



## Diet of *Lontra longicaudis* (Carnivora: Mustelidae) in a pool system in Atlantic Forest of Minas Gerais State, southeastern Brazil

Fabiano Aguiar da Silva<sup>1\*</sup>, Emmanuel de Melo Nascimento<sup>2</sup> and Fernando Marques Quintela<sup>3</sup>

<sup>1</sup>Universidade Federal de Viçosa, Museu de Zoologia João Moojen, Programa de Pós-graduação em Biologia Animal, Vila Gianetti, casa 32, Campus Universitário, 36571-000, Viçosa, Minas Gerais, Brazil. <sup>2</sup>Curso de Ciências Biológicas, Faculdades Integradas de Cataguases, Cataguases, Minas Gerais, Brazil. <sup>3</sup>Universidade Federal do Rio Grande do Sul, Instituto de Biociências, Programa de Pós-graduação em Biologia Animal, Porto Alegre, Rio Grande do Sul, Brazil. \*Author for correspondence. E-mail: biofaguiar@hotmail.com

**ABSTRACT.** The present study aimed to investigate the feeding habits of *Lontra longicaudis* in a pool system within the Private Reserve of Natural Patrimony (RPPN) Usina Maurício, located in Paraíba do Sul river basin, Atlantic Forest of southeastern Minas Gerais State. The diet composition was determined based on the identification of items present in 212 scats sampled between July 2008 and October 2009 in a 4.1 km stretch of the pool system. The found items and its respective percentages of occurrence were: mollusks (0.5%), insects (16.5%), spiders (1.4%), crustaceans (3.3%), fish (96.7%), amphibians (0.9%), snakes (3.8%), birds (2.8%), mammals (8.5%) and fruits (0.5%). Among fish, the identified families and respective percentages of occurrence were: Loricariidae (65.4%), Pimelodidae (42.9%) Cichlidae (22%), Characidae (7.3%), Erythrinidae (3.9%), Synbranchidae (2.4%), Anostomidae (2%). Therefore fish make up the most consumed item in the study area, with the predominance of benthic siluriformes (families Loricariidae and Pimelodidae).

**Keywords:** neotropical otter, feeding habits, Loricariidae, Pimelodidae, Zona da Mata.

## Dieta de *Lontra longicaudis* (Carnivora: Mustelidae) em um sistema de poções na Floresta Atlântica do Estado de Minas Gerais, sudeste do Brasil

**RESUMO.** O presente estudo teve como objetivo investigar os hábitos alimentares de *Lontra longicaudis* em um sistema de poções na Reserva Particular do Patrimônio Natural – RPPN Usina Maurício, localizada na bacia do rio Paraíba do Sul, Mata Atlântica do Sudeste do Estado de Minas Gerais. A composição da dieta foi determinada com base na identificação de itens presentes em 212 amostras de fezes coletadas entre julho de 2008 e outubro de 2009 em um trecho de 4,1 km de um sistema de poções. Os itens alimentares encontrados e suas respectivas porcentagens de ocorrência foram: moluscos (0,5%), insetos (16,5%), aranhas (1,4%), crustáceos (3,3%), peixes (96,7%), anfíbios (0,9%), serpentes (3,8%), aves (2,8%), mamíferos (8,5%), frutos (0,5%). Dentre os peixes, famílias identificadas e suas respectivas porcentagens de ocorrência foram: Loricariidae (65,4%), Pimelodidae (42,9%) Cichlidae (22%), Characidae (7,3%), Erythrinidae (3,9%), Synbranchidae (2,4%), Anostomidae (2%). Os peixes, portanto, representaram o item mais consumido na área de estudo, com predominância de siluriformes bentônicos (famílias Loricariidae e Pimelodidae).

**Palavras-chave:** lontra neotropical, hábitos alimentares, Loricariidae, Pimelodidae, Zona da Mata.

### Introduction

The Neotropical river otter *Lontra longicaudis* (Olfers, 1818) is a semi-aquatic mustelid, inhabitant of continental water bodies and even marine systems. It is distributed from northeastern Mexico to Uruguay to Buenos Aires Province, Argentina (CHEIDA et al., 2006; EMMONS; FEER, 1997).

