IUCN OTTER SPECIALIST GROUP BULLETIN
VOLUME 20 ISSUE 1 PAGES 6 - 18

Citation: Alarcon, G.G. and Simões-Lopes, P.C.. (2003) Preserved Versus Degraded Coastal Environments: A Case Study Of The Neotropical Otter In The Environmental Protection Area Of Anhatomirim, Southern Brazil . IUCN Otter Spec. Group Bull. **20**(1): 6 - 18

PRESERVED VERSUS DEGRADED COASTAL ENVIRONMENTS: A CASE STUDY OF THE NEOTROPICAL OTTER IN THE ENVIRONMENTAL PROTECTION AREA OF ANHATOMIRIM, SOUTHERN BRAZIL

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(received 21st March 2003, accepted 25th August 2003)

Abstract: In Brazil, the data available on the ecology of the Neotropical otter in marine-coastal areas are scarce. The relationship between their spraint and environmental quality has been little studied. The Environmental Protection Area (APA) of Anhatomirim extends over about 12 km of the North Bay of Florianopolis. In this area two studies were carried out, one in May/August 2000 and the other from January 2001 to January 2002. In the first stage, otter signs and environmental characteristics were registered; the spraints were collected and the rivers and sign sites were georeferenced. In the second stage, a preserved and a non-preserved strip with high anthropological influence were inspected periodically. The methodological procedure was the same as that used in the first stage. Along preserved rivers (13%), footprints, excavations and burrows were all found, whilst at rivers with a low degree of degradation (41%), both footprints and excavations were found but not burrows. Of the 474 spraints collected, 60% were from the preserved area. In the degraded area, 37% of the spraints were located in a strip between 100 and 150m from an urban nucleus. In the coastal area of this APA, the Neotropical otter is very flexible with a high capacity to survive impacts, since these don't directly affect the trophic chain and impede the making of burrows.

INTRODUCTION

The Neotropical otter *Lontra longicaudis* (OLFERS, 1808) is the Lutrinae species with the largest distribution in Latin America, occurring from Mexico to northern Argentina (MASON, 1990). Over most of its distribution area, and especially in the Amazon and Pantanal, it cohabits with the giant otter, *Pteronura brasiliensis* (CHEHEBAR, 1990).

In Brazil, studies on this species are usually related to diet and habitat use in fluvial environments. A relationship between the distribution of otters spraints and environmental factors has been reported in some studies (BLACKER and SOLDATELI, 1996; PARDINI, 1996), although none of these has compared the use of preserved and degraded areas as habitats, nor have they studied this species in marine-coastal environments.
A correlation between the presence of *Lutra lutra* signs and a good state of conservation of forested areas has been reported by MACDONALD and MASON (1985) in Greece and by NORES et al. (1990) in Spain, although the latter authors also verified the presence of otters signs in waters with a low index of contamination. The use of spraints as a factor of species abundance in a population is still under debate and clearly needs more research (KRUUK et al., 1986). Among the main problems of using spraints as indicators of a population's status is the variation in the number of spraints through the year (CONROY and FRENCH, 1987). MACDONALD and MASON (1987) affirm that seasonal fluctuation in the number of spraints can interfere in the interpretation of field data, however, they suggest that there is a relationship between the marking level and the success of a population, with fragmented populations leaving less spraints than healthy populations. Among the main threats to Southern American otters are aquatic pollution, deforestation along riverbanks and drainage of rivers for agriculture and pasture (CHEHEBAR, 1990). Human disturbances caused by the use of motorboats have also been mentioned as threats to the populations of otters in Brazil (OLIMPIO, 1992; PARDINI, 1996).

According to the International Union for the Conservation of Nature (IUCN, 2000), the status of the Neotropical otter is unclassified due to 'insufficient data'; whilst in Brazil, it is considered as 'threatened

with extinction' The present study intends to supply information on the ecology of Neotropical otters in coastal habitats, as well as evaluate the anthropogenic influence and threats to their natural habitats.

