UNIVERSIDADE FEDERAL DE LAVRAS

Luciano Carramaschi de Alagão Querido

ANTHROPIC PARAMETERS OF LANDSCAPE AND ITS INFLUENCE ON MEDIUM TO LARGE MAMMALS

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LUCIANO CARRAMASCHI DE ALAGÃO QUERIDO

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Dissertação apresentada à Universidade Federal de Lavras, como parte das exigências do Programa de Pós-Graduação em Ecologia Aplicada, área de concentração em Ecologia e Conservação de Recursos Naturais em Paisagens Fragmentadas e Agrossistemas, para a obtenção do título de Mestre.

Prof. Dr. Marcelo Passamani
Orientador

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RESUMO

Existe uma lacuna na amostragem de mamíferos de médio e grande porte na região Sul de Minas Gerais, da mesma forma diversos trabalhos sobre mamíferos não levam em conta as características da paisagem que circunda os fragmentos estudados. Diante disso, esse trabalho teve como objetivo entender como as espécies de mamíferos de médio e grande porte estão distribuídas na região Sul de Minas Gerais e se essas espécies são afetadas por modificações ambientais em uma escala local ou uma escala regional. No primeiro artigo temos um levantamento das espécies de mamíferos de médio e grande porte nos municípios estudados, buscando conhecer as espécies e como elas estão distribuídas nesse ambiente. Neste artigo realizamos uma análise de NMDS para entendermos se existe diferença na composição de espécies entre os municípios. Também realizamos uma análise de beta diversidade para entender se existe diferença na distribuição das espécies entre os municípios estudados, seja por substituição ou compartimentalização das espécies. Nossos resultados mostram uma grande diferença na riqueza e na composição de espécies, assim como uma grande diversidade beta entre os municípios, evidenciando uma grande prioridade para conservação de toda essa região na esperança de manter essas espécies presentes. No segundo artigo buscamos entender quais são as variáveis ambientais que melhor explicam a riqueza de espécies encontradas em oito paisagens com diferentes proporções de vegetação, próximas ao Complexo da Serra da Mantiqueira. Buscamos ver quais variáveis eram mais influentes tanto na escala local, quanto na escala regional. Os resultados mostram uma grande influência do tamanho do fragmento amostrado e o tamanho das árvores, na escala local, e da proporção de vegetação e média do tamanho do fragmento, na escala regional. Com os resultados obtidos nessa dissertação esperamos trazer a luz a importância dessa região para conservação dessa comunidade de mamíferos de médio e grande porte, mostrando a importância de se conservar uma grande quantidade de fragmentos ao longo de toda a região e que esses fragmentos sejam manejados para manter, preferencialmente uma grande extensão.

Palavras-chave: Ecologia de Paisagem; Mamíferos; Mata Atlântica Camera-trap; Diversidade

ABSTRACT

There is a gap in the sampling of medium and large mammals in the southern region of Minas Gerais, in the same way several works on mammals do not take into account the characteristics of the landscape that surrounds the fragments studied. The objective of this study was to understand how the medium and large sized mammals are distributed in the southern region of Minas Gerais and whether these species are affected by environmental modifications at a local or regional scale. In the first article we have a survey of mammal species of medium and large size in the South of Minas Gerais, seeking to know the species and how they are distributed in this environment. In this paper we performed an NMDS analysis to understand if there is a difference in species composition among the municipalities. We also performed a beta diversity analysis to understand if there is a difference in the distribution of the species among the studied municipalities, either by substitution or compartmentalization of the species. Our results show a great difference in the richness and composition of species, as well as a great beta diversity among the municipalities, showing a great priority for the conservation of the whole region in the hope of keeping these species present. In the second article we try to understand which are the environmental variables that best explain the species richness found in eight landscapes with differences in the vegetation proportion, in the proximity of the Serra da Mantiqueira complex. We sought to see which variables were most influenced both locally and regionally. The results show a great influence of the size of the sampled fragment and the size of the trees in the local scale, and the proportion of vegetation and average of the size of the fragment, in the regional scale. With the results obtained in this dissertation we hope to bring to light the importance of this region for the conservation of this community of medium and large sized8+ mammals, showing the importance of conserving a large quantity of fragments throughout the region and that these fragments are managed for maintain, preferably to a large extension.

Keywords: Landscape Ecology; Mammals, Atlantic Forest, Camera-trap; Diversity

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PRIMEIRA PARTE

1 INTRODUÇÃO

O Domínio Atlântico apresenta aproximadamente 250 espécies de mamíferos, o que representa aproximadamente 38% do número de espécies de mamíferos presentes no Brasil (REIS et al., 2011). Devido a localização predominantemente litorânea, esse domínio sofreu pressões do desenvolvimento econômico desde os primórdios da sociedade brasileira até a expansão atual da agropecuária e silvicultura, o que culminou no alto grau de fragmentação encontrado na Mata Atlântica (RIBEIRO et al., 2009). Essas pressões levaram a redução da vegetação até sobrarem alguns poucos remanescentes, que se encontram isolados e perturbados (OLIVEIRA-FILHO; FLUMINHAN-FILHO, 1999; RIBEIRO et al., 2009; SOSMA E INPE, 2016). A remoção de habitat, causada pela fragmentação, associada com a alta pressão de caça, tem levado a uma alta taxa de declínio no número de espécies de mamíferos nessas áreas (TREVES; BRUSKOTTER, 2014).Se levarmos em conta que cerca de 50 espécies são endêmicas desse domínio, o alto perigo de remoção e a importância ecológica do domínio, fica evidente o porque de considerarmos a Mata Atlântica como um dos principais hotspots para conservação no Brasil (HERINGER; MONTENEGRO, 2000; MITTERMEIER et al., 2005).

Toda esta pressão sobre a comunidade de mamíferos leva a quebra da homeostase do ecossistema, ocasionando diversos problemas ambientais (ESTES et al., 2011; JORGE et al., 2013). Esses problemas ambientais causam grandes perdas econômicas para a sociedade, já que os mamíferos são importantes para manutenção da floresta de uma maneira funcional, mantendo os serviços ambientais operando em equilíbrio. Já é conhecido que a presença de mamíferos de médio e grande porte mantêm as taxas de predação de sementes equilibradas (GALETTI; BOVENDORP; GUEVARA, 2015), uma alta complexidade ambiental mantêm uma teia trófica mais complexa e a presença de predadores de topo leva a um maior equilíbrio ambiental (SMITH; PETERSON; HOUSTON, 2003), além da presença de espécies de mamíferos ser extremamente importante na persistência e recuperação de áreas florestais (WILKIE et al., 2011).

A Ecologia de Paisagens é usada para explicar as interações existentes entre os padrões espaciais/geográficos da paisagem e as características ecológicas intrínsecas das espécies que estão presentes nela. Buscando entender a importância da configuração espacial de uma paisagem para os processos ecológicos das espécies (TURNER; GARDNER; O'NEILL, 2001). Portanto, a Ecologia de Paisagens é uma importante ferramenta para entendermos como a sociedade promove variações ambientais em uma paisagem e quais as consequências dessas modificações nas comunidades biológicas.

Os mamíferos são extremamente vulneráveis a variação no uso da terra (DAVIDSON et al., 2009). A riqueza e composição de mamíferos também são afetadas pelo formato e tamanho do fragmento, bem como a qualidade da matriz, em paisagens pequenas. Em estudos que consideram paisagens com maior escala somente o número de fragmentos foi responsável pelas variações na assembleia de mamíferos (GARMENDIA et al., 2013). Outras espécies também respondem às variações no tamanho dos fragmentos, tanto em florestas tropicais fora do Brasil (PRUGH et al., 2008) como em áreas de Mata Atlântica do sudeste do Brasil (CHIARELLO, 1999). Também já foi descrito uma grande sensibilidade dos mamíferos de médio e grande porte a variação na matriz que contorna os fragmentos, mostrando uma grande modificação na composição entre diferentes culturas agrícolas (CASSANO; BARLOW; PARDINI, 2012; ROCHA; PASSAMANI; YANKOUS GONÇALVES FIALHO, 2014; UMETSU; PAUL METZGER; PARDINI, 2008). As paisagens estudadas nesses trabalhos são, geralmente, de menores escalas (até 5 km2 no trabalho de GARMENDIA e colaboradores (2013), por exemplo) ou o efeito das paisagens são desconsideradas inteiramente.

Perante essa necessidade de conhecimento sobre a influência da interação de variáveis ambientais locais e regionais sobre a comunidade de mamíferos, este estudo busca ampliar a escala nos estudos de paisagem para médios e grandes mamíferos, focando em descobrir se as espécies estudadas respondem à variação que ocorre em uma escala maior do que a que tem sido tratada nos trabalhos atuais. Buscamos entender quais são as modificações antrópicas que mais influenciam as espécies na área Sul de Minas Gerais. Para isso, levantamos as características estruturais das paisagens, avaliando a qualidade dos remanescentes florestais, o reflexo do uso da terra (baseado na supressão de áreas naturais) e a porcentagem de vegetação remanescente na paisagem. Esses impactos foram avaliados em função da variação da riqueza e a composição de espécies de mamíferos de médio e grande porte, entre as paisagens.

2 REFERENCIAL TEÓRICO

.2.1 Mata Atlântica

O Brasil é considerado um dos países com maior biodiversidade no mundo, apresentando um tamanho continental esse país apresenta uma rica variedade ambiental. Essa variedade favorece a ocorrência de diversos fatores ambientais que possibilitam a presença de uma enorme diversidade biológica, tanto vegetal quanto animal. Dentro dessa gama de ambientes extremamente ricos, a Mata Atlântica é um dos biomas mais importantes no país e é considerado como um hotspot para conservação, por conta da sua alta riqueza de espécies, alta taxa de endemismos e pela enorme pressão de supressão ao longo dos anos (MITTERMEIER et al., 2005; MYERS et al., 2000).

A Mata Atlântica cobria originalmente uma área de 150 milhões de ha e era distribuída ao logo de quase toda a costa brasileira. Essa larga distribuição geográfica é dita como uma das importantes características para explicar a alta diversidade de espécies presentes ali principalmente por causa do aumento da quantidade de chuvas próximos ao litoral (RIBEIRO et al., 2009; SANT'ANNA NETO, 2005) e também por causa da grande variação altitudinal do bioma (OLIVEIRA-FILHO; FONTES, 2000). Portanto sua distribuição geográfica é uma das principais causas da alta riqueza do bioma, porém essa distribuição é a causa do grande desmatamento do bioma (RIBEIRO et al., 2009), principalmente por conta da alta exploração sofrida desde os primórdios da sociedade brasileira até a expansão atual da agropecuária e monoculturas (MITTERMEIER et al., 2005). Essa exploração desacerbada causou a alta fragmentação da Mata Atlântica, que hoje se encontra com alguns poucos fragmentos florestais isolados e altamente perturbados (OLIVEIRA-FILHO; FLUMINHAN-FILHO, 1999; RIBEIRO et al., 2009; SOSMA E INPE, 2016).

.2.2 Minas Gerais

O estado de Minas Gerais é o quarto maior estado da federação brasileira, cobrindo cerca de 6.89% do território nacional. É recoberto principalmente pelos biomas do Cerrado e da Mata Atlântica, com uma pequena mancha de caatinga no norte do estado (IBGE, 2012). O estado se encontra como um dos mais impactados no Brasil, onde a expansão do agronegócio e a ineficácia de implementação e manutenção de áreas de proteção são as principais causas para a supressão desses biomas naturais (BOYD et al., 2008; DIAS, 2008; RIBEIRO et al., 2009). Como consequência temos uma alta taxa de supressão dos ambientes naturais e uma baixa taxa de proteção, o que leva os biomas a se apresentarem em extremo perigo.

Na região Sul de Minas Gerais, onde a maior parte desse trabalho foi desenvolvido, a principal fonte de supressão de habitats tem sido a expansão da cultura cafeeira que tem levado a grandes modificações da paisagem (FILETTO; ALENCAR, 2001). Diante dessas pressões, a ecologia de paisagem pode ser usada para entender como que as modificações nas variáveis ambientais causadas pela sociedade impactam as comunidades biológicas nesse local.

.2.3 Ecologia de Paisagem para Médios e Grandes Mamíferos

A ecologia de paisagem busca explicações para a interação entre os padrões espacias da paisagem e os processos ecológicos das espécies que a compõem (TURNER; GARDNER; O'NEILL, 2001), tentando entender como essas modificações na configuração espacial da área (remoção/fragmentação de habitats) vão influenciar nos processos ecológicos das espécies.

Os mamíferos são extremamente vulneráveis a essas variações no uso da terra, respondendo a pequenas modificações no mesmo (DAVIDSON et al., 2009). A riqueza e composição de mamíferos também são afetadas pelo formato e tamanho do fragmento, bem como a qualidade da matriz (MAGIOLI et al., 2015; MENDES; RIBEIRO; GALETTI, 2016). Outras espécies também respondem às variações no tamanho dos fragmentos, tanto em florestas tropicais fora do Brasil (PRUGH et al., 2008) como em áreas de Mata Atlântica do sudeste do Brasil (CHIARELLO, 1999).

Os fragmentos florestais e a comunidade de espécies ali presente, são muito influenciados pela presença de espécies de mamíferos. Sendo que os mamíferos de médio e grande porte apresentam uma importância muito grande na manutenção de diversos serviços ecossistêmicos nesse ambiente (ESTES et al., 2011). Os mamíferos são influentes na manutenção das dinâmicas de predação/remoção de sementes afetando a permanência (LINDSELL et al., 2015) e colonização de novas áreas (BORDIGNON; MONTEIRO-FILHO, 2000) pelas espécies vegetais; influenciam diretamente na manutenção de uma rede trófica equilibrada tanto os grandes predadores (RIPPLE; BESCHTA, 2004) quanto os predadores de menor porte (ROEMER; GOMPPER; VALKENBURGH, 2009).

Dessa forma, a manutenção de uma comunidade de mamíferos de médio e grande porte leva a melhorias no ambiente que possibilitam a restauração ambiental e a manutenção de uma rede trófica equilibrada, aumentando a resistência dessa rede aos impactos causados pela fragmentação.

REFERENCIAL BIBLIOGRÁFICO

BORDIGNON, M.; MONTEIRO-FILHO, E. L. A. O Serelepe Sciurus ingrami (Sciuridae: Rodentia) Como Dispersor do Pinheiro do Paraná Araucaria angustifolia (Araucariaceae: Pinophyta). **Arquivos de Ciências Veterinárias e Zoologia da UNIPAR**, v. 3, n. 2, 2000.

BOYD, C. et al. Spatial scale and the conservation of threatened species. **Conservation Letters**, v. 1, n. 1, p. 37–43, 12 maio 2008.

CASSANO, C. R.; BARLOW, J.; PARDINI, R. Large Mammals in an Agroforestry Mosaic in the Brazilian Atlantic Forest. **Biotropica**, v. 44, n. 6, p. 818–825, nov. 2012.

CHIARELLO, A. Effects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. **Biological Conservation**, v. 89, n. 1, p. 71–82, jul. 1999.

DAVIDSON, A. D. et al. Multiple ecological pathways to extinction in mammals. **Proceedings of the National Academy of Sciences**, v. 106, n. 26, p. 10702–10705, 30 jun. 2009.

DIAS, B. F. DE S. Conservação da Biodiversidade no Bioma Cerrado: histórico dos impactos antrópicos no Bioma Cerrado. In: FALEIRO, F. G.; NETO, A. L. DE F. (Eds.). . **Savanas: Desafios e Estratégias para o Equilíbrio entre Sociedade, Agronegócio e Recursos Naturais**. Brasília, DF: Embrapa Informação Tecnológica, 2008. p. p 303-336.

