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Taxonomic comments and an identification key to species for the Smooth-hound sharks genus *Mustelus* Link, 1790 (Chondrichthyes: Triakidae) from the Western South Atlantic

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Abstract. Five species of smooth-hound sharks genus *Mustelus* (Family Triakidae) are know in the western South Atlantic, as follows: *Mustelus canis* (Mitchell 1815); *Mustelus fasciatus* (Garman 1913); *Mustelus higmani* Springer & Lowe 1963; *Mustelus norrisi* Springer 1939; and *Mustelus schmitti* Springer 1939. In the present paper, new data on the anatomy, morphometrics and meristic characters are given. Taxonomic aspects and comparison between the species are discussed. Most general body morphologic measurements and proportions are useless as a tool for species identification, since many of them show remarkable intraspecific variations. Head proportions and structures related seem to be a more adequate procedure to identify the species of *Mustelus*. The labial folds proportions, internasal distance and orbit diameter were the most useful character to separate the western South Atlantic species. The buccopharingeal pattern of denticles as well as tooth counts not was useful to distinguish the *Mustelus* species from western South Atlantic adequately, due great intraspecific variation.

Key words: Taxonomy, smooth dogfish shark, distribution, morphology, Brazil.

Resumo. Comentários sobre a taxonomia e chave de identificação para espécies de tubarões do gênero *Mustelus* Link 1790 (Chondrichthyes: Triakidae) do Atlântico Sul Ocidental. São conhecidas cinco espécies de tubarões do gênero *Mustelus* (família Triakidae) no Atlântico Sul Ocidental, a saber: *Mustelus canis* (Mitchell 1815); *Mustelus fasciatus* (Garman 1913); *Mustelus higmani* Springer & Lowe 1963; *Mustelus norrisi* Springer 1939 e *Mustelus schmitti* Springer 1939. Novos dados sobre anatomia, morfometria e meristicos são aqui apresentados. Aspectos taxonômicos e comparações entre as espécies são discutidos. A maioria das medidas corporais e proporções usualmente empregadas se mostraram ineficazes como ferramenta para identificação das espécies, uma vez que exibem grande variação intra-específica. Proporções da cabeça e estruturas associadas são mais adequadas para a separação das espécies de *Mustelus*. A proporção dos sulcos labiais, a distância internasal e o diâmetro da órbita foram os caracteres mais eficientes para a separação das espécies do Atlântico Sul ocidental. O padrão dos dentículos bucofaringeanos, bem como a contagem de dentes não foram adequados para distinção das espécies, em função da grande variação intra-específica..

Palavras chave: Taxonomia, cação-canejo, distribuição, morfologia, Brasil.

Introduction

Smooth-hound sharks genus *Mustelus* are one of the most numerous elasmobranch genera and also one of the most troublesome groups concerning taxonomic aspects. *Mustelus* species are usually difficult to separate from one another due to their conservative morphology and to the highly variable meristic characters usually used to distinguish species (Compagno 1984, 1988).

There are about 30 described species around the world (Compagno 1999, Pérez-Jiménez *et al.* 2005, White & Last 2006, 2008). *Mustelus* species are small demersal species of about 1500 mm total length, inhabiting the continental shelves of

temperate to tropical waters, from shallow waters to about 500 m deep. They are usually found over rocks, mud and sandy bottoms, including estuaries where they are able to stand low salinity values. There are no *Mustelus* species with oceanic habits. Reproductive modes include both placental and yolk-sac viviparity (Compagno 1984).

The taxonomic problems have not been adequately solved in the western South Atlantic where at least five species are recognized: *M. canis* (Mitchell 1815); *M. fasciatus* (Garman 1913); *M. higmani* Springer and Lowe 1963; *M. norrisi* Springer 1939; *M. schmitti* Springer 1939 (Figueiredo 1977, Heemstra 1997, Gadig 2001), all of them occurring in the Brazilian waters.

Smooth-hound sharks represent an important fishery resource, mainly in southern Brazil (Vooren & Klippel 2005) and Venezuela (Cervigón & Alcala 1999, Tavares 2005). All western South Atlantic species are in the IUCN Red List. *Mustelus canis* appears as near threatened (Conrath 2005), *M. fasciatus* as critically endangered (Hozbor *et al.* 2004), *M. higmani* as least concern (Faria & Furtado 2006), *M. norrisi* with data deficient (Jones *et al.* 2008), and *M. schmitti* as endangered (Massa *et al.* 2006). Although all these species are under strong fishing pressure, no effective fisheries management was have been adopted to minimize such impact over exploited populations.

Species from the western Atlantic have been little studied. Springer (1939) firstly provided a key to species identification, providing the description of two species. Bigelow & Schroeder (1940, 1948) for the western North Atlantic and Heemstra (1997) for the western Atlantic and world ocean also dealt with *Mustelus* species with data from the unpublished Master and Doctorate theses of the latter. Studies (see also Heemstra 1969, 1973). In these published data the author described two new species (*Mustelus minicanis* Heemstra 1997 and *Mustelus sinusmexicanus* Heemstra 1997, both from the western North Atlantic) and one subspecies (*Mustelus canis insularis* Heemstra 1997, western North Atlantic). However, he examined just a few specimens from the western South Atlantic deposited in US ichthyological collections. Additionally, Compagno (1984) presented a key to identification of the all known extant *Mustelus* to date, compiled most from published studies. The specimens restricted to the western South Atlantic were listed by Figueiredo (1977), Gadig (2001), and Gadig & Gomes (2003) but all studies dealt with limited data sets or regional characteristics.

Field identification of the western South Atlantic *Mustelus* species is still problematic due to the presence of few specimens in scientific collections, and to the difficulty in keeping large specimens, leading to a lack of ontogenetic comparative observations to be used in the species diagnosis as well as in keys to identification.

In this study we propose a key for identification of *Mustelus* species recorded in the western South Atlantic, based in specimens herein examined. New data on morphological and morphometrics are also presented and regarded here as useful in the species identification.

Materials and Methods

This paper considers all the *Mustelus* species known to occur in the Brazilian coast. Geographic areas herein adopted are according to Gadig (2001) which considers the following: North (Amapá to western Maranhão State coast), Northeast (eastern Maranhão coast to Salvador, central Bahia State), Central coast (southward Salvador to North Rio de Janeiro coast), Southeast (North Rio de Janeiro to Cabo de Santa Marta, Santa Catarina State) and South coast (Cabo de Santa Marta to Rio Grande do Sul state, extreme south Brazil).

Morphometrics and nomenclature followed mainly Heemstra (1997). Measurements were expressed as percentage of total length (TL, in mm) and were taken from preserved specimens from the main ichthyological collections both in Brazil and in the United States Museums, where specimens from western South Atlantic are deposited.

