THE POST-RELEASE SURVIVORSHIP OF CUBAN DOGFISH CAUGHT ON LONGLINES

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INTRODUCTION

Commercial fisheries have been moving deeper due to advancements in fishing technology and the overexploitation of shallow water stocks (Koslow et al., 2000). Deep sea sharks are especially vulnerable to overexploitation and stress associated with capture (Norse et al., 2012) because these sharks have low energy storage and are slow to mature and reproduce (Koslow et al., 2000). They also face extreme pressure, light and temperature changes upon capture and ascent.

Bycatch

Bycatch is accidental capture. It is estimated globally that up to 40% of fishes caught annually are caught as bycatch (Davies et al., 2009). It is generally unknown whether or not discarded bycatch survives post release and how capture stress affects the fitness of an individual and a population. However, longline fisheries typically assume a 0% post-release mortality rate for deep sea sharks.

Cuban Dogfish

The target species of this study is the Cuban dogfish (*Squalus cubensis*). In the Gulf of Mexico, these sharks are the most common bycatch in their family, Squalidae (NMFS, unpublished data; Jones et al., 2013). This deep-water shark species is abundant in depths ranging from 450-650 meters in the Exuma Sound.

Objectives

- To determine the different factors that contribute to mortality in *S. cubensis* such as pH and total length.
- To estimate a 24-hour post release mortality rate for *S. cubensis* caught on longlines.

