Universidade do Estado do Rio de Janeiro
Centro Biomédico
Instituto de Biologia Roberto Alcantara Gomes

Julian Nicholas Garcia Willmer

Edge effects in fragmented landscapes: patterns and processes

Rio de Janeiro
2023

Julian Nicholas Garcia Willmer

Edge effects in fragmented landscapes: patterns and processes

Tese apresentada como requisito parcial para a obtenção do título de Doutor, ao Programa de Pós Graduação em Ecologia e Evolução, da Universidade do Estado do Rio de Janeiro

Orientador: Prof. Dr. Jayme Augusto Prevedello

Rio de Janeiro

2023

CATALOGAÇÃO NA FONTE
UERJ/REDE SIRIUS/BIBLIOTECA CTC/A

W737 Willmer, Julian Nicholas Garcia.
Edge effects in fragmented landscapes: patterns and processes/ Julian Nicholas Garcia Willmer. – 2023.
196 f.: il.

Orientador: Jayme Augusto Prevedello.
Tese (Doutorado em Ecologia e Evolução) - Universidade do Estado do Rio de Janeiro, Instituto de Biologia Roberto Alcantara Gomes.

1. Ecologia das paisagens - Teses. 2. Paisagens fragmentadas - Teses. 3. Mudanças climáticas - Teses. I. Prevedello, Jayme Augusto. II. Universidade do Estado do Rio de Janeiro. Instituto de Biologia Roberto Alcantara Gomes. III. Título.

CDU 574

Patricia Bello Meijinhos CRB7/5217 - Bibliotecária responsável pela elaboração da ficha catalográfica

Assinatura Data

Julian Nicholas Garcia Willmer

Edge effects in fragmented landscapes: patterns and processes

Tese apresentada como requisito parcial para
a obtenção do título de Doutor, ao Programa
de Pós Graduação em Ecologia e Evolução,
da Universidade do Estado do Rio de Janeiro

Aprovada em 30 de outubro de 2023

Banca examinadora:

____
Prof. Dr. Jayme Augusto Prevedello (Orientador)
Departamento de Ecologia - UERJ

____
Prof.ª Dra. Marina Zanin Gregorini
Departamento de Ecologia - UERJ

____
Prof.ª Dra. Aliny Patricia Flauzino Pires
Departamento de Ecologia – UERJ

____
Prof. Dr. Cristian Dambros
Universidade Federal de Santa Maria

____
Prof. Dr. Pavel Dodonov
Universidade Federal da Bahia

Rio de Janeiro
2023

DEDICATION

Para a minha avó Idenir

ACKNOWLEDGMENTS

Esta tese representa o fim de uma longa jornada de formação acadêmica. Não há como negar as dificuldades vividas nesses, como a passagem do COVID, que nos restringiu durante esses anos, alterando calendários e vidas inteiras. Dificuldades emergiram também do pequeno reconhecimento que a pesquisa tem no nosso país, refletido pelo baixo investimento em ciência, poucas oportunidades de financiamento e na baixa remuneração aos estudantes, tornando a jornada acadêmica muito mais difícil e socialmente exclusiva. Apesar dessas dificuldades sou muito grato a todo esse processo. Durante essa jornada tive o prazer de encontrar excelentes professores que me ensinaram não somente sobre ecologia, mas como ser um cientista crítico, buscando sempre a excelência naquilo que faço e sempre estimulando o pensamento criativo. Por isso, sou especialmente grato ao professor Eduardo Arcoverde que sempre estimulou esse espírito crítico nos alunos, ajudando a entender processos ecológicos a partir de conversas.

Essa tese só foi possível pois tive o apoio de várias pessoas ao meu redor que me apoiaram bastante ao longo desse processo. Em primeiro lugar, agradeço ao meu orientador Jayme pela oportunidade e entusiasmo para desenvolver esse projeto e pela paciência (por vezes, necessária) em nossas reuniões recheadas de discussões ecológicas e filosóficas. Me sinto privilegiado de ter um orientador com quem as reuniões traziam alivio e otimismo e que estimula seus alunos a superar as dificuldades encontradas. Certamente essa tese só foi possível por causa dessa orientação maravilhosa. Não poderia deixar de agradecer ao Thomas Püttker que inspira excelência e senso crítico ao revisar de forma tão cuidadosa os manuscritos, elevando consideravelmente a qualidade dos trabalhos. Agradeço à professora Marion Pfeifer que prontamente me recebeu no seu laboratório em Newcastle, mesmo com toda a dificuldade imposta pelo COVID e sempre apresentou comentários que elevaram a qualidade do trabalho. Agradeço ao Atilla e à Nena que colaboraram no trabalho cedendo os dados de mamiferos da Reserva Natural da Vale.

Agradeço à minha mãe, que como professora, fez da educação um valor e o conhecimento uma virtude dentro de casa. Obrigado pelo apoio ao longo desses anos.

Agradeço à minha companheira Thaís, que trouxe sorte de um amor tranquilo, minha eterna gratidão por todo o amor, apoio e paciência. Agradeço ao meu psicólogo Guilherme que me acolheu e me ajudou a superar minhas maiores dificuldades. Comecei a me tratar buscando ter estrutura para fazer o doutorado. Hoje, posso afirmar que cumprimos esse objetivo.

Agradeço a todos do laboratório e da salinha: Clarice, Marcos, Gabriel, Tiago, Quezia, Pedro, que me sempre deram apoio e contribuíram pra discussões ecológicas fantásticas nos nossos seminários.

Agradeço aos professores e ao corpo administrativo do PPGEE, em especial à Eugênia Zandonà que me ajudou muito a conseguir ir ao Reino Unido fazer meu doutorado sanduiche e à Silvia que sempre estava disponível para resolver quaisquer questões relacionadas ao programa. Agradeço também ao Bruno Rosado que se manteve à frente do PPGEE durante esses últimos anos turbulentos, sempre tão atarefado, mas disponível para qualquer tipo de esclarecimentos. Agradeço à CAPES pela bolsa de pesquisa no Brasil e no Reino Unido a partir do programa CAPES-PrInt. Agradeço ao PPGEE pelo recurso cedido para ida a campo do projeto que acabou não sendo desenvolvido. Agradeço à UERJ por ser essa universidade inovadora e com especial preocupação com a inclusão social, que tive o prazer de frequentar. Agradeço também à *Newcastle University* por me receber e prover condições de trabalho que jamais imaginei ter, incluindo o uso do supercomputador Rocket-HPC. Sou especialmente grato à equipe da universidade que me deu as orientações necessárias para que eu conseguisse usar corretamente esse recurso tão importante para minha tese. Confesso que foi divertido rodar modelos em 528 núcleos. Agradeço também à Jelaine e ao Tony pela amizade durante o sanduiche e para a vida.

Agradeço à professora Aliny por aceitar participar como revisora do trabalho. Agradeço aos membros da banca, incluindo os suplentes: professores: Aliny, Cristian, Maria Lucia, Mariana, Marina e Pavel que demonstraram interesse no trabalho aceitaram o convite prontamente.

Agradeço a todos que vieram antes de mim, que pavimentaram esse caminho que percorro agora. Espero poder retribuir a altura e ajudar tantos outros nesse caminho.

The delver into nature aims

Seeks freedom and perfection

Let calculation sift his claim

With faith and circumspection

Goethe

ABSTRACT

WILLMER, Julian Nicholas Garcia. Edge effects in fragmented landscapes: patterns and processes. 2023. 196 f. Tese (Doutorado em Ecologia e evolução) – Instituto de Biologia Roberto Alcantara Gomes, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2023.

Edge effects consist of environmental changes on the boundaries of forest remnants, affecting all levels of biological organization. These changes can increase or decrease species abundance near edges. Although important patterns of variation in the direction and intensity of edge effects have been detected, the mechanisms underlying these patterns need to be better explored. This thesis sought to better understand some of the mechanisms explaining variation in edge effects globally and locally. Here we used null models to infer the importance of local environmental variables and species functional traits determining their response to edges. In the first chapter, our meta-analysis showed that tropical communities are more subjected to edge effects leading to a reduction in species richness near the edges, and that communities subject to historical disturbances are subject to milder negative edge effects than communities not subject to these disturbances. The second chapter showed that, in a forest reserve in the Atlantic Forest, forest mammals have their response to edges determined by hunting, and that considering the stochastic distribution of individuals of a species does not help to explain their response to edges. Furthermore, considering this stochastic distribution did not change the effects of environmental variables in qualitative and quantitative terms. The third chapter showed that stochastic models based on the random placement of home ranges underestimate the negative edge effects on species. Specifically, this chapter showed that species with a more specialized diet tend to deviate less from stochastic predictions, and that the impact of the edge effect tends to be more underestimated in diet generalists. In general, this study shows that the response of species to edges is mainly driven by ecological factors related to the environment and the natural history of the species, while environmental variations at a global scale are also important moderators of the direction and intensity of these effects.

Keywords: edge effect; fragmentation; landscape; null models.

RESUMO

WILLMER, Julian Nicholas Garcia. *Efeitos de borda em paisagens fragmentadas:* padrões e processos. 2023. 196 f. Tese (Doutorado em Ecologia e Evolução) – Instituto de Biologia Roberto Alcantara Gomes, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2023.

Efeitos de borda consistem em mudanças ambientais nos limites de remanescentes florestais, afetando todos os níveis de organização biológica. Essas mudanças podem levar ao aumento ou redução na abundância das espécies. Embora importantes padrões de variação na direção e intensidade desses efeitos tenham sido detectados, os mecanismos subjacentes a esses padrões necessitam ser melhor explorados. Esta tese buscou entender melhor alguns mecanismos que levam à variação de efeitos de borda global e localmente. Utilizou-se modelos nulos para inferir a importância de variáveis ambientais locais e atributos funcionais das espécies determinando sua resposta às bordas. No primeiro capítulo, a meta-análise apresentada mostrou que comunidades tropicais estão mais sujeitas à efeitos de borda que levam à redução da riqueza próximo às bordas, e que comunidades sujeitas a distúrbios históricos estão sujeitas à efeitos de borda negativos mais brandos que comunidades não sujeitas a esses distúrbios. O segundo capítulo mostrou que, em uma reserva florestal na Mata Atlântica, mamíferos florestais têm sua resposta às bordas determinada pela caça, e que considerar a distribuição estocástica dos indivíduos de uma espécie não ajuda a explicar sua resposta a bordas. Além disso, considerar essa distribuição estocástica não mudou os efeitos das variáveis ambientais em termos qualitativos e quantitativos. No terceiro capítulo mostramos que modelos estocásticos baseados no posicionamento aleatório de áreas de vida subestima os efeitos de borda negativos nas espécies. Especificamente, o capítulo mostrou que espécies com dieta mais especialista tendem a desviar menos das predições estocásticas, e que o impacto do efeito de borda tende a ser mais subestimado em espécies com dieta generalista. De forma geral, este trabalho mostra que a resposta das espécies às bordas é derivada principalmente de fatores ecológicos relacionados ao ambiente e à história natural das espécies, enquanto que variações ambientais em escala global também são importantes moderadores da direção e intensidade desses efeitos.

Palavras-chave: efeito de borda; fragmentação; paisagem; modelos nulos.

LIST OF FIGURES

LIST OF TABLES

SUMÁRIO

INTRODUÇÃO GERAL

A conversão de ambientes florestais em áreas para uso antrópico leva a mudanças na composição e configuração das paisagens e, em última análise, à perda de habitats das espécies, que é considerada o maior vetor de extinção das espécies no último século (HADDAD et al., 2015a). Além da perda de ambientes florestais, que acarreta a perda imediata de recursos importantes para a sobrevivencia dos animais, as áreas florestais remanescentes frequentemente estão sujeitas à efeitos de borda, definidos como mudanças microclimáticas nas bordas desses remanescentes (MURCIA, 1995) com potenciais alterações no meio biótico (EWERS; BANKS-LEITE, 2013; ARROYO-RODRÍGUEZ et al., 2017; MENDES; PREVEDELLO, 2020), levando à mudanças na composição e estrutura da vegetação (HARPER et al., 2005; LAURANCE et al., 2011) e na abundância e riqueza de espécies animais (HADDAD et al., 2015a; PFEIFER et al., 2017; RIES et al., 2017). Tais efeitos de borda também afetam a dinâmica de uma série de processos ecossistêmicos, como produtividade primária (HARPER et al., 2005; ALMEIDA et al., 2019), fixação de carbono (PÜTZ et al., 2014a; BRINCK et al., 2017) entre outros (HARPER et al., 2005; LAURANCE et al., 2011), além de interações em níveis tróficos superiores como herbivoria, predação (WIMP et al., 2011) e parasitismo (PERALTA et al., 2017). Espera-se que toda a área florestal do planeta esteja a menos de 1km de uma borda até o final do século (FISCHER et al., 2021), portanto sujeitas à efeitos de borda, aumentando a demanda para compreendermos os mecanismos subjacentes à respostas das espécies à essas alterações.

Apesar de sua importância, a observação de padrões gerais de intensidade e direção dos efeitos de borda tem sido particularmente desafiadora (EWERS; DIDHAM, 2006; RIES et al., 2017). Entre as causas para a raridade de padrões encontrados podemos citar o fato do efeito de borda corresponder à uma mudança local no ambiente a partir da perda e fragmentação de habitat na paisagem, uma vez que efeitos de borda nunca ocorrem na ausência de outros efeitos da fragmentação, como perda de área e isolamento (DIDHAM; KAPOS; EWERS, 2012). Logo, atribuir mudanças na abundância devido somente à efeitos de borda isoladamente é um desafio (FLETCHER et al., 2007). Além da dificuldade de se isolar o efeito de borda de outros efeitos da fragmentação de habitat, a resposta das espécies às bordas depende da mudança ambiental que ocorre localmente (por exemplo, aumento ou redução da temperatura; MENDES; PREVEDELLO, 2020) e como a espécie em questão responde à essas mudanças. Além disso, essas mudanças acarretam maior ou menor disponibilidade de recursos em função da espécie analisada, tornando a resposta de cada espécie e, consequentemente, das comunidades, bastante difícil de se prever. Por exemplo, a resposta de uma espécie à uma matriz com grande contraste pode ser positiva, dependendo de como esse ambiente adjacente provê recursos complementares ou suplementares (RIES et al., 2004). Respostas negativas, por outro lado, ocorrem quando a exposição ao habitat adjacente causa a redução da disponibilidade de recursos no habitat preferencial da espécie (RIES et al., 2004). De forma geral, atributos funcionais das espécies, como tamanho de corpo, dieta e mobilidade (CAITANO et al., 2020)**,** são importantes moderadores da sua resposta à fragmentação, incluindo efeitos de borda (VETTER et al., 2011; NEWBOLD et al., 2020a). Finalmente, padrões globais, como gradientes latitudinais em variáveis ambientais e ecológicas, podem afetar a resposta de populações e comunidades à bordas e outros processos associados à fragmentação de habitat (ANDERSEN, 2019; BETTS et al., 2019; NEWBOLD et al., 2020b; BANKS-LEITE et al., 2022).

Conforme colocado acima, a grande quantidade de fatores que moderam efeitos de borda em diferentes escalas dificulta a observação de padrões e, consequentemente, traz dificuldades para a geração de hipóteses testáveis. Para superar esse desafio, devemos quantificar a importância de cada um desses potenciais moderadores de forma separada para então sintetizar a informação na forma de previsões. Particularmente, efeitos de borda têm sido estudados considerando apenas a distância para a borda mais próxima como a variável preditora de mudanças bióticas e abióticas. Embora útil para identificar padrões, essa abordagem dificulta a compreensão dos mecanismos subjacentes, uma vez que espera-se que este seja um proxy das diferentes variáveis ambientais determinantes da abundância das espécies (RUFFELL; DIDHAM, 2016). Além disso, a variação ambiental em ambientes próximos à bordas tende a responder mais intensamente à múltiplas bordas e em fragmentos menores, que em geral estão mais expostos à bordas e à matriz (FLETCHER, 2005; FLETCHER et al., 2007), mostrando potencial vantagem de métodos incorporando a exposição dos fragmentos à múltiplas bordas, considerando também o contraste com a matriz (PFEIFER et al., 2017).

Dada a complexidade dos efeitos de borda, a busca por explicações mecanicistas pode se beneficiar da aplicação de modelos nulos que incorporam apenas parte dos mecanismos atuando nos sistemas, para que possamos quantificar algum outro mecanismo de interesse (ver exemplo abaixo, GOTELLI; MCGILL, 2006). Esses modelos têm sido utilizados na ecologia para os mais diversos objetivos, incluindo: investigar os padrões de co-ocorrência de espécies, padrões de abundância relativa, e distribuição global da riqueza de espécies, entre outros

(GOTELLI; GRAVES, 1996). Modelos nulos têm sido principalmente utilizados na Ecologia de Paisagens para entender os mecanismos envolvidos nas relações espécie-área, tentando separar mecanismos estocásticos, como a amostragem passiva (COLEMAN, 1981), de mecanismos ecológicos, como a heterogeneidade ambiental, capacidade de suporte, dinâmica temporal ou intensidade de distúrbios (GOTELLI; GRAVES, 1996b,CHASE et al., 2020; GOORIAH et al., 2021). A aplicação desses modelos estocásticos na ecologia de paisagens se dá considerando o padrão de amostragem aleatória como um cenário base sobre o qual os diferentes mecanismos ecológicos vão atuar. Nesse sentido, desvios entre os padrões preditos pelos modelos nulos e aqueles observados na realidade podem ser atribuídos aos mecanismos ecológicos. Esses desvios podem ser derivados de aspectos ambientais locais (CHASE et al., 2020) ou mediados pelos atributos funcionais das espécies. Por exemplo, ilhas maiores se tornam menos isoladas para espécies com alto potencial de dispersão, fazendo com que essas ilhas possuam maior riqueza do que esperado pela amostragem passiva (MACDONALD et al., 2021). Modelos baseados na amostragem passiva em ilhas ou fragmentos florestais podem ser estendidos, incorporando a área de distribuição das espécies para prever padrões globais de riqueza a partir de modelos baseados no efeito do meio do domínio (*mid-domain effects*, COLWELL; LEES, 2000). Esse modelo prevê que a sobreposição de áreas de ocorrência das espécies aleatoriamente posicionadas nas massas continentais são parcialmente responsáveis pelos padrões de riqueza observados regionalmente e globalmente (COLWELL; RAHBEK; GOTELLI, 2004).

Modelos baseados no efeito do meio do domínio foram aplicados para entender a distribuição de espécies em paisagens fragmentadas (PREVEDELLO et al., 2013), tentando compreender a variação na abundância e riqueza das espécies em manchas a partir de diferenças no uso de habitats pelas espécies e seu tamanho de área de vida (PREVEDELLO; GOTELLI; METZGER, 2016). O modelo também permite a inferir padrões de abundância dentro dos fragmentos, simulando a distribuição aleatória de áreas de vida, gerando variados padrões de resposta à bordas (RIBEIRO et al., 2016). De forma análoga aos modelos de efeito do meio do domínio, a aplicação mais simples desse modelo assume uma paisagem binária, onde as espécies devem ocorrer nos ambientes adequados (por exemplo, áreas de floresta) e não ocorrer nos demais classes de uso do solo (matriz), explicitamente ignorando diferenças na qualidade de habitat dentro de fragmentos. Além disso, esse modelo ignora efeitos positivos e negativos da matriz (RIES; SISK, 2010; DRISCOLL et al., 2013) e isolamento (VIEIRA et al., 2018a). Esse modelo, baseado na teoria metabólica (BROWN et al., 2004) assume que as áreas de vida dependem do tamanho de corpo e dieta das espécies e prevê que a variação das espécies às bordas se dará a partir da interação dos tamanhos de área de vida e do formato dos fragmentos. Especificamente, espécies maiores tenderão a ter maior abundância no centro dos fragmentos florestais devido às restrições geométricas, enquanto espécies de menor área de vida serão menos sujeitas à efeitos de borda geométricos. Mesmo considerando apenas a restrição geométrica, o modelo gera uma grande diversidade de padrões (COLWELL et al., 2009; PREVEDELLO et al., 2013), que podem ter maior ou menor aderência aos padrões observados. Dessa forma, podemos utilizar padrões de abundância gerados por modelos nulos incorporando somente os efeitos de borda geométricos (EBGs, ou GEE- *geometric edge effects*, em inglês) e desconsiderando a seleção de habitat pelas espécies para quantificar a influência da seleção de habitat. Considerando que as espécies selecionam habitats em função da sua necessidade de recursos e suas interações biológicas, atributos funcionais como dieta e tamanho de corpo são fundamentais para entender o quanto que a distribuição das espécies é derivado da seleção ativa de habitats e de mecanismos estocásticos(MACDONALD et al., 2021). Dessa forma, incorporar a influência de mecanismos estocásticos pode nos ajudar a avaliar a importância de aspectos ambientais e dos atributos funcionais envolvidos na resposta das espécies às bordas.

Nesta tese, tentamos tanto detectar padrões globais quanto compreender melhor alguns dos mecanismos que moderam as respostas das espécies à borda localmente. No primeiro capítulo, realizamos uma meta análise para sintetizar o conhecimento de efeitos de borda gerado a partir de estudos de caso individuais. Nesse capítulo, focamos na variação global de efeitos de borda sobre a riqueza de comunidades, buscando compreender os moderadores da direção e da intensidade desses efeitos a partir de gradientes globais, como latitude, clima e distúrbio histórico, mas também fatores locais como contraste da matriz e distância para a borda sobre a riqueza de espécies.

Nos outros dois capítulos, fazemos uso de modelos nulos com objetivo de controlar alguns dos mecanismos biológicos que podem vir a confundir as respostas encontradas (EWERS; DIDHAM, 2006). No segundo capítulo, buscamos compreender os mecanismos subjacentes à resposta de espécies às bordas. Especificamente, quantificamos a influência relativa dos efeitos de borda geométricos e de características ambientais locais e da paisagem local (sensu FAHRIG, 2021) a partir de modelos de ocupação hierárquicos considerando preditores ambientais, incorporando ou não, efeitos de borda geométricos.

Embora possamos inferir que de geralmente as espécies vão responder positivamente à disponibilidade de recursos na paisagem, a direção e intensidade dessas respostas é moderada por diversos atributos funcionais das espécies. Dessa forma, além de compreendermos os moderadores ambientais, também devemos investigar os atributos das espécies que determinam a importância relativa de mecanismos baseados em nicho e em fatores estocásticos. Para isso, no terceiro capítulo simulamos modelos nulos para compreender como o tamanho da área de vida, a dieta e o uso de diferentes estratos moderam a importância de mecanismos estocásticos para gerar os padrões de abundância observados em paisagens fragmentada.

1 GLOBAL IMPACTS OF EDGE EFFECTS ON SPECIES RICHNESS*

Abstract

Almost all world's forest areas are predicted to be near edges by 2100, making the detection and prediction of biodiversity responses to edges an urgent need. Yet, idiosyncratic observations across studies have hampered general inferences on the main drivers of edge effects. We provide a global meta-analysis on 674 forest edge-interior comparisons of plant and animal communities, considering both global and local drivers as well as their interactions, to predict the direction and magnitude of edge effects on species richness. We found a clear latitudinal gradient in both the direction and magnitude of edge effects, with edges in temperate regions having more species than interior forests, while tropical communities generally had fewer species at edges. Unexpectedly, communities near high-contrast edges had higher richness at edges more frequently than near low-contrast edges. In addition, richness decreases at edges were weaker in regions subjected to historical disturbance than regions without historical disturbance. These patterns were modulated by distance from the edge and became clearer when comparing more distant sampling locations. Our results provide possible explanations for the variable impacts of edge effects and thereby forest fragmentation on biodiversity, showing that a combination of local and global predictors are able to partially predict variation in edge effects.

*Publicado na revista Biological Conservation- agosto/2022.

https://doi.org/10.1016/j.biocon.2022.109654.

1.1 Introduction

As three-quarters of the world`s remaining forests are within 1km from edges (HADDAD et al., 2015b), predicting biodiversity responses to edge effects is crucial to improve ecological understanding and guide management and conservation efforts in forested landscapes (ARROYO-RODRÍGUEZ et al., 2021). Yet, biodiversity responses to edge proximity are highly heterogeneous or idiosyncratic, challenging our ability to make general predictions on plant and animal responses to edges (RIES et al., 2004, 2017). Despite this variability of responses, edge effects are regarded as one of the main drivers of habitat fragmentation impacts on biodiversity (PFEIFER et al., 2017; PÜTTKER et al., 2020). The models proposed to explain this variability and predict edge responses focus generally only on single species and require a priori knowledge of species requirements and resource availability across habitat-matrix edges (RIES; SISK, 2004; RIES et al., 2017), which are frequently not available. In addition, general syntheses on community-level responses to edge effects, incorporating drivers at global and local scales, are still rare (Ries et al., 2017, but see Betts et al. (2019), PFEIFER et al., 2017). These limitations have contributed to a lack of consensus on the effectiveness of different approaches of edge management in fragmented landscapes, such as maintaining buffer areas or uncultivated field margins, among others (see e.g. Sutherland et al., 2019).

