Investigating the abundance and habitat use of pelagic fishes in the Exuma Sound

Jules Holland, Gus Martens, Filip Engstrom, Caroline Kevin, Peter Napoli, and Celine Romero Garcia
Advisors: Brendan Talwar, Savannah Ryburn, Alexa Hoffman and Jawanza Small

Introduction

The pelagic zone is similar to a desert oasis due to its lack of shelter, nutrients, and regular activity. Commercial fisheries target the pelagic areas where migratory fish do congregate and during the fishing process, they accidentally catch some species that are referred to as bycatch. Pelagic sharks, like silky sharks, can make up more than 85% of bycatch in tuna purse seine fisheries alone (Hutchinson *et al. 2019)*. Managing juvenile silky sharks to avoid overexploitation is difficult because they co-occur with commercial fish, have conservative life histories, and migrate across numerous Exclusive Economic Zones. Past work has shown that juvenile pelagic sharks occur in Exuma Sound, but we don't know the significance of it.

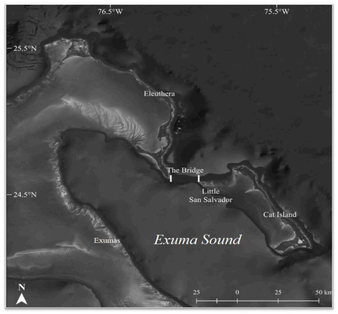

Image 1: A map of the study site of the Exuma Sound, Bahamas

Objectives
- Determine the abundance of pelagic fishes in the Exuma Sound
- Determine the movement of juvenile silky sharks through the use of satellite tagging

Methods

Longlining

Image 2: Different sizes of hooks; wire and monofilament leaders

Image 3: Our Island School research group longlining

Our longline is a series of baited hooks alternating between mullet on wire leaders and squid on monofilament leaders that extends from the surface to 400 meters deep. We take total length, precaudal length, and fork length measurements of all fishes we pull up to the boat. We also record the location, time, and water temperature when we attach the tags.

Satellite Tagging and Polyball Fishing

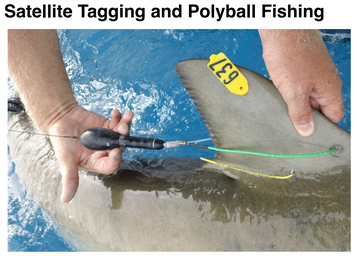

Image 4: Bridal attachment method on the dorsal fin

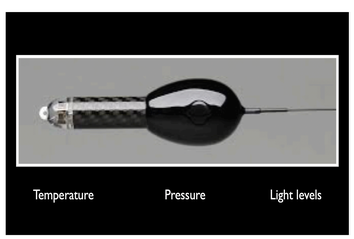

Image 5: Satellite tag that records temperature, light levels, and pressure

We use polyball fishing to deploy satellite on juvenile silky sharks. Polyball fishing allows for the targeting of individual juvenile silky sharks. A combination of samples are taken from sharks caught with both longlining and polyball fishing: white muscle tissue, fin clips, epibionts, endoparasites, and blood. In addition to the longlining workup, we attach an archival satellite tag to the dorsal fin (Image 4). This tag allows us to determine the movement of the shark over the course of the eight months during which the tag is active. The tags also record light levels, temperature, and pressure (image 5).

Results and Discussion

After a total of forty longline sets over eight months, a total of nine fishes were caught (Table 1). Out of all the species caught, four were sharks. These sharks are all listed as vulnerable, endangered, or critically endangered on the International Union for the Conservation of Nature (IUCN) Red List due to overexploitation.

Table 1: This table shows what pelagic fishes we have caught on the longline.

Common Name	Scientific Name	N	N Males	N Females	Mean Total Length (cm)
Oilfish	*Ruvettus pretiosus*	1	-	-	43.5
Snake mackerel	*Gempylus serpens*	1	-	1	70.2
Tiger shark	*Galeocerdo cuvier*	2	1	1	253
Dusky shark	*Carcharhinus obscurus*	1	0	1	310
Oceanic whitetip	*Carcharhinus longimanus*	1	0	1	92
Silky shark	*Carcharhinus falciformis*	3	3	0	114

Image 6: A) dusky shark, B) oceanic whitetip, C) tiger shark

Table 2: This shows our expected deployment of our satellite tags on juvenile silky sharks and what we have tagged so far.

