

# Trophic ecology and the use of shelters and latrines by the Neotropical otter (*Lontra longicaudis*) in the Taquari Valley, Southern Brazil

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**ABSTRACT.** This manuscript presents information about the ecology of *Lontra longicaudis* (Olfers, 1818) in the Taquari Valley, State of Rio Grande do Sul, southern Brazil. The study was carried out in two areas located in the Forquetinha Creek and in the Forqueta River from January to December 2003. The otters are specialist feeders ( $B_{sta} = 0.24$ ), with a diet based mostly on fish, especially those of the families Loricariidae and Cichlidae. Most shelters used by the species were excavated burrows underneath tree roots, while shelters within rocks were used less frequently. The burrows showed great variation in size, being found on average 3.5 m (sd = 3.6 m) away from the margin and 2.5 m (sd = 1.2 m) above the water level. Scent marks were made preferentially on rocks and fallen tree trunks at the edge of the water. There was a tendency to increase the reutilization of latrines in detriment of using new sites throughout the sample period.

**KEYWORDS.** Neotropical otter, feeding habit, scent marking, resting sites, Brazil.

**RESUMO.** Ecologia trófica e o uso de abrigos e latrinas pela lontra Neotropical (*Lontra longicaudis*) no Vale do Taquari, Rio Grande do Sul, Brasil. O presente estudo apresenta dados sobre a ecologia de *Lontra longicaudis* (Olfers, 1818) no Vale do Taquari, sul do Brasil. O trabalho foi realizado em duas áreas localizadas no arroio Forquetinha e rio Forqueta, entre janeiro e dezembro de 2003. A população apresentou hábito alimentar especialista ( $B_{sta} = 0,24$ ), baseado em peixes das famílias Loricariidae e Cichlidae. Os abrigos utilizados pela espécie foram formados em sua maioria, por escavações sob raízes de árvores e, com menor frequência, entre rochas. Os abrigos escavados apresentaram dimensões bastante variáveis, sendo que estiveram em média a 3,5 m (s = 3,6 m) de distância da margem e 2,5 m (s = 1,2 m) de altura em relação ao nível da água. A utilização de marcas odoríferas se deu preferencialmente sobre rochas e troncos caídos na margem, sendo que houve uma tendência de aumento na reutilização de latrinas, em detrimento de novos pontos de deposição de fezes, no decorrer do período amostrado.

**PALAVRAS CHAVE.** Lontra Neotropical, hábito alimentar, marcação odorífera, locais de descanso, Brasil.

Otters are carnivores with semi-aquatic habits found in every continent, with the exception of Antarctica and Australasia (FOSTER-TURLEY, 1990). The Neotropical otter (*Lontra longicaudis* (Olfers, 1818)) is one of the five species of the sub-family Lutrinae living in the Neotropical region. The species is found from Mexico to northern Argentina, and it occurs along the entire Brazilian territory (EISENBERG & REDFORD, 1999). *Lontra longicaudis* inhabits preferentially freshwater environments, such as rivers and continental lakes, although it may use marine and salt-water habitats (BLACHER, 1987).

Studies involving *L. longicaudis* have referred mainly to its diet (HELDER-JOSÉ & ANDRADE, 1997; PARDINI, 1998; COLARES & WALDEMARIN, 2000; GORI *et al.*, 2003; KASPER *et al.*, 2004a, b), to the use of scent marks and shelters (SPÍNOLA & VAUGHAN, 1995; SOLDATELI & BLACHER, 1996; PARDINI & TRAJANO, 1999; QUADROS & MONTEIRO-FILHO, 2002; KASPER *et al.*, 2004a), and to the species distribution (CHEHÉBER, 1985; CHEHÉBER *et al.*, 1996; BLACHER, 1987; REYNOSO, 1997; GORI *et al.*, 2003). Such studies are favoured because of the habit of the Neotropical otter of defecating (sprainting) in conspicuous sites of its home range, a behavior observed in many other otter species. This, in turn, facilitates the determination of areas of occurrence and studies based

on fecal analysis. Therefore, such studies can be conducted, once direct observation is quite difficult, because of the elusive habits of many otter species (MACDONALD, 1990).

