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LISTS OF SPECIES

Medium and large-sized mammals of RPPN Estação Veracel, southernmost Bahia, Brazil

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ABSTRACT: One of the largest private reserves in the Atlantic Forest is the RPPN Estação Veracel, which along with the contiguous forested area of the Pau-Brasil Ecological Station, is an important part of the remaining Atlantic Forest of southern Bahia. We carried out an inventory of medium and large mammals in the Reserve during a 16-month camera trap survey, as well as conducted interviews with park rangers and searched for direct/indirect records, which revealed 33 species belonging to nine different Orders. Among the species recorded, six are categorized as threatened in the national list and four in the IUCN global list. The RPPN harbors species which are crucial to the ecosystem, many of which are in decline and threatened by high hunting pressure and reduction of habitat. The results confirm the relevance of the RPPN as a Key Biodiversity Area (KBA) for globally threatened species.

INTRODUCTION

The Brazilian Atlantic Forest is one of the top five global biodiversity hotspots (Mittermeier *et al.* 2005) harboring an extremely rich assemblage of endemic plants and animals, and only *c.a.* 11% of the original biome remaining (Ribeiro *et al.* 2009). In northeastern Brazil this biome is not only reduced, but also fragmented into small forest patches generally isolated and embedded by a surrounding matrix profoundly modified by humans (Galindo-Leal and Câmara 2003). Forest fragmentation is directly linked to the dynamics of land use, including livestock, farm buildings, and deforestation by the timber industry (Coimbra-Filho and Câmara 1996; Galindo-Leal and Câmara 2003). Southern Bahia harbors the largest remnants of the Atlantic Forest of northeastern Brazil and is included in the Bahia center of endemism, one of the five Atlantic Forest centers of species endemism (*sensu* Silva and Casteletti 2003). The Bahia center is characterized by high levels of alpha and beta diversity and endemism of butterflies, birds, mammals and plants (Brown and Freitas 2000; Silva and Casteletti 2003; Martini *et al.* 2007; Tabarelli *et al.* 2010).

Protected areas are one of the most efficient tools available for biodiversity conservation, since they harbor natural populations and their ecological roles (Peres 2005; Possingham *et al.* 2006). Although protected areas are subject to external pressures, deforestation can usually be better controlled, and the effects of timber harvesting, hunting, grazing and fires can be mitigated (Bruner *et al.* 2001). According to Ribeiro *et al.* (2009) strictly protected areas (IUCN categories I and II) cover only 9% of the remaining, and 1% of the original Atlantic Forest.

In Brazil, one category of protected area is the Private Reserve of Natural Heritage (RPPN – *Reserva Particular do Patrimônio Natural*). One of the largest RPPN in the Atlantic Forest is RPPN Estação Veracel, which along with the contiguous forested area of the Pau-Brasil Ecological Station, is an important part of the remaining Atlantic Forest of southern Bahia. Several studies of medium and large mammals have been carried out within the RPPN, and most of them indicate the presence of endangered species in the reserve, although several records were obtained only through interviews (Teixeira unpublished data; Moura 2003; Melo unpublished data). A more comprehensive study of mammals in southern Bahia (Moura 2003) suggests the potential occurrence of 32 species of mammals in RPPN Estação Veracel, and the RPPN´s management plan (Schiavetti *et al.* 2007) indicates 38 potential mammal species, but some of these could be locally extinct, such as the jaguar (*Panthera onca*), the white-lipped peccary (*Tayassu pecari*), the giant armadillo (*Priodontes maximus*) and the maned sloth (*Bradypus torquatus*). The main purpose of our study was to build an updated list of medium and large-sized mammals of the RPPN Estação Veracel through different methods, which will serve as a tool for management and conservation plans of the Reserve.

MATERIALS AND METHODS

Study Area

The RPPN Estação Veracel, owned by the Veracel S.A., was created in November, 1998. The RPPN is located in the municipalities of Porto Seguro and Santa Cruz Cabrália between latitudes 16°18'00" and 16°24'00" S, and longitudes 39°06'00" and 40°00'00" W (Figure 1). The clime is Af type, hot and humid, without a dry season, according to Köppen classification (Kottek *et al.* 2006). The mean temperature is 22.6 ºC, with a range of 18.9 ºC to 27.9 ºC, the altitude ranges between 10 m and 80 m above sea level and the slope is mainly flat to gently undulating

(Schiavetti *et al.* 2007).

