

## Short Communication

### Diet and habitat associations of bush dogs *Speothos venaticus* in the Interior Atlantic Forest of eastern Paraguay

Gerald L. Zuercher, Philip S. Gipson and Osvaldo Carrillo

**Abstract** The diet and habitat associations of bush dogs *Speothos venaticus*, categorized as Vulnerable on the IUCN Red List, are virtually unknown in the wild. In eastern Paraguay, bush dogs occur in the Reserva Natural del Bosque Mbaracayú. The Reserve contains one of the largest remaining fragments of the Interior Atlantic Forest in Paraguay as well as cerrado and grassland habitats. We analysed bush dog faeces to determine their diet. Bush dogs in the Reserve mostly ate vertebrates. Although small mammals (marsupials and rodents)

were the most numerically dominant foods, agoutis *Dasyprocta azarae* and pacas *Cuniculus paca* represented 90.5% of biomass consumed. *Cecropia* fruit was also present in the diet. This is the first documentation of fruit consumption by bush dogs. Signs of bush dogs were detected in all habitats, with the greatest proportion in high forest.

**Keywords** Bush dog, diet, habitat, Interior Atlantic Forest, Paraguay, *Speothos venaticus*.

The bush dog *Speothos venaticus* is categorized as Vulnerable on the IUCN Red List (IUCN, 2003) based on an estimated population of < 10,000 mature individuals, with continuing decline and severe fragmentation (criterion C2a; IUCN, 1994). There is a notable lack of information on their ecology in the wild, and no study of bush dogs has previously been conducted in any part of their range (Macdonald, 1996). Bush dogs occur from eastern Panama and northern South America south through Paraguay and north-eastern Argentina (Redford & Eisenberg, 1999) with isolated populations possibly occurring west of the Andes Mountains in Colombia and Ecuador (Tirira, 2001). Fossil deposits from the Lagoa Santa Caves in Brazil indicate bush dogs have existed in South America since at least the late Pleistocene (Berta, 1984).

The only population of bush dogs known to occur within a protected area in Paraguay is in the Reserva Natural del Bosque Mbaracayú (Mbaracayú Forest Nature Reserve) in the Interior Atlantic Forest ecoregion in the east (Yahnke *et al.*, 1998). We studied bush dogs

in the Reserve to evaluate their diet and habitat associations. The Reserve was established in 1991 and is now the centerpiece of a Biosphere Reserve (Reserva de la Biósfera del Bosque Mbaracayú), recognized in 2000 by UNESCO through the Man and the Biosphere Program. Most areas surrounding the Reserve have been converted into agricultural land.

Modified carnassial teeth, similar to those found in African wild dogs *Lycaon pictus* and Asian dholes *Cuon alpinus*, suggest bush dogs are probably hypercarnivorous (having diets that consist almost entirely of animal flesh; Van Valkenburgh, 1991), if not exclusively carnivorous. They are thought to commonly hunt large caviomorph rodents such as pacas *Cuniculus paca* and agoutis *Dasyprocta* spp. (Deutsch, 1983), and these prey species comprised 53 and 28%, respectively, of observations of bush dogs hunting reported by indigenous peoples in central-western Amazonia (Peres, 1991). Local and indigenous peoples have reported that bush dogs, despite weighing only 5–7 kg, take prey considerably larger than themselves, including capybaras *Hydrochaeris hydrochaeris*, rheas *Rhea americana*, and deer *Mazama* spp., by hunting in packs (Peres, 1991; Strahl *et al.*, 1992). Wallace *et al.* (2002) documented an attempt by six bush dogs to kill a tapir *Tapirus terrestris*. Bush dogs in captivity readily consume small mammals (i.e. rats *Oryzomys* spp. and *Proechimys* spp., rabbits *Sylvilagus brasiliensis*, and opossums *Didelphis* spp.; Van Humbeck & Perez, 1998).

Faeces from bush dogs at Mbaracayú Forest Nature Reserve were opportunistically collected between late June and early September of 1999, 2000 and 2001, with

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3–5 days spent searching for faeces in seven predetermined areas in all 3 years. Members of the Arroyo Bandera Aché village also collected carnivore faeces from the Reserve and provided one sample identified as originating from a bush dog. Faecal collection procedures and molecular analyses are described by Zuercher *et al.* (2003).

After molecular identification, samples were transferred to nylon bags, washed twice in a washing machine, and air dried. Contents were separated into bones, scales, hair, feathers, teeth, shells and vegetation. Separated contents were identified to the species level when possible, or otherwise to genus. Percentage occurrence of each food item in the faeces and the proportion of the total diet that each food item represented were estimated. Mean weight of vertebrate prey was estimated (Jaksic, 1983) as a measure of biomass consumed. Mass estimates for pacas (7.5 kg) and agoutis (2.7 kg) were obtained from Redford & Eisenberg (1999). Small mammals, which could not be identified to the species level, were collectively estimated at 250 g, tinamous *Crypturellus tataupa* at 0.8 kg, and reptiles at 100 g.

