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FEEDING HABITS OF THE MANED WOLF (*Chrysocyon brachyurus*) IN THE BRAZILIAN CERRADO

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ABSTRACT: The maned wolf feeds mainly on fruits and small vertebrates. The diet of maned wolf was studied at Águas Emendadas Ecological Station (AEES) through 328 faecal samples collected from November 1996 to August 1999. To evaluate the seasonal variation in food availability, the fruit phenology of the wolf's fruit, the main food item in maned wolf's diet, was monitored counting the fruits produced in 20 marked plants. Fructification phenology of fleshy fruit plants in the cerrado habitat of AEES was recorded monitoring five plots of 100 x 20 m, where the number of fruit producing species and individuals were recorded. The diet composition was 60% vegetal items and 40% animal ones. The wolf's fruit, other fruits and small mammals were the most frequent consumed categories, but armadillos, wolf's fruit, medium size mammals, and small mammals were the most important categories considering biomass. Maned wolves are generalist, with a broad diet, and consume most of the food items according to their availability. However, wolves are selective with regard to some food items, particularly the wolf's fruit during the dry season.

RESUMEN: Hábitos alimentarios del aguará guazú (*Chrysocyon brachyurus*) en el dominio del Cerrado, Brasil. El aguará guazú se alimenta principalmente de frutos y vertebrados pequeños. Si bien se ha obtenido mucha información acerca de la dieta del aguará guazú, datos sobre la ecología trófica de esta especie en reservas pequeñas del Cerrado son importantes para establecer estrategias de conservación. Se estudió la dieta del aguará guazú en la Estación Ecológica de Águas Emendadas (EEAE) a través de 328 muestras de heces colectadas entre noviembre de 1996 y agosto de 1999. Para evaluar la variación estacional en la disponibilidad de alimentos se analizó la fenología frutal de *Solanum lycocarpum*, el principal componente de la dieta de este cánido, contando los frutos producidos en 20 plantas marcadas. Se estudió la fenología de fructificación de plantas con frutos carnosos en el ambiente de Cerrado de la EEAE en cinco parcelas de 100 x 20 m, registrándose el número de especies productoras de frutos y sus individuos. La composición de la dieta fue de 60% de ítems vegetales y de 40% de ítems animales. *Solanum lycocarpum*, otros frutos y los micromamíferos fueron las categorías consumidas con mayor frecuencia, pero considerando la biomasa las categorías más importantes fueron los armadillos, el *Solanum lycocarpum* y los mamíferos medianos y pequeños. El aguará guazú es generalista, con una dieta amplia, consumiendo la mayor parte del ali-

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mento de acuerdo a su disponibilidad. Sin embargo, estos cánidos son selectivos al considerar algunos alimentos, particularmente el *Solanum lycocarpum* durante la estación seca.

Key words. Cerrado domain, diet composition, food availability, *Solanum lycocarpum*, trophic ecology.

Palabras clave. Dominio del Cerrado, ecología trófica, composición de dieta, disponibilidad de alimentos, *Solanum lycocarpum.*

INTRODUCTION

The maned wolf (*Chrysocyon brachyurus*, Illiger), or aguará guazú, is the largest South American canid, weighting between 20 and 30 kg (Rodden et al., 2004). It is broadly distributed in the open vegetation of South America, mainly in the Cerrados of Central Brazil (Rodden et al., 2004). The maned wolf is listed as "Near Threatened" by IUCN (Sillero-Zubiri and Hoffmann, 2004), but is classified as "Vulnerable" by the Brazilian Red List of Threatened Species, manly due to habitat fragmentation, the highest risk to the species conservation. In Brazil, most of its original habitat has been replaced by farms and ranches remaining only 20% of the Cerrado's original area preserved (Myers et al., 2000), generally as small reserves. Knowing the ecology of the maned wolf in these small and fragmented habitats is fundamental for the species conservation.

The diet of the maned wolf has been studied since the 1970's in Brazil (Carvalho, 1976), but the first detailed study quantifying the frequency of food items was Dietz's (1984) monograph, which alongside more recent studies revealed that the diet of the maned wolf is composed mainly by small vertebrates and fruits (Dietz, 1984; Carvalho and Vasconcellos, 1995; Motta-Junior et al., 1996; Azevedo and Gastal, 1997; Motta-Junior, 1997; Motta-Junior, 2000; Aragona and Setz, 2001; Queirolo, 2001; Bueno et al., 2002; Juarez and Marinho-Filho, 2002; Motta-Junior and Martins 2002; Silva and Talamoni, 2003; Santos et al., 2003; Jácomo et al., 2004). However, most of these studies present only a description of the consumed items and just a few have a more focused ecological approach, as comparisons with other canids (Juarez and Marinho-Filho, 2002; Jácomo et al., 2004), seed dispersal (Motta-Junior and Martins, 2002) and relationship between food availability and consumption (Motta-Junior, 2000; Queirolo, 2001). In spite of the apparent homogeneity among the studies in relation to the main consumed items, the frequency of these items can change among localities. Yet, most studies agree that the "wolf's fruit" (*Solanum lycocarpum*, Solanaceae) is the main consumed item (e. g., Dietz, 1984; Motta-Junior et al., 1996; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Santos et al., 2003; Silva and Talamoni, 2003; Jácomo et al., 2004). The methods employed to evaluate the importance of the different food items in the diet vary also among the studies. Some studies use only the occurrence frequency of the item to describe the maned wolf's diet (e. g., Carvalho and Vasconcellos, 1995; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Santos et al., 2003; Jácomo et al., 2004), while others seek to verify its importance as expressed by volume (Dietz, 1984) or dry weight of the faeces remains (Azevedo and Gastal, 1997), as well as by biomass estimate (Motta-Junior et al., 1996; Juarez and Marinho-Filho, 2002; Santos et al., 2003). Few studies attempt to compare the diet with available resources (Motta-Junior, 2000; Queirolo, 2001). The objective of this study was to quantify the frequency and importance in biomass of different food items in the maned wolf's diet, evaluating the relationship between food availability and consumption by these carnivores.

