

Reproductive Biology of the Bonefish, *Albula vulpes*, at Los Roques Archipelago National Park, Venezuela

DENISE DEBROT and JUAN M. POSADA
Departamento de Biología de Organismos
Universidad Simón Bolívar
Apdo. 89000
Caracas 1080-A, Venezuela

ABSTRACT

The bonefish, *Albula vulpes*, is a common species in Los Roques Archipelago National Park and is considered an important recreational fish in this area. The purpose of this study is to describe the reproductive characteristic of *A. vulpes* (i.e., spawning season, length at sexual maturity) in Los Roques. A total of 440 specimens were collected from October 1999 to September 2000. Fish sizes ranged from 286 to 717 mm fork length (FL) and females were significantly larger than males (Mann Whitney U-test, $P < 0.001$). The smallest sexually mature female and male were 351 and 424 mm FL, respectively. The length at 50% sexual maturity was calculated in 456 mm FL for females and 467 mm FL for males. Spawning season extended from June to January and peaked from November to December.

KEY WORDS: Bonefish, reproduction, seasonality

Biología Reproductiva del macabí, *Albula vulpes*, en el Parque Nacional Archipiélago de Los Roques, Venezuela

El macabí, *Albula vulpes*, es una especie común en las aguas del Parque Nacional Archipiélago de Los Roques, y aunque carece de interés para el consumo humano, es de gran importancia para la pesca deportiva, por ser un excelente luchador. Con el fin de describir el desarrollo gonadal y estimar la época de mayor actividad reproductiva y la talla de madurez sexual, se colectaron 440 ejemplares de *A. vulpes*, desde Octubre de 1999 hasta Septiembre del 2000. Se calcularon los índices gonadosomáticos (IGS) de todos los individuos colectados y se examinaron histológicamente las gónadas de 120 ejemplares. La talla de los individuos capturados oscilaron entre 28,6 y 71,7 cm de longitud de horquilla (LH), siendo las hembras significativamente más grandes que los machos (Prueba U Mann-Whitney, $P < 0.001$). El macho maduro más pequeño midió 35,1 cm de LH y la hembra madura más pequeña midió 42,2 cm de LH. La talla a la que madura el 50% de la población fue 47.32 cm de LH para los machos y 45.19 cm para las hembras. La actividad gonadal de esta especie es estacional con un pico reproductivo prolongado desde Junio hasta Enero. El IGS promedio, tanto para machos como para hembras, fue mayor durante los meses de Octubre a Diciembre y menor durante Febrero-Abril. Se espera que los resultados obtenidos

ayuden a las autoridades responsables del manejo del parque y sus recursos pesqueros, en el establecimiento de un programa que garantice el aprovechamiento y protección de esta especie.

PALABRAS CLAVES: Macabí, *Albula vulpes*, biología reproductiva

INTRODUCTION

The bonefish, *Albula vulpes*, is found in the tropical western Atlantic and is a common species in Los Roques Archipelago National Park, Venezuela (Pulido 1983, Cervigón 1991). *Albula vulpes* supports important recreational fisheries in the Florida Keys, the Bahamas and other Caribbean islands (Mojica et al. 1995). Recently, this activity has been growing in Los Roques Archipelago National Park, where big schools of bonefish can be found in waters of less than one meter deep. Despite its recreational importance, there is no information about the biology of this species in Venezuela, except for brief comments made by Cervigón (1991). Contrarily, Mojica et al. (1995) studied its recruitment patterns in the Bahamas, while Crabtree et al. (1996, 1997) described its population and reproductive parameters in South Florida waters, respectively. Therefore, the aim of the present study is to contribute to the knowledge of the reproductive characteristics of this species in Los Roques Archipelago National Park, Venezuela.

METHODS

Study Site

Los Roques Archipelago National Park is a complex reef system located 155 Km to the north off the central coast of Venezuela (11°44'45'' to 11°58'36'' N and 66°57'27'' to 66°57'27'' W), comprising an area of 1250 km². Samplings were conducted in the shallow waters (< 2 meters) surrounding Dos Mosquises Sur island.

Sampling and Processing

A total of 440 specimens were collected from October 1999 to September 2000 (average: 35 ind/month), using a beach seine (2 cm mesh opening). All individuals were measured to the nearest millimeter of fork length (FL) and weighted to the nearest gram. The sex of all specimens was determined macroscopically. Their gonads were removed and weighted to the nearest 0.1 gram. Preserved gonads (10% buffered formalin) from 120 representative specimens were embedded in paraffin, sectioned (6 µm), and stained (hematoxylin and eosin).