Eleven faecal samples originating from bush dogs were collected from the Reserve and positively identified by molecular analyses (Zuercher *et al.*, 2003). Six of these contained food remains from multiple sources and the remaining five contained remains from a single food item. Vertebrate prey represented 17 of 19 identified food items and mammalian prey comprised the largest portion (Fig. 1). Small mammals were numerically the most common mammal prey, followed by agouti and paca. No other mammal prey was detected. Avian prey, exclusively tinamous, represented the next most common food item, followed by reptiles, terrestrial invertebrates, and *Cecropia* fruit, which all occurred equally. Mean vertebrate prey weight was 2.2 kg.

Our examination of bush dog faeces revealed a diet consisting largely of vertebrate prey, supporting the idea of hypercarnivory by the species (Van Valkenburgh, 1991). Although paca and agouti represented only 37% of identified food items, they constituted *c.* 91% of the vertebrate biomass eaten. That these species were the most important contributor, in terms of biomass, to bush dog diets in the Reserve agrees with reports that caviomorph rodents are primary food sources for bush dogs (Peres, 1991).

Despite the common occurrence of small mammals in the diet, they contributed little to total vertebrate biomass consumed. Consumption of fruit by bush dogs has not been previously documented, and the presence of *Cecropia* suggests bush dogs may take advantage of seasonally available fruits. This could, however, be an opportunistic or incidental event, as also reported for neotropical felids (Oliveira, 1994).

Mean weight of vertebrate prey was 39% of bush dog average body mass in Paraguay (*c.* 5.5 kg; Redford & Eisenberg, 1999), which is high compared to other similar-sized neotropical predators (Oliveira, 1994, 2002) and similar to the much larger and strictly carnivorous puma *Puma concolor* and jaguar *Panthera onca* (39.2 and 61.4 kg, respectively) (Oliveira, 1994, 2002). This suggests that bush dogs may be ecologically intermediate between large felids and smaller carnivores.

Bush dogs occur in a variety of habitats including Interior Atlantic Forest, tropical rainforest, wet savannah, cerrado, Chaco and steppe. They have often been observed in lowland (< 1,500 m) forested habitats including primary and gallery forest (Defler, 1986), semi-deciduous forest, and seasonally flooded forest (Aquino & Puertas, 1997). Observations have also been made in cerrado habitat in Brazil (Oliveira, 1993; Silveira *et al.*, 1998) and Paraguay (Zuercher & Villalba, 2002), Chaco

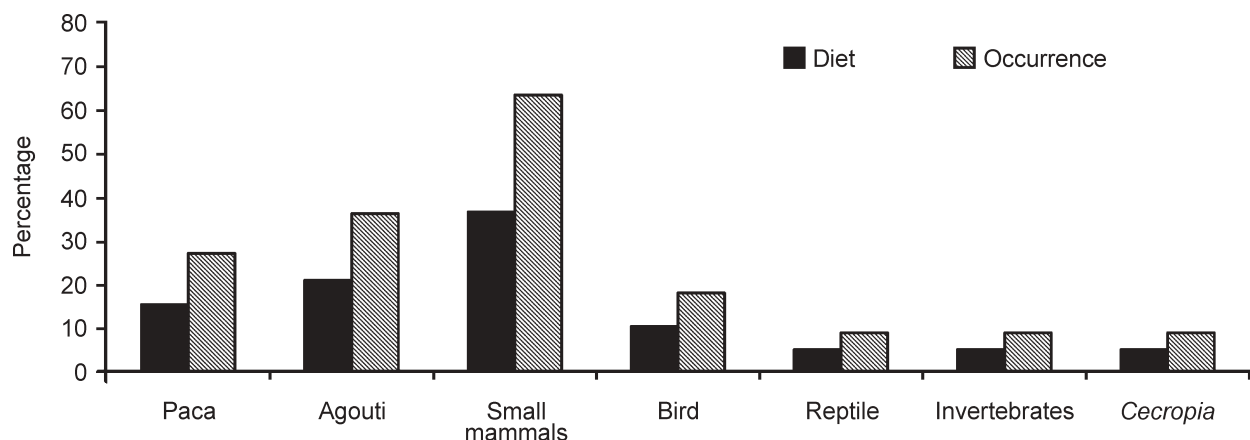


Fig. 1 The percentage that each of seven food items represents in the diet (number of items of a specific food / total number of food items) and percentage occurrence (number of faeces in which a specific food item was detected / total number of faeces) as determined from collected faeces of bush dogs at Mbaracayú Forest Nature Reserve.

in Paraguay (N. Neris, pers. comm.), and pantanal (wet savannah) edge/riparian areas (Strahl *et al.*, 1992). Although bush dogs are generally considered forest-dwellers, they have been observed in open habitats as far as 5.7 km from the nearest forest (Silveira *et al.*, 1998).

