

Occurrence of the largetooth sawfish *Pristis pristis* (Linnaeus, 1758) in northern Peru

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The largetooth sawfish (*Pristis pristis*) is listed as Critically Endangered on the IUCN Red List (Kyne *et al.* 2013). This species has been recorded in the Eastern Tropical Pacific, where its range has been described as extending from Mazatlan, Mexico, to northern Peru (Chirichigno & Cornejo 2001). Recent research efforts suggest that largetooth sawfish are now extremely rare or locally extinct on Mexico's Pacific coast (Bonfil *et al.* 2018). There is no current information on the status of largetooth sawfish in Panama or Colombia; the most recent record of a largetooth sawfish captured on Colombia's Pacific coast occurred in 2007 (Chasqui *et al.* 2017). In Ecuador, the species had been considered extirpated. However, in 2014, a large largetooth sawfish was captured by local fisherman in southern Ecuador, taken to the fishing port of Salinas and then released by the environmental agency (Barriga 2012; Rosas-Luis 2014). In Peru, recent reports of largetooth sawfish have been rare, but two captures of largetooth sawfish by fishermen (2014 and 2015) in northern Peru were reported (Mendoza *et al.* 2017). This confirms that the species is still occasionally encountered in this region.

Currently, there are technologies and techniques which promote the quick and efficient identification of species (Chanchay & Pereira, 2017). The use of DNA sequences has been proposed as a fundamental basis in biological classification (Tautz *et al.*, 2003) and as an analytical tool for the recognition and identification of species, particularly in complex groups (Besansky *et al.*, 2003). One specific method that serves for the discrimination of closely related species involves the analysis of sequences from a fragment of the cytochrome c oxidase subunit I (COI) gene and their comparison to a library of sequences obtained from verified specimens (DNA barcoding) (Hebert *et al.*, 2003). However, it is key that the organisms from which the reference sequences are established are correctly identified, whether by morphological, ethological or molecular methods, by expert taxonomists (Vera *et al.*, 2012). Likewise, the use of Local Ecological Knowledge (LEK), also known to fishermen as local ecological knowledge (Bonfil *et al.* 2018), is important when gathering baseline information (such as taxonomic identification) about poorly documented or threatened species, including teleosts, sea turtles, cetaceans and sawfishes (eg Tregenza 1992, Carreras *et al.* 2004, Turvey *et al.* 2010, Leeney & Poncelet 2015).

The present work aimed to study in an integrative way the information available for the correct identification of the largetooth sawfish. A combined approach, using DNA barcoding, the ecological identification provided by fishermen and taxonomic identification based on characteristics of the rostrum, was employed in order to report a new occurrence of the largetooth sawfish in the waters of northern Peru and, therefore, propose better management policies for the conservation of this critically endangered species.

On March 1, 2017, a largetooth sawfish was incidentally caught by an artisanal fishing boat (target species: tuna), using a gillnet (mesh size: 7"), approximately 2 miles from the coast off of El Ñuro, Piura (4°13'S; 81°10'W). The animal was landed on the south side of the pier of Máncora, Piura (4°06'S; 81°03'W). The fishermen indicated they knew of the historical presence of this species in the area from stories but this was the first time they had actually seen an individual in person.

It is important to note that the fins of this animal were sold for approximately US\$ 35 (pers. obs.). The fisherman indicated there was interest in the purchase of the rostrum from people dedicated to the sale or use of the rostral teeth of the largetooth sawfish as spurs for cockfighting. In addition, although the fisherman decided to keep the rostrum, after 11 months, due to fishing shortages, he sold the rostrum for approximately US\$ 1180 (pers. obs.) to buy new fishing equipment. The rest of the animal was sent to Chiclayo, Lambayeque ($6^{\circ}46'S$; $79^{\circ}50'W$) for sale, but according to the person who did this work, he could not sell the specimen because its meat does not have a market in that locality.

It was possible to collect photographs of the rostrum of this specimen for morphological identification (Figure 1a, 1b, 1c and 1d). In addition, tissue was collected from the rostrum, which was sent to the coastal Laboratory of the Tumbes-Instituto del Mar del Perú (Peruvian Institute of Sea), where DNA extraction by commercial kit and PCR amplification of the barcode DNA region were performed for sequencing and genetic analysis, following the methodology described by Siccha-Ramirez *et al.* (2014).

