

First record of *Sphyrna gilberti* Quattro et al., 2013, on the coast of Campeche, México

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ABSTRACT

Sphyrna gilberti is a large hammerhead shark described off South Carolina and data distribution on other regions of the Western Atlantic are unknown. An adult male with a total length of 240 cm was collected in 2021 on Campeche, Southwestern Gulf of México. The precaudal vertebral count of the examined individual was 89, and a large head and a robust caudal peduncle were observed. This study documents the first record of *S. gilberti* in Mexican waters.

Keywords: *Sphyrna gilberti*, Cephalofoil, distribution, First-record, Campeche

Introduction

The hammerhead sharks (Carcharhiniformes: Sphyrnidae) are characterized with their distinctive feature being the presence of a modified head with two folds or blades expanded and compressed dorso-ventrally, known as cephalofoil (Compagno, 1984). In general, species identification of hammerhead sharks is based mainly on the morphological differences that occur in the cephalofoil. Within the family are currently accepted two valid genera *Eusphyrna* and *Sphyrna* (Compagno, 1984), and ten recognized species (*Eusphyrna*= 1, *Sphyrna*= 9) (Ebert et al., 2021). Hammerhead sharks are inhabitants of coastal and insular waters, distributing in tropical and subtropical zones of all the oceans (Compagno, 1984). Some of the sphyrnid sharks, such as the scalloped hammerhead (*Sphyrna lewini*) and the great hammerhead (*Sphyrna mokarran*), are considered as nomadic and migratory (Commission SSGotISS, 2007). Hammerhead sharks can be divided into two large groups by the shape of their cephalofoil: the large cephalofoil group (*E. blochii*, *S. mokarran*, *S. zygaena* and the *S. lewini-gilberti* group) and the small cephalofoil group (*S. tudes*, *S. corona*, *S. tiburo* and *S. media*) (Cavalcanti, 2007). Within these groups, the "*lewini-gilberti* group" is of great interest due to the complexity of species identification.

The presence of seven species of hammerhead shark have been reported in Mexican waters being these for the Pacific Ocean: *S. corona*, *S. lewini*, *S. media*, *S. mokarran*, *S. zygaena* (Pérez-Jimenez, 2014) and *S. vespertina* (Del Moral-Flores et al., 2016), and for the Gulf of México and Caribbean Sea: *S. lewini*, *S. mokarran*, *S. tiburo* (Salomón-Aguilar, 2012). To date, there is no record of the presence of *S. gilberti* for Mexican waters.

The South Carolina hammerhead shark *Sphyrna gilberti* is the most recently described species of the family Sphyrnidae, considered a cryptic species of *S. lewini*, presents as diagnostic characteristic 81 to 90 precaudal vertebrae (Quattro et al., 2013). To date, the distribution range of *S. gilberti* in Western Atlantic Ocean is recorded only off the coast of South Carolina, United States (Quattro et al., 2013). Aspects about its biology are unknown mainly due to incorrect identification and confusion with *S. lewini*, but it is believed to share habitat, show similar behavior and have the same reproduction type (Ebert et al., 2021). In the present study, authors report on the first record of *S. gilberti* off the Mexican coasts of the Gulf of México.

Material and Methods

On 10th of March, 2021, a male specimen of a hammerhead shark (Sphyrnidae) with 240 cm of stretched total length (SLT) was incidentally caught by a snapper bottom longline with 250 m of length, with 100 snoods attached to No. 8 fishing hooks and operating at a deep between 20-30 m in the southern coast of the state of Campeche, México, near of the 91°30'36"W 19°49'26"N point (Fig. 1).