In Brazil, studies on feeding habits of the Neotropical river otter have been conducted in coastal and limnic systems mainly in the South and Southeast regions (ALARCON; SIMÕES-

LOPES, 2004; CARVALHO-JUNIOR et al., 2010; COLARES; WALDEMARIN, 2000; HELDER-JOSÉ; ANDRADE, 1997; KASPER et al., 2004, 2008; PARDINI, 1998; PASSAMANI; CAMARGO, 1995, QUADROS; MONTEIRO-FILHO, 2001; QUINTELA et al., 2008). These studies show a predominant piscivorous diet, while other items such as mollusks, insects, crustaceans, amphibians, reptiles, birds and mammals may occur at lower frequencies. Quadros and Monteiro-Filho (2000) also mentioned the occurrence of fruits in the diet of *L. longicaudis*.

In the State of Minas Gerais, southeastern Brazil, information on diet of *L. longicaudis* is scarce. Passamani and Camargo (1995) analyzed eight scats in Furnas reservoir, in the western Minas Gerais. Moreover, there no available data on feeding habits of *L. longicaudis* in the State. In face of scarcity about information on diet composition of the species in this region, the present study presents data on *L. longicaudis* feeding habits in Private Reserve of Natural Patrimony (RPPN) Usina Maurício, Atlantic Forest of southeastern Minas Gerais State.

