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WHAT ARE YOU EATING? STOMACH CONTENTS OF ROADKILLED MAMMALS OF NORTHERN RIO GRANDE DO SUL

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Abstract: Roads modify the landscape and act as a barrier to fauna movements between habitat patches, which may cause changes in mammals' diet. Our objective was to analyze the food items found in stomach contents and which trophic categories are most abundant in roadkilled mammals of northern Rio Grande do Sul state. We analyzed 50 stomachs of 18 species collected from 2008 to 2010 and 2015 to 2017, belonging to 5 trophic categories: Omnivores (9 species), Carnivores (5 species), Herbivores (2 species), Myrmecophagides (1 species) and Piscivores (1 species). Our results suggest that roadkilled mammals utilized a wide range of trophic categories, in which half of the species recorded here presented omnivorous habits and are categorized as generalist species.

Keywords: feeding diet; habitat fragmentation; habitat loss; mammalian fauna; roadkill.

Throughout the centuries, the Brazilian Atlantic Forest has been severely converted into settlements, such as agricultural lands and urban centers, in such a way that these areas with large impacts overlap with the most defaunated areas of this biome (Bogoni *et al.* 2018). The massive expansion of roads, which connects these urban and rural centers, is related with an increase of animal-vehicle collision, contributing to biodiversity reduction (Abra *et al.* 2019, Seiler 2001, Cáceres 2011) and might be considered one of the main current causes of vertebrate mortality in the world (Forman & Alexander 1998, Van Der Ree *et al.* 2011). Furthermore, roads can also act as a barrier to mammal movements between habitat patches, which may hamper the access to some food resources (Seiler 2001, Cáceres 2011). Since medium and large sized mammals cover long distances daily, these animals are constantly vulnerable to risks offered by roads (Seiler 2001, Cáceres 2011). In landscapes where native vegetation is reduced and fragmented, such as the northern of Rio Grande do Sul state, these risks offered by roads might become worse.

Such landscape configuration may alter the patterns of habitat use by fauna, as well as the availability of habitat resources, and may culminate in the insertion of non-usual food items in these animals' diet (Seiler 2001, Cáceres *et al.* 2002, Tumeleiro *et al.* 2006, Rocha *et al.* 2008, Driscoll *et al.* 2013). In this way, feeding habits of mammals may become an important issue, considering

that predators in terrestrial ecosystems may limit populations of their prey that could become over abundant (Johnson *et al.* 2007) and affect vegetal community regeneration (Juarez & Marinho-Filho 2002, Pimentel & Tabarelli 2004, Gatti *et al.* 2006). Furthermore, the knowledge of the feeding habits of the animals might help to prepare conservation strategies of mammals and its habitat (Abreu *et al.* 2010). For roadkilled mammals from Northern Rio Grande do Sul state, Brazil (see Hegel *et al.* 2012), there are not much data available regarding their diet (Redford 1986, Sikes 1990, Cáceres 2002, Alves-Costa *et al.* 2004, Tumeleiro *et al.* 2006, Rocha *et al.* 2008, Abreu *et al.* 2010), with information coming mainly from other countries database (e.g. *M. coypus* in Guichón et al. 2003, Wisley *et al.* 1991, and Marini *et al.* 2013).

The objective of this study was to make a description of the food items of roadkilled mammals of the northern Rio Grande do Sul state, and to assess how frequent those items are consumed by the species and guilds. This information could assist future efforts to protect wild animals with the development of protocols for collecting information of diet from roadkilled species.

The northern Rio Grande do Sul state was originally covered by Mixed Ombrophilous Forest, an Atlantic Forest biome' phytophisionomic formation (Quadros & Pillar 2002). Currently, the main economic activity in the region is agriculture and the native vegetation patches are severely reduced and fragmented, bordering croplands, urban settlements, and roads.

We used stomach contents obtained from the roadkilled mammals. The stomach contents were removed from the stomach' carcasses, preserved in a mixture with 10 % formaldehyde and 70 % alcohol, and deposited in Coleção Anexa de Mamíferos da Universidade de Passo Fundo (CAMUPF), in Passo Fundo, Rio Grande do Sul state, Brazil (Appendix 1). The specimens came from intercity roads and highways from the northern Rio Grande do Sul state, mainly from RS-135, BR-153, and BR-285 (Figure 1), collected from 2008 to 2010 and from 2015 to 2017. The specimens deposited in the scientific collection between 2008 and 2010 were collected during a previous study (see Hegel *et al.* 2012), while the specimens deposited between 2015 and 2017 were taken by the local citizens.

