

A note on strandings and age of sperm whales (*Physeter macrocephalus*) on the Brazilian coast

RENATA M. A. RAMOS*, SALVATORE SICILIANO⁺, MÔNICA BOROBIA[#], ALEXANDRE N. ZERBINI**, JOSÉ LUIS A. PIZZORNO⁺⁺, ANA BERNADETE L. FRAGOSO^{xy}, JOSÉ LAILSON-BRITO JR.^{yz}, ALEXANDRE DE FREITAS AZEVEDO^{yz}, PAULO CÉSAR SIMÕES-LOPES[§] AND MARCOS CÉSAR DE OLIVEIRA SANTOS[‡]

Contact e-mail: renataramos.@terra.com.br

ABSTRACT

This note compiles recorded strandings of sperm whales on the Brazilian coast. A known total of 95 sperm whales (62 single and one mass stranding of 33 individuals) stranded along the Brazilian coast from 1967-2000. A higher incidence of single strandings was observed in northeastern Brazil (~05°-17°S). No strandings occurred in lower latitudes (<14°S) from June-September. The seasonal and spatial pattern observed by the reported strandings may indicate higher stranding rates in higher latitudes (~18-25°S) between June and August (winter) and in lower latitudes (~3-7°S) between January and April (summer and spring). Strandings of smaller sperm whales (3-4.5m) were observed during the austral summer and autumn, indicating seasonality in the birth season. Growth-layer counts of three specimens provide the first data on age of sperm whales for Brazil.

KEYWORDS: SPERM WHALE; AGE ESTIMATION; STRANDING; BRAZIL; TEETH

INTRODUCTION

The distribution of sperm whales off eastern South America is known primarily from whaling data. Information was obtained from whaling stations operating in Costinha (7°S) and Cabo Frio (~23°S), Brazil in the 20th century (Paiva and Grangeiro, 1965; 1970; Williamson, 1975; and statistics originally provided to the Bureau of International Whaling Statistics and now held by the Secretariat of the International Whaling Commission). During the past 40 years, strandings have been regularly reported (e.g. Castello and Piñero, 1974; Clarke *et al.*, 1980; Alves *et al.*, 1996) although knowledge of sperm whale biology along the coast of eastern South America remains poor.

Length and age data of whales have been frequently used to infer the social structure of sperm whales from the Pacific and the North Atlantic Oceans (Martin, 1980; Avila de Melo and Martin, 1985; Arnobom and Whitehead, 1989). Age estimation by counting the growth layers groups (GLGs) in teeth (IWC, 1980) has become a standard procedure and a key parameter in assessing and managing marine mammal stocks (Scheffer and Myrick, 1980). Nishiwaki *et al.* (1958) were the first to analyse maxillary and mandibular teeth. They reported that the buried teeth in the maxillary gum are most useful for age determination of the sperm whale. Some authors consider that the first mandibular tooth is preferable for age determination, as it tends to be relatively unworn. However, for individuals that have worn mandibular teeth, it is preferable to use a straight, unerupted maxillary tooth (IWC, 1980).

A compilation of available strandings of sperm whales on the Brazilian coast is presented in this note, along with limited information on age estimation. Growth layer counts of three specimens provide the first information on age estimation of sperm whales in Brazilian waters.

MATERIALS AND METHODS

Strandings data on sperm whales reported in this paper were obtained from scientific literature, unpublished information, printed media files (e.g. newspapers and magazines) and collections from Brazilian museums for the period from 1967-2000. The distribution of strandings was analysed by geographical area: northern (~01°S), northeastern (~05°-19°S), southeastern (~20°-26°S) and southern (~27°-34°S) Brazil (Fig. 1).

To analyse seasonal and latitudinal distribution by category, specimens were classified as: mature males (>13m); females and immature individuals (7-12m); first-year individuals (5-6m); and calves (<4.5m) (Whitehead *et al.*, 1997). The interactive relationship between month and latitude of single strandings was analysed by distance weighted least squares using the 3D contour plot procedure of Statistic 5.5 for Windows.