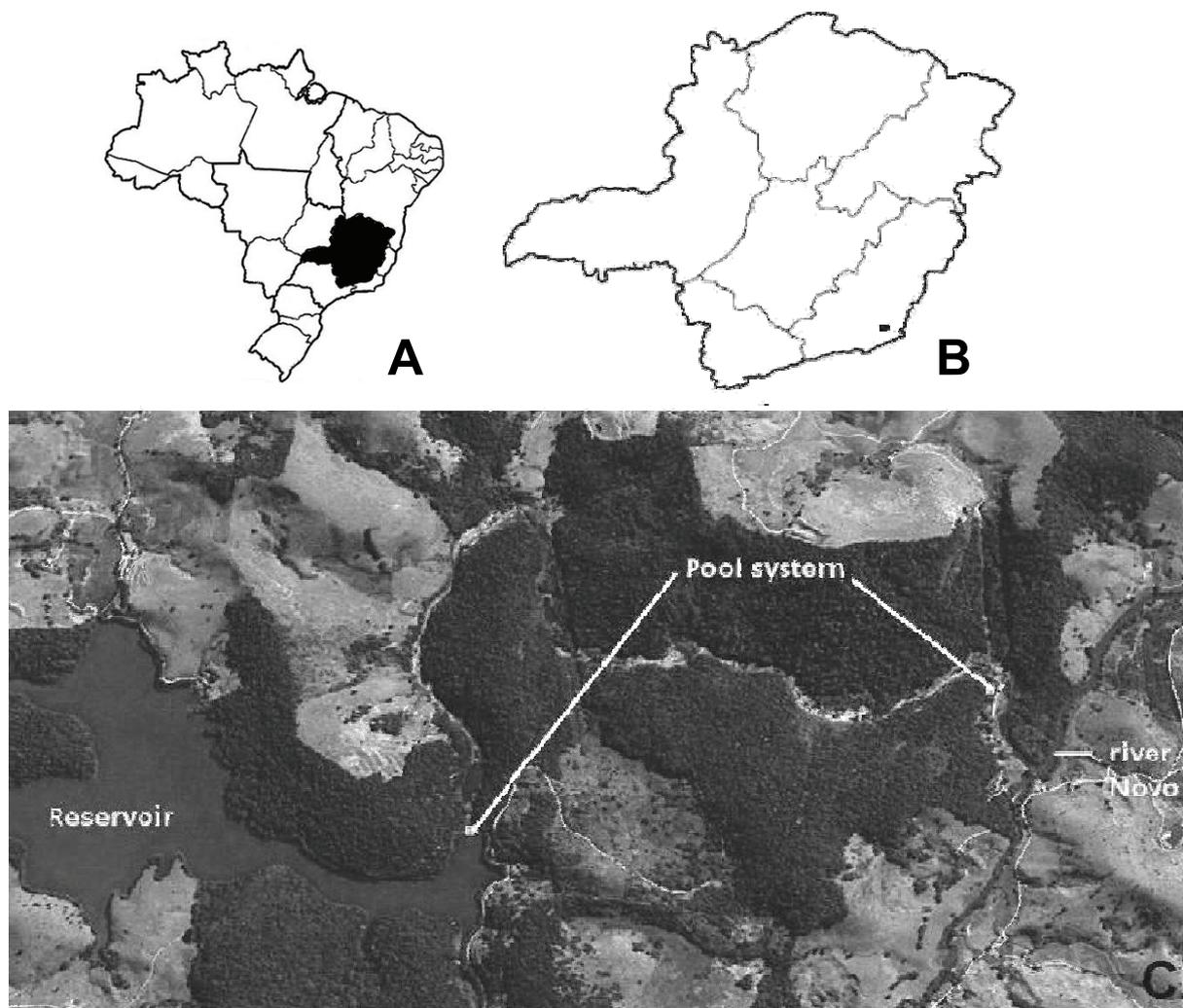
## Material and methods

### Study area

The Private Reserve of Natural Patrimony (RPPN) Usina Maurício is located in Pomba river sub-basin, Paraíba do Sul river basin, in the border of the municipalities Leopoldina and

Itamarati de Minas, southeastern Minas Gerais State (*Zona da Mata*), between the coordinates 21°27'50"S - 42°50' 52"W and 21°29'10"S - 42°49'24"W (Figure 1).

The RPPN Usina Maurício is inserted in Atlantic Forest biome (IBGE, 2004). The climate in the region is classified as Cwa (tropical humid) of Köppen. The study was conducted in 4.1 km of the stretch with reduced flow of the Usina Maurício hydroelectric power plant, composed by a system of 19 pools with varied lengths, widths and depths. The three largest pools present the following measures (length x width): 150 x 52 m, 86 x 37 m, 63 x 28 m (Ricardo A. Silva, pers. com.). The pools remain isolated most of the year, connecting during the raining season (November to February). Pool bottom and banks are predominantly rocky, and vegetation in the area is composed by Stational Semidecidual Forest.



**Figure 1.** Location of Minas Gerais State (A) and Private Reserve of Nature Patrimony Usina Maurício, Usina Maurício (B and C).

### Data sampling

The diet composition of *L. longicaudis* was determined based on identification of scats. From July 2008 to October 2009 biweekly samplings were performed, except for the period from the second half of December and early March (summer season), when heavy floods did not allow access to the study area. All the scats found were collected, stored in individual labeled plastic bags and then frozen. Afterwards, scats were washed through a 1mm sieve and solid remains were dried in an oven at 36°C. Screening was realized with the aid of a stereoscopic microscope. The consumed taxa were determined based on the identification of remains such as scales, vertebrae, hairs, carapaces and other structures, which were compared with specimens stored in a reference collection of the study area. The frequency of occurrence of each prey item was calculated by the rate of the number of scats containing such item over the total number of analyzed scats.

### Results

A total of 212 scats was collected and analyzed. Fish was the most consumed item, present in 96.69% (n = 205) of the scats. Other items found with lower frequencies were insects (16.50% of total scats), mammals (8.49%), snakes (3.77%), crustaceans (3.30%), birds (2.83%), spiders (1.41%), amphibians (0.94%), mollusks and fruits (0.47 each) (Table 1, Figure 2).

Among fish, *Hypostomus affinis* (Loricariidae), *Pimelodus fur* (Pimelodidae) and *Gymnotus carapo* (Gymnotidae) were the most frequent, present in 63.20, 41.50 and 21.22% of the scats containing fish remains, respectively. Other fish taxa identified with lower frequencies were Cichlidae (*Oreochromis niloticus* and unidentified species; 21.20%), Characidae (*Salminus brasiliensis* and unidentified species; 7.07%), *Hoplias malabaricus* (Erythrinidae; 3.77%), *Synbranchus marmoratus* (Synbranchidae; 2.35%) and *Leporinus mormyrops* (Anostomidae; 1.88%). Bones of unidentified fishes occurred in two samples (0.94%). Other vertebrate structures found in samples were anuran amphibians bones (0.9%), dipsadid snakes scales (3.7%), birds feathers (2.8%) and rodents hairs (8.4%).

