

Ecology and Distribution of Tarpons (*Megalops atlanticus*) at the Boquerón Wildlife Refuge, Puerto Rico

Ecología y Distribución de Sábalo (*Megalops atlanticus*) en el Refugio de Vida Silvestre de Boquerón, Puerto Rico

Écologie et Distribution d'Alose (*Megalops atlanticus*) dans le Refuge de Vie Sauvage de Boquerón, Puerto Rico

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RESUMEN

El sábalo, *Megalops atlanticus*, es una de las especies más importantes en la pesca recreativa, modalidad de captura-liberación en Puerto Rico. Su importancia en el Refugio de Vida Silvestre de Boquerón (RVSB), un estuario artificial, hacen indispensable la evaluación de la población para su manejo y conservación. Esta investigación estimó su abundancia, las clases de edad, la variabilidad en abundancia estacional y sus tasas de crecimiento mediante la evaluación de longitud y peso. Datos colectados desde 2007 de longitud-peso y de captura por unidad de esfuerzo (CPUE) fueron evaluados y desde el 2011 se marcaron sábalo con transmisores internos lo cual nos permitió conocer su ubicación e identidad durante la recaptura. Más de 400 individuos fueron marcados y 11 han sido recapturados. Tanto la laguna interior como los canales que conectan las lagunas con el mar presentaron una mayor frecuencia de individuos de 41 – 50 cm de longitud de horquilla. La tasa de CPUE mostró su máximo durante el mes de julio cuando el nivel del agua estuvo en promedio bajo por falta de precipitación. Esta información provee datos actualizados para ampliar el conocimiento de la población de sábalo y promover estrategias de manejo en el RVSB que garanticen la sustentabilidad de este importante recurso pesquero.

PALABRAS CLAVE: Sábalo, marca y recaptura, pesca recreativa, manejo

INTRODUCTION

The tarpon *Megalops atlanticus* is a large, migratory fish that are found in a wide variety of habitats, from freshwater lakes and rivers to offshore marine waters (Crabtree 1995). This popular species is prized in sport fishing, and supports important recreational fisheries in Florida and the Caribbean (Cyr 1991, Chaverri 1992). Fisheries regulations established catch and release practices for tarpon throughout the Puerto Rico waters (DNER 2010).

The Boquerón Wildlife Refuge (BWR) is an artificial water impoundment project that was originally developed for waterfowl hunting enhancement on the southwestern coast of Puerto Rico. This site has the capability of sustaining populations of tarpons and other marine and freshwater fish that are popular in recreational fisheries; but changes in land use and agricultural practices of the region have led to the obstruction of saltwater flow into the BWR including the sedimentation of dikes and channels during the past decades, which have also been colonized with vegetation.

Tarpon populations need to be assessed on a regular basis in order to help in the development, adaptation, and implementation of appropriate management strategies. Based on these specific needs the following objectives were pursued with this project:

- i) Describe the spatial distribution,
- ii) Describe habitat utilization, and
- iii) Estimate abundance.

MATERIAL AND METHODS

Study Site

The Boquerón Wildlife Refuge (BWR) is part of an extensive coastal ecosystem that supports a variety of economic activities including commercial and recreational fisheries, marine and aquatic recreation, birdwatching, hiking, wildlife photography and waterfowl hunting during a limited season. It was designated in 1964, and is located in Cabo Rojo, southwestern Puerto Rico (Figure 1). The area is composed of a mangrove basin forest with salt flats and wetland habitats subject to marine influence due to tides and freshwater inputs due to rainfall. Currently, the BWR is an artificial impoundment of 1.8 km² adjacent to the mangrove lined brackish lagoon known as Laguna de Rincón in Boquerón, and surrounded by canals to the North-east.

