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Young humpback whale *Megaptera novaeangliae* feeding in Santa Catarina coastal waters, Southern Brazil, and a ship strike report

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Abstract

Background: Humpback whales *Megaptera novaeangliae* are cosmopolitan and highly migratory animals that rarely feed in low latitude waters during their breeding seasons. The western South Atlantic humpback whale population breeds off the Brazilian coast, from Natal (4°S) to Cabo Frio (23°S) and migration to their feeding grounds is known to be undertaken through offshore waters.

Results: Here we report on an unusual stranding of a young humpback whale that was feeding in the coastal waters of Santa Catarina state (27°S), in October 2014. Evidence of a ship strike and that the animal had fed in no more than a few hours before death are also presented. Additionally, it is the first time that *Peisos petrunkevitchi*, a sergestid shrimp species, is described as prey for large whales.

Conclusions: Although more information is required before we can further discuss whether the area could provide an important source of food for young humpback whales, the present ship strike highlights a possibly important threat in case this ecological feature is confirmed in the future.

Keywords: Large whale, Migration, *Peisos petrunkevitchi*, Prey, Distribution, Western South Atlantic

Background

Cosmopolitan and highly migratory animals, humpback whales *Megaptera novaeangliae* (Borowski 1781) are rarely observed feeding in low latitude waters during their annual breeding season (Clapham 2000). An exception is the population inhabiting the Arabian Sea that does not migrate (Pomilla et al. 2014). At-sea observations and data from stranded animals indicate that they normally feed in high-latitude regions during summer and autumn months (Mackintosh 1942; Chittleborough 1965; Dawbin 1966; Clapham 2000). Although this seems to remain a general pattern for humpback whale populations around the world, increasing records in recent years have reported

animals feeding beyond their usual feeding grounds and seasons, and during migration (e.g. Stone et al. 1987; Baraff et al. 1991; Gendron and Urbán 1993; Swingle et al. 1993; Best et al. 1995). In Brazil, Alves et al. (2009) reported humpback whales lunge-feeding near an oil platform, and Danilewicz et al. (2009) presented evidence of feeding in coastal waters from a young female that stranded in the coast of Rio Grande do Sul state (~29°).

Humpback whales of the western South Atlantic (WSA) population breed in the Brazilian coast during winter and spring months, and their main concentration site is the Abrolhos Bank (16°40'–19°30'S) (Martins et al. 2001; Andriolo et al. 2010), a wide portion of the Brazilian continental shelf. According to satellite-tagging studies (Zerbini et al. 2006), during this period their range of occurrence comprises the continental shelf, i.e. from the shore to the shelf-break, with a latitudinal distribution from Cabo Frio (~23°S), in Rio de Janeiro state, to

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Natal (~4°S), in Rio Grande do Norte state (Fig. 1). That study also indicates that these whales use offshore waters for migration, when they travel to feeding grounds off South Georgia and South Sandwich islands. The coast of Rio de Janeiro state therefore represents their southern limit of departure. Coastal occurrence of animals further south is to be considered unusual for Brazil. There are few records of humpback whales in

the southern coast of the country (e.g. Danilewicz et al. 2009), and although they have been observed in the coast of Santa Catarina (Cherem et al. 2004), their presence remains rare (*personal observation* C.K.M.K and P.C.S.L.). Here we report on an unusual stranding of a young humpback whale in Santa Catarina state, the presence of food items in its stomach and a ship strike as the cause of death.