Institutional acronyms followed Leviton *et al.* (1985). Additional institutional abbreviations are: CUNESP-CLP (Universidade Estadual Paulista, Campus Experimental do Litoral Paulista, São Paulo, Brazil); NUPEC (Núcleo de Pesquisa em Elasmobrânquios, Santos, São Paulo, Brazil), GEES (Grupo de Estudo de Elasmobrânquios de Sergipe, Aracajú, Sergipe, Brazil), MZUSP (Museu de Zoologia da Universidade de São Paulo), C.DBAV-UERJ (Departamento de Biologia Animal e Vegetal da Universidade do Estado do Rio de Janeiro) and MOVI (Museu Oceanográfico da Univali, Camburiú, Santa Catarina, Brazil); MNRJ (Museu Nacional do Rio de Janeiro; REVIZEE (Recursos Vivos da Zona Econômica Exclusiva - Living Resources of the Exclusive Economic Zone, Brazilian Federal Program).

Tooth rows counts were taken in approximately transverse lines to the anteroposterior longitudinal jaw axis, and include functional and replacement teeth. Tooth rows of juvenile specimens were not counted due to their undefined pattern and, thus, were given as a ratio of the number of rows in the upper and lower jaws. The tooth shape of upper

and lower jaws were recorded, although comparisons of tooth morphology were based only on the upper jaws, following Compagno (1988) and Heemstra (1997).

Dermal denticles were analyzed from the flank area below the first dorsal fin, at a midpoint between its origin and rear base, and their individual shape and number of ridges recorded.

The buccopharingeal pattern of denticles, a character proposed by Heemstra (1997), was herein analyzed, but was not regarded as useful to distinguish *Mustelus* species from western South Atlantic, and therefore were not included in the species diagnosis and description.

Results

Morphometric measurements for the five species occurring in Brazilian waters, *i.e*., *Mustelus canis*, *M. fasciatus*, *M. higmani*, *M. norrisi*, and *M. schmitti*, expressed as percentage of the TL are presented in Table I. A diagnostic and general morphological description, biological summary and data on the geographic distribution for each species account are presented below.

***Mustelus canis* (Mitchill, 1815)** (Fig. 1)

Squalus canis Mitchill 1815. Trans.Lit.Philos.Soc.New York, Holotype not preserved. Type locality: New York, USA.

Large species, measuring about 1500 mm TL; body depth 6.9 - 13.4% TL and width 9.6 - 11.4% TL with snout moderately long, preoral length 3.9 - 7.8% TL; head short, prepectoral distance 17.8 - 23.8% TL; eye large, orbit diameter 2.4 - 4.1% TL; interorbital distance 3.4 - 7.5% TL; internasal distance 0.7 - 4.1% TL; upper-jaw labial fold more longer than lower-jaw labial about (0.7% TL); upper labial fold 1.3 - 2.6% TL and lower labial fold 0.9 - 1.7% TL; mouth width 4.9 - 7.1% TL and depth 2.1 a 4.4% TL. Pectoral and pelvic margins concave, dorsal fins relatively short with large base; caudal fin with well defined ventral lobe, smaller and pointed in juveniles, ventral caudal fin lobe angle 110° to 130°, higher and rounded in adults, ventral caudal fin lobe angle 89° to 110°. Juveniles have teeth with a lot of basal ridges, low rounded cusp detached of base, with two accessory cusplets on both sides of mid cusp; adults with pavement-like and asymmetric teeth, with low rounded cusps lacking basal ridges; 64 – 74 tooth rows in the upper jaw and 58 – 75 in the lower jaw. Dermal denticles of mid-lateral flank lanceolate, with four ridges, two major in the center that reach the posterior margin of scale and two smaller, on both sides, reaching the middle of the scale.

Body color in juveniles and newborns light grey, adults brownish with ventral surface light; specimens from deeper waters or shadowed environments, as well as large adults (larger than 1000 mm TL) are more dark-brownish; specimens caught in deep water from the Southeast and South Brazilian coast shows dorsal surface and dorsal fins remarkably dark-brown coloration (Vianna *et al*. 2000); the species displays ontogenetic color variation, newborn and juveniles are light brown or grey with the apex and posterior margin of dorsal and pectoral fins with narrow light belt, disappearing in adults.

The known geographic distribution is restricted to western Atlantic, from Florida (USA) to Argentina. Found in subtropical and temperate coastal shelves, from very shallow waters to about 480 m deep (Bigelow & Schroeder 1948, Figueiredo 1977, Gadig 2001).

Figure 1. *Mustelus canis*, about 1000 mm TL adult male, Espírito Santo Coast, Central Brazil coast (Photo: Otto B. F. Gadig)

