Diversidade, Espécies Ameaçadas e Sustentabilidade

Inventory of medium and large mammals in the Biological Reserve of Araucárias, Paraná, Brazil

Inventário de mamíferos de médios e grande porte na Reserva Biológica de Araucárias, Paraná, Brasil

ELVIRA D'BASTIANI^{1*},

MARLOS D'BASTIANI²,

ALAN DEIVID PEREIRA³, RICARDO SIQUEIRA BOVENDORP⁴,

HEITOR FARACO JÚNIOR⁵, JORGE LUIZ DE ALMEIDA MARQUES⁵,

& SÉRGIO BAZILIO⁶

Brazil is the country with the greatest richness of mammals catalogued worldwide (PAGLIA *ET AL.*, 2012), from 5,536 species of mammals described worldwide (IUCN, 2016), approximately 12 % (701) occurs in Brazil and among those, 42 % (298) occurs in the Atlantic Forest biome, of which 30 % (90) of these species are endemic (PAGLIA *ET AL.*, 2012). Nowadays, the populations of mammals show the highest rate of decline in tropical regions (DIRZO *ET AL.*, 2014), on which the Brazilian Atlantic Forest presents an alarming history, even though it is one of the five most important centers of biodiversity and endemism of the world (MYERS *ET AL.*, 2000).

¹Universidade Federal do Paraná (UFPR), C. postal 19.031, Cep 81531-980, Curitiba, PR, Brasil. ²Unidade de Ensino Superior Vale do Iguaçu (UNIGUAÇU), C. postal (42)3522-6192, União da Vitória (PR), Brasil. ³Universidade Estadual de Londrina (UEL). C. postal 10.011, Cep 86057-970, Londrina (PR), Brasil. ⁴Institute de Biociências, Depto Ecologia, Universidade Estadual de São Paulo (UNESP), Cep 13506-900, Rio Claro (SP), Brasil. ⁵Instituto Chico Mendes Instituto de Conservação da Biodiversidade (ICMBio), Cep 84015-600, Ponta Grossa (PR), Brasil. ⁶Universidade Estadual do Paraná (UNESPAR), União da Vitória *campus* C. postal 241, Cep 84600-000, União da Vitória (PR), Brasil. Correspondência para: elviradebastianii@gmail.com

However, this diversity is severely affected by human activity (LAURANCE *ET AL.*, 2012; GALETTI *ET AL.*, 2016; CEBALLOS *ET AL.*, 2015). The habitat loss and fragmentation, the hunting activity and the forest conversion to extensive agricultural and urban areas are the main anthropogenic causes of loss of medium and large mammals (MAGNAGO *ET AL.*, 2014; GALETTI & DIRZO, 2013). This defaunation often leads to changes on the composition of local communities, which can produce strong collateral effects on ecosystem functions (REDFORD, 1992; CANALE *ET AL.*, 2012; DIRZO *ET AL.*, 2014). Medium and large mammals are recognized and important on the maintenance and regulation of ecosystems, the loss of these animals often interfere on the structure and dynamic of populations and communities, affecting in this way, the dispersion and predation of seedbanks, on trophic compositions and on the quantity of biomass on the area (GALETTI *ET AL.*, 2016; GALETTI & DIRZO, 2013; KURTEN, 2013).

Inventories of mammal communities are less frequent on the subtropical of the Atlantic Forest, in the region where the Mixed Ombrophilous Forest (FOM), also known as Forest of Araucárias or Forest of Pines, is predominant. Currently remains around 12 % of all the original area covered by FOM, and only 3 % of these remnants are in Conservation Units (RIBEIRO *ET AL.*, 2009), what makes it one of the priority areas to conservation and research efforts on the Atlantic Forest biome (COSTA *ET AL.*, 2005; RIBEIRO *ET AL.*, 2009). It is expected, for this region, a greater probability of local extinction of large size species due to the reduction of remnants and intense hunting activity (BOGONI *ET AL.*, 2016). The knowledge of biodiversity is fundamental for a greater effectiveness on species conservation (BRITO, 2004) as well as on the orientation and implementations of biodiversity conservation proposals, management plans and in governmental decision-making. Nonetheless, there is a great lack of knowledge about the fauna that inhabits some of the areas in this region that are not inventoried already. In order to meet this gap, the present study aimed to conduct a survey of terrestrial mammal of medium and large size in remnants of Mixed Ombrophilous Forest on the Biological Reserve of Araucárias of Paraná, Brazil.

MATERIALS & METHODS

STUDY AREA

The study was conducted on the Biological Reserve of Araucárias (Rebio) (Fig. 1) created by Federal Decree of March 23, 2006. With 14,930.49 hectares, it covers the municipalities of Imbituva, Ipiranga and Teixeira Soares (25°08'59,71" W, 52°25'5,37" S) in the center-east region of the Paraná state, Brazil.

Fig. 1. Location map of Biological Reserve of Araucárias (Paraná, Brazil) (Source: ICMBio).

The forest formation is mainly composed by remnants of Mixed Ombrophilous Forest, characterized by the presence of *Araucaria angustifolia* (Bertol.) Kuntz, in medium stage of regeneration and wetlands (Rebio of Araucárias, 2016). The remnants are inserted in a landscape matrix highly anthropized, mainly by the extension of the agricultural areas and by reforestations with exotic species (*Pinus* sp. Engelm).

