

## Marine Record

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# First confirmed location of *Carcharhinus signatus* in Puerto Rico

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## Abstract

A new location record for the night shark, *Carcharhinus signatus*, is reported for Puerto Rico. DNA barcoding was used to confirm the photo identification of a shark captured incidentally by a small-scale commercial fisher. The adult female night shark was recovered from a depth of 330 m entangled in hook and line gear used in the deep-water snapper and grouper fishery. This record is the first confirmed sighting for Puerto Rico, increasing the shark species reported for the island and supporting its range up to the Mona Passage in the eastern Caribbean Sea.

## Introduction

Although 14 species of carcharhinid sharks have been reported in Puerto Rico (Russell *et al.*, 1988; Dennis, 2000; Bunkley-Williams & Williams, 2004), this number may be an underestimate due to a lack of monitoring and data reporting on the island, especially for the pelagic and deep-water species. The night shark (*Carcharhinus signatus*, Poey 1868) is a species of pelagic and coastal distribution throughout its range in the Atlantic Ocean with reports from shelf regions of the eastern North, Central and South American continents, a few Caribbean islands, and off western Africa (Espinoza *et al.*, 2018; Ehemann *et al.*, 2019; Mejía-Falla & Navia, 2019). Genetic connectivity between the north and south Atlantic populations of this species is considered low (Domingues *et al.*, 2018), and once common in Cuban waters it is now considered rare (Castro, 2011). In US waters, fisheries-dependent data indicated no apparent decline of *C. signatus* (Carlson *et al.*, 2008), yet significant population reductions throughout its range led to the species' reclassification from 'Vulnerable' to 'Endangered' (A2bd ver 3.1) by the IUCN in the most recent Red List assessment (Carlson *et al.*, 2021). The native range of *C. signatus* has been postulated to include Puerto Rico, yet no confirmed records were available to date.

Elasmobranchs are a common occurrence in Caribbean fisheries, either targeted directly or caught incidentally (Bonfil, 1997; Hacothen-Domené *et al.*, 2020; Del Pilar Blanco-Parra & Niño-Torres, 2022). The diversity and abundance of sharks in the insular Caribbean have been reportedly low except in areas with relatively lower fishing pressure (Ward-Paige *et al.*, 2010; Van Beek *et al.*, 2013; MacNeil *et al.*, 2020). Small-scale fisheries in Puerto Rico generally do not target pelagic sharks, however incidental captures and discards of sharks are rarely reported to the species level. Landings of sharks by commercial fishers in Puerto Rico are relatively low (less than 20,000 lb year<sup>-1</sup>), yet the species composition for elasmobranchs is mostly unknown (Schärer-Umpierre *et al.*, 2021), which may limit the identification of fisheries impacts upon threatened and endangered sharks.

Confirmed species reports and accurate distributions are key to inform biodiversity hot-spots, conservation status and to inform fisheries management in the region (Macbeth *et al.*, 2018). Challenges with accurate shark species identification, limited research and lack of monitoring as well as a scarcity of fishery discard reports increase the probability that rare and uncommon species are overlooked and unreported (Mucientes *et al.*, 2022). The development and increased accessibility of genetic identification techniques such as DNA barcoding have improved the accuracy and number of elasmobranch reports in areas with limited capacity (Cañedo-Apolaya *et al.*, 2021). In a combination of fishers' cooperation, photo identification and genetic analysis of samples collected, this note provides the first confirmed record of *C. signatus* in Puerto Rico.

## Materials and methods

A large unidentified species of shark was captured during a small-scale commercial fishing trip targeting deep-water (100–500 m) snappers and groupers. This incidental capture occurred on 23 August 2019, off western Puerto Rico, 51.5 km west of Mayagüez (18.256°N 67.637°W) in a fishing ground known as *La Rondana*. This area is situated in between seamounts and deep (200–500 m) ridges that extend from Puerto Rico towards Cabo Engaño, Dominican Republic (Figure 1).

