

**ASPECTS OF THE REPRODUCTIVE BIOLOGY OF THE SILKY SHARK,
CARCHARHINUS FALCIFORMIS (NARDO, 1827), IN THE VICINITY OF
ARCHIPELAGO OF SAINT PETER AND SAINT PAUL,
IN THE EQUATORIAL ATLANTIC OCEAN**

Fábio H. V. Hazin¹; Paulo G. V. Oliveira¹; Bruno C. L. Macena¹

SUMMARY

A total of 96 silky sharks, 48 males and 48 females, caught in the equatorial region, close to the Archipelago of Saint Peter and Saint Paul (0°55'10"N; 29°20'33"W) were examined, with a view to study their reproductive biology. Total length (TL) ranged from 83.0 to 272.0 cm, for males, and from 75.0 to 295.0 cm, for females. The present data suggest a size at first sexual maturity for the silky shark in the equatorial Atlantic of about 230 cm, for females, and from 210 to 230 cm, for males. The monthly distribution of female sexual stages do not show any clear trend, suggesting that, at least close to the equator, the species might not have a clear seasonal cycle of gestation. Litter size ranged from 4 to 15, with a sex ratio of embryos equal to 1:1.4 (male: female)

RÉSUMÉ

Un total de 96 requins soyeux, 48 mâles et 48 femelles, capturés dans la région équatoriale à proximité de l'archipel de St Pierre et St Paul (0°55'10"N ; 29°20'33"W) ont été examinés dans l'objectif d'étudier leur biologie de reproduction. La longueur totale s'est établie entre 83,0 et 272,0 cm pour les mâles et entre 75,0 et 295,0 cm pour les femelles. Les données présentes suggèrent une taille à la première maturité sexuelle pour le requin soyeux dans l'Atlantique équatorial d'environ 230 cm pour les femelles, et entre 210 et 230 cm pour les mâles. La répartition mensuelle des stades sexuels femelles n'indique aucune tendance claire, ce qui suggère qu'au moins près de l'équateur, l'espèce n'a peut-être pas un cycle de gestation saisonnier clairement établi. La taille de la portée va de 4 à 15, avec un sex-ratio d'embryons égal à 1 : 1,4 (mâle : femelle).

RESUMEN

Se examinó un total de 96 tiburones jaquetón, 48 machos y 48 hembras, capturados en la región ecuatorial, cerca del Archipiélago de Saint Peter y Saint Paul (0°55'10"N; 29°20'33"W), para estudiar su biología reproductiva. La longitud total (TL) osciló ente 83,0 y 272,0 cm, para las hembras y entre 75,0 y 295,0 para los machos. Estos datos sugieren una talla de primera madurez para el tiburón jaquetón en aguas ecuatoriales de aproximadamente 230 cm, para las hembras y de 210 a 230 cm, para los machos. La distribución mensual de las fases sexuales de las hembras no mostraba ninguna tendencia clara, lo que sugiere que, al menos en las zonas cercanas al Ecuador, esta especie podría no tener un ciclo de gestación estacional claro. El tamaño de las camadas osciló entre 4 y 15 crías, con una ratio de sexos de embriones de 1:1.4 (macho: hembra)

KEYWORDS

*Reproductive cycle, Carcharhinidae, Carcharhinus falciformis,
silky shark, Equatorial Atlantic Ocean*

¹Laboratório de Oceanografia Pesqueira-LOP, Departamento de Pesca e Aquicultura- DEPAQ, Universidade Federal Rural de Pernambuco-UFRPE, Rua Dom Manoel de Medeiros, s/n, Dois Irmãos, Recife-PE, CEP 52171-900; e-mail: fhvhazin@terra.com.br

1. Introduction

The silky shark, *Cacharhinus falciformis*, is an abundant oceanic species, which occurs in equatorial and tropical areas around the globe. It has an epipelagic distribution, being commonly found near the edge of continental shelves, as well as in the proximity of oceanic Islands (Bigelow and Schroeder, 1948; Bass *et al.*, 1973; Compagno, 1984). Common in the southwestern Atlantic Ocean, it is often caught by tuna longliners targeting tunas and swordfish (Hazin *et al.*, 1991). Off the Brazilian northeast coast, it is particularly abundant in the vicinity of the Archipelago of Saint Peter and Saint Paul (ASPSP), where it is caught by hand line and longline.

