

Occurrence and biological aspects of southern sawtail catshark *Galeus mincaronei* (Elasmobranchii: Scyliorhinidae) from southern Brazil

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From 2009 to 2011, bottom-trawl research cruises were done by the RV Soloncy Moura throughout the continental shelf border and upper slope off the Santa Catarina State, Southern Brazil, to study its marine demersal biodiversity (MOBIO Project). The depth range operation was from 160 to 600 m. Biological information was obtained from a group of deep-sea elasmobranch species, *i.e.*, length compositions, sex-ratios, weight-length relationships and reproductive stages, associated with some oceanographic parameters. Catches of the southern sawtail catshark *Galeus mincaronei*, were analyzed, an endemic species from southwestern Atlantic. A total of 34 individuals were captured, 20 were males and 14 females. Catches occurred between the latitudes 27°35.071' S and 28°40.328' S and depths from 290 to 508 m. The males measured 31.7 to 42.6 cm total length (TL); 5% were immature, 10% maturing and 85% mature. Females measured 30.0 to 41.2 cm TL; 7.1% were immature, 35.7% maturing, 42.9% mature, and only 14.3% were pregnant. An approximate value of size-at-first-maturity (TL_{50}) was between 34.0 and 37.0 cm for males and 38.0 cm TL for females. Even though a small amount of specimens were caught, the information obtained contributes to fill the gaps of biological knowledge on the species, which is considered *data deficient* (DD), to assess its regional conservation status, using IUCN Red List criteria.

Key words: Reproduction, conservation, elasmobranchs.

Presencia y aspectos biológicos del tiburón cola de sierra del sur *Galeus mincaronei* (Elasmobranchii: Scyliorhinidae) del sur de Brasil

Entre 2009 y 2011, el buque de investigación Soloncy Moura realizó cruceros para investigar acerca de la biodiversidad marina demersal (Proyecto MOBIO) de la plataforma continental y el talud superior del estado de Santa Catarina al sur de Brasil. La profundidad de operación fue de entre 160 y 600 m. Se obtuvo información biológica de un grupo de especies de elasmobranquios de aguas profundas, *i.e.*, la estructura de longitudes, la proporción sexual, la relación peso-longitud y fases reproductivas, que fue asociada con los parámetros oceanográficos. Se analizaron las capturas del tiburón cola de sierra del sur *Galeus mincaronei* (Scyliorhinidae), una especie endémica del Atlántico sudoccidental. Se capturaron en total 34 ejemplares: 20 machos y 14 hembras. Las capturas sucedieron entre las latitudes 27°35.071' S y 28°40.328' S y 290 a 508 m de profundidad. La longitud de los machos varió de 31.7 a 42.6 cm de longitud total (TL); 5% de inmaduros, 10% en maduración y 85% maduros. Las hembras midieron entre 30.0 y 41.2 cm TL; 7.1% de inmaduros, 35.7% en maduración, 42.9% de maduros y apenas 14.3% de grávidas. La longitud de primera madurez estimada (LT_{50}) fue de entre 34.0 y 37.0 cm para los machos y de 38.0 cm para las hembras. A pesar del bajo número de organismos capturados, los datos contribuyen a llenar los vacíos de conocimiento existentes, ya que se considera que es una especie con *datos insuficientes* (DD) de acuerdo con la lista roja de la UICN para evaluar el estatus de conservación regional.

Palabras clave: Reproducción, conservación, elasmobranquios.

Introduction

The southern sawtail catshark *Galeus mincaronei* Soto 2001 (Fig. 1), which belongs to the Scyliorhinidae family, is endemic to the southwestern Atlantic and is found at the edge of the continental

shelf and upper slope of southeastern-southern Brazil. Catches of these animals were recorded off the states of Rio Grande do Sul, Santa Catarina, Rio de Janeiro (Soto 2001, Rincon and Vooren 2006) and Espírito Santo (Soto *et al.*

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2007¹). This species is a part of Brazilian deep-sea fauna, located in the zoogeographical Argentinean province (Menni *et al.* 2010).

Soto (2001) noted that *G. mincaronei* is morphologically similar to *Galeus antillensis* Springer 1979, which occurs mainly in the Caribbean. For the description of *G. mincaronei*, Soto (2001) was based on an Holotype - MOVI 00147, mature male (40.4 cm TL), 30°14'51" s, 048°03'03" w, 430 m depth, off Rio Grande do Sul, Brazil, 04 Apr. 1988, baited trap, F/V "Icanhema" - and three Paratypes, all captured in the same haul with the holotype - MOVI 00090, ovigerous mature female (38.6 cm TL); MOVI 00091, immature male (23.7 cm TL); and MOVI 00146, ovigerous mature female (38.8 cm TL). *Galeus mincaronei* is differentiated from *G. antillensis* by its dorsolateral coloring, fewer diplospondylous vertebrae, smaller size of the pectoral fin and between all species of the *Galeus* complex by its largest geographical isolation. More recently, Rincon and Vooren (2006) tried to differentiate *G. mincaronei* from *G. antillensis* based on the measurement of the prepectoral length and the number of diplospondylous vertebrae. However, due to the small sample size and the wide range of variation in the number of diplospondylous vertebrae in the *Galeus* genus, genetic studies would be necessary to clarify the difference between *G. mincaronei* and *G. antillensis*. In this study we will consider the species only as *G. mincaronei*, given their geographical isolation in its meridional distribution.

