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Diet of the maned wolf, *Chrysocyon brachyurus* (Mammalia: Canidae), during wet and dry seasons at Ibitipoca State Park, Brazil

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Abstract

Analysis of 141 scats of maned wolf *Chrysocyon brachyurus* collected in a region of upland forest and meadows of south-eastern Brazil yielded 351 food items in the wet season (60 scats) and 407 in the dry season (81 scats). Scarabaeidae and rodents were the most frequent animal food in both seasons, complemented by birds in the wet season and unidentified mammals in the dry season. Seeds revealed *Solanum lycocarpum* to be the most frequent plant food in the dry season and an Annonaceae and a Cactaceae the most frequent in the wet season. A total of 33 seed morphospecies were retrieved. Although our results reveal some shared and some divergent trends from dietary studies undertaken in savanna ('cerrado') areas, we found a very high frequency of potentially harmful tourists' garbage. This highlights the necessity for better environmental education and confirms that the maned wolf is a generalist and opportunist omnivore.

Key words: *Chrysocyon brachyurus*, diet, season, tourism

INTRODUCTION

The maned wolf *Chrysocyon brachyurus* is the largest canid of South America. Characteristic of grasslands and savanna, this species can also inhabit inundated areas and uplands > 1500 m in altitude. Its geographical distribution includes north-eastern Argentina, eastern Peru and Bolivia, Paraguay and sub-Amazonian Brazil, excluding coastal areas (Dietz, 1984; Silva, 1994). Adult animals weigh 20–23 kg, measure 145–190 cm from head to tail and are 80–90 cm high at the shoulder (Dietz, 1985 cited in Figueira, 1995; Silva, 1994). The maned wolf is reddish-brown and is distinguished by long and erect black back hairs, big ears and long dark limbs, which Solokowsky (1927 cited in Figueira, 1995) suggests is an adaptation to tall grass fields, providing better vision and locomotion. It is a monogamous, solitary foraging canid, with long-duration pairs, which associate only during the reproductive period. A pair shares a home range from 21.7 to 30.0 km^2, which is demarcated by urine and scats. Scats are frequently deposited at prominent points (Dietz, 1984). Foraging activity is typically nocturnal, starting at twilight. Small mammals, fruits, insects and birds are frequently reported in its diet. In 'cerrado' areas, *Solanum lycocarpum* fruit is the main plant item in its diet (Dietz, 1984; Motta-Jr *et al*., 1996).

While other studies on maned wolf diet have been conducted in 'cerrado' areas or cattle ranches, our study was conducted in high-elevation fields or 'campo rupestre' (1050–1784 m) inside a state park. *Solanum lycocarpum* is rare in the area, although small plants are found where scats are frequent. Maned wolves regularly visit the camping area of the park and consume left-over food from trash bins.

Here we compare the diet and trash consumption of the maned wolf between wet and dry seasons in a region of natural upland vegetation and evaluate seasonal variation of fruit availability.

STUDY AREA

The study site was the 1488 ha Ibitipoca State Park (21°42′S and 43°53′W) in south-eastern Minas Gerais State, Brazil. The Ibitipoca Mountains divide two river basins (Rio Grande and Paraíba do Sul), both with black waters (Andrade *et al*., 1984). The climate is characterized by cool temperature (annual average 18.9 °C), continual winds and pronounced dry winter (June–September) and wet summer (December–March)

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Table 1: Categories of food items found in maned wolf scats at Ibitipoca State Park

Origin		Common name	Taxonomic level identified	Code
Animal	Mammals	Marsupial	Marsupialia	MAR
		Armadillo	Dasypodidae	DAS
		Rat	Rodentia	ROD
		Cavy	Cavidae (*Cavia* sp.)	CAV
		Rabbit	Leporidae (*Sylvilagus brasiliensis*)	LEP
		Unidentified mammal	–	NIM
	Birds	Bird	–	BIR
		Egg shell	–	EGG
	Reptiles	Snake	Colubridae	COL
		Lizard	Scincidae	SCI
	Arthropods	Ant	Formicidae	FOR
		Grasshopper/cricket	Acridoidea	ACR
		Katydid	Tettigonoidea	TET
		Beetle	Scarabaeidae	SCA
		Unidentified orthoptera	–	NIO
		Unidentified insects	–	NII
		Tick	Acarinae	ACA
		Spider	Aranae	ARA
Plant		Grasses	–	GRA
		Fruit peels	–	FrP
		Seeds (01–33)	–	S01 . . . S33
		01	Myrtaceae (cf. *Myrcia*)	S01
		02	Cactaceae (cf. *Cereus*)	S02
		03	cf. Annonaceae	S03
		04	Myrtaceae (cf. *Myrcia*)	S04
		06	Palmae (cf. *Syagrus*)	S06
		07	*Solanum lycocarpum*	S07
		09	Melastomataceae	S09
		11	cf. Solanaceae	S11
		17	Cactaceae	S17
		24	Tiliaceae (cf. *Triumfetta*)	S24
		33	Solanaceae	S33
Anthropic		–	–	ANT

