

## NOTA CIENTÍFICA

**A STOP FOR A SNACK: EVIDENCE OF HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) FEEDING BEHAVIOR AND ASSOCIATION WITH GILLNETS DURING MIGRATION OFF SOUTHEASTERN BRAZIL**Salvatore Siciliano<sup>1\*</sup>, Júlio Cardoso<sup>2</sup>, Arlaine Francisco<sup>2</sup>, Sérgio Carvalho Moreira<sup>3</sup><sup>1</sup> Laboratório de Referência Nacional de Enteroinfecções Bacterianas (Labent), Instituto Oswaldo Cruz/Fiocruz and Grupo de Estudos de Mamíferos Marinhos da Região dos Lagos (GEMM-Lagos), Rio de Janeiro, RJ, Brazil<sup>2</sup> Projeto Baleia à Vista, São Sebastião, SP, Brazil<sup>3</sup> Setor de Mastozoologia, Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, Rio de Janeiro, RJ

\*Corresponding author e-mail: gemmlagos@gmail.com

## RESUMO

Baleias-jubarte (*Megaptera novaeangliae*) migram anualmente desde as águas frias dos polos, onde alimentam-se de krill e peixes, em direção a regiões subtropicais e tropicais em busca de ambientes favoráveis para reprodução e cria de filhotes. Os casos de alimentação das baleias-jubarte em áreas de reprodução são ainda pouco conhecidos pelo mundo. Nesse trabalho relatamos observações em campo de uma baleia juvenil – *yearling*, em águas brasileiras, com evidências de comportamento de forrageamento, em busca de pequenas presas, camarões ou lulas, durante curtos mergulhos. Adicionalmente são relatadas outras observações semelhantes no sudeste do Brasil nas quais as baleias mostraram interesse e aproximação de redes de emalhe, provavelmente atraídas por peixes ali enredados. Considera-se que em alguns desses casos a aproximação das baleias em direção às redes tenha causado emalhamentos, e que pelo menos em um caso o exemplar libertou-se das redes. Em outros casos as redes podem ter causado ferimentos nas baleias-jubarte. Recomenda-se um acompanhamento dessas interações de baleias-jubarte com redes de pesca pela costa brasileira para uma melhor avaliação, uma vez que podem representar uma forma nova de comportamento desses migrantes.

## ABSTRACT

Humpback whales (*Megaptera novaeangliae*) migrate annually from the cold waters of the poles, where they feed on krill, towards subtropical and tropical regions in search of favorable environments for breeding and calving. Cases of humpback whales feeding on breeding grounds are still poorly known in the world. This study reports field observations of a juvenile whale - *yearling*, in Brazilian waters, with evidence of foraging behavior, in search of prey that seemed to be prawn or squid, during short dives. In addition, other similar observations are reported in southeastern Brazil in which the whales showed interest and approach gillnets, probably attracted by entangled fish. In some of these cases, it is considered that whale approaching towards the nets has caused entanglements, and in at least one case the specimen freed itself from nets. In other cases, nets may have caused humpback whale injuries. A follow-up of these interactions throughout the Brazilian coast is recommended for a better evaluation of these interactions with fishing nets, since they may represent a new form of behavior of these whales in their migratory period.

Key words: Humpback whale; feeding areas; entanglement; Brazil

Humpback whales (*Megaptera novaeangliae* Gray, 1846) migrate seasonally from high latitude waters, where they feed, to tropical and subtropical waters for breeding and calving (Dawbin, 1966; Jefferson *et al.*, 2008). In the Southern Hemisphere, this species migrates from the summer feeding areas in the Antarctic and Subantarctic regions to mating and calving grounds located in tropical and subtropical regions, generally in coastal shallow waters or near oceanic islands (Chittleborough, 1958,

1965; Herman & Antinoya, 1977; Siciliano, 1997). Although considered unusual behavior, humpback whales can engage in feeding activity while migrating to the tropics and subtropics (Baraff *et al.*, 1991; Stockin & Burgess, 2005). These humpback whale feeding events in mid-latitudes have been linked to highly productive waters in specific areas, such as northern Chile and southern Peru, Baja California, off Oman and Namibia (Papastavrou & Van Waerebeek, 1997), the Mexican Pacific coast

(Villegas-Zurita and Castillejos-Moguel 2013) and, more recently, off the Pacific coast of Nicaragua (De Weerd & Ramos, 2019).