DATA COLLECTION

The data was monthly collected from October 2012 to July 2014. The inventory was performed by using camera-trap and direct/indirect search (visualizations, feces, footprints and specimens run over by car). It was used 13 camera-traps (Bushnell) which remained active during 24 hours.

To obtain the records, the systematized courses, tracks, margins of watercourses, interior and edges of the unit fragments were checked by walking during the morning, afternoon and some nights. The footprints were identified according to Becker & Dalponte (1999), CARVALHO & LUZ (2008) e De ANGELO *ET AL.* (2008), however, the small cat species, cervids and possums was not discriminated, and later on, they were confirmed in the area through photographic records. The feces analysis was based on QUADROS & MONTEIRO-FILHO (2006a; 2006b) and on reference collection of the Laboratory of Zoology of Vertebrates from State University of Paraná, União da Vitória campus, PR.

The taxonomic ordination and the species nomenclature followed references of PAGLIA *ET AL.* (2012) except for the genus *Leopardus* which was adopted the description of TRIGO *ET AL.* (2013) and for *Sapajus* which followed the description of LYNCH-ALFARO *ET AL.* (2012). The species were framed according to the threat category to the Paraná State (Paraná, 2010), Brazil (Brazil, 2014) and also worldwide (IUCN, 2016). It was considered mammals of medium and large size those ones with body weight $\geq 1,0$ when adults (REIS *ET AL.*, 2011). However, species of small size were included when surely identified at the study area. This research was conducted under the authorization (n° 37691-1) by the Chico Mendes Institute of Biodiversity Conservation (ICMBio).

DATA ANALYSIS

In relation to the photography records, the sampling effort was calculated as the number of camera-traps multiplied by the number of sampled days, which corresponds to a period of 24 hours. The sampling success was calculated by the function: (number of independent records/effort of capture) $\times 100$ (SRBEK-ARAUJO & CHIARELLO, 2005). An event was considered as independent when they were: (a) consecutive photographs from the same camera separated from each other by the minimum of 60 minutes and (b) nonconsecutive photographs from the same camera.

In addition, it was estimated a species accumulation curve based on the monthly sampling and it was analyzed the total abundance of records (AR) considering only the records from camera-trap. The relative abundance was calculated by ($AR = N_{tot} / N_{fe} \times 100$), where N_{tot} is the number of records and N_{fe} is the total number of photographs by species. Then, it was evaluated the local status of the registered species. In order to do that, it was established three distribution classes of species (ROCHA & DALPONTE, 2006) according to the following criteria: (1) rare species, those ones that showed individual sequence of photographic records from 0.01 to 0.10; (2) common species, those ones that showed from 0.11 to 0.50; and (3) abundant species, those ones that showed more than 0.50.

RESULTS

With 140 hours of active search and 172.800 hours of camera-traps, during 600 days of sampling effort, it was registered 28 species of native medium and large size mammals (Table 1), two small size species (*Cavia aperea* e *Guerlinguetus ingrami*) and two exotic species (*Lepus europaeus* e *Sus scrofa*).

In relation to the native species registered, ten are in one of the categories of species threatened to extinction on Paraná State, six nationally and three worldwide are endangered. When considering the richness described to the Rebio of Araucárias, 43% of the species are categorized in one of the threatened category.

The observed cumulative curve of species richness reached the asymptote after the 18^o sampling (Fig. 2), suggesting that the sampling effort was enough to register the number of medium and large size mammals from the Rebio of Araucárias.

Among the species that occurs at the study area (Fig. 3), seven was registered only by camera-trap: *Cuniculus paca*, *Didelphis aurita*, *Didelphis albiventris*, *Cabassous unicinctus*, *Mazama americana*, *Mazama gouazoubira*, *Tamandua tetradactyla*; one by feces analysis: *Coendou villosus*; one by footprint: *Dasypus septemcinctus*; one by visual identification: *Sapajus nigritus*; and nineteen species was registered by more than one methodology: *Alouatta guariba clamitans*, *Hydrochoerus hydrochaeris*, *Myocastor coypus*, *Dasyprocta azarae*, *Leopardus guttulus*, *Leopardus pardalis*, *Puma concolor*, *Puma yagouaroundi*, *Leopardus wiedii*, *Galictis cuja*, *Eira barbara*, *Cerdocyon thous*, *Nasua nasua*, *Procyon cancrivorus*, *Sylvilagus brasiliensis*, *Euphractus sexcinctus*, *Dasypus novemcinctus*, *Dasypus septemcinctus* e *Pecari tajacu* (Table 1).

Fig. 2. Accumulation curve of terrestrial mammals of medium and large size from the Rebio of Araucárias (Paraná, Brazil). Recorded: between October of 2012 and July of 2014.

Table 1. Terrestrial mammals of medium and large size from the Rebio of Araucárias (Paraná, Brazil). Recorded: from October of 2012 to July of 2014.