Initially, it was supposed that it was a specimen of *Sphyrna lewini* (Griffith & Smith, 1834), however, there were doubts due to notable differences in the length of the head and a some robustness in the caudal peduncle that the fishermen did not recognized for *S. lewini*. Due to its size, the specimen was processed as fillets, so photographs and measurements were taken *in situ*, the vertebrae were counted after processing, and the jaw was examined by the third author and preserved by the fishermen who catch it. The photographs taken in the landing site were used to calculate, as far as possible, the measurements proposed by Compagno (1984, 1988) using Photoshop ® following Reiss's recommendations (Reiss, 2007). Measurement comparisons were made using the proportions published by Quattro et al. (2013) for *S. gilberti* and *S. lewini*. Vertebrae counting was performed after traditional commercial processing. Being *S. gilberti* a species only identifiable by the vertebral counts (Quattro et al., 2013) and by the unexpected presence of the examined specimen, the lack of freezing infrastructure, lack of quick access to conservation chemicals (alcohol), and the speed of the filleting and sale of the shark at the commercial processing zone made impossible to preserve a tissue sample for genetic analysis.

Results and Discussion

The specimen presented a 240 cm of stretched TL and 160 of precaudal length. The posterior margins of the pelvic fins are weakly convex with an angle of just over 160° (Figure 2A, 2B & 2C), it was a mature male with well-calcified clasper and mating bruises (Figure 2D) and semen flowing under the pressure of the siphonal sac.

A total of 25 morphometric measurements were taken (Table 1). Of the morphological characteristics was highlighted that the specimen had 89 precaudal vertebrae, a head length (HDL) to total length ratio of 25 % and its dental formulae was 15-1-15/14-1-14/ (Figure 3), a remarkable characteristic was the rounded caudal peduncle (Figure 4A).

Table 1. Morphometric proportions of *Sphyrna lewini*, *S. gilberti*, and the specimen studied in this work * according to Gilbert (1967)

Morfometrics	Quattro et al., 2013		Present study	
	<i>Sphyrna lewini</i> *	<i>Sphyrna gilberti</i>	Specimen	Measurements in cm
Stretched total length				240
Precaudal length		66	67	160
Furcal length		77	76	182
Natural total length		97	96	230
Head length	22.34	24	25	60
Prepectoral length	21.36	23	22	53
Prepelvic length	44.67	46	48	115
Preanal length	57.02	58	60	144
Pectoral-pelvic space	18.56	19	21	50
Pelvic-anal space	7.75	7	7	16
Caudal anal space	6.46	7	6	14.5
Caudal pelvic space	18.65	18	18	42
Head width	28.01	30	29	70
Indentation half lateral space	6.74	7	8	19
Posterior margin of the head	7.88	7	8	18
Nose length	6.79	8	7	17
Nacelle length	8.66	10	11	27
Nacelles height	2.65	3	3	7
Eye length	2.16	2	2	5
Eye height	1.93	2	2	5
Internarinal space	13.3	14	15	36
Mouth wide	6.92	7	7	16
Mouth length	3.75	4	4	9
Interbranchial length	5.58	6	6	15
Number of vertebrae	92-99	87	89	
Dental formulae	U 15 to 16 - 0 to 2-15 to 16, L 15 to 16-1 to 2-15 to 16*	11 to U 15-1 to 2-11 to 15, L 11 to 14-0 to 2-11 to 14	U 15-1-15, L14-1-14	