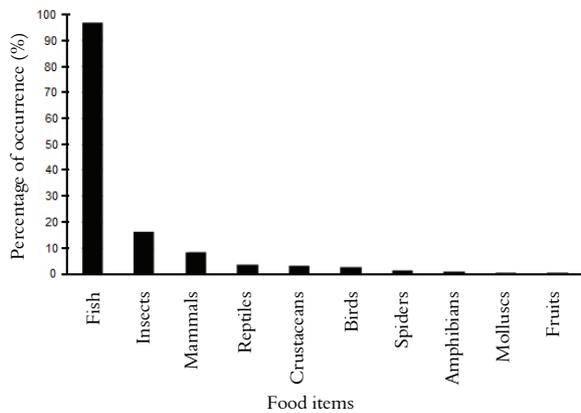
Among invertebrates, megalopteran larvae (*Corydalus* sp.) were present in 31.6% of the samples containing invertebrate remains. Other found invertebrates were decapod crustaceans and unidentified insects (18.4% each), coleopterans (15.8%), spiders (7.9%), orthopterans, belostomatid

heteropterans, and gastropod mollusks (2.6% each). In eight samples it was not possible to identify the present arthropods. Fruits occurred in one single sample, together with remains of birds and *G. carapo*.

**Table 1.** Food items identified in 212 scat samples of *Lontra longicaudis* in Private Reserve of Nature Patrimony Usina Maurício, Minas Gerais State, Brazil. N = number of scats containing each item, % = percentage of occurrence in total scats.

Taxa (food items)	N	%
Fruits	1	0.47
Molusca		
Gastropoda	1	0.47
Arthropoda		
Hexapoda		
Orthoptera	1	0.47
Coleoptera	6	2.83
Heteroptera		
Belostomatidae	1	0.47
Megaloptera		
Corydalidae		
<i>Corydalus</i> sp. (larvae)	12	5.66
not identified	7	3.30
Aracnida		
Araneae	3	1.41
Crustacea		
Decapoda	7	3.30
not identified	8	3.77
Chordata		
Actinopterygii		
Characiformes		
Anostomidae		
<i>Leporinus mormyrops</i>	4	1.88
Erythrinidae		
<i>Hoplias malabaricus</i>	8	3.77
Characidae		
<i>Salminus brasiliensis</i>	6	2.83
others	9	4.24
Siluriformes		
Pimelodidae		
<i>Pimelodus fur</i>	88	41.50
Loricariidae		
<i>Hypostomus affinis</i>	134	63.20
Perciformes		
Cichlidae		
<i>Oreochromis niloticus</i>	15	7.07
others	30	14.15
Synbranchiformes		
Synbranchidae		
<i>Synbranchus marmoratus</i>	5	2.35
Gymnotiformes		
Gymnotidae		
<i>Gymnotus carapo</i>	45	21.22
not identified	2	0.94
Amphibia		
Anura	2	0.94
Reptilia		
Squamata		
Dipsadidae	8	3.77
Aves	6	2.83
Mammalia		
Rodentia	18	8.49

Insects, fishes, snakes and birds occurred in autumn, winter and spring. Spiders and mammals were recorded in winter and spring. Decapod crustaceans occurred in autumn and spring. Anuran amphibians were observed in autumn and winter. Gastropod mollusks occurred in winter.



**Figure 2.** Percentage of occurrence of food items in 212 scat samples of *Lontra longicaudis* in the Private Reserve of Nature Patrimony Usina Maurício, Minas Gerais State, Brazil.