Mbaracayú Forest Nature Reserve has three major forest habitats (high, medium, and low; Marín *et al.*, 1998) that each cover *c.* 30% of the Reserve, with most of the remaining 10% being cerrado and grasslands (FMB, 1997). For each detected bush dog sign (i.e. faeces, tracks, dens) the habitat and location (with a Global Positioning System) was noted. A Geographical Information System was used to compare the proportion of signs in the four major habitats with the availability of each habitat type within the Reserve. The null hypothesis of non-selective habitat associations of bush dogs was tested with a *G* test (Zar, 1996).

Thirty-four bush dog signs were detected, of which 11 were faeces, 22 were tracks and one a den. Habitat associations of signs differed significantly from the available habitat ( $G = 10.21$ ,  $0.025 > P > 0.001$ ,  $df = 3$ ). The majority of signs were detected in forest (Fig. 2). This pattern agrees with most reports for this species (Aquino & Puertas, 1997; Redford & Eisenberg, 1999). Bush dogs are also known to occur in open habitats such as savannah (Defler, 1986) and cerrado (Oliveira, 1993; Silveira *et al.*, 1998; Zuercher & Villalba, 2002).

Within forest proportionally more signs occurred in high forest and fewer in medium and low forest (Fig. 2). Caution should, however, be exercised in interpreting the relatively high occurrence of bush dog signs found in forest. The sparse vegetation on the floor of high forest may result in higher detectability of signs. High forest contains the tallest canopy within the Reserve, being 20 m on average and with some trees  $> 30$  m (Marín *et al.*, 1998); the typically dense canopy results in a relatively sparse ground cover. Medium and low forests are characterized by shorter trees with less dense canopy and more understorey vegetation (Marín *et al.*, 1998).

Our limited encounters with bush dog signs over 3 years in Mbaracayú Forest Nature Reserve support suggestions (Zuercher *et al.*, 2004) that bush dogs are rare or are at least rarely encountered. Our data suggest that bush dogs in the Reserve have relatively general diets and are able to utilize a variety of habitats. These findings should be considered in future conservation planning of Interior Atlantic Forest in eastern Paraguay. More detailed investigations of diet and habitat use by bush dogs in both this Reserve and other areas are needed.

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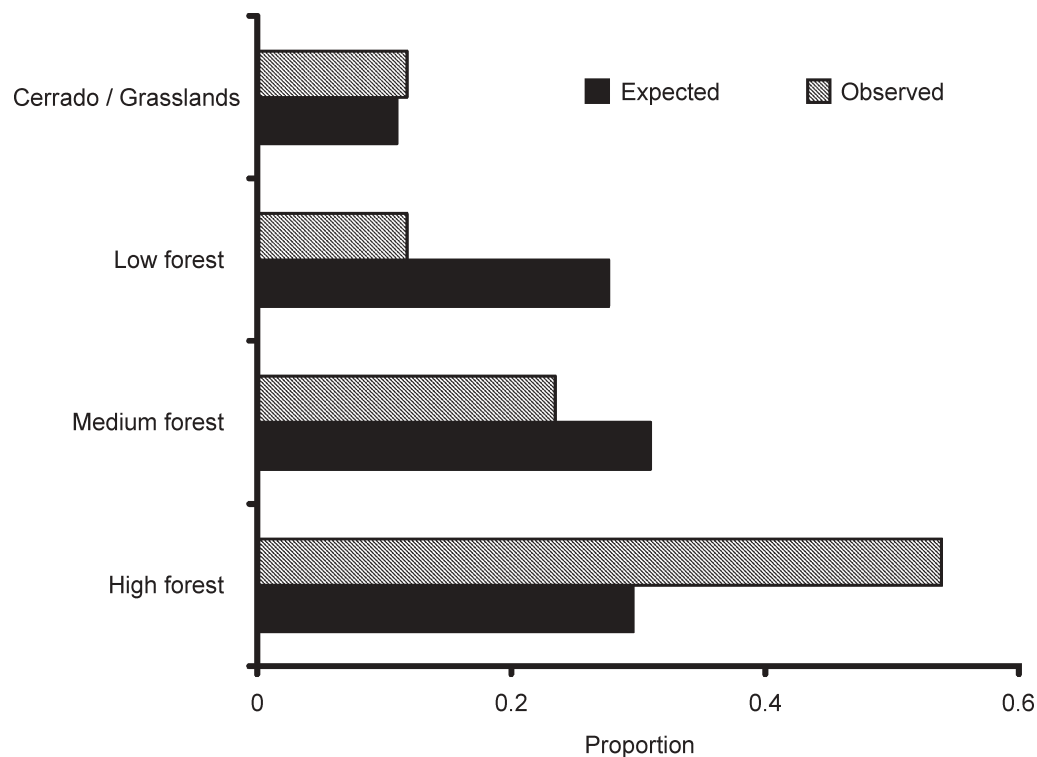


Fig. 2 Proportion of observed bush dog signs (faeces, tracks and den site) by habitat type relative to expected encounters based on a uniform distribution within available habitat types in Mbaracayú Forest Nature Reserve.

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