

## LETTER FROM THE CONSERVATION FRONT LINE

## Savannah for sale: is there hope for neotropical biodiversity on private, Brazilian properties?

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Brazil is a mega-diverse country. While many national and international conservation research programs and government policies are focused on tropical forests in Brazil (Plotkin, 2020), few efforts are made to conserve the country's arid and semi-arid environments. For example, the cerrado (Brazilian savannah) is recognized for being home to threatened mammals as much as the Amazon rainforest (Costa *et al.*, 2005). Known as the 'new agricultural frontier', the cerrado originally covered one-fourth of Brazil (around 2 million km<sup>2</sup>) (MMA, 2015), but currently comprises less than half of its original area, with only 8% of this secured in public protected areas (PAs; see <http://sistemas.mma.gov.br/portalcnucl/rel/index.php>). Agriculture and transport infrastructure have major impacts on both cerrado and its threatened mammals (De Marco *et al.*, 2018). With this rapid conversion of cerrado into agriculture and with a system of small and scattered PAs, where are the cerrado's mammal populations?

Between 2014 and 2019, I worked on rapid survey protocols for environmental licensing of 13 private agribusiness and mining properties in north and northeastern Minas Gerais, Brazil. Although my sampling effort was relatively low (ranging from 12 to 40 h/woman on each property), I still registered 56 terrestrial mammal species (Table 1), which represent 11% and 38% of terrestrial mammal species present in Brazil and in the cerrado biome, respectively (Paglia *et al.*, 2012). I recorded seven species classified as vulnerable and five near threatened globally as per the IUCN Red List (Table 1), including new records of an unknown *Blastocercus dichotomus* population (Rosa, 2018), an endangered species that has had its habitat dramatically reduced in recent decades (Duarte *et al.*, 2016). The surveys were concentrated in legal reserves (LRs) and private protection areas (PPAs) around water bodies which, in Brazil, are areas located in private properties with restricted use (Federal Law 12 651 of May 25, 2012). In the cerrado biome, all private properties in rural areas must maintain 20% of preserved native vegetation in LR, which may or may not overlap with PPAs (Federal Law 12 651 of May 25, 2012). Despite the fact that RLs and PPAs comprise a larger area in the cerrado than do the PAs, the majority of mammal research (>67%) is focused on PAs (Lima *et al.*, 2017; Santos *et al.*, 2019). This

happens for several political and historical reasons that allow easier researcher access to PAs as compared with private properties. Ultimately, this leads to a significant gap in scientific research on the biodiversity of the cerrado.

Although I did not carry out any systematic environmental measurements at the sampling sites, I observed poor conservation practices in both LR and PPA, and their immediate surroundings (e.g., garbage, pesticide residues, selective logging, and poaching). On the other hand, I also observed good practices such as fencing off LR and PPA to prevent the ingress of domestic animals, environmental education for employees and local communities, and ongoing inspection to avoid the entrance of unauthorized people. In many cases, these practices were more efficient than those delivered by public authorities in PAs; however, good practices are often personal initiatives or aimed to avoid other actions (e.g., machinery inspection against thieves, which also discourages poacher entry). Although some usage restrictions are noted in Brazilian law (Federal Law 12 651 of May 25, 2012), no specific regulation for LR and PPA or land use policies are set at the landscape level.

Adding to efforts already achieved with the creation of LR and PPA, there is an enormous potential for fauna conservation in privately owned properties of the cerrado, if adequate land use planning, social policies, and research incentives are put in place (Federal Law 12 651 of May 25, 2012), and scientists recognize the value of data obtained through the technical research for environmental licensing (e.g., Lima *et al.*, 2017; Santos *et al.*, 2019). To this end, new steps must be taken that encourage the union between technical and scientific research, as well as encouraging rural land owners to maintain and even increase their areas of LR and PPA. A vegetation restoration program is also needed in the cerrado that incorporates land use planning to increase the connectivity between private and public areas, as well as a payment program for environmental services. Biodiversity is a public good, and Brazil is an important source of natural resources in the global market, especially through food production on private cerrado properties. Therefore, the conservation of Brazilian biodiversity, as well as the halting of deforestation and the broader degradation of Brazilian ecosystems, is a global responsibility. It is time for

