

Whale-watching in Brazil

Turismo de observação de cetáceos no Brasil

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ABSTRACT

This study aimed to investigate whale-watching in Brazil by surveying its areas of occurrence, key species, and current guidelines and regulations. The methodology includes a bibliographic search of cetacean occurrence and whale-watching areas in Brazil, legal instruments, and codes of conduct regulating this activity. A search for whale-watching areas was carried out on the homepage of tourist agencies and operators. In addition, data were collected via telephone, email, and social media of the tourist agencies and operators. In this study, we identified seven cetacean species and 29 whale-watching areas, 79% of which are protected areas. The results of this study may help monitor and enforcement measures for whale-watching aimed at protecting these animals.

Keywords: Whale. Ecotourism. Dolphin. Aquatic mammals. Protected areas.

RESUMO

Este estudo pretendeu investigar o turismo de observação de cetáceos no Brasil a partir de um levantamento de suas áreas de ocorrência, espécies-chave, e normas e regulamentos vigentes. A metodologia inclui uma pesquisa bibliográfica sobre áreas de ocorrência de cetáceos no Brasil, turismo de observação, instrumentos legais e códigos de conduta para o ordenamento dessa atividade. Foi realizada uma busca por áreas de referência do turismo de observação de cetáceos em homepage de agências e operadoras de turismo. A coleta de dados se deu por meio de contato telefônico, e-mail e redes sociais das agências e operadoras de turismo. Neste estudo, foram identificadas sete espécies de cetáceos-chave do turismo de observação, 29 áreas de referência, com 79% dessas áreas inseridas em Unidades de Conservação.

Os resultados deste estudo poderão subsidiar ações de monitoramento e fiscalização do turismo de observação de cetáceos, visando seu ordenamento e a proteção desses animais.

Palavras-chave: Baleia. Ecoturismo. Golfinho. Mamíferos aquáticos. Unidades de conservação.

1 INTRODUCTION

In Brazil, whale-watching originated in the 1980s in Fernando de Noronha, Pernambuco state (PE), with the spinner dolphin, *Stenella longirostris*, and the Amazonas state (AM) with the Amazon River dolphin, *Inia geoffrensis* (VIDAL *et al.*, 2017). Currently, other cetacean species are crucial to whale-watching in Brazil, such as the Guiana dolphin, *Sotalia guianensis* (LUNARDI *et al.*, 2017), humpback whale, *Megaptera novaeangliae* (FERNANDES; ROSSI-SANTOS, 2018) and the southern right whale, *Eubalaena australis* (GROCH, 2018). In addition, this activity may produce economic benefits by creating jobs and income for the local population (LUNARDI *et al.*, 2017) and environmental and educational benefits by protecting natural resources and promoting tourist awareness (GARCÍA-CEGARRA; PACHECO, 2017; TISCHER *et al.*, 2018).

Although there are some benefits from whale-watching, biodiversity conservation and socioeconomic sustainability are not always achieved. When motorized boats are involved, whale-watching has often been associated with adverse effects (MACEDO *et al.*, 2020). According to the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species, five cetacean species and 19 subspecies are critically endangered worldwide, while 12 species and 12 subspecies are endangered (IUCN, 2022). Four of these endangered species are key to whale-watching in Brazil: the southern right whale, Amazon River dolphin, tucuxi, *Sotalia fluviatilis*, and Guiana dolphin (MMA, 2022).

For whale-watching control, some countries enact specific legislation. For example, in Australia, the activity has been regulated since 2000 by Law nº 181/2000, which governs environmental protection and biodiversity conservation, with a chapter dedicated to cetacean interaction and watching (AUSTRALIA, 2000). In New Zealand, the Marine Mammal Protection Regulation (MMPR), enacted in 1988 and updated in 1992 and 2008, establishes adequate whale-watching conditions, boat approaches, and other interaction guidelines for marine mammals (NEW ZEALAND, 1992). In the Azores, Portugal, whale-watching is regulated by regional Decree nº 10, of March 22, 2003/A, aimed at protecting and conserving cetaceans and promoting tourism development and management (AÇORES, 2003). In Chubut, Argentina, whale-watching is regulated by Law nº 5.714, of December 21, 2007, which forbids approaching and following the southern right whale, and Decree nº 167, of February 29, 2008, which establishes the technical aspects allowed and prohibited for transport services (CHUBUT, 2008). In Brazil, Law nº 7.643, of December 18, 1987, prohibits cetacean hunting in Brazilian jurisdictional waters (BRASIL, 1987), while Ibama (Brazilian Federal Environmental Agency) Ordinance nº 117 of December 26, 1996, updated by Ordinance nº 24 of February 8, 2002, forbids cetacean molestation and establishes limits for boats that operate in Brazilian jurisdictional waters (IBAMA, 2002).

