

Short Note

Botos (*Inia geoffrensis*) in the Upper Reaches of the Tocantins River (Central Brazil) with Observations of Unusual Behavior, Including Object Carrying

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The boto or Amazon river dolphin, *Inia geoffrensis* (although there are competing views of the taxonomy of *Inia*, in this note we adopt the conservative arrangement of a monotypic genus) is a small freshwater cetacean found in northern South America that ranges widely in lakes and rivers of the Amazon, Orinoco, and the Araguaia-Tocantins watersheds of Brazil, Bolivia, Colombia, Ecuador, Peru, and Venezuela, an estimated area of more than 7,000,000 km². Although the general occurrence of the species is known, finer details about distribution in some regions are poorly understood (da Silva & Martin, 2010); the Tocantins River of the present study area is one such region that lacks even some of the most basic information about this species. The main natural barriers to the distribution of *Inia* appear to be rapids and waterfalls such as those in the lower Xingú River, middle Tapajós River, and in the upper Madeira River (da Silva et al., 2008). The permeability of these natural barriers to gene flow, especially during large infrequent flood events, is not well known. The damming of rivers for electrical power generation (a human activity that has been increasing in recent years) has resulted in additional obstacles to the movement of botos and, thus, fragmentation of populations (Reeves & Leatherwood, 1994; da Silva et al., 2008). In the Tocantins River, the most upstream (and southerly) published records of botos were well above the rapids, near Jatobal (Best & da Silva, 1989).

The boto is also well known for object carrying behavior, which is unusual among cetaceans. Unlike bottlenose dolphins (*Tursiops* sp.), which have been observed to carry objects for foraging purposes (Krützen et al., 2005; Allen et al., 2011), Martin et al. (2008) believed that boto object

carrying behavior might be sociosexual in nature and a fundamental part of the mating rituals of at least some populations of this species.

In this note, we report on sightings that extend the known range of the species in the Tocantins River and describe observations of feeding activities and unusual behaviors, such as object carrying, that were recorded during some initial land- and boat-based surveys in the upstream reaches of the Tocantins River in central Brazil.

Systematic and exploratory surveys were conducted in two stretches of the upper Tocantins River: from about 5 km upstream to 16 km downstream of Paranã in the Paranã River, and to about 27 km downstream from the Peixe Angical dam (Figure 1). These surveys were conducted from 16 to 21 August 2011, 5 to 14 November 2011, and 9 to 17 February 2012. Surveys were conducted using different methods: strip-transects (boat-based) along the river banks for estimation of relative densities, fixed-point observations at specific sites along the river (boat-based); point sampling (land-based) for studying behavior and use of area near the dam; and random searching of the waters near and downstream of the dam for photo-identification purposes (boat-based).

The total on-effort search area covered during boat surveys was 263.1 km. For fixed-point-sampling, there were eight preset sites from which we made observations over a total of 13.5 h, with 26 h of land-based observations conducted. A total of 20 sightings of botos were documented from throughout the study area (Figure 1), with botos always seen in waters just downstream of the Peixe Angical dam and in greatest numbers near the dam. Sightings of botos in the Paranã River (a tributary of the Tocantins River) in the present