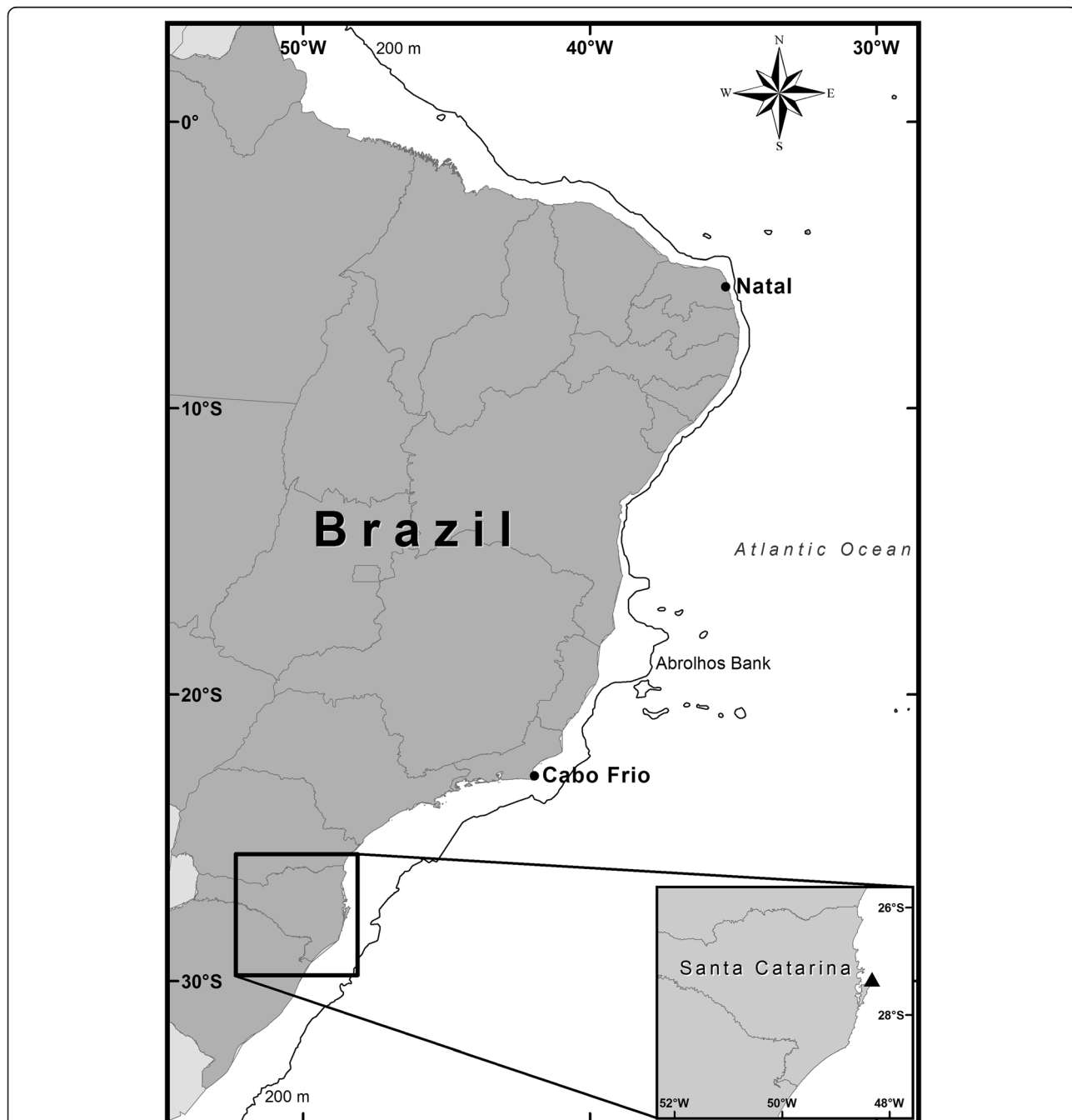


Fig. 1 The Brazilian coast and the usual occurrence range of humpback whales in the area, from Cabo Frio to Natal. A black triangle indicates the stranding site of a humpback whale at Ingleses beach, Florianópolis, Santa Catarina state