Galeus mincaronei is considered a deep-water species (Gadig 2015) inhabiting the breaking of the continental shelf and the upper slope between 200 and 600 m deep, and is associated with deep reefs (Kitahara *et al.* 2009). According to Rincón and Vooren (2006) the species was captured at an average temperature of 8 °C, and bottom salinities between 34.5 and 35.0‰.

Due to the small number of studied specimens, there is little information about *G. mincaronei*. Besides of Soto (2001), other works on the capture of this species were published by Rincon and Vooren (2006), REVIZEE Program (Haimovici *et al.* 2004, 2008), Soto *et al.* (2007¹) and Gadig (2015). This study aimed to analyze the biological information obtained regarding the *G. mincaronei* catches during research cruises, on the coast of Santa Catarina State, South Brazil.

Material and methods

Through the Biodiversity Monitoring Project on the coast of Santa Catarina (MOBIO), between the years 2009 and 2011, the RV Soloncy Moura of the National Center for Research and Conservation of Marine Biodiversity in the Southeast and South (CEPSUL) of the Chico Mendes Institute for Biodiversity Conservation (ICMBio) carried out 11 fishing cruises prospecting the areas of the outer edge and upper slope of the southern Brazilian continental shelf, using trawls and traps nets. The RV Soloncy Moura is a 26 m stern trawler displacing 216 tons, and powered by a 600 HP Caterpillar main engine (Haimovici *et al.* 2008).

All *G. mincaronei* specimens were caught by trawl-to-bottom technique for catching fish (Table 1). The net used had a 32 m wide head rope

1. Soto JMR, MM Mincarone, RGO de Amorim. 2007. Ampliação da distribuição de *Galeus mincaronei* Soto 2001 e *Schroederichthys tenuis* Springer 1966 (Carcharhiniformes, Scyliorhinidae) no sudoeste do Atlântico. *XII Congresso Latino-Americano de Ciências do Mar* - Florianópolis.



Fig. 1. Female *Galeus mincaronei* captured during the cruise of RV Soloncy Moura for the MOBIO project.

and 29 m wide ground rope. During the sets, surface water temperature (°C), depth of the trawling (m), towing distance (nautical miles), towing duration (minutes), boat speed (knots), as well as additional information –such as direction and speed of wind and tide–, were registered. Of the 11 fishing cruises, *G. mincaronei* were caught only twice *i.e.*: October 2009 and July 2010.

The captured specimens were labeled, placed in plastic bags and frozen at -40 °C on board RV Soloncy Moura. Later, the specimens were taken to the CEPSUL Lab, where they were identified at the species level and biological data of interest obtained. Each specimen was registered and measured its total length (TL, cm), total weight (TW, g) and gutted weight (GW, g). It was also possible to collect some reproductive data according to the gender of the animal. For males the clasper inner length (CLI) was externally measured (Fig. 2) and its calcification state (flacid/rigid) registered.

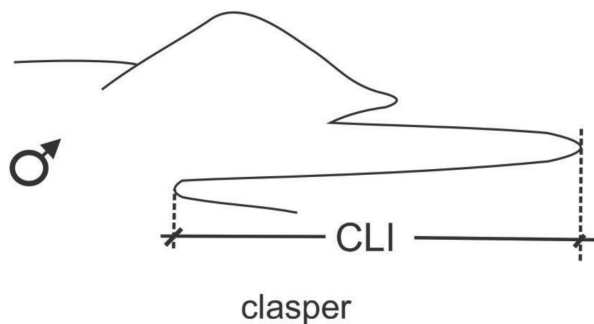


Fig. 2. The clasper inner length (CLI) externally measured in *Galeus mincaronei* (Compagno 1984).

Liver weight (LW), along with the total testes length (TTL) and width (GTW), testes total weight (TTW), as well as the individual maturity stage was obtained. For females, liver weight (LW), ovary total length (OTL) and maximum ovary width (OMW), as well as the ovary total weight (OTW) were registered. Additionally, the largest oocyte diameter (LOD), the oviductal gland width (OGW), the uterus maximum width (UMW) and their maturation stage were also registered.

