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Seasonal occurrence of killer whales (*Orcinus orca*) in waters of Rio de Janeiro, Brazil

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Killer whales (*Orcinus orca*) are found in all oceans and seas, from the polar regions to the equator, in both hemispheres. However, they appear to be more common near shores in cold temperate to subpolar waters (Jefferson et al. 1993). Records of killer whales are few or nearly absent for most parts of the Brazilian coast. The first reported Brazilian record is a stranding 128 km north of Rio Grande (31°57′ S), southern Brazil (Castello 1977). Additional records have remained anecdotal (e. g. Castello and Pinedo 1986; Daniel et al. 1992; Santos and Siciliano 1994) and only one stranding record is known for the Rio de Janeiro coast (Geise and Borobia 1988). More recently, a study on killer whale interactions with the swordfish and tuna fishery was conducted south and southeastern of Brazil (Dalla Rosa 1995). A collection of recent sightings of killer whales for the Rio de Janeiro State coast (21°37′ S–23°10′ S) is presented and provides an opportunity for discussion of their presence and ecological requirements in an area previously uncovered.

Information on killer whale presence was provided through the implementation and development of a sighting network along the Rio de Janeiro coast. The data set was analysed to study individual occurrence and location patterns, based on characteristics that can be used to identify individuals uniquely (i. e. dorsal fin, saddle patch; Bigg et al. 1987; O'Sullivan and Mullin 1997).

A total of 29 records of killer whale groups was confirmed on the coast of Rio de Janeiro for the period between October 1993 and November 1997 (Tab. 1, Fig. 1). One additional record was obtained for November 1983. The period between August 1996 and February 1997 represents 76.7 % of all sightings. Killer whale sightings were concentrated on spring and summer months, accounting for 93 % of all confirmed records. Group size ranged from one to 15 individuals, but averaged 3.9 animals. Four groups included at least one adult male, and four groups at least one calf. Four individual killer whales have been photoidentified to date on the coast of Rio de Janeiro. While not every individual was photographed from each group, catalogued photographs showed that at least one individual was resighted at a time interval of 37 days. All groups sighted were found in shallow coastal waters, well located inside the continental slope. The furthest offshore sighting was 38.9 n. miles off Atafona (21°35′ S), the northern coast of the state. The fact that most records are known for the area between Búzios (22°44′ S) and the city of Rio de Janeiro (22°56′S) may suggest higher chances for opportunistic sightings due to the increased human recreational activity during the warmer months. However, this observed seasonality

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Table 1. Sighting records of killer whales (*Orcinus orca*) on the coast of Rio de Janeiro, Brazil.

Map key	Date	Location	Depth (m)	Group size	Remarks	Source
1	November 1983	Praia de São Conrado, Rio de Janeiro	<20	2+	located close to the surf zone	This study
2	16 October 1993	Palmas Inlet, Ilha Grande bay	10–15	4	adult male, mother-calf and a juvenile; fast swimming	P. Bianco
3	March 1994	Pau a Pino and Meio Is., Ilha Grande bay	10–15	3	adult male, adult female and a juvenile	This study
4	21 October 1994	Praia da Armação, Búzios	10–12	4	adult male, adult female and juveniles	E. Fernandes
5	21 October 1994	Praia da Armação, Búzios	<20	5	reported	E. Fernandes
6	12 July 1995	off Atafona	<30	4	04:30 PM	A. P. Di Beneditto and R. Ramos, pers. com.
7	20 August 1996	38,9 n off Atafona	30	3	02:30 PM	A. P. Di Beneditto and R. Ramos, pers. com.
8	September 1996	29 n off Atafona	20	1	02:30 PM	A. P. Di Beneditto and R. Ramos, pers. com.
9	02 October 1996	6,4 n off Iquipari	14	1	11:20 PM	A. P. Di Beneditto and R. Ramos, pers. com.
10	23 November 1996	Praia do Foguete, Cabo Frio	<20	ca. 15	at least one adult male and several juveniles; located close to the surf zone	This study
11	30 November 1996	Búzios	<20	3	located close to the surf zone	This study
12	01 December 1996	Geribá, Búzios	<20	3	possibly the same group sighted the day before, located close to the surf zone	This study
13	15 December 1996	Jaconé, Saquarema	<20	3	located close to the surf zone	This study
14	18 December 1996	Praia do Foguete, Cabo Frio	<20	ca. 12	large concentration of rays in the sighting area; located close to the surf zone	This study

