

DISTRIBUTION AND REPRODUCTIVE BIOLOGY OF THE  
STRIPED SMOOTH-HOUND *Mustelus fasciatus* (GARMAN, 1913)  
(CARCHARHINIFORMES, TRIAKIDAE)

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The distribution and reproductive biology of the striped smooth-hound *Mustelus fasciatus* were investigated, based on a review of the literature, 52 specimens stored in museum collections, and the analysis of 109 specimens collected between January 1988 and November 1992, all on the coast of Rio Grande do Sul, southern Brazil (n=161). Maturity is reached at approximately 111.5 cm TL for females, and approximately 119 cm TL for males. The size at birth is about 35 cm TL and gestation lasts around 11-12 months, with parturition occurring between October and November. Viviparous, with a yolk-sac placenta, fecundity varies from 6 to 12, increasing with female size. This endangered coastal species declined dramatically throughout the 1980s and early 1990s due to over fishing, together with its small horizontal and vertical distribution, between the State of Rio Grande do Sul (Brazil) and the Province of Buenos Aires (Argentina), 29° to 39°S, and from 1 to 250 m in depth. The analysis of stomach contents of 17 specimens showed that it feeds mainly on crustaceans.

A distribuição e biologia reprodutiva do tubarão-malhado *Mustelus fasciatus* foram estudadas com base na revisão da literatura e de 52 espécimes de coleções de museus, assim como na análise de 109 espécimes coletados entre janeiro de 1988 e novembro de 1992, na costa do Rio Grande do Sul, sul do Brasil (n=161). A maturidade é alcançada aproximadamente aos 111,5 cm CT, para fêmeas, e aproximadamente aos 119 cm CT, para machos. O tamanho de nascimento é de cerca de 35 cm CT e a gestação dura 11-12 meses, com partos ocorrendo entre outubro e novembro. Vivípara placentária, a fecundidade varia entre 6 e 12, aumentando com o tamanho da fêmea. Esta espécie costeira ameaçada declinou dramaticamente durante os anos 80 e meados dos anos 90, devido a sobrepesca, associada com a pequena distribuição horizontal e vertical, entre o Estado do Rio Grande do Sul (Brasil) e a Província de Buenos Aires (Argentina), 29° a 39°S, e entre 1 e 250 m de profundidade. A análise do conteúdo estomacal de 17 espécimes indicou a preferência por crustáceos.

The striped smooth-hound *Mustelus fasciatus* (Garman, 1913) has a very restricted coastal distribution, occurring between the northern coast of the State of Rio Grande do Sul, Brazil (Soto, 2001) and the southern coast of the Province of Buenos Aires, Argentina (López-Casorla & Menni, 1983). The first recorded adult specimen was collected in Uruguayan waters (Sadowsky, 1977), and later, a few adult specimens were cited from Uruguay (Carrera, 1991), and the southern (Vooren, 1992) and northern (Soto, 2001) coasts of the State of Rio Grande do Sul, Brazil.

The most distinctive feature of *M. fasciatus* is the absence of cusps on the teeth (adults) (Fig. 1), and its color pattern, characterized by stripes and saddles on the dorsolateral surface (juveniles) (Fig. 2) (Bigelow & Schroeder, 1948; Compagno, 1984b). Common in the early 1970's and 1980's, the species is currently rare in

the distribution limits and sporadic in the area of major concentration. Vooren (1992) found that only 1 or 2 specimens are caught per otter trawler off the coast of Rio Grande do Sul.

The only specific reference to reproductive aspects of *M. fasciatus* was published in abstract form by Vasconcellos & Vooren (1991). Bigelow & Schroeder (1948) suggest that maturity is not reached until it reaches a length of perhaps 90 to 100 cm, or about the same size as in *M. canis*. Compagno (1984b) stated that it is live-bearing, but the mode of reproduction is unknown, with size at maturity for males above 62 cm and size at birth at or below about 39 cm. Vooren (1992) affirms that this species has a placenta and mentions a female measuring 155 cm. Heemstra (1997) mentions that the largest specimen (male) he examined was 62 cm, still with undeveloped claspers, and that the umbilical scar