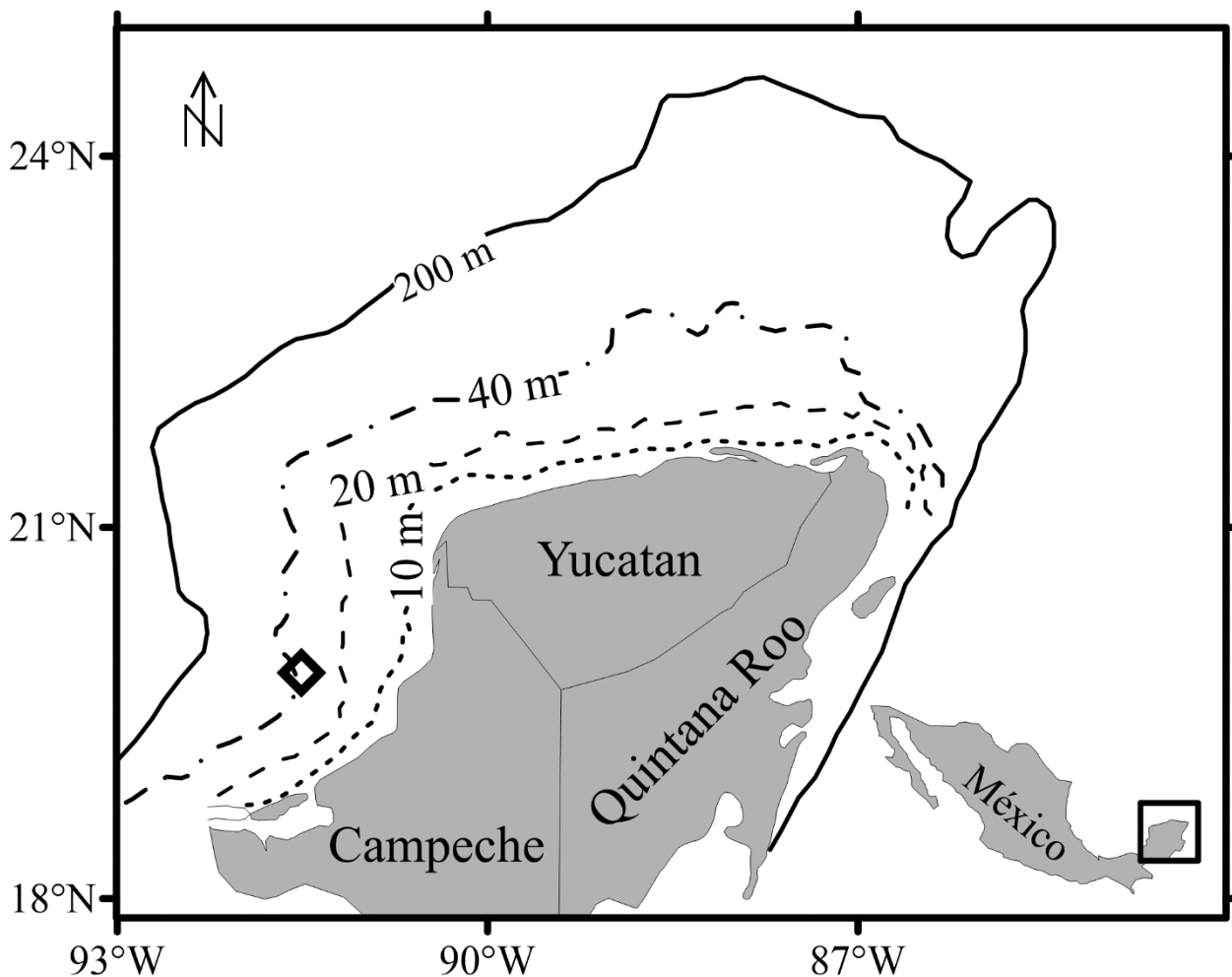


Figure 1.—Point of capture of the specimen (open rhombi) of *Sphyrna gilberti* in Southwestern Gulf of México

The examined hammerhead shark presented the main characteristic that Quattro et al. (2013) mention as diagnoses of *S. gilberti*, being this, that the count of precaudal vertebrae of the specimen (89) is in the range of reported for *S. gilberti*, which is from 81 to 90, while *S. lewini* has 92 to 99 (Quattro et al., 2013). Moreover, the expanded head (HDL to TOT = 25 %) of the examined specimen indicates that it belongs to *S. gilberti*, which Quattro et al. (2013) mention to be greater than 23 % for the species. Dentition of the examined specimen are very similar to *S. lewini* in form, however, the dental formula of palatoquadrate and Meckel's cartilage is more similar to *S. gilberti*. That is, it has fewer teeth than *S. lewini* (Gilbert, 1967; Quattro et al., 2013). On the other hand, in the detailed descriptions made for *S. lewini* and *S. gilberti* (Gilbert, 1967; Quattro et al., 2013; Ebert et al., 2021), the shape of the caudal peduncle has not been considered.

