UNIVERSIDADE FEDERAL DO PARANÁ

ERIC MEDEIROS

DIFFERENT TYPES OF INDIVIDUAL HABITAT USE IN TWO CLOSE SITES BY GUIANA DOLPHIN (*Sotalia guianensis*) IN THE CANANÉIA ESTUARY – BRAZIL.

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Dissertação apresentada como requisito parcial à obtenção do grau de Mestre em Zoologia, no Curso de Pós-Graduação em Zoologia, Setor de Ciências Biológicas, da Universidade Federal do Paraná.

Orientadora: Prof. Dr. Emygdio Leite de Araujo Monteiro Filho

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TERMO DE APROVAÇÃO

Eric Medeiros

"Different Types of Individual Space Use in Two Close Sites by Guiana Dolphin (Sotalia guianensis) in the Cancanéia Estuary – Brazil"

Dissertação aprovada como requisito parcial para obtenção do grau de Mestre em Zoologia, do Setor de Ciências Biológicas da Universidade Federal do Paraná, pela seguinte Comissão Examinadora:

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Curitiba, 10 de março de 2015.

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"Um homem precisa viajar. Por sua conta, não por meio de histórias, imagens, livros ou TV. Precisa viajar por si, com seus olhos e pés, para entender o que é seu. Para um dia plantar as suas árvores e dar-lhes valor. Conhecer o frio para desfrutar o calor. E o oposto. Sentir a distância e o desabrigo para estar bem sob o próprio teto. Um homem precisa viajar para lugares que não conhece para quebrar essa arrogância que nos faz ver o mundo como o imaginamos, e não simplesmente como é ou pode ser; que nos faz professores e doutores do que não vimos, quando deveríamos ser alunos, e simplesmente ir ver".

Amyr Klink em Mar Sem Fim

RESUMO

A marcação e recaptura é um de diferentes métodos utilizados para amostrar a distribuição espacial e temporal de animais. Utilizando uma técnica não invasiva de marcação e recaptura, este trabalho apresenta resultados de uso heterogêneo do espaço pelo boto cinza em um estuário tropical do litoral sudeste brasileiro. Um total de 98 indivíduos, de distinguibilidade variável, foi capturado através da foto identificação utilizando as águas de uma baía abrigada dentro do estuário. De todos os 98 indivíduos, cerca da metade foi capturada em dois pontos em terra, ambos dentro da baía. De todos 48 indivíduos capturados nestes pontos em terra, cerca da metade foi capturada uma única vez. Um dos pontos em terra foi responsável pela maioria das capturas. No outro, dois indivíduos foram capturados seis vezes mais que qualquer outro indivíduo. Os resultados indicam que ambas as áreas são utilizadas pelos botos, porém de forma heterogênea: Ponta da Trincheira como área de alimentação por uma grande porção da população e Praia do Pereirinha para criação de filhotes por um número menor de indivíduos. Pelos fatos de que: (i) Baía de Trapandé pode conter indivíduos transitórios, mas a maioria volta para esta área e (ii) áreas diferentes dentro do estuário desempenham papeis importantes, porém distintos, no ciclo de vida dos botos em Cananéia, conclui-se que esforços direcionados à conservação na região devem levar em consideração tais informações.

Palavras-chave: marcação e recaptura; conservação; foto identificação.

ABSTRACT

Mark-recapture is one of different methods used for sampling animal distribution over space and time. Using mark-recapture non-invasive techniques, this work presents results of Guiana dolphin heterogeneous spatial use in a tropical estuary in Southeastern coast of Brazil. A total of 98 individuals, of varying distinctiveness, were photo identified using waters of a bay inside the estuary. Of all 98 individuals, about half were captured as well in two land-based sites, also inside the bay. Of all 48 individuals captured in land-based sites, about half were captured only once. One land-based site was responsible for the majority of land-based captures. In the other, two individuals were captures six times more than any other. Results indicate that both areas are used by dolphins, but in a heterogeneous manner: Ponta da Trincheira as feeding area for a large portion of the population and Praia do Pereirinha for calf-raising by a reduced number of individuals. The facts that: (i) Baía de Trapandé may have transient individuals but most of them do return to the area, and (ii) different areas inside the bay play important but distinct roles in life cycle of dolphin in Cananéia waters leads to the conclusions here taken that conservations efforts in the region should take in consideration such information.

Key words: Mark-recapture; conservation; photo identification.

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1 INTRODUCTION

Individuals, populations, or species are driven to use more certain habitats due to several factors such as prey availability, behavior response, environmental variability, among others (KREBS, 2009). There are different ways to understand how space is being used by a species over time depending on the sample unit being the individual or the population (MATTHIOPOULOS; AARTS, 2010).

Identifying which factors drive such selection may be a challenge and habitat modelling acts as a tool used to better understand several vertebrate species, from fish (MORRIS; BALL, 2006) to bird (BUCKLAND; MARSDEN; GREEN, 2008). Data gathering may be done through distance sampling (THOMAS *et al.*, 2010), telemetry (AARTS *et al.*, 2008), or mark recapture (OVASKAINEN, 2004). While distance sampling may achieve representative spatial coverage with one observation per animal and telemetry have all observations on one animal usually with an unrepresentative sample of environment, mark-recapture methods balance features from both methods (MATTHIOPOULOS; AARTS, 2010).

Mark-recapture can be made in a wide variety of forms with several different animals, e.g. earring tagging for rats (ERNEST; MARES, 1986); fur dying with pinnipeds (ERICKSON; BESTER; LAWS, 1993); implanted transponder in snakes (GIBBONS; ANDREWS, 2004); genetic tagging with Humpback whales (PALSBØLL, 1999); leg rings for birds (MARION; SHAMIS, 1977).

