

Distribution, habitat utilization and conservation of the Vulnerable bush dog *Speothos venaticus* in northern Brazil

T A D E U G . D E O L I V E I R A

Abstract The bush dog *Speothos venaticus* remains one of the lesser-known Neotropical canids. To understand better the species' natural history and conservation requirements an assessment was made of its distribution and habitat use, and relevant conservation issues, in northern Brazil, using museum collections, field observations and published literature. The Parnaíba River and the Cerrado biome comprised the eastern limit of an apparently patchy distribution in northern Brazil. In addition to making use of lowland and pre-montane rainforests and savannahs, bush dogs were found in highly disturbed areas. The latter finding is unexpected and contrary to previous assumptions. Habitat loss, prey depletion and disease transmission from domestic animals appear to pose the main threats to the bush dog's long-term conservation. Although there are considerable tracts of protected areas in the region, their efficacy for bush dog conservation remains questionable.

Keywords Brazil, bush dog, canid, distribution, habitat, *Speothos venaticus*.

Introduction

The bush dog *Speothos venaticus* is one of the lesser-known Neotropical canids. Although it has been the subject of several captive behavioural studies (Kleiman, 1972; Brady, 1981; Biben, 1983; Macdonald, 1996) only two ecological studies have been conducted in the wild (Zuercher et al., 2005; E. Lima & J.C. Dalponte, pers. comm.). The majority of information comes from scattered incidental observations of predatory behaviour (Peres, 1991; Aquino & Puertas, 1997; Wallace et al., 2002), group size (Dalponte, 1995; Aquino & Puertas, 1997; Silveira et al., 1998), and presence (Strahl et al., 1992; Silva & Soares, 1999; Barnett et al., 2001). The bush dog is categorized as Near Threatened globally (IUCN, 2008) but Vulnerable in Brazil (Oliveira & Dalponte, in press) and regionally Endangered in Maranhão state, northern Brazil (Oliveira, 2007), in particular because of high rates of habitat loss and fragmentation in eastern Amazonia (INPE, 2008).

Although historically reported from eastern Panama south through to south-eastern Brazil, eastern Paraguay

and north-eastern Argentina, the actual distribution of the species is unclear. Current distribution maps lack exact locations (Ginsberg & Macdonald, 1990; Eisenberg & Redford, 1999) and may overestimate or, conversely, show gaps in the species' distribution (Emmons & Feer, 1997), as appears to be the case in eastern Amazonia.

Given the scarcity of information on the distribution and natural history of the bush dog I report here a test of the hypotheses that the species is almost exclusively associated with conserved areas, as indicated in earlier literature, and that, as widely assumed, it is found throughout all of northern Brazil. I also evaluated the role that the region's conservation units and the bush dog's biology could play in the species' conservation.

Methods

The areas of northern Brazil considered in this analysis include the states of Amapá, Pará, Maranhão and Tocantins, especially that part east of the Tocantins River (Fig. 1). The majority of this region is covered by both disturbed and undisturbed Amazon forest, with mangroves and other coastal vegetation, savannah in the south and east, and transitional areas between (IBGE, 1993).

I used three sources of information. Firstly, I located museum specimens in the Museu Paraense Emílio Goeldi (Belém, Brazil) and Smithsonian National Museum of Natural History (Washington, DC, USA). Secondly, during 1991–2007 field observations were made sporadically throughout eastern Amazonia and adjacent areas in Maranhão state by myself, other biologists, and/or knowledgeable local people. Biologists who contributed information had previous experience with carnivores. Information from knowledgeable local people was included only from those who made a precise morphological description followed by correct identification of plates or photographs and could provide information on bush dog biology (e.g. 'the bush dog that hunts in packs pursuing paca, agouti and deer'). Thirdly, I reviewed the literature for additional locations. Where possible, estimated geographical coordinates were assigned to each reported location, and otherwise the municipal coordinates were used. However, the habitat described was always that of the observation location. For museum specimens habitat type was determined using Brazil's most recent vegetation map (IBGE, 1993) and was assumed to come from undisturbed areas.

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Received 22 December 2007. Revision requested 16 February 2008.
Accepted 21 May 2008.

