

Former Widespread Abundance and Recent Downfall of Sawfishes in Mexico as Evidenced by Historical Photographic and Trophy Records

Ramón Bonfil, Océanos Vivientes A. C. [Living Oceans Civil Association], Cerrada Monserrat #9, La Candelaria. Coyoacán, Mexico City, 04380, Mexico. E-mail: ramon.bonfil@gmail.com

Oscar Uriel Mendoza-Vargas, Posgrado en Ciencias Biológicas de la Universidad Nacional Autónoma de México [Postgraduate in Biological Sciences of the National Autonomous University of Mexico], Mexico City, Mexico.

Melina Ricaño-Soriano, Tihuatlán, Veracruz, México.

Paola Yanira Palacios-Barreto and Nataly Bolaño-Martínez, Instituto de Ciencias del Mar y Limnología de la Universidad Nacional Autónoma de México [Institute of Marine Sciences and Limnology of the National Autonomous University of Mexico], Mexico City, Mexico.

Sawfishes (family Pristidae) have declined worldwide at an alarming rate due to combined effects of their habitat preferences, incidental catches in coastal fisheries, and habitat loss and deterioration (Dulvy et al. 2014). In Mexico, two species occurred previously, Smalltooth Sawfish *Pristis pectinata* and Largetooth Sawfish *P. pristis*, but available information suggest that the latter may be already extirpated and the status of the former is uncertain (Dulvy et al. 2014). Unfortunately, to date not a single survey or study has focused on sawfishes in Mexico and the only available information consists of records in checklists and fish catalogues (Castro-Aguirre and Espinosa 1996; Castro-Aguirre et al. 1999; Schmitter-Soto et al. 2009). Here, we present photographic and trophy record evidence collected during a recent nationwide survey demonstrating the former widespread presence of both species in Mexican coastal and inland waters and documenting their decline throughout the 1970s and 1980s.

During 2015, we conducted a structured-interview survey directed at collecting information about past and current sawfish occurrences, which included 805 people in 71 communities. At each locality visited, we attempted a census of fishers by either inviting them in advance to a meeting where we delivered a short sawfish awareness audio-visual presentation or visiting all of the fishing cooperatives in the community. In both cases, we showed photographs of Largetooth and Smalltooth sawfishes and asked who had personally seen or caught any of them; only persons with first-hand experience with sawfishes were asked to respond to our questionnaire (Appendix 1 available online). The questionnaire was applied during an informal chat with each interviewee and every effort was made to deliver the questions in a nontechnical and colloquial way. The questionnaire was applied to a total of 246 interviewees whose ages ranged from 24 to 92 years (mean = 62.4 years; SD = 12.1 years).

While conducting the survey, we discovered nine pre-21st century photographs of Largetooth Sawfish specimens and remains (Figure 1). Two additional photographs were obtained from committed individuals who posted to our public social-media page (Facebook: ProyectoPristisMexico) developed for the project (Figure 2). We also collected records of 20 Smalltooth Sawfish and 34 Largetooth Sawfish rostrum trophies kept by fish-

ers and the general public. Such trophies and other preserved marine life are relatively common in fishers' homes as well as in seafood restaurants in coastal towns and inland cities, where they are used as ambient decoration. In all cases, every effort was made to collect the most accurate data on location and date of capture for each of those sawfish records.

Photographic and trophy evidence collected during our study shows that sawfishes were once widespread along the Mexican coastline and some freshwater habitats hundreds of kilometers from the coast (Figure 3). Sawfishes were recorded in every state along the Mexican Gulf of Mexico and Caribbean coast, as well as every state between Sinaloa and Chiapas in the Pacific Coast. However, none of the persons interviewed during our 2015 survey could provide verifiable reports of live sawfishes observed recently (< 5 years) anywhere in Mexico, suggesting that their populations have crashed or have been extirpated.