Edge effects cause changes in plant and animal communities through changes in abiotic conditions (MURCIA, 1995). A combination of intrinsic and extrinsic aspects varying across sampling sites and the globe (HARPER et al., 2005; RIES et al., 2017) will affect the extent to which each species responds to these changes. Intrinsic drivers, such as life-history traits, influence edge responses across species (EWERS; DIDHAM, 2006). Mobility, for example, is an important trait influencing response to edges both within and among taxa (EWERS; DIDHAM, 2006; TSCHARNTKE et al., 2012; CAITANO et al., 2020). On the other hand, abiotic conditions influencing edge effects are expected to vary across climatic regions (MENDES; PREVEDELLO, 2020), but also locally, across different types of adjacent matrix and even in response to edge orientation (HARPER et al., 2005; BERNASCHINI et al., 2019). Thus, to understand variations in biodiversity response to edge effects, it is important to account for differences across taxa as well as consider extrinsic drivers influencing edge effects at multiple scales.

Globally, tropical animal species experience stronger impacts of habitat fragmentation compared to their temperate counterparts (BREGMAN; SEKERCIOGLU; TOBIAS, 2014). This latitudinal gradient in community responses to disturbance probably emerges from differences in the variation of the environment within which species evolved (WILLIG; KAUFMAN; STEVENS, 2003; STRATFORD; ROBINSON, 2005). Temperate taxa have experienced broader variation in environmental conditions due to intra-annual seasonal variability (STRATFORD; ROBINSON, 2005), as well as historical variability, for example, due to glaciation events, which represent an important filter for species (BETTS et al., 2019; BANKS-LEITE et al., 2022). On the other hand, tropical taxa have narrower ranges of tolerable microclimatic conditions, are expected to live closer to their microclimatic limits, have lower dispersal capacity, have smaller range areas(SALISBURY et al., 2012), and experience more negative interactions than temperate species (STRATFORD; ROBINSON, 2005). Thus, tropical animal populations are expected to have lower resilience to habitat fragmentation impacts (EWERS; DIDHAM, 2006; BREGMAN; SEKERCIOGLU; TOBIAS, 2014; NEWBOLD et al., 2014), including edge effects on species abundance (BETTS et al., 2019). Latitude, therefore, represents a useful proxy to capture global variation in several ecological patterns and processes (WILLIG; KAUFMAN; STEVENS, 2003; GASTON; CHOWN; EVANS, 2008; SCHEMSKE et al., 2009), potentially mediating community response to edges.

Further, historical disturbance occurrence may influence the composition of biological communities. Species less able to persist in face of disturbances, such as historical forest loss, hurricanes or fires, are likely to be filtered out over time, thereby creating communities dominated by more resilient species (BALMFORD, 1996). Such historical filtering indeed affects community responses to landscape-wide habitat loss (DASKALOVA et al., 2020) and species-specific responses to habitat fragmentation (BETTS et al., 2019). However, the importance of historical disturbance as a moderator of edge effects on community structure, for example community richness, is still unclear (FLETCHER et al., 2018; FAHRIG et al., 2022) and more investigation should provide important insights to predict edge effects globally.

At the local scale, the environmental contrast between forest and adjacent matrix, frequently inferred from differences in vegetation structure parameters (LAURANCE et al., 2002; HARPER et al., 2005), proved to act as a strong mediator of the impact of edge effects (WATLING et al., 2011; DODONOV; HARPER; SILVA-MATOS, 2013). Considering forest ecosystems, environmental contrast often increases with matrix land-use intensity (DRISCOLL et al., 2013; ARROYO-RODRÍGUEZ et al., 2020). Water availability moderates the environmental contrast between forest and matrix by influencing forest biomass and canopy openness, which makes a forest more or less similar to adjacent matrix habitats (GIBB et al., 2015; PFEIFER et al., 2018; ANDERSEN, 2019). Environmental contrast may lead to richness increases at edges through resource complementation and inter-habitat spillover, as different environments tend to have different sets of species and resources leading to an “ecotonal effect” (RIES; SISK, 2004; FROST et al., 2015). However, more commonly, high environmental contrast seems to result in a decrease in species richness at edges, as strong changes in abiotic conditions or spillover of matrix-inhabiting predators may create population sinks at edge habitats (TSCHARNTKE et al., 2012; DRISCOLL et al., 2013; BOESING; NICHOLS; METZGER, 2018). As there is evidence for both outcomes, the most frequent mechanisms and the underlying factors causing increase or decrease of richness as a function of environmental contrast at edges need further investigation.

Finally, community responses to edges may depend on the distance to the nearest edge of “interior” sampling locations. Changes in abiotic and biotic aspects at edges can extend for dozens or even hundreds of meters toward forest interiors (LAURANCE et al., 2002; HARPER et al., 2005; BRINCK et al., 2017), and can vary strongly across this distance gradient. Despite the likely importance of this spatial variation on biodiversity, previous syntheses addressing edge effects have disregarded the potential effect of distance to edges and relied on spatially non-explicit measures (e.g. mean response or maximum response, e.g. CAITANO et al. 2020; De Carvalho Guimarães et al., 2014). Importantly, variation in community responses to each of the formerly described predictors (e.g. latitude) is likely to depend on the distance to the edge. Therefore, all explanatory variables described above might interact with distance to the edge. Additionally, the high dynamism of abiotic conditions within edge habitats (LAURANCE et al. 2002) may lead to high variation in biodiversity responses near edges. Therefore, general patterns of edge effects on communities, if present, should emerge more clearly when comparing edges to environmentally more stable habitat at the interior portions of the forests (RIES et al. 2004).

Here, we conducted a meta-analysis on 674 forest edge-interior comparisons of plant and animal communities to understand the global variation in the impacts of edge effects on biological communities. Specifically, we quantified the relative importance of latitudinal gradients, historical disturbance occurrence, water availability, matrix contrast and distance to edges, as well as interactions among these variables, as predictors of edge effects on species richness.

We hypothesized that: i) due to differences in life-history traits of species, higher richness at edges compared to the interior predominate at higher latitudes, while edges tend to have fewer species than the interior at lower latitudes; ii) due to environmental filtering, communities that evolved in face of historical disturbance have a relatively higher probability to harbour more species at edges compared to interior plots than those not exposed to historical disturbances; iii) higher matrix contrast leads to a higher probability of decrease in species richness at edges, due to the prevalence of negative effects of habitat change over “ecotonal” effects that increase species richness at edges, iv) matrix contrast will drive an increase in the magnitude of edge effects, regardless whether representing an increase or decrease in species richness, through ecotonal effects or deleterious habitat changes, respectively. We show that edge effects are not entirely idiosyncratic but are at least partly predictable based on a combination of global and local factors.

1.2 Methods

1.2.1 Literature search and inclusion criteria

To search for relevant publications, we based our procedures on the seminal reviews on edge effects by RIES and colleagues (2014, 2017). Following RIES et al. (2014, 2017), we performed a systematic search for published papers on the Web of Science from 1960 to 2019 using the following terms in the title: "Edge" OR "Edges" Or "Boundary" Or "Boundaries" Or "Limit" Or "Limits" Or "Ecotone" OR "ecotones". We also added the terms "Interface" OR "Interfaces", since exploratory searches indicated frequent use of these terms in the literature. We restricted the results to the following Web of Science categories: “Biodiversity Conservation”, “Biology”, “Forestry”, “Plant Sciences”, “Ecology”, OR “Zoology”. The category "Environmental Sciences", previously included by RIES et al. (2014), was not included here since it led to overly frequent duplication of results, which mostly missed our central objective of quantifying edge effects on species richness, rather than on abiotic response variables. We included papers from 1980 to 2019.

From the 7 290 papers retrieved from the initial search, 519 addressed edge effects on biological communities. From these 519 papers, we retained 98 that: i) quantified edge effects on communities in forest ecosystems (including dry forests such as Savannas, Chaco, and Cerrado, among others); ii) quantified edge effects measuring species richness in at least two locations at different distances to the physical edge, one corresponding to the “edge” plot and at least one corresponding to the “interior” plot; and iii) reported the distances between plots and the physical edge (i.e. we excluded studies that reported interior distances as minimum distances, frequently described as "at least...meters from the edge").

From the remaining papers, we extracted all results related to complete communities of the group investigated, i.e. we excluded results based on vaguely defined community subsets, e.g. those that relied on data obtained by species-specific playback or baiting, or data analyses limited on subsets for unspecified reasons (YOUNGENTOB et al., 2012; SCHNEIDER-MAUNOURY et al., 2016) However, we kept results of community subsets when: 1) data on entire communities were not available, and 2) the definition of the subsets of species was based on functional traits based on trophic position (SVOBODOVÁ et al., 2011), habitat preferences (e.g. HATFIELD et al., 2020; KOTZE et al., 2012), greater taxonomic differences such as large and small mammals (e.g. NORRIS et al., 2008), plant life forms (lianas, bromeliads, lichens, grasses and herbs, trees and shrubs), or different age-classes for plants (seedlings, saplings, adults with the diameter at breast high larger than 20 cm (e.g KRISHNADAS et al., 2019; WILLIAMS-LINERA et al., 1998). We considered only responses extracted within 500m from the edge to avoid extreme data scattering for longer distances. We extracted data directly from tables or plots using the Metagitise package in R (PICK, 2019).

1.2.2 Response variables and data extraction

We quantified edge effects as the log response ratio (LRR) between community richness (number of species) at edges and interior sampling plots: LRR = ln (Obs edge/Obs Interior). Positive LRR values indicate increased species richness at edges compared to interior, whereas negative LRR values indicate fewer species at edges compared to the interior. Further, the absolute LRR value refers to the magnitude of the effect. We analyzed positive and negative effect sizes (LRR values) separately, as their combination in a single analysis could mask patterns (IBÁÑEZ et al., 2014; DASKALOVA et al., 2020). For example, if the magnitude of both positive and negative edge effects increased with matrix contrast, as expected, a single combined analysis could detect no overall effect of matrix contrast, as positive and negative responses could nullify each other (IBÁÑEZ et al., 2014).

Recent reviews on edge effects generally used only one or a single mean distance of interior plots from the edge for comparison (DE CARVALHO GUIMARÃES; VIANA; CORNELISSEN, 2014; IBÁÑEZ et al., 2014; MAGURA; LÖVEI; TÓTHMÉRÉSZ, 2019; CAITANO et al., 2020). By using all interior plots and including their distance to the edge as a covariate in models, we acknowledge the fact that the magnitude of edge effects likely represents a gradient from the edge to the interior (RIES et al., 2017), thereby accounting for heterogeneity in edge responses as a function of distance to the edge. Thus, for each study, we included multiple comparisons of edge/interior plots, when available, as distinct results. For example, if a study took samples at the edge and four interior distances along an edge-interior transect, we included the four distinct responses (interior/edge comparisons) in our analyses. To account for the lack of independence of multiple responses at the same transect, we included transect identity, or identity of a group of transects (when more than one transect was sampled), as a random factor in the statistical analyses. Group identity assignment followed the authors' description of data grouping and consisted of: i) different sites reported separately (e. g. Dodonov et al. 2013; Stevens and Husband, 1998); ii) different taxa (i. e. Marsh et al., 2018);

iii) different years (e. g. SPECTOR; AYZAMA 2003); iv) different matrix types (e. g. Sánchez et al., 2016); v) different age classes or any other functional grouping as explained above. Group identity was then nested within the study level, which should account for variation in sampling design, replication and other particularities among studies (JACKSON; FAHRIG, 2015). Importantly, we used fragment number and not transects as the unit of replication used for weighting observations in our models, given that a higher number of replicates leads to more accurate effect size estimates (ROSENBERG; ROTHSTEIN; GUREVITCH, 2013). In addition, considering transect replicates inside the same fragment may increase type I error as data is likely to be less independent than considering fragments. When sampling was performed in a single large fragment or continuous forest, we only considered transects as independent from each other (and therefore replicate number > 1) if distances between transects were greater than 1 km.

As an example, Marsh et al. (2018) investigated edge effects on ants and beetles in Amazonian forest fragments adjacent to two different matrix types and sampled forest interiors at three distances to the edge in each fragment. The authors sampled five fragments (replicates) adjacent to each matrix type. Thus, this study returned 12 comparisons, as the product of 2 matrix types x 2 taxa x 3 distances. In this case, we would have four transect groups, one for each matrix-taxon combination. For the example above, we had n = number of fragments = 5.

1.2.3 Latitude, water deficit and disturbance history

For each study, we recorded the geographic position (latitude and longitude). If the author provided only the name of the sampling location, the coordinates were determined using Google Earth®. For each study location, we calculated the mean historical annual water deficit from 1958-2019 as the annual difference between potential evapotranspiration and precipitation. Climate data was extracted from Terra Climate variables (Abatzoglou et al. 2018) at a 1/12 degrees resolution (~4km). The occurrence of historical disturbance was included as a binary variable inferred from Betts et al. (2019), comprising the occurrence of natural fires, historic glaciation, hurricane incidences and historic habitat conversion until the year 2000. As in Betts et al. (2019), sites at lower latitudes were exposed to less historical disturbance compared to sampling sites in temperate and boreal ecosystems (ANOVA $F_{1,96}$= 7.13, p = 0.01, Supporting Information Figure S1). Due to this correlation, we did not include both disturbance and absolute latitude in the same models.

1.2.4 Environmental contrast and taxonomic variation

For each response, we classified the type of adjacent matrix as “hard” or “soft”, representing a high or low structural contrast between the forest and the surrounding matrix, respectively. Hard matrix types comprised grasslands, pastures, agriculture, urban, water and mixed high contrast land uses. Soft matrix types comprised secondary forests, planted forests and agroforests. Finally, we classified taxa according to a major classification (vertebrates, invertebrates and plants).

1.2.5 Statistical analysis

We applied a mixed-modelling approach and included study ID as a random variable, to control for differences in methodology as well as sampling effort among studies(JACKSON; FAHRIG, 2015). To incorporate the nested structure of the data, intercepts varied randomly among groups, nested within study ID (i.e. y0,1 ~ Var(i...n) + (1 | Study_ID / Group_ID), where Var(i...n) represents the ith predictor variable), and observations were weighted by the number of fragments, as explained before. However, to account for the large variation in the number of replicates among studies (1-51 fragment replicates) -which would introduce an unrealistically high influence of the number of replicates on the results- we used the rounded square root of the number of fragments. All predictor variables were z-transformed for the analyses, and subsequently, parameter estimates were back-transformed.

To predict the direction of edge effects (increase versus decrease in species richness at edges compared to interior plots), we used a logistic mixed-effects model approach. Because we expected a priori differences across the interior-edge gradient, we included distance to the edge in all models. We built five sets of candidate models corresponding to i) models including only one predictor separately (matrix or latitude or water deficit or historical disturbance); ii) models assuming an additive effect among predictor variables; iii) models assuming an interaction between each predictor variable and distance to edge; iv) models assuming an interaction among the different predictor variables and v) models assuming an additive effect of two predictor variables interacting with interior distance or among them. Next, we evaluated candidate models by model selection procedures based on AIC values and considered the ΔAICc < 2 thresholds to indicate equally plausible models (BEIER; BURNHAM; ANDERSON, 2001) and extracted the weight of evidence of variables included in the best models (I.e. the sum of the weight of evidence of the models which the variable was included, Tables S1 and S2).

To investigate the magnitude of edge effects, we separated positive and negative effect sizes and fitted separate models with a gamma error distribution using a log link function. Setting candidate models followed the same procedures adopted for predicting the direction of edge effects. However, we included the minimum species richness from each interior-edge comparison as a predictor of LRR in all models, because response ratio values are likely to be higher for richer communities due to the use of proportions. For example, if “Obs interior” = 1, the presence of only 2 species at the edge would already double species richness (resulting in a response ratio = 2); however, if “Obs interior” = 100, a much higher number of species (200) would need to occur at the edge to double richness. The inclusion of the minimum richness thus allowed controlling heterogeneity from this mathematical issue among comparisons and studies. For each model, we estimated trigamma pseudo R^2 values and checked models for over/under dispersion. In addition, in case of convergence warnings during model fit, we evaluated model outputs using the allFit function. All analyses were conducted in R, using packages lme4 (Bates et al., 2015), MuMIn (BARTON, 2021), parameters (LÜDECKE et al. 2022) and jtools (Long et al, 2021) to extract the model parameters, and interactions (LONG et al., 2022) to plot the results. We present parameter estimates with 95% confidence intervals in the supplementary material (Tables S1, S2).

1.3 Results

1.3.1 Literature search results

Our search and filtering resulted in 98 studies, from which we determined 195 distinct transects/groups with 674 comparisons between edge and interior species richness. From this total, plants had 439 comparisons, invertebrates 129 and vertebrates had 106 comparisons. Most comparisons were concentrated on relatively short distances to the edges, and only one-quarter of all comparisons sampled interior plots farther than 90 m from the edge (25th, 50th and 75th quantiles: 15, 38 and 90 m respectively (Figure S2), and more than 25% of comparisons were obtained from a single fragment (Figure S3).

1.3.2 Direction of edge effects

Four models were selected as plausible models (ΔAIC< 2) explaining the direction of edge effects (increased versus decreased species richness at edges compared to forest interiors). The selected models predicted a higher probability of finding greater species richness at the edges than interior plots at higher latitudes and in fragments adjacent to hard compared to soft matrices (Figure 1, Table 1, model coefficients provided in tables S1, S2, Apendice A). All figures are based on the top-ranked model of each model selection. Based on the first model, vertebrate communities tended to have relatively fewer species at edges more often than plants and invertebrates (Table S1). In addition, the probability of finding more species at edges tended to increase with increasing distance to the edge from interior plots. The top-ranked model had a pseudo-R2 value of 0.93 when considering both the random- and fixed-effects components (conditional pseudo-R2) and 0.23 when considering only the fixed effects component (marginal pseudo-R2; Table 1). The second-best model additionally included an interaction term between absolute latitude and matrix type. The effect of this interaction, however, was not different from zero (Table S2) and both models had similar predictive power based on AIC weight (wi, Table 1). The third and fourth models included water deficit, however estimated coefficients of the effect of water deficit were not different from zero (Table S2).

1.3.3 Magnitude of edge effects

Both plausible models explaining the variation in magnitude of species richness increases at edges predicted an interaction effect between distance to edge and latitude, indicating that the positive effect of latitude on the magnitude of species richness increases at edges was stronger for more distant plots (Figure 2, Tables 1 and S1). The second-best model included an effect of water deficit, however, its estimated coefficient was not different from zero (Table S2). The fact that the first and simpler model is nested within the second model reinforces the lack of importance of water deficit to predict species richness increases at edges. Regarding observations where richness decreased at edges, three models were equally plausible to explain variation in species richness (Table 1). The top-ranked model included historical disturbance, distance to the edge and their interaction (Table 1; Figure 3). Richness decreases at edges were higher at locations subject to historical disturbance compared to locations without historical disturbance for short distances (~0 – 30m), but the opposite occurred for farther distances (Table S2). Consequently, negative effect sizes tended to decrease in magnitude with increasing distance to edges subjected to historical disturbances, and, conversely, tended to increase in magnitude at edges not subjected to disturbances (Figure 3). Estimate of the effect of water deficit, included in the second-best model, was not different from zero (Table S2). Again, the first and simpler model was nested within the second model, reinforcing the lack of importance of water deficit.

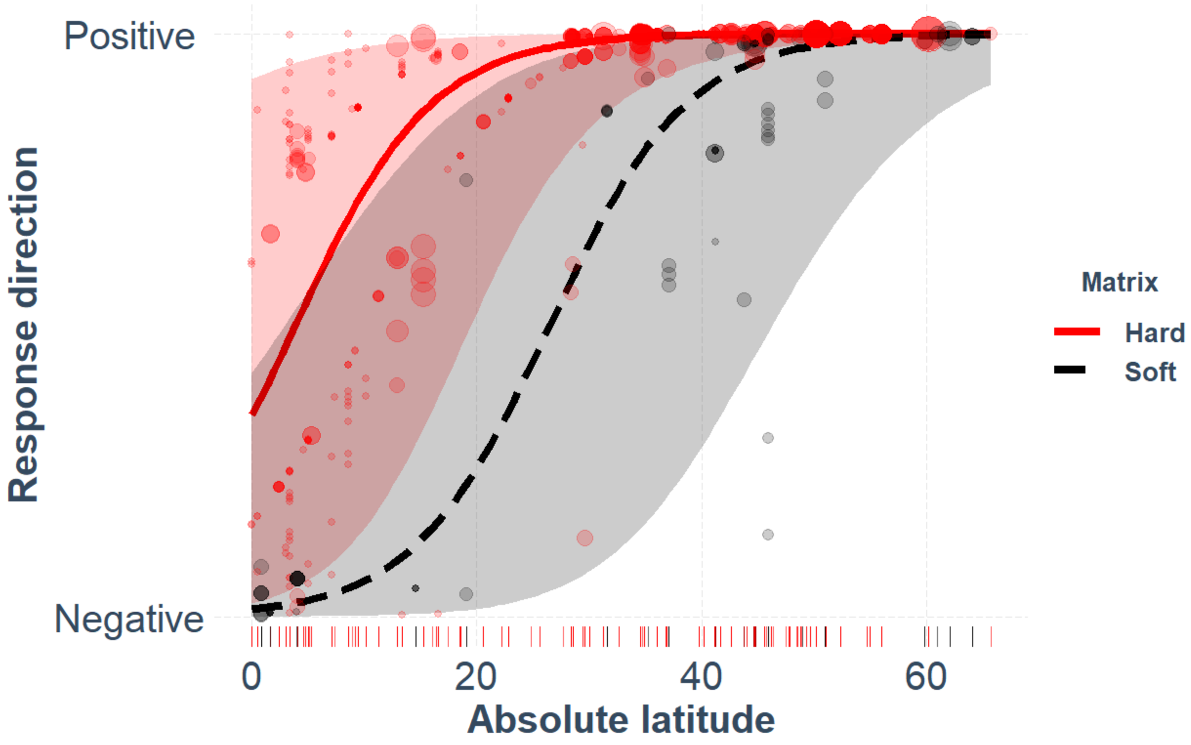
Table 1 - Best models (AIC<2) describing the direction and the magnitude of species richness increases and decreases at edges.

Response Variable	Formula	Mar R^2	Cond R^2	K	AICc	ΔAICc	wi	Cum wi
Direction	Taxon + Distance + Matrix + Abs.Lat.	0.23	0.93	8	823.08	0	0.24	0.24
	Taxon + Distance+ Matrix + Abs.Lat. + Abs.Lat. *Matrix	0.22	0.94	9	823.36	0.28	0.21	0.44
	Taxon + Distance + Matrix + Abs.Lat. + MWD + Matrix *MWD	0.24	0.95	10	823.71	0.63	0.17	0.61
	Taxon + Distance + Matrix + Abs.Lat. + MWD + Matrix *Abs.Lat.	0.23	0.93	10	824.93	1.85	0.09	0.71
	Taxon + Distance + Matrix + Abs.Lat. + MWD	0.22	0.94	9	825.38	2.29	0.08	0.78
	Null	0	0	3	848.63	25.27	0	1
Magnitude of positive effect sizes	Abs Lat + Distance + Minor Obs + Abs Lat * Distance	0.14	0.66	8	-1053.82	0	0.16	0.16
	Abs Lat + MWD + Distance + Minor Obs + Abs Lat * Distance	0.16	0.66	9	-1053.33	0.49	0.12	0.28
	Matrix + Abs Lat + Distance + Minor Obs + Abs Lat * Distance	0.14	0.66	9	-1051.80	2.02	0.06	0.34
	Null	0	0	4	-864.43	189.39	0	1
Magnitude of negative effect sizes	Disturbance + Distance + Minor Obs + Disturbance * Distance	0.07	0.76	8	-513.53	0	0.2	0.2
	Disturbance + MWD + Distance + Minor Obs + Disturbance * Distance	0.08	0.76	9	-511.60	1.93	0.08	0.28
	Disturbance + MWD + Distance + Minor Obs + Disturbance * Distance + MWD * Distance	0.08	0.77	10	-511.56	1.97	0.08	0.36
	Disturbance + Matrix + Distance + Minor Obs + Disturbance * Distance	0.07	0.76	9	-511.39	2.14	0.07	0.43
	Null	0	0	1	-491.00	22.75	0	1

Legenda: The null model is presented for comparison. Formulas indicate variables included in models and interactions between variables (denoted by "*"). K: number of parameters estimated, AICc: Akaike's information criterium corrected for small sample sizes, ΔAICc: difference in AICc between model and best model, wi: Akaike weight, i.e. the overall model weight of evidence, Cum w: cumulative weight of evidence of models. Matrix: matrix type (hard or soft); Abs. Lat: absolute latitude; MWD: mean water deficit; distance: distance from the plot to the edge, Taxon: taxonomic group (invertebrate, plant or vertebrate); Minor. obs: the lowest richness observed among the two plots compared (edge and interior). See Table S1 for model coefficients and estimated confidence intervals of top-ranked models and Tables S3-S5 for the complete set of candidate models.