Teeth of three specimens from the collection of the Museu Nacional, MN 50098 (#29 in Appendix Table 1) and MN 54999 (#44 in Appendix Table 1) and the collection of Universidade Federal de Santa Catarina, UFSC 1118 (#53 in Appendix Table 1), were used for age estimation. An etched half-tooth was used following the method and

* Universidade Estadual do Norte Fluminense, Laboratório de Ciências Ambientais, Av. Alberto Lamego, 2000, Campos dos Goytacazes, RJ, 28015-620, Brazil.

⁺ Museu Nacional/UFRI, Depto. de Vertebrados, Setor de Mamíferos, São Cristóvão, Rio de Janeiro, RJ, 20940-040, Brazil.

[#] United Nations Environment Programme, Box 16227, 2500 BE, The Hague, The Netherlands. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the United Nations.

** Washington Cooperative Fish and Wildlife Research Unit, Box 355020, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA, 98195-5020, USA.

⁺⁺ Av. Maracanã, 772/307, Rio de Janeiro, RJ, 20551-000, Brazil.

^{xy} Projeto MAQUA, Universidade do Estado do Rio de Janeiro, Depto. de Oceanografia, RJ, 20550-013, Brazil.

^{yz} Universidade Federal de Santa Catarina, Laboratório de Mamíferos Aquáticos (LAMAQ), Dpto. de Ecologia e Zoologia, CCB, Florianópolis, SC, 88040-970, Brazil.

[§] Universidade de São Paulo, Departamento de Ecologia Geral, Instituto de Biociências, Projeto Atlantis/LabMar, Rua do Matão, Travessa 14, Cidade Universitária, São Paulo, SP, 05508-900, Brazil.

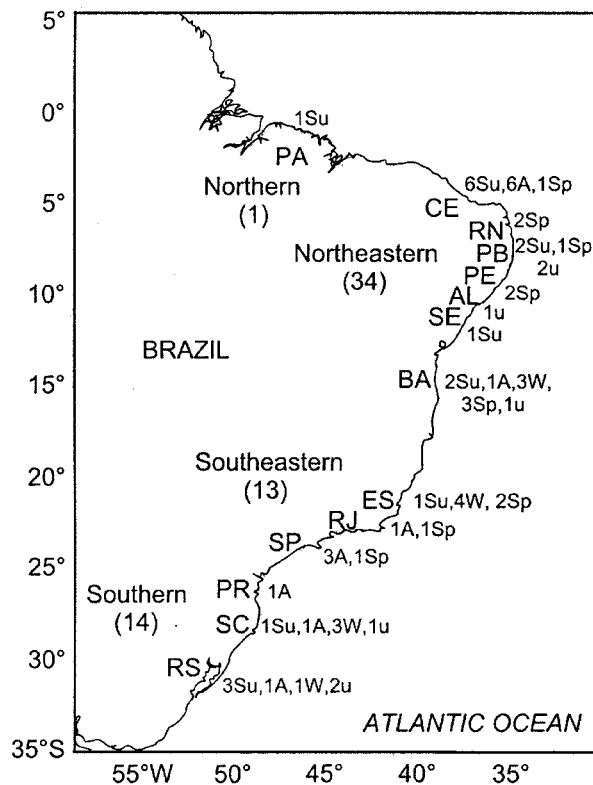


Fig. 1. Map of Brazil indicating the number of sperm whale strandings by geographical area and season. Geographical areas: northern ($\sim 01^{\circ}\text{S}$) - Pará (PA); northeastern ($\sim 05^{\circ}\text{-}19^{\circ}\text{S}$) - Ceará (CE), Rio Grande do Norte (RN), Paraíba (PB), Pernambuco (PE), Alagoas (AL), Sergipe (SE) and Bahia (BA); southeastern ($\sim 20^{\circ}\text{-}26^{\circ}\text{S}$) - Espírito Santo (ES), Rio de Janeiro (RJ) and São Paulo (SP); southern ($\sim 27^{\circ}\text{-}34^{\circ}\text{S}$) - Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RS). Season: Summer (Su) - December to February; Autumn (A) - March to May; Winter (W) - June to August; Spring (Sp) - September to November; and undated (u).

recommendations of Pierce and Kajimura (1980). One mandibular and one maxillary tooth from specimen MN 54999, one tooth of unknown position from specimen MN 50098 and one mandibular tooth from specimen UFSC 1118 were used. GLGs, consisting of a pair of adjacent layers, one prominent ridge and one groove in the etched tooth (IWC, 1980) were counted. The GLG counts for MN 50098 were made by four readers (RMAR, MB, W. Hoek and V.M. Kozicki) and the GLG counts for MN 54999 and UFSC 1118 were made by one of the authors (RMAR). The GLGs were counted with a binocular dissecting microscope with a magnification of 8x.