Although whale-watching is an instrument to promote environmental conservation and an important source of employment and income, there are no studies describing how this activity occurs in Brazil's main cetacean concentration areas. Therefore, this study aims to answer two questions: (i) What are the whale-watching reference areas in Brazil and their main key species? (ii) How is whale-watching conducted in Brazil? The results presented here, such as the distribution of reference areas, key whale-watching species in Brazil, and the variables to consider in a comprehensive judicial instrument, may contribute to a national whale-watching enforcement plan to promote cetacean conservation and sustainable ecotourism.

2 METHODOLOGY

Brazil has one of the longest coastlines in Latin America, at more than 7400 km long, and its coastal waters, contiguous zone, and exclusive economic zone exceed 3.4 million km² (NOTHEN, 2015). In addition, Brazil owns some oceanic and fluvial islands that include island complexes (IBGE, 2011).

Since 2008, via Decree nº 6.698, of December 17, 2008, Brazilian jurisdictional waters were declared a whale and dolphin sanctuary, allowing scientific research and sustainable tourism (BRASIL, 2008). As a result, fifty-nine cetacean species have been recorded in Brazil (ICMBIO, 2019) along a coastal zone extending for more than 7400 km (NOTHEN, 2015), in a marine zone, and inland waters.

To identify and describe the main whale-watching areas in Brazil, a broad bibliographic search (SOUSA *et al.*, 2021) was conducted in these areas and a documental analysis of legal instruments and codes of conduct from July 2020 to June 2022. In addition, we included scientific articles and book chapters published in the last 30 years, in Portuguese, English, and Spanish, on the Capes platform (www.periodicos.capes.gov.br), Scielo (www.scielo.br), ScienceDirect (www.sciencedirect.com) and Google Scholar (scholar.google.com.br) databases, in addition to legal instruments disseminated on government platforms. The data obtained in this study were analyzed according to the documental analysis approach (CECHINEL *et al.*, 2016), which started with the assessment and preliminary examination of each legal instrument from the standpoint of elements such as the administrative sphere of the protected areas, key species, and whale-watching planning variables.

In addition, a search for whale-watching information was conducted on the homepage of tourist agencies and operators and via telephone contact, email, and social media. Whale-watching was considered a commercial activity, offering a service for tourists to observe one or more cetacean species in their natural environment. Therefore, whale-watching reference areas were those whose information on tour sales is available on the online platforms of tourist agencies or published in scientific articles. The following were recorded to describe whale-watching in Brazil: (i) area, municipality, and state of occurrence of the activity; (ii) key whale-watching species; (iii) whale-watching takes place in a protected area; (iv) observation platform; (v) legal instrument in force; (vi) duration of the tour; (vii) tour cost (R\$) and (viii) existence of lectures or other types of environmental communication, before or during the tour. Restrictive measures were also registered in the case of the current legal instrument in the area aimed at enforcing whale-watching.

Whale-watching data in Brazil were grouped and submitted for comparative analysis. It is important to note that although there are different areas of cetacean concentration in Brazil, some do not have local commercial operators, or information on their activities is unavailable online and therefore not included in this study. This is the case for humpback whale watching in the Fernando de Noronha Archipelago (PE) and the south coast of Rio Grande do Norte state (RN).

3 RESULTS

In Brazil, whale-watching focuses on two whales and five dolphin species and occurs in 26 municipalities in 11 Brazilian states and four regions (Table 1). The humpback whale, for example, can be observed on the coast of Salvador, Mata de São João, Porto Seguro, Ilhéus, Itacaré and Caravelas, and the Abrolhos Archipelago, all in Bahia state, as well as on the south coast of Rio Grande do Norte state (RN), the coast of Vitória, Espírito Santo state (ES) and the Alcatrazes Archipelago, in São Paulo state (SP). The southern right whale can be observed on Garopaba, Imbituba, and Laguna's coast in Santa Catarina state (SC). Among the dolphin species is the Guiana dolphin, which can be seen on the coast of Fortaleza, Ceará state (CE) and Tibau do Sul (Figure 1), Nísia Floresta and Baía Formosa (RN), and on the coast of Ilhéus, Caravelas and Jandaíra (BA). Guiana dolphin watching occurs on the coast of Mangaratiba, Guapimirim and Paraty, Rio de Janeiro state (RJ), and in Cananéia (SP), Paranaguá and Guaraqueçaba, Paraná state

(PR), and on the coast of Governador Celso Ramos and São Francisco do Sul (SC). The spinner dolphin is often observed in the Fernando de Noronha Archipelago (PE), and the bottlenose dolphin, *Tursiops truncatus*, in Laguna (SC). In addition, the Amazon River dolphin is key to whale-watching in Manaus and Novo Airão, Amazonas state (AM), and Santarém, Pará state (PA), while the tucuxi can be seen in Santarém (PA), and the Mamirauá Reserve for Sustainable Development in Tefé (AM) (Figure 2).