Fonte: O autor, 2022

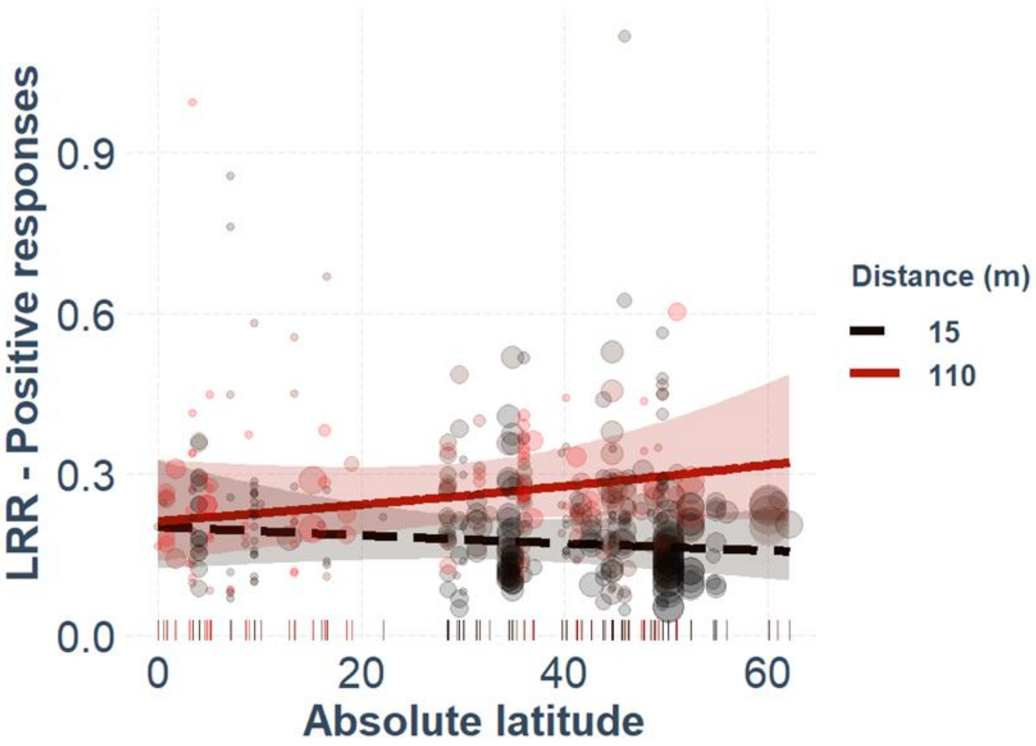
Figure 1 - Effect of latitude on the direction of edge effects on species richness



Legenda: Black points and the dashed line indicate the response to edges adjacent to soft matrices (planted forests, restoration sites and secondary forests).Lines are predicted means and the dispersion of points reflects the partial residuals of the best model (Table 1). Light red and grey areas represent 95% confidence intervals. Point size reflects the number of replicates (fragments) for individual observations. Vertical lines at the bottom indicate the position of observations on the x-axis.

Fonte: O autor, 2023

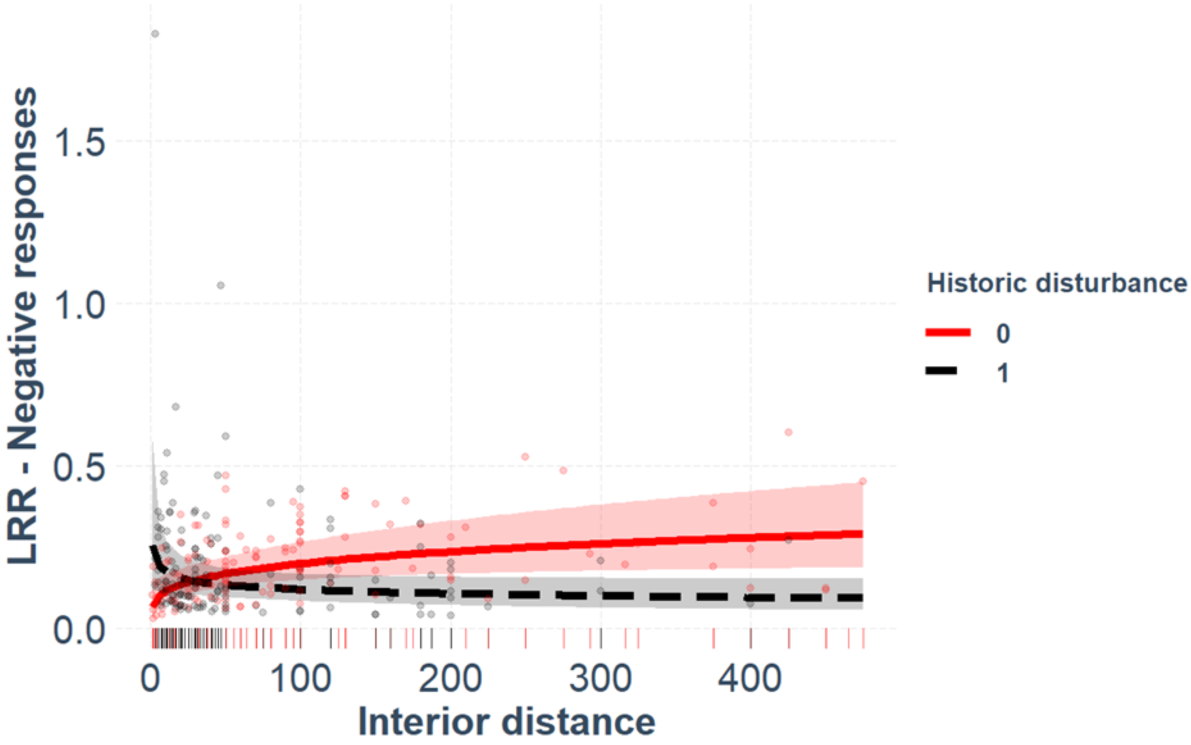
Figure 2 - Effect of latitude on the magnitude of positive effect sizes.



Legenda: LRR, log response ratio between edge and interior plots), considering either sampling plots closer to the edge (black points and dashed line, 1-35 m, mean = 15 m) or interior plots (red points and line, 36-450 m, mean= 110 m. Lines are predicted means and the dispersion of points reflects the partial residuals of the best model (Table 1). Light red and grey areas represent 95% confidence intervals. Point size reflects the number of replicates (fragments) for individual observations. Vertical lines at the bottom indicate the position of observations on the x-axis.

Fonte: O autor, 2023

Figure 3 - Effect of the distance to the edge on the magnitude of negative effect sizes



Legenda: LRR (log response ratio between edge and interior plots) for sites that either experienced historical disturbance (1, black points and dashed line) or did not experience historical disturbance (0, red points and line). Lines are predicted means and the dispersion of points reflects the partial residuals of the best model (Table 1) and light red and grey areas represent confidence intervals. Point size reflects the number of replicates (fragments) for individual observations. Vertical lines at the bottom indicate the position of observations on the x-axis.

Fonte: O autor, 2023

1.4 Discussion

Despite the considerable heterogeneity in the evidence on edge effects available globally, our analyses detected relevant patterns in the direction and magnitude of edge effects on biological communities. Community responses to edge effects vary along a latitudinal gradient and between regions, independent of historical disturbance occurrence, but also respond to local factors, namely adjacent matrix type. At higher latitudes, forest edges tend to have more species than forest interiors, whereas edges frequently have fewer species than forest interiors at lower latitudes. Further, environmental contrast influences the relationship between the direction of edge effects and latitude, making richness increases at edges more likely at any latitude at hard-contrast edges. By separating positive and negative effect sizes, we were able to show that in regions that did not suffer historical disturbance (such as glaciation, hurricanes, fires, and historic deforestation), species richness decreases at edges are greater in magnitude.

In addition, distance to edge influenced the magnitude of both positive and negative effect sizes, highlighting the importance of sampling design to quantify edge effects properly. In the following paragraphs, we discuss these results in detail.

1.4.1 Global variation in edge effects

Corroborating our first hypothesis, we found that increases in species richness at edges are more likely in temperate than in tropical regions, where edges tended to have fewer species than forest interiors. In addition, richness increases near edges tend to be stronger toward the poles. Latitudinal gradients on biological responses to habitat fragmentation have been formerly detected for birds (BREGMAN; SEKERCIOGLU; TOBIAS, 2014; KEINATH et al., 2017) and seem to be widespread across animal species in general (BETTS et al., 2019). However, a former synthesis failed to find this pattern in plants (Ibáñez et al., 2014). We corroborate and extend the findings of Betts et al. (2019) by showing that the latitudinal gradients of responses of individual animal species to edges scale up to the community level. Further, our results based on 439 plant edge-interior comparisons provide robust evidence that plant communities are responding accordingly. The widespread evidence across taxa and regions shown in our results and former studies (Betts et al. 2019) indicate that considering latitudinal variation as a mediator of fragmentation effects is paramount in conservation planning. Thus, we suggest caution when attempting to use a single landscape design as ideal for conservation globally (e.g. Arroyo Rodriguez et al., 2020), as the magnitude and direction of edge impacts are spatially variable.

The most likely mechanism by which latitude moderates edge effects is environmental filtering, which increases the frequency of generalist species in high-latitude communities, due to strong seasonal variation in environmental conditions (Stratford and Robinson, 2005; Bregman et al. 2014). Generalists may cope with edge habitats or even benefit from abrupt changes in the spatial distribution of resources (RIES; SISK, 2004). Therefore, communities at edges in high latitudes are more likely to gain species since they should not only cope with habitat degradation at edges but also benefit from resource complementation from adjacent land uses (RIES; SISK, 2004), leading to richer communities at edges. On the other hand, high degrees of specialization in tropical communities (Stratford and Robinson, 2005; Salisbury et al., 2012) probably cause higher sensitivity to the abrupt changes in environmental conditions caused by edge creation, leading to species losses at fragment edges.

In agreement with our initial expectations, richness decreases at edges tended to be weaker at sites that experienced historical disturbances compared to sites that did not. Communities that evolved in environments subjected to historical disturbance events probably comprise many species able to better cope with contemporary disturbances, such as forest loss and habitat degradation (Balmford, 1996; Betts et al 2019). Accordingly, communities that evolved in historically less disturbed regions are likely to present stronger negative responses to contemporary forest loss (Daskalova et al. 2020). Together with the latitudinal gradient shown before, our study provides further evidence for the importance of the legacy of past environmental filtering on the present communities. This may explain, at least partially, the apparent heterogeneity in the effects of habitat fragmentation on biodiversity, since edge effects are an important driver of fragmentation effects (e.g. Fahrig, 2020; Püttker et al., 2020).

Importantly, the presence of historical disturbance was only important to explain variation in the magnitude of richness decreases at edges, but not the direction nor the magnitude of richness increases at edges. As richness decreases at edges predominated at lower latitudes, our results suggest that tropical communities are more responsive to historical disturbance. This may occur since the higher intra-annual (seasonal) variation in environmental conditions at higher latitudes forces more generalist communities, similar to the effects of historical disturbance events, although such seasonal and historical effects occur at different time scales (Balmford, 1996; Stratford and Robinson, 2005). Therefore, temperate communities, which tend to have higher species richness at edges, seem to be less responsive to habitat disturbance.

1.4.2 Environmental contrast

Unexpectedly, higher environmental contrast between forest and matrix increased rather than decreased the probability of richness increases at edges. This is contrary to the expectation that high-contrast matrices would affect conditions in forest fragments more strongly than low-contrast matrices, leading to a loss of species richness at fragment edges (Arroyo-Rodriguez et al., 2017; Boesing et al., 2018; Dodonov et al., 2013). A possible explanation for these results is that resource complementation may be stronger at high-contrast matrices, that are likely to contain different types of resources compared to the adjacent forest (BLITZER et al., 2012; FROST et al., 2015). This outcome is in accordance with the resource mapping model of Ries and Sisk (2004), which predicts increased species richness at edges when different resources are divided between a habitat patch and the surrounding matrix.

1.4.3 Distance to edge

Distance to edge proved to be an important predictor of both the direction and the magnitude of edge effects, and therefore as a mediator of global patterns. Former evidence suggested that edge effects are mainly perceived at <100 meters from the forest edge (LAURANCE et al., 1997; HARPER et al., 2005), which possibly influenced many authors to sample more often at relatively short distances from edges (Ries et al., 2017, 2004). Accordingly, three-quarters of the edge-interior comparisons used in our study were taken at <90 m from edges. We limited the maximum distance to edges (i.e. <= 500 m from the edge) and therefore did not address the whole extent of forests potentially exposed to edge effects (EWERS; DIDHAM, 2006). Nevertheless, including distance improved model fit considerably, highlighting its importance for valid inferences, and calling attention to the possibility of underestimating edge effects on biodiversity when relying exclusively on sampling locations near edges. Although many environmental and community changes are likely to be stronger up to 100 m from edges, edge effects have been shown to extend for more than 1 km for insects and even more for vertebrates (BENÍTEZ-LÓPEZ; ALKEMADE; VERWEIJ, 2010). In addition, comparing plots more distant to edges may provide a better picture of the impact of edge effects, since responses tend to be less variable at greater distances from the edge (LAURANCE et al., 2007; MARSH et al., 2018). Quantification of areas impacted by edge effects requires the assessment of the extent of edge influence. Because of the reduced number of responses taken farther from 100m from edges, the extent of forest area impacted by edges is still unknown. Thus, future synthesis addressing edge effect extent will benefit from responses taken at more interior parts of the forest.

Finally, although species richness is the most frequenly used biodiversity status indicator in the edge effect literature (Ries et al, 2004, 2017), it is important to note that changes in species richness do not necessarily lead to straightforward inferences about the biodiversity status (HILLEBRAND et al., 2018; FINDERUP NIELSEN et al., 2019). Species richness increases may not translate directly into the desired conservation outcome of preserving biodiversity, given that frequently most of the species benefiting from habitat change are generalists, which are often broadly distributed and therefore of minor concern in the context of biodiversity conservation (FILGUEIRAS et al., 2021). Thus, in addition to the evaluation of edge effects on species richness, evaluating concurrent changes in community composition across edge-interior gradients should be a focus of future studies to understand the entire spectrum of possible consequences of habitat edges on species.

1.5 Conclusions

Overall, edge effects tend to cause a decrease in species richness at tropical forest edges more frequently than in temperate communities. In addition, richness decreases at edges are stronger in regions not subjected to historical disturbance. Thus, environmental filters at different time scales mediate community responses to edges.

Considering environmental contrasts, increases in species richness are more likely to occur adjacent to hard matrices. This suggests that mechanisms such as resource complementation might be more important than anticipated. The finding that edge effects contribute to both increases and decreases in species richness at forest edges, depending on the historical and ecological conditions of the study site, provides a possible explanation for the well-known heterogeneity in both edge- and fragmentations effects on biodiversity (BANKS-LEITE et al. 2022).

Given that both the direction and magnitude of edge effects vary according to local and global drivers, we reinforce the conclusion that tropical communities are more prone to local species loss due to edge proximity. Therefore, actions to reduce edge density may be especially needed in tropical landscapes (PÜTTKER et al. 2020). Finally, our study indicates that assuming a unique landscape design is ideal for biodiversity conservation globally may be inadequate, since edge impacts on species richness are clearly spatially heterogeneous.

2 POACHING IS THE MAIN DRIVER OF MAMMAL ABUNDANCE EVEN AFTER CONSIDERING STOCHASTIC GEOMETRIC CONSTRAINTS

Abstract

The negative responses of mammals to the edge effects at tropical forests are expected to arise from ecological drivers such as resource availability and species interactions. However, the entangled complexity involved in understanding and quantifying the species niche makes it difficult to isolate and test the importance of few components at a time, undermining the comprehension of important processes driving abundance changes near edges. Alternatively to niche-based frameworks, spatially-explicit null models, based on mid-domain effects, can help disentangle complex ecological processes by selectively excluding them. Here, we use a null model based on the random placement of individual home ranges to assess the importance of habitat quality to explain the abundance of seven mammal species in a forest reserve. First, we selected best models explaining abundance variation including or not geometric constraints. Then, we fixed geometric edge effects in models to investigate whether considering geometric constraints would change the interpretation of any ecological driver for any species. Geometric constraints were an important predictor for only one of seven species. Despite its importance in explaining the abundance of ocelots, vegetation complexity was also a good predictor pointing to the additive effect of the environment and stochastic drivers. Finally, considering geometric constraints as an underlying mechanism did not lead to any changes in the interpretation of ecological drivers of edge effects in the reserve studied. Although stochastic abundance distributions due to geometric constraints are expected to be important in the absence of environmental filters, poaching and water resources seem to be the strongest ecological filters in the studied landscape.

2.1 Introduction

Forest loss driven by pasture and crop areas (RADWAN et al., 2021; WINKLER et al., 2021) leads to several effects on biodiversity patterns on habitat remains (PFEIFER et al., 2017). In addition to area and isolation effects, changes in biodiversity patterns across landscapes also occur due to environmental changes near habitat edges, the so-called edge effects (MURCIA, 1995; HADDAD et al., 2015b). Edge effects are expected to affect virtually all forest areas by 2100 (HADDAD et al., 2015b; FISCHER et al., 2021). However, the mechanisms underlying species' responses to edge effects remain poorly explored (DIDHAM; KAPOS; EWERS, 2012). Strong structural differences have been observed between forest vegetation and adjacent land use, including agricultural production systems or pastures, which are frequently an important moderator of edge effects within natural forests. These ‘abrupt edges’ can have a positive or negative effect on abundance, depending on the entangled interactions between populations and their environment, or depending on whether local changes bring net positive or negative results for species abundance (CADENASSO et al., 2003; RIES et al., 2004; HARPER et al., 2005).

As observed, the active habitat selection as a consequence of search for resources, named resource mapping (RIES et al., 2004, 2017) is an important mechanism frequently evoked to explain the variation of species abundance along edge-interior gradients (EIGs) (RIES et al., 2017). Therefore, under resource mapping lens, the observed animal responses to edges would depend on tracking cascading nutrient availability due to changes in productivity along EIGs (e.g. Cadenasso et al., 2003; Frost et al., 2015). This mechanism is reflected by more consumption events at edges (i.e., herbivory and predation, MARTINSON; FAGAN, 2014), potentially indicating a positive net effect of edges on ecosystem productivity on upper trophic levels. However, assumptions and predictions based on resource mapping are difficult to test given the sparsity of data and limited prior knowledge of the species of interest (INSTITUTE, 2003; HARPER et al., 2005; IBÁÑEZ et al., 2014). Thus, the prediction of the consequences of edge effects on biotic communities is highly uncertain due to a lack of detailed information on habitat preferences and resource changes for many species, particularly in the tropics (Ries et al., 2017). Within tropical forest habitats, productivity and possibly the amount of resources typically increase toward the forest interior along edge interior gradients (LAURANCE et al., 2011; PÜTZ et al., 2014a; BRINCK et al., 2017; ORDWAY; ASNER, 2020), leading to changes species and communities changes (HADDAD et al., 2015a). If we assume that resources for most species would correlates with primary productivity, which would cascade up to vertebrate species, assessing proxy measures for ecosystem productivity such as tree height, forest complexity, and vegetation greenness from remote sensing data can clarify species' responses to edges due to resource mapping (CROWLEY; CARDILLE, 2020).

In addition to ecological predictions based on the niche of the species, which ultimately regulates species' distribution more or less strongly, alternative mechanisms, such as geometric constraints of the ranges, also may affect species abundance in fragmented landscapes. These 'geometric edge effects' (GEE) models can reproduce a variety of abundance patterns, analogously to the mid-domain effect (MDE) observed for species richness across continental spatial scales (COLWELL; LEES, 2000). In summary, the model places individuals randomly in suitable habitat pixels and spreads until they reach their home ranges. Home ranges often rebound at edges, generating a multitude of abundance curves across EIGs. This is expected to reflect a random distribution of individuals in geometrically constrained habitat areas (that is, forest fragments for forest-exclusive species), which can be incorporated into abundance estimation as a baseline pattern (GOTELLI; ULRICH, 2012; ZHANG, 2020) over which species resource mapping and interactions will drive abundance distribution patterns across edge interior gradients. Thus, species abundance near edges is expected to be driven by the varying importance of stochastic and niche-related mechanisms.

GEE models can provide a useful null model to evaluate to what extent observed abundance distributions of species along EIGs can be explained by the random placement of home range areas of individuals within landscapes that vary in habitat configuration and/or species home range sizes (Fig. 1,PREVEDELLO; GOTELLI; METZGER, 2016; RIBEIRO et al., 2016). Random placement models, when used as null hypotheses to understand causal relationships, do not aim primarily to be a priori predictions of observed patterns (GOTELLI; MCGILL, 2006). However, on regional scales, when performed with process-based modelling using relatively simple assumptions, random placement models may generate surprisingly similar patterns to observed variation in species richness (JETZ; RAHBEK, 2001; RANGEL et al., 2018). Furthermore, contrasting models with and without considering GEE is expected to be a more robust assessment of ecological drivers since it tests the existence of environmental driver effects against a process-based null hypothesis. Thus providing an additional "ecological" null hypothesis to usual tests against statistical "intercept-only" null models (GOTELLI; MCGILL, 2006). In othe words, instead of considering 'intercept only' null hypothesis, we tested ecological drivers against the null hypothesis that the distribution is driven by random placement of home ranges. This is especially important if the environmental driver considered is correlated with stochastic predictions obtained from random placement models, i.e. both environmental and stochastic prediction points to the same patterns; Chase et al., 2020; MacDonald et al., 2021). Therefore, this null model reduces the probability of type I error - i.e. assessing effects of deterministic drivers after stochastic effects are accounted - (e.g. assume exclusively resource-driven edge responses). As such, the inclusion of GEE as a null model in the modelling of species abundance distributions within fragments can provide a more rigorous or, at least more meaningful test on the importance of deterministic drivers compared to using ordinary 'intercept-only' null models (Zhang, 2020).

Despite the potential of considering GEEs in modelling species abundance within habitat patches, to date, GEE models have been tested only twice previously, in a few fragments (PREVEDELLO et al., 2016; RIBEIRO et al., 2016) focusing on small mammal species (*P. frenatus and D. aurita*) in small forest fragments up to 273 ha. So far, evidence points to a change in inference about species' habitat preferences. Incorporate geometric edge effects led to infer higher edge sensitivity (PREVEDELLO et al., 2013) than considering only observed patterns, but also led to lower edge sensitivity (RIBEIRO et al., 2016. Such a contrasting result within the same region (Brazilian Atlantic Forest) and taxon (small mammals) calls for more and more diverse tests on the prevalence of GEE in fragmented landscapes. This includes the need to test across a wider set of taxa and a wider set of landscape configuration, and the need to incorporate habitat quality variables and additional environmental variables into the modelling framework.

The shape of species abundance across EIGs are highly unpredictable and depends mainly on fragment shape, species range, and resolution (COLWELL; LEES, 2000). Therefore, random placement models will generate a smaller, equal, or greater edge sensitivity to edges than the abundance observed, depending on the species' home range and its actual habitat requirements. Greater sensitivity mean that species responses to edges are steeper across EIGs than predicted solely by geometric constraints and other mechanisms are driving responses to edges. Frequently, large home-range species are more prone to experience geometric constraints, resembling negative edge effects responses, while patterns for smaller species can be highly variable (PREVEDELLO et al. 2016). For example, let us consider a large species whose abundance response to fragmentation is classified as an "edge avoiding pattern" - i.e., expected to negatively respond to decreases in resource availability near edges (EWERS; DIDHAM, 2006; RIES; SISK, 2010) - which could emerge due to geometric effects, rather than variation in habitat quality (see Fig. 1 in PREVEDELLO et al., 2013). In the opposite direction, if a species is more sensitive to edge effects than predicted by stochastic models, it reinforces the need to maintain forest core areas in the landscapes for that species (BANKS-LEITE et al., 2010).

If geometric edge effects determine species abundances across edge-interior gradients, random placement models would reproduce the observed abundance. If geometric constraints are not important to predict the change in species abundance across EIGs, environmental variables should explain most of the variation in species abundances, independently of geometric edge effect predictions (RIBEIRO et al., 2016). Considering that previous tests on the importance of such null models were restricted to small mammals in small fragments (up to 273 ha in previous tests, PREVEDELLO et al., 2016, RIBEIRO et al., 2015), we predict that smaller species will be equally distributed across large forest fragments, not experiencing geometric constraints. On the contrary, larger home ranges lead to an increase in observed occupancy toward interiors by GEE models as a product of geometric constraints

(PREVEDELLO et al., 2016) and due to ecological predictions (EWERS; DIDHAM, 2006). Given that both are very different mechanisms, distinguishing between them is necessary to improve our predictive capacity for species responses under habitat fragmentation (RIES et al., 2017). Importantly, past studies have assumed increased animal abundance in forest interiors, rather than tracking some specific resources, which may not necessarily increase toward fragment interior (FAHRIG, 2020). Therefore, with information on forest resources, we can potentially unravel these two mechanisms.