Taxonomy	Record	PR	BR	UCN
<i>Order Primates</i>				
Family Atelidae				
<i>Alouatta guariba clamitans</i> Cabrera, 1940	V - O	NT	VU	LC
Family Cebidae				
<i>Sapajus nigritus</i> (Goldfuss, 1809)	V	-		NT
<i>Order Rodentia</i>				
Family Erethizontidae				
<i>Coendou villosus</i> (F. Cuvier, 1823)	F	-	-	LC
Family Cuniculidae				
<i>Cuniculus paca</i> (Linnaeus, 1766)	A	EN	-	LC
Family Caviidae				
<i>Hydrochoerus hydrochaeris</i> (Linnaeus, 1766)	F - P	LC	-	LC
Family Myocastoridae				
<i>Myocastor coypus</i> (Molina, 1782)	F - P	-	-	LC
Family Dasyproctidae				
<i>Dasyprocta azarae</i> Lichtenstein, 1823	A - V	LC	-	DD
<i>Order Didelphimorphia</i>				
Family Didelphidae				
<i>Didelphis albiventris</i> Lund, 1840	A	LC	-	LC
<i>Didelphis aurita</i> (Wied-Neuwied, 1826)	A	LC	-	LC
<i>Order Carnivora</i>				
Family Felidae				
<i>Leopardus guttulus</i> (Trigo, 2013)	A - F	VU	VU	VU
<i>Leopardus pardalis</i> (Linnaeus, 1758)	A - F - P	VU	VU	LC
<i>Puma concolor</i> (Linnaeus, 1771)	F - P	VU	VU	LC
<i>Puma yagouaroundi</i> (E. Geoffroy Saint-Hilare, 1803)	A - F-EA	DD	VU	LC
<i>Leopardus wiedii</i> (Schinz, 1821)	A - F	VU	VU	NT
Family Mustelidae				
<i>Galeotis cuja</i> (Molina, 1782)	A - V - P - F	LC	-	LC
<i>Eira barbara</i> (Linnaeus, 1758)	A - V - F	LC	-	LC
Family Canidae				
<i>Cerdocyon thous</i> (Linnaeus, 1766)	A - P - V-EA	LC	-	LC
Family Procyonidae				
<i>Nasua nasua</i> (Linnaeus, 1766)	A - V - P	LC	-	LC
<i>Procyon cancrivorus</i> (G. [Baron] Cuvier, 1798)	A - P - V-EA	LC	-	LC
<i>Order Pilosa</i>				
Family Myrmecophagidae				
<i>Tamandua tetradactyla</i> (Linnaeus, 1758)	A	LC	-	LC
<i>Order Lagomorpha</i>				
Family Leporidae				
<i>Sylvilagus brasiliensis</i> (Linnaeus, 1758)	F - V	VU	-	LC
<i>Order Cingulata</i>				
Family Dasypodidae				
<i>Euphractus sexcinctus</i> (Linnaeus, 1758)	A - P	LC	-	LC
<i>Dasypus septemcinctus</i> Linnaeus, 1758	A - P	NE	.	LC
<i>Dasypus novemcinctus</i> Linnaeus, 1758	A - P	LC	.	LC
<i>Cabassous unicinctus</i> (Linnaeus, 1758)	A	-	.	LC
<i>Order Artiodactyla</i>				
Family Tayassuidae				
<i>Pecari tajacu</i> (Linnaeus, 1758)	A - C	VU	.	LC
Family Cervidae				
<i>Mazama americana</i> (Erxleben, 1777)	A - P	DD	-	DD
<i>Mazama gouazoubira</i> (G. Fischer, 1814)	A - P	VU	-	LC

Legend: Form of registration: A, photographic trap; F, feces; P, foodprint; V, display; O, vocalization; C, skull; EA, run over specimen; Threat category: EN, endangered; NT, almost in danger; VU, vulnerable; DD, insufficient data; NE, not evaluated; LC, bit worrisome.

Fig. 3. Terrestrial mammals of medium and large size to the Biological Reserve of Araucárias, Paraná, Brazil from October of 2012 to July of 2014. A) *A. g. clamitans*, B) *C. paca*, C) *H. hidrochoerus*, D) *M. coypus*, E) *D. azarae*, F) *D. albiventris*, G) *D. aurita*, H) *P. concolor*, I) *L. pardalis*, J) *E. barbara*, K) *N. nasua*, L) *P. cancrivorus*, M) *D. novemcinctus*, N) *C. unicinctus*, O) *M. gouazoubira* e P) *P. tajacu*.

It was obtained a total of 4,598 of photographic records. According to the AR of these records, the species classified as rare was: *S. villosus*, *C. paca*, *D. albiventris*, *D. aurita*, *L. tigrinus*, *L. pardalis*, *P. yagouaroundi*, *L. wiedii*, *G. cuja*, *C. thous*, *P. cancrivorus*, *T. tetradactyla*, *E. sexcinctus*, *D. novemcinctus*, *C. unicinctus*, *P. tajacu*, *S. scrofa*, *M. americana*, *M. gouazoubira*; comuns: *N. nasua*, *E. barbara*; and the most abundant species was *D. azarae* only. The camera-trap was the method that presented more efficiency to register the occurrence of mammal species at this study area (Table 2).

Table 2. Number of records by species (S), relative abundance based on camera-trap records (AR) and local status of mammal species registered at the Biological Reserve of Araucárias on Paraná State, Brazil.

