ETHNOBIOLOGY OF *SOTALIA FLUVIATILIS* (GERVAIS, 1853) IN THE NORTHERN COAST OF SÃO PAULO STATE, BRAZIL.

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Abstract
The frequent occurrence of *Sotalia fluviatilis* (marine tucuxi) in the northern coast of São Paulo State (Caraguatatuba, São Sebastião and Ilhabela) has been confirmed through records of sightings and stranded or accidentally captured animals, along the last 12 years of monitoring by *"Projeto SOS Mamíferos Marinhos"*. As fishers have related the presence of marine tucuxi in their daily activities at sea, we conducted an ethnobiological research with fishing communities of this region. We show the preliminary results regarding the ethnobiological knowledge of fishermen from São Sebastião, which could contribute to the conservation and management of this area.

Resumen
El tucuxi marino (*Sotalia fluviatilis*) és una espécie que ha sido registrada con frequencia en la costa norte del Estado de São Paulo (Distritos de Caraguatatuba, São Sebastião y Ilhabela), sea en situaciones de varamientos, capturas accidentales o avistajes registradas por el *"Projeto SOS mamíferos Marinhos"* en 12 años de pesquisas. Los pescadores de la región confirman la presencia desta espécie durante sus fainas en el mar, por lo cual empezamos un estudio etnobiologico con estas comunidades pesqueras. Presentamos en este trabajo informaciones preliminares acerca del conocimiento etnobiológico de los pescadores de São Sebastião, que puedem ser útiles en la elaboracción de nuevas estrategias de conservación y manejo ambiental.

Introduction

The northern coast of São Paulo State is 161km long and it is composed by 164 beaches and 17 islands. It encompasses the municipalities of Ubatuba, Caraguatatuba, São Sebastião and Ilhabela (Figure 1), which totalize a population around 240.000 people. Currently, tourism is the most important commercial activity in the region, followed by commercial artisanal fishing.

The marine tucuxi *Sotalia fluviatilis* is one of the most common species in this part of the coast and it has been recorded through sightings or occurrences of stranded or accidentally captured animals. Along the last 12 years, the research project *"Projeto SOS Mamíferos Marinhos"* recorded 27 dead individuals (25 stranded and 2 accidentally captured in gillnets) and groups of marine tucuxi were sighted in 11 occasions among 60 efforts of observation (at land and cruises) (Figure 2). Marine tucuxi stranding records accounted for 17% of the total of marine mammals stranding in this period.

Fishers have related the presence of marine tucuxi and other species of dolphins in during their fishing trips at sea. In order to better understand the interaction between fishers and dolphins, we performed an ethnobiological research in 11 communities of Caraguatatuba, São Sebastião and Ilhabela.

Ethnobiology studies the relation among plants, animals and human societies, analyzing the way people classify the nature (Berlin, 1992). Studies on folk knowledge have compiled biological information based on local knowledge, such as the study by Begossi and Figueiredo (1995). According to Berkes (1999) local ecological knowledge is a cumulative body of knowledge and beliefs, evolved by adaptive processes and transmitted by generations, about the relationship of living beings with one another and with their environment. Additionally, ethnobiological studies have produced new approaches to conservation and management issues (Begossi *et al.,* 2002; Gadgil *et al.*; 2003).

In Brazil a few studies on Cetacean ethnobiology have been carried out. Oliveira and Monteiro-Filho (2006) have studied the knowledge of fishers about marine tucuxi (*Sotalia fluviatilis*) in Cananéia and Ilha do Cardoso (São Paulo State), collecting information about social organization, behavior, feeding ecology, sense organs, spatial distribution, parental care, epimeletic behavior, interspecific interactions and nocturnal activities. Pinheiro and Cremer (2002) have researched fishers knowledge about marine tucuxi (*Sotalia fluviatilis*) and Franciscana dolphin (*Pontoporia blainvillei*), at Babitonga Bay (Santa Catarina State), recording information on classification, diet, feeding behavior, habitat use, group size, seasonality, accidental capture, and use of accidentally captured dolphins. At Maranhão State (northern coast of Brazil), Garri *et al*. (2006) have carried out interviews with local fishers to obtain information about marine tucuxi meat consumption captured in fisheries activities.

