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Short Communication

New records and morphometry of the Atlantic sixgill shark *Hexanchus vitulus* in the Caribbean coast of Guatemala

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ABSTRACT. The present study constitutes the first records and morphometry of *Hexanchus vitulus* on the Caribbean coast of Guatemala. A total of 10 Atlantic six-gill sharks were captured by artisanal fishers during 2015-2019, showing a sex ratio of 2.3:1 (males:females) and a total length that ranges 61-165 cm. Morphometric measurements are provided for future comparisons in other coastal regions. Recorded sharks corresponded mostly to sexually mature individuals, which differs from that reported for different areas of the Caribbean.

Keywords: Hexanchiformes; measurements; distribution; segregation; deep-sea species; Central America

The Atlantic sixgill shark *Hexanchus vitulus* Springer & Waller, 1969 is one of the three species of the genus *Hexanchus*, along with the bluntnose sixgill shark *H. griseus* (Bonnaterre, 1788) and the bigeye sixgill shark *H. nakamurai* Teng, 1962 (Compagno *et al*., 2005; Daly-Engel *et al*., 2019). In previous decades, both *H. nakamurai* and *H. vitulus* were recognized as the same species; however, recent genetic studies have suggested the divergence between both taxa (Ebert *et al*., 2013; Daly-Engel *et al*., 2019). In the Caribbean Sea, the knowledge of *H. vitulus* and other deep-sea sharks is scarce, as these species were infrequently captured by local artisanal fishers, and therefore scientific research regarding its biology has not been developed (Hacohen-Domené *et al*., 2016, 2017). Although there are occasional records of *H. vitulus* in Belize (Daly-Engel *et al*., 2019), Colombia (Mejía-Falla & Navia, 2019), Venezuela (Ehemann *et al*., 2019), and the Dutch Caribbean (Van Beek *et al*., 2012), there is no information about its presence in Guatemalan waters or its morphometry in any locality of the Caribbean Sea. The present study aims to report the first records with morphometry data of *H. vitulus* in Guatemala to provide useful information for future comparisons with specimens caught in other regions.

A total of 10 sixgill sharks were captured 80 km offshore the port of El Quetzalito (15°44'25"N; 88°16'27"W) by artisanal Guatemalan fishers (Fig.1). The date of capture, fishing gear, used bait, sex, total length (TL), precaudal length (PL), and fork length (FL) were registered from each shark (Table 1). Taxonomic identification was carried out by the descriptions published by Compagno *et al*. (2005) and Daly-Engel *et al*. (2019).

All the specimens were identified as *H. vitulus* due to the presence of six gills, a slender body with brown dorsal and white ventral coloration, narrow head and mouth, anterior serrations on lower teeth, and large eyes (Compagno *et al*., 2005; Fig. 2). These characteristics are the same described for *H. nakamurai*, as *H. vitulus* is considered a cryptic species with no evident external differences (Daly-Engel *et al*., 2019). The length of the specimens ranged between 61-165 cm TL, with a mean of 142 ± 29 cm TL. All the captured sharks were mature individuals, except for one juvenile female caught in 2015 (Table 1). The sex ratio was 2.3:1 (males:females), where 90% of the sharks were mature individuals. Finally, a total of 82 measurements were obtained from the last captured individual caught in June 2019 (Table 2).

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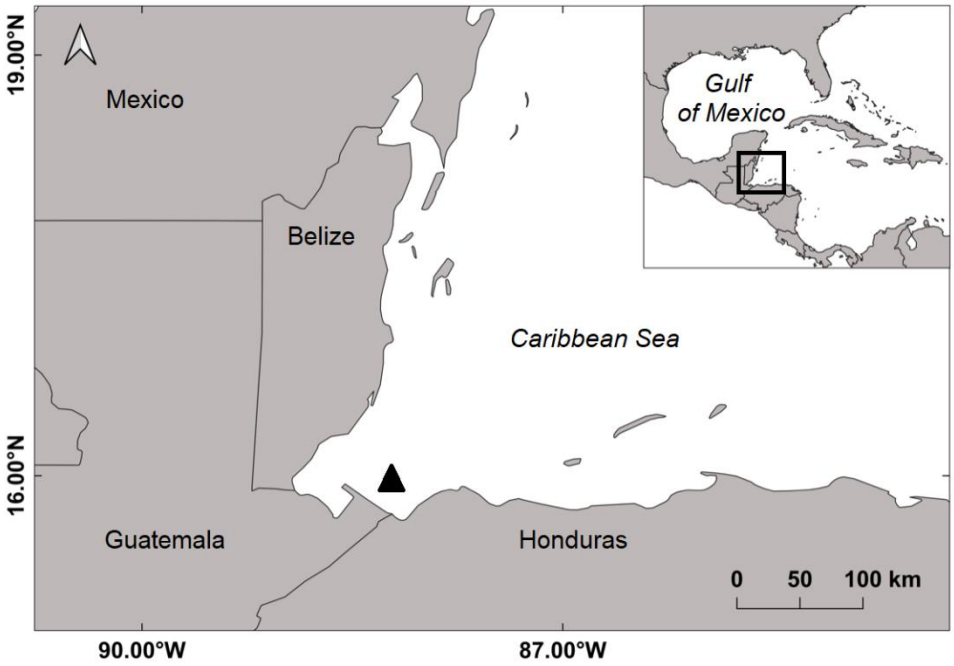