METHODS

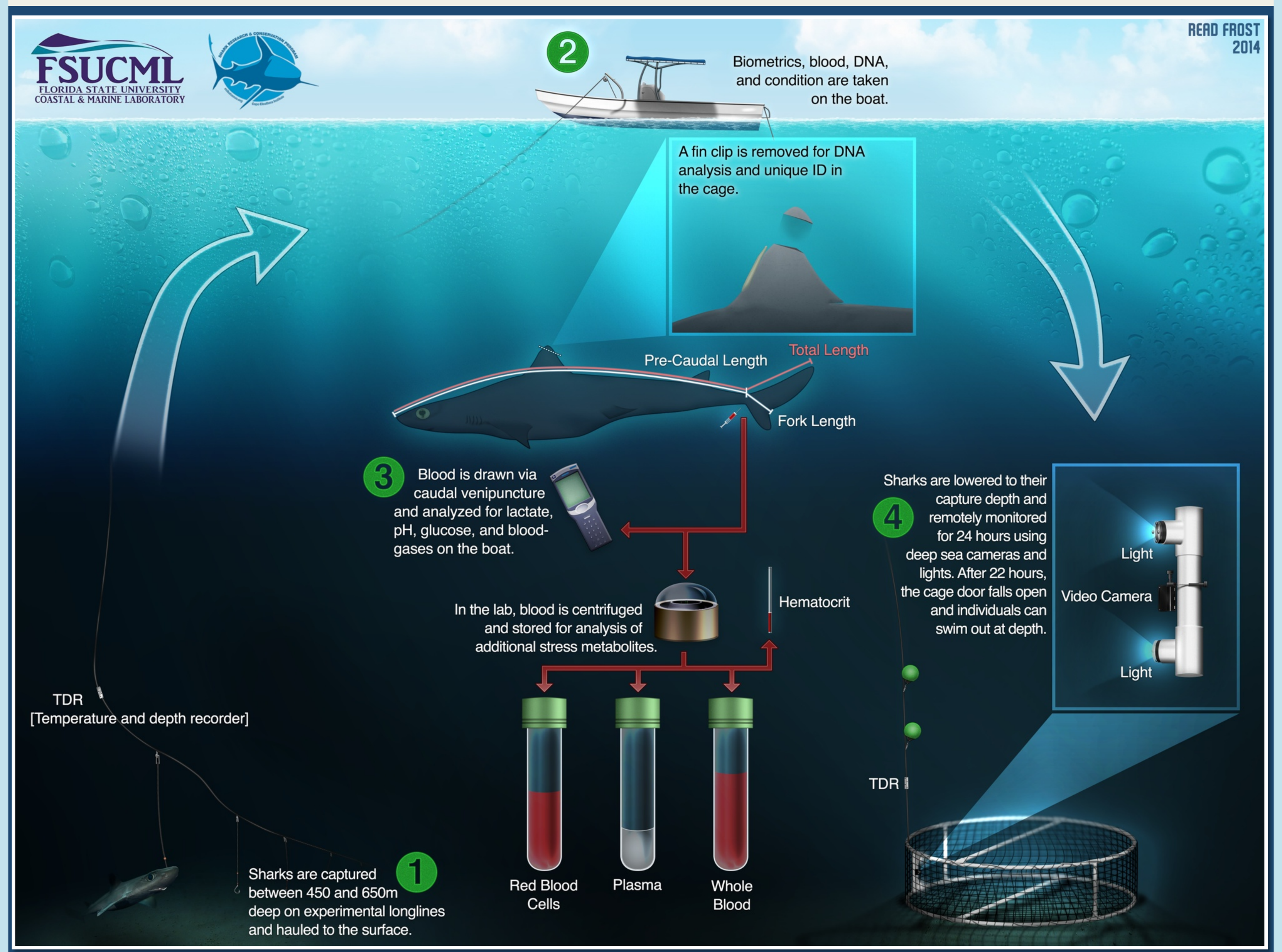


FIGURE 1: A diagram illustrating the methods of this study.

Off the wall in the Exuma Sound (Image 1), a 900-meter experimental longline is set with 20 gangions spaced 5 meters apart. After 2 to 4 hours soaking at 10 to 13 degrees Celsius, the line is hauled from depths ranging from 450 to 650 meters. Immediately after a shark is brought onto the vessel, it is placed in a cooler of water to reduce air exposure. Next, blood samples are drawn via caudal venipuncture and analyzed using an iSTAT (Abbott Point of Care Inc., Princeton NJ), which measures lactate, pH, and blood gas levels. Then, the pre-caudal length, fork length, and total length measurements are taken. A DNA sample is taken from the dorsal or caudal fin, which allows for identification in the cage. The sharks are placed in a circular cage with a 2-meter diameter, lowered to the capture depth, and monitored for locomotion and behavior using GoPro cameras synchronized with lights. After 22 hours the cage door opens which allows live sharks to swim out at the bottom. After 24 hours, the cage is hauled and any living sharks are released (Figure 1).

IMAGE 1: A map of the study site in the Exuma Sound, The Bahamas.

RESULTS AND DISCUSSION

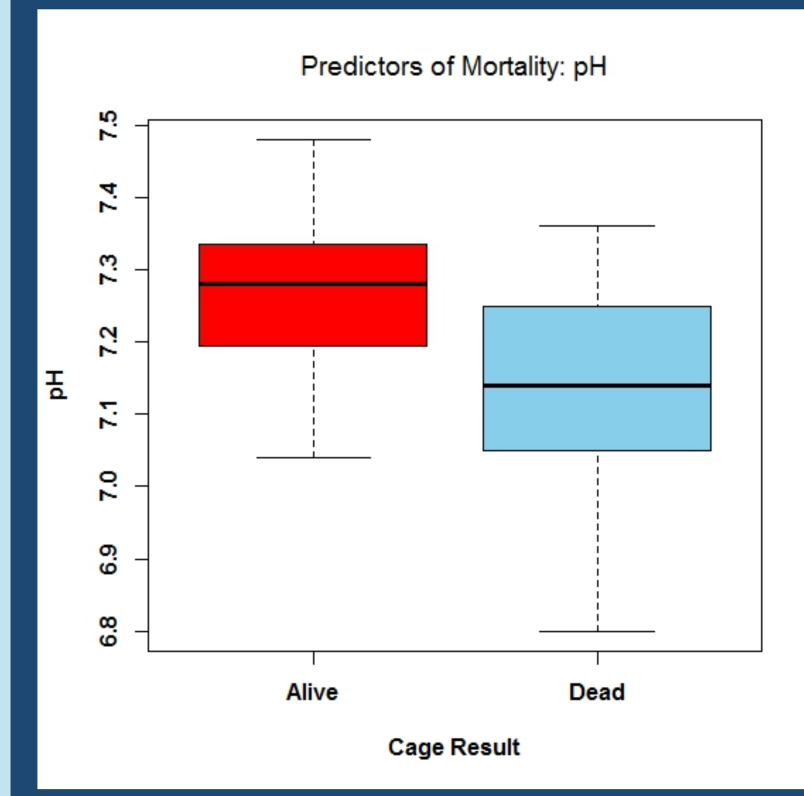
After a total of 30 longline sets over 3 months, 24 *S. cubensis* were caught and placed in the cage. Out of these 24 individuals, 6 were male and 18 were female (Table 1). The 24-hour post release mortality rate of these 24 individuals was 55% (Table 2). It was found that the two significant predictors of mortality are total length and blood pH (Figure 2 and 3).