The diet of *L. longicaudis* is based on fish and crustaceans, complemented by a variety of other organisms (PARDINI, 1998; COLARES & WALDEMARIN, 2000). There are very few references about the size of prey taken by the Neotropical otter (QUADROS & MONTEIRO-FILHO, 2001; KASPER *et al.*, 2004b). However, it is probable that the species does not dedicate much time attempting to capture large-sized prey. In fact, it seems to show a preference for prey with benthonic habits or relatively sedentary, such as the fishes of the Loricariidae family and crustaceans (KASPER *et al.*, 2004a). These items have been shown to be of great importance in the diet of *L. longicaudis* in different habitats (HELDER-JOSÉ & ANDRADE, 1997; PARDINI, 1998; COLARES & WALDEMARIN, 2000; GORI *et al.*, 2003).

Scent-marking behavior plays an important role for the species, and has been reported by many authors (SPÍNOLA & VAUGHAN, 1995; SOLDATELI & BLACHER, 1996; PARDINI & TRAJANO, 1999; QUADROS & MONTEIRO-FILHO, 2002; KASPER *et al.*, 2004a). The Neotropical otter has the habit of sprainting on rocks and on fallen trunks at the

margins of bodies of water where it lives, and such behavior, common to many carnivores, usually plays a key role in territory marking and in communication among individuals (GORMAN & TROWBRIDGE, 1989).

The use of shelters by the Neotropical otter has also been the subject of some studies (PARDINI & TRAJANO, 1999; QUADROS & MONTEIRO-FILHO, 2002; KASPER *et al.*, 2004a). Such shelters are usually located close to water, and are generally composed by (re-entrances) holes and cavities in the steep banks, above water level. In this paper, we present information on food habits, use of shelters, and scent marking by *L. longicaudis* in the Taquari Valley, southern Brazil.

Although there are several studies regarding the species diet, there are, still, many aspects to be studied, especially when one compares the amount of knowledge, gathered so far, for other otter species. This manuscript intends to evaluate new ecological parameters, such as, niche breadth, as well as to compare the results found in this study with studies undertaken in the past in the same region.

## MATERIALS AND METHODS

The Taquari Valley is located within the coordinates 29°38'22"S, 51°22'22"W and 29°55'12"S, 52°39'10"W, an area of approximately 3,775 km<sup>2</sup>. The vegetation in the region is defined as seasonal deciduous forest with alluvial and sub-mountain formations (IBGE, 1986). The landscape is characterized by the presence of the Forqueta River and the Taquari River, and their many tributaries. The remaining forest is highly fragmented, especially on the plains, near the rivers and streams, where the riparian forest is restricted to a narrow strip, a few meters wide. The main forest fragments are located on the hillsides and on the crests of the hills with great declivity.

The study was carried out in two areas encompassing the municipalities of Lajeado, Forquetinha, Arroio do Meio and Marques de Souza. One of the study areas was located in the final portion of the Forquetinha Creek, the last tributary of the Forqueta River, along a stretch of approximately four kilometers. The other area, about three kilometers long, was located in the Forqueta River, located upstream of the mouth of the Forquetinha Creek.

The study area was divided in two sections, one corresponding to a part of the Forquetinha Creek, and another corresponding to a part of the Forqueta River, which we visited monthly throughout 2003. In each field trip, both margins were examined, in search of shelters and latrines. Once they were found, their structures and localizations were described.

In this study, the term shelter refers to all the cavities that could give some protection against adverse weather conditions, and where otter spraints were found, indicating use by the otter. The composition, structure, site of occurrence, and dimensions of each shelter were described. It was also characterized whether they were excavated burrows or natural burrows, and the degree of degradation of the margins around them. The margins were defined arbitrarily, considering three categories:

“Degraded”, when the margins did not present any arboreal vegetation and showed signs of erosion; “Altered”, when the margins presented arboreal vegetation, but with signs of erosion; and “Conserved”, when the margins presented arboreal vegetation without signs of erosion. Once identified, the shelter was monitored in regard to its use.

The term Latrine was adopted for the description of all the sprainting sites. Latrines were characterized as far as its nature, dimensions and its location in relation to the river banks. Just as for the shelters, each latrine was also monitored for reutilization. Reutilized latrines were considered in every case where new spraints were found in a previously utilized site.