Figure 1 | Guiana dolphin, *Sotalia guianensis*, watching (a), Coastal Wildlife Reserve of Tibau do Sul (Refauts) (RN), Brazil, where five (b) and seven (c) boats operate in the Restricted Use Zone. Tourist boarding area (d).
 Source: LUNARDI, D. G.; LUNARDI, V. O., 2021.

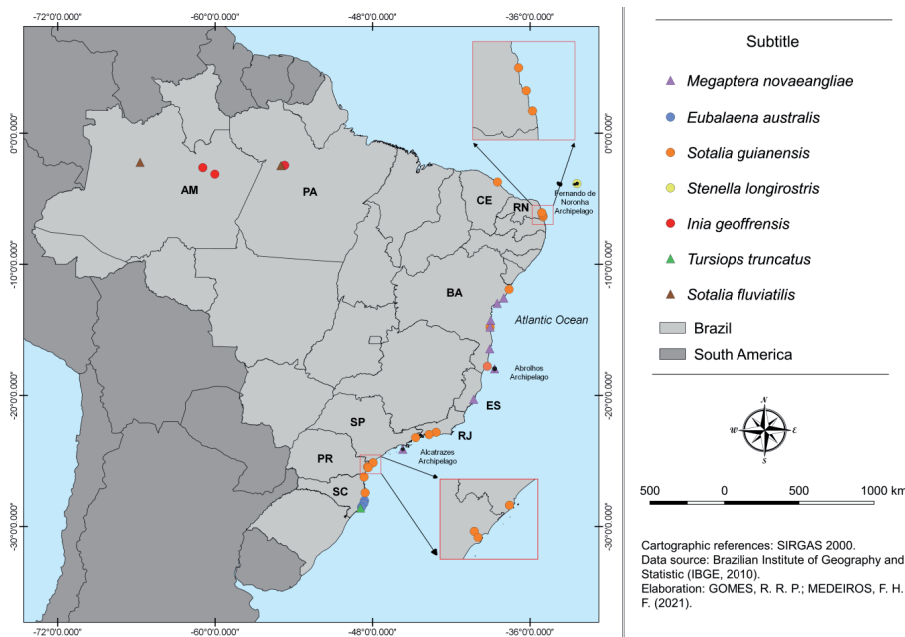


Figure 2 | Reference areas of whale-watching in Brazil.

Source: GOMES and MEDEIROS, 2021.

Of the 29 reference areas of whale-watching, 23 (79%) include a legally protected area, 10 federal, 10 states, and four municipal (Table 1 and 2). It is important to note that the Guaraqueçaba Environmental Protection Area (EPA) includes two municipalities in Paraná state: Paranaguá and Guaraqueçaba. The protected areas indicated in this study are for Sustainable Use (n=17) and Integral Protection (n=4), belonging to the Brazilian System of Protected Areas (Snuc) (BRASIL, 2000a), designed as an EPA (n=13), National Park (n=3), Extravist Reserve (n=2), Wildlife Reserve (n=1), Sustainable Development Reserve (n=1) and Wildlife Refuge (n=1), created by a law or Decree, starting in 1981.

Table 1 | Whale-watching reference areas in Brazil. Marine National Park (MNP). Environmental Protection Area (EPA). Extravist Reserve (ER). Wildlife Refuge (WIREF). MD: Municipal Decree. SD: State Decree. FD: Federal Decree.

<i>Species</i>	<i>Area</i>	<i>State</i>	<i>Protected Area?</i>	<i>Legal instrument of the Protected Area</i>
<i>Megaptera novaeangliae</i>	Salvador	BA	no	—
	Abrolhos	BA	Abrolhos MNP	FD nº 88.218/1983
	Mata de São João	BA	Litoral Norte do Estado da Bahia EPA	SD nº 1.046/1992
	Porto Seguro	BA	Marinha do Corumbau ER	FD s/n 2000
	Ilhéus	BA	Lagoa Encantada e Rio Almada EPA	SD nº 2.217/1993 modified by SD nº 8.650/2003
	Itacaré	BA	no	—
	Vitória	ES	Baía das Tartarugas EPA	MD nº 17.342/2018
	Arquipélago de Alcatrazes	SP	Arquipélago de Alcatrazes WIREF	FD s/n 2016
<i>Eubalaena australis</i>	Imbituba	SC	Baleia Franca EPA	FD s/n 2000

Source: Prepared by the authors, 2022.

Table 2 | Whale-watching reference areas in Brazil. Wildlife Reserve (WR). Environmental Protection Area (EPA). Marine National Park (MNP). National Park (NP). Extravist Reserve (ER). Sustainable Development Reserve (SDR). MD: Municipal Decree. SD: State Decree. FD: Federal Decree. ML: Municipal Law.