The RPPN Estação Veracel has an area of 6,069 hectares of Forest, mostly in the advanced stage (Schiavetti *et al.* 2007). The Forest patch including the adjacent Pau-Brasil Ecological Station is almost 7,300 ha. The predominant vegetation at RPPN Estação Veracel is a well-preserved *Tabuleiro* forest, a tropical lowland rainforest characterized by a uniform canopy with emergent individuals (Jardim 2003) associated with flat areas on Tertiary deposits known as Barreiras Formation (Dominguez *et al.* 2002).

Data collection

Several methods were used during monthly visits from December 2007 to April 2009, which were:

Interviews

A total of 12 interviews were conducted. Those selected for interviews were park rangers who had more than 10 years of experience making systematic rounds on the reserve and living in the surrounding area. The interviews were open-ended and conducted individually using free lists (Quinlan 2005), which allowed for the interviewee to speak freely about the region's mammal fauna. Furthermore, the technique of semantic cues, which has been proven to maximize the output in free-listing tasks, was used to enhance recall (Brewer 2002). After filling out the list, each interviewee was shown pictures of animals that could potentially exist in the reserve, alongside pictures of animals from other regions in order to confirm the cited species in the list.

Figure 1. Location of RPPN Estação Veracel, state of Bahia, northeastern Brazil. Triangles indicate the location of camera traps.

Non-systematic records

Sixteen monthly field trips, each lasting around 2-3 days, were made to check the camera traps. In each field trip, two researchers walked along the internal roads and trails within the forest, searching for direct (*e.g.* sightings, vocalizations, carcasses of dead animals) and indirect (*e.g.* footprints, skeletons, burrows/roosts) evidence of mammals. The location, habitat, and date were taken. Some physical evidence like carcasses, footprints, and burrows were also photographed and documented.

Camera Traps

Sixteen camera traps (Tigrinus Conventional v 4.0 c) were distributed throughout the Reserve (Figure 1), and maintained in their locations for 16 months, from the first week of December 2007 to the last week of April 2009. The model has an automatic Canon 35mm BF10 camera loaded with Fuji Pro Value 200 ASA film, with 36 exposures, contained in a weatherproof case, and the camera traps were settled near ponds, animal paths or fruit trees, which showed direct or indirect evidence of mammal presence. The equipment was programmed to shoot at intervals of at least 30 seconds between shots and operated continuously (24 hours / day). Cameras were checked every four weeks in order to rewind the film, change batteries if necessary, and ensure they were working properly. Identification and taxonomic nomenclature follows recent mammal compilations (Wilson and Reeder 2005; Gardner 2008; Alfaro *et al.* 2011; Reis *et al.* 2011). Threat category follows Machado *et al.* (2008) and IUCN Red List of Threatened Species (IUCN 2012).

The total camera trap sample effort was approximately 7840 trap-days (16 traps x 490 days). A species accumulation curve based on sample day was calculated analytically (S_{obs} *Mao Tau,* Colwell *et al.* 2004) using EstimateS 8.2 (Colwell 2009). The accumulation curve was compared with the projected species richness estimated with non-parametric incidence-based estimators (Chao 2 and Jackknife 1) through 100 randomizations without replacement using EstimateS 8.2 (Colwell 2009).

RESULTS AND DISCUSSION

The inventory revealed 33 species of medium and large mammals belonging to nine different Orders. The majority of the species (14, 42%) were Carnivora, followed by Rodentia (6, 18%). Camera traps recorded 15 species, representing 45% of the total number of species (Table 1) and 16 were recorded only by interviews, representing 48% of the species (Table 2). Among the species recorded, six are threatened in the national list (Machado *et al.* 2008) and four in the global list (IUCN 2012) (Tables 1 and 2). The accumulation curve of observed species (Sobs) using the camera trap data showed an asymptote at 15 species. The 95% confidence interval of Sobs includes species richness predicted by Chao 2, which was lower than Jack 1, which predicted 16 species for the Reserve (Figure 2).

