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Occurrence of blue whales (*Balaenoptera musculus*) in offshore waters of southeastern Brazil

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Abstract

At-sea sightings of blue whales, *Balaenoptera musculus*, in Brazil are rare. A mother-calf pair was observed in deep (2645 m) waters off southeastern Brazil (22°11'S 038°58'W); during a seismic survey in July 2014. It is unknown to which of the subspecies the animals sighted belong. The presence of a calf suggests that blue whales use deep waters off Brazil as calving or nursing grounds. The identification and conservation of wintering grounds for blue whale populations is important to promote the recovery of blue whales as their numbers were critically reduced as a result of commercial whaling.

Keywords: Southwestern Atlantic Ocean, Brazil, Wintering ground, Distribution

Background

Blue whales (*Balaenoptera musculus*) were abundant in the Southern Hemisphere prior to commercial whaling, which began in the early twentieth century. Three subspecies of blue whales are recognized in the Southern Hemisphere: the pygmy blue whale (*B. m. brevicauda*), the Antarctic blue whale (*B. m. intermedia*) and an unnamed subspecies referred to as the Chilean blue whale (Committee on Taxonomy 2017). Due to the comparatively small historical catches outside the Antarctic and the observed number of pygmy and Chilean blue whales, at least in some areas of their ranges (Williams et al. 2011), these subspecies appear to be less depleted than the Antarctic subspecies, which was primary target of the commercial whaling industry and is still listed as 'Critically Endangered' (IUCN (International Union for Conservation of Nature) 2017).

Despite have been fully protected from commercial whaling for several decades, blue whale numbers globally remain low and the recovery process appears slow (Branch et al. 2004; Branch et al. 2007). Recovery of blue whales ranks high among global priorities for baleen whale conservation (Thomas et al. 2016) and could have

important implications not only for maintaining biodiversity but also for ensuring ecosystem integrity and functionality (Roman et al. 2014).

In some areas, blue whales are difficult to study in view of their low abundance and tendency to remain in deep offshore waters (Reeves et al. 2004). Little is known about the biogeography and life strategies of Southern Hemisphere blue whales. Outside Antarctic waters, only a few consistent occurrence areas are known (e.g. Hucke-Gaete et al. 2004; Branch et al. 2007; Double et al. 2014).

Although there have been progresses to understand winter distribution and migration patterns of the Southern Hemisphere blue whale in the Indian and Pacific Oceans (Double et al. 2014; Torres-Florez et al. 2015; Balcazar et al. 2016; LeDuc et al. 2017; Attard et al. 2018; Hucke-Gaete et al. 2018) very little is known in the Atlantic.

In contrast to the common occurrence of blue whales on the Pacific side of South America (Hucke-Gaete et al. 2004; Torres-Florez et al. 2014; Vernazzani et al. 2017), the species seems to be rare on the Atlantic side (Williamson 1975; Zerbini et al. 1997; Branch et al. 2007). According to Branch et al. (2007), the western South Atlantic has the lowest numbers of catches, sightings and strandings of blue whales in the Southern Hemisphere. Although a fossil blue whale was recently found in southeastern Brazil (Buchmann et al. 2017), in

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the 1940s and 1960s only three blue whales were captured on the whaling grounds off northeastern and southeastern Brazil, in spite of the fact that they would have been prime targets and were not yet legally protected (da Rocha 1983; Zerbini et al. 1997) and between 1966 and 1981, three sightings were recorded during whaling operations off northeastern Brazil (da Rocha 1983). On 29th of April, 1992, a 23m female stranded alive on the southernmost coast of Brazil (33°45'S). This is the only confirmed stranding record for the species along the entire >8,000 km long Brazilian coast (Dalla and Secchi 1997). Recently, in the 27th and 31st of July 2011, two mother-calf pairs of blue whales were observed in Potiguar Basin, northeastern Brazil (04°42' S, 036°40'W) (de Oliveira 2015). Here, we report a new sighting in the offshore waters of southeastern Brazil.