## Discussion

Benthic siluriformes (Loricariidae and Pimelodidae species) represented the major prey of *L. longicaudis* in the pool system investigated in the present study. Loricariidae was also the most recorded fish prey in the works of Pardini (1998) and Kasper et al. (2004, 2008). Meanwhile, estimative of fish availability made by Pardini (1998) indicated a high numerical predominance of Characidae species in the system investigated by the author, suggesting selectivity on fish predation. Kasper et al. (2004) also found a high preference for Pimelodidae family. These authors mentioned a preference of *L. longicaudis* for benthic and sedentary fishes, whose habits facilitate their capture. In RPPN Usina Maurício *Hypostomus affinis* was the most captured species in the sampled pools. The utilized gillnets present a wide range of sampling, capturing species at surface, midwater and bottom, which indicate that *H. affinis* may be a numerically well representative larger-sized species in the study area. In this context, a higher abundance associated to a benthic sedentary habit reflected in the predominance of the loricariid *H. affinis* in diet of *L. longicaudis* in the studied area.

Other recorded fish families (Gymnotidae, Anostomidae, Erythrinidae, Synbranchidae, Characidae and Cichlidae) occurred with relatively low frequencies. Except for the characids and cichlids, it was possible to identify the other fish remains until species level. Scales of *S. brasiliensis* differ in size and thickness from the scales of other characid species sampled in the pools (*Astyanax bimaculatus* and *Myleus micans*). In this case, the consumption of young individuals of *S. brasiliensis* could be underestimated considering the morphological similarities with the other smaller characid species. Among cichlids, *Geophagus*

*brasiliensis*, *Cichla monoculus*, *Crenicichla lacustris* and *Oreochromis niloticus* were sampled in the pools. The exotic *O. niloticus* has cycloid scales, which allowed a differentiation from *G. brasiliensis*, *C. lacustris* and *C. monoculus*, characterized by having ctenoid scales (pers. obs.). *Hoplias malabaricus*, *Leporinus mormyrops*, *Gymnotus carapo* and *Synbranchus marmoratus* were also the only species of their respective families sampled in the pool system. However, recorded 67 fish species in Pomba river, including 17 characids, eight loricariids, six cichlids and the erythrinid *Hoplias lacerdae*. Thereby, possibly, other fish species not captured in our samplings could occur in the pool system, and the dietary spectrum of *L. longicaudis* in the area could be wider than determined in the present study.

Among invertebrates, insects were a well representative group in the analyzed samples, present in 16.5% of total scats ( $n = 35$ ). The occurrence of insects seems to vary among investigations about *L. longicaudis* diet, present in higher (e.g. PASSAMANI; CAMARGO, 1995; PARDINI, 1998) or lower frequencies (e.g. HELDER-JOSÉ; ANDRADE, 1997; QUADROS; MONTEIRO-FILHO, 2001; ALARCON; SIMÕES-LOPES, 2004; KASPER et al., 2004, 2008; QUINTELA et al., 2008). Furthermore, insects, spiders and other arthropod remains found in *L. longicaudis* scats can also represent digestive tract content of predated fish, as pointed out by Quadros and Monteiro-Filho (2001) for terrestrial arthropods. In the present study, however, arthropods may be an important component in the otter diet once insects not associated to fish remains were found in six samples, one of those with only megalopteran *Corydalus* sp. larvae. Megalopteran larvae were also recorded by Pardini (1998) and Kasper et al. (2004, 2008) while belostomatids were registered by Colares and Waldemarin (2000), Kasper et al. (2004) and Quintela et al. (2008). Coleopterans were found with low frequency by Quintela et al. (2008) while orthopterans are herein recorded by the first time in *L. longicaudis* diet. Orthopterans (*Gryllotalpa gryllotalpa*, Gryllotalpidae) were also verified in the diet of the Eurasian otter *Lutra lutra* in southeastern Bulgaria (GEORGIEV, 2006).

Mollusks occurred in only one scat in the present study, and is generally recorded with low frequencies in the diet of the Neotropical otter (see ALARCON; SIMÕES-LOPES, 2004; CARVALHO-JUNIOR et al., 2010; COLARES; WALDEMARIN, 2000; KASPER et al., 2004; QUINTELA et al., 2008). Decapods crustaceans were also few represented in the analyzed scats.

