



## Taxonomic and biological records on the south Atlantic marbled catshark, *Galeus mincaronei* Soto, (Elasmobranchii: Scyliorhinidae) off the Southern Brazilian coast

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**Abstract.** The description of *Galeus mincaronei* states that it differs from the closest related species, *G. antillensis*, in its color pattern and in morphometric diagnostic characters. However, recent analyses have revealed that the pigmentation pattern of *G. mincaronei* is highly variable, with markings along the head and dorsolateral surface ranging from elongated and fused to distinct blotches. Length of pectoral anterior margin and pectoral posterior margin displayed some degree of overlap between both species. The remaining diagnostic characters (prepectoral length and diplospondylous vertebral number), must be carefully considered due to the small sample size of *G. mincaronei* available and wide range of variation of diplospondylous vertebral number within the genus *Galeus*. The largest female (425 mm TL) had developed follicles (18 mm in diameter) in the single right ovary and enlarged nidamental glands. A mature male (410 mm TL) with testes measuring 41 and 47 mm long and calcified claspers was recorded. This information provides evidence of reproductive activity in the region of capture. *Galeus mincaronei* may be a common species of the continental slope elasmobranch community of southern Brazil, but its taxonomic resolution seems to be not clear and further comparisons to *G. antillensis* and a larger sample size are strongly advised.

**Key words:** chondrichthyes, shark, reproduction, biogeography, Carcharhiniformes.

**Resumo. Registros sobre a taxonomia e biologia do tubarão serra *Galeus mincaronei* Soto, (Elasmobranchii: Scyliorhinidae) na costa sul do Brasil.** A descrição de *Galeus mincaronei* afirma que esta se distingue de *G. antillensis*, a espécie mais semelhante, no padrão do colorido e em quatro caracteres diagnósticos morfométricos. Espécimes capturados recentemente revelaram que o padrão pigmentar em *G. mincaronei* é altamente variável e que as marcas ao longo da cabeça e superfície dorso-lateral variaram de ocelos alongados e fusionados a ocelos distintos. O comprimento das margens anterior e posterior da peitoral apresentaram certo grau de sobreposição entre as duas espécies. As características diagnósticas restantes (comprimento pré-peitoral e número de vértebras diplospondílicas) devem ser consideradas com cuidado devido ao pequeno número de exemplares analisados de *G. mincaronei* e à ampla variação do número vertebral nas espécies do gênero *Galeus*. A maior fêmea (425 mm CT) apresentou folículos desenvolvidos (18 mm de diâmetro) no único ovário direito e largas glândulas nidamentárias. Um macho adulto (410 mm CT) também foi examinado e apresentou testículos com 41 e 47 mm de comprimento e cláspes calcificadas. Estas evidências sugerem que haja uma atividade reprodutiva desta espécie na região de captura. Desta forma, *G. mincaronei* deve ser uma espécie comum na comunidade de elasmobrânquios da plataforma continental do sul do Brasil. No entanto, sua resolução taxonômica não está claramente definida e necessita de maiores comparações com *G. antillensis* e baseada em uma amostra maior.

**Palavras Chave:** chondrichthyes, cação-lagarto, biogeografia, Carcharhiniformes.

## Introduction

The south Atlantic marbled catshark *Galeus mincaronei* Soto 2001 was described based on four specimens captured in 1988 off Santa Catarina State in southern Brazil. The diagnosis of this new species is supported by four main characters: prepectoral length (16.1-18.6% of total length TL), pectoral anterior margin (8.9-10.1%TL), pectoral posterior margin (7.4-8.5%TL) and number of diplospondylous vertebrae (35-36). According to Soto (2001), this species has been misidentified with *G. antillensis* Springer 1979, which is certainly the closest related species due to the large size of mature specimens and anal fin base less than 13%TL.

The occurrence of this species in southern Brazil is quite far from the known distribution for the genus *Galeus* along the western Atlantic, previously with a southernmost record off Caribbean coast of Colombia (Bigelow & Schroeder 1948, Springer 1966, 1979, Castro 1982, Compagno 1984).

More recently, as part of a detailed assessment of deep demersal teleost species inhabiting the continental slope of Brazil, twelve additional specimens of the south Atlantic marbled catshark previously identified as *G. antillensis* were captured off Santa Catarina State. In order to identify the species, these specimens were measured and compared to the descriptions of *G. antillensis* and *G. mincaronei*. The aim of this study was to record taxonomic and reproductive aspects of *G. mincaronei*, a recently described species.