seasons (Pinto, 1991). The poorly developed soils with rocky outcrops support a particular regionally endemic vegetation, the high elevation meadows ('campo rupestre'). The herbaceous stratum is primarily Gramineae and Cyperaceae, with some scrub trees and shrubs. *Vanillosmopsis erythroppapa*, an Orchidaceae, is a dominant species in this community (Ururahy *et al*., 1984). Gallery forests border the water courses and grasslands cover the hillsides.

METHODS

The diet of the maned wolf was studied through the analysis of scats collected from January 10 to February 20 (wet season, WS) and from July 1 to 31 (dry season, DS) in 1996. The scats were identified as maned wolf by size/diameter, being smaller than those of mountain lion and bigger than those of other canids, and their characteristic odour. Two routes (A = 14 km and B = 12 km) were established along major park trails to collect scats and fruits. These were examined every 3 or 4 days (A: 7 + 4 times and B: 7 + 3 times, WS and DS respectively). Scats found elsewhere were also collected and included in the sample. Scats were initially put into plastic bags and subsequently air-dried in paper bags. In the laboratory, the scats were washed with tap water over 2 fine-mesh screens (Korschgen, 1980) and recovered material dried in an oven (55 °C).

All the remains were examined macroscopically and the food items separated and identified to the level of order, or lower (Table 1). The taxonomic level reached differed among classes. Seeds were morphotyped and represent species, although some were not identified. In our classification of food items, Cavidae were separated from other rodents. Acridoidea includes 3 grasshoppers belonging to the superfamily Acridoidea and to the family Romaleidae and 1 *Rhammatocerus* (Acrididae) species. VgF includes grasses and FrP includes fruit remains other than seeds. Unlike other studies, a category for inorganic items was not established because mineral grains (quartz and glist) were always present, apparently owing to the very friable rock substrate at the study site. Anthropic items comprised tourists' garbage.

The availability of fruit was evaluated by counting the number of fruiting plants in transects of 50 × 2 m on 1 side of the trail. These transects were divided into 3 categories according to the abundance of woody vegetation: A, predominantly grassy vegetation; B, grass with some shrubs and trees; C, grass with greater number of shrubs and trees than B. For each category, 3 transects

were sampled once at each season (at 10 day intervals). A seed reference collection was made for the fruiting species found in the transects. Arthropods were sweep sampled in order to make reference collections.

All the results were compared by χ^2 test and Q-statistic Whittaker diversity index (Magurran, 1991).

RESULTS

Sixty scats were collected during the wet season and 81 during the dry season. Route A provided the greatest number of scats (route A: 50% and 60%, route B: 38% and 27%, WS and DS respectively) and a few scats were obtained outside of these trails. The 31% decrease of scats collected in the wet season can be attributed in part to scats disintegrating more rapidly under rainy conditions. Of the 81 dry season scats, 45 were collected the first time each route was walked. In July, a pair of maned wolves was observed walking together and vocalizing frequently to one another, and at least two 9-month-old wolf pups were observed in the Park in this season. Presence of pups could also have caused the greater number of scats in the dry season. After a 4-day interval during the dry season, 25 scats were found between consecutive collections on route A. In the wet season, even after longer time intervals, fewer scats were collected on any given day.

Scats were primarily deposited on tops of rock outcrops and on patches of bare ground (97%). Termite mounds, a low wall and vegetation were occasionally used. Deposits on rocky outcrops predominated in both seasons, but ground deposits were significantly more frequent during the dry season than during the wet season ($\chi^2 = 7.17$, d.f. = 2, $0.01 < P < 0.05$). This may also be related to the presence of pups.

The average number of food classes found in each scat in the wet season (5.85) was significantly larger than in the dry season (5.02, $t = 2.26$, d.f. = 139, $P < 0.05$). The number of classes is not equivalent to the number of individual food items eaten. This is especially true for seeds, because we cannot count the number of fruits ingested. We found scat samples with remains of at least five individuals/species of rodents and we found samples with at least 20 scarabeid individuals.

