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NOTE

LIVE RELEASE OF A BIGEYE SAND TIGER *ODONTASPIS NORONHAI* (ELASMOBRANCHII: LAMNIFORMES) IN THE WESTERN NORTH ATLANTIC OCEAN

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Although occasionally sighted by manned and unmanned submersibles (see Benfield et al., 2008), large deep-water sharks are rarely captured in part due to the inability of hook-and-line fishing gear to effectively target deep mesopelagic (200–1000 m) and bathypelagic (1000–4000 m) depths. To date, less than 15 bigeye sand tigers *Odontaspis noronhai* (Maul, 1955) have been described from both jaws and whole specimens. Three of these captures are from the North Atlantic: two from Madeira (including the holotype: Maul, 1955) and a single specimen from the western Gulf of Mexico (GOM; Branstetter and McEachran, 1986). Although little is known about the behavior and biology of *O. noronhai*, and fisheries interactions are rare, this species is thought to inhabit depths of 600 to > 1000 m (Compagno et al., 2005).

Here we describe the second reported capture and first documented release of a live *O. noronhai* in the western North Atlantic (WNA), including a first description of live coloration. This sighting is significant given the rarity of interactions involving this species and the general lack of knowledge regarding its biology.

Methods

On 27 March 2008, a bigeye sand tiger was captured by pelagic longline gear fishing in the upper 35–45 m of water approximately 900 m in depth at 29.2°N, 79.1°W in the WNA off of eastern Florida. The animal was hooked in the corner of the right lower jaw with a size 18/0 circle hook baited with dead Atlantic mackerel, *Scomber scombrus* Linnaeus, 1758 (Fig. 1). Upon reaching the side of the vessel, the shark was recognized as a rare species by the captain and crew and 12 digital photographs of the animal were taken from a distance of approximately 1 m (8.1 mega-pixel resolution; model DMC-FZ18, Panasonic Corporation: Secaucus, NJ). These photos include images of the entire head and right side dentition extending from the tip of the snout to the mid-point of the first dorsal fin. The shark was very aggressive at boatside, and the captain ordered the crew to release the animal by cutting the monofilament line near the hook (G. O'Neill, F/V Carol Ann, pers. comm.).

Results

The estimated total length (TL) of 360 cm was calculated by comparing known hook dimensions with proportional measurements of the animal from photographs, then comparing these dimensions with the proportional TL values described in Humphreys et al. (1989). The snout was conical with a rounded tip. The mouth was large, extending well past the posterior margin of the eye, with dark membranes on the upper palate, but whitish coloration along the palatoquadrate. The upper dental bulla indentation was very pronounced, with the lower dental bulla less so. The eye was large and dark orange with a vertically oval greenish pupil. A small spiracle was located distal and lateral to the ventral margin of the eye. Five gill slits were present,

Figure 1. Lateral view of a bigeye sand tiger *Odontaspis noronhai* captured and released in western North Atlantic in March 2008, showing hooking location and gross anatomy of head. White strip along bottom margin of photo is side of capturing vessel.

with the ventral edges terminating just below the insertion of the pectoral fin. The first dorsal fin origin was distal to the posterior insertion of the pectoral fin.

The teeth had a large central cusp and one pair of lateral cusplets, with a moderately broad and arched crown. Dentition pattern and counts for lateral, intermediate, and anterior teeth were within the range of prior described specimens (Maul, 1955; Sadowsky et al., 1984; Branstetter and McEachran, 1986; Humphreys et al., 1989). One symphysial tooth (small teeth next to the center of the jaw symphysis) was visible on each side of the lower jaw, with detailed photographs of the symphysial tooth area in Figure 2.

The photographs do not provide any gross detail distal to the origin of the first dorsal fin. The overall coloration was a chocolate brown with reddish undertones. No dark trailing edges were seen on any fins, although the pectoral fins were broader than described for the holotype, and no white coloration was seen on the rounded dorsal fin. Sex was not noted at the time of capture, nor was there a photograph taken of the pelvic area for later determination. The captain recorded the sea surface temperature in his personal logbook as 25.6 °C.

Despite the lack of a physically preserved specimen, several characters allow the definitive identification to species from photographs of this WNA animal. Unlike the sand tiger, *Carcharias taurus* Rafinesque, 1810, which has three upper anterior tooth rows on each side of the jaws, there are only two rows of upper anterior teeth in this specimen (Fig. 1). The main diagnostic character between recognized *Odontaspis* species is that the tooth of *O. noronhai* generally only has one cusplet on each side of the main cusp, whereas the ragged-tooth *Odontaspis ferox* (Risso, 1810) usually has two per side. Additionally, *O. noronhai* generally has only one row of intermediate teeth between the anterior and lateral rows; *O. ferox* usually has more than two rows (Shimada, 2002). Body coloration was also uniformly dark brown, with no spots, which have been observed on *O. ferox*. Other potentially diagnostic characters (e.g., the origin of the second dorsal or anal fin shape, as described by Compagno, 2001) could not be evaluated.

