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Diet of the maned wolf, *Chrysocyon brachyurus*, in central Brazil

J. C. MOTTA-JUNIOR[1*], S. A. TALAMONI[1], J. A. LOMBARDI[2] AND K. SIMOKOMAKI[3]

[1]*Universidade Federal de São Carlos, PPG-ERN, São Carlos, SP, 13565–905, Brazil*
[2]*Universidade Federal de Minas Gerais, Departamento de Botânica, Instituto de Ciências Biológicas, Belo Horizonte, MG, 31270–901, Brazil*
[3]*Universidade Federal de São Carlos, PPG-GEV, São Carlos, SP, 13565–905, Brazil*

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Analysis of 105 scats of the maned wolf (*Chrysocyon brachyurus*) collected in central Brazil yielded 304 occurrences of food items of which fruits of *Solanum lycocarpum*, rodents, and birds accounted for 61.5%. By analysis of minimum number of individual animals, rodents and birds were 75% of a total of 156 prey. On the other hand, fruits of *S. lycocarpum* and armadillos (*Dasypus* spp.) were the bulk of the total estimated biomass consumption, yielding 63.7% in a total of 73.5 kg. Rodents were mostly captured during the dry season, while miscellaneous fruits were consumed mostly in the wet season. The consumption of *S. lycocarpum* fruits and armadillos was aseasonal. Small rodents were taken in about the ranks of abundance in the study area, but *S. lycocarpum* fruits were actively searched by maned wolves, for its occurrence is limited to secondary savanna. Prey and fruits typical of savanna ('cerrado') and grassland ('campo') were the bulk of species, occurrences, prey numbers, and biomass consumed. These findings reinforce the importance of conservation of cerrado and campo in central Brazil. Despite maned wolf being a vulnerable species, its feeding habits are opportunistic, and the main reasons for its decline are likely to be habitat destruction and human disturbance.

Introduction

The maned wolf, *Chrysocyon brachyurus*, is a large (20–25 kg) and vulnerable canid species inhabiting central South America (Medel & Jaksic, 1988; Groombridge, 1993; Silva 1994). It is distributed over central Brazil, reaching eastern Bolivia, Paraguay, and north-eastern Argentina (Langguth, 1975; Dietz, 1984; Medel & Jaksic, 1988). The long limbs of this canid seem adapted to cursorial and hunting habits in tall grass of savannas and grasslands (Langguth, 1975). The foraging activities are mostly solitary, crepuscular, and nocturnal, when wolves pounce on prey (Dietz, 1984; Bartmann & Bartmann, 1986). Home ranges of each bounded pair of wolves are from 21.7 to 30.0 km^2 (Carvalho, 1976; Dietz, 1984).

Few studies have been conducted on the ecology of maned wolf (e.g. Carvalho, 1976; Dietz, 1984; Bartmann & Bartmann, 1986), and its food habits have been reported only as proportional occurrence of total number of scats (Schaller, 1983) or total prey occurrences (Dietz, 1984). Small mammals, fruits, and birds are the most frequently reported items (Langguth, 1975; Carvalho, 1976; Schaller 1983; Dietz, 1984; Bartmann & Bartmann, 1986). This study is the first to quantify the diet of the maned wolf by number and estimated biomass of prey (see reviews in Dietz, 1984; Medel & Jaksic, 1988; Silva 1994). Aspects of prey size distribution, seasonality, and selectivity were also considered. Field data reported here are intended to aid in the management of both wild and captive populations of maned wolves.