This arthropod group is generally present in the Neotropical otters diet (ALARCON; SIMÕES-LOPES, 2004; COLARES; WALDEMARIN, 2000; HELDER-JOSÉ; ANDRADE, 1997; KASPER et al., 2004, 2008; PARDINI, 1998; QUADROS; MONTEIRO-FILHO, 2001; QUINTELA et al., 2008), occurring in varied frequencies. Crustaceans may represent few available preys in the studied pool system, otherwise represented the second most important food item in a significant part of the studies in southeast and southern Brazil (ALARCON; SIMÕES-LOPES, 2004; CARVALHO-JUNIOR et al., 2010; COLARES; WALDEMARIN, 2000; HELDER-JOSÉ; ANDRADE, 1997; PARDINI, 1998; QUADROS; MONTEIRO-FILHO, 2001; QUINTELA et al., 2008). Spiders were found with low frequency in the studied area. Quadros and Monteiro-Filho (2001) identified spiders in a single scat, this was the only previous study where this item was recorded.

Mammals represented the third item regarding frequency (18%), a higher value than those reported in earlier studies (e.g. PARDINI, 1998; QUADROS; MONTEIRO-FILHO, 2001; KASPER et al., 2004, 2008; QUINTELA et al., 2008). Other terrestrial vertebrates (amphibians, reptiles and birds) were less representative, which is in agreement with all abovementioned studies. Quadros and Monteiro-Filho (2001) also emphasize the difficulties to recognize amphibian remains in scats due to the lack of keratinized structures. In this context, amphibian occurrence may have been underestimated, considering that samples contained very fragmented bones, which does not allow its identification. Also Weber (1990) found a relationship between the presence of amphibian remains in *Lutra lutra* scats and the availability of this item in environment. Anuran amphibians are abundant in the studied pool system (especially the cycloramphid *Thoropa miliaris*) and the utilization of this food resource could be higher than determined.

Unidentified fruits occurred in one sample (0.47%). The consumption of vegetal items is rarely reported in studies on Neotropical otter diet. Quadros and Monteiro-Filho (2000, 2001) found fruit remains of three arboreal species in 2.97% of analyzed samples while Kasper et al. (2008) identified grass remains in a mean frequency of 0.7%. Quadros and Monteiro-Filho (2000) consider that fruits consumption is opportunistic and complementary in *L. longicaudis* diet, considering the high availability of this food item in the environment and low frequency in fecal samples.

Interestingly the fruits were found in one single sample containing remains of unidentified bird, and therefore can represent content of the digestive tract from the predated bird.

We observed a varied diet of *L. longicaudis* in the studied area, with a prominent dominance of benthic fish. Our data, therefore, contributes to the knowledge on Neotropical otter feeding habits in pools systems of the still poorly investigated Minas Gerais Atlantic Forest, highlighting the importance of RPPN Usina Maurício for the species conservation.

## Conclusion

The neotropical otter presented a varied diet in the study area. Fish, however, represented the most consumed item, as observed in previous investigations on the species diet. Among fishes, the predominance of Loricariidae was already determined in *L. longicaudis* trophic ecology studies conducted in Southeastern and Southern Brazil. Molluscs, insects, spiders, crustaceans, amphibians, reptiles, birds and mammals can also be considered minor preys in the studied system.

## Acknowledgements

We are grateful to José M. da Silva, Aldinéa F. A. da Silva, Ricardo A. da Silva and Fausto A. P. Menta for incentive and logistic support, Jorge C. Medina for friendship and field support, Pedro P. R. Alves and Lucas G. do Valle for support in the fieldwork, Raul S. Melo for fish sampling, Frederico Belei for fish identification, Clodoaldo L. de Assis for support in the laboratory work, William C. Ramos for English review, Georgina M. F. Mucci and Faculdades Integradas de Cataguases for access to laboratory, Energisa S. A. for financial support.

## References

- ALARCON, G. G.; SIMÕES-LOPES, P. C. The neotropical otter *Lontra longicaudis* feeding habits in a marine coastal area, southern Brazil. **IUCN Otter Specialists Group Bulletin**, v. 21, n. 1, p. 24-30, 2004.
- CARVALHO-JUNIOR, O.; MACEDO-SOARES, L. C. P.; BIROLO, A. B. Annual e interannual food habits variability of a neotropical otter (*Lontra longicaudis*) population in Conceição Lagoon, South of Brazil. **IUCN Otter Specialists Group Bulletin**, v. 27, n. 1, p. 24-32, 2010.
- CHEIDA, C. C.; NAKANO-OLIVEIRA, E.; FUSCO-COSTA, R.; ROCHA-MENDES, F.; QUADROS, J. Ordem carnívora. In: REIS, N. R.; PERACCHI, A. L.; PEDRO, W. A.; LIMA, I. P. (Ed.). **Mamíferos do Brasil**. Londrina: Editora da Universidade Estadual de Londrina, 2006. p. 231-275.