Located at about 600 nautical miles away from the Brazilian coast, the ASPSP has a permanent research station, which serves as a platform for the development of several researches on insular fauna and flora of the Equatorial Atlantic. Its remote location, between the northern and southern hemispheres, as well as between the African and South American continents, makes it a strategic site for the study of pelagic species of the Atlantic Ocean. Since the middle eighties, several fishing vessels based in the Brazilian northeast coast, from Recife to Fortaleza, often cover the long distance separating the ASPSP from the mainland, in order to exploit the abundant fisheries resources present in its vicinity. Although yellowfin tuna, wahoo, flying fish and the rainbow runner are the main targets, silky sharks are also commonly caught.

Despite the silky shark is a common species along the entire Brazilian coast (Gadig and Moreira-Júnior, 1992), information on its biology is virtually non-existing as yet. The objective of the present work was thus to provide preliminary data on the reproductive biology of silky sharks caught in the equatorial Atlantic, close to the Archipelago of Saint Peter and Saint Paul.

2. Material and methods

From September 1998 to April 2004, 96 silky sharks caught by commercial longline operations in the vicinity of the Archipelago of Saint Peter and Saint Paul (0°55'10"N; 29°20'33"W) were examined. Sharks were dissected and examined immediately after being boarded. The reproductive organs of both males and females were collected and preserved in 10% sea-water formalin solution. From females, both oviducal glands and the ovary were collected, weighted and measured, and the stage of ovarian development was observed. The number of vitellogenic follicles was counted and the diameter of the largest one was measured using a Vernier caliper. Both uteri were measured and their contents observed, following dissection. Whenever there were eggs or embryos present, they were counted, measured, weighted, and sexed (embryos). Male testes were also collected and measured, including width, length and weight. Clasper length was recorded and its calcification stage observed.

3. Results and discussion

The silky shark was the most abundant shark species in the fishing operations carried out by the longliners, yellowfin tuna being the most frequent fish caught. Of the 96 specimens examined, 48 were females and 48 males, resulting in a sex ratio (male:female) of 1:1, which is close to the ratio of 1:1.2 found by Branstetter (1987) in the Gulf of Mexico, from a sample of 119 specimens. Total length (TL) ranged from 83.0 to 272.0 cm, for males, and from 75.0 to 295.0 cm, for females (**Figure 1**). Males were found in 3 different sexual stages: juvenile (n= 26/ 54%); Maturing (n= 13/ 27%); and Adult (n= 9/ 19%). Juvenile males, with a TL up to 186 cm, had flexible and uncalcified claspers, measuring up to 12.0 cm. Maturing specimens ranged from 185 to 210 cm TL, with a clasper length from 13 to 24 cm. Adult specimens had fully calcified claspers, with more than 27 cm. Their TL ranged from 234 to 272 cm (**Figure 2**). Females, in turn, were found in four different sexual stages: Juvenile (n= 24/ 50%), with a TL ranging from 75.0 to 180.0 cm; Maturing (n= 6/ 12%), TL from 210 to 225 cm; Pre-ovulatory (n= 8/ 18%), TL from 245 to 295 cm; and Pregnant (n= 10/ 20%), TL from 237 to 270 cm. Juvenile females had undeveloped sexual organs with thin uteri and oviducal gland (less than 1.0 cm in width). Maturing females were approaching sexual maturity for the first time. They already had well developed oviducal glands and wider uteri (up to 5 cm), as well as some vitellogenic follicles in the ovary, but with less than 2.0 cm in diameter. The 8 pre-ovulatory specimens were clearly adult, with large vitellogenic follicles in the ovary, with more than 2.5 cm in width. The present data suggest a size at first sexual maturity for the silky shark in the equatorial Atlantic of about 230 cm, for females, and from 210 to 230 cm, for males, which are similar to those found by Branstetter (1987), for silky shark specimens from the northwestern Gulf of Mexico.