<i>Species</i>	<i>Area</i>	<i>State</i>	<i>Protected Area?</i>	<i>Legal instrument of the Protected Area</i>
<i>Sotalia guianensis</i>	Fortaleza	CE	no	—
	Tibau do Sul	RN	Tibau do Sul WR	MD nº 14/2006 modified by Law nº 616/2018
	Nísia Floresta	RN	Bonfim-Guaráira EPA	SD nº 14.369/1999
	Baía Formosa	RN	no	—
	Ilhéus	BA	Lagoa Encantada e Rio Almada EPA	SD nº 2.217/1993 modified by SD nº 8.650/2003
	Caravelas	BA	Ponta da Baleia EPA	SD nº 2.218/1993
	Jandaíra	BA	Mangue Seco EPA	SD nº 605/1991
	Mangaratiba	RJ	Boto-cinza EPA	ML nº 940/ 2014
	Guapimirim	RJ	Guapi-Mirim EPA	FD nº 90.225/1984
	Paraty	RJ	Baía de Paraty EPA	ML nº 685/1984
	Cananéia	SP	Cananéia-Iguape-Peruíbe EPA	FD nº 90.347/1984
	Paranaguá	PR	Guaraqueçaba EPA	FD nº 90.883/1985
	Guaraqueçaba	PR	Guaraqueçaba EPA	FD nº 90.883/1985
	São Francisco do Sul	SC	no	—
	Governador Celso Ramos	SC	Anhatomirim EPA	FD nº 528/1992

Species	Area	State	Protected Area?	Legal instrument of the Protected Area
<i>Stenella longirostris</i>	Fernando de Noronha	PE	Fernando de Noronha MNP	FD nº 96.693/1988
<i>Tursiops truncatus</i>	Laguna	SC	Baleia Franca EPA	FD s/n 2000
<i>Inia geoffrensis</i>	Novo Airão	AM	Anavilhanas NP	FD nº 86.061/1981 modified by Law nº 11.799/2008
	Manaus	AM	no	—
	Santarém	PA	Tapajós-Arapiuns ER	FD s/n 1998
<i>Sotalia fluviatilis</i>	Tefé	AM	Mamirauá SDR	SD nº 12.836/1990 modified by Law nº 2.411/1996
	Santarém	PA	Tapajós-Arapiuns ER	FD s/n 1998

Source: Prepared by the authors, 2022.

Most whale-watching tours in Brazil occur on vessels such as schooners, catamarans, and motorboats, but whale-watching can also occur from the beach, lookout points, and floating platforms, such as the floating platform of Novo Airão (AM), used to view the Amazon River dolphin. The cost of whale-watching varies from R\$ 30.00 to R\$ 458.00 (US\$ 5.50 to 84.50), depending on the area, duration of the tour, and infrastructure available to tourists. It is important to note that these values were obtained from tour operators between January and June 2022 (Table 3). Humpback whale watching occurs from May to October, while the southern right whale season is from July to November since both species are migratory. For dolphin-watching, tours occur daily or weekly throughout the year (Table 3).

Table 3 | Description of whale-watching in Brazil. *The tour is not sold separately and includes lodging and meals.

Key species	Area	Platform	Cost (R\$)	Duration (min.)	Season
<i>Megaptera novaeangliae</i>	Salvador	boat	300,00	240	July - Oct.
	Abrilhos	boat	458,00	300	
	Mata de São João	boat	280,00	300	
	Porto Seguro	boat	250,00	240	
	Ilhéus	boat	250,00	240	
	Itacaré	boat	250,00	240	
	Vitória	boat	360,00	480	
	Alcatrazes Archipelago	boat	450,00	540	May - Aug.
<i>Eubalaena australis</i>	Imbituba	observation point	200,00	240	July - Nov.

Key species	Area	Platform	Cost (R\$)	Duration (min.)	Season
<i>Sotalia guianensis</i>	Fortaleza	boat	40,00	120	Jan. - Dec.
	Tibau do Sul	boat	60,00	50	
	Nísia Floresta	observation point	50,00	120	
	Baía Formosa	boat	40,00	60	
	Ilhéus	boat	250,00	300	
	Caravelas	boat	120,00	180	
	Jandaíra	boat	150,00	120	Nov. - May
	Mangaratiba	boat	150,00	90	Jan. - Dec.
	Guapimirim	boat	150,00	150	
	Paraty	boat	100,00	300	
	Cananéia	boat	50,00	360	
	Paranaguá	boat	100,00	240	
	Guaraqueçaba	boat	100,00	180	
	São Francisco do Sul	boat	80,00	240	
	Governador Celso Ramos	boat	125,00	300	
<i>Stenella longirostris</i>	Fernando de Noronha	boat	450,00	300	
		observation point	147,00	120	
<i>Tursiops truncatus</i>	Laguna	observation point	300,00	180	Jan. - Dec.
<i>Inia geoffrensis</i>	Novo Airão	floating platform	30,00	60	
		boat	120,00	180	
	Manaus	floating platform	160,00	360	
	Santarém	boat	120,00	60	
<i>Sotalia fluviatilis</i>	Tefé	boat	*	240	
	Santarém	boat	120,00	60	

Source: Prepared by the authors, 2022.

