

DWARF MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA* SUBSP.) INTERACTIONS WITH VESSELS OFF THE COAST OF BRAZIL

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Abstract

The dwarf minke whale (*Balaenoptera acutorostrata* subsp.) is a hard to detect small baleen whale whose behavior towards vessels and man-made structures in South Atlantic waters is still not well characterized. This study compiles records on the behavior of this species in Brazil, employing citizen science reports and data from ship and sailboat surveys. A total of 16 records were obtained from 2001 to 2021. The data indicate a consistently curious approach toward boats (81.25% of all identified behaviors). Other identified behaviors included traveling/fleeing (6.25%), and breaching (6.25%). These assessments comprise valuable tools for field identification of this species, as color patterns may become exposed during different aerial displays. This is the first approach to understand the ephemeral behavior of the dwarf minke whale along the southeastern coast of Brazil.

Key words: Mysticetes, dwarf minke whale, *Balaenoptera acutorostrata* subsp., anthropogenic activities, behavioral responses.

Nine baleen whale species comprise the *Balaenoptera* genus, including the common minke whale (*B. acutorostrata*) (Wada *et al.*, 2003; Rosel *et al.*, 2021), the smallest of all (Stewart *et al.*, 2002). This species is further categorized into three subspecies, the North Atlantic common minke whale (*B. acutorostrata acutorostrata*), the North Pacific common minke whale (*B. acutorostrata scammoni*),

and a Southern Hemisphere, still unnamed subspecies generally referred to as the dwarf minke whale (*B. acutorostrata* subsp., Best, 1985), whose geographical distribution encompasses tropical, temperate, and polar waters of the South Atlantic, South Pacific, and Indian Oceans (NOAA Fisheries, 2022).

A clear taxonomical separation between the dwarf minke whale and the Antarctic minke whale (*B. bonaerensis*) is noted, as well as differences in size and coloration (Best, 1985; Arnold *et al.*, 1987). Furthermore, genetic evidence suggests a separation between the Western South Atlantic and Western South Pacific dwarf minke whale populations (Pastene *et al.*, 2010; Milmann *et al.*, 2021). However, both species can reach similar sizes, depending on their age class, exhibiting certain common morphological traits, such as a third white shoulder patch near the fluke insertion (da Rocha and Braga, 1982; Secchi *et al.*, 2009; Milmann *et al.*, 2018) that hinder their field identification in geographical areas where they can be sympatric. This is of significant interest, as the International Union for Conservation of Nature categorization of “Least Concern” refers to all *B. acutorostrata* subspecies, with no specific separate category assigned to dwarf minke whales, and is based on estimates from parts of the species range in the Northern Hemisphere only (The Minke Whale Project, 2022). The species, however, is at risk for several threats common to other whale species, comprising entanglement in fishing gear, ocean noise, vessel strikes and climate change effects (NOAA Fisheries, 2022).

Concerning behavior, common minke whales have been known to swim close to ships (Leatherwood *et al.*, 1976), while dwarf minke whales have been known to voluntarily approach dive tourism vessels and passengers and maintain contact for prolonged periods off Australia’s Great Barrier Reef, in the Western South Pacific (Arnold *et al.*, 1987; Mangott *et al.*, 2011). Very limited information on this species behavior and reactions to vessels and man-made structures is, however, available, especially for Western South Atlantic waters.

In this regard, dwarf minke whales appear in most lists and reviews concerning stranded or opportunistically sighted cetaceans off the coast of Brazil (Geise and Borobia, 1988; Simões-Lopes and Ximénez, 1993; Magalhães *et al.*, 2008; Zerbini *et al.* 1996, 1997; Santos *et al.*, 2010; Costa *et al.*, 2017; Mayorga *et al.*, 2020), and dedicated surveys on land, oil platforms and at sea, have proven invaluable in detecting this species off the coasts of the states of Rio de Janeiro (Hassel *et al.*, 2003), Santa Catarina (Cremer *et al.*, 2009), São Paulo (Santos *et al.*, 2019; Figueiredo *et al.*, 2020) and in Northeastern Brazil (Zerbini and da Rocha, 1999). Incidental dwarf minke whale entanglements in fishing gear have also been reported in the state of Rio Grande do Sul, Southern Brazil (Secchi *et al.*, 2003). See Milmann *et al.* (2020) for a recent compilation on minke whale stranding records off the coast of Brazil.