The inflexion point in the relationship between CLI/TL (%) and TL (cm) of the *G. mincaronei* right clasper, together with their status (non-calcified/soft or calcified/hard), provided an indication of approximate value of size at maturity in males. In the same way, the relationships between (1) LOD/TL (%) and TL (cm), (2) OTL/TL (%) and TL (cm) and (3) UMW/TL (%) and TL (cm) of *G. mincaronei* were used to detect the size at maturity in females.

The Stehmann maturity scale (2002) for oviparous sharks (ELASMO 1) was adapted to the macroscopic observations made in the CEPSUL laboratory. Instead of considering the Stehmann males stages as A, B, C and D, and females stages as A, B, C, D, E and F, our observations classified the males individuals as immature, maturing and mature; while females as immature, maturing, mature and pregnant.

Therefore, individuals with undeveloped and flexible claspers, not exceeding the caudal end of the pelvic fins were considered Immature (A). In this case, the testes were small and the sperm ducts filamentary, straight and empty.

Table 1
Characteristics of the captures of the *Galeus mincaronei* during the cruise of RV Soloncy Moura for the MOBIO project

	Set 23	Set 22	Set 56
Date	27/10/2009	26/10/2009	01/07/2010
Individuals	32	1	1
Latitude	28°40.328' s	27°35.071' s	28°38.984' s
Longitude	47°19.874' w	47°08.27' w	47°18.553' w
Depth (m)	290 - 346	468 - 508	350 - 292
Traveled distance (Naut. miles)	1.49	1.56	1.39
Speed (Knots)	3	3	3
Towing Duration (min)	30	30	30
Surface seawater temperature (°C)	22	22.1	20.9
Direction and wind speed (Knots)	SW / 1	NE / 3	N / 1
Direction and tide speed (Knots)	w / 1	s / 1	s / 1

Maturing (B) individuals possessed claspers even if flexible, reaching the caudal end of the pelvic fins and in some cases, surpassing them, or if the clasper glands began to present more differences, such as developed testes, and sperm ducts already starting the meandering process. Mature (C and D) males had claspers lengths at maximum, beyond the caudal ends of the pelvic fins (Fig. 3), with rigid claspers and fully developed testes, and sperm ducts full and meandered along their lengths (Fig. 4). In the most advanced stage of maturity (D), *i.e.* coupling phase, the glands of the present claspers were dilated with a hemorrhagic aspect and sperm flowing through by a light compression of the cloaca, whilst the seminal vesicle was full of sperm.



Fig. 3. Male mature stage of *Galeus mincaronei* with rigid clasper surpassing the rear end of the pelvic fins.

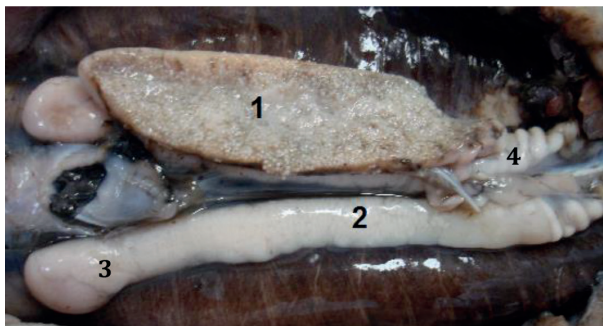


Fig. 4. Male reproductive system in mature stage of *Galeus mincaronei* (C and D of Stehmann scale). 1) Right testes, 2) epididymal trunk, 3) head of the epididymis, 4) vas deferens full of sperm.

Immature females (A) exhibited small ovaries, with gelatinous or granulated internal structure. Oocytes were not distinguished macroscopically and when they occurred, they had the appearance of monomorphic beads, whereas the oviducts were filamentous. Maturing (B) females presented more developed and transparent ovaries, with small oocytes already differentiating. They also began to show an enlargement process in the posterior region of the uterus. Mature (C, D and E) females, presented large and firm ovaries, their oocytes were already more developed and some were very large, filled with yolk; however the uterus was still empty, showing widening along its length (Fig. 5). Pregnant females (F) were so classified when presented an ovulation state, with well-developed ovaries (oocytes reaching its maximum diameter and whitish appearance) and uterus egg capsules with well-developed vitelline membranes, ready for extrusion (Fig. 6).