## Materials and Methods

Eight specimens (6 females and 2 males) of the marbled catshark *G. aleus mincaronei* were captured in September of 1996 (29°11'S-48°00'W one specimen) and May of 1997 (29°12'S-47°54'W, one specimen and 28°08'S-46°56'W, six specimens) by the commercial vessel "Margus II", with bottom longline at depths between 236 and 495 meters (Figure 1). All specimens were fixed in 10% formalin, preserved in 70% ethanol and deposited in the collection of the Oceanography Department at the Rio Grande University (FURG-96-0038 female 425 mm total length-TL; FURG-97-0107 female 385 mm TL and FURG-97-0108 female 310 mm TL, female 345 mm TL, female 385 mm TL, male 410 mm TL, female 365 mm TL and a male 360 mm TL). The "Margus II" longline used about 1000 Mustad Tuna Circle Hook 13/0 baited with squid (*Illex argentinus*) and a mean fishing time of 1 hour. Four additional specimens of *G. mincaronei* (captured off Santa Catarina State at the location of

"Ilha do Moleque do Sul" by commercial vessels using baited trap as fishing gear in depths between 130 and 450 m) were also examined and constitute part of the collection of the Núcleo de Pesquisas e Estudos em Chondrichthyes-NUPEC (NUPEC-545 male 415 mm TL, NUPEC-540 male 432 mm TL, NUPEC-556 male 415 mm TL and NUPEC-560 male 416 mm TL). In addition, two specimens of *G. arae* captured off Cape Canaveral, Florida-USA at depths of 425 m (NUPEC-1705 – female 280 mm TL and NUPEC-1708 – mature male 249 mm TL) were used as comparative material. Measurements to the nearest mm followed Compagno (1984) and tooth formulae were defined according to Springer (1979). Skin samples were collected from the right side of the body at the level of first dorsal fin for the analysis of dermal denticles with a scanning electron microscope ESEM 2020 ELECTROSCAN/PHILIPS (UNESP-Geociências).

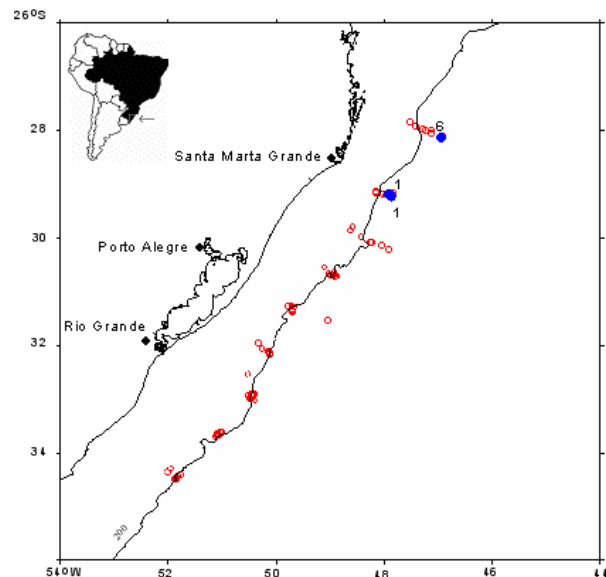


Figure 1. Sampled area where *Galeus mincaronei* was captured by Margus II. Open red dots are the stations with no captures while solid blue dots are stations where *G. mincaronei* occurred. The number of specimens captured in each sample is identified. The line crossing the stations represents the 200-m isobath.

Females were considered mature when large yolky follicles were present in their ovary or when egg cases were present in their uteri. Data collected from females included weight (g) and width (mm) of the functional ovaries, diameter of all vitellogenic follicles, width of nidamental gland, and presence of eggs in the uterus. Males were considered mature when their claspers were calcified or sperm was found in their seminal vesicles. Data collected from males included length, width and weight of testes, length (from inner axis of clasper to the clasper tip) and calcification of claspers and presence of seminal

fluid in the *ampulla ductus deferens* (seminal vesicle).

## Results

The most distinctive feature of these specimens was the strongly asymmetrical enlarged dermal denticles along the upper edge of the caudal fin and the color pattern on its dorsolateral surface (Figures 2 and 3).