15	18 December 1996	Praia da Vila, Saquarema	<20	3	located close to the surf zone	This study
16	21 December 1996	Praia Seca, Araruama	<15	4	mother-calf and two juveniles, low speed swimming	This study
17	24 December 1996	Pesqueiro dos Cafés e dos Gatos, off Saquarema	<20	4	killer whales aprroached the fishing boat	This study
18	29 December 1996	Praia Seca, Araruama	<20	3	03:00 PM; located close to the surf zone	This study
19	30 December 1996	Praia Seca, Araruama	<20	3	slow speed swimming	This study
20	01 January 1997	Praia da Vila, Saquarema	<20	3	located close to the surf zone	This study
21	08 January 1997	Praia de Ipanema, Rio de Janeiro	<15	3	located close to the surf zone	This study
22	12 January 1997	Praia da Vila, Saquarema	<20	4	located close to the surf zone	This study
23	14 January 1997	Praia da Vila, Saquarema	<20	4	lob tailing, located close to the surf zone	This study
24	20 January 1997	Praia Seca, Araruama	<25	3	located close to the surf zone	This study
25	27 January 1997	Praia da Vila, Saquarema	<20	3	located close to the surf zone	This study
26	February 1997	Itaipuaçu, Niterói	<20	4	reported	This study
27	14 February 1997	Praia da Barra da Tijuca, Rio de Janeiro	<15	3	one killer whale attacking a ray; breaching	This study
28	16 February 1997	Praia Brava, Arraial do Cabo	<20	3	reported	This study
29	summer 1997	Búzios	<20	3	reported	This study

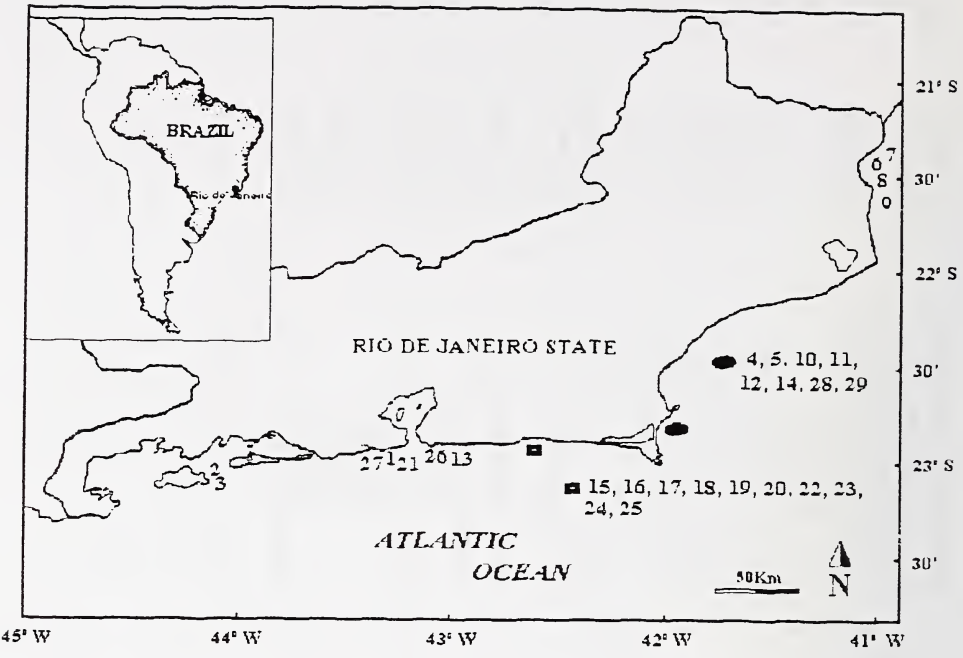

Fig. 1. Sighting locations of killer whales (*Orcinus orca*) along the Rio de Janeiro state coast. Map key refers to table 1.

may also reflect a true killer whale occurrence pattern at the Rio de Janeiro coast. Upwelling conditions present along the Rio de Janeiro coast in summer months lower surface water temperature to 18 °C, or even less.

The resighting interval of 37 days for an individual whale poses some questions on group composition, habitat preferences and distribution patterns. Baird et al. (1992) listed some of the behavioural and ecological differences between transient and resident killer whale populations in the Pacific northwest. According to these authors, the most important differences relate to diet and habitat use. Transient killer whales show small groups sizes (1–15); unpredictable seasonal occurrence and foraging area generally in coastal waters. Our observations suggest some degree of ecological requirements listed for transient killer whales in Baird et al. (1992). Killer whales may visit shallow waters of Rio de Janeiro in search of favorable prey that could include small as well as large whales. Some potential prey are the marine tucuxi (*Sotalia fluviatilis*), the franciscana (*Pontoporia blainvillei*), the rough-toothed dolphin (*Steno bredanensis*), the Atlantic spotted dolphin (*Stenella frontalis*), the bottlenose dolphin (*Tursiops truncatus*), the common dolphins (*Delphinus* spp.) and Bryde's whale (*Balaenoptera edeni*).

However, there is no evidence of feeding by killer whales on marine mammals in our observations. On the other hand, such potential predation pressure on small dolphins could explain why *Sotalia* groups are virtually confined to coastal shallow bays and/or river mouths associated with turbid waters. More recently, Ott and Danilewicz (1996) reported the presence of three franciscanas in the stomach of a stranded female killer whale in southern Brazil. It is also possible that killer whales take advantage of the upwelling conditions on the coast of Rio de Janeiro and may forage on a variety of seasonally abundant sharks, rays, large fish (e. g. *Euthynnus alletteratus* "bonito", *Scomberomorus* spp. "cavala", and *Coryphaena hippurus* "dourado") and cetaceans. At least two

observations were conducted on the presence of rays: it was noted in one case a whale attacking a ray (unidentified species).

These sightings indicate that killer whales, once thought to be rare in shallow coastal waters of southeastern Brazil, may use this habitat seasonally as a foraging ground.

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