The hook and line gear used is known locally as 'cala con boya' with a weighted vertical long line with 12 circle hooks (size #9) at the distal end baited with skipjack tuna



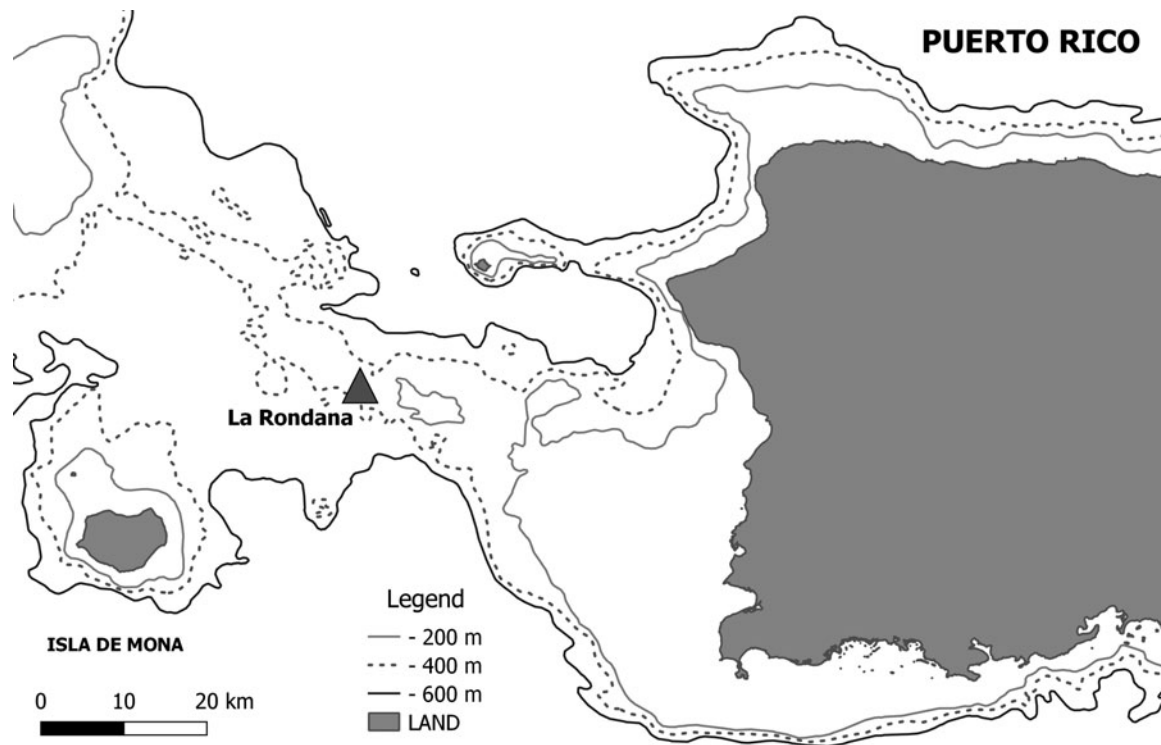


Fig. 1. Location of capture site (▲) *La Rondana*, in the Mona Passage, Puerto Rico.

(*Katsuwonus pelamis*), attached to a floating buoy that is left to drift with the current. Hook leaders measure ~46 cm from the main vertical braided line, which is retrieved with an electric reel. Upon retrieval the shark was dead, entangled by the main line at the distal end of the gear, with lines tightly wrapped around the tail and body with multiple hooks embedded in its skin. The gear had been soaking for ~30 min at a depth of 330 m. Photos, a description of the shark's appearance and a small tissue sample preserved in 90% alcohol were made available to the authors. All measurements were estimated by the crew prior to discarding it at sea.

DNA barcoding using mitochondrial gene cytochrome oxidase subunit 1 (CO1) was used to genetically identify the species. A small amount of white muscle was preserved in 90% ethanol, and genomic DNA was extracted from ~25 mg of the tissue sample using the QIAGEN DNeasy kit (QIAGEN Inc., Valencia, CA, USA). A ~355-base pair (bp) fragment from the region was amplified with polymerase chain reaction (PCR) using the primer set LCOI (5'- ggtcaacaaatcataagatattgg -3'), and HCOI (5'- taaacttcagggtgaccaaataatca -3') (Folmer *et al.*, 1994). The thermal conditions of the PCR reaction were: 3 min at 94°C; 35 cycles of 40 s at 94°C, 40 s at 50°C and 1 min at 72°C; and a final extension of 7 min at 72°C as was performed by Fariña *et al.* (2014). The amplified product was sent to MCLAB-San Francisco, CA for sequencing. DNA (CO1) sequences were inspected for quality, end-trimming and base assignment accuracy in Geneious (v11.1.5). Sequence direction was determined and standardized across sequence sets using Geneious and the Basic Local Alignment Search Tool (BLASTn) in the National Center for Biotechnology Information (NCBI) for identification.