MATERIALS AND METHODS

Study area

The study was carried out at Águas Emendadas Ecological Station (AEES), located in the northeast of Distrito Federal (15º 32' S and 47º 33'W), 40 km from Brasília, Central Brazil. AEES is located in the center of Cerrado biome, the second largest biome of South America, with about 2 million km^2. The Cerrado is characterized by a mosaic of vegetation types ranging from open grasslands to forests (Oliveira-Filho and Ratter, 2002). The reserve contains representative samples of the main vegetation types of the Cerrado biome, with prominence of cerrado stricto sensu (a semideciduous, xeromorphic tree/shrubs, woodland with an open canopy and a ground cover of forbs and grasses) and vereda (marsh grassland habitat associated with forest boundaries and with the occurrence of the palm tree 'buriti'). The dry season occurs from April to September, with an average monthly precipitation of 24.3 mm, and the wet season from October to March, with an average monthly precipitation of 212.4 mm.

In the edges of AEES predominates pastures, farms and the city of Planaltina. In some areas of the limits, the houses reach the AEES fences. The urban area has been growing substantially, causing high pressure on the protected area, with hunt, invasion of domestic dogs and isolation of the reserve from other natural areas.

Samples

We collected faecal samples of maned wolves from November 1996 to August 1999 in the internal trails of AEES. Rodrigues (2002) estimated the population of wolves in ESECAE in five couples. Therefore, the collected faecal samples are assumed to belong to these couples and their young up to one and a half year of age. The number of faecal samples varied along the months (range 7 to 49), with 148 faeces analysed in the dry season and 180 in the wet season. We washed the samples through a 2 mm mesh screen, separating seeds, feathers, scales, bone, fruit fragments and arthropods, and grouping the identified food items into nine classes: wolf's fruit, other fruits, arthropods, reptiles, birds, eggs, small mammals (Rodentia and Didelphimorphia), armadillos and medium sized mammals. Seeds were identified by comparison to a reference collection made for the study area. For Small Mammals and Birds we identified the consumed species comparing to the reference collection of Universidade de Brasília and Museu Nacional (UFRJ). We analysed the maned wolf's diet through frequency of occurrence and consumed biomass, because both methods reflect distinct aspects of the importance of food types in the diet. For animal items, we estimated the biomass consumed multiplying the average weight of each species by its minimum number found in faeces. The minimum number was obtained counting teeth, jaws, beaks and other parts of the animal. We estimated the consumed biomass of each fruit species based in the number of seeds found in faeces and the relation between the number of seeds and the pulp weight of previously analysed fruits. We obtained fruit weights from fruits collected in AEES or from literature (Lorenzi, 1992; Almeida et al., 1998) and the animal weight from the literature (Emmons and Feer, 1997; Marinho-Filho et al., 1998; Eisenberg and Redford, 1999) or own data.

To assess the seasonal variation in food availability we monitored the fruit phenology of the wolf's fruit from May 1998 to April 1999. We tagged 20 plants and all their fruits produced in the period, counting the fruits in the plants and on the ground twice a week. We also recorded the fructification phenology of fleshy fruit plants in the cerrado habitats of AEES, monitoring five plots of 100 x 20 m, totalling 1 ha. We monthly recorded the number of species and individuals with fruits in these plots from February 1997 to January 1998. The availability of small mammals in the area was assessed through published data (Anciães et al., 1997).

We tested the monthly variation in the fruit production of *S. lycocarpum* by Analysis of Variance (ANOVA), having the individuals as the random factor and the months as the fixed factor. Orthogonal contrasts were used as a posteriori tests when the monthly differences were significant to evaluate seasonal variation: dry season (April to September) and rainy season (October to March). The distributions of relative frequency of food items consumed during the dry and rainy seasons, as well as seasonal comparisons in the frequency of consumption of animal and vegetal items, were analysed through G test. The amount of consumption of animal and vegetal items were analysed through t-test. The hypothesis that the amount of wolf's fruits consumed depended on its availability was tested through linear regression, using the number of seeds found in the faeces as an indicator of the consumed biomass. For this analysis we used only faecal samples collected in the same period of the fruit production samples. The data were transformed in neperian logarithm when nec-

essary to obtain normality. The residues were checked graphically to verify if there was some tendency in the estimates. The statistical analyses followed Sokal and Rohlf (1995).

RESULTS

We recorded 71 species with fleshy fruits at AEES and a total of 1626 records of individuals with fruits (the sum of all records, during one year). There was seasonal variation in the fruit production at AEES, with less fruiting species and individuals found in the dry season (**Fig. 1A**, **Table 1**). The fruiting pattern of the wolf's fruit is distinct from most of the other cerrado plant species: fruit is available during the whole year, but large fruit crops are concentrated in some months (**Fig. 1B**).