The diet was determined through fecal analysis. Therefore, every spraint collected was washed and sieved (sieve of thin mesh = 0.5 mm) under running water to remove all the soluble material. The resulting items, composed of hard parts of ingested food, were conditioned in individual plastic recipients in a solution of alcohol 70% to be sorted out afterwards. The undigested material was sorted out manually, with the aid of a stereoscopic microscope, and all the structures that could help indicate the taxon of the consumed prey, such as scales, spiny rays, teeth and feathers were selected. Such structures were compared with a reference collection from the study site. Prey items were identified, preferentially, to family level.

To determinate the importance of each prey in the samples, the data was analyzed as frequency of occurrence (FO%), or, the percentage of spraints that presented that item in relation to the total number of examined spraints x 100; and percentage of occurrence (PO%), the frequency of each food item divided by the sum of the frequency of all items x 100. The FO% indicates how common an item is in the diet, while the PO% indicates the importance of an item in the diet. The food niche breadth was calculated using Levins' (1968) index. This index estimates quantitatively the degree of specialization of the species' diet, being calculated as following:

$$B = 1/\sum p_i^2$$

Where:

B = Levins' measure of niche breadth

$p_i$  = Fraction of items in the diet that are of that food category

The measurement of food niche breadth was standardized in a scale ranging from zero to one (COLWELL & FUTUYMA, 1971).

$$B_{sta} = (B - B_{min}) / (B_{max} - B_{min})$$

Where:

$B_{sta}$  = Standardized niche breadth

B = Levins' measure of niche breadth

$B_{min}$  = 1 (minimum niche breadth possible)

$B_{max}$  = Total number of food categories considered in the study

A value close to one means a more equally-distributed diet (*i.e.* prey items are consumed in more equal proportions to one another). A value close to zero means that very few prey categories are taken in greater frequency, while most of the prey categories are taken in lower frequency. As the piscivorous character of the Neotropical otter is well-documented, we decided to apply

the standardized niche breadth index within the “fish category”, in other words, taking in account only the occurrence of items of this category, in order to verify the “degree of specialization” in the consumption among the different fish families found in this study ( $B_{\text{sta(fish)}}$ ). To investigate a possible temporal variation in the niche breadth of *L. longicaudis* in the region, we also calculated the standardized niche breadth index for the time period of years 2000 and 2001, based on data previously published by Kasper *et al.* (2004a) about the diet of the Neotropical otter in the same region, but with different study sites.

## RESULTS

**Diet.** The Neotropical otter presented a narrow trophic niche, consisting basically of fish, which were present in 97.5% of all samples, complemented by mammals and insects, plus decapods, crustaceans, birds and reptiles in very low quantities (Tab. I). The presence of plant material in spraints (small amounts of grass) was recorded only three times.

Among fish, the most consumed group was Loricariidae, present in 73.3% of the samples, followed by Cichlidae and Pimelodidae, 37.4% and 22.5%, respectively. Less consumed was the Characidae family, found in 11.6% of the analyzed spraints; Curimatidae and Erythrinidae were present in 2.7% and 1.0% of all fecal samples. In 18.6% of the spraints, fish remains could not be securely identified (Tab I).

The result of the standardized niche breadth index (Tab. II) indicates that the Neotropical otter has a specialist feeding habit, where few prey items (*i.e.* fish) are taken in greater frequency, while the remnant of other prey categories (*i.e.* mammals, insects, birds and snakes) are occasional occurrences in the diet.

**Shelters.** Two basic types of shelter were identified: excavated burrows underneath tree roots (77.2%) and shelters within rock crevices (22.8%). The measurements of the shelters are shown in Tabs. III and IV. In the case

of shelters excavated underneath tree roots, the otters usually dig in places that presented an initial erosive process, which makes digging easier. Therefore, shelters with a large entrance that usually corresponds to the entire width of the shelter are formed, usually with little depth and with only one internal chamber.

The pattern of utilization was variable: 33.3% of the shelters were used only once, 22.2% were used from two to three times, 33.3% were used from four to six times and 11.2% were used from seven to nine times throughout the study period.

Most shelters were located in conserved margins (57.9%), fewer in altered margins (36.8%). On the other side of the river, in front of the shelters, forest cover was conserved in 31.6%, altered in 26.3% and degraded in 42.1% of the cases.

