

A note on site fidelity of marine tucuxis (*Sotalia fluviatilis*) in Guanabara Bay, southeastern Brazil

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ABSTRACT

Since 1995, photo-identification techniques have been used to study the marine tucuxis (*Sotalia fluviatilis*) found in Guanabara Bay (22°50'S, 43°10'W), southeastern Brazil. The bay is surrounded by a metropolitan complex and is the most degraded area of this species' distribution. From May 1995 to June 2003, 47 photo-identification boat surveys were conducted in the bay. Sixty-nine individuals were identified and catalogued. The results indicate that individual tucuxis have high site fidelity in Guanabara Bay. On average, dolphins were seen for 4.5 consecutive years, with a range of 1 to 8 years. Additionally, calves have remained in the area beyond sexual maturity. Guanabara Bay provides food and breeding grounds for this dolphin population, despite its high degree of degradation. The fact that such a small dolphin population, composed of resident individuals, depends on such a degraded area may pose serious problems for its conservation.

KEYWORDS: TUCUXI; SITE FIDELITY; PHOTO-ID; SOUTH AMERICA; SOUTH ATLANTIC; SURVEY-VESSEL

INTRODUCTION

The marine tucuxi (*Sotalia fluviatilis*) occurs exclusively in the western Atlantic coastal waters of South and Central America, from southern Brazil (27°35'S, 48°34'W) to Nicaragua (14°35'N, 83°14'W), with possible records from Honduras (15°58'N, 79°54'W) (Flores, 2002). This small delphinid inhabits shallow waters and is often found year-round in bays and estuaries (Da Silva and Best, 1996). Due to its nearshore distribution, the marine tucuxi may be vulnerable to the effects of human activities such as habitat loss, chemical pollution, noise and bycatch. Despite these possible threats, there is little information on the ecology, biology and abundance of this species; it is listed as 'Data Deficient' by IUCN – the World Conservation Union (Reeves *et al.*, 2003).

Individual identification can be an effective approach for collecting detailed data on population parameters for many free-ranging cetaceans (e.g. Hammond *et al.*, 1990; Wells and Scott, 1990). Recently, this approach has been used to provide the first observations into site fidelity and calving intervals (e.g. Flores, 1999; Pizzorno, 1999; Santos *et al.*, 2001) for marine tucuxi, mainly in south and southeastern Brazil.

Since 1995, photo-identification techniques have been used to study marine tucuxi found in Guanabara Bay, southeastern Brazil. Recent studies showed that the bay is used daily by this species and calves are found year-round (Geise, 1989; Pizzorno, 1999). Approximately 70 individuals use the Bay (Pizzorno, 1999; Azevedo *et al.*, 2003a), seen most commonly in groups of 6-15 individuals, although they can form aggregations of up to 50 dolphins (Azevedo, 2000; Azevedo *et al.*, 2003b). However, little is known of the ecology of the species in this region.

Guanabara Bay is surrounded by a metropolitan complex and the habitat has been degraded by *inter alia* overfishing, harbour activities, inputs of metals and organochlorines (Amador, 1997; Perin *et al.*, 1997). The area is the second largest industrial concentration in Brazil, with 10,000

industries, the Rio de Janeiro Port Authority, 16 oil terminals, 12 shipyards, and two oil refineries (FEEMA, 1993). For these reasons Guanabara Bay represents the poorest habitat in the species' distribution (Lailson-Brito, 2000).

The present study was conducted from 1995-2003 to examine the site fidelity of marine tucuxis in Guanabara Bay, using photo-identification techniques.

MATERIALS AND METHODS

Guanabara Bay (22°50'S, 43°10'W) is located in Rio de Janeiro State, southeastern Brazil. The bay has a total area of 371km² and a total extension of 30km, with an entrance 1.8km wide (Fig. 1). Although the mean depth is only 5.7m, along the main channel, which follows the central S-N axis of the bay, depths reach an average of 20m (Costa, 1998). The bay possesses some features of an estuarine system. The freshwater contribution is derived from the 35 rivers that flow into the bay and from waste input (Mayr *et al.*, 1989).

From May 1995 to June 2003, 47 photo-identification surveys were conducted in Guanabara Bay. The effort was not equally distributed and the intervals between surveys ranged from 1-360 days (Table 1). All surveys were carried out in Beaufort sea states <3, in small (4.5-6.6m) outboard-powered boats. Photographs were taken at close range (usually <10m). An auto-focus camera with a variable-length (70-300mm) lens was used. Most photographs were taken on ASA 400 colour and black-and-white film. Dorsal fin pictures were examined by negative projection. Nicks and notches along dorsal fins were the main features used to distinguish individual dolphins, but scars along dolphin bodies were used as auxiliary marks.

Photographs of individual dorsal fin marks were used to confirm each identification. Poor and intermediate quality photographs were rejected. From 9,690 photographs taken, about 30% were of good enough quality for individual recognition.

