Behavior of neotropical otter, *Lontra longicaudis* (Olfers, 1818) (Carnivora, Mustelidae) in captivity

Comportamento da lontra neotropical, Lontra longicaudis (Olfers, 1818) (Carnivora, Mustelidae) em cativeiro

DOI: 10.34188/bjaerv5n1-049

Recebimento dos originais: 25/11/2021
Aceitação para publicação: 03/01/2022

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ABSTRACT
The study of the behavior of the *Lontra longicaudis* was conducted from January to April 2010. The main objective was to determine the individual and social patterns of three otters in captivity, correlating the data with average temperatures. The methodology was based on random observations, the *ad libitum* method, and the *focal animal* method, during which the animals are observed thanks to standardized spreadsheets. The sampling effort was four hours daily, resulting in a total of 196 hours. Twenty-nine listed activities were divided into two categories and ten sub-categories. The adult couple showed a similar pattern of activities. The young female, however, showed a different pattern in the activities, compared with adult animals. There was no difference in activity for day and night. However, on days with lower average temperatures, some activities decreased significantly, such as swimming, diving and rolling in the sand, while resting activities increased.

Keywords: ethogram, activities patterns, environmental enrichment, patterns of posture.

RESUMO
O estudo do comportamento da *Lontra longicaudis* foi realizado de janeiro a abril de 2010. O objetivo principal foi determinar os padrões individuais e sociais de três lontras em cativeiro, correlacionando os dados com as temperaturas médias. A metodologia baseou-se em observações aleatórias, método ad libitum e método animal focal, durante as quais os animais são observados com auxílio de planilhas padronizadas. O esforço amostral foi de quatro horas diárias resultando em um total de 196 horas. Vinte e nove atividades listadas foram divididas em duas categorias e dez subcategorias. O casal adulto apresentou um padrão semelhante de atividades. A fêmea jovem, porém, apresentou um padrão diferente nas atividades se comparada aos animais adultos. Não houve diferença na atividade diurna e noturna. Porém, em dias com temperaturas médias mais baixas,

algumas atividades diminuíram significativamente, como nadar, mergulhar e rolar na areia, enquanto as atividades de descanso aumentaram.

Palavras-chave: etograma, padrões de atividades, enriquecimento ambiental, padrões de postura.

1 INTRODUCTION

Few studies related to the behavior of neotropical otter in captivity can be found. This is probably because there are few otters in captivity available for research. Another reason is that places that keep neotropical otters in captivity do not perform any research or the data collected are not published. In Latin America, the only Neotropical Otter Scientific Breeding is the Animal Refugee from Ekko Brasil Institute, in south of Brazil. A report to the IUCN OZ Task Force, Neotropical Otter Sub-Group, in July 2013, found that, in Latin America, among the few data available, the most common one were protocol for rescue and transport, blood collection, faces analysis for parasites and weight control. The study of behavior of neotropical otter in captivity was not mentioned by any of the 11 institutions that returned the questionnaire.

Ferrari *et al.* (2011) reported behavioral changes of the species with stimuli through environmental enrichment techniques in the Zoo of Santos (Parque Zoobotanico Orquidario Municipal de Santos). Although the authors have not observed significant behavioral changes, otters exhibited new behavioral activities, like those observed in the wild.

Another study, by Cunha *et al*. (2011), analyses the frequency and spatial preferences in an enclosure by the otter. In this study, two males were studied, showing that the animals exhibit preferences for certain quadrants according to activity. The area most used was the water tank. Study of reproduction in captivity was performed by Arcila and Ramirez (2004) in Colombia. In this study, the authors estimated gestational period of the neotropical otter in 86 days.

Protocols for studies of reproductive behavior, parental care and development of pups in captivity for *Pteronura brasiliensis* were defined by Louzada-Silva (2008). The importance of enrichment to improve the quality of life of animals in captivity is stressed by Pizzutto *et al*. (2009). The authors review the importance of environmental enrichment techniques in behavior, reproduction, and quality of life of animals in captivity. However, research related to neotropical otter patterns of postures is rarely found in literature. Studies in the wild with *Lontra provocax* in Chile were performed using radio-tracking data and results were related to distribution, home range and few behavior patterns (Sepulveda *et al*., 2015).

