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*Short Communication*

# Presence of a white shark (*Carcharodon carcharias* Linnaeus, 1758) on the coast of Veracruz, Mexico

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**ABSTRACT.** Historically, scientific records of great white sharks (*Carcharodon carcharias*) in the Gulf of Mexico have been rare; however, on January 24, 2024, a subadult male was captured in Tamiahua, Veracruz, Mexico. The specimen measured 353 cm in total length and weighed 411.9 kg, which complements the reported presence of females of the species in other regions of the Gulf of Mexico. Although capture records suggest the species is rare, local ecological knowledge from fishermen indicates that specimens were captured in previous years. The presence of *C. carcharias* in this region may be associated with the fact that, in other areas (e.g. Mexican Pacific), individuals of similar size tend to remain near the continental shelf. This record is the first officially documented record of a subadult male of *C. carcharias* in the region. This finding expands our knowledge of the species' dynamics in the Gulf of Mexico, suggesting that, as in the Mexican Pacific (Guadalupe Island), the Veracruz coast plays a key role in the conservation of this endangered vulnerable species.

**Keywords:** *Carcharodon carcharias*; artisanal fishing; sharks, endangered species; fishing refuge zone; Gulf of Mexico

White sharks (*Carcharodon carcharias*) are considered apex predators, since they feed on a wide variety of species and are preyed upon only by killer whales (*Orcinus orca* Linnaeus, 1758); therefore, the species occupies a high position in the food chain (Compagno 2001). This species can regulate its body temperature, allowing it to inhabit tropical and temperate waters (Ebert et al. 2021). In Pacific Mexican waters, *C. carcharias* is well known for inhabiting the north-western coast, especially off Baja California, the Gulf of California, and the Cedros, San Benito, Guadalupe, and Revillagigedo islands (Galván-Magaña et al. 2010).

Although rare in the Gulf of Mexico, great white sharks have been reported along the northeastern coast of Mexico, primarily between Tamaulipas and Veracruz (Del Moral-Flores et al. 2015). González-Gándara et al. (2012) documented *Isurus oxyrinchus* (Rafinesque, 1810) and *C. carcharias* in fishery records off Veracruz. The latter is considered rare in the region due to its low abundance, with sightings restricted almost exclusively to incidental catch records (Adams et al. 1994). However, recent satellite telemetry data from organizations such as the "Atlantic White Shark Conservancy" and "OCEARCH" have confirmed that white sharks are moving into the Gulf of Mexico and the Caribbean Sea.

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On February 26, 2023, a subadult female named "Caroline" (393.1 cm of total length, TL) was detected off the central coast of Veracruz (Fig.1). Subsequently, on May 14, 2023, she was localized further south, near the shelf break off Yucatán (OCEARCH & Esri 2023). One year later, on February 28, 2024, a 430 cm TL female named "LeeBeth" was tracked off the coast of Tamaulipas (Fig. 1). In contrast to "Caroline", "LeeBeth" showed a higher frequency of detections, remaining in coastal waters over the continental shelf until March 3, 2024 (Atlantic White Shark Conservancy & Conserve.OI 2024).

**Registration of the specimen in the present study**

On January 24, 2024, during routine monitoring of artisanal fishery landings in Tamiahua, Veracruz, Mexico, a specimen of *C. carcharias* was identified (Fig. 2). Morphological examination confirmed the species based on key diagnostic characters: long gill slits, a large first dorsal fin, minute second dorsal anal fins, pronounced caudal keels, a lunate (crescent-shaped) caudal fin, dark axillary spots on the pectoral fins, and large, broad, triangular, serrated teeth.

The fishermen responsible for the catch initially misidentified the specimen, as juvenile white sharks are often confused with mako sharks (*Isurus* spp.). Since the specimen was part of the commercial catch, the carcass was retained for processing and sale; however, a jaw examination was performed to verify species identity, confirming the specimen as *C. carcharias*. Figure 3 illustrates the diagnostic difference in dental morphology; unlike the serrated teeth of the white shark, mako sharks possess narrow, smooth-edged teeth lacking serrations (Martínez-Ortiz 2009).

The specimen measured 353 cm TL and had a total weight (TW) of 411.9 kg. Based on morphological characteristics, it was classified as a subadult male due to the presence of elongated but uncalcified claspers (Stehman 2002). These reproductive structures extended past the posterior margin of the pelvic fins but lacked the rigidity of functional claspers. Clasper measurements were 43/44 cm (internal length) and 28/30 cm (external length). Given that maturity occurs at 350-380 cm TL in males and 450-500 cm TL in females, the presence of this individual in the region is unlikely to be related to mating aggregations, as the specimen was not yet sexually mature (SEMARNAT 2020).

