

Characterizing the behavior of bonefish in nearshore habitats during the reproductive season in Eleuthera, The Bahamas



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Introduction

Bonefish (*Albula vulpes*) are a coastal marine dwelling sport fish of the tropics and are found in nearshore habitats such as tidal flats and creeks. Recreational angling of this prized sport fish provides islands such as The Bahamas with important sources of revenue (Danylchuk et al. 2008). However, there have been few scientific studies on the biology of bonefish and little is known about their reproductive ecology (Crabtree et al. 1997). Knowledge of the movements and behavioral patterns of bonefish, especially during the reproductive season, are necessary for creating effective management and conservation strategies of bonefish stocks (Danylchuk et al. 2008).

The objective of this study was to conduct an assessment of bonefish behavior in a variety of habitat types during the reproductive season.



Figure 1. Methods used to observe bonefish behaviors. A) Snorkeling, B) VR100, C) VR2

Methods

This study was conducted between December 2008 and April 2009 in South Eleuthera, The Bahamas. Methods used for studying bonefish behavior included visual observations and telemetry (Fig. 1). Both methods are useful for studying fish in their natural habitats (e.g. Müller et al. 1998; Cooke et al. 2004). Bonefish behavior was examined in two habitat types: 1) tidal creeks/flats/wetlands (i.e., Kemps Creek, Poison Flats, and the Wetland at the Cape Eleuthera Institute (CEI), and 2) nearshore deepwater cuts (i.e., No Name Harbor, and The Pole at Guardhouse Cut) (Fig. 2).

Snorkeling surveys were conducted in the morning, afternoon and evening in deepwater cuts to document bonefish behavior. Observations of bonefish were also made in the Wetland at CEI by standing on a bridge that stretched the length of the area. The Wetland was chosen as a surrogate location for tidal creek/tidal flat observations because of the ease of viewing throughout the day (i.e., no tidal influence, great vantage point).

The telemetry equipment used included accelerometers, VR2 receivers, and a portable VR100 receiver with hydrophone (see Whitney et al. 2007; Larkin et al. 2008 for a description of the gear). Accelerometer tags, which transmit fish acceleration and depth in addition to fish ID, date and time, were surgically implanted in 10 bonefish (mean total length = 527 mm) in the wild in December 2008. Three accelerometer tagged bonefish (mean total length = 420 mm) were released in the Wetland in January 2009. All accelerometer derived data was examined graphically for trends and where applicable was analyzed using ANOVA followed by a Tukeys HSD test in SYSTAT.

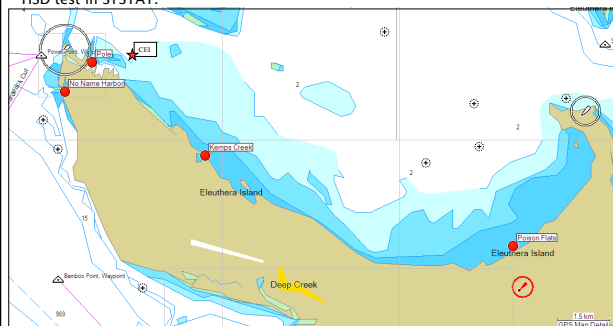


Figure 2. Locations of VR2 receivers in South Eleuthera, The Bahamas

Results

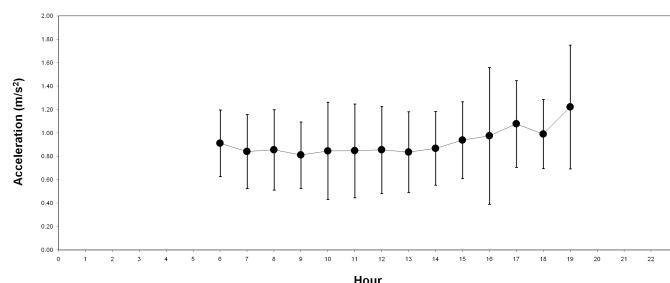


Figure 3. Average acceleration (m/s²) per hour of fish 132/133 at No Name Harbor

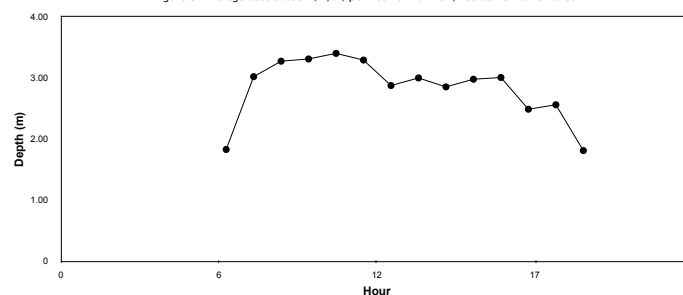


Figure 4. Average depth per hour of fish 138/139 at No Name Harbor

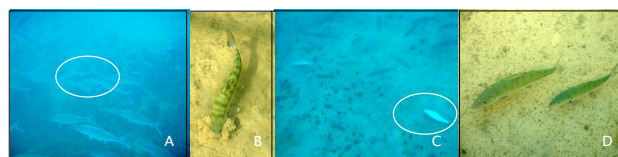


Figure 5. Bonefish behaviors A) Ventral nuzzle, B) Face wedge, C) Flash, D) Swimming.