During the 16 months of camera trapping we did not register some of the threatened species listed for the Reserve in the management plan (Schiavetti *et al.* 2007), namely jaguar (*Panthera onca*), giant armadillo (*Priodontes maximus*) and maned sloth (*Bradypus torquatus*). The park rangers are trained in identification of large mammals,
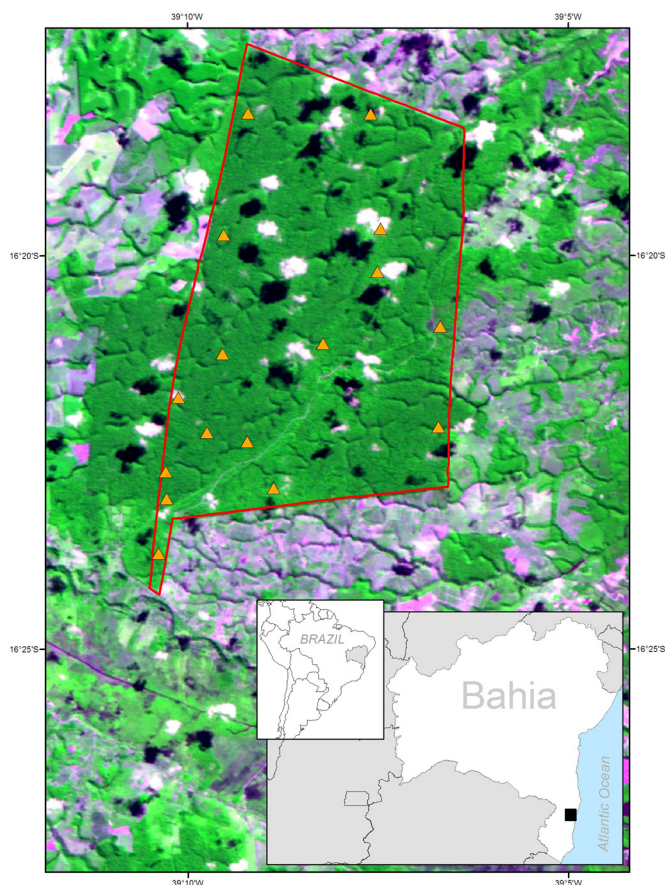
including vestiges, and they walk by tracks in the forest five days per week. None of them reported encounters with these species or their vestiges. We assume that these species are locally extinct.

Our inventory confirmed the occurrence of species that are difficult to observe in the field, such as the felids margay (*Leopardus wiedii*) and puma (*Puma concolor*) listed as Vulnerable in the Brazilian national red list (Machado *et al.* 2008) (Figure 3). Prior to our inventory their occurrence had been recorded only through interviews (Moura 2003). These felids are at the top of the food chain and deserve special attention since they have large territories and therefore require large forest fragments to maintain viable population sizes (Currier 1983; Murray and Gardner 1997; Oliveira 1998; Michalski *et al.* 2006).

Threatened primate species were also recorded, such as the titi monkey (*Callicebus melanochir*) and the black capuchin monkey (*Sapajus robustus*). Intense hunting
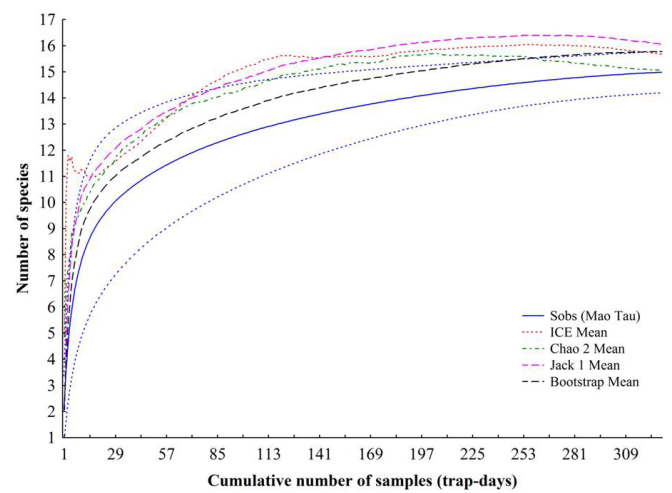

FIGURE 2. Accumulation curve of observed species – Sobs (Mao Tau) with 95% confidence interval (blue dashed line) and species richness predicted by non-parametric incidence-based estimators.