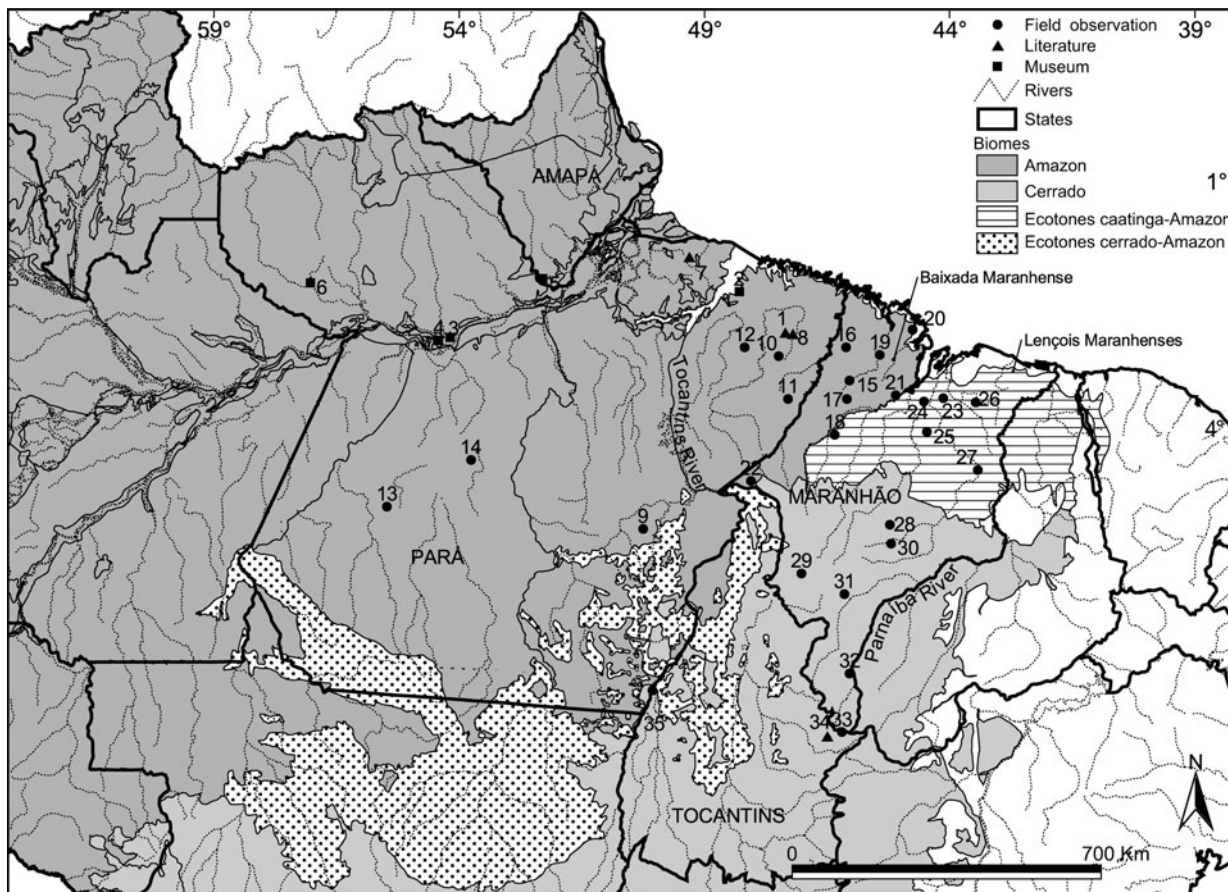


FIG. 1 Distribution of the bush dog in northern Brazil, illustrating the locations of field observations and records in the literature and in museums (the numbers correspond to the numbered localities in Table 2).

The impact of six human activities and one natural effect on bush dogs was assessed (Table 1; Oliveira, 1998, 2007). Each impact was ranked as: high negative, low/moderate negative, no effect/not applicable, unknown, uncertain, and positive. To evaluate each impact factor, information on species biology and conservation (Oliveira, in press) were associated with data gathered in the states of Pará and Maranhão. These areas ranged from highly impacted to pristine, mostly within Amazonia but also in savannah.

Results

Distribution

The distribution of bush dogs in northern Brazil is widespread but patchy. The majority of the 35 locations obtained were in eastern Amazonia, with a few in the Cerrado biome characteristic of central Brazil (Table 2). No records were found for the Parnaíba Delta region or the adjoining sand dune formations of Lençóis Maranhenses (north-eastern Maranhão). The species also appears to be absent from most of the floodplains of Baixada Maranhense. The Parnaíba River and the savannahs therefore appear to be the eastern limit of bush dog distribution in northern Brazil (Fig. 1), and

thus the hypothesis that the bush dog is found throughout all of northern Brazil is refuted.