Concerning general dwarf minke whale behavior, it has been reported interacting with other species, such as humpback whales (*Megaptera novaeangliae*) and small odontocetes like bottlenose dolphins (*Tursiops truncatus*) and rough-toothed dolphins (*Steno bredanensis*) off the state of Bahia, Northeastern Brazil (Rossi-Santos *et al.*, 2006). Data on reactions to anthropogenic activities for this species off the coast of Brazil, however, are sorely lacking. In this regard, one of the few studies available indicates that dwarf minke whales can swim close to offshore structures, as reported by Cremer *et al.* (2009) for Southern Brazil, as well as near tourist and fishing boats, during feeding in the summer in coastal waters off Arraial do Cabo, in Southeastern Brazil (Hassel *et al.*, 2003). Another, ethnobiological approach study conducted off the central Bahia coast, in Northeastern Brazil, described dwarf minke whale (locally known as “*tauaçu*”) interactions with fisheries activities, noting that fishers there believe that the minke whale attacks people, mainly due to its vessel-approaching behavior, and, in this regard, they may have negative attitudes reflected in behaviors that can harm these animals (Seminar *et al.*, 2019).

In this context, it is relevant to report unpublished records concerning dwarf minke whale approaches to vessels and interactions with other man-made structures off the coast of Brazil. This study, therefore, compiles unpublished records from multiple sources on dwarf minke whale reactions to human activities along the SE and NE Brazilian coastlines. The categorized reactions motivated by human

activities follow Watkins (1986) for four baleen whales (common minke whale, fin whale *B. physalus*, northern right whale *Eubalaena glacialis* and humpback whale *M. novaeangliae*), defined as Positive (P), Uninterested (U) and Negative (N). “Positive” reactions include apparent curiosity to the presence of the vessel, “Uninterested” reactions comprise events in which stimuli were apparently ignored, and the whales continued their activities uninterrupted, and “Negative” reactions include sudden changes in behavior (e.g., activity to inactivity, inactivity to activity, or changes in activity). Behaviors that were not clearly identified as P, U, or N, or that could not be identified due to lack of information, were classified as Undetermined (Und).

A total of 16 dwarf minke whale records concerning reactions to anthropogenic activities were obtained for Brazil, comprising 13 positives (boat attraction), two negatives (traveling/fleeing and intensive breaching), and one undetermined. These behaviors were identified by both research (n=9; platform D) and platform of opportunity vessels (n=5; platform C), as well as literature reports (n=2; platform L). Geo-referenced available records are listed in Table 1 and depicted in Fig. 1. Sightings from dedicated surveys were performed by experienced observers when the boats were in motion, while “platform C” refers to opportunistic sightings with or without the boat in motion. Remarkably, the only two cases of negative behavior were recorded from opportunistic platforms, which could be related to a sudden movement of the boat towards the animal or even a sudden stop from the boat for observation.

Dwarf minke whales off the coast of Brazil are seemingly very inquisitive, similar to behavior observed in Australia, where whales voluntarily approach dive tourism vessels and passengers and maintain contact for prolonged periods of time (Mangott *et al.*, 2011). This behavior was detected in two areas in Brazil, along the Northeastern coast for both Antarctic and dwarf minke whales, and in Campos Basin, in Southeastern Brazil, where whales approached vessels curiously after perceiving them and remained immobile while the vessels passed by. This curious approach towards vessels may comprise a valuable tool to detect and identify dwarf minke whales in the field, considering their lower detectability when compared to other baleen whales (Zerbini *et al.*, 2006; Martin *et al.*, 2013) due to their smaller size and almost undetectable respiratory blow in tropical areas.