Behavior studies with other species focus mainly on patterns of activity, diet and postures adopted while feeding (Albuquerque and Codenotti, 2006; Porto and Piratelli, 2005; Nascimento *et al.*, 2008). An ethogram is considered the beginning of the research on a specie behavior (Freitas

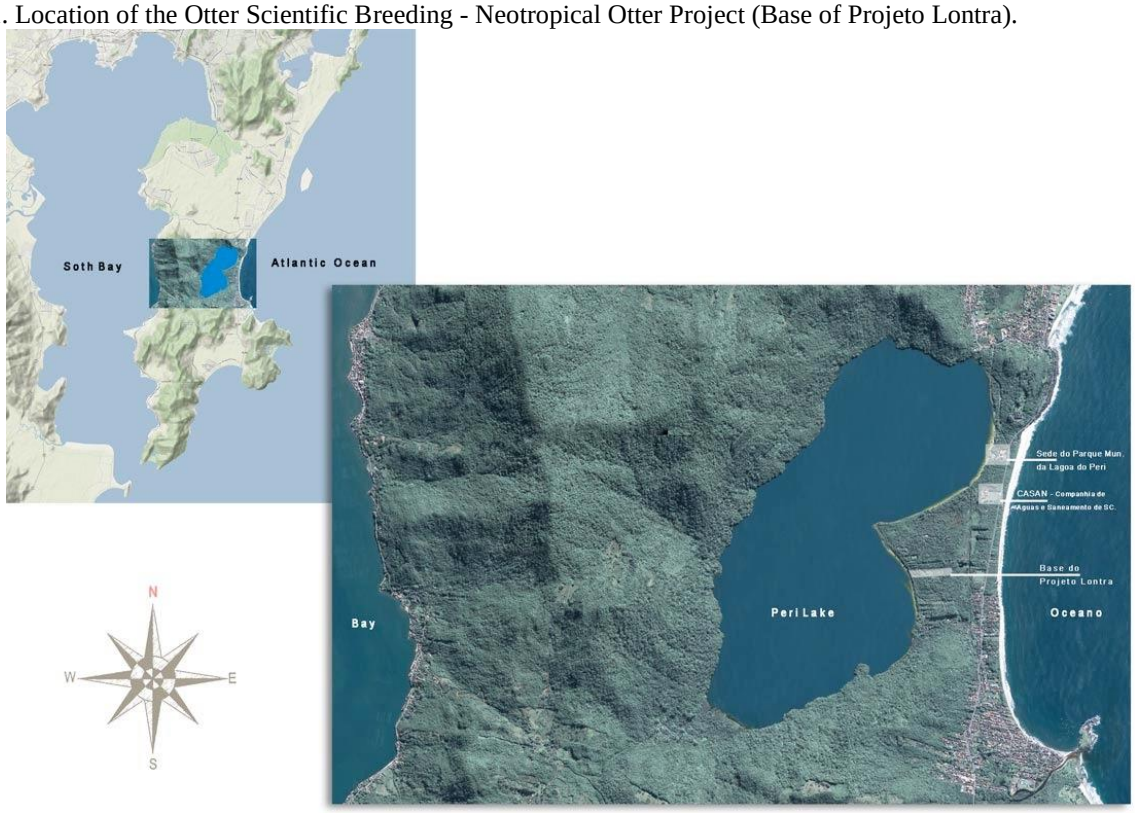
and Nishida, 2007; Nascimento *et al*. 2008; Barlow, 1977). The study of the behavior of animals in captivity helps to understand the effect that the conditions of an enclosure can have on the natural behavior of animals. Behavioral studies also look at the alternatives that allow animals to adapt to a captive life (Peixoto, 1998).

The purpose of this work is to define basic behavior categories in captivity of neotropical otter and perform some quantitative analysis on the data. The research was conducted at the Neotropical Otter Scientific Breeding of the Ekko Brazil Institute, in Santa Catarina Island, south of Brazil.