Here, we investigate the benefits of incorporating spatially-explicit null models to explain the observed variation of edge-driven fragmentation effects on seven medium-sized and large tropical mammals in a highly fragmented nature reserve that covers 23,000 ha. We applied a novel method to incorporate null expectations into occupancy models considering fixed coefficients (i.e. assuming that the stochastic mechanism is present) and fitted coefficients (assuming that the effect size of stochastic patterns can have different effect sizes on species occupancy). By incorporating null models, we aim to: 1) quantify the relative importance of environmental vs. stochastic processes to determine occupancy of medium and large mammals along edge-interior gradients (EIGs), and 2) assess whether considering a null expectation impacts inferences on the main environmental drivers of forest mammal occupancy. We hypothesise that the mammal response to edges is partly caused by the stochastic distribution of individuals, thus predicting the presence of GEE in selected models for most species. Furthermore, we expect that edge responses of larger species are more determined by GEEs, given that their larger home ranges would lead to increased geometric constraints. Finally, we expect that considering geometric constraints reduces the effect size of predictor variables, especially those that vary along EIGs, such as forest structure and poaching.

2.2 Methods

2.2.1 Mammal Data Set

We relied on extensive camera trap data collected in Vale Natural Reserve (VNR) in Espirito Santo state, Brazil. The VNR is a 230 km² private reserve of lowland semi-deciduous forests located within the Atlantic Forest biodiversity hotspot. The data set comprises images of 36 camera traps (Bushnell TM) randomly distributed throughout the reserve with a minimum distance of 1 km between the cameras (APENDICE B). Sampling occurred between 2013 and

2017 in 20 five-day sampling periods during eight sampling seasons, resulting in a total of 800 days of camera trap sampling. Four sampling seasons occurred during the dry season (April to September) and four sampling seasons during the wet season (November to March). For detailed information on sampling, see FERREGUETTI; TOMÁS; BERGALLO, 2015; FERREGUETTI; TOMAS; BERGALLO, 2017, 2019; FERREGUETTI et al., 2018, 2023.

From the total of 27 recorded species, seven species were considered forest dependent (Table 2), as they were not observed using the matrix adjacent to forest fragments during sampling, and therefore are likely to meet the assumption of occupying exclusively the confined space of the forest patch, an important assumption for our model. Furthermore, we inferred two classes of forest dependency from a) sources from the literature (ICMBIO, 2018, IUCN), b) the accumulated experience of researchers working in VNR, and c) applying the edge response software BIOFRAG, which classifies species according to their sensitivity to edges based on the spatial distribution of occurrences (PFEIFER et al., 2017). Based on the analysis of the BIOFRAG software, five of seven species were classified as ‘forest core’ (that is, they are highly sensitive to edges) and two as ‘forest unknown’ (that is, their abundance patterns cannot be analysed with certainty to allow categorisation). The study design only included sampling points located within the forest fragment, which may limit the accuracy of the BIOFRAG software classification of species into forest core, forest edge, or forest generalist species. To test the robustness of our classification, we used the BIOFRAG software for the other six species recorded within the VNR and known to be habitat generalists, namely: *Tapirus terrestris*, *Nasua nasua*, *Dasypus novemcinctus*, *Euphractus sexcinctus*, *Didelphis aurita,* and *Cerdocyon thous*. The software correctly classified these species as less edge-sensitive compared to the seven species included in our subsequent analyses.

Table 2 - Species diet, home range size, number of records, habitat preference and edge influence sensitivity according to BioFrag Software.

Species	Diet	Home range ha	Category	EI sensitivity
Cuniculus paca	Herb	38.49	Forest Core	0.63
Eira barbara	Carn	378.78	Forest Core	0.63
Leopardus pardalis	Carn	1489.11	Forest Core	0.54
Leopardus wiedii	Carn	301.73	Forest Core	0.83
Mazama americana	Herb	116.56	Forest Core	0.59
Mazama gouazoubira	Herb	82.92	Unknown	0.27
Puma yagouaroundi	Carn	758.31	Forest noPref	0.29

Legenda: Information on diet was obtained from Wilman et al. 2015 (Carn = Carnivore; Herb = Herbivore). Home range size estimates were obtained from Tamburello (2015) and EI sensitivity indicates species` sensitivity to edge influence (PFEIFER et al, 2017).

Fonte: O autor, 2023

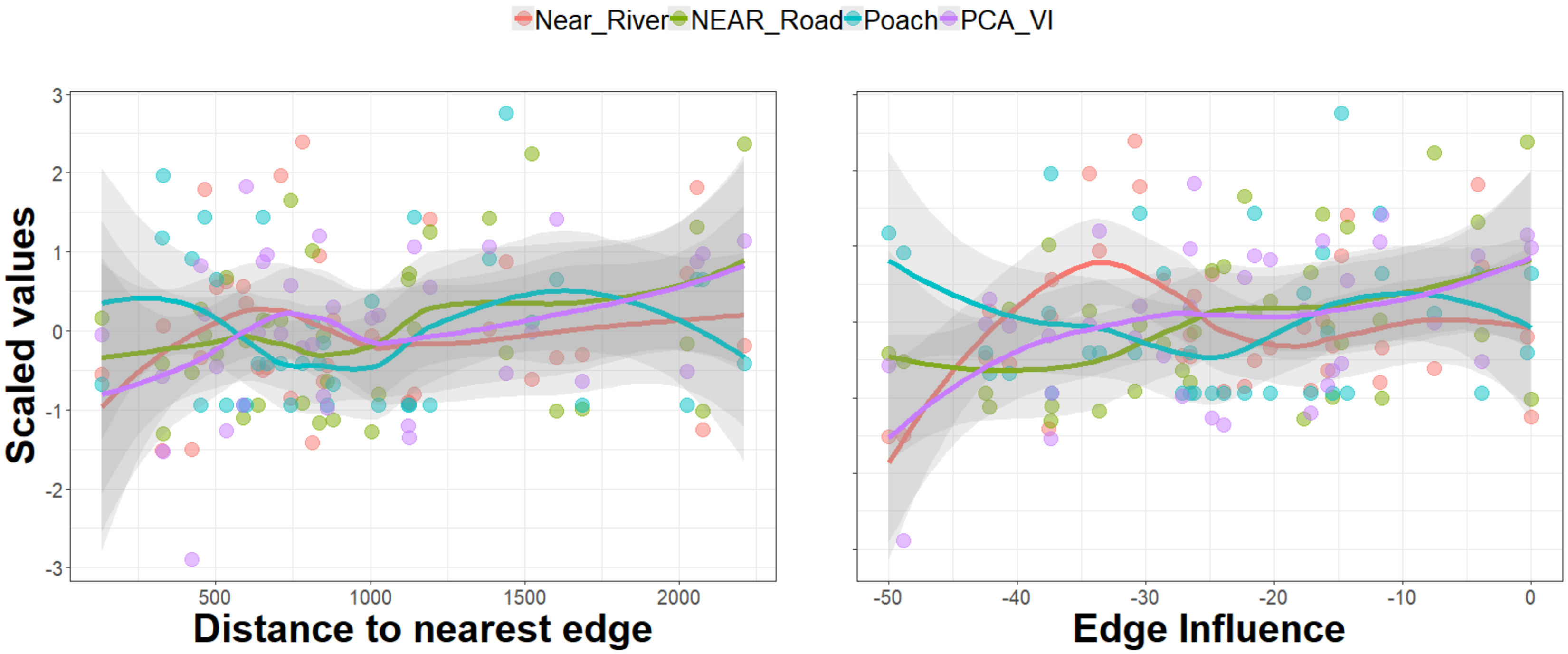
2.2.2 Environmental data

In total, we included six environmental variables used to predict mammal occupancy in previous studies in the region (FERREGUETTI et al., 2023, 2015) and elsewhere (MICHALSKI; PERES, 2005). These variables are considered deterministic (or ecological) factors, in opposition to the stochastic (or probabilistic) factor represented by geometric constraints (see the next section), and were measured at each of the 36 sampling points. First, we measured the distance from each camera trap to the nearest water body, since water represents an important resource for mammals (FERREGUETTI; TOMÁS; BERGALLO, 2015; FERREGUETTI; TOMAS; BERGALLO, 2019), as well as the distance to the nearest road, used as a proxy of human access (DA SILVA et al., 2020). Furthermore, we considered the "edge influence" metric as a measure of edge exposure. This metric considers both the contrast of land cover between habitats and the composition and configuration of local landscapes (PFEIFER et al., 2017). Values of edge influence from -50 to zero, where – 50 indicate maximum edge exposure and zero indicate absence of edge effects. Here we chose to use circular local landscape with 2km radius. This radius best fits the observed maximum distance from the plots to the nearest edge (min: 59; max: 2209m), thus capturing the variation in the local landscape cover. If we chose a smaller radius, the local landscape cover would comprise mainly forest, losing heterogeneity. Furthermore, the medium mammals studied are likely to experience the landscape on larger scales (JACKSON; FAHRIG, 2015).

We inferred the intensity of poaching from previous occupancy modelling of poacher density in the same landscape (obtained from FERREGUETTI et al., 2020), which was infered from occupancy models predicting poacher abundance as a function of prey availability, distance to roads and to rivers. We inferred forest productivity from the Normalised Difference Vegetation Index (NDVI) and forest structure from the Enhanced Vegetation Index (EVI, HUETE et al., 2002). Using Google Earth Engine, we extracted both vegetation indices (NDVI and EVI) from 30 m Landsat images collection from the years of the sampling period (Landsat 7 and 8 Level 2 Collection 2, Tier 1, image, courtesy of the US Geological Survey). Although these indices are expected to be highly correlated, the EVI is mostly associated with forest structure, being less variable over time than the NDVI (HUETE et al., 2002). After examining the variation of the vegetation indexes (EVI and NDVI) across sites and seasons, we calculated the median vegetation indexes across the sampling period (4 years). To infer landscape vegetation, we calculated median vegetation index considering the focal pixel value and at 250, 500m, 1km and 2km radii around sampling points. We chose to use vegetation index medians across all sampling periods as site variables since they did not present any systematic variation, such as directional temporal trends, while potentially subjecting our analysis to observation errors, such as outlier values. Furthermore, the region is subject to high cloud cover throughout the sampling period. Thus, vegetation information across different seasons would have a different amount of information (i.e. observed pixels) representing additional sources of error. To check the trends of our predictor variables along the edge-interior gradients, we plotted the variables as a function of distance to the nearest edge and the edge influence gradient (Figure

4). As expected, the vegetation indexes obtained at different scales were highly correlated. Thus, to plot the overall trends of vegetation along with other variables, we calculated the principal component vector that captured about 76% variation in vegetation indexes and used the first principal component for plotting data. Finally, since the original data collection aimed to capture seasonal differences between dry and wet seasons, we also considered this variable in models that predicted occupancy and detectability.

Figure 4 - Variation of environmental predictors of mammal abundance with distance to edge and edge influence in the studied reserve.



Legenda: Edge-interior gradient measured as distance from the nearest edge on the left and edge influence considering 2km radius on the right. In red, distance to the nearest river, in green, distance to the nearest road; in blue, poaching. Vegetation index first component obtained from PCA (76% variation) in purple. Values with greater edge influence (on the right side) are those less exposed to edge since edge influence in forest is measured from -50 to zero, with zero meaning no edges.

Fonte: O autor, 2023

2.2.3 Modelling Geometric Constraints

To simulate the occurrence of individuals driven by GEE, we relied on the model of PREVEDELLO et al. (2013). Our simulations assumed that: i) landscapes are binary mosaics of forest and non-forest patches; ii) organisms are restricted to forest patches; iii) the forest patch is homogeneous so that all map pixel are equally likely to receive a new or a spreading individual; iv) the home range size is solely determined by body size and diet (TAMBURELLO; CÔTÉ; DULVY, 2015).

First, for each species, we excluded forest patches smaller than the species' home range. Then, the model randomly places each individual in a pixel within forest patches (representing its 'birth'). Subsequently, the home range expands to adjacent pixels until reaching the predicted home range size for that species, excluding those already occupied by that same individual or other unsuitable cells (i.e., matrix cells), using the spreading dye algorithm (JETZ; RAHBEK, 2001). Home range sizes for each species (Table 2) were estimated from allometric equations from body size and diet information (TAMBURELLO et al., 2015). Unfortunately, observed data on the home range are highly variable depending on season, region, and method used (varying up to 100 times for the same species; TAMBURELLO et al., 2015, KELT; VAN VUREN, 1999; STEPHENS et al., 2020), challenging validating home range estimates with 'real' local data. Furthermore, our average home range size estimate obtained under metabolic theory should provide a reasonable estimate of home range to be applied globally, based on a broader theoretical background (BROWN et al., 2004), being readily transferred to other studies investigating population or community assemblages (WHITE et al., 2007). To infer the diets of mammal species, we used data from Wilman et al. (2014), binning species within herbivores or carnivores classes when species had more than 50% of their diet based on any category of herbivory (seeds, leaves, unknown diet) or carnivory (vertebrate, invertebrate, fish, unknown). The number of individuals placed for each species was based on their estimated densities, which were inferred from transect data (FERREGUETTI; TOMÁS; BERGALLO, 2015; FERREGUETTI; TOMAS; BERGALLO, 2019; FERREGUETTI et al., 2023), number of records, and expected density given its home range size. Despite density information availability for some species, we chose to use occupancy estimates (see below) since density estimates from transect surveys were not available for all species and transect data output does not apply to our 30m scale analysis. We assumed a lack of territoriality, i.e. that individuals can occupy pixels already occupied by other individuals' home range (which does not change overall model output according to PREVEDELLO et al., 2016).

We classified each pixel of the landscape map into either forest or non-forest areas, based on a tree cover map from 2000. We used an image from 2000 since land cover has not changed significantly after checking more recent maps (MapBiomas, 2021), and continuous classification enabled us to perform tests on species habitat preferences using BioFrag software. We used an 80% threshold to define a pixel as forest (the original map represented tree cover as a continuous variable from zero to 100%), arguably a conservative threshold, but comprising mostly high-quality forests, intending to exclude degraded forests and openings.

In general, we ran 426 iterations of each species, extracted mean abundance values, and normalised the abundance from zero to one to obtain a relative abundance layer on the same scale of occupancy. Finally, we standardised the estimated abundance of each species based on the simulation to predict occupancy. Then we contrasted the predicted occupancy patterns using random placement with those relying on environmental variables. Although the patterns obtained from random placement models depend on domain (fragment) size, cell size and home range size (analogue to geographic range in macro ecology) (COLWELL et al., 2009), our results did not change qualitatively between analyses using 10m or 90m cell size resolution. Larger cell sizes were not considered because larger cells would lack important information on abundance variation, since most edge effects are reported in the first 100 m (WILLMER; PÜTTKER; PREVEDELLO, 2022). Smaller cell sizes were not included because of lack of the sufficient resolution of the satellite images and heavy computational use.

2.2.4 Occupancy modelling

To infer the importance of geometric constraints vs. deterministic predictors, we modelled occupancy probabilities from camera trap observations assuming imperfect detection using a hierarchical occupancy model framework using *unmarked* package (FISKE; CHANDLER, 2011). We built capture historic based on camera trap sampling comprising 100 days in the dry season (May to September) and 100 days in the wet season (November to March) in each of the four years. We considered five consecutive days as independent observations

(FERREGUETTI et al., 2023). Thus, our data have 8 seasons with 20 occasions each, resulting in 160 occasions in each of the 36 sites. Within each season, we assumed the absence of immigration, death, birth, and emigration at the sites and opted to use a repeated measured single species, single-season analysis with stacked seasons, including site and season random effects in all models, which were retained if these random effects increased the model AIC (FULLER; LINDEN; ROYLE, 2016; LINDEN et al., 2017).

To build occupancy models, we first chose the best random structure based on AIC, considering all combinations of siteID and SeasonID affecting both occupancy and detectability considering the full model with all the fixed predictors (ZUUR et al., 2009; HARRISON et al., 2018). To include vegetation information, we retained only one VI predictor (NDVI or EVI) on a single best-fitting scale. After selecting the best random structure and the best VI predictors, we added other fixed environmental variables. We built three sets of models considering i) only environmental predictors; ii) only the predicted abundance by the GEE model, and iii) both environmental and predicted abundance by the GEE. We then assessed model R^2 and the precision from the AUC values of selected models (ZIPKIN et al., 2010). To obtain the AUC values, we calculated the cumulative detection probability on n occasions and multiplied it by the predicted occupancy probability for each site and season:

$$Z_{\mathrm{Obs}} \sim Z_{\mathrm{Predicted}} = (\text{cumulative detectability} * \text{occupancy probability}),$$

where $Z_{\mathrm{obs}} = 0,1$ and Z predicted <0,1. Next, to check for a possible influence of spatial autocorrelation, we calculated Moran I and visually diagnosed semivariograms (Table S4). To confirm the absence of collinearity of predictors, we checked for any collinearity among variables present in averaged models, for each species using partial r^2. To infer the importance of stochastic vs. deterministic drivers, we directly contrasted predicted and observed abundance as a function of edge influence. We then evaluated the relative support of different variables considering the model's relative weight of evidence.

To test whether taking stochastic processes into account would reduce the estimates for environmental drivers' effects, we compared coefficients of models that only included environmental predictors to those that also included GEE model predictions. For the latter, we set the slope of GEE predictions equal to one to predict occupancy probability, since stochastic variation predicted by GEE models is expected to be present and drive species occupancy, at least partially. Since it was not possible to confidently establish a single best model for all species (that is, no single model with ΔAIC< 2 difference from the second best model), we fitted an averaged model that included all parameters of the selected models, weighting coefficients based on the importance of variables using the MuMIn package in R (BARTON, 2023). All simulations and occupancy analysis were performed using R (R Core Team, 2022). Coefficient estimates were obtained using '*parameters'* (Lüedeck et al., 2020) and we used '*interactions'* (Long, 2019) to produce the graphs.

2.3 Results

Models based on geometric edge effects (GEEs) predicted clear gradients with occupancy peaks at different portions of the edge-interior gradient (EIG), depending on home range size (Figures 5, 6). Overall, based solely on GEE, models predicted edge avoidance was stronger near multiple edges, especially for larger species (Figure 5). The predicted abundance variation according to the GEE models followed three main patterns: species with larger home ranges were more abundant in forest interiors (*Puma yaguarundi*, *Leopardus pardallis* and *Leopardus wiedii*), medium species were more abundant at intermediate distances from the edges (*Eira Barbara*, *Mazama americana*, *Mazama gouzabira),* and the smallest species (*Cuniculus paca*) more abundant close to the edges (about 100 m from the edge). Although GEE models were more likely predictors of species occupancy than intercept-only models (traditional null model, Table 3), considering solely random placement models resulted in less informative estimates of species occupancy near edges, mostly not resembling observed patterns, but with similarities to prediction based on the best fitting models (Figure, 7).

When considering models including both stochastic and environmental predictors, models including geometric constraints predictions were among the best fitting models (ΔAIC<2) to five out of seven species (Table 3), although several other models not including geometric effects were equally plausible. The coefficients of the stochastic predictors averaged in the model were positive for all but one species, but significantly different from zero and with high support for its inclusion in one species only (*L. pardalis*, sum $w_i = 0.87$, Table 4, Figure 9). The only species with a significantly negative average coefficient of the stochastic predictor was *C. paca* (sum $w_i = 0.35$, Tables 3, 4), indicating the low importance of stochastic processes for the spatial distribution of this species.

Importantly, even after considering geometric constraints, poaching was still the most important factor driving species responses to edges. The occupancy of five out of seven species was negatively affected by poaching (Figure 8). Herbivorous species were more sensitive to poaching than carnivores (i.e. presented steeper slopes, Table 4). Only ocelot (*Leopardus. pardallis*) occupancy was partially explained by GEE model predictions (Figure 9), but also responded negatively to EVI. For tayras (*Eira barbara*) the best model predicted a constant occupancy across the edge-interior gradient. Finally, considering the occupancy predictions of geometric constraints, the null models did not lead to changes in inference in the effect of any environmental predictor considered (Figure 10).

Table 3 - Best models (ΔAIC<2) predicting mammal occupancy at Vale Natural Reserve, Brazil.

Species	Explanatory variables	K	AICc	ΔAICc	w_i	Cum. Wi	R^2
M. americana	NDVI 500m + Near River + Near Road + Poach	6	5 415.14	0	0.13	0.13	0.49
	Near River + Near Road + Poach	5	5 415.29	0.15	0.12	0.24	0.49
	NDVI 500m + Near River + Near Road + Poach + Sim M amer	7	5 415.62	0.48	0.10	0.34	0.50
	Near Road + Poach	4	5 416.77	1.63	0.06	0.40	0.48
	Near River + Near Road + Poach + Sim M amer	6	5 416.95	1.82	0.05	0.45	0.49
	NDVI 500m + Near River + Near Road + Poach	7	5 417.18	2.04	0.05	0.49	0.49
	Sim M amer	3	5 594.88	179.74	0.00	1.00	0.04
	~1	2	5 603.47	188.34	0.00	1.00	-
M. Gouzabira	Poach + pt EVI	4	5 969.68	0	0.15	0.15	0.50
	Near River + Poach + pt EVI	5	5 970.57	0.88	0.09	0.24	0.50
	Poach + pt EVI + Sim M gouza	5	5 970.57	0.88	0.09	0.33	0.50
	Near Road + Poach + pt EVI	5	5 971.50	1.81	0.06	0.39	0.50
	Poach + pt EVI	5	5 971.64	1.96	0.05	0.45	0.50
	dry + Poach + pt EVI	5	5 971.72	2.03	0.05	0.50	0.50
	Sim M gouza	3	6 163.63	193.95	0.00	1.00	0.01
	~1	2	6 164.72	195.03	0.00	1.00	-
C. paca	Near River + Near Road + Poach + Sim C.paca	6	2 399.19	0	0.17	0.17	0.49
	Near River + Near Road + Poach + pt NDVI + Sim C.paca	7	2 399.20	0.01	0.17	0.34	0.49
	Near River + Poach + pt NDVI + Sim C.paca	6	2 399.84	0.65	0.12	0.46	0.49
	Near River + Near Road + Poach + Sim C.paca	7	2 401.14	1.95	0.06	0.53	0.49
	Near River + Near Road + Poach + pt NDVI + Sim C.paca	8	2 401.16	1.97	0.06	0.59	0.49
	Near River + Poach + Sim C.paca	5	2 401.17	1.97	0.06	0.65	0.48
	dry + near river + Near Road + Poach + Sim C.paca	7	2 401.28	2.09	0.06	0.71	0.49
	Sim C.paca	3	2 584.16	184.96	0.00	1.00	0.01
	~1	2	2 585.25	186.06	0.00	1.00	-

Ends next page

Table 3 - cont.

Species	Modnames	K	AICc	Δ AICc	w_i	Cum Wi	R^2
L. Parda	dry + pt EVI + Sim L parda	5	3 187.74	0	0.18	0.18	0.09
	dry + Poach + pt EVI + Sim L parda	6	3 188.75	1.00	0.11	0.29	0.09
	dry + Near River + pt EVI + Sim L parda	6	3 189.14	1.40	0.09	0.38	0.09
	dry + Near Road + pt EVI + Sim L parda	6	3 189.70	1.96	0.07	0.45	0.09
	dry + pt EVI + Sim L parda	6	3 189.78	2.04	0.07	0.51	0.09
	Sim L parda	3	3 202.73	14.99	0.00	1.00	0.02
	~1	2	3 207.58	19.83	0.00	1.00	-
L. Wiedii	Poach	4	2 455.55	0	0.11	0.11	0.07
	EVI 2000m + Poach	5	2 456.23	0.68	0.08	0.19	0.08
	Near River + Poach	5	2 456.50	0.95	0.07	0.26	0.07
	dry + Poach	5	2 456.69	1.13	0.06	0.32	0.07
	EVI 2000m + Near River + Poach	6	2 456.96	1.41	0.05	0.37	0.08
	Near Road + Poach	5	2 457.37	1.81	0.04	0.42	0.07
	dry + EVI 2000m + Poach	6	2 457.38	1.83	0.04	0.46	0.08
	Poach + Sim L wiedii	5	2 457.51	1.95	0.04	0.50	0.07
	EVI 2000m + Near Road + Poach	6	2 457.53	1.98	0.04	0.55	0.08
	dry + Near River + Poach	6	2 457.66	2.10	0.04	0.58	0.08
	~1	2	2 472.64	17.09	0.00	1.00	-
	Sim L wiedii	3	2 474.26	18.70	0.00	1.00	0.00
P. yagua	NDVI 500m + Near Road + Poach	6	2 392.27	0	0.21	0.21	0.11
	NDVI 500m + Near River + Near Road + Poach	7	2 393.60	1.33	0.11	0.31	0.11
	NDVI 500m + Near Road + Poach + Sim P yagua	7	2 394.18	1.92	0.08	0.39	0.11
	dry + NDVI 500m + Near Road + Poach	7	2 394.36	2.09	0.07	0.47	0.11
	~1	2	2 416.66	24.39	0.00	1.00	-
	Sim P yagua	3	2 418.70	26.43	0.00	1.00	0.00
E. bar	~1	3	2653.87	-	0.06	0.06	-
	EVI 2000m	3	2654.18	0.31	0.05	0.11	0.01
	EVI_2000m + Near River	4	2654.64	0.77	0.04	0.15	0.01
	Near River	3	2654.68	0.81	0.04	0.19	0.00
	EVI_2000m + Near Road	4	2655.61	1.74	0.02	0.22	0.01
	~1	4	2655.65	1.78	0.02	0.24	0.00
	NEAR Road	4	2655.77	1.90	0.39	0.26	-
	Poach	4	2655.85	1.98	0.37	0.29	-
	Sim E. bar	4	2655.87	2.00	0.37	0.31	-
	EVI 2000m+Near-River+ Near Road	6	2655.88	2.01	0.37	0.33	-

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_M_amer indicates geometric edge effect predictions for *Mazama americana,* and other 'Sim' variables refer to predictions for other species. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and

Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O Autor, 2023

Table 4 - Average model coefficients predicting occupancy for seven species at Vale Natural Reserve, Brazil.

