

Diet of two sympatric felids (*Leopardus guttulus* and *Leopardus wiedii*) in a remnant of Atlantic forest, in the montane region of Espírito Santo, southeastern Brazil

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Dieta de dois felídeos simpátricos (*Leopardus guttulus* e *Leopardus wiedii*) em um remanescente de Mata Atlântica, região serrana do Espírito Santo, sudeste do Brasil.

RESUMO: Foi analisada a dieta de duas espécies simpátricas de felídeos da Mata Atlântica brasileira, o gato-do-mato-pequeno (*Leopardus guttulus*) e o maracajá (*Leopardus wiedii*), em um fragmento de Mata Atlântica, localizado no município de Santa Maria de Jetibá, região serrana do Espírito Santo, Brasil. A dieta das espécies de felinos foi estudada através da análise de amostras fecais. As amostras foram coletadas entre os anos de 2003 e 2005. As amostras fecais foram lavadas em peneiras e secas em estufa, e o material triado foi identificado com auxílio de coleções de referência. Das 52 amostras fecais examinadas, 34 foram confirmadas como sendo de gato-do-mato-pequeno e 18 de maracajá. Pequenos mamíferos (Rodentia e Didelphimorphia) foi o item alimentar mais importante, seguido por insetos e aves. Os hábitos alimentares do gato-do-mato-pequeno e do maracajá na área de estudo, foram classificados como sendo de um carnívoro predador de pequenos vertebrados, alimentando-se de uma variedade de presas, sendo os pequenos mamíferos o item mais consumido. A coexistência entre estas espécies podem envolver segregação espacial e temporal e a utilização de presas complementares na dieta.

Palavras-Chave: hábitos alimentares, carnívoros, gato-do-mato-pequeno, maracajá, Brasil.

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ABSTRACT: We analyzed the diet of two sympatric felids, the southern oncilla (*Leopardus guttulus*) and the margay (*Leopardus wiedii*), in a remnant of Atlantic forest, municipality of Santa Maria de Jetibá, montane region of Espírito Santo, Brazil. We determined the diet of both species by the analysis of scats. Fecal samples were collected from 2003 to 2005. Scats were oven-dried and washed on a sieve, and the screened material was identified using reference collections. Of the 52 fecal samples examined, 34 were confirmed to be from the southern oncilla and 18 of them from the margay. Small mammals (Rodentia and Didelphimorphia) were the most important food item, followed by insects and birds. The food habits of the southern oncilla and the margay in the area were classified as a carnivore predator of small vertebrates, feeding in a variety of prey, which mammals were the most consumed item. The coexistence between those species may involve spatial and temporal segregation and the use of complementary items in the diet.

Key words: food habits, carnivores, southern oncilla, margay, Brazil.

Small felids species are top predators and perform an important ecological role in the forest community (Fonseca & Robinson, 1990), influencing the abundance of their prey-species, including herbivores, and, consequently, the dynamics of the plant community and its diversity (Terborgh, 1992). Although there are relevant ecological studies (Emmons, 1987; Konecny, 1989; Azevedo, 1996; Wang, 2002; Silva-Pereira *et al.*, 2010; Bianchi *et al.*, 2011; Trigo *et al.*, 2013), the diet description of many small felids remains largely unknown.

The southern oncilla, *Leopardus guttulus* (Hensel, 1870), and the margay, *Leopardus wiedii* (Schinz, 1821), are small felids (2-3 kg) with a wide distribution in the Neotropics. They are sympatric species and their ranges overlap in South America (Oliveira & Cassaro, 2005). The southern oncilla and the margay are found in a variety of habitats and the diets of both consist of small mammals (terrestrial and arboreal), Squamata, amphibians and birds (Oliveira & Cassaro, 2005; Silva-Pereira *et al.*, 2010; Bianchi *et al.*, 2011; Trigo *et al.*, 2013). Previous studies indicate that sympatric species with non-discrepant body size overlap their food resources (Novack *et al.*, 2005; Davies *et al.*, 2007; Martins *et al.*, 2008), suggesting that this pattern can be found in the southern oncilla and margay, because of their similar morphological and physiological specializations. Also, interspecific competition between both felids should be higher because they are both solitary and nocturnal carnivores (Oliveira & Cassaro, 2005; Trigo *et al.*, 2013).