2 MATERIALS AND METHODS

The research is conducted in an otter scientific breeding located at 27°42'S and 48°30'W, in the southeast of Santa Catarina Island, south of Brazil (Fig. 1). The place is within a conservation area, surrounded by Atlantic Forest and in front of a lake of 5 km^2. The otter enclosure has 322 m^2, natural ground, vegetation and 3 water tanks with different sizes (3.30 x 2.00 x 1.30; 2.00 x 2.00 x 0.50; 3.00 x 2.00 x 0.90), summing up 15.98 m^3 of water volume and 16.6 m^2 of water surface.

Figure 1. Location of the Otter Scientific Breeding - Neotropical Otter Project (Base of Projeto Lontra).



Between February and April 2010, a group of three otters was studied. The methodology was based on random observations, *ad libitum sampling* method, where everything relevant that the animals do is noted (Lehner, 1996; Altmann, 1974). It was also applied the *focal sampling* method, focused on the group of otters as a unit, using a standard spreadsheet to record all instances of its behavior (Martin and Bateson, 1993; Altmann, 1974).

The sampling effort for the *focal sampling* method is 4 hours/day, 3 days/week, for 3 months, totaling 196 hours. During these hours, the individuals were observed every five minutes until the total hours were completed. The daily observation was organized in periods, 2 hours in the morning and 2 hours in the afternoon. The work was carried out with three otters, a young female, one adult female and one adult male. Mean values of each behavioral category of the three otters were used to statistical analysis.

Two-way ANOVA was performed to test whether individual and social behavioral categories and temperature differed significantly among months (February to April) and day period (morning and afternoon). Tukey`s test was used to explain differences found on the ANOVA output. All count data were [log10(x+1)] transformed to stabilize the variance and fit the data to a normal distribution (Zar, 1996). The tests were performed on Statistic 7.0 (Statsoft Inc., 1984-2004).

3 RESULTS

It was identified and described 29 different behavior patterns, subdivided into 2 categories: individual and social behavior (Figure 2). Individual includes 7 subcategories: maintenance (stretching, scratching, urinating, defecating, vomiting), feeding (eating, drinking), motor task (playing, diving, vocalizing), movement (walking, swimming), explore (looking inside, looking outside), rest (sleep, repose) and cleaning (rolling in the sand, licking). Social is organized in 3 subcategories: affiliative (being licked, licking, approaching to staying, playing alone, resting alone, diving together, vocalizing alone, swimming together), agonistic (fight, struggle for food) and courtship (attempting to copulate) (Table 1).

Figure 2. Schematic view of the behavior patterns.