For animals that impose difficulties for physical capture for both, researcher and animal, the photo identification technique is an interesting alternative for gathering of mark-recapture information in a non-invasive manner (WÜRSIG; WÜRSIG, 1977). Different species [e.g. sea dragons (MARTIN-SMITH, 2011), turtles (REISSER *et al.*, 2008), frogs (KENYON; PHILLOTT; ALFORD, 2009), and cheetahs (KELLY, 2001)] may have different characteristics used by researchers for photo identification, and cetaceans in particular, present a wide variety of such natural markings. Right whales present distinct callosities on their head (KRAUS *et al.*, 1986) and Humpback whales have distinct color patterns in their tail fluke (STEVICK *et al.*, 2001). The Guiana dolphin Sotalia guianensis (VAN BÉNÉDEN, 1864), as many other toothed cetaceans, present a dorsal fin with conspicuous individually distinct scar pattern used in individual identification (IRVINE; WELLS; SCOTT, 1982).

The Guiana dolphin is a small delphinid found in Central and South America Atlantic coast (EDWARDS; SCHNELL, 2001; SIMÕES-LOPES, 1988). Although, some sightings have been made as far as 36km from the coast (ROSSI-SANTOS; WEDEKIN; SOUSA-LIMA, 2006), the occurrence of the Guiana dolphin is more associated with estuarine and sheltered waters (BOROBIA *et al.*, 1991; DA SILVA *et al.*, 2010). Whether in the southern limit of its distribution (WEDEKIN *et al.*, 2007), or almost in the northern limit (EDWARDS; SCHNELL, 2001), dolphins restricted their activities to well-defined areas. This also seem to happen in sheltered bay waters (AZEVEDO *et al.*, 2007; e.g. Baía de Guanabara – SE Brazil: GEISE, 1991) as well as in coastal ocean waters (e.g. Fortaleza – NE Brazil: OLIVEIRA et al., 1995).

The species also present high local fidelity throughout its distribution with different degrees of residency (CANTOR *et al.*, 2012; ESPÉCIE; TARDIN; SIMÃO, 2010; FLACH; FLACH; CHIARELLO, 2008; LODI, 2003; NERY; ESPÉCIE; SIMÃO, 2008; SIMÃO *et al.*, 2000). Some individuals were seen during up to 11.25 years in a 12 year study (NERY; ESPÉCIE; SIMÃO, 2008), some may use areas up to 35km apart (ROSSI-SANTOS; WEDEKIN; MONTEIRO-FILHO, 2007). All the above authors concluded that there should be a restricted resident population and a larger transient population using a wider area. So, heterogeneity in habitat use follows as literature for the species (ARAÚJO et al., 2007; AZEVEDO et al., 2007; CREMER et al., 2011; EDWARDS; SCHNELL, 2001; FLACH; FLACH; CHIARELLO, 2008; GARCÍA; TRUJILLO, 2004; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011; JAPP; FILLA, 2012; LODI, 2003; OLIVEIRA et al., 1995; ROSSI-SANTOS; WEDEKIN; MONTEIRO-FILHO, 2007; WEDEKIN et al., 2007) and for other living organisms in which non-random pattern is rather a rule than an exception (PERRY *et al.*, 2002).

With high environmental heterogeneity, the estuarine environment allows differential use of area by dolphins depending on foraging strategies and calf care (MONTEIRO-FILHO, 1991). Therefore, through photo identification technique, the objective of this work is to assess space use by different individuals in two different areas in an estuarine environment, in southeast Brazil.

In Cananéia estuary, a very productive and extensive tropical estuary in southeastern Brazil (INSTITUTO DE PESCA, 2003; MENDONÇA; KATSURAGAWA, 2001), several techniques, including photo identification, have been used to yield preliminary results on individual residency and habitat use by *S. guianensis*. Twenty five individuals were followed up to 14 months (DE OLIVEIRA; MONTEIRO-FILHO, 2008), three were recaptured during five years (SANTOS; ACUNÃ; ROSSO, 2001), and seven revealed home ranges of at least 22,9 km² (OSHIMA *et al.*, 2010). Of explicit local conservation importance, Baía de Trapandé present the higher density estimates in the region and is used by dolphins year round (GEISE; GOMES; CERQUEIRA, 1999; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011) due fish shoals stressing out the importance of local conservation for dolphin population (GODOY; ANDRIOLO; FILLA, 2015). With high environmental heterogeneity, Baía de Trapandé allows differential use of area by dolphins whether forming large groups in complex to foraging strategies, whether in small groups for calf care (MONTEIRO-FILHO, 1991).

Believing that individual behavioral heterogeneity may be correlated to heterogeneity in area use, this study objective to identify individual Guiana dolphins regularly using the estuary, then to test if use was random in two different areas in Cananéia estuary mouth; reasoning possible explanations for a heterogeneous use, guidelines for future research, and implications for conservation.

2 MATERIAL AND METHODS

2.1 DEFINITION

Preference is ordinarily claimed to be independent of availability, but is generally defined by reference to the choice made at equal availabilities (JOHNSON, 1980). In order to avoid misleading interpretations on consciousness of selection, the term “use” was used, since it merely indicates actual distribution of individuals with no indicative if it was conscious or not (for more see HUTTO, 1985).

