- Adding further zones
- Seasonal variation
- Baseline for future studies

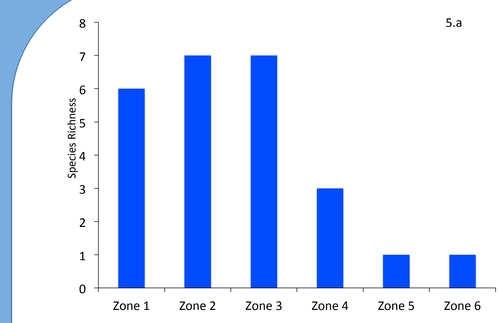
Results

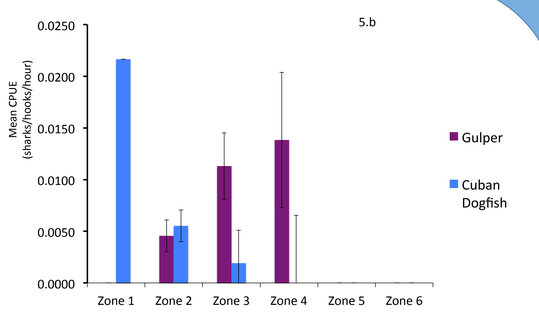
The results were combined with the existing data set from last fall. From September 2010 to December 2011, 63 deepwater survey lines were conducted at depths ranging from 473m to 1024m. 139 sharks were caught that comprised 9 different species.

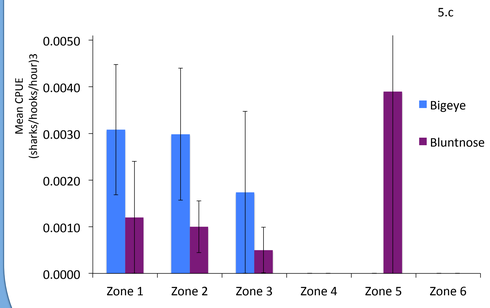
Species richness declined through zones (Figure 5.a). Both sixgill species decreased with increasing depth (Figure 5.c). Gulper increased with increasing depth, and Cuban Dogfish decread with increasing depth (Figure 5.b). No significant trends seen in other species caught (Figure 5.d).

Table 1. Table showing various demographics of deepwater sharks caught.

Species	# Captured	Mean Total Length (cm)	Mean Temp (c°)	Mean Depth (m)	% Female	% Male
S. cubensis	53	61	12.1	594.1	56.6	43.4
C. granulosus	38	87	9.5	733.9	75.7	24.3
H. nakamurai	14	148	11.8	623.4	22.4	78.6
C. niakang	10	133	9.5	731.6	100	0
H. griseus	8	287	10.4	696.8	50	50
M. canis insularis	7	92	13.8	549.6	85.7	14.3
C. owstoni	4	74	6.9	932.7	75	25
G. springeri	3	42	10.4	706.8	66	33
F. falciformis	2	112	13	548.6	100	0
P. microdon	1	227	100	100	0	100







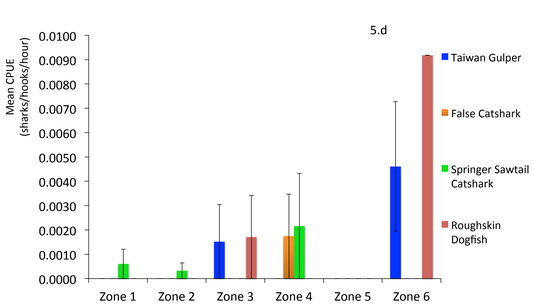


Figure 5.a-d.Graph of species richness of deepwater sharks between zones (Figure 5.a). Trends in Mean CPUE (catch per unit effort) between zones of the Bigeye Sixgill and the Bluntnose sixgill. Large value for zone 5 Bluntnose was due to less replicates taken than zones 1-4 (Figure 5.c) , Gulper and Cuban Dogfish P=0.002 (kruskall wallis) (Figure 5.b), Taiwan Gulper, False Catshark, Springer Sawtail Catshark and Roughskin Dogfish (Figure 5.d), error bars signify ± 1 standard error. Dissimilar letters indicate significant difference.

Figure 6. Species caught throughout the deepwater shark survey from September 2010 to December 2011. These species are threatened because of their K-selected life history which includes extreme longevity, late maturation, slow growth, and low fecundity.

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