Species	Predictor	Est.	Lower CI95	Upper CI95	∑(w_i) variable
M amer	p(Int)	-0.35	-0.41	-0.29	NA
	psi(Int)	1.26	0.82	1.69	NA
	psi(Poach)	**-2.66**	**-3.27**	**-2.06**	**1.00**
	psi(Near Road)	**0.58**	**0.17**	**0.99**	**0.96**
	psi(Near-River)	**-0.39**	**-0.78**	**-0.01**	**0.75**
	psi(NDVI 500m)	0.37	-0.09	0.82	0.54
	psi(Sim M. amer)	0.25	-0.24	0.75	0.35
M gouza	p(dry)	0.02	-0.10	0.14	0.27
	p(Int)	-0.53	-0.60	-0.47	NA
	psi(Int)	3.15	2.24	4.05	NA
	psi(Poach)	**-3.39**	**-4.35**	**-2.43**	**1.00**
	psi(pt EVI)	**-0.81**	**-1.33**	**-0.29**	**0.99**
	psi(Sim M. gouza)	0.37	-0.31	1.04	0.37
	psi(Near River)	-0.25	-0.70	0.20	0.36
	psi(Near Road)	-0.12	-0.59	0.35	0.29
C. Paca	p(Int)	-0.56	-0.67	-0.45	NA
	p(dry)	0.04	-0.16	0.24	0.27
	psi(Int)	-3.89	-5.26	-2.53	NA
	psi(Poach)	**-5.26**	**-6.96**	**-3.57**	**1.00**
	psi(Sim C.paca)	**-0.84**	**-1.41**	**-0.26**	**0.97**
	psi(Near Road)	**-0.37**	**-0.78**	**0.04**	**0.64**
	psi(Near River)	**-1.29**	**-1.90**	**-0.68**	**1.00**
L.Parda	p(Int)	-1.40	-1.49	-1.30	NA
	psi(dry)	**-0.73**	**-1.22**	**-0.24**	**0.96**
	psi(Int)	0.32	-0.02	0.67	NA
	psi(pt EVI)	**-0.41**	**-0.67**	**-0.15**	**0.98**
	psi(Sim L. parda)	**0.31**	**0.06**	**0.57**	**0.87**
	psi(Poach)	-0.13	-0.39	0.12	0.40
	psi(Near River)	-0.11	-0.36	0.15	0.33
	psi(Near Road)	0.04	-0.20	0.29	0.28

Ends next page

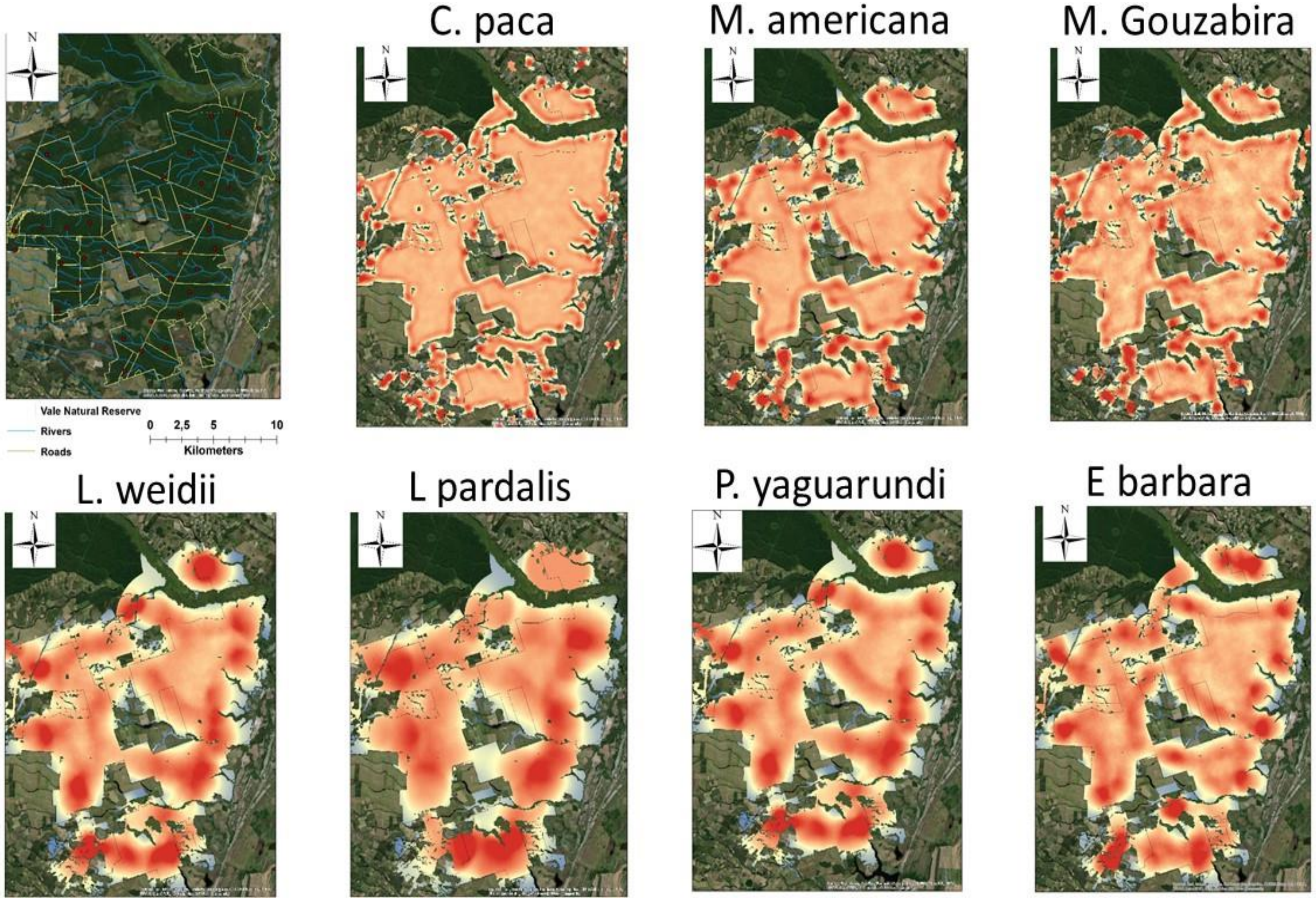
Table 4: - Cont.

Species	Predictor	Est.	Lower CI95	Upper CI95	∑(wi) variable
L.wiedii	p(dry)	0.39	0.16	0.61	0.99
	p(Int)	-1.61	-1.77	-1.44	NA
	psi(dry)	-0.24	-0.74	0.25	0.36
	psi(Int)	-0.53	-0.82	-0.24	NA
	psi(Poach)	**-0.41**	**-0.68**	**-0.14**	**0.98**
	psi(EVI 2000m)	0.16	-0.10	0.42	0.44
	psi(Near River)	-0.14	-0.40	0.11	0.40
	psi(Near Road)	-0.09	-0.35	0.17	0.32
	psi(Sim L. wiedii)	0.04	-0.20	0.29	0.27
P.Yagua	p(Int)	-1.51	-1.68	-1.34	NA
	p(dry)	0.34	0.12	0.56	0.97
	psi(Int)	-0.70	-0.96	-0.44	NA
	psi(Poach)	**-0.54**	**-0.83**	**-0.25**	**1.00**
	psi(Near Road)	**-0.29**	**-0.56**	**-0.03**	**0.78**
	psi(NDVI 500m)	**0.29**	**0.02**	**0.56**	**0.75**
	psi(Near River)	-0.12	-0.39	0.15	0.32
	psi(Sim P. yagua)	-0.06	-0.32	0.21	0.28
E. bar	p(Int)	-1.69	-1.81	-1.57	NA
	p(dry)	0.06	-0.17	0.28	0.29
	psi(Int)	-0.16	-0.40	0.08	NA
	psi(EVI 2000m)	-0.17	-0.42	0.07	0.50
	psi(Near River)	0.15	-0.10	0.39	0.42
	psi(Near Road)	0.07	-0.18	0.33	0.31
	psi(Poach)	0.03	-0.21	0.27	0.27
	psi(Sim E. bar)	0.03	-0.21	0.26	0.28

Legenda: Averaged models considering models with ΔAIC<2, p indicates the predictors of detection probability and Psi is the occupancy predictor. Coefficients and errors are weighted according to the values of variable importance (sum of weights of evidence where the variable is present); Lower and upper 95% confidence interval, variable importance (wi). *Near road* indicates the distance to the nearest road; *near river* indicates the distance to the nearest river, Sim M Amer indicates the predictions of geometric edges for *Mazama americana*, and other variables refer to predictions for other species. Poach refers to the records of the poacher during the sampling. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season on detectability.

Fonte: O autor, 2023

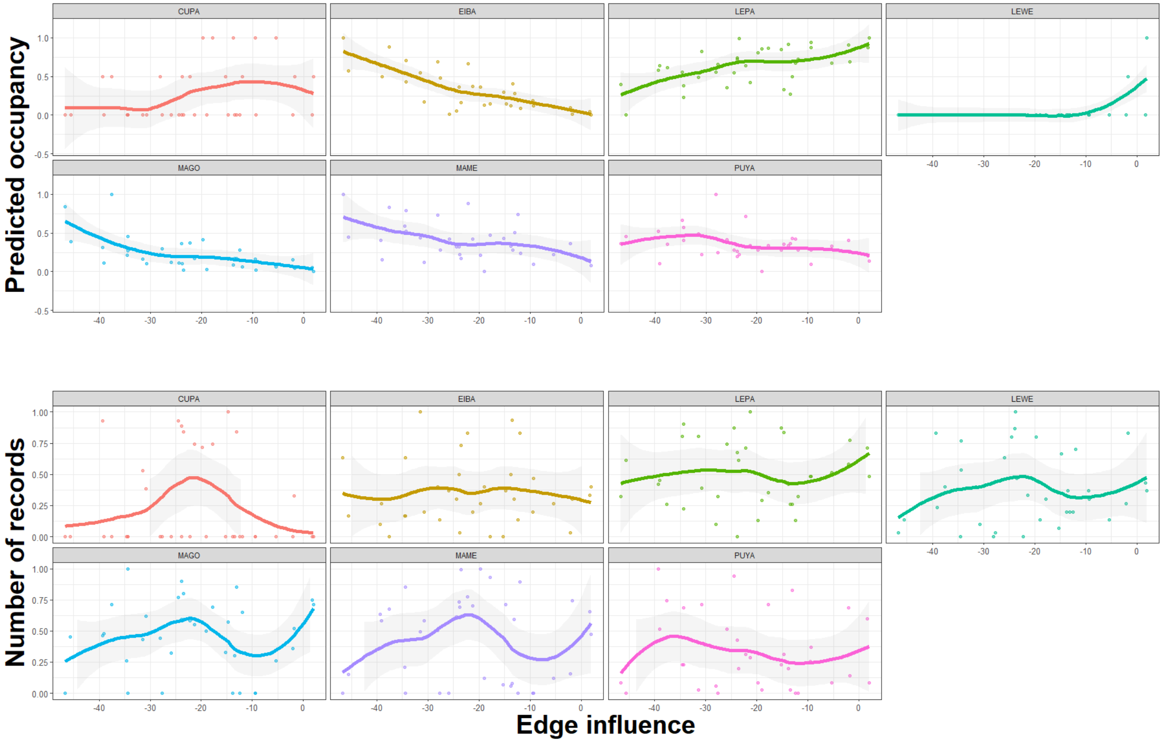
Figure 5 - Predicted abundance according to the geometric edge effect model, for seven forest mammal species



Legenda: Red areas represent higher abundance. Species: Cuniculus paca, Mazama americana, Mazama gouzabira, Leopardus wiedii, Leopardus pardallis, Leopardus pardallis, Puma yaguarundi and Eira Barbara.

Fonte: O autor, 2023.

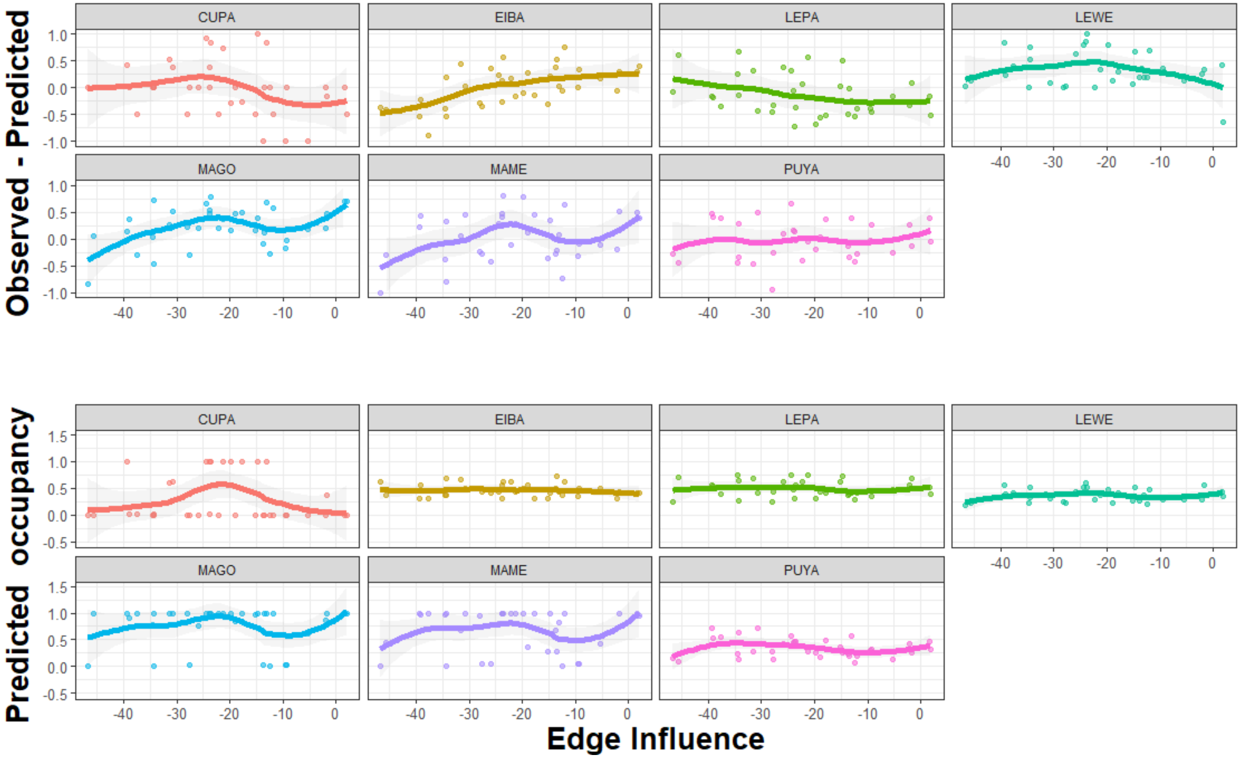
Figure 6 - Predicted vs observed abundance across edge-interior gradient



Legenda: First pannel indicates predicted abundance by GEE model. Second panel show normalized (between 0-1) number of records for each species considering all the four years. Edge influence was calculated considering 2km radius the left portion of graphs indicate edge regions while right portin of the graphs indicate interior areas not exposed to edge influence. Species: *Cuniculus paca, Mazama americana*, *Mazama gouzabira, Leopardus wiedii*, *Leopardus pardallis*, *Leopardus pardallis*, *Puma yaguarundi* and *Eira Barbara*.

Fonte: O autor, 2023

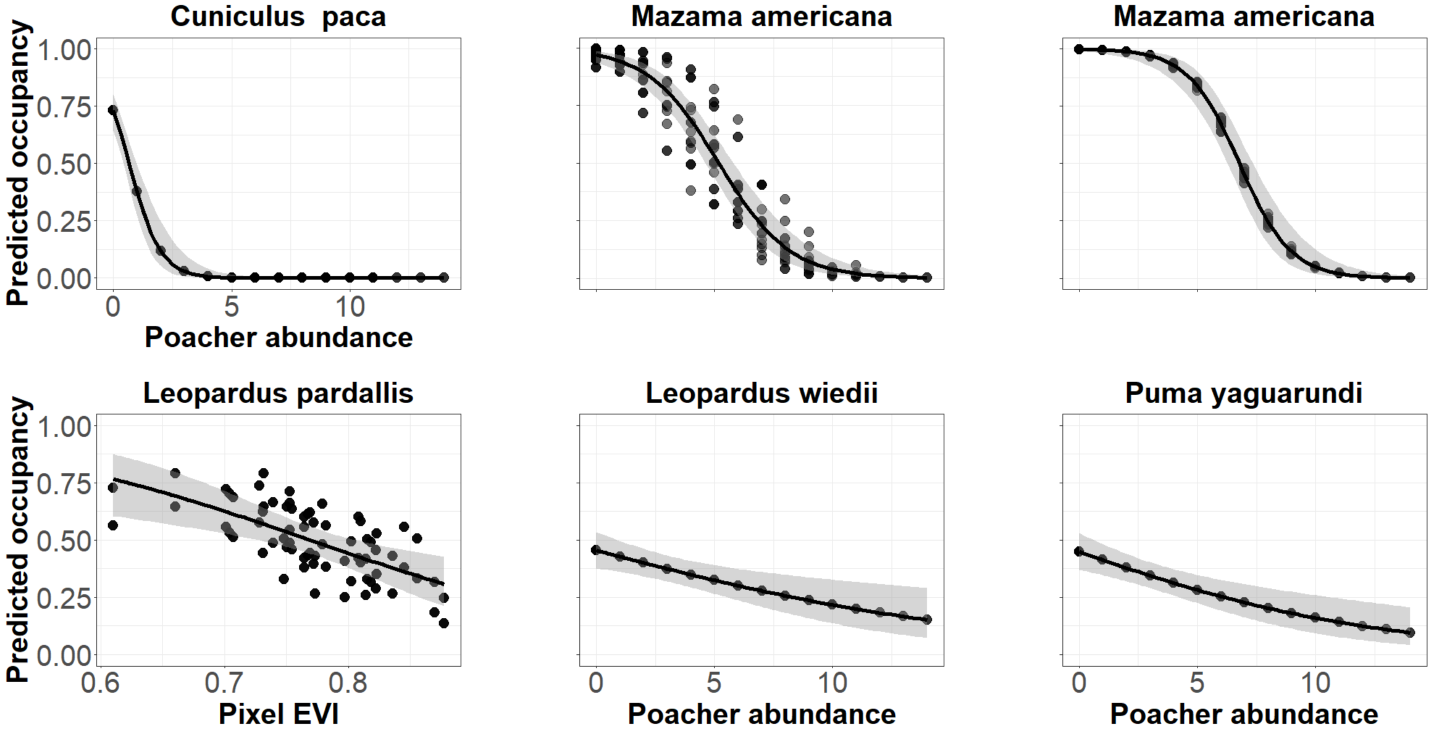
Figure 7 - Predicted occupancy as predicted by the best fitting model from environmental and stochastic predictors.



Legenda: First pannel indicates difference between predicted occupancy by GEE model and observed abundance. Second panel predicted occupancy by the best fitting model. Edge influence was calculated considering 2km radius the left portion of graphs indicate edge regions while right portin of the graphs indicate interior areas not exposed to edge influence. Species: CUPA: *Cuniculus paca*, EIBA: *Eira Barbara*, LEPA: *Leopardus pardallis*, Lewe *Leopardus wiedii*, MAGO: *Mazama gouzabira*, MAME: *Mazama americana* and PUYA: *Puma yaguarundi*.

Fonte: O autor, 2023

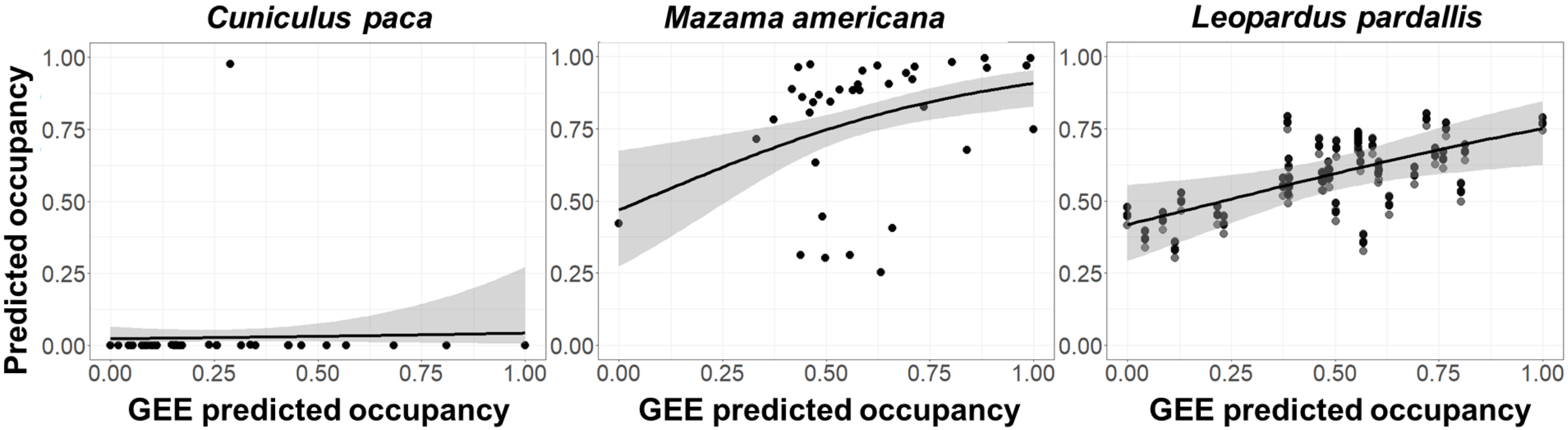
Figura 8 - Variation of predicted occupancy with poacher abundance and local habitat quality.



Legenda: Pixel EVI: Enhanced Vegetation Index calculated from landsat data; Species: *Cuniculus paca, Mazama americana, Mazama gouzabira, Leopardus pardallis, Leopardus wiedii,* and *Puma yaguarundi*. Species on the top are herbivorous whereas species at the bottom are carnivores.