Habitat association

The majority of records were from undisturbed lowland terra firme forest but also included pre-montane forest, savannah and disturbed areas (Table 2). Excluding museum localities, c. 43% of records were from impacted areas. In

TABLE 1 Factors affecting bush dogs in northern Brazil (modified from Oliveira, 2007).

Factors	Impact
Anthropogenic	
Deforestation/habitat loss	High
Timber exploitation	Low/moderate
Habitat alteration	Low/moderate
Poaching	No effect
Predator control	No effect
Human encroachment	
Diseases	High
Hunting of prey	High
Natural	
Competition with other carnivores	Possibly high

TABLE 2 Location and habitat type for bush dogs in northern Brazil (Fig. 1).

Locality, state	Coordinates	Habitat ¹	Source ²
1. Km 97 Belém-Brasília highway, Pará	02°10'S 47°35'W	Lowland rainforest	Carvalho & Toccheton (1969)
2. Aurá River, near Belém, Pará	01°26'S 48°29'W	Lowland rainforest	MPEG 1778, 1780
3. Taperinha, Pará	02°2'S 54°18'W	Lowland rainforest	MPEG 5614, 5615, 8791, 8793
4. Santarém, Pará	02°26'S 54°42'W	Lowland rainforest	MPEG 1038, 1042
5. Jari River, Amapá	01°00'S 52°30'W	Lowland rainforest	MPEG 317, 1037
6. Cachoeira Porteira, Mapuera River, Oriximiná, Pará	01°08'S 57°04'W	Lowland rainforest	MPEG 13112, USNM 546298
7. Igarapé Peixe Boi, Anajás, Marajó Island, Pará	00°56'S 49°32'W	Lowland rainforest near fields	Silva & Soares (1999)
8. Iritiua, Pará	02°13'S 47°20'W	Moderately disturbed lowland rainforest	Lopes & Ferrari (2000)
9. Carajás, Pará	06°10'S 50°25'W	Pristine/lightly disturbed pre-montane rainforest	This study
10. Capim River, Paragominas, Pará	02°58'S 47°48'W	Highly disturbed rainforest/pasture	This study
11. Km 30 Paragominas, Pará	03°45'S 47°30'W	Disturbed lowland rainforest	This study
12. Tomé Açu, Pará	02°40'S 48°18'W	Disturbed lowland rainforest	This study
13. Jamanxim National Park, Pará	05°39'S 55°28'W	Pristine/lightly disturbed lowland rainforest	R. de Paula, pers. comm.
14. Terra do Meio Ecological Station, Pará	04°41'S 53°45'W	Pristine/lightly disturbed lowland rainforest	R. de Paula, pers. comm.
15. Alto Turiaçu Indian Reserve-A, Maranhão	03°07'S 46°04'W	Pristine/lightly disturbed lowland rainforest	This study
16. Alto Turiaçu Indian Reserve-B, Maranhão	02°40'S 46°12'W	Pristine/lightly disturbed lowland rainforest	This study
17. Caru Indian Reserve, Maranhão	03°45'S 46°09'W	Pristine/lightly disturbed lowland rainforest	This study
18. Near Nova Vida (Buriticupu), Maranhão	04°18'S 46°35'W	Lightly disturbed lowland rainforest	This study
19. Nova Olinda, Maranhão	02°55'S 45°43'W	Lightly disturbed lowland rainforest	G.S. Sousa, pers. comm.
20. Near Uru River (Miritiua), Maranhão	02°02'S 44°45'W	Secondary forest/seasonally flooded grasslands	R.R. Veloso Jr, pers. comm.
21. Pindaré Indian Reserve, Maranhão	03°37'S 45°10'W	Highly disturbed babassu palm forest	P. Dias, pers. comm.
22. Vila Nova dos Martírios, Maranhão (Bico do Papagaio)	05°12'S 48°05'W	Highly disturbed lowland rainforest/ <i>Eucalyptus</i> plantation/pasture	This study
23. Pirapemas, Maranhão	03°43'S 44°13'W	Disturbed secondary forest/babassu palm forest	This study
24. Conceição do Lago Açu, Maranhão	03°50'S 44°53'W	Disturbed secondary forest/babassu palm forest	This study
25. Near Bacabal, Maranhão	04°12'S 44°47'W	Secondary forest/babassu palm forest	J. Silva Jr, pers. comm.
26. Chapada Limpa, Maranhão	03°31'S 43°28'W	Lightly disturbed swamp forest/scrub-open woodland savannah (cerrado sensu stricto)	A.C. de Brito, pers. comm.
27. Inhamum Municipal Park (Caxias), Maranhão	04°54'S 43°26'W	Scrub-open woodland savannah (cerrado sensu stricto)	This study
28. Near Papagaio, Barra do Corda, Maranhão	06°02'S 45°22'W	Disturbed deciduous forest	This study
29. Chapada das Mesas National Park, Maranhão	07°01'S 47°02'W	Lightly disturbed scrub-open woodland savannah (cerrado sensu stricto)/gallery forest	This study