ESTES, J. A et al. Trophic downgrading of planet Earth. **Science (New York, N.Y.)**, v. 333, n. 6040, p. 301–306, 2011.

FILETTO, F.; ALENCAR, E. Introdução E Expansão Do Café Na Região Sul De Minas Gerais. **Organizações Rurais e Agroindustriais**, v. 3, n. 1, p. 1–10, 2001.

GALETTI, M.; BOVENDORP, R. S.; GUEVARA, R. Defaunation of Large Mammals Leads to an Increase in Seed Predation in the Atlantic Forests. **Global Ecology and Conservation**, v. 3, p. 824–830, 2015.

GARMENDIA, A. et al. Landscape and patch attributes impacting medium- and large-sized terrestrial mammals in a fragmented rain forest. **Journal of Tropical Ecology**, v. 29, n. 4, p. 331–344, jul. 2013.

HERINGER, H.; MONTENEGRO, M. M. **Avaliação e Ações Prioritárias Para a Conservação da Biodiversidade da Mata Atlântica e Campos Sulinos**. 1. ed. Brasilia, DF: MMA/ SBF, 2000.

IBGE. **Manual Técnico da Vegetação Brasileira**. [s.l: s.n.].

JORGE, M. L. S. P. et al. Mammal defaunation as surrogate of trophic cascades in a biodiversity hotspot. **Biological Conservation**, v. 163, p. 49–57, jul. 2013.

LINDSELL, J. A. et al. Availability of large seed-dispersers for restoration of degraded tropical forest. **Tropical Conservation Science**, v. 8, n. 1, p. 17–27, 2015.

MAGIOLI, M. et al. Thresholds in the relationship between functional diversity and patch size for mammals in the Brazilian Atlantic Forest. **Animal Conservation**, v. 18, n. 6, p. 499–511, dez. 2015.

MENDES, C. P.; RIBEIRO, M. C.; GALETTI, M. Patch size, shape and edge distance influence seed predation on a palm species in the Atlantic forest. **Ecography**, v. 39, n. 5, p. 465–475, maio 2016.

MITTERMEIER, R. A. et al. Hotspots revisitados. **Conservaçao Internacional**, p. 16, 2005.

MYERS, N. et al. Biodiversity hotspots for conservation priorities. **Nature**, v. 403, n. 6772, p. 853–858, 24 fev. 2000.

OLIVEIRA-FILHO, A.; FLUMINHAN-FILHO, M. Ecologia da vegetação do parque florestal Quedas do Rio Bonito. **Cerne**, v. 5, n. 2, p. 51–64, 1999.

OLIVEIRA-FILHO, A. T.; FONTES, M. A. L. Patterns of Floristic Differentiation among Atlantic Forests in Southeastern Brazil and the Influence of Climate1. **BIOTROPICA**, v. 32, n. 4, p. 793, 2000.

PRUGH, L. R. et al. Effect of habitat area and isolation on fragmented animal populations. **Proceedings of the National Academy of Sciences**, v. 105, n. 52, p. 20770–20775, 30 dez. 2008.

REIS, N. R. DOS et al. **Mamíferos do Brasil**. 2. ed. Londrina, Paraná: [s.n.].

RIBEIRO, M. C. et al. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. **Biological Conservation**, v. 142, n. 6, p. 1141–1153, jun. 2009.

RIPPLE, W. J.; BESCHTA, R. L. Wolves and the Ecology of Fear: Can Predation Risk Structure Ecosystems? **BioScience**, v. 54, n. 8, p. 755, 2004.

ROCHA, M. F.; PASSAMANI, M.; LOUZADA, J. A small mammal community in a forest fragment, vegetation corridor and coffee matrix system in the brazilian atlantic forest. **PLoS ONE**, v. 6, n. 8, 2011.

ROCHA, M. F.; PASSAMANI, M.; YANKOUS GONÇALVES FIALHO, M. Can vegetation corridors provide habitat in fragmented landscapes? A case-study in the Brazilian Atlantic Domain. **Studies on Neotropical Fauna and Environment**, v. 49, n. 3, p. 180–184, 2014.

ROEMER, G. W.; GOMPPER, M. E.; VALKENBURGH, B. VAN. The Ecological Role of the Mammalian Mesocarnivore. **BioScience**, v. 59, n. 2, p. 165–173, 2009.

SANT'ANNA NETO, J. L. DECÁLOGO DA CLIMATOLOGIA DO SUDESTE BRASILEIRO. **Revista Brasileira de Climatologia**, v. 1, n. 1, 31 dez. 2005.

SMITH, D. W.; PETERSON, R. O.; HOUSTON, D. B. Yellowstone after Wolves. **BioScience**, v. 53, n. 4, p. 330–340, 2003.

SOSMA E INPE. ATLAS DOS REMANESCENTES FLORESTAIS DA MATA ATLÂNTICA PERÍODO 2013-2014. **Fundação SOS Mata Atlântica e Instituto de Pesquisas Espaciais**, p. 1–61, 2016.

TREVES, A.; BRUSKOTTER, J. Tolerance for Predatory Wildlife. **Science**, v. 344, n. 6183, p. 476–477, 2 maio 2014.

TURNER, M. G.; GARDNER, R. H.; O'NEILL, R. V. **Landscape Ecology in Theory and Practice: pattern and process**. [s.l.] Springer, 2001.

UMETSU, F.; PAUL METZGER, J.; PARDINI, R. Importance of estimating matrix quality for modeling species distribution in complex tropical landscapes: a test with Atlantic forest small mammals. **Ecography**, p. 80304020349105–0, 4 mar. 2008.

WILKIE, D. S. et al. The empty forest revisited. **Annals of the New York Academy of Sciences**, v. 1223, n. 1, p. 120–128, mar. 2011.

SEGUNDA PARTE – ARTIGOS

Artigo 1 - Diversity and Richness of Medium and Large Mammals in the South of the State of Minas Gerais

Artigo escrito nas normas de formatação da revista Checklist

1 INTRODUCTION

The South Region of the Minas Gerais state present an enormous ecological and environmental importance in the maintenance of biodiversity (LE SAOUT et al., 2013). Although this importance the this region suffers some great environmental impacts, being the second most populous area in the state, behind only to the central area (AMM, 2016). The region's main economy is the coffee, agribusiness and industry (AMM, 2016). This socioeconomic scenario leads to an enormous environmental pressure, causing a high suppression rate of the natural areas (SOSMA E INPE, 2016). The mammal community are extremely affected by habitat reduction and isolation, and its richness tend to decrease as the fragmentation increases (CHIARELLO, 1999; GALETTI et al., 2009).

The species richness is one of the first ecological parameters that decrease from the fragmentation processes. This local loss in the number of species causes great impacts in the conservation of the environment (FAHRIG, 2003), in the maintenance of complex ecological services (CARDINALE et al., 2012), and in the perception and appreciation of the natural environment by the human being (LINDEMANN-MATTHIES; JUNGE; MATTHIES, 2010). The way this species are distributed in a landscape is also important to take in account when thinking for conservation. When higher the difference in species richness and composition between fragments in a landscape, more important is the protection of the whole landscape for the conservation of a higher diversity of species. This way this difference of the species richness between sampling points can be called β diversity and it can be divided in two complementary components: the spatial turnover component (β_{sim}), that account for the replacement of species between the sampling points; and the nestedness component, that account for the loss of some of the species between points (BASELGA, 2010).

Nestedness and turnover are opposite processes, from a conservation point of view, the species loss or species substitution is always different, and present differences implications

(BASELGA, 2010). Understanding the divergences between the components in the beta diversity index is a key point for developing conservation strategies, because a region were one of the components of the index is prominent (βsim or βnes) will have a different pattern of species distribution (BASELGA, 2010) and will need different conversation efforts.

The objective of this work was to access the species richness of medium and large-sized mammals in the south region of the Minas Gerais state. Seeking to understand how this species were distributed between the municipalities and the ecological difference between them.

2 MATERIALS AND METHODS

.2.1 Study Site

This study was conducted in eight municipalities (São Gonçalo do Sapucaí, Heliodora, Conceição do Rio Verde, Baependi, São Sebastião do Rio Verde, Itajubá, Conceição das Pedras e Delfim Moreira) in the South Region of Minas Gerais state, in Brazil (Figure 1). The mean altitude of the sampled areas varies from 962 to 1462 meters and with a great range of climate variation (Table 1). This range causes differences in the humidity along the year (Always Humid / Dry Winters / Dry Summers) as did the temperature of the hottest months (Hot Summer / Soft Summer).

All the sampling points were located in the Atlantic Domain, within or really close to the Serra da Mantiqueira Environmental Protection Area (APA Mantiqueira), which is one of the most irreplaceable areas for the conservation of biodiversity in the world (LE SAOUT et al., 2013).

.2.2 Data Sampling

The area were sampled from October 2015 to November 2016. Each of the 22 sampling points received a Bushnell digital camera trap (model Trophy Cam HD), and were two kilometers apart, seeking the spatial independence between points. The camera traps remained in field for a minimal of 90 days to 122 days, and were checked every 30 days to replace batteries and acquisition of the recorded photos.

The sampling points were arranged randomly within forest fragments, and each sampling point (Table 1, Figure 1) was within an independent forest fragment. The fragments were chosen for an experiment in landscape ecology, this experiment consisted in six landscapes with 10 x 10 km spaced 10 km between themselves. Each of the landscapes were divided in 20 grids of 2.5km lengthwise and 2km wide, each of the junctions of this grids

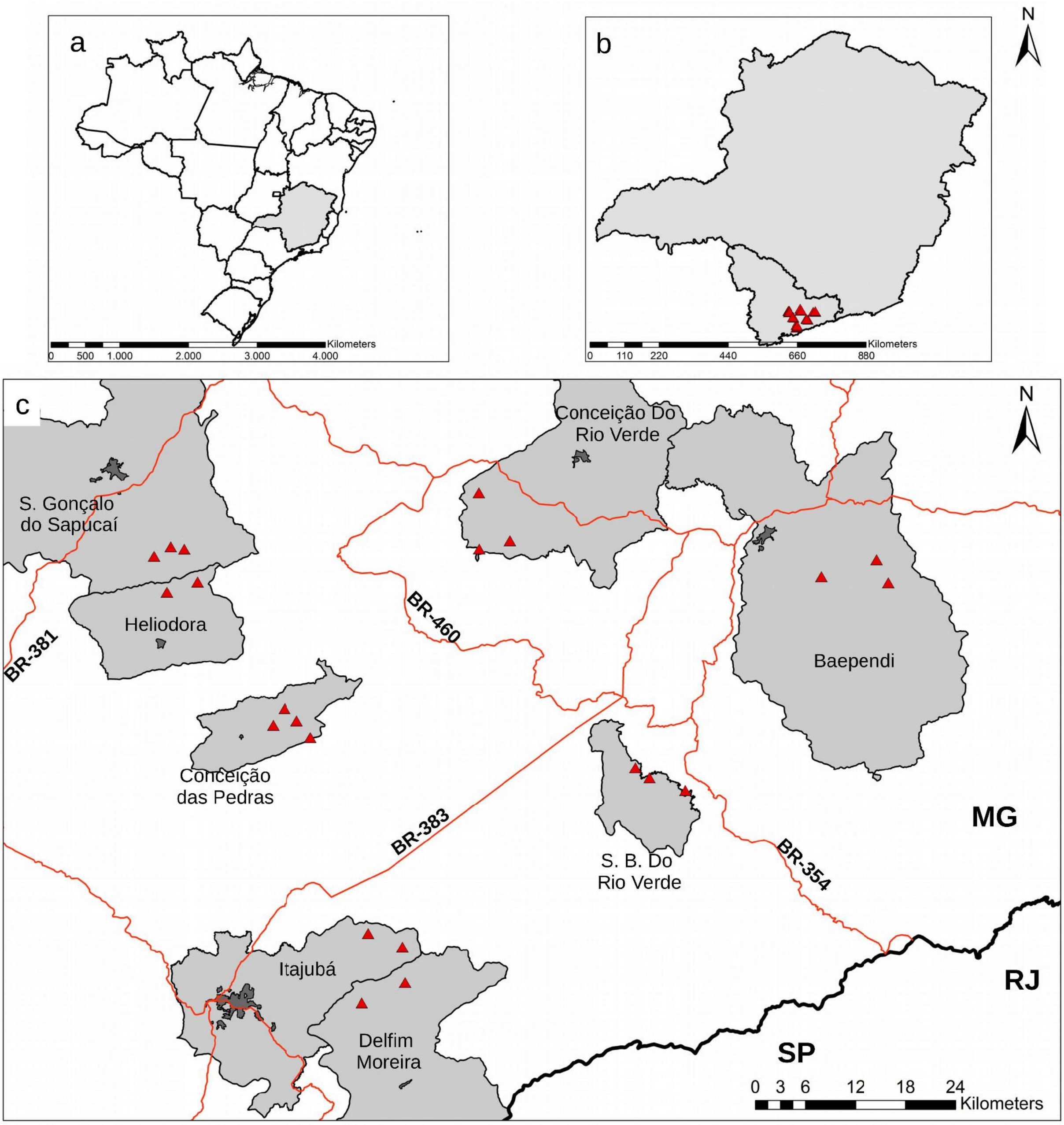

Figure 1: Map of the study site. a) Brazil map, highlighting the Minas Gerais state. b) Minas Gerais State, focusing in the Regional Superintendence of the Environment and Sustainable Development of the South of Minas Gerais (**SUPRAM Sul de Minas**), were are located the sampling points (Red triangles). c) Municipalities of the South of Minas Gerais, surveyed during the sampling of medium and large mammals.

were considered a sampling point if there was a forest fragment on this intersection. This way the number of sampling points was proportional to the vegetation proportion of the

Table 1: Characterization of the municipalities sampled. Koppen's climate (According to KOTTEK et al., (2006), GPS coordinates, number of sampling points per municipalities, sampling efforts (Consisting of number of sampling points*field days*24hours) and mean altitude of the municipalities.

Municipalities	Coordinates	Koppen's Climate	Climate characterization	Points	Sampling Effort	Mean Altitude
Baependi	44° 49' 49.5192" W , 22° 0' 2.4948" S	Cfb	Warm temperate climate, fully humid with warm summers	3	7920	1162±158
Conceição das Pedras	45° 25' 12.8604" W , 22° 8' 55.1256" S	Cfb	Warm temperate climate, fully humid and warm summers	4	8400	1399±227
Conceição do Rio Verde	45° 9' 55.242" W , 21° 57' 53.982" S	Cwa	Warm temperate climate, with dry winters and hot summers	3	8856	1068±117
Delfim Moreira	45° 16' 40.9692" W , 22° 24' 17.9748" S	Cfb	Warm temperate climate, fully humid with warm summers	2	5664	1462±225
Heliodora	45° 32' 4.4916" W , 22° 0' 58.8384" S	Cfa	Warm temperate, fully humid and with hot summers	2	5856	1120±134
Itajubá	45° 19' 3.99" W , 22° 21' 22.7916" S	Cfb	Warm temperate climate, fully humid and warm summers	2	4704	1438±258
São Gonçalo do Sapucaí	45° 31' 49.8288" W , 21° 58' 15.51" S	Csa	Warm temperate climate, with dry summers and warm summers	3	7080	1141±124
São Sebastião do Rio Verde	44° 58' 35.1268" W , 22° 12' 48.645" S	Cfb	Warm temperate climate, fully humid with warm summers	3	6480	962±36

landscapes, because one landscape with bigger vegetation proportion would have a higher probability of the sampling points to be on a forest fragment.

As individuals could not be identified, each of the records of one specie in the same sampling point, that happened within one hour period were discarded (following Srbek-Araújo & Chiarello (2013)).