Of the 29 reference areas, in at least 17, whale-watching has partnerships with research projects or institutions, favouring the presentation of lectures before or during the tour. Of these, 16 conduct lectures during the whale-watching tours, but only three operators in the Abrolhos, Ilhéus, and Jandaíra reference areas contain whale-watching codes of conduct on their homepage to ensure the well-being of these animals.

Eight of the 29 reference areas contain legal whale-watching enforcement instruments (Table 4). These legal instruments restrict the speed, duration of the tour, type of manoeuvre, and several simultaneous boats in the cetacean concentration area. Ordinance ICMBio/MMA nº 1.112, of December 17, 2018, regulates tourist activities in the Baleia Franca EPA, with headquarters in Imbituba (SC), but whale-watching also occurs in Laguna and Garopaba, both located on the migratory route of this species. It is important to note that southern right whale-watching has been suspended since 2013, as determined by the Federal Justice Court of Laguna (SC). Since then, watching has occurred from the coast (TRF4, 2013).

Table 4 | Legal instruments that enforce whale-watching in Brazil. *Distance between boat and cetacean.

Species Legal instrument	Distance*	Boat speed	Observation time	Prohibited manoeuvre	Max. nº of boats
Mysticeti, <i>Physeter macrocephalus</i> , and <i>Orcinus orca</i> Ordinance nº 24/2002 (IBAMA, 2002)	100 m	—	30 min.	persecution	02
<i>Eubalaena australis</i> Ordinance nº 1.112/2018 (ICMbio, 2018)	≥120 m	≤5 knots	≤30 min.	persecution or interruption of travelling	02
<i>Sotalia guianensis</i> Law nº 349/2007 (Tibau do Sul-RN, 2007)	≥50 m	≤4 knots	≤20 min.	approach or persecution	01
<i>Sotalia guianensis</i> Law nº 832/2012 (MANGARATIBA-RJ, 2012)	—	—	—	—	02
<i>Sotalia guianensis</i> Law nº 2.129/2011 (Cananéia-SP, 2011)	≥50 m	low speed ≤500 m of dolphin	≤30 min.	change of direction, approach, or persecution	02
<i>Sotalia guianensis</i> Law nº 3833/2019 (PARANAGUÁ-PR, 2019)	≥50 m	low speed ≤500 m of dolphin	≤30 min.	change of direction, approach, or persecution	02
<i>Sotalia guianensis</i> Ordinance nº 5-N/1998 (IBAMA, 1998)	—	≤2 knots	≤15 min.	persecution and circular movements	02
<i>Stenella longirostris</i> Ordinance nº 5-N/1995 (IBAMA, 1995)	≥200 m	≤5 knots	—	persecution	02
<i>Inia geoffrensis</i> Regulation nº 28/2018 (CEMAAM, 2018)	≥100 m	≤5 knots	≤15 min.	change or interruption of travelling	—

Source: Prepared by the authors, 2022.

4 DISCUSSION

Of the 59 cetacean species in Brazilian waters (ICMbio, 2019), at least seven are key to whale-watching, recorded in fluvial waters and widely distributed along the coast, extending from Santa Catarina to Ceará. In Brazil, this activity occurs predominantly in protected areas. Of the 29 whale-watching reference areas, 23 included protected areas, most of the sustainable use. The EPA category is the most common among sustainable use protected areas with whale-watching. EPA aims to protect biological diversity, regulate occupation and ensure sustainable use of natural resources (BRASIL, 2000a). However, considering the current conservation status of some cetacean species, EPA may not be the most adequate protected areas category to protect these animals, given that they allow the direct use of natural resources. Endangered species, such as the southern right whale or Guiana dolphin (MMA, 2022), should be protected by protected areas that restrict human occupation and anthropic activities, such as Wildlife Reserves and Sustainable Development Reserves, which only allow sustainable management of natural resources (BRASIL, 2000a).

Currently the southern right whale has only the Baleia Franca EPA to protect its habitat (BRASIL, 2000b), while part of the geographic distribution area of the Guiana dolphin is protected by the Boto-cinza EPA (RJ) (MANGARATIBA-RJ, 2014), Cananéia-Iguape-Peruíbe EPA (SP) (BRASIL, 1984) and Bonfim-Guaíba EPA (RN) (RIO GRANDE DO NORTE, 1999).

Many legally protected whale-watching reference areas are located in Bahia, likely due to its extensive coastal zone. However, Santa Catarina harbours the largest number of key whale-watching species, including the southern right whale (RENAULT-BRAGA *et al.*, 2018), bottlenose dolphin (AGRELO *et al.*, 2019), and Guiana dolphin (MACEDO *et al.*, 2020). The Guiana dolphin is the key species with the largest number of whale-watching reference areas in Brazil, occurring in 48% of the areas, due to its coastal habitat and wide geographic distribution, extending from the Atlantic coast of South and Central America to Honduras (SECCHI; SANTOS; REEVES, 2018).

