NOTE FROM THE EDITOR

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Dear Friends, Colleagues and Otter Enthusiasts!

As you well may have observed we are not only working on the current regular issues, but in the last weeks, more articles have been added to the Proceedings from Frostburg, Hwacheon and Pavia. All this work is ongoing in parallel with the regular issues meaning that many of you have received requests for reviews. Thanks to all who provide immediate and high quality reviews. I also want to thank those Spanish speakers that have volunteered to translate the abstracts following a note from me. Right now this is going smoothly: Laurent Mercier needs special thanks as almost all French translations are done by him.

At the beginning of March, we had an open meeting of the OSG Steering Group here in Luxemburg. In addition to Nicole, Anna, Lesley, Carole, Tom and me, Andreas, Gerard and Hanne also participated. We discussed both specific but also very generic topics ranging from country-specific problems to fund raising or the organisation of a workshop for field methods to be held in South East Asia hopefully later this year. The minutes are now available in the “Members-only” section and updates on actions will notified on the home page of our website when they take place. A special thanks from all participants in the meeting to Prof. Lucien Hoffmann from the CRP - Gabriel Lippmann for hosting this event.

I can already forecast, since we have enough manuscripts in the pipeline to fill this issue, that we will probably have three issues again this year. If you are in doubt whether to submit your work to our journal keep in mind that all articles are not only fully peer reviewed but once accepted also uploaded to the Directory of Open Access Journals ensuring a wide distribution. I also observe that articles from the IUCN OSG Bulletin are more and more often cited in other journals showing that you and the reviewers do a real good work.

If you have good pictures of otters for which you have the copyright feel free to send them either to me or to Lesley. We may choose one of them for the title page of the forthcoming issues!

Finally - like always but not as a simple routine - I definitely have to specially thank Lesley for all her dedication to the IUCN OSG Bulletin, the website and the huge number of hours that she spends keeping all this online and running.

R E P O R T

NEW OCCURRENCE DATA OF NEOTROPICAL OTTERS *Lontra longicaudis* (OLFERS, 1818), IN BAHIA STATE, NORTHEASTERN BRAZIL

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Abstract: Very little is known about the neotropical otter (*Lontra longicaudis*) in the Brazilian state of Bahia. The purpose of this study was to record the number and location of sites where otters have been recorded in this area. Between 1988 and 2009, there were 29 records of otters in Bahia, including the collection of 13 living (9) and dead (4) otters. Of the live otters, 61.53% were adults and 38.46% pups. Five of these were males, five were females and the gender of three individual was not established. The majority (41,37%) of otter records were made in northern Bahia, and 31.03% were made in southern Bahia (31.03%). Eight records (27,58%) were made in the area around *Todos os Santos* bay, including seven sites where the species was not previously known to occur. No observations were made in the mid-west region of the state, so future studies are needed in this region.

Key words: distribution range, neotropical otter, northeastern Brazil.

INTRODUCTION

The neotropical otter (*Lontra longicaudis*) is classified as 'Data Deficient' by the International Union for Conservation of Nature (IUCN) (Waldemarin and Alvarez, 2008), with an equivalent classification used by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA, 2001). This means there are insufficient data available to accurately ascertain the conservation status of this species. In the few Brazilian states where lists of endangered species already exist, such as Minas Gerais, Espírito Santo, São Paulo, Paraná and Rio Grande do Sul , otters are classified as 'Vulnerable' (Silva, 1998; Indrusiak et al., 2003; Mikich and Bérnils, 2004; MMA, 2010; Passamani and Mendes, 2007). One problem faced by conservationists is the lack of detailed knowledge concerning population size and distribution of the species. In 2010, Regulation n. 88 approved the Plan of National Action for the Conservation of Ariranha (*Pteronura brasiliensis*) - which includes neotropical otters (*L. longicaudis*) - in order to protect those two species. This information is required to assess the conservation status of the species and to track spatial and temporal changes, and is therefore of crucial importance for the development of species conservation strategies (Foster-Turley et al. (1990). To comply with goal n. 2.6 of the Executive Summary of the Plan of Action for Conservation of Ariranha (MMA, 2010), we need to confirm the current distribution of otters (Lontra longicaudis), with emphasis on the areas North and Northeast of Brazil.

The neotropical otter appears to have a widespread range throughout South America, extending from Mexico to Argentina (Chehébar, 1990; Mason, 1990; Parera, 1996; Emmons, 1997; Gallo, 1997). In its Brazilian territory, research has focused on the southern and southeastern regions (Pardini, 1998; Waldemarin and Colares, 2000; Quadros and Monteiro-Filho, 2001; Alarcon and Simões-Lopes, 2004; Kasper et al., 2004; Carvalho et al., 2010) and it has received little research attention in the north, despite reports of its presence in the states of Pernambuco, Paraíba, and Bahia (Fonseca et al., 1994; Almeida, 1997; Araújo and Souto, 2004; Leal, 2008; Muritiba, 2008). Data from these areas tend to originate from occasional and isolated reports that lack complementary information. More information is needed in order to establish the conservation status of the neotropical otter in Bahia and other parts of northern Brazil.

The neotropical otter is usually found in aquatic environments, including freshwater (streams, rivers, and lakes) and saltwater environments (bays, lagoons, and rivers) (Larivière, 1999; Carvalho-Jr., 2007). On land, the most characteristic indirect signs of otters are their spraints (faeces), which otters frequently deposit in prominent places as territorial markers (Kasper et al., 2004). Otter spraints are easily identifiable, as they contain fish scales, remains of crustacean exoskeletons and bones of fish, small mammals, amphibians and birds (Pardini, 1998; Quadros and Monteiro-Filho, 2001; Carvalho et al., 2010, Rheingantz et al., 2011).

The purpose of the current study was to use a variety of methods, including spraint collection, to report the distribution of the neotropical otter in the northern Brazilian state of Bahia.

ANIMALS, MATERIAL AND METHODS

The current study collated evidence for the presence of neotropical otters in Bahia. Indirect evidence included records of footprints and spraints, and historical reports of otters in the region, obtained through a bibliographical review (Almeida, 1997; Araújo and Souto, 2004; Siciliano and Franco, 2005; Leal, 2008; Muritiba, 2008). These data were combined with direct evidence of otters, including live animal confiscations, collection of carcasses and direct sightings of otters. All records were collected in an ad hoc manner (Table 1). For both live and dead specimens, the total length of the individual and a further four morphological measurements (length of head and body, diameter at the height of the jaw, tail length and hind leg length) were taken (Figure 3). Age class and gender were also recorded where possible.

Records were grouped into geographic areas: (north (N) and south (S) of the state and the area of *Reconcavo Baiano* (RB) (which surrounds *Todos os Santos* bay). These areas were analyzed by percentage values. The species was considered to occur in an area if that area presented at least one type of otter sign or where a direct observation of the species was made. Biological material from the recovered specimens and spraints collected in Pojuca, Caraipe and Caraipé rivers were deposited in the Scientific Collection of the Aquatic Mammals Institute (*Instituto Mamíferos Aquáticos* - IMA).

RESULTS AND DISCUSSION

Between 1988 and 2009, 13 neotropical otter specimens (9 living and 4 dead) were collected from Bahia. These data were combined with indirect (n=14, spraint and track reports, six of which originated from the bibliography and eight from unpublished material) and direct observations (n=2) of otters, resulting in the identification of a total of 29 sites in Bahia that were considered positive for otter occurrence (Figure 1, Table 1).

Most of the records (37.93%, n=12) originated in the northern coast of Bahia. This may be partly because of a disproportionate presence of researchers in this area. The rivers of this region with records of otters were, from north to south, Cromaí, Quiricó, Pojuca and Capivara (Araújo and Souto, 2004; Figure 2). In the south of Bahia, evidence was found for neotropical otters in 31.03% (n=9) of all reported occurrence sites in Bahia. These included the rivers Contas, Almada, Maroin, Buranhém, and Mucuri (Siciliano and Franco, 2005; Rebouças and Affonso, 2006). There were only two historical records of neotropical otters in the *Recôncavo Baiano* region. A further seven records were made during the current study, meaning that 27,58% (n=8) of all reported occurrence sites in Bahia are in this region. Evidence of otter presence was found in the rivers Catu, Tanquinho, Paraguaçu, Dona, Caraipe and Caraipé (the latter two rivers are effluents of the Jaguaribe river) (Almeida, 1997; Araújo and Souto, 2004; Leal, 2008; Muritiba, 2008). It is worth emphasizing that this species was not previously known to occur in these rivers.

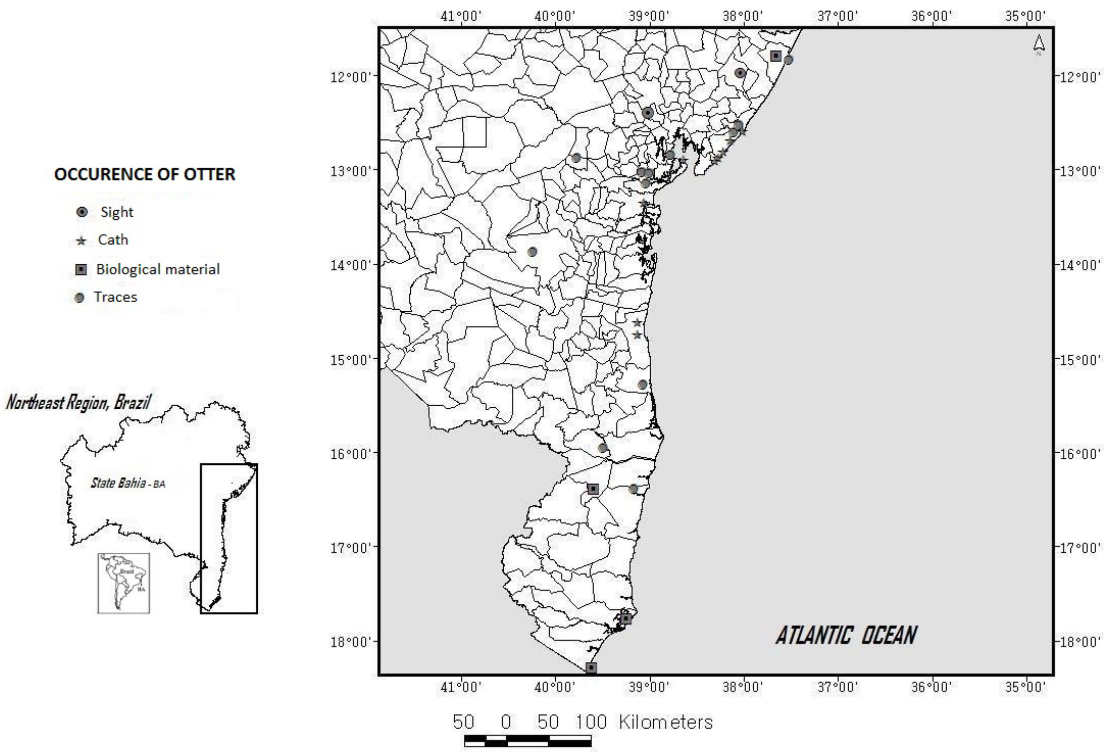

Figure 1. Occurrence of otters, *Lontra longicaudis*, collected in Bahia, 1988-2009. The box represents the coastal area of Bahia, which corresponds to our study area.

The biometric values of the live otters collected was in line with previous reports for this species, with length varying from 51 to 130 cm and weight varying from 6 to 12 kg (Figure 3). These otters were identified as five males (38,46%), five females (38,46%) and three individual of uncertain gender (23,07%). It would be interesting to further explore the demographic aspect of this species in this region, because the current data set is too small to permit valuable conclusions from being drawn. Of these live individuals, 61.53% were adults and 38.46% were pups (with evidence of nursing). Neotropical otters are believed to nurse for three to four months and stay with their mother for approximately one year (Nowak, 1991; Parera, 1996). Therefore, the relatively high number of observations of cubs was unexpected, and may reflect the pups' inexperience regarding the dangers of leaving parent care and their curiosity about the environment outside the den. It is also possible that the pups were orphaned or abandoned by their parents. Pups collected from Catu and Almada rivers following floods in the region, suggesting that this may be the case.

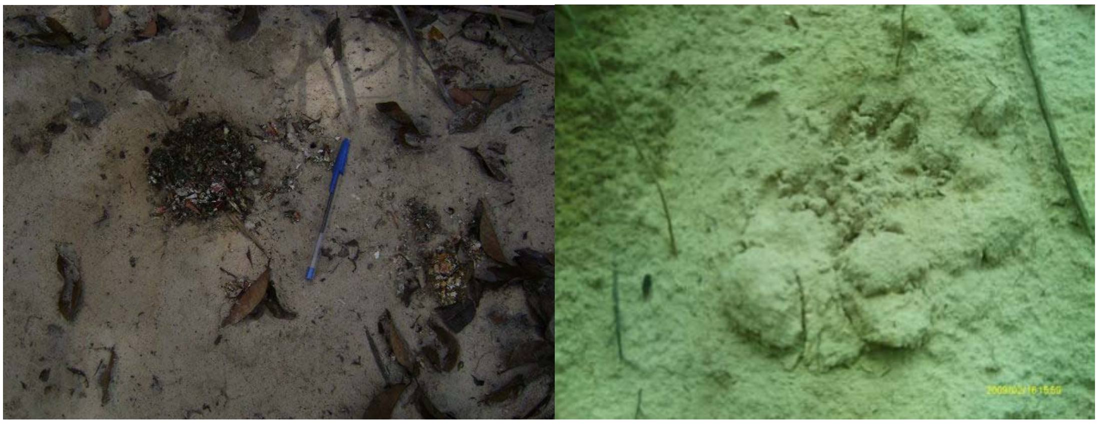

Figure 2: Spraint and footprint of neotropical otters *Lontra longicaudis* in Quiricó rivers (12°17'52.5"S e 38°09'18.4"W; Photos: Luciano R. Alardo Souto).

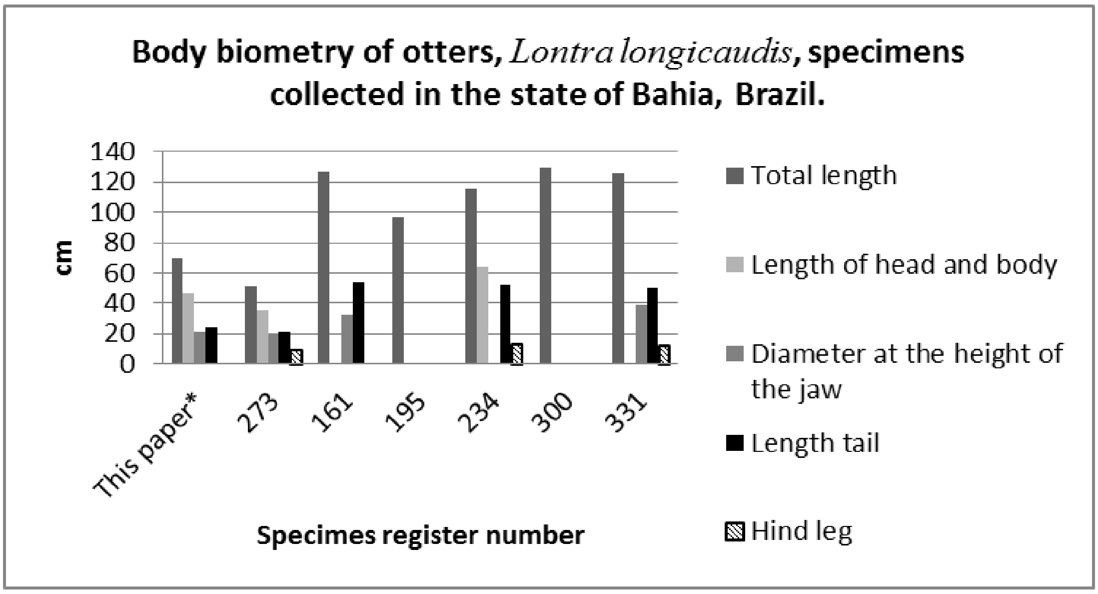

Figure 3. Body biometry of otters, *Lontra longicaudis*, specimens collected in the state of Bahia, Brazil (* Sampaio, S.S., personal communication).

CONCLUSION

This study reports the distribution of neotropical otters in Bahia, Brazil, including the identification of seven rivers where this otter was not previously known to occur. These findings suggest that neotropical otters are present throughout the coast of Bahia, with evidence found in nine of the state's twelve hydrographic basins (SRH, 2004). There is a need for more studies on the distribution and ecology of otters in Bahia, particularly focused in the mid-west region, in order to accurately assess their conservation status in this region so that conservation measures may be developed where necessary.

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Table 1. Records of *Lontra longicaudis* in the state of Bahia (Brazil) in the period from 1988 to 2009 (n=29).