Margay and southern oncilla are categorized as “Vulnerable” in Brazil

(Machado *et al.*, 2008) and Espírito Santo state (Passamani & Mendes, 2007). Thus considering the conservation status of these felids and the need for detailed studies on biological aspects of this group, the purpose of this research was to investigate the feeding habits of *L. guttulus* and *L. wiedii* that sympatrically occur in the Atlantic forest in southeastern Brazil. It is also important to note that in the evaluation made by the Brazilian agency Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) on the extinction risk of *L. guttulus*, more research about the species biology was suggested (Oliveira *et al.*, 2013), which includes similar studies to the one presented here, particularly in the Atlantic Forest.

Field work to collect fecal samples was carried out in a forest fragment of 140 ha, located in São Sebastião de Belém (20°04'S; 40°69'W), municipality of Santa Maria de Jetibá, in the montane region of Espírito Santo, southeastern Brazil. Climate in this region is tropical, hot and humid according Köppen, with an average annual precipitation of 1250 mm, and average yearly temperature of 23.3°C (CECAM, 2014). The predominant vegetation is Montane and Sub-Montane Rainforest, in which some trees lose their leaves during the winter (deciduous trees) (Veloso *et al.*, 1991).

The fecal samples were collected by the “Projeto Muriqui” team from 2003 to 2005 on trails along the studied area. The samples were packed and taken to the laboratory, where they were oven-dried and washed using a sieve. The food items were separated and classified in categories: hair, bones, nails, teeth, feathers, scales and, occasionally, fibers. The cuticle pattern of the guard-hair was the main component to identify *L. guttulus*, *L. wiedii* and the mammals consumed by them (Quadros & Monteiro-Filho, 2006). After identification, we prepared slides for the guard-hair micro-structure analysis (Quadros & Monteiro-Filho, 2006). We performed two other independent analyses, for cuticular identification and medullar patterns, using an optical microscope (*Model U-MDOB3, Olympus*). The identification of other food items was done by comparison with specimens deposited in the zoological collections at the Universidade Federal do Espírito Santo (UFES) and Museu de Biologia Professor Mello Leitão (MBML).

The diets were established by identifying all the items to the lowest taxonomic level possible. We calculated the frequency of occurrence (FO), i.e. the proportion (in %) of scats with a given item, and the relative frequency (FR), i.e. the proportion (in %) of a particular item of all items (Krebs, 1999). The FO indicates whether the item is more or less common in the diet, and FR shows its importance in the diet.

We identified a total of 34 fecal samples as belonging to the southern oncilla and 18 to the margay. We were able to identify 22 food items, from a

total of 77 that occurred in southern oncilla samples. Mammals were the most common group found in the diet of *L. guttulus* (FO = 97.06%) and it was also the most important item (FR = 53.20%). Among those, Didelphidae (FR = 26.00%) and Rodentia (FR = 28.60%) had a great importance in the southern oncilla diet composition. Other items found in the scats of this felid were birds (FO = 35.29%), followed by Insecta (FO = 32.35%), Squamata and fiber (FO = 14.71% each) (Table 1).

We identified 17 different food items in the margay fecal samples among the 42 found. Mammals (FO = 100%, FR = 54.80%) were the most abundant and important group among the food items. Rodentia (FO = 66.80%) and Didelphimorphia (Didelphidae) (FO = 44.50%) were the most common items of the total samples, followed by Insecta (FO = 39.10%), birds (FO = 38.90%) and fibers (FO = 27.80%) (Table 1). Squamata was not observed in any margay fecal samples.

The diets we observed in this study were very similar. Both felids fed most frequently on small, nocturnal, and scansorial mammals, and small birds. The frequent consumption of arboreal and scansorial mammals was also reported in other studies in the Atlantic Forest (Wang, 2002; Bianchi *et al.*, 2011), and other biomes, such as Cerrado (Trovati *et al.*, 2008), and Pampas (Trigo *et al.*, 2013). Other studies have shown that birds are similarly consumed by both species (Wang, 2002; Silva-Pereira *et al.*, 2010), indicating they have some degree of importance on their diets. The consumption of squamates has also been reported in the literature (Wang, 2002; Silva-Pereira *et al.*, 2010; Bianchi *et al.*, 2011; Trigo *et al.*, 2013), although in lower proportions as reported in this study. Since prey availability has not been evaluated in the area, it was not possible to conduct a feeding preference for each species. However, the consumption of different food items may indicate an opportunistic foraging strategy, as reported by Rocha-Mendes & Bianconi (2009) for *L. wiedii*.