RESULTS

Strandings

A total of 95 sperm whale strandings (62 single and one mass stranding of 33 individuals) was recorded along the Brazilian coast during the period 1967-2000 (Fig. 1). Strandings are reported from Pará ($\sim 01^{\circ}\text{S}$) to Rio Grande do Sul ($\sim 34^{\circ}\text{S}$) States (Appendix Table 1). The highest incidence (54.8%) of single strandings was observed in northeastern Brazil ($\sim 05^{\circ}\text{-}19^{\circ}\text{S}$). The stranding frequency in northern ($\sim 01^{\circ}\text{S}$), southeastern ($\sim 20^{\circ}\text{-}26^{\circ}\text{S}$) and southern ($\sim 27^{\circ}\text{-}34^{\circ}\text{S}$) Brazil was 1.6%, 21.0% and 22.6%, respectively.

Table 1

Summary of the strandings information given in Appendix Table 1.

	Total single strandings		With length information	
	Number	Percentage	Number	Percentage
Single strandings	62	100.0	38	61.3
Of which				
Males*	21	33.9	18 ¹	85.7
Females	4	6.5	3 ²	75.0
Unknown	37	59.7	17 ³	45.9

* Includes three for which sex was inferred from their lengths (all were $>ca$ 15m) - see Jefferson *et al.*, 1993.¹ Includes 3 calves and 1 probable yearling. ² Includes 1 calf. ³ Includes 2 calves.

Table 1 breaks down the samples of single strandings by sex. Almost 60% of the animals were of unknown sex. The lengths of these animals, where known ($n=17$) ranged from 3.0-12.0m. Males comprised about one-third of the total and the lengths of these, where known ($n=18$) ranged from 3.1-18.0m. Only 6.5% of the animals were females and the three with known length ranged from 3.8-8.0m.

No records occurred in lower latitudes ($<14^{\circ}\text{S}$) from June-September (austral winter and early spring). However, during the austral spring and summer, from October-May, strandings of sperm whales occurred in both lower and higher latitudes (Figs 1 and 2).

The seasonal and latitudinal distribution for each estimated category is shown in Fig. 2. During the winter, mature male strandings were recorded only in higher latitudes ($>14^{\circ}\text{S}$). In contrast, during the summer, they were recorded only in lower latitudes ($<14^{\circ}\text{S}$). In spring and autumn, there were mature male records for both lower and higher latitudes. Strandings of sperm whales assigned to the class of females and immature individuals occurred along the Brazilian coast in all seasons except winter. The only probable yearling (see Discussion), a 5.7m male, stranded during summer in the lower latitudes. A higher percentage of the six strandings of calves ($<4.5\text{m}$) occurred during the summer (83.3%), followed by the autumn (16.7%). Four calves were recorded in lower ($<14^{\circ}\text{S}$) and two in higher ($>14^{\circ}\text{S}$) latitudes.

Age estimation

The tooth of MN 50098, a *ca* 11.0m specimen of unknown sex, showed 21-22+ GLGs (Fig. 3A). The tooth was worn and the neonatal line could not be identified. This specimen was probably older than 21-22 GLGs, but presumably no more than one or two GLGs over this estimate, given the tooth size and shape.

The maxillary tooth of MN 54999, a 12.0m male, showed 33 GLGs (Fig. 3B). Based on the mandibular tooth of this specimen, 34 GLGs were estimated (Fig. 3C). Given the unworn condition of the teeth, the neonatal line was considered to be the first dark band. The maxillary tooth showed numerous accessory layers, mainly between layers 7 and 11, and osteodentine in three separate parts of the dentine (Fig. 3B).