*Address for correspondence: J. C. Motta-Junior, Rua Estados Unidos, 429, 13566–050, São Carlos, SP, Brazil

Study area

The research was developed at Fazenda Água Limpa—FAL (15°57′ S, 47°56′ W), an ecological reserve located 18 km SSW of downtown Brasília, Federal District, with a total area of 4062 ha. The elevation is approximately 1100 m and the climate is within Köppens' Awi, tropical with pronounced dry (May–September) and wet (October–April) seasons. The annual rainfall and temperature average 1526 mm and 20.4 °C, respectively (Eiten, 1984). Vegetation is typical of central Brazil: grasslands ('campo'), savannas ('cerrado' *sensu lato*), and gallery forests. Campo and cerrado covered more than 60% of the total area of the study site, and approximately 20–25% was occupied with experimental cultivars and pastures. FAL is administered by the University of Brasília—UnB and since the sixties has been a protected area for research uses. More detailed descriptions of FAL and vegetation of central Brazil can be found in Eiten (1984) and Ratter (1980).

Methods

The diet of the maned wolf was studied by analysis of 105 scats collected during 18 months in 1988–1989, and sporadically during 5 months in 1990–1991. Scats were attributed to maned wolves because of their high diameters (> 25 mm), odour, texture, and for being found mostly on roads, paths, and above termite nests (cf. Dietz, 1984). During analysis, they were soaked in water for 12–24 h with occasional stirring and then washed with water over a fine-mesh screen, dried, and examined under magnifying glasses (2–10 ×). Remains of mandibles, teeth, bills, feathers, scales, and seeds were used to identify food items. Mean number of seeds per fruit species was obtained in the field in order to estimate the number of fruits consumed by counting seeds in scats (Castro *et al.*, 1994). Seeds per fruit species ranged from one (e.g. *Mangifera indica*, *Pouteria* spp.) to 700 (*Solanum lycocarpum*). Reference collections of fruits and animals were used as aids in the identifications, but some material was sent to museum specialists. Identification of major age classes was possible for reptiles and mammals from teeth and bone analysis.

To describe the diet of the maned wolf quantitatively, 3 levels were considered: occurrence of items in scats as a function of total prey numbers (Dietz, 1984), minimum number of individual animals and estimated biomass consumption (Emmons, 1987). The number of fruits consumed was used only for estimates of biomass consumption because an individual fruit is not comparable to an individual animal prey. In order to avoid duplications in counting prey numbers, the minimum number of individuals in each scat was counted from identifiable remains (cf. Emmons, 1987). Mean weights of prey were obtained from field data obtained with spring balances or, when possible, from studies at FAL, and even from other neighbouring areas of Federal District (references in **Appendix**). Preferential habitats of fruiting plants and of prey in central Brazil, as well as locomotor features and activity periods of prey were obtained from published accounts (cited in **Appendix**) and personal observation. Analysis of prey seasonality was performed by means of Chi-square tests on occurrences and numbers (Sokal & Rohlf, 1969; Dietz, 1984). Prey selection of small rodents (< 100 g) was assessed by comparison of scat contents with trapping results from published data of the study area.

Results

Three to four maned wolves have frequented FAL, at least during our field work, as part of their home ranges, as indicated by visual and indirect observations (tracks, scats). The sample size for scats appeared to be adequate as no new food item was added to the diet after analysis of the 95th scat. At least 33 animal and nine fruit species were recorded as food items of maned wolves in FAL (**Appendix**). Grasses (Poaceae and Cyperaceae) were also found in 34.3% of all scats analysed,

TABLE I

Major food items found in scats of maned wolves in central Brazil. Values in parentheses are percentages.The number of individual fruits consumed were not considered here because of difficulties for comparisons with that of animals (see **Appendix** *for numbers). Values of estimated biomass are in grams*