**Latrines.** A total of 81 latrines used by *L. longicaudis* were identified. About 58% (n=47) of them were on rocks, 23.5% (n=19) by tree trunks and roots, 11.1% (n=9) were located in steep banks with exposed soil and 7.4% (n=6) in rock platforms.

Among those on rocks, 48.9% (n=23) were found inside the river bed, and 46.8% (n=22) were found on the margin of the body of water. The dimensions presented by these rocks were: 2.9 m (sd=1.3 m) long and 1.8 m (sd =0.8 m) wide. The rocks used inside the river bed were on average 1.3 m (sd=0.8 m) away from the margin, while rocks located on the margins projected themselves, on average, 1.75 m (sd=0.8) towards the river.

On average, about 3.45 scent marks were found in each latrine throughout the study period. Latrines were, on average, used twice. However, there was major variation: 53.1% (n=43) of the latrines were used only on one occasion, 30.9% (n=25) were used from two to three times, and 16.0% were used from four to six times. The number of new latrines (not used previously) was larger than the number of reutilized latrines until the seventh field trip. From then on, the number of reutilized sites started to exceed the number of the sites not used before as a latrine (Fig. 1).

Table I. Seasonal frequency of occurrence of food items found in the spraints of *Lontra longicaudis* (Olfers, 1818) in the Forqueta River and Forquetinha River, Rio Grande do Sul, Brazil.

Táxon	Summer (n=125)	Autumn (n=59)	Winter (n=152)	Spring (n = 68)	Mean (n=404)	
					FO%	PO%
Loricariidae	84.8	67.8	65.1	75.0	73.3	41.1
Cichlidae	32.8	40.7	47.3	20.6	37.4	21.0
Pimelodidae	16.6	28.8	28.3	20.6	22.5	12.6
Characidae	4.0	13.6	16.4	13.2	11.6	6.5
Curimatidae	4.0		3.9		2.7	1.5
Erythrinidae	1.6	1.7	0.7		1.0	0.6
Unidentified fish	9.0	16.9	15.8	26.5	18.6	10.4
Megaloptera	6.4	1.7	11.2		6.4	3.6
Mammals	6.4		1.3	2.9	2.2	1.2
Insecta	2.4				0.7	0.4
Decapoda		1.7			0.2	0.1
Birds		1.7	0.7		0.5	0.3
Snakes	0.8		0.7		0.5	0.3
Plant matter	1.6	1.7			0.7	0.4

Table II. Temporal variation of *Lontra longicaudis* (Olfers, 1818) niche breadth in the Taquari Valley. ( $B_{\text{sta}}$ , standardized niche breadth index considering all the prey categories found in the otters spraints;  $B_{\text{sta(fish)}}$ , standardized niche breadth index considering only the fish category). \* Based on data published by Kasper *et al.* (2004).

Period of study	$B_{\text{sta}}$	$B_{\text{sta(fish)}}$
2003	0.24	0.42
2000-2001*	0.20	0.43

Table III. Measurements of *Lontra longicaudis* (Olfers, 1818) shelters located within rocks on the Forqueta River and Forquetinha River, Rio Grande do Sul, Brazil.

Shelter	Length	Depth	Distance to the margin	Height above water level
I	3.1	1.8	2.7	2.1
II	4.8	3.6	0.8	0.8
III	2.8	2.0	0.1	0.3
IV	3.3	2.6	2.2	0.9
Mean	3.5	2.5	1.45	1.0
SD	0.9	0.8	1.2	0.8

Table IV. Measurements of *Lontra longicaudis* (Olfers, 1818) shelters located underneath tree roots on the Forqueta River and Forquetinha River, Rio Grande do Sul, Brazil.