.2.3 Data Analysis

Para avaliar a riqueza de espécies foi construída uma curva de rarefação utilizando o programa Primer (CLARKE; WARWICK, 2001) using the Jacknife 1 estimator.

Beta diversity analysis was performed for presence/absence data from the community, excluding accidental sighting (table 2). Thus, we produced the global beta diversity index (βsor) that was later subdivided into the spatial turnover (βsim) and nestedness (βnes) components (BASELGA, 2010). The global β diversity (βsor) is an index that varies from 0 to 1, were 1 represents a great difference of species richness among the sampling points. The turnover component (βsim) is one of the components that explain the variation of the βsor and also varies from 0 to 1, meaning that higher this index the greater the turnover of species among the sampling points. Finally, the nestedness component (βnes) is the final component of βsor and exemplifies how different areas are in terms of nestedness and not turnover.

The analysis of the beta diversity were conducted in the R software (TEAM, 2013), using the package "*betapart*" (BASELGA; ORME, 2012).

3 RESULTS

In a total of 54.960 camera-trapping hours we founded 22 species, including two exotics species: domestic dog (*Canis familiaris*) and cattle (*Bos taurus*), which were not included in the analysis. On average, we found 5 species per municipality, with a maximum of 9 and a minimum of 3 species. The rarefaction curve shows that the sampling was enough to access part of the community in the region, although the Jacknife estimator show that we would still find new species if we continued the survey (Figure 2).

From the 22 found species, ten were from the Order Carnivora, three from Order *Rodentia*, three from the Order *Xenartha*, two from the Order *Didelphimorphia*, one from the Order *Artiodactyla* and one from the Order *Lagomorpha* (Table 2).

The most frequent species found were *Leopardus guttulus* and *Didelphis aurita* found in six and five of the municipalities, respectively; *Guerlinguetus ingrami*, *Dasypus novemcincuts* and *Eira barbara* were found in four municipalities; *Leopardus pardalis*, *Sylvilagus brasiliensis* and *Nasua nasua* were found in three of the municipalities; *Cuniculus paca* e *Didelphis albiventris* in two municipalities; The other 10 species were found in only one municipality.

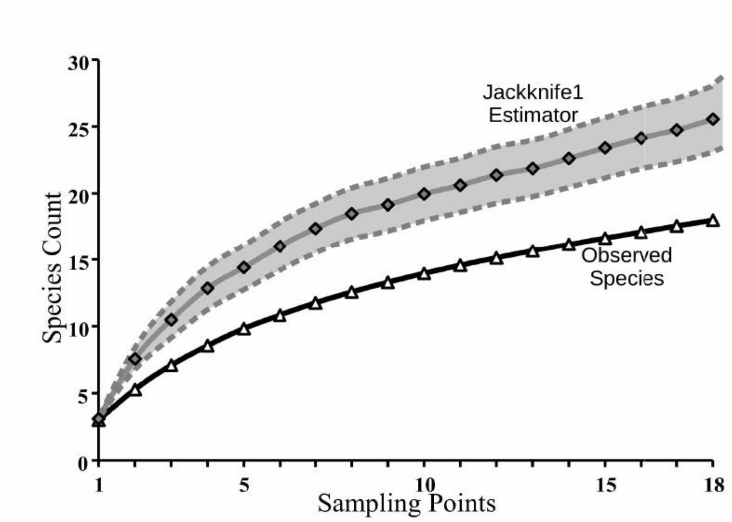

Figure 2: Species accumulation curve for the municipalities studied in the sampling of medium and large-sized mammals, in the south region of the Minas Gerais state. The black continuous line shows the accumulation of the observed species and the grey line show the Jacknife 1 estimator and its standard deviation.

Ordem	Species	Municipalities								Conservation Status		
		São Gonçalo do Sapucaí	Heliodora	Conceição das Pedras	Itajubá	Delfim Moreira	São Sebastião do Rio Verde	Baependi	Conceição do Rio Verde	IUCN	BR	MG
Native Species												
Artiodactyla	*Mazama sp*	0	0	0	2	0	0	0	0	-	-	-
Carnivora	*Cerdocyon thous*	0	0	0	2	0	0	0	0	LC	LC	LC
	Chrysocyon brachyurus	0	0	2	0	0	0	0	0	NT	VU	VU
	Conepatus semistriatus *	0	0	0	0	0	0	1	0	LC	LC	LC
	Eira barbara	0	0	23	7	0	3	0	4	LC	LC	LC
	Galictis cuja	0	0	0	0	2	0	0	0	LC	LC	NE
	Leopardus guttulus	20	0	7	15	0	6	4	5	VU	VU	NE
	Leopardus pardalis	4	0	30	0	0	0	2	0	LC	LC	VU
	Nasua nasua	0	6	4	0	21	0	0	0	LC	LC	LC
	Procyon cancrivorus	4	0	0	0	0	0	0	0	LC	LC	LC
	Puma yagouaroundi	2	0	0	0	0	0	0	0	LC	VU	LC
Xenartha	*Dasypus novemcinctus*	4	0	8	0	2	17	0	0	LC	LC	LC
	Dasypus septemcinctus	4	0	0	0	0	0	0	0	LC	LC	LC
	Euphractus sexcinctus	0	0	0	0	0	3	0	0	LC	LC	LC
Rodentia	*Cuniculus paca*	0	1	0	0	0	0	0	4	LC	LC	LC
	Coendou prehensilis *	0	0	0	1	0	0	0	0	LC	LC	LC
	Guerlinguetus ingrami	0	0	6	2	5	0	3	0	NE	LC	LC
	Didelphis albiventris	6	0	0	0	0	2	0	0	LC	LC	LC
	Didelphis aurita	2	6	6	0	4	170	0	0	LC	LC	LC
Lagomorpha	*Sylvilagus brasiliensis*	0	0	6	0	0	28	0	1	LC	LC	LC
Domestic Species												
Artiodactyla	*Bos taurus*	242	0	0	268	0	1274	0	0	-	-	-
Carnivora	*Canis familiaris*	6	0	1	3	0	5	0	0	-	-	-

Table 2: Number of photographic records of the species found in the eight municipalities and conservation status according to the IUCN red-list, the Brazilian List of Engendered Species and the Minas Gerais List of Engendered Species (**LC** = Least concerned, **VU** = Vulnerable, **NT** = Near Threatened and **NE** = Not Evaluated) . The marked species (*) were found as roadkill, and as such did not entered in the statistical analysis of the beta diversity.

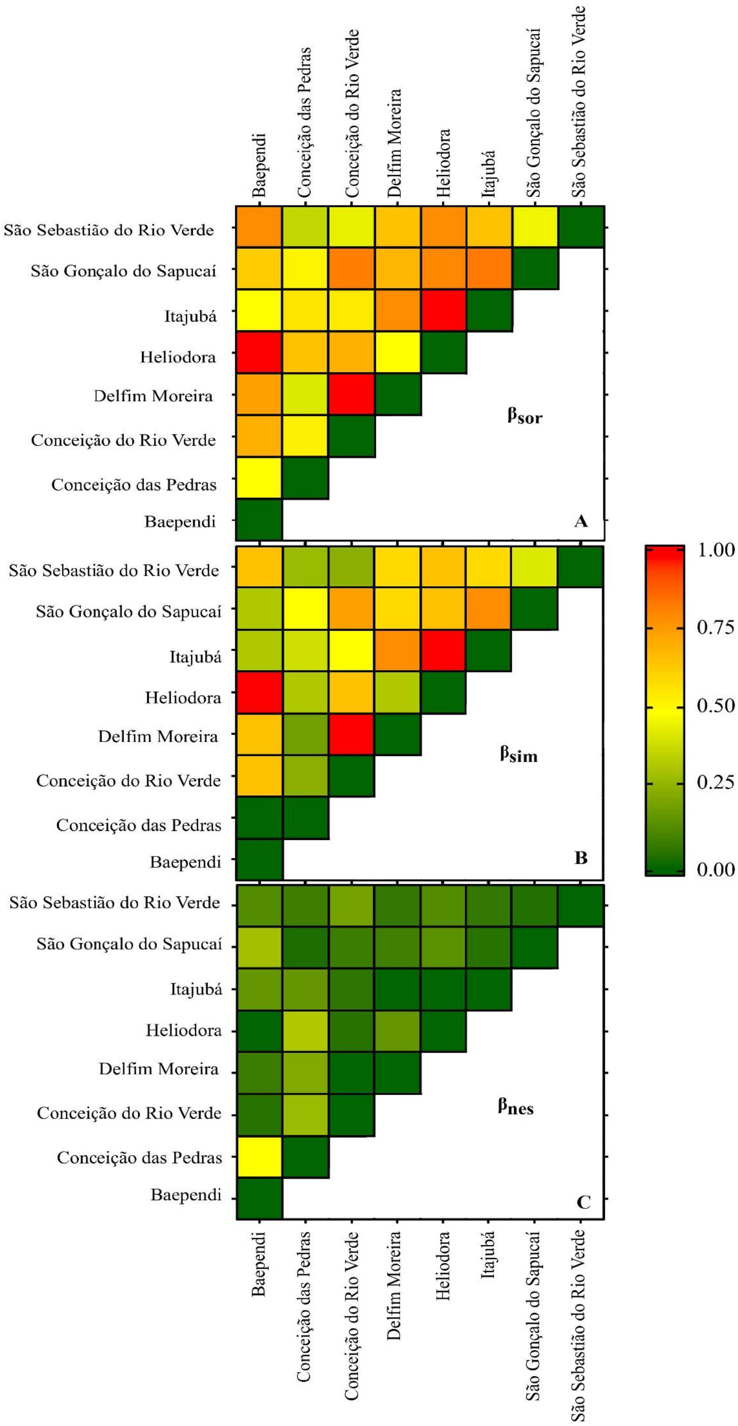

Figure 3: Beta diversity analysis between the sampled municipalities using the presence/absence data of medium and large mammals. The colours vary from green to red as the value of the index varies from 0 to 1, so the closer the square is from the red colour bigger the index. A) Sørensen's Dissimilarity Index (Beta diversity – βsor), showing the pairwise difference in species richness between municipalities. B) The turnover component of the beta diversity (βsim), representing the change of species between the municipalities. C) Nestedness component of the beta diversity (βnes), presenting the loss of gain of species between the municipalities.

The beta diversity analysis showed that there is a great difference in the species richness between the municipalities (βsor = 0.79), and we found that the turnover (βsim =

Table 3: Comparison between studies with similar methodologies for inventory of medium and large mammals. All information was gathered from articles cited. The sampling effort consist in the number of hour each of the camera-trap was left in the field. The sampling points are the number of camera-traps. The number of species are show as the total number of species found using all the different methodology, and in highlight the number of species registered by the camera-traps.

Study Area	Sampling Effort (camera hours)	Sampling Points	Number of Species	Methodology	Authors
South of Minas Gerais	54960	22	22 (20)	Trap Camera	QUERIDO et al. (Present study)
São Paulo state	126720	176	29 (29)	Trap Camera, sight survey	BECA et al., 2017
Uberaba, MG	5760	4	31 (16)	Trap Camera, sight survey	FONSECA et al., 2016
Lavras, MG	10272	4	19 (10)	Trap Camera, sandplots	SANTOS et al., 2016
Linhares, ES	253608	58	30 (30)	Trap Camera	SRBEK-ARAUJO; CHIARELLO, 2013
Carancas Region, MG	-	-	19 (-)	Sight survey	MACHADO et al., 2017
Jahú, SP	-	-	26 (-)	Sight survey	REALE et al., 2014
Campinas, SP	-	-	18 (-)	Sight survey	MAGIOLI et al., 2014

0.70) is a more prominent explanation than the nestedness component (βnes = 0.09).

When we compared the municipalities, we found between most of them a high beta diversity index (βsor >0.5), as were the turnover component. The nestedness component was lower, with small values in most of the comparisons, although we found a difference between the Baependi and the Conceição das Pedras municipalities (βnes = 0.5) (Figure 3).

4 DISCUSSION

The species richness registered in this study were consistent with others studies (Table 3), such as in Uberaba, MG (FONSECA et al., 2016), which found 31 species, being 16 by camera-trap only; in the Ecologic Park Quedas do Rio Bonito, in Lavras Minas Gerais, Santos et al (2016) found 19 species with camera-traps; in the Espirito Santo state there were 30 mammal species in the Vale Natural Reserve (SRBEK-ARAUJO; CHIARELLO, 2013). As did other studies that used different methodology, as the study by Magioli et al (2014) that found 19 species using only active search in Sao Paulo state; or the paper by Machado et al. (2017) that consists only in eventual sightings, and found a richness of 19 species in six years of sampling in the Minas Gerais state; or the paper by Reale; Fonseca and Uieda (2014) that found 26 species with interviews and direct and indirect sightings, in the Reserve of Natural Heritage in the Municipality of Jahú in the Sao Paulo state.

One specie that is present in almost all the larger fragments of other works (MACHADO et al., 2017; MAGIOLI; FERRAZ; RODRIGUES, 2014; REALE; FONSECA; UIEDA, 2014; ROCHA; SOARES; PEREIRA, 2015) is the *Puma concolor* being, one of the biggest predators in the Atlantic Forest biome (SUNQUIST; SUNQUIST, 2002). We expected to find this species in our sampling, since most of the landowners said that they are used to find this specie in almost all the sampling points. This non-detection could be because of the short sampling periods of this work, that didn't manage to register this species because of it's big area of life, that can be of 610 km² (PAULA et al., 2015) and small population density (NEGRÕES et al., 2010).

We found two species considered vulnerable (VU), in the Minas Gerais level(table 2), *Leopardus pardalis* and *Chrysocyon brachyurus*, the last being considered vulnerable in the Brazil level. We also found the *Leopardus guttulus* to be the most prominent species in our study sites appearing in six of the eight municipalities, this species was not evaluated (NE) in the Minas Gerais level but is vulnerable in the IUCN and in the Brazil level. The presence of this species and the high species richness show the importance of this region to the maintenance of the biodiversity.

The high value of beta diversity ($\beta sor = 0.79$) shows that the municipalities present a big difference in the species richness, in general, and this is consistent with pattern found in the sampling, were we found a high number of species but with a low mean richness for each of the municipalities. This result shows the importance of this area for the conservation of an expressive diversity of mammals. The bigger turnover than the nestedness component shows that there is a great species replacement among the municipalities rather than the pattern of a smaller community being the partition of a bigger one. This pattern of nestedness, was observed between Bapendi and Conceição das Pedras municipalities (Figure 3) were the mammal community of Baependi (four species) is merely a small part of the Conceição das Pedras community (ten species) (Table 2). This pattern of distribution can mean that the environmental impacts of the habitat suppression, in the Baependi region, can select species that withstand this impacts and thrive in this situations.

From a conservation perspective this turnover pattern shows that the region should be a focus of bigger efforts for conservation and studies and that, in a scenario of planning for protected areas, we should focus on protecting most of it's natural environments as possible in the region because every one of the sampled areas are biologically important to sustain a unique mammal diversity seeing that most of the Atlantic Forest biome is extremely fragmented and that most of its fragments are smaller than 100 ha (RIBEIRO et al., 2009).

REFERENCES

(ESRI), E. S. R. I. **ArcGIS Release 10.1**Redlands, CA, 2012.

AMM, E. **Caracterização Econômica das Regiões de Planejamento – Portal AMM**. Disponível em: <http://portalamm.org.br/caracterizacao-economica-das-regioes-de-planejamento/>.

AUGUST, P. V. The Role of Habitat Complexity and Heterogeneity in Structuring Tropical Mammal Communities. **Ecology**, v. 64, n. 6, p. 1495–1507, dez. 1983.