The traveling/fleeing behavior reported herein has been described as depending on the number of whales in the group and type of group (Argüelles *et al.*, 2022). This behavior has been noted for other whale species, such as blue whales (*B. musculus*) (McKenna *et al.*, 2015), and southern right whale mother-calf pairs or solitary individuals (Argüelles *et al.*, 2022), where whales dive to deeper depths when at the surface or delay their surfacing following a diving period when near ships. However, avoidance behavior seems to be species-specific to a certain extent (Argüelles *et al.*, 2022), and the low number of records reported herein for this category may seem to indicate low dwarf minke whale sensitivity to vessels, potentially increasing vessel collision events and comprising a threat to the species.

Finally, the breaching behavior is more frequent in certain species, such as humpback and right whales (Segre *et al.*, 2020), and rarer in others, like fin whales (Aguilar and García-Vernet, 2018). Dwarf minke whales do not usually exhibit this behavior, although some records are available in the literature (Arnold and Birtles, 1999; Segre *et al.*, 2020). Concerning the present study, breaching was observed for one dwarf minke whale individual, which breached 17 times in a period of 15 minutes (13 h35 to 13 h50) on 1 May 2020 off Ilha de São Sebastião, in SE Brazil (Fig. 2). This high number of breaches in such a small period of time is likely to add up to a significant amount of spent energy, as breaching comprises a high energy expenditure in whales (Segre *et al.*, 2020), potentially associated with vessel proximity. However, ultimately, the reasons for this behavior are still unknown, although some hypotheses have been put forth, such as courtship, parasite dislodgement, communication, and reactions to nearby activities, including the presence of vessels, noise, and others (Werth and Lemon, 2020). Thus, breaching behavior when noted in association with nearby vessels should be interpreted cautiously. Further, this behavior may comprise a valuable tool for dwarf minke whale identi-

Table 1. Records from multiple sources on the ‘reaction’ behavior of dwarf minke whales (*Balaenoptera acutorostrata* subsp.) to anthropogenic activities. Abbreviations: Positive (P), Uninterested (U), Negative (N), Undetermined (Und), Rio de Janeiro State (RJ), São Paulo State (SP), Northeastern (NE), Bahia State (BA). Platform: C=citizen report, D=direct observation, L=literature.

Location	Platform	Date/Period	No. sightings	Behavior	Source	Latitude	Longitude
Pontal do Atalaia, Arraial do Cabo, RJ	L	2001	22	P	Hassel et al. (2003)	—	—
NE Brazil continental shelf	L	1998–2001	1	P	Zerbini and da Rocha (1999)	—	—
Campos Basin, RJ	D	13-April-2008	1	P	This study	—	—
Campos Basin, RJ	D	10-May-2008	1	P	This study	—	—
Campos Basin, RJ	D	23-May-2008	1	P	This study	—	—
Campos Basin, RJ	D	28-May-2008	1	P	This study	—	—
Campos Basin, RJ	C	23-Sep-2014	1	P	This study	—	—
Santos Basin, RJ	D	10-Mar-2020	1	P	This study	–25.72809	–46.03487
36nm off S. Sebastião, Ilhabela, SP	C	28-April-2020	1	Und	This study	–24.39166	–45.47201
ca. Parcel da Itapeirica, S. Ilhabela, SP	C	01-May-2020	1	N	This study	–23.91270	–45.07871
8 nm off Ilhéus, BA	C	04-Jun-2020	1	P	This study	—	—
Ilha de Búzios, Ilhabela, SP	D	23-Jun-2020	1	P	This study	–23.77620	–45.07871
São Sebastião, Ilhabela, SP	C	09-Jul-2020	1	N	This study	–23.82055	–45.38898
28 nm off São Sebastião, Ilhabela, SP	D	20-Jan-2021	1	P	This study	–24.18333	–44.90000
SE offshore area, RJ	D	27-May-2021	1	P	This study	–23.65395	–40.98630
70 nm off Ilhabela. São Sebastião, SP	D	21-Nov-2021	1	P	This study	–24.56666	–44.55933

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