STUDY SITE

The Environmental Protection Area (APA) of Anhatomirim is located in the district of Governador Celso Ramos, Santa Catarina, Brazil. It has a total area of 4,750 hectares, divided into terrestrial and marine habitats (Fig. 1). The coastal zone comprises 11,950m of rocky coasts, 10 sandy beaches and 22 streams. The presence of marine aquaculture close to urbanized areas is common. The terrestrial zone has a mountainous relief, with altitudes up to 445 m.a.s.l. The dominant vegetation is Atlantic Rain Forest and a great part of it has already suffered some type of human intervention, although the secondary advanced stage is still dominant. In the plains, increases in urbanization and agriculture are causing the degradation of mangroves and increasing water pollution.

The climate in the area is humid with temperatures varying between 12-14 °C in the winter and 24-26 °C in the summer. The rains are abundant and well distributed through the year, with a more humid period in the summer and a drier period in the winter. The average annual rainfall is 1,467 mm.

The preserved area, monitored in the present study, comprises 2.85 km of rocky coast with a small beach 20 m long. The Atlantic Forest reaches the sea through its entire extent. There is only one small stream and two constructions along the coast.

The degraded area extends for 3.0 km, with five urbanized beaches. Many constructions occupy the coastal zone and 80% of the streams are altered.

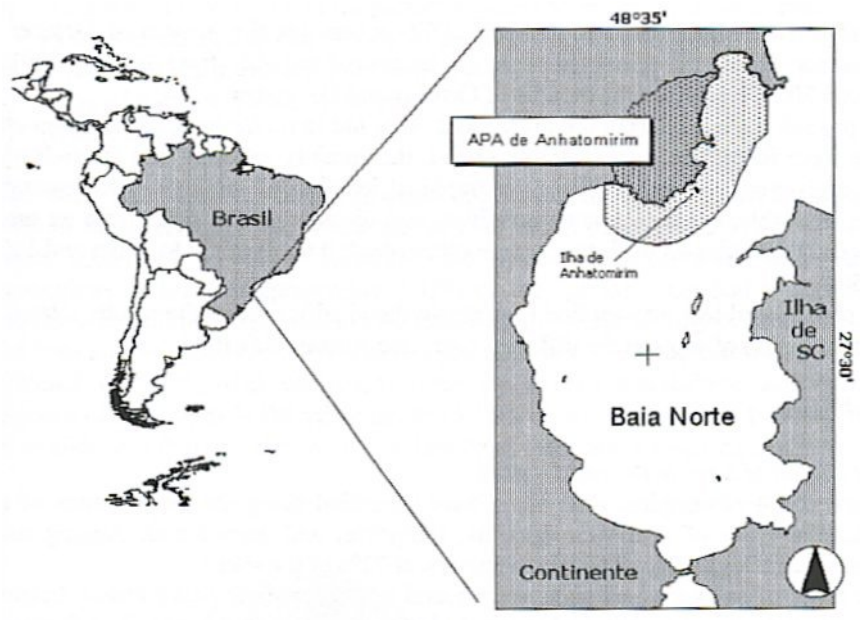

Figure 1. Geographical localization of the APA of Anhatomirim, Southern Brazil

METHODOLOGY

Distribution of otter signs along the coastal zone
From May to August 2000, meticulous searches were carried out on foot along the coastal zone of the APA. When an otter sign was found, the following data were taken: description of the sign, geographical location (global positioning system-GPS) and environmental characterisation of the sign site. The spraint sites identified were classified as natural shelters (burrows) or rocky areas as only these two categories were found in these habitats.

The streams were classified into three categories: *Preserved stream* - characterised by the presence of clean water with conserved forest along the stream banks; *Low degradation stream* - water seemingly

not polluted, natural or altered stream path, altered stream bank forest, presence of trash; *High degradation stream* - water polluted, presence of trash, stream bank forest and the natural course of the stream altered. The adopted criteria were visual analysesof the water quality, without biochemical analysis, along with an assessment of the potential for inputs upstream.

Monitoring of signs in preserved and degraded areas
After identifying the sites with occurrence of otter signs along the coastal zone of the APA, two areas with distinct characteristics were selected for monitoring. The area under the influence of human activity, evaluated as a degraded area, was monitored monthly from March 2001 to January 2002, except for the months of October to
December; whilst the preserved area was monitored monthly from January 2001 to January 2002, except for the months of October and December.