Material examined. CAS-SU 1474, Gulf do Mexico, Florida; USA; CAS-SU 52725 (MNRJ 6483), 680 mm, Baia de Guanabara, Rio de Janeiro; MZUSP 9969, male 425 mm, Rio Grande do Sul; MZUSP 37307, male 310 mm, Rio Grande do Sul; MZUSP 37308, male 820 mm, Rio Grande do Sul; GEES 0011751, male 804 mm, Aracajú, Sergipe; C.UNESP.CLP (three uncatalogued), female 940 mm and two male 691 mm; REVIZEE 0009505, male 787 mm, Central Brazil; REVIZEE 00110772, female 522 mm, Central Brazil; REVIZEE 0010426, male 728 mm, Central Brazil; NUPEC 1874, female 340 mm; NUPEC 1875, male 332 mm, NUPEC 1875, male 332 mm; NUPEC 1912, male 775 mm, Southeast Brazil; NUPEC 1913, male, Southeast Brazil; NUPEC 1914, male 704 mm, Southeast Brazil; NUPEC 1915, female 675 mm, Southeast Brazil; NUPEC 1916, female 1103 mm, Southeast Brazil; NUPEC 1917, male 704 mm, Southeast Brazil; NUPEC 1918, female 658 mm, Southeast Brazil; NUPEC 1919, male 817 mm, Southeast Brazil; NUPEC 1920, female 860 mm, Southeast Brazil; NUPEC 1921, male 739 mm, Southeast Brazil; NUPEC 1922, male 670 mm, Southeast Brazil; NUPEC 1923, male 737 mm, Southeast Brazil; NUPEC 1924, male 776 mm, Southeast Brazil; NUPEC 1925, male 746 mm, Southeast Brazil; NUPEC 1926, female 800 mm, Southeast Brazil; NUPEC 1927, male 822 mm, Southeast Brazil; NUPEC 1928, male 752 mm, Southeast Brazil; NUPEC 1929, male 741 mm, Southeast Brazil; NUPEC 1932, female 694 mm, Southeast Brazil; NUPEC 1933, male 690 mm, Southeast Brazil; NUPEC 1935, male 758 mm, Southeast Brazil; NUPEC 1936, male 730 mm, Southeast Brazil; NUPEC 1937, male 850 mm, Southeast Brazil; NUPEC 1938, male 747 mm, Southeast Brazil; NUPEC 1939, female 740 mm, Southeast Brazil; NUPEC 1940, male 750 mm, Southeast Brazil; NUPEC 1941, male 700 mm, Southeast Brazil; NUPEC 1942, male 710 mm, Southeast Brazil; NUPEC 1948, male 495 mm, Southeast Brazil; NUPEC 516, male 670 mm; NUPEC 461, male 713 mm; NUPEC 1959, male 738 mm, Southeast Brazil; NUPEC 1960, male 745 mm, Southeast Brazil; NUPEC 1961, female 830 mm, Southeast Brazil; NUPEC 1962, male 752 mm, Southeast Brazil; NUPEC 1963, male 736 mm, Southeast Brazil; NUPEC 1964, male 716 mm, Southeast Brazil; NUPEC 1965, male 811 mm, Southeast Brazil; NUPEC 1966, male 740 mm, Southeast Brazil; NUPEC 1967, male 650 mm, Southeast Brazil; NUPEC 1968, female 670 mm, Southeast Brazil; NUPEC 1969, male 725 mm, Southeast Brazil; NUPEC 1970, male 840 mm, Southeast Brazil; C.DBAV.UERJ 1818 (seven specimens from REVIZEE), five males (285 – 295 mm) and two females (290 and 292 mm); C.DBAV.UERJ 1815 (four specimens from REVIZEE), two males (272 and 290 mm) and two females (169 and 184 mm); C.DBAV.UERJ 1920 (three specimens), females (288 – 310 mm); C.DBAV.UERJ 1816 (nine specimens from REVIZEE), seven males (240 – 267mm) and two females (256 and 250 mm); C.DBAV.UERJ 650, male 606 mm, Rio de Janeiro; C.DBAV.UERJ 1817 (nine specimens from REVIZEE), two males (272 and 281 mm) and seven females (260 – 288 mm); C.DBAV.UERJ 360, male 630 mm, Itajaí, Santa Catarina; C.DBAV.UERJ 361, female 549 mm, Itajaí, Santa catarina; C.DBAV.UERJ 1904 (six embryos from REVIZEE), male 280 mm and five females (265 – 280 mm); C.DBAV.UERJ 1902 (six embryos from REVIZEE), males (175 – 190 mm); C.DBAV.UERJ 1903 (five embryos from REVIZEE), two males (249 and 255 mm) and three females (247 – 250 mm); C.DBAV.UERJ 1821, male 870 mm, REVIZEE; C.DBAV.UERJ 1823, female 715 mm, REVIZEE; C.DBAV.UERJ 1820, female 715 mm, REVIZEE; C.DBAV.UERJ 1824, male 680 mm, REVIZEE; C.DBAV.UERJ 1676, female 811 mm, REVIZEE; C.DBAV.UERJ 1675, male 854 mm, REVIZEE; C.DBAV.UERJ 1826, male 740 mm, REVIZEE; C.DBAV.UERJ 1822, male 860 mm, REVIZEE; C.DBAV.UERJ 1637, male 775 mm; C.DBAV.UERJ 1805, female 225 mm, REVIZEE; C.DBAV.UERJ 1825, male 755 mm, REVIZEE; C.DBAV.UERJ 1677, male 836 mm, REVIZEE. MOVI 00155, female 899 mm, Rio Grande do Sul; MOVI 00618 – 00630 (13 embryos), seven males (181 – 195 mm) and six females (186 – 206 mm), Rio Grande do Sul; MOVI 01560 – 01568 (nine embryos), five males (180 – 190 mm) and four females (175 – 191 mm), Rio Grande do Sul; MOVI 01569 – 01576 (eight embryos), six males (194 – 214 mm) and two females (211 – 212 mm), Rio Grande do Sul; MOVI 01577 – 01590 (14 embryos), eight males (189 – 199 mm) and six females (189 – 205 mm), Rio Grande do Sul; MOVI 01591 – 01599 (nine embryos), five males (170 – 179 mm) and four females (170 - 176 mm), Rio Grande do Sul; MOVI 01600 – 01605 (six embryos), male 219 mm and five females (217 – 220 mm), Rio Grande do Sul; MOVI 01606 – 01612 (seven embryos), four males (209 – 220 mm) and three females (216 – 223 mm), Rio Grande do Sul; MOVI 01613 – 01618 (six embryos), five males (172 – 177 mm) and female 175 mm, Rio Grande do Sul; MOVI 04890, male 868 mm, Santa Catarina; MOVI 08693, female 509 mm, Rio Grande do Sul; MOVI 08849, female 1100

mm, Rio Grande do Sul; MOVI 10124, male 876 mm, Rio Grande do Sul; MOVI 24701 – 24703, two males (305 and 310 mm) and female 34,6 mm, Amapá.

***Mustelus fasciatus* (Garman 1913)** (Fig. 2)

Galeorhinus fasciatus Garman 1913 [Mem. Mus. Comp. Zool. v. 36]. Holotype: MCZ 154, 607 mm TL, male. Type locality: Rio Grande do Sul, Brazil.

The largest western South Atlantic species, attaining 1550 mm TL; body depth, 8.9 - 12.6% TL and width 9.8 - 12.5% TL; snout and head long and broad, preoral distance 6.9 - 9.2% TL and prepectoral distance 19.5 - 24.5% TL; orbit diameter 1.3 - 3.3% TL; interorbital distance 4.5 - 6.3% TL; internasal distance 3.0 - 3.5% TL; upper labial fold (1.6 - 2.3% TL) longer than lower labial fold (1.3 - 1.8% TL); mouth width 6.1 - 7.3% TL and depth 2.4 - 4.0% TL. Pectoral and pelvic fins posterior margins nearly straight; dorsal fins short, rounded and broad with large base; caudal fin not well-developed with ventral lobe rounded and small. Hemispherical and uniform teeth, with low and rounded crown, lacking detached cusps; 65 tooth in the upper jaw and 55 to 58 in the lower jaw, both in juveniles and adults. Dermal denticles of middle-lateral flank lanceolate, with 2 to 4 low ridges or without ridges, when present, not reaching the posterior margin of denticles.

Dorsally grey or brownish, newborn and juveniles with transversal dark bars across dorsal surface and head, which tends to disappear in specimens larger than 800 mm TL. Adults are dark grey dorsally turning light grey at ventral surface.

