Habitat Preference of Juvenile Lemon Sharks *(Negaprion brevirostris)* in South Eleuthera, Bahamas

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Introduction

Global shark populations are declining as a direct result of human impact; thousands of sharks are killed each year due to commercial fishing (Murchie, et. al, 2008). The shark fin trade in particular has put a great deal of stress on shark abundance. Sharks have life history characteristics, such as slow maturation and low fecundity, which make them especially vulnerable to these threats (Chapman et. al, 2009). Though it is apparent that shark populations are in decline worldwide, data on the status of individual shark species is lacking.

The Bahamas are home to an abundant and diverse population of sharks. In 1993, longline fishing was banned, alleviating some stress from commercial fishing; however, sharks in the Bahamas still face other unique threats. Increased levels of tourism have added an equally destructive issue (Gruber et. al, 2008). Coastal development has resulted in the habitat loss of vital nursery grounds throughout the Bahamas. In 2001, the development of a resort in Bimini caused a 23.5% decline in first year survival rates of juvenile lemon sharks (Gruber et. al, 1993).

The Southern tip of Eleuthera is host to several important habitats for juvenile lemon sharks (Murchie, 2008). These areas are at risk with the threat of increased development on the horizon. If nursery areas become destroyed, not only will juvenile populations be at risk, so will the entire species by hindering the potential for future generations to be born. Because of this, it is critical that data be collected on shark habitat use. The purpose of this study is to identify juvenile lemon shark habitat preference. We hypothesize that the highest abundance of lemon sharks will be found in the creek habitats.

Figure 1. Juvenile Lemon Shark

Figure 2. Juvenile Lemon Shark on survey line

Study Sites

This study was conducted at six different sites along the coast of South Eleuthera, Bahamas. These six sites were composed of three distinct habitats: mangrove creeks (Figure 5), sandy beaches (Figure 4), and flats (Figure 3). Mangrove creeks have varied mouth widths that open into semi-protected lagoons. Sandy beaches are characterized by sand-lined coasts, while flats are characterized by rock or mangrove-lined coasts. Study sites included two mangrove creek habitats, Kemps Creek and Broad Creek, two sandy beach habitats, Red Bay and Boys Dorm Beach, and two flats habitats, Rock Sound Airport Flats and Poison Flats.

Figure 3. Flats Habitat

Figure 4. Sandy Beach Habitat

Figure 5. Mangrove Creek Habitat

Methods

Shark abundance was measured using a 100-meter long creek modified survey line. The line was secured in sediment with cement weights. Ten gangions were attached to the line with tuna clips and spaced every four meters. Gangions consisted of circle hooks baited with Bonita. The line was soaked for 2 hours, and the presence of bait was checked every 30 minutes. Empty hooks were re-baited. When a shark was caught, it was identified by species, classified by life stage, sexed, measured, and weighed. The precaudal length, fork length (Figure 7), total length, and stretch-total length were all measured in centimeters and recorded. If the shark had not been previously tagged, a conventional spaghetti tag was inserted into the dorsal rays (Figure 8). A small fin clip was also taken from the top of the first dorsal fin (Figure 8) for DNA sampling. The relative abundance of lemon sharks at each site was determined using the formula for Catch Per Unit Effort (CPUE) as a proxy.

$$\text{C.P.U.E.} = \frac{\text{Total number of sharks caught}}{\text{Total number of hooks set}} \times \text{Soak Time}$$

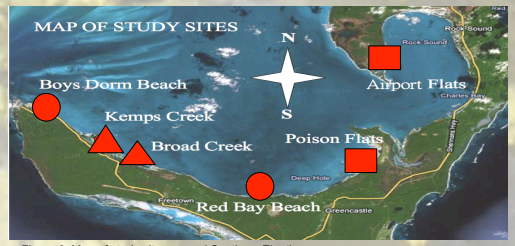

Figure 6. Map of study sites around Southern Eleuthera

Figure 7. Measuring fork length of a juvenile lemon shark

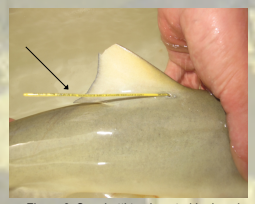

Figure 8. Spaghetti tag inserted in dorsal rays

Results

The flats habitats had the highest abundance of juvenile lemon sharks, with a CPUE of 0.03645 (sharks/minute), followed by creeks and concluding with beaches (Figure 9). Specifically Airport Flats had the highest abundance of sharks, with a CPUE of 0.0504 (sharks/minute), followed by Kemps Creek with a CPUE of 0.028 (sharks/minute). Figure 10 also indicates that Red Bay Beach had the lowest abundance with a CPUE of 0.0069 (sharks/minute).

The largest juvenile lemon sharks were caught off beaches, with a mea length of 64.08 cm, followed by flats and concluding with creeks. The smallest sharks were caught within the protected creek nurseries, with a mean length of 58.5 cm (Figure 11).

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Figure 9. Mean abundance of juvenile lemon sharks caught in each habitat

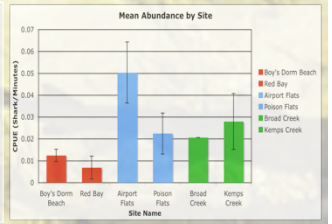

Figure 10. Mean abundance of juvenile lemon sharks caught at each site

Figure 11. Mean fork length of sharks caught in each habitat

Discussion

The purpose of this study was to determine the relative abundance of juvenile lemon sharks within three habitats of southern Eleuthera: mangrove creeks, flats, and sandy beaches. Mangrove creeks offer protection from predators, as well as an abundant prey community (Gruber et al 2008).These factors make creeks ideal nursery grounds (Jennings et al 2008). Natal site fidelity is a behavioral trend in lemon sharks that causes juveniles to remain close to their birthplace in the creeks for the first 3-6 years of their life (Chapman et al 2009). It was hypothesized that creeks would have the highest C.P.U.E. However, after conducting the study, flats were found to have the highest C.P.U.E. (Figure 9).

Because this study is so young, survey replicates are minimal. While this detracted from the statistical power of the results, certain trends were apparent. The C.P.U.E in flats was noticeably higher than in the other habitats (Figure 9). This may be due to the higher prey abundances within the flats and their close proximity to creeks, making them available to individuals who are able to expand their home ranges into during tidal changes (Gruber et al 2009). Sharks caught off beaches were found to be the largest, which is thought to be the result of an increased home range, lack of protection from the open-ocean and large predators (Figure 11). These factors make beaches a more practical environment for more mature sharks.

In the future, this study would benefit from an increased number of replicates, expansion of survey sites, and estimates of prey abundance acquired through seining. As a final measurement, abiotic factors influencing abundance, such as seasonal and tidal changes, could be considered. Although inconclusive as to which habitat is most important to juvenile lemon sharks, it is apparent that all habitats are used by juvenile lemon sharks. This preliminary data is critical to aiding the government in making informed decisions regarding coastal development in the future.

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