The objective of this study was to characterize fishers' knowledge about dolphins, with emphasis on marine tucuxis.

Material and Methods

The fishers' communities were selected by their importance in terms of the occurrence of artisanal fisheries, along with its geographical location, in order to obtain a representative range of information. The following communities were chosen: Cocanha, Camaroeiro and Porto Novo (Caraguatatuba), Enseada, São Francisco, Toque-Toque and Boiçucanga (São Sebastião), Bonete, Portinho and Pier dos Pescadores (Ilhabela), totalizing around 300 active artisanal fishers (Figure 3). Our objective was to interview 30% (n= 90) of this total. Presently, we have interviewed approximately 10 % of them (n=32), residents at São Sebastião, which are older than 35 years and have been fishing for 15 years or more.

During the interviews we used pictures of marine tucuxis in the sea, in addition to drawings of this species. Semi-structured questionnaires were the basis for interviews, which included questions on the occurrence, distribution, seasonality, group size, diet, reproduction, migration and interactions with fisheries. Additionally, we used pictures and drawings of other dolphins, common in the studied area, to evaluate the fishers' perception in relation to dolphin diversity and to observe how they group different species.

The answers given by the fishers were recorded as ´citations´, being possible more than one citation per answer relative to each question. In order to standardize the results, we show the data as the total number of citations for each question asked in the questionnaire.

Fish species cited by fishers as prey of marine tucuxi were identified comparing their common names with the common names mentioned in the literature on ethnoichthyological research in the studied area (Begossi and Fiqueiredo, 1995; Masumoto, 2003).

Results

Among the fishers interviewed in São Sebastião, only one is a woman. The number of fishers interviewed is 32, with a mean age of 54 years. Among them, 27 fishers have been fishing for more than 20 years. Nineteen of the interviewees have concluded only the primary school.

In the first part of the interview, a general question about cetaceans was asked to the fishers: - "Are cetaceans fish? - Why?" As a result, 21 fishers answered that cetaceans are fish and the most common explanations were: "cetaceans spend all their life at sea", "they eat fish and live at sea", "they are from the shark family", "they look like sharks, although they don't attack men". In other way, 6 of them answered that cetaceans are not fish and the most common explanations were: "they resemble fish but they aren't edible, their meat is not to sell", "they are mammals, not fish". Five fishers, out of 32 did not know how to answer the question (Table 1).

In relation to recognition and nomenclature of the marine tucuxi, only five fishers did not recognize the species in the picture. Among the positive the name "boto" (a popular name used for dolphins) was cited by 19 fishers, "golfinho" (dolphin) by five, and "toninha" by four (a popular name generally used for another species, the Franciscana dolphin).

When we showed pictures of different dolphin species, including *Sotalia fluviatilis*, and asked fishers to group them, most fishers (17) formed the group including *S. fluviatilis* with *Tursiops truncatus*. They explained this group due to the similarity of these species, differentiated by bigger size of *T. truncatus*.

In relation to the distribution of this species, the results of interviews show that marine tucuxi is commonly sighted by fishers on the studied coast (Figure 4) usually foraging, socializing or displacing from one area to another.

Group size was not well defined by the answers obtained, as fishers reported small groups including about 10 individuals (6 citations), or groups including 10 to 100 individuals (9 citations), or groups including hundreds of individuals (12 citations). Seven fishers did not know the answer.

When asked about the marine tucuxi habitat, 10 answers confirmed that these dolphins live in oceanic areas, while in 9 they considered them as coastal dolphins. One answer indicated this species as living in warmer waters and in 12 citations they didn't know about this species habitat.

Talking about seasonality, 12 citations confirmed that marine tucuxi is commonly seen year round, 5 mentioned they see it during the winter, 3 pointed out that its common in the summer and in another 12 they didn't know the answer.

In relation to marine tucuxi reproduction, 24 citations confirmed that fishers do not know about this species reproduction. Only 5 citations confirmed the presence of calves into the groups sighted in the studied area and 3 reported this presence to winter time.

