
FEEDING ECOLOGY OF THE MANED WOLF, *CHRYSOCYON BRACHYURUS* (ILLIGER, 1815) (MAMMALIA: CANIDAE), IN THE ECOLOGICAL STATION OF ITIRAPINA, SÃO PAULO STATE, BRAZIL.

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Abstract – The feeding ecology of the maned wolf (*Chrysocyon brachyurus*) was studied from 1998 to 2002 in the Ecological Station of Itirapina, São Paulo State, southeastern Brazil, including estimates of prey number and biomass consumption. A total of 325 faecal samples was collected in the area. The species is omnivorous, with a broad diet including 68 species or morphospecies of fruits and animals. Armadillos (Dasypodidae), wolf's fruit (*Solanum lycocarpum*) and small mammals (mostly *Clyomys bishopi*) were the bulk of the diet, comprising 72.8 % of the total estimated biomass consumed (185,323.4 g). In terms of frequency of occurrence, on the other hand, only small mammals and other miscellaneous fruits yielded 43.4 % of the total occurrences (N = 1,054). Animal prey ranging from 0.01 and 0.1 Kg were the most captured category, resulting in 44.2 % of 507 captured animals. The maned wolf seems to be seasonally opportunistic, at least for fruits and insects, as indicated by the variation of the consumption of these items along the year. The higher consumption of fruits and animals characteristic of savannah can be an important factor to consider in future management plans for the species.

Key words: *Chrysocyon brachyurus*, maned wolf, savannah, grassland, feeding ecology, diet, Brazil.

Resumo – A dieta do lobo-guará (*Chrysocyon brachyurus*) foi estudada entre 1998 e 2002 na Estação Ecológica de Itirapina, Estado de São Paulo, incluindo estimativas de número de presas e biomassa ingerida. Um total de 325 amostras fecais foi coletado na área de estudo. A espécie pode ser considerada onívora, com uma dieta variada incluindo 68 espécies ou morfo-espécies de frutos e animais. Os tatus (Dasypodidae), fruta-de-lobo (*Solanum lycocarpum*) e pequenos mamíferos (principalmente *Clyomys bishopi*) constituíram a base da dieta, com 72,8% do total de biomassa consumida (185.323,4 g). Por outro lado, em termos de frequência de ocorrência, apenas os pequenos mamíferos e outros frutos compreenderam 43,4% do total de ocorrências (N = 1.054). Presas animais entre 0,01 e 0,1 Kg foram as mais consumidas, representando 44,2 % do total de 507 indivíduos capturados. O lobo-guará apresenta oportunismo sazonal pelo menos para frutos e insetos, a julgar pela variação no consumo desses itens nas diferentes estações do ano. O alto consumo de frutos e animais provenientes do cerrado deve ser levado em conta em planos futuros de manejo da espécie.

Palavras-chave: *Chrysocyon brachyurus*, lobo-guará, cerrado, campo, ecologia alimentar, dieta, Brasil.

Introduction

The maned wolf (Fig. 1), *Chrysocyon brachyurus* (Illiger, 1815), is the largest (20 to 26 Kg) canid of the South American continent. It inhabits mostly savannah-like and grasslands habitats in central South America, including all Paraguay, north-eastern Argentina, north-western Uruguay, south-eastern Peru, large parts of central-east Bolivia and central-south Brazil (Langguth 1975, Dietz 1985, Mones & Olazarrí 1990, Nowak 1999). The species is included in the IUCN Red List as a “lower risk – near threatened” species (Hilton-Taylor 2000) whereas in the Brazilian official list it is considered threatened (Bernardes et al. 1990).

The maned wolf is a solitary animal, except in the breeding season, being active mainly in the crepuscular-nocturnal period. Its home range varies from 21.7 to 115.0 Km² (Dietz 1984, 1985, Carvalho & Vasconcellos 1995, Rodrigues et al. 1998). It is omnivorous, consuming similar proportions of fruits, mostly wolf’s fruit (*Solanum lycocarpum*) and small vertebrates (Dietz 1984, Motta-Junior et al. 1996, Aragona & Setz 2001, Motta-Junior & Martins 2002, Jácomo 1999). Medel & Jaksic (1988) and Motta-Junior et al. (1996) pointed out that quantitative studies about the diet of the maned wolf are lacking. Only a few studies, dealing with minimum number of individuals, provided estimates of biomass ingested (e.g., Motta-Junior et al. 1996, Motta-Junior 2000).