Food items	Occurrence	Number	Estimated biomass
S. lycocarpum fruits	78 (25.7)		25010.0 (34.0)
Miscellaneous fruits	28 (9.2)		6931.0 (9.4)
Grasses	36 (11.8)		
Subtotal Plants	**142 (46.7)**		**31941.0 (43.5)**
Insects	6 (2.0)	7 (4.5)	11.5 (0.00)
Lizards	8 (2.6)	6 (3.8)	3158.0 (4.3)
Birds	42 (13.8)	34 (21.8)	4573.1 (6.2)
Opossums	9 (3.0)	6 (3.8)	1203.0 (1.6)
Armadillos	28 (9.2)	18 (11.5)	21790.0 (29.7)
Rodents	67 (22.0)	83 (53.2)	5006.2 (6.8)
Deer	2 (0.7)	2 (1.3)	5800.0 (7.9)
Subtotal Animals	**162 (53.3)**	**156 (100.0)**	**41541.8 (56.5)**
Total	**304 (100.0)**	**156 (100.0)**	**73482.8 (100.0)**

representing 11.8% of all food occurrences. Similarly to smaller animal prey species (< 1 kg), the largest ones, such as deer, armadillos, and *Tupinambis* lizards were virtually eaten complete, for fragmented crania, mandibles, teeth, feet, tails, as well as hairs and scales were all found in scats. No dipteran larvae were found, thus indicating the predation was of living animals.

By occurrences, *S. lycocarpum* fruits, rodents, and birds yielded 61.5% of the total. By counting animal prey individuals, rodents and birds alone were 75% of the total number (Table I). On the other hand, when the analysis was performed for estimated biomass consumption, fruits of *S. lycocarpum* and armadillos yielded 63.7% of the total biomass. Birds and rodents were of minor importance (13%). Deer, although numerically unimportant in the diet, by biomass represented more than birds or rodents (Table I). Animals, both by occurrence and estimated biomass, were slightly more consumed than plant material (Table I).

Seasonality of consumption was pronounced for rodents and miscellaneous fruits; rodents were more frequently eaten in the dry season and fruits during the wet season (Table II). All other items were consumed in similar proportions regardless of season (Table II).

According to Alho (1981), Alho, Pereira & Paula (1986), Nitikman & Mares (1987) and Mares, Braun & Gettinger (1989), trapping results showed that *Bolomys lasiurus* is the most abundant small rodent in the cerrado habitats of FAL, followed by *Calomys* spp. and *Oryzomys* spp. (other than *O. capito*), and by the less abundant *Akodon cursor* and *Oryzomys capito*. Data from scats showed a similar rank pattern (**Appendix**).

Most prey were nocturnal, terrestrial, and inhabitants of savanna and grassland, whereas few species were diurnal, arboreal and/or occurred in gallery forest (**Appendix**, Table III).

By number of individuals, prey weighing between 10 and 1000 g yielded 83.4% of all animals in the diet (**Appendix**). On the other hand, by biomass, prey weighing more than 1000 g represented 64.4% of the total consumed (**Appendix**).

Discussion

Prey occurrences reported here are very similar to those found in previous studies (Schaller,

TABLE II

Seasonality in consumption of major prey items by maned wolf. The figures are observed absolute values of occurrences and number of individual animals. Forty nine and 56 scats were analysed, respectively, for dry and wet seasons

	Occurrence		Number		Chi-square; Probability	
Items	Dry	Wet	Dry	Wet	Occurrence	Number
S. lycocarpum fruits	38	40			0.27; $P > 0.60$	
Miscellaneous fruits	2	26			22.20; $P < 0.0001$	
Grasses	21	15			0.65; $P > 0.40$	
Birds	22	20	18	16	0.01; $P > 0.85$	1.23; $P > 0.25$
Armadillos	15	13	8	10	0.04; $P > 0.80$	2.42; $P > 0.10$
Rodents	47	20	62	21	9.19; $P < 0.005$	5.54; $P < 0.02$
Other animals	12	13	9	12	0.13; $P > 0.70$	3.34; $P > 0.06$
Total	**157**	**147**	**97**	**59**		

1983; Dietz, 1984). However, though numbers are roughly similar to occurrences, estimated biomass revealed a different result, with fruits of *S. lycocarpum* and armadillos representing the bulk of the diet regardless of season.