The procedures used during the inspections were the same for both areas. When otter signs were found, the signs were described, the spraints collected and the following data registered: substratum type; geographical location of the sign site; vegetation cover available; types of human activities; and distance of the signs from an urban nucleus. Three classes of distance were established: 0 to 50 m, 50 to 100m and 100m to 150m.

The chi-squared test was applied to evaluate the significance of the results related to the distribution of signs in the different areas and streams classified.

RESULTS

Distribution of signs in the coastal area
A total of 50 Neotropical otter signs were identified along the coastal zone of the APA. The types of sign were spraints, footprints, and excavations. Among these signs, spraints were more frequent, occurring at 72% of the sites.

Four types of habitat where signs were found were identified: rocky coasts, burrows (natural shelters among the rocks), sandy beaches and stream banks. The footprints and excavations accounted for 28% of the signs and were present on the beaches, stream banks and, less often, in burrows (Fig. 2). Among the spraint sites, 58%
occurred on rocky coasts and 42% in burrows.

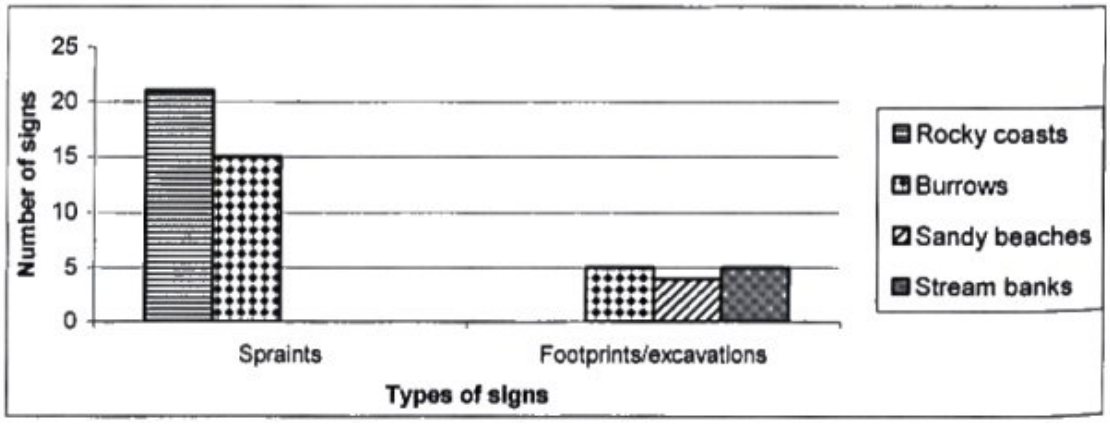

Figure 2. Types of coastal habitat at Neotropical otter sign sites

Characterization of macro-habitats
The types of habitat identified along the coastal zone were:

a. areas with a high degree of urbanization (urban nucleus): characterized by a high density of constructions, degraded streams and trash

b. areas with a low degree of urbanization (areas of urban expansion): characterized by the presence of few constructions and less degraded streams
c. areas under marine aquaculture influence
d. areas with preserved forest covering
e. pasture areas

The areas with preserved forest, representing 39% of the coastal zone, accounted for 44% of the otter sign sites, whilst the areas of urban expansion (31% of the coastal zone) accounted for 27%. However, the preserved forest areas under marine aquaculture influence (representing 2.47% of the coastal zone) had a significantly high concentration of sign sites (13%) according to the availability of these habitats in the total area of study ($P<0.05$). These signs occurred where the coastal zone was not polluted with discarded equipment from the marine aquaculture activities. The absence of otter signs in the urban nuclei (5.75% of the coastal zone) had a high level of confidence ($P<0.05$), due to the availability of these areas along the coast.