Table 1. Behaviors of bonefish observed in three locations

| Behavior | Wetland | Guardhouse Cut | No Name Harbor |
|----------------|---------|----------------|----------------|
| Burst | X | X | X |
| Flash | X | X | X |
| Nose Dip | X | X | |
| Swimming | X | X | X |
| Drifting | X | X | X |
| Stationary | X | | |
| Face Wedge | X | | |
| Surfacing | | | X |
| Ventral Nuzzle | | | X |
| Chasing | | | X |

Discussion

Of the 10 accelerometer tagged bonefish released in the wild, only seven were detected after December 2008. Three of those fish were detected in all four study locations (i.e., No Name Harbor, The Pole at Guardhouse Cut, Kemps Creek, and Poison Flats (Fig. 1). Those three fish were further analyzed to obtain a representation of bonefish movement and behavior. No observable differences were detected in the acceleration data of the bonefish between the four study locations. There was however a trend in the depth data. On average, bonefish were close to the bottom everywhere except for at No Name Harbor, thus moving the focus of the study to the harbor. Two of the three bonefish showed an increase in acceleration at No Name Harbor between 1700 and 1900 (e.g., Fig. 3). This event corresponded with surfacing behavior observed at No Name Harbor. The only bonefish that did not show this trend was the only female. All of the bonefish arrived around 0600 and were within two meters of the surface (e.g., Fig. 4). For the rest of the day they descended but remained off the bottom. Around 1900, when the bonefish left, they returned to two meters.

All three bonefish show a similar trend in acceleration in the Wetland. Maximum mean acceleration occurred around 2000, and the minimum mean acceleration occurred around 0600. Overall, there were no obvious trends in depth with time of day, however there were some significant differences between hours. In addition, the depth of the wetlands varies from zero to half a meter, meaning the fish could be on the bottom at any depth.

Visual observations revealed some behaviors occurring at all study locations (Table 1, Fig. 5). Nose dipping and face wedging were seen mainly in the Wetland, although a nose dip was recorded in Guardhouse. Surfacing, ventral nuzzling, and chasing were noticed only in No Name Harbor. No Name Harbor was also the only location where large pre-spawning aggregations were observed (Fig. 6).

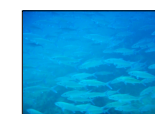


Figure 6. Pre-spawning aggregations at No Name Harbor

Acknowledgements

Several distinct behaviors were observed that linked to searching for food (e.g., swimming and drifting), consuming prey (e.g., nose dip and face wedge), evading predation (e.g., burst) and possibly reproduction (e.g., ventral nuzzling, surfacing, and chasing). The stationary and face wedging behavior exhibited by bonefish in the Wetland may have been due to the low number of predators in the Wetland. The presence of snorkelers in No Name Harbor and Guardhouse Cut may have made the bonefish more skittish, decreasing the number of behavioral activities observed. This data is not only important for studies on the behavior of bonefish in nearshore areas in South Eleuthera, but for research on the ecology of bonefish and flats in general. As this is the first study to use accelerometers on bonefish, it validates their usage as a reliable research tool for the movements and behavioral patterns of bonefish, as observational data that was collected coincided with the data picked up by the accelerometers in those same areas (i.e., No Name Harbor, Guardhouse Cut, and the Wetland). As research continues to be conducted concerning bonefish and especially their reproductive ecology, conservation and management efforts of the fish can be effectively supported and hopefully increased. Analyzing the data of accelerometer-tagged bonefish in the wetland shows that tides and predation greatly influence the bonefish's acceleration. Further analysis of all accelerometer-tagged fish in the wild may allow us to elucidate any sex or size related trends. Future studies investigating bonefish behavior would benefit from tools such as Critter Cams small enough to fit on bonefish, as well as focusing on bonefish movements and behaviors outside of the reproductive season to contrast their behavior in non-spawning times. In addition, more areas with VR2 receivers would result in a more accurate picture of bonefish behaviors across Eleuthera and the Bahamian Archipelago.

Literature Cited

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