Results

On 3rd of July 2014 a mother-calf pair of blue whales was observed in the offshore waters of southeastern Brazil (22°11'S, 038°58'W) (Fig. 1) by the Marine Mammal Observer team (MMOs) aboard the seismic

vessel M/V Oceanic Champion. The sighting occurred while the vessel was in transit. The whales were traveling along the same course as the vessel (150° heading) at 2645 m deep (Fig. 2). The blue whales could not be identified to the subspecies, as they are difficult to distinguish in the field (Torres-Florez et al. 2015).

Discussion

The scarcity of sighting and stranding records along the Brazilian coast is probably due to a combination of factors. Blue whale populations in the Southern Hemisphere were depleted by commercial whaling (IWC (International Whaling Commission) 2006) and their numbers have yet to recover (Branch et al. 2004; Branch et al. 2007). Furthermore, the species tends to inhabit deep offshore waters during the breeding season (Double et al. 2014; Torres-Florez et al. 2015; Lesage et al. 2017; Hucke-Gaete et al. 2018) and the limited cetacean-oriented survey efforts in deep waters of the western South Atlantic (e.g. Di Tullio et al. 2016) translates in few chances of blue whale encounters.

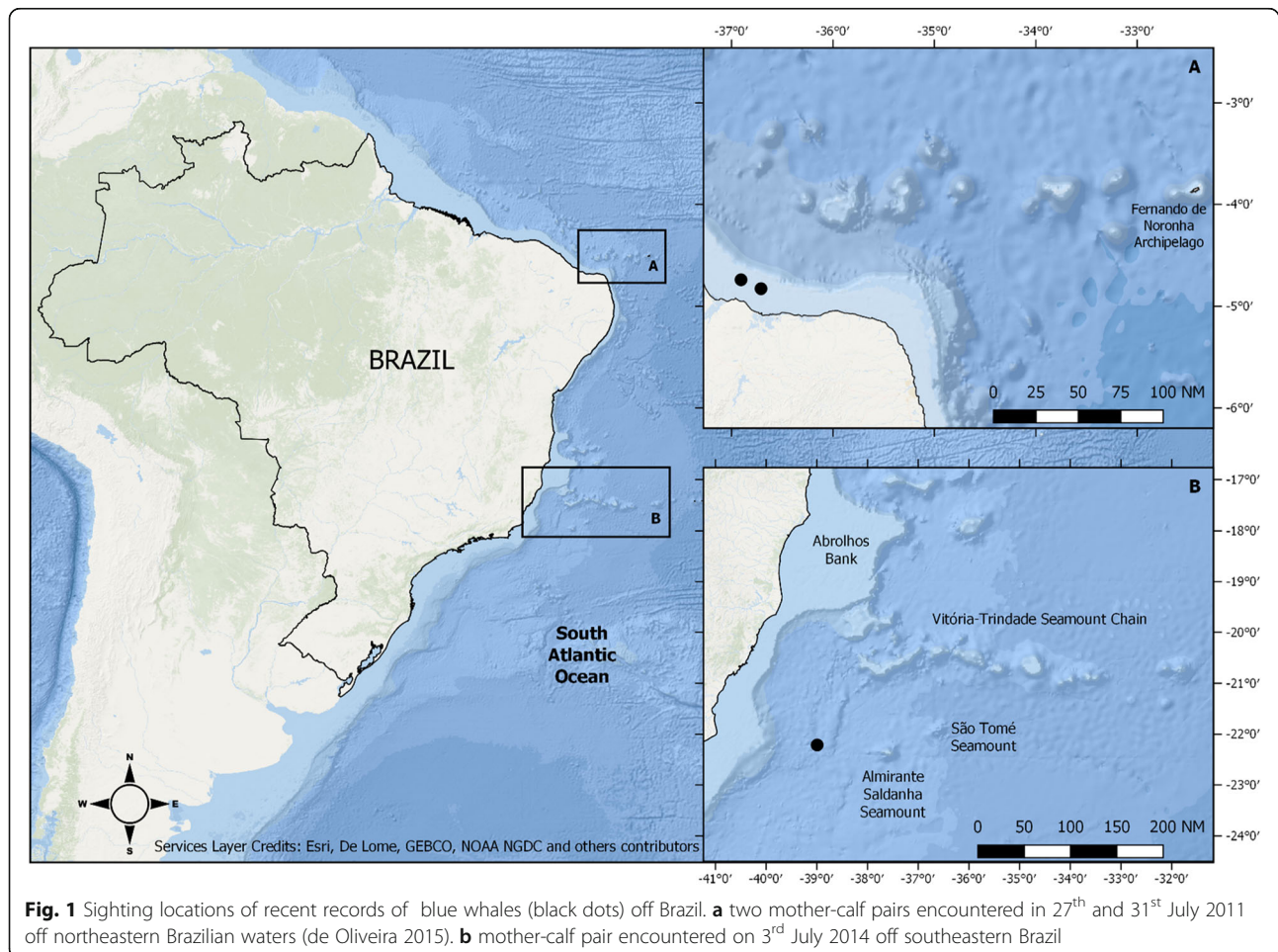


Fig. 1 Sighting locations of recent records of blue whales (black dots) off Brazil. **a** two mother-calf pairs encountered in 27th and 31st July 2011 off northeastern Brazilian waters (de Oliveira 2015). **b** mother-calf pair encountered on 3rd July 2014 off southeastern Brazil



Fig. 2 Mother-calf pair of blue whales photographed off southeastern Brazil on 3rd of July, 2014. Photos: L. Pacheco, A. Rocha, C. Marchetto

Indirect evidence suggests that the whales observed in July 2014 were Antarctic blue whales. Relatively large catches of Antarctic blue whales were made in the eastern Atlantic Ocean in winter during the whaling period (Mackintosh et al. 1929; Branch et al. 2007). Furthermore, the year-round acoustic recordings of Antarctic blue whales off Namibia, with peak in June (Thomisch 2017) indicate that South Atlantic waters might represent an important overwintering habitat for the Antarctic subspecies.