2.2 STUDY AREA

Cananéia estuary (24°53’ – 25°05’S; 47°48’ – 48°02’W; Figure 1) is a very productive and extensive tropical estuary in southeastern coast of Brazil (MENDONÇA; KATSURAGAWA, 2001; INSTITUTO DE PESCA, 2003). One of the estuary connections with ocean water is through a channel that separates Ilha de Cananéia and Ilha do Cardoso, the Barra de Cananéia. Sheltered by three islands, the two above and Ilha de Cananéia, there is a bay, Baía de Trapandé where most researches were conducted and area with higher concentration of Guiana dolphin, even though some studies report occurrence of individuals in a much wider area (MONTEIRO-FILHO, 1991, 1992, 2000; GEISE; GOMES; CERQUEIRA, 1999; SANTOS et al., 2000; SANTOS; ACUNÃ; ROSSO, 2001; ATEM; MONTEIRO-FILHO, 2006; DE OLIVEIRA; MONTEIRO-FILHO, 2008; SANTOS; ROSSO, 2008; FILLA; MONTEIRO-FILHO, 2009; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011).

Field efforts were made in two different land-based sites and one boat-surveyed area. Pereirinha Beach (hereafter called site “P”) is located in Ilha do Cardoso while Ponta da Trincheira (hereafter called site “T”) is located in Ilha Comprida. Boat-based efforts were conducted in Baía de Trapandé (hereafter called site “B” – it should not be interpreted as a point, but an area).

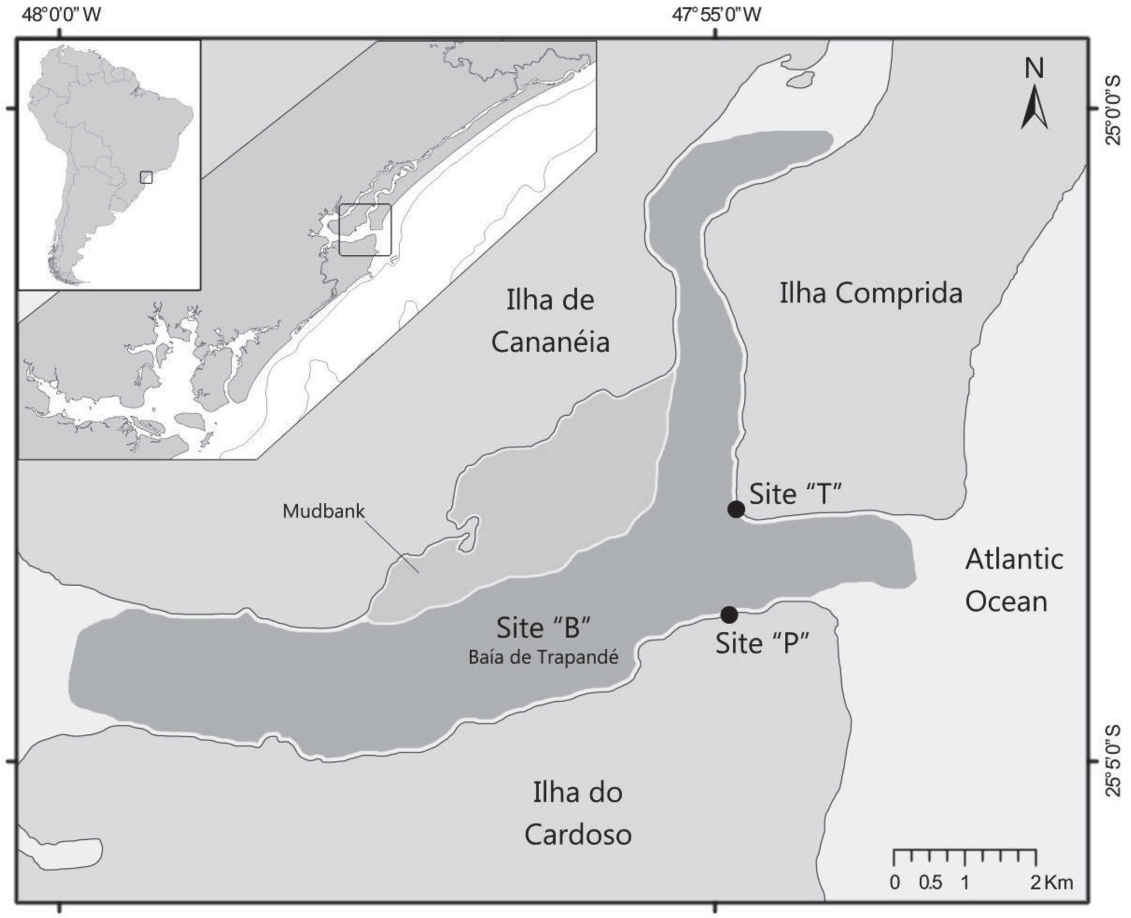

Figure 1 Study area map in Cananéia estuarine system, Southeastern coast of Brazil. Dots represent survey sites about 2 km apart: Ponta da Trincheira (Site "T") and Pereirinha beach (Site "P"). Shaded area represents boat-surveyed area – Baía de Trapandé (Site "B"). Source: author (2015).

2.3 PROCEEDINGS

In 2010, 12 exploratory surveys were conducted being six boat surveys in site "B" and three in each of sites "P" and "T". Effort was made registering all animals found in or passing through the site through photo identification technique (WÜRSIG; JEFFERSON, 1990; WÜRSIG; WÜRSIG, 1977) using a 28–135mm lens mounted on a 1.6x crop factor DSLR camera. The catalog with 41 individuals created then did not enter in analyzes due to time spacing between samples, but was included herein for discussion.