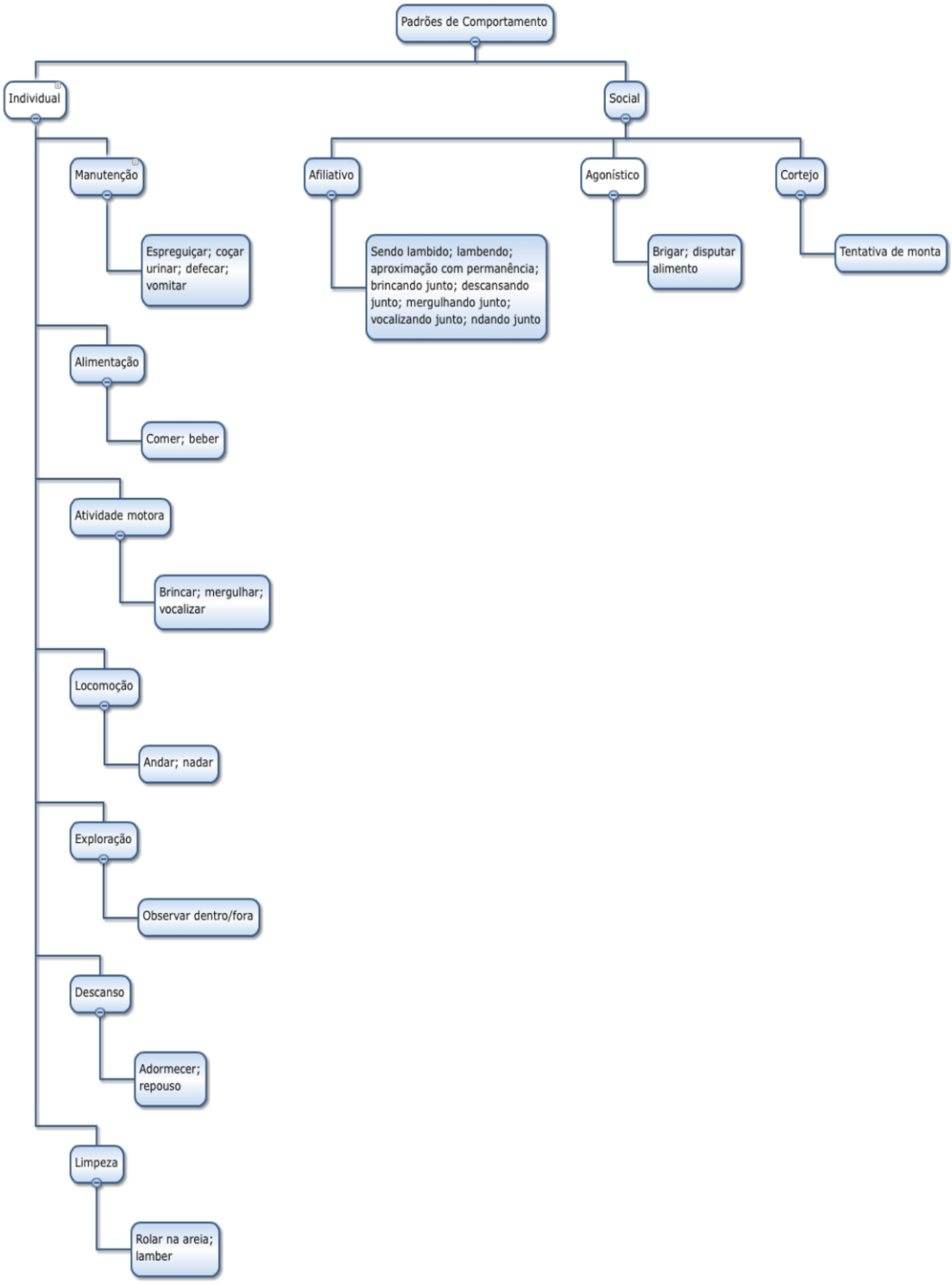


Table 1. It was identified and described 29 different behavior patterns, subdivided into 2 categories (individual and social behavior) and subcategories.

Categoria	Code	Activity	Description
Individual	ET	Eating	Handle the fish in the water, get out of the pool, lay belly-down holding the fish with its forepaws. By the tail starts tearing the flesh with the canines, raising his head, throwing the meat back and chewing with the molars and then swallow. To eat a fish 250-300 g, the animal takes about 12 minutes on average.
	DK	Drinking	They approach de swimming pool, crouch down by the pool's edge, insert the tip of their mouth in the water and drink.
	RS	Rolling in the sand	With their back facing the floor, they roll themselves on sand, rubbing their back on the sand surface. They also lower themselves and rub their face and neck on the sand.
	LU	Licking up	They either sit or lay down and turn their had to lick their back, side or front paws
	SO	Stretching out	With their back facing the floor, they stretch front and back legs.
	ST	Scratching	They use their nails from their back legs to scratch themselves on the front part of their body.
	UR	Urinate	They slightly lower themselves, so their genitals are close to the ground, they raise their tail and urinate.
	DF	Defecate	They slightly lower themselves, apart slightly their back legs, raise their tail and defecate.
	PA	Play alone	Using some object in the swimming pool, they manipulate it, bite it, raise it with their head, dive with it, carry it out of the water and throw it inside again.
	SW	Swim	They move their back legs back and forwards with their fingers and interdigital membrane stretched out, they use their tail to change direction on the swimming. They keep their head slightly out of the water.
	DV	Dive	They first insert their head into the water, right after, using their back legs, they dive in the water.
	VA	Vocalizing alone	They emit a sound through their mouth wile displaying some specific behavior.
	FS	Fall asleep	They lay down, sometimes curled up, lower their head, and close their eyes.
	RA	Rest alone	After fall sleep, they keep sleeping.
	LI	Look inside	They observe something in specific inside their enclosure.
	LO	Look outside	They observe something in specific outside their enclosure.
	WK	Walk	They walk in a sequence of left and right limbs, moved parallel to the body. While walking, they bend the back upwards.
Social	BL	Being licked	Hygiene of genitals, cleaning.
	LK	Licking	To approximate or interact with another individual.
	AP	Approach permanency	The species approaches the edges of the enclosure to observe some new person or noise. In the natural environment, this was recorded as a way to distract the observers on behalf of the puppies.