**Table 1** Mammals registered in private Brazilian savannah areas alongside their respective conservation status according to the IUCN Red List of Threatened Species (VU, vulnerable; NT, near threatened; DD, data deficient; LC, least concern; NA, not available)

Order	Family	Species	IUCN Red List			
Artiodactyla	Cervidae	<i>Blastocerus dichotomus</i>	VU			
		<i>Mazama americana</i>	DD			
		<i>Mazama gouazoubira</i>	LC			
		<i>Mazama</i> sp.	NA			
		<i>Ozotocerus bezoarticus</i>	NT			
		<i>Pecari tajacu</i>	LC			
Carnivora	Canidae	<i>Tayassu pecari</i>	VU			
		<i>Cerdocyon thous</i>	LC			
		<i>Chrysocyon brachyurus</i>	NT			
	Felidae	<i>Lycalopex vetulus</i>	LC			
		<i>Leopardus braccatus</i>	NT			
		<i>Leopardus pardalis</i>	LC			
Mephitidae	Mustelidae	<i>Leopardus tigrinus</i>	VU			
		<i>Panthera onca</i>	NT			
		<i>Puma concolor</i>	LC			
	Mephitidae	<i>Puma yagouaroundi</i>	LC			
		<i>Conepatus semistriatus</i>	LC			
		<i>Eira barbara</i>	LC			
	Mustelidae	<i>Galictis cuja</i>	LC			
		<i>Lontra longicaudis</i>	NT			
		<i>Nasua nasua</i>	LC			
	Procyonidae	<i>Procyon cancrivorus</i>	LC			
		<i>Didelphis albiventris</i>	LC			
		<i>Didelphis</i> sp.	NA			
Didelphimorphia	Didelphidae	<i>Gracilinanus agilis</i>	LC			
		<i>Monodelphis americana</i>	LC			
		<i>Monodelphis domestica</i>	LC			
	Lagomorpha	Leporidae	<i>Monodelphis</i> sp.	NA		
			<i>Thylamys karimii</i>	VU		
			<i>Sylvilagus brasiliensis</i>	LC		
	Perissodactyla	Tapiridae	<i>Tapirus terrestris</i>	VU		
			Pilosa	Dasypodidae	<i>Cabassous</i> sp.	NA
					<i>Dasybus novemcinctus</i>	LC
	<i>Dasybus</i> sp.	NA				
	Primates	Myrmecophagidae	<i>Euphractus sexcinctus</i>	LC		
			<i>Priodontes maximus</i>	VU		
<i>Myrmecophaga tridactyla</i>			VU			
Atelidae		<i>Tamandua tetradactyla</i>	LC			
		<i>Allouata</i> sp.	NA			
		<i>Callithrix penicillata</i>	LC			
Callitrichidae		<i>Sapajus apella</i>	LC			
		Cebidae	<i>Hydrochoerus hydrochaeris</i>	LC		
			Caviidae	<i>Calomys tener</i>	LC	
<i>Cerradomys subflavus</i>				LC		
Rodentia		Cricetidae		<i>Hylaeamys megacephalus</i>	LC	
			<i>Necomys lasiurus</i>	LC		
	<i>Oecomys catherinae</i>		LC			
	Cuniculidae	<i>Oligoryzomys</i> sp.	NA			
		<i>Rhipidomys macrurus</i>	LC			
		<i>Wiedomys pyrrhorhinus</i>	LC			
	Dasypodidae	<i>Cuniculus paca</i>	LC			
		<i>Dasyprocta</i> sp.	NA			
		Echimyidae	<i>Carterodon sulcidens</i>	DD		
	<i>Thrichomys apereoides</i>		LC			
	<i>Trynomys albispinus</i>		LC			
	Erethizontidae	<i>Coendou prehensilis</i>	LC			

the world to turn to the Brazilian savannah as it turns to the Amazon, creating international incentive policies for cerrado research and conservation that encompass both PAs and private properties, thereby bringing hope for the long-term future of this unique ecosystem.

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