From February 2011 to May 2012, effort was made in opportunistic manner in all three sites. Photographs were taken using a 70–200mm lens mounted on a full frame DSLR camera. After cropping and minor photographic enhancement (contrast, levels, and curves) were made, images entered in this catalog were classified – from 1 to 5 – according to focus, contrast, size, and positioning of the animal in relation to the photographer and water. All data used in this work was filtered according to image quality, considering only high-quality images, which enables identification of both well and poorly-marked animals.

Beside image quality, each individual in the catalog received an index number related to its distinctiveness. Individuals with most conspicuous natural marking on its dorsal fin where coded $DIST_5$, while those with most discrete and small notches coded $DIST_1$.

From all individuals using waters of site "B", only individual with distinctiveness code $DIST_{3,\ 4}$ or $_5$ were used in most analysis to have unbiased results due to heterogeneity in capture probability caused by the technique used. To assess catalog performance, a discovery curve was plotted on cumulative number of individuals by the cumulative number of identifications and to distinguish between sampled population and the biological population, Lagged Identification Rate (LIR) (WHITEHEAD, 2007) models were tested in program SOCPROG 2.5 (WHITEHEAD, 2009). The three models fitted were: (i) closed model (assuming no change in individuals in study area), (ii) emigration model (assuming that individuals could leave study area but never return), and (iii) emigration and reimmigration model. Model selection was based on quasi AIC as well as p-value from chi-square goodness-of-fit test (WHITEHEAD, 2007).

If animals use the area randomly then, it is reasonable that in any given site of the occupied area, individual would have a Poisson-like distribution of capture frequencies with lambda equal to mean capture rate (LUDWIG; REYNOLDS, 1988). Therefore, for this test, filter was applied to individual distinctiveness code $DIST_{3,\ 4}$ or $_5$ to avoid heterogeneity in capture probability due mark conspicuity. To test data distribution under the null hypothesis that individual capture frequencies did not differ from a natural (expected) distribution, a chi-square test was made between observed and expected values from a Poisson distribution. Poisson parameters were used as λ equals to the mean number of records per individual (including zeros for individuals only captured in site "B") and *n* equal to the total number of individuals identified in adjacent waters of site “B”. This test was made to assess rather individuals captured in site “B” were using randomly site “P” or “T”.

Another Poisson-like distribution would be expected if individual using site “P” or “T” would use it randomly. Considering only individuals captured in land-based sites, Poisson parameters were used as λ equals to the mean number of records per individual (only individuals captured in each land-based site) and n equal to the total number of individuals captured in these sites. This test was made to asses rather individuals using either sites “P” or “T” were using it in randomly over time.

On most analysis filter was applied selecting only top 3 categories of distinctiveness; for a schematic drawing with captures solely in sites “P” and “T” – to visualize use frequency of individuals captured in a least one of these sites – however, this filter was removed to visualize all individual captures in either site. Sampling periods were defined *a posteriori* as effort was not equally distributed over time or space.

A general schematic diagram was made based on individuals captured in both sites “P” and “T”. As diagram intention was the visual comparison between both sites, the same number of sampling days and period were considered to provide similar probabilities of capture in both sites throughout the study period.

3 RESULTS

From February 2011 to May 2012, 64 surveys were made being 31 boat surveys in site “B” and 33 land-based surveys, being 13 in site “P”, and 20 in site “T” adding 276.0h and 23,300 photographs of field effort. Table 1 summarizes information on effort and number of dolphins captured in each site separately and both land-based sites pooled for comparison with boat surveys. Only the first capture of each individual in the day was considered. A total of 98 individuals were captured in site “B”, while 45 in site “T” and only 12 in site “P”. Effectiveness (Captures/hour) went as expected due to sampling platform as boat surveys sampled more individuals (n=98) with higher effectiveness (3.5 captures/hour) at a greater cost (542 total captures).

Table 1 Description on effort and number of captures in site “P”, “T”, and “B”. $E_{HOUR-DAYS}$ – effort in hours – in days; Photos – Number of photographs taken; IDs – Number of individuals identified; Cap – Number of captures; Cap/h – Mean number of individuals identified per hour of field work.

Site	Survey Platform	$E_{HOUR-DAYS}$	Photos	IDs	Cap	Cap/h
"P"	Land	53.7 – 13	1,014	12	22	.4
"T"	Land	76.3 – 20	5,345	44	85	.9
"B"	Boat	145.9 – 31	16,940	98	542	3.5

Source: author (2015).

In this first view of data, all individuals were used with no restriction on mark distinctiveness to give a more realistic scenario on data. Filters and samplings periods were defined in different forms depending on the analysis proponed and is detailed and discussed below (Table 2).

Captures in adjacent water revealed at least 98 individual dolphins using this area. Discovery curve presented some stabilization in this number of individuals, but still had new individuals being added to catalog in late identifications (Figure 2). With the first 100 identifications, 64 individuals were identified and this number rose to 87 within 300 identifications; 11 individuals were added to the catalog during last 216 identifications. One individual was identified in the last sampling day, represented by final step in the discovery curve.

Table 2 Sampling period and filter definitions for each investigation made. SP – Division and number of sampling periods; Ind – Number of individuals used in the analysis after filtering; Cap – Number of captures after filtering.

Investigation	Site	Analysis	Filter	SP	Ind	Cap
Discovery curve	B	Visual	None	-	98	516
Distribution of identifications	B	Visual	None/$DIST_{3,4,5}$	Monthly; 16	98/65	309/436
Movement in/out study area	B	LIR	$DIST_{3,4,5}$	Daily; 31	65	359
Site use randomness	P	Poisson; χ² test	$DIST_{3,4,5}$	Monthly; 13		
Site use randomness	T	Poisson; χ² test	$DIST_{3,4,5}$	Monthly; 13		
Individual use randomness	T	Poisson; χ² test	$DIST_{3,4,5}$	Monthly; 13	28	53
Individual use visualization	P + T	Visual	13 P + T	Monthly, 1st day; 13P + 13T		

Source: author (2015).