The small median denticles of the caudal crest were in fewer than five rows, which start immediately posterior to the second dorsal fin and disappear on the proximal half of the dorsal margin of the dorsal lobe of caudal fin. The preventral margin of the ventral lobe of caudal fin was free of these enlarged dermal denticles. The lateral denticles at the first dorsal level were tricuspid with a median longer cusp. The crown was covered by a superficial web design except at the cusps (Figure 4). The pigmentation pattern was pale brown along the whole body with darker blotches on the dorsolateral surface. The dorsoanterior blotches were well defined, elongated antero-posteriorly and outlined with whitish circles; blotches fade to a less defined pattern posterior to the second dorsal fin. All specimens had three similar-sized blotches between the dorsal fins at each side, but the blotches between the pectoral-pelvic fins were variable in number (1 to 4) and form. One blotch covered each dorsal fin and only the posterior margin was white. The pectoral fins were light brown fading to gray on dorsal surface and dirty white on the ventral surface. All other fins had the same color pattern, except the caudal fin, which had dark pigmented marks on the corner of ventral lobe and at the subterminal notch. The ventral surface of the sharks was off white to gray, unmarked and with a more pigmented region posterior to the pelvic fins.



Figure 2. Male of *Galeus mincaronei* with 432 mm total length (NUPEC-540) in lateral view. Scale bar with 20 mm.

The tooth was pentacuspoid with a central

larger cuspid and distinct longitudinal ridges on the crown. Three series were functional simultaneously and no significant differences in tooth morphology were found between males and females. The lining of mouth was dark gray pigmented and had pinhead-sized buccal and pharyngeal dermal *oral papillae* on the palate and mouth floor (Figure 5).



Figure 3. Lateral view of the head of *Galeus mincaronei* (NUPEC-540). Scale bar with 20 mm.

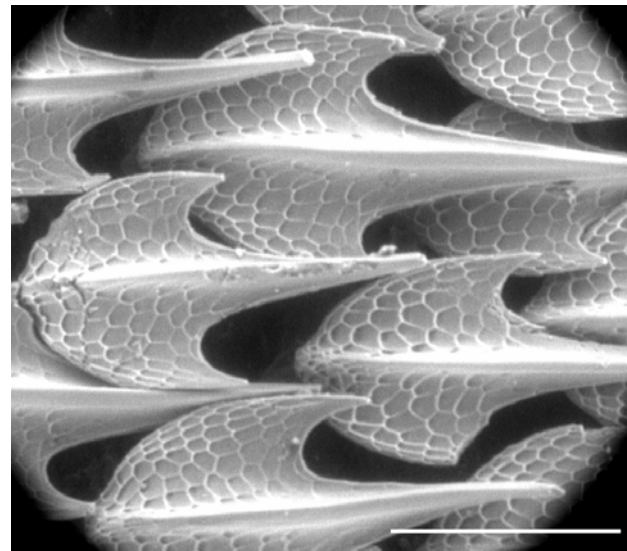


Figure 4. Microphotography of the lateral denticles of *Galeus mincaronei* (NUPEC-540). Scale bar is 150  $\mu$ m.

All specimens had a slender body with the base of first dorsal fin originating posterior to the origin of pelvic fins (Figure 2). The pelvic fins were remarkably broad, covering large area of the belly, and rounded at the angles with a slight convex anterior margin; their greatest widths measured straight across the fin near the convex distal margin were greater than the mouth width. The morphometrics and tooth formulae for males and females are given in Table I.

Eight specimens showed an anal fin base length less than the interdorsal space (anal fin base length and interdorsal space as percentage of TL, respectively: 13.4-13.6; 12.7-13.8; 12.2-13.9; 11.7-13.4; 12.8-13.7; 12.3-13.7; 13-13.7; 11.5-13.2),

Table I. Morphometry expressed as percentage of total length and tooth formulae for *Galeus mincaronei*.