Nº	Date	Local	TL = Total length	Sex	AR	Register Number	Record Type	Reference	Sub-region of the state
1	1988	Mucuri river, Mucuri	____	____	____	MN28999	skin	Siciliano & Franco, 2005	S
2	1990	Maroim river, Reserva de Una	____	____	____	____	spraints and footprint	This paper (Freitas, M.A., Personal communication)	S
3	18.06.1992	Catu river, Catu	70	FM	P	____	collected alive	This paper (Sampaio, S.S., Personal communication)	N
4	19.06.1992	Catu river, Catu	____	FM	P	____	collected alive	This paper (Sampaio, S.S.,	N

								Personal communication)	
5	1992	Ilha de Itaparica	____	FM	P	____	collected alive	This paper (Abbehusen, A., Personal communication)	RB
6	1992	Pojuca river, Praia do Forte	____	____	____	____	spraints	This paper (Freitas, M.A., Personal communication)	N
7	1994	Reserva Veracel, Porto Seguro	____	____	____	____	footprint	This paper (Freitas, M.A., Personal communication)	S
8	1995	Sítio do Conde	____	____	____	____	spraints	This paper (Sampaio, C.L.S., Personal communication)	N
9	1996	Tanquinho de Feira	>100	MA	AD	____	sighting	Araújo & Souto, 2004	RB
10	1997	Barra do Paraguaçu, Salinas da Margarida	____	____	____	____	spraints and footprint	Almeida, 1997	RB
11	1999	Serra da Jibóia, Santa Terezinha	____	____	____	____	footprint	Moraes & Freitas, 1999	RB
12	11.09.2001	Caravelas	127	MA	AD	IMA00161	skeleton	Araújo & Souto, 2004	S
13	20.07.2002	Conde	____	____	____	IMA00187	skeleton	Araújo & Souto, 2004	N
14	31.10.2002	Jauá, Camaçari	97	MA	P	IMA00195	collected alive	Araújo & Souto, 2004	N
15	2002	Jequitinhonha river, Itapebi	____	____	____	____	footprint	This paper (Freitas, M.A.,	RB

								Personal communication)	
16	2002	Cromaí river, Sítio do Conde	——	——	——	——	sprains and footprint	This paper (Reis, M.S.S., Personal communication)	N
17	2002	Entre Rios	>100	IN	AD	——	sighting	This paper (Sampaio, S.S., Personal communication)	N
18	21.08.2003	Capivara river, Arembepe, Camaçari	115,5	MA	AD	IMA00234	collected alive	Araújo & Souto, 2004	N
19	12.08.2004	Almada river, Ilhéus (14º40'001''S e 39º04'248''W)	51	MA	P	IMA00273	collected alive	Araújo & Souto, 2004	S
20	06.2004	Pojuca river, Praia do Forte, Mata de São João	——	——	——	——	sprains	This paper (Adriano Paiva)	N
21	01.03.2005	Una river, Valença	——	FE	AD	IMA00290	collect dead	This paper	S
22	28.04.2005	Itabuna	130	FE	AD	IMA00300	collect dead	This paper	S
23	20.09.2005	Pojuca river, Praia do Forte, Mata de São João	125,7	MA	AD	IMA00331	collect dead	This paper	N
24	2006	Contas river, Jequié	——	——	——	——	sprains	Rebouças & Affonso, 2006	S
25	2008	Caraipe river, Aratuipe	——	——	——	——	sprains and tracks	Leal, 2008	RB
26	2008	Caraipé river, Aratuipe	——	——	——	——	sprains and footprint	Muritiba, 2008	RB
27	2008	Dona river, Aratuipe	——	——	——	——	sprains and footprint	Muritiba, 2008	RB
28	2008	Buranhém river, Eunápolis (39º 45' 338' S e 16º 21' 088"W	——	——	——	——	skull and skin	This paper (Reis,J.A., Personal	S

								communication)	
29	16.2.2009	Quiricó river, Pojuca, 12°17'52.5" e 38°09'18.4"	——	——	——	——	spraints and footprint	This paper	N

Legend: AD = Adult; IMA = Scientific Collection of the Aquatic Mammals Institute; TL = Total length; AR = Age range; P = Pup; FM = Female; UN = Undetermined; NC = North coast of Bahia; MA= Male; RB = Recôncavo Baiano; S = South Bahia.

RÉSUMÉ

NOUVELLES DONNÉES DE PRÉSENCE DE LOUTRE À LONGUE QUEUE *Lontra longicaudis* (OLFERS, 1818), DANS L'ÉTAT DE BAHIA AU BRÉSIL

On sait très peu de choses sur la loutre à longue queue (*Lontra longicaudis*) dans l'état Brésilien de Bahia. Le but de cette étude était d'enregistrer le nombre et la localisation précise des sites ou la loutre était présente sur ce territoire. Entre 1988 et 2009, 29 données sont recensées comprenant notamment l'observation visuelle de 13 loutres. Parmi ces loutres, 61,53% étaient des adultes et 38,46% des juvéniles. Cinq de ces individus étaient des males, cinq étaient des femelles et le sexe de trois individus n'a pas pu être identifie. La majorité (27,58%) des données émanent du nord de Bahia, et 31,03% sont localisées dans le sud. neuf données (41,37%) sont issues d'une zone autour de la baie de Todos os Santos parmi lesquelles 7 sites ou l'espèce n'était pas connue avant cette enquête. aucune observation n'a été faite dans le mid-ouest de l'état c'est pourquoi de futures études seraient nécessaires dans ce secteur géographique.

RESUMEN

EL TÍTULO NO HA SIDO TRADUCIDO AÚN

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RESUMO

DADOS SOBRE NOVAS OCORRÊNCIAS DE LONTRAS *Lontra longicaudis* (OLFERS, 1818), NO ESTADO DA BAHIA, NORDESTE DO BRASIL

A lontra, *Lontra longicaudis*, é um animal pouco conhecido na Bahia. As investigações a cerca da distribuição exata das lontras é de suma importância para a manutenção de populações e são prioritárias para estratégias de conservação da espécie. Este estudo tem como objetivo reportar as ocorrências de *L. longicaudis* na Bahia, com comentários sobre a distribuição e a biologia da espécie. Entre os anos de 1988 e 2009, foram coletados 13 espécimes de *L. longicaudis* vivos, que junto com registros indiretos (fezes e pegadas) totalizam 29 registros para a Bahia. A maior parte das ocorrências foi no litoral norte (41,37%, n=12). No recôncavo baiano, sete novos registros foram adicionados à região (27,58%, n=8). Descendo para o sul do Estado, encontramos 31,03% (n=9) das ocorrências. A faixa etária observada nos animais foi de 61,53% para adultos e 38,46% para filhotes. A proporção sexual foi 38,46% para machos, 38,46% para fêmeas e 23,07% para indivíduos de sexos indeterminados. Com base nesse trabalho, notamos a carência e a necessidade da implantação de outros estudos sobre a distribuição e bioecologia das lontras na Bahia.

A R T I C L E

ARE OTTERS GENERALISTS OR DO THEY PREFER LARGER, SLOWER PREY? FEEDING FLEXIBILITY OF THE NEOTROPICAL OTTER *Lontra longicaudis* IN THE ATLANTIC FOREST

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Abstract: Despite there being several studies focusing on feeding habits of *Lontra longicaudis*, few studies aimed to evaluate its prey selectivity and none of them considered prey mobility. In this study, we report both its feeding flexibility and specialist feeding behaviour between two parts of Mambucaba River, Southeastern Brazil. We observed that they fed mainly on fish, crabs and crayfish. We did not observe seasonality either in diet or prey community availability. However, using ANOVA, we found differences between stretches for diet composition and in the availability of prey. Monotonic Multi-Dimensional Scaling ordination showed that the otter diet in mangroves was dominated by Brachyura and the prey availability by Brachyura, Caridea, Ariidae, Mugilidae, Gerreidae, Centropomidae and Cichlidae, while the diet in the river stretch was dominated by Cichlidae, Caridea and Heptapteridae, and the prey availability by Characidae, Erythrinidae and Heptapteridae. According to Ivlev Electivity Index, along the river few preys were consumed according to their abundance, the majority being selected. Otters preferred slower prey, no matter their size. We observed variation in the level of preference of the same prey in different stretches, with flexibility in otter diet. Otter ate few preys according to their abundance, but showed specialist feeding behaviour, eating the slowest prey of the stretch.

Key words: Brazil; diet; *Lontra longicaudis*; optimal foraging; prey preference

INTRODUCTION

The Neotropical otter *Lontra longicaudis* (Olfiers 1818) is a top predator in aquatic environments, and has a widespread distribution in Latin America, from

Central Argentina to Mexico (Eisenberg and Redford 1999). Despite its wide distribution, it is one of the less studied otter species, with most of the work being done on distribution (Astúa et al., 2010), use of shelters (Pardini and Trajano, 1999), or feeding habits (Pardini, 1998; Quadros and Monteiro-Filho, 2001; Rheingantz et al., 2011). Neotropical otters feed mainly on fish, with crustaceans as the second main prey item, but few studies have identified the relative importance of each prey species in the diet (Pardini, 1998; Quadros and Monteiro-Filho, 2001; Gori et al., 2003).

Otter populations seem to be influenced by the stock of available food resources (Ostfeld, 1982; Kruuk and Moorhouse, 1990; Carss and Kruuk 1996). However, according to various studies, diet composition of otters does not always reflect total prey abundance in the environment, which suggests that otters have feeding preferences (van der Zee, 1981; Wise et al., 1981; Kruuk and Moorhouse, 1990; Kruuk, 1995; Pardini, 1998; Quadros and Monteiro-Filho, 2001; Kasper et al., 2004). On the other hand, several studies have suggested that, when considering the prey available for otters in the aquatic environment, they might feed mainly on animals with greatest abundance or on those with habits facilitating their predation (e.g. low mobility, solitary) (Erlinge, 1968; Adrian and Delibes, 1987; Tumlison and Karnes, 1987; Weber, 1990; Cote et al., 2008).

The predator's decision whether to attack their prey or not depends on whether the foraging time and the energy spent capturing the prey is compensated for or exceeded by the prey's energy content (Charnov, 1976; Pianka, 2000). However, the predator can choose not to eat a prey that is easy to catch but having low energy content, preferring to continue searching for higher quality food (Krebs and Davies, 1987). Considering that prey availability and the time needed to find the prey varies, the predator's decision must involve balancing a cost-benefit relationship to maximize its chances of survival (Krebs and Davies, 1987). The prey availability concept integrates notions of prey abundance, prey concealment and prey capture success once detected (Johnson, 1980), but we concentrated our discussion in this study only on prey abundance, as the other measures were not available, being very difficult to establish in our field conditions. However, despite lacking prey behaviour information, this field study may still lead to relevant insights on variables that affect prey selection by predators (Charnov, 1976).

Based on optimum foraging theory, we predicted that Neotropical otters are generalists, feeding on preys according to their abundance from mangrove to river, in both wet and dry seasons, without seasonality. If Neotropical otters actively select certain prey, we predicted that they prefer less mobile, larger prey, avoiding highly mobile, smaller prey. Thus, we believed that larger prey would have higher energy content and cost less energy to catch, and so would be present in the diet in higher proportion than their actual occurrence in the environment.

The present study aimed to identify the main preys of the Neotropical otter in the lower Mambucaba river catchment (Rio de Janeiro state, Brazil), including seasonal and spatial differences in the feeding behaviour of the species, in relation to aquatic prey availability in the same catchment, and to analyze prey selectivity by Neotropical otters.

MATERIAL AND METHODS

Study area

The present study was conducted in Angra dos Reis municipality, including the last 13km of the Mambucaba River, 1km of the Perequê river (tributary of Mambucaba River), and 1km of nearby swamp channels at the outlet of the

Mambucaba River in Ilha Grande Bay; a typical coastal Atlantic Forest environment (Fig. 1).

Fig. 1.

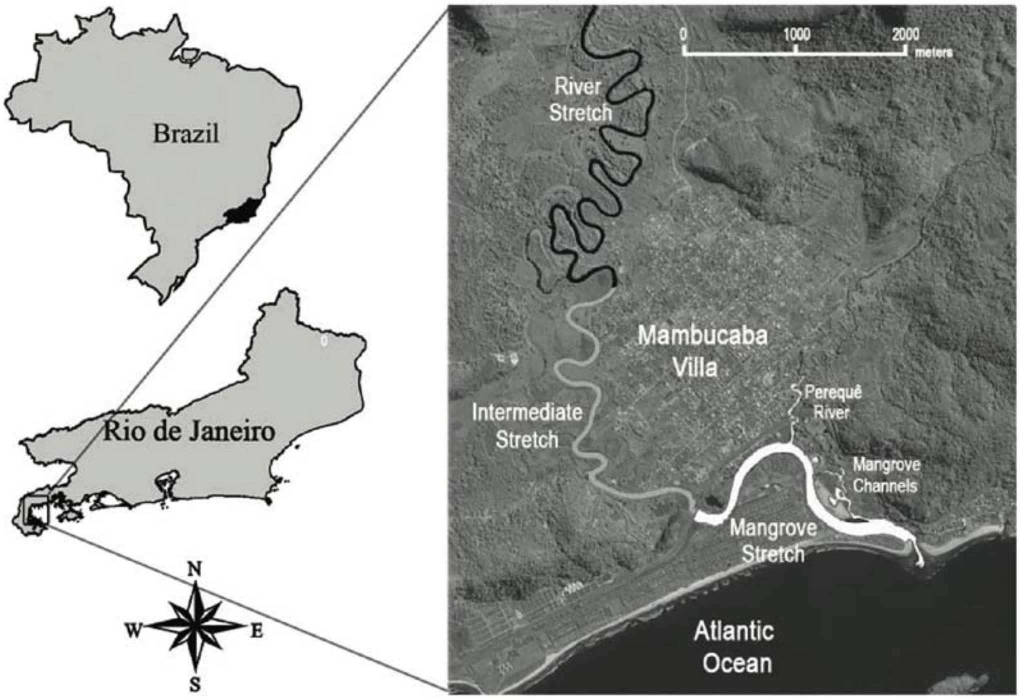

Figure 1. Study area in the lower Mambucaba watershed, in Rio de Janeiro state, Brazil, showing the three stretches (mangrove, intermediate and river) where spraints of *Lontra longicaudis* and potential otter prey were sampled.

The weather is hot and wet, with marked seasonality. Annual precipitation is approximately 2.240 mm, with maximal rainfall occurring in January (75mm) (rainfall data obtained by Meteorology System of Nuclear Central Almirante Álvaro Alberto). The temperature is about 23.2 ºC, with the highest temperature in February (25.3 ºC) and July is the coldest month, with 20 ºC (Natrontec, 1998). The study area, in the lower Mambucaba River (between 23º01'40,61'' S, 44º 31'12,02'' W and 22º59'16,50'' S, 44º32'33,88'' W) (Fig. 1), has low water flow and a high level of anthropogenic influence. A national roadway crosses the river, and there is deforestation, houses, sand extraction, and sewage flowing into the river (Natrontec, 1998).

The stretch of Perequê River studied consists in its lower part, without riparian vegetation, and with sewer discharge. The Mangrove channels, on the other hand, show good mangrove vegetation and no more sewer discharges.

We divided the study area in three stretches (5 km each) along the river, in coast-continent direction:

(1) Mangrove stretch: this diversified stretch includes the lower stretch of Perequê River, a tributary of Mambucaba River, and mangrove channels. It is close to the coast, with saline water (between 0 to 18 ppt), and tidal (50-100 cm) influences. The bottom is composed of mud and sand, and the water has the highest temperatures (21.5-24.1 ºC).

(2) Intermediate stretch (3-8 km from the river's mouth): this section has freshwater and does not have tidal influence. It has higher water flow, depth (3.2-5.5 meters), and water transparency (>1m), all the while having lower conductivity (36.9-132 µS) and

water temperature (18.5-22.1 ºC) than the mangrove stretch. The riverbed is dominated by sand, with few rocks and some fallen trees.

(3) River stretch: located in the upper part of the study area (9-13 km from the river's mouth), has large rocks and many of fallen trees, with a gravel-sand riverbed. This stretch has the lowest values of conductivity (27.8-67.1 μS) and water temperature (17.5-21.3 ºC).

Neotropical otter diet

We carried out six spraint sampling sessions from October 2004 to April 2006, three per season (dry and rainy). In each spraint sampling, we traveled the chosen river stretch by boat, going up the river along one margin and down the river on the other, collecting all the spraints found. Otters usually defecate in conspicuous places such as riverbanks, large rocks in the river, or latrines found on river beaches (Kruuk 2006). We packed each spraint found into a plastic bag and labeled it with stretch and season information. We then later placed the spraint on a sieve (1 mm net) and washed it in flowing water. After washing, we dried each sample in an oven (40 ºC) for 48 hours, separating the remaining prey content in taxonomic groups, with the help of ichthyologists, (fish down to family level), carcinologists (classifying as crabs or crayfish) and reference collections. Fish were identified mainly by scales (when they have unique scale format), head bones and vertebrae and the crustaceans were identified by hard pieces, legs and chelas. Diet composition was described in frequency of occurrence of the spraint items: number of spraints in which each prey type occurs divided by the total number of spraints (Erlinge, 1968).