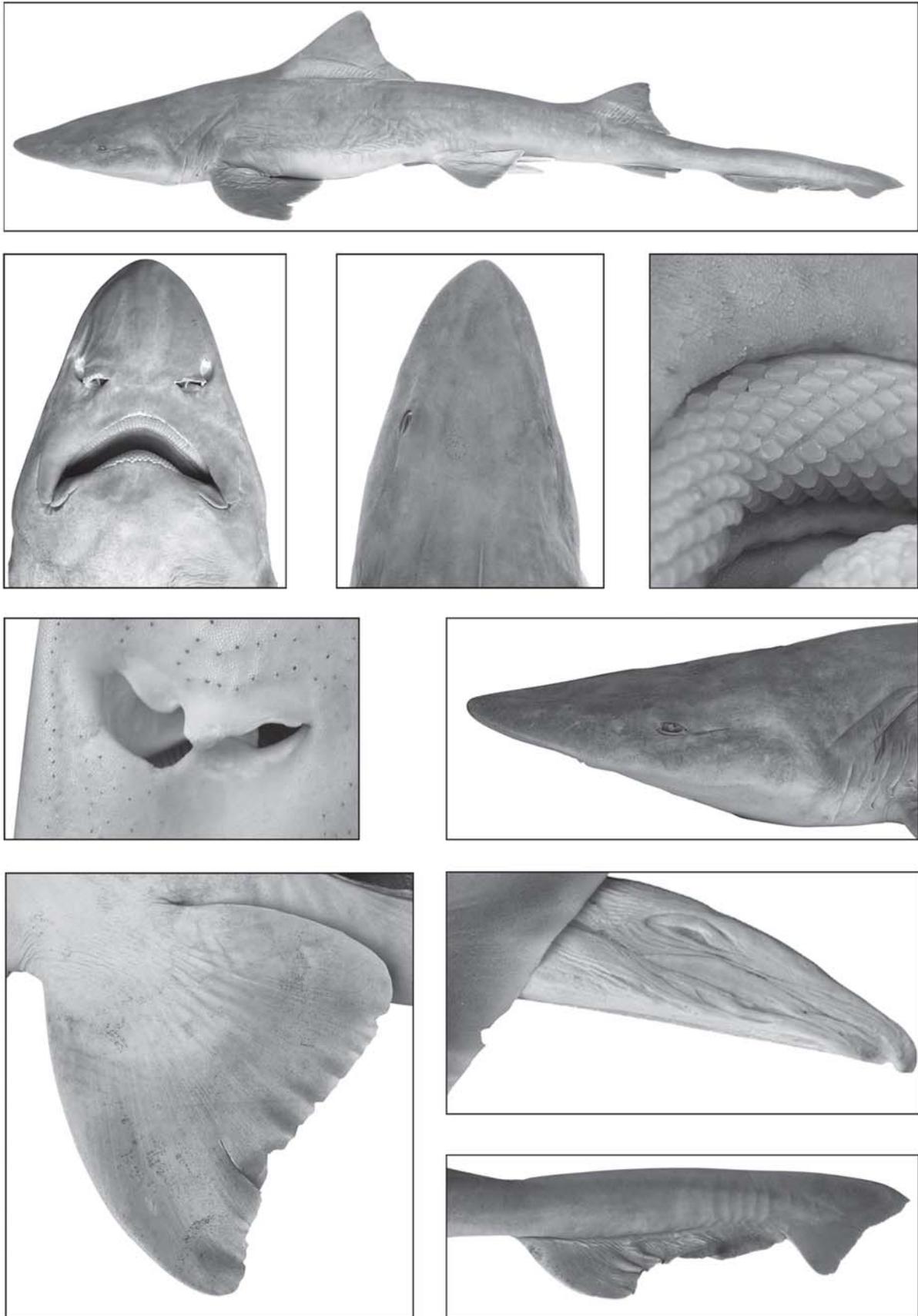


Figure 1 . *Mustelus fasciatus*, MOVI 08804, adult male 1350 mm TL, captured at Rio Grande do Sul, Brazil. Left to right and upper to lower: lateral view; ventral and dorsal view of head; teeth; nostril; lateral view of head; ventral view of pectoral fin; right clasper; and caudal fin.



Figure 2. *Mustelus fasciatus*, MOVI 05445, juvenile male, 419 mm TL, captured at Rio Grande do Sul, Brazil.

had not yet completely healed in a 39 cm specimen. The evident decline due to over fishing, associated with the small distribution, justified further studies on the biology and reproduction of this species, based solely on specimens sporadically collected and/or stored in museums.