	Females					Males						
Total Length	425	345	385	385	310	365	360	410	415	432	415	416
Preorbital Length	5.9	7.0	6.8	6.8	7.1	7.1	6.9	6.6	7.0	6.5	6.5	6.7
Eye Length	4.0	4.1	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.5	3.6	3.4
Eye Height	1.6	1.7	1.6	1.6	1.9	1.9	1.7	1.7				
Prenarial Length	5.2	5.2	5.2	5.5	5.2	5.5	5.6	5.4	3.6	3.2	3.4	3.4
Prespiracular Length	10.8	11.3	10.9	11.2	10.6	11.0	11.1	10.5	11.3	10.9	11.1	10.8
Internarial Space	2.6	2.6	2.3	2.6	2.6	2.7	2.5	2.4	2.7	2.8	2.9	2.9
Pre-First Dorsal Fin Length	44.7	40.6	44.2	43.1	41.9	43.8	43.1	43.9	43.9	42.8	44.8	44.0
First Dorsal-Fin Anterior Margin	6.2	7.2	7.8	7.3	7.7	8.2	7.8	7.6	7.7	7.4	7.5	7.9
First Dorsal-Fin Posterior Margin	3.3	3.5	3.6	2.9	2.9	3.3	3.6	3.4	3.4	3.0	3.4	2.9
First Dorsal Fin Base	4.5	5.2	5.7	5.2	5.5	5.5	5.6	5.1	5.5	4.9	5.1	5.3
Pre-Second Dorsal-Fin Length	62.6	59.4	61.0	62.1	59.7	61.6	62.5	62.4	62.7	61.8	62.7	62.3
Second Dorsal-Fin Anterior Margin	7.3	7.2	8.3	7.8	8.4	7.9	7.8	7.3	7.7	7.6	8.0	7.7
Second Dorsal-Fin Posterior Margin	3.5	3.5	3.4	3.1	3.2	3.3	3.6	3.4	3.6	2.8	3.1	2.9
Second Dorsal-Fin Base	5.9	5.8	5.7	5.7	6.5	6.6	5.6	5.4	6.3	5.8	5.5	5.0
Prepectoral-Fin Length	17.9	16.8	18.2	18.2	17.4	17.3	18.3	18.3	17.6	17.1	17.1	16.8
Pectoral-Fin Anterior Margin	9.4	10.4	10.1	9.9	10.6	10.7	10.3	9.5	9.4	9.5	9.6	9.1
Pectoral Fin Posterior Margin	8.2	8.4	8.6	9.1	8.1	7.9	8.9	8.0	8.0	7.6	7.7	7.9
Pectoral-Fin Base	6.6	5.8	6.0	6.5	6.5	6.3	6.4	6.1	6.0	6.0	6.3	6.3
Pectoral-Fin Pelvic-Fin Space	8.2	13.0	12.7	17.4	10.6	14.2	12.2	15.9	14.7	14.8	14.0	14.7
Length of Base of Pelvic Fins	8.2	8.1	8.6	9.4	8.1	7.9	8.3	8.3	6.7	6.7	7.5	6.7
Pelvic-Fin Length	11.3	11.3	12.5	11.9	11.0	11.8	11.1	11.7	9.6	9.0	10.4	8.7
Pelvic-Fin Anal-Fin Space	5.6	7.0	6.8	6.8	6.8	7.7	8.6	8.3	9.4	9.0	9.4	
Anal-Fin Anterior Margin	6.1	6.4	7.0	6.2	6.5	6.3	7.5	6.8	5.8	6.5	7.7	7.9
Anal-Fin Posterior Margin	8.9	9.9	9.6	9.1	9.0	8.8	9.2	7.8	7.5	7.6	7.0	7.2
Anal-Fin Base	13.4	14.5	12.7	12.7	13.5	12.3	12.2	11.7	12.8	12.3	13.0	11.5
Interdorsal Space	13.6	13.9	11.9	13.8	12.3	12.3	13.9	13.4	13.7	13.7	13.7	13.2
Prebranchial Length	15.1	14.5	14.5	15.6	13.5	13.7	14.7	14.4	14.0	13.9	14.2	14.2
Head Length	19.1	18.3	18.2	19.0	18.4	17.8	17.8	18.0	17.8	18.1	18.6	17.5
Mouth Width	7.5	8.1	8.8	8.1	8.7	8.8	8.9	8.8	8.4	8.1	8.0	7.7
Tooth Formulae (Upper Jaw)		28-1-28	30-1-29	32-2-32	31-1-31	31-1-32	32-1-32	35-2-34				
Tooth Formulae (Coger Jaw)				29-1-29			31-1-31	27-1-28				

three specimens showed an inverse pattern (14.5-13.9; 12.7-11.9; 13.5-12.3) and, in one specimen, this relation was equal (12.3-12.3). The prepectoral length ranged from 16.8-18.2 and 16.8-18.3, while the pectoral anterior margin ranged from 9.4-10.7 and 9.1-10.3 and the pectoral posterior margin ranged from 7.9-9.1 and 7.6-8.9 for females and males, respectively.



Figure 5. Snout and mouth of *Galeus mincaronei* male with 415 mm TL (NUPEC-556). Scale bar with 20 mm.