The mandibular tooth of UFSC 1118, a 13.8m male, showed 40+ GLGs (Fig. 3D). The apical layers could not be identified. This tooth showed osteodentine in six separate parts of the dentine.

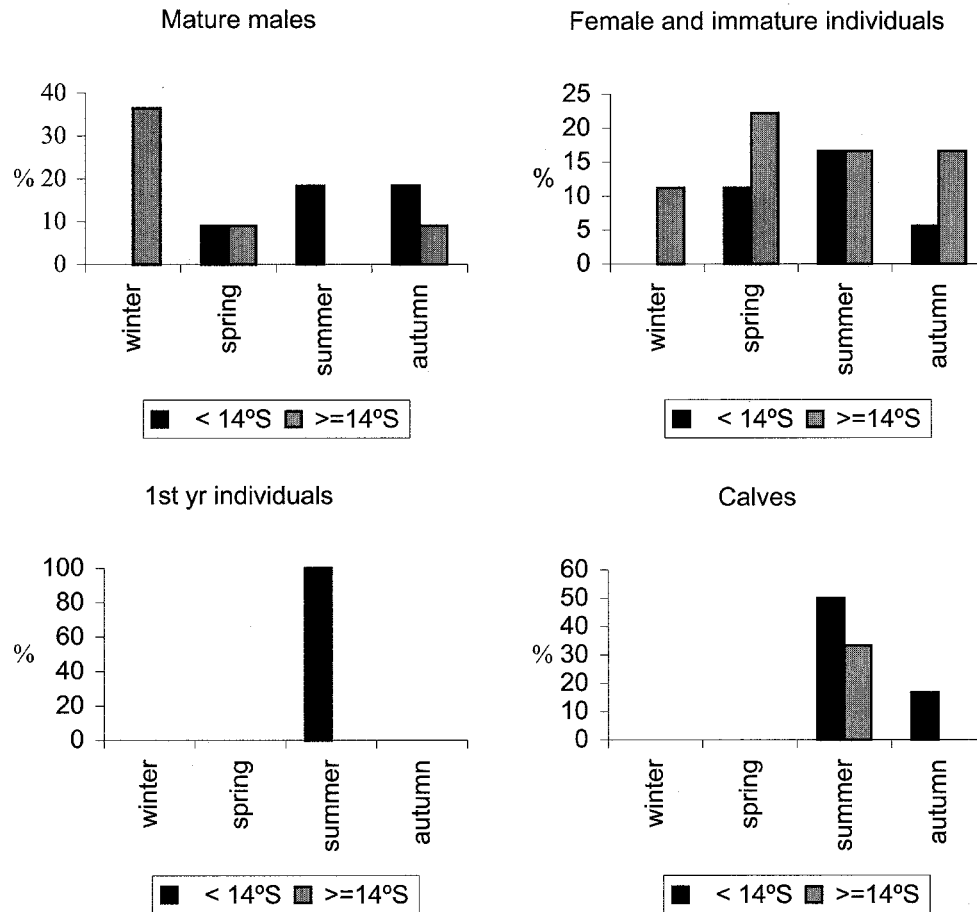


Fig. 2. Single strandings of sperm whales on the Brazilian Coast for each length-class: larger males (>14m), females and immature individuals (7-12m), first-year individuals (5-6m) and calves (<4.5m), by area (<14°S and ≥ 14°S) and season.

DISCUSSION

Strandings data are difficult to interpret and it is not possible to draw many inferences about sperm whale distribution, seasonal occurrence or biology based solely on these data. However, some patterns were detected and are consistent with previous findings for the species.

The seasonal and spatial pattern observed by the reported strandings suggests greater incidence of strandings in higher latitudes (~18-25°S) between June and August (winter) and in lower latitudes (~3-7°S) between January and April (summer and spring), as may be seen in Fig. 4. This might be related to possible seasonal concentrations of animals. However, this needs to be confirmed by long-term directed studies.