	RT	Rest together	Behavior observed when in pairs in the same environment, either in captivity or in the wild. In the natural environment, the behavior was observed between mother and puppies.
	ST	Swim together	They move their back legs back and forwards with their fingers and interdigital membrane stretched out, they use their tail to change direction on the swimming. They keep their head slightly out of the water. One otter goes in front and the other individual follows right behind or right next to it.
	DT	Dive together	They first insert their head into the water, right after using their back legs they dive in the water. One otter goes in front and the other individual follows right behind or right next to it.
	VT	Vocalizing together	Way of communication between species and with the external environment.
	PT	Play together	They swim after each other, in a higher speed than just normal swim. They often stop swimming to bite each other's neck and/or attempt to. Furthermore, they also grab each other's front with their teeth and roll sideways together.
	FT	Fight	They display agonistic vocalization, they position themselves front to front, the attacker tries to bite the other individual while the attacked tries to avoid the bites.
	AT	Attempting to copulate	They start with playing together, afterwards the male bites the female's neck and position himself on the top of the female, they both, attached, turn either sideways or belly up, the male tries to insert its penis in the female's genital.

According to ANOVA results, air temperature was significantly higher in February and March (Table 2). Behavior categories related to feeding, cleaning and rest showed significantly more activity in the months with higher temperature (Table 2 and Fig. 3). However, categories as maintenance, motor task, reconnaissance and mobility seem to present the opposite relation. Relating to daily periods, afternoon was significantly warmer than the morning, and only the behaviors defecate, roll in the sand, and lick up showed any variability between morning and afternoon according to ANOVA (Table 2). In this case, all categories showed significantly higher activity in the afternoon, when it was warmest.