Geographical distribution endemic to the western South Atlantic in South Brazil (Cabo de Santa Marta, Santa Catarina coast), Uruguay and Argentina. Occasional specimens can be found northward, in south São Paulo state, where were caught two specimens (male 1450 mm TL and female 1460 mm TL) in 1960´s (Figueiredo 1977, Gadig 2001).

Figure 2. *Mustelus fasciatus*, 407 mm TL juvenile female, Rio Grande do Sul coast, South Brazil (Photo: Otto Gadig)

Material examined. CAS-SU 52867 (two embryos), 370 and 390 mm, Uruguay; MZUSP 10596, male 385 mm, Tramandaí, Rio Grande do Sul; MZUSP 10597, female 405 mm, Tramandaí, Rio Grande do Sul; MZUSP 10598, male 393 mm, Tramandaí, Rio Grande do Sul; MZUSP 10599, female 407 mm, Tramandaí, Rio Grande do Sul; MZUSP 37309, female 400 mm, Tramandaí, Rio Grande do Sul; C.DBAV.UERJ 648 (three specimens), males (395 – 441 mm), Rio Grande do Sul; C.DBAV.UERJ 0243, male 397 mm, Capão da Canoa, Rio Grande do Sul; C.DBAV.UERJ 0292, male 452 mm, Rio Grande do Sul; MOVI 00120, female 488 mm, Rio Grande do Sul; MOVI 00143 – 00144 (two embryos), female 184 mm and male 188 mm, Rio Grande do Sul; MOVI 01149, female 573 mm, Rio Grande do Sul; MOVI 01150, female 578 mm, Rio Grande do Sul; MOVI 05442, 05444 – 05448 (six specimens), five males 369 – 416 mm and female 352 mm, Rio Grande do Sul; MOVI 08437, female 394 mm, Rio Grande do Sul; MOVI 08804, male 1350 mm, Rio Grande do Sul; MOVI 24669, female 762 mm, Rio Grande do Sul; MOVI 24670, male 644 mm, Rio Grande do Sul; MOVI 24671, male 553 mm, Rio Grande do Sul; MOVI 24672, male 414 mm, Rio Grande do Sul; MOVI

24673, female 305 mm, Rio Grande do Sul; MOVI 24674, male 561 mm, Rio Grande do Sul; MOVI 24675, male 483 mm, Rio Grande do Sul; MOVI 24676, male 487 mm, Rio Grande do Sul; MOVI 24677, female 496 mm, Rio Grande do Sul; MOVI 24678, female 502 mm, Rio Grande do Sul; MOVI 24711, female 452 mm, Rio Grande do Sul; MOVI 24886, female 342 mm, Rio Grande do Sul; MOVI 37639, male 452 mm, Rio Grande do Sul. CAS-SU 13432 (two specimens), 590 – 600 mm, Uruguai.

***Mustelus higmani* Springer & Lowe, 1963** (Fig. 3)

Mustelus higmani Springer & Lowe 1963. [Copeia 1963 (no. 2)]. Holotype: USNM 156930, 480 mm TL, male. Type locality: Northeast of Paramaribo, Suriname.

The smallest *Mustelus* from the western South Atlantic, measuring about 640 mm TL; body depth 7.9 - 12% TL and width 8.6 - 11.6% TL, snout long and pointed, preoral length 7.1 a 9.3% TL; head large, prepectoral distance 17.9 a 24.9% TL; orbit diameter 2.1 - 3.1% TL; interorbital distance 2.9 - 8.1% TL; internasal distance 2.7 - 3.8% TL; labial folds (0.8 - 1.8% TL) with length equal or nearly equal in upper and lower jaws; mouth width 5.7 - 6.8% (0.8 - 1.8% TL and depth 2.6 - 4.2% TL. Dorsal fins triangular and wide; pectorals fins short with posterior margin concave; caudal fin well developed with acute ventral lobe, ventral caudal fin angle 90° – 130°. Teeth morphology similar both in juveniles and adults, with asymmetric low rounded crown lacking detached cusps, with 8 to 15 basal ridges; 65 to 75 teeth in the upper jaw and 62 to 70 teeth in lower jaw. Dermal denticles tricuspidate, with four basal ridges reaching the posterior margin of denticles.

Live or fresh specimens have a distinctive golden-yellow body coloration and preserved specimens are light gray or light brownish, with ventral surface light, without marks, spots or bars. Springer and Lowe (1963) pointed that the golden-yellow color in *M. higmani* is an anomaly from British Guiana, but all specimens collected in North and Southeast Brazilian waters display this golden color pattern, such as reported by Heemstra (1997) for specimens from Central America.

Geographical distribution along the western South Atlantic, from Venezuela and Trinidad Tobago to Santos (Southeast Brazil), between 8 to 110 m deep. Most records from Brazilian coast are from North (Amapá and Pará States) and from Southeast (north Rio de Janeiro State) coasts, between 10 and 90 m deep (Figueiredo, 1977, Faria 2001, Gadig 1994, 2001).

Figure 3. *Mustelus higmani*, 459 mm TL adult male, north Rio de Janeiro coast, Southeast Brazil (Photo: Otto Gadig)

Material examined. USNM 156930 (Holotype), male 480 mm, Paramaribo,Suriname; MZUSP 3251 (two specimens), male 265 mm and female 245 mm, São Paulo; MZUSP 9972, male 550 mm, Rio Doce,Espírito Santo; MZUSP 37310, male 310 mm, southern São Paulo; MZUSP 37311 (two specimens), male (250 - 385 mm), Ilha Grande, Rio de Janeiro; MZUSP 37312, female 525 mm, Ilha de Alcatrazes, São Paulo; MZUSP 37329, male 352 mm, Southeast Brazil; MZUSP 37330, male 400 mm (misidentified as *M. canis*); NUPEC 266, female 266 mm, Baia do Cação, Espírito Santo; NUPEC 440, male 342 mm, Baia do Cação, Espírito Santo; NUPEC 1322, male 238 mm, Baia do Cação,

Espírito Santo; NUPEC 1320, male 375 mm, Santos, São Paulo; NUPEC 1319, female 398 mm, Santos, São Paulo; NUPEC 1323, female 237 mm, Baia do Cação, Espírito Santo; NUPEC1321, male 285 mm, Baia do Cação, Espírito Santo; NUPEC 700, male 240 mm, Baia do Cação, Espírito Santo; NUPEC 621, male 270 mm, Espírito Santo; C.DBAV.UERJ 444, male 459 mm, Macaé, Rio de Janeiro; MOVI 24132, male 478 mm, Bahia; MOVI 24697 – 24699 (three specimens), females (224 – 315 mm), Amapá; MOVI 37965, female 397 mm, Amapá.