Our data also allowed a reconstruction of how sawfishes declined in Mexico as time passed by and fisheries developed. The historical photographic evidence suggests that large Largetooth Sawfish were more common during the 1940s to 1960s but became scarce afterwards, coinciding with Mexico's first major fisheries development that took place in the 1970s and 1980s (Grande-Vidal 2006; Cisneros-Montemayor et al. 2015): three Largetooth Sawfish were recorded from the 1940s to 1950s, seven from the 1960s, one from the 1980s, two from the 1990s, and only one during the present century (Figures 1 and 2). Photographic equipment was much less common in the 1940s to 1960s than in recent decades, especially now that nearly everyone has a cellular phone with a camera. This suggests that Largetooth Sawfish, especially large specimens, were probably even more commonly caught in the 1940s to 1960s than our photographic records imply. But despite sustained high fishing effort in Mexico during 1999 to 2015, especially in coastal small-scale fisheries, only a single Largetooth Sawfish was caught and photographed in that period (Figure 2a). Thus, the photographic record evidences a strong decline in the abundance and range of the Largetooth Sawfish in Mexico after the 1960s.

Sawfishes were first protected in Mexico in 2002 by environmental legislation (NOM-059-ECOL-2001; Official Diary



Figure 1. Historical photographs collected during nation-wide survey. (a) Large-tooth Sawfish caught in Paso Nacional, Alvarado, Veracruz, Mexico, 1950. Photo credit: Casa de la Cultura of Alvarado. (b) Large-tooth Sawfish caught in Frontera, Tab, 1950s. The carcass of the fish can be seen behind the fishers. Photo credit: Plácido Santana, chronicler of Frontera. (c) Two very large specimens of Large-tooth Sawfish caught in Paraíso, Catazajá Lagoon, Chiapas, Mexico, circa 1960. Photo credit: Rodolfo (Fito) Inurrieta. (d) Family from the Municipality of Catazajá, Chiapas, 1960s, holding a medium-sized and two large rostra of Large-tooth Sawfish. Photo credit: Francisco Inurrieta Ceballos. (e) Large female Large-tooth Sawfish caught in shrimp trawling nets in 1964 off Sinaloa. Photo credit: Fernando Rosales. (f) Painting depicting a very large Large-tooth Sawfish, and based on a lost photograph of a specimen caught off Vega de Alatorre, Veracruz, Mexico, 1964. Photo credit: Vicente Navarro. (g) Large-tooth Sawfish caught in Barra de Palmas, Veracruz, Mexico, 1982. Photo credit: Eloy Reyes Martínez. (h) An adult female Large-tooth Sawfish caught in Isla Mujeres, Quintana Roo, Mexico, 1997. Photo credit: Raziel Rivero, who caught the fish. (i) An adult male Large-tooth Sawfish caught in Isla Tamancab, Chetumal Bay, Mexico, 1998. Photo credit: Carlos "Calim" Quintana Poot.

of the Federation 2002) and later in 2007 by fisheries legislation (NOM-029-PESC-2006; Official Diary of the Federation 2007). Unfortunately, little dissemination of such legislation in coastal communities and insufficient surveillance, monitoring, and application of most fisheries and environmental legislation in Mexico (Bonfil 2014) mean that effective protection of sawfishes is virtually nonexistent. As an example, authorities did not even learn about the Large-tooth Sawfish caught in Michoacán in 2010 (Figure 2a), much less were there any consequences for killing and selling it. However, we learned about this capture through electronic social media. Taken together, the above suggests that the decline in sawfish catches through

time (as measured by rostrum trophies and photographs) reflects a true decline in population size and is not the result of protection through legislation. In addition, only eight sawfishes were reported as seen after 2002 by the 274 interviewees, and only two of these records could be confirmed with rostra or photographs.

Additional data collected during our surveys indicated that sawfishes were mostly an incidental catch; however, 9% of questionnaire respondents indicated that they targeted sawfishes in the past. Respondents targeted sawfishes for human consumption (salt-dried), trophies (rostra), liver oil, fins, and hides, in that order of importance.

Table 1. Year of capture of sawfish rostrum trophies recorded during this study (not all records had capture date data).