The total length of females showed 3 different modes, corresponding, respectively, to juvenile (140 to 160 cm), Maturing (200 to 220 cm), and adult specimens, including both pregnant and pre-ovulatory (260 to 280 cm) (**Figure 1**). No females were found within the 30-cm gap, from 180 to 210 cm, which separates immature from maturing specimens, suggesting the occurrence of a size segregation. A similar trend was also found for males, with no specimen measuring from 210cm to 234 cm TL, a 24 cm gap, which separates maturing specimens from the adults (**Figures 1 and 2**).

Litter size in the 10 pregnant females varied from 4 to 15 embryos, with a sex ratio (male: female) of 1: 1.17. Only one female, caught in October, was in early gestation, with embryos measuring from 12.5 to 15.0 cm TL. In other 5 pregnant females, embryos ranged roughly from about 35 to 50 cm, being thus in mid-term, since size at birth is about 75 cm (Compagno, 1984; Springer, 1960). In the remaining 4 pregnant specimens, however, the embryo size was not recorded. Embryos collected by the fishermen during January and February, ranged from 11.0 to 77.5 cm, although no information on the mother was provided. Such a wide range of embryo size in similar periods of the year suggests that silky sharks might not have a marked seasonal gestation cycle, as already reported by several authors (Strasburg, 1958; Bane, 1966; Bass *et al.*, 1973). This seems to be supported by the monthly distribution of female sexual stages, since all stages seem to be indistinctively present throughout the year (**Figure 3**). This differs from Branstetter (1987), however, who suggested a seasonal gestation period for the species in the Gulf of Mexico. The much narrower seasonal amplitude of sea surface temperature close to the equator, in the present case, when compared to the Gulf of Mexico, above of 20°N of latitude, may account for such a difference.

4. Acknowledgements

The present work was made possible by funding from the Secretaria Especial de Aquicultura e Pesca da Presidência da República do Brasil.

References

- BANE, G.W. 1966. Observations on the silky shark, *Carcharhinus falciformis*, in the Gulf of Guinea. *Copeia* 1966: 354-356.
- BASS, A.J., J.D. D'Aubrey & N. Kistnasamy. 1973. Sharks of the east coast of southern Africa. I. The genus *Carcharhinus* (Carcharhinidae). *Oceanogr. Res. Int.* (Durban). Invest Rep. 33. 168 pp.
- BIGELOW H.B. and W.C. Schroeder. 1948. Fishes of the western North Atlantic-Part 1. Sears Found. Mar. Res. Yale Univ. Mem., 1, 59-546.
- BRANSTETTER, S. 1987. Age, growth and reproductive biology of the silk shark, *Carcharhinus falciformis*, and the scalloped hammerhead, *Sphyrna lewini*, from the northwestern Gulf of Mexico. *Environmental Biology of Fishes* Vol. 19, No. 3, pp. 161-173.
- COMPAGNO, L.J. 1984. FAO Species Catalogue, Vol. 4, Parts 1 and 2. Sharks of the World. An annotated and illustrated catalogue of shark species known to date. FAO Fish. Synop., (125) Vol. 4, 655 pp.
- GADIG, O.B.F. 1994. Fauna de tubarões da costa/nordeste do Brasil (Chondrichthyes: Elasmobranchii). Dissertação de Mestrado, não publicada, Universidade Federal da Paraíba, João Pessoa, XIX + 230 p.
- HAZIN, Fábio H.V., Couto, A. Alceu A., Kohei Kihara, Kazuyuki Otsuka, and Makoto Ishino. 1990. Distribution and abundance of pelagic sharks in the southwestern equatorial Atlantic. *J. Tokyo Univ. Fish.*, 77(1):51-64.
- STRASBURG, D.W. 1958. Distribution, abundance, and habits of pelagic sharks in the central Pacific Ocean. *U.S. Fish Bull.* 58: 335-361.