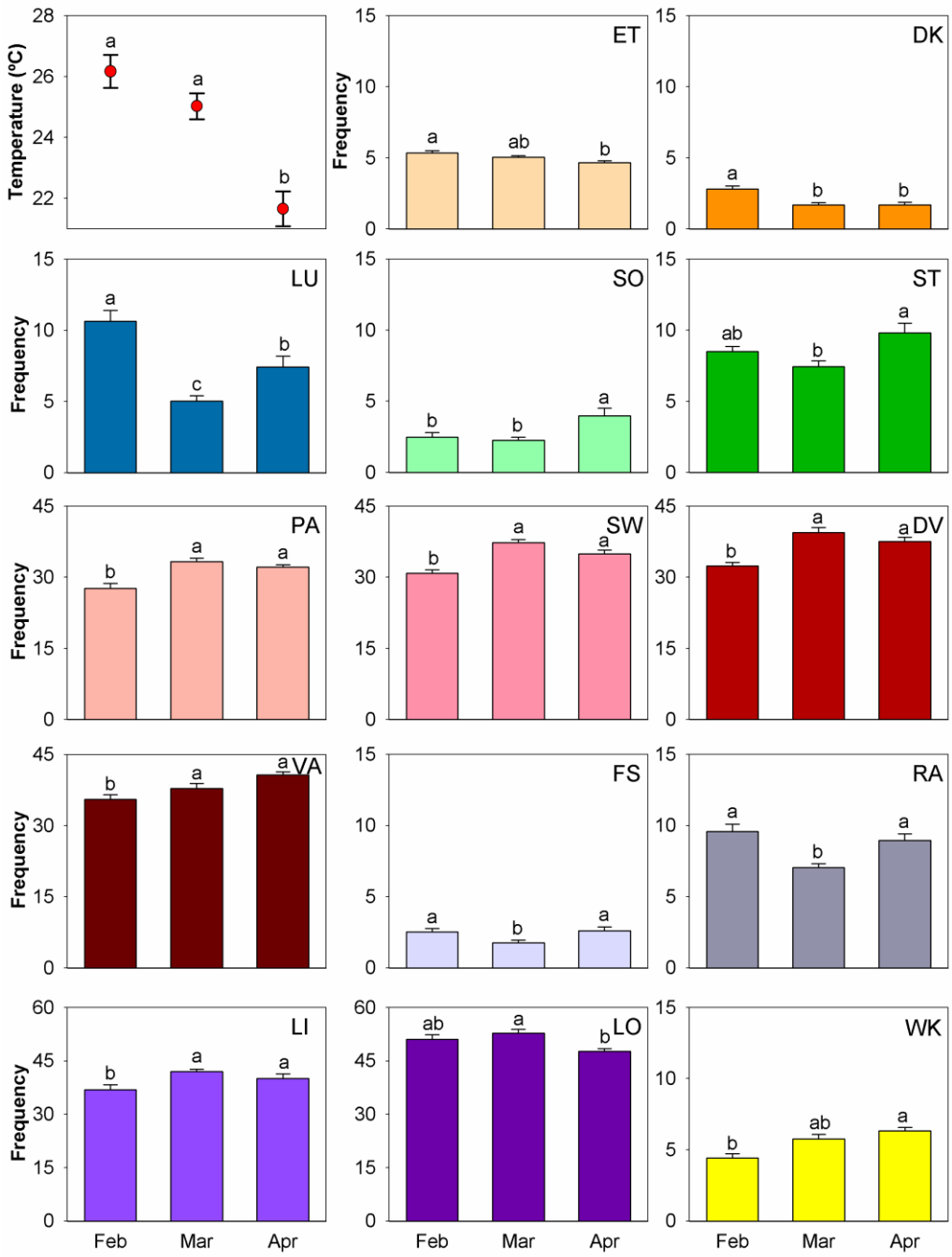
Table 2. Results and significance level (*p<0.05, **p<0.01) for two-way ANOVA performed to test whether temperature and frequency of behaviors differed significantly between months and daily periods. ns: no significant. Residual degrees of freedom (d.f.) 90.

[1]Letters indicate significantly different means from Tukey test.
[2]Month: Feb, February; Mar, March; Apr, April.
[3]Period: Mor, Morning; Aft, Afternoon.

		Month (d.f. = 2)		Period (d.f. = 1)		Tukey test results[1]	
		F	p	F	p	Month[2]	Period[3]
Temperature	TP	20.14	0.0000**	13.69	0.0004**	Feb[a] Mar[a] Apr[b]	Aft[a] Mor[b]
Eat	ET	4.71	0.0114*	0.29	0.5884	Feb[a] Mar[ab] Apr[b]	
Drink	DK	12.82	0.0000**	1.62	0.2062	Feb[a] Apr[b] Mar[b]	
Roll in the sand	RS	0.18	0.8360[ns]	6.21	0.0145*		Aft[a] Mor[b]
Lick up	LU	32.40	0.0000**	9.08	0.0033**	Feb[a] Apr[b] Mar[c]	Aft[a] Mor[b]
Stretch out	SO	6.26	0.0028**	0.89	0.3471[ns]	Apr[a] Feb[b] Mar[b]	
Scratching	ST	6.81	0.0017**	0.15	0.6987[ns]	Apr[a] Feb[ab] Mar[b]	
Urinate	UR	0.73	0.4862[ns]	0.60	0.4394[ns]		
Defecate	DF	2.90	0.0603[ns]	6.19	0.0147*		Aft[a] Mor[b]
Play alone	PA	16.01	0.0000**	0.01	0.9430[ns]	Mar[a] Apr[a] Feb[b]	
Swim	SW	26.39	0.0000**	0.20	0.6589[ns]	Mar[a] Apr[a] Feb[b]	
Dive	DV	17.73	0.0000**	0.21	0.6440[ns]	Mar[a] Apr[a] Feb[b]	
Vocalizing alone	VA	12.64	0.0000**	1.70	0.1961[ns]	Apr[a] Mar[a] Feb[b]	
Fall asleep	FS	4.45	0.0143*	1.62	0.2061[ns]	Apr[a] Feb[a] Mar[b]	
Rest alone	RA	9.98	0.0001**	0.46	0.4989[ns]	Feb[a] Apr[a] Mar[b]	
Look inside	LI	9.43	0.0002**	0.81	0.3711[ns]	Mar[a] Apr[a] Feb[b]	
Look outside	LO	4.56	0.0129*	0.00	0.9918[ns]	Mar[a] Feb[ab] Apr[b]	
Walk	WK	8.18	0.0005**	1.27	0.2627[ns]	Apr[a] Mar[ab] Feb[b]	
Being licked	BL	4.54	0.0132*	0.71	0.4917[ns]	Apr[a] Mar[ab] Feb[b]	
Licking	LK	1.04	0.3570[ns]	0.36	0.5511[ns]		
Approach permanency	AP	7.99	0.0006**	0.06	0.8157[ns]	Mar[a] Feb[b] Apr[b]	
Rest together	RT	2.73	0.0703[ns]	0.04	0.8413[ns]		
Swim together	ST	1.52	0.2234[ns]	1.20	0.2761[ns]		
Dive together	DT	5.59	0.0051**	0.01	0.9407[ns]	Feb[a] Mar[b] Apr[b]	
Vocalizing together	VT	0.93	0.3965[ns]	0.01	0.9311[ns]		