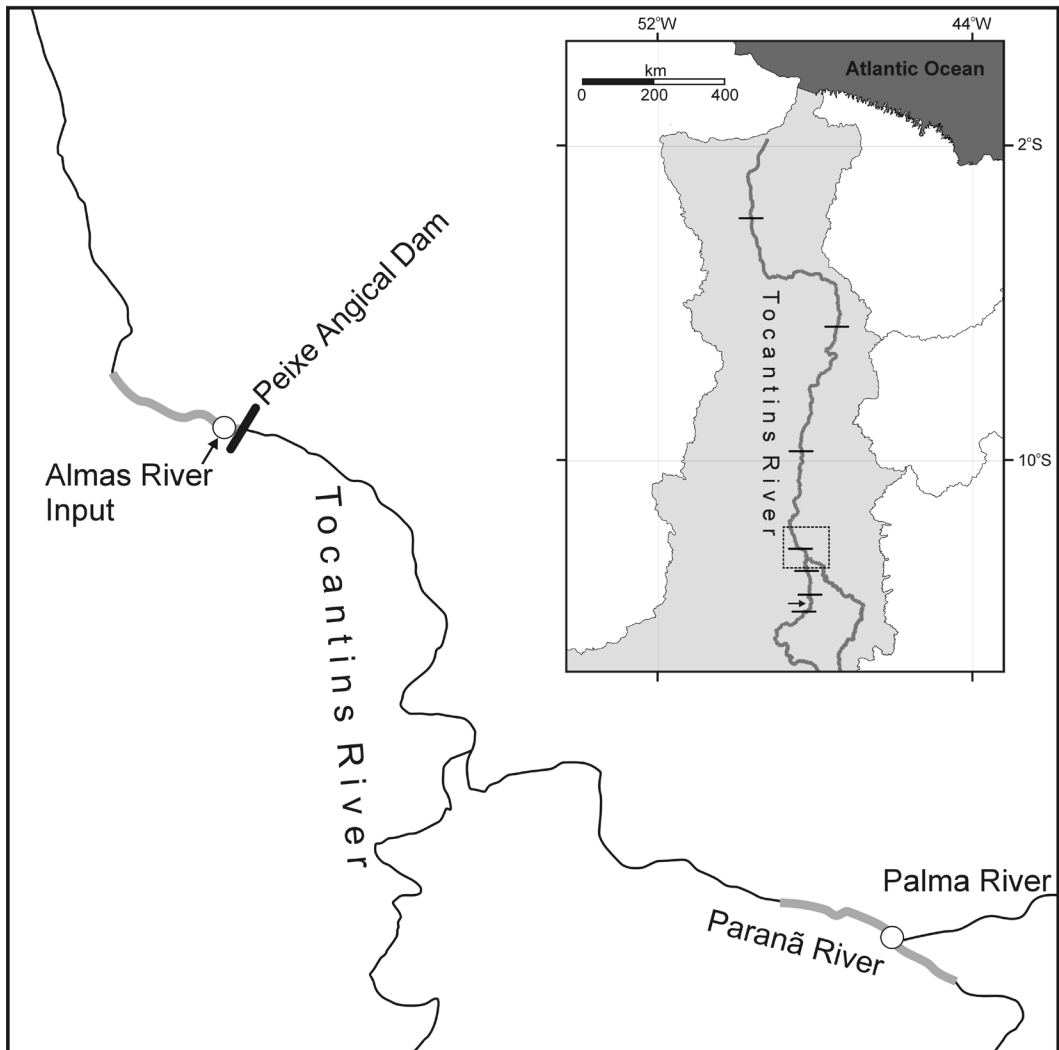


Figure 1. Map of the Tocantins River basin (inset) and the study area; the seven existing dams in the Tocantins River system are represented by the bold lines. Boto sightings are shown by the grey shaded areas on the rivers. Locations of object carrying events are indicated by open circles. The unpublished sighting information in da Silva et al. (1998) is shown by the arrow (inset).

study represented a considerable upstream extension of the confirmed distribution of this species in the Tocantins River from previously published records (Best & da Silva, 1989); however, we acknowledge that there are unpublished sightings of boto from the waters just below the Serra da Mesa dam near Uruaçú (da Silva et al., 1998—this report can be provided upon request) (Figure 1). There are also reliable reports of botos upstream of this dam by the pilot of our survey vessel (A. Tomás, pers. comm., 2012). Further investigations are underway to better understand the upstream limit of this species in the Tocantins River.