This report consists of evident feeding behavior of a yearling humpback whale plunge-diving in pursuit of shrimp or squid in southeastern Brazilian waters. In addition, records of apparent feeding behaviors of yearling humpback whales while migrating in mid-latitude waters off southeastern Brazil are discussed. Such feeding events were recorded in close association with gillnets and may lead to consequent entanglements.

Information on entanglements and live and stranded cetaceans along the coast of the state of Rio de Janeiro was collected through the stranding network developed by Grupo de Estudos de Mamíferos Marinhos da Região dos Lagos (GEMM-Lagos) since March 1999. Information on apparent humpback whale feeding behavior and entanglements off the coast of the state of São Paulo was provided by the “Baleia à Vista” Project (PROBAV), a citizen science project. Cetacean sighting cruises have been carried out by PROBAV monthly on the coast of the Ilhabela and São Sebastião Archipelago (northern São Paulo, southern Brazil) since 2005. A total of 170 day-cruises and 855 hours of navigation were conducted in 2016 and 2017, resulting in 25 humpback whale sightings. This report considers only records between 2016-2018 along the coasts of the states of Rio de Janeiro and São Paulo.

A total of six events including evidence of whale feeding behavior, proximity to gill nets and entanglements were observed along the coasts of Rio de Janeiro and São Paulo from June 2016 to July 2018, and are described chronologically in more detail as follows:

**Record #01:** June 18, 2016. – A floating humpback whale carcass was observed off Arraial do Cabo (22°57'S, 42°1'W), Rio de Janeiro, wrapped in nets. Fishermen reported that the whale became entangled in gillnets set off Praia Grande (AC) (Figure 1).

**Record #02:** July 10, 2016. – A yearling humpback whale became entangled in a gillnet set just off Barra do Una and Juqueí beaches (23°46'S, 045°45'W), São Sebastião, São Paulo. A local group of sailors and fishermen, after prolonged efforts, were able to rescue and free the apparently exhausted whale.

**Record #03:** July 13, 2016. – A yearling humpback whale, approx. 9 m in length, was spotted at Baía de Castelhanos (23°5'S, 045°15'W), off Ilhabela, São Paulo, and filmed from a boat (idle

position, but not anchored), for about 2 hours, from 11AM to 01PM, diving repeatedly in circles, plunging at about 25 to 30 meters in depth. The boat sonar indicated a large shoal of small shrimp (perhaps squid) at about 10 to 15 meters in depth.

**Record #04:** June 17, 2017 – A yearling humpback whale, approx. 9 m in length, was sighted close to Ilha dos Búzios (23°48'W, 045°09'W), off Ilhabela, São Paulo, after breaching three times in about 15 minutes. The whale was observed moving towards a gillnet, passing near it and then returning and directing itself again in the direction of the device, as if it was checking the net and its contents. The whale turned upside down, displaying aerial behaviors with both pectoral fins and soon after, for a brief period, suddenly got entangled, dragged the gillnet forward and rapidly disentangled itself and moved on to the open sea (Figure 2).

**Record #5:** July 5, 2018 – Two large humpback whales, presumably adults, with total lengths of around 13 to 14 m, were spotted circling a gillnet off Barra de Guaratiba, Rio de Janeiro (23°4'S, 043°34'W).