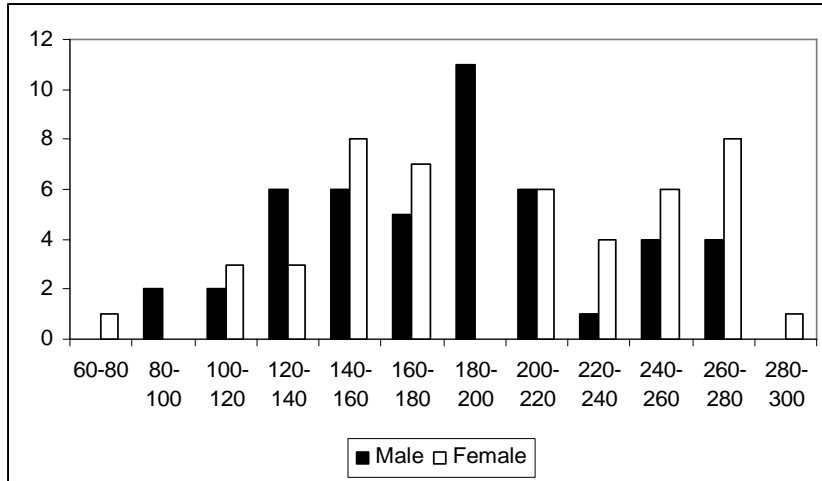


Figure 1. Length-frequency distribution of male (n= 48) and female (n=48) silky sharks caught in the equatorial Atlantic, in the vicinity of the Archipelago of Saint Peter and Saint Paul.

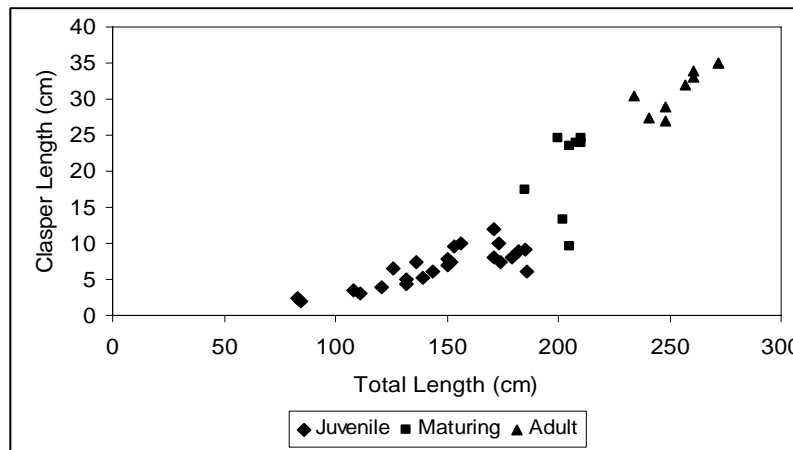


Figure 2. Relationship between total length and clasper length, in male silky sharks caught in the equatorial Atlantic, in the vicinity of the Archipelago of Saint Peter and Saint Paul.

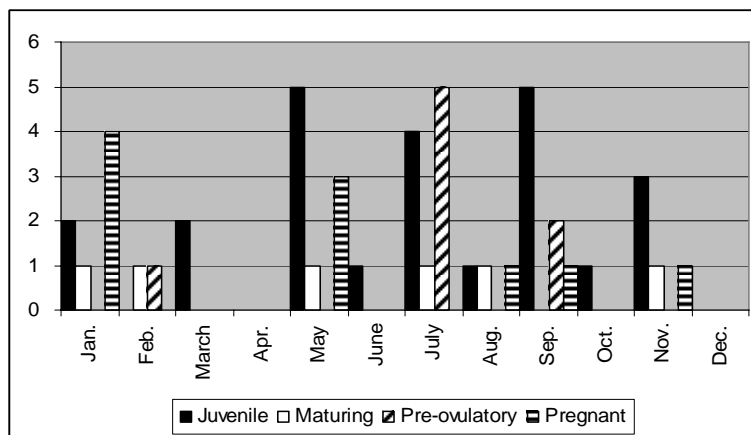


Figure 3. Monthly frequency distribution of sexual stages of female silky sharks caught in the equatorial Atlantic, in the vicinity of the Archipelago of Saint Peter and Saint Paul.