Prey availability

We estimated the relative abundance of fish, crayfish and crab species during six prey sampling sessions concomitant with the six otter spraint sampling sessions. Fish abundance was estimated in each stretch using a standardized gillnet, composed of five nets (15, 20, 25, 30 and 40 mm between knots, each net was $15m^2$) for 24 hours. The fish were identified to species level and the species' relative abundance was measured in number of individuals per square meters per hour (Catch Per Unit Effort). The crayfish abundance was estimated in each stretch using 10 crayfish pots (2l. PET bottles without bottle cover cut into its middle. The top part is turned and inserted inside the other). Crayfish were identified to species level and the relative abundance was measured as number of individuals per pot per hour. Crab abundance was sampled, in each stretch, by active searching carried by two observers during 15 minutes. To avoid biased abundance estimates between stretches' differences in habitat structure that could cause heterogeneity in crabs' detection, this active searching was carried on the stretch margins, where we found similar visible conditions. The crabs were identified to species level and the species' relative abundance in each sample was measured as the number of individuals collected per sampling session.

Data analyses

In our analyses we used all prey items (fish, crayfish and crabs) to test our predictions, assuming that the energetic rewards of these items is proportional to their size. This assumption is supported by bioenergetic and physiological studies showing that the calorific value (CF) and digestibility (D) of crustaceans (CF ~ 4.1 kJ g^{-1} and D = 50-60%) are similar to fish (CF ~ 4.5 kJ g^{-1} and D = 70%) (see details in Prus, 1970; Cummins and Wuycheck, 1971; Costa, 1982). Since these values were taken in temperate areas where fish are fatter than tropical fish, this assumption might be even more valid in our study because Neotropical fish probably have calorific value and digestibility even more similar to crustaceans.

We used Monotonic Multi-Dimensional Scaling (MMDS) ordination to reduce the dimensionality of the prey items found in each spraint, from a Jaccard similarity matrix. Prey composition was defined as the presence or absence of each prey item in each spraint. We assumed that fish bones and scales, and crab and crayfish exoskeletons have a similar chance to be found in the otter spraint once eaten by the animal. Although this assumption was not tested, it seems to be realistic, because all these prey have large proportion of indigestible parts.

We checked whether the spraint composition (MMDS dimension – dependent variable) varied depending on the stretch and season factors, using two-way analysis of variance (ANOVA) (Zar, 1999). For analysis, we assumed that the prey items found in otter spraints in a certain stretch represented the diet of the Neotropical otter in that stretch. The fish found in the otter spraints were classified just to family level and the crabs and crayfish were classified to infra-order level, so we pooled the prey abundance data into the same categories groups used for otter spraints, to permit comparisons.

We also used MMDS ordination to reduce the dimensionality of the availability of prey in each prey sampling session from a Bray-Curtis similarity matrix. We defined the relative frequency of the various species found as the availability of prey. As we used different sampling methods for different prey (fish, crayfish and crabs), generating different scales of abundance measures between prey, we standardized the abundance of each prey item. The standardization was done by dividing the abundance of each prey, in each sampling stretch, by the total sum of the abundances within this prey, before generating the similarity matrix. This procedure standardized potential differences in abundance among the main prey groups (fish, crayfish and crabs) that were sampled using different methods and scales, and permitted the abundance comparison among these groups. We checked if the availability of prey (MMDS dimension - dependent variable) varied depending on the stretch and season factors, using two-way analysis of variance (ANOVA) (Zar, 1999).

The generalist behaviour of otters was checked graphically, identifying if the more frequent prey in the environment for each stretch, within each season, were more abundant in the otter spraints for the same stretch and season. We characterized the otter preferences for each prey, in each stretch, within each season, using the Ivlev Electivity Index (IEI) (Krebs, 1998) adjusted to a symmetrical output with respect to zero (see Reynolds-Hogland and Mitchell, 2007). Values close to -1 indicated that the otter rejected the prey, values close to 1 indicated that otters preferred the prey and values around 0 indicated that the prey was consumed according to its abundance. Although the approach based on frequency of occurrence is assumed to under or overestimate some prey in the diet, we believe that these problems were decreased in our analysis, once we supposed that fish scales or bones, crab and crayfish exoskeletons have similar likelihood of being found in the otter spraint once eaten by an otter. We acknowledge that this assumption was not tested here, but it seems to be realistic, since all these prey have a large proportion of indigestible parts. Furthermore, Jacobsen and Hansen (1996) and Perini et al. (2009) show elegantly, in controlled studies with captive otters, that the frequency of occurrence could retrieve about 80% of the real diet offered to an individual otter, enabling us to use this measure in our analysis. For each stretch within each season, we checked if otters preferred (IEI – dependent variable) prey with low mobility and a larger size using analysis of covariance (factor: prey mobility; co-variable: prey size) (ANCOVA) (Zar, 1999). The mobility of each prey species was classified as fast or slow-sedentary, according to its behaviour, with specialist help. We could not measure this variable in a continuous scale (e.g. velocity) because they require controlled laboratory experiments. On the other hand, we believe that our coarse classification holds ecological meaning, and that it is an adequate way to test the mobility effect on otter prey preferences. Prey size was measured (length in cm) based on specimens collected during the prey sampling. Fish were measured by standard length, as were crayfish, and crabs were measured by shell length. All analyses were performed in Systat 11.0 (Systat software, Inc., 2004).

RESULTS

We examined 105 spraints in the Mambucaba River watershed. Fish (mainly Cichlidae), crayfish, crabs and amphibians were the most abundant food items found (Table 1). Since we collected in the intermediate stretch only two spraints during the dry season and only five spraints during the rainy season, we removed this stretch from the analysis. One dimension in MMDS ordination recovered 87% of the diet composition variation indicated in Jaccard Similarity Matrix (Stress = 0.12). We observed differences in diet composition when we compared mangrove and river stretches (two-way ANOVA; $F_{1,94}$=3.39; P=0.03) (Fig. 2a). However, we did not observe seasonal differences ($F_{1,94}$=0.03; P=0.87), nor interaction between the stretch and season factors ($F_{1,94}$=0.04; P=0.96). Diet composition in the mangrove stretch was dominated by crabs (Brachyura), while in the river stretches, Cichlidae, Caridea, and Heptapteridae were more common (Fig. 2b). Insects, amphibians, reptiles, mammals and Characidae appear in the spraints along the entire study area (Fig. 2b).

Table 1. Frequency of occurrence of the prey items found in the spraints of the Neotropical otter (*Lontra longicaudis*) in the Mambucaba river in each stretch by season.

Prey		**Wet season**		**Dry season**	
		Mangrove	**River**	**Mangrove**	**River**
Fish	Ariidae	0.20	0.00	0.38	0.00
	Centropomidae	0.00	0.00	0.03	0.00
	Cichlidae	0.52	0.45	0.54	0.60
	Characidae	0.04	0.00	0.11	0.04
	Erythrinidae	0.00	0.00	0.05	0.20
	Loricariidae	0.00	0.00	0.08	0.40
	Mugilidae	0.08	0.09	0.08	0.00
	Heptapteridae	0.00	0.27	0.03	0.16
Crayfish	Caridea	0.12	0.82	0.05	0.68
Crabs	Brachyura	0.44	0.00	0.49	0.16
Amphibia		0.08	0.18	0.08	0.24
Mammalia		0.04	0.09	0.16	0.16
Reptilia		0.00	0.00	0.05	0.00
Insecta		0.08	0.09	0.03	0.12
	Total of spraints	25	11	37	25

MMDS ordination in one dimension recovered 68% of the prey community variation indicated by Bray-Curtis similarity matrix (Stress = 0.22). We observed differences in prey availability between the mangrove and river stretches (two-way ANOVA; $F_{1,8}$=21.837; P<0.001) (Fig. 3a), but we did not find differences between seasons ($F_{1,8}$=0.624; P=0.45), nor interaction of stretch and season factors ($F_{1,8}$=1.046; P=0.38). The prey availability in the mangrove stretch was dominated by crabs (Brachyura), crayfish (Caridea) and fish families Ariidae, Mugilidae, Gerreidae, Centropomidae, and Cichlidae (Fig. 3b), while the river stretch was dominated by fish of the families Characidae, Erythrinidae, and Heptapteridae.

Concerning the general longitudinal differences from mangrove to freshwater stretch, prey such as crabs (Brachyura) and fish of the family Heptapteridae were consumed along the stretches sampled according to their abundance (Table 2; Fig. 2, 3), while some fish families were consumed in different proportions than expected along the river (Table 2; Fig. 2, 3) and within each stretch (Table 2).

Table 2. Neotropical Otter (*Lontra longicaudis*) prey preferences according the adjusted Ivlev Electivity Index (IEI) in each stretch sampled, the categorical prey mobility and the prey mean size. The preys used in this analysis were fishes, crabs and crayfishes.

Preys	IEI		Mobility	Mean size (cm ± SD)
	Mangrove	River		
Ariidae	0.033	0.000	slow - sedentary	18.0 ± 3.1
Heptapteridae	0.032	0.107	slow - sedentary	25.1 ± 3.3
Sciaenidae	-0.212	0.000	fast	16.1 ± 1.0
Mugilidae	-0.364	0.026	fast	19.2 ± 5.3
Erythrinidae	0.063	0.196	slow - sedentary	25.3 ± 7.4
Characidae	0.084	-0.585	fast	14.2 ± 4.1
Eleotridae	*	*	slow - sedentary	7.7**
Poecilidae	*	*	slow - sedentary	3.5**
Cichlidae	0.501	0.486	slow - sedentary	13.7 ± 2.3
Centropomidae	-0.177	*	fast	26.0 ± 6.0
Gerreidae	-0.066	*	fast	11.7 ± 2.5
Paralichtyidae	-0.033	*	slow - sedentary	3.4**
Belonidae	-0.033	*	fast	8.7**
Loricariidae	0.092	0.526	slow - sedentary	13.1**
Brachyura	0.156	0.250	slow - sedentary	7.8 ± 1.8
Caridea	-0.194	-0.049	slow - sedentary	6.6 ± 0.8

* Rare species - IEI was not calculated because this index is not accurate to these species.
**Standard deviation was not calculated because only one specimen was captured.

Since our results indicated that there was no seasonal effect on the otters' diet composition and on the availability of prey, the seasonal data were grouped together in the analysis of prey preference. Slower prey were preferred in the mangrove stretch (two-way ANCOVA; $F_{1,11}$=3.97, P<0.05), regardless of its size ($F_{1,11}$=0.05, P=0.82) (Figure 4). The same pattern was observed in the river stretches [two-way Ancova; (mobility effect; $F_{1,7}$=4.42, P<0.05 and prey size effect; $F_{1,7}$=0.001, P=0.99)] (Figure 4). There was no interaction between mobility factors and size of prey in the stretches tested (mangrove stretch; $F_{1,11}$=0.98, P=0.35 and river stretch; $F_{1,7}$=0.26, P=0.63). There was no co-linearity between prey mobility and prey size factors, because fast and slow or sedentary prey showed similar sizes ($t_{1,14}$ = 1.44; P=0.20).

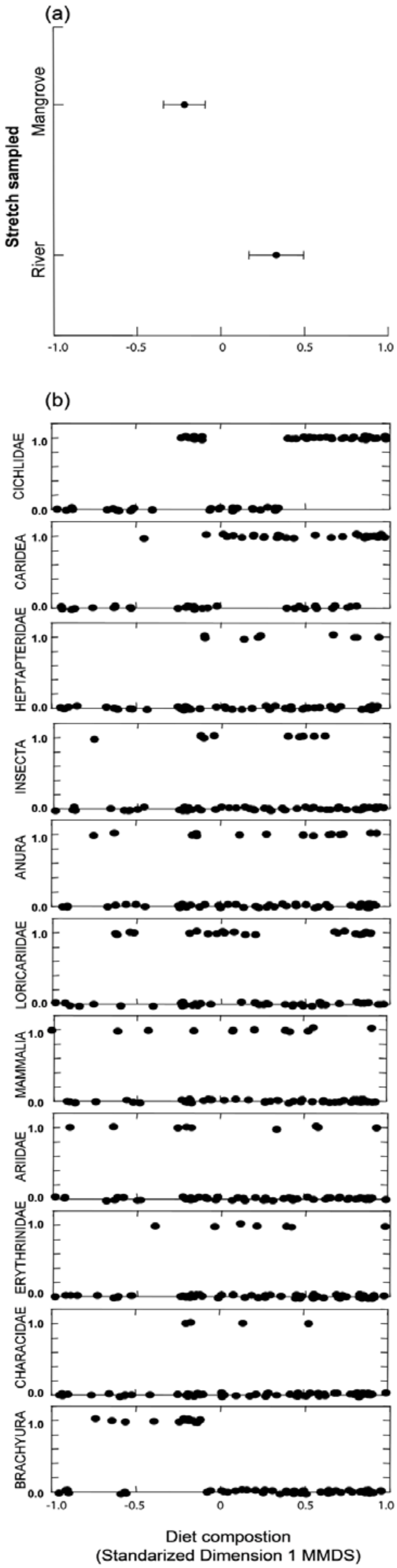

Figure 2. Neotropical otter (*Lontra longicaudis*) diet differences in the Mambucaba River between mangrove and river stretch. (a) Diet differences between stretches sampled. The Standardized Dimension 1 MMDS is the ANOVA residuals of the non-significance season effect on diet composition ordination based on the Monotomic Multi-Dimensional Scaling (MMDS). (b) Occurrence of prey items (item presence = 1 and item absence = 0 in each spraint sampled) through the diet composition ordination (Standardized Dimension 1 MMDS).

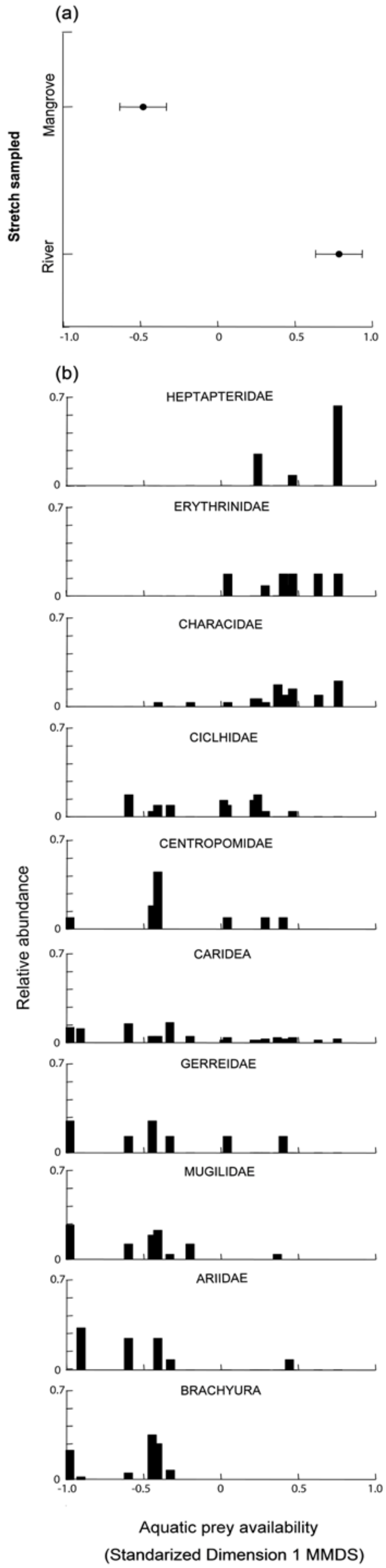

Figure 3. Differences in prey availability in the Mambucaba River between mangrove and river. (a) Differences in the aquatic prey availability between stretches sampled. The Standardized Dimension 1 MMDS is the ANOVA residuals of the non-significance season effect on the prey availability ordination based on the Monotomic Multi-Dimensional Scaling (MMDS). (b) Prey abundance through the prey availability ordination (Standardized Dimension 1 MMDS).

Fig. 4.