A total of 50 stomach contents were macroscopically analyzed. The items were identified using stereomicroscope, specialized

Figure 1. Location of the main roads where the study was performed, in the northern Rio Grande do Sul state, Brazil.

bibliography (Lorenzi 1992, Rafael et al. 2012), and consults with experts. We determined vertebrate animals partially digested at the class, order and species taxonomic levels when possible. The items were classified in seven categories: plants, human food, milk, insects, birds, rodents and snakes. We identified the roadkilled animals based on their current geographical distributions and followed the descriptions in Oliveira & Cassaro (1997), Reis *et al.* (2011), and Patton *et al.* (2015). Recent taxonomic reviews were adopted, including information on the genera *Leopardus* (Nascimento & Feijó 2017; Espinosa *et al.* 2018), *Galictis* (Poo-Muñoz *et al.* 2014) and *Dasypus* (Feijó *et al.* 2018).

We estimated the proportion of food items mammals consumed by calculating the frequency of occurrence (FO) of each item for each species. To this end, we divided the number of times a given food item was present by the total of items found in the stomachs. Species were grouped in trophic categories, adapted from Dotta & Verdade (2007) and Paglia *et al.* (2012), as follows: Omnivores (O), Carnivores (CA), Herbivores (H), Myrmecofages (M), and Piscivores (P). The trophic category of each species was defined based on Paglia *et al.* (2012). The species classified as Insectivore/Omnivore, Carnivore/Omnivore, and Frugivore/Omnivore by Paglia *et al.* (2012) were grouped in the Omnivores category.

We registered eighteen roadkilled species that belong to five trophic categories (Table 1). Omnivores are represented by nine species (50 % of the species), carnivores are represented by five species (27.7 % of the species), herbivores are represented by two species (11.1 % of the species), and myrmecophages and piscivores are represented by one species each (each one representing 5.55 % of the species).

Seven different types of food items were recorded among the trophic categories (Table 1). Plants were the most consumed item, appearing in all the trophic categories, being ingested by 32 individuals (belonging to 14 species), and representing 64 % of occurrence within all individuals. Among plants, we found parts of roots, seeds, fruits, leaves, and stems.

Within omnivores, the most consumed item was plants, appearing in eight species, followed by insects (six species) and birds (two species). The other items registered in this trophic category only appeared in one species. Within carnivores, the most consumed item was rodents (four species), followed by birds and plants (both consumed by two species). Insects were consumed by only one species, within the carnivores. Herbivores and piscivores consumed essentially plants, and the only myrmecofage species fed both on plants and insects (Table 1).

Cerdocyon thous and *D. novemcinctus* showed a diversified diet, both omnivores and with five types of food items. *Cerdocyon thous* fed on rodents (38.89 %), plants (33.33 %, especially *Hovenia dulcis* – Rosales, Rhamnaceae), insects (16.67 %), birds (5.56 %) and snakes (5.56 %). Among the plants consumed by the canid, there was also *Vitis* sp. (Vitales, Vitaceae). Considering that *Vitis* sp. was introduced in the country by humans and it is cultivated in rural areas (Klock *et al.* 2011), the consumption of this plant might illustrate the search for alternative food resources in human-modified areas. In another study on roadkilled animals performed in Rio Grande do Sul, *C. thous* also showed diet composed by rodents (100 %), arthropods (66.6 %) and seeds (33.3 %) (Tumeleiro *et al.* 2006), and for the Paraná state it was reported for this species a large consumption of *H. dulcis* (30 %) (Rocha *et al.* 2008), probably associated with the high availability of this fruit in the environment. In this way, the feeding habits of *C. thous* might be opportunistic by ingesting non-native species, being capable of adapting its diet according to what is available in the environment (Motta-Junior *et al.* 1994, Rocha *et al.* 2008). *Cerdocyon thous* was the only species present in the study that fed on snakes, a pattern already described in the literature (Rocha *et al.* 2008). Thus, in addition of being a seed disperser (Motta-Junior *et al.* 1994), the consumption of snakes and rodents shows that this species may also perform an important ecological/sanitary role by controlling urban plague populations (Bueno & Motta-Junior 2004, Pedó *et al.* 2006, Abreu *et al.* 2010).

