Bonefish (Albula vulpes) Movement Patterns During The Reproductive Season

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Introduction

Bonefish (Albula vulpes) are popular sport fish because their strength and cryptic coloring make them difficult to catch, posing a challenge to recreational anglers. Anglers also enjoy wading the calm, tropical tidal flats bonefish inhabit (Danylchuk et al. 2008). Economically, bonefish are important because they attract many tourists to destinations like the Bahamas. As a comparison, the Florida Keys acquires one billion dollars annually from bonefish angling (Humston, 2001). It has been suggested that bonefish may be ecologically important because they connect near shore and offshore habitats, consuming food in the tidal creeks, and then excreting those nutrients offshore (Murchie, Personal Communication).

Despite their importance to both the economy and the ecosystem, little is known about the life history of bonefish (Danylchuk et al. 2008). Research on their reproductive spatial ecology is imperative so that the bonefish population can be properly managed and conserved. The purpose of this study is to assess the movement patterns of bonefish in relation to environmental factors such as time of day, current, and moon phase, during their reproductive season from December to May (Danylchuk et al. 2008). Bonefish were hypothesized to gather in pre-spawning aggregations in deeper, protected, near shore waters. It was predicted they move offshore at night around the new and full moon to spawn, a trend that has been observed in other marine fish (Johannes et al. 1978).

Methods

The movement patterns of bonefish were tracked using acoustic telemetry, a technique that monitors fish movements in water. Bonefish were captured in local tidal creeks using a seine net and 42 fish were implanted with acoustic transmitters. VR2 listening stations (range 300m) were deployed around Cape Eleuthera that recorded an acoustic signal from tagged bonefish (Figure 1). VR2s were collected once a month (December 2008 to March 2009), and the data was downloaded and sorted using VUE software. The VR2s record the date and time of acoustic signal and the unique serial code of the fish. The VR100 manual hydrophone, which provides real time data with a range of approximately 150m.

Two ripe fish captured from a large aggregation of bonefish in No Name Harbor had continuous pinger tags inserted into their stomachs. The fish were continuously followed from No Name Harbor at sunset until sunrise using a directional probe in conjunction with the VR100 over three days.

For statistical analysis, the VR2s were grouped into three zones determined by exposure to weather, proximity to shore, and depth. Tidal creeks were protected, shallow areas of about 1-2m deep with a mosaic of sandy bottoms, algae and sea grass beds. Near shore deeper cuts were protected waters, which were at most 5m deep, with primarily algae beds. In the offshore waters, there were patch reefs, sandy bottoms and high exposure to weather with depths up to 500m. When fish were detected with the VR100, the number of fish and size of the aggregation were visually confirmed by a snorkeling survey.

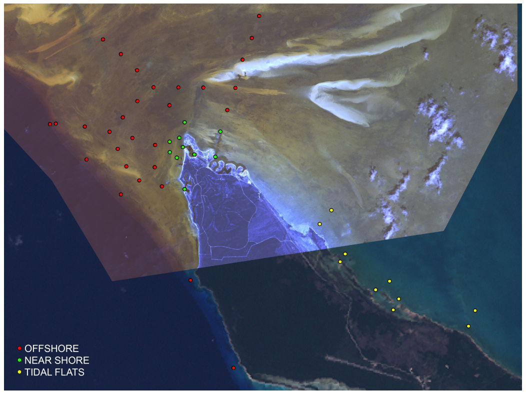

Figure 1: The array of VR2 acoustic telemetry receivers are depicted with colored dots around Cape Eleuthera. For data analysis, the receivers were classified into different coarse habitats: 1) yellow dots indicate shallow 1-2m tidal creeks 2) green dots indicate deeper 2-5m near shore habitats, 3)red dots indicate deep >3m offshore habitats.

Results

Bonefish were detected in all three habitat areas throughout the sampling period (Fig. 2). Bonefish aggregated in a near shore deeper water channel, No Name Harbor, in numbers of 300 to 3,000. Fish sizes ranged from 300 to 800mm. VR2 detections suggested, and snorkeling confirmed that bonefish left No Name Harbor at sunset and returned by sunrise (Fig. 3).