Three mature females (385, 385 and 425 mm TL) had a single developed ovary on the right hand side with yellow follicles of diameters ranging from 12 to 18 mm. The largest female (425 mm TL) had both oviducts with large nidamental glands (width of 23 mm in the left and 21 mm in the right), both uteri were flabby and empty, 8 mm wide and length of 68 mm for the left uterus and 9 mm wide and 55 mm long for the right uterus. One female (365 mm TL) had 19 white follicles of 11 mm in diameter in its ovary, nidamental glands 11 mm wide, and both uteri 6 mm wide and 57 mm long. This female was considered maturing or recently matured. Another female, 345 mm TL, was immature, based on its undeveloped reproductive tract, with its ovary full of 3 mm white follicles, small nidamental glands (4 mm wide), and both uteri with 2 mm wide and 42 mm long.

One male (410 mm TL) was mature with calcified claspers (length of 35 mm) and both developed testes with lengths of 41 mm (right) and 47 mm (left) and widths of 11 mm for both. The seminal vesicles were translucent and measured 21

mm and 24 mm of length for right and left sides, respectively. The other male (360 mm TL) was considered to be an adolescent (in the maturing process) with partially calcified claspers (length of 32 mm) and testes with lengths of 41 mm and widths of 9 mm for both sides. The seminal vesicles were 20 mm long and whitish in color. All NUPEC specimens had calcified claspers with total lengths ranging from 415 to 432 mm.

## Discussion

Konstantinou *et al.* (2000) analyzed the *Galeus arae* subspecific complex and concluded that the three subspecies, *G. arae arae*, *G. arae antillensis* and *G. arae cadenati*, showed differences in morphometric and meristic characters that support the recognition of these taxa as distinct species. These authors stated that the three species differed in at least three morphometric characters: vertebral number, size at maturity, maximum size, and, to some degree, in coloration. The Brazilian *Galeus* are larger than the reported maximum size for 207 specimens of *G. arae arae* (340 mm TL for males and 360 mm TL for females) and 5 specimens of *G. arae cadenati* (314 mm TL for females) examined by Springer (1979), but fall within the size range provided for *G. arae antillensis* (345-435 mm TL for adult females).

Soto (2001) described *G. mincaronei* and stated that it differs from *G. antillensis* in its color pattern (arrangement and number of blotches), shorter prepectoral length, smaller pectoral anterior margin, pectoral posterior margin and number of diplospondylous vertebrae. However, the differences of color pattern were not described and the form and arrangement of blotches in *G. mincaronei* could be somewhat variable (figures 1 and 2). The number of blotches in the pectoral-pelvic space ranged from one elongated and fused to 4 distinguishable blotches, while the blotches over the head varied from deformed stripes to partially fused blotches. The holotype presented in the description of *G. mincaronei* (MOVI-00147 male 404 mm TL) (Soto 2001 page 12-Figure 2) was strongly discolored, probably due to a long period of preservation in alcohol, and the line drawing in Figure 1 did not correspond to the actual color of the animal. This color inconsistency in the description of *G. mincaronei* complicates the identification of future specimens and comparisons with the holotype.

Two of the four main morphometric diagnostic characters showed some degree of overlap between *G. mincaronei* and *G. antillensis*. The pectoral anterior margin ranged from 9.1 to 10.7

as percent of TL, which overlaps the values for *G. antillensis* (10.2-12.7) provided by Konstantinou *et al.* (2000). The pectoral posterior margin ranged from 7.6-9.1 and also overlapped the range for *G. antillensis*, which was 8.8-11.6 as percentage of TL. The only non overlapping external measurement is the prepectoral length, which ranged from 16.8-18.2 and 16.8-18.3 as percent of TL for females and males, respectively, differing from the data provided for *G. antillensis* (19.4-21.8) (Konstantinou *et al.* 2000). The analysis of the vertebral number was not performed due to the lack of a good quality X-ray machine. However, according to Soto (2001), the number of diplospondylous vertebrae ranged from 35-36 (n=3) in *G. mincaronei* versus 39-48 (n=41) in *G. antillensis* (Konstantinou & Cozzi 1998, Konstantinou *et al.* 2000). Therefore, the only remaining diagnostic characters for *G. mincaronei* were the prepectoral distance and diplospondylous vertebral number. Although apparently sufficient distinctive, these significance of characters must be considered carefully due to the small sample size of *G. mincaronei* and wide range of variation of diplospondylous vertebral number within the genus *Galeus* (Springer 1979, Konstantinou *et al.* 2000). Due to these evidences, the south Atlantic marbled catshark diagnosis requires revision and further comparisons to *G. antillensis* in order to conclusively distinguish both species and validate *G. mincaronei* as a new species.