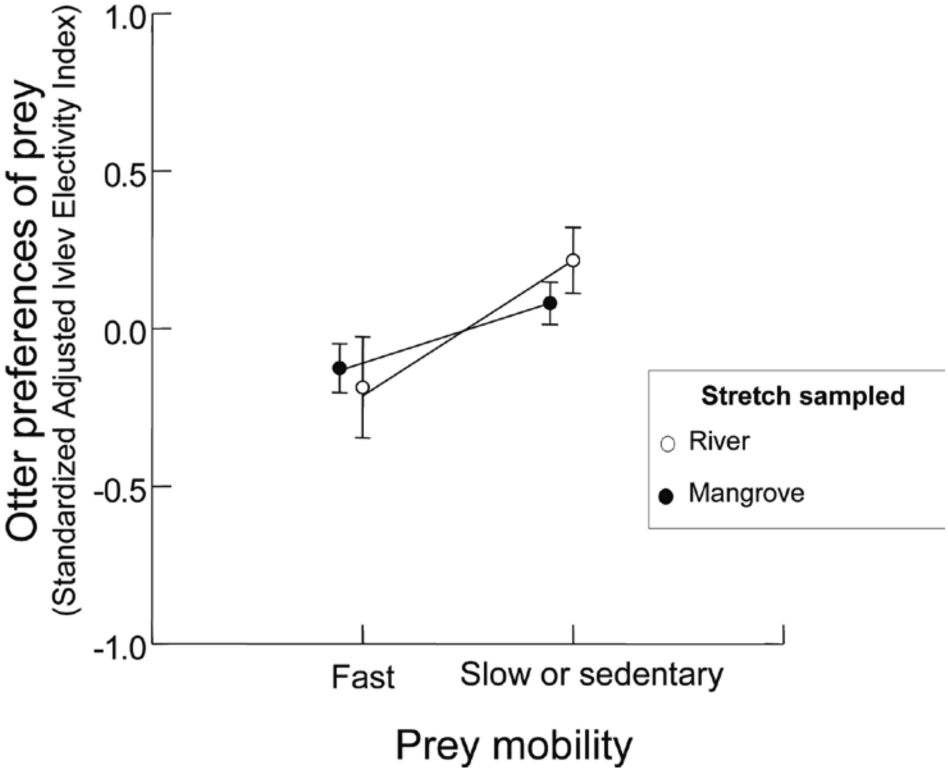

Figure 4. Differences in otter preferences for prey according to mobility in the mangrove stretch and in the river stretch. The prey used in this analysis were fish families, crabs and crayfish. The prey preferences were measured using the adjusted Ivlev Electivity Index (IEI). The standardized IEI is the linear regression residuals of the non-significant prey size effect on the IEI.

DISCUSSION

The otters studied feed mainly on fish and crustaceans, as recorded in several previous studies on *Lontra longicaudis* (José and Ker de Andrade, 1997; Pardini, 1998; Spinola and Vaughan, 1998; Colares and Waldemarin, 2000; Quadros and Monteiro-Filho, 2001; Gori et al., 2003; Rheingantz et al., 2011) as well as in other otter species (Stenson et al., 1984; Adrian and Delibes, 1987; Roche et al., 1995; Clavero et al. 2003, 2006; Cote et al., 2008). Freshwater otters' diets usually show seasonal patterns (Pardini, 1998), but in our study, we did not observe diet seasonality. The diet and prey availability were uniform through the seasons, similar to what was found for otters living in non-seasonal marine and coastal environments (Kruuk et al., 1988; 1993; Cote et al., 2008).

Despite the fact that otters are usually described as generalist fish predators (Kruuk and Moorhouse, 1990, Breathnach and Fairley, 1993, Carss, 1995), eating the most abundant items (Jenkins and Harper, 1980; Tumlison and Karnes, 1987; Taastrom and Jacobsen, 1999), the present study shows that the Neotropical otter is capable of feeding on several available prey types, but the longitudinal variation observed in its diet was not equivalent to longitudinal variation in the prey abundance. In this way, some studies that analyzed prey abundance showed that otters select some kinds of prey or sizes (Wise et al., 1981; Kruuk and Moorhouse, 1990; Pardini, 1998; Quadros and Monteiro-Filho, 2001). Our results suggest that otters can have an adaptive diet, similar to the findings of other studies focusing on different otter species (Reid et al., 1994; Laidre and Jameson, 2006), feeding on a few prey species according to their abundance but mainly having a specialist feeding behaviour, preferring some items and avoiding others.

Laidre and Jameson (2006) also reported that sea otters *Enhydra lutra* (Fleming, 1822) changed their main prey when the first chosen was depleted, and suggested that when the sea otter densities approach population equilibrium, those animals diversify their diet, eating less profitable prey. Our results were similar to the observations of Stenson et al. (1984) with Nearctic otters *Lontra canadensis* (Schreber, 1777) and Wise et al. (1981) with Eurasian otters *Lutra lutra* (Linnaeus, 1758), which concluded that the fish most frequently eaten by the otters were those that were sluggish or fatigued faster, with a lower capacity for maintaining escape maneuvers. This suggests that otters capture the prey in direct proportion to its abundance and in inverse proportion of its escape ability.

In spite of the high feeding flexibility of the Neotropical otter, Pardini (1998) and Quadros and Monteiro-Filho (2001) suggested that it selects mainly bottom-dwelling and slow swimming prey. Similar patterns were suggested by other authors with different species of otters, predicting that otters feed mainly on prey with low escape ability (Erlinge 1967, 1968; Wise et al., 1981; Stenson et al., 1984), if this selectivity behaviour requires less energy for prey capture (Pardini, 1998; Cote et al., 2008).

According to Roper (1994) and Quadros and Monteiro-Filho (2001), a feeding specialist is an animal that has a diet based on few food items and the use of these items is not dependent on its abundance. This specialist behaviour can be predicted according to optimal foraging theory (MacArthur and Pianka, 1966), where the predator will prefer to catch prey that increase the energetic return and decrease the energetic cost to catch them (Krebs and Davies, 1987). This specialist feeding behaviour is widespread among carnivores (Nowak et al., 2005) and normally the predator will prefer to catch larger and/or more vulnerable prey. On the other hand, a predator can choose to catch the "easier prey" that does not present toxic or mechanical defenses, group defense strategies, aggressive behaviour, or high escape ability (Barbosa and Castellanos, 2005). In this trade-off, the Neotropical otters in our study preferred to catch the slower prey, no matter their size. Cote et al. (2008) have demonstrated that coastal-marine Nearctic otters selected both slower and larger prey. However, this selection of larger individuals was detected within each prey species, while our study tested preferences between prey species themselves.

Many fast fish were very abundant and reached low preference rank, while other slow-sedentary fish were rare and highly preferred. For instance, the fish families that were the most abundant in the mangrove stretch (Mugilidae) and the river stretch (Characidae), were the most avoided because they were represented by very fast species. Rare species in the mangrove stretch (Cichlidae) and in the river stretch (Erythrinidae) were preferred because they present slow-sedentary habits. Indeed, when we consider the longitudinal differences in the prey abundance in the assemblage, the same prey was avoided in one stretch and preferred in another. We hypothesize that the relative mobility ranking of each prey species depends on the prey community composition. For instance, one species could be the slowest in one stretch while in another stretch, there could be a prey species that is even less mobile and so would be the slowest, even when the first one was also present. This hypothesis could explain why some prey were preferred or avoided in one stretch and consumed according to its abundance in another, and why some prey were preferred in one stretch and avoided in the other one (see Mugilidae, Sciaenidae, Characidae and Loricariidae).

In this study, Neotropical otters presented high feeding flexibility, this being the first work to examine longitudinal variation in their diet, through mangrove to freshwater part of the river. The availability of prey was constant throughout the seasons and the diet composition was also constant. Neotropical otters consumed some prey according to their abundance, but they showed also a specialist feeding behaviour, preferring or avoiding several kinds of prey. Slower preys were preferred no matter their size, and the low frequency in the diet of faster prey could be expected due the high energetic cost to catch them. These results corroborate the hypothesis that the otters tend to forage optimally, looking to minimize the expense of energy in the capture of the prey, even where the result is less caloric earning per item, thus increasing the available energy to be allocated in, for example, reproduction (Kruuk and Moorhouse, 1990; 1991; Estes et al., 2003).

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RÉSUMÉ

LES LOUTRES SONT-ELLES GENERALISTES OU PREFERENT-ELLES LES PROIES PLUS GROSSES ET PLUS LENTES?

FLEXIBILITE ALIMENTAIRE DE LA LOUTRE A LONGUE QUEUE *Lontra longicaudis* EN FORET ATLANTIQUE

Bien qu'il existe plusieurs études portant sur les habitudes alimentaires de *Lontra longicaudis*, peu d'études visent à évaluer la sélectivité des proies et aucune d'entre elles ne considère la mobilité de ces proies. Dans cette étude, nous rapportons à la fois sa souplesse alimentaire et son comportement plus spécialisé entre deux zones de de la rivière Mambucaba au sud-est du Brésil. Nous avons observé que la Loutre se nourrit principalement de poissons, de crabes et d’écrevisses. Nous n'avons pas observé de saisonnalité à la fois dans l'alimentation ou dans la disponibilité en proies. Cependant, grâce à l’analyse de la variance, nous avons constaté des différences entre la composition du régime et la disponibilité des proies. L’analyse multidimensionnelle montre quant à elle que le régime de la Loutre dans les mangroves est dominé par Brachyura et la disponibilité des proies par: Brachyura, Caridea, Ariidae, Mugilidae, Gerreidae, Centropomidae et Cichlidae, alors que dans le tronçon fluvial, le régime est dominé par : Cichlidae, Caridea et Heptapteridae, et la disponibilité des proies par Characidae, Erythrinidae et Heptapteridae. Selon l'indice de prédation « Ivlev », peu de proies sont consommées le long de la rivière en compraison de leur abondance, la majorité étant sélectionnées. Les loutres préfèrent les proies lentes, peu importe leur taille. Nous avons observé des variations dans le niveau de préférence de la proie entre tronçons, accompagné d’une flexibilité dans le régime. Les loutres ne mangent que peu de proies comparé à leur abondance mais elles montrent une spécialisation de leur comportement alimentaire en mangeant les proies les plus lentes du tronçon.

RESUMEN

¿LAS NUTRIAS SON GENERALISTAS O PREFIEREN LAS PRESAS MÁS GRANDES Y MÁS LENTAS?

FLEXIBILIDAD ALIMENTARIA DE LA NUTRIA NEOTROPICAL *Lontra longicaudis* EN EL BOSQUE ATLANTICO

Aunque hay varios estudios que se enfocan en los hábitos alimentarios de *Lontra longicaudis*, pocos estudios se dirigieron a evaluar su selectividad de presas, y ninguno consideró la movilidad de las presas. En este estudio, informamos acerca de su flexibilidad alimentaria así como su comportamiento alimentario especialista, en dos porciones del Río Mambucaba, en el Sudeste de Brasil. Observamos que se alimentan principalmente de peces, cangrejos y langostinos. No observamos estacionalidad ni en la dieta ni en la disponibilidad en la comunidad de presas. Sin embargo, usando ANOVA, encontramos diferencias entre las dos porciones, en cuanto a la composición dietaria y la disponibilidad de presas. La ordenación Monotónica Multidimensional mostró que la dieta de la nutria en los manglares estuvo dominada por Brachyura, y la disponibilidad de presas por Brachyura, Caridea, Ariidae, Mugilidae, Gerreidae, Centropomidae y Cichlidae, en tanto que la dieta en el tramo de río estuvo dominada por Cichlidae, Caridea y Heptapteridae, y la disponibilidad de presas por Characidae, Erythrinidae y Heptapteridae. De acuerdo al Indice de Electividad de Ivlev, a lo largo del río pocas presas fueron consumidas de acuerdo a su abundancia, siendo la mayoría seleccionadas. Las nutrias prefirieron las presas más lentas, independientemente del tamaño. Observamos variación en el nivel de preferencia hacia la misma presa, en distintos tramos, con flexibilidad en la dieta de la nutria. Las nutrias comieron pocas presas de acuerdo a su abundancia, mostrando en cambio un comportamiento alimentario especialista, comiendo las presas más lentas del tramo.

RESUMO

AS LONTRAS SÃO GENERALISTAS OU PREFEREM AS PRESAS MAIORES E MAIS LENTAS? FLEXIBILIDADE ALIMENTAR DA LONTRA NEOTROPICAL Lontra longicaudis NA MATA ATLANTICA

Apesar da existência de vários estudos anteriores enfocando o hábito alimentar de Lontra longicaudis, poucos estudos procuraram avaliar sua seletividade quanto as presas e nenhum deles considerou a mobilidade delas. Neste estudo, relatamos tanto a flexibilidade como o seu comportamento especialista do seu hábito alimentar em duas partes do rio Mambucaba, Sudeste do Brasil. Observou-se que elas se alimentavam principalmente de peixes, caranguejos e pitús. Não observamos sazonalidade nem na dieta nem na disponibilidade de presas. No entanto, a partir da utilização da análise de Variância, foram observadas diferenças entre os trechos tanto na composição da dieta como na disponibilidade de presas. A técnica de ordenação de escala monotônica Multi-Dimensional mostrou que a dieta da lontra no trecho de manguezal foi dominada por Brachyura e a disponibilidade de presas por Brachyura, Caridea, Ariidae, Mugilidae, Gerreidae, Centropomidae e Cichlidae, enquanto a dieta no trecho do rio foi dominada por Cichlidae, Caridea e Heptapteridae, ea disponibilidade de presas por Characidae, Erythrinidae e Heptapteridae. De acordo com o índice de eletividade de Ivlev, ao longo do rio poucas presas foram consumidas de acordo com a sua abundância, a maioria sendo selecionada. Lontras preferiram as presas mais lenta, não importando o seu tamanho. Observou-se a variação no nível de preferência da mesma presa em trechos diferentes, com flexibilidade na dieta das lontras. As lontras comeram poucas presas de acordo com a sua abundância, mas mostrou comportamento alimentar especialista, comendo a presa mais lenta do local.

R E P O R T

DISTRIBUTION OF NEOTROPICAL OTTER, *Lontra longicaudis* (OLFERS, 1818) (MUSTELIDAE) IN COASTAL ISLANDS OF SANTA CATARINA, SOUTHERN BRAZIL

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Abstract: This study presents the distribution of neotropical otters (*Lontra longicaudis*) in coastal islands of Santa Catarina State. A total of 23 islands were surveyed, through 46 field trips. Otter's signs were found in 9 islands, representing 39% of the total. It is believed that the *Lontra longicaudis* use these islands as a support for its movement from one place to another. The results could be indicating the existence of a coastal ecological corridor used by the neotropical otter.

Keywords: Brazil; *Lontra longicaudis*; ecology of otter; coastal habitats; ecological corridor

INTRODUCTION

Distribution of *Lontra longicaudis* in marine habitats along the coast of Brazil is poorly known. The neotropical otter in Brazil is often recorded in rivers, estuaries, mangroves, lakes and lagoons (Carvalho-Junior, 1990; Helder and Andrade, 1997; Pardini, 1998; Quadros and Monteiro-Filho, 2001; Alarcon and Simões-Lopes, 2004; Quintela et al., 2008; Carvalho-Junior et al., 2010a,b). However, citations of neotropical otter on coastal islands are rare.

Santa Catarina state has at least 130 islands, Santa Catarina Island (Florianópolis) being the largest one (Figure 1). The island of Santa Catarina has an average length of 54 km and width average of 18 km. It has several bays, promontories, islands, bays and lagoons. The island is located parallel to the mainland and separated by a narrow channel.

Some islands are distant from the mainland such as Badejo Island (21.2 km), Xavier Island (17.8 km), Mata-Fome Island (16.4 km), Campeche Island (16.0 km) and Arvoredo Island (12.62 km). If the presence of Santa Catarina Island is taken into account , some distances can be reduced. Campeche Island, for example, is 16 km away from the mainland, but only 1.4 km distant from Santa Catarina Island.

Arvoredo Island, on the other hand, is located north of Santa Catarina Island and its distance from mainland and from Santa Catarina Island is similar, 10.6 km.

Figure 1. Landsat satellite photo of Santa Catarina Island (Source: https://zulu.ssc.nasa.gov/m). The two main lagoons are shown, Peri Lake in the south and Conceição Lagoon in the north.

The presence of *Lontra longicaudis* on islands close to the mainland of Santa Catarina state (less than 1 km), has been reported before. Anhatomirim Island (Alarcon and Simões-Lopes, 2004) and Porto Belo Island (João da Cunha Island) (Carvalho-Junior, 2007) are known for the presence of the species throughout the year. However, a comprehensive study of the distribution of the species on costal islands has never been carried out before.

Carvalho-Junior et al. (2004) studied the distribution and characteristics of environments used by the neotropical otter in the coastal region of Santa Catarina State, Brazil. It is important to point out the indented coastline of the state. It is replete with small bays and promontories that can in turn result in different effective distances between mainland and islands, depending on the angle the observer uses.

The coastal area of Santa Catarina is also rich in lakes, lagoons and river mouths. The largest number of lagoons on the mainland is located between Arvoredo Island (27°17'98" S/48°21'53" W) and Lobos Island (28°26'48" S/48°42'33" W). This area has a number of lakes that includes (from south to north), the Camacho Lagoon (6.32 km^2), Santo Antonio Lagoon (33.85 km^2), Imaruí Lagoon (86.32 km^2), Mirim Lagoon (63.77 km^2), Ibiraquera Lagoon (8.65 km^2) and Garopaba Lagoon (5.15 km^2), along with several rivers flowing into the sea.

In Santa Catarina Island the most important water bodies are the Peri Lake (5.1 km^2) and the Conceição Lagoon (19.71 km^2) (Figure 1). To the north of Santa Catarina Island there are more river mouths such as Tijucas River, Itajai-Açú, Itapocu River, and Babitonga Bay in the extreme north of the state. The presence of promontories is also significant such as Penha, Porto Belo and Governador Celso Ramos Promontories (Figure 2).