Calves were observed to strand only in summer and autumn along the Brazilian coast, possibly reflecting a seasonal birth period. Sperm whales attain a length of 5-6m by the end of their first year (Whitehead *et al.*, 1997) suggesting that the 5.7m male, stranded in January 1996, was a yearling born during the previous summer. The possibility that sperm whale births occur in the summer-autumn period along the coast of Brazil concurs with observations from other areas. Whitehead *et al.* (1989) estimated that the birth season for the Galápagos Islands, in the Pacific Ocean, occurs during summer, with spring being the apparent peak of the breeding season. In the North Atlantic, conceptions have occurred by September or October (summer-autumn)

and the breeding season also occurs during spring months (see Avila de Melo and Martin, 1985).

An age-length relationship was used here to infer maturity condition for the animals of known sex. According to a model for sperm whale dynamics (Allen, 1973; Perrin and Donovan, 1984), females are classified as either juveniles (0-2 years), sexually immature (3-9 years), or sexually mature (10+ years). Males are classified as either juveniles (0-2 years), sexually immature (3-~20 years), sexually mature (~20-24 years), or socially mature (25+ years). The body lengths of males and females at sexual maturity ranges from 12.5-13.7m and 8.6-10.2m, respectively (Best *et al.*, 1984; Mitchell and Kozicki, 1984; Perrin and Donovan, 1984; Clarke and Paliza, 1988; Whitehead *et al.*, 1997; Hooker, 1998). Males over about 13.7m in length are considered to be socially mature (e.g. Best, 1984).

Male MN 54999 (33-34 GLGs) corresponds to an age class attributed to socially mature males, but its body length of 12.0m is small in comparison with lengths reported for males of similar age quoted in the literature. Male (UFSC 1118) measuring 13.8m, was just within range of the accepted socially mature males but its length was relatively short for males of its age (40+ GLGs). Thus in both cases, individuals were older than the corresponding size observed for other areas (Perrin and Donovan, 1984).

Given the very small sample size, this may reflect either natural variation (other studies have revealed a wide variation in age-at-length – e.g. Mitchell and Kozicki, 1984; Clarke and Paliza, 1988) or that animals off Brazil are