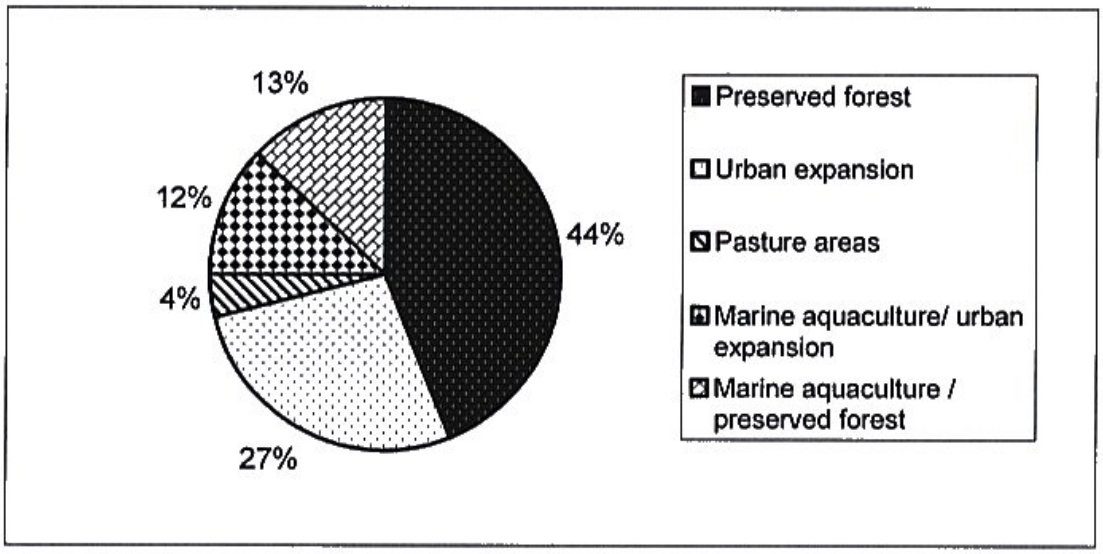

Figure 3. Distribution of otter sign sites in the different types of area

Characterization of the streams
Twenty-two streams along the coastal zone of the APA were found. Among these, 13.6% are considered as preserved, and were characterized by the presence of footprints and burrows. In the streams with a low degree of degradation (41%), burrows were not observed, although footprints and isolated spraints were found. The footprints appeared at 44% of these streams, in a wide area of urban expansion, whilst spraints were found in 22% of streams.

The presence of the otter in a stream with good water quality, but diverted by drainage channels was mentioned, however, by two fishermen, who reported seeing an otter frequently leaving the concrete piping towards the sea early in the mornings.

The absence of otter signs in the streams with a high degree of degradation was highly significant ($P<0.002$). These streams represented 45.4% of all streams found in the coastal zone of the APA.

Monitoring of otter signs in the preserved and degraded areas
The types of signs found differed for each of the studied areas. In the preserved area the most frequent signs were burrows (n=13), and spraints (n=22) and footprints (n=7) in areas of rocky coasts. Eighty six percent of footprints were found on a deserted sandy beach. The footprints in 50% of the cases were along the whole beach, and twice there were footprints from two individuals walking side by side. These footprints led to the ocean or to one small lagoon that has been modified by drainage work. The presence of otters in the lagoon was reported by the only resident of the area. On one occasion the

footprints along the beach led also to spraint sites, although these weren't included in the research results as they were out of the study area. Less frequent signs appeared as isolated mucus on rocks (n=4) and trails amongst vegetation (n=2). Footprints of otter cubs were found at the entrance of a trail in July. Among the 13 burrows identified in the preserved area, just one was within the strip 0-50m from an urban nucleus. A second burrow and 2 spraints in rocky coastal areas occurred 50-100m from isolated houses. All the other signs were found at a greater distance from the urban nucleus and isolated houses.

In the degraded area, the most frequent signs were burrows (n=6) and spraints in rocky coastal areas (n=17). Footprints were only found during two field surveys, whilst isolated mucus on rocks and trails among the vegetation were absent. The largest number of spraints (n=7) was concentrated in areas with forest covering, present within a strip 100 to 150m from the urban nuclei. In the strip at 0-50m, 2 spraints were found in rocky coastal areas while 5 spraints were found in rocky coastal areas outside the zone, 100-150m from urban nuclei.

Frequency of use of burrows and rocky coastal areas as spraint sites
The pattern of burrow use variation differs for the two study areas, except in April and August when there is a simultaneous fall in the number of burrows used in both areas (Fig. 4).

The frequency of burrow use in the preserved area was higher, with an average of 4.8 and a maximum of 8.0 burrows used per month. On the other hand, in the degraded area, the number of burrows used was lower with little variation through the year, varying between 1 and 3 burrows used per month with an average of 2.5.

The use of rocky coastal areas had a more accentuated variation, reaching a maximum number of 12 sites in July and August in the preserved area, and 10 in June and July in the degraded area.

