Observations of reproductive behavior of Atlantic tarpon *Megalops atlanticus* using aerial surveys

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Abstract

Due to the logistical and financial challenges of studying migratory marine species, there is relatively limited knowledge of the reproductive biology, behavior, and habitat use of many species of ecologically important migratory megafauna. Atlantic tarpon (*Megalops atlanticus*) is an understudied but economically and ecologically important teleost species. In this study, we present a novel observation utilizing emerging technology (i.e. drones) to observe behaviors of a tarpon aggregation (N=182) over the course of a three-day long fish aggregation event. Following the event, we analyzed and compared observed behaviors with other fish species with well-documented reproductive aggregations, revealing behaviors consistent with courtship. Significantly, this aggregation occurred in highly altered and urbanized habitat, off the coast of South Florida, outside of documented spawning season. This suggests that during this aggregation, tarpon are likely vulnerable to overexploitation by recreational fishers and subject to a wide array of anthropogenic environmental impacts.

Introduction

- Populations of Atlantic tarpon have declined since the 1950s and are currently listed as "Vulnerable" with a decreasing population trend by the IUCN (Adams et al. 2019).
- Tarpon are one the most sought-after marine gamefish (Luo et al. 2020) with an annual economic impact of more than $6 billion in the US (Mill et al. 2010).
- To date, there have been no formal population assessments of Atlantic tarpon (Luo et al. 2020).
- Fish spawning aggregations (FSAs) are critical life-cycle events where fish form large groups for the sole purpose of reproduction (Domeier 2012).
- Many species of marine fish of similar size and life history traits (e,g,, grouper, permit, and bonefish) have well-documented FSAs (Domeier 2012).
- No FSAs for Atlantic tarpon have previously been identified,

Figure 1 : study species

Objectives

1) Report a previously undescribed aggregation Atlantic tarpon
2) Describe the identified behaviors and their potential reproductive significance
3) Demonstrate the potential of drone research to examine teleost behavior and habitat use

Methods

- Drone-based biodiversity surveillance surveys were conducted off the coast of Miami by FAA Part 107 Certified Remote Pilots recording in 4k.
- Each recording was independently analyzed by two different observers who replayed, zoomed in, and viewed footage frame-by-frame.
- For each of the aggregations, each individual fish was counted as they entered the frame, and the presence or absence of other fauna was noted.

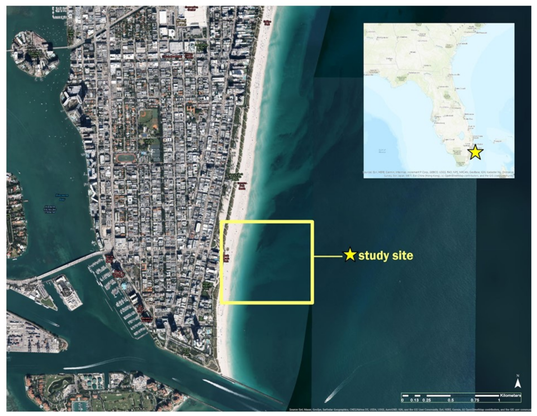

Figure 2: Study Site

Figure 3: DJI Phantom 4 Drone used for study.

Figure 4: screen capture from drone survey

Results

- We identified and described 7 distinct behaviors: (1) small individuals surrounding large individuals, (2) inactive clustering, (3) active clustering, (4) parallel stationary, (5) parallel cruising, (6) individual stationary, and (7) individual cruising.

Behaviors	Definition	Diagram
#1 Small Individuals Surrounding Large Individuals	2+ relatively smaller individuals surround a relatively larger individual.	
#2 Inactive Clustering	4+ individuals are clustered facing varying directions and stationed in place.	
#3 Active Clustering	4+ individuals are clustered facing varying directions cruising.	
#4 Parallel Stationary	2+ individuals are stationary but parallel to one another.	
#5 Parallel Cruising	2+ individuals cruising parallel to one another.	
#6 Individual Stationary	Individuals are stationary but independent and spread out from the rest of the aggregation.	
#7 Individual Cruising	Individual moving in a direction independent from the rest of the aggregation.	

Figure 5: description of behaviors

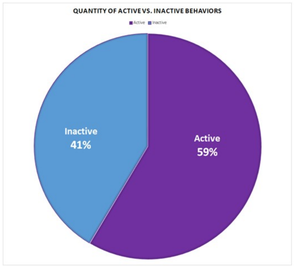

Figure 6: active vs. inactive behaviors

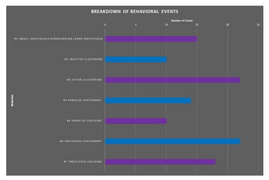

Figure 7: breakdown of behaviors

- Behaviors 1-5 were identified as potential courtship behaviors, based on similarities to past studies which documented teleost behaviors.
- Behaviors 1, 3, 5, and 7 were defined as active behaviors, behaviors 2, 4, and 6 were defined as inactive
- During 100% of the recorded aggregation there were courtship behavior occurring among some individuals.
- During the aggregation 98.9% (180/182) of individuals were observed exhibiting at least 1 of the courtship behaviors.

Conclusion

- Based on the sizable number of behaviors observed which are associated with spawning in other teleosts, this site may be an FSA (Fish Spawning Aggregation).
- FSAs are easily overexploited by targeting of sites and removal of reproductively important individuals from populations (Sadovy de Mitcheson et al. 2008; Sadovy de Mitcheson and Erisman 2012).
- As a migratory spawner, with life history traits characterized by slow growth, large size, long lifespan, late maturity, and seasonal migrations to spawn (Chollet et al. 2020), Atlantic Tarpon FSAs may be especially vulnerable to disturbance.
- Although the tarpon fishery is predominantly catch and release (C&R) in US waters, it may not be sustainable as post-release mortality estimates in C&R fisheries range from near 0% to 90% depending on the species and location (Muoneke and Childress, 1994).
- This aggregation was almost all sexually mature large tarpon (>1 m fork length) which show greater physiological capture stress than smaller tarpon (<1 m fork length) (Guindon, 2011).
- Physiological stress from capture can have adverse effects on reproduction (Bouchard et al. 2021).
- Despite not identifying predators in or around this aggregation, shark depredation is a known risk for recreationally angled tarpon (Saltzman and Macdonald, Unpublished data 2021)
- *Comprehensive management which recognizes the presence of aggregations is needed to ensure proper management of the Atlantic tarpon fishery*

KEY TAKEAWAYS

Drones

Drones are an underutilized tool to study the behavior of fish

Courtship

Atlantic tarpon may exhibit courtship behaviors

Aggregations

Atlantic tarpon aggregations occur in highly altered habitats leading to extreme vulnerability

Acknowledgements

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