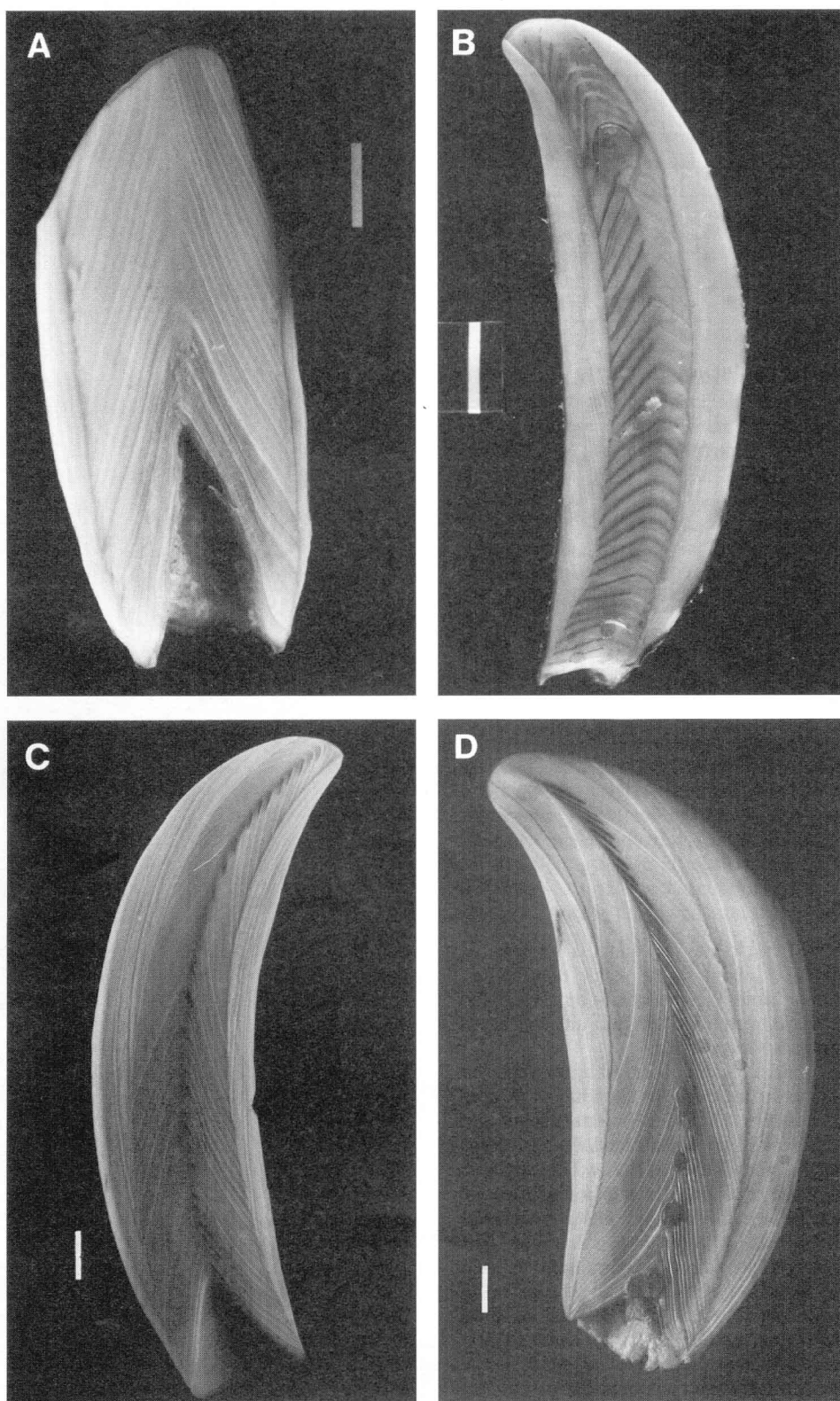


Fig. 3. Photographs of sperm whale teeth: (A) acid-etched tooth of 21-22 GLGs specimen MN 50098; (B) acid-etched maxilar tooth of 33 GLGs male MN 54999; (C) acid-etched mandibular tooth of 34 GLGs male MN 54999 and (D) acid-treated mandibular tooth of 40+ GLGs male UFSC 1118. Scale bar represents 1cm. (Photographs: Márcia Adriana Dutra and Arthur Rodrigues).

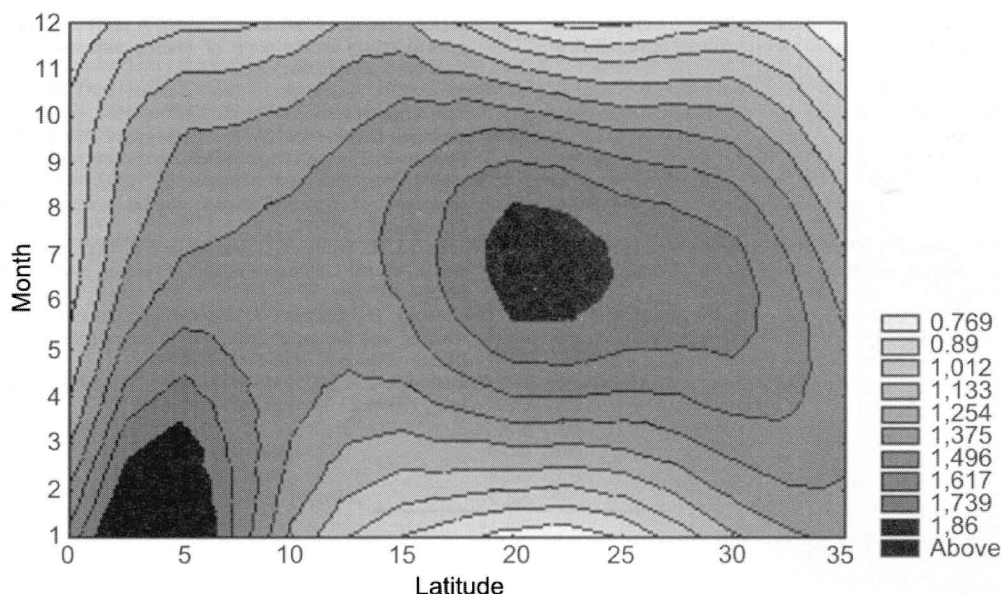


Fig. 4. Seasonal and spatial distribution of single strandings of sperm whales on the Brazilian Coast.

smaller than those in other areas. Clearly, a much greater sample size is required before any conclusion can be reached.