Fonte: O autor, 2023

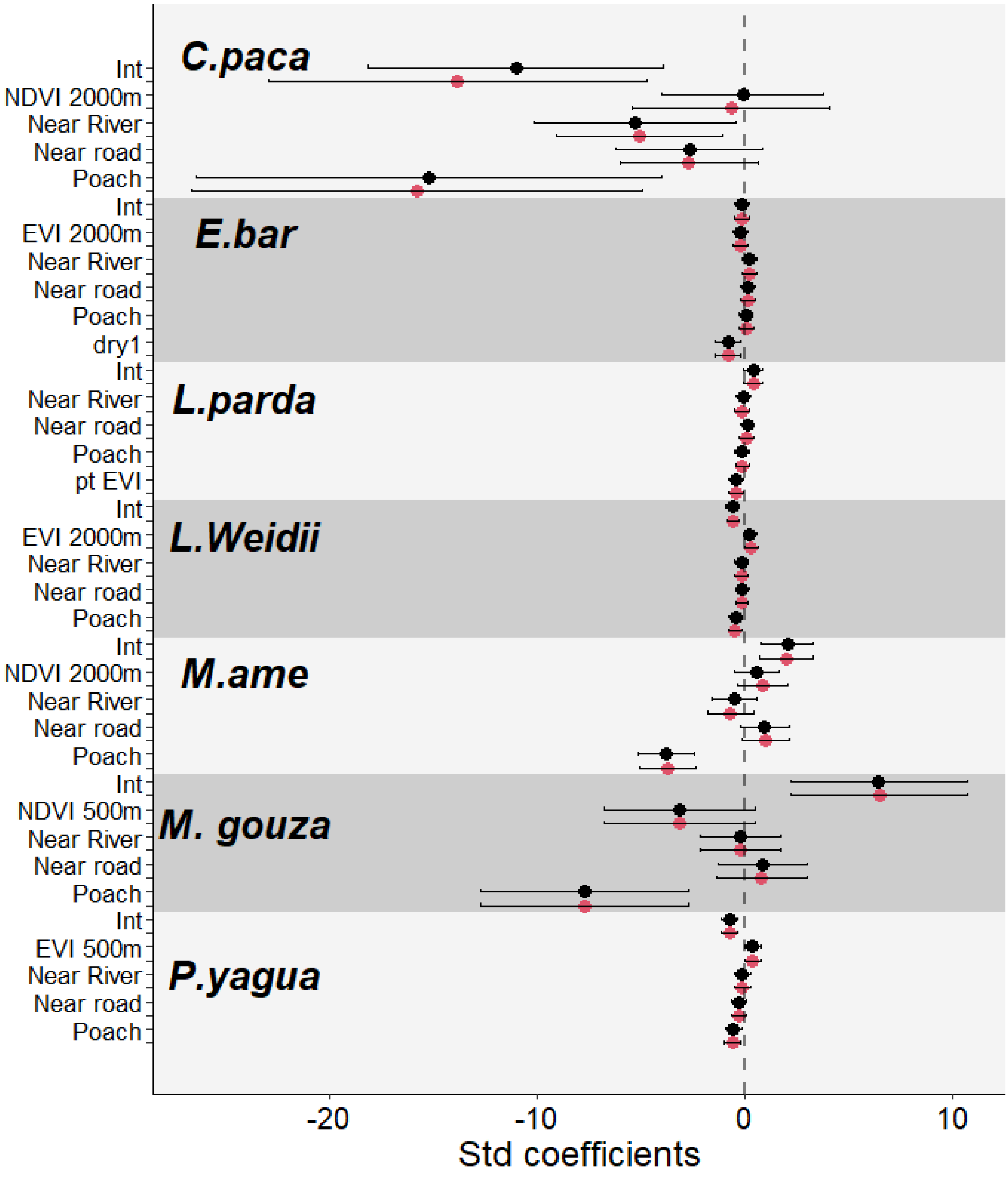
Figure 9 - GEE model predictions explaining occupancy for three species.



Legenda: Plots are considering partial residuals i.e. controlling for variation in every other variable in the model.

Fonte: o autor, 2023

Figure 10 - Considering geometric constraints does not change the estimated effect of environmental predictors of forest mammal occupancy in Vale Natural Reserve, Brazil.



Legenda: The variables included in models with AIC<2 are presented on the left, followed by the abbreviation of the species name. Black dots indicate mean standardised coefficients (logit scale) predicted by models that do not consider geometric edge effects prediction. Red dots indicate coefficients considering the geometric edge effects. The lines refer to 95% confidence intervals.

Fonte: O autor, 2023

2.4 Discussion

Our findings suggest that the occupancy of mammal species in VNR generally is not governed by stochastic processes and can be sufficiently predicted by deterministic factors, namely poaching pressure. Our model tended to overestimate the occupancy of species with larger home ranges at edges and underestimate the occupancy in forest interiors, as indicated by decreasing trends in residuals across EIGs (Figure 2c). Compared to results ignoring possible effects of GEEs, including geometric constraints does not change either qualitative or quantitative inferences regarding the effects of environmental predictors, and poaching remains the most important predictor for mammal distribution at VNR.

Although the size of the stochasticity effect varied between species, overall, GEE models predicted shallower responses to edge influence than predicted responses using environmental variables and observed occupancy responses, expressed by decreasing trends of the residuals. We expected GEE models to reproduce more closely abundance patterns of large-ranged species, namely medium carnivores, but this did not occur. Simulated occupancy considering exclusively geometric constraints proved to be of minor importance in explaining mammal occupancy for most species, except ocelots (*Leopardus pardalis)*, a medium-sized cat that prefers areas close to water, often more abundant in clearings and grassy vegetation near forests, reflected by the negative influence of vegetation complexity found here. Since *L. pardallis* has the largest home range in our dataset, this could indicate that larger range species can be particularly subject to geometric constraints, in addition to niche-driven mechanisms, such as the search for less dense forest areas. However, *P. yaguarundi* has a similar home range size but was not affected by geometric constraints, indicating that the importance of geometric constraints can vary even between very similar species, potentially depending on the availability and distribution of resources (SANTOS et al., 2019). Finally, the reduced complexity of vegetation inferred from EVI was an important predictor of the abundance of ocelots, reinforcing resource mapping importance to a lesser or greater extent, even when geometric constraints play a role.

Our last objective was to test whether considering geometric constraints can change the effect size of environmental predictors. If deterministic (i.e., environmental) predictors correlate with stochastic predictions, the coefficients for environmental predictors are expected to be significantly smaller, suggesting that observed patterns could arise, at least partially, from stochastic patterns (GOTELLI; MCGILL, 2006; ZHANG, 2020). However, considering null model predictions and fixing the linear coefficient to one did not change inferences regarding the influence of environmental predictors. In particular, game species such as the occupancy of *C. paca* and *M. americana* were affected by poacher pressure and distance to water bodies as found in previous studies (FERREGUETTI et al., 2016, 2019). Since poaching depends strongly on human access (usually road proximity) and the presence of a hunting culture (BOGONI; PERES; FERRAZ, 2020), both present in the region (FERREGUETTI et al., 2018), the importance of poaching was not a surprise. Poaching affected not only herbivorous game species but also inconspicuous and less-hunted cats such as *L. wiedii* and *P. yaguarundi*. This is probably because predators can respond both directly (i.e., avoiding human contact), but also indirectly to poaching activity itself, since the absence of prey species due to poaching leads to lower predator occupancy (DE CASSIA BIANCHI; MENDES; DE MARCO JNIOR, 2010; SANTOS et al., 2019). In fact, VNR is next to one of the main cross-country roads with one of the heaviest vehicle flows in Brazil (BR-101, 4650 km long), also adjacent to low-quality pastures and several secondary roads (Apendice B, Figure S4). Mammal communities in the Atlantic Forest have been subject to historical forest loss and disturbance for more than 500 years (DEAN, 2004). This could have filtered out most edge-sensitive species in our site (MACEDO et al., 2018; BETTS et al., 2019; MARQUES; GRELLE, 2021), such as *L. gutullus*, *Potus flavus,* and several species of monkeys that are potentially subjected to niche-driven and stochastic mechanisms that predict increased abundance toward forest interiors (EWERS; DIDHAM, 2006). Past disturbance potentially reduced the pool of edge-sensitive species (BETTS et al., 2019; STRATFORD; ROBINSON, 2005), which estimates of stochastic importance could particularly reduce the importance of ecological mechanisms. Perhaps, geometric edge effects mechanisms are more important in more pristine forests, comprising a more complete species pool where one may find more species responding to fragmentation geometry.

Null models utility does not depend on fitting observed data. Indeed, failure to do so might reinforce the importance of ecological anthropogenic drivers, providing further insight on ongoing mechanisms (GOTELLI; GRAVES, 1996; GOTELLI; MCGILL, 2006), and hints on where to perform further investigation (DUNN et al., 2007). This study is not an exhaustive exercise in evaluating every possibility of model parameters, as we restricted our analysis to the species most likely to hold the assumption of binary landscape and forest exclusivity. However, this may not always hold for the same species elsewhere, especially where the matrix provides more resources (NORRIS et al., 2008). Although not the purpose of this study, one could relax most of the assumptions of the GEE model, incorporating most of the realism resulting in virtually infinite outcome possibilities. For example, we could set different habitat quality values, attributing cell probability as a function of vegetation indexes such as NDVI or Leaf Area Index (PFEIFER et al., 2017). Furthermore, we could change matrix suitability values (PREVEDELLO et al., 2016), allow territoriality, incorporate time, and derive dynamic models encompassing migration, births, and deaths (RANGEL; DINIZ-FILHO, 2005; GOTELLI et al., 2009). Such realism could be useful to predict species occupancy across EIGs when occupancy drivers are known (e.g., RUSHTON et al., 2006) or to investigate individual drivers by ‘nullifying’ the drivers of interest (removing its effect when simulating community), rather than investigating the importance of stochasticity (ZHANG, 2020).

Despite its utility in understanding multiple mechanisms driving abundance distribution, our random placement model predicts mostly increased abundance towards the forest interior as well as former mid-domain effects, which is not the only observed edge effect trend (PFEIFER et al., 2017). Former studies evaluating the consequences of geometric constraints on species-area relations using slightly different models showed that species traits, such as forest dependence (ALMEIDA-GOMES et al., 2022) and dispersal capacity moderate perceived isolation among forested islands (MACDONALD et al., 2021). Although our study provides some insight into the importance of home range size, evaluating species traits was not the purpose of our study. However, other mechanisms probably act in addition to geometric constraints, and the importance of stochasticity should vary between environments and the traits of the species. These are unexplored questions, and future research should focus on these topics.

Although very useful, null models are subjected to many subjective decisions when parameterising models, based on several philosophical and technical assumptions that profoundly impact model outcomes (e.g., different matrix suitability leads to very different patterns, PREVEDELLO et al., 2016) and can be difficult to be entirely met in the real world, although heuristic (such as forest exclusivity). In real-world conservation, if a species is negatively impacted by edges, reduce habitat loss and remaining forest fragmentation should be a priority, whether the cause is ecological or stochastic. Thus, stochastic predictions might not be necessary information to guide conservation efforts but are still important for understanding the underlying mechanisms. Furthermore, the huge number of possibilities to model species occupancy using this simple model (e.g., variation in habitat quality, matrix use, assumptions underlying home range area, etc.) represents a challenge for model calibration and interpretation, since data become more difficult to access and more assumptions have to be met

(ZHANG, 2020). Complexity increases must be carefully evaluated due to the increased chance of cumulative flaws, possibly because of the somewhat subjective process of parameterizing system components (CABRAL; VALENTE; HARTIG, 2017). Despite these bottlenecks, we encourage ecologists to incorporate null predictions more frequently in landscape ecology to investigate species' response to fragmentation under different sets of parameterisation and scenarios. In this study, the null models did not demonstrate an improvement in their estimates or a reduction in the effect of variables already known to be important drivers of mammal abundance in the landscape. However, there was a wide variation in the importance of null models between species. This may indicate that in situations with less environmental filter pressure, null models may reproduce observed patterns more closely, particularly when comparing models with increasing complexity and realism.

2.5 Conclusion

We explored an initial test of the GEE model to quantify the importance of local environmental and stochastic drivers of edge effects on forest mammals, incorporating null predictions into occupancy models. Here, null predictions were not as important as poaching and habitat quality to predict species occupancy near edges. In addition, incorporating stochasticity did not change any inference regarding any ecological driver. Although our null predictions may be more important in the absence of strong environmental drivers, this is probably not the case in our study site, where poaching strongly affects occupancy patterns over edge-interior gradients for most of the species evaluated. Nevertheless, given its potential to disentangle different drivers of species' response to fragmentation, we encourage ecologists to increase the usage of null models in other landscapes and other organisms to better understand the biological and environmental moderators of stochasticity importance, carefully balancing realism and simplicity.

3 DETERMINANTS OF STOCHASTICITY IMPORTANCE DRIVING MAMMALS' SENSITIVITY TO EDGE EFFECTS

Abstract

We investigated the extent to which stochastic mechanisms are responsible for species' responses to local edge effects and edge-driven fragmentation at the landscape scale. We simulated the abundance of 40 forest mammal species across three datasets around the world comparing observed outcomes to predictions of geometric edge effects models and investigated which species' traits moderate the importance of stochasticity. Stochastic models predicted that most forest species have no preference for edge or interior habitat, whereas observed data indicated that most of the species were forest core dependent. In addition, we found that species with smaller home ranges occupy narrower portions of edge-interior gradients than large-ranged ones and perceive stronger fragmentation impacts. However, the GEE model underestimated the edge sensitivity of diet generalists, which presented larger residuals and had their fragmentation impact heavily underestimated by GEE models. Overall, our results show that species are more sensitive to edges than predicted solely by spatial constraints, reinforcing the significance of ecological drivers of edge responses.

3.1 Introduction

Forest conversion to agricultural and urban lands creates new forest edges leading to important biodiversity changes in fragmented landscapes (PFEIFER et al., 2017). Edge effects - i.e. changes in habitat conditions near habitat edges possibly driving species abundance variation (MURCIA, 1995) – is a local mechanism through which fragmentation impacts species abundance across landscapes (DIDHAM; KAPOS; EWERS, 2012; FAHRIG, 2020). Edge effects can increase or decrease species abundance near edges with varying intensities, making predictions challenging (RIES et al., 2004). Despite its variability in direction and intensity, several patterns have been observed recently at different spatial scales. For example, latitudinal gradients and historic disturbance lead to increased sensitivity of tropical forest animals to forest fragmentation (STRATFORD; ROBINSON, 2005; BETTS et al., 2019), especially when adjacent to very contrasting matrix types (WATLING et al., 2011; DRISCOLL et al., 2013). In addition, several traits such as body size and diet moderate species' responses to environmental changes near edges (PFEIFER et al., 2017; NEWBOLD et al., 2020a). However, underlying mechanisms driving these patterns remain largely untested and sound mechanistic explanations depend on testing data locally, analysing data on its smallest scale - abundance at plot (PFEIFER et al., 2014). This is a necessary piece of information to provide more understanding and predictability of species' responses to local edges and surrounding landscapes.

Abundance responses to edges can be predicted to a certain extent by inferring species responses according to the resource availability at fragmented landscapes and species' requirements (RIES; SISK, 2004). This includes the search for different resources across different habitats such as forest interiors, edges and the matrix for more suitable habitat conditions (RIES; SISK, 2004; FROST et al., 2015; PERALTA et al., 2017), to avoid predators (GAYNOR et al., 2019), or poachers (FERREGUETTI et al., 2023; Chapter 2 of this thesis). In the tropics, we can expect that forest-dependent species will respond negatively to edges (STRATFORD; ROBINSON, 2005; BETTS et al., 2019; WILLMER; PÜTTKER; PREVEDELLO, 2022), given the increased sensitivity of species to habitat loss and degradation. Since edge effects are expected to change environments near edges, forest core species should be particularly affected because of habitat area reduction (BANKS-LEITE; EWERS; METZGER, 2010), in addition to species occupying mostly portions near edges that experience stronger microclimatic changes (HARPER et al., 2005; EWERS; BANKS-LEITE, 2013; ARROYO-RODRÍGUEZ et al., 2017; MENDES; PREVEDELLO, 2020).

Impacts of habitat changes on populations are frequently moderated by species' traits (VETTER et al., 2011; KEINATH et al., 2017; NEWBOLD et al., 2020a), with forest-dependent species with larger body size being more sensible to edges (PFEIFER et al., 2017). Those with larger home ranges are expected to be more negatively affected by edge-related habitat changes since their individuals would have a higher demand for resources, which is expected to reduce with environmental changes related to edge effects (EWERS; DIDHAM, 2006; BANKS-LEITE; EWERS; METZGER, 2010; BARTLETT et al., 2016). Accordingly, we can expect species at higher trophic levels to be more often affected by edge effects (NEWBOLD et al., 2020a). In addition to preffered food items (i.e. being more herbivore or carnivore), species relying on more types of food resources are expected to be less affected by habitat loss (MASSOL et al., 2017) since have less chance of getting resource shortages in fragmented landscapes (DORNELAS et al., 2019; FILGUEIRAS et al., 2021). Finally, it is widely observed that forest edges have less complex forest structure, reflected by the reduction of their aboveground biomass worldwide (PÜTZ et al., 2014b; BRINCK et al., 2017). Thus, species relying mostly on the arboreal stratum would be more affected by edge effects (DA ROSA et al., 2018).

As observed above, the interplay between traits and environment offer several explanations for population changes near edges, although useful, these require information on individual species and their complex interactions (RIES et al., 2004). Thus, from another perspective, incorporating null models can offer additional tools to understand species' responses to fragmentation-induced edge effects (RIES et al., 2017). Ecologists currently focus on the application of stochastic models based on random placement (COLEMAN, 1981) to understand the “ecological *per-se*” mechanisms underlying species-area relation, such as ecosystem decay (CHASE et al., 2020) or important traits driving island isolation and area importance (MACDONALD et al., 2021). The landscape model proposed by PREVEDELLO et al. (2013, 2016), conceived under the same rationale of mid-domain effect models (COLWELL; LEES, 2000), simulates random placement of home ranges within geometrically constrained habitat fragments, assumed to explain some extent of species’ abundance distribution. Thus, it is expected to be a good null model since it incorporates some aspects of reality but can be kept relatively simple to test the importance of other ecological mechanisms (GOTELLI; MCGILL, 2006). When assuming binary habitat suitability, we can compare predicted populations generated without resource mapping and observed abundance patterns to investigate its importance (GOTELLI; MCGILL, 2006; PREVEDELLO; GOTELLI; METZGER, 2016). Furthermore, outputs of null models used here can be interpreted as an abundance baseline upon which ecological forces will act, leading to a potential reinterpretation of species habitat preference considering the edge-interior gradient (RIBEIRO et al., 2016). For example, a species observed to have equal abundance across edge-interior gradients can have its habitat preferences reinterpreted as edge-avoiding, if its stochastic patterns predict higher abundance at edges (e.g. RIBEIRO et al., 2016, figure 1). At the plot level, differences between observed and predicted abundance are assumed to be caused by ecological factors driving edge effects. After considering observed and predicted abundance surfaces across the landscape, one can infer the overall species’ response to fragmentation at the landscape and the extent to which species traits moderate the importance of stochastic mechanisms. Thus, simple null models offer alternative interpretations of observed results, potentially explaining some of the variation in species' responses to edges. However, the extent to which stochasticity will determine abundance distribution across species and landscapes remains to be investigated.

Here we investigate the extent to which stochastic and niche-based mechanisms drive species' responses to local edge effects and edge-driven fragmentation at the landscape. Specifically, we aim to: i) quantify the extent to which edge-driven fragmentation impact is predicted by stochastic models based on geometric constraints and ii) identify traits moderating stochasticity importance when explaining forest mammal responses to edges. To do so, we simulated the abundance of 40 forest species across three datasets around the world comparing predicted and observed outcomes in metrics reflecting local abundance and landscape-scale responses.

3.2 Methods

3.2.1 Dataset

We gathered mammal datasets sampled with camera traps from the BioFrag database (PFEIFER et al., 2014). Selected datasets had to contain plots at continuous forests or fragments at different distances to the edge. From these datasets, we selected forest species classified as "Forest Core", "Forest Edge", "Forest with no preference" and "Forest unknown" from Betts et al., (2019), since these species are more likely to hold the assumption of the GEE model of exclusive forest use. Furthermore, we used only datasets where habitat preference classification is not likely to be an artefact of poor sampling design as formerly tested by Betts et al., (2019). In addition, we retained only studies performed on dense vegetation forests (with most of tree cover values larger than 0.85 for core forest, using Hansen et al., 2013), where the binary landscapes assumption is more easily met. We also excluded species that could not be classified due to small abundance in datasets (classified as "non-abundant" by BioFrag software). Finally, we retained two datasets from Biofrag (Mexico and Borneo) and added a third dataset from Ferreguetti et al., (2023; the same used in Chapter 2 of this thesis) having, respectively, 25, 10 and 5 species.

3.2.2 Fragmentation metrics

Here, we contrasted observed and stochastic abundance patterns based on three predictors at two different scales. First, we calculated residuals from relative abundance (observed – predicted by the GEE model) at the plot level. To summarise species' responses to edge-driven fragmentation at the landscape, we used the *Edge Response Software* (PFEIFER et al., 2017) to obtain “Edge Sensitivity” and “Fragmentation Impact” metrics. The software converts a 0-100% cover raster (e.g. tree cover, or NDVI) into an edge influence raster based on chosen radius of analysis around a given cell. We used a 2 Km radius since plots in most interior portions were around 2km from the nearest edge. From the abundance responses to tree cover and edge influence variation, we infer edge sensitivity and fragmentation impact. The first is defined as the range along the edge influence gradient (EIG) that a species occupies. Thus, core species occupying narrow portions of the EIG (i.e. small fragments) will have higher Edge Sensitivity values than species occupying broader portions of EIGs (i.e. larger fragments). Fragmentation impact, based on species edge sensitivity, assesses the extent of abundance change due to edge influence alone by dividing its observed abundance by the total expected abundance if the species was not affected by edge influence (PFEIFER et al., 2017). Both metrics inform the intensity, but not the direction of edge responses (positive or negative edge responses). Then, we also used categories of habitat preference for forest species, obtained from Edge Response Software: “Forest Core”, “Forest Edge”, “Forest with no preference” and “Forest unknown” (PFEIFER et al., 2017). To explore the possibility of considering geometric edge effecs would change inferences about species’ habitat preferences, we contrasted habitat preference classification, based on observed and simulated abundance across edge-interior gradients at the landscape scale. Here, we analysed abundance differences for all species, but focused analysis of edge sensitivity and fragmentation impact on core species since the direction of these metrics is only interpretable when knowing the direction of species response (i.e. to be posetively or negatively affected by edges). Furthermore, these species are expected to be more affected by edge-driven fragmentation given the frequent reduction in forest core ares. Nevertheless, results considering all species are presented in the Apendice C.

3.2.3 Random placement simulation

To generate null expectations on mammal abundance, we used the landscape model from Predevello et al., (2016). Accordingly, we classified the landscape as a binary raster of Forest and Non-forest areas with 30m resolution considering the 80% pixel cover threshold from Hansen et al., (2013), which is likely to represent dense canopy forests. Next, for each species, we set habitat patches smaller than the species’ home range unsuitable (as in Predevello et al., 2016). For each individual of each species within each dataset, we randomly selected one habitat pixel as a birth pixel. But different from COLEMAN (1986), the "birth" is followed by the spreading of the individual area until it reaches its home range (i.e. a "spreading dye" algorithm; JETZ; RAHBEK, 2001; PREDEVELLO et al., 2016). Then, the model places a second individual and so on. After placing each individual, it checks if the number of records of the original dataset, or chosen abundance for simulation, has been reached. If not, the model will place another individual, until it reaches the observed (or chosen) number of records. Here, we simulated populations that would generate 100 records. Importantly, datasets had different numbers of sampling points, at different sampling densities. Communities dominated by large-ranged species will tend to need fewer individuals to fulfil 100 observed individuals for each species across all sampling points used here. Thus, our simulation result in different number of individuals to place in each iteration. After running 528 iterations for each species, we extracted the mean abundance for pixels with sampling points and recorded the number of individuals expected to be found at each sampling point (i.e. camera traps). For each species in each dataset, we standardized the resulting simulated abundance to vary between 0 and 1, to have a measure of relative abundance across sites.

We inferred home ranges from alometric equations, based on body size, diet and habitat dimensionality (i.e. to experience a 2D or a 3D environment such as birds and monkeys) (TAMBURELLO; CÔTÉ; DULVY, 2015). We extracted body mass and diet information from Wilman et al., (2015). As Tamburello et al. (2015) equations specify only "carnivore" or "herbivore" diets, we classified as carnivores all species with more than 50% of diet based on terrestrial vertebrates, invertebrates, fishes, insects or unknown vertebrates, and classified as herbivores species with more than 50% of their diet from any kind of herbivory (Nectar-feeding, seed-eating, frugivore, and Plant unknown). If a species had less than 50% of a given diet category, we calculated the home range using weighted mean slopes from the allometric equations predicting home range size as a function of body mass and diet from Tamburello et al., (2015). Here, we used parameters for terrestrial mammals experiencing a 2D environment.

To make sure the model output had stabilized after 528 iterations, we evaluated model output precision by considering the decrease in abundance coefficient of variation at the plot level with increasing number of iterations. We also tested if changes in resolution would change the model by running simulations in 10 and 90m resolution rasters, which returned similar results. We did not considered larger cell sizes due to the fact that most edge effects occur within 100m from edges, thus, smaller resolution would lead to loss in information.