The knowledge of fishers concerning marine tucuxi diet, comprehended 5 answers that it eats "fish or small fish" (Table 2). "Tainha" and "parati" (mullets, *Mugil* spp.) were the fishes most commonly mentioned, followed by "manjuba" (broadband anchovy, *Anchoviella lepidentostole*), "sardinha" (sardine, *Sardinella* sp.), "peixe-espada" (cutlassfish, *Trichiurus lepturus*), "pescadinha" (weakfish, *Cynoscion* spp., *Macrodon ancylodon, Nebris microps* or *Isopisthus parvipinnis*), "betara" (southern kingcroaker, *Menticirrhus americanus*), "guaivira" (leatherjack, *Oligoplites saurus*) and "lula" (squid, *Loligo* sp.). Six fishermen didn't know about the diet.

Regarding marine tucuxi interactions with fishery nets, in 15 citations fishers were evasive or deny knowing about accidental capture of dolphins. Three of them categorically denied any event of accidental capture. On other hand, 7 citations confirm the possibility of accidental

capture of marine tucuxis in gillnets. Other 7 citations referred to interactions between marine tucuxis and boats or fishes themselves.

Discussion

According to Dupré (1999), until the beginning of the 80's, the folk taxonomy of marine animals commonly regarded whales as fishes, which meant any aquatic animal, especially vertebrates. Nevertheless, as cetaceans became more exposed by the media, bringing new information on their biology, perception about them has been changing and most people do not consider them as fishes anymore. Fishers studied seem to be halfway of this change, acquiring new information which sometimes conflict with their old beliefs.

The process of recognizing and naming dolphins might depend on how abundant they are in the studied area. According to Medin and Atran (1999) two theories explain the origin of popular (or traditional) knowledge: utilitarism, in which popular knowledge is more detailed in relation to species that are useful to the community and mentalism (or intellectualism) in which that knowledge is result of the species abundance in the nature, its salience or another perceptible feature. Analyzing the interviews we verify that marine tucuxi is readily recognized, what could be explained by its greater local abundance in relation to other dolphin species, by its coastal habits and its higher frequency of accidental capture in gillnets, that makes it very salient to fishers. Folk names show local or regional variation in their use, but the most used, in this case, is "boto", a name used by fishers around Brazilian coast for dolphins in general. This generality could be explained by the fact that dolphins are not commercially used by fishermen, so they do not need to name them in detail.

Marine tucuxi distribution reported by fishers from S. Sebastião, in coastal waters and estuarine areas of the northern coast of São Paulo, agrees with information found in literature about this species (Jefferson *et al*. 1993; Martuscelli *et* al., 1996; Santos *et al*., 2000; Di Beneditto *et al*., 2004). The occurrence sites mentioned by fishers are coincident to the main points of fishing activities.

Sightings of this species in the studied area, recorded by *"Projeto SOS Mamíferos Marinhos"*, revealed variation in relation to group size, from small (n= 6) to medium groups (n= 50). Azevedo *et al*. (2005) studying group characteristics of marine tucuxis in Guanabara Bay found groups from one to 40 individuals and they suggest that group size may be a function of resources availability in the area.

The lack or generality of information about habitat, seasonality and reproduction could be understood by the same explanation given above, in relation to the popular name. As dolphins are not a target in the fishery, fishers do not necessarily need to have knowledge on dolphins in order to improve their catches Silvano *et al*. (in press) studying fish reproduction also found a lack of knowledge by fishers in relation to the reproduction of these animals. They suggest that this could be because fish reproduction is a difficult event to be observed at nature, as we could say about dolphin reproduction.

Di Beneditto *et al*. (2001) studying the diet of *S. fluviatilis* found as main prey species cutlassfish (*Trichiurus lepturus*), rockfish (*Porichthys porosissimus*), anchovy (*Anchoa fllifera*), weakfishes (*Paralonchurus brasiliensis* and *Isopisthus parvipinnis*), conger eel (*Ariosoma opisthoophthalma*) and squids (*Loligo sanpaulensis, L. plei* and *Lolliguncula brevis*). One species from this list (*Trichiurus lepturus*) and another prey from four families (Engraulidae, Sciaenidae, Trichiuridae and Lolliginidae) are coincident with information given by fishers, confirming their knowledge about marine tucuxi diet (Table 2).

According Silvano *et al.* (in press) the comparison between fishers' knowledge and scientific literature confirms that fishers' information reflect real biological patterns and could contribute to marine research projects towards conservation and management.