BARTOŃ, K. MuMIn: Multi-Model Inference. **R package version 1.9.13**, 2013.

BASELGA, A. Partitioning The Turnover And Nestedness Components Of Beta Diversity. **Global Ecology and Biogeography**, v. 19, n. 1, p. 134–143, jan. 2010.

BASELGA, A.; ORME, C. D. L. betapart : an R package for the study of beta diversity. **Methods in Ecology and Evolution**, v. 3, n. 5, p. 808–812, out. 2012.

BECA, G. et al. High mammal species turnover in forest patches immersed in biofuel plantations. **Biological Conservation**, n. March, mar. 2017.

BERNARD, E. Vertical stratification of bat communities in primary forests of Central Amazon, Brazil. **Journal of Tropical Ecology**, v. 17, n. 1, p. S0266467401001079, jan. 2001.

BORDIGNON, M.; MONTEIRO-FILHO, E. L. A. O Serelepe Sciurus ingrami (Sciuridae: Rodentia) Como Dispersor do Pinheiro do Paraná Araucaria angustifolia (Araucariaceae: Pinophyta). **Arquivos de Ciências Veterinárias e Zoologia da UNIPAR**, v. 3, n. 2, 2000.

BOWERS, M. A.; MATTER, S. F. Landscape Ecology of Mammals: Relationships between Density and Patch Size. **Journal of Mammalogy**, v. 78, n. 4, p. 999–1013, 26 nov. 1997.

BOYD, C. et al. Spatial scale and the conservation of threatened species. **Conservation Letters**, v. 1, n. 1, p. 37–43, 12 maio 2008.

BRIANT, G.; GOND, V.; LAURANCE, S. G. W. Habitat fragmentation and the desiccation of forest canopies: A case study from eastern Amazonia. **Biological Conservation**, v. 143, n. 11, p. 2763–2769, nov. 2010.

BURNHAM, K. P.; ANDERSON, D. R. **Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach (2nd ed)**. [s.l: s.n.]. v. 172

CARDINALE, B. J. et al. Biodiversity loss and its impact on humanity. **Nature**, v. 486, n. 7401, p. 59–67, 6 jun. 2012.

CARVALHO, L. M. T. DE et al. Flora. In: SCOLFORO, J. R. S.; CARVALHO, L. M. T. DE; OLIVEIRA, A. D. DE (Eds.). . **Zoneamento Ecológico-Econômico do Estado de Minas Gerais: componentes geofísico e biótico**. 22. ed. Lavras, Minas Gerais: Editora UFLA, 2008. p. 137–148.

CASSANO, C. R.; BARLOW, J.; PARDINI, R. Large Mammals in an Agroforestry Mosaic in the Brazilian Atlantic Forest. **Biotropica**, v. 44, n. 6, p. 818–825, nov. 2012.

CHIARELLO, A. Effects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. **Biological Conservation**, v. 89, n. 1, p. 71–82, jul. 1999.

CLARKE, K. R.; WARWICK, R. M. **Change in marine communities: an approach to statistical analysis and interpretation**. Plymouth (UK): [s.n.].

COLLINS, C. D. et al. Fragmentation affects plant community composition over time. **Ecography**, v. 40, n. 1, p. 119–130, jan. 2017.

DA FONSECA, G. A. B.; ROBINSON, J. G. Forest size and structure: Competitive and predatory effects on small mammal communities. **Biological Conservation**, v. 53, n. 4, p. 265–294, 1990.

DAVIDSON, A. D. et al. Multiple ecological pathways to extinction in mammals. **Proceedings of the National Academy of Sciences**, v. 106, n. 26, p. 10702–10705, 30 jun. 2009.

DAVIDSON, C. Economic Growth and the Environment:Alternatives to the Limits Paradigm. **BioScience**, v. 50, n. 5, p. 433, 2000.

DEAN, W. R. J.; MILTON, S. J.; JELTSCH, F. Large trees, fertile islands, and birds in arid savanna. **Journal of Arid Environments**, 1999.

DE SÁ JÚNIOR, A. et al. Application of the Köppen classification for climatic zoning in the state of Minas Gerais, Brazil. **Theoretical and Applied Climatology**, v. 108, n. 1–2, p. 1–7, 27 abr. 2012.

DEBINSKI, D. M.; HOLT, R. D. A Survey and Overview of Habitat Fragmentation Experiments. **Conservation Biology**, v. 14, n. 2, p. 342–355, 2000.

DIAS, B. F. DE S. Conservação da Biodiversidade no Bioma Cerrado: histórico dos impactos antrópicos no Bioma Cerrado. In: FALEIRO, F. G.; NETO, A. L. DE F. (Eds.). . **Savanas: Desafios e Estratégias para o Equilíbrio entre Sociedade, Agronegócio e Recursos Naturais**. Brasília, DF: Embrapa Informação Tecnológica, 2008. p. p 303-336.

ESTES, J. A et al. Trophic downgrading of planet Earth. **Science (New York, N.Y.)**, v. 333, n. 6040, p. 301–306, 2011.

FAHRIG, L. Effects of Habitat Fragmentation on Biodiversity. **Annual Review of Ecology, Evolution, and Systematics**, v. 34, n. 1, p. 487–515, nov. 2003.

FELTON, A. M. et al. The role of timber tree species in the nutritional ecology of spider monkeys in a certified logging concession, Bolivia. **Forest Ecology and Management**, 2010.

FILETTO, F.; ALENCAR, E. Introdução E Expansão Do Café Na Região Sul De Minas Gerais. **Organizações Rurais e Agroindustriais**, v. 3, n. 1, p. 1–10, 2001.

FONSECA, P. H. M. et al. Levantamento dos Mamíferos Terrestres de Médio e Grande Porte , na Reserva Particular do Patrimônio Natural – Vale Encantado, Uberaba, estado de Minas Gerais, Brasil. **Acta Zoológica Lilloana**, v. 60, n. 1, p. 47–56, 2016.

GALETTI, M. et al. Priority areas for the conservation of Atlantic forest large mammals. **Biological Conservation**, v. 142, n. 6, p. 1229–1241, jun. 2009.

GALETTI, M.; BOVENDORP, R. S.; GUEVARA, R. Defaunation of Large Mammals Leads to an Increase in Seed Predation in the Atlantic Forests. **Global Ecology and Conservation**, v. 3, p. 824–830, 2015.

GARMENDIA, A. et al. Landscape and patch attributes impacting medium- and large-sized terrestrial mammals in a fragmented rain forest. **Journal of Tropical Ecology**, v. 29, n. 4, p. 331–344, jul. 2013.

GEISE, L. et al. Pattern of elevational distribution and richness of non volant mammals in Itatiaia National Park and its surroundings, in Southeastern Brazil. **Brazilian Journal of Biology**, v. 64, n. 3b, p. 599–612, ago. 2004.

GIBBONS, P.; LINDENMAYER, D. **Tree Hollows and Wildlife Conservation in Australia**. 2. ed. Collingwood: Csiro Publishing, 2002.

GONÇALVES, F. H. P. **A INVASÃO DO JAVALI NA SERRA DA MANTIQUEIRA: Aspectos populacionais, uso do habitat e sua relação com o Homem**. [s.l.] Universidade Federal de Lavras, 2015.

HERINGER, H.; MONTENEGRO, M. M. **Avaliação e Ações Prioritárias Para a Conservação da Biodiversidade da Mata Atlântica e Campos Sulinos**. 1. ed. Brasilia, DF: MMA/ SBF, 2000.

IBGE. **Manual Técnico da Vegetação Brasileira**. [s.l: s.n.].

INÁCIO, L.; TAI, D. W. **Censo Agropecuário 2006 - Resultados preliminaresDE GEOGRAFIA E ESTATÍSTICA - IBGE**. [s.l: s.n.].

JANZEN, D. Herbivores and the Number of Tree Species in Tropical Forests. **American Naturalist**, v. 104, n. 940, p. 501–528, 1970.

JORGE, M. L. S. P. et al. Mammal defaunation as surrogate of trophic cascades in a biodiversity hotspot. **Biological Conservation**, v. 163, p. 49–57, jul. 2013.

KOTTEK, M. et al. World Map of the Köppen-Geiger climate classification updated. **Meteorologische Zeitschrift**, v. 15, n. 3, p. 259–263, 1 jun. 2006.

LANG, S.; TIEDE, D. **vLATE Extension für ArcGIS - vektorbasiertes Tool zur quantitativen Landschaftsstrukturanalyse**ESRI Anwenderkonferenz 2003 Innsbruck., , 2003.

LE SAOUT, S. et al. Protected Areas and Effective Biodiversity Conservation. **Science**, v. 342, n. 6160, p. 803–805, 15 nov. 2013.

LINDEMANN-MATTHIES, P.; JUNGE, X.; MATTHIES, D. The influence of plant diversity on people's perception and aesthetic appreciation of grassland vegetation. **Biological Conservation**, v. 143, n. 1, p. 195–202, jan. 2010.

LINDENMAYER, D. B.; LAURANCE, W. F. The ecology, distribution, conservation and management of large old trees. **Biological Reviews**, v. 92, n. 3, p. 1434–1458, ago. 2017.

LINDSELL, J. A. et al. Availability of large seed-dispersers for restoration of degraded tropical forest. **Tropical Conservation Science**, v. 8, n. 1, p. 17–27, 2015.

LINDSTEDT, S. L.; MILLER, B. J.; BUSKIRK, S. W. Home Range, Time, and Body Size in Mammals. **Ecology**, v. 67, n. 2, p. 413–418, abr. 1986.

MACARTHUR, R. H.; WILSON, E. O. The theory of island biogeography. Monographs in Population Biology. **The theory of island biogeography. Monographs in Population Biology**, 1967.

MACHADO, F. S. et al. Registros ocasionais de mamíferos de médio e grande porte na microrregião de Lavras e São João del Rei, Campo das Vertentes, Minas Gerais. **Revista Agrogeoambiental**, v. 9, n. 1, 12 abr. 2017.

MAGIOLI, M. et al. Thresholds in the relationship between functional diversity and patch size for mammals in the Brazilian Atlantic Forest. **Animal Conservation**, v. 18, n. 6, p. 499–511, dez. 2015.

MAGIOLI, M.; FERRAZ, K. DE B.; RODRIGUES, M. G. Medium and large-sized mammals of an isolated Atlantic Forest remnant, southeast São Paulo State, Brazil. **Check List**, v. 10, n. 4, p. 850–856, set. 2014.

MENDES, C. P.; RIBEIRO, M. C.; GALETTI, M. Patch size, shape and edge distance influence seed predation on a palm species in the Atlantic forest. **Ecography**, v. 39, n. 5, p. 465–475, maio 2016.

MENDES PONTES, A. R. et al. Mass Extinction and the Disappearance of Unknown Mammal Species: Scenario and Perspectives of a Biodiversity Hotspot's Hotspot. **PLOS ONE**, v. 11, n. 5, p. e0150887, 18 maio 2016.

METZGER, J. P. O que é ecologia de paisagens. **Biota Neotropica**, v. 1, p. 1–9, 2001.

MITTERMEIER, R. A. et al. Hotspots revisitados. **Conservaçao Internacional**, p. 16, 2005.

MYERS, N. et al. Biodiversity hotspots for conservation priorities. **Nature**, v. 403, n. 6772, p. 853–858, 24 fev. 2000.

NEGRÕES, N. et al. Use of Camera-Trapping to Estimate Puma Density and Influencing Factors in Central Brazil. **Journal of Wildlife Management**, v. 74, n. 6, p. 1195–1203, ago. 2010.

OKSANEN, J. et al. **vegan: Community Ecology Package**R package 2.4-0, , 2016.

OLIVEIRA-FILHO, A.; FLUMINHAN-FILHO, M. Ecologia da vegetação do parque florestal Quedas do Rio Bonito. **Cerne**, v. 5, n. 2, p. 51–64, 1999.

OLIVEIRA-FILHO, A. T.; FONTES, M. A. L. Patterns of Floristic Differentiation among Atlantic Forests in Southeastern Brazil and the Influence of Climate1. **BIOTROPICA**, v. 32, n. 4, p. 793, 2000.

PAULA, T. A. R. et al. Aspectos do uso territorial por onça parda (Puma concolor), através de monitoramento via satélite, na região do Parque Estadual da Serra do Brigadeiro, MG. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v. 67, n. 1, p. 80–88, fev. 2015.

PRUGH, L. R. et al. Effect of habitat area and isolation on fragmented animal populations. **Proceedings of the National Academy of Sciences**, v. 105, n. 52, p. 20770–20775, 30 dez. 2008.

REALE, R.; FONSECA, R.; UIEDA, W. Medium and Large-sized Mammals in a Private Reserve of Natural Heritage in the Municipality of Jaú, São Paulo, Brazil. **Check List**, v. 10, n. 5, p. 997–1004, out. 2014.

REIS, N. R. DOS et al. **Mamíferos do Brasil**. 2. ed. Londrina, Paraná: [s.n.].

REMM, J.; LÕHMUS, A. Tree cavities in forests – The broad distribution pattern of a keystone structure for biodiversity. **Forest Ecology and Management**, v. 262, n. 4, p. 579–585, ago. 2011.

RIBEIRO, M. C. et al. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. **Biological Conservation**, v. 142, n. 6, p. 1141–1153, jun. 2009.

RIPPLE, W. J.; BESCHTA, R. L. Wolves and the Ecology of Fear: Can Predation Risk Structure Ecosystems? **BioScience**, v. 54, n. 8, p. 755, 2004.

ROCHA, E. C.; SOARES, K. L.; PEREIRA, I. M. Medium- and large-sized mammals in Mata Atlântica State Park, southeastern Goiás, Brazil. **Check List**, v. 11, n. 6, p. 1802, 2 dez. 2015.

ROCHA, M. F.; PASSAMANI, M.; YANKOUS GONÇALVES FIALHO, M. Can vegetation corridors provide habitat in fragmented landscapes? A case-study in the Brazilian Atlantic Domain. **Studies on Neotropical Fauna and Environment**, v. 49, n. 3, p. 180–184, 2014.

ROEMER, G. W.; GOMPPER, M. E.; VALKENBURGH, B. VAN. The Ecological Role of the Mammalian Mesocarnivore. **BioScience**, v. 59, n. 2, p. 165–173, 2009.

ROSA, C. A. DA. **Mamíferos exóticos invasores no Brasil: situação atual, riscos potenciais e impactos da invasão de porcos selvagens em florestas tropicais**. Universidade Federal de Lavras, 2015.

SAFI, K. et al. Understanding global patterns of mammalian functional and phylogenetic diversity. **Philosophical Transactions of the Royal Society B: Biological Sciences**, v. 366, n. 1577, p. 2536–2544, 12 set. 2011.

SANDOM, C. et al. Mammal predator and prey species richness are strongly linked at macroscales. **Ecology**, v. 94, n. 5, p. 1112–1122, maio 2013.

SANT'ANNA NETO, J. L. DECÁLOGO DA CLIMATOLOGIA DO SUDESTE BRASILEIRO. **Revista Brasileira de Climatologia**, v. 1, n. 1, 31 dez. 2005.

SANTOS, K. K.; PACHECO, G. S. M.; PASSAMANI, M. Medium-sized and large mammals from Quedas do Rio Bonito Ecological Park, Minas Gerais, Brazil. **Check List**, v. 12, n. 1, p. 1830, 23 jan. 2016.

SCHNEIDER, C. A.; RASBAND, W. S.; ELICEIRI, K. W. NIH Image to ImageJ: 25 years of image analysis. **Nature Methods**, v. 9, n. 7, p. 671–675, 28 jun. 2012.