The objective of the present study was to quantify the maned wolf’s diet as expressed by: frequency of occurrence as a percentage of total occurrences (Dietz 1984), the minimum number of consumed individuals (Emmons 1987), and the estimated biomass ingested (Emmons 1987, Motta-Junior et al. 1996). We also investigated if there was any seasonality in the consumption of major groups of food items. Additionally, aspects of prey size distribution and the importance of savannah-like habitats as a source of food for the maned wolf were considered.



Figure 1. The maned wolf (*Chrysocyon brachyurus*). © J. C. Motta-Junior.

Material and Methods

Fieldwork was conducted from January 1998 to May 2002 in the 2,300 ha Ecological Station of Itirapina (ESI, 22°15' S; 47°49' W) and adjacent areas, São Paulo State, Brazil. The climate is rainy/tropical, with two distinct seasons (Köppen’s Cwa). The mean annual rainfall is 1,388.7 mm, defining a wet season from October to March (105 to 311 mm monthly), and a dry season from April to September (18 to 85 mm) (RIPASA S/A Meteorological Office, Fazenda Seriema, Brotas, SP). The elevation ranges from 705 m to 750 m (SEMA 2000). The ESI protects one of the last remnants of natural cerrado (mostly as savannahs and grasslands) in São Paulo State. The vegetation includes grassland (“campo limpo”), grassland savannah (“campo sujo”, see Fig. 2, and “campo cerrado”), and savannah (“cerrado”) (see Coutinho 1978). Marshes and gallery forests are also found in the area (Mantovani 1987). Plantations of *Pinus* sp., *Eucalyptus* sp. and *Citrus* sp., besides pastures surround the ESI.



Figure 2. Grassland savannah (“campo sujo”) at ESI. © J. C. Motta-Junior.

Roads and trails were walked and driven bimonthly from 1998 to July 1999 and once a month for the rest of the study period to search for faecal samples of maned wolf. The samples were then taken to the laboratory and washed in water through a fine (1 mm) mesh screen (Emmons 1987) or in a washing machine (e.g., Springer & Smith 1981, Uresk & Sharps 1986). Afterwards, they were oven-dried (at 50°C) during 24-48 hours, stored, and later individually examined.

Remains of teeth, bones, fur, bills, feathers, scales, exoskeletons, and seeds were identified by comparison with a reference collection of the study site available at the Laboratório de Ecologia Trófica (Dep. Ecologia, IB/USP, São Paulo). Specialists from museum and herbaria collections were also consulted for the different groups of prey. The remains of body parts were used to count the minimum number of individual animals consumed (Emmons 1987). The

prey biomass consumption was estimated by counting the number of individuals in the faeces and then multiplying this number by the mean body mass of each prey species at the study site (Emmons 1987, Motta-Junior et al. 1996). Body masses of snakes were estimated by the width of the larger ventral scales found in faeces, which was applied in a regression equation (see Appendix). We assumed complete ingestion of prey when teeth, claws and bones of all parts of the skeleton were found in the faeces, including larger prey as armadillos (Motta-Junior et al. 1996). The average number of seeds and mass per fruit species was compared with the number of seeds in faeces to estimate the number of fruits and their biomass ingested by the maned wolf (e.g., Castro et al. 1994). Prey and fruit mass was obtained in the field with spring scales (1 g). Chi-square goodness-of-fit tests were employed to test for seasonality in the consumption of major food items (see Dietz 1984).

The habitat of each plant and animal consumed was identified by personal observation or literature in order to evaluate the dependence of the maned wolf on savannah species (cf. Motta et al. 1996).

Results and Discussion

Approximately two to four maned wolves, possibly two couples, were utilising the study area as part of their home ranges, as indicated by sightings and indirect evidence such as faeces and tracks during fieldwork.