In *D. novemcinctus*, we found plants (50 %) and insects (25 %, coleopterans). A young individual presented greasy substance resembling milk (25 %, Table 1). The species is described as feeding on roots and tubers, insects, fruits, small invertebrates and fungi (Deutsch & Puglia 1990), with a very opportunistic diet (Redford 1986, Sikes 1990). For the other armadillo species presented in

this study, all classified as Omnivores, *Euphractus sexcintus* stomachs presented only insects (40 %, coleopterans) and plants (60 %), while *Dasypus septemcintus* was the only species in this study that fed exclusively on insects (100 %, Table 1).

The main orders of insects recorded in this study among Omnivores, Carnivores and Myrmecophages trophic categories were Coleoptera, Hymenoptera, Lepidoptera, and Orthoptera, in this order of importance. The only roadkilled mammal that fed on Hymenoptera was *T. tetradactyla*, with the ingestion of ants (juvenile and adults) and termites. Non identified individuals from the family Gryllidae (Orthoptera) were consumed only by *L. gymnocercus* (representing 25 % of the items consumed by this species), while Lepidoptera was present only in the stomach contents of *N. nasua*, which had a diet composed by insects in 66.67 % of the analyzed samples (Table 1).

In *N. nasua* and *L. gymnocercus,* we also recorded the consumption of native fruits (33.33 % and 50 %, respectively). *Nasua nasua* fed on guamirim (*Myrcia* sp. – Myrtales, Myrtaceae) and alligator apple (*Annona* sp. – Magnoliales, Annonaceae), while *L. gymnocercus* showed the consumption of butia (*Butia* sp. – Arecales, Arecaceae). The ingestion of native fruits suggests the importance of *N. nasua* and *L. gymnocercus* in the dispersion of native seeds, especially in reduced and fragmented areas, where larger herbivores tend to be less frequent (Alves-Costa *et al.* 2004, Varela *et al.* 2008). *Leopardus wiedii* and *L. pardalis* fed exclusively on rodents, including a porcupine (*Coendou villosus*) in the latter species. *Leopardus guttulus* ingested rodents and birds (Table 1).

Myocastor coypus was registered feeding on corn seeds (*Zea mays* – Poales, Poaceae) (Table 1), and the species is described as feeding

Table 1. Food items and trophic category (Paglia *et al.* 2012) from roadkilled mammals in northern Rio Grande do Sul state, Brazil. N = total number of analyzed individuals; F = number of stomachs per species containing the food item; N.I. = non identified items; F.O. (%) = food items' frequency of occurrence).

Trophic Categories/Species	N	F	Food Item	Description of items	F.O. (%)
Omnivore					
Cerdocyon thous (Linnaeus, 1766)	10	1	Birds	N.I.	5.56%
		7	Rodents	N.I.	38.89%
		6	Plants	*Vittis* sp., *Hovenia dulcis*, plants N.I.	33.33%
		3	Insects	Coleopterans and larvae N.I.	16.67%
		1	Snakes	*Tomodon* sp.	5.56%
Lycalopex gymnocercus (G. Fischer, 1814)	2	1	Rodents	N.I.	25%
		2	Plants	*Butia* sp., plants N.I.	50%
		1	Insects	Gryllidae family	25%
Nasua nasua (Linnaeus, 1766)	5	1	Plants	*Myrcia* sp., *Annona* sp.	33.33%
		4	Insects	Lepidopteran larvae, larvae N.I., insects N.I.	66.67%
Procyon cancrivorus (G. Baron Cuvier, 1798)	1	1	Plants	Seeds N.I.	100%
Didelphis albiventris Lund, 1840	1	1	Plants	Tomato skin	50%
		1	Human food	Bread pieces	50%
Dasypus novemcinctus Linnaeus, 1758	3	2	Plants	N.I. and seed endocarp	50%
		1	Insects	Coleopterans and pupae N.I.	25%
		1	Milk	N.I.	25%

Table 1: Continued on next page...