Table 2 (Continued)

Locality, state	Coordinates	Habitat ¹	Source ²
30. Mirador State Park, Maranhão	06°40'S 45°20'W	Moderately disturbed scrub-open woodland savannah (cerrado sensu stricto)	This study
31. Gerais de Balsas, Maranhão	07°43'S 46°15'W	Scrub-open woodland savannah (cerrado sensu stricto)	F. Rodrigues, pers. comm.
32. Pedra Furada River, Serra do Penitente, Maranhão	09°05'S 46°04'W	Scrub-open woodland savannah (cerrado sensu stricto)	This study
33. Nascentes do Rio Parnaíba National Park, Tocantins	10°25'S 46°20'W	Scrub-open woodland savannah (cerrado sensu stricto)	B. Britto, pers. comm.
34. Jalapão State Park, Tocantins	10°22'S 46°31'W	Scrub-open woodland savannah (cerrado sensu stricto)	Arruda & Behr (2002)
35. Cantão State Park, Tocantins	09°40'S 50°06'W	Amazon forest with savannah influence	L. Silveira, pers. comm.

¹Habitat was considered pristine unless noted otherwise

²MPEG, Museu Paraense Emílio Goeldi, Belém, Brazil; USNM, Smithsonian National Museum of Natural History, Washington, DC, USA

eastern Amazonia these included heavily logged and fragmented forest, *Eucalyptus* plantation, and cattle-pasture mosaic in Maranhão's Bico do Papagaio region (with one live-captured specimen) and heavily logged forest patches and pasture by the Capim River in Paragominas and Tomé Açu. In both areas pristine or well-preserved forests no longer exist in or around the vicinity, and thus the hypothesis that the bush dog is almost exclusively associated with conserved areas is refuted.

There were also records from babassu palm *Orbignia phalerata* forests (anthropogenic formations dominated by these palms). Records also exist in a late secondary forest/babassu palm forest area in a densely populated and disturbed region around Bacabal in central Maranhão, a disturbed secondary forest/babassu palm forest mosaic around Pirapemas and Conceição do Lago Açu, and a highly disturbed babassu palm forest in the Pindaré Indian Reserve. The observation in Papagaio was made in a disturbed deciduous forest, whereas in Mirador State Park, an area of moderate to highly disturbed savannah, a pack of bush dogs was seen using an armadillo burrow as a den for 2 years. These are the first reports of bush dogs using highly disturbed habitats.

In Maranhão bush dogs were absent from mangrove forests and coastal vegetation, as well as from most of the Baixada Maranhense floodplains. In the 1970s an experienced hunter reported bush dogs in the Nova Olinda area, which is located in the border area of the Amazonian rainforest and Baixada floodplains (a mosaic of Amazonian forest and seasonally flooded grasslands). Recent surveys found evidence of bush dogs in only one area in the floodplains region of Baixada Maranhense (R.R. Veloso Jr, pers. comm.).

Conservation issues

Bush dogs are rare throughout the region surveyed. Deforestation, and hence habitat loss (Oliveira, 1998, 2007) and

anthropogenic impacts (infectious diseases from domestic dogs and hunting for prey) appear to be the main threats to the bush dog in the states of Pará and Maranhão (Table 1). Poaching and predator control to protect livestock does not seem to be a current threat. Neither commercial use nor use as pets was detected. There was a single instance of an individual killed, for no specific reason, after being detected by group vocalizations. Competition with other carnivores has a potential negative impact.

In northern Brazil bush dogs have been recorded in or adjacent to some protected areas (Arruda & Behr, 2002; Oliveira & Dalponte, in press). Of these the most important for bush dog conservation in the rainforest is the area around Serra dos Carajás (Fig. 1, location 9), totalling c. 27,280 km², and the interconnected mega-reserves that form the Calha Norte corridor, totalling > 167,000 km² (CI-Brasil, 2006), because of their size, good habitat quality, and low human pressure. In the savannah the area around Nascentes do Rio Parnaíba National Park (Fig. 1, locations 33 & 34), totalling c. 15,000 km², appears to be the most important in the Cerrado.

