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Predation by a shortfin mako shark, *Isurus oxyrinchus*, Rafinesque, 1810, on a pantropical spotted dolphin, *Stenella atenuatta*, calf in Central Atlantic waters

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This report details a shark attack on a calf of pantropical spotted dolphin *Stenella attenuata* (Gray 1846), and discusses some evidences of the possible causes of the attack. The female calf was found in the stomach of a shortfin mako shark, *Isurus oxyrinchus*, Rafinesque, 1810, in central Atlantic waters. The entire dolphin was the only prey item inside the stomach. The shark, 210 cm in total length, was caught by the tuna longliner "Chun Kuo 289" in February 2006, in the position 01°N, 26°W, approximately 500 km eastward of the Saint Peter and Saint Paul Archipelago, at 5000 m local depth. The stomach of the shark was extracted onboard, stored frozen, and later analyzed in the laboratory. The dolphin retrieved from it was 85.0cm in total length, weighed 5.5 kg, had unerupted dentition, presented vibrissae on the upper rostrum, and had no spots, all considered features of a newborn (Perrin, 2001). It was sectioned by one clear bite, which divided the body of the dolphin in three segments. The segment of the bite went from the posterior end of the dorsal fin to the caudal peduncle. This segment measured 24.0cm in widh, which is equivalent to the width of the shark's mouth. The dolphin's body was in good condition, including the natural colors (Figure 1). Several small scars made by the teeth of the shark were observed along the dolphin's body, and the skin had started to peel off. External measurements of the dolphin, taken following Norris (1961), are shown in Table 1.

Thirty-eight teeth were counted on each side of both mandibles using an x-ray photograph of the lateral-posterior position.

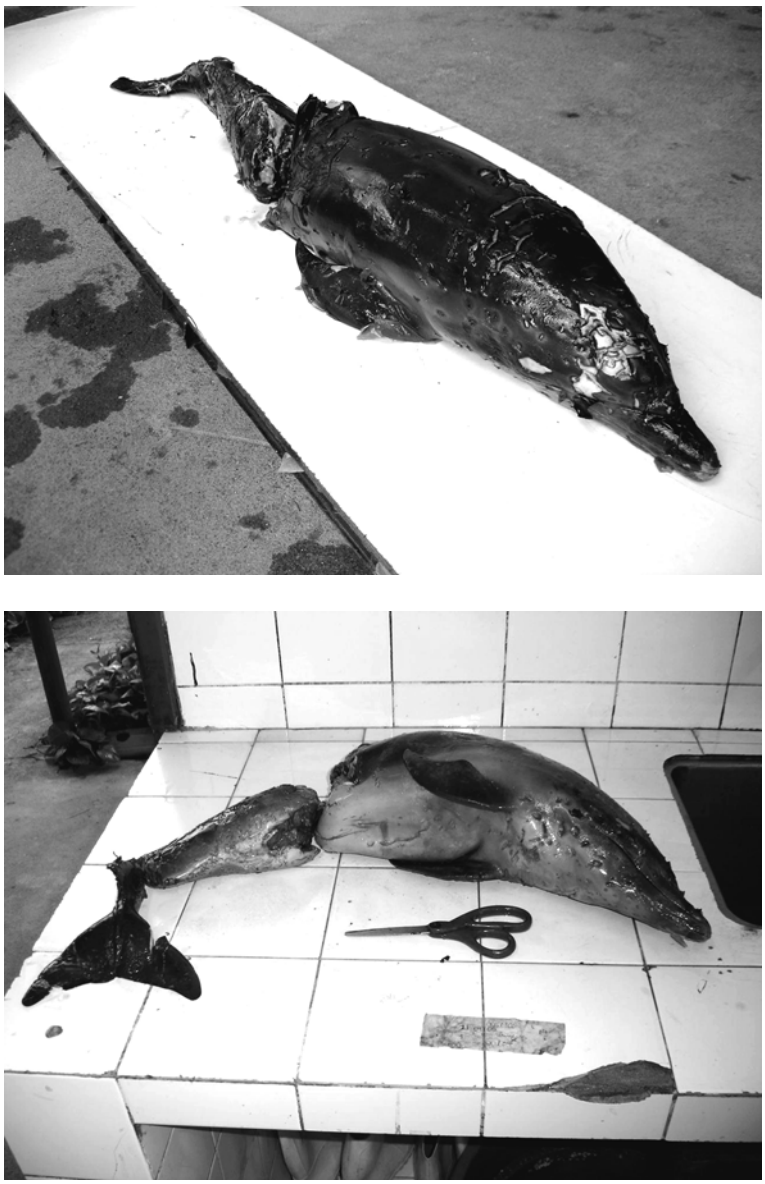

Figure 1. A pantropical spotted dolphin preyed upon by a shorfin mako shark caught by a tuna longliner in central Atlantic waters.

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Table 1. Measurements of the *Stenella atenuatta* calf, according Norris (1961), retrieved from the stomach of a shorfin mako shark caught by a tuna longliner in central Atlantic waters.