Methods and results

A dead female humpback whale was found stranded on 16th October 2014, at Ingleses beach (27°26'27.6"S, 048°22'26.4"W) in Florianópolis, Santa Catarina, southern Brazil (Fig. 1). The 8.36 m long carcass (total length) was in good condition and did not show any clear external signs of interaction with human activities (e.g. fishing gear marks). Cookie-cutter shark wounds, live whale lice and live barnacles were present on the body's surface. Necropsy revealed an evident hematoma (Fig. 2) on the right side of the body, extending from the thoracic to the abdominal muscular layers. When the abdominal cavity was accessed from its caudal edge, far from large veins or arteries, a large amount of blood flowed indicating internal haemorrhage. Examination of stomach contents revealed a great amount of undigested small shrimp-like crustaceans. The whale's biological samples are deposited in the collection of mammals of the Universidade Federal de Santa Catarina (Federal University of Santa Catarina) under number UFSC1422.

Discussion

Although stranding sites can be at considerable distance from where death occurred, as a consequence of ocean currents and wind drift (Peltier et al. 2012), the fresh condition of the carcass strongly indicates that the animal died within a few hours of when it was found. Moreover, the approach of Víkingsson (1997) on the "mean time of passage of food from the fore-stomach to the fundic chamber" for fin whales, as adopted by Danilewicz et al. (2009), supports the contention that the animal was alive and also feeding in no more than about 10 hours prior to death. Additionally, the presence of live whale lice indicates that the stranding occurred in less than three days

(Leung 1976), and the general aspect of skin was compatible with the previous conclusions. Furthermore, the site of stranding is in a residential area and there is no doubt that the carcass had beached on the day it was recorded.

The prey items were identified as *Peisos petrunkevitchi* (Fig. 3) (Burkenroad 1945) (Decapoda: Sergestidae) by A.S.F. at the Crustacean and Plankton Laboratory and are deposited in the biological collection of the Universidade Federal de Santa Catarina (number LCP/ECZ/UFSC101). This small shrimp species occurs from Rio de Janeiro state to Península Valdés (44°S), in Argentina (Ruiz and Fondacaro, 1997; D'Incao and Martins 2000). Danilewicz et al. (2009) described another sergestid species, *Acetes americanus* (Ortmann 1893) as the main prey item for the stranded humpback whale reported for Rio Grande do Sul, 250 km further south. Both species are small pelagic shrimps that occur in coastal waters up to 50 m deep and their distributions overlap in the southern coast of Brazil (D'Incao and Martins 2000). Dense patches of *P. petrunkevitchi* are likely to be ideal for large planktivore whales to feed (Nicol 2006) since sergestid shrimps are already known to support the energetic demands of other large planktivorous animals such as whale sharks (Rohner et al. 2015). Because *A. americanus* and *P. petrunkevitchi* inhabit the pelagic realm, they probably present equivalent potential to be preyed on by whales in the coastal waters of southern Brazil. Besides the inclusion of *P. petrunkevitchi* in the list of recorded species preyed on by humpback whales, the current report suggests a new contribution of the shrimp as prey in Brazilian waters, being already described as an important food source for sciaenid fishes (Pombo et al. 2013) and wasp jellyfish (Nogueira Jr and Haddad 2008) in the area.



Fig. 2 Hematoma on the right side of a humpback whale carcass, in the thoracic/abdominal muscular layers. The whale carcass is facing right. (Picture: R3 Animal)



Fig. 3 *Peisos petrunkevitchi* collected from the stomach of a stranded humpback whale. The horizontal bar represents 1 cm. (Picture: Thais Peixoto Macedo, LCP/UFSC)

The total length of the stranded animal (8.63 m) suggests that it was a juvenile, since this size corresponds to a one year old humpback whale (Clapham et al. 1999). Humpback whales at this age are usually approaching independence from their mother (Clapham et al. 1999) and this young animal could be starting to prey on crustacean after being recently weaned. The feeding may therefore have been opportunistic as a result of a large patch of prey being encountered. Also, large amounts of *P. petrunkevitchi* were found beached near the stranding site in the previous and following years (*personal observation* A.S.F.) so it is likely that the shrimp was abundant in the area in the year of the stranding.