On the northern savannahs the main areas for bush dog conservation are Mirador State Park (5,000 km²) and Nascentes do Rio Parnaíba National Park/Tibagi Ecological Station/Jalapão State Park, which forms a total protected area of c. 15,000 km².

Discussion

Distribution and habitat association

The eastern limit of the bush dog's distribution in northern Brazil (Fig. 1) differs from previously published distribution maps (Ginsberg & Macdonald, 1990; Eisenberg & Redford, 1999), which often include the entire north-east of Brazil. No records or specimens have, however, ever been reported in the xeric north-east (Mares et al., 1985; Willig & Mares, 1989).

The absence of bush dogs from almost all of the floodplains of Baixada Maranhense contrasts with its occurrence in the floodplains of the Brazilian Pantanal (Oliveira, in press; Oliveira & Dalponte, in press). However, this absence could be a consequence of a long history of human occupation and subsequent habitat degradation and prey depletion.

In Venezuela bush dogs occur in tropical and pre-montane humid and very humid forests (Bisbal, 1989) and in Guyana the species' habitat range includes scrub forest, evergreen montane forest, scrub savannah and lowland rainforest (Barnett et al., 2001). Emmons & Feer (1997) stated that most bush dog records were for dry forests and rainforests near savannah. Langguth (1975) considered the species primarily a forest dweller that visits open areas on the edge of forests. The species' habitat (consisting of open and closed vegetation) is similar in the Interior Atlantic Forest and Cerrado of eastern Paraguay (Zuercher & Villalba, 2002; Zuercher et al., 2005). Although undoubtedly associated with forests (Langguth, 1975; Bisbal, 1989; Dalponte, 1995) bush dogs have been recorded in more open habitats in Brazil and Paraguay (Silveira et al., 1998; Zuercher & Villalba, 2002). Within the Cerrado biome in Brazil they have been found mostly in gallery forests (Dalponte, 1995; Eisenberg & Redford, 1999) but also far from forest cover, in open woodland savannah (cerrado sensu stricto; Oliveira, 1996; Silveira et al., 1998). The species' association with watercourses suggested by some authors (Langguth, 1975; Strahl et al., 1992) appears to be correct for all reported records in northern Brazil. This is not surprising as the semi-webbed feet of bush dogs appear to be an adaptation for swimming and indicate that watercourses are not a barrier to movement (Strahl et al., 1992). However, there are also records of bush dogs far from watercourses (Silveira et al., 1998).

Although a recent survey obtained unconfirmed information about the species in the semi-arid thorny scrub of the caatinga (central Bahia state; C. Campos, pers. comm.) there are no other records of bush dogs in this biome (Mares et al., 1985; Willig & Mares, 1989). The closest location to this semi-arid environment with confirmed records of bush dogs is Chapada Diamantina National Park, a mosaic of savannah, semi-arid scrub and deciduous forest in central Bahia (R. Leite, pers. comm.).

Conservation issues

The bush dog appears to be rare in northern Brazil, as it is across its entire range (Strahl et al., 1992; Zuercher et al., 2004). Although no threats, with the possible exception of habitat encroachment, have been previously described for this canid (Ginsberg & Macdonald, 1990), exposure to infectious diseases from domestic dogs, as a result of human encroachment, could affect bush dogs because they appear to be highly susceptible (Oliveira, in press). Canine distemper virus, canine parvovirus and rabies can cause popula-

tion declines and even local extinctions of wild canids and other carnivores (Funk et al., 2001). Such epidemics may have been responsible for the temporary disappearance of short-eared dog *Atelocynus microtis* during 1970–1987 in the Manu area of Peru (Leite-Pitman & Williams, 2004). Similarly, in the late 1980s in Mirador State Park, Brazil, an epidemic may have caused a population crash of crab-eating zorros *Cerdocyon thous* (Oliveira, 1996). Habitat alteration was originally thought to have a high negative impact on the bush dog (Oliveira, 1998) but the records presented here suggest the species is more resilient to human disturbances than previously thought.