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In order to catalogue individuals, a tracing of each recognisable dorsal fin was made by projecting the negative onto a 8cm × 14cm area of white paper (adapted from Defran *et al.*, 1990). When a visual match was located in the catalogue, the new dorsal fin photograph was projected onto the tracing of the potential match to confirm the resighting. Some dorsal fins attained new notches over the course of the study. In this case, a new tracing was made and the match was analysed by measuring the distance between the two largest notches and dividing that by the distance of the lower measured notch to the top of each dorsal fin (Defran *et al.*, 1990). The matches were always confirmed by at least two researchers.

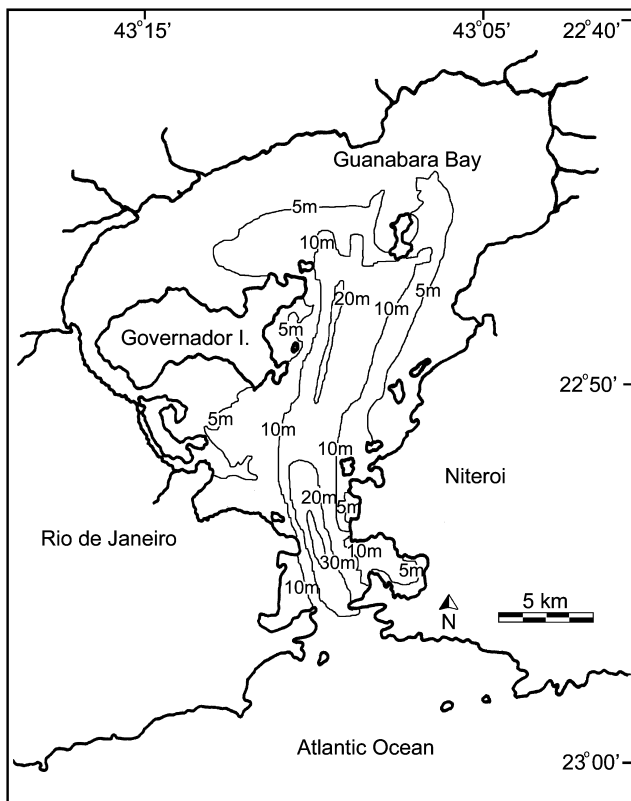


Fig. 1. Map of Guanabara Bay (22°50'S, 43°10'W), southeastern Brazilian coast, where marine tucuxi photo-identification surveys were conducted between 1995 and 2003. The study area has a mean depth of 5.7m and a total area of 371km². The main channel is represented by isobaths of more than 10m.

Table 1

Marine tucuxi photo-identification effort in Guanabara Bay, southeastern Brazil (1995-2003).

Year	No. of surveys	Minimum number of days between surveys	Maximum number of days between surveys
1995	9	1	77
1996	4	20	140
1997	3	30	230
1998	6	35	138
1999	2	57	57
2000	6	1	295
2001	8	14	62
2002	2	20	20
2003	7	5	60
Total	47		

RESULTS

Sixty-nine individuals were identified and catalogued. Thirty-one of these dolphins (44.9%) were first photo-identified in 1995. About 55% (n=17) of the 31 animals identified in 1995 were seen during 2003 surveys. Only 17 (24.6%) of the 69 catalogued individuals were not seen during the 2003 surveys (Fig. 2). On average, dolphins were seen for 4.5 consecutive years, with a range of 1 to 8 years.

The percentage of re-photographed individuals in each year was high (Fig. 3) and was correlated with effort (Spearman test, n=8, rs=0.789; P=0.011). Sixty-five recognisable dolphins (94.2%) were resighted more than once and the 10 most frequently photographed animals were present in more than 50% of the surveys. Three dolphins were seen in at least 20 consecutive surveys and 11 others were present on more than 10 consecutive days.

A resighting index (RI) was calculated for each identified individual. This is the proportion of surveys subsequent to its first sighting during which the dolphin was identified:

$$RI = (F_i / N)(n_i / N);$$

where F_i = total number of sightings of an individual i after the first identification;

n_i = total number of sightings of an individual i ;

N = total number of surveys from the first identification of individual i .

Resighting indices (Fig. 4) ranged from 0.0 to 0.89 (0.38 ± 0.25) and 43 dolphins were photographed in one third of surveys after their first identification. The 10 most frequently photographed dolphins had resighting indices between 0.41 and 0.86.

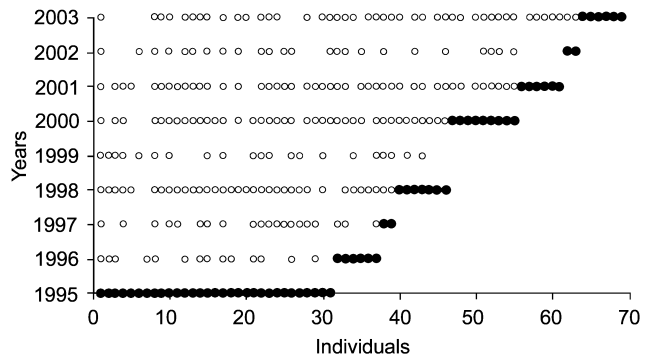


Fig. 2. Summary of new identifications (●) and resightings (○) for marine tucuxis (n=69) in Guanabara Bay from 1995-2003.