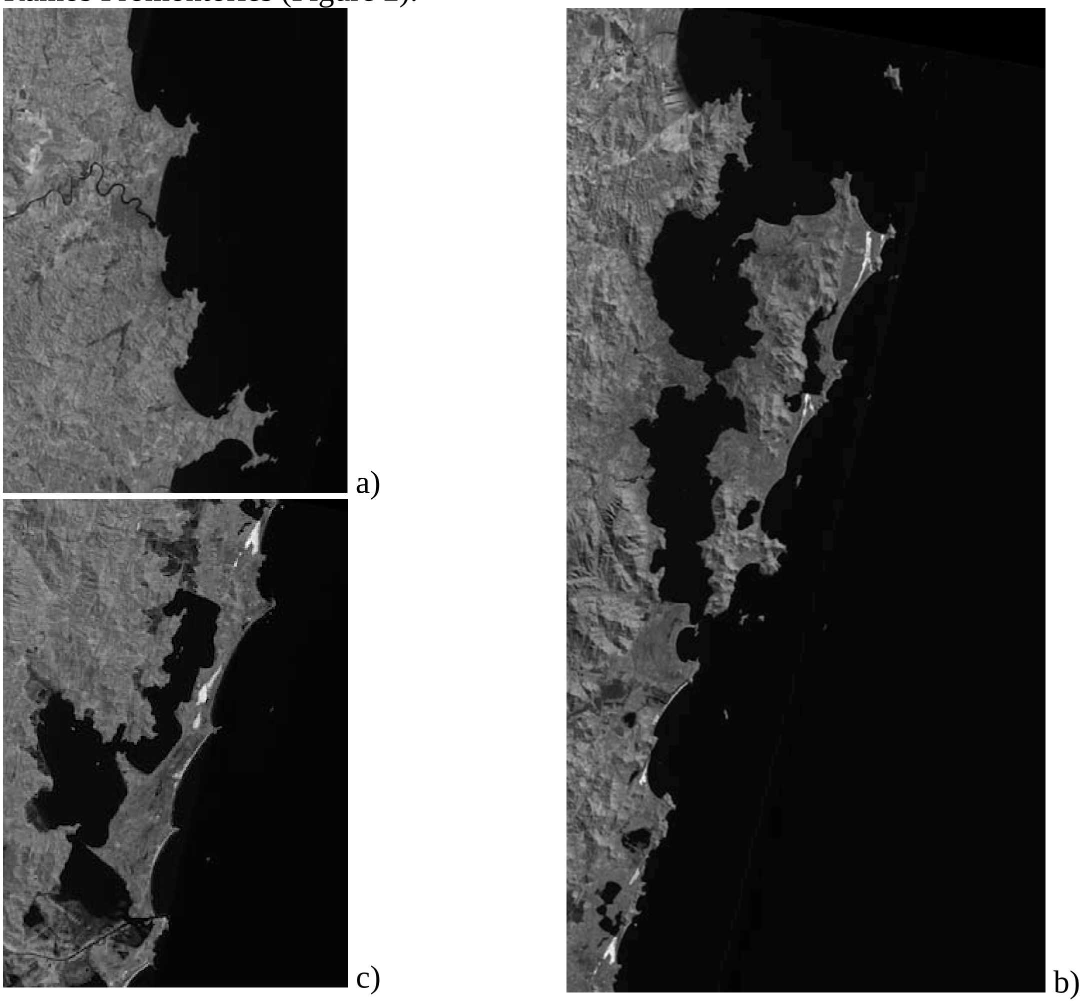

Figure 2. CBERS Satellite Image of the Coastline of Santa Catarina State. (a) North, (b) Central, (c) South. (Courtesy: INPE - National Institute of Spatial Research).

Distribution of otters on coastal islands, further away from the continent, such as Campeche Island and Irmã-do-Meio Island, has been reported only recently (Carvalho-Junior, 2007), suggesting that the presence of the *Lontra longicaudis* in marine environments could be more widespread than expected. This work represents a record of the presence of *Lontra longicaudis* in coastal islands of Santa Catarina State located between 26°42`33” S and 28° 32` 21” S (Figure 3).

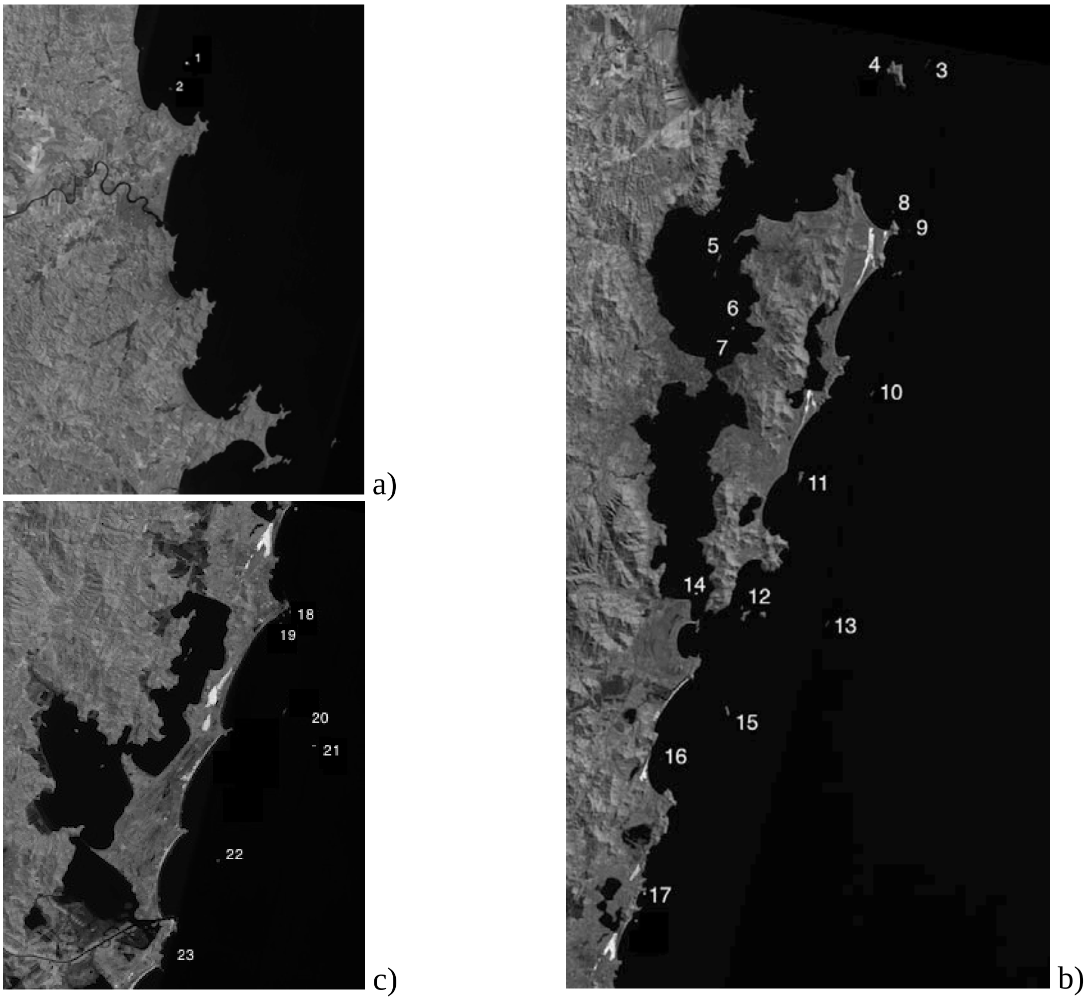

Figure 3. CBERS Satellite Image of the Coastline of Santa Catarina State. (a) North, (b) Central, (c) South. (Courtesy: INPE - National Institute of Spatial Research). The study area included 23 islands from 26°42`33" S to 28°32`21" S. (1.Itacolomis Island, 2. Feia Island, 3. Deserta Island, 4. Arvoredo Island, 5. Ratones-Grande Island, 6. Guará-Grande Island, 7. Guarás-Pequeno Island, 8. Mata-Fome Island, 9. Badejo Island, 10. Xavier Island, 11. Campeche Island, 12. Irmã-do-Meio Island, 13. Moleques-do-Sul Island, 14. Cardos Island, 15. Corais Island, 16. Siriú Island, 17. Batuta Island, 18. Santana-de-Dentro Island, 19. Santana-de-Fora Island, 20. Araras Island, 21. Tacami Island, 22. Lobos Island, 23. Ilhota).

MATERIALS AND METHODS

Each island was inspected on foot, from 6:00 AM to 06:00 PM, searching for signs of otters. Indirect signs of the presence of otters were considered to be footprints, feces, scent marks (urine and mucus) and the presence of active shelters. The islands were visited twice: Fall/winter and spring/summer 2007/2008.

The organization and planning of field trips included preliminary data collection, such as maps, aerial photos, satellite images and selection of the islands to be visited. The study area chosen was the one with the islands scattered in the central coast of Santa Catarina. The 23 islands selected for research and their locations can be seen in Figure 3 and are listed in Table 1.

The fieldwork on each island was considered complete after the entire surface had been explored. The time spent on each island varied depending on the size and difficulty of movement due to density of vegetation and topography.

Small islands which are flat and smooth, such as Guarás-Pequeno, Guarás-Grande, Cardoso, Itacolomis, Santanas and Ilhota Islands, were examined from 30 minutes to 3 hours. Larger islands such as Arvoredo, Irmã-de-Dentro, Moleques-do-Sul and Corais took longer, resulting in 1 to 3 days of fieldwork.

A total of 23 field trips were conducted in the spring/summer, totaling 127 hours worked, and 21 field trips in the fall/winter, with 105 hours worked. The total effort was 44 visits, corresponding to 232 hours of research.

Table 1. Surveyed Islands and coordinates.

Island	Coordinates
1. Itacolomis	26°42'35" S/48°37'05" W
2. Feia	26°44'41" S/48°38'11" W
3. Arvoredo	27°17'98" S/48°21'53" W
4. Deserta	27°1617” S/48°19’50” W
5. Campeche	27°41'49" S/48°27'52" W
6. Xavier	27°33'09" S/48°35'05" W
7. Mata-Fome	27°25́29" S/48°22´00" W
8. Badejo	27°26́'33" S/48°20´49" W
9. Ratones-Grande	27°42'30" S/48°35'44" W
10. Guarás-Grande	27°33'09" S/48°35'05" W
11. Guarás-Pequeno	27°32'58" S/48°33'09" W
12. Irmã-do-Meio	27°50'19" S/48°31'33" W
13. Moleques-do-Sul	27°50'45" S/48°25'53" W
14. Cardos	27°48'52" S/48°34'51" W
15. Siriú	27°59'15" S/48°37'04" W
16. Corais	27°56'13" S/48°32'32" W
17. Tacami	28°21'06" S/48°36'04" W
18. Santana-de-Dentro	28°14'28" S/48°39'06" W
19. Santana-de-Fora	28°14'53" S/48°39'58" W
20. Batuta	28°09'10" S/48°38'32" W
21. Araras	28°19'17" S/48°38'55" W
22. Lobos	28°26'48" S/48°42'33" W
23. Ilhota	28°32'21" S/48°45'35" W

RESULTS

According to Filippini (2009), on the 23 islands, 14 different habitats were classified: supralittoral rocky, supralittoral sandy, mesolittoral rocky, mesolittoral sandy, herbaceous vegetation, shrub vegetation, arboreal vegetation, disturbed vegetation, wetland, ground, cave, lagoon, creek and buildings.

All 23 islands surveyed presented the supralittoral rocky habitat, dominated by rock, absence of vegetation, subjected to solar radiation, rain, wind and marine spray. All islands have rocky supralittoral zone. *Lontra longicaudis* signs were found in this habitat, together with *Zonotrichia capensis*, *Pitangus sulphuratus*, *Chatartes sp*, *Tupinambis sp*, *Sula leucogaster*, *Phalacrocorax brasilianus*, *Otaria flavescens*, *Arctochephalus australis*, domestic goat, *Larus dominicanus*, and *Thalasseus sp*. In total, 40 species of vertebrates were found in the supralittoral rocky habitat.

The supralittoral sandy habitat is found between the end of the vegetation and the high tide. This habitat was found on five islands: Ratones-Grande, Guarás-Grande, Guarás-Pequeno, Campeche and Corais. Signs of neotropical otter were not found in this region. Other vertebrates observed in this habitat consist mainly of *Larus dominicanus*, *Coragyps atratus*, and domestic goats.

The mesolittoral rocky zone represents the rocky surface covered by marine benthos, positioned between the maximum high tide and the low tide. All 23 surveyed islands have rocky mesolittoral zone. 20 vertebrate species were found to inhabit this zone. The typical species is the *Haematopos palliatus* (American Oystercatcher), adapted to feed on molluscs in the rocks. Other vertebrates are the *Larus dominicanus*, *Zonotrichia capensis*, *Troglodytes musculus*, *Pitangus sulphuratus*, *Ceryle torquata*, *Charadrius semipalmatus*, three species of Scolopacídeos and five species of the Ardeidae family. Where otters were observed in the supralittoral zone it is likely that they also use this zone.

The mesolittoral sandy is the habitat formed by the intertidal action on sandy beaches. The islands that presented mesolittoral sandy were: Ratones-Grande, Guarás-Grande, Guarás-Pequeno, Campeche and Corais. Five species were observed in this region: *Larus dominicanus*, *C. atratu*, *Haematopos palliatus*, *Polyborus plancus* and *Zonotrichia capensis*. As for the supralittoral sandy, signs of neotropical otter were not found in this region.

The herbaceous vegetation habitat is formed predominantly by herbaceous vegetation with up to a meter height. It is present on 14 islands and appears along the cliffs, flat areas and wetlands, overlying sandy deposits. The most common plants are Ipomoea, Panicum, Paspalum, Spartina, Remirea, Lantana, Tibouchina, Vitex, Aechmea, Vriesea, Cereus, Opuntia, and Polypodium. 34 species of vertebrates were observed in this habitat, including *Larus dominicanus* and *Sula leucogaster*. It is also common to see forest birds, such as *G. aequinoctialis*, *B. culicivorus*, *Troglodytes musculus*, *Zonotrichia capensis*, *Pitangus sulphuratus*, *Coragyps atratus*, *Speotyto cunicunaria*, *Milvago chimango*, *Milvago chimachima*, *Polyborus plancus*, *Rupornis magnirostris* and *Syrigma sibilatrix*. Other species are lizards, snakes, rabbits and rodents of the Cavidae family.

The shrub vegetation habitat consists of shrubby plants from 1 to 5 meters tall, and was found on 15 islands. As for herbaceous vegetation, it is found overlying sandy deposits along the coasts. The main species of vegetation are *Schinus terenetifolius*, *Ocotea sp.*, *Butia capitata*, *Eugenia sp.*, *Myrcia sp.*, *Vitex sp.*, *Campomanesia sp.*, *Tibouchina sp.*, *Guapira opposita*, *Myrsine sp.*, *Psidium sp.*, *Tabebuia sp.*, Cereus and Opuntia. 42 species were observed in this habitat, consisting mainly of birds adapted to a more diverse plant condition. *Tyrannus melancholicus* and *Guira guira* are frequently seen in this habitat. The presence of birds adapted to the shade and humidity of trees were also recorded, such as *Turdus sp.* (Muscicapidae), *Elaenia sp.* (Tyrannidae), *Vireo chivi* (Vireonidae), *Ranphocelus bresileus*, *Thraupis sayaca*, and *Coereba flaveola* (Emberezidade).

Trees with height greater than 0.5 m form the arboreal vegetation habitat. The main species are *Clusia sp*, *Syagrus romanzzofiana*, *Alchornea sp.*, *Ficus sp.*, *Coussapoa sp.*, *Inga sp.*, *Nectandra sp.*, *Ocotea sp.*, *Psidium sp.*, *Ilex sp.*, *Cecropia sp.*, *Myrsine sp.*, *Eugenia sp.*, *Guapira opposita*, *Gomidesia sp.*, *Myrcia sp.*, *Citharexylum miriantum*, *Cupania sp.*, *Tabebuia sp.*, *Hibiscus sp.* and *Huberia sp.* The largest number of vertebrates, with 48 species, inhabits this habitat. The typical species are those adapted to shadows and humidity of the forest, such as Chiroptera, Muscicapidae, Tyrannidae, Colubridae, Hylideos and *Didelphis sp.*

The disturbed vegetation habitat is formed by exotic vegetation. Often this habitat is close to buildings. It was found on 9 islands and it is inhabited by 30 vertebrate species, which are mainly native and domestic introduced animals as birds (*Troglodytes musculus*, *Zonotrichia capensis* and *Pitangus sulfuratus*), lizards (*Tabebuia sp*), Brazilian Game Fowl, ducks, geese, chickens, cats and dogs.

The wetland habitat is formed in depressions due to the accumulation of rainwater or groundwater, accompanied by vegetation adapted to flooding. The most common species are the grasses *Paspalum sp*, *Spartina sp*, *Scirpus sp*, *Cyperus scleria* and *Typha sp*. Four wetlands were found on 3 islands: The Mata-Fome, Xavier and Corais. Three of these habitats were in the high parts of the islands and a fourth was located near sea level. Only amphibians were found to be using this habitat.