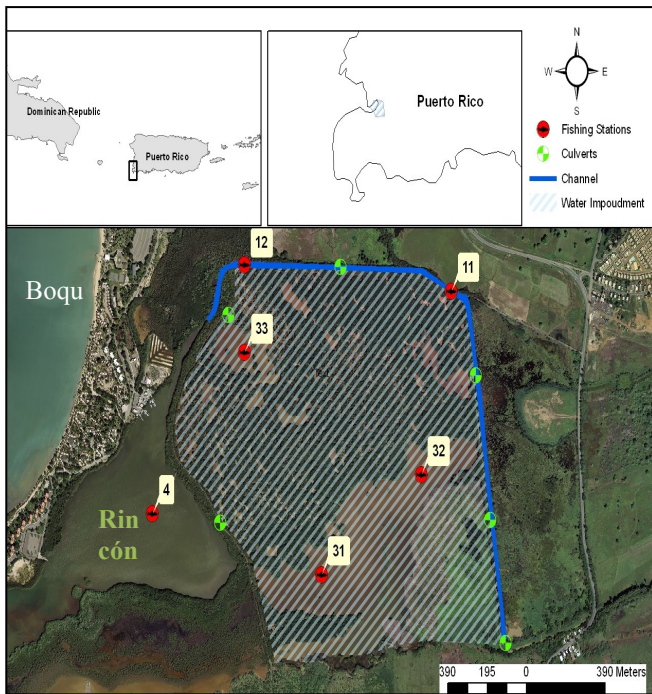


Figure 1. Fishing station at the study area. Stations 1.2 and 1.1 are located in canal habitat, while stations 3.1, 3.2, 3.3 are located within the artificial impoundment, and station 4 is located in the Rincon Lagoon.

The impoundment is surrounded by three main dikes around the inner lagoons and wetland habitats to which fresh water is channeled during floods generated by heavy rains. A total of six water control culverts are distributed along the dikes to allow the flow of freshwater draining from the Lajas Valley through the eastern drainage canal (located at southeast corner of the BWR), and seawater enters during extremely high tides from the marine shallow lagoon Laguna Rincón. These culverts represent the only points of passage for tarpon between the canals and the inner lagoons of the impoundment and they are closed most of the year until extreme floods occur. The canals are one of the main habitat types in the BWR, which are constantly flooded and serve as habitat for tarpon and other fish species.

The BWR was created to maintain and restore coastal wetlands in order to support optimal habitats for fish and waterfowl resources, providing habitat for diadromous fish and migrant waterfowl. Initially this resulted in an increase in the abundance and diversity of diadromous fishes (i.e. tarpon, snook, mullet), waterfowl, and other wildlife species. In recent years, dense stands of cattails and other aquatic vegetation have colonized over 80% of the drainage canals within the refuge. Concurrent with this rapid loss of open water habitat, there has been a significant decrease in the abundance and diversity of fish species within the canals.

Sampling Design and Data Collection

Tarpon were collected from November 2011 to October 2012 within the BWR and the Rincón Lagoon in six areas that were established throughout the different habitats (Figure 1). Stations 1.1 and 1.2 are within the main canals, which are connected with the Rincón Lagoon. Stations 3.1, 3.2 and 3.3 are located in the internal lagoon and are not directly connected to the canals unless the flood control culverts are operated. Station 4, Rincón Lagoon, is located outside the BWR and provides connectivity between the BWR (impoundment and canals) and the rest of the coastal habitats.

Gillnetting and rod & reel methods were the two techniques used to capture tarpon. Gillnet method was modified at canal location vs. in the internal lagoon. Within the internal lagoon, the gillnet soaked 30 minutes, while in the canals, the gillnet procedure was adapted to an active sampling technique to capture tarpon. The active gillnet method consists of walking along the canal, coaxing tarpon into the net that is set during 30 minutes. The net is nylon and with mesh size 24 – 80 mm.