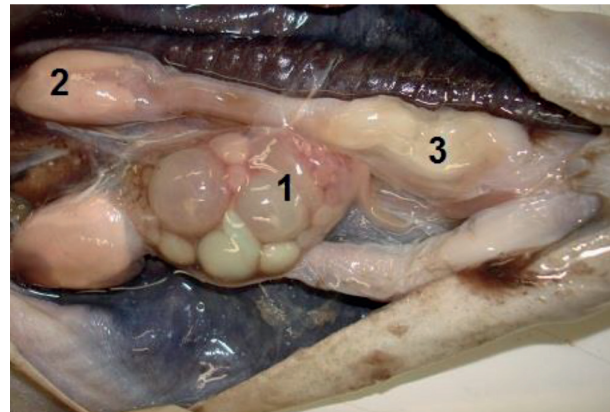


Fig. 5. Female of *Galeus mincaronei* in mature stage with 1) oocytes in different diameters, 2) oviductal gland, 3) developed uterus but without egg capsules.

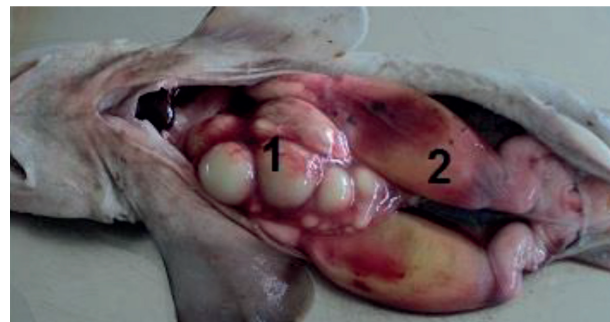


Fig. 6. Pregnant female of *Galeus mincaronei* with 1) oocytes with different diameters and some ready for ovulation, 2) egg capsule well developed and ready for extrusion.

The weight-length relationship (TW-TL) was adjusted with a potential model of the type $Y = \alpha X^\beta$. To estimate the parameters α and β , initially residual analysis was done. If the error structure was multiplicative, the parameters were estimated using the logarithm transformation, the equation being as follows:

$$\ln Y = \ln \alpha + \beta \ln X + \epsilon \quad \text{Ec. 1}$$

where: α is the intersection on the Y axis ($\alpha = \exp(\ln \alpha)$), β is the regression line slope and ϵ is a random error term with mean 0 and constant variance σ^2 .

If the error structure was additive, the non-linear least-square fit would be used (Quinn and Deriso 1999, Jennings *et al.* 2001, Xiao *et al.* 2011). The residuals normality was proven with the Kolmogorov-Smirnov and Shapiro-Wilks tests and their independence with the Durbin-Watson test (Durbin and Watson 1951).

A “t” test was used to contrast the hypothesis of isometric growth ($\beta = 3$), taking into account the significance level of $p = 0.05$.

Also the statistical differences between sexes in the TW-TL relationship was proven with a “t” test, comparing the regression coefficients (β_{males} and β_{females}) estimated by the logarithm transformation of the TW-TL relationships and considering the error structure multiplicative (Zar 1999).

All biological data were organized in Office Excel spreadsheets (2016 version) and the R program was used to apply the statistical analysis. The maps were developed and drawn using the ArcGIS software (version 10.1).

Results

A total of 34 sawtail catshark individuals were captured during the MOBIO cruises; of which, 20 were males and 14 females. The captures occurred between latitudes $27^\circ 35.071' \text{ S}$ - $28^\circ 40.328' \text{ S}$ and longitudes $47^\circ 08.27' \text{ W}$ - $47^\circ 19.874' \text{ W}$. The depths of all catches ranged from 290-508 m, confirming the occurrence of the *G. mincaronei* on the upper slope of the continental shelf (Fig. 7 and Table 1).

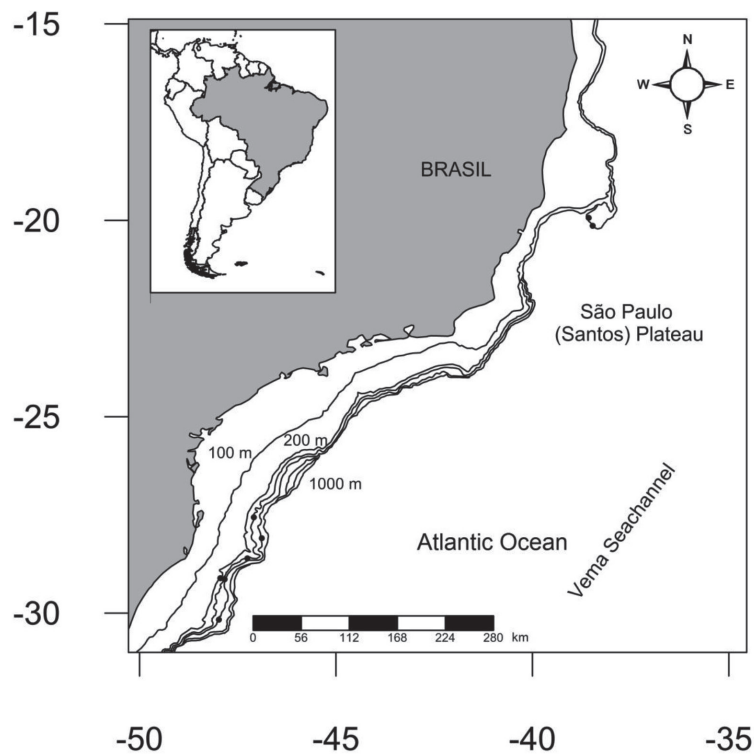


Fig. 7. Map with the capture events (in black dots) of *Galeus mincaronei*. Source: Soto (2001), Rincon and Vooren (2006), Soto *et al.* (2007²) and MOBIO Project (2016).