Species	Number of records	Relative abundance	Local Status
<i>Dasyprocta azarae</i>	3319	0.66	Abundant
<i>Nasua nasua</i>	424	0.85	Common
<i>Mazama gouazoubira</i>	339	0.061	Rare
<i>Dasypus novemcinctus</i>	275	0.05	Rare
<i>Sus scrofa</i>	235	0.04	Rare
<i>Didelphis aurita</i>	163	0.03	Rare
<i>Cuniculus paca</i>	39	0.01	Rare
<i>Pecari tajacu</i>	29	0.01	Rare
<i>Mazama americana</i>	23	0.01	Rare
<i>Leopardus pardalis</i>	22	0.01	Rare
<i>Didelphis albiventris</i>	20	0.01	Rare
<i>Leopardus tigrinus</i>	19	0.01	Rare
<i>Eira barbara</i>	16	0.01	Rare
<i>Puma yagouaroundi</i>	9	0.01	Rare
<i>Leopardus wiedii</i>	8	0.01	Rare
<i>Cabassous unicinctus</i>	6	0.01	Rare
<i>Galictis cuja</i>	5	0.01	Rare
<i>Procyon cancrivorus</i>	2	0.01	Rare
<i>Tamandua tetradactyla</i>	2	0.01	Rare
<i>Sphiggurus villosus</i>	1	0.01	Rare
<i>Cerdocyon thous</i>	1	0.01	Rare
<i>Euphractus sexcinctus</i>	1	0.01	Rare
Total: 4958			

DISCUSSION

The obtained results to the medium and large size mammals on Biological Reserve of Araucárias represent 13% of 180 species that occurs on Paraná State (MIKICH & BÉRNILS, 2004) and 9 % of 298 species of mammalian fauna from Atlantic Forest (PAGLIA ET AL., 2012). The richness and the record of endangered species indicate the value and importance of Rebio on the maintenance of biodiversity to the Atlantic Forest as it has been presented in previous studies with the mammalian fauna (CHIARELLO, 1999; CHIARELLO, 2000B; WALLAUER, 1999; MENDES ET AL., 2005; ROCHA & DALPONTE, 2006; NEGRÃO & VALLADARES-PÁDUA, 2006; PRADO ET AL., 2008; Brocardo; CÂNDIDO JÚNIOR, 2012; OLIVEIRA ET AL., 2012; WOLFART ET AL., 2013; TORTATO ET AL., 2014).

In this study, it was registered species that are in the Paraná list of threatened species that belongs to the Carnivores and Artiodactyl orders. Species at the Rebio, as puma (*Puma concolor*) e o collared peccary (*Pecari tajacu*), are important to conservational delineations and actions (JENKINS ET AL., 2013), which confirms the immense value of the area to the conservation of mammals. Besides the majority of listed species in this study are not inserted on the lists of threatened species, is not an indicative that they are not being affected by habitat loss and others

anthropic actions (BECA ET AL., 2017). The majority of those species has vast distribution through the biome and show higher plasticity and tolerance to the anthropic effects (SANTOS ET AL., 2008). However, many of the registered species in this study are locally considered as rare, even when abundant in other Atlantic Forest areas. Most of times, the rarity of species records is associated to the hunting actions, the presence of exotic and domestic animals (dogs, pigs and cows), and the monoculture of *Pinus sp.*

Studies show that the limited size of forest fragments associated to the quantity of roads that marge it, increases the susceptibility of mammals to the hunting activity (CULLEN ET AL., 2001; BECA ET AL., 2017; GALETTI ET AL., 2016). Also, the lack of specialized people (park guards) to the surveillance of protected areas and its limits is scarce, and most of times, it facilitate the entrance of hunters and the removal of forest resources inside the UCs (GALETTI ET AL., 2016). Without the limits surveillance, the UCs stays vulnerable to the population entrance, and consequently, to domestic animals that lives around the area.

Recent studies indicate that the introduction of domestic and/or exotic animals in Conservation Units drastically affects the native local fauna. (Pedrosa et al. 2016; FARIA ET AL., 2016; BARRIOS-GARCIA AND BALLARI, 2012). The presence of exotic species, as *Lepus europaeus* e principally *Sus scrofa*. has been changing the ecological processes such as succession and the composition of native species (MAGRACH ET AL., 2012) and, in a few cases, it could lead to the diminishing and introduce the extinction on native species of fauna and flora (DORCASA ET AL., 2012). The presence and expansion of *L. europeus* distribution and, principally of *S. scrofa*, are leading to a disruption in biological communities on Atlantic Forest (PEDROSA ET AL., 2015). These species are capable to influence a series of ecological interactions, such as predation, competition and seed dispersion (GALETTI ET AL., 2015; METZGER, 2006; MIRANDA & ALENCAR, 2007) and the adequate management of these species is one of the priorities nowadays among conservationists to the conservation of forest remnants (PEDROSA ET AL., 2015).

It is known that the large forest remnants can maintain the high habitat diversity and could retain higher richness of species (LAURANCE, 2008), meanwhile in smaller remnants, the local extinctions could reach 80% of the species (BECA ET AL., 2017). Nevertheless, besides the presence of monoculture of Pines sp. turn the area fragmented, the Rebio still has forest corridors that are used as paths and stepping stone so species could cross to close and larger remnants, maintaining the flux of species and the integrity of regional community (BECA ET AL., 2017). This connectivity between the fragments could maintain the genetic diversity,

migration, population dispersion from local to regional scope (GALETTI *ET AL.*, 2009), preventing the defaunation and favoring the conservations of this and other groups that occurs in this area.

Nevertheless, the maintenance of Rebio and the creation of new protected areas, mainly in regions indicated as priority areas to the conservation could assist to animal and forest protection besides capitalization of financial resources to use on biodiversity (BANKS-LEITE *ET AL.*, 2014). Revert the forest loss and increase the connection between areas could benefit the species richness and functional diversity (BECA *ET AL.*, 2017; MAGIOLI *ET AL.*, 2016), besides to aggregate value to the fragments to species conservation, increasing its potential as corridors to medium and large size mammals (GALETTI *ET AL.*, 2009).