TABLE 1: These are the three most common species caught over 30 longline sets in the Exuma Sound in the fall of 2014. This table shows the amount of sharks caught (n), sex, mean total length, and mean depth of capture.

Common Name	Species	N	M	F	Mean Total Length (cm)	Mean Capture Depth (m)
Cuban Dogfish	*Squalus cubensis*	24	6	18	65.2	573
Dusky Smoothound	*Mustelus canis insularis*	8	3	4	82.9	496
Bigeye Sixgill	*Hexanchus nakamurai*	5	4	1	123.8	575

TABLE 2: These are the at-vessel and post-release mortality rates of *S. cubensis* caught on longlines.

Common Name	Species	At Vessel Mortality Rate (%)	Post Release Mortality Rate (%)
Cuban Dogfish	*Squalus cubensis*	21%	55%



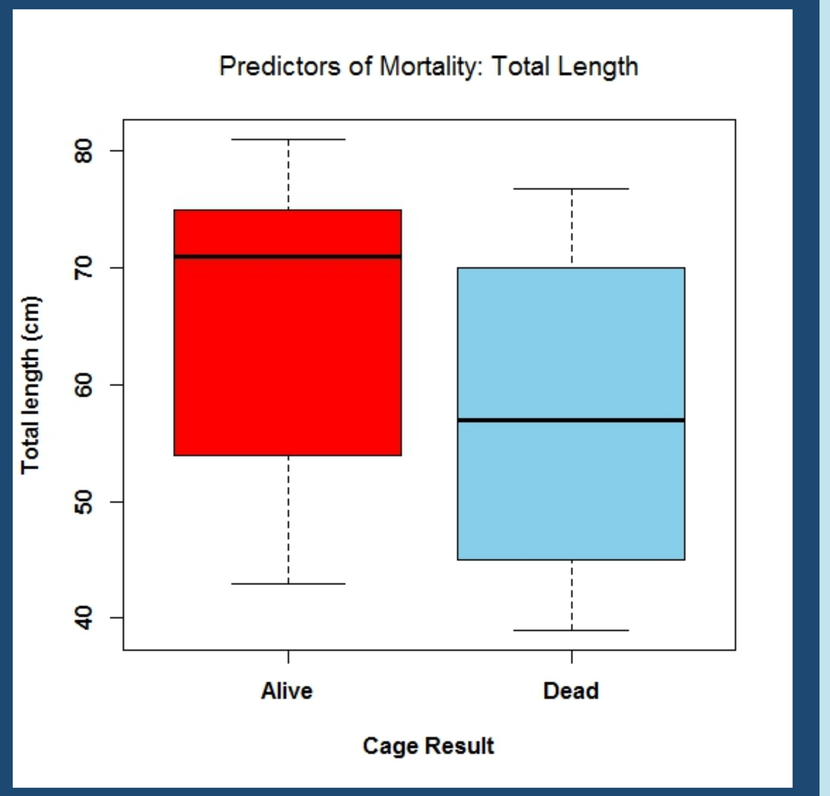


FIGURE 2:
As pH decreases, the 24-hour post release mortality rate of *S. cubensis* increases significantly (GLM, $p<0.05$, binomial). This trend may be due to sharks having limited ventilation during capture, resulting in increased pCO_2 levels in the blood. In addition, lactic acid may build up in the blood due to physical exertion during capture. Both of these factors lead to blood acidification and a decreased pH. Therefore, an individual that struggled more during capture may have a lower pH and be more likely to die post release.