Regarding the presence of this young whale in the coast of Santa Catarina, an important point to consider is that migration between breeding and feeding grounds for this population is known to be undertaken through offshore waters (Zerbini et al. 2006). Since the present stranding occurred after the usual peak of humpback whales occurrence along the Brazilian coast (Martins et al. 2001; Andriolo et al. 2010), most animals would have departed or were about to depart to their feeding area. Therefore the present animal could have started its migration but using a coastal route when travelling southwards instead. Because younger animals are less capable of accumulating energy reserves due to their smaller bodies, they also have a reduced capacity for spending long periods without feeding (Craig et al. 2003). For that reason, a coastal route that permits the animals to feed before travelling through areas where they are more unlikely to find food (i.e. offshore migratory regions) could be very profitable, if not essential, for a young whale.

Another possibility is that this young and sexually immature (i.e. incapable of reproducing) whale did not go to the population's usual breeding area on that season, but to an alternative habitat where it could feed during winter and spring (Swingle et al. 1993). Little is known, however, about specific feeding habitats for young animals of this population and more information is needed before we can determine if the present area may provide them with an important source of food.

The humpback whale population that inhabits the coast of Brazil has been showing clear signs of recovery since being severely depleted by commercial whaling in the mid-1900s (e.g. Ward et al. 2011; Zerbini et al. 2011; Bortolotto 2014). A proportional increase in their interactions with human activities is therefore expected, and ship strikes are recognized as an important threat to marine mammals in the Southern Hemisphere (Van Waerebeek et al. 2007) and around the world (Laist et al. 2001; Carrillo and Ritter 2010; Martins et al. 2013). In a recent study, the potential risk of ship strikes on humpback whales at the Abrolhos Bank was estimated (Bezamat et al. 2014) and the authors indicated that, depending on the vessels speed for example, the risk of whales being impacted by vessels in that area was very high. Although the density of whales in the present area is much lower than in the Abrolhos Bank, individual whales are subject to the risk of being struck when in areas of shipping traffic as the coastal regions of Santa Catarina. The characteristic haematoma in the body region most likely to be hit when the animal was alive (Laist et al. 2001), together with signs of internal haemorrhage strongly indicate that the present animal suffered a very strong impact

that caused its death. Only a ship strike would explain such an impact.

Conclusions

This is the northernmost record of food items for a stranded humpback whale ever found in Brazil, and it constitutes strong evidence of feeding in the coastal waters of Santa Catarina (27°S), far beyond the usual feeding grounds of the western South Atlantic population. The evidence of a fatal ship strike indicates a potential threat, particularly if future observations confirm that the area is regularly used by at least a portion of these animals (e.g. young individuals). It is also the first time *Peisos petrunkevitchi* is described as prey for large whales, expanding the current knowledge on the possible trophic roles of this crustacean species. Although more information is needed before we can make robust inferences concerning the ecological importance of the coastal waters of southern Brazil for humpback whales, the findings presented here highlight important conservation concerns.

Abbreviations

cm, centimetre; km, kilometre; LCP/UFSC, Laboratório de Crustáceos e Plâncton (Crustacean and Plankton Laboratory), Universidade Federal de Santa Catarina; m, metre; WSA, Western South Atlantic

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Availability of supporting data

The dataset supporting the conclusions of this article is included within the article as photographs.

Authors' contributions

CKMK and GAB conducted the necropsy, took photographs and collected samples. ASF identified the prey item. ASF, CKMK, GAB and PCSL wrote the manuscript together. All authors have read and approved the final version of the manuscript.

Authors' information

CKMK and GAB have degrees in veterinary medicine.

Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

This work was conducted under the permission number 24110–4 (SISBIO – ICMBio).

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