A total of 325 faeces were collected (193 and 132 from the dry and wet seasons, respectively), yielding 1,054 occurrences of 68 identified prey and fruit items (see Appendix). We believe our sample is representative of the maned wolf's diet in the study site, since 95% of all items were already found among the first 200 faeces. No new food item was added after the analysis of the 305th faeces.

Twenty-four (35.3%) items were plant material and 44 (64.7%) were animal material (see Appendix). By frequency of occurrence, the wolf consumed plant and animal items in similar proportions (49.3% and 50.7%, respectively; Table 1). Even though the sample portrays the diet of a few individuals, these results are in the range shown in other studies (Dietz 1984, Motta-Junior et al. 1996, Motta-Junior 2000, Aragona & Setz 2001), which also described a typically omnivorous diet for this canid. The most consumed items in our study (Table 1) were rodents (22.5%) and miscellaneous fruits (20.6%). In contrast, according to the biomass ingested, the most important items were armadillos (36.2%) and wolf's fruits (19.6%) (Figs. 3 and 4, respectively) (Table 1). Although the most abundant armadillo species at ESI were *Cabassous unicinctus* and *Euphractus sexcinctus* (Bonato 2002), the maned wolf consumed mainly *Dasypus* spp. (see Appendix). It is possible that the low incidence of *C. unicinctus* in the wolf's diet is due to its primarily diurnal habits (Bonato 2002) and its fast-digging ability (Redford



Figure 3. The nine-banded armadillo (*Dasypus novemcinctus*). © J. C. Motta-Junior.



Figure 4. The wolf's fruit (*Solanum lycocarpum*). © J. C. Motta-Junior.

1994). The lack or low consumption of the diurnal-nocturnal *E. sexcinctus* (Bonato 2002) noted at ESI (this study) and reported for other areas (Motta-Junior et al. 1996, Motta-Junior 2000, Belentani 2001) may be explained by an escape strategy that includes mainly running and secondarily digging (Redford 1994). On the other hand, *Dasypus* spp. (Fig. 3) is commonly reported in the maned wolf's faeces, even though they were not frequently found at ESI (Bonato 2002), suggesting higher vulnerability to predation or selection by the wolf.

The maned wolf's diet varied seasonally. While wolf's fruit ($c^2 = 23.3$; $p < 0.001$) and grass leaves ($c^2 = 7.8$; $p < 0.005$) were consumed mainly during the dry season, other fruits ($c^2 = 47.2$; $p < 0.001$) and insects/arthropods ($c^2 = 6.9$; $p < 0.01$) were consumed mainly during the wet season (Fig. 5). Although the availability of food resources was not assessed in the study site, other researchers in Brazilian savannahs reported that fruits and insects are more abundant in the wet season (Dietz 1984, Motta-Junior 2000, Belentani 2001). Thus, the maned wolf appeared to feed opportunistically on these groups also in the study area. The maned wolf seemed to switch from the wolf's fruits to other wild fruits, with fruit in general present in the diet along the whole year (Fig. 5). This fact was also reported by Motta-Junior (2000). The high consumption of grass leaves (12.0% of total oc-

currences), mainly during the dry season, may have a beneficial effect in the digestion process (Dietz 1984), though they were not significant in the biomass analysis (Table 1). All other items were consumed in similar proportion in both seasons (Fig. 5).

In spite of its large body size, the maned wolf consumed mainly small vertebrates between 0.01 and 0.1 kg (44.2% of a total number of 507 individuals), represented mostly by small mammals, which accounted for the bulk of the animal prey (Fig. 6A). This apparent preference for smaller prey could be a result of its solitary hunting strategy and/or due to the most common prey size found in the study site (J. A. Simonetti, pers. comm.). However, the most consumed rodent was *Clyomys bishopi* (277.3 g). This spiny rat (Fig. 7) is reported to be one of the most abundant small mammals in the ESI (Vieira 1997, A. A. Bueno & S. C. S. Belentani, unpublished data), and this may explain the high consumption. Predation on this species by wolves was lower in areas where it was less abundant (Carvalho 1976, Bueno & Motta-Junior, submitted). On the other hand, vertebrates,

mostly armadillos, weighing between 1.0 and 10.0 kg yielded 59.0% from a total of 126,383.4 g (Fig. 6B). The high biomass proportion of armadillos in the maned wolf's diet has already been found in other studies (Motta-Junior et al. 1996, Belentani 2001, Bueno & Motta-Junior, submitted).