***Mustelus norrisi* Springer 1939** (Fig. 4)

Mustelus norrisi Springer 1939 (Proc. U. S. Natl. Mus. v. 86). Holotype USNM 106639, 723 mm TL, male. Type locality: Florida, USA.

Large species, maximum size about 1150 mm TL; body depth 9 - 10.5% TL and width 8.5 - 9.4% TL; snout rounded and short, preoral distance 3.8 - 5.5% TL; prepectoral distance 16 - 18.4% TL; orbit diameter 2.3 - 2.8% TL; interorbital distance 4.0 - 6.4% TL; internasal distance 4.0 - 6.4% TL; upper and lower jaw labial fold equal or nearly equal in length, about 1 - 2.2% TL; mouth wide 4.5 - 6.0% TL and length 3.0 - 4.4% TL. Pectoral fins narrow, long and thin, with posterior margin falcate; first dorsal fin high, narrow and with short base (7,5 - 10% TL) and second dorsal fin high (6.0 a 7.5% TL); caudal fin well developed, with ventral lobe deeply falcate in juveniles and more straight in large adults (about 900 mm TL), ventral caudal fin lobe angle 69° to 101° with ventral tip more acute in juveniles than in adults. Juveniles with asymmetric teeth with rounded detached cusp, one or two accessory cusplets in both side of main cusp and lots of short basal ridges; adults with tooth crowns low and asymmetric with rounded cusp and basal ridges much less visible; 60 – 65 tooth rows in the upper-jaw and 55 – 60 in the lower jaw Dermal denticles of midlateral flank lanceolate, with four longitudinal ridges, the mid two reaching the rear margin of denticle.

Dorsally grey or brownish and ventrally light, with the apex of first dorsal fin and posterior margin of pectoral and dorsal fins with narrow white band, newborns and juveniles with dark spots or sooty smudges on the apex of second dorsal fin.

The known geographic distribution given to *M. norrisi* ranges from the west coast of Florida – USA, western Central America - Caribbean Sea (Colombia and Venezuela) to Southern Brazil, Cananéia – São Paulo State between shallow waters to about 400 m deep (Heemstra 1997, Gadig 2001, Costa *et al.* 2005, Meneses *et al.* 2005).

Figure 4. *Mustelus norrisi,* about 900 mm TL adult male, Espírito Santo Coast, Central Brazil (Photo Otto Gadig)

Material examined. USNM 106639 (Holotype), male 710 mm, Gulf of Mexico, Florida, U.S.A; REVIZEE 04, female 844 mm, Central Brazil; REVIZEE 0007184, female 869 mm, Central Brazil; USNM 317610 (Paratype), six embryos, New York, U.S.A (embryos from USNM 57369); USNM 104333 (Paratype), male 690 mm, Florida, U.S.A; USNM 116444, male 660 mm, Florida, U.S.A; USNM 201920, 790 mm, Venezuela; USNM 208075, male 788 mm, Venezuela; USNM 57369 (Paratype), female 820 mm, New York, U.S.A; CAS-SU 52724, male 410 mm, Recife, Pernambuco; CAS-SU 52866, male 490 mm, Recife, Pernambuco; C. UNESP. CLP (uncatalogued from REVIZEE) female 800 mm, Central Brazil; 006903, male 778 mm, Central Brazil; 0009736, female 869 mm, Central Brazil; 0011007, male 804 mm, Central Brazil; 006905, male 800 mm, Central Brazil;

C.DBAV.UERJ 1806, male 825 mm; C.DBAV.UERJ 1811 (four embryos), two males 202 and 201 mm and two females 210 and 208 mm, GEES 0057, female 907 mm, Aracajú, Sergipe;

***Mustelus schmitti* Springer, 1939** (Fig. 5)

Mustelus schmitti Springer 1939. [Proc. U. S. Natl. Mus. v. 86 (no. 3058)]. Holotype: USNM 106640, 742 mm TL, male. Type locality: Uruguay, western South Atlantic.

Medium size species, measuring up to about 750 mm TL; body flattened, depth 7.1 - 10.9% TL, and width 9.9 - 11.3% TL, preoral length 5.2 a 7.9% TL; rounded snout, prepectoral distance 16.8 - 20.9% TL; orbit diameter 2.1 - 3.8% TL; interorbital distance 4.4 - 7.9% TL; internasal distance short 1.7 - 3.2% TL; labial folds long, with upper much longer (1.6-2.5% TL) than lower (0.9-1.6% TL); mouth width 4.4 - 6.3% TL and depth 1.5 - 3.5% TL. The most distinctive character of *M. schmitti* is the naked posterior margin of dorsal fins with narrow dark band due to the exposed ceratotrichia, giving the frayed appearance, pectoral and pelvic posterior margins slightly concave and broad, dorsal fins with rounded apex and with ventral tip not acute. Teeth asymmetric with cusp low and rounded; 55 to 60 rows in the upper jaw and 52 to 55 in the lower jaw, both in juveniles and adults. Dermal denticles lanceolate, with 2 to 4 ridges reaching to the half of scale.

Coloration grey dorsally and light grey bellow, adults up to 620 mm of TL with light spots distributed on dorsal and head surface; posterior margin of dorsal fins with a dark band due to the exposed ceratotrichia extremities.

Mustelus schmitti is an endemic coastal species from the western South Atlantic coast, reported from from Rio de Janeiro, Brazil, to southern Patagonia, inhabiting depths from 20 and 160 m. (Figueiredo 1977, Vooren 1997, Chiaramonte & Pettovello 2000, Gadig 2001).

