Aquatic Mammals 2006, *32*(2), 140-144, DOI 10.1578/AM.32.2.2006.140

Evidence of Bottom Contact Behavior by Estuarine Dolphins (*Sotalia guianensis*) on the Eastern Coast of Brazil

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Abstract

We present herein the first records of evidence of bottom contact behavior by *Sotalia guianensis*. From April 2002 to December 2004, boat cruises were conducted along a 135-km stretch of coast on the Abrolhos Bank, eastern coast of Brazil. Evidence of bottom contact behavior was observed directly or through photographs on 25 occasions during the study period. On 16 occasions, one or more dolphins were observed with mud adhered to their dorsum, flanks, peduncle, head/melon, or dorsal fin. On five occasions, a mud-plume suspended by the movement of the dolphins and their contact with the bottom was observed. During four other occasions, both types of evidence (mud adhered to the body and mud-plume) were observed for the same group of dolphins. Contact by cetaceans with the sea floor is widely reported for several species and seems mainly related to feeding behavior, which probably is also the case for the observation presented here.

Key Words: estuarine dolphin, *Sotalia guianensis*, bottom contact, feeding behavior, mud-plume, Abrolhos Bank, Brazil

Introduction

The estuarine dolphin (*Sotalia guianensis*) is a small dolphin endemic to the coastal waters of the Western Atlantic Ocean (Borobia et al., 1991). Shallow, close to the coast, and productive marine environments seem to be its typical habitats (Borobia et al., 1991; Silva & Best, 1996), where the species exploits a diverse array of fish species, as well as squids and shrimps (Borobia & Barros, 1989; Santos et al., 2002; Gurjão et al., 2003).

Despite increasing research in the past decade focusing on *S. guianensis*, the behavior and ecology of this marine species is not well-known. This is mainly due to the limited underwater visibility along its coastal distribution, restricting underwater observations. The few pieces of literature available on *S. guianensis* deal with surface activity, unusual behavior descriptions, or interspecific interactions (e.g., Geise, 1991; Monteiro-Filho, 1992, 1995; Monteiro-Filho et al., 1999; Santos et al., 2000; Araújo et al., 2001; Cremer et al., 2004; Wedekin et al., 2004).

Some of these studies reported that *S. guianensis* have a diverse repertoire of feeding behaviors, including individual and cooperative strategies (Monteiro-Filho, 1991; Rossi-Santos & Flores, 1998). The hunting behavior may also vary according to fine-scale habitat characteristics (Monteiro-Filho, 1991).

This paper aims to describe, for the first time, evidence of physical contact of *S. guianensis* with the mud bottoms of the coastal waters of the Abrolhos Bank, Brazil. We also provide an analysis of the social and ecological context of the bottom contact behavior for the species in the study area and a discussion about the possible functions of this behavior.

Materials and Methods

The Abrolhos Bank (16° 40' to 19° 30' S and 38° 00' to 39° 30' W) on the eastern coast of Brazil is a large extension of the continental shelf that includes sandy beaches; one of the greatest concentrations of coral reefs in the South Atlantic Ocean; and a large estuarine-mangrove system, the Caravelas River Estuary (Leão, 1994; Figure 1). This estuarine-mangrove system spreads over an area of approximately 66 km² (Herz, 1991). Mud sediments predominate the sea floor of the study area, especially the Caravelas River Estuary (Figure 2). A 135-km stretch of coast, between Corumbau and Nova Viçosa, was monitored during the surveys of a larger long-term study on the ecology of *Sotalia guianensis*. The present paper comes from data taken from this larger study. Effort was concentrated in waters < 10 m in depth and rarely exceeded 10 km away from the coast.

Figure 1. Study area along the coastal waters of the Abrolhos Bank, eastern coast of Brazil; dotted lines show the 10-m isobath.

Figure 2. Mud bottom of *Sotalia guianensis* habitats inside the Caravelas River Estuary exposed by the low tide; mangrove forests can be seen in the background of this picture.

Data collection was conducted using a 5-m inflatable boat powered with a 50-hp four-stroke outboard engine. Each month, between April 2000 and December 2004, daily surveys were conducted following routes designed to cover the study area homogeneously. Whenever a group of dolphins was encountered, it was followed using the focal-group behavioral sampling (Lehner, 1996). Data, including geographical position (GPS), group size, and behavior were collected at 5-min intervals after a group was sighted. Environmental parameters also were registered, including tidal state, salinity, depth, wind speed and direction, and water temperature (°C). Additional unusual or noteworthy behaviors, such as the ones described in this article, were recorded *ad libitum*. Evidence of bottom contact behavior was recorded either by direct observation in the field, by analysis of

pictures taken for photoidentification purposes, or both. We refer in this paper to "occasion" as a moment in which we observed evidence of bottom contact behavior, indicating that at least one individual in the group of dolphins was having contact with the bottom.