Individuals had varying number of captures in site “B” during study period (Figure 3). Data was pooled over monthly-divided sampling period to ease visualization (e.g. if one individual has been captured three times in one single site during one month, data enters as one record of presence for the month, not three). Three individuals were captured in 10 out of 16 months of study while 38 were captured in less than four months.

Data was also filtered by individual distinctiveness, selecting only top three out of five categories (Figure 3). Out of 98 individuals captured in site “B”, 65 were considered as presenting high-quality marks. Only these categories of individual distinctiveness were used to assess a probable pattern behind population dynamic through Lagged Identification Rates model fitting (Table 3). The top model selected with ΔQAIC and GOF p-value assumes that individuals could leave study area but are not allowed to return.

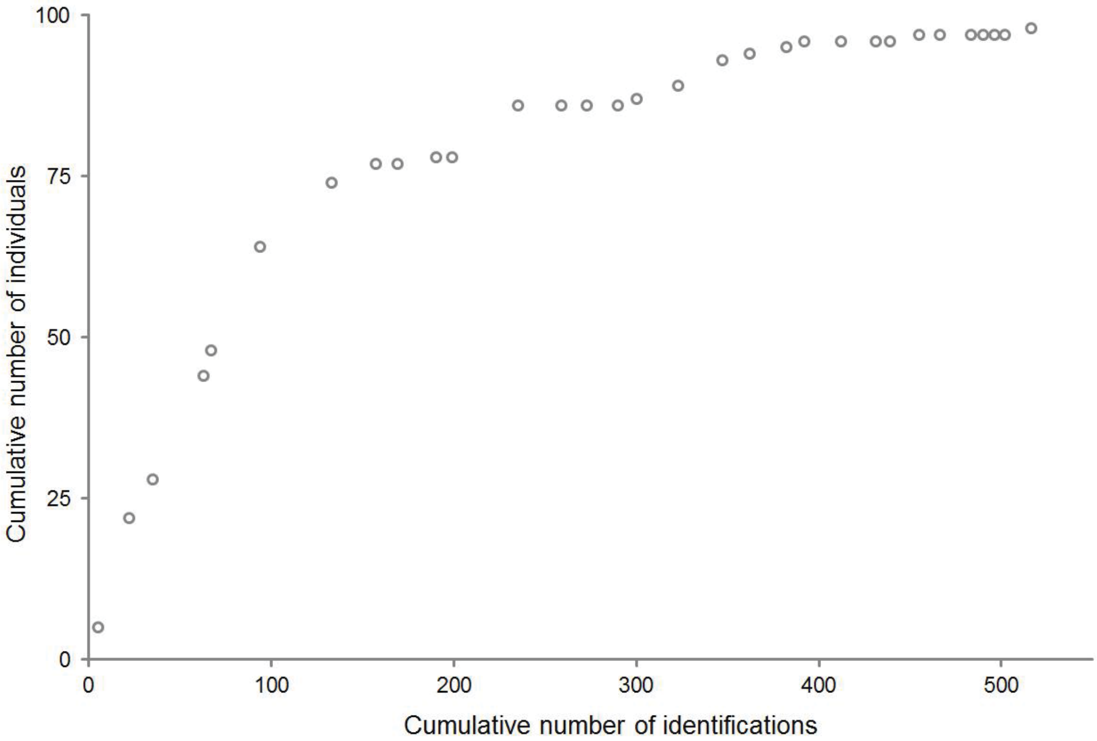

Figure 2 Discovery curve of individuals identified in site "B" from february 2011 to may 2015 in Cananéia estuary. With 516 identifications, 98 individuals were input into catalog. Source: author (2015).

