

NOTA CIENTÍFICA

EVIDENCE OF A FAILED PREDATION ATTEMPT ON A GUIANA DOLPHIN, *Sotalia guianensis*, BY A BULL SHARK, *Carcharhinus leucas*, IN BRAZILIAN WATERS

Evidência de uma tentativa mal-sucedida de predação pelo tubarão-cabeça-chata, *Charcharinus leucas*, sobre o boto-cinza, *Sotalia guianensis*, em águas brasileiras

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ABSTRACT

Even though shark-cetacean interactions have been the subject of numerous studies worldwide, several ecological aspects such as competition, predation risk and co-evolution remain unclear. On February 16th, 2008, during a photo-identification survey to investigate population parameters of Guiana dolphins, *Sotalia guianensis*, in estuarine waters of Paraná State (25°S; 48°W), Brazil, an adult dolphin was photographed without its dorsal fin. A detailed analysis of the healed area on the injured dolphin showed that the circular, crescent-shaped outlined wound was provoked by the bite of a bull shark, *Carcharhinus leucas*. Wound shape, prey-predator distributional patterns (sympatry) and feeding habits of the shark species here considered were indicative of the species' identity. The wound is likely to be the result of a failed predation attempt. Interactions between *C. leucas* and *S. guianensis* should be expected, since they are sympatric along almost all of their distribution range in the tropical and subtropical western South Atlantic. The presented observation adds *S. guianensis* to the list of cetacean species involved in interactions with large coastal predatory sharks.

Keywords: *Carcharhinus leucas*, *Sotalia guianensis*, shark-cetacean interactions, shark-inflicted wounds.

RESUMO

Ainda que a interação entre cetáceos e tubarões seja tema de muitos estudos, vários aspectos ecológicos desses eventos, tais como competição, risco de predação e co-evolução, ainda são obscuros. Em fevereiro de 2008, durante um estudo populacional por foto-identificação de boto-tucuxi, *Sotalia guianensis*, em área estuarina do Paraná (25°S; 48°W), um exemplar adulto foi fotografado sem sua nadadeira dorsal. A análise detalhada mostrou que o ferimento circular de formato crescente foi provocado pela mordida de um tubarão-cabeça-chata, *Carcharhinus leucas*. Padrão e forma da lesão, padrão de distribuição de presa e predador (simpatria) e hábitos alimentares da espécie de tubarão aqui considerada foram os fatores que levaram à identificação da cabeça-chata como agressor. A lesão parece ser resultante de uma tentativa mal-sucedida de predação por parte do tubarão. Interações entre *C. leucas* and *S. guianensis* devem ser esperadas, uma vez que ambas espécies são simpátricas ao longo de praticamente toda sua área de distribuição no Atlântico ocidental tropical e subtropical. O presente trabalho adiciona *S. guianensis* à lista de cetáceos predados por grandes tubarões costeiros predadores.

Palavras-chaves: *Carcharhinus leucas*, *Sotalia guianensis*, interações tubarão-cetáceo, lesões por tubarão.

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Even though shark-cetacean interactions have been the subject of numerous studies worldwide, several ecological aspects such as competition, predation risk and co-evolution remain unclear. Heithaus (2001a) discussed overall factors related to such interactions, presented an overview on these predatory events, and postulated that the status of several shark species as predators of small cetaceans should be reconsidered. According to referred author, of at least 19 shark species reported in interactions with small cetaceans, only five were considered regular predators: white, *Carcharodon carcharias*; tiger, *Galeocerdo cuvier*; bull, *Carcharhinus leucas*; sixgill, *Hexanchus griseus*; and sevengill, *Notorynchus cepedianus*. Conclusions were based on stomach content analysis (Simpfendorfer, 1992; Lowe *et al.*, 1996), witnessed attacks (*e.g.* Mann & Barnett, 1999), and records of live cetaceans with fresh/healed shark-inflicted wounds and scars from unwitnessed interactions (Corkeron *et al.*, 1987; Cockcroft *et al.*, 1989; Cockcroft, 1991; Heithaus 2001b). Shark-induced wounds on cetaceans are an important tool to better understand the interactions between these two aquatic predators. In this paper we present the first evidence of a predation attempt on a Guiana dolphin, *Sotalia guianensis*, by a bull

shark based on the observation of a live dolphin with a healed shark-induced bite.