The maximum TL for captured specimens was a male with 42.6 cm TL, and the minimum a female with 30.0 cm TL. Considering both sexes, the mean TL was 38.3 cm (SD = 3.4 cm). Respect to weight composition, the maximum TW found was a female with 210 g, and the minimum another female with 52.87 g. For combined sexes, the mean TW was 132.7 g (SD = 40.9 g). The weight-length relationships estimated by separated sexes of *G. mincaronei*, are presented in figure 8. For males it was $TW = 0.00074 \cdot TL^{3.293}$ ($n = 20$; $r^2 = 0.816$) and for females $TW = 0.00009 \cdot TL^{3.923}$ ($n = 14$; $r^2 = 0.901$).

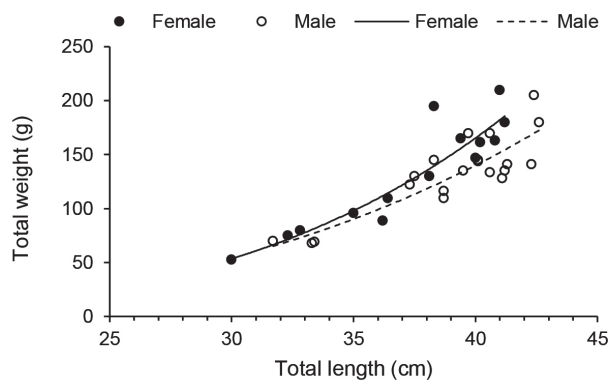


Fig. 8. Weight-length relationship by sex of *Galeus mincaronei*.

Females tended to weight more than males as their TL increases (Fig. 8). However, the “*t*” test for the two slopes of the regression (considering multiplicative errors) did not show significant difference ($p > 0.05$).

Residual analysis showed that the error structure was multiplicative for males and females weight-length relationships, justifying the logarithm transformation to estimate their coefficients. Also for both sexes, the Normal Q-Q Plots showed normality in the residual distribution. The residual normality was confirmed by the Kolmogorov-Smirnov test, considering $\alpha = 0.05$ ($3.442e^{-15}$).

The analysis of occurrence frequency of the captured *G. mincaronei* in their various reproductive stages indicated that both males and females were in different stages of maturation, with a higher frequency in the mature phase, *i.e.*, in steps C, D and E of Stehmann scale. Among the males 85% were already mature, 10% maturing and only 5% were still immature. For females,

42.9% were mature, 35.7% maturing, 7.1% immature and 14.3% were pregnant.

The average values of CLI for both right and left male clasper were compared through a “*t*” test, and the difference was not significant ($p = 0.978$), the mean value was 4.8 cm.

The relationship between CLI/TL (%) and TL (cm) of the *G. mincaronei* right clasper, together with their status (non-calcified/soft or calcified/hard) (Fig. 9), provided an indication of approximate value of size at maturity in males, *i.e.*, with a TL at around 34.0-37.0 cm. Figure 9 shows a big gap where maturity appears to occur, thus it is impossible to know the real form of the curve.

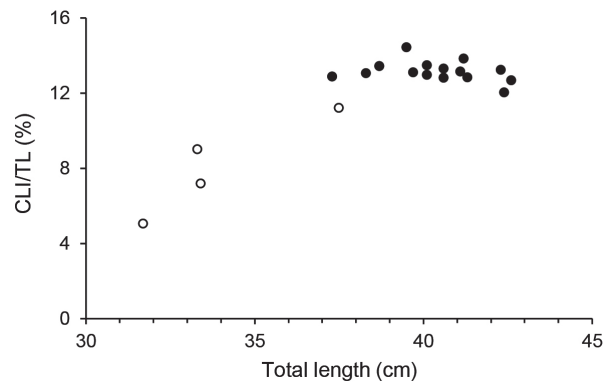


Fig. 9. Ratio analysis between the CLI/TL (%) and TL (cm) of *Galeus mincaronei* males (right clasper). White dots (non-calcified); black dots (calcified).