FIGURE 3:
As total length decreases, the 24-hour post release mortality rate increases significantly (GLM, $p<0.05$, binomial). This may be due to larger sharks being more insulted during ascent (Brooks et al., 2014). These individuals would take longer for their internal temperatures to increase and would therefore face less thermal stress and be more likely to survive post release. By being aware of this relationship, fisheries are able to visually decide whether to harvest or release a Cuban dogfish based on an individual's total length.

CONCLUSIONS

Throughout this study, a 55% 24-hour post release mortality rate of *S. cubensis* was estimated. In addition, it was found that the two most significant predictors of post-release mortality are total length and blood pH levels. Total length will be extremely useful for fisheries management because it is a visual cue for commercial fisheries to know whether or not to release an individual shark. This study is the first of its kind in warm waters and provides a post-release mortality rate for a common data deficient bycatch species that lives in the deep sea.

The limitations that could occur during this study are the possible underestimation or overestimation of this post-release mortality rate. The cage eliminates predation as a factor from this calculation because the cage protects the sharks inside from predators. It is possible that the cage could also add confinement stress which could contribute to the mortality of an individual. However, data suggest that the density of individuals in the cage at a given time does not affect mortality.

Future studies can be conducted utilizing similar methodology in order to calculate post-release mortality rates for other bycatch species. With advancing technologies, satellite tags that are appropriately sized for small sharks would be useful. Satellite tags would extend the post release mortality rate for longer than 24 hours (Image 2) and would eliminate the limitations associated with caging (Image 3 and Image 4).

IMAGE 2: If appropriately sized, a satellite tag would give more long term post release mortality rates .

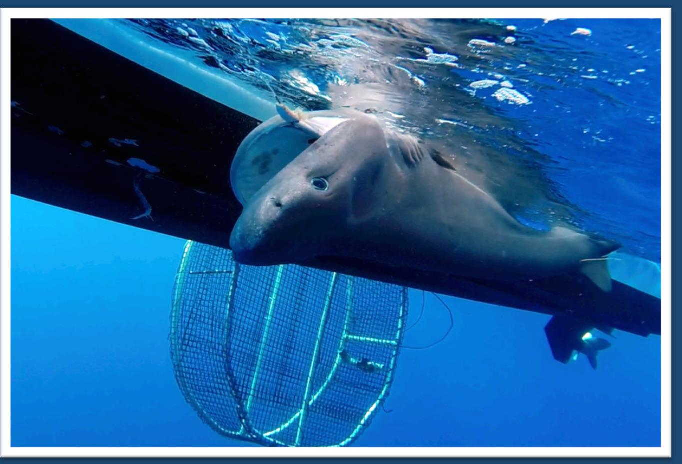


IMAGE 3: A bluntnose sixgill shark (*Hexanchus griseus*), a potential predator of *S. cubensis* .

IMAGE 4: This is a view of the cage tied onto the vessel with 2 *S. cubensis* inside.

IMAGE 5: A Cuban dogfish recovers from capture inside the cage.

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LITERATURE CITED

Brooks E.J., Brooks A.M., Williams S., Jordan L.K.B., Abercrombie D., Chapman D.D., Howey-Jordan L.A., Grubbs R.D. *In review*. First examination of the deep water elasmobranchs in the Exuma Sound, The Bahamas: diversity, distribution and population structure. *Deep Sea Research Pt II*.

Davies, R.W.D., Cripps, S. J., Nickson, A., & Porter, G. 2009. Defining and estimating global marine fisheries bycatch. Marine Policy 33(4): 661-672.

Jones, L. M., Driggers III, W. B., Hoffmayer, E. R., Hannan, K. M., & Mathers, A. N. 2013. Reproductive Biology of the Cuban Dogfish in the Northern Gulf of Mexico. *Marine and Coastal Fisheries* 5(1): 152-158.

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.

Norse, E.A., Brooke, S., Cheung, W.W., Clark, M.R., Ekeland, I., Froese, R., Gjerde, K.M., Haedrich, R.L., Heppell, S.S., Morato, T., Morgan, L.E., Pauly, D., Sumaila, R.U., Watson, R. 2012. Sustainability of deep-sea fisheries. *Marine Policy* 36: 307-320.