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Trophic Categories/Species	N	F	Food Item	Description of items	F.O. (%)
Dasypus septemcinctus (Desmarest, 1804)	1	1	Insects	N.I.	100%
Euphractus sexcintus (Linnaeus, 1758)	3	3	Plants	N.I.	60%
		2	Insects	Coleopterans N.I., insects N.I.	40%
Myocastor coypus (Molina, 1782)	4	4	Plants	Roots, grasses, plants N.I., corn seeds	100%
Total of individuals:	**30**				
Carnivore					
Galictis cuja (Molina, 1782)	2	1	Birds	N.I.	25%
		1	Rodents	N.I.	25%
		1	Plants	N.I.	25%
		1	Insects	Larvae N.I.	25%
Herpailurus yagouaroundi (É. Geoffroy Saint-Hilaire, 1803)	1	1	Plants	Seeds N.I.	100%
Leopardus wiedii (Schinz, 1821)	2	2	Rodents	N.I.	100%
Leopardus guttulus (Hensel, 1872)	3	1	Birds	N.I.	25%
		3	Rodents	N.I.	75%
Leopardus pardalis (Linnaeus, 1758)	1	1	Rodents	*Coendou villosus*	100%
Total of individuals:	**9**				
Herbivore					
Cavia aperea Erxleben, 1777	4	4	Plants	N.I.	100%
Coendou villosus (F. Cuvier, 1823)	4	4	Plants	N.I.	100%
Total of individuals:	**8**				
Myrmecophage					
Tamandua tetradactyla (Linnaeus, 1758)	2	1	Plants	Seeds N.I.	33.33%
		2	Insects	Hymenopterans, coleoptean larvae and pupae N.I.	66.67%
Total of individuals:	**2**				
Piscivore					
Chironectes minimus (Zimmermann, 1780)	1	1	Plants	Leaves N.I.	100%
Total of individuals:	**1**				

preferably on aquatic plants (Borgnia *et al.* 2000, Guichón *et al.* 2003, Colares *et al.* 2010). However, the consumption of terrestrial plants has been observed for the species when aquatic vegetation is scarce (Prigioni *et al.* 2005). A great part of the wetlands shown in our study area is surrounded by agricultural lands, especially corn and soybean, which might explain the presence of corn in the individuals' stomach contents. Furthermore, in Italy, Europe, the species has already been reported feeding on croplands (Panzacchi *et al.* 2007).

Didelphis albiventris showed non-usual items on its diet, such as pieces of bread and tomato skin (*Solanum lycopersicum* - Solanales, Solanaceae). These items were highlighted among the fragments of leaves and stems presented in the stomach sample, showing the species' search for food in periurban environments. *Didelphis albiventris* is a generalist species (Lessa & Geise 2010, Silva *et al.* 2014) that adapt easily to human presence (Silva *et al.* 2014) and therefore, may have been favored in this habitat, complementing its diet with food remains found in garbage cans or

streets (Cáceres 2002).

In reduced and fragmented landscapes, natural habitats are normally small sized patches, and movements among patches for reproduction of feeding purposes can turn species more vulnerable to vehicle collision (Cáceres 2011). Non-native plants and/or crops might become the most available food source in the environment, which may cause (1) the isolation of more sensitive species in the natural patch, since these animals will not be able to cross the matrix (Chiarello 1999, Andrade-Núñez & Aide 2010, Cáceres *et al.* 2010, Driscoll *et al.* 2013); or (2) cause adaptations in the diet of more generalist/opportunistic species, through the partial replacement of native vegetation for non-usual items (Duarte *et al.* 2012). This might also lead herbivores that partially feed on cultivated plants to disperse non-native seeds within natural patches (Panter & Dolman 2012). If the plant species dispersed is able to germinate in the natural patches and have some invader characteristics, they may change plant composition of that patch, decreasing the availability of native plants (Panter & Dolman 2012).

Although our data is limited by the methodology used, it shows an overview of the current situation regarding the diet of small and medium-sized roadkilled mammals of Rio Grande do Sul state, southern Brazil. Our results suggest that the heterogeneous landscape in the study area probably supports mostly generalist species, as half of the species presented omnivore habits (Dotta & Verdade 2007). In this way, information about mammals' diet is important to contribute to the knowledge on the natural history of these species and to help creating conservation strategies, mainly in areas where there is constant human disturbance.