We analysed 328 faecal samples of maned wolves and recorded 901 items consumed, being 40% animal and 60% vegetal (**Table 2**). The ratio of animal/vegetal items changed seasonally, but we found monthly significant differences only during the dry season, which were related to the higher consumption of animal items in August and September (**Table 3**, **Fig. 2**). The most frequent food categories represented in the maned wolf's faeces at AEES were respectively: Wolf's Fruit, Other Fruits (mainly *Annona crassiflora*, *Salacia crassiflora* and *Mangifera indica*), Small Mammals (mainly *Calomys* spp. and *Didelphis albiventris*), Birds and Armadillos (mainly *Dasypus septemcinctus*). We identified 20 fruit species consumed by maned wolves, being the wolf's fruit the most frequent, present in 74.4% of the samples and totalising 27.1% of the records (**Table 2**). We found at least 28 vertebrate species, mainly small mammals (Rodentia + Didelphimorphia, 16.7% of the records) (**Table 2**). Considering biomass, Armadillos, Wolf's Fruit, Medium Sized Mammals and Small Mammals accounted for the most important categories (**Table 4**). Arthropods and Eggs were less frequent and responsible for only a small fraction of the consumed biomass (**Tables 2** and **4**).

As a whole, fruit as a food item occurred in the faecal samples of both rainy (87%) and dry (92%) seasons. The wolf's fruit alone was found in 66% of rainy and 84% of dry season samples, with significant differences between the two seasons ($G = 15.7$; $df = 1$; $p < 0.001$). However, we did not find seasonal differences in the number of seeds per sample ($t = -1.145$; $df = 19.5$; $p = 0.266$) and there was no relationship between fruit production and consumption by maned wolves ($y = 27.2 + 75.3x$, $r^2 = 0.078$, $p = 0.5$).

We found Other Fruits in 54% and 40% of the rainy and dry season samples, respectively. Animal items were present in similar proportions along the year: 65% in rainy season and 67% in dry season. We did not find differences in consumption between rainy and dry season with regard to vegetal ($t = 0.441$; $df = 20$; $p = 0.664$), nor to animal items (total: $t = -0.900$; $df = 20$; $p = 0.379$; Small Mammals: $t = -0.103$; $df = 20$; $p = 0.918$; Armadillos: $t = -0.239$; $df = 20$; $p = 0.814$).

DISCUSSION

The maned wolf has a varied diet composed basically of 60% vegetal and the remaining by animal items. Other studies also demonstrate a balance between vegetal (ranging from 44.6 to 57.5%) and animal items (Dietz, 1984; Carvalho and Vasconcellos, 1995; Motta-Junior et al., 1996; Azevedo and Gastal, 1997; Motta-Junior, 1997; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Santos et al., 2003; Jácomo et al., 2004). The most frequent categories in the faeces of the maned wolf in AEES were: Wolf's Fruit, Other Fruits, Small Mammals, Birds and Armadillos. Among several other studies, the wolf's fruit appears as the most common food item in the wolf's diet (Dietz, 1984; Carvalho and Vasconcellos, 1995; Motta-Junior et al., 1996; Azevedo and Gastal, 1997; Motta-Junior, 1997; Santos et al., 2003), whereas small mammals (two localities in Motta-Junior, 1997; Bueno et al., 2002; Juarez and Marinho-Filho, 2002) and other fruit species (Jácomo et al., 2004) are reported as the top food items.

Except by Queirolo and Motta-Junior (2000) and Queirolo (2001), all the studies conducted in Cerrado report the wolf's fruit as the most