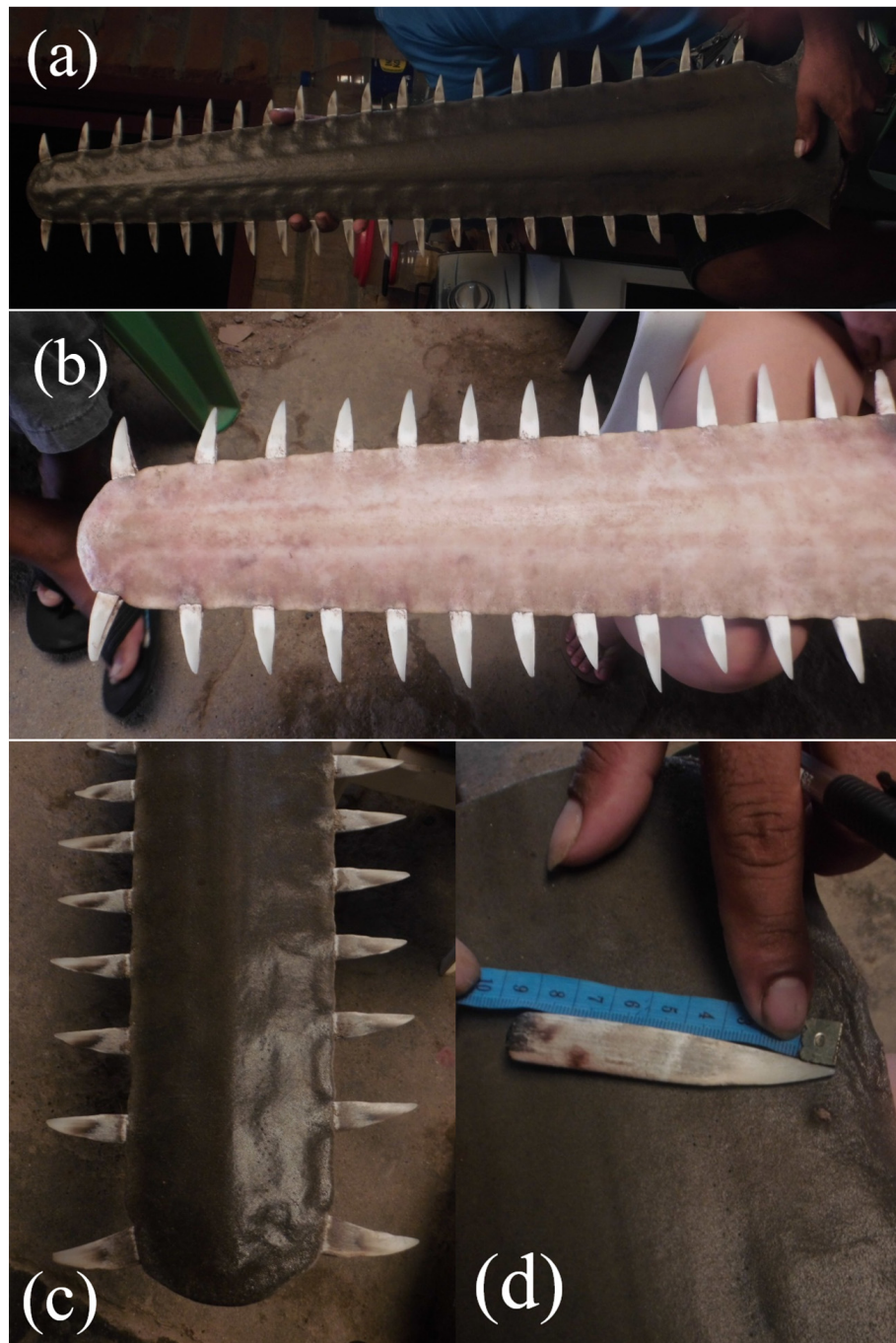


FIGURE 1. Rostrum and teeth of sawfish landed in Máncora. (a) Superior view of rostrum, (b) inferior view of rostrum, (c) zoom to rostral teeth, and (d) tooth extracted from the rostrum, measuring approximately 95 mm.

The genetic sequence comparison analysis (Figure 2), using BOLD as a reference base, indicates that the collected tissue belongs to the species *Pristis pristis* (100%), confirming the information provided by the fishermen and morphological identification of the rostrum. It is important to highlight that this species has synonyms that are still used in BOLD, therefore, for the genetic sequence comparison analysis, sequences of both *Pristis pristis* and *Pristis microdon* (a junior synonym) were considered.