The maximum number of burrows/km was 5 in the preserved area and 2 in the degraded area; however, the respective number of rocky coastal areas used was higher, 7.8 and 5.6 respectively (Table 1).

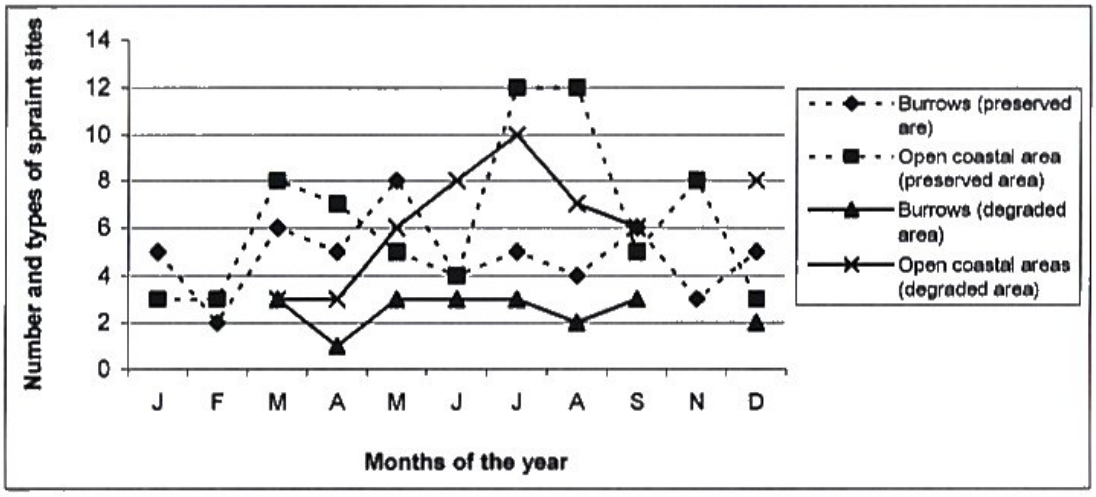

Figure 4. Frequency of use of burrows and rocky coastal areas

Table 1. Total number of burrows and rocky coastal areas used as spraint sites

	preserved area	degraded area
N° of burrows	13	6
N° of burrows/km	5	2
N° of rocky coastal areas	22	17
N° of rocky coastal areas/km	7.8	5.6

Variation in the number of spraints through the year
A total of 474 spraints were collected from the two study areas, 60% of them were located in the preserved area. The burrows presented an average of 2.6 spraints/month in the preserved area and 4.2 spraints/month in the degraded area. In the rocky coastal areas, the average number of spraints was low, with 1.9 and 1.8 in the preserved and degraded areas respectively. The maximum number of spraints found in the burrows and rocky coastal areas in the preserved area was 11 and 14 respectively, in the degraded area, the maximum number of spraints in burrows (10) was greater than that in the rocky coastal areas (8).

The index of spraints per km showed high variation, with a minimum of 1.78 spraints/km in February and 27.5 spraints/km in July (preserved area). For the degraded area, the months of the minimum and maximum variations of the spraints/km index coincided with those of the preserved area, although the values were smaller, with 1.3 for February and 15.6 for July.

DISCUSSION

Spraints, which are used as odoriferous markers, were the main type of otter sign found and, with the footprints, they represent more than 90% of the signs identified in the coastal area of the APA. Spraints are the main tool for the ecological study of several otter species and they have been widely used. Further, footprints, excavations, trails and rest places are frequently mentioned as complementary data (e.g. KRUUK et al., 1986; BLACKER and SOLDATELI, 1996).

In fluvial habitats, excavations and trails among the vegetation have previously been reported for the Neotropical otter (BLACKER and SOLDATELI, 1996; PARDINI, 1996), for *Lutra lutra* (JENKINS, 1981) and for *Lontra provocax* (CHEHEBAR et al., 1986). According to ERLINGE (1968), excavations are always associated with the deposition of spraints or mucus. OLIMPIO (1992) found the same behaviour for the Neotropical otter in a lagoon habitat in Southern Brazil, where 33% of the spraints were associated with excavations. According to KRUUK et al. (1986), in marine-coastal habitats of Scotland, excavations were absent and spraints, footprints and trails among vegetation were the signs used to study populations of *L. lutra*. In Anhatomirim, excavations were always associated with footprints. Some authors consider trails as serving only to access spraint deposition areas (ERLINGE, 1968) or for resting places (PARDINI, 1996). The trails found in the APA probably serve as such access routes to resting places and reproduction sites as the absence of fragments of terrestrial animals in the spraints indicates that they appear not to use that habitat to feed. The presence of cub footprints leading to one trail could also indicate that the females use the trails with their cubs.