Figure 1. Location site (▲) where the specimens of *Hexanchus vitulus* were captured in the Guatemalan Caribbean during 2015-2019.

Table 1. Records of *Hexanchus vitulus* on the Caribbean coast of Guatemala during 2015-2019. TL: total length; FL: fork length; PL: precaudal length; CL: clasper length. All measurements are reported in centimeters.

Date	Fishing gear	Bait	Sex	Maturity	TL	FL	PL	CL
21/12/2015	Gillnet	-	F	Immature	61	45	41	-
20/03/2016	Gillnet	-	M	Mature	152	119	110	12
15/02/2017	Longline	*Albula vulpes*	M	Mature	144	112	104	14
23/05/2017	Longline	*Megalops atlanticus*	F	Mature	165	127	117	-
26/05/2017	Longline	Mixed species	M	Mature	153	126	116	15
03/03/2018	Gillnet	-	F	Mature	147	107	100	-
07/03/2018	Longline	*Sarda sarda*	M	Mature	148	119	106	15
02/02/2019	Longline	*Sarda sarda*	M	Mature	152	116	106	15
06/06/2019	Longline	*Megalops atlanticus*	M	Mature	150	115	105	16
06/06/2019	Longline	*Megalops atlanticus*	M	Mature	148	114	104	17

The presence of *H. vitulus* in the Caribbean has been recently discussed by Daly-Engel *et al.* (2019) through the analysis of captured individuals in Belize. In such a study, immature sharks were obtained mostly during August, September and October, at depths of 242-333 m, and temperatures of 13-17°C. In the present work, the sharks were caught through similar fishing techniques and at a similar depth (270-350 m), but with a high presence of mature individuals during March, May and July. These preliminary observations could suggest those mature individuals may be segregated from immature sharks of northern areas like Belize, which can be related to nursery areas or differences in the feeding sites for each group.

Regarding its trophic ecology, the presence of mature and immature individuals in several areas of the Caribbean could be related to differences in feeding habits according to maturity, as it has been suggested for similar species such as *H. griseus* (Compagno *et al.*, 2005; Becerril-García *et al.*, 2017). The preference of *H. vitulus* for benthic fishes and crustaceans could include hunting or scavenging of other prey such as cephalopods, marine mammals, or other elasmobranchs (Compagno *et al.*, 2005). In this manner, a potential ontogenetic dietary shift could be determined through the analysis of stomach contents and stable isotopes analysis. However, these statements are beyond the scope of this paper and should be evaluated for future