Most protected areas in Brazil that include whale-watching in their territory are federally managed, with only four under municipal administration: Coastal Wildlife Reserve of Tibau do Sul, Baía das Tartarugas EPA, Boto-cinza EPA, and Baía de Paraty EPA. Unlike municipal protected areas, environmental management in federally controlled areas has a greater specialized organizational structure. For example, the Marine National Park of Fernando de Noronha has a platform containing all its information (www.parnanoronha.com.br), which includes access guidelines, tourist attractions, and legal instruments, such as the Ordinance that instituted the Center for Integrated Management of Fernando de Noronha.

The integrated management of ICMBio Noronha aims at more effective biodiversity conservation and the creation of protected areas, acting as the only consultative council (ICMBIO, 2017). In addition, the Marine National Park of Fernando de Noronha contains an agency that supports public visitation and visitor fee collection.

Unlike the Marine National Park of Fernando de Noronha, the municipally managed Coastal Wildlife Reserve of Tibau do Sul (Refauts) has no facilities for the sustainable management of natural resources, visitor reception, or online platform to allow access to information on the Refauts or Guiana dolphin watching. In this respect, many people who visit the Refauts and take the Guiana dolphin-watching tour are unaware that this species is endangered or that this area is a Wildlife Reserve (SILVA *et al.*, 2021). Furthermore, more than ten years after its creation, management of the Refauts remains inadequate, given the absence of a specialized administrative agency.

In June 2021, the Federal Public Ministry issued Recommendation 06/2021 to create an interinstitutional group; devise strategies to stop the slaughter of Guiana dolphins in Tibau do Sul (RN); develop a plan to monitor fishing activities and whale-watching; carry out a technical study to control fishing activities; conduct a dissemination and environmental awareness campaign and provide a continuous environmental conservation training course for social actors (MPF, 2021).

The creation of protected areas that include cetacean concentration areas in Brazil dates from 1981, with the establishment of the Anavilhanas Reserve (AM), which became the Anavilhanas National Park – an important Amazon river dolphin protection area (BRASIL, 2008). Most protected areas were created in the 1980s and 90s and included whale-watching reference areas, contrasting with the last decade, when only three new protected areas were established in the country. The last protected area was instituted in 2018 with the creation of the Baía das Tartarugas (Turtle Bay) EPA, which protects a small part of the geographic distribution area of the humpback whale (VITÓRIA-ES, 2018). Since 2019, no new protected area has been created to protect key whale-watching species in Brazil, although they are urgently needed.

At least six whale-watching reference areas are still not legally protected: Salvador and Itacaré (BA) for humpback whale watching; Fortaleza (CE); Baía Formosa (RN), and São Francisco do Sul (SC) for Guiana

dolphin watching, and Manaus (AM), for the Amazon river dolphin. The absence of legal protection in these areas may compromise cetacean conservation, especially endangered species, given that they are more exposed to the negative effects caused by whale-watching (KASSAMALI-FOX *et al.*, 2020; MAREGA-IMAMURA *et al.*, 2018). Therefore, these animals' protection and long-term sustainability require new protected areas that focus on controlling tourist activities and conserving endangered species.

Whale-watching is a significant financial resource, providing higher income than that other tourist activities (SOTO-CORTÉS; ACOSTA; MAYA, 2021). The economic benefits of whale-watching include job creation and an annual income of millions of dollars for the sector (GUIDINO *et al.*, 2020). The cost of these tours in Brazil varies due to their duration, infrastructure, and other tourist attractions, but prices seem similar to those charged by neighbouring countries. For example, in Colombia, 12-hour humpback whale watching tours in the Uramba Bahía Málaga National Park cost around R\$ 600.00 (≈US\$ 110.00) (grancolombiatours.com) in June 2022. In Brazil, reference areas such as the Abrolhos, Alcatrazes, and Fernando de Noronha archipelagos are costly to maintain, likely because they are difficult to access and exhibit high species richness and degree of conservation of their natural areas (DUTRA *et al.*, 2006).

Although most whale-watching tours occur from boats, there are reference areas where watching is also possible from the coast, on a stretch of beach, or from a lookout point - a feasible and environmentally more adequate alternative since it reduces the negative environmental impacts caused by motorized boats (TISCHER *et al.*, 2020). For example, until 2013, southern right whale watching occurred mainly from motorized boats but was suspended (TRF4, 2013) due to the negative impacts they may cause to this endangered species (CHALCOBSKY; CRESPO; COSCARELLA, 2020).

Southern right whale watching currently occurs on Imituba, Laguna, and Garopaba (SC) coast. Although fixed platforms reduce the negative impacts, they can also be used inadequately. For example, in Novo Airão (AM), Amazon river dolphins have exhibited behavioural changes due to feeding (ALVES *et al.*, 2013) from floating platforms (CEMAAM, 2018). However, in 2010, after Dolphin Tourism Enforcement (GT Botos in Portuguese) was implemented, a series of initiatives reduced the negative effects of this activity, with the publication of Ordinance nº 47 of April 9, 2012, which established guidelines for visiting the Anavilhanas National Park that prohibit tourists from feeding the dolphins (CEMAAM, 2018).