Blue whale habitat can sometimes be defined in relation to that of their principal prey, euphausiids, and to particular oceanic features (such as up-welled modified waters) and topographic features (such as ocean seamounts, coastal shelf and slope areas) (Reilly and Thayer 1990; Branch et al. 2007). The Vitória-Trindade Seamount chain off Brazil is known to have high aggregate production of phytoplankton and zooplankton (Gaeta et al. 1999; Genin 2004). Our sighting was in the vicinity of the Almirante Saldanha Seamount (c. 75nm distant) and of the Vitória-Trindade Seamount Chain (c. 100nm distant) (Fig. 1). Such highly productive seamounts of the South Atlantic can provide feeding opportunities and therefore constitute important blue whale habitats. Previous surveys along the Vitória-Trindade Seamount chain have recorded fin (*Balaenoptera physalus*), Antarctic minke (*B. bonaerensis*), humpback whales (*Megaptera novaeangliae*) (Zerbini et al. 2011; Wedekin et al. 2014; Bittencourt et al. 2016) and also mother-calf pairs of sei whales (*Balaenoptera borealis*) (Heissler et al. 2016).

The mother-calf pairs of blue whales observed off northeastern Brazil (de Oliveira 2015) (Fig. 1) were close to the shelf break, and in the vicinity of deep ocean structures, a suitable environment for the euphausiid aggregation (Genin 2004; Lesage et al. 2017). Mother-calf pairs of humpback whales have been recorded along the Potiguar basin (de Oliveira 2015) and the waters off northeastern Brazil have been considered a breeding ground for minke whales (Andriolo et al. 2010).

These recent records of mother-calf pairs of blue whales off Brazil suggest that deep waters of the western South Atlantic Ocean are used for nursing by a slowly recovering population. Further studies in offshore waters along the Brazilian coast are essential for a better understanding of blue whale ecology. Identification and conservation of the areas used by blue whales are fundamental for improving their chances of recovery from the depletion that is the legacy of commercial whaling. Nevertheless, blue whales may face other challenges such as entanglement in fishing gear (Reeves et al. 1998), ship strikes (de Vos et al. 2013; Brownell et al. 2014; Rockwood et al. 2017), noise disturbance (Di Iorio and Clark 2010; Martins et al. 2013), to name a few.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

AR, CM and LP were the Marine Mammals Observers (MMOs) on duty at the time of sighting. AR defined the scope and coordinated the draft of the manuscript. ERS reviewed the manuscript and helped with the identification of the blue whales. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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