Female size-at-maturity of *G. mincaronei* was evaluated by the analysis of the relationship between LOD/TL (%) and TL (cm) (Fig. 10), and considering the enlargement condition of the uterus. The approximate value of size at maturity in females was at around 38.0 cm TL. Also the average of the LOD found in maturing females was 1.5 mm (SD = 0.4 mm), increasing to 13 mm (SD = 2.7 mm) in mature females and decreasing to 10.3 mm (SD = 4.4) in pregnant females.

Oocytes in maturing females were not yet ready for ovulation. On the other hand, when females mature, the oocytes are at their maximum diameter development, and ready for fertilization in the oviductal gland. For their part, pregnant females continue with the ovulatory process while egg development in the uterus occurs simultaneously.

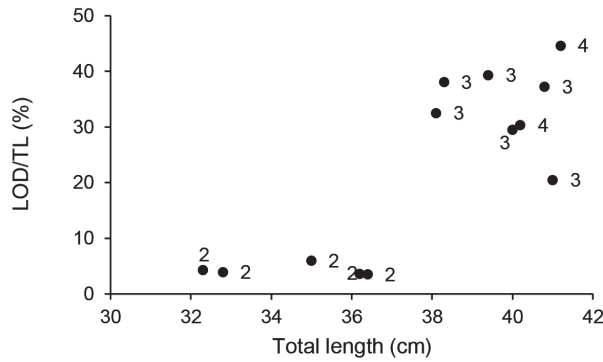


Fig. 10. Relationship between LOD/TL (%) and TL (cm) of *Galeus mincaronei* females. Numbers beside the dots are related to the maturity scale (1-immature; 2-maturing; 3-mature and 4-pregnant).

The relationship between OTL/TL (%) and TL (cm) also indicated the approximate value of size-at-maturity in females at around 37.0-38.0 cm TL (Fig. 11). The ovary's total length (OTL) increased exponentially during their sexual development phase (Fig. 11), *i.e.* in mature females, OTL tended to be bigger than in previous phases. In immature females the OTL average was 20.8 mm, while in maturing females it was 27.7 mm and in mature females 44.4 mm. Finally, in pregnant females the OTL average was 63.5 mm.

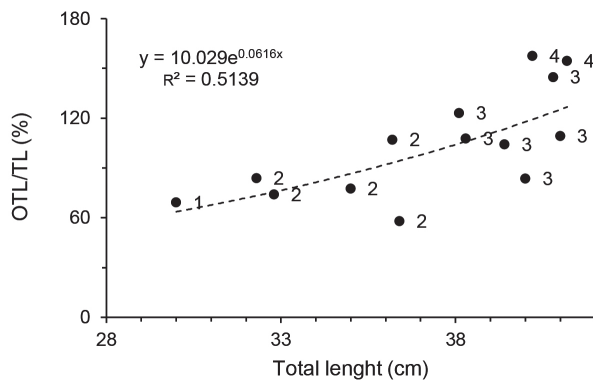


Fig. 11. Relationship between OTL/TL (%) versus TL (cm) of *Galeus mincaronei* females. Numbers beside the dots are related to the maturity scale (1-immature; 2-maturing; 3-mature and 4-pregnant).

The development of the uteri was analyzed by means of their bigger widths (UMW) for both right and left uteri. The relationship between UMW/TL (%) and TL (cm) also indicated the approximate value of size at maturity in females at around 37.0-38.0 cm TL (Fig. 12). The average

uterus width in immature females (UMW) was 1.95 mm, while in maturing females 4.5 mm, in mature females 11.2 mm, and finally 21.5 mm in pregnant females. It was observed that as ovulation proceeded, an enlargement of the uterus occurred, with the passage of the oocyte through the oviductal gland (where theoretically the fertilization occurs), and with the subsequent deposition of the egg into its capsule in the uterus until the extrusion.

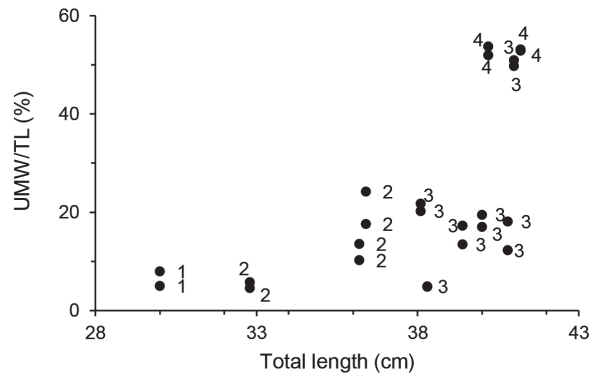


Fig. 12. Relation between UMW/TL (%) (right and left) versus TL (cm) in *Galeus mincaronei* females. Numbers beside the dots are related to the maturity scale (1-immature; 2-maturing; 3-mature and 4-pregnant).