Length at Sexual maturity

Length at 50% sexual maturity was estimated using the inflection point of a logistic function fitted to the percentage of sexually mature females and males and to their respective length. To avoid misclassifying regressed and immature fish, all the specimens collected in the postreproductive months (February - April) were excluded from this analysis (Crabtree et al. 1997). The length of the smallest sexually mature female and male were also recorded.

Reproductive Seasonality

The Gonadosomatic index (GSI, Htun-Han, 1978) was calculated for each gonad, according to the following equation

$$\text{GSI} = [\text{GW} / (\text{TW} - \text{GW})] \times 100$$

Where, GW and TW represent gonad weight and total body weight (in grams), respectively. Monthly median GSI values were plotted for each sex to show changes in reproductive state throughout the year.

RESULTS

Of the 440 *A. vulpes* examined 255 were females (57.9%) and 185 (42.1%) males. The sex ratio of 1:1.38 was significantly different from the unity ($X^2 = 11.184$, $P < 0.001$). Females ranged from 286 to 717 mm FL (mean = 49.22 mm; s.d = 65.36; n = 255) and males from 334 to 600 mm FL (mean = 459.36; s.d = 35.15; n = 185) (Figure 1). Length-frequency distributions of females and males were significantly different (Kolmogorov-Smirnov two-sample test, $D = 0.0410$, $P < 0.001$) and females were significantly larger than males (Mann Whitney U-test, $P < 0.001$).

Length at sexual maturity

The smallest sexually mature female and male were 351 and 424 mm FL, respectively. The length at 50% sexual maturity was estimated in 456 mm FL for females (95% confidence interval 446 - 466 mm) and 467 mm FL for males (95% confidence interval 454 - 479 mm) (Figure 2).

Reproductive season

Three oocyte stages were identified in female *Albula vulpes*: primary growth, cortical alveolar and vitellogenic (Figure 3). Females with vitellogenic oocytes were observed in most of the months except between March and May and were most abundant in October. This appears to agree with median GSI values, which suggest that *A. vulpes* spawning season extend from June to January, with a peak from November to December (Figure 4). However, evidences of imminent or recent spawning, such as fully hydrated oocytes and postovulatory follicles, were not observed.

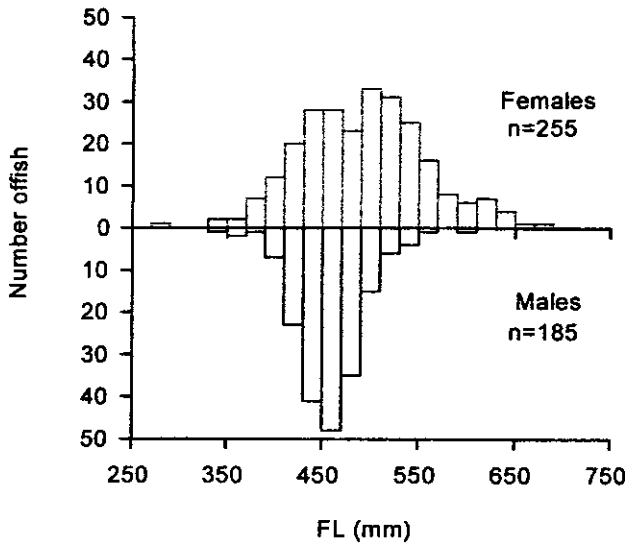


Figure 1. Length-frequency distributions of female and male bonefish, *Albula vulpes*, at Los Roques Archipelago National Park

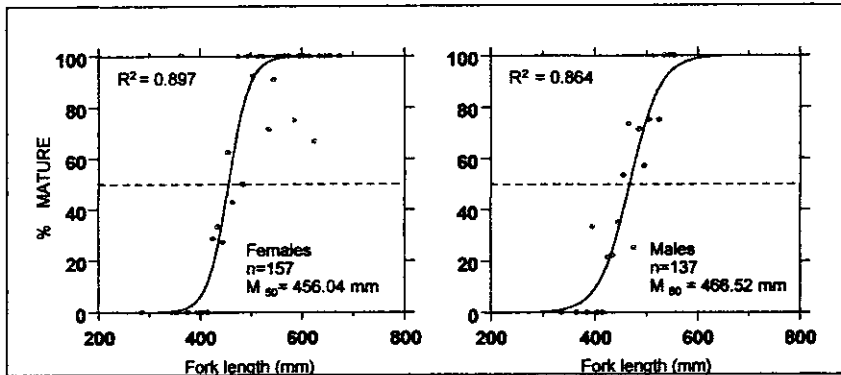


Figure 2. Length-maturity relations for females and males of the bonefish, *Albula vulpes*, sampled in Los Roques Archipelago National Park. Lengths plotted are the midpoints of 10 mm size classes. The red line represents the predicted relation from the logistic function: $Y = 100 / (1 + \exp(-a(X-b)))$. Parameter b in the equation is the inflection point and is the estimate of the length at which 50% of the individuals were sexually mature (M_{50}).