REFERENCES

Abra, F. D., Granziera, B. M., Huijser, M. P., Ferraz, K. M. P. M. B., Haddad, C. M., & Paolino, R. M. 2019. Pay or prevent? Human safety, cost to society and legal perspectives on animal-vehicle collisions in São Paulo state, Brazil. PLoS ONE, 14(4), 1–2. DOI: 10.1371/journal.pone.0215152

Abreu, M., Wieliczko, A., Mesquita, A., & Vieira, E. 2010. Consumo de pequenos mamíferos por canídeos simpátricos do sul do Brasil: sobreposição de nichos e seleção de presas. Neotropical Biology and Conservation, 5(1), 16–23. DOI: 10.4013/nbc.2010.51.03

Alves-Costa, C. P., Da Fonseca, G. A. B., & Christófaro, C. 2004. Variation in the diet of the Brown-nosed coati (*Nasua nasua*) in Southeastern Brazil. Journal of Mammalogy, 85(3), 478–482. DOI: 10.1644/1383945

Andrade-Núñez, M. J., & Aide, T. M. 2010. Effects of habitat and landscape characteristics on medium and large mammal species richness and composition in northern Uruguay. Zoologia (Curitiba), 27(6), 909–917. DOI: 10.1590/S1984-46702010000600012

Bogoni, J. A., Pires, J. S. R., Graipel, M. E., Peroni, N., & Peres, C. A. 2018. Wish you were here: How defaunated is the Atlantic Forest biome of its mediun to large-bodied mammal fauna? PLoS ONE, 13(9): 1–23. DOI: 10.1371/journal.pone.0204515

Borgnia, M., Galante, M. L., & Cassini, M. H. 2000. Diet of Coypu (Nutria, *Myocastor coypus*) in Agro-Systems of Argentinian Pampas. The Journal of Wildlife Management, 64(2), 354–361. DOI: 10.2307/3803233

Bueno, A. D. A., & Motta-Junior, J. C. 2004. Food habits of two syntopic canids, the maned wolf (*Chrysocyon brachyurus*) and the crab-eating fox (*Cerdocyon thous*), in southeastern Brazil. Revista Chilena de Historia Natural, 77(1), 5–14. DOI: 10.4067/S0716-078X2004000100002

Cáceres, N. C. 2002. Food Habits and Seed Dispersal by the White-Eared Opossum *Didelphis albiventris* in Southern Brazil. Studies on Neotropical Fauna and Environment, 37(1), 97–104. DOI: 10.1076/snfe.37.2.97.8582

Cáceres, N. C., Nápoli, R. P., Casella, J., & Hannibal, W. 2010. Mammals in a fragmented savannah landscape in south-western Brazil. Journal of Natural History, 44(7-8), 491–512. DOI: 10.1080/00222930903477768

Cáceres, N. C. 2011. Biological characteristics influence mammal road kill in an Atlantic Forest-Cerrado interface in south-western Brazil. Italian Journal of Zoology, 78(3), 379–389. DOI: 10.1080/11250003.2011.566226

Chiarello, A. G. 1999. Efects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. Biological Conservation, 89(1), 71–82. DOI: 10.1016/S0006-

3207(98)00130-X

Colares, I. G., Oliveira, R. N. V., Liveira, R. M., & Colares, E. P. 2010. Feeding habits of coypu (*Myocastor coypus* Molina 1978) in the wetlands of the Southern region of Brazil. Anais da Academia Brasileira de Ciências, 82(3), 671–678. DOI: 10.1590/S0001-37652010000300015

Deutsch, L., & Puglia, L. R. R. 1990. Os Animais Silvestres: Proteção, Doenças e Manejo. 2nd ed. São Paulo: Globo: p. 191.