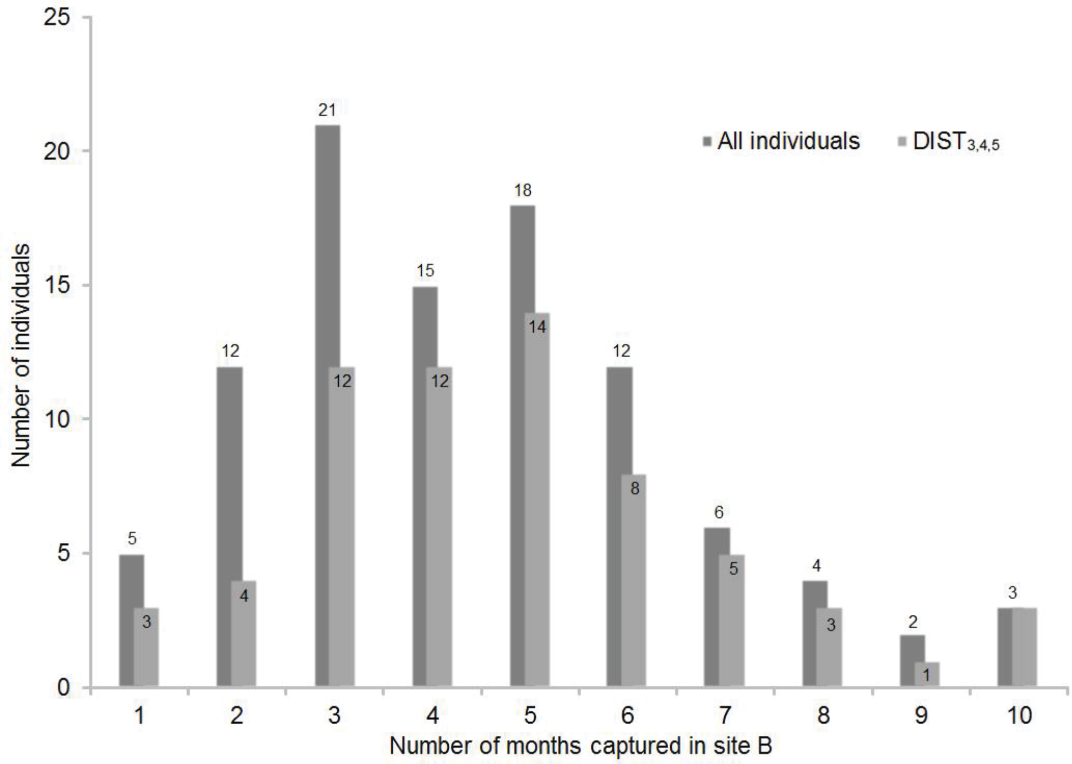

Figure 3 Distribution of number of individuals by number of captures in site "B". All 98 individuals are represented in dark shaded bars. Light shaded bars represent only individuals with top three out of five distinctiveness categories. Source: author (2015).

Table 3 Models for Lagged Identification Rates (LIRs) of Guiana dolphins from Cananéia Estuary from February/2011 to May/2012. Identification rates of individuals (R) as given as function of the time lag (t) as models that follow where parameters are: Population size (N), Emigration rate (ε), and others (a2, a3).

LIR Model	Explanation	QAIC	Δ QAIC	GOF p-value	Support
R(t) = 1 ⁄ N*e^(-ε*t)	Emigration	9764.5840	0	0.9973	Best
R(t) = 1 ⁄ N	Closed	9795.3037	30.7197	0.3076	None
R(t) = a2+a1*e^(-ε*t)	Emigration + Reimmigration	9799.2829	34.6989	0.2588	None

Source: author (2015).

Considering land based sited “P” and “T”, a heterogeneous use of these areas was revealed. As different tests were made for each site and sites were being investigated separately, every field day was used to assess fit to Poisson distribution. Data was pooled over monthly-divided periods to increase capture probability and reduce bias from short-term use of an area by individuals.

First, site “P” and “T” use randomness by individuals captured in adjacent waters of site “B” was assessed by investigating data fit to a Poisson distribution. Only 65 top marked individuals were used and Poisson parameters were λ = 0.169 and 0.815 records/individual for sites “P” and “T”, respectively, with n = 65 individuals in both sites. Chi-square p-value revealed that data distribution was different from a Poisson in both sites “P” ($p \ll 0.001$) and “T” ($p=0.04$).

Then, use randomness by individuals captured exclusively in sites “P” or “T” was assessed by investigating data fit to a Poisson distribution. Only top three out of five mark distinctiveness categories were used and Poisson parameters were λ = 1.833 and 1.893 records/individual and n = 6 and 28 individuals for sites “P” and “T”, respectively. Although 12 individuals have been identified using site “P”, with mark distinctiveness filter, only 6 individuals with 11 identification were considered. This small number of events inhibited further data distribution investigations. In site “T”, after filtering for mark distinctiveness, only 28 individuals with 53 identifications were considered from the 46 individuals identified. Chi-square ($p=0.318$) revealed that data distribution of individuals captured in site “T” was not different from a Poisson. Individual capture distribution in site “T” may perhaps follow random pattern or indeed follows a non-random pattern which was not detected in this test.

From all 98 individuals captured in site “B”, 50 were captured exclusively in site “B” while 48 were captured in at least one land-based site as well. In other words, every individual captured in site “P” or “T” was also captured in adjacent waters of site “B”. The schematic diagram of individuals captured in both land-based sites “P” and “T” (with no mark distinctiveness filter) show heterogeneity in capture distribution (Figure 4). Only 35 individuals were represented in the diagram because it was considering only the first sampling day of site “T” in each month to have equal numbers of effort days in both sites throughout the study.