The consumption of grass is known to be voluntary and involuntary, possibly aiding in food digestion (Dietz, 1984). *Solanum lycocarpum* is a shrub locally abundant only in disturbed or secondary savanna and grassland, with fruits present in virtually all months of the year (Dietz, 1984; Lombardi & Motta-Junior, 1993). In FAL this shrub is also found alongside roads within savanna and grassland, where maned wolves commonly walk. Seed dispersal by the wolves seems to benefit these shrubs (Lombardi & Motta-Junior, 1993). Insects were poorly represented in the diet of maned wolf, contrasting with that of smaller sympatric canids inhabiting savannas and grasslands of South America, as *Dusicyon* (= *Cerdocyon*) *thous* , *Dusicyon gymnocercus*, and *Dusicyon vetulus*, which feed on insects more frequently (cf. Crespo, 1971; Medel & Jaksic, 1988; Motta-Junior, Lombardi & Talamoni, 1994). This pattern was also observed by Dietz (1984) in Minas Gerais State, Brazil. Armadillos (*Dasypus septemcinctus* and *D. novemcinctus*) inhabit both savanna/grassland and gallery forest (Redford & Eisenberg, 1992), but were probably preyed upon in open areas, where maned wolves can walk and pounce on prey easily. Of special interest is the apparent selection of *D. septemcinctus* by the maned wolf, since this is the least common species of *Dasypus* reported for Federal District and central Brazil (Mares *et al.*, 1989).

TABLE III

Distribution of prey and fruits found in scats of the maned wolf by habitat. Data were computed from ***Appendix****. Figures in parentheses are percentages*

Habitat	Species	Occurrences	Number*	Biomass
Gallery Forest	6 (14.0)	15 (4.9)	12 (7.7)	1945.9 (2.7)
Savanna Grassland	20 (46.5)	210 (69.1)	80 (51.3)	39172.9 (53.3)
Gallery Forest and Savanna Grassland	5 (11.6)	41 (13.5)	32 (20.5)	29412.5 (40.0)
Disturbed (Farms, Orchards)	2 (4.6)	3 (1.0)	1 (0.6)	1600.0 (2.2)
Unknown	10 (23.3)	35 (11.5)	31 (19.9)	1351.5 (1.8)
Total	**43 (100.0)**	**304 (100.0)**	**156 (100.0)**	**73482.8 (100.0)**

*Only for animal prey

However, this could also be due to the inconspicuousness of this armadillo to humans (A. Langguth, pers. comm.).

Although most mammals and birds living in the savanna region of central Brazil occur in, or are relatively dependent on, gallery forests (Negret *et al.*, 1984; Fonseca & Redford, 1984; M. A. Marini & J. C. Motta-Junior, unpubl. data), most prey consumed by maned wolf inhabits open areas, supporting the assertion of Langguth (1975) about the long limbs of this canid. This stresses the importance of conservation of 'cerrado' and 'campo' habitats of central Brazil. The large proportion of nocturnal and terrestrial prey species (**Appendix**) upholds the cursorial and crepuscular-nocturnal habits of maned wolf.

Seasonality pattern of diet is similar to that found by Dietz (1984). Maned wolves appeared to catch the seasonally most abundant prey/fruit. Dietz (1984) and Rocha *et al.* (1994) found that, in the cerrado habitat of central Brazil, mature fruits and insects are more abundant and conspicuous during the wet season. On the other hand, Alho & Pereira (1985) and Alho, Pereira & Paula (1986) captured more small rodents in Federal District during dry rather than wet months.

The similar rank order of trapped and preyed small rodents (< 100 g) indicate that, at least for this prey category, possibly there has been no prey selection.

Although the maned wolf appears to be an opportunistic omnivore (Dietz, 1984; This study), there have been reports in different localities showing high consumption of *S. lycocarpum* fruits (Langguth, 1975; Carvalho, 1976; Schaller, 1983; Dietz, 1984; S. A. Talamoni, unpubl. data; This study), even though there may appear to be a scarcity or absence of this shrub in undisturbed savannas (Ratter, 1980; Felfili & Silva, Jr, 1993; pers. obs.). These observations suggest that maned wolves actively search for this food in disturbed sites, such as secondary savanna and alongside roads.