3.2.4 Predictor variables

Here, we assessed differences in stochasticity responses across species traits, namely home range size, diet and foraging strata from Wilman et al., (2015). Diet categories were inferred considering original categories: Vertebrate-eating, Invertebrate-eating, folivores, nectarivores, seed-eaters, fruit-eaters saprofilic, and unknown. Additionally, we inferred a diet specialization index from the evenness of species' diet across Wilman et al., (2015) categories, calculated from Shannon Index evenness as $1 - Shannon\ Obs\ / Shannon\ Max$. Thus, diet specialists have value one and rely upon one or a few resource types (invertebrates, plants, etc.), and zero are generalist species (consuming several item types). We also used forage strata based on the same dataset (WILMAN et al., 2015), with categories: Arboreal, semi-arboreal, terrestrial and semi-aquatic. Despite our focus being on intrinsic species' traits, we acknowledge that abundance variation along EIGs is important to identify extrinsic moderating effects of edge responses (WILLMER; PÜTTKER; PREVEDELLO, 2022). Thus, we used edge influence calculated around a 2km radius buffer as a predictor of differences in observed and predicted abundance at the plot level.

3.2.5 Statistical analysis

First, we contrasted observed and predicted patterns of plot level abundance using a paired t-test. To quantify differences between predicted and observed values, we calculated residuals as "observed minus predicted" values, for each of three metrics: i) plot-level relative abundance, ii) species-level edge sensitivity and iii) species-level edge-driven fragmentation impact (Table 5). When analysing residuals, positive values (between 0, and +1) in relative abundance occur when the GEE model predicts less abundance at the plot (here, camera trap location) than observed. Conversely, negative residuals (between -1 and 0) indicate that the GEE model predicted more abundance than observed. Unfortunately, observed abundance data is frequently subjected to lots of zeros due to detectability issues, potentially leading to abundance overestimation by simulated data, since it produces a relative abundance surface with few or none zero abundace values. To infer the moderators of plot-level abundance residuals, we modelled residuals (observed-predicted) as a function of plot edge influence and species traits using mixed-effect linear models. Here, species did not occur many times across many datasets and we had few datasets. In addition, we expect that each species in each dataset would have differences in edge influence responses. Thus, we considered intercepts and the slope of edge influence to vary across unique combinations of species and datasets. Ideally, we would nest these unique combinations inside dataset levels (SCHIELZETH; NAKAGAWA, 2013), but this approach led to convergence issues during the model fit, restricting model complexity. We also considered model interactions between edge influence and all traits (Table 5). We considered interactions between home range size and diet since we expect that larger species at higher trophic positions would be particularly affected by fragmentation (EWERS; DIDHAM, 2006).

When considering the edge sensitivity metric, positive residuals indicate more edge-sensitive species than predicted by GEE alone, suggesting that species' abundance concentrates in narrower portions of edge influence gradient than predicted by GEE models and positive fragmentation impact values indicate an underestimated impact of edge-driven change in abundance by GEE models. We modelled residual edge sensitivity and fragmentation with fixed effect linear models, since fixed or mixed effects models would result in similar qualitative and quantitative patterns given our small number of datasets. We also considered interactions between home range size and other traits explaining edge sensitivity and fragmentation impact residuals (Table 5). We expected that species occupying narrower EIGs ranges would be more affected by fragmentation, due to their small occurrence areas. Also, species more sensible to edges are expected to have larger positive ES residuals and show larger residuals of fragmentation impact. Thus, we included observed edge sensitivity as a predictor of fragmentation responses to control this mirroring effect and identify other traits related to increased edge sensitivity. All linear model assumptions were checked graphically in full and best-fitting models. We also checked for highly collinear variables (VIF>5, not considering interactions) in full models and for models with AIC<4. We performed simulation and analysis using the packages MuMIn (BARTON et al., 2013), parameters, lme4 (BATES et al., 2015), glmmtbm, performance and sjplots to plot graphs R (R CORE TEAM, 2023).

Table 5 - Full models considered to explain differences in three metrics related to habitat fragmentation impact across species

Dependent variable	Variable scale	Fixed Full model	Random Structure
Residual abundance	Plot	~ EI+ HR + Diet Cat + Diet Spec. + Forage Statum + EI * HR + EI * Diet Cat + EI * Diet Spec + EI * Forage Statum + Diet Cat* HR	(1 + EI | ID_SP_Dataset)
Residual Edge Sensitivity	Species/ Landscape	~ HR + Diet Cat + Diet Spec. + Forrage Statum + Diet Cat* HR	NA
Residual Fragmentation impact	Species/ Landscape	~ HR + Diet Cat + Diet Spec. + Forrage Statum + Diet Cat* HR	NA

Legenda: EI: Edge influence; HR: Log10(home range size) in Hectars; Diet Cat: Diet category classification, Diet Spec: Diet Specialization Index; ID_SP_Dataset refers to unique combinations of species within dataset. * simbol indicates interaction term between variables.

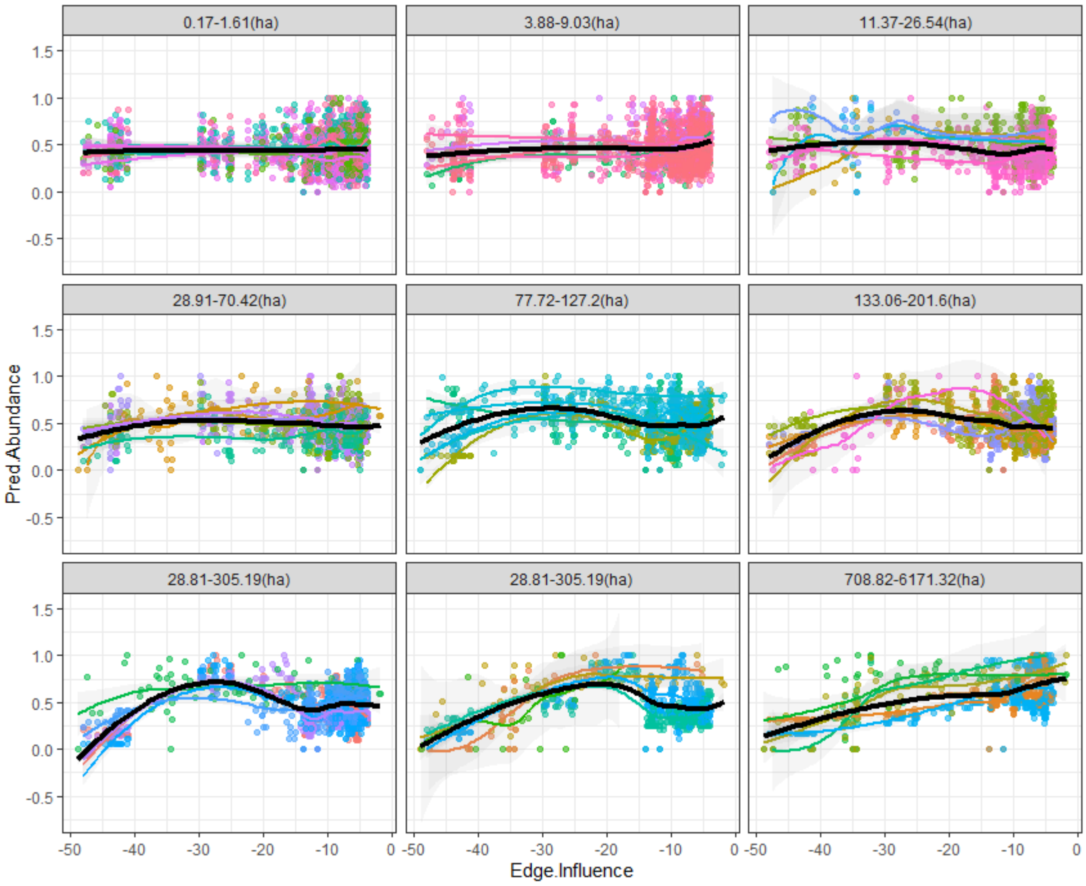
Fonte: O autor, 2023.

3.3 Results

3.3.1 Literature search and inclusion criteria

The GEE model produced clear patterns of increasing abundance towards edges across home range sizes (Figure 11), whereas observed patterns were more variable and less clear (Figure 12). Nevertheless, species abundance accounting solely for geometric constraints led to edge sensitivity and fragmentation impacts underestimation for most species. While GEE predictions led to the classification of 32 out of 43 species as having “no preference” for edge or core areas, the observed patterns point to most of the species being “forest core” (28 out of 40, Table 6).

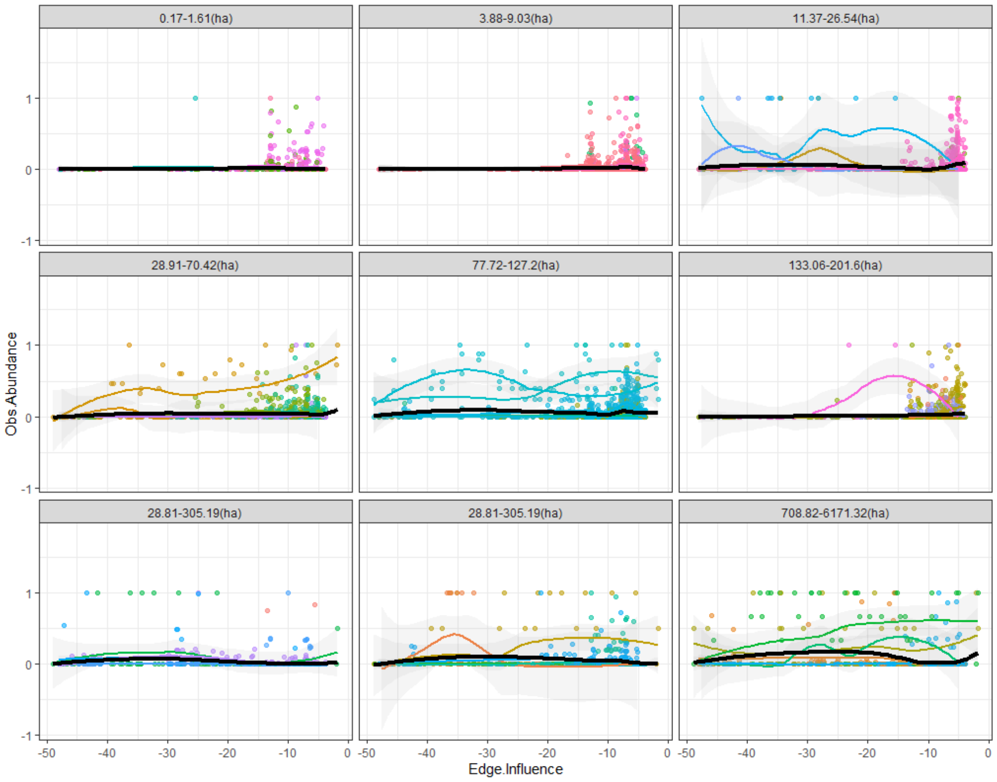
Figure 11 - Predicted abundance along edge Influence gradient across home range classes.



Legenda: Frames indicate different home range size classes. Thin coloured lines represent individual species trends across the edge influence gradient. Smaller home range are shown in the top left and larger home ranges are shown in the bottom right corner. Thick black lines indicate average trend considering species within home range classes. Points at the left side are subjected to high edge influence and points on the right side are at interior portions of forest fragments.

Fonte: O autor, 2023.

Figure 12 - Observed abundance along edge Influence gradient across home range classes



Legenda: Frames indicate different home range size classes. Thin coloured lines represent individual species trends across the edge influence gradient. Smaller home range are shown in the top left and larger home ranges are shown in the bottom right corner. Thick black lines indicate average trend considering species within home range classes. Points at the left side are subjected to high edge influence and points on the right side are at interior portions of forest fragments.

Fonte: O autor, 2023

Table 6 - Confusion matrix indicating number of species among habitat-preference classes according to observed (columns) and predicted abundance by geometrical edge effects models (rows).

Observed Predicted	Forest core	Forest edge	No pref	Unknown
Forest core	2	4	0	0
Forest edge	0	0	0	0
No pref	25	1	3	3
Unknown	1	4	0	0

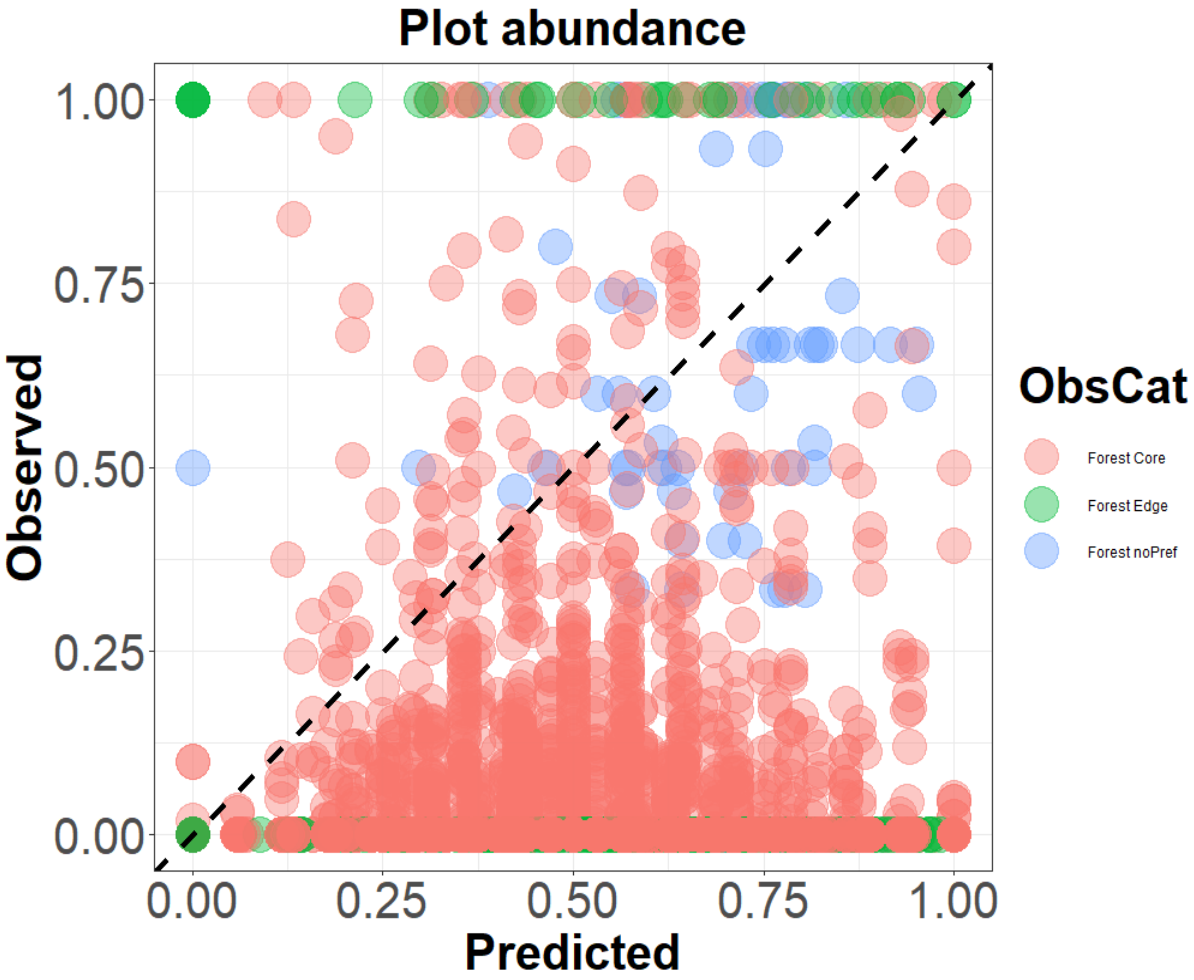
Legenda: No Pref indicates forest species with no preference for any kind of forest habitat and Unknown refers to species that could not be confidently classified by the Edge Response Software.

Fonte: O autor, 2023.

3.3.2 Plot-level abundance

Considering all the species, the GEE model overestimated plot-level abundance for 99.78% of plots (mean difference = 0.47 ±0.006, t=147, df=5859, p<0.001, Figures 13, S4). Considering core species only, also led to GEE overestimation of abundance (mean difference = 0.47 ±0.006, t=158.33, df=5514, p<0.001). The GEE model particularly overestimated abundance at interior plots, while abundance near edges was less overestimated (Figure 14). In addition, GEE model prediction overestimated more carnivore abundance than herbivores. Models including home range size and diet specialization were included among the best models (ΔAIC<2) to explain variation in residual abundances (Table 7), but having coefficients not different from zero (Table 8). Furthermore, a simpler nested model was selected in the first place. Thus, we infer patterns of residual variation from the first best-fitting model (Tables 7, 8). Finally, considering all species or only forest core species did not change these patterns of overestimation (Apendice C).

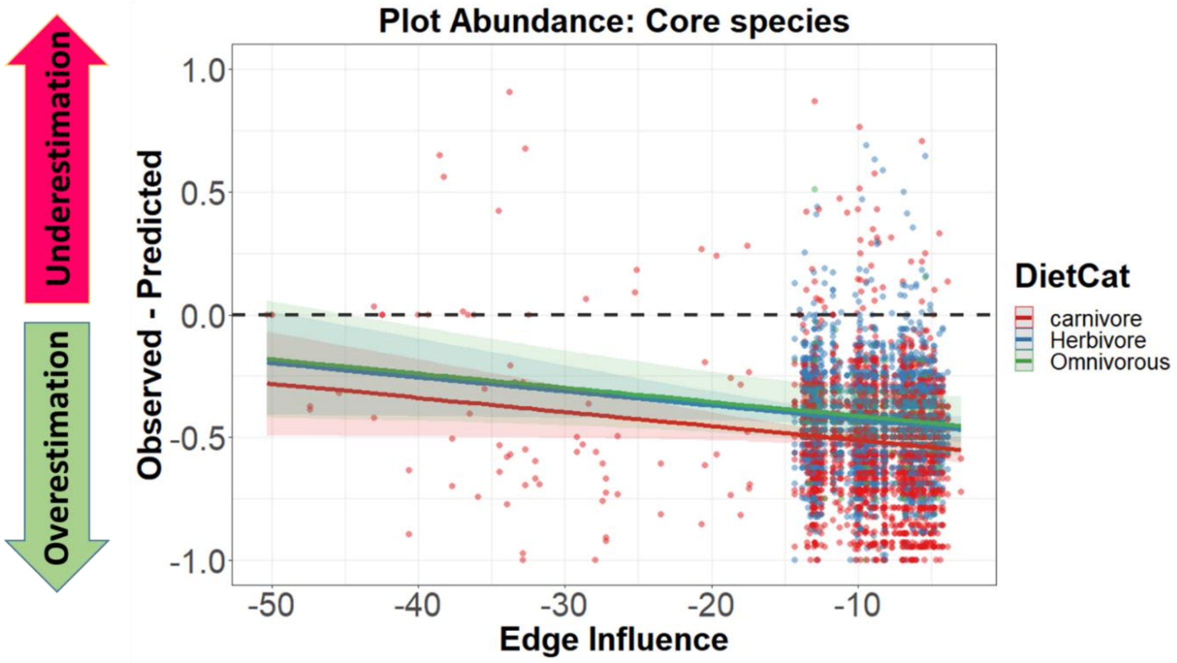
Figure 13 - Predicted Vs. Observed plot-level abundance across all species in the dataset. Model predictions overestimated 99.7% of plot-level observed abundances.



Legenda: Red dots indicate abundance of forest core species, green dots indicate forest edge and blue dots indicate forest species with no habitat preference. The dashed line represent a 1:1 correlation. Values above the line indicate that the model underestimated observed abundance and value below the line indicate abundance values overestimated by the model. A histogram of residuals is provided in Apendice 3).

Fonte: O autor, 2023

Figure 14 - Residuals (difference between observed and predicted relative abundance) across edge influence gradient.



Legenda: Edge influence decreases toward larger values such that interior plots have edge influence values near zero and edges are on the left side of the plot. Red lines and points reefers to carnivore species, Blue line and points refers to herbivorous species and green lines and points refers to omnivore species. Negative residuals indicate GEE abundance overestimation and positive indicate underestimation of model.

Fonte: O autor, 2023

Table 7 - Best models predicting residuals (Observed – Predicted) of Plot abundance, edge sensitivity and edge-driven fragmentation impacts considering forest core species.

Dependent variable	Model formulas	K	Δ AICc	AICc	AICc Wt	Cum Wt
Plot abundance residuals	DietCat + EI + (1 + EI | ID.sp.pid)	8	- 1 783.99	-	0.13	0.13
	DietCat + EI + HR + (1 + EI | ID.sp.pid)	9	- 1 783.52	0.47	0.10	0.23
	DietCat + EI + Spec. diet + (1 + EI | ID.sp.pid)	9	- 1 782.01	1.98	0.05	0.28
	DietCat + EI + HR + Spec. diet + (1 + EI | ID.sp.pid)	10	- 1 781.97	2.02	0.05	0.32
	EI + (1 + EI | ID.sp.pid)	6	- 1 777.12	6.87	0.00	0.92
	~1 + (1 + EI | ID.sp.pid)	5	- 1 775.17	8.83	0.00	0.98
Edge sensitivity residuals	Spec. diet	3	- 5.94	-	0.50	0.50
	HR + Spec. diet	4	- 3.93	2.01	0.18	0.69
	~1	2	1.85	7.79	0.01	0.97
Fragmentation impact residuals	Spec. diet	3	- 18.02	-	0.22	0.22
	HR	3	- 17.80	0.22	0.20	0.42
	HR + Spec. diet	4	- 17.20	0.82	0.15	0.56
	HR + ObsEs)	4	- 16.78	1.24	0.12	0.68
	ObsEs + Spec. diet	4	- 15.50	2.53	0.06	0.74
	~1	2	- 13.71	4.32	0.03	0.87

Table 8 - Coefficients from the best-fitting model explaining residual variation between observed and predicted abundance at each plot for all the species.

Effect	Parameter	Coef	Lower CI95	Upper CI95	p
fixed	Intercept	-0.51	-0.56	-0.46	0.00
fixed	DietCat Herb	0.11	0.03	0.18	0.00
fixed	DietCat Omni	0.13	-0.09	0.34	0.25
fixed	Edge influence	-0.04	-0.07	-0.01	0.00
random	SD (Intercept: ID sp.pid)	0.20			
random	SD (Edge influence: ID.sp.pid)	0.01			
random	Cor (Intercept~ Edge influence: Id.sp.pid)	0.86			
random	SD Residual	0.22			

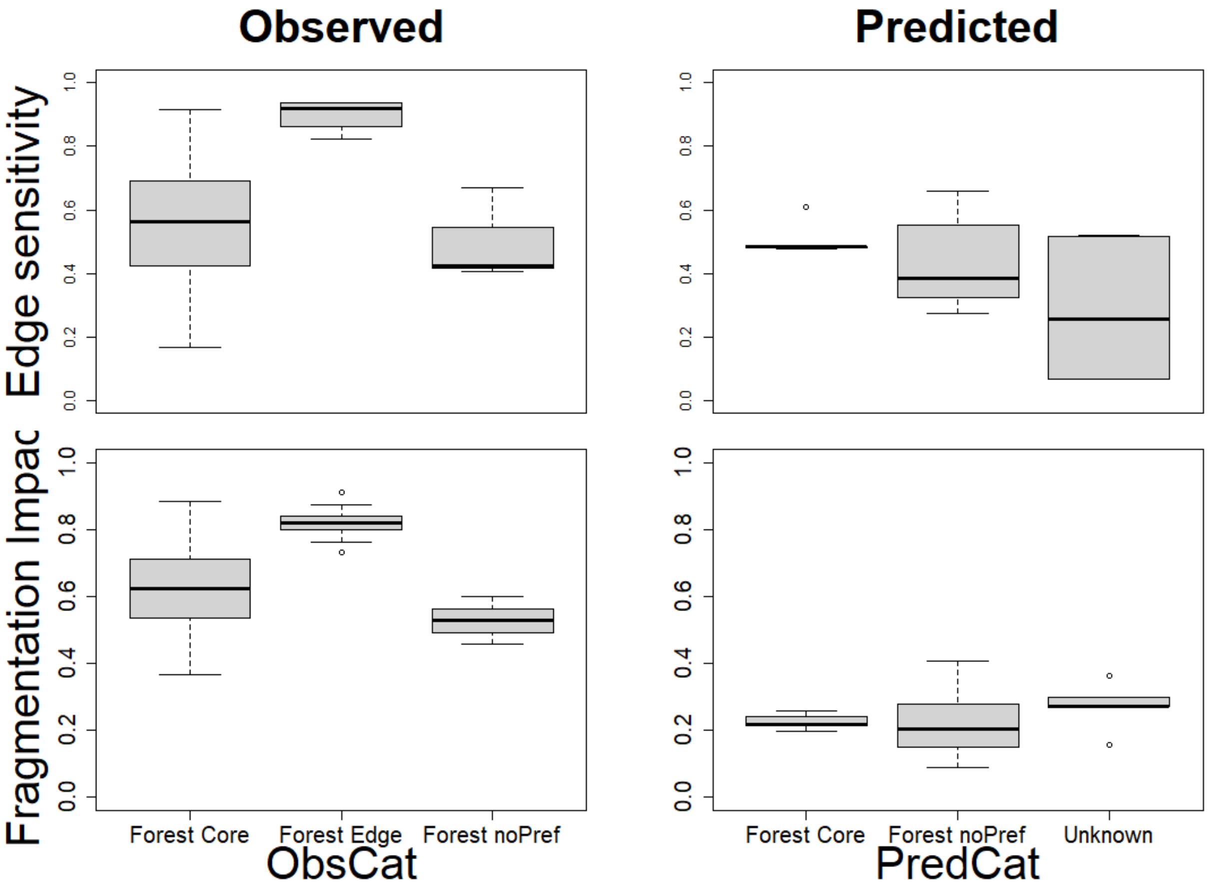
Legenda: DietCat refers to the diet category. Omni: omnivorous, Herb: Herbivorous. Carnivores were used as the baseline category. ID.sp.PID: Unique combination of species within datasets.Coefs: coefficients, lower and upper confidence interval considering 95% of observations.