In coastal habitats, the rocks constitute the main substratum type used for spraint sites. *Lontra felina* uses natural shelters in the rocky coasts to defecate and to rest (CONAF, 1983) and, in Scotland, *L. lutra* spraint sites are also found on rocky substrate, a great part of these being associated with pools of fresh water (KRUUK et al., 1986, 1989). The use of abandoned houses and boats as spraint sites has also been reported (MACDONALD and MASON, 1980). In the APA, spraint sites were preferentially found on rocks in rocky coastal areas or in natural shelters (62%). The use of abandoned structures was not observed with the exception of the presence of spraints found on a piece of wood.

MACDONALD and MASON (1980), KRUUK et al. (1986, 1989), and PARDINI (1996) all attribute the proximity of spraint sites and burrows to fresh water pools to the necessity of fresh water sources for coastal otters to clean salt from the fur. This pattern was also found for the Neotropical otter in Anhatomirim where, though fresh water pools were practically absent, 32% of streams in the hydrographic basin were regularly used. In this sense, fresh water constitutes an important resource for coastal riving otters in the area and its degradation could compromise the success of the species.

In Anhatomirim, otter signs were widely distributed along the coastal zone. According to the chi-squared test, in spite of its minor representation, the preserved forest/marine aquaculture area had the highest concentration of otter signs per km. On the other hand, areas of urban expansion were also used, accounting for 39% of the signs. Many studies have been carried out in an attempt to evaluate the relationship between the presence of otter signs and the quality of the habitat and level of human disturbance (e.g. MACDONALD and MASON, 1980; GREEN et al., 1984). MACDONALD and MASON (op. cit.) found otter spraints very close to urbanized areas in Scotland. The same authors, researching populations of *L. lutra* in Greece, found no relationship between the number of spraint sites and the areas with preserved forest covering (MACDONALD and MASON, 1985). CHEHEBAR et al., (1986) and PERRIN and CARUGATI (2000) reported contrary patterns for *L. provocax* and *L. maculicolis*, where they found a direct correlation between the presence of spraints and the conservation state of the forest areas. For the Neotropical otter, there are few studies relating to the presence of spraints and the conservation state of a certain area, in southern Brazil, *L. longicaudis* uses deforested passages along rivers and areas with human disturbances, although this behaviour has been attributed to the proximity of human influence to the protected areas (PARDINI, 1996). In Anhatomirim, the occurrence of spraint sites in areas with little forest covering was 13%, located within the 0-50m strip from urban nuclei, but 56% were still located in a strip between 100-150m from urban nuclei.

The different patterns of otter presence in areas under human influence can be related to the type of urbanization and to the availability of suitable sites. In Anhatomirim, as well as in lagoon habitats (OLIMPIO, 1992; BLACKER and SOLDATELI, 1996), otters use areas that have a certain degree of urban disturbance. It is difficult to confirm which factors determine the use of disturbed areas but two possible factors include availability of suitable habitat within a disturbed area and the degree of continuous human presence. Suitable sites could be determined by the availability of burrows and other sites that can be used for sign deposition, while the degree of human presence is related to the frequency and type of activity in certain areas. The use of streams modified by drainage work and the presence of burrows in areas close to the urban nucleus in the coastal zone are examples of such cases. However, more intensive study of the characteristics of otter sites in urban or semi-urbanized areas is necessary to clarify these findings.

Marine aquaculture does not adversely affect the pattern of otter presence; in fact, it can provide a more effective feeding site. Indeed, three fishermen have confirmed that otters in the APA feed on the molluscs from the marine aquaculture.

