Intra-habitat variation of mangrove creeks as they relate to bonefish (*Albula vulpes*) populations in Eleuthera, Bahamas

Alexia Knowles, Amnahir Pena-Alcantara, Emma Barbera, Joe Eynck, Mac McDonald, Max Spencer, Zachary Dellacqua
Faculty Advisors: Liane Nowell, Ally Waters, Ian Rossiter

Introduction

Mangroves are woody halophytes; the only trees capable of living in saltwater. In the Bahamas there are four species of mangroves: red, black, white, and buttonwood (Fig. 1). Mangroves provide many services such as preventing erosion, acting as accumulation sites for sediment, nutrients, contaminants, and CO_2 as well as acting as nursery grounds and habitat for many fish, including bonefish (*Albula vulpes*). The recreational bonefishing industry is estimated to generate over $141 million annually in the Bahamas (Fig 12). Despite the economic, ecological, and cultural importance of both mangroves and bonefish they are being impacted by coastal development (Fig. 2,3). Coastal development is a product of tourism and includes threats such as deforestation and dredging for hotels, marinas and ports (Ellison and Farnsworth, 1996).

The purpose of this research is to identify the factors of an ideal mangrove habitat for bonefish to aid in prioritizing mangroves for inclusion in Marine Protected Areas.

It was hypothesized that creek mouth width and location will be the greatest determining factors of an ideal bonefish habitat.

Figure 1. Red, white, black, and buttonwood mangrove leaves.

Figure 2,3. Coastal development.

Methodology

Research was conducted in several mangrove creeks (Fig. 9) on South Eleuthera in the Bahamas (24°50’05” N; 76°20’32” W) in the spring of 2012. Creek mouth width (m) as well as bonefish abundance were measured. To determine bonefish abundance in each creek, seine nets were deployed across creek mouths at high tide and left in place to intercept bonefish as they left creek systems with the outgoing tides (Fig. 4). Bonefish fork and total length were measured. Small plastic tags were inserted and anchored in the dorsal musculature (Fig. 5). A total count was then taken and the fish were released (Fig. 6). Bonefish abundance in each mangrove creek was used as a proxy for identifying ideal mangrove habitats.

Figure 4. Seine net set at mouth of creek.

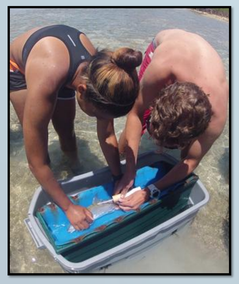

Figure 5. Bonefish being tagged.

Figure 6. Bonefish in flow through cage.

Results

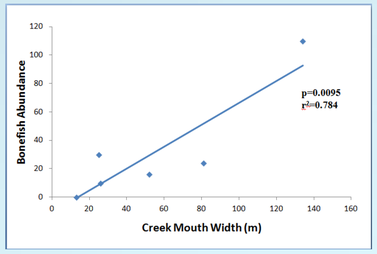

Figure 7. The relationship between bonefish abundance and creek mouth width.

With the exception of one outlier (Kemp’s Creek), Figure 7 shows that bonefish abundance increases as the creek mouth width increases. Using a linear regression, it was determined that there was a statistical significance between bonefish abundance and creek mouth width (R^2=0.784, p=0.009).

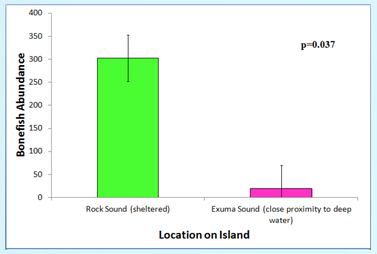

Figure 8. The relationship between bonefish abundance and location on the island. Error bars represent ±1 standard error.

As seen in Figure 8, there is generally a larger number of bonefish in the mangrove creeks on the sheltered side of the island (Rock Sound), as oppose to the creeks on the Exuma Sound which are in close proximity to deeper waters (Fig 10). Using a Man Whitney, it was determined that bonefish abundance was statistically different depending on the location on the island (p=0.037).