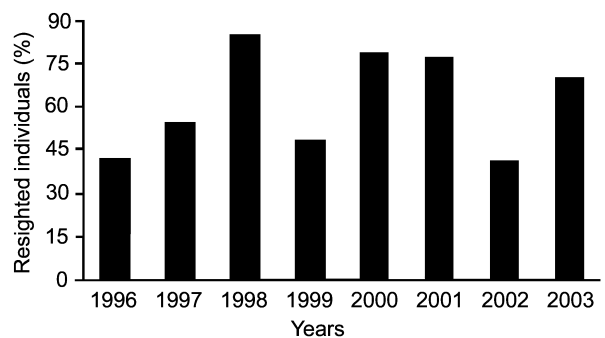


Fig. 3. Percentage of all individuals photographed in a year that had been seen in previous years.

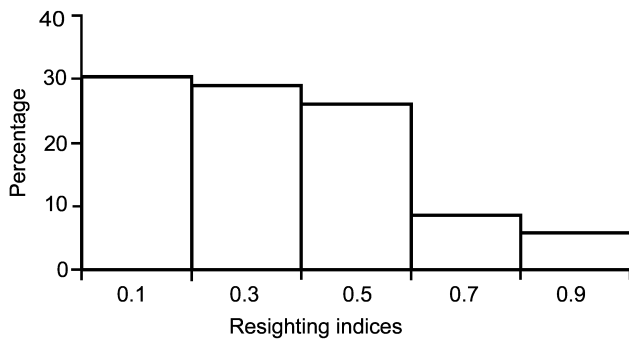


Fig. 4. Histogram of the resighting indices of marine tucuxis ($n=69$) in Guanabara Bay from 1995-2003.

DISCUSSION

The results indicate that marine tucuxis show high site fidelity in Guanabara Bay. Despite the long intervals between some surveys, a trend of residency was clearly identified. Most individuals had relatively high frequency of sightings and only a small number of individuals were not seen in the study area after their first identification. Additionally, most individual identifications were made in the first years of the study and many dolphins were seen for eight years.

Individuals resightings were high in each year, but the sampling effort was unevenly distributed and it was not possible to analyse individual year-round residence. However, a habitat use study was conducted from September 2002 to September 2003 and at least eight easily identifiable tucuxis (photo-identification tools not needed) were seen in all 21 surveys (A.F. Azevedo, unpublished data), which suggests that at least some dolphins are year-round residents in Guanabara Bay.

Site fidelity has already been documented in some coastal species of dolphin, such as Hector's dolphins, *Cephalorhynchus hectori* (e.g. Slooten *et al.*, 1993) and bottlenose dolphins, *Tursiops truncatus* (e.g. Connor *et al.*, 2000). For the tucuxi, two other studies concerning site fidelity also showed resident individuals. In North Bay, Santa Catarina, some marine tucuxis were observed for 4.8 years (Flores, 1999). At the Cananéia Estuary, individuals also have high residency patterns (Santos *et al.*, 2001). These two areas, as well as Guanabara Bay, are relatively protected coastal waters, providing shelter from predators and abundant food (Santos *et al.*, 2001). The level of site fidelity may be a function of prey availability. In areas where prey density is high, dolphins are not forced to range over long distances in search of food, resulting in a high level of site fidelity (Karczmarski, 1999).

Two calves photo-identified in 1995 were seen throughout the study. One of them has been seen with a calf since 2001, which indicates that tucuxi offspring remain in the area beyond sexual maturity. This pattern was reported for long-term resident bottlenose dolphins in western Florida (Scott *et al.*, 1990). In Guanabara Bay, other females (sex determined by consistent association with a calf or examination of collected carcasses) also have high resighting indices and short intervals between resightings. Guanabara Bay is also an important site for breeding in this species.

The marine tucuxi 'population' of Guanabara Bay is small (Pizzorno, 1999; Azevedo *et al.*, 2003b), in contrast to other near coastal sites where dolphin communities reach up to 200 individuals (Simao *et al.*, 2000). The high resighting indices suggest that these dolphins spend a considerable

amount of time within the bay. This site thus provides food and breeding habitat, despite being an area of high anthropogenic influence. However, the combination of a small resident dolphin population and a heavily degraded area may have serious implications for its conservation. Potential threats that require monitoring and possible mitigation include those related to chemical pollution (tucuxi from the Bay have high PCB and DDT concentrations in the blubber, comparable to some cetaceans which live in industrialised sites of the North Hemisphere; Lailson-Brito *et al.*, 2003), intense vessel traffic (disturbance and strikes), and fishing activities (bycatches and overfishing). Such activities may have long-term effects and may operate cumulatively (Whitehead *et al.*, 2000) and synergistically. Further research into abundance, biological parameters, habitat use and environmental disturbance is required to assess and monitor the status of these resident tucuxi dolphins.

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