The decline of the maned wolf is likely to be more related to habitat destruction and human persecution or hunting practices (Silva, 1994) than to food constraints. The cerrado and campo of central Brazil are threatened biomes with increasing rates of destruction (Dias, 1994). Hunting has diminished by government fiscalization, but still occurs. Road mortality is apparently another important depressing factor (pers. obs.), but it has been overlooked and not studied.

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Appendix

List of prey items consumed by maned wolves. Numerical data are, respectively: mean weight[a] (g) in parentheses; occurrence; number of individual fruits or animals; estimated biomass (g) in brackets; and preferred habitat, locomotor adaptation and activity period. Abbreviations for habitat: SG – savanna/grassland, FS – gallery forest and savanna/grassland, GF – gallery forest, DT – disturbed, UN – unknown; Locomotor adaptation: Te – terrestrial, Ab – arboreal or scansorial, Sa – semiaquatic; Activity period: Di – diurnal, No – nocturnal. Scientific names follow Heringer ***et al.*** *(1977) and Ratter (1980) for plants; Rocha* ***et al.*** *(1994) for lizards; Meyer de Schauensee (1966) for birds; and Mares* ***et al.*** *(1989) for mammals*

Fruits[b]
Annona crassiflora – (660.0); 5; 3; [1980.0]; SG
A. monticola – (200.0); 2; 2; [400.0]; SG
Campomanesia sp. – (3.0); 4; 91; [273.0]; SG
Mangifera indica – (300.0); 2; 4; [1200.0]; DT
Melancium campestre – (126.0); 1; 1; [126.0]; SG
Pouteria ramiflora – (30.0); 2; 2; [60.0]; SG
P. torta – (60.0); 9; 44; [2640.0]; SG
Salacia crassifolia – (28.0); 3; 9; [252.0]; SG
Solanum lycocarpum – (610.0); 78; 41; [25010.0]; SG
Grasses (Poaceae, Cyperaceae) – 36 occurrences; SG
Insects[b]
Acrididae sp. – (1.0); 1; 1; [1.0]; UN, Ab, Di
Reduviidae sp. – (1.5); 1; 1; [1.5]; UN, Ab, No
Cicadidae sp. – (2.0); 1; 1; [2.0]; UN, Ab, No
Scarabaeidae sp. A – (2.0); 2; 3; [6.0]; UN, Te, No
Scarabaeidae sp. B – (1.0); 1; 1; [1.0]; UN, Te, No
Lizards
Ameiva ameiva, subadult[b] – (64.0) [b]; 3; 2; [128.0]; SG, Te, Di
A. ameiva, juvenile[b] – (15.0); 3; 2; [30.0]; SG, Te, Di
Tupinambis teguixin, subadult[c] – (1500.0); 2; 2; [3000.0]; SG, Te, Di
Birds – Nonpasserines
Speotyto cunicularia[d] – (168.0); 2; 1; [168.0]; SG, Te, No-Di
Crypturellus aff. *parvirostris*[b] – (160.2); 1; 1; [160.2]; SG, Te, Di
Gallus gallus, subadult[b] – (400.0); 1; 1; [400.0]; DT, Te, Di
Micropygia schomburgkii[d] – (36.0); 14; 10; [360.0]; SG, Te, Di
Rhynchotus rufescens[e] – (763.3); 3; 3; [2289.9]; SG, Te, Di
Unidentified small Tinamidae[d] – (150.0); 4; 4; [600.0]; UN, Te, Di
Birds – Passerines[d]
Cyanocorax cristattelus – (200.0); 2; 2; [400.0]; SG, Ab, Di
Volatinia jacarina – (11.0); 5; 5; [55.0]; SG, Ab, Di
Unidentified spp., small – (±20.0); 10; 7; [140.0]; UN, Ab, Di
Opossums
Didelphis albiventris[f] – (692.0); 3; 1; [692.0]; GF, Te-Ab, No
D. albiventris, subadult[f] – (221.0); 2; 2; [442.0]; GF, Te-Ab, No
Marmosa cf. *agilis*[g] – (26.4); 3; 2; [52.8]; GF, Ab-Te, No
M. cf. *agilis*[g] – (16.2); 1; 1; [16.2]; GF, Ab-Te, No
Armadillos
Dasypus novemcinctus[h] – (2000.0); 2; 1; [2000.0]; FS, Te, No-Di
Dasypus septemcinctus[h] – (1450.0); 17; 11; [15950.0]; FS, Te, No-Di?
D. septemcinctus, subadult[b] – (640.0); 9; 6; [3840.0]; FS, Te, No-Di?
Rodents
Akodon aff. *cursor*, subadult[g] – (21.5); 2; 2; [43.0]; GF, Te, No-Di
Bolomys lasiurus[g] – (42.2); 11; 18; [759.6]; SG, Te, No-Di
B. lasiurus, subadult[g] – (30.8); 10; 12; [369.6]; SG, Te, No-Di
Calomys spp.* (*callosus, tener*)[i] – (22.2); 8; 14; [310.8]; SG, Te, No
C. spp.* (*callosus, tener*), subadult[b] – (9.0); 2; 3; [27.0]; SG, Te, No
Cavia aperea[j] – (435.0); 4; 3; [1305.0]; FS, Te, No-Di
C. aperea, juvenile[b] – (210.0); 2; 2; [420.0]; FS, Te, No-Di
Proechimys longicaudatus[j] – (315.0); 1; 1; [315.0]; GF, Te, No
Nectomys squamipes[j] – (267.5); 1; 1; [267.5]; GF, Sa, No
Oryzomys spp.** (*nigripes, fornesi*)[i] – (18.9); 2; 3; [56.7]; FS, Te-Ab, No