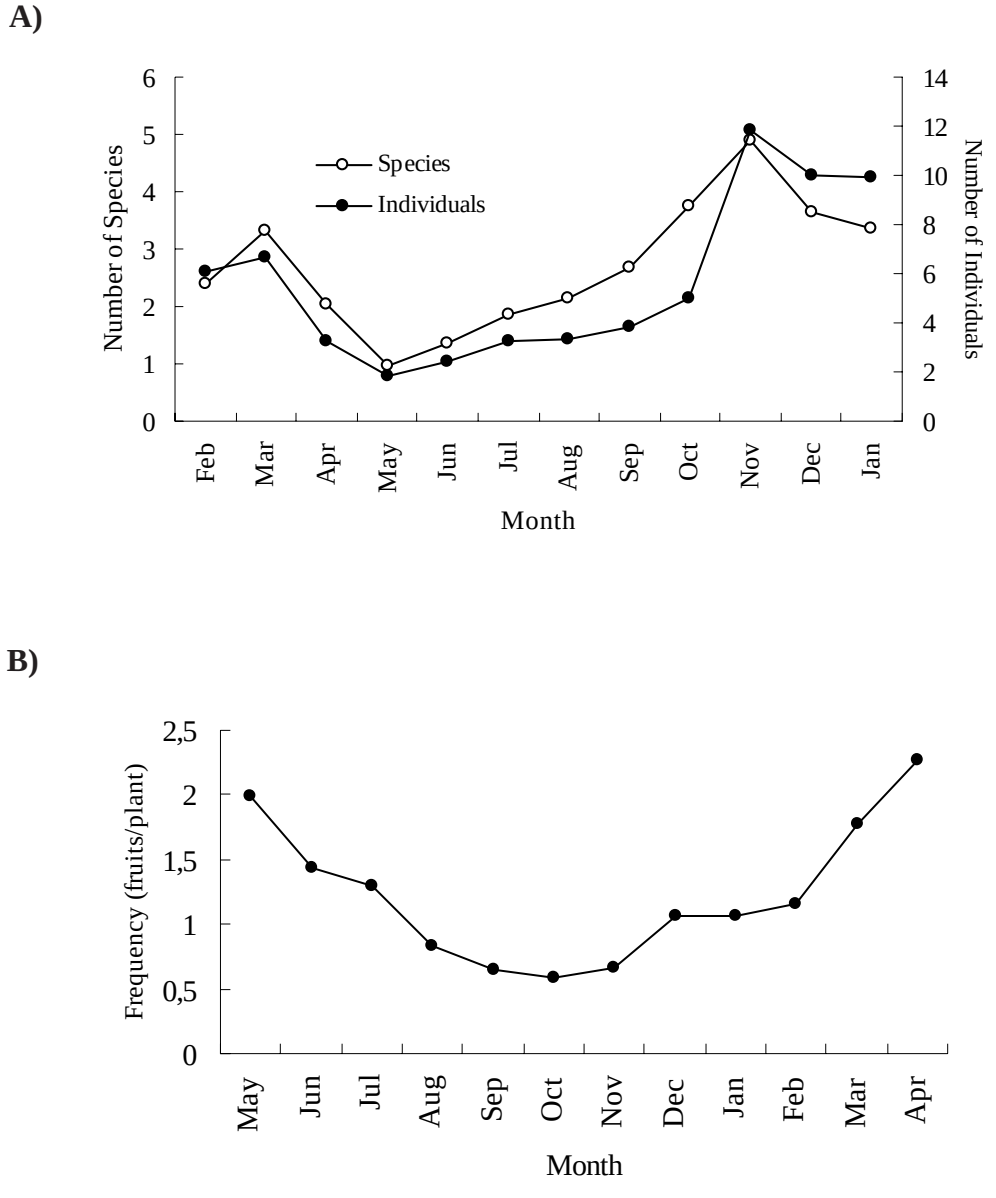

Fig. 1. Seasonal variation on fleshy fruit production at Águas Emendadas Ecological Station. A) Average number of species and individuals in five plots sampled, from February 1997 to January 1998. B) Average number of fruits of *Solanum lycocarpum* per plant, from May 1998 to April 1999.

consumed fruit species (Dietz, 1984; Motta-Junior et al., 1996; Lilienfeld, 2000; Aragona, 2001; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Silva and Talamoni, 2003; Jácomo et al., 2004). Queirolo and Motta-Junior (2000) found a low frequency of the wolf's fruit in the maned wolf faecal samples at Serra da Canastra National Park, the same locality where Dietz (1984) found a high frequency of this fruit in faeces, and suggests that the abundance of *S. lycocarpum* declined after cattle have been removed from

Table 1

ANOVA results for the seasonal variation in fruit production in Águas Emendadas Ecological Station, Brazil.

Source	Sum of squares	df	Square average	F	p
WOLF'S FRUIT	67.617	19	3.559	19.088	0.000
Month	6.730	11	0.612	3.282	0.000
Dry x wet	2.590	1	2.590	13.893	0.000
Error	38.967	209	0.186		
FRUITING PLANTS	5.773	4	1.443	5.713	0.001
Month	16.297	11	1.482	5.865	0.000
Dry x Wet	11.402	1	11.402	45.136	0.000
Error	10.863	43	0.253		
FRUITING SPECIES	0.592	4	0.148	2.494	0.056
Month	5.373	11	0.488	8.228	0.000
Dry x Wet	3.453	1	3.453	58.167	0.000
Error	2.612	44	0.059		

Table 2

Food items and frequency of consumption in the diet of maned wolves in Águas Emendadas Ecological Station, Brazil.

Items	Frequency of records (% of samples with the item)	Relative frequency (%)
VEGETAL		
Annonaceae		
Annona crassiflora	32 (9.8)	3.6
Annona sp.	1 (0.3)	0.1
Duguetia furfuracea	5 (1.5)	0.6
Anacardiaceae		
Mangifera indica	22 (6.7)	2.4
Apocynaceae		
Hancornia speciosa	not quantified	-
Araliaceae		
Schefflera macrocarpa	4 (1.2)	0.4
Arecaceae		
Syagrus flexuosa	2 (0.6)	0.2
Cucurbitaceae		
Cayaponia espelina	3 (0.9)	0.3
Erythroxyllaceae		
Erythroxyllum suberosum	3 (0.9)	0.3
Poaceae		
Poaceae sp.1 (infructescences)	46 (14.0)	5.1
Poaceae sp.2 (infructescences)	8 (2.4)	0.9
Poaceae (leaves)	74 (22.6)	8.2
Zea mays	2 (0.6)	0.2
Hippocrateaceae		
Salacia crassiflora	30 (9.1)	3.3
Icacinaceae		
Emmotum nitens	1 (0.3)	0.1
Melastomataceae		
Miconia sp.	1 (0.3)	0.1
Myrtaceae		
Psidium sp.1	7 (2.1)	0.8

(Table 2, cont.)