Further studies are needed on sperm whales off Brazil, including effort to collect biological data such as sex, age and the reproductive status of stranded sperm whales. The distribution, movements and population structure of sperm whales off eastern South America should be further investigated.

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Appendix

[Appendix Table 1 on following page]

Table 1

Strandings of sperm whales along the Brazilian coast (1967-2000). PA: Pará; CE: Ceará; RN: Rio Grande do Norte; PB: Paraíba; PE: Pernambuco; AL: Alagoas; SE: Sergipe; BA: Bahia; ES: Espírito Santo; RJ: Rio de Janeiro; SP: São Paulo; PR: Paraná; SC: Santa Catarina; RS: Rio Grande do Sul; Cn: Collection number; MN: Museu Nacional da Universidade Federal do Rio de Janeiro; PA-USP: Projeto Atlantis da Universidade de São Paulo; UFSC: Universidade Federal de Santa Catarina; GEMARS: Grupo de Estudos de Mamíferos Aquáticos do Rio Grande do Sul; M¹: estimated to be male due to length >12m; * : a mass stranding of 33 sperm whales.

No.	Approx. latitude	Area	Locality	Date	Total length (m)	Sex	Source
01	~ 01°S	PA	Colares	11 Feb. 2000	ca 11.0	-	Present study
02	~ 05°S	CE	Praia do Peixe Gordo, Aracati	19 Mar. 1984	17.0	M	Alves-Júnior <i>et al.</i> , 1996
03			Praia da Cofeco, Fortaleza	24 Dec. 1989	ca 15.0	M ¹	Alves-Júnior <i>et al.</i> , 1996
04			Praia da Córca	9 Apr. 1993	ca 15.0	M ¹	Alves-Júnior <i>et al.</i> , 1996
05			Praia do Uruarú	13 Mar. 1994	-	-	Alves-Júnior <i>et al.</i> , 1996
06			Praia do Paracurú	1 Feb. 1995	8.0	-	Alves-Júnior <i>et al.</i> , 1996
07			Praia do Paracurú	2 Feb. 1995	-	-	Alves-Júnior <i>et al.</i> , 1996
08			Praia de Prainha	12 May 1995	3.1	M	Alves-Júnior <i>et al.</i> , 1996
09			Praia do Mutamba	8 Oct. 1995	-	-	Alves-Júnior <i>et al.</i> , 1996
10			Porto das Dunas	9 Jan. 1996	5.7	M	Alves-Júnior <i>et al.</i> , 1996
11			Praia da Cofeco, Fortaleza	10 Jan. 1996	4.5	-	Alves-Júnior <i>et al.</i> , 1996
12			Barra Nova	31 Jan. 1996	8.1	F	Alves-Júnior <i>et al.</i> , 1996
13			Praia de Aranaú	1 Mar. 1996	ca 10.0	-	Alves-Júnior <i>et al.</i> , 1996
14			Sabiaguaba do Norte	19 Mar. 1996	-	-	Alves-Júnior <i>et al.</i> , 1996
15	~ 06°S	RN	Praia de Barreira D'água, Natal	16 Oct. 1985	-	-	Photo
16			Praia da Pipa, Tibau do Sul	18 Oct. 1988	-	-	Photo
17	~ 07°S	PB	Praia do Macaco	7 Nov. 1987	10.2	-	Present study
18			Baía da Traição	Feb. 1988	ca 14.0	M	Present study
19			Praia do Poço, Cabedelo	-	-	-	Present study
20			Praia de Oiteiro	11 Jan. 1998	3.3	M	A. Lucena, unpub. data
21			Praia de Barra de Camarutuba	-	8.0	-	A. Lucena, unpub. data
22	~ 08°S	PE	Ilha de Itamaracá	28 Oct. 1989	17.0	M	Pimentel <i>et al.</i> , 1990