Species and coast	<1950	1950s	1960s	1970s	1980s	1990s	2000s	2010s
Smalltooth Sawfish (Gulf of Mexico/Caribbean)	4	3	1	4	5	0	1	0
Large-tooth Sawfish (Gulf of Mexico/Caribbean)	2	2	2	0	1	1	0	0
Large-tooth Sawfish (Pacific)	3	2	4	8	4	1	0	0
Total	9	7	7	12	10	2	1	0



Figure 2. Historical photographs received through the project's Facebook page. (a) Large-tooth Sawfish caught in Caleta de Campos, Mich. 2010. Photo courtesy of Pedro Valencia. (b) Large-tooth Sawfish caught in Puerto Vallarta, Jal. ca. 1940s. Photo courtesy of Alberto Rivera González, grandson of the man in the left of the photograph.



Figure 3. Capture locations for sawfishes in the photographic and trophy record and live specimen found January 20, 2016.



Figure 4. Specimen of Smalltooth Sawfish (juvenile female, 154 cm TL) caught alive in Barra de Cazon, Veracruz, Mexico, January 20, 2016. Photo credit: Saaid Hernández.

The timeline of the decline of Smalltooth and Largetooth sawfishes in Mexico is even more clearly evident in the records of rostrum trophies. The large majority of sawfishes from which we found trophies were caught pre-1990s (Table 1), despite the continuation of, or increases in, the amount of fishing in Mexican waters post-1980s (Grande-Vidal 2006; Cisneros-Montemayor et al. 2015). This demonstrates that sawfishes became scarce in Mexico after the 1980s. A pattern of low numbers of rostra collected during a period when fishing effort was relatively low (pre-1950, 1950s, and 1960s), increased numbers of rostra taken during a period of great fisheries expansion (1970s and 1980s), and much less, to no rostra, taken in the recent past (1990s to date), is clear for Smalltooth Sawfish, Largetooth Sawfish from the Pacific Coast, and total sawfish count, and less clear for Largetooth Sawfish from the Gulf of Mexico/Caribbean, the latter probably due to a smaller sample size (Table 1).

The conservation status of Smalltooth and Largetooth sawfishes in Mexico is critical. The photographic and trophy record data presented here show that the abundance and range of both species have collapsed and both species might have already or are at the brink of being extirpated from Mexican waters. Our data also suggest that the decline in both species started well before protective legislation was put in place. There is still hope for Smalltooth Sawfish: a live juvenile female (154 cm total length, approximately 2 years old) was caught on January 20, 2016, in Barra de Cazones, Veracruz, by one of the fishers interviewed during our survey (Figure 4). This fish is now safe and protected in the Veracruz Aquarium, where a captive breeding program should eventually be established. Though the latter finding suggests that the Smalltooth Sawfish might still be reproducing in Mexican waters (the nearest known breeding population is in Florida [NMFS 2009], and Smalltooth Sawfish are not known to perform large migrations at sea [Carlson et al. 2014]) and therefore, the siblings and mother of this specimen might still be at large, the situation for Largetooth Sawfish could be even more alarming.

It should be no surprise that sawfishes, which are large and eminently coastal-demersal elasmobranchs with a large rostrum full of rostral teeth, became the first species to be heavily impacted by fisheries expansion in a country, where coastal gill nets are the most common fishing gear and where shrimp fishing with bottom trawl nets has been historically important. However, this is the first study to actually document the acute decline in Smalltooth and Largetooth sawfish abundances and ranges in Mexico. Our study is also an example of how ancillary forensic information can be a very helpful way to reconstruct the past and current situation of sawfishes; this model could be applied in other tropical countries with a lack of previous studies about sawfishes.

Future conservation efforts in Mexico should concentrate in actively looking for pockets of remnant sawfish aggregations or isolated individuals in areas where they used to be especially abundant and where their essential mangrove habitats (NMFS 2009; Dulvy et al. 2014) still exist. Once located, these sawfishes should be effectively safeguarded by involving local fishing communities in their protection and in the recovery of their populations. This will imply a considerable amount of grassroots and environmental awareness work. But this mission is of an urgent nature and should not be postponed any longer.

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SUPPLEMENTARY MATERIALS

Supplemental material for this article can be accessed on the publisher's website at www.tandfonline.com/ufsh.

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