Play toguether	PT	2.07	0.1318^{ns}	0.01	0.9824^{ns}	
Fight	FT	0.14	0.8709^{ns}	1.43	0.2354^{ns}	
Attempting to copulate	AC	3.73	0.0278*	3.24	0.0752^{ns}	Apr^{a} Feb^{ab} Mar^{b}

Figure 3. Monthly mean (±se) temperature (ºC) and monthly mean (±se) frequency of observations for the individual behavioral categories. Letters indicate significantly different ($p < 0.05$) means from Tukey test. Abbreviations are in Table 2.



The adults presented a similar pattern of activity, unlike the young female, who practiced more often, playing, swimming, and diving. In general, the larger number of activities carried out by the otters was: watching out of the enclosure (7.8%), watching inside the enclosure (6%), walking (5.8%), diving (5.5%), swimming (5.2%), playing alone (4.7%), diving together (1.3%), swimming together (1.3%), and playing together (1.2%). No difference in activity was found from day to night, but on days when average temperatures were lower, swimming, diving, and rolling in the sand, decreased significantly, increasing resting activities.

4 DISCUSSION

It is important to consider that behavioral changes can occur with the animal in captivity. In captivity, the pattern may be different from in the wild due to handling conditions. This is because the animals tend to condition the activities with the schedules of handling operations, such as feeding time and cleaning enclosures periods.

It can be argued that some behaviors have also been observed in stressful situations in the wild, but the concern with captive animals is that an abnormal behavior might become a stereotype (Wickins-Dražilová, 2006). In this study, it was observed the act of "eating grass". This pattern seemed to promote a form of relaxation in moments of anxiety that preceded the provision of food, since it was often followed by a resting period. However, the act of observing outside the enclosure caused more concern since it may be indicative of stress.

Lontra longicaudis as a highly specialized animal and solitary habit (Carvalho Junior, 2007), does not show a pattern of foraging in captivity and common stereotypes. Opportunistic species tend to show more problems in captive environments because they are adapted to highly variable environments and captivity normally does not offer enough stimulation. Social animals have higher cognitive abilities, which also increase the need for constant sources of stimulation (Robinson et al., 2019).

Different ways of providing food represent a suitable alternative for breaking the monotony in the management of the animal. For example, a catapult that shoots food in the enclosure at random intervals has been applied with good results (Gothard, 2007). In this study, offering blocks of ice with fish in it, and live fish, helped to stimulate the hunting instinct, resulting in the breakdown of the regularity of day-to-day of the otter in captivity.

From the 29 standards behaviors described throughout the study, none was exclusively for female or male. This shows that male and female of *Lontra longicaudis* have similar patterns of activity.

ACKNOWLEDGMENTS

The authors thank Luis C. P. de Macedo Soares for his suggestions and contribution to the statistical analysis.

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