Index	Deployment Target	Deployment Date	Sex	Length (cm)	Maturity	Expected Deployment Duration (days)	Actual Deployment Duration (days)
1	Feb-April	2/15/2019	F	160	Immature	240	
2	Feb-April	3/14/2019	F	144	Immature	240	42
3	Feb-April	3/21/2019	F	145	Immature	240	
4-5	May-July					240	
6-7	Aug-Oct					240	

We have tagged three juvenile female silky sharks and plan on tagging another four this year. The three GPS points in this image represent the locations in which the shark was initially captured in 2018, re-captured and where the satellite tag popped off. This is extremely important because it means that the shark either stayed in the Exuma Sound for the entire year or that it returned for the spring, which supports the idea that there is something important about the Exuma Sound for silky sharks.

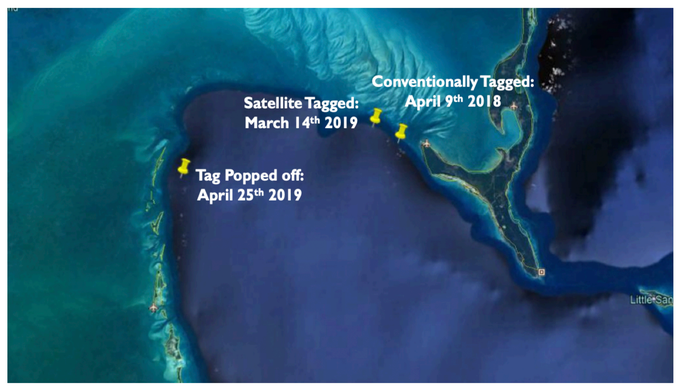

Image 7: The initial capture, the re-capture with the satellite tag, and the location of the tag after is popped off.

Conclusions

- Gathering more information on the abundance of fishes across different seasons and years, as well as further satellite tracking of juvenile sharks, will suggest the habitat usage and migratory paths of pelagic species
- We have caught 6 species of pelagic fishes, roughly half of which were considered threatened or worse by the IUCN red list.
- Our results show that the juvenile life stage is the most abundant life stage for pelagic sharks in the Exuma sound. These preliminary data suggest that they may be resident for that life stage.

Image 8: Students and researchers with a tiger shark, the largest predator we have ever encountered on our surveys

The end goal of this research is to provide the information necessary to support the conservation of pelagic ecosystems in the future.

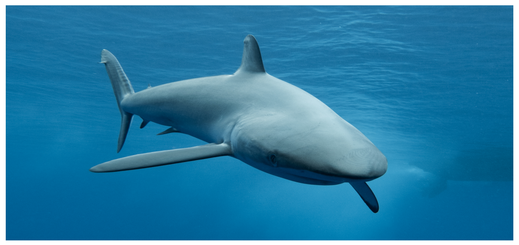

Image 9: A juvenile silky shark that was caught and satellite tagged in the Exuma Sound, tagged March 21st, 2019

Acknowledgments

We would like to thank Brendan Talwar, Savannah Ryburn, Alexa Hoffman, and Jawanza Small for their support and guidance throughout our research class. We also thank the Moore Charitable Foundation, Microwave Telemetry, Florida International University, the University of Glasgow, and Annabelle Brooks for supporting this research.

Literature Cited

Briscoe, D., Maxwell, S., Kudela, R., Crowder, L., & Croll, D., 2015. Are we missing important areas in pelagic marine conservation? Redefining conservation hotspots in the ocean. Inter-research, Santa Cruz, California, 229-237.
Cortés, E., Arocha, F., Beerkircher, L., Carvalho, F., Domingo, A., Heupel, M., Holtzhausen, H., Santos, M. N., Ribera, M., Simpfendorfer, C. 2010. Ecological risk assessment of pelagic sharks caught in Atlantic pelagic longline fisheries. Aquatic Living Resources. 23:25-34.
Duffy, E., & Stachowicz, J., 2005. *Why biodiversity is important to oceanography*: potential roles of genetic species, and trophic diversity in pelagic ecosystem processes. Inter-research, Newburgh, UK, 179-189.
Hutchinson, M., Coffey, D.M., Holland, K., Itano, D., Leroy, B., Kohin, S., Vetter, R., Williams, A.J., and Wren, J. 2019. Movements and habitat use of juvenile silky sharks in the Pacific Ocean inform conservation strategies. Fisheries Research. 210:131-142.
Norse, E., Brooke, W., Cheung, M., Clark, I., Ekeland, R., Froese, K., Gierde, R., Haedrich, S., Heppell, T., Morata, L., Morgan, D., Paul, U., 2011. *Are Deep Sea Fisheries Sustainable?* High biological vulnerability and economic incentives challenge the viability of deep-sea fisheries, 1-4.