Similar percentage occurrences were found for animal (46% and 45%) and plant (38% and 37%) food items between seasons. The frequency of scats with grass remains was high (14% and 17%) in both seasons. The presence of grass (83%) was associated with fruit absence or with the consumption of only one fruit species, representing 32% and 25%, respectively, of the samples with grasses.

Seeds were present in 42 (70%) of the wet season scats and in 51 (63%) of the dry season ones. Thirty-three seed morphospecies were distinguished: nine (27%) were present only in the wet season, 10 (30%) only in the dry season and 14 (43%) in both seasons. The latter includes the three species with the highest average percentage of presence: *Solanum lycocarpum* (S07, 40%), an annonaceous (S03, 24%) and a cactus (S02, 22%).

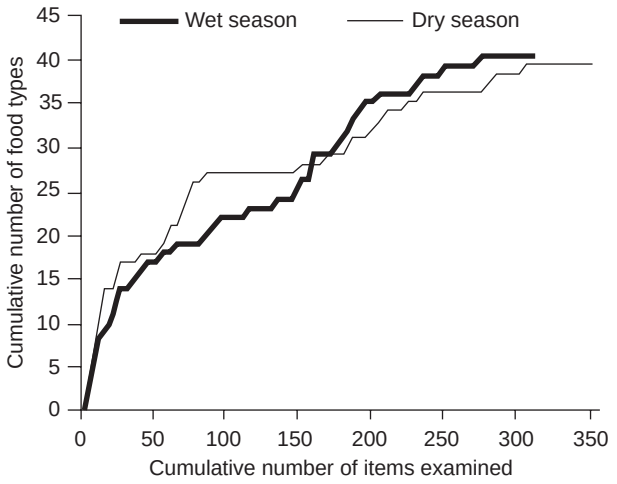

Fig. 1. Cumulative number of types of food items in maned wolf diets for wet (thick line) and dry (thin line) seasons at Ibitipoca State Park, Minas Gerais, Brazil.

In the wet season, scats with more than one seed species predominated (1.37 + 1.15), while dry season scats tended to include only one (1.13 + 1.11). Despite this, the number of seed morphospecies between seasons was not significant ($\chi^2 = 8.16$, d.f. = 4, $0.05 < P < 0.10$). Richness (23 seed morphospecies in WS *vs* 24 in DS) and diversity ($Q_w = 9.02$ and $Q_d = 8.66$) were similar for both seasons, despite the apparent *S. lycocarpum* dominance in the dry season.

It is curious that the higher frequency of fruit peels occurs in the dry season (more resistant fruits), since fruit consumption did not differ significantly between seasons and 14 morphospecies of seeds were found in both seasons. Vegetation transects with shrubs and trees (categories B and C) had greater numbers of fruiting individuals (fleshy fruits) in the wet than in the dry season. In contrast, category A, with predominant grass vegetation, had a greater number of fruiting individuals (grass seeds) in the dry season.

Ants were probably ingested while maned wolves ate fruits or scavenged prey contaminated with ants. The percentages of ants are similar in both seasons. Similarly, ticks and *Triumfetta* (Tiliaceae, S24) seeds are probably ingested accidentally. *Triumfetta* produces fruits in the form of burrs in June and July (Leitão Filho, Araha & Bacchi, 1972) and these stick to animal fur. Maned wolves may ingest *Triumfetta* seeds and ticks while autogrooming or eating a mammal carrying them.

Birds, rodents, beetles, anthropic material, Cactaceae (S02) and Annonaceae (S03) seeds predominated in the wet season diet (Table 2). Anthropic items included plastic, paper, aluminium foil, cigarette filters, string, glass, charcoal and the lead wrapper from a bottle of wine. In the dry season, rodents, beetles, unidentified mammals, fruit peels, *S. lycocarpum* seeds (S07) and another Solanaceae (S11) predominated. Total diversity

Table 2. Contents of maned wolf scats at Ibitipoca State Park during the wet and the dry seasons of 1996. *n*, number of scats; *n*/*N*, percentage of scats; *n*/*Σn*, frequency