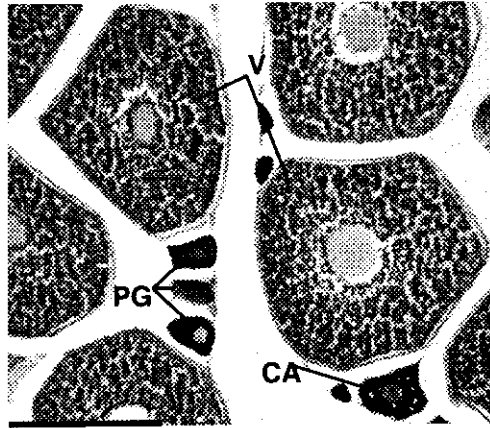


Figure 3. Histological section from an ovary of a 548 mm-FL *Albula vulpes*, sampled in Los Roques Archipelago National Park. Oocyte stages: primary growth (PG), cortical alveolar (CA) and vitellogenic (V). Scale bar = 400 microns.

DISCUSSION

There is a good level of agreement between present and Crabtree et al. (1996, 1997) studies. In both cases, the sex ratio was biased towards the females. The size ranges of the sampled populations in the two regions overlapped (228 to 700 and 290 to 700 mm FL for females and males in South Florida, respectively), with females being significantly larger than males.

Albula vulpes examined at Los Roques reached sexually maturity at a similar length than reported by Crabtree et al. (1997) in the Florida Keys (358 and 425 mm FL for females and males, respectively). However, females in the present study reached 50% maturity at a smaller size than reported by Crabtree et al. (1997) while the opposite result was observed for males.

The reproductive seasonal patterns were also similar for Los Roques, South Florida and Bahamas. Crabtree et al. (1997) reported that *A. vulpes* from South Florida runs sexually mature from November to June, while are reproductively inactive during a few months of the summer. Mojica et al. (1995), based on the presences of field-collected larvae, suggests that *A. vulpes* in the Bahamas may spawn continuously from mid October through early January and probably extends until May. The absence of females with fully hydrated oocytes and postovulatory follicles in our sample may indicate that bonefish does not spawn in shallow waters (< 2 m) as suggested by Crabtree et al. (1997).

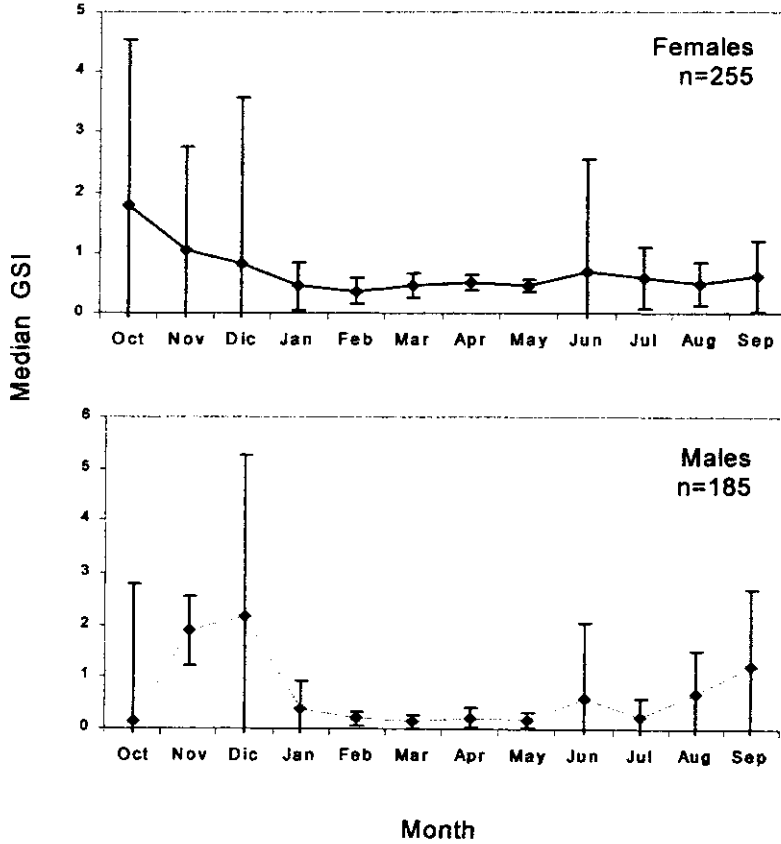


Figure 4. Monthly median gonadosomatic index (GSI) and interquartil ranges for females and males of the bonefish, *Albula vulpes*, sampled in Los Roques Archipelago National Park.

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