**Record #6:** July 6, 2018 – A yearling humpback whale, approx. 9 m in length, was spotted entangled in a gillnet set off Icaraí, Niterói (22°54'S, 043°67'W), in the mouth of Guanabara bay, Rio de Janeiro. Fishermen tried unsuccessfully to release the net from the whale, and it was reported to have moved out of the bay carrying the attached net (Figure 3).

All records are indicated in Figure 4.

**Entanglements:** The three entanglement records and the observation of apparent feeding behavior were recorded off the coast of São Paulo and Rio de Janeiro states are represented by humpback whales interacting with gillnets. Record #01 is represented by a floating carcass located near the coast off Monte Alto, Arraial do Cabo, eastern Rio de Janeiro state, wrapped in a gill net. Records #02 and #06 were represented by yearling humpback whales entangled in gillnets set off São Sebastião and Niterói, respectively. Apparently, these whales were successfully released by fishermen and/or sailors and freed from nets with minor injuries. The whale off São Sebastião seemed to be emaciated and was apparently exhausted, due to the extended entanglement period. Record #04 was also represented by a yearling humpback whale, observed breaching for three times in about 15 minutes, and moving towards a gillnet and being entangled. Surprisingly the whale rapidly disentangled itself and moved on to the open sea (Figure 2). In all cases, yearlings participated in the events, in

distinct situations. As unexperienced whales, they may simply not detect or perceive surface nets, even at short distances. Another possibility is the apparent curiosity of whales towards nets and, if this is the case, a negative impact is expected. These records combine two poorly understood situations concerning migrating humpback whales: apparent feeding behavior in mid-latitude waters and interest in fishing gear.

**Apparent feeding behavior:** Record #3 is represented by an opportunistic observation by the PROBAV team of a yearling humpback whale actively plunge-diving at 25-30m in depth, pursuing a shoal of shrimp (or possibly squid) at the beginning of the breeding season. Sea conditions were very calm, and the whale was not disturbed by the presence of the nearby boat. The whale looked healthy, and the behavior was very much like the active feeding of a humpback whale throughout the water column.

Finally, record #5 refers to two large humpback whales, presumably adults, with total lengths around 13 to 14 m, circling a gillnet off Barra de Guaratiba, Rio de Janeiro, in relatively shallow waters, maximum 20 m.

According to Dolphin (1987), dive and surfacing duration, number of blows per surfacing and mean blow interval of feeding humpback whales are positively correlated with diving depth. Previous information on humpback whale feeding, or apparent feeding, activity in mid-latitudes off the Brazilian coast include: (a) two juveniles of approx. 10m in length encircling and lunge-feeding unidentified fish near an oil rig (Sá Alves *et al.*, 2009); (b) a fresh stranded yearling carcass, 7.27m in length, with its stomach full of *Acetes americanus* shrimp (Crustacea, Decapoda, Sergestidae) and Brachyura planktonic larvae (Danilewicz *et al.*, 2009); and (c) a fresh stranded yearling humpback whale carcass, 8.36 in body length, with its stomach full of *Peisos petrunkevitchi* shrimp (Crustacea, Decapoda, Sergestidae) (Bortolotto *et al.*, 2016a).

Danilewicz *et al.* (2009) consider that humpback whales may occasionally undertake feeding behavior in mid-latitude waters in the western South Atlantic Ocean. These conclusions are sustained by the higher biological productivity of the Cabo Frio upwelling system, in southeastern Brazil. In accordance with this assumption, during the austral summer, off Rio de Janeiro, dwarf minke whales (*Balaenoptera acutorostrata*) were observed feeding in the productive coastal waters of Arraial do Cabo (Hassel *et al.*, 2003). In addition, Siciliano *et al.* (2004) reported Bryde's whale (*B. brydei*)

observed preying on Brazilian sardines (*Sardinella brasiliensis*) along the São Paulo and Rio de Janeiro State coasts (22–248S), while the stomachs of two stranded Bryde's whales from Rio de Janeiro presented a large amount of *Acetes americanus* (Siciliano *et al.*, 2004). Therefore, it is possible that the seasonally productive waters of southeastern Brazilian coast may be used by baleen whales as an opportunistic feeding zone, and that small shrimp, as observed in the stomach contents of stranded juvenile humpback whales, may play a significant role in the feeding of these species.

