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SHORT COMMUNICATION

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Introduction

Many carnivore species are of conservation concern due to habitat conversion and conflict with humans. Depletion of a carnivore's prey base can reduce its population size and lead to local extinction (Karanth and Chellam 2009). Thus, understanding dietary requirements of carnivores is a prerequisite for their conservation.

The jaguar *Panthera onca* (Linnaeus, 1758) is the largest cat of the American continent. With more than 80

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documented prey species (Seymour 1989), jaguars are opportunistic predators that feed preferably on medium to large prey species (Lopez-González and Miller 2002; Oliveira 2002). The jaguar is classified as 'near threatened' owing to decreasing population trends (IUCN 2011). Its range has reduced by approximately 45 % over the last century (Zeller 2007). Here, we investigate jaguar diet in the Cerrado grasslands of central Brazil, where the species remains little studied and is classified as endangered (Moraes Jr. 2012).

Material and methods

The Cerrado covers 21 % of Brazil; over the last 35 years, more than half has been transformed into cultivated land (Klink and Machado 2005). Emas National Park (ENP) is located in south-western Goiás (18°19′ S, 52°45′ W), in a highly productive agricultural region. Its 1,320 km^2 protect large tracts of grassland plains with patches of shrub fields, marshes and riparian forest. During the wet season (October to March), rainfall averages 1,500 mm. There is very little precipitation during the rest of the year.

We quantified jaguar diet based on 39 genetically identified jaguar scats collected with the aid of scat detector dogs (14 collected by the Jaguar Conservation Fund—JCF—in 2009 (Sollmann 2011) and analysed as described in Roques et al. (2011); 25 collected and analysed as described in Vynne et al. (2011, 2012) between 2004 and 2008) along 3,500 km of transects in ENP. Because yearly sample sizes were too small for separate analysis, we pooled samples across years. Genetic fingerprinting showed that samples belonged to at least 12 individuals (CV and JCF, unpublished data).

We identified non-digested prey remains to the lowest possible taxonomic level using a reference collection (Quadros 2002). For each prey species *i*, we counted the frequency of occurrence in the scats f_i; when a scat sample contained remains of more than one species, these were counted as fractional contributions to the frequency of the respective species (Link and Karanth 1994). We calculated relative scat frequency fr_i as

$$fr_i = f_i \Big/ \sum f.$$

To estimate the contribution of biomass of each species, we applied the method by Wachter et al. (2012) who, based on feeding trials with cheetahs, established a regression formula to calculate biomass consumed per field collectable scat, *y*, as a function of live weight of prey species, *x*, taking into account that this relationship is not linear:

$$y = 2.358 \times (1 - \exp(-0.075x)).$$

Table 1 Prey species identified in 35 jaguar scats from Emas National Park, central Brazil

Species	*f*	fr	MPW (kg)	BPS (kg)	*b*
Tapir	2.00	0.06	239	2.36	0.08
Peccary	2.00	0.06	24.5	1.98	0.07
Giant anteater	26.17	0.74	30.5	2.12	0.76
Agouti	1.17	0.03	2.9	0.46	0.01
Opossum	0.33	0.01	1.25	0.21	<0.01
Domestic cattle	1.00	0.03	175	–	0.05
Capybara	0.50	0.01	50	2.30	0.03
Unidentified felid[a]	1.33	0.04	–	–	–
Unidentified bird/reptile[a]	0.50	0.01	–	–	–

f absolute scat frequency, *fr* relative scat frequency, *MPW* mean prey weight according to unpublished data by the Jaguar Conservation Fund (unpublished data) and Reis et al. (2006), *BPS* biomass consumed per field collectable scat, following Wachter et al. (2012), *b* relative biomass consumed

[a] Not considered in calculations involving biomass because body weight could not be determined

We calculated relative biomass consumed b_i as

$$b_i = fr_i y_i \Big/ \sum fr \times y.$$

We obtained body weight of prey species from field data from ENP (JCF, unpublished data) and Reis et al. (2006). To estimate dietary niche breadth, we calculated Levins' index B (Levins 1968):

$$B = 1 \Big/ \sum b^2.$$

We standardized *B* according to Hurlbert (1978):

$$B_A = (B - 1)/(I - 1),$$

where *I* is the total number of species in the diet. We performed all calculations in the free software R version 2.13.0 (R Development Core Team 2011).

Results

Four scats did not contain identifiable prey remains. In the remaining 35 scats, giant anteater *Myrmecophaga tridactyla* was the dominant prey species, contributing 76 % to the consumed biomass. We also found remains of tapir (*Tapirus terrestris*), capybara (*Hydrochaeris hydrochaeris*), opossum (*Didelphis albiventris*), domestic cattle (*Bos taurus*), peccaries (*Tayassu pecari* or *Pecari tajacu*), agouti (*Dasyprocta* sp.) and unidentified birds/reptiles and felids (Table 1). Since the felid and bird/reptile remains could not be identified to genus level, these were excluded from further analyses. Standardized niche breadth was 0.121.

Discussion

Although the results from our small data set collected across several years and seasons need to be interpreted with care, with over 75 % of consumed biomass giant anteaters seemed the most important prey species of jaguars in ENP. Though large (30 kg), these solitary foragers are well below a jaguar's own body weight and thus unlikely to inflict serious injury, which is one of the main foraging costs for large predators (Berger-Tal et al. 2009). As jaguar population density in ENP is as low as 0.3–0.6 individuals/100 km^2 (Sollmann et al. 2011) and there are 20 to 40 giant anteaters per 100 km^2 (Miranda et al. 2006), they may be sufficiently abundant to become the stock prey of the jaguar.

A strong preference of the giant anteater by the jaguar has not been observed before. In general, jaguar dietary niches are broader than the 0.121 observed in the present study (Leite and Galvão 2002; Núñez et al. 2002; Scognamillo et al. 2003; Azevedo and Murray 2007; Azevedo 2008). Only Foster et al. (2009) observed a similarly narrow niche in undisturbed forests in Belize, where armadillos made the largest contribution to jaguar diet. However, the small sample size in the present study (Foster et al. 2010) and the fact that we excluded unidentified species from niche breadth analysis may have contributed to the narrow niche we observed.

Both tapirs and peccaries made relatively low contributions (6–7 % of consumed biomass) to the jaguar diet in ENP. Most studies report tapirs as an infrequently taken prey (Novack et al. 2005), which may be a consequence of tapirs being larger than the jaguar. In contrast, peccaries are often cited as important prey (Polisar et al. 2003; Azevedo and Murray 2007; Cavalcanti and Gese 2010). The low frequency of occurrence in scats could be a function of the overall small sample size. Alternatively, jaguars may prey less intensely on the group-living peccaries in ENP because of the abundance of the more vulnerable giant anteater. Small mammals (agoutis and opossums) played a secondary role in jaguar diet in ENP, which is expected for this large predator (Lopez-González and Miller 2002).

Giant anteaters have undergone a steady population decline in the region of ENP over the last decades (Collevatti et al. 2007); peccaries are frequently killed in the park's surroundings in retaliation to crop raiding (Jácomo 2004). Since the conservation of large felids depends on the conservation of their prey, these and other prey species should be included in future jaguar research and conservation efforts in ENP.

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