#### MATERIAL AND METHODS

The specimens of *M. fasciatus* were sporadically collected by local fisherman, on the beaches, and by small fishing vessels equipped with a gillnets and trawlers, operating on the continental shelf and upper slopes of the southern Brazilian coast, at a depth of between 1 and 250 m. The area studied ranged from approximately 29°30'S to 34°00'S and 49°30'W to 53°30'W.

The sample consisted of 109 specimens, collected in the Imbé Harbor between January 1988 and November 1992, and 52 specimens stored in museums, all collected from the coast of Rio Grande do Sul, in southern Brazil (Tab. 1). The total sample consisted of 161 specimens measuring between 18.4 and 148.5 cm TL (Fig. 3).

Institutions: Fundação Universidade Federal do Rio Grande, FURG (Rio Grande, Rio Grande do Sul); Museu Oceanográfico do Vale do Itajaí, MOVI (Itajaí, Santa Catarina); Museu de Ciência e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, MCT (Porto Alegre, Rio Grande do Sul); and the Museum of Comparative Zoology, Harvard University, MCZ (Cambridge, United States).

The measurements are in accordance with Compagno (1984a) and the parameters used to determine the stages of development were: neonate - umbilicus not totally closed; juvenile - umbilicus totally closed but sexually immature; adult - claspers rigid (calcified) and sperm found in the seminal vesicles (males), or large yolk follicles present in ovary and/or embryos present in uterus (female).

The identification and taxonomic list of prey items is in accordance with Rios (1994), for mollusks, Pérez-Farfante (1969) and Melo (1996, 1999), for crustaceans, and Figueiredo & Menezes (1978, 2000), for fish. The percentage of frequency occurrence  $[F=(n_i/n_t) \times 100]$  and percentage of empty stomachs  $[E=(n_e/n_t) \times 100]$  is in accordance with Hyslop (1980).

Table 1. Specimens of *Mustelus fasciatus* used in the study, all collected in Rio Grande do Sul, Brazil.

Institution	Development Stage				Sex			Total	Observation
	E	N	J	A	M	F	I		
MOVI	2	10	14	4	16	13	1	30	Collected between 1987 and 1997 Collected in the 1980's
FURG			8	1	6	3		9	
MCP			11		8	3		11	Collected between 1969 and 1973
MCZ			2		1	1		2	Collected in Thayer Expedition (types)
Field	71		17	21	15	23	71	109	Collected between 1988 and 1992
Total	73	10	52	26	46	43	72	161	

Abbreviations: E - embryo; N - neonate; J - juvenile; A - adult; M - male; F - female; I - indeterminate.

**RESULTS AND DISCUSSION**

The distribution and records of *M. fasciatus* on the Brazilian coast are restricted to the State of Rio Grande do Sul (Soto, 2001). This species is cited in the Uruguayan waters (Carrera, 1991) and in the Province of Buenos Aires, Argentina (Menni *et al.*, 1984), off the Mar del Plata (López-Casorla & Menni, 1983) and off the Bahia Blanca, which is probably the southernmost limit of distribution of the species. The general distribution occurs in the area 29°S to 39°S (Fig. 4). *Mustelus fasciatus* is a demersal shark which inhabits continental shelves and upper slopes, at depths of between 1 and 250 m. Neonates are typically found on beaches of between 1 and 5 m in depth, juveniles are found in inshore waters at between 15 and 50 m, and adults are found down to 50 m and on upper slopes of up to 250 m in depth.

The species is viviparous, with a yolk-sac placenta; females have an 11-12 month gestation with parturition occurring between September and October (and probably November too), ovulation occurring between October and January, probably in late November and early December, and mating occurring between October and March (Fig. 5). Fecundity ranges from 6 to 12 pups, and is related to the length of the female, with a mean of 7.88 pups (Fig. 6). Sperm was found in the terminal zone of the oviducal gland of all adult females. Males matured at 119 cm TL and the inner length of the clasper was plotted against the total length, to determine size at maturity (Fig. 7). The distribution of bathymetrical size classes indicates that *M. fasciatus* migrates to the beaches to give birth, for the shortest length of time possible.