TABLE 1. Medium and large-sized mammals recorded in RPPN Estação Veracel with national (Machado *et al.* 2008) and global (IUCN 2012) threat category. LC = Least Concern; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient. Records: I = Interview, S = Sighting; C = Camera trap; F = Footprint.

ORDER	SPECIES	RECORD	CONSERVATION STATUS	
			National	**Global**
Artiodactyla	*Mazama gouazoubira*	I,C		LC
	Pecari tajacu	I,S,F,C		LC
Carnivora	*Canis lupus familiaris*	C		LC
	Leopardus wiedii	I,C	VU	NT
	Nasua nasua	I,S,C		LC
	Puma concolor	I,C,S	VU	LC
Cingulata	*Cabassous unicinctus*	I,C		LC
	Dasypus novemcinctus	I,C,S		LC
Didelphimorphia	*Didelphis aurita*	I,C		LC
	Metachirus nudicaudatus	C		LC
Perissodactyla	*Tapirus terrestris*	I,C		VU
Pilosa	*Bradypus variegatus*	I,S		LC
	Tamandua tetradactyla	I,C,S		LC
Primates	*Callithrix geoffroyi*	I,S		LC
	Sapajus robustus	I,S	VU	EN
Rodentia	*Cuniculus paca*	I, C		
	Dasyprocta leporina	I,S,F,C		LC
	Guerlinguetus ingrami	I,S,C		-

TABLE 2. Medium and large-sized mammals recorded in RPPN Estação Veracel by interviews, with common names.

ORDER	SPECIES	COMMON NAME
Carnivora	*Cerdocyon thous*	Crab-eating Fox
	Conepatus semistriatus	Striped Hog-nosed Skunk
	Eira barbara	Tayra
	Galictis sp.	Grison
	Puma yagouaroundi	Jaguarundi
	*Leopardus pardalis**	Ocelot
	Lontra longicaudis	Neotropical Otter
	Potos flavus	Kinkajou
	Procyon cancrivorus	Crab-eating Raccoon
Cingulata	*Euphractus sexcinctus*	Six-banded Armadillo
Lagomorpha	*Sylvilagus brasiliensis*	Tapeti
Primates	*Callicebus melanochir**&	Southern Bahian Masked Titi
Rodentia	*Chaetomys subspinosus**&	Thin-spined Porcupine
	Hydrochoerus hydrochaeris	Capybara
	Sphiggurus insidiosus	Bahia Porcupine

* Species threatened with extinction in the national red list (Machado *et al.* 2008)
& Species threatened with extinction in the global red list (IUCN 2012)

pressure and habitat loss are the main threats to their survival in the region, and have contributed to population declines (Canale 2008; Martins 2008). Among the rodents, the park rangers report the occurrence of the black urchin (*Chaetomys subspinosus*), classified as Vulnerable in the national and in the global lists (Machado *et al.* 2008; IUCN 2012). In addition, the reserve harbors one of the last populations of the tapir (*Tapirus terrestris*) in northeastern Brazil, which is also threatened with extinction in the global list (IUCN 2012) (Figure 4). In southern Bahia, the tapir populations are now restricted to larger forest fragments in the south of the Jequitinhonha River (Moura 2003).

Records of domestic dogs inside the Reserve indicate that hunting, despite intensive surveillance by park rangers, is still a problem (Figure 5). This fact could be related to the presence of two urban centers close to the RPPN, and also to the presence of municipality roads inside the limits of the reserve. Studies reveal a negative impact of subsistence hunting on the vertebrate fauna, especially mammals (Peres 2000). Hunting often causes changes in diversity and population structure of the target species (Robinson *et al.* 1999; Peres 2001), and can result in local extinctions As pointed out by Cullen Jr. *et al.* (2000) hunting pressure can exceed the effects of fragmentation,

whether genetic or demographic, and is probably the most important factor in the short term concerning species extinction. In fact, this kind of pressure has been reported in southern Bahia (Moura 2003) and also in other regions of northeastern Brazil (Oliveira 2003). This raises concerns for southern Bahia because it harbors the largest forest remnants of the northeastern Atlantic Forest, which is the most threatened part of this biome in South America (Silva & Tabarelli 2000).