Whale-watching may be an opportunity to make tourists aware of the importance of environmental conservation (GARCÍA-CEGARRA; PACHECO, 2017), in addition to promoting economic benefits, such as job creation and income generation (LUNARDI *et al.*, 2017) and their environmental counterparts, such as landscape protection (BRUMATTI, 2013). Although this activity is an opportunity to broaden scientific studies, disseminate information on cetaceans, and promote tourist awareness (FERNANDES; ROSSI-SANTOS, 2018), a little more than half of the whale-watching reference areas in Brazil are supported by research projects or institutions, which contribute with lectures, training or provide ecological and biological data on key species. Reference areas supported by research institutions or projects generally impose whale-watching codes of conduct, whereby tourism in these areas may have fewer negative impacts on the species observed (TISCHER *et al.*, 2017). Tourist satisfaction increases when the tour includes educational components and the boat operators comply with the regulations (SITAR *et al.*, 2017).

In Brazil, Law nº 7.643, of December 18, 1987, was the first to protect cetaceans, banning hunting these animals in Brazilian jurisdictional waters (BRASIL, 1987). Ibama Ordinance nº 2.306, of November 22, 1990, subsequently reformulated by Ordinance nº 117, of December 26, 1996, established a minimum distance of 100 m between a motorized boat and any whale species, minimum altitude of 100 m between aircraft and cetaceans; maximum whale-watching time of 30 min; a minimum distance of 50 m to dive or swim near any whale species; and guidelines for tour boats operating in protected areas (IBAMA, 1990; IBAMA, 1996).

Ordinance nº 24, of February 8, 2002, stipulated that boats must keep their motors in the idle position during humpback whale watching and idle or turned off for other cetacean species. It also established a limit of two boats that can simultaneously approach an individual or group of whales (IBAMA, 2002).

In general, the distance between boats and cetaceans established in Brazilian legal instruments varies between 50 and 200 m, regardless of the number of boats near these animals. In other countries, such as New Zealand and Portugal, the distance between boats and cetaceans may vary according to the number of boats (AÇORES, 2003; NEW ZEALAND, 1992). When three or more boats are present simultaneously in New Zealand, they must keep at least 300 m away from any whale species (NEW ZEALAND, 1992). In the Azores, Portugal, each boat can remain near a cetacean for up to 15 min and maintain a distance of at least 50 m from any cetacean species. When there are three or more boats, a distance of 300 m must be maintained for small cetacean species and 500 m for whales (AÇORES, 2003). Although these legal instruments are somewhat similar, such as the distance between boats and cetaceans, there are also some differences, such as the maximum time boats can remain in the presence of cetaceans. However, in some Brazilian legal instruments, this variable is not even mentioned (IBAMA, 1995; MANGARATIBA-RJ, 2012).

To control whale-watching, measures were proposed to protect whales and dolphins based on the mentioned legal instruments (Figure 3). To interact with species of the suborder Mysticeti, a limit of ≥ 100 m is suggested between boats and whales, based on Ibama Ordinance nº 117, of December 26, 1996 (IBAMA, 1996) and the environmental protection and biodiversity conservation regulation of Australia (AUSTRALIA, 2000). Although swimming with whales is prohibited in several countries, in Brazil, Ordinance nº 117, of December 26, 1996, forbids this practice only at 50 m or less between the swimmers and any whale species (IBAMA, 1996). However, this type of interaction is risky and may result in negative impacts (FIORI *et al.*, 2019). Therefore, based on the Australian regulation, swimmers and divers are suggested to maintain a distance ≥ 100 m from whales. For species of the suborder Odontoceti, a distance of ≥ 50 m is suggested between boats and dolphins, given the risk of running them over (TOLEDO *et al.*, 2017). This distance has also been adopted in the legal instruments of Australia and the Azores (AÇORES, 2003; AUSTRALIA, 2000).

As a protection measure, it is suggested that aircraft should not approach to ≤ 150 m above sea level and horizontally from a point directly above any cetacean species, based on the New Zealand guidelines (NEW ZEALAND, 1992). Interactions should not exceed 30 min (IBAMA, 1996), given that prolonged cetacean exposure to boats may reduce the resting time of these animals (FUMAGALLI *et al.*, 2018). Although there is no consensus between legal instruments, a speed less than or equal to 4 knots is suggested since studies show that boats travelling at this speed may cause fewer adverse responses in key species (SPROGIS; VIDESEN; MADSEN, 2020). Feeding cetaceans should be prohibited to avoid compromising the health of these animals (VIDAL *et al.*, 2017).