CONCLUSION

Species richness and abundance described in the present study highlights the importance of Rebio of Araucárias to local and regional mast fauna conservation. The maintenance of this diversity depends mainly of surveillance that warrant the habitats integrity that occurs over there, and the forest fragments that exist around of the UC. Atrophic actions such as hunt, introduction of exotic and domestic animals and the planting of monoculture are the mainly threats to mammal species that occurs in this area. Besides the non-qualification of hunt effects, the evidences left by hunters was constantly found during the study. It is recommended that further studies in this area seek, since the origin, the cause and minimization of anthropic processes here exposed in order to maintain the Rebio biodiversity. In addition, it is recommended the preservation of adjacent fragments, considering that they are used by mast fauna to displacement between forest remnants. In conclusion, the implementation of a management plan to the Biological Reserve of Araucárias is needed, reiterating this way, its local and regional biological value to the conservation of fauna, in special, to the focus groups in the present work, the mammals.

SUMMARY

Since the 20th century researchers have highlighted the ecological importance of forest areas and their biodiversity. The fauna present in these forest areas, preserved by law or not, guarantee the local maintenance of ecological processes. In turn, mammals represent a key group for evaluations of environmental quality, with inventories of mammals being one of the main instruments employed in the design

public policies for biodiversity conservation. In order to contribute to conservation and management policies, the first inventory of medium and large mammals in the Biological Reserve of Araucárias was carried out monthly from October 2012 to June 2014. The species were recorded through both direct (visualization, vocalization) and indirect (photographic traps, eschatological material and caught) searches. Twenty-eight species of mammals were recorded, 12 of which are considered threatened. The species richness herein documented highlights the importance of the Araucárias Biological Reserve as a conservation unit. The maintenance of mammal richness mainly depends on inspection by rangers that guarantee the integrity of the species and the habitats present in the reserve, especially forest fragments. Our results contribute to the knowledge of the mammal diversity of one of the largest remnants of Araucárias forest in the state of Paraná, warn about existing threats, and provide support for further design of conservation policies.

KEYWORDS: diversity; mixed-ombrophilus-forest; inventory, conservation

SUMÁRIO

Desde o século XX, os pesquisadores têm destacado a importância ecológica das áreas florestais e sua biodiversidade. A fauna presente nessas áreas florestais, preservada por lei ou não, garante a manutenção local dos processos ecológicos. Por sua vez, os mamíferos representam um grupo chave para avaliações de qualidade ambiental, com inventários de mamíferos sendo um dos principais instrumentos empregados nas políticas públicas de desenho para a conservação da biodiversidade. Para contribuir com as políticas de conservação e manejo, o primeiro inventário de mamíferos de médio e grande porte da Reserva Biológica de Araucárias foi realizado mensalmente de outubro de 2012 a junho de 2014. As espécies foram registradas por meio direto (visualização, vocalização) e indireta Armadilhas fotográficas, material escatológico e pegadas). Vinte e oito espécies de mamíferos foram registradas, 12 das quais são consideradas ameaçadas. A riqueza de espécies aqui documentada destaca a importância da Reserva Biológica de Araucárias como unidade de conservação. A manutenção da riqueza dos mamíferos depende principalmente da inspeção dos rangers que garantam a

integridade das espécies e dos habitats presentes na reserva, principalmente fragmentos florestais. Nossos resultados contribuem para o conhecimento da diversidade de mamíferos de um dos maiores remanescentes da floresta de Araucárias no estado do Paraná, alertam sobre as ameaças existentes e fornecem apoio para a elaboração de políticas de conservação.

PALAVRAS-CHAVE: diversidade, floresta-ombrófila-mista, inventário; conservação

ACKNOWLEDGMENTS — To the workers of Biological Reserve of Araucárias and of National Park of Campos Gerais for the support and incentive, and to Juliane Coimbra Bczuska for the assistance in part of the data collection.

BIBLIOGRAPHY

- ANTUNES, A.P.; R. M. FEWSTER.; E. M. VENTICINQUE; C. A. PERES; T. LEVI; F. ROHE & G. H. SHEPARD. 2016. Empty forest or empty rivers? A century of commercial hunting in Amazonia. *Science Advances* 2 (10): 1600936.
- BARNOSKY, A.D.; E. A. HADLY; J. BASCOMPTE; E. L. BERLOW; J. H. BROWN; M. FORTELIUS; W. M. GETZ; J. HARTE; A. HASTINGS; P. A. MARQUET; N. D. MARTINEZ; A. MOOERS; P. ROOPNARINE; G. VERMEIJ; J. W. WILLIAMS; R. GILLESPIE; J. KITZES; C. MARSHALL; N. MATZKE; D. P. MIDELL.; E. REVILLA & A. B. SMITH. 2012. Approaching a state shift in Earth's biosphere. *Nature* 486 (7401): 52-58.
- BARRIOS-GARCIA, M. N., & S. A. BALLARI. (2012). Impact of wild boar (*Sus scrofa*) in its introduced and native range: a review. *Biological Invasions*, 14 (11): 2283–2300. <<http://doi.org/10.1007/s10530-012-0229>>-
- BECA, G., M. H. VANCINE; C. S. CARVALHO; F. PEDROSA, R. S. C. ALVES & D. BUSCARIOL. 2017. High mammal species turnover in forest patches immersed in biofuel plantations. *Biological Conservation*. <<http://doi.org/10.1016/j.biocon.2017.02.033>>.
- BECKER, M. & J. C. DALPONTE. 1999. *Pegadas de mamíferos silvestres brasileiros — um guia de campo*. Brasília: Editora UnB. 180 pp.
- BRASIL. 2014. Portaria do Ministério do Meio Ambiente, n 444, de 17 de dezembro de 2014. Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção. *Diário Oficial da União*, Brasília, n 245, Seção I, pp.121-126. 18 de dezembro de 2014.
- BOGONI, J. A.; J. J. CHEREM; E. L. HETTER GIEHL; L. G. OLIVEIRA-SANTOS; P. V. CASTILHO; L. PICINATTO FILHO; F. M. FANTACINI; M. A. TORTATO; M. RIBEIRO; L. R. RIZZARO; M. E. GRAIPEL. 2016. Landscape features lead to shifts in communities of medium- to large-bodied mammals in subtropical Atlantic Forest. *Journal of Mammalogy*, 97 (3): 713–725. <<http://doi.org/10.1093/jmammal/gyv215>>