Psidium sp.2	2 (0.6)	0.2
Campomanesia sp.	6 (1.8)	0.7
Ochnaceae		
Ouratea hexasperma	2 (0.6)	0.2
Sapotaceae		
Pouteria ramiflora	6 (1.8)	0.7
Solanaceae		
Solanum lycocarpum	244 (74.4)	27.1
Solanaceae sp. 1	1 (0.3)	0.1
Undetermined seeds	34 (10.4)	3.8
REPTILIA		
Squamata		
Tropidurus sp.	1 (0.3)	0.1
MAMMALIA		
Didelphimorpha		
Didelphis albiventris	30 (9.1)	3.3
Didelphidae not ident.	7 (2.1)	0.8
Xenarthra		
Dasypus novemcinctus	4 (1.2)	0.4
Dasypus septemcinctus	54 (16.5)	6.0
Euphractus sexcinctus	1 (0.3)	0.1
Cabassous unicinctus	2 (0.6)	0.2
Carnivora		
Cerdocyon thous	1 (0.3)	0.1
Canidae not indet.	1 (0.3)	0.1
Carnivora not indet.	1 (0.3)	0.1
Artiodactyla		
Mazama sp.	1 (0.3)	0.1
Pecari tajacu	1 (0.3)	0.1
Rodentia		
Necromys lasiurus	13 (4.0)	1.4*
Calomys spp.	67 (20.4)	7.4*
Sigmodontinae	6 (1.8)	0.7*
Cavia aperea	5 (1.5)	0.6*
Echimyidae not. ident.	5 (1.5)	0.6*
Thrichomys apereoides	5 (1.5)	0.6*
Rodent not indet.	11 (3.4)	1.2*
AVES		
Egg shell	4 (1.2)	0.4
Cuculiformes		
Crotophaga ani	1 (0.3)	0.1
Tinamiformes		
Crypturellus parvirostris	14 (4.3)	1.6*
Nothura maculosa	3 (0.9)	0.3*
Nothura sp.	3 (0.9)	0.3*
Rhynchotus rufescens	6 (1.8)	0.7*
Tinamidae not ident.	6 (1.8)	0.7*
Strigiformes		
Tyto alba	1 (0.3)	0.1
Speotyto cunicularia	1 (0.3)	0.1
Galliformes		
Gallus gallus	2 (0.6)	0.2
Psittaciformes		
Psittacidae not ident.	1 (0.3)	0.1
Passeriformes		
Furnarius rufus	3 (0.9)	0.3*
Emberizinae	6 (1.8)	0.7 *

(Table 2, cont.)

Sporophila spp.	3 (0.9)	0.3*
Aves not identified	43 (13.1)	4.8*
ARTHROPODA		
Coleoptera	21 (6.4)	2.3
Coleoptera larvae	13 (4.0)	1.4
Formicidae not indet.	3 (0.9)	0.3
Acrididae not ident.	5 (1.5)	0.6
Insect not ident.	10 (3.0)	1.1
Total 328 samples	**901**	**100**

Table 3

G test results for the seasonal variation in vegetal and animal consumption by the maned wolf in Águas Emendadas Ecological Station, Brazil.

Comparison	df	G	p
All months	11	24.0	**0.013**
Wet season	5	2.7	0.740
Dry season	5	21.3	**0.001**
Dry season, except when animal>vegetal	3	7.2	0.067
All months, except when animal>vegetal (August-September)	9	13.2	0.152
Between August and September	1	1.6	0.201

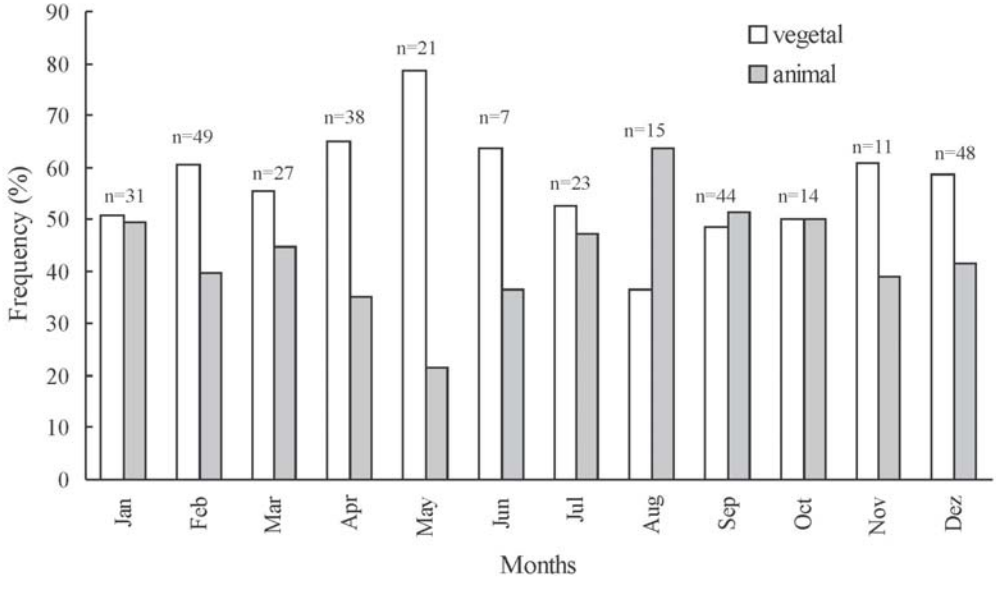

Fig. 2. Proportion of animal and vegetal items consumed by maned wolves at Águas Emendadas Ecological Station.

Table 4

Biomass consumed estimated by the maned wolf in Estação Ecológica de Águas Emendadas, Brazil.