The confirmed records of young collared peccaries (*Pecari tajacu*; Figure 6) and brown brocket deer (*Mazama gouazoubira*; Figure 7) are very important, and indicate that these species may have sustainable populations in the Reserve. The other mammals confirmed through camera traps are presented in Figure 8. The RPPN harbors species that are crucial for the ecosystem, many of which are in decline and threatened by high hunting pressure and reduction of habitat. The results confirm the relevance of the RPPN as one of the last large remnants of *Tabuleiro* forest in southern Bahia and a Key Biodiversity Area – KBA (Paese *et al.* 2010) for globally threatened species. Environmental education activities surrounding the RPPN and increased surveillance should be encouraged to reduce hunting and extraction of other natural resources from the Reserve.

FIGURE 3. Species listed as Vulnerable in the Brazilian national red list (Machado *et al.* 2008) recorded in the reserve: a) puma (*Puma concolor*); b) margay (*Leopardus wiedii*).

FIGURE 4. Tapir (*Tapirus terrestris*), a globally threatened species recorded in the Reserve.
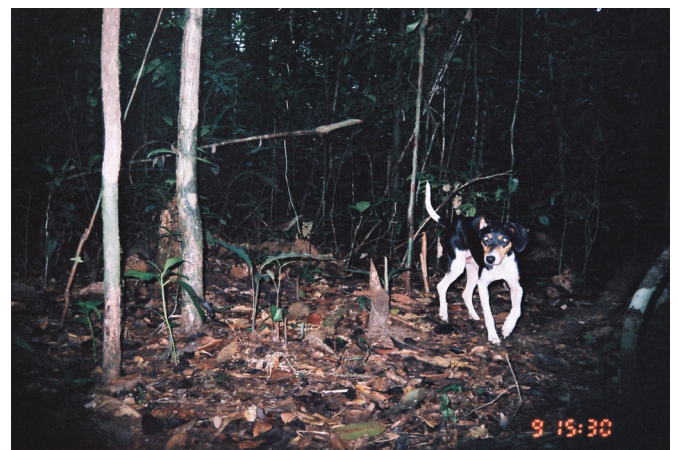
FIGURE 5. Domestic dog (*Canis lupus familiaris*) captured in camera traps, an indicative of hunting pressure in the RPPN Estação Veracel.

FIGURE 6. Collared peccary (*Pecari tajacu*) with infant, recorded in the Reserve.