## Results

The non-gravid female shark had an estimated total length of 215 cm and approximate weight of 65 kg (Figures 2 and 3). Photos were examined by one of the authors and some of the most

notable characteristics used for preliminary identification of *Carcharhinus signatus* included large green coloured eyes, a slender pointed snout, and relatively low first dorsal fin. Genetic analysis of the tissue sample's COI sequences (363 bp) matched 99.45% with the COI sequence of *C. signatus* (GenBank: MH911151.1). There was no sequence divergence (p-distance) between the Puerto Rico and the Brazil specimen. Thus, the species identification of this specimen is confidently assigned to *C. signatus* (GenBank: MZ413382).

## Discussion

This observation confirms the species range and increases the island's recorded elasmobranch biodiversity. The range of *C. signatus* includes most of the Atlantic Ocean, mainly off the North-west Atlantic continental shelf, including the USA, Caribbean and Gulf of Mexico to South America extending to Argentina (Bigelow *et al.*, 1948; Compagno, 1984; Menni *et al.*, 1995; Marín *et al.*, 1998). It has also been reported off the West African coast in both Senegal and Namibia (Castro, 2011; Ebert *et al.*, 2013). Caribbean reports to date have occurred mostly off the Central American and South American continental shelves and the islands of the Bahamas and Cuba (Kohler *et al.*, 1998; Santana *et al.*, 2006; Aguilar *et al.*, 2014; Cortés *et al.*, 2015; Hacohen *et al.*, 2020). Movement data gleaned from one tagged *C. signatus* showed migration between Cuba and Belize (Baremore *et al.*, 2019).

Although Puerto Rico is within the reported range of *C. signatus* a confirmed locality is key to understanding their population connectivity in the western Atlantic (Domingues *et al.*, 2018). It is also important for studies of zoogeography, since one other elasmobranch, *Urobatis jamaicensis*, occurs only at Mona Island (Dennis *et al.*, 2005), and not 42 km eastwards on the insular platform of Puerto Rico. This report also increases the confirmed number of species in the family Charcharhinidae



Fig. 2. Ventral view of shark head.

occurring in Puerto Rico to 15 (Russell *et al.*, 1988; Dennis, 2000; Bunkley-Williams & Williams, 2004).

The night shark is a deep-water coastal or semi-oceanic species inhabiting waters ranging from 50–600 m in depth (Compagno, 1984; Ebert *et al.*, 2013). Its vertical distribution coincides with pelagic long-lines as well as demersal hook and line gears, often deployed at seamounts and abrupt seafloor features (D'Ambrosio-Ferrari *et al.*, 2018). Fisheries interactions with sharks in Puerto Rico have only recently been documented for the local small-scale commercial fleet (Schärer-Umpierre *et al.*, 2019), and very limited information regarding mortality and discards from long-liner logbooks is available for the region (Cortés *et al.*, 2007; Mucientes *et al.*, 2022). The size of this female suggests it was mature, based on the total length at maturity (205 cm) reported in the south-western equatorial Atlantic (Hazin *et al.*, 2000). Due to the scant information available regarding the ontogenetic habitat use of sharks, the relative risk of non-targeted fishery interactions to highly migratory species in the US Caribbean remains unknown.

Confirmation of *C. signatus* occurrence in Puerto Rico for the first time is likely due to a combination of misidentifications, misreporting, lack of a fisheries landing's validation programme, absence of at-sea observers (contrary to the fleets operating off USA) and research capacity limitations. The low biological productivity, highly migratory nature, low resilience to fishing mortality (Musick *et al.*, 2011) combined with unreported discards of endangered, threatened and protected sharks (Mucientes *et al.*, 2022) require a particular methodology to evaluate the



Fig. 3. Lateral view of shark head and pectoral fins.

effectiveness of fisheries management and conservation strategies for this and other highly migratory as well as threatened and endangered species. Species-specific information regarding the distribution, habitat use and types of fishery interactions is required to design adequate strategies to address the decline of shark populations in the region.

#### SYSTEMATICS

Order CARCHARHINIFORMES  
Family CARCHARHINIDAE  
Genus *Carcharhinus*  
*Carcharhinus signatus* (Poey, 1868)

**Data.** All relevant data are within the manuscript.

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**Author contributions.** M.T.S. conceptualized the research, collected the data, investigated, created the figures, drafted the original manuscript, and edited the various versions. G.F.-R. conducted the laboratory and sequencing analyses and reviewed and edited the manuscript.

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**Conflict of interest.** None.

**Ethical standards.** Not applicable.

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