Dotta, G., & Verdade, L. M. 2007. Trophic categories in a mammal assemblage: diversity in an agricultural landscape. Biota Neotropica, 7(2), 287–292. DOI: 10.1590/S1676-06032007000200031

Driscoll, D. A., Banks, S. C., Barton, P. S., Lindenmayer, D. B., & Smith, A. L. 2013. Conceptual domain of the matrix in fragmented landscapes. Trends in Ecology and Evolution, 28(10), 605–613. DOI: 10.1016/j.tree.2013.06.010

Duarte, J. M. B., Piovezan, U., Zanetti, E. dos S., & Ramos, H. G. da C. 2012. Plano de Ação Nacional para a Conservação dos Cervídeos Ameaçados de Extinção. Espécies de Cervídeos Brasileiros Não Ameaçadas de Extinção, p. 20–27.

Espinosa, C. C., Trigo, T. C., Tirelli, F. P., da Silva, L. G., Eizirik, E., Queirolo, D., Mazim, F. D., Peters, F. B., Favarini, M. O., & de Freitas, T. R. O. 2018. Geographic distribution modeling of the margay (Leopardus wiedii) and jaguarundi (Puma yagouaroundi): a comparative assessment. Journal of Mammalogy, 99(1), 252–262. DOI: 10.1093/jmammal/gyx152

Feijó, A., Patterson, B. D., & Cordeiro-Estrela, P. 2018. Taxonomic revision of the long-nosed armadillos, genus *Dasypus* Linnaeus, 1758 (Mammalia, Cingulata). PLoS ONE, 13(4), e0195084. https://doi.org/10.1371/journal.pone.0195084

Forman, R. T. T., & Alexander, L. E. 1998. Roads and Their Major Ecological Effects. Annual Review of Ecology and Systematics, 29(1), 207–231. DOI: 10.1146/annurev.ecolsys.29.1.207

Gatti, A., Bianchi, R., Rosa, C. R. X., & Mendes, S. L. 2006. Diet of the crab-eating fox, Cerdocyon thous (Carnivora, Canidae) in Paulo Cesar Vinha State Park, Espírito Santo State, Brazil. Mammalia, 70(1–2), 153–155. DOI: 10.1515/MAMM.2006.021

Guichón, M. L., Benítez, V. B., Abba, A., Borgnia, M., & Cassini, M. H. 2003. Foraging behaviour of coypus Myocastor coypus: Why do coypus consume aquatic plants? Acta Oecologica, 24(5–6), 241–246. DOI: 10.1016/j.actao.2003.08.001

Hegel, C. G., Consalter, G. C., & Zanella, N. 2012. Mamíferos silvestres atropelados na rodovia RS – 135, norte do Estado do Rio Grande do Sul. Biotemas, 25(2), 165–170. DOI: 10.5007/2175-7925.2012v25n2p165

Johnson, C. N., Isaac, J. L., & Fisher, D. O. 2007. Rarity of a top predator triggers continent-wide collapse of mammal prey: dingoes and marsupials in Australia. Proceedings of the Royal Society B, 274(1), 341–346. DOI: 10.1098/rspb.2006.3711

Juarez, K., & Marinho-Filho, J. 2002. Diet, habitat use, and home ranges of sympatric canids in central Brazil. Journal of Mammalogy, 83(4), 925–933. DOI: 10.1644/1545-1542(2002)083<0925

Klock, C. L., Botton, M., & Ferla, N. J. 2016. Mitefauna (Arachnida: Acari) associated to grapevine, Vitis vinifera L.(Vitaceae), in the municipalities of Bento Gonçalves and Candiota, Rio Grande do Sul, Brazil. Check List, 7(4), 522–536. DOI: 10.15560/7.4.522

Lessa, L. G., & Geise, L. 2010. Hábitos alimentares de marsupiais didelfídeos brasileiros: Análise do estado de conhecimento atual. Oecologia Australis, 14(4), 918–927. DOI: 10.4257/oeco.2010.1404.08

Lorenzi, H. 1992. Árvores brasileiras: manual de identificação e cultivo de plantas arbóreas nativas do Brasil. Nova Odessa: Plantarum, p. 368.

Marini, F., Gabrielli, E., Montaudo, L., Vecchi, M., Santoro, R., Battisti, C., & Carpaneto, G. M. 2013. Diet of coypu (*Myocastor coypus*) in a Mediterrenean coastal wetland: a possible impact on threatened rushbeds? Vie et Mileu – Life and Environment, 63(2), 97–103.