For several authors, occasional migrating baleen whale, especially humpbacks, opportunistic feeding in (sub)tropical waters should be considered as a possible balance concerning an energy deficit incurred throughout the winter fast (Baraff *et al.*, 1991; Stockin & Burgess, 2005; Papastavrou & Van Waerebeek, 1997). In contrast, some of these observations were previously considered 'aberrant feeding behavior' (Baraff *et al.*, 1991) on the part of an animal whose physiology is adapted to prolonged fasting.

Regarding the age classes of whales observed feeding or presumably feeding in mid-latitudes, all age classes are included, namely: (a) yearlings, maximum of 9m in length, in Brazil (Danilewicz *et al.*, 2009; Bortolotto *et al.*, 2016a; and this study); (b) sub-adults in Hawaii, USA (Salden, 1989), Brazil (Sá Alves *et al.*, 2009), Oaxaca, Mexico (Villegas-Zurita & Castillejos-Moguel, 2013), off Eden, New South Wales, Australia (Silva *et al.*, 2011), a sub-adult of known age (approx. 5 years, 'Manta') in Samana Bay, Dominican Republic (Baraff *et al.*, 1991) and in the Adriatic Sea, Mediterranean (Genov *et al.*, 2009); (c) adult whales off Queensland, Australia (Stockin & Burgess, 2005).

The hypothesis of humpback whales stopping at certain specific areas along the south-eastern coast of Brazil during their northbound migration for feeding and recharging their energies after a long journey should be considered. In such cases, important productive coastal waters become key stopping points, as utilized by migrating shorebirds and others. One of the observations presented herein was a clearly emaciated whale, in rather poor body condition (Record #02), which gives support to this idea. As stated previously by Kawamura (1980) and supported by Baraff *et al.* (1991), auxiliary feeding by baleen whales at their wintering grounds can be expected, based on the energetic theory.

In our records, one yearling humpback whale was actively plunge-feeding in the direction of a possible 'shrimp-like' shoal. According to Baraff *et*

*al.* (1991), feeding humpback whale prey are often difficult to detect unless they are quite close to the surface. In this respect, zooplankton biomass and ichthyoplankton abundance are usually high in south-southern Brazilian coastal areas under the influence of brackish water outflows from large embayments or lagoonal systems (Lopes *et al.*, 2006).

In general, this report comprises the first observations of this kind of behavior for a yearling humpback whale in Brazilian waters in the literature, as the prey was either shrimp or squid. In the other case, of a more emblematic nature, the whale moved towards the gillnet, as if it was interested in its contents. Again, in most cases yearlings were involved, the most naïve and curious of all humpback whale class ages (Glockner-Ferrari & Ferrari. 1985)

As the “Brazilian” humpback whale population, or stock A according to the IWC, grows (Bortolotto *et al.*, 2016b), more interaction events and possible feeding in tropical areas are expected to be reported. The need for cetacean awareness campaigns and training of local environmental officers are required for dealing with these situations.

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### Additional sources:

Yearling humpback whale (*Megaptera novaeangliae*) undergoing apparent feeding behavior, Baía de Castelhanos, Ilhabela, São Paulo, 13 July 2016:

<https://vimeo.com/263942676> or

<https://www.projetobaleiaavista.com.br/videos>

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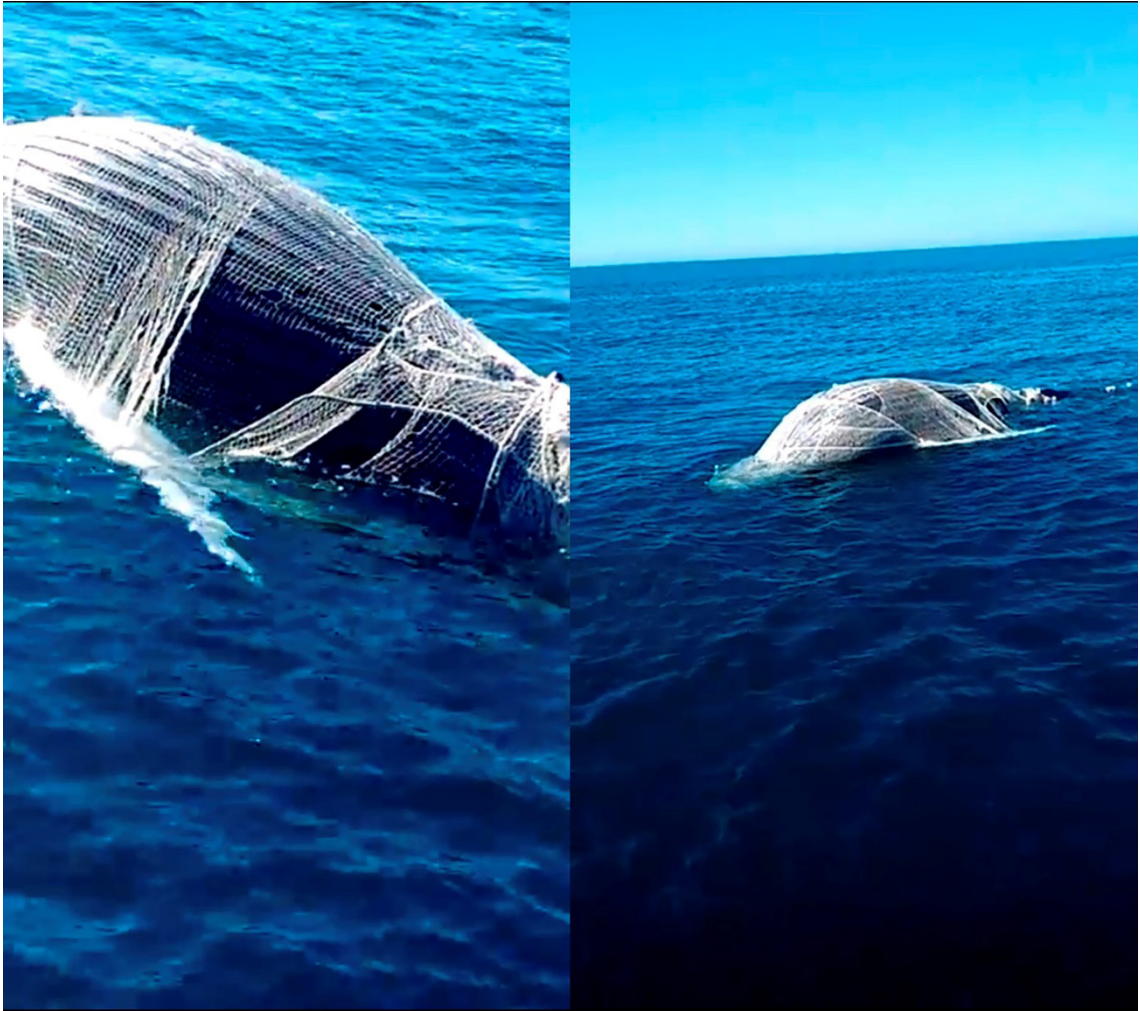


Figure 1. Floating humpback whale (*Megaptera novaeangliae*) carcass wrapped in nets observed off Arraial do Cabo (22°57'S, 42°1'W), RJ, on June 16th, 2016. Source: <http://g1.globo.com/rj/regiao-dos-lagos/noticia/2016/06/baleia-morta-enrolada-em-rede-de-pesca-e-vista-no-mar-de-arraial-rj.html> or <https://oglobo.globo.com/rio/baleia-jubarte-encontrada-morta-em-mar-de-arraial-do-cabo-19539925>



Figure 2. Yearling humpback whale (*Megaptera novaeangliae*) entangled in a gillnet off Ilha dos Búzios, São Paulo, on June 17<sup>th</sup>, 2017. Photos by J. Cardoso.