SHEN, Z. et al. Decrease of Large-Bodied Dispersers Limits Recruitment of Large-Seeded Trees But Benefits Small-Seeded Trees. **Israel Journal of Ecology & Evolution**, v. 58, n. 1, p. 53–67, 2012.

SMITH, D. W.; PETERSON, R. O.; HOUSTON, D. B. Yellowstone after Wolves. **BioScience**, v. 53, n. 4, p. 330–340, 2003.

SOSMA E INPE. ATLAS DOS REMANESCENTES FLORESTAIS DA MATA ATLÂNTICA PERÍODO 2013-2014. **Fundação SOS Mata Atlântica e Instituto de Pesquisas Espaciais**, p. 1–61, 2016.

SRBEK-ARAUJO, A. C.; CHIARELLO, A. G. Influence of camera-trap sampling design on mammal species capture rates and community structures in southeastern Brazil. **Biota Neotropica**, v. 13, n. 2, p. 51–62, abr. 2013.

SUNQUIST, F.; SUNQUIST, M. **Wild Cats of the World**. Chigado and London: [s.n.].

SURACI, J. P. et al. Fear of large carnivores causes a trophic cascade. **Nature Communications**, v. 7, p. 10698, 23 fev. 2016.

TABACHNICK, B. G.; FIDELL, L. S. **Using multivariate statistics (6th ed.)**. 6th. ed. New York: Pearson Education, 2013.

TAYLOR, P. D.; FAHRIG, L.; WITH, K. A. Landscape Connectivity: A return to the basics. In: **Connectivity Conservation**. [s.l.] Cambridge University Press, 2006. p. 29–43.

TEAM, R. R Development Core Team. **R: A Language and Environment for Statistical Computing**, 2013.

TEWS, J. et al. Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. **Journal of Biogeography**, v. 31, n. 1, p. 79–92, jan. 2004.

TREVES, A.; BRUSKOTTER, J. Tolerance for Predatory Wildlife. **Science**, v. 344, n. 6183, p. 476–477, 2 maio 2014.

TURNER, M. G.; GARDNER, R. H.; O'NEILL, R. V. **Landscape Ecology in Theory and Practice: pattern and process**. [s.l.] Springer, 2001.

UMETSU, F.; PAUL METZGER, J.; PARDINI, R. Importance of estimating matrix quality for modeling species distribution in complex tropical landscapes: a test with Atlantic forest small mammals. **Ecography**, p. 80304020349105–0, 4 mar. 2008.

WILKIE, D. S. et al. The empty forest revisited. **Annals of the New York Academy of Sciences**, v. 1223, n. 1, p. 120–128, mar. 2011.

Artigo 2 - Influence of Local and Regional Scale in Medium and Large-Sized Mammals

Artigo escrito nas normas de formatação da revista Plos One

1 INTRODUCTION

The Minas Gerais state presents the Atlantic Forest and the Cerrado biomes, which are considered hotspots for biodiversity conservation in the world (MITTERMEIER et al., 2005). This biomes are currently being extremely impacted by the expansion of agribusiness, most importantly in the Minas Gerais state the coffee and cattle exploration (INÁCIO; TAI, 2006) and the inefficiency of implementation and maintenance of protected areas (RIBEIRO et al., 2009). This pattern occur in the south region of Minas Gerais, showing a high historical economic dependence of the agribusiness (FILETTO; ALENCAR, 2001) but nowadays the industry is becoming more prominent being responsible for an important part of the regions economy (AMM, 2016). As the macroregion grows economically, so does the impacts in the natural environments (DAVIDSON, 2000) that could lead to losses in habitat area and species richness (FAHRIG, 2003).

The loss in habitat area will cause a huge variety of impacts in the mammal community, that could lead to a significant change in the dynamic equilibrium of this community leading to a new less diverse composition of species (CHIARELLO, 1999). This usually happens because of the local extinction of species, because of the isolation from others forest-like vegetation that could be the source for recolonization (MACARTHUR; WILSON, 1967). This isolation allied with the inability of the smaller fragments to provide food or other vital resources (DA FONSECA; ROBINSON, 1990), explain the impact that the species will suffer from this high fragmentation.

The landscape ecology can be applied to understand what could be the environmental variables that would determinate the presence of the species in this environment (TAYLOR; FAHRIG; WITH, 2006). But in the same way the species could be responding to variations in a local scale since changes in the fragment could be modifying the natural responses of species, making it unlikely to the species to be able to stay there. This way is necessary to take into account that the response of mammals, and other species, can be influenced by the local and landscape scale (BOWERS; MATTER, 1997), being necessary to understand how both this scales dictate the prevalence of species.

With this impacts in mind and taking in account the importance of scale, the aim of this study was to understand how the variation in the parameters of regional and local scale would affect the community of medium and large-sized mammals, in the south region of the Minas Gerais state. Investigating which of the environmental variables were responsible for modifications in the species richness and composition.

2 METHODOLOGY

.2.1 Study Area

This study was conducted in eight different landscapes in the south region of the Minas Gerais state. The area is part of the Atlantic Forest Domain, with vegetation that vary from 30m high forests to shrubs and grass (IBGE, 2012). The most representative forest on the area is Semideciduous Montane Forest, with some areas of Ombrophilous Forests and Natural Grasslands on the highest areas (CARVALHO et al., 2008).

The climate (Table 1) variate within the region sampled, with the existence of three main kinds of classification: 1) Cfa - warm temperate climate, fully humid and with hot summers, 2) Cfb - Warm temperate climate, fully humid and warm summers and 3) Cwa -Warm temperate climate, with dry winters and hot summers (DE SÁ JÚNIOR et al., 2012; KOTTEK et al., 2006).

The studied landscapes are 10 x 10 Km and are located on the Atlantic Domain, with the mean altitude varying from 900 to 1800 m. The sampling points were arranged randomly within forest fragments, and each sampling point was within an independent forest fragment. Each of the landscapes were divided in 20 grids of 2.5km lengthwise and 2km wide, each of the junctions of this grids were considered a sampling point if there was a forest fragment on this intersection. This way the number of sampling points was proportional to the vegetation proportion of the landscapes, because one landscape with bigger vegetation proportion would have a bigger chance of the sampling points to be on a forest fragment.

Table 1: Characterization of the different landscapes, the red symbols categorize the proportion of vegetation of each landscape, being: the landscape with small proportion of vegetation (<20% ▲ - Figure 1), landscapes with a high proportion of vegetation (35% ♦- Figure 1) and the control landscapes (80% ● - Figure 1). The geographical coordinates of the landscapes and the average altitude of these localities. The number of sampling points in each landscape is proportional to the percentage of vegetation. The sampling effort is defined as the number of photographic traps x the number of sampling days x 24 hours. The climatic characterization was based from the definition of Kottek et al. (2006).

Landscape	Coordenates	Mean Altitude	Vegetation Percentage	Sampling Points	Sampling Efforts	Koppen's Climate	Climate Characterization
♦ Hp1	45° 32′ 53.646″ W 21° 58′ 50.275″ S	1117±127	27	5	12936	Cfa	Warm temperate climate, fully humid and with hot summers
♦ Hp2	45° 24′ 28.631″ W 22° 7′ 55.546″ S	1298±242	37	4	8400	Cfb	Warm temperate climate, fully humid and warm summers
♦ Hp3	45° 19′ 3.99″ W 22° 21′ 22.792″ S	1438±234	39	4	10368	Cfb	warm temperate climate, fully humid and warm summers
▲ Sp1	45° 1′ 48.776″ W 22° 11′ 27.518″ S	973±49	18	3	6480	Cfb	warm temperate climate, fully humid and warm summers
▲ Sp2	44° 46′ 14.131″ W 21° 59′ 2.623″ S	1162±158	21	3	7920	Cfb	warm temperate climate, fully humid and warm summers
▲ Sp3	45° 11′ 55.41″ W 21° 55′ 0.8″ S	1055±116	20	3	8856	Cwa	Warm temperate climate, with dry winters and hot summers
● PNI	44° 37' 22.46" W 22° 26' 0.962" S	1279±597	88	8	17280	Cfa	Warm temperate climate, fully humid and with hot summers
● RPPN	44° 48' 45.554" W 22° 21' 39.314" S	1839±419	76	8	17280	Cfb	Warm temperate climate, fully humid and warm summers

This landscapes were divided in three categories: Three landscapes with high vegetation proportion with 35% of coverage (♦ Hp 1 to 3); Three landscapes with a maximum of 20% of vegetation coverage (▲ Sp 1 to 3) and two control landscapes with 80% vegetation coverage (● PNI and RPPN) (Figure 1, Table 1).

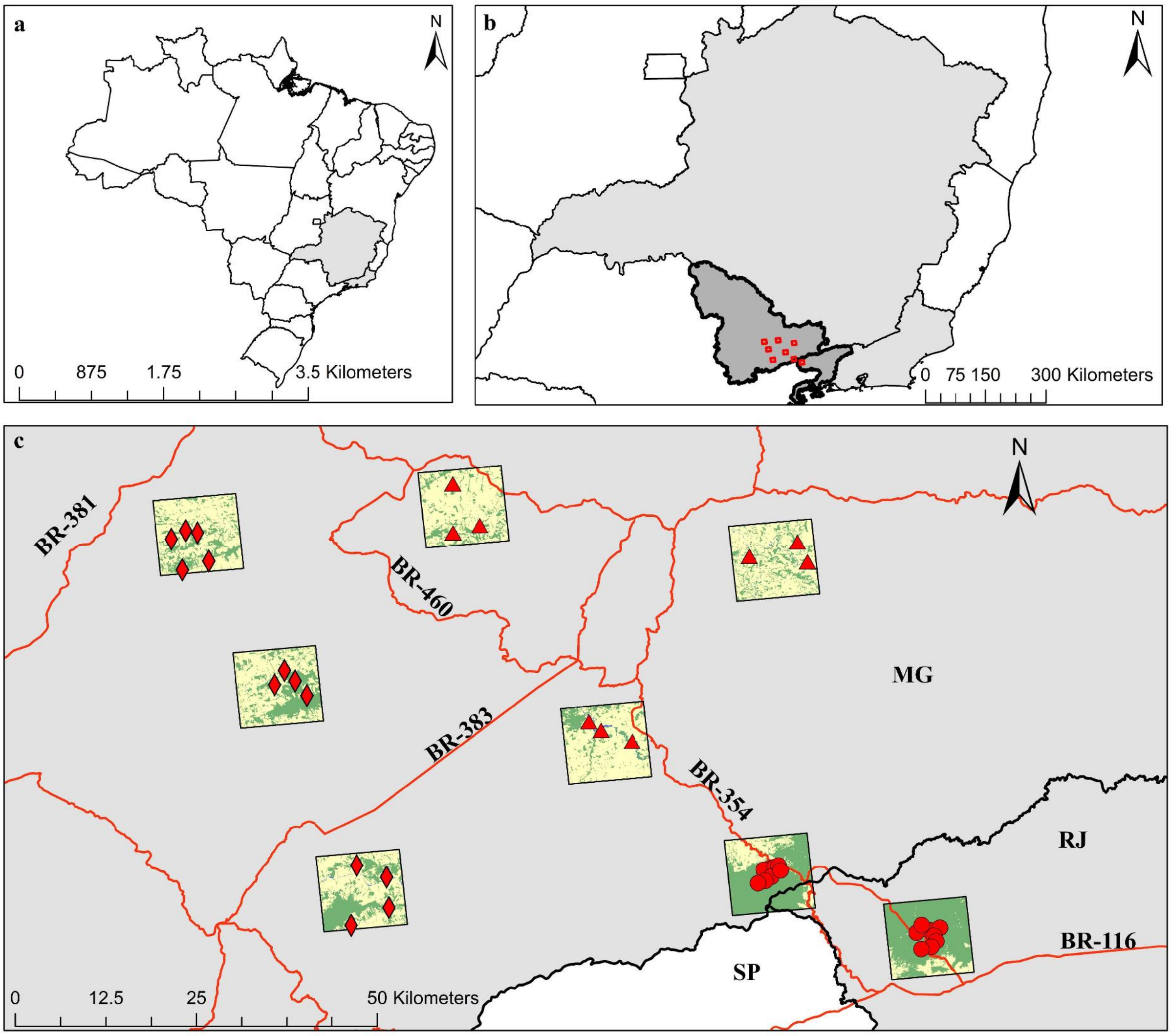

Figure 1: Map of the study area. a) Brazil map, showing location of the studied landscapes. b) Minas Gerais and Rio de Janeiro states, highlighting the mesoregions of the south of Minas Gerais and the south of Rio de Janeiro. The red dot show the location of the landscapes. c) Limits of the studied landscapes represented by the black quadrant. The different symbols represent the sampling points in each of the vegetation proportion (Small vegetation proportion ▲, High vegetation proportion ♦ and Control landscape ●). The green polygons represent the forest fragments and the non-florest matrix is represented in beige.

.2.2 Sampling Design

At each sampling points we installed a Bushnell camera trap model *Trophy Cam HD*, with a minimal distance of 2 km between them. The cameras were placed at 50 centimetres from the ground fixed in trails. The cameras were checked every 30 days for retrieval of the cards and maintenance, they were left in field for 90 to 120 days, when they were reallocated to the next landscape. The sampling effort for each point consisted as the number of days in the field multiplied by 24h (Table 1), and for the landscape the sampling effort is the total number of sampling points of the sampling efforts for each of the sampling points.

The landscapes described as control areas were sampled from 2013 to 2015 in previous studies carried by Gonçalves et at (2015) and Rosa et al. (2015) in Itatiaia National Park (● - PNI, Table 1, Figure 1) and the Private Reserve of Natural Heritage Alto Montana (● - RPPN, Table 1, Figure 1) respectively. Their studies took plane in the border between the south region of the Minas Gerais state and the Rio de Janeiro state. We compared those areas with our sampling points, as they are part of the Serra da Mantiqueira complex and present a bigger vegetation proportion than those found on the other locations of this study. These studies consisted in 8 sampling points each, and were conducted from early 2013 until late 2015. To enable the comparison with our sampling points, we randomly selected three consecutive months from their annual sampling (April to August 2014).

.2.3 Data Analysis

As individuals could not be identified, each of the records of one specie in the same sampling point, that happened within one hour period were discarded (following Srbek-Araújo & Chiarello (2013)).

To compare the species richness between the sampling points, we performed a rarefaction curve and calculated the expected number of species in each of the landscapes and also the expected number of species in each of the sampling points. As we have a sampling design that is proportional to the vegetation coverage in each of the landscapes, the rarefaction curve allows us to decrease the bias on the variation of species richness due to sampling effort or different efficiency of capture between different locations.

We performed a Non-metric multidimensional scaling (NMDS) to visualize and ordinate the sampling points according to the occurrence of medium and large-sized mammals. To test if there is a significant difference between the areas, we performed a Analysis of Similarity (ANOSIM) aiming to corroborate the spatial patterns visualized on the NMDS.

We performed an *a priori* Mantel test to see the correlation between the sampling points, and as they were highly correlated ($r = 0.102$, **p** = 0.026) we constructed generalized linear mixed models (GLMM) to analyze which of the environmental variables affected the species richness of medium and large-sized mammals. This analysis allowed us to understand the influence and importance of each of environmental factors on the landscapes. As we design the sampling as a landscape experiment (Figure 1) the GLMM analysis was necessary to define a method for block sampling, where the landscapes were fixated as random effects. This analysis was conducted in the R software using the MuMIN package for the GLMM and vegan package for the Mantel test (BARTOŃ, 2013; OKSANEN et al., 2016; R DEVELOPMENT CORE TEAM, 2013).