Savannah destruction due to farming practices seems to be one of the main causes for the decline of maned wolf populations (Dias 1994, Silva 1994). Road mortality may also be another important cause of non-natural death (Rodrigues et al. 1998), although this has not yet been systematically studied.

Considering only identified items, for which it was possible to determinate their habitats, the animal prey and fruits found in the faeces showed that grasslands and savannahs were the major source of food for this canid, regardless of the level of analysis (Table 2). Despite the use of areas with high degree of disturbance around the ESI, our results indicated that the wolves were foraging mainly in the savannah and grassland remnants. These findings

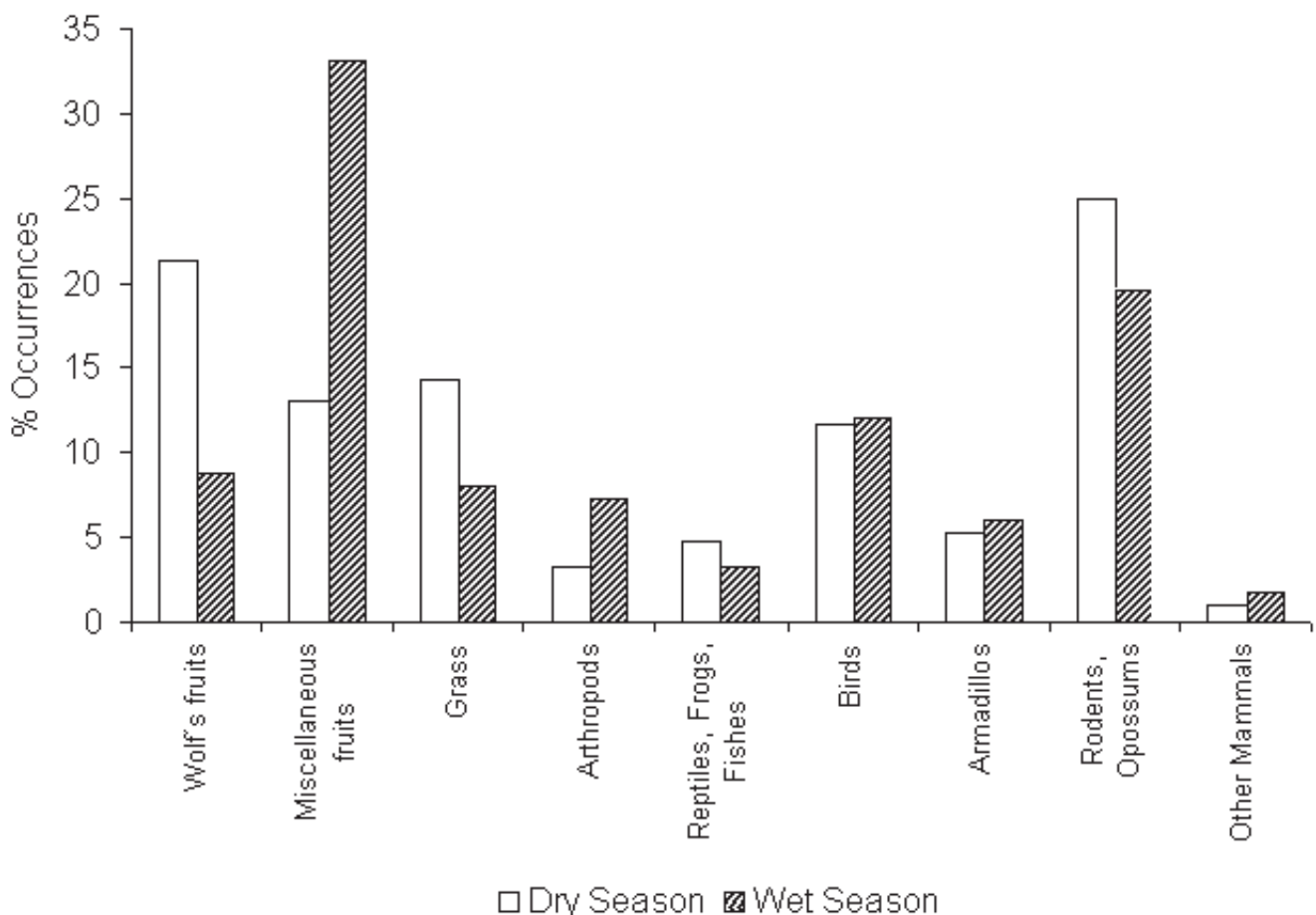


Figure 5. Seasonality in the consumption of major food item groups in the maned wolf's diet by frequency of occurrence, Ecological Station of Itirapina, southeastern Brazil. Values are percentages from 656 occurrences in the dry season and 398 occurrences in the wet season.

Food items	Occurrence	Number	Biomass