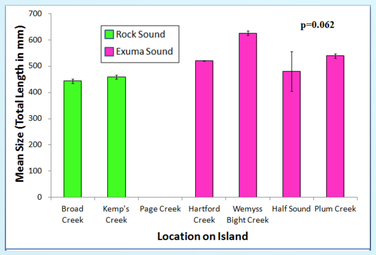

Figure 9. The relationship between bonefish size and location on the island. Error bars represent ±1 standard error.

Figure 9 shows that the mangrove creeks with close proximity to deep water in the Exuma Sound have bonefish with larger mean sizes than bonefish in Rock Sound. Using a Man Whitney, it was determined that although mean bonefish sizes were not statistically different depending on location of island, a trend was found (p=0.062).

Figure 10. Map of creeks.

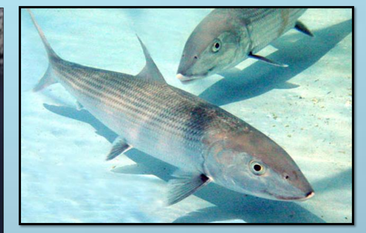

Figure 11. Bonefish.

Discussion

It was found that creek mouth width and location on island significantly affect bonefish populations:

- Bonefish abundance increases as creek mouth width increases
- Bonefish abundance is greater on sheltered sides of islands
- Bonefish tend to be smaller in size on the sheltered side of South Eleuthera

Bonefish abundance was greater on the sheltered side of the island due to potentially fewer large predators, protection from the elements, such as storms and hurricanes, as well as increased larval recruitment. The bonefish abundance and size results may also be related since smaller fish tend to form larger schools.

It was postulated that bonefish abundance might increase with creek mouth width since larger creek mouths provide easier access, more foraging area and potentially greater biodiversity (Danylchuk et al. 2003)

Conclusion

This data can be used to inform policy at the national and international levels (Diaz, 2004). Marine protected areas based on the most pertinent bonefish mangrove creeks is one solution to the conservation of bonefish. We recommended that marine protected areas be placed based on creeks with larger creek mouth widths as well as creeks on sheltered sides of islands.

Directions for Future Research

For future research bonefish populations should be re-assessed to improve sample sizes. Assessing fish abundance and diversity for all fish species in mangrove creeks would also provide more information on the importance of mangroves and aid in their conservation.

Figure 12. Flyfishing for bonefish.

Figure 13. Mangroves.

Literature Cited

Alongi, Daniel M. 2002. Present state and future of the world’s mangrove forests. Environmental Conservation 29 (3): 331–349.

Danylchuk, A.J., Danylchuk, S.E., Cooke, S.J., Goldberg, T.L.,Koppelman, J., and Philipp, D. P. Ecology and Management of bonefish (Albula spp) in the Bahamian Archipelago. Ecology & Management of Bahamian Bonefish.

Diaza, Robert J., Solanb, Martin, Valente, Raymond M., 2004. A review of approaches for classifying benthic habitats and evaluating habitat quality. Journal of Environmental Management 73: 165–181.

Ellison, Aaron M., Farnsworth, Elizabeth J., 1996. Anthropogenic Disturbance of Caribbean Mangrove Ecosystems: Past Impacts, Present Trends, and Future Predictions. Biotropica 28 (4a): 549-565.

Humston, Robert, Ault, Jerald S., Larkin, Michael F., Luo, Jiangang, 2005. Movements and site fidelity of the bonefish Albula vulpes in the northern Florida Keys determined by acoustic telemetry. Marine Ecology Progress Series 291: 237–248.

Mumby, Peter J., Edwards, Alasdair J., Arias-González, J. Ernesto, Lindeman, Kenyon C., Glackweel, Paul G., Gall, Angela, Gorezynska, Malgosia I., Harbornel, Alastair R., Pescod, Claire L., Renken, Henk, Wabnitz, Colette C. C., and Llewellyn, Ghislane. 2003. Mangroves enhance the biomass of coral reef fish communities in the Caribbean. Nature 427: 533-536.