The environmental variables were divided in two categories, referring to the scale of this variables: The Environmental Qualities of the Fragment (local scale) and the Landscape Quality (regional scale). All spatial variables were obtained through the ArcGis software (ESRI, 2012).

In the Environmental Qualities (local scale) there was four variables: the border area of the fragment (100 meters of border effect, estimated by the Vlate plugin in ArcGis (LANG; TIEDE, 2003)); the mean canopy opening (the mean canopy opening of ten independent points within a 100 meters long transect for each of the studied fragments) this was conducted with the ImageJ software (SCHNEIDER; RASBAND; ELICEIRI, 2012)); the tree height (mean of the estimated heights of four trees for each of the ten points used to estimate the canopy opening, totaling 40 trees per fragment); and the sampling effort for each sampling point.

The environmental variables in the category of Landscape Quality (regional scale) were consistent for all the points in each landscapes. These were the mean area of fragments in the landscape (Vlate); mean border area for all the fragments (mean of 100 meters of border effect * the fragment perimeter for all the fragments, in the Vlate); mean perimeter of fragments (MSI (LANG; TIEDE, 2003)); and mean distance between the fragments (Nndist (LANG; TIEDE, 2003)). The vegetation proportion was also used as an environmental variable, been used to choose the sampling landscape and as a variable in the regional scale (Table 1).

All the variables were incorporated as explanatory variables in the GLMM analysis, in order to understand which one of them offered a better explanation for the variation in the species richness of the medium and large mammal community in the landscapes. This variables were standardized *a priori* so that they could be compared between each other. This standardization consisted in the subtraction of the mean and the division by the standard deviation of all the values, for each variable. The analysis were conducted in both scales separately.

3 RESULTS

There was a distinct pattern between the landscapes, as they showed a variation in the mammal species richness and composition. In the landscapes with small vegetation proportion (20% vegetation proportion – Sp 1 to 3, Table 1) we found 10 species, in the landscapes with high vegetation proportion (35% vegetation proportion – Hp 1 to 3, Table 1) we found a richness of 17 species and in the control landscapes (80% vegetation proportion – PNI and RPPN, table 1) we found 18 species. The sampling was probably not enough to access all the species in the community, as showed by the rarefaction curve (Figure 2).

The NMDS analysis (Figure 4) showed the formation of distinct groups, showing that the fragmented landscapes (Hp and Sp, Table 1) presents a different species composition than the control landscapes (PNI and RPPN, Table 1). The ANOSIM, confirmed this patterns and showed that the formed groups were statistically different (**p** = 0.0013, stress = 0.2995). There was no difference between the small vegetation proportion and the high vegetation proportion (**p** = 0.5142) but there was a difference between the small vegetation proportion when compared with the PNI (**p** = 0.0008) and the RPPN (**p** = 0.0015). This pattern is the same when we compared the landscapes with high proportion with the PNI (**p** = 0.0048) and with the RPPN (**p** = 0.0063). It also showed a significant difference between the RPPN e PNI (**p** = 0.0004).

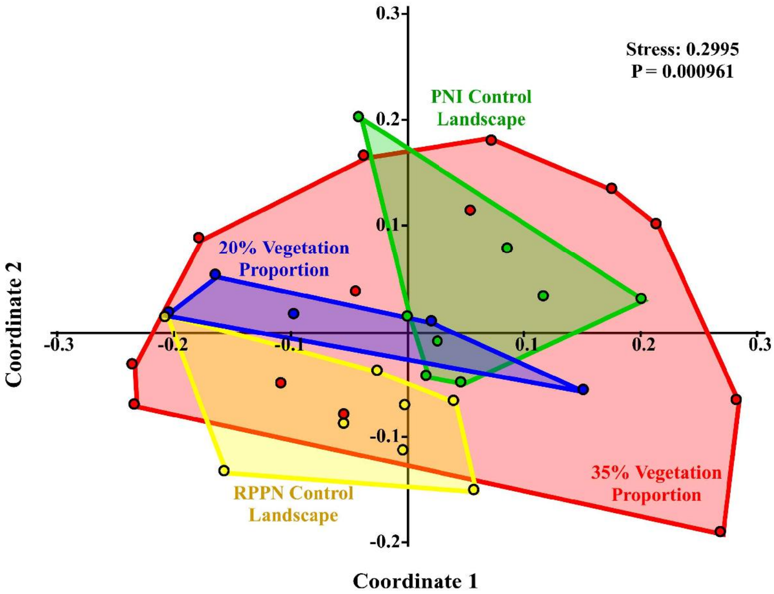

Figure 2: Results of the NMDS analysis for the structure of the medium and large mammals. In red the fragmented landscapes with high vegetation proportion (35%), in blue the fragmented landscapes with small vegetation proportion (20%). The green and yellow dots are correspondents to the Itatiaia National Park (PNI) and Private Reserve of Natural Heritage Alto Montana (RPPN), respectively.

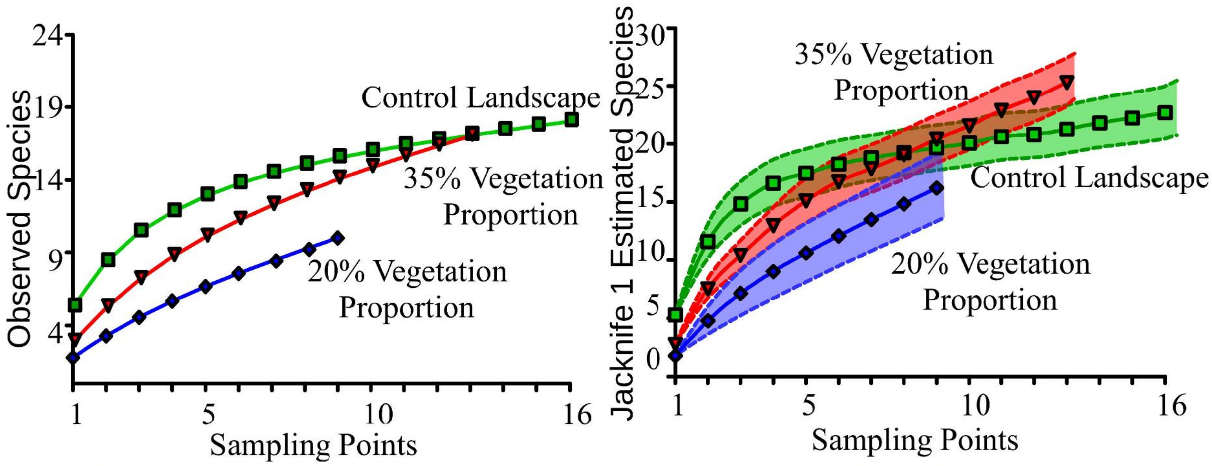

Figure 3: Species accumulation curve for the sampled points. On the left there's the observed species and the in the right the estimated species with the Jackknife 1 estimator. In red we have the landscapes with 35% vegetation proportion, in blue the ones with 20% and in green both the controls landscape.

For the GLMM analysis, as the variables presented a high correlation between them, we made all the possible models for the interaction between the variables making sure that the correlated variables were not present in the same model (TABACHNICK; FIDELL, 2013). In the local scale there were 64 models (Supplementary Table 1) and in the landscape scale 16 models (Supplementary Table 2). As there were more than one best model and we want to investigate the best estimates for the species richness from the parameters presented in all the best models, we conducted the model averaging in both scales (BURNHAM; ANDERSON, 2002).

.3.1 Local Scale

In the Local scale the models presented a loss in confiability as we choose the best models, as such we decided to make the averaging of the models with ΔAICc < 1, this solution was based in the evidence ratio (BURNHAM; ANDERSON, 2002). As the ΔAICc became bigger than 1 the evidence ratio started to increase to much showing a loss in the possible response of the subsequent models (BURNHAM; ANDERSON, 2002). With the evidence ratio it was possible to disregard the models with ΔAICc >1, since they were not explaining much of the variation in the species richness. This way the model averaging was conducted with three models.

Table 2: Summary of the averaged model selected by the GLMM analysis the * shows the variables that were significant and present in the best models to explain the variance in the species richness and their significance

Model Parameters	Estimate	Std. Error	Adjusted SE	p(>|z|)
Local Scale				
Intercept	1.36	0.088	0.092	0.000
Canopy Opening	0.18	0.092	0.095	0.056
Tree Height (*)	0.19	0.092	0.096	0.046
Fragment Area (*)	0.23	0.100	0.103	0.026
Landscape Scale				
Intercept	1.36	0.088	0.092	0.000
Mean Frag. Area (*)	0.28	0.088	0.092	0.002
Vegetation Proportion (*)	0.27	0.088	0.092	0.004
Mean Frag. Perimeter	-0.07	0.085	0.089	0.436

The averaged model showed that the canopy opening, tree height and the fragment size were the most important variables to explain species richness in the local scale (figure 4, Table 2). Although the canopy opening was not significant (GLMM, $t = 0.11$, **p** = 0.056), both the tree height (GLMM, $t = 0.19$, **p** = 0.046) and the fragment area (GLMM, $t = 0.22$, **p** = 0.026) were significant to explain the variation in the species richness (Figure 2).

.3.2 Landscape Scale

In landscape scale the evidence ratio only started to increase to much as the ΔAICc gets bigger than two, so we maintain the usually used threshold. This way we ended with three best models to make the averaging.

The averaged model showed the variables mean size of the fragments, vegetation proportion and mean perimeter of the fragments were present in the best models. Among this variables we found that the mean perimeter was not significant (GLMM, t = -0.07, **p** = 0.436), but the mean size of the fragments (GLMM, t = 0.28, **p** = 0.002) and the vegetation

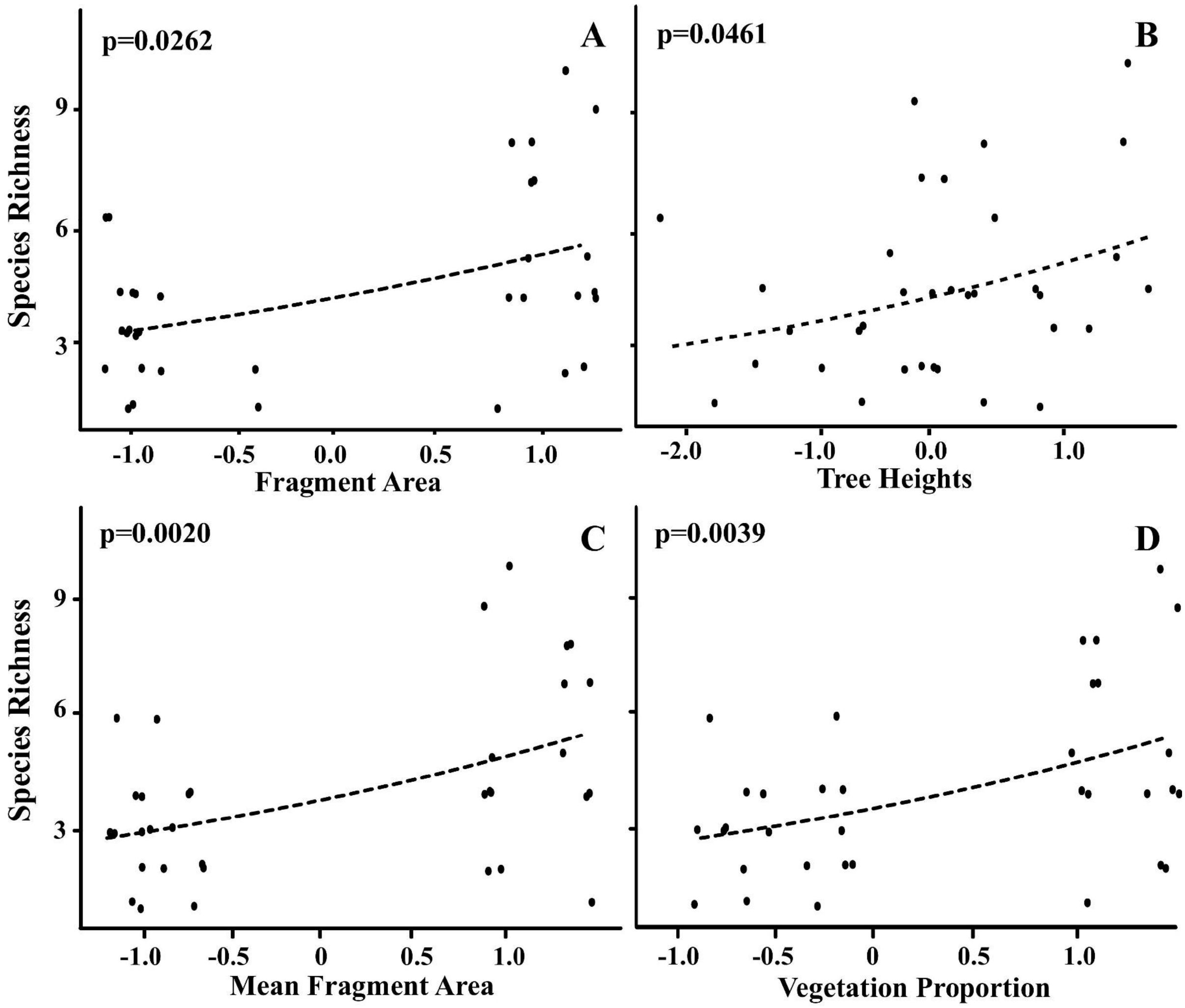

Figure 4: Graphs of the averaged models for the effect on species richness of the fragment area (**A**), tree height (**B**), mean area of fragments in the landscape (**C**) and vegetation proportion (**D**). **A** and **B** represents the local scale, and **C** and **D** represents the landscape scale.

proportion (GLMM, t = 0.28, **p** = 0.004) were significant (Figure 2).

4 DISCUSSION

Our results support the hypothesis that the community of medium and large mammals is influenced by the variations in the local scale, but its presence is also influenced by variations in the regional scale. This highlights the importance of studying the encircling areas together with the characteristics of the sampled fragment, when concerning the study of medium to large mammals.

The results of the NMDS and the ANOSIM analysis showed that the mammal community presented in the fragmented landscapes (Hp and Sp, Table 1) are probably equally impacted, independent of how much habitat is left from the fragmentation process. This shows that the difference of 35% to 20% of vegetation in the landscape is not a significant factor to the species composition. We found that the PNI and the RPPN have a different species richness and composition, when compared to the fragmented landscapes and between themselves. This patterns shows that the vegetation proportion of less than 40% can present the same impact on the mammal community, evidencing that the fragmentation impact is bigger than we anticipated and even with a relative medium amount of habitat (35% when compared to 20% of vegetation proportion) the community still suffers the same impacts from the fragmentation.

.4.1 Local Scale

The GLMM results are consistent with the importance of a high quality forest fragment, in maintaining a higher number of mammal species (MAGIOLI et al., 2015). The quality of the fragment is represented here by the importance of bigger fragments and taller trees.

One possible explanation for this results is that in highly fragmented landscapes there is usually a decrease of fragment size which leads to changes in the phenology of the vegetation, which excludes larger species, favouring smaller trees (BRIANT; GOND; LAURANCE, 2010). Such changes can be the modification in the richness and composition of plant species (COLLINS et al., 2017) that would lead to losses in the food source availability and diversity (AUGUST, 1983) causing trophic cascade effect. The fragment size could be influencing directly in the species richness by the fact that a smaller fragment maintain a smaller community (DEBINSKI; HOLT, 2000; FAHRIG, 2003), since species that are habitat specialist and dietary specialist cannot persist in smaller fragment (MAGIOLI et al., 2015).