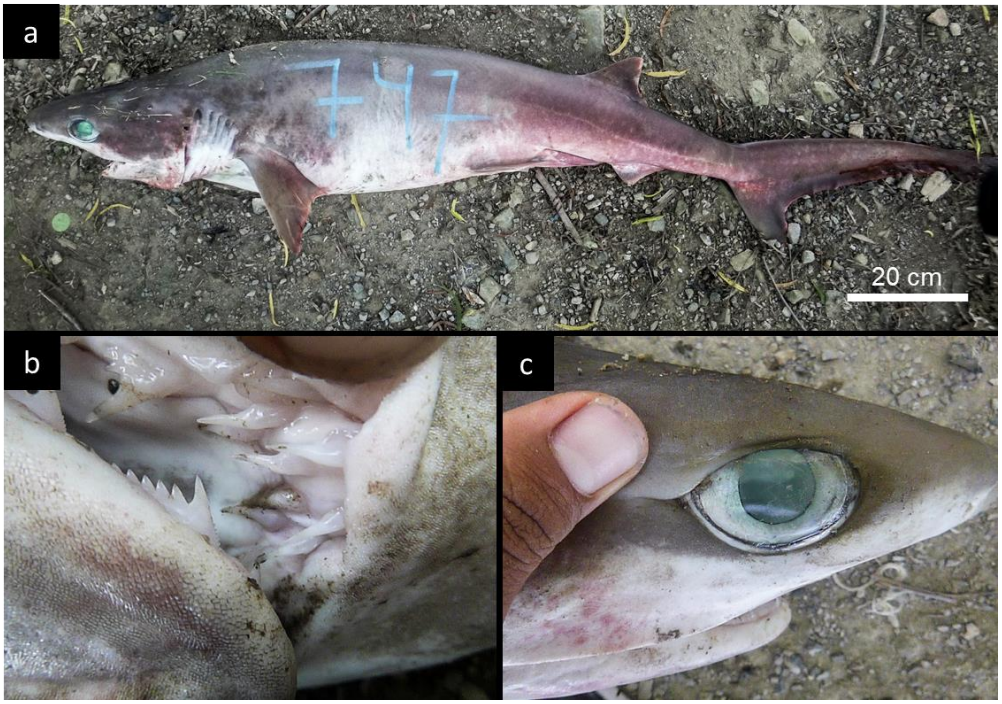

Figure 2. One of the 10 Atlantic sixgill sharks *Hexanchus vitulus* captured in the Guatemalan Caribbean during 2015-2019; a) full body showing one dorsal fin and six-gill slits, b) upper and lower comb-shaped teeth, c) large eyes.

Table 2. Morphometry (length (cm) and proportion (%)) of a mature male of *Hexanchus vitulus* caught on June 6, 2019 on the Caribbean coast of Guatemala.

Measure	Length (cm)	Proportion (%)
Total length	148	100.0
Fork length	114	77.0
Precaudal length	104	70.3
Pre-first dorsal-fin length	82	55.4
Head length	37	25.0
Prebranchial length	25	16.9
Prespiracular length	20	13.5
Preorbital length	9	6.1
Prepectoral-fin length	32	21.6
Prepelvic-fin length	68.5	46.3
Snout-vent length	74	50.0
Preanal-fin length	90	60.8
Dorsal caudal-fin space	15.7	10.6
Pectoral-fin pelvic-fin space	30.1	20.3
Pelvic-fin anal-fin space	11.7	7.9
Anal-fin caudal-fin space	11.5	7.8
Pelvic-fin caudal-fin space	28.5	19.3
Vent caudal-fin length	60.1	40.6
Prenarial length	2.8	1.9
Preoral length	8	5.4
Eye length	5.3	3.6
Eye height	3	2.0
Intergill length	6.5	4.4
First-gill slit height	13	8.8
Second-gill slit height	10.1	6.8
Third-gill slit height	8.5	5.7
Fourth-gill slit height	8	5.4
Fifth-gill slit height	7.2	4.9
Sixth-gill slit height	6	4.1
Pectoral-fin anterior margin	17	11.5
Pectoral-fin base	8.7	5.9
Pectoral-fin inner margin	7.3	4.9
Pectoral-fin posterior margin	12.8	8.6
Pectoral-fin height	22.7	15.3
Pectoral-fin length	15	10.1
Dorsal caudal-fin margin	43.8	29.6
Preventral caudal-fin margin	14.1	9.5
Upper postventral caudal-fin margin	24.5	16.6
Lower postventralcaudal-fin margin	6.6	4.5
Caudal-fin fork width	11	7.4
Caudal-fin fork length	10.6	7.2
Subterminal caudal-fin margin	5	3.4
Subterminal caudal-fin width	4.5	3.0
Terminal caudal-fin margin	8.3	5.6
Terminal caudal-fin lobe	10.5	7.1
First dorsal-fin length	10.5	7.1
First dorsal-fin anterior margin	9.5	6.4
First dorsal-fin base	8.5	5.7
First dorsal-fin height	5.8	3.9
First dorsal-fin inner margin	3.4	2.3
First dorsal-fin posterior margin	7	4.7
Pelvic-fin length	22	14.9