Motta-Junior, J. C., Lombardi, J. A., & Talamoni, S. A. 1994. Notes on crab-eating fox (*Dusicyon thous*) seed dispersal and food habits in southeastern Brazil. Mammalia, 58(1), 156–159.

Nascimento, F. O. & Feijó, A. 2017. Taxonomic revision of the tigrine *Leopardus tigrinus* (Schreber, 1775) species group (Carnivora, Felidae). Papéis Avulsos de Zoologia, 57(19), 231–264. DOI:10.11606/0031-1049.2017.57.19

Oliveira, T. G. D. & Cassaro, K. 1997. Guia de identificação dos felinos brasileiros. São Paulo:
Sociedade de Zoológicos do Brasil: p. 60.

Paglia, A.P., Fonseca, G.A.B. da, Rylands, A. B., Herrmann, G., Aguiar, L. M. S., Chiarello, A. G., Leite, Y. L. R., Costa, L. P., Siciliano, S., Kierulff, M. C. M., Mendes, S. L., Tavares, V. da C., Mittermeier, R. A. & Patton J. L. 2012. Annotated Checklist of Brazilian Mammals. Occasional Papers in Conservarion Biology, p. 82.

Panter, C. J., & Dolman, P. M. 2012. Mammalian herbivores as potential seed dispersal vectors in ancient woodland fragments. Wildlife Biology, 18(3), 292–303. DOI: 10.2981/11-112

Panzacchi, M., Cocchi, R., Genovesi, P., & Bertolino, S. 2007. Population control of coypu *Myocastor coypus* in Italy compared to eradication in UK: a cost-benefit analysis. Wildlife Biology, 13(2), 159-–171. DOI: http://doi.org/cdk95f

Patton, J. L., Pardiñas, U. F. J., & D'Elía, G. 2015. Mammals of South America, 2: Rodents. Chicago: University of Chicago Press: p. 1336.

Pedó, E., Tomazzoni, A. C., Hartz, S. M., & Chirstoff, A. U. 2006. Diet of crab-eating fox, *Cerdocyon thous* (Linnaeus) (Carnivora, Canidae), in a suburban area of southern Brazil. Revista Brasileira de Zoologia, 23(3), 637–641. DOI: 10.1590/S0101-81752006000300005

Pimentel, D. S., & Tabarelli, M. 2004. Seed Dispersal of the Palm Attalea oleifera in a Remnant of the Brazilian Atlantic Forest. Biotropica, 36(1), 74–84. DOI: 10.1111/j.1744-7429.2004.tb00298.x

Poo-Muñoz, D. A., Escobar, L. E., Peterson, A. Townsend, A., F., Organ, J. F., & Medina-Vogel, G. 2014. *Galictis cuja* (Mammalia): an update of current knowledge and geographic distribution. Iheringia. Série Zoologia, 104(3), 341–346. DOI: 10.1590/1678-476620141043341346

Prigioni, C., Balestrieri, A., & Remonti, L. 2005. Food habits of the coypu, *Myocastor coypus*, and its impact on aquatic vegetation in a freshwater habitat of NW Italy. Folia Zoologica-Praha, 54(3), 269–277.

Quadros, F. L., & Pillar, V. P. 2002. Transições floresta-campo no Rio Grande do Sul. Ciência & Ambiente, 24(1), 109–118.

Rafael, J. A., Melo, G. A. R., De Carvalho, C. J. B., Casari, S. A., & Constantino, R. 2012. Insetos do Brasil: Diversidade e Taxonomia. Ribeirão Preto. Holos Editora, 810 p.

Redford, K. H. 1986. Dietary specialization and variation in two mammalian myrmecophages (variation in mammalian myrmecophagy). Revista Chilena de Historia Natural, 59(1), 201–208.

Reis, N. R., Peracchi, A. L., Pedro, W. A., & Lima, I. P. (Eds.). 2011. Mamíferos do Brasil. Londrina: N. R. Reis: p. 439.

Rocha, V. J., Aguiar, L. M., Silva-Pereira, J. E., Moro-Rios, R. F., & Passos, F. 2008. Feeding habits of the crab-eating fox, *Cerdocyon thous* (Carnivora: Canidae), in a mosaic area with native and exotic vegetation in Southern Brazil Revista Brasileira de Zoologia, 25(4), 594–600. DOI: 10.1590/S0101-81752008000400003.