Species	No. records	Mass (g)	Biomass consumed per feces (g)	Total estimated biomass consumed (g)	Proportion of total biomass consumed (%)
VEGETAL					
Annona crassiflora	32	650	135	4320	1.46
Annona sp.	1	300	18	18	0.01
Duguetia furfuracea	5	180	20	100	0.03
Mangifera indica	22	300	450	9900	3.35
Schefflera macrocarpa	4	1	1	4	0.00
Syagrus flexuosa	2	30	30	60	0.02
Cayaponia espelina	3	5	5	15	0.01
Erythroxyllum suberosum	3	0.3	0.3	0.9	0.00
Zea mays	2			0	-
Salacia crassiflora	30	25	80	2400	0.81
Emmotum nitens	1	5	5	5	0.00
Miconia sp.	1	0.2	0.4	0.4	0.00
Psidium spp.	9	8	12	108	0.04
Campomanesia sp.	6	3	100	600	0.20
Ouratea hexasperma	2	0.2	0.6	1.2	0.00
Pouteria ramiflora	6	30	300	1800	0.61
Solanum lycocarpum	244	630	309	75396	25.55
Solanaceae sp. 1	1	5	5	5	0.00
ANIMAL					
Tropidurus sp.	1	35	35	35	0.01
Didelphis albiventris	30	656	656	19680	6.67
Didelphidae not ident.	7	40	40	280	0.09
Dasypus novemcinctus	4	4000	4000	16000	5.42
Dasypus septemcinctus	54	1500	1500	81000	27.45
Euphractus sexcinctus	1	5000	5000	5000	1.69
Cabassous unicinctus	2	3000	3000	6000	2.03
Cerdocyon thous	1	6500	6500	6500	2.20
Canidae undetermined	1	4500	4500	4500	1.52
Carnivora undetermined	1	2000	2000	2000	0.68
Mazama sp.	1	17000	17000	17000	5.76
Pecari tajacu	1	17000	17000	17000	5.76
Bolomys lasiurus	13	43	43	559	0.19
Calomys spp.	67	26.5	26.5	1775.5	0.60
Sigmodontinae	6	40	40	240	0.08
Cavia aperea	5	300	300	1500	0.51
Echimyidae not. ident.	5	300	300	1500	0.51
Thrichomys apereoides	5	400	400	2000	0.68
Crotophaga ani	1	100	100	100	0.03
Crypturellus parvirostris	14	227.5	227.5	3185	1.08
Nothura maculosa	3	321.5	321.5	964.5	0.33
Nothura sp.	3	321.5	321.5	964.5	0.33
Rhynchotus rufescens	6	980	980	5880	1.99
Tinamidae not ident.	6	500	500	3000	1.02
Tyto alba	1	472.5	472.5	472.5	0.16
Speotyto cunicularia	1	217.5	217.5	217.5	0.07
Gallus gallus	2	1300	1300	2600	0.88
Furnarius rufus	3	46.5	46.5	139.5	0.05
Emberizinae	6	10	10	60	0.02
Sporophila spp.	3	9	9	27	0.01

(Table 4, cont.)

Coleoptera	21	1	1	21	0.01
Coleoptera larvae	13	0.5	0.5	6.5	0.002
Formicidae	3	0.5	0.5	1.5	0.001
Acrididae	5	1	1	5	0.002
Total			**68365.8**	**295082.5**	**100.0**

the Park. This contrast, however, could just reflect an annual variation in fruit consumption, since in other localities where the wolf's fruit is rare, as in the Emas National Park (FHGR, pers. obs.), the consumption of this fruit by wolves was high (Jácomo et al., 2004).

In the present study the wolf's fruit proved to be very important in the diet of maned wolves, being the most frequent food item and the second in biomass. It is available during the whole year, although somewhat reduced during the dry season. Nonetheless, in the dry season this fruit is more frequently consumed and the amount ingested does not vary, indicating that the maned wolf actively searches for the wolf's fruit during this time. The wolf's fruit was also more consumed during the dry season in Emas National Park (Jácomo et al., 2004) and Ibitipoca State Park (Aragona and Setz, 2001), although the consumption was higher in the wet season at São Luís Farm, a human altered area where cultivated fruits were more important in the wolf's diet than wild fruits (Santos et al., 2003). The consumption of *S. lycocarpum* was also high during the dry season in the Jataí Ecological Station, where the production is higher during the dry season, although consumption and fruit availability were not correlated (Motta-Junior, 2000).

In general, fruits of other plant species (Dietz, 1984; Motta-Junior et al., 1996) and arthropods (Dietz, 1984; Santos et al., 2003) are more consumed in the rainy season and small mammals in the dry season (Dietz, 1984; Motta-Junior et al., 1996; Motta-Junior, 2000; Santos et al., 2003; Bueno and Motta-Junior, 2006). In the AEES other fruits were less available in the dry season, with a few plant species and individuals producing fruits, and the maned wolf seemed to consume them according to their availability, in agreement with Motta-Junior (2000), who found a strong relation between consumption and availability of other fruit species. These fruits appear more frequently in the faeces during short periods of availability, like *A. crassiflora*, *S. crassiflora* and the introduced mango (*M. indica*), although poorly represented in the biomass fraction.

Among the fruits other than *S. lycocarpum*, the family Annonaceae (*Annona* spp. and others) was the most frequent in this study (3.6% of the records), and the second most consumed fruit in other studies (Motta-Junior et al., 1996; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Jácomo et al., 2004). Small mammals were the most common animal item in the wolf's diet, in agreement with all other studies, except by Azevedo and Gastal (1997).