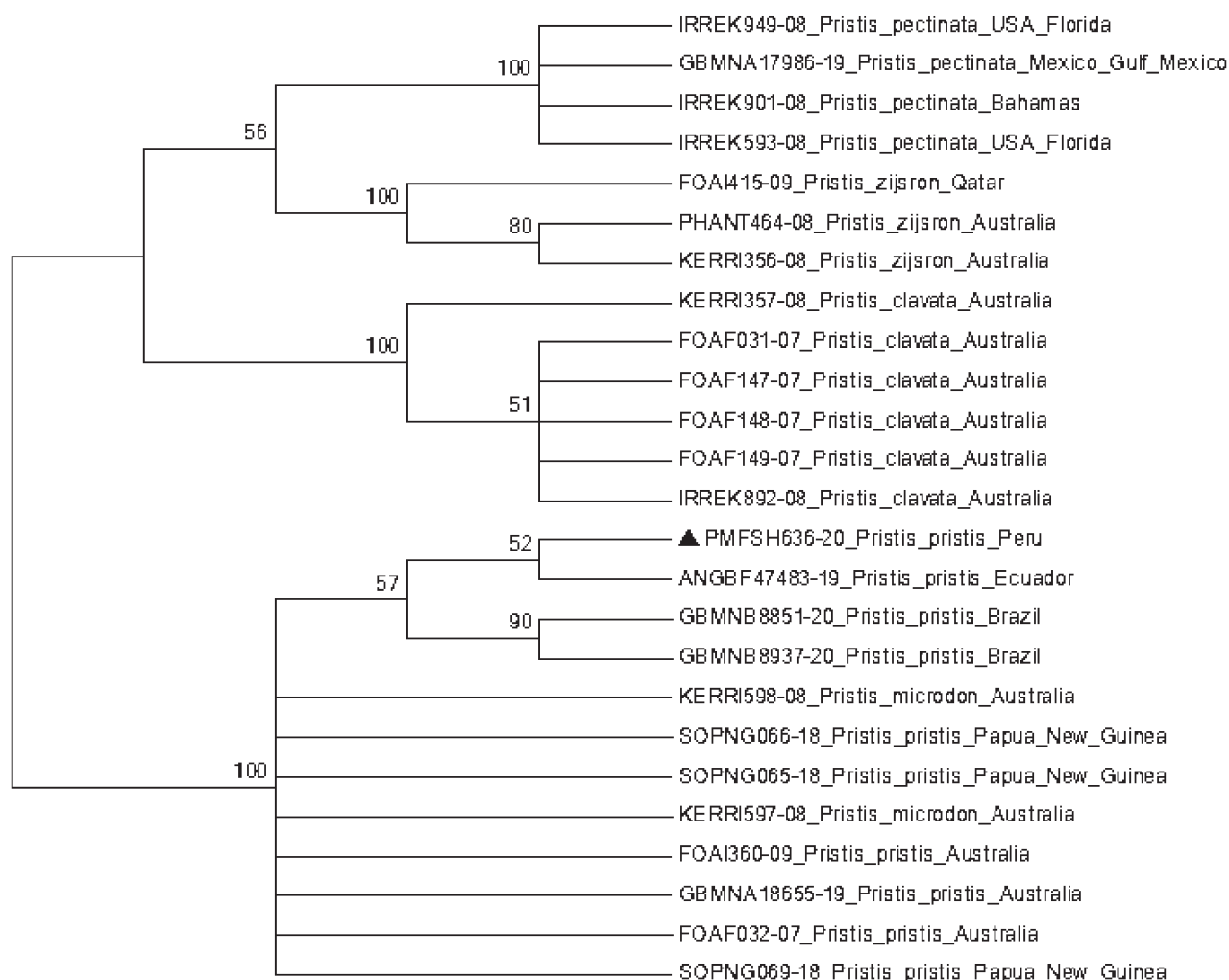


FIGURE 2. Neighbor-joining phylogenetic tree based on sequences of the COI gene of *Pristis* species available in Barcode of Life Data Systems (BOLD) and sequence of *Pristis pristis* from Peru (indicated by triangle in tree; BOLD ID Code: PMFSH636-20).

This specimen was morphologically identified following Whitty *et al.* (2014), the toolkit developed by the Sawfish Conservation Society (www.sawfishconservationsociety.org) and also based on the fishermen's local ecological knowledge. The gap between the rostral teeth gradually increases from the base to the tip of the rostrum (Figure 1a, 1b and 1c). This is a key characteristic of *Pristis pristis* which differentiates it from other sawfish species. This suggests that the largetooth sawfish continues to live in Peruvian waters. However, its occurrence is limited, most likely revealed due to bycatch, overfishing, as well as the destruction of their habitat.

Considering this species is vulnerable to fishing and there is new legislation which prohibits their capture, conservation strategies, marine education programs and scientific data dissemination campaigns are urgent, especially in the Tropical Pacific Ocean of Peru.

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