- BRITO D. 2004. Lack of adequate taxonomic knowledge may hinder endemic mammal conservation in the Brazilian Atlantic Forest. *Biodiversity and Conservation* 13: 2135-2144.
- BROCARD, C.R. & J. F. C. JÚNIOR, 2012. Persistência de mamíferos de médio e grande porte em fragmentos de Floresta Ombrófila Mista no estado do Paraná, Brasil. *Revista Árvore*, Viçosa, 36 (2): 301-310.
- CÁCERES, N. C.; R. NAPOLI; J. CASELLA, J. & W. HANNIBAL. 2010. Mammals in a fragmented savannah landscape in south-western Brazil. *Journal of Natural History*, London, 44 (7): 491-512.
- CANALE, G.R.; C. A. PERES; G. E. GUIDORIZZI; C. A. F. GATTO & C. M. KIERULFF. 2012. Pervasive defaunation of forest remnants in a tropical biodiversity hotspot. *PlosOne* 7 (8): 41671.
- CARVALHO JR. O. & N. C. LUZ. 2008. *Pegadas: Série Boas Práticas, Belém* — PA: Editora da Universidade Federal do Pará. 3, 64 pp.
- CEBALLOS, G.; P. R. EHRLICH; A. D. BARNOSKY; A. GARCIA; R. M. PRINGLE & T. M. PALMER. 2015. Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Science Advances*, 1 (5), e1400253–e1400253. <<http://doi.org/10.1126/sciadv.1400253>>
- CHIARELLO, A. G. 1999. Effects of fragmentation of the Atlantic Forest on mammals communities in south-eastern Brazil. *Biological Conservation*. Boston 89 (1): 71-82.
- CHIARELLO, A.G. 2000b. Influência da caça ilegal sobre os mamíferos e aves das matas de tabuleiro do norte do estado do Espírito Santo. *Bol. Mus Biologia Mello Leitão* 11 (12): 229-247.
- COSTA, L. P.; Y. L. R. LEITE; S. L. MENDES & A. D. DITCHFIELD. 2005. Mammal Conservation in Brazil. *Conservation Biology*, 19 (3): 672–679. <<http://doi.org/10.1111/j.1523-1739.2005.00666.x>>
- CUARÓN, A. D. 2000. A global perspective on habitat disturbance and Tropical Rainforest mammals. *Conservation Biology* 14 (6): 1574-1579.
- DE ANGELO, C.; A. PAVIOLO; Y. DI BLANCO & M. DI BITETTI. 2008. Guía de huellas de los mamíferos de Misiones y otras áreas Del subtrópico de Argentina. Ediciones Del Subtrópico. 120 p.
- DIRZO, R.; H. S. YOUNG, M. GALETTI; G. CEBALLOS; N. J. B. ISAAC & B. COLLEN. 2014. Defaunation in the Anthropocene. *Science* (New York, N.Y.), 345 (6), 401–406. <<http://doi.org/10.1126/science.1251817>>
- DORCAS, M. E.; J. D. WILLSON; R. N. REED; R. W. SNOW; M. R. ROCHFORD; M. A. MILLER & K. M. HART. 2012. Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. *Proceed. Nat. Acad. Sciences* 109 (7), 2418-2422.
- DRUMMOND, G. M.; C. S. MARTIN; A. B. M. MACHADO; F. A. SEBAIO & Y. ANTONINI. 2005. *Biodiversidade em Minas Gerais*. Um atlas para