continuation

Measure	Length (cm)	Proportion (%)
Pelvic-fin anterior margin	7	4.7
Pelvic-fin base	10	6.8
Pelvic-fin height	5	3.4
Pelvic-fin inner margin	13	8.8
Pelvic-fin posterior margin	19	12.8
Anal-fin length	8.3	5.6
Anal-fin anterior margin	3.4	2.3
Anal-fin base	5.3	3.6
Anal-fin height	5	3.4
Anal-fin inner margin	3.6	2.4
Anal-fin posterior margin	5.3	3.6
Head height	16	10.8
Trunk height	18	12.2
Caudal-fin peduncle height	13	8.8
Second dorsal-fin origin anal-fin origin	5	3.4
pelvic-fin midpoint second dorsal-fin origin	8.5	5.7
Mouth length	10.3	7.0
Mouth width	17	11.5
Internarial space	1.5	1.0
Anterior nasal-flap length	0.5	0.3
Clasper outer length	8	5.4
Clasper inner length	17	11.5
Clasper base width	3.7	2.5
Interorbital space	11.5	7.8
Spiracle length	0.5	0.3
Eye spiracle space	5.5	3.7
Head width	18	12.2
Trunk width	29	19.6
Tail width	8.9	6.0
Caudal-fin peduncle width	4	2.7

studies regarding deep-sea elasmobranchs of the Caribbean Sea.

Future research related to the biodiversity of elasmobranchs in the Caribbean should include the use of non-lethal techniques, such as baited remote underwater video or environmental DNA analysis at different localities, depths and months (Hacohen-Domené *et al*., 2017; Daly-Engel *et al*., 2019), which could be useful to provide some insights about environmental conditions effects on elasmobranch's ecology. Artisanal fishers and deep-sea fisheries could increase in the area for the economic exploitation of sea bottom resources (Daly-Engel *et al*., 2019).

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REFERENCES

Becerril-García, E.E., Aguilar-Cruz, C.A., Jiménez-Pérez, A.A. & Galván-Magaña, F. 2017. New record and morphometry of the bluntnose sixgill shark *Hexanchus griseus* (Chondrichthyes: Hexanchidae) in Baja California Sur, Mexico. Latin American Journal of Aquatic Research, 45(4): 833-836.

Compagno, L., Dando, M. & Fowler, S. 2005. Sharks of the world. Princeton University Press, New Jersey.

Daly-Engel, T.S., Baremore, I.E., Grubbs, R.D., Gulak, S.J., Graham, R.T. & Enzenauer, M.P. 2019. Resurrection of the sixgill shark *Hexanchus vitulus* Springer & Waller, 1969 (Hexanchiformes, Hexanchidae), with comments on its distribution in the northwest Atlantic Ocean. Marine Biodiversity, 49(2): 759-768.

Ebert, D.A., White, W.T. & Ho, H.C. 2013. Redescription of *Hexanchus nakamurai* Teng 1962, (Chondrichthyes: Hexanchiformes: Hexanchidae), with designation of a neotype. Zootaxa, 3752(1): 20-34. doi: 10.11646/zootaxa.3752.1.4

Ehemann, N.R., González-González, L.D., Tagliafico, A. & Weigmann, S. 2019. Updated taxonomic list and conservation status of chondrichthyans from the exclusive economic zone of Venezuela, with first generic and specific records. Journal of Fish Biology, 95(3): 753-771. doi: 10.1111/jfb.14061

Hacohen-Domené, A., Polanco-Vásquez, F. & Graham, R.T. 2016. First report of the white saddled catshark *Scyliorhinus hesperius* (Springer 1966) in Guatemala's Caribbean Sea. Marine Biodiversity Records, 9(1): 101. doi: 10.1186/s41200-016-0103-9

Hacohen-Domené, A., Polanco-Vásquez, F. & Graham, R.T. 2017. First record of *Heptranchias perlo* (Bonnaterre 1788) in Guatemala's Caribbean Sea. Marine Biodiversity Records, 10(1): 12. doi: 10.1186/s41200-017-0118-x

Mejía-Falla, P.A. & Navia, A.F. 2019. Checklist of marine elasmobranchs of Colombia. Universitas Scientiarum, 24(1): 241-276. doi: 10.11144/Javeriana.SC24-1.come

Van Beek, I.J.M., Debrot, A.O. & De Graaf, M. 2012. Elasmobranchs in the Dutch Caribbean: current population status, fisheries and conservation. IMARES, Wageningen University Research, 12 pp.

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