The liver weight (LW) and the total body length (TL) showed a positive relation for females. In this case the approximate size at maturity was found at around 38.0 cm TL. On the other hand for males there was a gap between 34.0 and 37.0 cm TL, and the size at maturity seemed to be found within this size interval (Fig. 13).

Discussion

Sawtail catsharks *G. mincaronei* have been only observed in southern Brazilian waters, and are therefore considered an endemic species of the Southwest Atlantic (Dulvy *et al.* 2014). Soto (2001) recorded the occurrence of four individuals of *G. mincaronei* at latitude 30°14'5" S and longitude 48°03'03" W captured in 1988. Rincon and Vooren (2006) recorded catches of *G. mincaronei* made in 1996 and 1997 along the coordinates of 29°11' S 48°00' W, 29°12' S and 28°08' S, 47°54' W and 46°56' W. The REVIZEE program published in 2005 the records of eight specimens

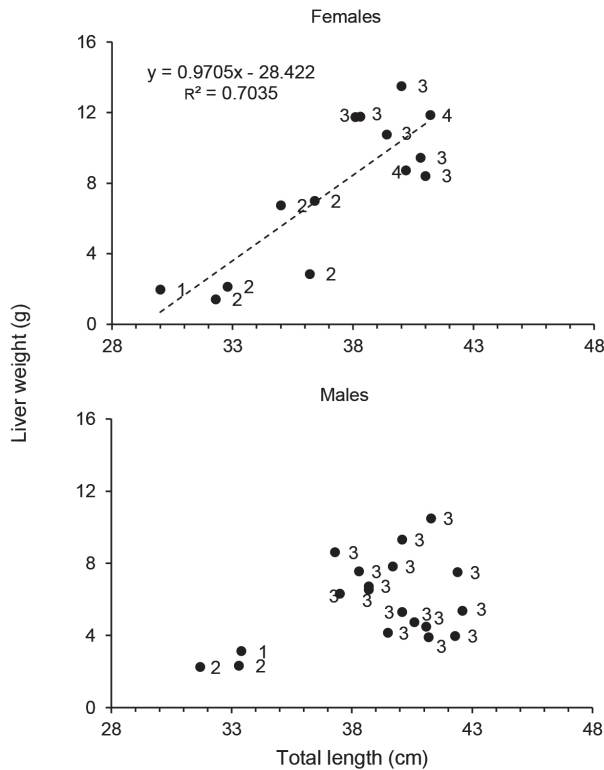


Fig. 13. Relationship between the liver weight (g) and the total length (cm) for females and males of *Galeus mincaronei*. Numbers beside the dots are related to the maturity scale (1-immature; 2-maturing; 3-mature and 4-pregnant).

of *G. mincaronei* caught in 1996 and 1997 between latitudes 22°00' S and 34°40' W (Haimovici *et al.* 2004). In 2008, it was referred that 25 specimens were captured in 2001 and 2002 between latitudes 32°52.75' S - 23°05.47' S and longitudes 50°32.66' W - 42°03.43' W (Haimovici *et al.* 2008). Soto *et al.* (2007²) expanded the distribution of this species between latitudes 19°51.8' S - 20°03.7' S and longitudes 38° 7.0' W - 38°21.0' W, based on three individuals of this species found in 2005. All records are within the occurrence area of *G. mincaronei* and between 200 and 700 m deep (Fig. 7).

As most of the specimens for the present study were captured in spring, showing an advanced reproductive stage, it easily could be thought that its reproductive event occurs in spring. Albeit, since no specimens were captured in other seasons, the present evidence should be not considered as part of a seasonal analysis of this species' life cycle.

In the present study the captured males presented a higher TL average than females.

However, *t-test* analysis was not significant ($p = 0.1508$). Similarly, the average TW for males and females showed no significant differences ($p = 0.9752$). In turn, the relationship between TW vs. TL of *G. mincaronei* obtained for separated genders shows that females tend to weigh more than males as their TL increases. This phenomenon is observed in females of most young sharks, as they acquire more weight to reach the reproductive stage, depending on the oocyte development and storage of eggs in the uterus.

For the species of elasmobranchs that occur along the continental shelf and slope in southern Brazil, spring is considered as their reproductive period (Vooren and Klippel 2005). Most *G. mincaronei* individuals captured during the MO-BIO cruises were in a mature condition and almost all of the individuals were caught in spring. Thus, the evidence presented in this work could indicate that the reproductive event of this species could occur at that time of the year. Forthcoming records of catches of this species in their different reproductive stages at different times of the year might confirm this hypothesis.

Male individuals with 37.0 cm TL and 120 g TW presented right clasper calcification, which evidences their initial reproductive stage, and their possible copulating phase from that size on. Of the 20 males caught, 80% had calcified clasper. This result needs confirmation by future analysis of the proportion of sexually mature individuals per size range and subsequent adjustment curve, when a larger amount of data is collected.

