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Short Note

Water Spouting by Botos (*Inia geoffrensis*): A Risky Behaviour?

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Nostrils (or nares) of terrestrial mammals function not only as conduits for gas exchange but also as carriers of environmental stimuli to the olfactory receptors (Harkema et al., 2006). These structures are especially important because olfaction is a primary sensory modality for many terrestrial mammals to detect water, food, predators, and mates (Conover, 2007). For some species, particularly elephants (*Loxodonta* spp.), the nose has also developed into an elongated, prehensile appendage that can be used for handling objects (Wittemyer, 2011).

In fully aquatic cetartiodactyls (i.e., cetaceans), olfaction is greatly reduced. While the blowholes (noses) of baleen whales (Mysticeti) maintain anatomical structures related to olfaction, those of toothed whales (Odontoceti) lack these structures altogether (Thewissen, 2009; Kishida et al., 2015). As such, the main direct function of odontocete nares (or blowhole) must be gas exchange, with structures related to biosonar adjacent to the blowhole (Berta et al., 2014). In other mammals, the introduction of water from the environment into the nasal apparatus is often unpleasant and can be dangerous because the vital gas exchange process can be disrupted. Although Gero & Whitehead (2007) postulated that the blowhole and nasal passages were involved in suckling by sperm whale (*Physeter macrocephalus*) calves (adding the possibility of an interesting and unusual function to these structures), this hypothesis was later rejected by direct observations of calves suckling through their mouths in typical cetacean manner (Johnson et al., 2010). It also was suggested that the sperm whale's unusual nasal passage, which passes through the large spermaceti organ, can be flooded with environmental water (which is usually cooler than body temperature) through the blowhole. In this way, sperm whales might control their buoyancy by changing the density of the spermaceti lipids through temperature regulation of the spermaceti organ (Clarke, 1978). However, some authors argued that buoyancy control by sperm whales is not related to thermoregulation of the spermaceti organ (see Cranford, 1999; Madsen et al., 2002; Miller et al., 2004), and there has been no evidence of sperm whales inhaling sea water, which would also be an osmoregulatory stressor on more delicate nasal tissues (Cranford, 1999).

Among mammals, only elephants are known to intentionally take fluids into their highly modified nares. Elephants are well known for drawing water into their proboscises (or trunks) to aid drinking and for spraying water onto various body parts for thermoregulation and grooming purposes (Wickler & Seibt, 1997; Wittemyer, 2011). Other mammals with elongated proboscises, such as tapirs, are not known to deliberately take in water in this manner (Medici, 2001). Drawing water into the proboscis for any reason presumably increases the risk of water accidentally entering the respiratory tract, which, in turn, could increase the chance of introducing foreign infectious or obstructive agents, resulting in injury to delicate air exchange tissues or even in the death of the animal. In the case of elephants, however, adaptations in the respiratory tract prevent harm from high negative intrathoracic pressures that occur when water is drawn into the trunk (Gaeth et al., 1999; West, 2001).

Some cetaceans are known to spit water from their mouths (e.g., Irrawaddy dolphins [*Orcaella brevirostris*]; see Smith et al., 1997; Smith, 2009), but the ejection of large amounts of water through the blowhole is not known for cetaceans. Although many ancient mariners and naturalists believed that the visible blow of cetaceans was the exhalation of water (as depicted in old illustrations), it is now known that the blow is a combination of condensation, water vapor and moisture from the lungs, and the remnant water on top of the

blowhole, which is carried up during exhalation, rather than water being inhaled and then exhaled or "spouted." In this paper, we report for the first time the unusual behaviour of botos (*Inia geoffrensis*) intentionally spouting copious amounts of water from their blowholes.

On 20 August 2015, we witnessed this behaviour for the first time just downstream of a dam on the Tocantins River (central Brazil). A boto (likely a male) ejected a tall (> 50 cm high), wide (about 1.5 to 2 cm) stream of water from its blowhole. After the water expulsion ended, this animal, at its next surfacing, exhaled forcefully and, in the process, expelled several masses of phlegm. Forceful expectoration of phlegm is not uncommon in botos; they sometimes blow loudly many times in succession before and after such expectoration (Araújo & Wang, 2012). Our first observation of water spouting was at a close distance (~10 m away from the animal) but was not photographed. A few days later, on 23 August, a group of botos (~5 individuals) was swimming slowly in a low-current area when a mother and calf pair began to depart from the group. They were followed by a third individual (again, likely a male), which started to blow water from its blowhole in an obvious wide stream. This behaviour was not accompanied by a perceptible loud exhalation noise. Although this individual was further from us than had been the case for the 20 August observation (about 250 m), and it was traveling directly away from us, it was possible to determine that a copious volume of water was being expelled from the blowhole each time it surfaced (Figure 1). In this event, we observed the individual expelling jets of water from its blowhole during at least 12 successive surfacing events. Each time, the stream of water reached about 50 cm or more above the animal's blowhole. The large amount of water expelled each time and the number of spouting events suggest that the multiple spoutings were the result of multiple inhalations of water.

Figure 1. A boto (*Inia geoffrensis*) spouting one of at least 12 large streams of water from its blowhole (Photo credit: ©John Y. Wang/CetAsia Research Group)

To the best of our knowledge, this is the first confirmed report of apparently intentional inhalation and spouting of water through the blowhole for any cetacean species. However, another event of this kind was observed in the Marañón River of Peru. It was a single ejection of water, probably of less volume, by one individual while surfacing in a vigorous, arching fashion (B. Würsig, pers. comm., 31 March 2016). Although we were not able to confirm if our two observations were performed by different individuals, it is likely not just an anomalous individual because this behaviour also was observed in another area (see above). The function (assuming it has one) of this bizarre behaviour is unclear as it seems counterintuitive for a cetacean to draw water into its breathing apparatus and then expel it. The large volume of water that was ejected appeared to be much more than what can be contained within the nasal cavities of botos. Therefore, for this behaviour to occur, two mechanisms seem to be required: (1) inhalation of water through the blowhole into the oral cavity for storage before ejection or (2) intake of water through the mouth and then ejection through the blowhole. Regardless of the mechanism, the expelling of such volumes of water must mean that water can flow freely between the nasal and oral cavities. This would require that botos have the ability to retract the epiglottis, as has been suggested for Indus river dolphins (*Platanista gangetica*) (Pilleri, 1979), or to relax or dilate the palatopharyngeal sphincter.

Because this behaviour was followed, at least on some occasions, by jettisoned phlegm, one possible function would be to cleanse the nasal structures and sinuses. Because neither of the water spouting events observed in the Tocantins River immediately preceded or followed foraging behaviour, we conclude that water spouting is probably not related to feeding. Given the other socio-sexual behaviours exhibited by this species, such as object carrying (Martin et al., 2008; Araújo & Wang, 2012) and the observation of a likely male following a mother-calf pair, it is possible that water spouting is part of the socio-sexual behavioural repertoire of botos. Clearly, more data are needed to better understand the function of this apparently risky behaviour. Also, knowing if this behaviour is exhibited by botos elsewhere might contribute to understanding the function of and potential motivation(s) for water spouting.

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