Conservation implications of bush dog biology

Although knowledge of bush dog diet is largely anecdotal, they are considered highly carnivorous, with large rodents being their main prey. In bush dog scats from the dry season in eastern Paraguay 63% contained large rodents (Azara's agouti *Dasyprocta azarae* and paca *Agouti paca*) and 64% small mammals (Zuercher et al., 2005). In the savannahs of Mato Grosso, Brazil, a radio-tracked pack is preying heavily on armadillos *Dasyopus novemcinctus* (E. Lima & J.C. Dalponte, pers. comm.). These findings support reports from local people about the bush dog's diet (Peres, 1991; Oliveira, in press). Even larger prey, such as deer *Mazama* spp., capybara *Hydrochaeris hydrochaeris* and peccaries *Tayassu* spp. may be predated (Wallace et al., 2002). There are observations of two dogs chasing black-rumped agouti *Dasyprocta prymnolopha* and paca, and a pack of six chasing and killing an adult paca (J. Silva Jr, pers. comm.; P. Dias, pers. comm.).

Large rodents and armadillos are important in the diets of jaguar *Panthera onca*, puma *Puma concolor* and ocelot *Leopardus pardalis* (Oliveira, 2002a; Moreno et al., 2006; Oliveira et al., in press) and thus competitive intra-guild interactions could affect bush dogs. Prey availability may possibly be more important for long-term bush dog conservation than habitat integrity per se, as noted for other carnivores (Fuller & Sievert, 2001; Oliveira et al., in press). In Paraguay the mean weight of the vertebrate prey of bush dogs is 2.2 kg (Zuercher et al., 2005). This is c. 40% of the species' body mass, a unique feature for a c. 6 kg carnivore. The hyper-carnivorous diet of bush dogs therefore appears to be more similar to the diets of larger sympatric felids than to the diets of sympatric canids (short-eared dog, crab-eating zorro, maned wolf *Chrysocyon brachyurus*, and hoary fox *Pseudalopex vetulus*), which all have omnivorous diets. The preliminary minimum home range estimate for a radio-tracked bush dog pack is > 100 km² (E. Lima & J. Dalponte, pers. comm.), which is large compared to that of hyper-carnivorous, equivalent-sized, Neotropical felids (Oliveira et al., in press). If such large home ranges are usual, then huge areas will be needed for long-term conservation of the bush dog.

Protected areas

Within the states of Amapá, Pará, Maranhão and northern Tocantins there are 18 protected national parks and strictly protected areas encompassing c. 145,056 km² (> 477,000 km² if protected areas that allow resource use, and indigenous lands, are included; IBAMA, 1995; CI-Brasil, 2006). However, bush dogs have been reported in only nine of these areas. Additionally, because the bush dog appears to be rare everywhere, it is unlikely that any of these areas, if isolated, could maintain viable populations in the long-term. However, the areas of Calha Norte, south-western Pará (Carajás) and the northern savannah conservation block, considered important for jaguar conservation because of their size and habitat integrity (Oliveira, 2002b), are important for bush dog conservation.

Protected areas large enough to maintain jaguars and pumas will probably not be able to support viable populations of a smaller competitor such as the bush dog (Woodroffe, 2001; Oliveira et al., in press). The latter would have to range more widely to acquire the necessary resources and, thus, live at lower densities. Therefore no conservation units could maintain, if isolated, long-term viable populations of this canid.

Current conservation measures for bush dogs in Brazil exist solely on paper. They are protected by the native wildlife law and the threatened species law but no specific conservation action has ever been taken. The captive population in Brazil is small, with only 22 specimens in five institutions, and is not reproducing adequately (Ramos et al., 2003). Additional research on the species' ecological and conservation needs, especially those related to density and area requirements, associated with stronger environmental actions to guarantee the effective protection of reserves are needed to develop a conservation strategy for the species throughout Brazil. As there is insufficient information available on this naturally rare canid, integrated multidisciplinary studies on all aspects of the species' natural history throughout its wide geographic range are required to develop a conservation action plan.

Acknowledgements

I greatly appreciate the invaluable comments on earlier versions of the manuscript by Karen DeMatteo, Gerald L. Zuercher, Flávio H.G. Rodrigues, Renata Leite-Pitman and two anonymous reviewers. I also thank the field information provided by Geraldo Sousa, José de Sousa e Silva Jr, Roberto Rodrigues Veloso Jr, Alexandre Caminha de Brito, Bernardo Britto and Paulo Adriano Dias, and Rogério Cunha de Paula for the map. Logistical support in several areas was provided by CENAP-ICMBio and Instituto Pró-Carnívoros.

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Biographical sketch

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