FIGURE 7. A young brown brocket deer (*Mazama gouazoubira*) registered in the Reserve.
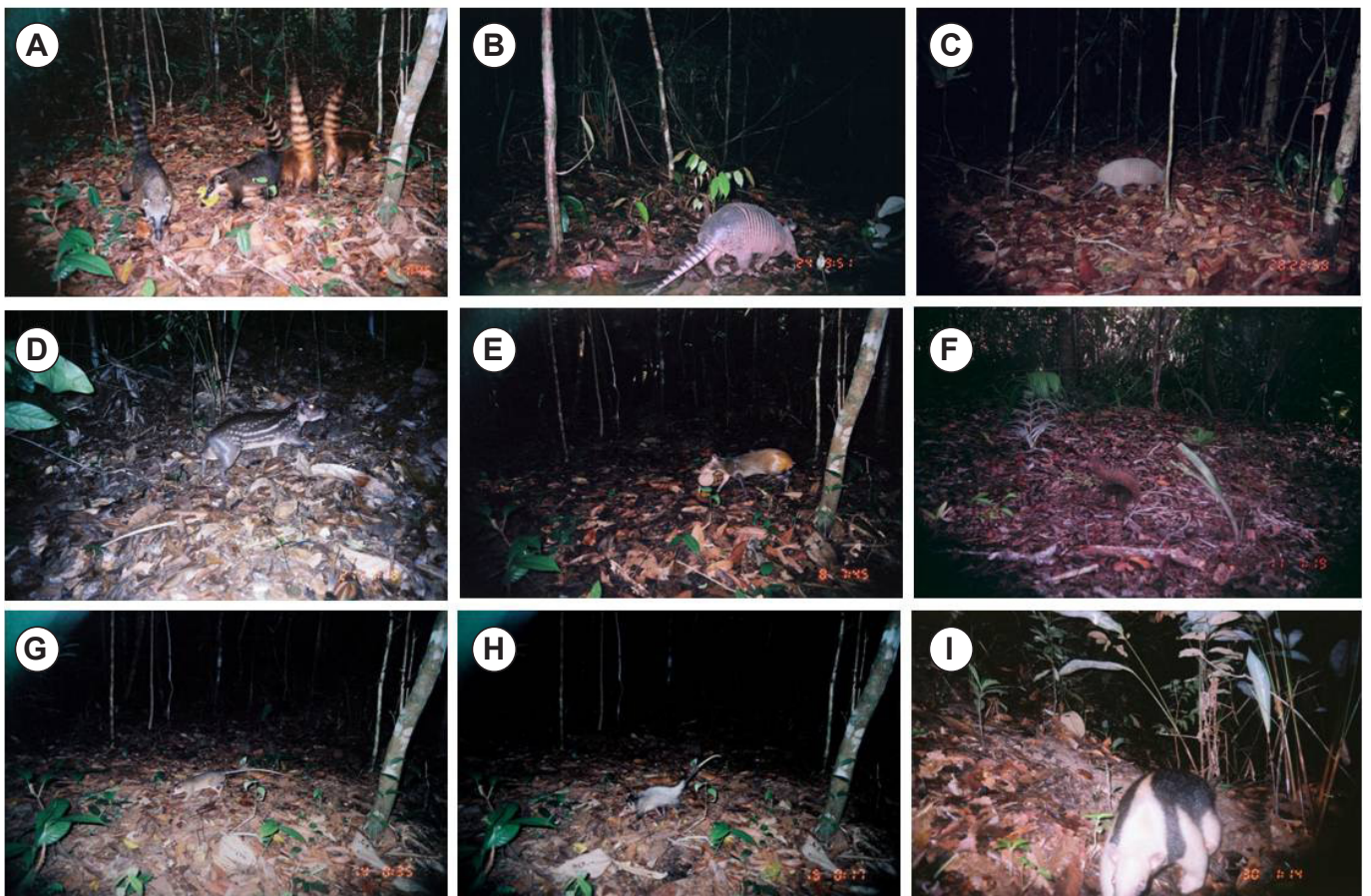

FIGURE 8. Other mammals recorded by camera traps in RPPN Estação Veracel. (a) *Nasua nasua*, (b) *Dasypus novemcinctus*, (c) *Cabassous unicinctus*, (d) *Cuniculus paca*, (e) *Dasyprocta leporina*, (f) *Guerlinguetus ingrami*, (g) *Metachirus nudicaudatus*, (h) *Didelphis aurita*, (i) *Tamandua tetradactyla*.

LITERATURE CITED

Alfaro, J.W.L., J.P. Boubli, L.E. Olson, A.D. Fiore, B. Wilson, G.A. Gutiérrez-Espeleta, K.L. Chiou, M. Schulte, S. Neitzel, V. Ross, D. Schwochow, M.T.T. Nguyen, I. Farias, C.H. Janson and M.E. Alfaro. 2011. Explosive Pleistocene range expansion leads to widespread Amazonian sympatry between robust and gracile capuchin monkeys. *Journal of Biogeography* 39(2): 272-288.

Brewer, D.D. 2002. Supplementary interviewing techniques to maximize output in free listing tasks. *Field Methods* 14(1): 108-118.

Brown-Jr., K.S. and A.V.L. Freitas. 2000. Atlantic Forest butterflies: indicators for landscape conservation. *Biotropica* 32(4b): 934–956.

Bruner, A.G., R.E. Gullison, R.E. Rice. and G.A.B. Fonseca, 2001. Effectiveness of parks in protecting tropical biodiversity. *Science* 291(5501): 125–128.