The dry season is generally a stressing period for most of the Cerrado plant species, due to the low availability of water and a consequently low primary production (Franco, 2002). To maned wolves, this represents a period of fruit scarcity, but small rodents and marsupials are more available in this period. Evaluating the variation on small mammals abundance at AEES, Anciães et al. (1997) found that in forested habitats higher densities were recorded during the whole dry season, whereas in open areas (cerrado and wet fields) the higher densities occurred in the end of the dry season and beginning of the rainy season, the same period when we found an increase in the consumption of animal items. Studies at other areas in Distrito Federal also found higher densities of small mammals in dry season (Alho and Pereira, 1985; Alho et al., 1986), even though, we did not find significant differences in the rate of small mammals con-

sumed both in dry and wet seasons in AEES. This pattern can indicate an active search for small mammals in the wet season or that the abundance of small mammals is very high, and the decrease in abundance during the wet season does not affect the behaviour of maned wolves. Another possible explanation is that the higher abundance of small mammals during the dry season reflects only changes in the behaviour of these mammals and not an actual increase in abundance. As food availability is usually low in the dry season (Oliveira, 1998; Pinheiro et al., 2002), small rodents and marsupials could increase their movements in search of food, making these animals prone to be attracted to baited traps. Furthermore, some rodent species reproduce well in dry season (Alho and Pereira, 1985; Vieira, 1997) and the possible change in the movement pattern makes these animals more vulnerable to predation, resulting in higher food availability to wolves, even if their density does not change.

Frequency of occurrence is a good method to describe the food habits of vertebrates, although it can overestimate the importance of small items, like insects. To compensate this bias, some authors have used the volume of each item in the faeces (Dietz, 1984) or the dry weight of the remains (Azevedo and Gastal, 1997). However, these methods do not reflect the importance of the food items, because the digestibility varies among different food items. Biomass calculations through counts of minimum number of each category multiplied by their weight can be a more accurate estimate of the importance of food categories in the diet. Some authors are in disagreement with the method for calculating the preys' weight. According to them, the medium weight should consider juveniles and adults, because the use of adults' weights alone results in an overestimation of their importance regarding biomass. Likewise, considering the consumption of whole preys also leads to an overestimation regarding biomass. However, juveniles are available just in a restricted time of the year and probably the possible overestimate was not significant. Besides, the several times that we observed wolves eating small mammals they consumed the whole prey. Therefore, overestimates can just be happening in the case of larger animals. The biomass estimating method was used in this study and in at least other six related studies (Motta-Junior et al., 1996; Motta-Junior, 2000; Queirolo, 2001; Juarez and Marinho-Filho, 2002; Santos et al. 2003; Silva and Talamoni, 2003), allowing data comparison.

In the AEES, armadillos were the principal category in the biomass calculation, followed by the wolf's fruit, medium sized mammals and small mammals (rodents and Didelphidae marsupials). Santos et al. (2003) obtained similar results, with 45.0% of the biomass represented by armadillos, 42.3% by wolf's fruit and 9% by small mammals, whereas Motta-Junior (2000) found armadillos (27.1%), small mammals (26.9%) and wolf's fruit (23.2%) as the main categories consumed. Motta-Junior et al. (1996) and Juarez and Marinho-Filho (2002) found that the wolf's fruit was the category with greater consumption regarding biomass (respectively 53.5 and 34.0%) and Queirolo (2001) found that fruits (except wolf's fruit) and small mammals represent most of the biomass consumed (30.9 and 16.8%, respectively). Silva and Talamoni (2003) reported an unusual situation where 96% of the biomass consumed where animal items, mainly small mammals (44.9%). According to these studies, other items well represented in biomass were the small mammals and the armadillos (respectively 22.2 and 13.3%, Juarez and Marinho-Filho, 2002), and the armadillos, the small mammals and the medium sized mammals (respectively 29.7, 8.4 and 7.9%, Motta-Junior et al., 1996). The biomass of the wolf's fruit was probably overestimated by Juarez and Marinho-Filho (2002), because these authors assigned one whole fruit consumed to each faecal sample containing *S. lycocarpum* seeds. The relation between the average number of seeds and the average fruit weight (this study, Motta-Junior et al., 1996; Motta-Junior, 2000; Queirolo, 2001; Silva and Talamoni, 2003) is a more adequate measure to estimate the fruit biomass consumed, specially in the case of the wolf's fruit, because wolves can consume

just a bite or up to four or more fruits in few minutes (FHGR, pers. obs.). The biomass of other fruit species was low in AEES and other studies, except for another area in the Distrito Federal (Motta-Junior et al., 1996) and in Serra da Canastra National Park (Queirolo, 2001). The low importance of other fruit species in the diet of the maned wolf is related to the fact that their consumption is restricted mainly to the rainy season.

The animal prey items eaten by maned wolves were mainly of small size, as observed in previous studies (Carvalho, 1976; Dietz, 1984; Motta-Junior et al., 1996; Juarez and Marinho-Filho, 2002; Jácomo et al., 2004), although larger species can be occasionally included in the diet, like peccaries (this study), deer (this study, Juarez and Marinho-Filho, 2002; Jácomo et al., 2004), and the giant anteater, *Myrmecophaga tridactyla* (Dietz, 1984). Remains of large vertebrates in faeces are not necessarily a proof of predation on these animals, since maned wolves are known to scavenge (e.g., snakes, FHGR pers. obs.) and rheas, *Rhea americana* (Silveira, 1999). In addition, predation on pampas deer (*Ozotoceros bezoarticus*) has been recorded (Bestelmeyer and Westbrook, 1998) and is quite common to observe wolves pursuing pampas deer at night (FHGR pers. obs.). Also, the alarm behaviour of pampas deer in the presence of wolves indicates that deer perceives the wolf as a potential predator (Rodrigues, 1996), although the opposite is observed for giant anteaters, which are found walking close to maned wolves without any alarm behaviour (Dietz, 1984; FHGR pers. obs.).