Figure 5. *Mustelus schmitti*, 356 mm TL juvenile male, Rio Grande do Sul coast, South Brazil (Photo: Otto Gadig)

Material examined. MZUSP 9970, female 435 mm, Rio Grande do Sul; MZUSP 9971, male 325 mm, Rio Grande do Sul; MZUSP 10608 (two specimens), females (465 - 492 mm), Rio Grande do Sul; MZUSP 13048 (four specimens), male 530 mm and three females (630 – 687 mm), São Paulo; MZUSP 37313 (two specimens), females (378 mm - 393 mm), Rio Grande do Sul; MZUSP 37314 (two specimens), male 350 mm and female 362 mm, Rio Grande do Sul; MZUSP 37315 (two specimens), males (535 - 545 mm), Rio de Janeiro; MZUSP 37316, male 282 mm, Rio Grande do Sul; 37317 (five specimens), three males (287 - 291 mm), Rio Grande do Sul; MZUSP 37318, female 420 mm, Rio Grande do Sul; MZUSP 37319 (five specimens), three males (300 – 360 mm) and two females (520 and 505 mm), Rio Grande do Sul; MZUSP 37320 (two specimens), male 350 mm and female 385 mm, Rio Grande do Sul; MZUSP 37321 (two specimens), males (270 mm and 310 mm), Rio Grande do Sul; MZUSP 37322 (three specimens), two males (350 and 356 mm) and female 304 mm, Rio Grande do Sul; MZUSP 37323, female 444 mm, São Paulo; MZUSP 37324 (two specimens), males (270 and 278 mm), Rio Grande do Sul; MZUSP 37325, male 292 mm, Rio Grande do Sul; MZUSP 37326 (two specimens), male 370 mm and female 493 mm, Rio Grande do Sul; MZUSP 37328, female 317 mm, Rio Grande do Sul; MZUSP 37331 (three specimens), male 500 mm and two females (400 mm), Uruguay; MZUSP 37332 (four specimens), male 555 mm and three females (482 – 650 mm), Santa Catarina; MZUSP 37333 (three specimens), two males (366 and 385 mm) and female 400 mm, Rio Grande do

Sul; C.UNESP.CLP (three specimens, uncatalogued), males (690 – 727 mm); NUPEC 1435, male 210 mm, Santos, São Paulo; NUPEC 112, female 218 mm, Itajaí, Santa Catarina; NUPEC 1103, male 400 mm, Santos, São Paulo; NUPEC 1586, female 250 mm, Santos, São Paulo; NUPEC 1490, female 270 mm; NUPEC 1469, female 230 mm, Santos, São Paulo; NUPEC 129, male 226 mm, São Paulo; NUPEC 130, male 222 mm, Espírito Santo; NUPEC 1585 (three specimens), two females (253 and 294 mm) and male 314 mm, Santos, São Paulo; NUPEC 1911, female 420 mm, Ubatuba, São Paulo; NUPEC 1317, female 396 mm; NUPEC 0153, female 516 mm, Southeast Brazil; NUPEC 1348, female 442 mm, Southeast Brazil; NUPEC 1345, male 437 mm; NUPEC 1184, male 433 mm Southeast Brazil; NUPEC 1339, female 433 mm; NUPEC 1219, male 438 mm; NUPEC 1208, female 447 mm; NUPEC 1258, female 463 mm; NUPEC 1220, male 390 mm; NUPEC 0137, female 476 mm; NUPEC 0138, male 494 mm; NUPEC 1176, male 425 mm; NUPEC 1172, male 480 mm; NUPEC 0150, male 452 mm; NUPEC 1145, female 450 mm; NUPEC 1274, male 440 mm; NUPEC 1186, female 415 mm; NUPEC 1342, female 592 mm; NUPEC 1584, female 535 mm; NUPEC 0125, male 630 mm; NUPEC 0111, male 640 mm; NUPEC 0114, male 610 mm; NUPEC 0142, female 502 mm; NUPEC 0133, male 640 mm; NUPEC 1944, female 466 mm; NUPEC 1945, female 380 mm; NUPEC 1946, male 427 mm; NUPEC 1947, female 430 mm; NUPEC 1949, female 435 mm; NUPEC 1950, male 485 mm; NUPEC 1951 (head); NUPEC 1952, male 320 mm; NUPEC 1538, male 670 mm; NUPEC 156, male 670 mm; NUPEC 1953, female 410 mm; NUPEC 1954, male 425 mm; NUPEC 1955, male 450 mm; NUPEC 1956, male 620 mm; NUPEC 1957, male 515 mm; NUPEC 1958, female 490 mm; NUPEC 1974, male 320 mm; NUPEC 1975, male 620 mm, NUPEC 1977, male 490 mm; NUPEC 1976, female 530 mm; NUPEC 1978, male 685 mm; NUPEC 1979, male 210 mm, (all from southeast Brazil); C.DBAV.UERJ 1875 (two specimens), male 476 mm, and female 456 mm, Juréia, São Paulo; C.DBAV.UERJ 651 (two specimens), males 584 and 590 mm, Rio de Janeiro; C.DBAV.UERJ 369 (eight specimens), four males (570 – 670 mm), three females (520 – 670 mm) and one head; C.DBAV.UERJ 0368 (11 specimens), four males (134 – 151 mm) and seven females (140 – 152 mm), Itajaí, Santa Catarina; C.DBAV.UERJ 0367 (12 specimens), six males (94 – 116 mm) and six females (91 – 114 mm), Itajaí, Santa Catarina; C.DBAV.UERJ 0649 (four specimens), two males (467 and 499 mm) and two females (485 and 493 mm), Rio Grande do Sul; C.DBAV.UERJ 0366, female 667 mm, Itajaí, Santa Catarina; C.DBAV.UERJ 0362, male 669 mm, Itajaí, Santa Catarina; C.DBAV.UERJ 0359, male 661 mm, Itajaí, Santa catarina; C.DBAV.UERJ 0364, female 688 mm, Itajaí, Santa Catarina; C.DBAV.UERJ 0365, female 682 mm, Itajaí, Santa Catarina; C.DBAV.UERJ 2014, male 580 mm, Pontal da Barra, Rio de Janeiro; C.DBAV.UERJ 0363, female 633 mm, Itajaí, Santa Catarina; MOVI 37637, female 212 mm, Rio Grande do Sul; MOVI 24887 – 24900 (14 embryos), seven males (227 – 249 mm) and seven females (230 – 254 mm), Rio Grande do Sul; MOVI 25260 - 25276 (17 embryos and Juveniles), nine males (331 – 534 mm) and eight females (350 – 385 mm), Rio Grande do Sul; MOVI 00129, male 471 mm, Rio Grande do Sul; MOVI 00634, female 487 mm, Rio Grande do Sul; MOVI 00635, male 642 mm, Rio Grande do Sul; MOVI 01154, female 505 mm, Rio Grande do Sul; MOVI 05449, male 657 mm, Rio Grande do Sul; MOVI 05450, male 646 mm, Rio Grande do Sul; MOVI 05451, male 471 mm, Rio Grande do Sul; MOVI 08694, male 436 mm, Rio Grande do Sul; MOVI 10121, female 742 mm, Santa Catarina; MOVI 10171, male 208 mm (embryo), Santa Catarina; MOVI 16085 – 16088 (four specimens), three males (640 – 660 mm), and female 650 mm, Rio Grande do Sul; MOVI 23123, male 680 mm, Rio Grande do Sul; MOVI 24681, female 725 mm, Rio Grande do Sul, MOVI 24682, male 628 mm, Rio Grande do Sul; MOVI 24783, male 495 mm, Rio Grande do Sul; MOVI 24684, female 665 mm, Rio Grande do Sul; MOVI 24685, female 544 mm, Rio Grande do Sul; MOVI 24686, female 581 mm, Rio Grande do Sul; MOVI 24687, male 434 mm, Rio Grande do Sul; MOVI 24688, female 712 mm, Rio Grande do Sul; MOVI 24694 (five specimens) one pregnant female 821 mm, and their four embryos (two males 235 – 247 mm, and two females 240 mm), Rio Grande do Sul; MOVI 25412, male 771 mm, Rio Grande do Sul; MOVI 25413, female 781 mm, Rio Grande do Sul; MOVI 25528 – 25535 (eight specimens), one pregnant female 787 mm, and their seven embryos (two males 226 - 227 mm, and five females 223 - 240 mm), Rio Grande do Sul.