Tagging procedure — Once captured the tarpon were processed as soon as possible to reduce stress and avoid handling-related mortality. All handling was performed with wet surfaces to minimize removal of the fish's mucus outer layer. First each tarpon was scanned with a handheld passive internal transponder (PIT) tag reader in order to determine if it was previously tagged. Measurements were taken with an ichthyometer to determine fork length (FL) and total length (TL) to the nearest cm. Weight was recorded to the nearest g by suspending the fish in a net hanging from a spring scale that was previously calibrated. In order to implant the PIT tag a few scales were removed on the left side of the body behind the pelvic fin and a 3-5 millimeters incision was made with a dissection kit to insert a PIT tag. Two different sizes of PIT tags were used (23 or 32 mm diameter) for fish under and above 20 cm FL respectively. Each PIT tag ID number was confirmed after insertion with the handheld tag reader. After tagging, fish were held underwater with both hands and moved parallel to the surface to increase water flow over the gills before release once the fish began swimming on its own.

RESULTS

A total of 438 individuals were capture and tagged and FL ranged from 21.6 to 88.6 cm with a mean of 49 cm FL. Of these, 314 were captured with the gillnetting and 124 were captured with rod & reel; mortality rate was 3.6% (16 individuals) and it was mainly caused by high stress during gillnetting. Recapture rates were low, 4.1% (18 tarpons) overall, while individuals tagged in the channels showed a higher recapture rate (11%) than the inner lagoons of the impoundment (1.4%). The maximum time at large of a tarpon was 337 days with a mean growth rate of 0.17 mm/day. The highest growth rate was observed at station 1.1 with 0.8 mm/day, for an individual measuring 47.4 cm FL.

Spatial Distribution

Within the internal lagoons 287 tarpon were captured and 95% of these individuals ranged from 40 to 60 cm FL, while the 141 tarpon captured in the canals and 11 captured in the Rincón Lagoon showed a wider range of sizes (Figure 2).

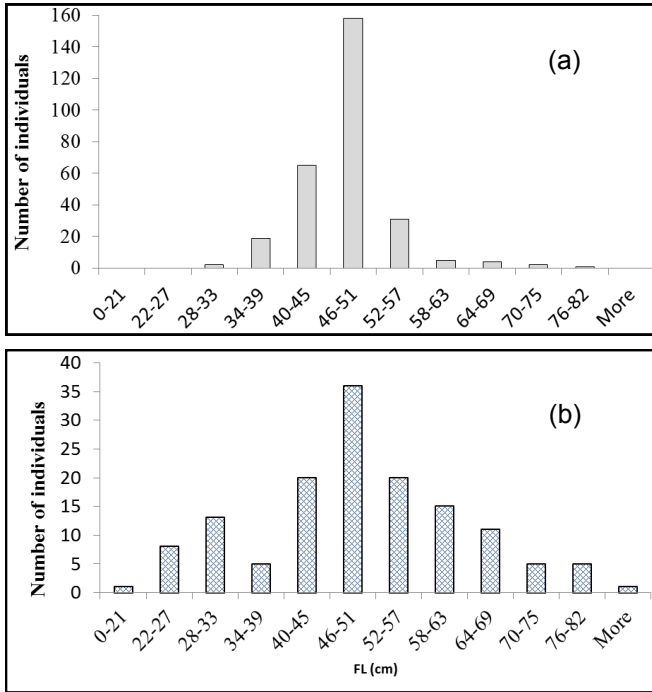


Figure 2. Size-frequency distribution of (a) n = 287 tarpon captured within the internal lagoons and, (b) n = 140 tarpon captured in canals.

A non-parametric test (Wilcoxon) did not reflect any significant differences in the mean size of individuals between the different habitats. However, significant differences ($p < 0.001$) were found between stations 1.1 and 1.2 in the canal habitat (Figure 3).