On February 16, 2008, during a *S. guianensis* photo-identification survey in estuarine waters of Paraná State (~25°S, 48°W), Southern Brazil, an adult Guiana dolphin with *ca.*180cm of total length was photographed without its dorsal fin. The sighting took place in the channel bordered by the islands of Superagui and Peças (Figure 1), approximately 6 km distant from the closest connection to coastal waters. Water depth where the sighting took place ranged from 10.6 to 11.1m, the salinity was 24psu and the superficial temperature of the water was 27°C. The observed dolphin was in a group of 20 individuals composed by 14 adults and 6 calves, all photographed. The injured dolphin presented a crescent-shaped healed wound (Figure 2) provoked by the bite of a carcharhinid shark. The base of the dorsal fin was still intact, but slightly leaned to the right side, suggesting the attack came from that side. This unique rounded wound caused by the upper jaw of the shark suggests the attack was probably the result of an unsuccessful predation attempt. The wound shape, prey-predator distributional patterns (sympatry) and feeding habits of the shark species here considered were the main clues to reach the

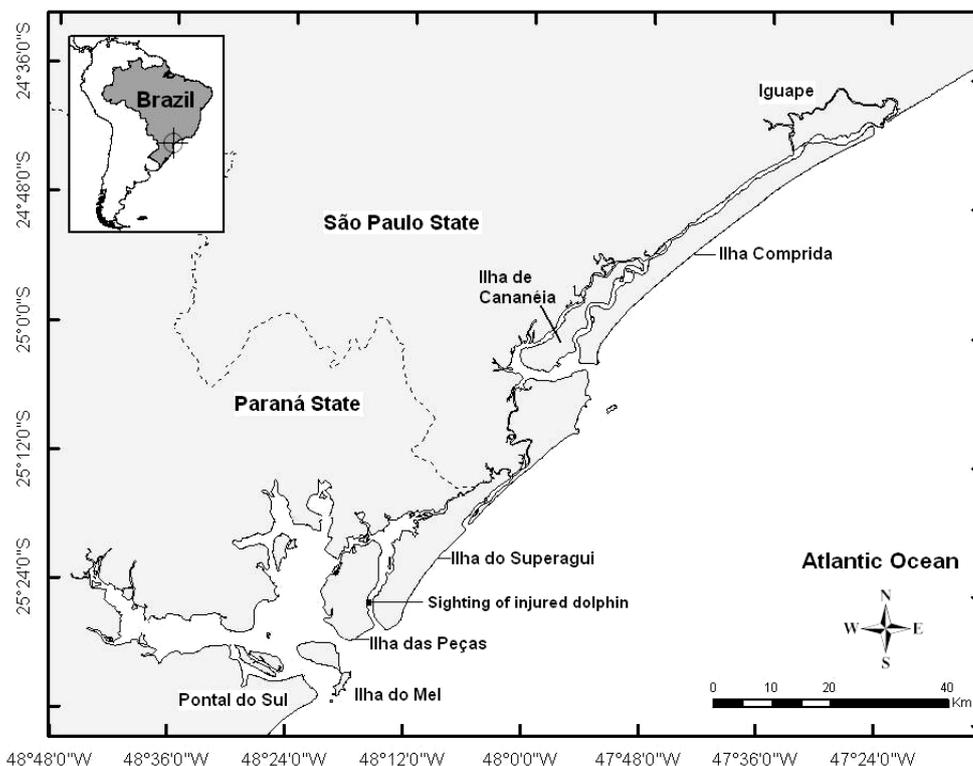


Figure 1 - Map of estuarine waters of Paraná-São Paulo States, southern Brazil, indicating the location where the injured Guiana dolphin (*Sotalia guianensis*) was observed.



Figure 2 - Right side of an adult Guiana dolphin (*Sotalia guianensis*) showing a healed wound provoked by a bull shark predation attempt that took off the dorsal fin.

identity of the predator: a bull shark. It was not possible to estimate when the predation attempt occurred, since it was the first sighting of the injured dolphin and the wound was completely healed. Therefore, it was not possible to estimate the length of the shark.

The observed bite resembles a wide semilunar mouth, similar to the shape of a bull shark's jaw. The anterior part of the mouth is wider when compared to a tiger shark. In the later, the upper symphysis between the jaws orbital process is longer and less wide, comparatively. Besides that, the relatively smaller, most numerous and less spaced upper teeth in *C. leucas* usually leave more regular and smooth cuts, while the larger, less numerous and widely spaced upper teeth in *G. cuvier* leave identifiable individual tooth marks in most cases (Long & Jones, 1996; Heithaus, 2001b). Identifying shark species involved in predation attempts of small cetaceans has been considered a limiting factor for a better understanding of such interactions. White shark bite wounds on cetaceans have been successfully identified (Long & Jones, 1996). Large tropical Carcharhinid sharks (mainly bull and tiger) show an almost similar jaw architecture, but differs in topography, number and disposition of teeth (Garrick, 1982; Corkeron *et al.*, 1987; Compagno, 1988). If studied in detail, these characteristics may allow the identification of the species responsible for a wound (Ross & Bass, 1971; Gadig & Sazima, 2003).