It is interesting to know that in the area of capture of the examined specimen, the fishermen recognize two groups of

common hammerhead sharks: those with round peduncle (*S. gilberti*, Figure 4A) and oval peduncles (*S. lewini*, Figure 4B), being a diagnostic characteristic to be explored.

It's also noteworthy that Barker et al. (2019) found that there's a hybridization between *S. gilberti* and *S. lewini* on the distribution range, being *S. gilberti* nearly always the maternal species. Unfortunately, Barker et al. (2019) did not analyze morphological or meristical characteristics of the hybrids so the only way to detect hybrids is by genetic methods. For further encounters of *S. gilberti* at the locality, it is necessary to be prepared to take tissue samples for genetic analysis in order to correlate meristic and genetic data to identify the possible presence of hybrids.

This shows that the analyzed specimen belongs to the species *Sphyrna gilberti*, which confirmed the extension of range to south at Mexican waters.

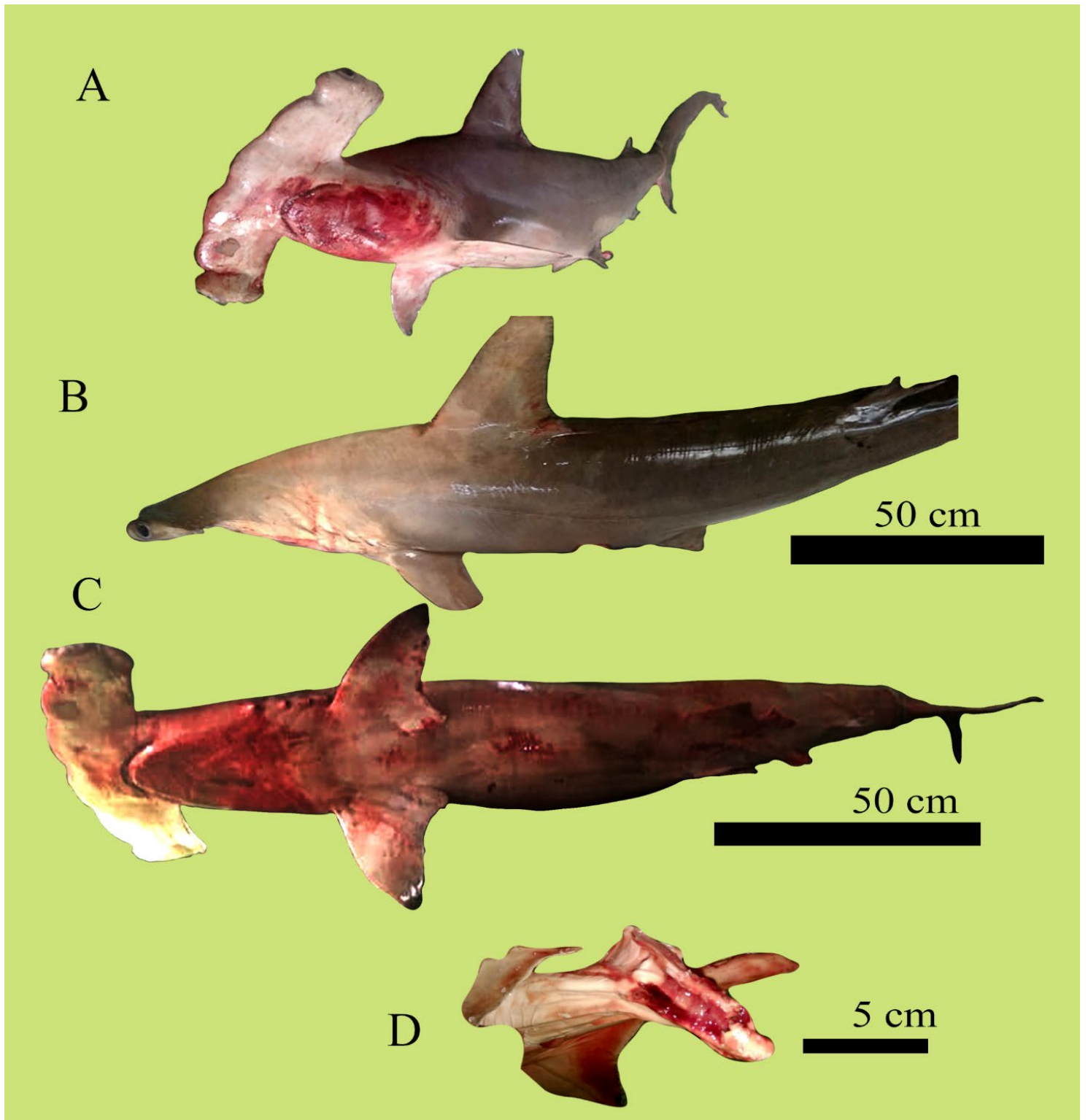


Figure 2. View of the specimen analyzed (A, B and C), clasper in extension and with mating hematomas (D). Photographs by Andrés Irigoyen-Solís

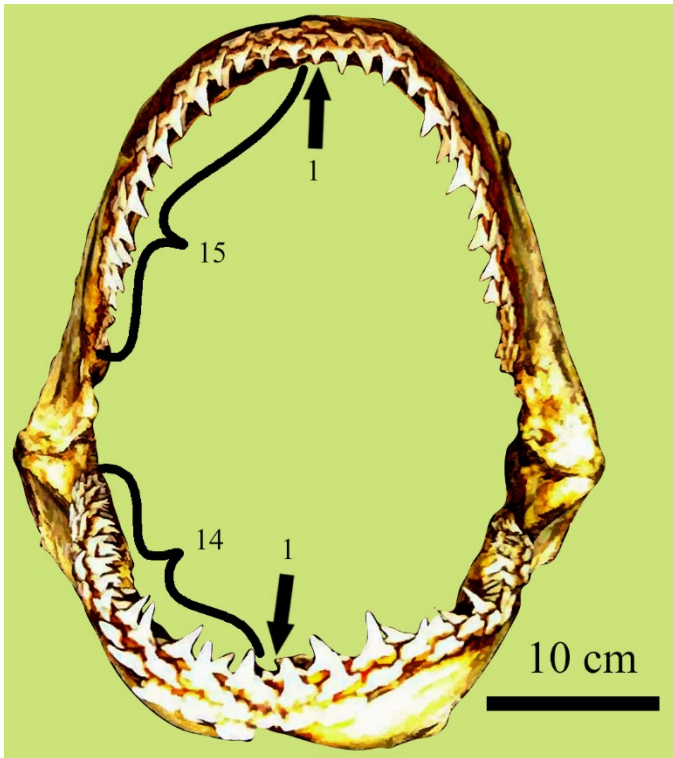


Figure 3. Jaws of analyzed specimen of *Sphyrna gilberti*, number is the countable teeth. Photograph by Andrés Irigoyen-Solís.