- sua conservação. Belo Horizonte: Fundação Biodiversitas. 222 pp.
- FARIA, G. M. M. DE; C. A. ROSA; G. L. CASTRO CORRÊA; F. PUERTAS; K. M. OLARTE JIMÉNEZ & L. N. PERILLO. (2016). Geographic distribution of the European hare (*Lepus europaeus*) in Brazil and new records of occurrence for the Cerrado and Atlantic Forest biomes. *Mammalia*, 80 (5): 497–505. <<http://doi.org/10.1515/mammalia-2015-0036>>
- GALETTI, M.; C. R. BROCARDO; R. A. BEGOTTI; L. HORTENCI; F. ROCHA-MENDES; C. S. S. BERNARDO. 2016. Defaunation and biomass collapse of mammals in the largest Atlantic forest remnant. *Animal Conservation*. <<http://doi.org/10.1111/acv.12311>>
- GALETTI, M.; H. CAMARGO; T. SIQUEIRA; A. KEUROGHLIAN; C. I. DONATTI; R. A. BEGOTTI; F. MEIRELLES; R. A. NOBRE; A. G. CHIARELLO & C. A. PERES. 2015. Diet Overlap and Foraging Activity between Feral Pigs and Native Peccaries in the Pantanal. *PLoS ONE*, 10 (11), e0141459. <<http://doi.org/10.1371/journal.pone.0141459>>
- GALETTI, M. & R. DIRZO. 2013. Ecological and evolutionary consequences of living in a defaunated world. *Biological Conservation* 163: 1-6.
- GALETTI, M., H. C. GIACOMINI; R. S. BUENO; C. S. BERNARDO & W. F. LAURANCE. 2008. Theory meets reality: how habitat fragmentation research has transcended island biogeographic theory. *Biological Conservation* 1 (41):1731-1744.
- IUCN. 2016. The World Conservation Union. Red List of Threatened Species: version 2. 2016. Cambridge: IUCN — Species Survival Commission, Disponível em <<http://www.iucnredlist.org>>. Acesso em 8 novembro 2016.
- JENKINS, C.N.; S. L. PIMM & J. N. JOPPA. 2005. Global Patterns of terrestrial Vertebrate Diversity and Conservation. *Proceedings of the National Academy of Sciences* 110 (28): e2602-e2610.
- KURTEN, E. L. 2013. Cascading effects of contemporaneous defaunation on tropical forest communities. *Biological Conservation*, 163, 22–32. <http://doi.org/10.1016/j.biocon.2013.04.025>
- LAURANCE, W.F.; D. C. USECHE; J. RENDEIRO; M. KALKÁ; C. J. A. BRADSHAW; S. P. SLOAN; S. G. LAURANCE ET AL. 2012. Averting biodiversity collapse in tropical forest protected areas. *Nature* 489.
- LYNCH ALFARO, J.W.; J. S. SILVA & A. B. RYLANDS. 2012. How Different Are Robust and Gracile Capuchin Monkeys? An Argument for the Use of *Sapajus* and *Cebus*. *American Journal of Primatology*, Hanoi, Vietnam 74(4): 273-286.
- MAGNAGO, L.F.S.; D. F. EDWARDS; F. A. EDWARDS; A. MAGRACH; S. V. MARTINS & W. F. LAURANCE. 2014. Functional attributes change but functional richness is unchanged after fragmentation of Brazilian Atlantic forests. *Journal of Ecology* 102 (2): 475–485.

- MAGRACH, A.; A. R. LARRINAGA & L. SANTAMARIA. 2012. Effects of matrix characteristics and interpatch distance on functional connectivity in Fragmented Temperate Rainforests. *Conservation Biology*, Boston 26 (2): 238-247.
- MENDES, F. R.; S. B. MIKICH; G. V. BIANCONI & W. A. PEDRO. 2005. Mamíferos do município de Fênix, Paraná, Brasil: etnozoologia e conservação. *Revista Brasileira de Zoologia*, Curitiba, 22 (4): 991-1002.
- METZGER, J.P.; L. G. ALVES; G. GOULART; A. M. G. TEIXEIRA; S. J. C. SIMÕES & E. L. M. CATHARINO. 2006. Uma área de relevante interesse biológico, porém pouco conhecida: a Reserva Florestal do Morro Grande. *Biota Neotropica* 6 (2): <<http://www.biotaneotropica.org.br/v6n2/t/abstract?article+bn00206022006>>
- MIKICH, S.B.; BÉRNILS, R.S. 2004. *Livro vermelho da fauna ameaçada no Estado do Paraná*. Curitiba: Instituto Ambiental do Paraná. 763 pp.
- MIRANDA C. L. & G. D. ALENCAR. 2007. Aspects of hunting activity in Serra da Capivara National Park, in the state of Piauí, Brazil. *Natureza & Conservação*, 5 (1):114-121.
- MYERS, N.; R. A. MITTERMEIER; C. G. MITTERMEIER; G. A. B. DA FONSECA, ; & J. KENT. 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403 (6772): 853–858.
- NEGRÃO, M. F. F. & C. VALLADARES-PÁDUA. 2006. Registro de mamíferos de maior porte na Reserva Florestal do Morro Grande, São Paulo. *Biota Neotropica*, Campinas 6 (2): 1-13.
- OLIVEIRA, L.P.; D. AGUIAR; T. C. C. MARGATIDO & J. R. PACHALY. 2012. Caracterização faunística de mamíferos de médio e grande porte de um fragmento florestal do noroeste do estado do Paraná, Brasil. *Arq. Ciên.Vet. e Zool. Unipar*, Umuarama 15 (2):109-114.
- PAGLIA, A.P.; G. A. B. FONSECA; A. B. RYLANDS; G. HERRMAN; L. M. S. AGUIAR; A. G. CHIARELLO; Y. L. R. LEITE; L. P. COSTA; S. SICILIANO; M. C. M. KIERULFF; L. S. MENDES; V. C. TAVARES; R. A. MITTERMEIER, & J. L. PATTON. 2012. Annotated Checklist of Brazilian Mammals. *Occasional Papers in Conservation Biology*. 76 pp.
- PARANÁ 2010. Decreto 726 – 1 de junho de 2010. Lista de Espécies de Mamíferos pertencentes à Fauna Silvestre Ameaçadas de Extinção no Estado do Paraná. *Diário Oficial* nº. 8233 de 1 de junho de 2010. Curitiba, 1 de junho de 2010.
- PARDINI, R. & F. UMETSU. 2006. Pequenos mamíferos não-voadores da Reserva Florestal do Morro Grande: distribuição das espécies e da diversidade em uma área de Mata Atlântica. *Biota Neotropica*, Campinas, 6 (2):1-22.