The social and ecological context of the occurrence of bottom contact behavior was tested by means of nonparametric statistics. This procedure aimed to verify if the dolphins performed the bottom contact behavior in any particular habitat or social context that was different from the context in which the dolphins are usually observed in the study area. Mean group size, water depth, temperature, distance from coast, and distance from river mouth (when dolphins were sighted inside the Caravelas River Estuary) of the groups that exhibited bottom contact behavior were compared with overall sightings of *S. guianensis* in the study area using the Mann-Whitney test (Zar, 1999). Tidal state between groups that exhibited bottom contact behavior and overall sightings were compared using the chi-square test (Zar, 1999). For all comparisons, we considered only the first interval of the focal-group period (overall sightings) or, in the case of bottom contact observations, the moment when the evidence was observed. All tests were performed using *Statistica*, *Version 5.0*.

Results

From April 2002 to December 2004, more than 1,230 h of observation effort were expended. Approximately 165 h of direct observation of *Sotalia guianensis* groups were conducted. On 25 occasions, we observed directly or through photographs two examples of evidence of bottom contact behavior by the dolphins: (1) mud adhered to a dolphin's body (n = 16), and (2) a mud-plume near the dolphins (n = 5). Sometimes both of these examples were observed on the same occasion for the same group of dolphins (n = 4), with the sediment in suspension generally preceding the view of the mud adhered to the dolphin's body.

Vestiges of dark gray/brown mud were observed adhered to different parts of a dolphin's body such as the dorsum, flanks, peduncle, head/melon, and dorsal fin of one or more individuals. Frequently, the mud adhered to more than one part of a dolphin (Figures 3 & 4).

The mud-plumes varied in shape and size. During one occasion (11 November 2003), two bottom contact sightings were observed during the day in the mouth of the Caravelas River Estuary. The first was in the morning where one dolphin of a group of three dolphins was observed with mud adhered to the body. The second bottom contact observation occurred in the afternoon when a group of four adults and two calves was observed foraging near a U-shaped mud-plume track caused by the dolphins' movements. Some minutes later, another 8-shaped mud-plume track was observed near the foraging group. Unfortunately, we do not have a sequential or detailed description of the dolphins' movements and behavior during the production of such mud clouds.

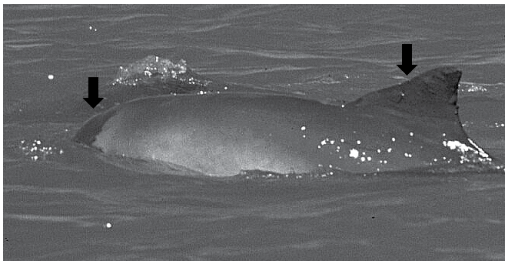

Figure 3. Mud adhered to the melon and dorsal fin of a *S. guianensis* in the Caravelas River Estuary

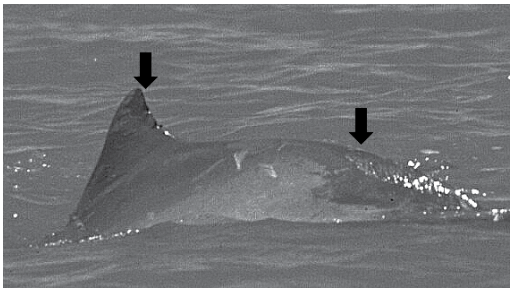

Figure 4. Mud adhered to peduncle and dorsal fin of a *S. guianensis* in the Caravelas River Estuary

All the observations of mud near or on dolphins took place when the dolphins were performing feeding/foraging behavior. On six occasions, active feeding movements were noted, characterized by behavioral events such as breaching, tail slaps, cooperative feeding (coordinated movement of individuals), or school fish leaping and escaping in front of the dolphins. During two events, the dolphins also were observed manipulating the prey with their mouths after chasing it.

Sightings of *S. guianensis* groups that exhibited bottom contact behavior were concentrated in the usual study area. This suggests that there was not a preferential site for conducting bottom contact behavior.

In relation to habitat specificity, groups that showed bottom contact behavior did so at about the same distance from the coast (Mann-Whitney, DF = 1, $p > 0.05$) and distance from the river mouth (Mann-Whitney, DF = 1, $p > 0.05$) as were the overall sightings of *S. guianensis* groups. Evidence of bottom contact behavior was observed in shallower waters than the depth for overall sightings of

groups (Mann-Whitney, DF = 1, $p > 0.05$). Tidal state ($X^2 = 4.60$, DF = 15, $p > 0.05$) and temperature (°C) (Mann-Whitney, DF = 1, $p > 0.05$) did not differ between groups that exhibited bottom contact behavior and groups that did not.