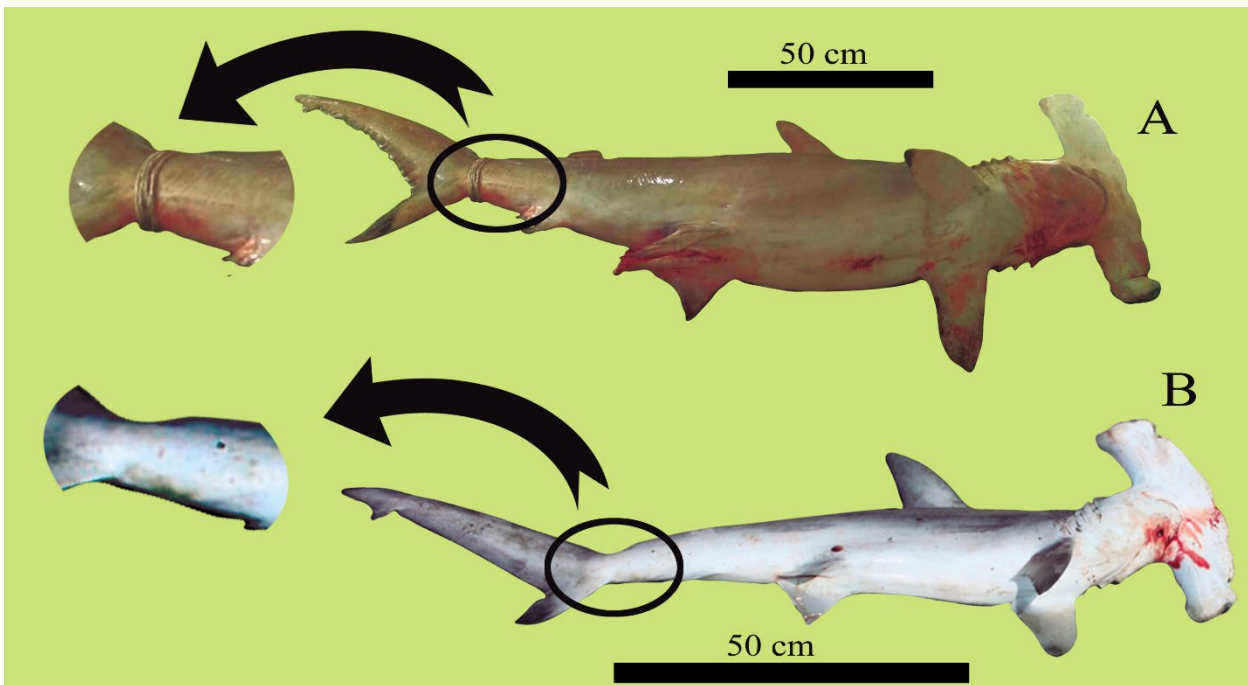


Figure 4. A graphical comparative of caudal peduncle of *Sphyrna gilberti* (A, male 240 cm of stretched total length of this work) and *Sphyrna lewini* (B, female 125 cm of Stretched total length of Oaxaca coast). Photographs A by Andres Irigoyen-Solis, and B by Vicente Anislado Tolentino.

Conclusion

The confirmation of the presence of *S. gilberti* in Mexican waters highlights the need for greater taxonomic control of the identifications of hammerheads made in the studies by the researchers, this due to great similarities with *S. lewini*. It also generates new challenges for the conservation and management of the hammerhead sharks (Sphyrnidae) on the southern coasts of the Gulf of México and Caribbean Sea. Is necessary better-trained staff for the identification of this two species to generate more realistic fisheries data for a better stock assessment, management and inspection and surveillance. On the future, this also can lead to a possible *S. gilberti* inclusion to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for more control on the international trade of this large hammerhead species.

Compliance with Ethical Standard

Conflict of interests: The authors declare that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: The present study is within the legal framework established in México: General Law of Sustainable Fisheries and Aquaculture, Official Mexican Regulations for recreational sport fishing activities in the waters of federal jurisdiction of the United Mexican States (NOM-017-PESC-1994), and Official Mexican Regulations for Environmental Protection-Mexican native species of wild flora and fauna, risk categories and specifications for their inclusion, exclusion or change to the list of species at risk (NOM-059-SEMARNAT-2001).

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Disclosure: -

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