Food categories	Wet season (*n* = 60)			Dry Season (N = 81)		
	n	*n*/*N*	*n*/*Σn*	*n*	*n*/*N*	*n*/*Σn*
MAR	6	10.0	0.020	6	7.4	0.019
DAS	5	8.3	0.017	10	12.4	0.032
ROD	23	38.3	0.074	30	37.0	0.097
LEP	10	16.7	0.034	14	17.3	0.045
CAV	–	–	–	2	2.5	0.006
NIM	11	18.3	0.037	21	25.9	0.068
BIR	22	36.7	0.074	17	21.0	0.055
EGG	2	3.3	0.007	–	–	–
COL	5	8.3	0.017	4	4.9	0.013
SCI	6	10.0	0.020	5	6.2	0.016
FOR	21[a]	35.0	–	36[a]	44.4	–
ACR	2	3.3	0.007	6	7.4	0.019
TET	2	3.3	0.007	–	–	–
SCA	40	66.6	0.135	23	28.4	0.074
NIO	1	1.7	0.003	2	2.5	0.006
NII	6	10.0	0.020	5	6.2	0.016
ACA	1[a]	1.7	0.003	2[a]	2.5	–
ARA	1	1.7	0.003	–	–	–
ANIMAL subtotal	*Σn* = 142+22[a]		0.478	*Σn* = 145+38[a]		0.466
GRA	50	83.3	0.168	67	82.7	0.216
FrP	32[a]	53.3	–	52[a]	64.2	–
S01	7	11.7	0.024	1	1.2	0.003
S02	16	26.7	0.054	4	4.9	0.013
S03	14	23.3	0.047	8	9.9	0.026
S04	7	11.7	0.024	–	–	–
S05	1	1.7	0.003	–	–	–
S06	2	3.3	0.007	–	–	–
S07	4	6.7	0.013	33	40.7	0.106
S08	1	1.7	0.003	1	1.2	0.003
S09	4	6.7	0.013	1	1.2	0.003
S10	1	1.7	0.003	–	–	–
S11	1	1.7	0.003	5	6.2	0.016
S12	3	5.0	0.010	1	1.2	0.003
S13	1	1.7	0.003	1	1.2	0.003
S14	1	1.7	0.003	–	–	–
S15	3	5.0	0.010	–	–	–
S16	1	1.7	0.003	–	–	–
S17	4	6.7	0.013	4	4.9	0.013
S18	1	1.7	0.003	–	–	–
S19	2	3.3	0.007	4	4.9	0.013
S20	2	3.3	0.007	2	2.5	0.006
S21	3	5.0	0.010	1	1.2	0.003
S22	1	1.7	0.003	1	1.2	0.003
S23	1	1.7	0.003	–	–	–
S24	–	–	–	7[a]	8.6	–
S25	–	–	–	1	1.2	0.003
S26	–	–	–	1	1.2	0.003
S27	–	–	–	1	1.2	0.003
S28	–	–	–	1	1.2	0.003
S29	–	–	–	1	1.2	0.003
S30	–	–	–	2	2.5	0.006
S31	–	–	–	2	2.5	0.006
S32	–	–	–	1	1.2	0.003
S33	–	–	–	1	1.2	0.003
Plant subtotal	*Σn* = 131 + 32[a]		0.437	*Σn* = 145 + 59[a]		0.463
Anthropic	24	40.0	0.081	20	24.7	0.065
Total	*Σn* = 297 + 54[a]		0.996	*Σn* = 310 + 97[a]		0.994

[a] Items not included in calculations.

does not differ significantly between seasons ($Q_w = 10.79$ and $Q_d = 10.47$), confirmed by cumulative items collector curve (Fig. 1).

There was a low percentage of snakes and lizards in both seasons, but a higher percentage in the wet summer season, suggesting that maned wolves captured them when they were active (reptiles hibernate in the colder months at Ibitipoca). Some samples that contained lizards included the feet of juveniles.

DISCUSSION

Our results from upland tropical meadows show some similarities and differences from those reported for mid-elevation savannas at Serra da Canastra National Park (Dietz, 1984), Fazenda Água Limpa in the Federal District (Motta-Jr *et al*., 1996) and Emas National Park (Jácomo, 1995).

The diameter of maned wolf scats was smaller at Ibitipoca than at Canastra (from 3 to 4.5 cm; Dietz, 1984). Scats were deposited in a fewer variety of places compared to Dietz's (1984) study where they were found on rocks, termite mounds, paths or roads, dirty mounds, clumps of grass, logs, wolf traps and substrate. The increase of deposits on the ground in the dry season may be attributed to denning, because around the den wolves defecate on the ground (Dietz, 1984). At Canastra, 27% of the deposit were recorded on termite mounds (Dietz, 1984), a common feature at that site. At Ibitipoca termite mounds are scarce and there was only one occurrence of this kind.