Bull and tiger sharks are large tropical coastal species found worldwide, attaining a total length of about 3.4 m and 6 m, respectively, and preying on a wide variety of food items (Compagno *et al.*, 2005). Both species dwell in shallow waters off the Brazilian coast, but apparently are more abundant in the lower latitudes of the northern coast (Gadig, 2001). These two sharks are considered potentially harmful to humans. In recent years, bull sharks provoked at least seven attacks on humans in Pernambuco, Northeast Brazil (~8°S), meanwhile the tiger shark provoked at least one (Gadig & Sazima, 2003; Hazin *et al.*, 2008). Bull sharks seem to be more dependent on estuarine ecosystems (Garrick, 1982; Snelson *et al.*, 1984). Although bull sharks have been frequently reported in freshwater incursions (Garrick, 1982; Thorson, 1971, 1972; Wueder & Alhanati, 1981; Heithaus, 2001), no predation records on estuarine or riverine cetaceans are confirmed. In the 1960s, studies conducted in the northern subset of the Lagamar estuary showed that three adult bull shark females and 91 newborns/juveniles were found in inner estuarine waters (Sadowsky, 1971). All individuals were found in summer, showing evidences of a seasonal occurrence for breeding purposes. Guiana dolphins can be found in coastal and estuarine waters of the western South Atlantic, from southern Brazil to Honduras (Flores, 2002). A resident population can be found year round in the northern subset of the Lagamar estuary (Santos *et al.*,

2001; Santos & Rosso, 2008). Therefore, the estuarine and coastal habits of *C. leucas* result in sympatry with *S. guianensis*.

Among large sharks that are predators of cetaceans, the bull shark is the only that more frequently preys on food larger than itself. Bull sharks start to ingest large food items at relatively smaller sizes than tiger and white sharks (Cockcroft *et al.*, 1989; Long & Jones, 1996; Heithaus, 2001a). This fact supports the hypothesis that young bull sharks already reported in the Lagamar estuary could be responsible for predation attempts on Guiana dolphins. Additionally, data on the stomach contents of bull sharks collected in the Lagamar estuary showed that the even small specimens with *ca.* 90 to 120cm in total length had relatively large food items such as other sharks and numerous teleostean fish. This suggests the local estuarine environment represented an important feeding area for bull sharks (Sadowsky, 1971). In Paraná (~25°S) and Santa Catarina (~26°S) coastal waters, stomach content analyses of 11 juvenile tiger sharks with *ca.* 70 to 195cm in length revealed small teleostean fish, bones and feathers of a brown boobie, *Sula leucogaster*, cephalopods, crustaceans and polychaetes (Bornatowski *et al.*, 2007).

Bull and tiger sharks are usually associated to predation on cetaceans, but to date, only four dolphin species were identified in the stomach contents of these sharks: *Tursiops truncatus* for bull and tiger, *Delphinus delphis* for bull, *Stenella attenuata* and *Pontoporia blainvillei* for tiger shark (Cockcroft *et al.*, 1989; Cliff & Dudley, 1991; Heithaus, 2001; Maldini, 2003; Di Benedetto, 2004). The two shark species with the highest number of identified cetacean preys are the white shark and the cookie cutter shark, *Isistius brasiliensis*, due to the fact that in both cases the marks left by the teeth are easily recognized (Long & Jones, 1996; Souto *et al.*, 2007). Other small cetaceans are likely to be preyed upon by bull and tiger sharks, but difficulties to identify stomach content items, as well as to recognize teeth marks on survivors, do not always allow the identification of dolphin and shark species, respectively.

Information on interactions between sharks and cetaceans in Brazilian waters is scarce. Several published studies report on wounds left by the small bathypelagic species, the cookie-cutter shark (Gasparini & Sazima, 1996; Zerbini & Santos, 1997; Souza *et al.*, 2005; Souto *et al.*, 2007). There is one record of a franciscana dolphin, (*Pontoporia blainvillei*, found in the stomach of a tiger shark (Di Benedetto, 2004), a pantropical spotted dolphin, *Stenella*

attenuata, calf found in the stomach of a shortfin mako shark, *Isurus oxyrinchus* (Monteiro *et al.*, 2006), and an Atlantic spotted dolphin, *Stenella frontalis*, found in the stomach of a white shark (Santos & Rosso, 2007). All mentioned records were based on the analysis of dead sharks/cetaceans. For Guiana dolphins, there is one record of crater wounds left by *I. brasiliensis* on an adult *S. guianensis* found washed ashore (Souto *et al.*, 2007). The presented observation is the first documented account of the interaction between a bull shark and a Guiana dolphin. Interactions between *C. leucas* and *S. guianensis* should be expected as both species are sympatric along almost the whole range of their distribution in the tropical and subtropical western South Atlantic. The presented observation adds *S. guianensis* to the list of cetacean species involved in interactions with large predatory sharks.

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