The ground habitat consists of the soil or substrate formed on the basement rock, usually covered by vegetation. Three species were found to be using this habitat: a snake *Amphisbaena sp*., an owl *Speotyto cunicunaria* and a rabbit *Oryctolagus cuniculus*.

The cave habitat represent natural rocky cavities, accessible to man, with variable dimensions, with only temporary short time periods of light, a higher thermal stability inside than the outside and a relative humidity that tends to saturation. Four caves were found on three islands: Arvoredo and Batuta Islands with one cave each, and Feia Island with two caves. These caves are located between 2 and 3 meters above sea level, at the interface between the supralittoral rocky and native vegetation. Neotropical otter signs were found in two caves, one at Batuta Island and another at Arvoredo Island.

The Batuta Island cave opens to the north, 3 meters wide and 5 meters long, 1 meter high and at 3 meters from sea level. It consists of a narrow corridor with walls and floor of granite. The end is covered with rocks and sediments from which runs a trickle of water drainage. The Arvoredo Island cave opens to the west, 1 meter wide, 5 meters long, 1 meter high and at 1.5 meters from sea level.

No signs of otters were found at the two caves of Feia Island. The first opens to the south, 8 meters wide, 60 meters long, 3 meters high and at 2.5 meters from sea level. The second opens to the north, 6 meters wide, 30 meters long, 4 meters high and at 2 meters from sea level.

The lagoon habitat is formed by a calm and shallow water body that maintains a restricted communication with the sea, with a salinity that can vary from almost fresh to hypersaline. This habitat is found only at Siriú Island. This is a small oval lagoon, 36 meters wide, 10 meters long and 1.50 meters deep, located in the center of the island and surrounded by rocks. The water of this lagoon is formed by mixing of rainwater with seawater that penetrates through a gap of 31 m located on the floor at the east side of the island. Three species of crabs were found in the lagoon: *Chasmagnathus granulata* and *Callinectes sp*. Only two species of vertebrates were found in the lagoon: *Larus dominicanus* and *Lontra longicaudis*.

The stream habitat is a small perennial water flow. Two streams were found on Arvoredo Island. One is approximately 550 m long and the other is approximately 1100 m long. Both are perennial and completely hidden in the Atlantic Forest that covers the island. The waters of the two streams are limpid, flowing through rocks, gravel and fallen logs. There were no fish but the crustacean *Macrobrachium sp* is common. This crustacean is one of the favorites in the diet of neotropical otter (Carvalho-Junior, 2010b). Signs of *Lontra longicaudis* were found at the longer creek.

The buildings habitat is the one constructed by man. It consists of houses, cottages, restaurants, fortifications, sheds, lighthouses, piers, water tanks, septic tanks, solar panels, stairs, walls, bathrooms, toilets, walkways or some kind of ruin. Among the islands surveyed, 11 exhibited some type of building. The island containing the smallest constructed area is Mata-Fome: a shack of 6 m^2. The island with the largest constructed area is Campeche, with 2 restaurants, 6 houses, a lodge, 2 barbecue grills, a bathroom, 2 power houses, a gas tank, 4 water tanks and 3 walkways, summing up all together 1700 m^2. Arvoredo Island presents a lighthouse, 4 homes, a lodge, a powerhouse, 9 solar panels, a fuel shed, a warehouse and 13 water tanks. *Lontra* *longicaudis* was found at Arvoredo and Campeche Islands, but not in the buildings areas.

The Islands and the neotropical otter

Itacolomis Islands are two granitic islands separated by a 30 meter wide channel. They are 6.2 km away from the mainland, approximately 25 and 40 meters high, 40 and 65 meters long respectively, with a total area of 0.52 ha. There are no buildings on these islands. The total coastline is 393 meters; maximum width is 26 and 52 meters each, with steep topography. The islets are used for research, camping and fishing, but not by the neotropical otter.

These islands are located furthest north in relation to the other surveyed islands. The surface of the islands is 62.63% rocky. In the upper areas of the southern promontory we found mainly herbaceous vegetation (31.33%), consisting of grasses and clumps of cactus, *Opuntia sp*, *Guapira opposita* and *Spinacia oleracea*. Shrubs appears only on the northern promontory, formed by groups of *Opuntia sp.*, covering 6.02% of the surface.

Feia Island is situated 4 km southeast of Itacolomis and 2 km from the coast. It is mountainous, has no buildings, the area is almost 11 ha and it is 80 m high. Its coastline of 1194 meters is very irregular and difficult to walk. The island is 500 m long and a maximum width of 375 m, with an area of 10.95 ha. It has 70% of its area covered by vegetation. It is used for research, camping, visitation and fishing. Most of the coastal coastline (6.32% of mesolittoral and 14.43% of supralittoral) presents several vertical cracks. Two of these cracks were considered caves, inhabited by *Streptoprogne zonaris*. *Lontra longicaudis* was not recorded on this island.

Deserta Island has an area of 15.30 ha and is one of the most distant from the coast (15.7 km) and 13.7 km from Santa Catarina Island. The east coast is steep and abrupt with 80 m height and a coastline of nearly 4 km. The island has no buildings. Signs of neotropical otter were found at the west side of the island. The island is covered by 22.22% of clumps of *Guapira opposita*, 27% by herbaceous vegetation of grasses and bromeliads. The remaining area is 15.13% of mesolittoral rocky and 35.63% of supralittoral rocky.

Arvoredo Island is one of the islands where signs of *Lontra longicaudis* were found. It is mountainous, 300 m high, with a length of 3.5 km, 1740 m wide and with a coastline of 10.5 km. It has an area of 324 ha and is one of the largest islands surveyed. This island is located 12.6 km from mainland and 10.7 km from Santa Catarina Island. It presents a variety of environments such as rocky coast, small streams of water, Atlantic Forest, dunes, and buildings, such as lighthouse, houses and sheds.

This island exhibits two unique habitats among all islands surveyed: the Atlantic Forest, which covers 80.76% of the surface of the island, and two perennial streams (0.02%). *Lontra longicaudis* uses both habitats, at the north of the island. No fish were found in these two streams. During the survey, 36 species of vertebrate were found, including *Didelphis aurita*, *Nasua nasua*, *Tupinambis merianae*, *Scinax perereca*, a variety of seabirds (e.g. *Sula leucogaster* and *Fregata magnificens*), birds such as *Egreta thula*, *Butorides striatus*, hawks and forest birds, and domestic species such as dogs and *Capra aegagrus hircus*.

Mata-Fome Island is a small island of 3.49 ha, 40 m high and with a coastline of 1225 m. It is relatively close to Santa Catarina Island (690 m) but 16.4 km away from the mainland. It has a small hut used by fishermen. In the central and highest portion of the island, there is a wetland with *Typha dominigensis*. No amphibians or other vertebrates were found in this habitat. Herbaceous grasses and bromeliads compose the vegetation; however the supralittoral rocky habitat is predominant (48%).

Badejo Island is located 2.4 km southeast of the Mata-Fome Island, 1 km north of the of Santa Catarina Island and 21.2 kilometers from the continent. The island is relatively small (2.84 ha), with steep topography and low altitude (35 m). It is 333 m long, with a coastline of 1168 m and maximum width of 155 m. It is used for research, camping, fishing and leisure. The island is rocky with meso and supralittoral representing 66.89% of the surface. Areas with herbaceous vegetation and shrubs are 33.14%. Vertebrates found on the island were birds (*Sula leucogaster, Coragyps atratus, Milvago chimachima, Milvago chimango, Haematopus palliatus, Larus dominicanus, Sterna hirundinacea, Pitangus sulphuratus, Troglodytes aedon, Zonotrichia capensis*) and one species of lizard *Hemidactylus mabouya*.

Ratones Grande Island is located 4.6 km from mainland and 2.3 km from Santa Catarina Island. It presents an area of 21.22 ha, 1 km long, 280 m wide and 44 m high. The total coastline is 2726 meters, mainly rocky. The island is covered by Atlantic Forest and the main building is a historic building, the Fortress of Santo Antonio, built in 1740. 33 vertebrate species were found, including 53 species of birds, 5 mammals, 5 reptiles and 1 amphibian. Among the mammals were the opossum *D. aurita*, a bat *M. nigricans*, and *Lontra longicaudis*.

Guarás-Pequeno Island was the smallest island with 0.25 ha, 1.7 m height, length of 45 m and a coastline of 512 m. It is situated within the North Bay, 2.4 km from Santa Catarina Island and 4.0 km away of the continent. This island is used mainly for camping and fishing. The only building is a barbecue place. The coastline of the island is rocky with a short sandy beach of 5 meters length. The centre of the island is covered by shrub. Mammals were not found on the island.

Guarás-Grande Island is also located in the North Bay, 2.4 km north of Santa Catarina Island and 3.7 kilometers from mainland. It has 1.1 ha, 5 m height and 171 m length. The west side of the island has small beaches separated by rocks. The east side is mainly rocky with some areas of sand. Buildings on the island include two warehouses, a house, a kiosk, solar panel, two water tanks, one chapel and a barbecue. Most of the original vegetation was replaced by exotic vegetation where chickens and dogs walk freely. Neotropical otter was not found in the island. The island is used for military training.

Xavier Island has an area of 8.71 ha and height of 50 m. The topography is steep and the length of 607 m is almost three times its maximum width (219 m). It is located 3.6 km east of Santa Catarina Island. This island is used mainly for research, camping, leisure and fishing, but there are no buildings. The coast of the island is all rocky with no beaches or springs of fresh water. The northern tip is only slightly higher than the rest of the island, allowing the formation of relatively flat areas, including the largest wetland of all the islands surveyed. The shrub vegetation covers 20.37% of the surface while herbaceous covers 48.82%. The terrestrial vertebrate fauna recorded is represented by 17 species, 14 birds, 2 mammals (*Oryctolagus cuniculus* and *Artocephalus australis*) and an exotic reptile (*Hemidactylus mabouya*).

Campeche Island is mountainous, with 53.56 hectares, a coastline of 5.5 km, 82 meters height, length of 1620 meters and maximum width of 560 meters. It presents rocky shores and a sandy beach of 500 meters long. This island is located 1415 m east of Santa Catarina Island and 16 km from mainland. It is covered by Atlantic Forest. The buildings (seven houses, bathrooms, two restaurants, four water tanks, barbecue places) cover approximately 1700 m^2, 0.31% of the surface of the island. The trees represent 58.51% of the area, followed by shrubs with 11.89%. This island is used for research, fishing, visitation, environmental education, and commerce. In the rocky supralittoral zone, three latrines of the neotropical otter were found. Different species of birds and mammals such as *Didelphis sp*, *Nasua nasua*, *Dasyprocta azarae*, *Mus musculus* and *Arctocephalus sp*. are also part of the fauna in the island.

Cardoso Island is located in the South Bay, 1.5 km away from Santa Catarina Island and 1.23 km from the continent. The relief is undulating and approximately 8 m high, 145 m in length, a coastline of 358 meters, maximum width of 80 meters and an area of 0.78 ha. It is used for signaling, boating, camping, fishing and research. The meso and supralittoral rocky represent 43.22% of the area of the island while herbaceous vegetation covers 56.76% of the surface. The terrestrial vertebrate fauna recorded on the island consists of 13 species, 11 birds, a mammal and an exotic reptile. Signs of *Lontra longicaudis* were not found on this island.

Irmã-do-Meio Island presents an area of 55 ha and a height of 103 m. Atlantic Forest covers 67.60% of its surface. The remaining is 14.75% of shrub distributed on the exposed side (east) and 0.26% of disturbed vegetation located on the north side of the island. The island has no permanent water and no buildings. It is used for fishing, camping and visitation. 33 species of vertebrates, 27 birds, 3 mammals (*Didelphis aurita*, a bat and the neotropical otter), two reptiles (*Tupinambis merianae*, *Hemidactylus mabouya*) and a frog (*Leptodactylus cf. gracilis*) were recorded. Along the nearly 6 km of coastline, in the rocky supralittoral zone, the presence of otters was verified from two latrines and a cave.

Moleques-do-Sul Island has no beaches and no caves. The island has an area of 10.6 ha with maximum width of 275 m. The coastline is 2464 m, with a length of 705 m and 115 m high. It is 14 km from mainland and 8 km from Santa Catarina Island. The island has no fresh water. The rocky area (supra and mesolittoral) covers 32.10% of the surface of the island. It is the only one of the 23 islands surveyed that has all three habitats of native vegetation (trees, shrubs and herbaceous). The vertebrate fauna includes 29 species, 26 birds, one mammal (*Cavia intermedia*) and one reptile (*Amphisbaena sp.*). The island is used for fishing, camping, research and collecting mussels. The neotropical otter was not found on the island.

Coral Island is 4.6 km distant from mainland. It has an area of 31.28 ha, length of 1130 m, maximum width of 406 m, height of 65 m, and a coastline of 3315 m. The terrain is mountainous. It is used for fishing, collecting mussels, visitation, catching birds, camping and nautical signage. The buildings include a lighthouse, a chapel and a staircase. Shrub represents 49.71% of the area and arboreal vegetation 23.60%. There are two wetlands. 35 species were found: 3 mammals (*Didelphis aurita*, *Arctocephalus australis*, *Capra aegagrus hircus*), 27 birds, 3 reptiles and 2 amphibians. Neotropical otter was not found on the island.

Siriu Island is a small island of less than 2 ha, 12 m height, 220 m long and a coastline of 744 m. The distance from mainland is 1167 m. The lagoon is a small body of water in the central part of the island maintained by rain and seawater. The area is used for fishing, camping, collecting mussels, visitation and research. The herbaceous vegetation accounts for 19.19% of the area. The rocky surface covers 79.10% of the island in which 44.33% is supralittoral and 34.77% is mesolittoral. The island is used by the neotropical otter. Otter feces were found in the rocky supralittoral zone. The vertebrate fauna of the island is 14 species, 11 birds, one mammal (the neotropical otter), a reptile and an amphibian.

Batuta Island is situated at 350 m from the mainland, in front of a lagoon (Ibiraquera Lagoon). It is 40 m height with an area of 8.17 ha, length of 343 m, maximum width of 307 m and a coastline of 1210 m. The island is used for fishing, collecting mussels and visitation. The surface is 64.51% shrubs, 5.35% herbaceous and 0.21% disturbed vegetation. There is a cave on the north shore used by the neotropical otter. 29 species wre recorded: 23 birds, 4 mammals, an amphibian and a reptile.

Santana-de-Dentro Island is very close to the continent (82 m). It has 3.72 ha, a coastline of almost 1 km, length of 270 m, maximum width of 172 m and 12 m height. Southeast of the island there is a natural salt-water pool with 7 m diameter and 3 m depth. The island is used for fishing, collecting mussels and visitation. There is no buildings in the area. The herbaceous vegetation covers 53.57% of the island. The other half is rocky (15.83% supralittoral and 30.58% mesolittoral). It was found 12 species, 11 birds and a mammal, the neotropical otter. Signs of the otter were found along the rocky shore.

Santana-de-Fora Island has 4.59 ha and is located 540 m from the mainland. It is 25 m height, with a coastline of 1155 m, 277 m of length and width of 197 m. The island is used for fishing, visiting and collecting mussels. There is only one house in the island. The rocky supralittoral represents 28.84% of the area and herbaceous vegetation covers 54.24% of the island. The supralittoral rocky is also used by the neotropical otter. Besides the otter, 14 species of exotic birds and a reptile were recorded.

Araras Island is an island with nearly 10 ha, 779 m in length, maximum width of 155 m, maximum height of 44 m and a coastline of 2512 m. This island is used for fishing, collecting mussels, research and visitation. There is a lighthouse and a cottage. The vegetation is predominantly shrub (27.52%) and herbaceous (13.94%). The rocky supralittoral occupies 40.33% of the island, followed by rocky mesolittoral with 15.63%. 19 species, 14 birds, 4 mammals and one reptile were recorded. Signs of neotropical otter were not found.

Tacami Island is one of the smaller islands (0.73 ha and 377 m coastline), 9.6 km away from the continent. It has a length of 87 m, maximum width of 53 m and 15 m height. It is used for fishing. The herbaceous vegetation occupies only 13.78% of the surface while the rocky area represents 86.21% of the island. Only five species of birds have been recorded. Signs of neotropical otter were not found on the island.

Lobos Island has 8.7 ha, height of 20 m, 400 m in length and maximum width of 284 m. It has a coastline of 2 km and is 3.7 km away from mainland. It is used for fishing, collecting mussels and camping. The island has a lighthouse for boating signage. There are two dominant habitats, the rocky supralittoral (41.98%) and vegetation (40.79%). 12 species, 10 birds, a mammal and an exotic reptile were recorded. Signs of neotropical otter were not found in this island.

Finally, the **Ilhota Island** has an area of 2.38 ha and it is 15 m high. Has a length of 233 m with a maximum width of 147 m and coastline of 947 m. It is located 156 m from the continent. It is used for fishing, collecting mussels, camping and research. The supralittoral rocky represents 44.13% of the total area while the mesolittoral rocky is 30.51%. The vegetation is predominantly shrub (22.62%) and herbaceous (2.72%). 21 species, two mammals and 18 species of birds were recorded. Signs of neotropical otter were not found on this island.