- PARDINI, R.; S. M. SOUZA; R. BRAGA NETO & J. P. METZGER. 2005. The role of forest structure, fragment size and corridors in maintaining small mammal abundance and diversity in an Atlantic forest landscape. *Biological Conservation*, Boston 124 (266): 253-266.
- PEDROSA, F., SALERNO, R.; F. V. B. PADILHA & M. GALETTI. 2015. Current distribution of invasive feral pigs in Brazil: economic impacts and ecological uncertainty. *Natureza & Conservação* 13 (1): 84-87. <http://doi.org/10.1016/j.ncon.2015.04.005>
- PERES, C. A. & E. PALACIOS. 2007. Basin-wide effects of game harvest on vertebrate population densities in Amazonian forests: implications for animal-mediated seed dispersal. *Biotropica* 39 (3): 304-315.
- POUGH, F. H.; C. M. JANIS & J. B. HEISER. 2008. *A vida dos vertebrados*. 4th ed. São Paulo: Atheneu Editora. 684 pp.
- PRADO, M. R.; E. C. ROCHA & G. M. L. GIUDICE. 2008. Mamíferos de médio e grande porte em um fragmento de Mata Atlântica, Minas Gerais, Brasil. *Revista Árvore*, Viçosa, 32 (4): 741-749.
- QUADROS, J. & E. L. A. MONTEIRO-FILHO. 2006a. Coleta e preparação de pelos de mamíferos para identificação em microscopia óptica. *Revista Brasileira de Zoologia*, Curitiba, 23 (1): 274-278.
- QUADROS, J. & E. L. A. Monteiro-Filho. 2006b. Revisão conceitual, padrões microestruturais e proposta nomenclatória para os pêlos-guarda de mamíferos brasileiros. *Revista Brasileira de Zoologia*, Curitiba, 23 (1): 279-292.
- REDFORD, K. H. 1992. The empty forest. *Bioscience*, 42 (6): 412- 422.
- Reis, N. R.; A. L. Peracchi; W. A. Pedro & I. P. Lima. 2011. *Mamíferos do Brasil*. Londrina: Universidade de Londrina. 439 pp.
- RESERVA BIOLÓGICA DAS ARAUCÁRIAS. 2016. Instituto Chico Mendes de Conservação da Biodiversidade. <<http://www.icmbio.gov.br/portal/unidade-desdeconservacao/biomas-brasileiros/mata-atlantica/unidades-de-conservacao-mataatlantica/2140-rebio-das-araucarias>>. Acesso em: 19 de novembro de 2016.
- RIBEIRO, M. C.; J. P. METZGER, A. C. MARTENSEN; F. J. PONZONI & M. M. HIROTA. 2009. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation*, 142 (6), 1141-1153. <<http://doi.org/10.1016/j.biocon.2009.02.021>>
- ROCHA, E. C. & J. C. DALPONTE. 2006. Composição e caracterização da fauna de mamíferos de médio e grande porte em uma pequena reserva de Cerrado em Mato Grosso, Brasil. *Revista Árvore* 30 (4): 669-678.
- SANTOS, T. G. D.; M. R. SPIES; K. KOPP; R. TREVISAN & S. Z. CECHIN. 2008. Mammals of the Campus of the Universidade Federal de Santa Maria, Rio Grande do Sul, Brazil. *Biota Neotropica* 8 (1): 125-131.

- SRBEK-ARAUJO, A. C. & A. G. CHIARELLO. 2005. Is camera-trapping an efficient method for surveying mammals in Neotropical forests? A case study in south-eastern Brazil. *Journal of Tropical Ecology* 21 (1): 121-125.
- TERBORGH, J. 1988. The big things that run the world A sequel to E. O. Wilson. *Conservation Biology* 2 (4): 402-403.
- TERBORGH, J. 1992. Maintenance of diversity in tropical forests. *Biotropica* 24 (2): 283-292.
- TERBORGH, LOPEZ, L.; P. NUNEZ; M. RAO; G. SHAHABUDDIN; G. ORIHUELA & L. BALBAS. 2001. "Ecological meltdown in predator-free forest fragments". *Science* 294 (5548): 1923-1926.
- TORTATO, F.R.; A. F. TESTONI & S. L. ALTHOFF. 2014. Mastofauna terrestre da Reserva Biológica Estadual do Sassafrás, Doutor Pedrinho, Santa Catarina, Sul do Brasil. *Biotemas*, Florianópolis, 27 (3): 123-129.
- TRIGO, T.C.; A. SCHNEIDER; T. G. OLIVEIRA; L. M. LEHUGEUR; L. SILVEIRA; T. R. O FREITAS & E. EIZIRIK. 2013. Molecular Data Reveal Complex Hybridization and Cryptic Species of Neotropical Wild Cat. *Current Biology*, London, 23 (24): 2528-2533.
- WALLAUER, J.P.; M. BECKER; L. G. MARINS-SÁ; L. M. LIERMANN & V. SCHERMACK. 2000. Levantamento de Mamíferos da Floresta Nacional de Três Barras– SC, *Biotemas*, Florianópolis, 13 (1): 103-127.
- WOLFART, M.R.; M. FRÉ; G. B. MIRANDA & E. M. LUCAS. 2013. Mamíferos terrestres em um remanescente de Mata Atlântica, Paraná, Brasil. *Biotemas*, Florianópolis 26 (4): 111-119.