Canale, G.R. 2008. *Callicebus melanochir*; p.772-773. *In* A.B.M. Machado, G.M. Drummond and A.P. Paglia (ed.). *Livro vermelho da fauna brasileira ameaçada de extinção*. Brasília: MMA; Belo Horizonte: Fundação Biodiversitas.

Coimbra-Filho, A.F. and I.G. Câmara. 1996. *Os limites originais do bioma Mata Atlântica na Região Nordeste do Brasil*. Rio de Janeiro: Fundação Brasileira para a Conservação da Natureza. 86p.

Colwell, R.K., C.X. Mao and J. Chang, 2004. Interpolating, extrapolating,

and comparing incidence-based species accumulation curves. *Ecology* 85(10): 2717-2727.

Colwell, R.K. 2009. *EstimateS: Statistical estimation of species richness and shared species from samples.* Version 8.2.0. Accessible at http://viceroy.eeb.uconn.edu/estimates/. Captured on 09 September 2011.

Cullen-Jr., L., R.E. Bodmer and C.V. Pádua. 2000. Effects of hunting in habitat fragments of the Atlantic Forest, Brazil. *Biological Conservation* 95(1): 49-56.

Currier, M.J. 1983. *Felis concolor. Mammalian Species* 200: 1-7.

Dominguez, J.M.L., L. Martin and A.C.S. Bittencourt. 2002. A Costa do Descobrimento, BA: a geologia vista das caravelas; p.233-241. *In* C. Schobbenhaus, D.A. Campos, E.T. Queiroz, M. Winge and M.L.C. Berbert-Born (ed.). *Sítios Geológicos e Paleontológicos do Brasil.* Brasília: DNPM/CPRM.

Galindo-Leal, C. and I.G. Câmara. 2003. Atlantic Forest hotspots status: an overview; p.3-11. *In* C. Galindo-Leal and I.G. Câmara (ed.).*The Atlantic Forest of South America: biodiversity status, threats, and outlook.* Washington D.C.: Center for Applied Biodiversity Science and Island Press.

Gardner, A. L. 2008. *Mammals of South America – Marsupials, Xenarthrans, Shrews and Bats. Volume I.* The University of Chicago Press, Chicago. 669p.

IUCN 2012. *IUCN Red List of Threatened Species. Version 2012.1.* Electronic Database accessible at http://www.iucnredlist.org/.Captured on 04 July 2012.

Jardim, J.G. 2003. Uma caracterização parcial da vegetação na região sul da Bahia, Brasil; p.1-200. *In* P.I. Prado, E.C. Landau, R.T. Moura, L.P.S. Pinto, G.A.B. Fonseca and K.N. Alger (ed.). *Corredor de Biodiversidade da Mata Atlântica do Sul da Bahia.* São Paulo: Microservice Tecnologia Digital S/A.

Kottek, M., J. Grieser, C. Beck, B. Rudolf and F. Rubel, 2006. World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift* 15 (3): 259-263

Machado, A.B.M., G.M. Drummond and A.P. Paglia. 2008. *Livro vermelho da fauna brasileira ameaçada de extinção. Volume II.* Brasília: MMA; Fundação Biodiversitas, Belo Horizonte. 1420p.

Martini, A.M.Z., P. Fiaschi, A.M. Amorim and J.L. Paixão. 2007. A hot-point within a hot-spot: a high diversity site in Brazil`s Atlantic Forest. *Biodiversity and Conservation* 16 (11): 3111-3128.

Martins, W.P. 2008. *Cebus robustus*; p.754-755. *In* A.B.M. Machado, G.M. Drummond and A.P. Paglia (ed.). *Livro vermelho da fauna brasileira ameaçada de extinção.* Brasília: MMA; Belo Horizonte: Fundação Biodiversitas.

Michalski, F., R.L.P. Boulhosa, A. Faria and C.A. Peres. 2006. Human–wildlife conflicts in a fragmented Amazonian forest landscape: determinants of large felid depredation on livestock. Animal Conservation 9(2): 179–188.

Mittermeier, R.A., R.P. Gil, M. Hoffman, J. Pilgrim, T. Brooks, C.G. Mittermeier, J. Lamoreux and G.A.B. Fonseca. 2005. *Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions.* 2nd ed. Boston: University of Chicago Press. 392p.