- COLARES, E. P.; WALDEMARIN, H. F. Feeding of the neotropical river otter (*Lontra longicaudis*) in a coastal region of the Rio Grande do Sul State, Southern Brazil. **IUCN Otter Specialist Group Bulletin**, v. 17, n. 1, p. 6-13, 2000.
- EMMONS, L. H.; FEER, F. **Neotropical rainforest mammals: a field guide**. Chicago: The University of Chicago Press, 1997.
- GEORGIEV, D. G. Diet of the otter *Lutra lutra* in different habitats of south-eastern Bulgaria. **IUCN Otter Specialist Group Bulletin**, v. 23, n. 1, p. 5-11, 2006.
- HELDER, J.; ANDRADE, H. K. Food and feeding habits of neotropical river otter *Lontra longicaudis* (Carnivora, Mustelidae). **Mammalia**, v. 61, p. 193-203, 1997.
- IBGE-Instituto Brasileiro de Geografia e Estatística. **Mapa de Biomas e de Vegetação**, 2004. Available from: <[http://www.ibge.gov.br/home/presidencia/noticias/noticia\\_visualiza.php?id\\_noticia=169](http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=169)>. Access on: Apr. 18, 2010.
- KASPER, K. B.; FELDENS, M. J.; SALVI, J.; GRILLO, H. C. J. Estudo preliminar sobre a ecologia de *Lontra longicaudis* no Vale do Taquari, Sul do Brasil. **Revista Brasileira de Zoologia**, v. 21, n. 1, p. 65-72, 2004.
- KASPER, K. B.; BASTAZINI, V. A. G.; FELDENS, M. J.; SALVI, J.; GRILLO, H. C. J. Trophic ecology and the use of shelters and latrines by the Neotropical otter (*Lontra longicaudis*) in the Taquari Valley, Southern Brazil. **Iheringia, Série Zoologia**, v. 98, n. 4, p. 469-474, 2008.
- PARDINI, R. Feeding ecology of the neotropical river otter *Lontra longicaudis* in an Atlantic Forest stream, south-eastern Brazil. **Journal of Zoology**, v. 245, n. 4, p. 385-391, 1998.
- PASSAMANI, M.; CAMARGO, S. L. Diet of the river otter *Lutra longicaudis* in Furnas Reservoir, south-eastern Brazil. **IUCN Otter Specialist Group Bulletin**, v. 12, p. 32-34, 1995.
- QUADROS, J.; MONTEIRO-FILHO, E. L. A. Fruit occurrence in the diet of the neotropical otter, *Lontra longicaudis*, in southern Brazilian Atlantic Forest and its implication for seed dispersion. **Mastozoologia Neotropical**, v. 7, n. 1, p. 33-36, 2000.
- QUADROS, J.; MONTEIRO-FILHO, E. L. A. Diet of the Neotropical Otter, *Lontra longicaudis*, in an Atlantic Forest Area, Santa Catarina State, Southern Brazil. **Studies on Neotropical Fauna and Environment**, v. 36, n. 1, p. 15-21, 2001.
- QUINTELA, F. M.; PORCIUNCULA, R. A.; COLARES, E. P. Dieta de *Lontra longicaudis* (Olfers) (Carnivora, Mustelidae) em um arroio costeiro da região sul do Estado do Rio Grande do Sul, Brasil. **Neotropical Biology and Conservation**, v. 3, n. 3, p. 119-125, 2008.
- WEBER, J. M. Seasonal exploitation of amphibians by otters *Lutra lutra* in north-east Scotland. **Journal of Zoology**, v. 220, n. 4, p. 641-651, 1990.

Received on June 5, 2010.

Accepted on October 13, 2010.

License information: This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.