The specimen was captured using longlines. The fishermen reported that the gear was along the continental shelf break, near the municipalities of Tampico Alto and Tamiahua, Veracruz, Mexico. By cross-referencing this information with previous fishery descriptions for the region, we identified a spatial overlap between established shark fishing grounds (Reyna-Matezans 2015) and the location provided by the fishermen. Consequently, the potential capture area was delimited within the coordinates: 21°48'43.412"N-97°15'54.309"W, and 21°34'52.138"N-97°13'59.594"W (Fig. 4).

**Overall conclusions**

The presence of white sharks in the Gulf of Mexico, particularly off Veracruz, is considered a seasonal occurrence driven by the migration of individuals into subtropical waters during late winter and early spring (January-March), largely in response to decreasing sea temperatures and foraging needs (Curtis et al. 2014). During summer and fall, white shark populations in the northwest Atlantic inhabit coastal waters, shifting offshore to the open ocean during winter and spring (Skomal et al. 2017). While these offshore movements can be extensive, there is no evidence of transequatorial migration or genetic mixing with populations from other latitudes, suggesting isolation from south Atlantic, Mediterranean, and Pacific populations (O'Leary et al. 2015). The occurrence of this species in the Gulf of Mexico may be linked to regional oceanography: between September and March, currents from the Atchafalaya and Mississippi rivers flow southward along the Tamaulipas-Veracruz continental shelf. These currents transport cold, low-salinity water, which promotes biological productivity and enhances trophic activity (Zavala-Hidalgo et al. 2003).

Sharks are considered highly opportunistic predators, since their diet includes fish, other elasmobranchs, marine mammals, birds, cephalopods, crustaceans, and turtles (Compagno 2001). Although a stomach content analysis was performed, the stomach was empty (no identifiable prey items). It is worth noting that on the same day, other large sharks were landed, including a tiger shark (*Galeocerdo cuvier* Peron & Lesueur, 1822), suggesting potential habitat overlap in the region.

The tiger shark's stomach was found to contain two partially digested carcasses of bottlenose dolphins (*Tursiops truncatus* Montagu, 1821) (Fig. 5). Two bull sharks (*Carcharhinus leucas* Müller & Henle, 1839) were also caught the same day, in this case, a butterfly ray (*Gymnura lessae* Yokita & de Carvalho, 2017), a juvenile Kemp's ridley sea turtle (*Lepidochelys kempii* Garman, 1880) and a carangid fish were found within the stomach contents of these specimens. The presence of these prey items highlights the region as a rich foraging ground for large predatory sharks.