Concerning the tree heights and its influence in the mammal richness, the bigger and/or older trees are responsible for the maintenance of a balanced environment in the forest's canopy, understory, as well as in the forest ground (DEAN; MILTON; JELTSCH, 1999). High trees are important to promote key sites to many mammal species, they are places for social aggregation, refuge, food source and water filled cavities (AUGUST, 1983; FELTON et al., 2010; GIBBONS; LINDENMAYER, 2002; LINDENMAYER; LAURANCE, 2017; REMM; LÕHMUS, 2011). This allows the prevalence of small or medium bodied animals (rodents, marsupials and other non-mammalian species) that are potential prey for the predators (SANDOM et al., 2013; TEWS et al., 2004). This increased the heterogeneity of the environment (BERNARD, 2001; DEAN; MILTON; JELTSCH, 1999; LINDENMAYER; LAURANCE, 2017), possibiliting the structure of a much more complex food web (ESTES et al., 2011; JORGE et al., 2013) and in this way the increased patch size and tree height could lead to a higher species richness.

.4.2 Landscape Scale

For the landscape scale, the GLMM results showed the importance of the quantity of habitat and it's influence in the large and medium mammal species richness. It shows that the quantity of habitat present in the landscape is important for the prevalence of the mammal species in the area. This result were verified by Beca et al. (2017) in areas of Atlantic Forest in the São Paulo state, making explicit the importance of the landscape scale in the study of mammals species, were smaller landscapes could mask the requirement of well structured landscapes and not only well preserved fragments (BOWERS; MATTER, 1997).

One explanation for this response to higher quantities of habitat (higher vegetation proportion and bigger mean area of the fragments) could be due to the possibility of maintaining several populations of the species in the environment, which would lead to a more complex landscape. This complexity would be both geographically because of the higher availability of habitat and ecologically because of the higher probability of different species to occur in this said habitats (METZGER, 2001). This would happen since the amount of habitat is important in maintaining a more diversified community in terms of functional diversity of the species (MAGIOLI et al., 2015) increasing the species richness (SAFI et al., 2011).

Other causes could be that a higher amount of habitat would influence directly the perseverance of species with bigger body mass, since they are dependant of larger areas for home range (LINDSTEDT; MILLER; BUSKIRK, 1986). The presence of this larger species can lead to significant changes in the environment, such as: controlling of mesocarnivore impacts, remedying trophic cascade by fear (SURACI et al., 2016) or actual presence of predators (ESTES et al., 2011; JORGE et al., 2013). The presence of bigger species can even help maintain the seed removal dynamics that can cause disbalance in tree populations (JANZEN, 1970), benefiting small-seeded species (SHEN et al., 2012) or even playing an important role in the restoration of degraded forests (ESTES et al., 2011; LINDSELL et al., 2015).

5 CONCLUSION

In conclusion this paper comes in agreement with several others (MAGIOLI et al., 2015; MENDES; RIBEIRO; GALETTI, 2016; MENDES PONTES et al., 2016) to show the importance in the conservation of habitats for the prevalence of a rich mammal community and shows the importance in preserving larger fragments of the Atlantic Forest intact, as well as the ecological importance of the south region of the Minas Gerais state.

6 ACKNOWLEDGMENTS

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REFERENCES

(ESRI), E. S. R. I. **ArcGIS Release 10.1**Redlands, CA, 2012.

AMM, E. **Caracterização Econômica das Regiões de Planejamento – Portal AMM**. Disponível em: <http://portalamm.org.br/caracterizacao-economica-das-regioes-de-planejamento/>.

AUGUST, P. V. The Role of Habitat Complexity and Heterogeneity in Structuring Tropical Mammal Communities. **Ecology**, v. 64, n. 6, p. 1495–1507, dez. 1983.

BARTOŃ, K. MuMIn: Multi-Model Inference. **R package version 1.9.13**, 2013.

BASELGA, A. Partitioning The Turnover And Nestedness Components Of Beta Diversity. **Global Ecology and Biogeography**, v. 19, n. 1, p. 134–143, jan. 2010.

BASELGA, A.; ORME, C. D. L. betapart : an R package for the study of beta diversity. **Methods in Ecology and Evolution**, v. 3, n. 5, p. 808–812, out. 2012.

BECA, G. et al. High mammal species turnover in forest patches immersed in biofuel plantations. **Biological Conservation**, n. March, mar. 2017.

BERNARD, E. Vertical stratification of bat communities in primary forests of Central Amazon, Brazil. **Journal of Tropical Ecology**, v. 17, n. 1, p. S0266467401001079, jan. 2001.

BORDIGNON, M.; MONTEIRO-FILHO, E. L. A. O Serelepe Sciurus ingrami (Sciuridae: Rodentia) Como Dispersor do Pinheiro do Paraná Araucaria angustifolia (Araucariaceae: Pinophyta). **Arquivos de Ciências Veterinárias e Zoologia da UNIPAR**, v. 3, n. 2, 2000.

BOWERS, M. A.; MATTER, S. F. Landscape Ecology of Mammals: Relationships between Density and Patch Size. **Journal of Mammalogy**, v. 78, n. 4, p. 999–1013, 26 nov. 1997.

BOYD, C. et al. Spatial scale and the conservation of threatened species. **Conservation Letters**, v. 1, n. 1, p. 37–43, 12 maio 2008.

BRIANT, G.; GOND, V.; LAURANCE, S. G. W. Habitat fragmentation and the desiccation of forest canopies: A case study from eastern Amazonia. **Biological Conservation**, v. 143, n. 11, p. 2763–2769, nov. 2010.

BURNHAM, K. P.; ANDERSON, D. R. **Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach (2nd ed)**. [s.l: s.n.]. v. 172

CARDINALE, B. J. et al. Biodiversity loss and its impact on humanity. **Nature**, v. 486, n. 7401, p. 59–67, 6 jun. 2012.

CARVALHO, L. M. T. DE et al. Flora. In: SCOLFORO, J. R. S.; CARVALHO, L. M. T. DE; OLIVEIRA, A. D. DE (Eds.). . **Zoneamento Ecológico-Econômico do Estado de Minas**

Gerais: componentes geofísico e biótico. 22. ed. Lavras, Minas Gerais: Editora UFLA, 2008. p. 137–148.

CASSANO, C. R.; BARLOW, J.; PARDINI, R. Large Mammals in an Agroforestry Mosaic in the Brazilian Atlantic Forest. **Biotropica**, v. 44, n. 6, p. 818–825, nov. 2012.

CHIARELLO, A. Effects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. **Biological Conservation**, v. 89, n. 1, p. 71–82, jul. 1999.

CLARKE, K. R.; WARWICK, R. M. **Change in marine communities: an approach to statistical analysis and interpretation**. Plymouth (UK): [s.n.].

COLLINS, C. D. et al. Fragmentation affects plant community composition over time. **Ecography**, v. 40, n. 1, p. 119–130, jan. 2017.

DA FONSECA, G. A. B.; ROBINSON, J. G. Forest size and structure: Competitive and predatory effects on small mammal communities. **Biological Conservation**, v. 53, n. 4, p. 265–294, 1990.

DAVIDSON, A. D. et al. Multiple ecological pathways to extinction in mammals. **Proceedings of the National Academy of Sciences**, v. 106, n. 26, p. 10702–10705, 30 jun. 2009.

DAVIDSON, C. Economic Growth and the Environment:Alternatives to the Limits Paradigm. **BioScience**, v. 50, n. 5, p. 433, 2000.

DEAN, W. R. J.; MILTON, S. J.; JELTSCH, F. Large trees, fertile islands, and birds in arid savanna. **Journal of Arid Environments**, 1999.

DE SÁ JÚNIOR, A. et al. Application of the Köppen classification for climatic zoning in the state of Minas Gerais, Brazil. **Theoretical and Applied Climatology**, v. 108, n. 1–2, p. 1–7, 27 abr. 2012.

DEBINSKI, D. M.; HOLT, R. D. A Survey and Overview of Habitat Fragmentation Experiments. **Conservation Biology**, v. 14, n. 2, p. 342–355, 2000.

DIAS, B. F. DE S. Conservação da Biodiversidade no Bioma Cerrado: histórico dos impactos antrópicos no Bioma Cerrado. In: FALEIRO, F. G.; NETO, A. L. DE F. (Eds.). . **Savanas: Desafios e Estratégias para o Equilíbrio entre Sociedade, Agronegócio e Recursos Naturais**. Brasília, DF: Embrapa Informação Tecnológica, 2008. p. p 303-336.

ESTES, J. A et al. Trophic downgrading of planet Earth. **Science (New York, N.Y.)**, v. 333, n. 6040, p. 301–306, 2011.

FAHRIG, L. Effects of Habitat Fragmentation on Biodiversity. **Annual Review of Ecology, Evolution, and Systematics**, v. 34, n. 1, p. 487–515, nov. 2003.

FELTON, A. M. et al. The role of timber tree species in the nutritional ecology of spider monkeys in a certified logging concession, Bolivia. **Forest Ecology and Management**, 2010.

FILETTO, F.; ALENCAR, E. Introdução E Expansão Do Café Na Região Sul De Minas Gerais. **Organizações Rurais e Agroindustriais**, v. 3, n. 1, p. 1–10, 2001.

FONSECA, P. H. M. et al. Levantamento dos Mamíferos Terrestres de Médio e Grande Porte , na Reserva Particular do Patrimônio Natural – Vale Encantado, Uberaba, estado de Minas Gerais, Brasil. **Acta Zoológica Lilloana**, v. 60, n. 1, p. 47–56, 2016.

GALETTI, M. et al. Priority areas for the conservation of Atlantic forest large mammals. **Biological Conservation**, v. 142, n. 6, p. 1229–1241, jun. 2009.

GALETTI, M.; BOVENDORP, R. S.; GUEVARA, R. Defaunation of Large Mammals Leads to an Increase in Seed Predation in the Atlantic Forests. **Global Ecology and Conservation**, v. 3, p. 824–830, 2015.

GARMENDIA, A. et al. Landscape and patch attributes impacting medium- and large-sized terrestrial mammals in a fragmented rain forest. **Journal of Tropical Ecology**, v. 29, n. 4, p. 331–344, jul. 2013.

GEISE, L. et al. Pattern of elevational distribution and richness of non volant mammals in Itatiaia National Park and its surroundings, in Southeastern Brazil. **Brazilian Journal of Biology**, v. 64, n. 3b, p. 599–612, ago. 2004.

GIBBONS, P.; LINDENMAYER, D. **Tree Hollows and Wildlife Conservation in Australia**. 2. ed. Collingwood: Csiro Publishing, 2002.

GONÇALVES, F. H. P. **A INVASÃO DO JAVALI NA SERRA DA MANTIQUEIRA: Aspectos populacionais, uso do habitat e sua relação com o Homem**. [s.l.] Universidade Federal de Lavras, 2015.

HERINGER, H.; MONTENEGRO, M. M. **Avaliação e Ações Prioritárias Para a Conservação da Biodiversidade da Mata Atlântica e Campos Sulinos**. 1. ed. Brasilia, DF: MMA/ SBF, 2000.

IBGE. **Manual Técnico da Vegetação Brasileira**. [s.l: s.n.].

INÁCIO, L.; TAI, D. W. **Censo Agropecuário 2006 - Resultados preliminaresDE GEOGRAFIA E ESTATÍSTICA - IBGE**. [s.l: s.n.].

JANZEN, D. Herbivores and the Number of Tree Species in Tropical Forests. **American Naturalist**, v. 104, n. 940, p. 501–528, 1970.

JORGE, M. L. S. P. et al. Mammal defaunation as surrogate of trophic cascades in a biodiversity hotspot. **Biological Conservation**, v. 163, p. 49–57, jul. 2013.

KOTTEK, M. et al. World Map of the Köppen-Geiger climate classification updated. **Meteorologische Zeitschrift**, v. 15, n. 3, p. 259–263, 1 jun. 2006.

LANG, S.; TIEDE, D. **vLATE Extension für ArcGIS - vektorbasiertes Tool zur quantitativen Landschaftsstrukturanalyse**ESRI Anwenderkonferenz 2003 Innsbruck., , 2003.

LE SAOUT, S. et al. Protected Areas and Effective Biodiversity Conservation. **Science**, v. 342, n. 6160, p. 803–805, 15 nov. 2013.

LINDEMANN-MATTHIES, P.; JUNGE, X.; MATTHIES, D. The influence of plant diversity on people's perception and aesthetic appreciation of grassland vegetation. **Biological Conservation**, v. 143, n. 1, p. 195–202, jan. 2010.

LINDENMAYER, D. B.; LAURANCE, W. F. The ecology, distribution, conservation and management of large old trees. **Biological Reviews**, v. 92, n. 3, p. 1434–1458, ago. 2017.

LINDSELL, J. A. et al. Availability of large seed-dispersers for restoration of degraded tropical forest. **Tropical Conservation Science**, v. 8, n. 1, p. 17–27, 2015.

LINDSTEDT, S. L.; MILLER, B. J.; BUSKIRK, S. W. Home Range, Time, and Body Size in Mammals. **Ecology**, v. 67, n. 2, p. 413–418, abr. 1986.

MACARTHUR, R. H.; WILSON, E. O. The theory of island biogeography. Monographs in Population Biology. **The theory of island biogeography. Monographs in Population Biology**, 1967.

MACHADO, F. S. et al. Registros ocasionais de mamíferos de médio e grande porte na microrregião de Lavras e São João del Rei, Campo das Vertentes, Minas Gerais. **Revista Agrogeoambiental**, v. 9, n. 1, 12 abr. 2017.

MAGIOLI, M. et al. Thresholds in the relationship between functional diversity and patch size for mammals in the Brazilian Atlantic Forest. **Animal Conservation**, v. 18, n. 6, p. 499–511, dez. 2015.

MAGIOLI, M.; FERRAZ, K. DE B.; RODRIGUES, M. G. Medium and large-sized mammals of an isolated Atlantic Forest remnant, southeast São Paulo State, Brazil. **Check List**, v. 10, n. 4, p. 850–856, set. 2014.

MENDES, C. P.; RIBEIRO, M. C.; GALETTI, M. Patch size, shape and edge distance influence seed predation on a palm species in the Atlantic forest. **Ecography**, v. 39, n. 5, p. 465–475, maio 2016.

MENDES PONTES, A. R. et al. Mass Extinction and the Disappearance of Unknown Mammal Species: Scenario and Perspectives of a Biodiversity Hotspot's Hotspot. **PLOS ONE**, v. 11, n. 5, p. e0150887, 18 maio 2016.

METZGER, J. P. O que é ecologia de paisagens. **Biota Neotropica**, v. 1, p. 1–9, 2001.

MITTERMEIER, R. A. et al. Hotspots revisitados. **Conservaçao Internacional**, p. 16, 2005.

MYERS, N. et al. Biodiversity hotspots for conservation priorities. **Nature**, v. 403, n. 6772, p. 853–858, 24 fev. 2000.

NEGRÕES, N. et al. Use of Camera-Trapping to Estimate Puma Density and Influencing Factors in Central Brazil. **Journal of Wildlife Management**, v. 74, n. 6, p. 1195–1203, ago. 2010.

OKSANEN, J. et al. **vegan: Community Ecology Package**R package 2.4-0, , 2016.

OLIVEIRA-FILHO, A.; FLUMINHAN-FILHO, M. Ecologia da vegetação do parque florestal Quedas do Rio Bonito. **Cerne**, v. 5, n. 2, p. 51–64, 1999.

OLIVEIRA-FILHO, A. T.; FONTES, M. A. L. Patterns of Floristic Differentiation among Atlantic Forests in Southeastern Brazil and the Influence of Climate1. **BIOTROPICA**, v. 32, n. 4, p. 793, 2000.