In addition to the range extension suggested by these sightings, we also witnessed some unusual behavior. Object carrying behavior was first described for *Inia* by Martin et al. (2008). Based on group composition of the dolphins observed carrying objects and the temporal distribution of this behavior, it is most likely that object carrying behavior is associated with sociosexual displays rather than play or feeding. Object carrying tends to be performed by adult males in large social groups during which aggressive behavior is displayed between males in the group. Because such behavior has not been recorded for *Sotalia fluviatilis*, which is sympatric with botos

in many regions, this display is most likely part of the mating behavioural repertoire of *I. geoffrensis* rather than just an artifact of accessibility to objects in the river (Martin et al., 2008). We observed object carrying behavior on five separate occasions (four of these events were also recorded photographically) during our surveys in February 2012 (Table 1). For each occasion, a different individual performed the behavior: three of these individuals possessed unique natural markings that allowed fairly easy individual identification using good quality photographs. The fourth individual possessed a very different overall base pigmentation (i.e., more or less completely uniformly grey) than the three recognizable individuals. Although the last individual was not seen well, it inhabited waters upstream of the dam, which were distant from the waters of the other four events. The dam presented a solid physical obstruction, so there was no real possibility that the fifth individual could have swum between the two locations. The minimum duration of object carrying above the surface ranged between 1 and 7 min; it was not possible to observe the animals underwater given the turbidity of the river.

The boto has the greatest sexual dimorphism among river dolphins with males being larger and heavier than females and also with the degree of pinkness and scarring being higher for adult males than females (Martin & da Silva, 2006). The pigmentation patterns and scars (nicks, wounds, and bends) have been demonstrated to be useful and reliable features for photo-identification of individual botos (Gomez-Salazar et al., 2011). The three recognizable individuals were possibly adult males based on their large overall size, degree of pink coloration, and overall more “ragged” appearance compared to other individuals in general. It was not possible to determine the age/sex class of the fourth object carrier, which may have been a female or young male given its overall grey appearance and small size. The objects carried were different types of plant material, including leaf litter balls (two occasions) (Figure 2a), a bare stick with a few short secondary branches, and a long (possibly as long as the body length of the dolphin)

multibranched stick with green foliage. The leaf litter balls were held in the mouth and raised vertically out of the water (Figure 2a), while sticks and branches were grasped in the mouth while swimming; and the long, multibranched stick was dragged along the water’s surface. Carrying of leaf litter balls was not reported previously in the literature, and we did not observe animals carrying some of the other objects reported by Martin et al. (2008) such as floating matting grass (*Paspalum repens*) and lumps of clay. During object-carrying events, the number of botos near the object carrier (i.e., within a radius of ~300 m) was between three and nine individuals. [Note: In this paper, we follow the group membership definition of Martin et al. (2008) as all individuals observed within an area with a radius of about 300 m.] Although our observation time was limited, we concur with Martin et al. (2008) that object carrying was likely social in nature and not related to feeding.

These new records of object carrying by *Inia* in the upper Tocantins River represent a point-to-point geographical separation of greater than 2,000 km from the Mamirauá Reserve where Martin et al. (2008) reported this behavior. Although no other direct reports of object carrying behavior have been published, it is probable that *Inia* of other regions also exhibit such behavior at least seasonally, but this has yet to be observed by researchers. Until more focused behavioral studies are conducted, it is not possible to determine if object carrying behavior evolved independently in the Amazon basin and the Tocantins River or if it was an ancestral characteristic that was lost in other populations.

During the study, other interesting events were also recorded. Aerial urination (Figure 2b) by males was observed and photographed twice (in November and February). On another two occasions, we observed the extension of the penis above the surface by males in a manner that was similar to the aerial urination events; however, observers were too distant to determine if urination occurred. The reason for this unusual behavior is uncertain. We also observed repeated forceful exhalations that were apparently attempts

Table 1. Description of the object carrying events with duration and objects carried; see Figure 1 for the locations of the sightings.