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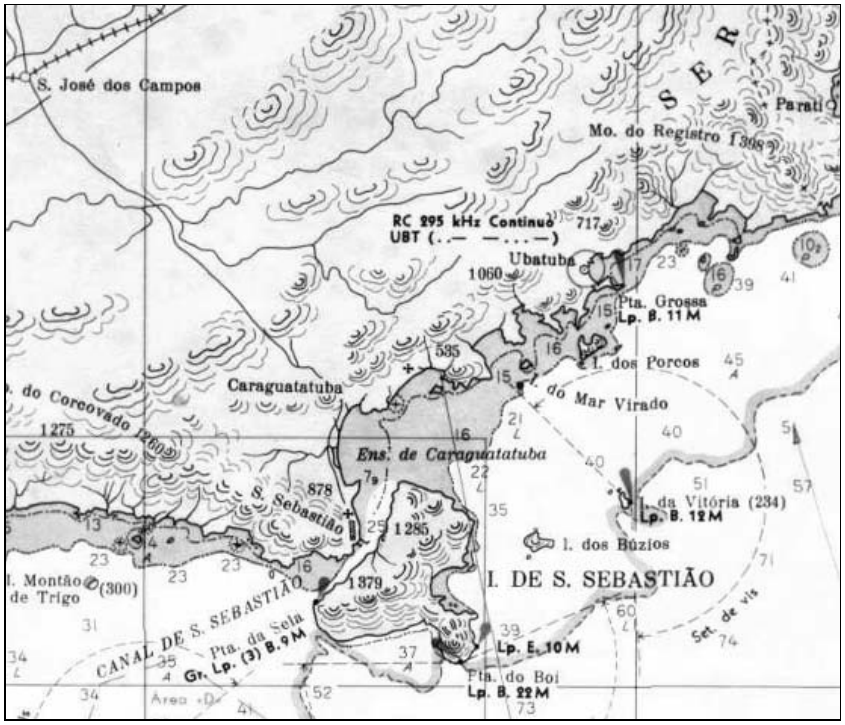

Figure 1. Northern coast of São Paulo State, Brazil (23° 21'S – 44° 41'W to 23° 41'S – 45° 53'W).

Figure 2. Marine tucuxis (*Sotalia fluviatilis*) sighted in January 2003, at Massaguaçú beach, Caraguatatuba, São Paulo, Brazil.

Figure 3. Fishers repairing gillnets during interviews at Boiçucanga beach, São Sebastião, São Paulo, Brazil.

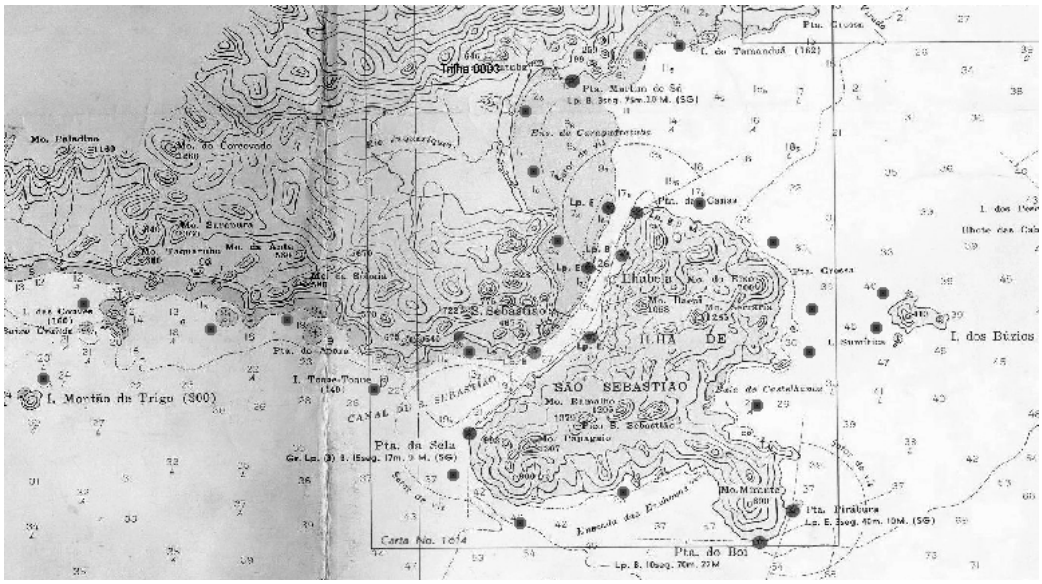

Figure 4. Distribution of *Sotalia fluviatilis* (black points) around São Sebastião and Ilhabela, according fishers' information.