O. spp.** (*nigripes, fornesi*), subadult[i] – (10.2); 3; 4; [40.8]; FS, Te-Ab, No
Oryzomys subflavus[i] – (85.7); 3; 4; [342.8]; SG, Te-Ab, No
O. subflavus, subadult[i] – (31.0); 1; 1; [31.0]; SG, Te-Ab, No
Oryzomys aff. *capito*[g] – (58.7); 2; 2; [117.4]; GF, Te-Ab, No
Unidentified cavid, juvenile[d] – (±200.0); 2; 1; [200.0]; UN, Te, No-Di
Unidentified sp., medium[d] – (±100.0); 2; 2; [200.0]; UN, ?, ?
Unidentified small murids[d] – (±20.0); 11; 10; [200.0]; UN, ?, ?
Deer[k]
Mazama aff. *americana*, juvenile (2900.0); 2; 2; [5800.0]; FS, Te, No

Citations: [a] all weights are for adults except when indicated; [b] field data; [c] A. S. Abe, pers. comm.; [d] Museum of UnB; [e] Contreras (1985); [f] Fonseca, Redford & Pereira (1982); [g] Nitikman & Mares (1987); [h] minimum adult weight in Redford & Eisenberg (1992); [i] weights from males in Mares *et al.* (1989); [j] Fonseca & Redford (1984); [k] Katia Cassaro, pers. comm.; * and ** sibling species difficult to identify; weights are weighted means of males from each pair of species. References consulted for prey habitats and habits were: fruits, Ratter (1980); insects, pers. obs.; lizards, Rocha *et al.* (1994); birds, Negret *et al.* (1984) and pers. obs.; armadillos and deer, Fonseca & Redford (1984), Redford & Eisenberg (1992); opossums and rodents, Alho (1982), Alho *et al.* (1986), Mares, Ernest & Gettinger (1986), Mares *et al.* (1989).