Event	Location	Duration of observation of object carrying	Objects carried	Marked individuals carrying objects
1	Mouth of Almas River	7 min	Leaf litter balls	PX-01
2	Mouth of Almas River	1 min	Leaf litter balls	PX-03
3	Mouth of Almas River	4 min	Branches with green leaves	PX-02
4	Mouth of Almas River	1 min	Bare sticks	PX-04
5	Mouth of Palma River	1 min	Unknown	PA-01

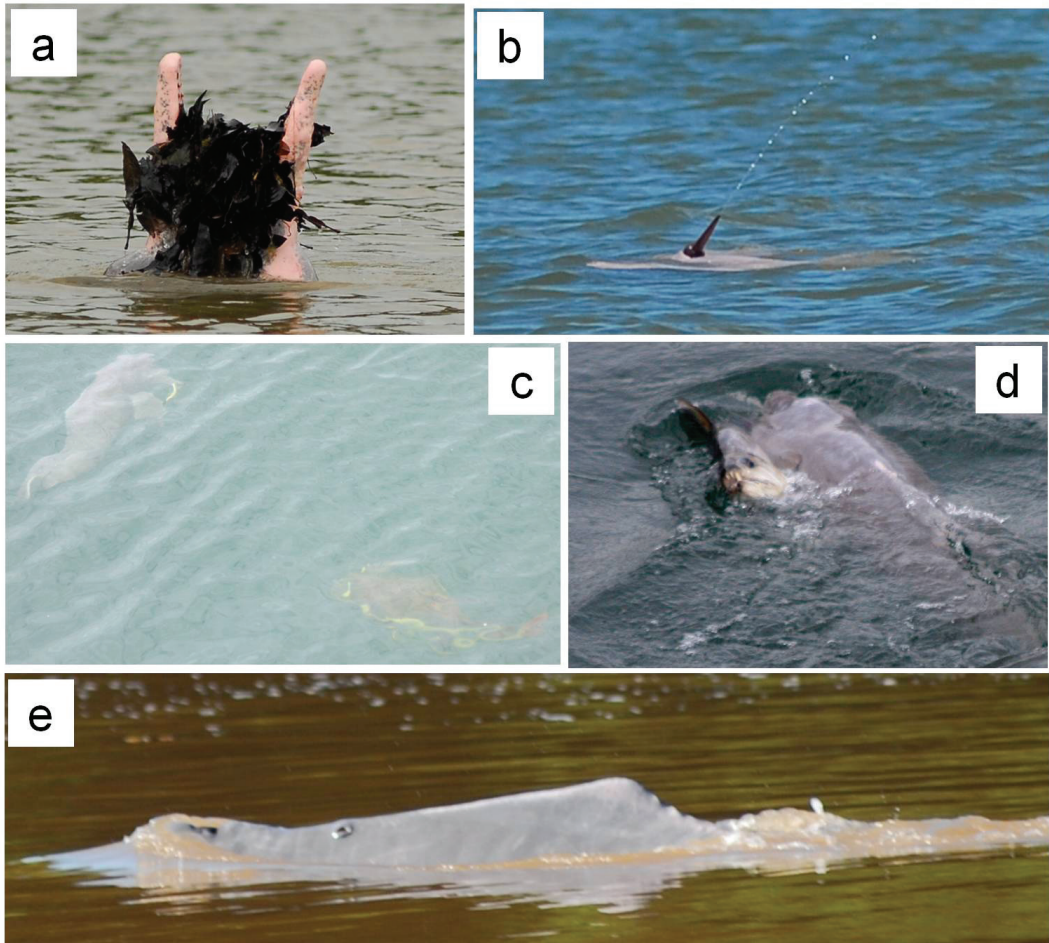


Figure 2. Photographs of botos in the study area (a) performing object carrying behavior with a leaf litter ball, (b) urinating in the air, (c) interacting with a large red-tailed catfish (*Phractocephalus hemioliopterus*), (d) feeding on a cachorra (*Hydrolycus armatus*), and (e) surfacing with an apparent healed bullet wound

to expunge phlegm from the respiratory tract (on three separate occasions). We attempted to collect the expectorant during one of these occasions but were unsuccessful even though we observed what appeared to be masses of phlegm being ejected and landing on the water. The masses could have dissipated, dissolved, or sunk before we arrived at the location where the expectorant landed.