Table 1. Fishers' classification of whales and dolphins.

Fishers' classification	Number of citations
"Whales are fish"	11
"Whales are from the shark family"	2
"Dolphins are fish"	10
"Dolphins are from the shark family"	2
"Whales aren't fish, they are mammals"	4
Don't know how to classify whales	3
"Dolphins aren't fishes, they are mammals"	3
Do not know	4

Table 2. Prey items from the diet of *Sotalia fluviatilis*, according citations of fishers from São Sebastião, SP. (Species and Families cited in the literature as main prey items from marine tucuxi's diet are highlighted)

Prey	Scientific Family	Scientific name	Number of citations
Fish (in general)			4
Small fish (in general)			1
Sardines	Clupeidae	*Sardinella* sp.	2
Broadband anchovy	Engraulidae	*Anchoviella lepidentostole*	4
Mullet	Mugilidae	*Mugil* sp.	8
White mullet	Mugilidae	*Mugil* sp.	7
Weakfish	Sciaenidae	*Cynoscion* spp., *Macrodon ancylodon, Nebris microps* or *Isopisthus parvipinnis*	1
Southern kingcroaker	Sciaenidae	*Menticirrhus americanus*	1
Cutlassfish	Trichiuridae	*Trichiurus lepturus*	2
Leatherjack	Carangidae	*Oligoplites saurus*	1
Squid	Lolliginidae	*Loligo* sp.	2
Do not know			6

WP13

RESIDENCE PATTERNS OF THE ESTUARINE DOLPHIN *SOTALIA GUIANENSIS* (CETACEA, DELPHINIDAE) IN THE BAÍA DA BABITONGA, NORTH COAST OF SANTA CATARINA STATE, BRAZIL .

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Abstract
From September 2000 to August 2004 a study on the residence patterns of *Sotalia guianensis* was carried out in the Babitonga Bay, north coast of Santa Catarina State. Photo identification techniques (from September 2000 to February 2003; 55 hours of direct observation) and video identification techniques (from August 2003 to August 2004; 24 hours of direct observation) were applied and fifty one animals were identified. Considering the whole period of study (34 months) residence rates, calculated as the division of the number of sightings per effort months, varied from 2.9% (n=1 sighting) to 67.6% (n=23 sightings). The residence patterns were also considered by the seasonal presence and absence of the identified animals in the study area. Almost half of

the animals (n=19; 37.2%) were considered as residents, with residence taxes of 11.7% or more. Only twenty percent (n=10) of the animals were considered as non resident s. Along the five years of study it was observed that more than thirty percent (n=16) of identified individuals occurred on three years, and twenty- five percent (n=13) occurred only on one year. The longest period of occurrence reached eight years for one individual. Due the high taxes of resightings observed for most of the animals, the small percentage of observed animals only one time and few differences of frequency in the sightings between the years and the seasons, is clear that *Sotalia guianensis* has a regular year round occurrence in the study area. The Babitonga Bay represent s an area of great impor tance for the studied population of *S. guianensis* , with most of animals using the area throughout the year, probably with low rates of exits from the bay.

Key words : residence patterns, *S. guianensis* , Babitonga Bay.

Introduction

Sotalia guianensis is also known as boto- cinza or estuarine dolphin in the south coast of Brazil. It has a continuous distribution, from Florianópolis, Santa Catarina (Simões - Lopes, 1988) until Nicarágua (Carr and Bonde, 1993). In some places throughout its distribution was observed certain degrees of residence for some individuals (Pizzorno *et al*., 1996; Santos *et al* ., 2001; Flores, 1999; 2002; Cremer, 2000; Hardt *et al*., 2002). A previous study showed that the Babitonga Bay is an impor tant shelter for the species throughout its distribution (Cremer, 2000). Cremer *et al* . (2001) in a three - year long study had identified areas of concent ration of the species in the area that, however, suffer variations throughout the years in result from antropic impacts origin and ambient variations. The knowledge of the habitat use and home range of a population is considered basic factor for the elaboration and implementation of strategies of a species' conservation, subsiding works of environment al assessment (Primack and Rodrigues, 2001). This work aims to know the residence patterns of *S. guianensis* in the Babitonga Bay, Santa Catarina.