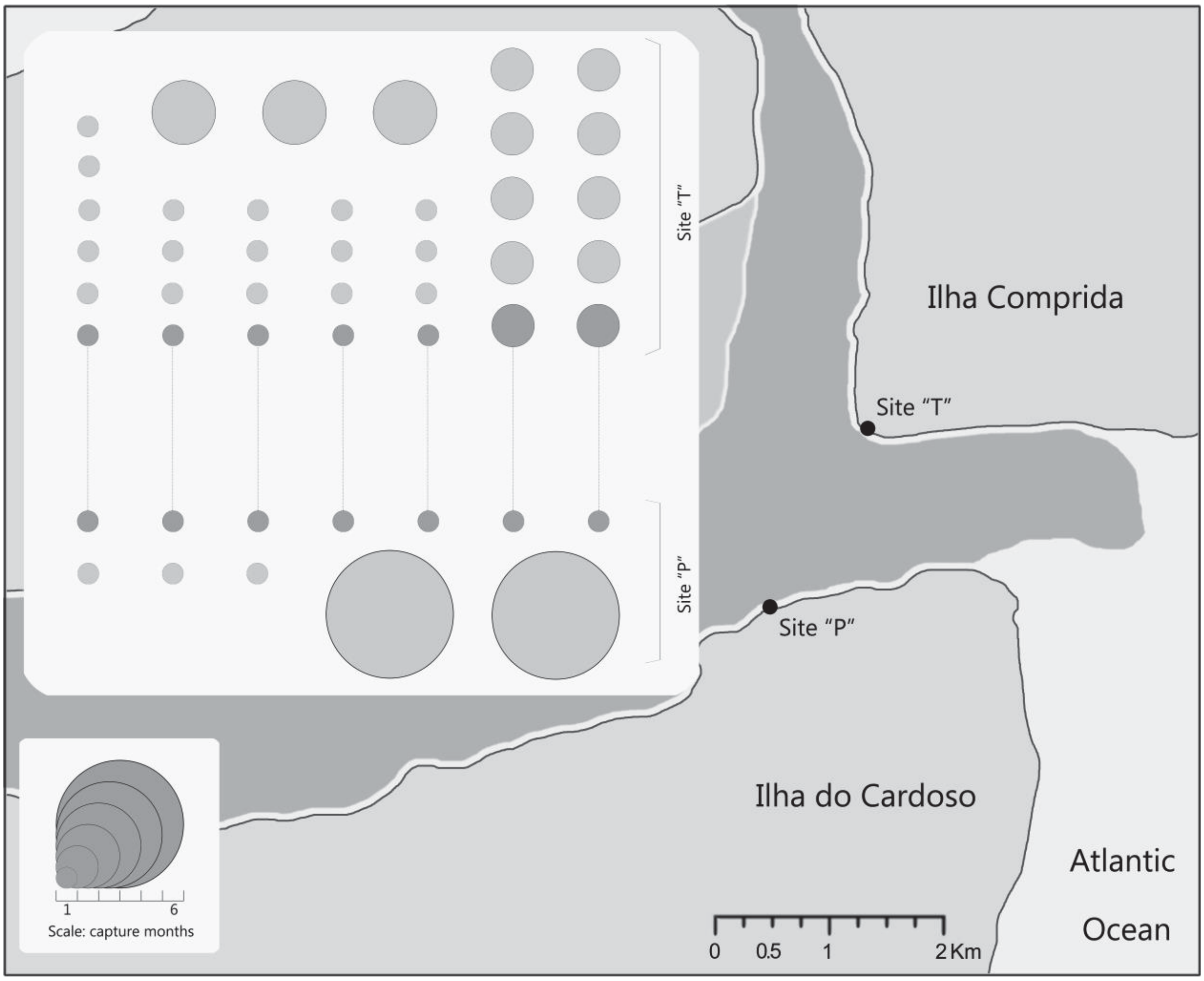

Figure 4 Schematic diagram of individuals captured in two land-based sites ("P" and "T") from February/2011 to May/2012 inside the estuary of Cananéia, Brazil. Each individual is represented by one circle with size relative to the number of captures in each sites. Dark shaded individuals were captured in both sites, being represented by two connected circles. Source: author (2015).

With this temporal restriction in site “T”, 40 individuals were captured in either sites “P” or “T”. A total of 12 and 35 individuals were captured at least once in site “P” and “T”, respectively, being seven captured in both. In site “P”, two individuals were captured 6 times and 10 individuals once. In site “T”, tree individuals were captured three times each, 10 twice, and 17 once.

4 DISCUSSION

Heterogeneity in space use, usually assessed at population or species scale, was also detected at individual scale. Baía de Trapandé presents a great importance for conservation of Guiana dolphin in the estuary as specific areas meet different needs of specific individuals. Individuals captured using estuarine waters of site “B” are part of the population that actually uses these waters. Because first, it is expected that only a portion of the population uses area at the time of survey, being the rest unavailable at the moment; and then, because not every animal using the area during survey was captured due technique limitation.

Unavailability relates to movement in and out the study area as it seems to be happening. With a high and significant fit, results of LIRs analyses indicate a population made of resident individuals while others may have a lower residency, this was interpreted as a consequence of the biological population occupying a much larger area than the study site. From the 41 individuals identified in 2010, only one was not captured again in this study. Leading to the conclusion that individuals use areas outside study area, but at least a part eventually does return to Baía de Trapandé waters. Nevertheless, it seem that population is undersampled in the sense that not all individuals with distinctive marks that use site “B” may have been captured.

Technique limitation has to do with individual heterogeneity in capture probability due quality of the natural marking used for identification. Some individual, even though using the area at the moment of survey will not be able to be captured due to lack of distinguishable mark. Inference are only made on marked animals, and extrapolated at some degree to the rest of the population. Conservation efforts usually assume individuals in habitat to be homogeneous in behavior and physiology, but such individual differences may regulate important process of partitioning space and resources (LOMNICKI, 1978). Individuals captured in sites “P” and “T” are part of a wider population using site “B”, the adjacent water. So, despite being spatially available for a larger proportion of the populations, not every individual using waters in site “B” was captured using waters in site “T” or “P”, given that a about half of the individuals captured in site “B” have been also captured in either one of these two sites. So, besides being relevant for the population as previously proposed, Baía de Trapandé also has an important role at individual level.

Local Guiana dolphin population individual home range may vary from 1.6 to 22.9 km² or even be larger (OSHIMA *et al.*, 2010), so home ranges must be surpassing the study area. Food availability is proposed as one factor driving the population to use more intensively the area near the estuary mouth compared to other area of the estuary (GEISE; GOMES; CERQUEIRA, 1999; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011; GODOY; ANDRIOLO; FILLA, 2015), so dolphins would occupy the whole region, but not with temporal nor spatial equivalence; as it happens with several populations of Guiana dolphin throughout its distribution, area available is used in a non-uniform and non-random pattern (OLIVEIRA *et al.*, 1995; EDWARDS; SCHNELL, 2001; LODI, 2003; GARCÍA; TRUJILLO, 2004; ARAÚJO *et al.*, 2007; WEDEKIN *et al.*, 2007; AZEVEDO *et al.*, 2007; ROSSI-SANTOS; WEDEKIN; MONTEIRO-FILHO, 2007; FLACH; FLACH; CHIARELLO, 2008; CREMER *et al.*, 2011; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011; JAPP; FILLA, 2012). Some studies, including ones using photo identification, yield preliminary insights on individual residency and habitat use by *S. guianensis* (DE OLIVEIRA; MONTEIRO-FILHO, 2008; SANTOS; ACUNÃ; ROSSO, 2001; OSHIMA *et al.*, 2010). Twenty five individuals were followed up to 14 months (DE OLIVEIRA; MONTEIRO-FILHO, 2008), three were recaptured during five years (SANTOS; ACUNÃ; ROSSO, 2001), and seven revealed home ranges of at least 22,9 km² (OSHIMA *et al.*, 2010).