Measurements	Length (cm)
Total length	85.0
Eye-maxilla (tip of upper jaw to center eye)	15.5
Melon-maxilla (tip of upper jaw to apex melon)	3.8
Mouth length (gape)	18.2
Ear-maxilla (tip of upper jaw to external auditory meatus)	17.0
Spiracle-maxilla (tip of upper jaw to to blowhole alone midline)	14.5
Dorsal fin – maxilla (tip of upper jaw to tip of dorsal fin)	39.0
Pectoral fin – maxilla (tip of upper jaw to tip of pectoral fin)	19.8
Anus – maxilla (tip of upper jaw to center anus)	53.0
Flipper width	17.5
Pectoral fin outside (anterior insetion to tip flipper)	14.4
Pectoral fin inside (flipper axilla to tip)	10.5
Pectoral fin width (flipper width maximum)	4.9
Dorsal fin base	10.0
Flukes width	7.8

Evidence of predator-prey and competitive interactions between sharks and dolphins can be observed through scarring patterns and wounds on live dolphins (Corkeron *et al.*, 1987; Heithaus, 2001; Celona *et al.*, 2006), on carcasses beached or floating at sea, on direct observations of attacks by sharks on live dolphins (Maldini, 2003; Gibson, 2006), and in shark stomach content studies (Crovetto *et al.*, 1992; Di Beneditto, 2004). Shark attacks on cetaceans are known worldwide, but are mostly commonly reported in coastal populations with only few records in cetaceans with open ocean distributions (Wood *et al.*, 1970). This predatory pressure has a strong influence on dolphin behavior, habitat use, and group size (Wells *et al.*, 1980, 1987; Heithaus, 2001; Heithaus and Dill, 2002, 2006; Crespi-Abril *et al.*, 2003; Gibson, 2006).

The shortfin mako is a common, extremely active and fast shark. It is found in oceanic waters where they are commonly caught by longline fishery in tropical and subtropical oceans (Compagno, 2001; Campana *et al.*, 2005). Dietary studies shows that this shark is a top predator, feeding on large teleosts (*e.g.* tunas, swordfish, billfish), as well as other sharks, rays, cephalopods, sea turtles and unidentified small cetacean material (including a pelagic dolphin), salps, isopods, penaeid shrimp, sponges, sargassum weed, and occasional stones and other detritus (Last and Stevens, 1994; Compagno, 2001). Experiments of depth preferences concluded that mako sharks spend around 90% of their time in surface waters between 0 and 12m (Sepulvida *et al.*, 2004), which reinforce the probability of encounters with cetaceans near the surface.

Due to the good condition of the dolphin, and the absence of fetal folds, it is suggested that the dolphin was alive when the shark attacked. The bite near the tail sectioned the vertebral column, and the tail remained connected only by the skin and muscles. This fact probably caused the immobilization of the dolphin thus facilitating the shark to swallow the entire body in one dash. The arched shape of the bite in the flank indicates that the shark probably attacked from the below, the dolphin being probably near the surface. In a fatal attack performed by a tiger shark (*Galeocerdo cuvier*) on a juvenile pantropical spotted dolphin in Hawaii, it was observed that the shark bit the caudal peduncle to immobilize the dolphin (Maldini, 2003). In Hawaii, spotted dolphins spent substantial proportions of their time in shallow waters (less than 10m) in part to avoid the tiger shark that prefer deeper waters (Baird *et al.*, 2001). Sharks may also attack Clymene dolphins (*Stenella clymene*), as evidenced by a probable shark bite on a dolphin stranded in Texas (Jefferson *et al.*, 1995). An aggressive interaction was observed between sharks and possible Clymene dolphins in the Gulf of Mexico, involving apparent cooperative behavior by the dolphins, including defense of the young (Springer, 1967). Gibson (2006) also reported non-fatal attacks on bottlenose dolphin (*Tursiops truncatus*) calves in Australia by carcharhinid sharks that also bit the caudal peduncle of the calves that were 10 to 20m far from their mothers. Corkeron (1987) found a relatively high proportion of nursing females in Moreton Bay in Australia with fresh visible shark bites and suggested that theses adults, or their calves, are more vulnerable to shark predation.

Relationships between dolphins and sharks may vary according to the size and number of sharks, size and group composition of dolphins, and the moment that the shark is detected (Mann and Watson-Capps, 2005). As pointed out by Wood *et al*. (1970), offshore dolphins are likely to be less preyed upon by sharks. Offshore species such as *S. attenuata* form large aggregations in the Atlantic Ocean and are more likely to be able to detect and avoid predators (Heithaus, 2001). Conversely, a predation attempt in such an open environment may be more likely to lead to death (Heithaus, 2001), as shown here. In this study, the calf probably ventured far from its mother for some time, which enabled the shark to attack, taking advantage of the lack of maternal supervision and the good visual conditions typically found in open waters.

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