Table I. Selected proportional measurements in *Mustelus* species expressed as percentage of the total length (in mm).

Measurements	*M. canis*	*M. fasciatus*	*M. higmani*	*M. norrisi*	*M. schmitti*
Total Number of Measured Specimens	33	9	11	16	23
Total Length	290 – 1100	360 – 1350	220 – 470	260 – 900	210 – 720
Body Height	6.9 - 13.4	8.9 - 12.6	7.9 – 12	9.0 – 12.0	7.1 - 10.9
Body Width	9.6 - 11.4	9.8 - 12.5	8.6 – 11.6	8.2 – 10.0	9.9 - 11.3
Preoral length	3.9 - 7.8	6.9 - 9.2	7.1 - 9.3	3.8 – 6.5	5.2 - 7.9
Prenasal length	4.6 - 5.4	5.3 - 7.3	5.6 - 7.5	3.2 - 4.3	4.2 - 5.7
Mouth Width	4.9 - 7.1	6.1 - 7.3	5.7 - 6.8	4.5 – 6.0	4.4 - 6.3
Mouth Length	2.1 - 4.4	2.4 - 4.0	2.6 - 4.2	2.5 - 4.4	1.5 - 3.5
Upper Labial Fold Length	1.3 - 2.6	1.6 - 2.3	1 - 1.8	1.0 - 2.2	1.6 - 2.5
Lowe Labial Fold Length	0.9 - 1.7	1.3 - 1.8	0.8 - 1.0	1.0 - 2.2	0.9 - 1.6
Internasal Length	2.7 - 4.1	3.0 - 3.5	2.7 - 3.8	2.3 - 2.8	1.7 - 3.2
Orbit Diameter	2.4 - 4.1	1.3 - 3.3	2.1 – 3.1	2.3 - 3.4	2.1 - 3.8
Interorbital Distance	3.4 - 7.5	4.5 - 6.3	2.9 - 8.1	3.3 - 6.4	4.4 - 7.9
Preorbital Distance	5.5 - 7.5	7.3 - 10.0	6.9 - 9.8	4.7 - 7.2	2.4 - 7.9
Pre First Dorsal Distance	19.5 – 29.5	28.8 - 33.1	25 - 32.3	24.4 – 34.0	24 - 30.9
Preanal DIstance	60.8 - 78.2	61.9 - 68.1	62.4 – 68	60.0 – 68.0	59.9 - 68.5
Interdorsal Distance	17.5 - 26.7	16.1 - 28.5	18.0 – 22.4	18.0 - 26.0	16.5 - 26.3
2nd Dorsal to Caudal	9.1 - 17.5	7.7 - 9.9	8.4 – 11.9	9.8 – 13.0	10.4 - 12.9
Prepectoral distance	17.8 - 23.8	19.5 - 24.5	17.9 – 24.9	16.0 - 20.0	16.8 - 20.9
Pre 1st Gill Slit Distance	14.0 – 18	16.7 - 21.0	13.9 – 19.6	12.0 - 17.0	13.4 - 18.6
Pectoral Anterior Margin Length	9.1 - 15.4	11.2 - 13.8	10.4 – 13.0	12.0 - 15.3	10.3 – 15.0
Pectoral Posterior Margin Length	6.9 - 11.9	7.7 - 12.6	6.3 - 9.9	7.9 - 12.0	6.4 - 9.8
Pelvic Anterior Margin Length	4.1 - 7.6	6.1 - 8.0	5.4 - 8.1	6.7 - 8.5	5.0 - 7.7
Pelvic Posterior Margin Length	4.2 - 6.1	5.1 - 8.2	3.6 - 6.1	4.1 - 6.2	4.8 - 6.9
Pelvic Inner Margin Length	2.3 - 5.2	3.3 - 5.8	2.5 - 6.6	2.1 – 4.8	2.9 - 6.4
Pelvic to Anal Distance	11.3 – 19.2	11.8 - 16.7	13.1 – 17.5	14.0 - 20.0	11.9 - 19.2
Anal to Caudal Distance	6.4 - 10.2	5.0 - 8.1	6.7 - 8.6	7.3 - 9.7	5.7 - 10.6
Anal Fin Height	2.1 - 5.7	2.0 - 3.5	2.1 - 4.9	2.6 - 3.7	1.6 - 2.7
Anal Fin Base Length	2.8 - 5.4	4.5 - 5.6	5.1 - 7.6	3.4 - 7.6	3.4 - 5.6
Anal Fin Inner Margin Length	1.5 - 3.2	1.6 - 3.2	2.0 - 3.8	1.6 - 2.3	1.7 - 3.7
1st Dorsal Fin Height	6.5 – 10	6.5 - 9.4	6.7 – 10.5	7.1 - 10.4	5.7 - 8.8
1st Dorsal Fin Base Length	6.4 - 11.1	10.0 - 13.7	8.1 – 11.8	7.5 – 13.0	8.5 - 11.5
1st Dorsal Fin Inner Margin Length	2.8 – 5.0	3.1 - 5.2	2.7 – 10.7	2.6 - 4.6	2.9 - 5.5
2nd Dorsal Fin Height	3.6 - 6.7	4.1 - 6.2	4.8 - 6.1	5.5 - 7.6	4.3 - 6.3
2nd Dorsal Fin Base Length	5.2 - 9.1	6.8 - 10.4	6.7 - 9.3	6.8 – 10.0	6.2 - 8.9
2nd Dorsal Fin Inner Margin Length	2.3 - 4.1	1.9 - 3.7	2.0 - 3.6	1.9 - 3.2	2.1 - 4.1
Upper Caudal Lobe Length	17.5 - 22.2	19.3 - 22.4	18.5 – 22.9	18.0 - 23.0	15.6 - 23.3
Lower Caudal Lobe Length	5.9 - 8.7	6.2 - 7.8	5.5 - 9.3	7.6 - 9.4	4.8 - 8.3