The occurrence of pups in the area of major incidence, indicate that the area from Cassino Beach to Chuí (32°10'S to 33°44'S) marks the important nursery area for this species. The sea-bed of these beaches consists mainly of sand and mud with a significant

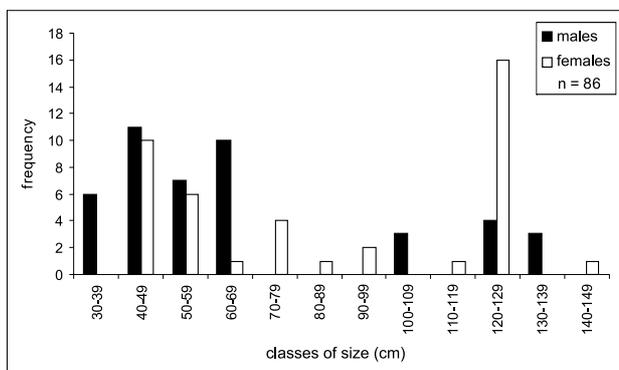


Figure 3. Frequency of total length (TL) by sex of *Mustelus fasciatus* used in the study (embryos not included).

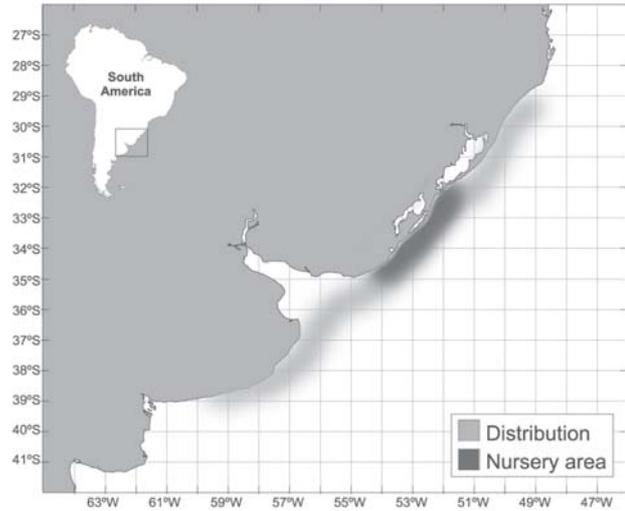


Figure 4. Distribution of *Mustelus fasciatus* with nursery area in southern Rio Grande do Sul and northern Uruguay.

number of associated crustaceans. Trawlers and gillnet fishing along this coast, including the intertidal and surf zones, are common and are placing constant pressure on the species (Vooren, 1992; Soto, 2001).

The stomach contents of 17 specimens, 2 adults and 15 juveniles, collected off the “Parcel da Solidão”, on the central coast of Rio Grande do Sul, consisted of at least 10 different prey items, with a predominance of the box crab *Hepatus pudibundus* (F=52.9%). Three stomachs analyzed were empty (E=17.6% - all juvenile). Crustaceans were the most abundant prey group with 82.4% of stomachs analyzed. Mollusks and fish were present in low numbers, 5.9% and 11.8%, respectively (Tab. 2).

The results obtained in this work were partially limited by the inconsistency of the sample in relation to the size of the specimens analyzed. The only reproductive data on the species was published in abstract form by Vasconcellos & Vooren (1991), based on 215 specimens

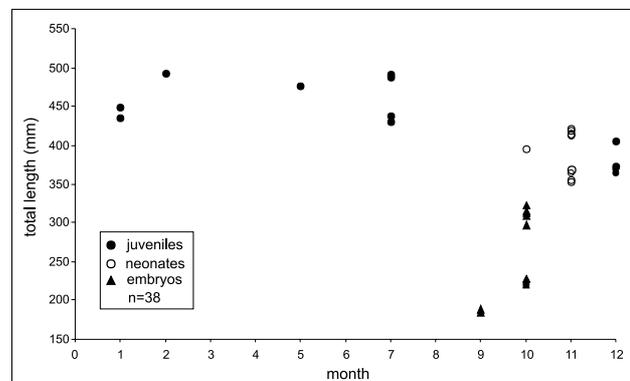


Figure 5. Relationship between month of capture and total length (TL) of embryos, neonates and juveniles to 500 mm of *Mustelus fasciatus*.

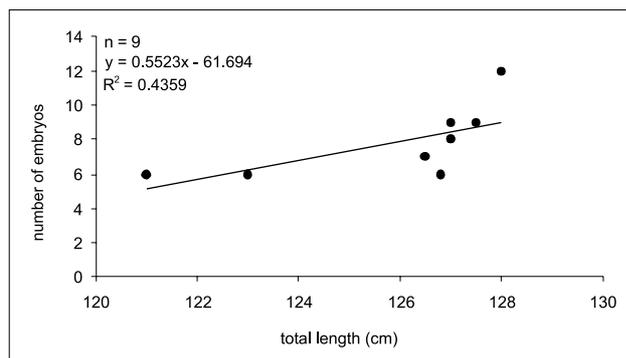


Figure 6. Relationship between fecundity (number of embryos) and total length (TL) of *Mustelus fasciatus*.