Shelter	Length	Depth	Distance to the margin	Height above water level
I	1.7	1.6	5.2	3.4
II	3.2	0.8	5.5	4.3
III	10.0	5.0	14.4	3.0
IV	3.4	0.6	2.1	1.7
V	1.7	1.6	1.3	0.7
VI	5.4	0.5	2.1	2.1
VII	1.9	1.8	1.2	2.1
VIII	1.3	2.9	1.4	1.3
IX	3.4	3.2	3.4	1.3
X	0.8	0.6	1.2	2.8
XI	1.4	0.4	3.2	3.6
XII	2.1	0.6	1.2	1.8
XIII	5.8	1.9	3.6	4.6
Mean	3.2	1.7	3.5	2.5
SD	2.5	1.4	3.6	1.2

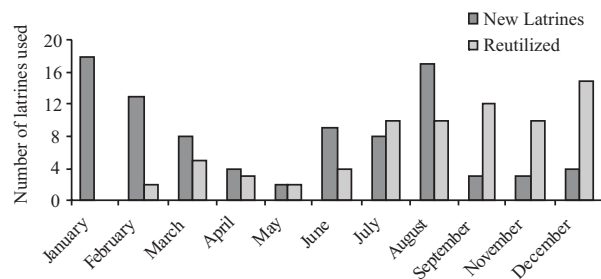


Fig. 1. Pattern of utilization of latrines by *Lontra longicaudis* (Olfers, 1818) in the Forqueta River and Forquetinha River, Rio Grande do Sul, Brazil.

## DISCUSSION

The diet showed a relatively regular pattern throughout the year. The greater variation verified was that related to the consumption of fish of the Loricariidae family, with a 19.7% decrease between summer and winter. However, this group was still the most important throughout the year. Its decreased utilization was compensated by an increased consumption of cichlids and pimelodids. Thus, this data suggests that there should be little influence of seasonality on the Neotropical otter diet, although this hypothesis has not been tested. PARDINI (1998) and GORI *et al.* (2003) also found little seasonal variation. Therefore, studies of longer duration are necessary to elucidate this question.

The result of the standardized niche breadth index was expected. Many studies have shown the piscivorous character of the species, with consumption of other groups of prey, other than fish, varying throughout its area of distribution (PASSAMANI & CAMARGO, 1995; PARDINI, 1998; LARIVIÈRE, 1999; COLARES & WALDEMARIN, 2000; QUADROS & MONTEIRO-FILHO, 2001; GORI *et al.*, 2003; KASPER *et al.*, 2004a).

There was not a significant variation between the results of the niche breadth index from the period of 2000-

2001 and from 2003. The niche breadth analysis amongst the fish category also showed a more specialized niche, with higher values for this index when compared to the one calculated for the diet as a whole. This fact is justified by the marked consumption of loricarids and cichlids and the more discrete consumption of fish belonging to other families, without any meaningful variation between 2000-2001 and 2003.

Based on KASPER *et al.* (2004a, b), it is possible to verify that the families Loricariidae, Cichlidae e Pimelodidae, when lumped, corresponded to ca. 74% of PO% in 2000-2001, and that this pattern is repeated in 2003. Hence, the equal values of overall and fish standardized niche breadths found for both study periods. This, in turn, is suggestive that the species' feeding habits does not suffer significant yearly variation, although this hypothesis may need further testing. The occurrence of the Loricariidae family as the most frequent item in the diet corroborates with PARDINI'S study (1998). On the other hand, the Cichlidae family was the most consumed group in three studies conducted in lentic environments; two of them conducted in reservoirs in Brazil (PASSAMANI & CAMARGO, 1995; HELDER-JOSÉ & ANDRADE, 1997) and one carried out in an Argentinean lake (GORI *et al.*, 2003).

Comparing these results with those of Kasper *et al.* (2004a), it is possible to verify a feeding pattern for *L. longicaudis* in the region, where fish is the basis of its diet and the consumption of crustaceans is practically null. The most consumed fish have benthonic habits, spending large periods of time hidden underneath rocks, as it is the case of loricariids and pimelodids, or have territorial habits, in the case of cichlids (KOCH *et al.*, 2000). Therefore, many speculations can be made about the otters' foraging strategy, which, most likely, is adapted to the habits of their prey.

The shelters observed in this study were formed by excavation underneath tree roots and in between rocks, as also observed by KASPER *et al.* (2004a) in a nearby area. The proportion of excavated shelters is larger than the proportion of shelters within rocks. This fact can be explained by the small availability of rocky formations along the water courses in the study site. Proportionally, the use of shelters in rocks was more frequent than the occurrence of shelters in the steep banks, which form the larger part of the river banks in the study area. PARDINI & TRAJANO (1999) described the structure of the shelters found in their research areas, where shelters within rock crevices were the most common, followed by cavities within tree roots.