Materials and Methods

Study Area

Babitonga Bay is located in the north of Santa Catarina State, southern Brazil (- 26º02' to - 26º28'S and - 48º28' to - 48º50'W) comprising an area of approximately 160 km ^{2}, being 20km long and having maximum wide of 5km. It is connected to the Atlantic Ocean through a deep channel of about 1.7km wide. In its surroundings there are mangrove vegetation, covering approximately 6.200ha, and margins of sand banks and rocks. The bay receives many rivers but is considered an homogenous estuary (IBAMA 1998). The mean depth is 6m reaching maximum of 28m to near main channel you the San Francisco do Sul harbour. The variation of the tide is about 2.3m according to the tide table will be the port of San Francisco do Sul.

Data collection

An aluminum boat with 5.50m length, and outboard engine 60Hp was used. For photo identification it was used a Canon EOS5 photographic camera with 100- 300 mm zoom lenses. For images was used a digital video camera (mini - DV) Sony DCR- TRV33. The animals were followed according to Würsig and Jefferson (1990) techniques. The residence patterns of *S. guianensis* were analyzed following an adaptation of the models proposed by Würsig and Jefferson (1990), Ballance (1990), Simões - Lopes and Fabian (1999) and Zolman (2002) for *Tursiops truncatus* . For estimating the residence patterns we observed the number of times that a photo identified animal was resighted throughout the study period. In this way it was elaborated a

table of monthly presence and absence. The residence rates of the individuals in the area, were calculated through the division of the number of resightings per number of effort months, and are expressed in %.

The residence patterns had been also considered as seasonal presence and absence of the identified individuals. The animals that were identified in the area in all the seasons, independent of the year, were considered as resident s (R). Those identified in three different seasons were considered as partially residents (PA- R). Animals observed exclusively in the same season of consecutive years were considered as seasonal resident s (R- S). Animals identified in two non consecutive seasons were considered as little resident s (PO- R). Animals identified in only one or two consecutive seasons had been considered as non resident s (N- R).

Results

The photo and video identification efforts comprises a period of 34 months and a total of 51 animals were identified. The residence rates varied of 2.9% (n=1 sighting) to 67.6% (n=23 sightings) (Table 1). Two identified animals were present through the five study years, with residence rates of 67.6% and 58.5% respectively. These high residence rates remained similar in both photo identification (September 2000 to February 2003) as in the video identification periods (August 2003 to August 2004). Nineteen animals (37.2%) were considered residents, with residence rates equal or superior of 11.7%. But ten (19.6%) animals were considered as non residents. Of these, seven (70%) were represented by only one sighting. The seasonal resident s animals represent only one small parcel of the identified individuals (n=5; 9.8%).
Analyzing the occurrence of the animals throughout the five effort years, it was observed that sixteen animals (31.3%) were present throughout three years of study, with residence rates equal or superiors of 15%. Only thirteen (25.4%) of the identified animals occurred in only one year.

Discussion

Resident populations of *S. guianensis* had been also observed in some localities. In the Guanabara Bay, Pizzorno (1999) observed that 32 animals were resident for a period of three years, and Santos (2001) observed that 16 animals were resident s throughout 2 years in the Cananéia estuary. In the Norte Bay, Santa Catarina, 23 animals were observed for 4.8 years (Flores, 1999). Considering the high taxes of resightings found for most of the animals of the Babitonga Bay, the small percentage of animals observed for only one time and the small differences of frequency in the sightings between the effort years and the seasons, it became clear that *S. guianensis* has a regular occurrence throughout the year in the study area. Great part of the identified animals (n=38; 74.5%) were observed in the area for more than two years and more than one third of the animals (n=16; 38%) had occurred in three or more years. Considering previous studies (Cremer, 2000), it is verified that two animals, “Peninha” and “Cut”, have been using the area for more than seven and eight years, respectively, showing a long term residence. Long term residence had been also observed in Norte Bay, where 13 animals had been observed by periods that varied from 3 to 10 years (Flores, 2002). The entrance and exit flow of animals in bays have been verified for *S. guianensis* in the Guanabara Bay (Geise, 1991). This contras t s to what we found in the Babitonga Bay. Only a small parcel of the identified animals (n=6; 11.7%) were considered as seasonal residents, showing that most of them did not prefer for occupying the area in a specific season. The residence of *S. guianensis* in the Babitonga Bay, as well as that was observed Norte Bay (Wedekin, 2003), indicates that the area probably posses ses necessary