Feeding was observed on several occasions near the dam's spillway. From photos, we were able to identify three fish species that were seen in the mouths of botos: (1) cachorra (*Hydrolycus armatus*), (2) mandí (*Pimelodus blochii*), and (3) abotoado (*Oxydoras niger*). The size of these fish were estimated to be at least 80 cm, 40 cm, and 60 cm, respectively. The mean size of fish prey reported by Best & da Silva (1989) was 20 cm (varying between 5 and 80 cm), while

Aliaga-Rossel et al. (2010) found fish between 5 and 15 cm standard length in the stomach contents of a juvenile *Inia* from Bolivian waters. Two of the fish prey observed in this study were at or greater than the upper size range of the prey reported previously, but field observations may be biased towards larger prey (i.e., larger prey may be easier to see). On the other hand, stomach content analyses may bias the mean size of prey downward because large prey are not swallowed whole, and the pieces eaten may have few hard parts that are resistant to digestion. Thus, identification of large prey species and determination of their size may not be possible.

On one occasion, a boto with a small fish in its mouth was observed being followed by a large red-tailed catfish (*Phractocephalus hemioliopterus*) (Figure 2c). It appeared that the catfish may have

been attempting to klepto-parasitize the fish in the mouth of the boto (such behavior occurs between fish), but the actual reason for the interaction is uncertain. We also witnessed two botos swimming in close proximity (within 4 to 5 body lengths) to a large caiman resting on the surface, but no interspecific interactions between these two species were observed or have been reported (Best & da Silva, 1989; da Silva, 2009).

Boat following behavior was common in fairly shallow water near the margins of the river. Dolphins that associated with the research vessel in this manner were possibly drawn by fish that were flushed and scattered by our vessel; thus, it is possible that our vessel made prey more easily accessible for botos to locate and/or catch. On four occasions when botos were scarce or far from our boat while we conducted stationary observations from preset points, starting the engine and traveling slowly parallel to the river bank attracted animals to closely follow in the boat's wake and propeller wash. Animals often swam quickly beside and behind the boat, but some also appeared to prefer being in front of the boat; other researchers also reported similar behaviors (e.g., Best & da Silva, 1989, 1993). Although we cannot be certain, the animals seemed to be focused on the fish being scattered by our boat, suggesting that the motive for such association with the research vessel was foraging rather than play.

Threats

The damming of rivers results in the fragmentation of populations of river dolphins (e.g., Reeves & Leatherwood, 1994). Presently, there are seven dams in the Tocantins River for hydroelectric power generation, with other similar projects being planned (Figure 1). These existing dams have divided the Tocantins' botos into eight fragments. The consequences of this isolation for the viability of these units and the population are still unclear. Some short-term changes in use of area near the dam have already been observed as the density of the boto appears to be highest just downstream of the dam where fish concentrate. Although this may benefit the boto in the short-term, impacts in the long-term are uncertain. More research on the viability of the Tocantins' boto population and how boto behavior may be altered by dams are needed (Reeves & Leatherwood, 1994) and underway.

Boto depredation of fish in nets and occasional entanglements have been reported from the Tocantins River. Damage to nets as a result of such interactions has also been reported. As a result of perceived competition with and economic nuisance caused by botos, some

fishermen may intentionally attempt to harm and kill botos (da Silva & Martin, 2010). In the Parana River, a boto was photographed in February 2012 with what appeared to be a healed exit wound from a bullet; the wound was located on the left dorsal surface and just anterior of the dorsal ridge (Figure 2e). There are also reliable reports of local fishermen shooting botos; such interactions may intensify and become more frequent as fish resources become depleted or more difficult to catch. Given the highly fragmented state of the population and negative perceptions and harmful interactions with humans, more research and conservation attention is urgently needed for the poorly studied botos of the Tocantins River.

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