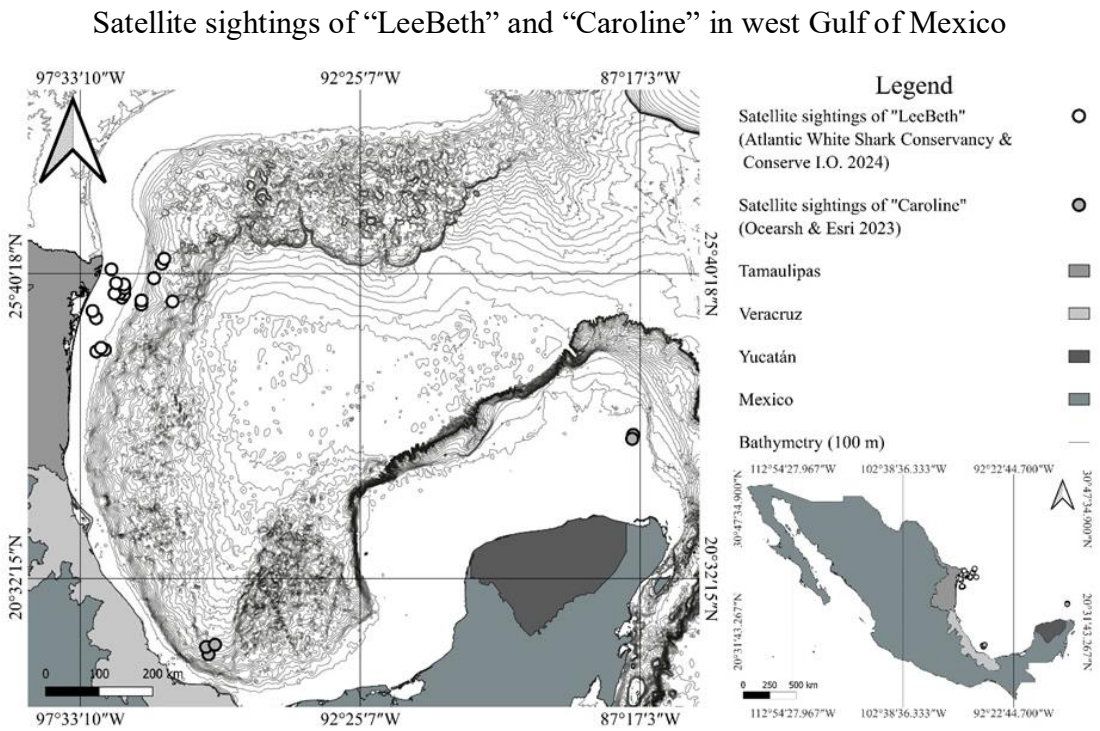


**Figure 1.** Satellite detections of "LeeBeth" and "Caroline" in the Gulf of Mexico. Data source: Atlantic White Shark Conservancy & Conserve.IO. (2024). In Sharktivity (Version 1.3.11). (https://www.atlanticwhiteshark.org/sharktivity-app) and OCEARCH, Esri (2023). Tracker (https://www.ocearch.org/tracker/detail/caroline).

**Figure 2.** Subadult male white shark (*Carcharodon carcharias*) captured off the coast of Tamiahua, Veracruz, Mexico, on January 24, 2024.

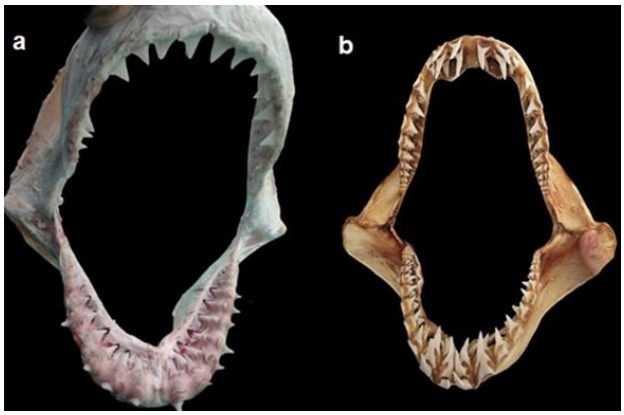


**Figure 3.** Comparison of dental morphology: a) serrated teeth of the white shark (*Carcharodon carcharias*), and b) smooth-edged teeth of the shortfin mako shark (*Isurus oxyrinchus*).

The northern coast of Veracruz offers abundant dietary resources that great white sharks can exploit. Fishery reports from Tamiahua indicate a high abundance of potential prey during the fall and winter months (September-January), particularly elasmobranchs and teleosts such as mullets and snappers (Argüelles-Jiménez et al. 2019). Throughout the Gulf of Mexico, sea turtles represent another important food source, specifically the green turtle (*Chelonia mydas* Linnaeus, 1758), loggerhead turtle (*Caretta caretta* Linnaeus, 1758), and leatherback turtle (*Dermochelys coriacea* Vandelli, 1761) (Long & Jones 1996, Fergusson et al.