Therefore, from the total number of islands visited, 9 (39%) showed signs of otters: Arvoredo, Campeche, Deserta, Ratones-Grande, Irmã-do-Meio, Siriú, Santana-de-Dentro, Santana-de-Fora e Batuta (Figure 4). Table 2 shows the main habitats in the islands where signs of otters were found.

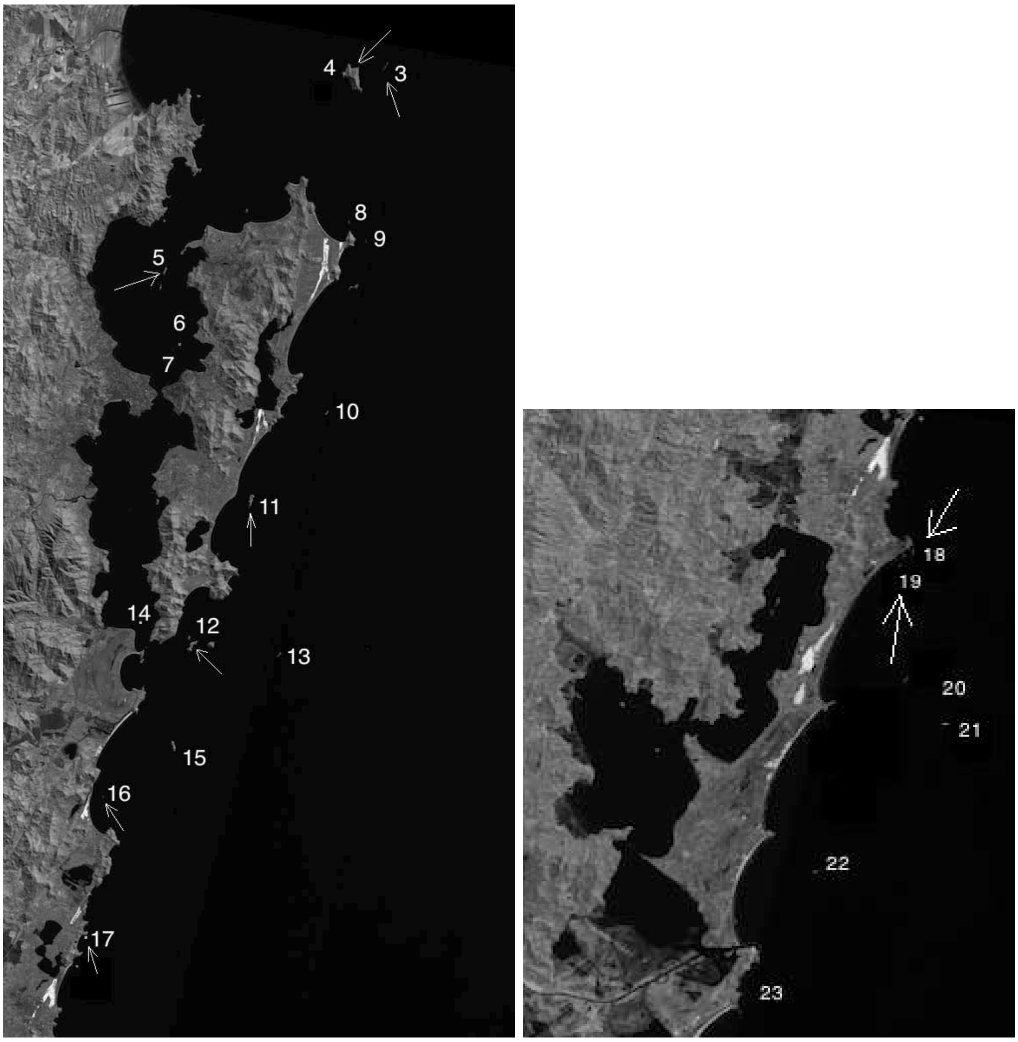

Figure 4. Islands where presence of the neotropical otter was recorded.

Table 2. Islands where signs of neotropical otters were present and main habitat characteristics.

	Island	Characteristics
3	Arvoredo	Atlantic Forest, fresh-water, caves
4	Deserta	Shrub and herbaceous vegetation
5	Campeche	Atlantic Forest, fresh-water, caves
9	Ratones-Grande	Atlantic Forest
12	Irmã-do-Meio	Atlantic Forest
15	Siriú	Herbaceous vegetation
18	Santana-de-Dentro	Herbaceous vegetation
19	Santana-de-Fora	Herbaceous vegetation
20	Batuta	Shrub and herbaceous vegetation, cave

DISCUSSION

Altogether, 98 species of vertebrates were recorded on the 22 islands surveyed: 75 birds (76.53%), 14 mammals (14.28%), 6 reptiles (6.1%) and 3 amphibians (3%). The neotropical otter appeared in 9 islands. Places where otters were observed were mainly related to the interface between sea and land.

The presence of otters was related to the rocky supralittoral zone associated with Atlantic Forest, caves and fresh-water (Arvoredo and Campeche Islands), to Atlantic Forest (Ratones-Grande and Irmã-do-Meio Islands), to shrub and herbaceous vegetation (Deserta Island), to herbaceous vegetation (Siriú, Santana-de-Dentro and Santana-de-Fora Islands), and to shrub, herbaceous vegetation and cave (Batuta Island).

The presence of the otter on these islands can be related to favorable conditions for the animal for short periods of time throughout the year. It can be also related to the ability of the species to perform short distance movements from promontories to islands and from islands to islands, parallel to the coastline. Rivers, lakes and lagoons, located in mainland, might play an important role on these movements, as protection, fresh water and food availability for the animal. Although there are no fish inland on the islands, neotropical otters should benefit from marine fish along the coast of the islands. In this case the supralittoral zone can be used for resting between hunting activities.

Therefore, the presence of otters on these islands might be associated with the availability of supralittoral substrate, caves, freshwater and vegetation. Characteristics of the islands, combined with rivers, lakes and lagoons in mainland, might be representing a large ecological corridor for neotropical movements, facilitating the contact between subpopulations along the coast.

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RÉSUMÉ

DISTRIBUTION DE LA LOUTRE A LONGUE QUEUE, *Lontra longicaudis* (OLFERS, 1818) (MUSTELIDAE), SUR LES ILES COTIERES DE SANTA CATARINA, SUD DU BRESIL

Ce travail présente la répartition de la Loutre à longue queue (*Lontra longicaudis*) sur les îles côtières de l'Etat de Santa Catarina. Vingt-trois îles ont été prospectées à partir de 46 circuits. La Loutre est présente sur 9 îles soit 39% des îles étudiées. Il est probable que *Lontra longicaudis* utilise ces îles comme étape durant ses déplacements d'un point à un autre. Ces résultats pourraient indiquer la présence d'un corridor écologique marin utilisé par la Loutre à longue queue.

RESUMEN

DISTRIBUCION DE LA NUTRIA NEOTROPICAL, *Lontra longicaudis* (OLFERS, 1818) (MUSTELIDAE) EN ISLAS COSTERAS DE SANTA CATARINA, SURESTE DE BRASIL

Este trabajo presenta la distribución de la nutria (*Lontra longicaudis*) en la zona costera de las Islas del estado de Santa Catarina. Esta investigación incluye 23 islas, a través de 46 áreas. Las nutrias están presentes en 9 islas, que representan el 39% de todas las islas estudiadas. Es probable que *Lontra longicaudis* pase sobre las islas durante sus movimientos de un punto a otro. Estos resultados podrían indicar la presencia de un corredor ecológico marino utilizado por las nutrias neotropicales.

RESUMO

DISTRIBUIÇÃO DA LONTRA NEOTROPICAL, *Lontra longicaudis* (OLFERS, 1818) (MUSTELIDAE) EM ILHAS COSTEIRAS DE SANTA CATARINA, SUL DO BRASIL

Este estudo apresenta a distribuição da lontra neotropical (*Lontra longicaudis*) em ilhas costeiras do Estado de Santa Catarina. O total de 23 ilhas foram amostradas em 46 expedições. Sinais de lontras foram encontrados em 9 ilhas, representando 39% do total. Acredita-se que a *Lontra longicaudis* utiliza estas ilhas como apoio para deslocamento de um lugar para o outro. Os resultados podem estar indicando a existência de um corredor ecológico utilizado pela lontra neotropical.

R E P O R T

A QUALITATIVE ASSESSMENT OF *Lontra longicaudis annectens* AQUATIC HABITATS IN ALVARADO, MEXICO

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Abstract: A laboratory screening study following USEPA SW-846 test methods allowed the detection of organic compounds in the aquatic habitat of the Neotropical river otter (*Lontra longicaudis annectens*), in the Alvarado Lagoon System, Veracruz, Mexico. The compounds detected included 2-chlorocyclohexanol, phenylethylene glycol, benzophenone, ethanol-2-butoxyphosphate, styrene, *p*-xylene, ethylbenzene, *trans*-1,2-cyclohexanediol, di-2-ethylhexyl phthalate, benzeneacetaldehyde, hexadecane, tetracosane, docosane, triacontane, sitosterol, hexadecanoic acid, 1-eicosanol, chlorobenzene, and phosphorothioic acid trimethyl ester. Literature review showed a lack of data on the compounds´ potential effects on wildlife, although some of them could be considered harmful to the otters and their prey. The different compounds detected needs follow-up.

Keywords: *Lontra longicaudis annectens*, aquatic habitat, organic compounds, Alvarado Lagoon System.

INTRODUCTION

The number of reports indicating the presence of *Lontra longicaudis annectens* in Mexican habitats increased in recent years (e.g., Maldonado and López-González, 2003; Carrillo-Rubio and Lafón, 2004; Guerrero-Flores et al., 2007; Macías-Sánchez and Hernández, 2007; Gallo Reynoso et al., 2008; Silva-López, 2009). However, little is known on the quality of the otter's aquatic environment. Some information has been presented by Gallo-Reynoso (1997), emphasizing that high concentrations of heavy metals such as lead, aluminum, zinc and tin, as well as organic chloride pesticides and its metabolites, are a major hazard to the otter's prey species, thus increasing the risks to *Lontra* due to the potential mixture effects of such elements. Records and observations confirming the otter's presence in the Alvarado Lagoon System, Mexico (Silva-López, 2009), underline the importance of evaluating its habitat and population, especially as regards to its aquatic environment. In a joint effort between our institutes and research unit, we conducted a laboratory screening study of water samples from eight lagoons of the complex, with the aim to detect organic compounds that may pose an environmental hazard to the otter and their prey. All of these lagoons are located along the Río Acula, which is allegedly far from the influence of the Rio Blanco and the pollutants this river carry from the upper-river, industrialized, highland cities of the interior .

METHODS

Study site

Water samples were obtained from the Clavellinas (13.13 ha), Tlalixcoyan (1,192 ha), La Flota (206.37 ha), Tacosta (86.21 ha), Sontecomapan (503.03 ha), Pajarillos (746.33 ha), Las Pintas (483.29 ha), and Alvarado (4,895.43 ha) lagoons. They all have been the object of several studies (e.g. Contreras E. and Castañeda L., 1995; Sauceda-Rodríguez, 1998; Sauceda-Rodríguez and Juárez-Eusebio, 1998; Contreras-Espinosa, 2010; Sauceda-Rodríguez and Silva-López, 2002; Gutiérrez-Mendieta, in prep.), especially as regards to the fishes and their physical-chemical parameters. The lagoons form part of the Alvarado Lagoon System, which is considered an area of critical importance by CIPAMEX, CONABIO (e.g., Arriaga-Cabrera et al., 1998, 2000), and the Ramsar Convention (Portilla-Ochoa et al., 2007). Several landscape units (LU) were recognized in the system (e.g., Silva-López, 2009); the Alvarado Lagoon forms part of the M1 (disturbed mangrove), while the remaining lagoons form part of the M2 (conserved mangrove) LU (Figure 1). The surrounding main vegetation type in the lagoons is the mangrove, with *Rizophora mangle*, *Laguncularia racemosa,* and *Avicennia germinans* as the dominant species, accompanied by small, dispersed populations of esparto (*Spartina spartinae;* pl. espartal), a halophyte and saline grass species. Other species present include: the palms *Sabal mexicana*, *Scheelea liebmannii*, and *Coccos nucifera*, near the few small villages; *Cyperus* sp. and *Typha dominguensis* as part of the aquatic flora; and *Pistia stratiotes* and *Eichhornia crassipes*, which in certain months of the year occur in massive concentrations on the water surface.

Analyses were conducted at the Analytic Resolution Support Services´ Unit from Universidad Veracruzana (SARA, by its initials in Spanish), at Xalapa, Veracruz, Mexico. Extractions using a liquid-liquid extraction method were performed on the water samples. Extraction was done by mechanical shaking with methylene chloride using the modified EPA 8270B SW-846 method (USEPA 1986). Extraction was carried out with a 50 mL aliquot of dichloromethane in a 1 L separatory funnel, and the process was repeated two more times with fresh solvent. The extracts were concentrated by evaporating the solvent; a 1 mL final aliquot was collected for qualitative analysis with GC-MS in a gas chromatograph (Hewlett-Packard GCD PLUS G1800-B) and HP-5 capillary column (5%-phenyl)-methylpolysiloxane (30 m; 0.25 mm i.d.; 0.25 μm film thickness). Oven temperature was held at 50°C for 1.0 min, ramped to 280°C at 20°C/min and held for 1.0 min, a helium flow rate of 1.0 mL/min. Each component was identified on the basis of its retention time and by comparing its mass spectrum (70 eV) in the HP-Chemstation-NIST MS, versión A.00.00-1995 library.

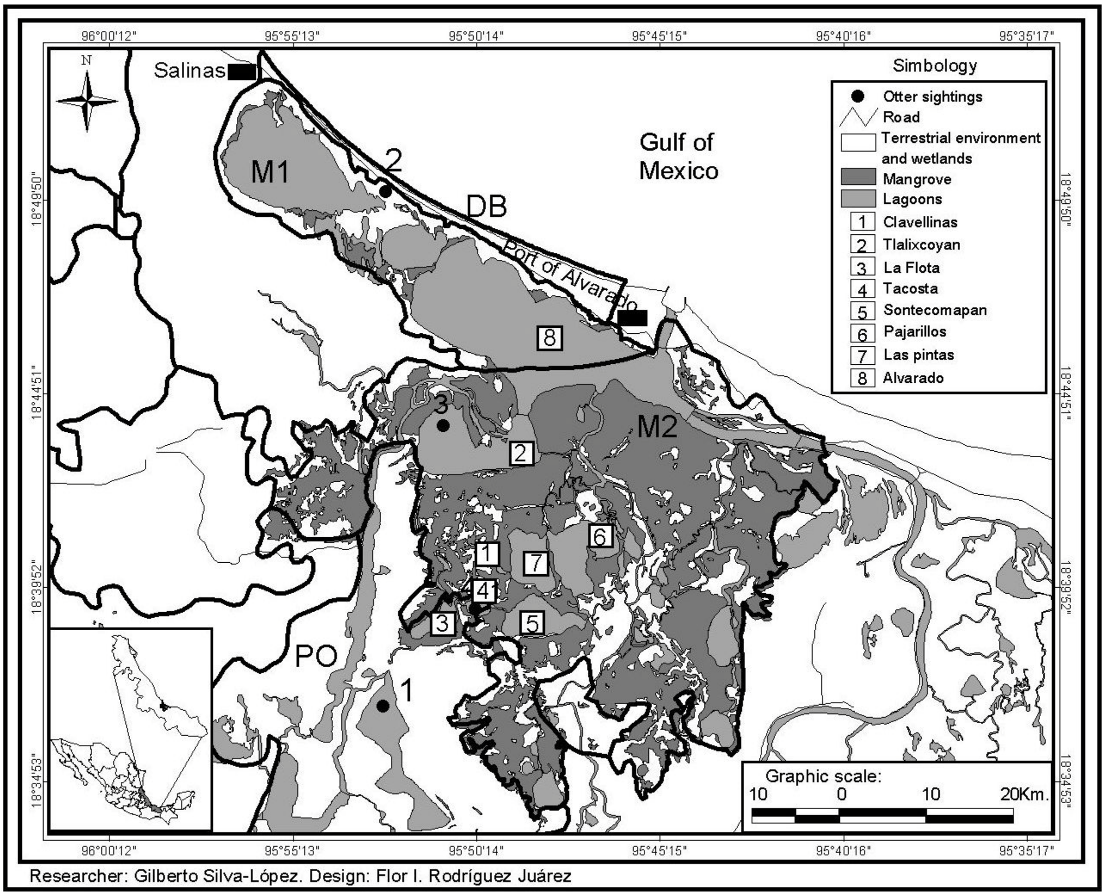

Figure 1. Water samples were taken from eight lagoons (numbered white squares) of the Alvarado Lagoon System. They all belong to the M1 (disturbed mangrove) and M2 (conserved mangrove) landscape units (base map modified from Silva-López, 2009).