After bonefish left No Name Harbor, they moved west towards Chubb Rock before making a direct route to Bamboo Point. After this the fish slowly returned to the mouth of No Name Harbor around 3 A.M. where they stayed until sunrise (Fig. 4).

There was a marked increase in detections in offshore areas during the new moon, followed by an increase in detections in near shore areas during the first quarter. The number of detections in tidal creeks remained consistent throughout the moon phases. An increase in sample size may have resulted in a significant difference for fish moving offshore during the new moon.

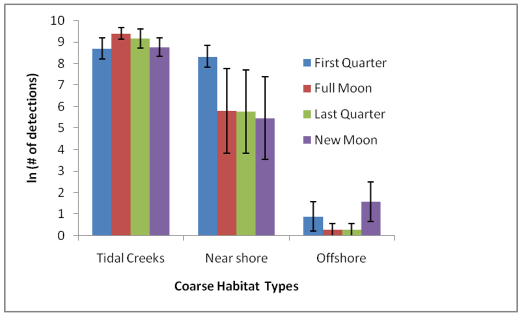

Figure 2: Mean number of detections of bonefish in each habitat across different moon phases. There is an increase in offshore detections during the new moon phase, as well as in near shore detections during the first quarter moon phase. Number of detections was log transformed for display purposes. Error bars represent +/- 1 SE.

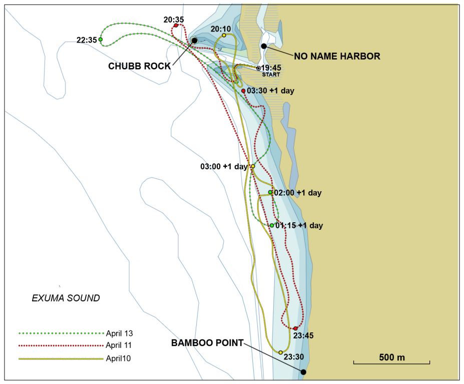

Figure 4: Continuous tracks of bonefish aggregations on the nights of April 10th, 11th, and 13th. Each night's path is represented with a different color. Start and end times, as well as times of major direction changes are noted on the map.

Literature Cited

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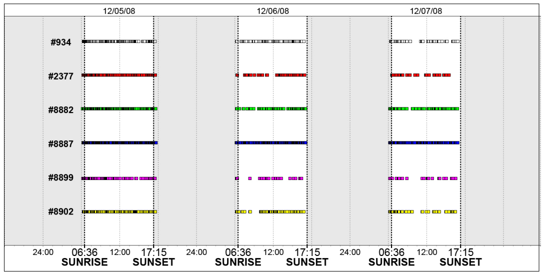

Figure 3: Detections of six tagged bonefish from the VR2 located in No Name Harbor on December 5th, 6th and 7th. Each square indicates a detection, and colors represent individual fish. Time is indicated along the x-axis, with white areas representing daylight hours and gray areas representing nighttime hours.

Figure 5: An aggregation of bonefish in No Name Harbor during the reproductive season.

Discussion

Results show bonefish spend time during the day in near shore-protected cuts like No Name Harbor, and leave at night, possibly to spawn offshore, before returning by sunrise. Because it is suggested that many other marine fishes go offshore to spawn because of less predation on their larvae, bonefish possibly exhibit these patterns at night as well (Johannes et al. 1978). An increase in the number of offshore detections for bonefish occurred during the new moon. During this time, tide fluctuations are greatest, there is the least amount of light which allow bonefish to move more easily offshore, and could potentially reduce predation. During the first quarter moon phase, the number of near shore detections increased and may be due to bonefish returning from their offshore spawning runs. The amount of detections in tidal creeks remains fairly constant, possibly because only ripe fish are moving offshore.

Bonefish are an important game fish species and it is important to adequately manage their stocks. Further research must be completed to understand bonefish ecology could help determine key areas to protect and conserve. One way to preserve bonefish populations is through the placement of a marine protected area (MPA) in areas where bonefish spawn and form pre-spawning aggregations. MPAs located in places where bonefish aggregate and spawn can help conserver their populations into the future. Locating where bonefish form pre-spawning aggregations and spawning sites can help determine the boundaries for MPAs. A proposed MPA around Cape Eleuthera should be delineated to include where bonefish have been observed to form pre-spawning aggregations.

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