Group sizes were larger when at least one dolphin was engaged in bottom contact behavior than when this behavior was not observed (Mann-Whitney, DF = 1, $p > 0.05$).

Discussion

The contact with the sea floor has been documented for several cetacean species, including large baleen whales (Nerine, 1984; Hain et al., 1995) and delphinids (Hoese, 1971; Lopez & Lopez, 1985), and has been suggested as being related to feeding strategy. The feeding function for the events described here is corroborated by its co-occurrence with feeding/foraging events.

Previous works about the feeding habits of *Sotalia guianensis* suggested strongly that common prey items for this species were associated with the bottom (e.g., Borobia & Barros, 1989; Santos et al., 2002; Gurjão et al., 2003). This indicates that *S. guianensis* can dive near the bottom during feeding. The results presented here add evidence of bottom contact behavior of *S. guianensis* not previously mentioned in the literature.

Although data on the diet of the *S. guianensis* population of the Caravelas River Estuary are still scarce, several potential prey items of this species are frequently caught in trawling fishing nets (MRS, pers. obs., 2004). These prey items include bottom-dwellers, such as fishes from the families Ariidae and Scianidae, and shrimps. Furthermore, the stomach of an *S. guianensis* found dead on the coast of our study area was filled with shrimp (MRS, pers. obs., 2004). Further data may reveal a more diverse diet of bottom-dwelling fish species for *S. guianensis* in our study area.

A feasible explanation for this behavior, as described for the humpback whale (*Megaptera novaeangliae*), is that the animals brush the sediment with their heads and mouths and may flush up prey that are burrowed in the sediment (Hain et al., 1995). In other cases, gray whales (*Eschrichtius robustus*) scooped a mouthful of the substrate and strained out the prey through their baleens (Oliver & Slattery, 1985). Bottlenose dolphins (*Tursiops truncatus*) dive and bury themselves in the sand, displaying a peculiar feeding strategy called "crater-feeding"; it is called this because of the marks the dolphins leave on the sea floor after performing this behavior (Rossbach & Herzing, 1997).

The use of a mud-plume by *S. guianensis* resembles a feeding strategy of bottlenose dolphins in the Florida Keys (Lewis & Schroeder, 2003). After the appearance of a thick cloud of suspended sediment by the dolphin, which grows linearly or curvinearly, the bottlenose dolphin lunges after fish through the mud-plume, breaking the surface (Lewis & Schroeder, 2003). According to the authors, fish would be attracted by the mud-plume either for protection or foraging. The utilization of mud-plumes as barriers around prey may also be the case. On one occasion, several individuals of mullets (*Mugil* sp.), a common *S. guianensis* prey, were observed in the study area swimming in circles inside a mud-plume near the surface of the water (LW, pers. obs., 2004). On this same occasion, a *S. guianensis* group was observed foraging nearby (< 50 m). We do not know if the mud-plume observed on this occasion was associated with that *S. guianensis* group, however.

All the feeding strategies described above require physical contact with the bottom. Many of them may cause a mud-plume suspension in the water column and the observation of mud adhered to the body of the dolphins. We cannot affirm with certainty what feeding strategy was used by the dolphins during the behaviors that we observed. Perhaps both strategies—either direct capture of bottom-dwellers or the utilization of mud-plume as a barrier or attractor—may be used during different or the same occasions.

Another possibility that cannot be discarded is that dolphins were simply rubbing in the bottom to remove skin parasites or passing by the mud fluid for a "good" tactile sensation (e.g., Dudzinski, 1998). Thermoregulation is an improbable explanation for the function of this behavior since we did not find any difference between overall and bottom contact water temperatures.

In addition, we did not observe any habitat specificity for this behavior, except for its observation in shallower waters as compared with overall sightings of dolphins. We are not sure, however, if this was a real trend or if it was an observation bias since a larger column of water may remove the mud from the dolphin's body more often—evidence of bottom contact.

The occurrence of bottom contact behavior in groups larger than that of overall sightings indicates that the bottom contact feeding strategy may be facilitated by the coordination of more than one individual.

Acknowledgments

We thank Instituto Baleia Jubarte staff and interns; Captain Uilson "Lixinha" Alexandre for his great maritime support; Simone Rondinelli and Felipe Caetano for early photo analysis; and Cláudio L. Sampaio, Fábio Daura Jorge, Jeanette Thomas, and an anonymous reviewer for valuable

comments which greatly improved the manuscript. Aracruz Celulose S.A. and Petrobras provided financial support.

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