The striking seasonality in maned wolf diet documented in the other studies (Dietz, 1984; Jácomo, 1995; Motta-Jr *et al*., 1996) was not observed at Ibitipoca. The reduced seasonality may be related to different ecological conditions at 'campo rupestre' compared to 'cerrado'. At Ibitipoca as well as at Emas (Jácomo, 1995), rodent occurrences in scats are high in both seasons (38% WS and 37% DS at Ibitipoca and 64% total average at Emas) in contrast with Canastra (Dietz, 1984) and Água Limpa (Motta-Jr *et al*., 1996), where rodents were eaten more frequently in the dry season. Alho & Pereira (1985) and Alho *et al*. (1986) report higher rodent abundances during the dry season in Água Limpa.

The relative importance of insects at Ibitipoca was constant (20% of frequency in the wet and 18% in the dry seasons), with little variation between seasons for most arthropod categories (except for beetles) differing from Água Limpa, where they were occasionally found (Motta-Jr *et al*., 1996). However, beetle consumption was very high in the wet season at Ibitipoca (leading animal item, with 67% of presence) and remains high in the dry season (third, with 28%). At Canastra, beetles were the fifth most important animal food item, although they represented only 4% of occurrences (Dietz, 1984). The high percentage of occurrence and the great volume of beetle remains suggest intense foraging, at least for the wet season (but see Dietz, 1984), when beetles are highly available (M. Aragona, pers. obs.).

The frequency of grass in maned wolf scats was very high at Ibitipoca (0.142 wet season and 0.165 dry season, or 83% of occurrence in scats in both seasons). Similar values were obtained for Água Limpa (0.102 wet season and 0.133 dry season; Motta-Jr *et al*., 1996) and Canastra (0.111 wet/dry; Dietz, 1984), showing that grass eating is common in maned wolves, where it perhaps aids in food transit (Dietz, 1984).

Seed richness in the diet at Ibitipoca (33 morphospecies) was higher than at Canastra (20 morphospecies; Dietz, 1984). This maybe due to (1) the rarity of *Solanum lycocarpum* at Ibitipoca or (2) the high diversity of campo rupestre vegetation compared to fire susceptible savanna of Canastra, since either seasonal coverage or sample size ($n = 740$ scats) was higher at Canastra. *S. lycocarpum* is rare at Ibitipoca and occurred in scats in much lower frequencies (0.111 wet season and 0.081 dry season) than in the studies conducted at lower elevations (from 0.195 to 0.326; Dietz, 1984; Jácomo, 1995; Motta-Jr *et al*., 1996). *Solanum lycocarpum* is a favoured food of the maned wolf, which is an efficient disperser of its seeds and they germinate well after passing through the wolf's digestive tract (Lombardi & Motta-Jr, 1993). However, *S. lycocarpum* has only recently been observed at Ibitipoca (R. Amancio, pers. comm.) and in 1996 only nine young plants were found (pers. obs.) along A and B routes. In the wet season one young plant, *c*. 1 m high, was flowering but fruits were never observed. *Solanum lycocarpum* frequently occurs in disturbed 'cerrado' areas and it seems possible that the studied wolves feed on *S. lycocarpum* fruits outside the Park, bringing back its seeds. The lack of success of *S. lycocarpum* plants in the park may be due to the shallow soil and high altitude with cooler temperatures (Ferri, 1974).

During the summer rainy season 40% of the scats examined contained inedible anthropic material, compared to 25% for winter samples. A high frequency of trash in maned wolf scats is here reported for the first time (cf. Dietz, 1984; Jácomo, 1985; Motta-Jr *et al*., 1996). This potentially harmful material comes from garbage discarded by tourists along the trails and from the trash bins in the Park's camping area. These open containers made from steel drums were about 50 cm high and 60 cm in diameter. Maned wolves were often observed rummaging inside trash bins, apparently seeking food discarded by Park visitors. It seems that maned wolves visited all the trash bins nightly looking for easy food. The availability of discarded food increases greatly during school vacations and holidays during the summer rainy season. The danger of ingesting these items calls attention to the necessity of an environmental education program for Park visitors and better garbage management with closed trash bins.

Our results confirm the opportunistic omnivorous nature of the maned wolf diet, not only in the diversity and the proportions of animal and plant food items, but also because of its disposition to feed on tourists' left-overs.

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