Seiler, A. 2001. Ecological effects of roads: a review. Uppsala: Sweddish University of Agricultural Sciences: p. 40.

Sikes, R. S., Heidt, G. A., & Elrod, D. A. 1990. Seasonal Diets of the Nine-banded Armadillo (*Dasypus novemcinctus*) in a Northern Part of Its Range. The American Midland Naturalist, 123(2), 383–389. DOI: 10.2307/2426566

Silva, A. R. da, Forneck, E. D., Bordignon, S. A. D. L., & Cademartori, C. V. 2014. Diet of *Didelphis albiventris* Lund, 1840 (Didelphimorphia, Didelphidae) in two periurban areas in southern Brazil. Acta Scientiarum. Biological Sciences, 36(2). DOI: 10.4025/actascibiolsci.v36i2.20444

Tumeleiro, L. K., Koenemann, J., Ávila, M. C. N., Pandolfo, F. R., & Oliveira, É. V. 2006. Notas Sobre Mamíferos da Região de Uruguaiana: Estudo de Indivíduos Atropelados com Informações Sobre a Dieta e Conservação. Biodiversidade Pampeana, 4(1), 38–41.

Van Der Ree, R., Jaeger, J. A. G., Van Der Grift, E. A., & Clevenger, A. P. 2011. Effects of Roads and Traffic on Wildlife Populations and Landscape Function: Road Ecology is Moving toward Larger Scales. Ecology and Society, 16(1). DOI: 10.2307/26268822

Varela, O., Cormenzana-Méndez, A., Krapovikas L., & Bucher, E. H. 2008. Seasonal diet of the pampas fox (*Lycalopex gymnocercus*) in the chaco dry woodland, Northwestern Argentina. Journal of Mammalogy, 89(4): 1012–1019. DOI: 10.1644/07-MAMM-A-125.1

Wisley, B. J., Chabreck, R. H., & Linscombe, R. G. 1991. Variation in nutria diets in selected freshwater

forested wetlands of Louisiana. Wetlands, 11(2): 263–278. DOI: 10.1007/BF03160853

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APPENDIX

Appendix 1. Voucher numbers of stomach contents of the species used in the Attached Mammal Collection of the University of Passo Fundo (CAMUPF), Rio Grande do Sul state, Brazil.

Carnivora: *Cerdocyon thous:* CAMUPF 0002, CAMUPF 0005, CAMUPF 0006, CAMUPF 0024, CAMUPF 0031, CAMUPF 0033, CAMUPF 0035, CAMUPF 0039, CAMUPF 0040, CAMUPF 0041. *Galictis cuja:* CAMUPF 0009, CAMUPF 0013. *Herpailurus yagouaroundi:* CAMUPF 0021. *Lycalopex gymnocercus*: CAMUPF 0008, CAMUPF0016. *Leopardus wiedii:* CAMUPF 0044, CAMUPF0048. *Leopardus guttulus*: CAMUPF0001, CAMUPF0015, CAMUPF 0049. *Leopardus pardalis:* CAMUPF 0042. *Nasua nasua:* CAMUPF 0022, CAMUPF 0023, CAMUPF0037, CAMUPF0046, CAMUPF 0051. *Procyon cancrivorus:* CAMUPF 0038. **Cingulata:** *Dasypus novemcinctus:* CAMUPF 0028, CAMUPF0034, CAMUPF 0043. *Dasypus septemcintus:* CAMUPF 0045. *Euphractus sexcintus:* CAMUPF 0007, CAMUPF 0017, CAMUPF 0018. **Didelphimorphia:** *Chironectes minimus:* CAMUPF 0047. *Didelphis albiventris:* CAMUPF 0050. **Rodentia:** *Cavia aperea:* CAMUPF0012, CAMUPF 0014, CAMUPF 0019, CAMUPF 0027. *Coendou villosus:* CAMUPF 0010, CAMUPF 0020, CAMUPF 0029, CAMUPF 0030. *Myocastor coypus:* CAMUPF 0003, CAMUPF 0004, CAMUPF 0011, CAMUPF 0032. **Pilosa:** *Tamandua tetradactyla:* CAMUPF 0025, CAMUPF 0026.