Wolf's fruit (<i>Solanum lycocarpum</i>)	16.6		19.6
Miscellaneous fruits	20.6		12.1
Grains	0.1		tr
Grasses and leaves	12.0		0.1
Subtotal Plants	49.3		31.8
Insects and other arthropods	4.8	179	tr
Fishes	0.4	0.8	0.5
Frogs	0.3	0.6	tr
Snakes	3.5	5.7	1.0
Lizards	0.2	0.4	tr
Birds	11.9	179	4.9
Opossums	0.3	0.4	0.8
Armadillos	5.5	8.1	36.2
Rodents	22.5	45.8	16.2
Rabbits	1.0	1.8	4.5
Other mammals	0.3	0.6	4.0
Subtotal Animals	50.7	100.0	68.2
Total (occurrence, number, biomass)	1,054	507	185,323.4

Note: tr –traces, values below 0.05%.

Table 1. Occurrence, number of animal prey and biomass of major groups of food items in the diet of the maned wolf at ESI. Values are percentages. The number of individual fruits consumed was not considered here because of difficulties for comparisons with that of animals. The total value for biomass is in grams.

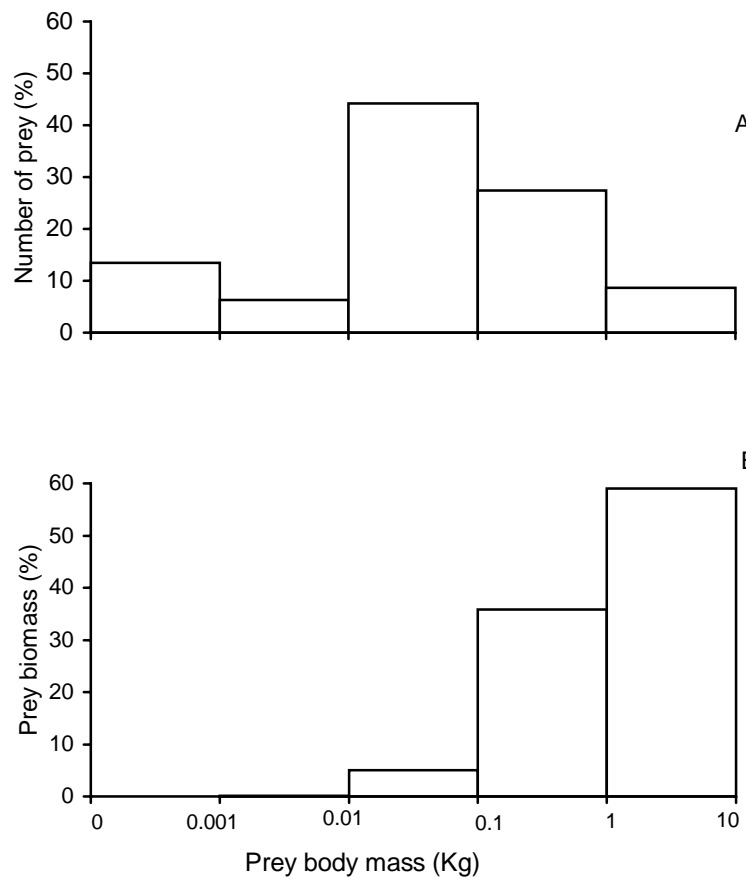


Figure 6. Proportions of number of individuals (A) and biomass (B) of prey represented in faeces, as a function of prey body weight class, in the EIS, southeastern Brazil. Values are percentages from 507 prey individuals and 126,38 Kg of total animal biomass.