The hunting success of this pursuit behaviour on deer and other large sized mammals is probably low, but it may be important for the wolf since the biomass represented by these prey items is high, probably yielding food for many days. Three cervid species occur in AEES (Marinho-Filho et al., 1998), of which the grey brocket deer (*Mazama gouazoupira*) is the most common, and was probably the species consumed by maned wolves in this study. On the other hand, peccaries are extremely rare in the region (Marinho-Filho et al., 1998) and both species, *Tayassu pecari* and *Pecari tajacu*, were spotted just once during the study. As a prey, peccaries can be more dangerous than deer and the consumption of these pigs has not been recorded before, even where peccaries are common (e. g., Emas National Park; Jácomo et al., 2004), suggesting that the record of this study could be a scavenging event.

At least six rodent and two marsupial species were eaten by maned wolves in AEES. All identified rodents were open areas inhabitants (as found in cerrado of Itirapina, São Paulo State, by Bueno and Motta-Junior, 2006) and the white-eared opossum *Didelphis albiventris*, which can be found in both forest and open areas. The most frequent non-volant small mammals sampled with live-traps in AEES (from a total of 16 captured species from November 1993 to October 1994) were *Oryzomys* gr. *subflavus*, *Necromys lasiurus*, and *Calomys* spp. in cerrado sensu stricto, *Oxymycterus delator* and *N. lasiurus* in wet field, and *Oecomys bicolor* and *Didelphis albiventris* in gallery forest (Anciães et al., 1997). From these species, *Calomys* spp., *D. albiventris*, and *N. lasiurus* were the most frequent in the wolf's faeces. Although the maned wolf feeds mainly upon common cerrado species, the high consumption of *Calomys* indicates certain selectivity in relation to the species and/or the habitat used for foraging. Similar results were obtained by Motta-Junior (2000), who found that *Calomys tener* and *Necromys lasiurus* were consumed more than expected, whereas *Oryzomys* gr. *subflavus* was consumed much less than expected by their respective abundances.

The birds identified in the wolf's faeces are grasslands and open cerrado inhabitants (Silva, 1995), except for the owl *Tyto alba* that also inhabits forest edges but hunts only in open areas (Motta-Junior, 1996). The frequency of birds in the maned wolf's diet was around 10%, in accordance with other studies (Dietz, 1984; Carvalho and Vasconcellos, 1995; Motta-Junior et al., 1996; Azevedo and Gastal, 1997; Motta-Junior, 1997; Aragona and Setz, 2001; Juarez and Marinho-Filho, 2002; Santos et al.,

2003; Jácomo et al., 2004), but their importance in terms of biomass is more variable, ranging from 3.5 to 9.4% (Motta-Junior et al., 1996; Juarez and Marinho-Filho, 2002). Egg consumption is rare, but it is possibly underestimated, as wolves do not ingest shell fragments. Verzenhassi and Setz (1996) observed that maned wolves, in captivity, consume whole quail eggs, which cannot be true for larger eggs. Many species of cerrado ground birds, like tinamous and rhea, nest on the ground level (Sick, 1997), making the eggs an easily obtainable resource. In Emas National Park a female maned wolf was observed carrying a rhea egg on the mouth up to 3 km and feeding it to its three puppies (FHGR, pers. obs.).

The animal biomass consumed by maned wolves in AEES was much higher than vegetal biomass (respectively 68 and 32%). The values found by Motta-Junior et al. (1996) and Santos et al. (2003) are less contrasting (respectively 43.5 and 43.1% vegetal and 56.5 and 54.0% animal), while Juarez and Marinho-Filho (2002) found more vegetal (54.5%) than animal (41.5%) biomass (but see discussion above on overestimated fruit biomass). Although there is an increase in the availability of small prey during the dry season, the low fruit production in the cerrado at this time can limit the access of the maned wolf to a richer fruit diet, including the wolf's fruit.

Sometimes maned wolves feed upon domestic animals, especially poultry (Dietz, 1984; 1987), leading farmers to kill them. The AEES is limited by Planaltina city in its southwestern boundary, and by small rural properties in the north and northeast. All the seven wolves monitored by Rodrigues (2002) had part of their home ranges outside AEES, making their contact with humans almost inevitable around AEES (Machado et al., 1998). As the majority of landowners in that region raise poultry in their properties, the predation by wolves and other carnivores can be high. We found chicken remains in only two faecal samples, indicating that its importance in the diet of maned wolves is very small. Low chicken predation by wolves was also reported by Dietz (1984) and Motta-Junior et al. (1996), confirming that the consumption of this food item is occasional.

Maned wolves are generalist canids, with a broad diet, and consume most of the food items according to its availability in the habitat. This diet flexibility allows maned wolves to adapt well to some human altered habitats, where they consume large amounts of cultivated fruits (Santos et al., 2003; Jácomo, et al., 2004; this study). Nonetheless, wolves can be selective with regard to some food items, mainly the wolf's fruit in the dry season, probably a key plant species in the maintenance of their populations in the Cerrado domain in Brazil.

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