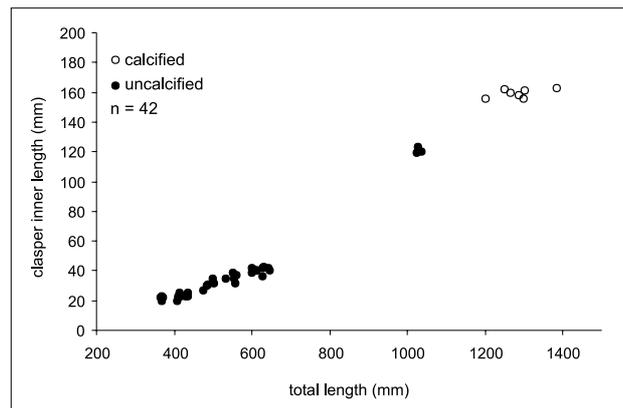


Figure 7. Relationship between clasper inner length (CLI) and total length (TL) of *Mustelus fasciatus*.

(89 males and 126 females) collected by trawlers (10-100 m), between 1980 and 1984, also in Rio Grande do Sul. In this reference, males matured at 130 cm and females at 135 cm, with parturition occurring in November. Fecundity ranged from 4 to 14 pups, with a mean of 8, and was not related to the length of female.

Carrera (1991) mentions a female specimen (98 cm CT) with 6 embryos of 20 cm CT, collected on the

Uruguayan coast in April 1974, but this does not agree with the data obtained by Vasconcellos & Vooren (1991) and the present work. However, the occurrence of juveniles with same size class between the months of January and July (Fig. 4) partly confirms that there may exist delays in birth.

*Mustelus fasciatus* is sympatric with *M. canis* and

Table 2. Stomach contents, in percentage of frequency occurrence, of 2 adults and 15 juveniles (3 empty) of *Mustelus fasciatus* collected in "Parcel da Solidão", Rio Grande do Sul, southern Brazil.

Prey items	F(%)		
	juvenile	adult	total
Mollusca			
Gastropoda			
Neogastropoda			
Olividae			
<i>Olivancillaria deshayesiana</i> (Duclos, 1857)	11.8		11.8
Crustacea			
Decapoda			
Penaeidea			
Penaeidae			
<i>Farfantepenaeus paulensis</i> (Pérez-Farfante, 1967)	17.6		17.6
Anomura			
Diogenidae			
<i>Dardanus insignis</i> (de Saussure, 1858)	5.9		5.9
<i>Loxopagurus loxocheles</i> (Moreira, 1901)	11.8		11.8
Brachyura			
Calappidae			
<i>Hepatus pudibundus</i> (Herbst, 1785)	41.1	11.8	52.9
Leucosiidae			
<i>Persephona mediterranea</i> (Herbst, 1794)	17.6		17.6
Majidae			
<i>Libinia spinosa</i> H. Milne Edwards, 1834		5.9	5.9
Portunidae			
<i>Callinectes sapidus</i> Rathbun, 1896	17.6		17.6
Pisces			
Osteichthyes			
Batrachoidiformes			
Batrachoididae			
<i>Porichthys porosissimus</i> (Valenciennes, 1837)	5.9		5.9
Pleuronectiformes			
Paralichthyidae			
<i>Paralichthys</i> sp.	5.9		5.9

*M. schmitti*, but appears to be endemic to the “Mouth of the Plata Region”, with a concentration area non larger than 600 km, at depths of between 1 and 250 m which, associated with the decline observed in the fishing harbors, makes this species one of the most threatened sharks in the world.

#### ACKNOWLEDGEMENTS

I would like to thank Rodrigo C. P. Beheregaray, Simone S. Vega and Walter de Nisa e Castro Neto, for their collaborations in my initial studies on this species in the harbor of Imbé. My thanks also to Carolus M. Vooren (FURG) and Carlos A. Lucena (MCT/PUCRS) for loaning several specimens, and Michael Maia Mincarone, Raphael Dias Neves and Rafael de Alcantara Brandi for their curatorial assistance.

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Date submitted: February 13, 2001

Date accepted: May 11, 2001