Moura, R.T.M. 2003. Distribuição e ocorrência de mamíferos da Mata Atlântica do Sul da Bahia; p.1-22. *In* P.I.Prado, E.C. Landau, R.T. Moura, L.P.S. Pinto, G.A.B. Fonseca and K.N. Alger (ed.) *Corredor de Biodiversidade da Mata Atlântica do Sul da Bahia.* São Paulo: Microservice Tecnologia Digital S/A.

Murray, J.L. and G.L. Gardner. 1997. *Leopardus pardalis. Mammalian Species* 548: 1-10.

Oliveira, J.A. 2003. Diversidade de mamíferos e o estebelecimento de áreas prioritárias para a conservação do bioma Caatinga; p.263-282. *In* J.M.C. Silva, M. Tabarelli, M.T. Fonseca and L.M. Lins, (org.). *Biodiversidade da Caatinga: áreas e ações prioritárias para a conservação.* Brasília: MMA; Recife: UFPE.

Oliveira, T.G. 1998. *Herpailurus yaguaroundi. Mammalian Species* 578: 1-6.

Paese, A., A. Paglia, L.P. Pinto, M.N. Foster, M.T. Fonseca and R. Sposito. 2010. Fine-scale sites of global conservation importance in the Atlantic Forest of Brazil. *Biodiversity and Conservation* 19(12): 3445–3458.

Peres, C.A. 2000. Effects of subsistence hunting on vertebrate community structure in Amazonian forests. *Conservation Biology* 14(1): 240–253.

Peres, C.A. 2001.Synergistic effects of subsistence hunting and habitat fragmentation on Amazon forest vertebrates. *Conservation Biology* 15(6): 1490-1505.

Peres, C.A. 2005. Why we need megareserves in Amazonia. *Conservation Biology* 19(3):728–733.

Possingham, H.P., K.A. Wilson, S.J. Andelman and C.H. Vynne. 2006. Protected areas: goals, limitations, and design; p.509-533. *In* M.J. Groom, G.K. Meffe and C.R. Carroll (ed.). *Principles of conservation biology.* Sunderland: Sinauer Associates Inc.

Quinlan, M. 2005. Considerations for collecting freelists in the field: examples from ethnobotany. *Field Methods* 17(3): 1-16.

Reis, N.R., A.L. Peracchi, W.A. Pedro and I.P. Lima. 2011. *Mamíferos do Brasil.* 2ª. ed. Londrina: Nélio dos Reis. 439p.

Ribeiro, M.C., J.P. Metzger, A.C. Martensen, F.J. Ponzoni and M.M. Hirota. 2009. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation - Special Issue* 142(6): 1141-1153.

Robinson, J.G., K.H. Redford and L. Bennett. 1999. Wildlife harvest in logged tropical forests. *Science* 284(5414): 595–596.

Schiavetti, A., M. Fonseca, L. Bedê and L.P. Pinto. 2007. *Plano de Manejo - Reserva Particular do Patrimônio Natural Estação Veracel.* Porto Seguro: Veracel and Conservação Internacional do Brasil. 308p.

Silva, J.M.C. and C.H.M. Casteletti. 2003. Status of the biodiversity of the Atlantic Forest of Brazil; p.43-59. *In* C. Galindo-Leal and I.G. Câmara (ed.). *The Atlantic Forest of South America: biodiversity status, threats, and outlook.* Washington D.C.: Center for Applied Biodiversity Science and Island Press.

Silva, J.M.C. and M. Tabarelli. 2000. Tree species impoverishment and the future flora of the Atlantic Forest of northeast Brazil. *Nature* 404(2): 72-74.

Tabarelli, M., A.V. Aguiar, L.C. Girão, C.A. Peres and A.V. Lopes. 2010. Effects of pioneer tree species hyper abundance on forest fragments in Northeastern Brazil. *Conservation Biology* 24:1654-1663.

Wilson, D. E. and D.M. Reeder. 2005. *Mammal Species of the World: A Taxonomic and Geographic Reference.* 3rd ed. Maryland: Johns Hopkins University Press. 2142 p.