Figure 3. Yearling humpback whale (*Megaptera novaeangliae*) entangled in a gillnet set off Icaraí, Niterói, mouth of Guanabara bay, Rio de Janeiro on July 6th, 2018. Source: [https://www.facebook.com/perninha.denikiti/videos/vb.100002780124597/1305236079579050/?type=2&video\\_source=user\\_video\\_tab](https://www.facebook.com/perninha.denikiti/videos/vb.100002780124597/1305236079579050/?type=2&video_source=user_video_tab)



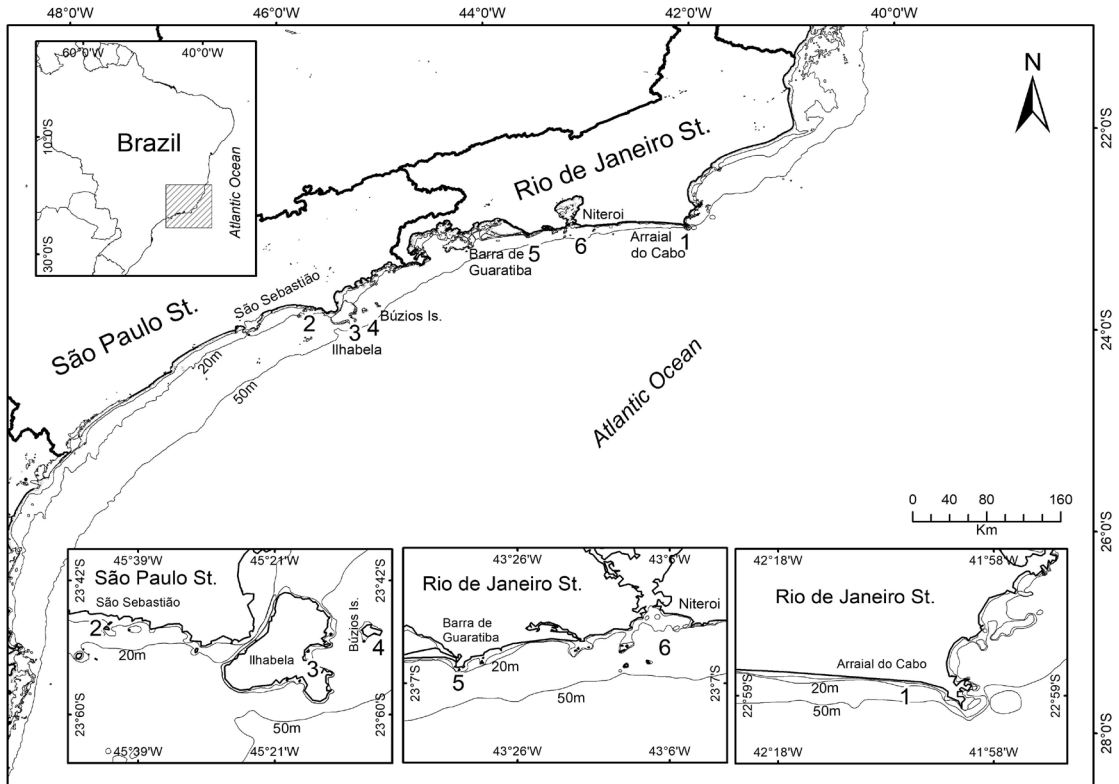


Figure 4. Locations of entanglements and observed feeding behaviors of humpback whales (*Megaptera novaeangliae*) off the coasts of the states of São Paulo and Rio de Janeiro, Brazil.