RESULTS AND COMMENTS

The compounds found in the samples included: 2-chlorocyclohexanol; phenylethylene glycol; benzophenone; ethanol-2-butoxyphosphate; styrene; *p*-xylene; ethylbenzene; *trans*-1,2-cyclohexanodiol; di-2-ethylhexyl phthalate; benzene acetaldehyde; hexadecane; tetracosane, docosane, triacontane; sitosterol; hexadecanoic acid; 1-eicosanol; chlorobenzene; and phosphorothioic acid trimethyl ester. These compounds may enter the environment through a wide variety of potential sources including water chlorination products, the disposal of products that contain them (*e.g.*, automotive antifreeze, as in the case of phenylethylene glycol), resins and herbicides, oil and gas byproducts, tints, insecticides, paints, softeners and plasticizers, fuels, latex, plastics, fats and fat removers, lubricants, cosmetics, and so on.

In reviewing sources of information on these compounds (*e.g.*, from the US Center for Disease Control and Prevention, the US Environmental Protection Agency, and the European Chemical Bureau, and several papers), we noted a lack of data on their potential effects to wildlife. Information in these reports generally relates to the compounds´ effect on humans, with notes on test results performed on laboratory animals. Nevertheless, information gathered suggests some of these compounds may pose a threat to the otters and their prey. The Pesticide Action Network (http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC35605) has indicated, for example, that the ethanol-2-butoxyphosphate, a compound that may survive treatment at water pollution control plants and at drinking water treatment plants (Henderson et al., 2001), may represent acute toxicity to humans and aquatic organisms. The toxicity of ethylbenzene has also been evaluated in laboratory experiments with the fathead minnow (*Pimephales promelas;* Cyprinidae), causing 50% mortality of the fish (Geiger et al., 1986). The European Food Safety Authority (EFSA, 2009) reported that liver and kidney were the primary target organs of benzophenone toxicity in rats and mice, causing liver adenomas in the mouse and a spectrum of adverse kidney adenoma responses in rat, including hyperplasia and nephropathy. It has been observed that exposure to environmental estrogens (endocrine disruptive chemicals) such as styrene may directly disrupt the male mice reproductive tract around the pubertal period (Takao et al., 2000). While some investigations suggest the actual adverse effects of several compounds can be debated (*e.g.*, Brown et al., 2000), information reviewed suggests more detailed studies regarding the assessment of the risk from exposure to these compounds are warranted.

Among the species that could be potentially affected by these compounds are some animals reported as prey to the otters at other sites (Altamirano-Álvarez, 2011; Gallo-Reynoso, 1997; Santiago-Plata et al., 2007; Platt and Rainwater, 2011; Gallo-Reynoso, 2007), all of which have been reported at the Alvarado Lagoon System (*e.g.*, Raz-Guzmán et al., 1992; Sauceda-Rodríguez et al., 1994; Altamirano-Álvarez et al., 1995; Guzmán-Guzmán, 1998; Cruz-Carretero and Ruelas-Inzunza, 1998)

Previous reports underline the importance of studies on the effects of contaminants to the otter and its aquatic habitat (*e.g.*, Gutleb et al., 1993; Mason, 1993; Röchert, 1989). In our assessment, the detection of ethanol-2-butoxyphosphate, styrene, ethylbenzene, and benzophenone, among others, suggest the threats to the aquatic habitat of the *perro de agua* (local name of the otter) in these landscape units of the lagoon system could be more diverse than expected (e.g., Guentzel et al., 2007). The wide number of different compounds detected needs follow-up; industrial products and byproducts could be harmful to habitat quality in the short-, mid-, and long-term, and they are appearing in the Alvarado Lagoon System at low human population levels (i.e., density of 11.76 inhabitants/km^2 in the M2 LU; Silva-López et al., 2010).

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RÉSUMÉ

UNE EVALUATION QUALITATIVE DES HABITATS AQUATIQUES DE *Lontra longicaudis annectens* A ALVARADO, MEXIQUE

Une étude prospective de laboratoire sur la base des expériences de la USEPA SW-846 a permis de détecter des composés organiques dans l’habitat aquatique de la loutre de rivière Néotropicale (*Lontra longicaudis annectens*), dans le réseau lagunaire d’Alvarado, dans l’Etat de Veracruz au Mexique. Les composés ont été identifiés comme étant: le 2-clorociclohexanol, le phényléthylèneglycol, la benzophénone, le 2-butoxy-1-phosphatoéthanol, le styrène, le *p*-xylène, le *trans*-1,2-ciclohexanediol, le 2-éthylhexylphtalate, le 2-phénylacéthaldéhyde, le *n*-hexadecane, le n-tétracosane, le docosane, le *n*-triacontane, le sitostérol, l’acide hexadecanoïque, le 1-éicosanol, le chlorobezène et triméthylester de l’acide phosphorothioïque. La consultation d’études sur cette question a révélé un manque de données sur les effets potentiels de ces composés dans la vie sauvage, bien que certains puissent être considérés comme nuisibles aux loutres et à leurs proies. L’étude des composés détectés doit être poursuivie.

RESUMEN

UNA VALORACIÓN CUALITATIVA DE LOS HÁBITATS ACUÁTICOS DE *Lontra longicaudis annectens* EN ALVARADO, MÉXICO

Un estudio prospectivo de laboratorio que siguió los métodos de prueba de la USEPA SW-846 hizo posible la detección de compuestos orgánicos en el hábitat acuático de la nutria de río Neotropical (*Lontra longicaudis annectens*), en el Sistema Lagunar de Alvarado, Veracruz, México. Los compuestos detectados incluyeron al 2-clorociclohexanol; feniletilenglicol; benzofenona; etanol-2-butoxifosfato; estireno; *p*-xileno; etilbenceno; *trans*-1,2-ciclohexanodiol; di-2-etilhexil ftalato; acetaldehido benceno; hexadecano; tetracosano, docosano, triacontano; sitosterol; ácido hexadecanoico; 1-eicosanol; clorobenceno; y el trimetil éster del ácido fosforotioico. La revisión de literatura mostró una falta de datos sobre los efectos potenciales de estos compuestos en la vida silvestre, aunque algunos podrían ser considerados dañinos para las nutrias y sus presas. Los compuestos detectados deben seguir siendo estudiados.

OSG MEMBER NEWS

OSG MEMBERS IN THE NEWS

Animal Protector of the Year: Addy de Jong has been nominated as Animal Protector of the Year in an annual event organised by Dierenbescherming , the Dutch animal protection organisation, and television channel SBS6.

http://www.hartvannederland.nl/nederland/2012/dierenbeschermer-van-het-jaar-verkiezing/

NEDERLAND

9 juli 2012 om 07:10

Dierenbeschermer van het jaar verkiezing

Ieder jaar zoekt de Dierenbescherming, in samenwerking met Hart van Nederland, naar mensen die zich het afgelopen jaar extra hebben ingezet voor het welzijn van dieren.

Het publiek nomineert én bepaalt uiteindelijk de winnaar door te stemmen op onze website. Een echte dierenbeschermer is bijvoorbeeld Addy de Jongh. Hij zet zich keihard in voor de otter in Nederland, die jaren geleden nog met uitsterven werd bedreigd.

Wilt u zelf iemand nomineren voor dierenbeschermer van het jaar? Klik dan op deze link

NEW MEMBERS OF OSG

Since the last issue, we have welcomed 7 new members to the OSG:

Giuseppina De Castro, Italy: I have studied *Lutra lutra* since 2004, and developed several research and conservation projects in Abruzzo, Molise and Puglia. Currently, I am collecting data for Laura Lerone's project: non-invasive genetic sampling of *Lutra lutra* in its peripheral Italian range.

Christina Fairbanks, USA: I am currently conducting an ongoing human-dimensions investigation involving the riparian and aquatic wildlife-viewing interest of non-consumptive wildlife related stakeholders. An important aspect of this investigation is focused on public options about river otters. I am also in the process of developing a river otter based curriculum to assist with the education of the public on the importance of aquatic and riparian resource conservation.

Katrina Fernandez, India: I am currently establishing the size and distribution of smooth-coated otter (*Lutra perspicillata*) populations along the river Mahadai/Mandovi, reviewing habitat requirements and developing an outreach program for the conservation of the species and the habitat that they depend on.

Caterina Ferrari, Italy: I am currently responsible of the Otter centre in the Gran Paradiso National Park (Italy). My aim is to help the conservation of otter and its aquatic ecosystem trough the scientific project and education to the public in the centre.

Caroline Leuchtenberger, Brazil: I haved worked with Giant Otters in the Brazilian Pantanal since 2006, on ecology, behaviour and conservation. I am currently looking at relic populations in areas of historical occupation by this species.

Victor Manuel, Costa Rica: I have worked on behaviour and enrichment with captive otters in my native Mexico and in Costa Rica, and also study otters in the wild: carnivorous mammal ecology, conservation biology, predator-prey interactions, habitat selection and ecology in general and keep learning different standardized techniques for monitoring otters. I am currently working on my Masters thesis on modeling potential distribution of Neotropical otters in Costa Rice.

Joel Mendoza, Peru: I am responsible for monitoring and doing otter censuses in the Madre de Dios Region, and I work to promote the conservation of Giant Otters involving local people of Madre de Dios.

Juliana Quadros, Brazil: I am a biologist, with masters degree and doctorate in Zoology, professor of the Universidade Federal do Paraná, Brazil. I am a specialist in mammalian tricology and an otter researcher, developing studies on neotropical otter distribution, ecology, and conservation

Marcia Sittenthaler, Austria: In my studies in Wildlife Ecology and Wildlife Management I have specialised in aquatic ecosystems and conflict species – investigating predator-prey relationships focusing on Eurasian otters (Lutra lutra), fish stocks and fishery management strategies in riverine otter habitats. I have experience in noninvasive genetic monitoring by analysing otter spraints for otter census and I am also interested in conservation genetics, monitoring otter mortality, field methods, international conferences and workshops on otter research.

Douglas Trent, Brazil: I am a professional photographer, and work with various agencies to document wildlife population baselines and direct biodiversity surveys for parks and reserves in Brazil. I also publish on biodiversity, conservation and sustainable community development. The government wishes to protect a large region of the Paraguay River in the Pantanal, which is home to Giant and Neotropical Otters, and I am working on the documentary evidence needed to achieve this.

Irene Weinberger, Switzerland: In my PhD thesis, I work on the Eurasian otter and its habitat und resource use in the alpine habitat. Data are gathered in a radio-tracking study of otters over the course of 2 1/2 years in the Austrian Central Alps. This study will help to increase knowledge on otters in such a habitat but also to model distribution in still abandonend areas where the species was once abundant.

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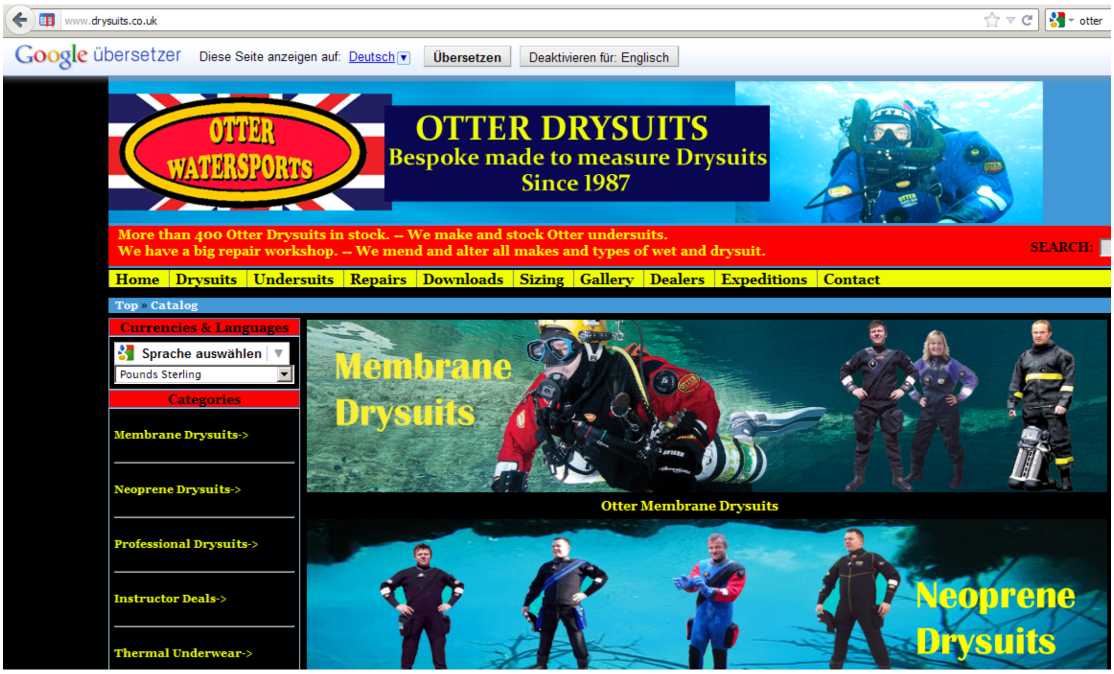
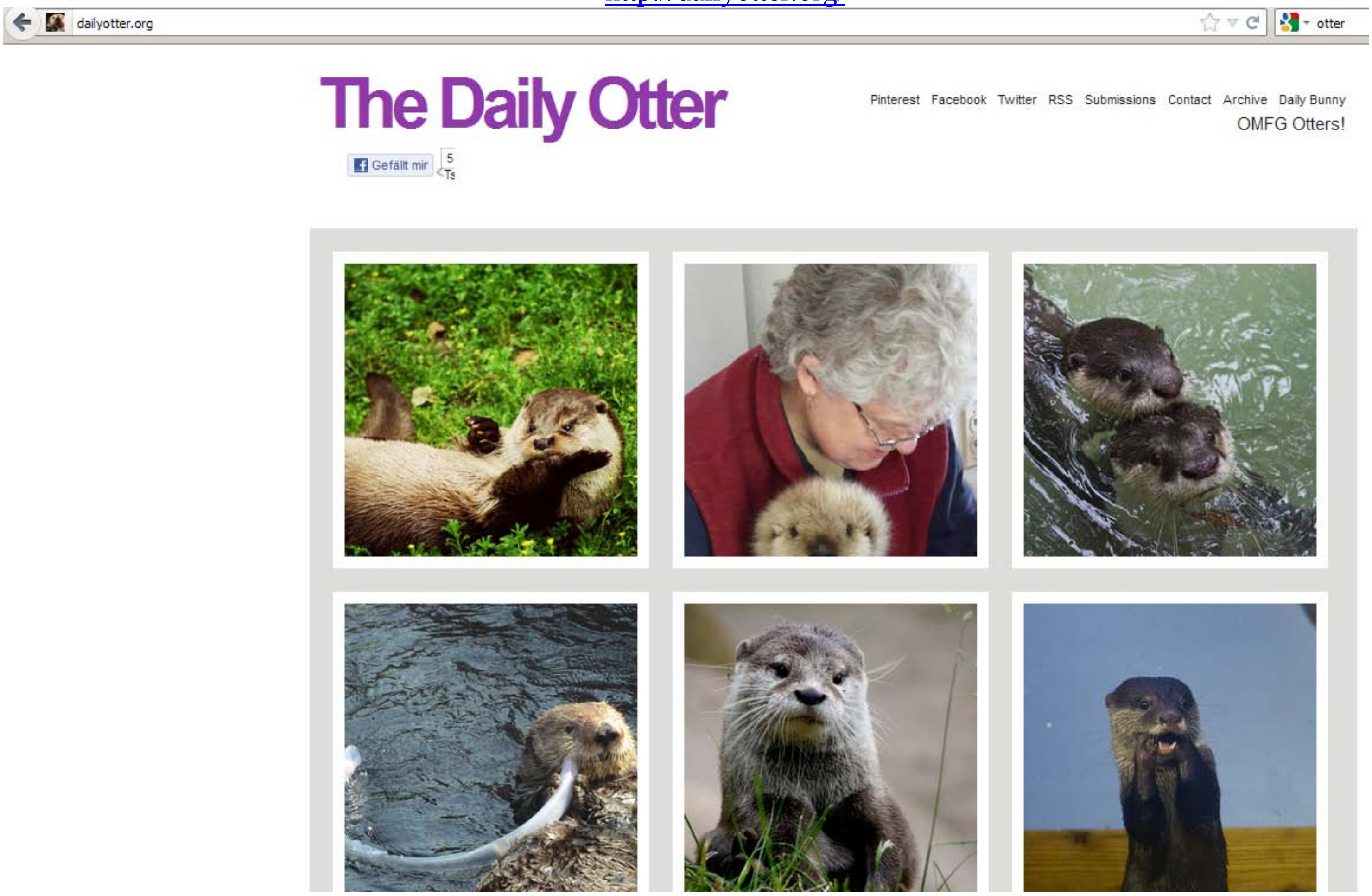
SCREEN SHOT OF THE MONTH



http://dailyotter.org/



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