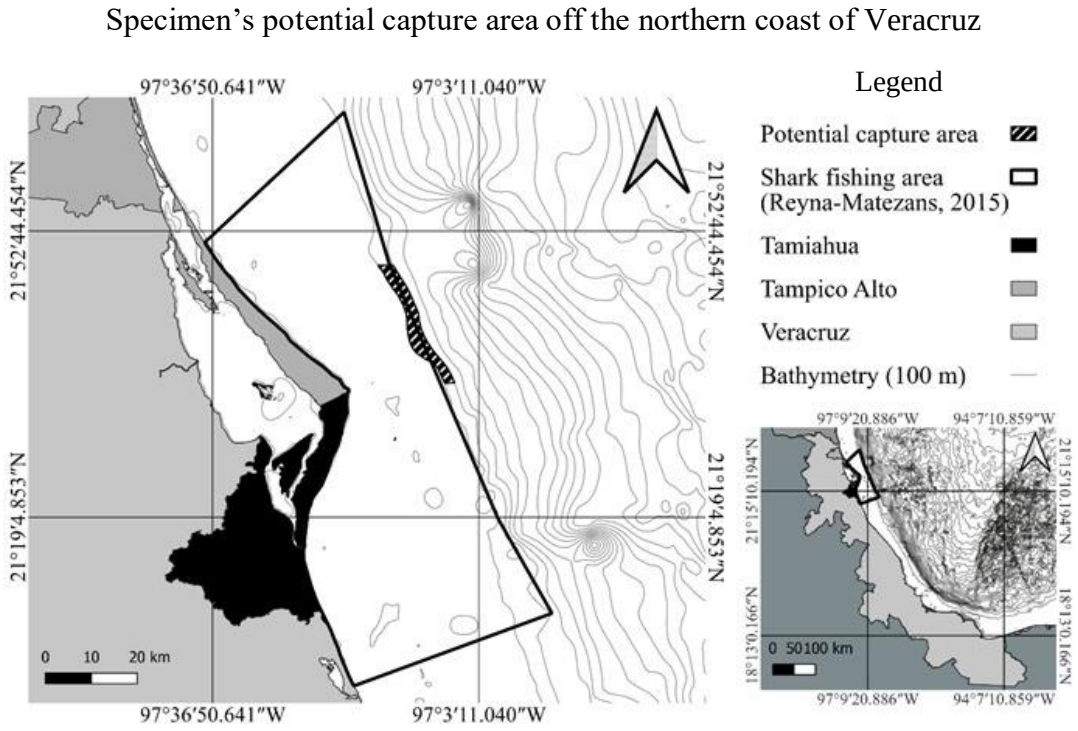


**Figure 4.** Map showing the potential capture area of the white shark specimen off the northern coast of Veracruz, Mexico.


**Figure 5.** Remains of bottlenose dolphins (*Tursiops truncatus*) recovered from the stomach contents of a tiger shark (*Galeocerdo cuvier*). a) juvenile, and b) specimen of undetermined maturity.

2000, Morey et al. 2003, Martínez-Barrientos et al. 2021). Similarly, marine mammals in the region provide potential prey or scavenging opportunities; these include dwarf sperm whales (*Kogia breviceps* Blainville, 1838), bottlenose dolphins (*T. truncatus*), striped dolphins (*Stenella coeruleoalba* Meyen, 1833), humpback whales (*Megaptera novaengliae* Gray, 1846), Bryde's whales (*Balaenoptera edeni* Anderson, 1879), and sperm whales (*Physeter macrocephalus* Linnaeus, 1758) (Long & Jones 1996, Dudley et al. 2000, Morey et al. 2003, Heckel et al 2018).

The capture of a white shark off Tamiahua, Veracruz, Mexico, together with other recent records, demonstrates the increasing occurrence of this species along the Mexican east coast. Given that most sightings are concentrated in the coastal areas near the continental shelf break and coincide with a period of

decreasing temperatures and high biological productivity, it is likely that their presence is driven by foraging behavior. These records indicate a pattern of subadult individuals utilizing the region. Consequently, these sharks may still feed on fish, invertebrates, and other elasmobranchs, or may be transitioning to marine mammals, as the ontogenetic trophic shift in white sharks typically occurs between 300 and 400 cm TL (Estrada et al. 2006).

The morphological resemblance between subadult white sharks and mako sharks poses a significant challenge, as white shark retention is prohibited in Mexican territorial waters (NOM-029-PESC-2006 and NOM-059-SEMARNAT-2010). Consequently, misidentification -whether accidental or intentional- may be occurring frequently in artisanal fisheries. Therefore, future management strategies should prioritize species identification training programs for the fishing sector. Furthermore, the region's importance to endangered species warrants consideration for establishing a fisheries refuge area.

In conclusion, given that *C. carcharias* is listed as Vulnerable on the IUCN Red List (Adams et al. 1994, DOF 2022, Rigby et al. 2022), addressing the data deficiency in the Gulf of Mexico is critically important. It remains unclear whether the species' occurrence is increasing or whether it is due to insufficient monitoring by authorities. Addressing these challenges represents a fundamental first step toward understanding the species' population dynamics, allowing for a better assessment of the Gulf of Mexico's role as a critical habitat for the conservation of this endangered vulnerable species.

### Authors contributions credits

F. Caudana-Hernández: conceptualization, validation, methodology, writing and original draft; J. Santos-Gallegos: conceptualization and provided information; Y.E. Torres-Rojas: validation, methodology, corrected language, review and editing. All authors have read and accepted the published version of the manuscript.

### Conflict of interest

The authors declare no conflict of interest.

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