Key to Identification of western South Atlantic *Mustelus*

1a. Both labial folds well developed and long, being the upper distinctly longer than lower (1.6-2.7% TL and labial fold 1.3-2.1% TL, respectively) …..... 2

1b. Both labial folds not well developed and short, being the upper equal or early equal to lower (both 0.8-1.8% TL). …..... 4

2a. Short internasal distance (1.8-2.4% TL); snout short (preoral length 5.2-7.9% TL); dorsal body coloration uniform gray, with light spots dorsally (in adults larger than 620 mm TL); posterior margins of the dorsal fin naked and dark due to the exposed ceratotrichia, giving a frayed appearance ……..…….. *M. schmitti*

2b. Wide internasal distance (2.7-3.6% TL); snout long (preoral length 8.0-9.1% TL); dorsal body coloration uniform or striped, lacking light spots dorsally in all sizes; posterior margins of the

dorsal not naked and dark, lacking exposed ceratotrichia …….…….... 3

3a. Prepectoral distance long (22-25% TL); eye small (orbit diameter 1.9-2.5% TL); teeth lacking detached cusps, tooth crown low, rounded and symmetric in all sizes; lower caudal lobe not well developed and with rounded; body color in newborn and juveniles (smaller than 800 mm TL) striped, with dark bars across dorsal surface of the body and head, that disappear in adults (larger than to 800 mm TL) ..... *M. fasciatus*

3b. Prepectoral distance short (17-21% TL); eyes large (orbital diameter 2.2-4.2% TL); teeth lacking detached cusp in adults, rounded and asymmetric; juveniles with detached cusp and accessory cusplets with 2 to 4 basal ridges that tend to disappear in adults; lower caudal lobe well developed and acute; body coloration uniform, lacking stripes in all sizes, grey or dark brown in adults, newborns and juveniles with dorsal fin tips and posterior margin of pectoral white ..... *M. canis*

4a. Dermal denticles tridentate; interorbital distance wide (4.5-6.3% TL); prepectoral distance long (19-24% TL); snout long (preoral distance 7.1-9.3% TL); body color golden yellow; maximum size up to 640 mm TL ..... *M. higmani*

4b. Dermal denticles lanceolate; interorbital distance short (3.3-4.2% TL); prepectoral distance short (16-20% TL); snout short (preoral distance 4.2-6.5% TL); body color gray brownish; maximum size up to 1150 mm TL …….... *M. norrisi*

Discussion

Mustelus species are morphologically very similar and their characteristics rather conservative, thus difficult to be separated from each other. The main morphological characters used to separate them were the shape of fins, eyes and the head proportions. Relevant interespecific differences found in this work were not detected by other authors in previous publications which dealt with western Atlantic *Mustelus* species (*e.g.* Compagno 1984; Figueiredo 1977; Gadig 2001) because they mainly followed Heemstra (1969, 1997), who had examined just a few specimens from the Central Atlantic and South America, including Brazil.

Head morphometrics (*e.g.*, snout length, internasal distance, labial fold length, and orbit diameter) were useful to distinguish the species of *Mustelus*. Contrarily, morphometric features of trunk and general body proportions where useless to distinguish species, by their great variation and errors due to distorted and twisted shapes. The diagnostic body proportions, relative position of body structures, as pointed out by Bigelow and Schroeder (1940, 1948) and Compagno (1984) were not used herein, because they have been considered very influenced by general body preservation, nutritional state, sex and ontogenetic factors (Heemstra 1997).

The length of labial folds was the main morphometric feature to distinguish *Mustelus* species. *Mustelus canis*, *M. schmitti* and *M. fasciatus*, have large labial folds with the upper fold longer than lower, but are separated from each other by the internasal distance and color pattern.

Mustelus fasciatus is the easiest distinguished species due to the triangular shape of its dorsal and pectoral fins with a wide base, not well developed lower caudal tip and wide head with small eyes. *Mustelus norrisi* is distinguished from other species by the well falcate, thin and long pectoral fins, with short inner margins, high dorsal fins, with posterior margins straight and transversal with longitudinal body axis, lower caudal tip developed, falcate and acute in juveniles and triangular in adults (about 780 mm).

Mustelus higmani and *M. norrisi* are very similar in general morphology. Both have short labial folds with similar lengths, but *M. higmani* has a longer thiner snout, larger internasal distance, less falcate pectoral fins and the lower caudal tip less acute than in *M. norrisi*. Concerning to general body coloration *M. higmani* is distinguished from *M. norrisi* (and from all other western Atlantic species) by its yellow gold coloration and small size of adults (it is the smallest western South Atlantic *Mustelus*, measuring up to 640 mm TL).

Mustelus canis and *M. schmitti* are the most similar morphologically, more so within adults of *M. schmitti* and juveniles of *M. canis*. But *M. canis* has relatively larger eyes and more brownish coloration than *M. schmitti* while lacking a naked posterior margin of dorsal fins and white spots on the body flanks (usually present in larger specimens of *M. schmitti*).

Mustelus fasciatus has unique tooth morphology among the western South Atlantic representatives of *Mustelus*, with blunt rounded smooth teeth, similar both in adults and juveniles. *M. norrisi* and *M. canis* have similar teeth between them, where juveniles show short basal ridges, slightly rounded cusps detached from the base and two or more lateral accessory cusps, whereas adults have pavement-like asymmetric, rounded teeth, lacking basal ridges, but more uniform and with cusp less detached in *M. norrisi* than in *M. canis*, which has lateral accessory cusps detached and asymmetric. *Mustelus higmani* has teeth with low, rounded and asymmetric cusps with 8 to 15 basal

ridges and *M. schmitti* with asymmetric, low and rounded cusps.

Dermal denticles were analyzed and did not show differences compared with forms from the western North Atlantic, except in *M. canis* where Heemstra (1997) described that 2/3 of dermal denticles are lanceolate and 1/3 tridentate. In spite of the fact that such a feature was not herein observed, Western South Atlantic specimens of *M. canis* have lanceolate dermal denticles, with two to four dorsal longitudinal ridges, similarly observed in *M. norrisi*, *M. schmitti* and *M. fasciatus*. Only *M. higmani* has dermal tricuspidate dermal denticles, being the only western South Atlantic species with this character, and therefore, easily to distinguish.

The buccopharingeal pattern of denticles, a character proposed by Heemstra (1997), was not useful to distinguish the *Mustelus* species from western South Atlantic, due high intraspecific variation, as observed by Perez Jimenez *et al*. (2005) for species from the Eastern North Pacific.

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