Considering the competitive exclusion principle (Schoener, 1974), it is expected that sympatric carnivorous species change their spatial, temporal, or trophic patterns (Jaksic *et al.*, 1981; Di Bitteti *et al.*, 2010) to survive. Although it was not possible to perform the niche overlap and niche breadth analyses in this study for none of the species, it is likely that *L. guttulus* and *L. wiedii* overlap their trophic niche, or part of it, in the study area. Hence, we expect that they can coexist because of the different use of temporal or spatial resources, as discussed by Wang (2002).

Studies on food habits of small felids are essential to understand its biology as well as to know the small vertebrates community from an area, which are consumed by them. This is especially important for rare species of small mammals, such as rodents of the genus *Juliomys* (Costa *et al.*, 2007; Lima *et*

Table 1. Food items found in 34 scats samples of *Leopardus guttulus* and 18 scats samples of *Leopardus wiedii* at remnant forest São Sebastião de Belém, Santa Maria de Jetibá, Espírito Santo State, Brazil. N = number of occurrence in each item; FO (%) = frequency of occurrence; FR (%) = frequency relative. (n.i.) non identified.

Item	<i>Leopardus guttulus</i>			<i>Leopardus wiedii</i>		
	N	FR(%)	FO(%)	N	FR(%)	FO(%)
Birds						
Birds n.i.	12	15.6	35.3	7	16.7	38.9
Insecta						
Insecta n.i.	3	3.9	8.8	-	-	-
Carabidae n.i.	1	1.3	2.9	1	2.4	5.6
Cerambycidae n.i.	1	1.3	2.9	-	-	-
Curculionidae n.i.	1	1.3	2.9	1	2.4	5.6
Cicindelidae n.i.	-	-	-	1	2.4	5.6
Scarabaeidae						
Scarabaeidae n.i.	4	5.2	11.8	2	4.8	11.1
<i>Dynastes</i> sp.	2	2.6	5.9	-	-	-
Formicidae n.i.	1	1.3	2.9	1	2.4	5.6
Ichneumonidae n.i.	1	1.3	2.9	-	-	-
Vespidae n.i.	-	-	-	1	2.4	5.6
Squamata						
Squamata n.i.	4	5.2	11.8	-	-	-
Tropiduridae						
<i>Tropidurus</i> sp.	1	1.3	2.9	-	-	-
Mammalia						
Mammalia n.i.	4	5.2	11.8	3	7.1	16.7
Didelphimorphia						
Didelphidae n.i.	5	6.5	14.7	3	7.1	16.7
<i>Gracilinanus microtarsus</i> (Wagner, 1842)	9	11.7	26.5	2	4.8	11.1
<i>Micoureus paraguayanus</i> (Tate, 1931)	6	7.8	17.6	3	7.1	16.7
Rodentia						
Rodentia n.i.	6	7.8	17.6	5	11.9	27.8
Cricetidae						
<i>Akodon cursor</i> (Winge, 1887)	2	2.6	5.9	1	2.4	5.6
<i>Juliomys</i> sp.	1	1.3	2.9	-	-	-
<i>Necomys lasiurus</i> (Lund, 1841)	1	1.3	2.9	-	-	-
<i>Oecomys catherinae</i> Thomas, 1909	-	-	-	3	7.1	16.7
<i>Oligoryzomys nigripes</i> (Olfers, 1818)	6	7.8	17.6	2	4.8	11.1
<i>Oxymycterus</i> sp.	1	1.3	2.9	-	-	-
Echimyidae						
<i>Trinomys</i> sp.	-	-	-	1	2.4	5.6
Fiber	5	6.5	14.7	5	11.9	27.8
TOTAL	77	100		42	100	

al., 2010), that cannot be recorded by conventional methods.

Because of the presence of forest fragments, these felids persist in disturbed landscapes, for example where agricultural activities are prevalent (Tortato *et al.*, 2013). According to Oliveira *et al.* (2013), areas without protection status, such as our area of study, may be important for the conservation of smaller cat species (<6 kg) in Brazil. Thus, the region of Santa Maria de Jetibá, where there was an increase in forest cover since the 1970's (Almeida Junior *et al.*, 2012), is important for maintaining local populations of endangered species.

Our observations of the diets of *L. guttulus* and *L. wiedii* in southeastern Brazil agrees with those reported in other parts of South America (Wang, 2002; Trovati *et al.*, 2008; Silva-Pereira *et al.*, 2010; Bianchi *et al.*, 2011; Trigo *et al.*, 2013). Southern oncilla and margay are predators of small vertebrates, especially mammals as didelphids and small rodents. Behavioural differences, such as differences in habitat use and/or daily activity patterns, could be the key factor allowing the co-existence of these sympatric species with similar sizes and diets.

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