PAULA, T. A. R. et al. Aspectos do uso territorial por onça parda (Puma concolor), através de monitoramento via satélite, na região do Parque Estadual da Serra do Brigadeiro, MG. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v. 67, n. 1, p. 80–88, fev. 2015.

PRUGH, L. R. et al. Effect of habitat area and isolation on fragmented animal populations. **Proceedings of the National Academy of Sciences**, v. 105, n. 52, p. 20770–20775, 30 dez. 2008.

REALE, R.; FONSECA, R.; UIEDA, W. Medium and Large-sized Mammals in a Private Reserve of Natural Heritage in the Municipality of Jaú, São Paulo, Brazil. **Check List**, v. 10, n. 5, p. 997–1004, out. 2014.

REIS, N. R. DOS et al. **Mamíferos do Brasil**. 2. ed. Londrina, Paraná: [s.n.].

REMM, J.; LÕHMUS, A. Tree cavities in forests – The broad distribution pattern of a keystone structure for biodiversity. **Forest Ecology and Management**, v. 262, n. 4, p. 579–585, ago. 2011.

RIBEIRO, M. C. et al. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. **Biological Conservation**, v. 142, n. 6, p. 1141–1153, jun. 2009.

RIPPLE, W. J.; BESCHTA, R. L. Wolves and the Ecology of Fear: Can Predation Risk Structure Ecosystems? **BioScience**, v. 54, n. 8, p. 755, 2004.

ROCHA, E. C.; SOARES, K. L.; PEREIRA, I. M. Medium- and large-sized mammals in Mata Atlântica State Park, southeastern Goiás, Brazil. **Check List**, v. 11, n. 6, p. 1802, 2 dez. 2015.

ROCHA, M. F.; PASSAMANI, M.; YANKOUS GONÇALVES FIALHO, M. Can vegetation corridors provide habitat in fragmented landscapes? A case-study in the Brazilian Atlantic Domain. **Studies on Neotropical Fauna and Environment**, v. 49, n. 3, p. 180–184, 2014.

ROEMER, G. W.; GOMPPER, M. E.; VALKENBURGH, B. VAN. The Ecological Role of the Mammalian Mesocarnivore. **BioScience**, v. 59, n. 2, p. 165–173, 2009.

ROSA, C. A. DA. **Mamíferos exóticos invasores no Brasil: situação atual, riscos potenciais e impactos da invasão de porcos selvagens em florestas tropicais**. [s.l.] Universidade Federal de Lavras, 2015.

SAFI, K. et al. Understanding global patterns of mammalian functional and phylogenetic diversity. **Philosophical Transactions of the Royal Society B: Biological Sciences**, v. 366, n. 1577, p. 2536–2544, 12 set. 2011.

SANDOM, C. et al. Mammal predator and prey species richness are strongly linked at macroscales. **Ecology**, v. 94, n. 5, p. 1112–1122, maio 2013.

SANT'ANNA NETO, J. L. DECÁLOGO DA CLIMATOLOGIA DO SUDESTE BRASILEIRO. **Revista Brasileira de Climatologia**, v. 1, n. 1, 31 dez. 2005.

SANTOS, K. K.; PACHECO, G. S. M.; PASSAMANI, M. Medium-sized and large mammals from Quedas do Rio Bonito Ecological Park, Minas Gerais, Brazil. **Check List**, v. 12, n. 1, p. 1830, 23 jan. 2016.

SCHNEIDER, C. A.; RASBAND, W. S.; ELICEIRI, K. W. NIH Image to ImageJ: 25 years of image analysis. **Nature Methods**, v. 9, n. 7, p. 671–675, 28 jun. 2012.

SHEN, Z. et al. Decrease of Large-Bodied Dispersers Limits Recruitment of Large-Seeded Trees But Benefits Small-Seeded Trees. **Israel Journal of Ecology & Evolution**, v. 58, n. 1, p. 53–67, 2012.

SMITH, D. W.; PETERSON, R. O.; HOUSTON, D. B. Yellowstone after Wolves. **BioScience**, v. 53, n. 4, p. 330–340, 2003.

SOSMA E INPE. ATLAS DOS REMANESCENTES FLORESTAIS DA MATA ATLÂNTICA PERÍODO 2013-2014. **Fundação SOS Mata Atlântica e Instituto de Pesquisas Espaciais**, p. 1–61, 2016.

SRBEK-ARAUJO, A. C.; CHIARELLO, A. G. Influence of camera-trap sampling design on mammal species capture rates and community structures in southeastern Brazil. **Biota Neotropica**, v. 13, n. 2, p. 51–62, abr. 2013.

SUNQUIST, F.; SUNQUIST, M. **Wild Cats of the World**. Chigado and London: [s.n.].

SURACI, J. P. et al. Fear of large carnivores causes a trophic cascade. **Nature Communications**, v. 7, p. 10698, 23 fev. 2016.

TABACHNICK, B. G.; FIDELL, L. S. **Using multivariate statistics (6th ed.)**. 6th. ed. New York: Pearson Education, 2013.

TAYLOR, P. D.; FAHRIG, L.; WITH, K. A. Landscape Connectivity: A return to the basics. In: **Connectivity Conservation**. [s.l.] Cambridge University Press, 2006. p. 29–43.

TEAM, R. R Development Core Team. **R: A Language and Environment for Statistical Computing**, 2013.

TEWS, J. et al. Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. **Journal of Biogeography**, v. 31, n. 1, p. 79–92, jan. 2004.

TREVES, A.; BRUSKOTTER, J. Tolerance for Predatory Wildlife. **Science**, v. 344, n. 6183, p. 476–477, 2 maio 2014.

TURNER, M. G.; GARDNER, R. H.; O'NEILL, R. V. **Landscape Ecology in Theory and Practice: pattern and process**. [s.l.] Springer, 2001.

UMETSU, F.; PAUL METZGER, J.; PARDINI, R. Importance of estimating matrix quality for modeling species distribution in complex tropical landscapes: a test with Atlantic forest small mammals. **Ecography**, p. 80304020349105–0, 4 mar. 2008.

WILKIE, D. S. et al. The empty forest revisited. **Annals of the New York Academy of Sciences**, v. 1223, n. 1, p. 120–128, mar. 2011.

7 SUPPLEMENTARY MATERIALS

Supplementary Table 1: GLMM results for all the tested models in the Local Scale, showing the models, the variables presented in each of the models, the AICc for every one of them, the difference between the small AICc and the next one (ΔAICc), the weight of each model, and the evidence ratio for each of them.

GLMM Models	(Intercept)	Opening	Height	Frag. Area	Frag. Border	Nndist	Frag. Perimeter	Effort	AICc	ΔAICc	Weight	Evidence Ratio
null model	**1.326**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**153.05**	**4.623**	**0.010**	**10.09**
m 3	1.360	0.218	0.191	-	-	-	-	-	148.43	0.000	0.102	1
m 26	1.369	-	-	0.258	-	-	-	-	148.62	0.192	0.092	1.10
m 11	1.363	0.121	-	0.189	-	-	-	-	149.37	0.944	0.063	1.60
m 4	1.356	0.164	0.143	0.116	-	-	-	-	150.14	1.711	0.043	2.35
m 2	1.378	0.204	-	-	-	-	-	-	150.25	1.822	0.041	2.49
m 61	1.365	-	-	0.295	-	0.093	-	-	150.29	1.861	0.040	2.54
m 19	1.366	-	0.085	0.226	-	-	-	-	150.38	1.953	0.038	2.66
m 30	1.357	0.195	0.183	-	-	-	-	-0.080	150.55	2.125	0.035	2.89
m 53	1.366	-	-	0.227	-	-	-	-0.078	150.67	2.237	0.033	3.06
m 6	1.358	0.230	0.203	-	-	0.062	-	-	150.76	2.327	0.032	3.20
m 10	1.360	0.205	0.180	-	-	-	0.028	-	151.13	2.697	0.026	3.85
m 5	1.360	0.216	0.189	-	0.004	-	-	-	151.19	2.763	0.026	3.98
m 14	1.359	0.122	-	0.227	-	0.096	-	-	151.20	2.767	0.025	3.99
m 17	1.372	0.158	-	-	-	-	0.112	-	151.61	3.178	0.021	4.90
m 12	1.373	0.157	-	-	0.107	-	-	-	151.69	3.263	0.020	5.11
m 29	1.373	0.177	-	-	-	-	-	-0.100	151.81	3.385	0.019	5.43
m 37	1.362	0.114	-	0.173	-	-	-	-0.054	151.89	3.466	0.018	5.66
m 7	1.351	0.167	0.146	0.151	-	0.098	-	-	152.11	3.679	0.016	6.29
m 22	1.362	-	0.084	0.263	-	0.091	-	-	152.25	3.822	0.015	6.76
m 27	1.382	-	-	-	0.193	-	-	-	152.26	3.834	0.015	6.80
m 64	1.382	-	-	-	-	-	0.199	-	152.27	3.843	0.015	6.83
m 56	1.361	-	-	0.264	-	0.103	-	-0.090	152.37	3.943	0.014	7.18
m 46	1.363	-	0.092	0.188	-	-	-	-0.087	152.47	4.042	0.013	7.55
m 13	1.378	0.208	-	-	-	0.023	-	-	152.77	4.338	0.012	8.75
m 31	1.354	0.156	0.144	0.098	-	-	-	-0.057	152.83	4.397	0.011	9.01
m 18	1.336	-	0.157	-	-	-	-	-	152.86	4.426	0.011	9.14
m 32	1.354	0.206	0.197	-	-	0.078	-	-0.094	152.87	4.444	0.011	9.23
m 45	1.373	-	0.159	-	-	-	-	-0.155	153.08	4.651	0.010	10.23
m 25	1.377	-	0.115	-	-	-	0.159	-	153.32	4.892	0.009	11.54
m 9	1.357	0.205	0.181	-	-	0.082	0.065	-	153.43	4.997	0.008	12.16
m 28	1.355	-	-	-	-	-	-	-0.148	153.46	5.030	0.008	12.36
m 36	1.357	0.196	0.184	-	-	-	-0.005	-0.082	153.52	5.092	0.008	12.75
m 20	1.375	-	0.108	-	0.149	-	-	-	153.62	5.194	0.008	13.42
m 8	1.358	0.218	0.191	-	0.028	0.068	-	-	153.67	5.239	0.007	13.73

Supplementary Table 1: Cont.

GLMM Models	(Intercept)	Opening	Height	Frag. Area	Frag. Border	Nndist	Frag. Perimeter	Effort	AICc	ΔAICc	Weight	Evidence Ratio
(cont.)												
m 16	1.370	0.156	-	-	-	0.084	0.153	-	153.70	5.269	0.007	13.94
m 54	1.378	-	-	-	0.152	-	-	-0.108	153.72	5.286	0.007	14.06
m 41	1.357	0.112	-	0.211	-	0.102	-	-0.064	153.83	5.402	0.007	14.90
m 38	1.370	0.145	-	-	0.084	-	-	-0.078	153.91	5.484	0.007	15.52
m 39	1.370	0.145	-	-	0.084	-	-	-0.078	153.91	5.484	0.007	15.52
m 59	1.378	-	-	-	-	-	0.154	-0.101	153.91	5.485	0.007	15.52
m 44	1.370	0.149	-	-	-	-	0.086	-0.072	153.93	5.502	0.006	15.66
m 15	1.371	0.156	-	-	0.134	0.069	-	-	153.98	5.550	0.006	16.04
m 63	1.379	-	-	-	-	0.088	0.241	-	154.10	5.668	0.006	17.01
m 49	1.358	-	0.094	0.224	-	0.104	-	-0.100	154.35	5.926	0.005	19.35
m 62	1.380	-	-	-	0.220	0.068	-	-	154.37	5.941	0.005	19.50
m 40	1.372	0.181	-	-	-	0.039	-	-0.106	154.41	5.983	0.005	19.92
m 52	1.372	-	0.125	-	-	-	0.103	-0.114	154.89	6.465	0.004	25.34
m 33	1.349	0.158	0.149	0.132	-	0.106	-	-0.070	154.90	6.466	0.004	25.36
m 47	1.372	-	0.119	-	0.096	-	-	-0.121	154.96	6.535	0.004	26.25
m 21	1.328	-	0.159	-	-	0.033	-	-	155.32	6.891	0.003	31.36
m 60	1.319	-	-	-	-	0.031	-	-	155.37	6.945	0.003	32.21
m 24	1.374	-	0.112	-	-	0.083	0.198	-	155.39	6.966	0.003	32.56
m 48	1.365	-	0.164	-	-	0.046	-	-0.161	155.63	7.206	0.003	36.70
m 58	1.375	-	-	-	-	0.093	0.196	-0.105	155.88	7.448	0.002	41.42
m 57	1.375	-	-	-	0.180	0.078	-	-0.115	155.88	7.449	0.002	41.45
m 55	1.347	-	-	-	-	0.039	-	-0.152	155.90	7.471	0.002	41.90
m 23	1.369	-	0.108	-	0.175	0.067	-	-	155.92	7.492	0.002	42.34
m 35	1.353	0.195	0.186	-	-	0.087	0.033	-0.086	156.00	7.573	0.002	44.10
m 34	1.354	0.205	0.197	-	0.001	0.078	-	-0.094	156.07	7.640	0.002	45.61
m 43	1.367	0.146	-	-	-	0.087	0.128	-0.074	156.21	7.779	0.002	48.88
m 42	1.368	0.143	-	-	0.113	0.076	-	-0.084	156.33	7.899	0.002	51.91
m 51	1.369	-	0.124	-	-	0.090	0.142	-0.119	157.10	8.666	0.001	76.18
m 50	1.370	-	0.119	-	0.123	0.077	-	-0.129	157.35	8.917	0.001	86.36

Supplementary Table 2: GLMM results for all the tested models in the Regional Scale, showing the models, the variables presented in each of the models, the AICc for every one of them, the difference between the small AICc and the next one (ΔAICc), the weight of each model, and the evidence ratio for each of them.

GLMM Models	(Inter.)	Mean Frag. Area	Mean Frag. Perimeter	Mean Border Area	Veg. Prop.	Mean Shape Index	Landscape NNDist	AICc	ΔAICc	Weight	Evidence Ratio
null model	**1.326**	-	-	-	-	-	-	**153.052**	**6.154**	**0.016**	**21.69**
m1	1.362	0.281	-	-	-	-	-	146.898	0	0.347	1
m5	1.367	-	-	-	0.265	-	-	148.162	1.263	0.184	1.88
m2	1.360	0.289	-0.069	-	-	-	-	148.825	1.927	0.132	2.62
m3	1.362	0.298	-	-0.047	-	-	-	149.277	2.378	0.106	3.28
m6	1.374	-	-	-	-	-0.245	-	150.555	3.656	0.056	6.22
m7	1.367	-	-0.004	-	0.265	-	-	150.739	3.841	0.051	6.82
m4	1.359	0.307	-0.069	-0.047	-	-	-	151.392	4.493	0.037	9.46
m8	1.373	-	-	-0.072	-	-0.283	-	152.752	5.854	0.019	18.67
m9	1.373	-	0.033	-	-	-0.260	-	153.009	6.111	0.016	21.23
m10	1.374	-	-	-	-	-	-0.174	153.259	6.360	0.014	24.05
m14	1.338	-	-	0.070	-	-	-	155.072	8.174	0.006	59.55
m11	1.370	-	0.055	-0.094	-	-0.320	-	155.187	8.288	0.005	63.06
m15	1.323	-	-0.057	-	-	-	-	155.229	8.331	0.005	64.41
m13	1.366	-	-0.048	-	-	-	-0.165	155.642	8.743	0.004	79.18
m16	1.336	-	-0.089	0.096	-	-	-	157.113	10.215	0.002	165.24