resources to suppor t the population during the year. The results presented in this study show that the Babitonga Bay represent s an area of great importance for the studied population of *S. guianensis* , with many animals using the area throughout the year, probably with low rates of exits from the bay.

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Table 1: Residence patterns and seasonality of *Sotalia guianensis* photo and video identified (n=51) between September 2000 and August 2004 in the Babitonga Bay, north coast of Santa Catarina. Abbreviators: R: resident; PA-R: partially resident; PO-R: little resident; R-S: seasonal residents and N-R: non residents.

Nº.	ID	2000	2001	2002	2003	2004	Nº. of years	Nº. of resightings	Residence taxes (in %)	Residence levels
36	Peninha	■	■	■	■	■	5	23	67.6	R
8	Cut	■	■	■	■	■	5	20	58.8	R
3	Blanco	■		■	■	■	3	14	41.1	R
19	Gilo		■	■	■	■	4	14	41.1	R
5	Cléo	■	■	■		■	4	12	35.2	R
45	Tony		■	■	■	■	4	11	32.3	R
17	Gaia		■	■			2	9	26.4	R
38	Pontinha	■	■	■			3	9	26.4	R
2	Ana		■	■	■	■	4	8	23.5	PA-R
15	Fredo		■	■	■		3	8	23.5	R
20	Godi		■	■			2	8	23.5	R
27	Leia		■	■	■		3	8	23.5	R
30	Mary		■	■			2	7	20.5	R-S
32	Mira		■	■	■		3	7	20.5	R
33	Nasua		■	■	■		3	7	20.5	R
51	Vê				■	■	2	6	17.6	R
6	Coelho	■	■	■			3	6	17.6	R
49	W		■	■		■	3	6	17.6	PA-R
13	Erso		■	■			2	6	17.6	R
22	Guido		■	■			2	5	14.7	R-S
24	Jaspi		■	■		■	3	5	14.7	R
41	Terê		■	■			2	5	14.7	R-S
4	Bravo		■	■			2	4	11.7	PA-R
11	Edu			■			1	4	11.7	PA-R
18	Gancho		■		■	■	3	4	11.7	R
26	Koke		■	■			2	4	11.7	R
28	Luca		■	■			2	4	11.7	PA-R
34	Onix		■	■	■		3	4	11.7	PA-R
48	Xande		■	■			2	4	11.7	PA-R
1	Agatha			■		■	2	3	8.8	R-S
7	Coral			■			1	3	8.8	PO-R
14	Fê		■	■			2	3	8.8	PO-R
16	Gabiru			■			1	3	8.8	N-R
21	Gota		■	■			2	3	8.8	R-S
23	Ita		■	■			2	3	8.8	PA-R
29	Malaquita		■	■			2	3	8.8	R-S
31	Mela		■	■			2	3	8.8	PA-R
39	Serra		■				1	3	8.8	N-R
47	Vero			■	■		2	3	8.8	N-R
9	Dan			■			1	2	5.8	PO-R
10	Dinho		■	■			2	2	5.8	PO-R

25	Jk	2	2	5.8	PO- R
40	Taiga	2	2	5.8	PO- R
42	Tiburcia	1	2	5.8	N- R
12	Elisa	1	1	2.9	N- R
35	Paulinha	1	1	2.9	N- R
37	Pongo	1	1	2.9	N- R
43	Tisa	1	1	2.9	N- R
44	Tonga	1	1	2.9	N- R
46	Tuc	1	1	2.9	N- R
50	Xel	1	1	2.9	N- R