23			Praia de Itapoama	6 Nov. 1989	ca 12.0	-	Pimentel <i>et al.</i> , 1990
24	~ 10°S	AL	Pontal do Peba, Piaçabuçu	1990	18.0	M	Present study
25	~ 11°S	SE	Praia de Pirambu	Jan. 1988	ca 3-4.0	-	Present study
26	~ 14°S	BA	Praia da Preguiça, Salvador	2 Feb. 1982	ca 12.0	-	Bezerra <i>et al.</i> , 1994
27			Praia da Penha, Itaparica	14 May 1987	-	-	Bezerra <i>et al.</i> , 1994
28			Praia da Gamboa, Salvador	-	-	-	Present study
29			Praia do Forte	22 Sep. 1990	ca 11.0	-	Present study (Cn: MN 50098)
30			Praia do Caipe	Jul. 1990	-	-	Bezerra <i>et al.</i> , 1994
31			Praia de São Miguel, Ilhéus	Jan. 1991	-	-	Bezerra <i>et al.</i> , 1994
32			Praia de Placaford, Salvador	Oct. 1991	-	-	Bezerra <i>et al.</i> , 1994
33			Praia dos Milionários, Ilhéus	Aug. 1992	-	-	Bezerra <i>et al.</i> , 1994
34			Barra de Caravelas	21 Jul. 1993	8.7	F	Bezerra <i>et al.</i> , 1994
35			Nova Viçosa	Oct. 1993	-	-	Bezerra <i>et al.</i> , 1994
36	~ 20°S	ES	Praia de Carapebus, Vitória	11 Jun. 1975	ca 16.0	M	Barros, 1991
37			Praia de Meaípe	6 Aug. 1981	8.0	-	Barros, 1991
38			Praia de Guriri, São Mateus	27 Jun. 1988	ca 17.0	M	Present study
39			Guarapari	7 Aug. 1992	-	-	Present study
40			Aracruz	28 Sep. 1992	> 10.0	-	Present study
41			Ubu	30 Sep. 1993	ca 7.0	-	Present study
42			Conceição da Barra	25 Feb. 1994	-	-	Present study
43	~ 23°S	RJ	Praia de Grumari	25 Nov. 1972	ca 7.0	-	Geise and Borobia, 1988
44			Praia Grande, Arraial do Cabo	10 Mar. 1999	12.0	M	Present study (Cn: MN 54999)
45	~ 25°S	SP	Praia Grande	15 May 1967	15.0	M	Present study
46			Praia da Balcia, São Sebastião	25 May 1991	9.5	-	Present study
47			Praia do Centro, Peruibe	5 Oct. 1991	15.0	M	Present study
48			Ilha Comprida	3 Mar. 1998	10.0	-	Present study (Cn: PA-USP 107)
49	~ 27°S	PR	Baía de Paranaguá	May 1990	-	-	Bittencourt and Zanelatto, 1992
50	~ 30°S	SC	Imbituba	2 Dec. 1987	8.0	-	Simões-Lopes and Ximenez, 1993
51			Praia de Figueirinha, Jaguaruna	13 Jun. 1989	17.9	M ¹	Simões-Lopes and Ximenez, 1993
52			Florianópolis	-	-	-	Simões-Lopes and Ximenez, 1993
53			Balneário Camboriú	21 Jun. 1993	13.8	M	Present study (Cn: UFSC 1118)
54			Barra do Sai	26 Jun. 1995	-	M	Present study (Cn: UFSC 1220)
55			Morro das Pedras, Florianópolis	1 Apr. 1995	-	M	Present study (Cn: UFSC 1238)
56*	~ 32°S	RS	Praia de Bojurú	Dec. 1972	-	-	Castello and Piñero, 1974
57			-	Aug. 1978	-	M	Clarke <i>et al.</i> , 1980
58			Chui	1990	-	-	E. R. Secchi, pers. comm.
59			Southern coast	-	-	F	Secchi <i>et al.</i> , 1991
60			Farol de Sarita	10 Feb. 1993	3.9	M	E. R. Secchi, pers. comm.
61			Praia de São Simão	25 Feb. 1994	3.8	F	GEMARS, unpub. data
62			Northern coast	17 Abr. 1998	-	-	GEMARS, unpub. data
63			Praia de São Simão	17 Jan. 1999	9.9	M	GEMARS, unpub. data