Females with calves may be the most frequent targets of whale-watching (BEJDER *et al.*, 2019). This is because changes in swimming and diving patterns are associated with evasive strategies. In addition, energy expenditure in response to disturbance may affect offspring development and survival (BEJDER *et al.*, 2019). As such, females with calves need more restrictive measures to guarantee their protection (FIORI *et al.*, 2019), and it is suggested that boats maintain a distance ≥ 200 m from females with calves (NEW ZEALAND, 1992) and that observation time does not exceed 15 min.

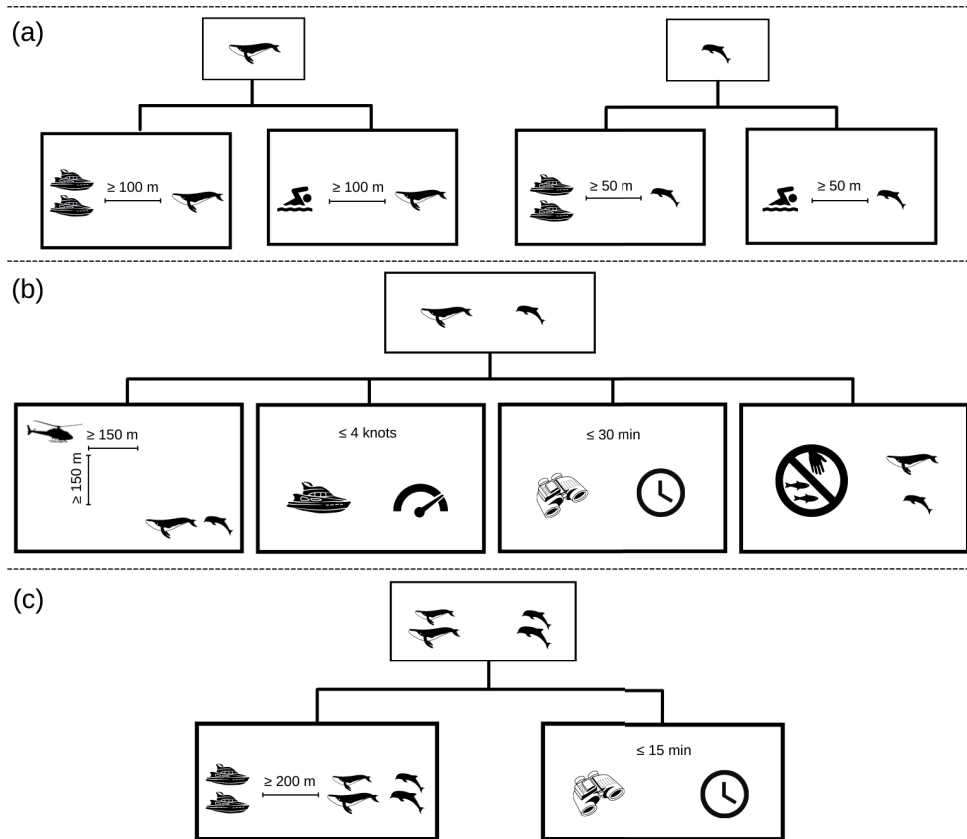


Figure 3 | Proposed measures to be included in standardized legal instruments to protect cetaceans: (a) Specific: the distance between boats and cetaceans and swimmers and cetaceans, (b) Common: the distance between aircraft and cetaceans, boat speed, observation time and not feeding the animals, (c) Specific for females with calves: distance of boats and observation time.

Source: Prepared by the authors, 2022.

5 FINAL CONSIDERATIONS

In this study, we sought to identify the whale-watching reference areas in Brazil and their key species. A total of 29 reference areas were found in 11 states, and seven key whale-watching species: humpback whale, southern right whale, Guiana dolphin, spinner dolphin, bottlenose dolphin, Amazon river dolphin, and tucuxi dolphin. In addition, we investigated how whale-watching is conducted in Brazil. Unfortunately, this activity does not have a single standardized legal instrument, although at the federal level, Ibama Ordinance nº 117, of December 26, 1996, aims at preventing and curbing intentional molestation of cetaceans found in Brazilian jurisdictional waters.

Given that boats have potential negative impacts on cetaceans, a standardized national legal enforcement instrument should regulate the following for all cetaceans subject to whale-watching: distance between boats and cetaceans; distance between swimmers and cetaceans; distance between aircraft and cetaceans; the maximum number of boats operating simultaneously; boat speed; observation time; and no animal feeding, in addition to a specific regulation for females with calves watching. This enforcement instrument should consider studies on cetacean behavioural changes resulting from interaction with boats. Ibama Ordinance nº 117, of December 26, 1996, stipulates that protected areas establish these limits. However, some whale-watching reference areas are not legally protected. To promote comprehensive cetacean conservation and sustainable ecotourism, it is suggested that legal

enforcement instruments be the basis for the continuous training of social actors and research on the environmental indicators for whale-watching monitoring.

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