The analysis of the reproductive tract showed that larger females (385-425 mm TL) were already in the process of reproduction, while maturation probably occurs between 345 and 365 mm TL. These findings are similar to those of *Galeus antillensis* where maturity is expected to occur between 335 and 350 mm TL (Springer 1979, Parsons & Candileri, 1986). The presence of mature males and several mature females undergoing vitelogenic processes are evidence of reproduction and the presence of a population since at least one stage of its life cycle occur in the area.

*Galeus mincaronei* was captured in the mid depths of the southern Brazilian upper continental break and slope (130 to 495 m) at local mean bottom temperatures of 8 °C and salinities of 34.5 to 35‰ (Castello & Möller 1977). According to Springer & Bullis (1956), *G. a. arae* is present at a temperature range of 5.6 to 11.1 °C, while Konstantinou *et al.* (2000) showed a bathymetric distribution of 293-695 m for *G. antillensis*. These data suggest that *G. mincaronei* may occur along the Brazilian continental slope at similar depths and/or temperatures.

The hook size used by the CV Margus II

was more likely to retain larger species, such as *Polyprion americanus*, *Epinephelus niviatus* and *Pseudopercis* spp., rather than smaller forms such as *G. mincaronei*. The capture of these specimens of the marbled catshark indicates that small sharks and other fishes may occur in the area studied but are not particularly vulnerable to the fishery. If a larger directed effort to capture small sharks such as *Galeus mincaronei*, *Scyliorhinus* spp., *Parmaturus campechiensis*, *Apristurus parvipinnis*, *Schroederichthys saurisqualus* and skates and rays such as *Dipturus* spp., *Benthobatis kreffti* and *Gurgesiella dorsalifera* is made in the region, it would probably change beliefs about the rarity of these animals. The increasing number of marine programs for the study of living resources in Brazil should provide biological and biogeographic information on a great number of poorly known fishes.

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### References

- Bigelow, H. B. & Schroeder, W. C. 1948. Sharks. p. 56-526. In: Tee-Van, J., C. M. Breder., S. F. Hildebrand., A. F. Parr & Schroeder, W. C. (Eds.). **Fishes of the Western North Atlantic, Volume I**. Memoir Sears Foundation Marine Research, Yale University, New Haven. 526 p.
- Castello, J. P. & Möller Jr., O. O. 1977. Sobre as condições oceanográficas no Rio Grande do Sul. **Atlântica**, 2 (2): 25-110.
- Castro, J. I. 1982. Sharks of North American Waters. Texas A & M. 249 p.
- Compagno, L. J. V. 1984. **Sharks of the World. An**

- annotated and illustrated catalogue of sharks species known to date.** Part.1- Hexanchiformes to Lamniformes. FAO Species Catalogue. Fish. Synopsis, Rome: FAO. 4 (125): 249 p.
- Konstantinou, H. & Cozzi, J. 1998. *Galeus springeri*, a new species of sawtail catshark from the Caribbean Sea (Chondrichthyes, Scyliorhinidae). **Copeia**, 1: 151-158.
- Konstantinou, H., J. D. McEachran & Woolley, J. B.. 2000. The systematics and reproductive biology of the *Galeus arae* subspecific complex (Chondrichthyes:Scyliorhinidae). **Environmental Biology of Fishes**, 57: 117-129.
- Parsons, G. R. & Candileri, S. I.. 1986. Observations on the reproductive biology of the marbled catshark *Galeus arae antillensis*. **North Gulf Science**, 8 (2): 149-150.
- Soto, J. M. R. 2001. *Galeus mincaronei* sp. nov. (Carcharhiniformes, Scyliorhinidae), a new species of sawtail catshark from southern Brazil. **Mare Magnum**, 1 (1): 11-18.
- Springer, S. & Bullis Jr., H. R. 1956. Collections by the Oregon in the Gulf of Mexico. **United States Fish and Wildlife Service, Special Scientific Report Fisheries**, 196:1-134.
- Springer, S. 1966. A review of Western Atlantic cat sharks, Scyliorhinidae, with descriptions of a new genus and five new species. **Fishery Bulletin**, 65 (3): 581-624.
- Springer, S. 1979. A revision of the catsharks, Family Scyliorhinidae. **NOAA Technical Report NMFS**, circular n° 422:152 p.

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