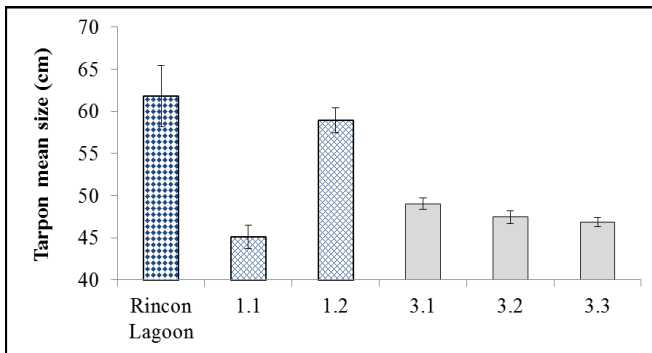


Figure 3. Tarpon mean size at the different sampling location. Rincon lagoon, n = 11; 1.1, n = 89; 1.2, n = 51; 3.1, n = 96; 3.2, n = 54; 3.3, n = 137.

CPUE

The CPUE was calculated from gillnet methods only due to the more consistent effort estimates. The CPUE within the internal lagoons was twice as high as in the canals, during the same time period. On the other hand, station 3.2 showed the highest value 2.95 fish/person*hr and station 1.2 had the lowest value 0.72 fish/person*hr (Figure 4). No significant differences in CPUE were detected.

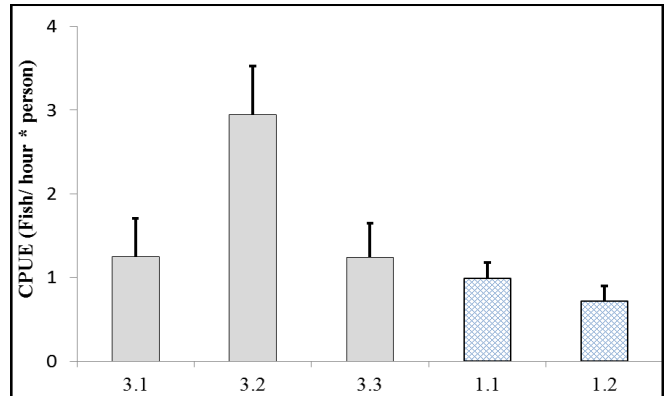


Figure 4. Catch per unit effort (CPUE) by sampling area.

DISCUSSION

We captured tarpon with two different techniques, rod and gillnet with different mesh sizes; consequently, all size classes were sampled contrary to Crabtree in 1995 which detected a bias in sizes of fish. We found a distinct pattern in the size-frequency distribution of fish within the internal lagoons where the 95% of the tarpon ranged between 40 – 60 cm compared to those in the canals, which had a wider range of sizes. According to previous studies in Florida (Crabtree 1995), the size range detected in the internal lagoon of the BWR suggests fish are between 1 and 3 years old. The dikes around the BWR impoundment could be limiting the connectivity of early life stages located inside the inner lagoon habitats with the habitats in the canals where they can find deeper waters and migrate to the marine habitats, but it also could be limiting the recruitment events inside the BWR.

Previous studies conducted in Puerto Rico have identified mudflats as an important recruitment habitat for early life stages of tarpon (Zerbi 2001, Aliaume and Miller 1999). These habitats are currently located inside the impoundment and support the fishery resource. The preliminary results of this study suggest that recruitment events occurred 2 or 3 years ago, concurring with a documented flood event that inundated the impoundment three years ago.

The data also showed differences in fish sizes within the canal habitats. Some areas of the canals are restricting the movement of larger tarpon. Larger individuals may be limited due to obstructions (accumulation of vegetation or sedimentation) and fluctuations in the water level (rains, tides), while smaller individuals can move freely through these obstructions.

If we use the CPUE value as an index to compare densities between different areas (FAO 1969) we can detect patterns in the spatial distribution of tarpon. The highest value was found at the station 3.2 indicating a higher density of tarpon at this sampling area. This may be due to small-scale differences in habitat structure or the proximity to canal habitat, although it is not accessible due to the operation of the flood control culverts.

Finally, this study suggests that the implementations of management strategies are necessary at the BWR. Temporal patterns in tarpon migrations, spawning and recruitment should be incorporated into the decision making process for the operation of the culverts along with other factors such as tide and flood levels. Maintenance of canals and culvert areas to eliminate obstructions could serve to improve the spatial distribution and habitat use of tarpon influencing the density and recruitment into the BWR.

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