What Is the Fate of Amputee Sawfish?

David L. Morgan, Barbara E. Wringer, Mark G. Allen, Brendan C. Ebner, Jeff M. Whitty, Adrian C. Gleiss, and Stephen J. Beatty

The sawfishes (Pristidae) are the most threatened of all of the world's shark and ray families, which is largely due to overfishing (Dulvy et al. 2014). There are five extant species of sawfish, all of which possess an enlarged, tooth-lined rostrum (or "saw"), which has unfortunately been central to their widespread global decline, due to the saw rendering them extremely susceptible to net entanglement (Faria et al. 2013; Dulvy et al. 2014; Whitty et al. 2014). Individuals may suffer mortality during entanglement or be euthanized or desawed prior to net removal for either operator safety or to simplify removal of the sawfish from the net.

The sawfish rostrum is a morphological marvel of nature. It includes a blade of elongated cranial cartilage, with teeth protruding from the lateral edges. Each species has a unique rostral morphology in terms of blade length and width, as well as the arrangement and shape of the rostral teeth (Whitty et al. 2014). Internally, the rostrum possesses three to five canals that extend most of its length. The medial canal, which is the largest and present in all species, represents an elongation of the brain cavity (Hoffmann 1912). The rostrum is covered in a dense array of electroreceptors (ampullae of Lorenzini), and between 80% and 84% of all receptors are restricted to the rostrum in the three species assessed by Wueringer et al. (2011).

Our understanding of how the rostrum is used is rudimentary; however, captive Freshwater Sawfish *Pristis pristis* have been shown to use their rostrum to actively sense prey-simulating electric fields and capture and manipulate prey by using lateral swipes of the rostrum to stun and/or impale fish in the water column (Wueringer et al. 2012). These behaviors have likely evolved in conjunction with the evolution of the elongated rostrum, because both *P. pristis* and their close relatives, rhinobatid shovelnose rays, respond to electric fields on the bottom in a similar fashion by biting them (Wringer et al. 2012). Though scant information exists on predator–prey interactions of sawfishes in the wild, some species exhibit ontogenetic changes in habitat selection that are hypothesized to be driven by dietary shifts and/or predator avoidance (e.g., Whitty et al. 2009).

For centuries, humans have interacted with sawfishes and have used the rostra as weapons or, more simply, taken them as curios or "trophies." This practice is akin to taking a rhinoceros horn or elephant tusks (Leader-Williams et al. 1990) and continues despite the international protection and listing of sawfishes by the International Union for Conservation of Nature as either critically endangered or endangered. The sale of sawfish rostra continues despite their international trade being prohibited through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (e.g., McDavitt and Charvet-Almeida 2004). The number of sawfish individuals impacted or killed by the removal of their rostra is unknown; however, Whitty et al. (2014) managed to readily source more than 1,000 rostra that had been removed from sawfishes in northern Australia, indicating that the practice of saw removal was at least historically commonplace. There have been a number of anecdotal reports of sawfish surviving following removal of their rostra. Removal of the rostrum is likely to severely diminish an individual's ability to detect and capture prey, and ongoing survival would presumably necessitate adaptations in terms of foraging behavior in order to meet nutritional requirements. The current study is the first to report on the ecology or behavior of sawfish that have had their rostra removed.

During a targeted sawfish survey using a monofilament gill net of 150-mm stretched mesh (see Morgan et al. 2015), the capture of an individual Green Sawfish *P. zijsron* without a rostrum in October 2011 provided a rare opportunity to examine the movement patterns and habitat utilization of an "amputee" sawfish. The wound of the sawfish appeared fresh and was bleeding, indicating that rostrum removal was recent. The male fish measured 1,445 mm total length (TL; sans rostrum) and was estimated to be approximately 1,950 mm TL if the rostrum had been intact, based on the total rostrum length = 0.2544TL + 8.164, a relationship derived from other individuals in the study area. The sawfish was tagged with a VEMCO acoustic tag (V13TP, Halifax, Nova Scotia) fitted with depth and temperature sensors and released within an existing VR2W acoustic hydrophone array spanning the Ashburton River estuary, several nearby mangrove-lined creeks, and nearshore intermediate waters in northern Western Australia (see Morgan et al. 2015). Acoustic tagging of an additional 38 individuals, ranging from 767 to 2,933 mm TL, also enabled a comparison in the movement patterns and habitat utilization of the amputee sawfish with other members of the population.

Following release, the amputee sawfish was detected on 1,069 separate occasions over a 75-day period within the acoustic array. The fish was detected at the largest number of receivers (10 of the 12) but had the lowest number of overall detections compared to all other individuals over the same time period. For example, individuals with sizes less than 1,000 mm TL, 1,000– 2,000 mm TL, and 2,000–3,000 mm TL were detected on average by 1.14 (±0.101 SE), 2.62 (±0.61 SE), and 5.8 (±1.131 SE) receivers for each size class, respectively. The largest individuals tagged (2,550–2,933 mm TL) were, on average, detected by 7.5 (±0.57 SE) receivers. Thus, this fish had the lowest site fidelity of all tagged sawfish. Additionally, a disparity was evident in habitat use between the amputee sawfish and other similarly sized individuals. For example, over 50% of the detections of the amputee were recorded when the fish was in less than 0.2 m of water, whereas an average of about 35% (±19.35) of detections of four similarly sized individuals were from the extreme shallows.

The observed differences in movement patterns and habitat use of the amputee compared to the other sawfish may reflect modifications in foraging behavior imposed by the removal of the rostrum. The individual may have ranged more widely in order to source “easy prey” (i.e., less mobile or more naive) to satisfy nutritional requirements. Additionally, or alternatively, this wide home-ranging behavior may have been a function of reduced capacity for this individual to defend itself from competitors and predators or could be related to pathological stress induced from having its rostrum removed. After 75 days at liberty, this fish was no longer detected and may have either emigrated outside the detection range of the acoustic array or may have perished given that emigration occurred infrequently for other tagged sawfish of that size.

Other preliminary evidence exists that indicates a short life expectancy for sawfishes that have suffered damage to, or removal of, their rostrum. During August 2013, the senior author captured and acoustically tagged an individual *P. pristis* (2,280 mm TL) contained in an isolated freshwater pool in the Fitzroy River, Western Australia, which had a rostrum that was partially severed near the base. This individual was severely emaciated; its damaged rostrum had undoubtedly had a considerable impact on its foraging ability. The fish, which was landlocked in a freshwater pool, was detected by a passive acoustic array on 3,538 occasions for 10 consecutive days and not thereafter. In comparison, two other similarly sized individuals tagged in the same pool within the same 24-h period were detected for several months, supporting the assumption that the injured sawfish perished within the pool and noting that there are large areas within the pool that are not covered by the acoustic array.

The decline of sawfishes due to fishing pressure is exacerbated by humans removing sawfish rostra, which undoubtedly negatively impacts survival rates of those fish, noting that most amputations in northern Australia are from the last few decades and much of the north was only recently populated by non-Indigenous people (Whitty et al. 2013). The few remaining human population centers that have sawfishes inhabiting their local waters must address this destructive phenomenon, and sawfish protection needs better enforcement globally. The conservation value of these unique species needs to be actively promoted, and the cruelty of taking rostra as trophies should be afforded the same attention as other endangered species that are similarly poached for their body parts—for example, rhinoceroses and elephants—especially because available evidence suggests that saw fih die a lingering death after rostrum removal.

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