Figure 7. The spiny rat *Clyomys bishopi*. © J. C. Motta-Junior.

Habitat	Number of species	Occurrences	Number of individuals	Bio mass
Savannah and Grassland	24 (35.3)	506 (48.0)	214 (42.2)	80,164.5 (43.3)
Savannah and Gallery forest	9 (13.2)	122 (11.6)	49 (9.7)	76,428.9 (41.2)
Disturbed	5 (7.4)	44 (4.2)	13 (2.6)	1,456.7 (0.8)
Unknown	30 (44.1)	382 (36.2)	230 (45.4)	27,273.3 (14.7)
TOTAL	68 (100.0)	1054 (100.0)	507 (100.0)	185,323.4 (100.0)

Table 2. Distribution of prey and fruits found in faeces of the maned wolf by habitat. Data computed from Appendix. Values in parenthesis are percentages.

are in accordance with those from studies in south-eastern and central Brazil (Motta-Junior et al. 1996, Belentani 2001, Bueno & Motta-Junior, submitted), emphasising the high value of savannah and grasslands for the survival of the maned wolf.

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APPENDIX. List of plant and animal items found in the maned wolf's diet at ESI. Numerical data are respectively mean weight (g) of one fruit or individual animal in parentheses; occurrence; number of individual prey for animals; estimated biomass (g) in brackets; and preferred habitat. Abbreviations for habitat: SG - savannah and grassland, FS - gallery forest and savannah/grassland, DT - disturbed, UN - unknown.

Fruits

- Alibertia* sp.^a - (6.9); 6; [421.5]; SG
Anacardium cf. *humile* - (30.0); 1; [30.0]; SG
Andira cf. *humilis* - (20.0); 1; [20.0]; SG
Annona cf. *crassiflora*^a - (1,021.0); 1; [263.6]; SG
Annona sp. - (136.4); 15; [821.0]; UN
Bromelia anthiacantha - (19.0); 30; [3,081.8]; SG
Campomanesia pubescens^a - (2.0); 62; [666.0]; SG
Citrus sp.^a - (128.5); 25; [9,137.5]; DT
Couepia cf. *grandiflora*^a - (13.2); 1; [48.0]; FS
Duguetia furfuracea^a - (75.8); 4; [65.5]; SG
Mangifera indica - (200.0); 1; [200.0]; DT
Melancium campestre^a - (65.4); 4; [19.4]; SG
Psidium guajava - (46.3); 11; [817.6]; FS
Psidium cf. *cinereum* - (4.8); 20; [3,137.8]; SG
Peritassa campestris - (18.3); 10; [1,466.8]; SG

Pouteria torta^a - (15.0); 5; [854.8]; SG
Pouteria cf. ramiflora^a - (14.0); 2; [136.0]; FS
Solanum lycocarpum - (370.0); 175; [36,356.8]; SG
Solanum sp. - (2.4); 1; [22.5]; DT
Syagrus romanzofiana^a - (5.2); 5; [968.8]; FS
Syagrus cf. petrea - (4.7); 10; [267.6]; SG
 Unidentified Palmae - (4.0); 2; [17.0]; UN