The Neotropical otter on the coastal zone of Anhatomirim has a high flexibility in terms of habitat use. The use of areas under human influence is common when burrows and other sites are available and when urban sites do not have direct and constant use by humans. However, pollution of streams and unorganised urbanization could become serious threats to Neotropical otter populations in the coastal zones in the future.

The use of the number of otter signs to evaluate population density is still under debate. However, according to MACDONALD AND MASON (1986), the number of signs left by otters in a certain area can be used to evaluate the population status, the patterns of activities and habitat preferences. In Anhatomirim, the number of burrows/km was higher in the preserved area (5 burrows/km) when compared to the degraded area (2 burrows/km). The values found in the preserved area resemble those reported by KRUUK et al., (1989) for a population of *L. lutra* in a sea habitat with little human interference, where the authors identified an average of 3.8 burrows/km. The same authors demonstrated that there is a relation between the number of refuges in use and the number of resident otters in an area, affirming that the number of burrows in use is a much more trustworthy index of the otter numbers than the number of spraints. MACDONALD and MASON (1980, 1983, 1985) used the number of spraint sites/km in the evaluation of the conservation state of *L. lutra* in different countries

in Europe, although their data refer to otters in fluvial habitats. During their studies carried out in Scotland they found an index of 0.37 burrows/km and 5.2 spraints/km (MACDONALD and MASON, 1980). These values are low when compared to other studies carried out by the same authors. In Portugal, where the populations of otters were considered quite healthy due to the low use of pesticides, the burrows/km index was 17 and spraints/km, 34.5. In Anhatomirim, the spraints/km index was higher than the burrows/km index, and both presented higher values during the winter months. The average spraints/km index was 9.3 in the preserved area and 7.9 in the degraded area. The seasonal pattern of *L. longicaudis* spraint deposition in the APA was similar to that found by BLACHER and SOLDATELI (1996) in the Conceição and Peri Lagoons, where the number of burrows/km was 3 and 2.8 and the number of spraints/km was 16 and 14, respectively. PARDINI (1996) found an index of 16 burrows/km with the largest number of burrows being used in the winter months. PARDINI (*op.cit.*) affirmed that the number of burrows is a good indicator of the size of the otter population, since this doesn't present much variation through the year, unlike the spraints, with a large seasonal variation, in comparison with these studies, the number of burrows and spraints/km of Neotropical otter populations in coastal habits is not well known, and the comparison between these indices and others from different areas needs to be clarified. The number of burrows used can be influenced by many environmental variables, such as the availability and distribution of suitable sites, weather conditions and other aspects not yet known. In this sense, the use of the number of burrows as indicative of the population status, as suggested by KRUUK et al. (1989) and PARDINI (1996) still needs more research, as along the coastal area of the APA, the numbers of burrows used through the year presented quite high variations. The seasonal variation in the number of spraints has been discussed in many works for L. lutra (e.g ERLINGE, 1968; CONROY and FRENCH, 1987; KRUUK and CONROY, 1987) but less intensively for the Neotropical otter (OLIMPIO, 1992; BLACHER and SOLDATELI, 1996). These authors verified an increase in the number of spraints during the winter, but the explanations are various. MASON and MACDONALD (1980) showed that spraint numbers varied seasonally for *L. lutra*, whilst CONROY and FRENCH (1987), MASON and MACDONALD (1987) and others associate these fluctuations to the changes in behaviour generated by the reproductive cycle. For the Neotropical otter, OLIMPIO (1992) and PARDINI (1996) suggest that the seasonal variations can be related to oscillations in the presence of prey species and, according to OLIMPIO (*op. cit*), to variations in the population density of otters. BLACHER and SOLDATELI (1996) suggested winter as the main season for cub births. In the coastal area of the APA, it was possible to observe a variation in the number of spraints in burrows and rocky coastal areas through the year. The rocky coastal areas, in both study areas, were more used during the months of winter (12 and 10 spraint sites for the preserved and degraded area, respectively). Spraint deposition at burrows was practically homogeneous in the degraded area, while the preserved area presented higher numbers and greater variation. The homogeneity in the use of the burrows in the degraded area could be associated with the low availability of burrows, although a deeper analysis is needed. The increase in spraint sites in the rocky coastal areas during the winter in both study areas could be related to a more effective strategy for intra-specific communication, if winter is considered as the period of yearling cub dispersion, as indicated by BLACHER and SOLDATELI (1996). Nevertheless, data on Neotropical otter reproduction and cub dispersion is scarce and the data found by BLACHER and SOLDATELI (*op. cit*), as in the present study, is very limited. It is also necessary to evaluate the seasonal fluctuations of the spraints with the levels of rainfall, as winter is characterized as a dry season in Brazil. However, meteorological conditions varied greatly in 2001, differing from the normal pattern.