Site “T” has shown to be of relevant importance for a wide range of individuals. Several individuals used this site over the study period at different rates. It is characterized by strong tidal currents (MIYAO; NISHIHARA; SARTI, 1986) and used by boat passing while exiting the estuary. Close to the estuary–ocean connection, site “T” can be one optimal area used by several individuals that tend to form larger groups engaging in complex foraging strategy. This hypothesis was previously proposed based on distribution, behavior, and correlation with environment variables (GEISE; GOMES; CERQUEIRA, 1999; MONTEIRO-FILHO, 2000; GODOY; ANDRIOLO; FILLA, 2015).

Site “P” is a touristic beach with high boat traffic while transporting tourists. This site was used by less individuals but, the fact that two individuals with calves were captured in six months while 11 others were captured only in one monthly-divided sampling period indicates that while a reduced number of individuals are using the area for raising their calves, a greater number of individuals may still use the area eventually.

Both sites studied inside Baía de Trapandé play important, but despite proximity, different roles in the sustainability of the population. Of explicit local conservation importance, Baía de Trapandé has high dolphin density estimates year-round (GEISE; GOMES; CERQUEIRA, 1999; HAVUKAINEN; MONTEIRO-FILHO; FILLA, 2011) due fish shoals stressing out the importance of local conservation for dolphin population (GODOY; ANDRIOLO; FILLA, 2015). Heterogeneity in declivity, depth, and tidal influence enables virtually all behavioral repertoire in different sites of the bay, but location used is usually selected based on need of different individuals or group of those with different ages (TEIXEIRA, 2013).

When trying to better understand population dynamics in a highly heterogeneous habitat, individual behavior comprehension may enable extrapolations of space-temporal patterns into greater scales (MORALES; ELLNER, 2002). Therefore, attention is called for the probability of similar patterns to happen through a population’s whole occupation area. Albeit detecting an individual heterogeneity in habitat use, if individual habitat selection indeed happens as expected in different parts of this or other areas along distribution of Guiana dolphin and to which extend is still a piece to be found. As different scenarios may result in the same detected pattern, each may be driven by a different factor, stressing the importance of systematic onboard sampling surveys in a greater area, which would generate quality information to assess individual heterogeneity in habitat use throughout a surface of occurrence in addition to population estimates.

The fact that despite physical proximity, both areas are used in different ways, leads to conclusions: (i) one area may be used for feeding by a large number of individuals thus, characterizing a core area at a population level, while (ii) the other may be more used by less individuals, but some with such frequency that characterizes a core area at individual level. As both sites are intensely used by both, dolphins and human-conducted vessels, the risk of collision is a concrete concern regarding the conservation status of Guiana dolphin population inhabiting the Cananéia estuary. This stresses out the importance of Baía de Trapandé for conservation and maintenance of the species in the region as individuals repeatedly use this area over time.

As human change environmental characteristics, habitat selection can be determinant in survival. In this sense, human-induced environmental change act as a form of predation risk (FRID; DILL, 2002), so behavior alterations will usually be the first response of individuals; influencing in survival, reproductive success, and individual distribution (TUOMAINEN; CANDOLIN, 2011). Despite the fact that the species' biological and ecologic characteristics are plastic enough to survive and thrive in distinct environments through an extensive latitudinal range (MONTEIRO-FILHO; MONTEIRO; REIS, 2008; DECONTO; MONTEIRO-FILHO, 2013), there is an increasing number of reports on alterations in Guiana dolphin distribution and area abandonment due anthropogenic pressures in other localities (EDWARDS; SCHNELL, 2001; AZEVEDO *et al.*, 2007; FILLA; MONTEIRO-FILHO, 2009; CREMER *et al.*, 2011). As alterations in spatial and temporal use of an area may be responses of habitat characteristics and behavior strategies to fit a varying environment, core areas may be regarded as critical habitats for conservation (WEDEKIN *et al.*, 2007).

Nevertheless, the fact that dolphin individuals continue to use all three sites in the estuary over time indicates that Baía de Trapandé waters still presents a positive balance between risk and reward. If costs leaving overwhelms costs of remaining individuals may invest in a large scale relocation of home range (e.g. – emigration, dispersion: MORRIS, 1992). Hereupon, it seems that future distribution, survival rates, and reproductive success of Guiana dolphin population of Cananéia relies more on human behavior than on dolphin's adaptive or misadaptive behavior response (REMEŠ, 2000).

At last, conservation efforts in Baía de Trapandé, and specifically in Ponta da Trincheira and Praia do Pereirinha should take in account differences in use of each habitat. While site Ponta da Trincheira is used by several individuals as an optimal area to forage. Site Praia do Pereirinha is used by a very strict number of individuals in a selective way in order to raise their calves; thus, stressing the importance of conserving an area which will be used by generations beyond.

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