Grains

Phaseolus vulgaris - (0.5); 1; [7.0]; DT

Grasses

Poaceae and Cyperaceae^b - 126; [113.0]; UN

Insects and Arthropods

Araneae - (1.0); 1; 1; [1.0]; UN
 Termitidae - (0.08); 1; 5; [0.4]; UN
 Blattidae/*Parahormetica* sp. - (1.8); 7; 6; [10.8]; UN
 Acridoidea - (1.5); 2; 2; [3.0]; UN
 Tettigoniidae/Copiphorinae - (1.0); 2; 3; [3.0]; UN
 Gryllidae - (0.9); 1; 1; [0.9]; UN
 Orthoptera unidentified - (1.0); 6; 6; [6.0]; UN
 Carabidae *Calosoma* sp. - (0.7); 1; 1; [0.7]; UN
 Scarabaeidae/*Dichotomius* sp. - (1.0); 1; 1; [1.0]; UN
 Scarabaeidae/*Bothynus* sp. - (2.0); 6; 12; [24.0]; UN
 Scarabaeidae/*Phanaeus* sp. - (4.0); 1; 1; [4.0]; UN
 Scarabaeidae unidentified - (2.0); 1; 1; [2.0]; UN
 Coleoptera unidentified - (1.0); 8; 8; [8.0]; UN
 Vespidae - (0.02); 5; 36; [0.5]; UN
 Unidentified insects - (1.0); 8; 7; [7.0]; UN

Fishes

Unidentified Fish - (250.0); 4; 4; [1,000.0]; UN

Frogs

Unidentified frogs^c - (13.8); 3; 3; [41.4]; UN

Lizards

Gymnophthalmidae^c - (2.0); 1; 1; [2.0]; SG
 Unidentified small lizard^c - (7.5); 1; 1; [7.5]; UN

Snakes

Unidentified snakes - (4); 36; 29; [1,710.5]; UN

Birds

Rynchotus rufescens - (870.0); 1; 1; [870.0]; SG
 Tinamidae unidentified - (206.3); 4; 3; [619.0]; SG
Mycropygia schomburgkii - (32.0); 4; 3; [96.0]; SG
Gallus gallus^c - (400.0); 16; 13; [5200.0]; DT
Volatina jacarina - (10.0); 4; 4; [40.0]; SG
 Unidentified Emberizidae - (15.0); 4; 4; [60.0]; UN
 Eggs - (10.0); 4; 3; [30.0]; UN
 Unidentified small Passerines - (15.0); 23; 18; [270.0]; UN
 Unidentified small birds - (30.0); 53; 36; [1,080.0]; UN
 Unidentified medium birds - (100.0); 9; 4; [400.0]; UN
 Unidentified large birds - (200.0); 3; 2; [400.0]; UN

Mammals

Cabassous unicinctus - (2,950.0); 3; 3; [8,850.0]; SG
Dasyops cf. novemcinctus - (1,787.5); 42; 25; [44,687.5]; FS
Dasyops cf. septemcinctus^e - (1,045.0); 13; 13; [13,585.0]; FS
Didelphis albiventris - (720.9); 3; 2; [1,441.8]; FS
Bolomys lasiurus - (42.4); 6; 19; [805.6]; SG
Calomys tener - (14.3); 32; 62; [114.4]; SG
Oryzomys cf. subflavus - (74.4); 4; 4; [297.6]; SG
Clyomys bishopi - (277.3); 111; 78; [21,629.4]; SG
Oligoryzomys nigripes - (17.2); 7; 11; [189.2]; SG
Cavia aperea - (390.0); 34; 26; [6,340.0]; FS
 Unidentified small rodents^e - (20.0); 45; 32; [640.0]; UN
Sylvilagus brasiliensis - (933.8); 11; 9; [8,404.2]; FS
 Unidentified medium mammal - (2,500.0); 3; 3; [7,500.0]; UN

Citations: All weights are from field data except where indicated:

(^a) Motta-Junior & Martins (2002); (^b) net weight of ingested grass was estimated by previous known net and dry mass of samples from the field; (^c) Marcio R. C. Martins, pers. comm.; (^d) the larger width of ventral scale from faeces was measured and applied as the independent variable (X) to the regression equation: $\log Y = 2.669 \log X - 1,540$, where Y is the dependent variable body mass ($R^2 = 0.999$; $p < 0.0001$; $N = 5$ snakes collected in the area); (^e) Motta-Junior et al. (1996). References consulted for prey and plant habitats were: Mendonça et al. (1998) and Motta-Junior & Martins (2002) for fruits; Márcio R. C. Martins (pers. comm.) for reptiles; Motta-Junior et al. (1996) for birds; Redford (1994) and Bonato (2002) for armadillos; Eisenberg & Redford (1999) and Motta-Junior et al. (1996) for other mammals.

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