Our data appears to indicate that the Neotropical otter is an adaptable species, capable of making use of all types of habitat, with varying degrees of disturbance, within the Anhatomirim APA. However, there appears to be a clear preference of undegraded forest and river sites with low disturbance and modification, though sites of aquaculture appear to be favoured feeding sites. Not only is there a potential threat of future conflict with fishermen, any future degradation or increase in disturbance of undegraded habitats could become a threat to Neotropical otter survival in the future.

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RÉSUMÉ

ENVIRONNEMENT CÔTIER PRÉSERVÉ OU PERTURBÉ : UNE ÉTUDE DE CAS CONCERNANT LA LOUTRE NÉOTROPICALE SUD-AMÉRICAINE SUR LA RÉSERVE D'ANHATOMIRIM AU SUD DU BRÉSIL

Au Brésil, les connaissances relatives à 1'écologie de la loutre néotropicale en zone côtière sont fragmentaires. La réserve (APA) d'Anhatomirim s'étend sur plus de 12km de long au nord de la Baie de Florianopolis. Dans ce secteur deux études y ont été engagées : durant la première période (mai à aôut 2000), les indices de loutres et les caractéristiques environnementales du site ont été relevés, les épreintes collectées et les sites géoréférencés; durant la seconde période (janvier 2001 à janvier 2002), deux sites particuliers, l'un préservé et l'autre subissant des perturbations d'origine anthropique, ont été prospectés périodiquement, suivant une méthodologie similaire à celle employée durant la la première période. Traces de loutres et excavations sont trouvés à la fois sur des sites non (13%) ou peu (41%) perturbés, mais les gîtes n'existent que dans le premier cas. Sur 474 épreintes collectées, 60% proviennent de la zone protegée. Dans la zone perturbée, 37% des épreintes se situent dans une bande distante de 100 à 150m d'un espace urbanisé. Sur la partie côtière de cette réserve, la loutre semble très souple pour s'adapter à de multiples impacts, dès lors que ces derniers n'ont pas d'effet sur la chaîne trophique et sur 1'aménagement des gîtes.

RESUMEN: AMBIENTES COSTEROS PRESERVADOS VS. DEGRADADOS: ESTUDIO DE UN CASO DE LA NUTRIA NEOTROPICAL EN EL ÁREA DE PROTECCÍON AMBIENTAL ANHATOMIRIM, EN EL SUR DE BRASIL

Las nutrias neotropicales en las áreas costeras son escasas. La relacion entre las heces y la calidad ambiental ha sido poco estudiada. El Área de Protectión Ambiental (APA) Anhatomirim abarca mas de 12 km del norte de la bahía de Florianópolis. En esta área dos estudios fueron llevados a cabo, uno en Mayo-Agosto de 2000 y el otro de Enero 2001 a Enero 2002. En la primera etapa los rastros de nutria y las características ambientales fueron registrados, las heces colectadas, y la ubicatión de los ríos y las heces fueron geográficamente referenciadas. En la segunda etapa, un área preservada y un área sin protección que se encuentra bajo una gran influencia antropogénica fueron inspeccionados periódicamente. La metodologia empleada fue la misma en ambas etapas. En los ríos que se encuentran dentro del área preservada (13%) se encontraron huellas, excavaciones, y madrigueras; mientras que los ríos con un nivel bajo de degradación (41%) presentaron huellas y excavaciones, mas no se encontró ninguna madriguera. De las 474 heces colectadas, 60% se encontraron en el área preservada. En el área degradada, 37% de las heces fueron encontradas dentro la franja ubicada a 100-150 m del núcleo de una zona urbana. En el área costera de esta APA la nutria neotropical es muy flexible puesto que presenta una gran capacidad para sobrevivir a los impactos antropogénicos, ya que estos no afectan directamente la cadena trófica o impiden la construcción de madrigueras.