The present reproductive observations made in *G. mincaronei* females have some limitations, because it was not possible to monitor the oocytes development temporally. In fact the research was restricted to "snapshots" of the reproductive condition of the females caught during a short period of time. Based on this information, the probable development of the oocytes was rebuilt. Similar situation was related to the uterus width. This continuous process of oocyte growth in the ovary, development of the gonad, followed by ovulation, fertilization, egg packaging and storage in the uterus, is typical of the family Scyliorhinidae (Castro 1983, Hamlett 1999).

Unfortunately, with the available data it was not possible to establish the timing of the

reproductive cycle, since a vast majority of samples were taken during spring. Although the information obtained in this study was insufficient to understand in detail the whole reproductive cycle of the *G. mincaronei*, the results provided an indication that the reproductive phase begins in females with 38.0 cm TL and 130 g TW. The relationship between liver weight (LW) and the total body length (TL) also confirmed this value.

On the other hand, for males there was a big gap between 34.0 and 37.0 cm TL, and the size at maturity seems to be found within this size interval.

In the present study it was found that the reproductive phase for *G. mincaronei* females begins with 38.0 cm TL. Comparing this result with what was found in other species of the genus *Galeus* throughout the Atlantic and Mediterranean (Table 2), it was observed that *G. mincaronei* is within a range of values, with a minimum of 30.0 cm TL for *Galeus polli* Cadenat 1959 and a maximum of 51.0 cm TL for *Galeus melastomus* Rafinesque 1810. On the other hand, the maximum size attained by *G. mincaronei* of 42.5 cm TL, was the

lowest value found in the genus *Galeus*, with a maximum of 90.0 cm TL for *G. melastomus*. These differences can be attributed to their distinct geographic distribution in the Mediterranean, North and South Atlantic. Finally, comparing the proportion of first maturation TL/Maximum TL (%), there is also a range of values between 42% for *G. melastomus* and 91% for *G. mincaronei*. This last one was found similar than *Galeus atlanticus* (Vaillant 1888) in this proportion.

As yet with minimum information, it is known that *G. mincaronei* is a deep-water species, endemic of the South Atlantic Ocean, which needs to be preserved (Dulvy *et al.* 2014). Among the deep-water Chondrichthyes, more than half are classified in the IUCN list as data deficiency category (Dulvy *et al.* 2014). Deep-water chondrichthyans have very different evolutionary adaptations than pelagic species and require different appropriate management procedures, getting more information about these species is necessary for their conservation and management (Cotton and Grubbs 2015). Despite the small number of specimens analyzed, the present

Table 2

Comparison of first maturation and maximum TL (cm) for different species of the genus *Galeus* in the Atlantic and Mediterranean

Species	Sex	First mature		Maximum		Percentage (First mature TL/ maximum TL)
		TL (cm)	Source	TL (cm)	Source	
<i>G. melastomus</i>	Female	38.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	90.0	Compagno <i>et al.</i> (2005)	42
<i>G. melastomus</i>	Female	51.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	90.0	Compagno <i>et al.</i> (2005)	57
<i>G. melastomus</i>	Female	38.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	67.0	Rey <i>et al.</i> (2002), Costa <i>et al.</i> (2005)	57
<i>G. melastomus</i>	Female	38.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	62.0	Rey <i>et al.</i> (2002), Costa <i>et al.</i> (2005)	61
<i>G. polli</i>	Female	30.0	Fowler (2004)	43.0	Fowler (2004)	70
<i>G. melastomus</i>	Female	51.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	67.0	Rey <i>et al.</i> (2002), Costa <i>et al.</i> (2005)	76
<i>G. mincaronei</i>	Female	34.5	Rincón (2004)	42.5	Rincón (2004)	81
<i>G. melastomus</i>	Female	51.0	Bauchot (1987), Tursi <i>et al.</i> (1993), Ungaro <i>et al.</i> (1994), Rey <i>et al.</i> (2002)	62.0	Rey <i>et al.</i> (2002), Costa <i>et al.</i> (2005)	82
<i>G. mincaronei</i>	Female	37.0	Present study	42.5	Rincón (2004)	87
<i>G. atlanticus</i>	Female	39.8	Bauchot (1987)	45.0	Rey <i>et al.</i> (2005)	88
<i>G. atlanticus</i>	Female	40.0	Compagno <i>et al.</i> (2005)	45.0	Rey <i>et al.</i> (2005)	89
<i>G. mincaronei</i>	Female	38.0	Present study	42.5	Rincón (2004)	89
<i>G. mincaronei</i>	Female	38.5	Rincón (2004)	42.5	Rincón (2004)	91

study contributes with important information for the assessment of its conservation status.

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