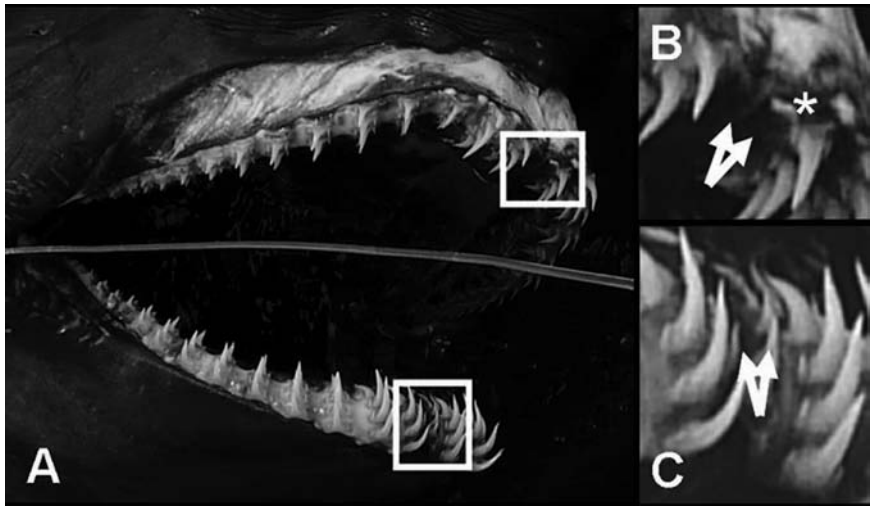

Figure 2. Detailed views of teeth in a bigeye sand tiger *Odontaspis noronhai* captured and released in the western North Atlantic in March 2008. (A) Oblique front view showing detail around (B) upper and (C) lower symphysial articulations. Double arrows point to lack of visible symphysial teeth rows in upper jaw and one row on each side of the lower jaw. Asterisk denotes white strip discussed in text.

Discussion

Although morphometric measurements of the fins and other gross characters were not physically taken, and the limited coverage of the specimen by the photos precludes more detailed image analyses, this individual specimen exhibits several details which differ from prior accounts of this species. For example, the trailing edges of fins were not "ragged" as described in Branstetter and McEachran (1986). Some other gross characters were intermediate between the GOM and holotype descriptions, such as the overall shape of the pectoral fin, suggesting some morphological variation within *O. noronhai*. Dental patterns were similar to the other Atlantic and the Hawaii specimens with only one intermediate tooth between the upper anterior and lateral teeth (see description revision in Shimada, 1999 of Hawaii specimen tooth row counts). Photographs of the WNA specimen show only two rows of symphysial teeth, both in the lower jaw, although it is not uncommon to have rows of symphysial teeth posterior to the leading tooth margin that would not be visible from an anterior view (K. Shimada, unpubl. data). In Figure 2B, a narrow white strip which could be a broken tooth is visible on the left side of the upper jaw where a symphysial tooth row would occur. Although this could represent a broken symphysial tooth, we do not interpret this feature as indicative of a symphysial tooth row due to the lack of any posterior symphysial teeth. The issue of varying numbers of symphysial teeth in both upper and lower jaws between the described specimens remains unresolved, although some have suggested an ontogenetic decrease with age (Branstetter and McEachran, 1986; Shimada, 2001).

Although presumed to be a deep-water shark (Compagno, 2001; Compagno et al., 2005), the vertical habitat utilization of *O. noronhai* is unknown, with reported captures occurring in depths between < 50 m (present WNA animal) to > 800 m (Madeira; Maul, 1955). Branstetter and McEachran (1986) found squid beaks and otoliths

in the stomach of the GOM specimen, although these contents were not identified in further detail. The capture of the GOM, the Hawaii, and the WNA specimens all by pelagic longline fishing gear at night suggests some degree of diurnal vertical movement by the species.

Compagno (2001) considered the species distribution as cosmopolitan, yet reported captures of *O. noronhai* are extremely rare in U.S. fisheries. As noted in Humphreys et al. (1989), no *Odontaspis* spp. were reported from extensive pelagic longline shark surveys in the Pacific from 1952–1955 (Strasberg, 1958), and *O. noronhai* specimens have only been reported three times in the National Marine Fisheries Services (NMFS) Pacific Islands Regional Office (PIRO) pelagic longline observer program from 1997–2007 (PIRO, 2007). Although other deep-water sharks such as bigeye thresher, *Alopias superciliosus* (Lowe, 1841) and longfin mako, *Isurus paucus* Guitart Manday, 1966 are not uncommon in Atlantic pelagic longline fishery bycatch, no catches of *O. noronhai* have been documented in the approximately 8700 observed sets monitored by the NMFS Atlantic Pelagic Observer Program from June 1992 through March 2008 (L. Beerkircher, NMFS Pelagic Observer Program, pers. comm.). Similarly, no *O. noronhai* catches were reported from 211 hauls observed between July 2005 and December 2006 in the directed shark bottom longline fishery in the GOM and offshore of the U.S. southeastern states (Hale and Carlson, 2007). Anecdotal reports suggest that one *O. noronhai* was caught by commercial pelagic longline gear in the same general area approximately 20 yrs ago (G. Helsing, A Fisherman's Best wholesale fish distributor, pers. comm.). It remains unclear to what degree the presumed preference of *O. noronhai* for deep-water habitat may provide a refuge from the intense fishing effort along most global deep-shelf waters.

The decision to place *O. noronhai* on the list of prohibited species for retention by U.S. commercial and recreational fishers was based in part on reproduction data extrapolated from the sand tiger (K. Brewster-Geisz, National Marine Fisheries Service, pers. comm.), and the species remains in the "Data Deficient" category by the International Union for Conservation of Nature (IUCN, 2008). The lack of specimens, or even tissue samples for some species, has resulted in a relatively poor understanding of the phylogeny of deep-water sharks. In the United States, many deep-water sharks are prohibited species and cannot be retained for sale by commercial pelagic longline vessels, and even retention of dead individuals for scientific purposes now requires an Exempted Fishing Permit (NMFS, 2007). While it is perhaps unfortunate for science that the WNA specimen could not be retained, the captain acted exactly as current regulations required. The reporting of this capture by the captain exemplifies the importance for improved communications between commercial fisheries and fishery scientists to obtain information on rare-event species.

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