The position of the shelters in relation to the margins is described by PARDINI & TRAJANO (1999) and QUADROS & MONTEIRO-FILHO (2002). Notably, in both studies, the occurrence of shelters located between 1 m and 1.49 m above the margin was greater than expected, and shelters located beyond 1.5 m were less frequent. However, in our study, the shelters were located on average 2.2 m (sd=1.3 m) above water level, with a difference between excavated burrows ( $2.5 \pm 1.2$  m) and the shelters within rocks ( $0.8 \pm 1.0$  m). The excavated shelters were submerged only on big floods, whereas shelters within rocks on just higher rainy periods. Nevertheless, shelters were rarely flooded, as also noted

by QUADROS & MONTEIRO-FILHO (2002). Thus, the otters seem to have a perception of water level variation, using shelters in drier areas.

In 68.4% of the cases, shelters were located within conserved riparian forest, suggesting the importance of this type of vegetation for the persistence of *L. longicaudis*. The state of conservation of the riparian forest assumes a greater importance in the immediate surroundings of the shelter than in the opposite margin of it. Thus, the data suggests that the otters show a certain tolerance to the alteration of their habitat, although they seem to depend on conserved portions, where they can take shelter.

The frequency of utilization is not uniform. While some shelters are used only eventually, others are systematically used. This pattern corroborates with that observed by PARDINI & TRAJANO (1999) and KASPER *et al.* (2004a). Their data suggest the existence of preferential shelters. QUADROS & MONTEIRO-FILHO (2002) also found a more intensive use of some shelters, while others were less used. In this way, there seems to be core activity areas within the otters' home range. The "preference" can be related to the shelter's localization, structure, accessibility and safety, or to the availability of food resources in its surroundings. These are interesting questions to be addressed.

The sprainting sites were formed basically by conspicuous sites, such as rocks and fallen trunks, on the margins of the water courses. These data are in agreement with the current literature (e.g. SPÍNOLA & VAUGHAN (1995), PARDINI & TRAJANO (1999), QUADROS & MONTEIRO-FILHO (2002), KASPER *et al.* (2004a)). Those authors reported these structures as the characteristic sites for the presence of latrines of *L. longicaudis*. Rocks and trunks that were more frequently used were located few meters away from the margins. These observations, added to the fact that animals were usually seen on the river margins, allow us to infer that the otters usually move, forage, and perform their social communication close to the margins. Besides, the observed latrines were in their majority on the river margin or in the river bed (95.7%), which shows that the species makes little use of scent marks out of its traveling path. In this study, there was no apparent relation between the use of latrines and their proximity to shelters. These observations were in agreement with PARDINI & TRAJANO (1999), contrary to those of SOLDATELI & BLACHER (1996) and QUADROS & MONTEIRO-FILHO (2002). Both studies reported an intensification of the scent marking activity close to some shelters.

Another important sprainting site was the shelters' interior, where 37.7% of the spraints were found. The values found in this study differ from those of QUADROS & MONTEIRO-FILHO (2002) and KASPER *et al.* (2004a). These authors found a higher number of spraints inside the shelters than on conspicuous places, such as, the top of fallen trunks or rocks as it was observed in this study.

Just as described for the Neotropical otter at other sites (SPÍNOLA & VAUGHAN, 1995; SOLDATELI & BLACHER, 1996; QUADROS & MONTEIRO-FILHO, 2002), the data obtained here showed that the species uses with some frequency the same latrines for the deposition of scent marks.

Many question related to the ecology of *Lontra longicaudis* begin to reveal certain patterns, as new studies are being published. In this study, we present data that indicates a specialist feeding behavior, and that indicates how otters use the environment in relation to the selection of resting and sprainting sites.

Nevertheless, we are still many steps away from understanding which environmental aspects influence their population structure and their success. Even relatively well studied aspects, such as diet composition, present countless questions, yet to be investigated. Therefore, we hope that this study serve as motivation to the publication of more and more studies, that expand our knowledge about the Neotropical otter ecology, supplying essential information for its conservation.

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