Fonte: O autor, 2023

3.3.3 Edge Sensitivity

Near two thirds of species had their edge sensitiveness underestimated by GEE models leading to overal GEE model underestimation (overall mean difference = 0.26 ± 0.09, t= 4.57, df= 39, p< 0.001). Yet, 11 out of 40 had their edge sensitiveness overestimated, most of which were originally classified as forest cores but with low (<0.5) ES (Figures 15, 16). Accordingly, GEE models predicted smaller ES variation range across species than observed (Figure 16). When assessing core species only, the mean difference was reduced to 0.21(± 0.09 df= 27, p<0.01). In addition, the GEE model underestimated ES for all habitat categories, particularly edge-attracted species (Figure 16). GEE simulations underestimated more ES for more generalist taxa, while species relying on fewer food types were less underestimated (Table 9, Figure 17).

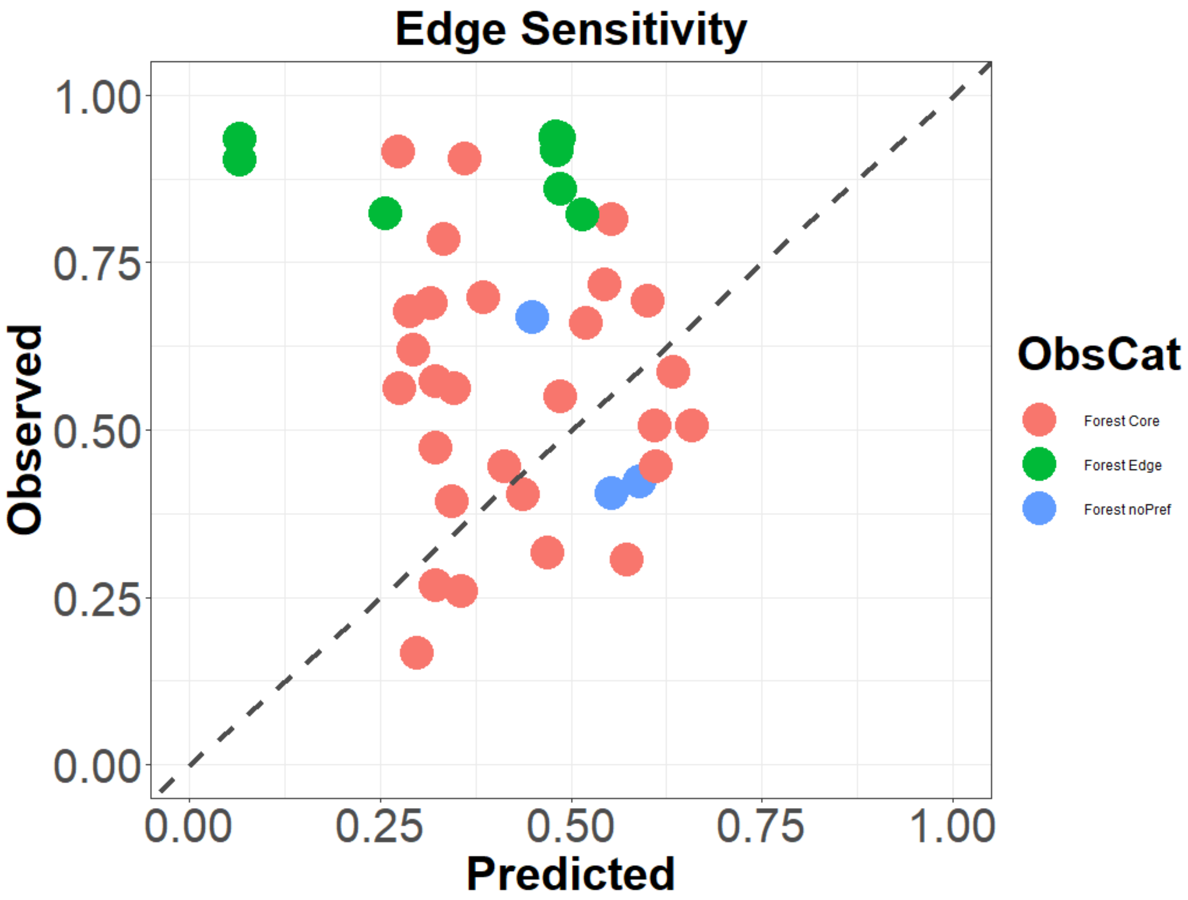
Figure 15 - Observed and predicted fragmentation impact and edge sensitivity across species edge response patterns.



Legenda: ObsCat refers to habitat preference categories using observed data. PredCat refers to habitat prefference categories using GEE model predictions. The GEE models had no species classified as Forest edge, while observed species were all categorised.

Fonte: O autor, 2023

Figure 16 - Observed vs. predicted Edge sensitivity of forest mammals.



Legenda: Colours indicate observed edge response patterns (core in red, edge in green or no preference in blue). The dashed line represent a 1:1 correlation. Values above the line indicate that the model underestimated observed species edge sensitivity and values below the line indicate GEE models overestimated edge-sensititiveness.

Fonte: O autor, 2023

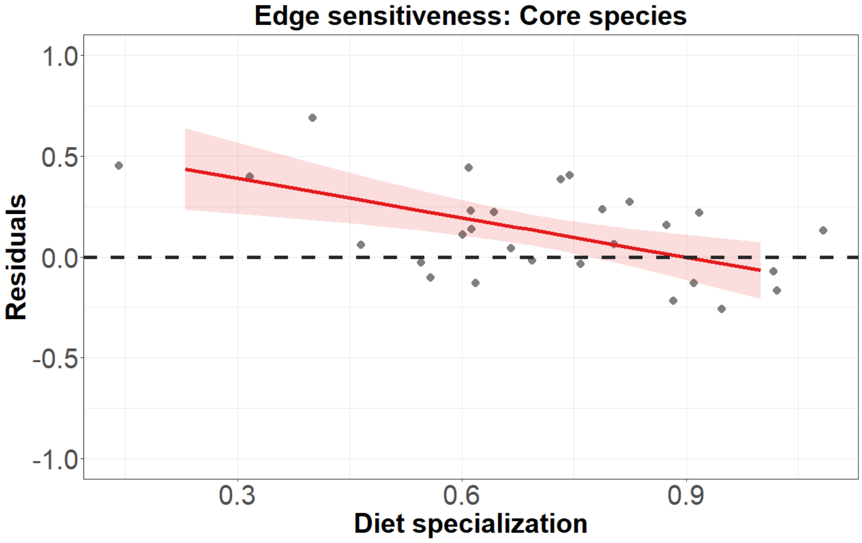
Table 9 - Parameters of best model predicting differences between observed and predicted Edge sensitivity and fragmentation impact across core species.

Response variable	Parameter	Coefficient	Lower CI95	Upper CI95	p
Edge sensitivity residuals	Intercept	0.13	0.05	0.21	0
	spec.Diet	-0.13	-0.21	-0.05	0
Fragmentation impact residuals	(Intercept)	0.41	0.35	0.48	0
	spec.Diet	-0.08	-0.15	-0.02	0

Legenda: spec.Diet: Species' diet specialization index, Lower and Upper CI95 refers to 95% confidence intervals.

Fonte: O autor, 2023

Figure 17 - Difference between observed and predicted (residual) edge sensitiveness as a function of diet specialization for core species species



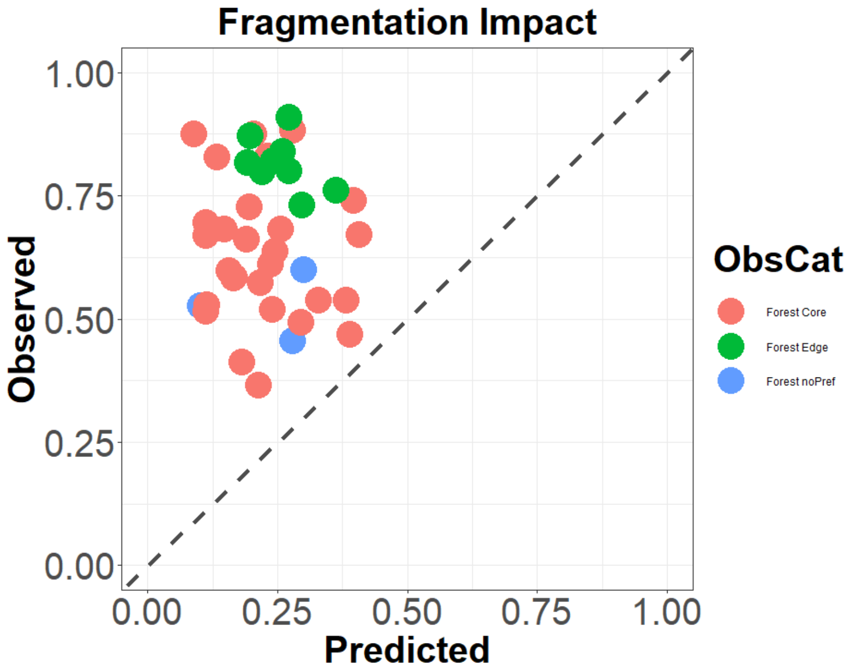
Legenda: Diet specificity refers to distribution of species diet among diet categories in Wilman et.al., (2015).

Fonte: O autor, 2023

3.3.4 Fragmentation impact

The predictions of GEE model underestimated fragmentation impacts for all species in our dataset (Figure 18, mean difference = 0.44 ± 0.06, t= 16.9, DF = 39, p< 0.001), predicting a narrower FI range [0.05, 0.45] vs. observed [3.2, 0.9]. Considering core species led to a similar conclusion (mean difference = 0.41 ± 0.07, DF = 27, p< 0.0001). Considering only forest core species, diet specialisation and home range size were predictors of fragmentation impact residuals (Tables 7, 9) and observed edge sensitivity values were the best predictor of residual difference of fragmentation impact considering all species.The edge-driven fragmentation impact of species with larger home ranges tended to be relatively less overestimated, whereas species with smaller home range sizes are more underestimated. Whereas considering only forest core species indicates a stronger effect of diet specialization (Table 9, Figure 19), considering all species reinforces the importance of observed edge sensitivity to explain fragmentation impact in addition to home range size (Apendice C).

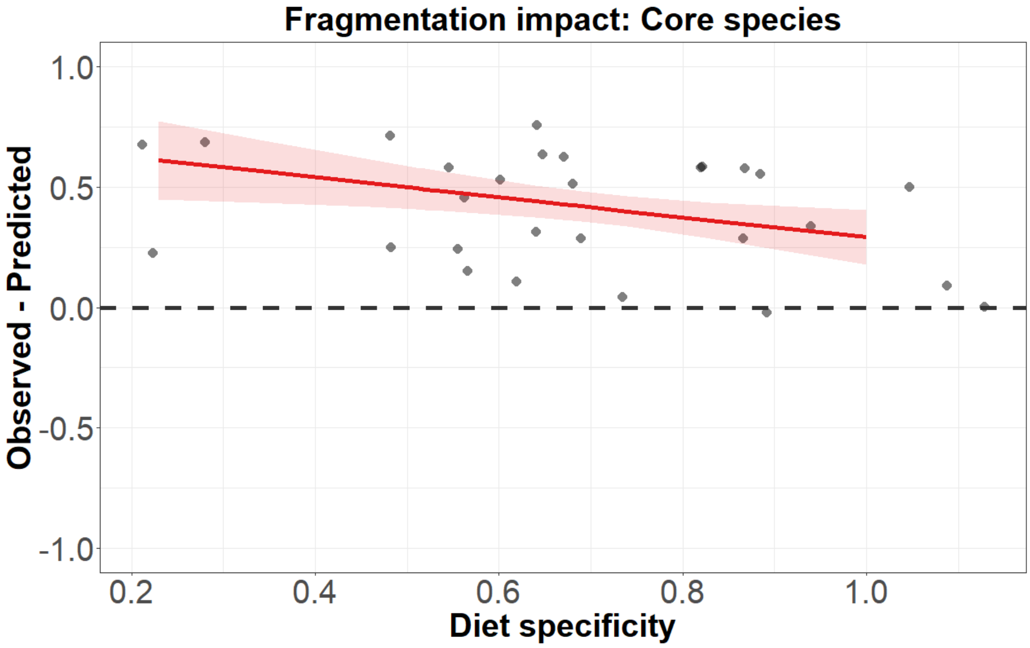
Figura 18 - Observed vs. predicted edge-driven fragmentation impact on forest mammals.



Legenda: Colours indicate observed edge response patterns (core in red, edge in green or no preference in blue). The dashed line represent a 1:1 correlation. Values above the line indicate that the model underestimated observed abundance and value below the line indicate abundance values overestimated by the model.

Fonte: O autor, 2023

Figure 19 - Difference between observed and predicted (residual) edge-driven fragmentation impact as a function of diet specialization for core species species



Legenda: Diet specificity refers to distribution of species diet among diet categories in Wilman et.al., (2015). Positive values >0 indicates that GEE model underestimated fragmentation impact, while negative values indicate overestimated fragmentation impact.

Fonte: O autor, 2023.

3.4 Discussion

By quantifying one stochastic force, the spatial constraint of habitat patches to home range placement, we can: i) identify the habitat preference of species after accounting for these constraints; ii) better quantify the impacts of edge effects on species abundance due to habitat selection along edge-interior gradients, and iii) infer the strength of different ecological factors driving species abundance after accounting for geometric constraints. Here, simulations considering binary landscapes with homogeneous forest habitat quality overestimated abundance for most species and, consequently, underestimated edge sensitivity and edge-induced fragmentation impacts. Overall, these results show that species are more sensitive to edges than predicted solely by spatial constraints, reinforcing the importance of ecological drivers of edge responses. Furthermore, our findings show that home range size and diet mediate the relative importance of these spatial constraints.

The GEE model predicted that most forest species have no preference for edge or interior habitat, whereas observed data indicated that most species preferred forest interiors. Differences between predicted and observed patterns are expected to arise mostly from niche-based processes, such as resource mapping, and biotic interactions (RIES et al., 2017). We initially expected that predictions of the GEE model would resemble edge sensitivity responses more closely among diet generalists, resulting in smaller differences between observed and predicted values (smaller positive residuals). However, we found that the GEE model underestimated the edge sensitivity of diet generalists, which presented larger residuals and predicted edge sensitivity more closely among diet specialists. According to the resource mapping framework (RIES; SISK, 2004), our results could be interpreted as diet specialist species tracking specific resources that are equally distributed across forest fragments, increasing their occurrence areas across EIGs, and reducing their edge sensitivity. These patterns oposed to our expectations may arise since diet categories used here are arguably coarse, as we considered diet item type (carnivore, herbivore, etc), instead of the number of diet items. In addition to diet specialization and other traits, species interactions and local habitat conditions, such as temperature and moisture (HARPER et al., 2005; ARROYO-RODRÍGUEZ et al., 2017) might determine species habitat selection. Therefore, many aspects of species niches can be further incorporated into models and quantify edge-driven fragmentation effects incorporating different layers of species information.

Despite the potential diversity of abundance patterns produced by geometric-constraint models (COLWELL et al., 2009; PREVEDELLO; GOTELLI; METZGER, 2016), the stochastic model used here tended to predict increasing abundance towards forest interiors, resembling the classic mid-domain effect (e.g. COLWELL; LEES, 2000; JETZ; RAHBEK, 2001; RIBEIRO et al., 2016). Here, a minor relative abundance at the edges occurred on both the simulated and observed data, resulting in smaller abundance residuals in these regions. We did not expect the species analysed here to be attracted by complementary or supplementary resources from or at the matrix since we focused our analysis on forest specialists (RIES; SISK, 2004). Addressing the whole pool of species could include species benefiting from matrix resources. However, this depends on knowing the suitability of one or more matrix habitats to be modelled (e.g. RIBEIRO et al., 2016, PREVEDELLO et al., 2016). Here, we attained the most simple set of assumptions, including binary landscapes (FISCHER; LINDENMAYER, 2007) and no interaction between species and adjacent habitat types. In addition to considering only forest species, the three species classified as more abundant at edges presented the largest edge sensitivity and had their fragmentation impact heavily underestimated by the GEE model. These species were particularly impacted by edge-induced fragmentation, occupying on a narrow portion of EIGs, despite being closer to fragment edges. This illustrates how the predictions of simple mid-domain effect models, such as the model we used, are unlikely to match the occurrence of species with narrow distributions across EIGs, especially at the domain's edges.

The stochastic model tended to overestimate plot-level abundance at forest interiors, but overestimation at these regions was not enough to result in greater predicted edge sensitivity for most of species. This probably occurred because GEE simulations predict considerably fewer zeros along the EIG, since predictions are an average of hundreds of simulations, resulting in a smoothed relative abundance surface, while observed data have several zeros, potentially due to low detectability. Perhaps, the most efficient way to account for geometric constraints while also considering imperfect detection is to incorporate occupancy estimates in hierarchical occupancy models (Zipkin et al., 2010; see also Chapter 2 of this thesis). Alternatively, one can incorporate GEE predictions in the conditional component of zero-inflated models, when multiple sampling occasions or hierarchical occupancy modelling is not available. Unfortunately, a bottleneck to the use of this model is the inaccessibility of raw data sets to perform occupancy analysis, limiting the use of models that incorporate imperfect detection (MACKENZIE et al., 2017). Edge sensitivity and fragmentation impact, however, are obtained from a smoothed abundance surface based on species' response to forest cover and edge influence, thus attenuating potential overestimations due to imperfect detection. Here, the GEE model did present a flatter abundance response to edge influence, leading to underestimated ES and FI. Yet, further investigation is needed to understand the extent to which sampling limitations affect investigation on geometric constrained patterns.

We expected larger edge-sensitivity residuals in both directions for species with smaller home ranges, as geometric constraints fo that species would be evident only at very short distances and perceiveid when using smaller scale of analysis (e.g 1- 5m PREVEDELLO; GOTELLI; METZGER, 2016). As a potential consequence, considering the scale of our study, small-ranged species would be less dependent on forest core areas, presenting lower fragmentation effects (EWERS; DIDHAM, 2006). Our results show that species with smaller home ranges occupy narrower portions of EIGs than large-ranged ones and perceive stronger fragmentation impacts. These species might experience forest fragments at smaller scales (KASPARI; WEISER, 2007; JACKSON; FAHRIG, 2012), possibly more dependent on spatially aggregated resources, restricting their favourable ES gradient portion (ALMEIDA-GOMES; PREVEDELLO; CROUZEILLES, 2016). In the opposite direction, species with larger home ranges were more subjected to geometric constraints, with GEE model predictions resembling more observed patterns, as expected (CONNOLLY et al., 2017). Frequently, both stochastic and niche-based explanations predict higher abundance at forest interiors for large ranged, or large-bodied species (COLWELL et al., 2009; PFEIFER et al., 2017), as forest complexity gradients usually follow that trend (PÜTZ et al., 2014b; HADDAD et al., 2015a; ALMEIDA et al., 2019). Through the lens of null models, this indicates a smaller effect of ecological drivers (GOTELLI; MCGILL, 2006), while criticisms may arise from assuming the existence of stochastic processes and model correctness, increasing type I error favouring stochastic processes (LAURIE; SILANDER, 2002; ZHANG, 2020). Nevertheless, preferred resources and conditions do not always follow edge-interior gradients (HARPER et al., 2005) and systems where they are not correlated have particular importance for advancing the quantification of geometric constraints importance. Here, we limited our analysis of plot-level data to edge influence as the only spatial variable, as we focused on species' traits. Since abundance distribution will arise from the interaction of different species with different habitats, further research to address both habitat and traits is needed.

In addition to within-patch aspects, in real landscapes, inter-patch movement is an important trait of meta-populations (LINDENMAYER ET AL., 2001, MENDENHALL ET AL., 2014; WARREN ET AL., 2015). In fragmented landscapes, dispersal success will depend on patch connectivity, which depends on matrix permeability for focal taxa (PREVEDELLO; VIEIRA, 2010; WATLING et al., 2011; VIEIRA et al., 2018b). Our stochastic model does not consider dispersal, which could contribute positively or negatively to the maintenance of population and community structure within patches, including edges (FAHRIG, 2020). In the case of positive dispersal net balance, edges should be more densely populated, increasing predicted abundance at edges, leading to even greater differences between observed and predicted plot abundance, due to the arrival and departure of individuals from, and to edges (FAHRIG, 2020). If a negative balance of inter-patch dispersal was predominant, we would see a decrease in predicted abundances at edges (POTTS; HILLEN; LEWIS, 2016). Although we expect to have focused on forest specialists, dispersion events still occur among fragments, including at less permeable matrices (MICHALSKI; PERES, 2007; PALMEIRIM et al., 2018). Our results show that residuals are smaller than predicted, especially at the edges, pointing out that if dispersal is playing an important role, it should be negative, since we observed a smaller abundance at the edge than predicted by the edge constraints, which often predicts abundance at edges. Importantly, two out of three datasets consisted of all or most of the plots in a single fragment, such that metacommunities dynamics promoted by dispersing individuals are not likely to be important across most of our sampling sites. Studies considering the importance of dispersion in determining within-patch abundance patterns are important per se (FAHRIG et al., 2022) and research including a null model approach when addressing dispersion is recommended to quantiy these effects under the assumption of stochastic distribution patterns.

The GEE model also assumed that matrix suitability was zero, excluding species occurrence at the matrix and causing rebound effects. Thus, we did not incorporate inter-habitat spillover (BLITZER et al., 2012). In addition to limiting dispersal, in real landscapes, matrix contrast can contribute to reduced or increased habitat quality at edges depending on species capacity to explore complementary or supplementary resources and survive in altered environmental conditions (RIES et al., 2004; WATLING et al., 2011; EWERS; BANKS-LEITE, 2013). If positive, positive matrix effects would lead to increased abundance at edges. The predictions of the GEE model did overestimate abundance near the edges, especially for carnivores, showing that, Considering our datasets, If matrix play a role in determining species near edges, these are expected to be negative, given that we found negative residuals at edges meaning more species than observed.

The GEE model used here is heavily based on home range size, which depends on body mass, thus largely based on metabolic theory (BROWN et al., 2004). For this reason, these models have potential transferability and might be applied considering mechanisms at different spatial scales. For example, one can incorporate global gradients when predicting community responses to edges. Stochastic edge responses are expected to vary across home range sizes, while both interspecific home range size as well as biomass and abundance distribution across species vary across communities in biogeographic regions (BROWN et al., 2004; WHITE et al., 2007). This is predicted to result in differential responses of communities to edges across global gradients (PREVEDELLO; GOTELLI; METZGER, 2016; BANKS-LEITE et al., 2022). Here, we restricted the pool of species to meet simpler assumptions. Nevertheless, we encourage applying other more complex landscape models, in addition to our binary GEE model. For example, incorporating local habitat characteristics such as distance to water resources, canopy complexity, vegetation indexes, or any spatially explicit variable. This would tend to overcome binary land use classifications (FISCHER; LINDENMAYER, 2007) enabling important insights into the underlying mechanisms and predicting emerging patterns of species response to habitat fragmentation by using adequate null models.

3.5 Conclusion

By accounting for geometric constraints on home range placement, our study reinforces the importance of habitat selection and potential resource mapping to moderate species' responses to habitat edges. Here, negative responses among diet generalists tended to be particularly underestimated by the GEE model, while diet specialists seem to resemble more stochastic predictions. Also, smaller home range-sized species tended to occupy narrower portions of the edge influence gradient, leading to greater edge-driven fragmentation impact. While our simple analysis investigating the importance of species' traits brought interesting insights, further analyses incorporating increasing layers of realism should provide a clearer picture of mechanisms driving species' responses to edges.

CONSIDERAÇÕES FINAIS

Neste trabalho buscou-se primeiro compreender alguns dos mecanismos regulando a resposta das comunidades às bordas, utilizando uma síntese da literatura para entender sua variação global. Em seguida, comparamos dados observados de abundância de espécies individuais com dados gerados por simulações, ignorando algumas das dimensões do nicho das espécies, para assim quantificar a importância dessas dimensões. Buscou-se entender como aspectos ambientais locais e diferentes atributos das espécies afetam a direção e a intensidade dos efeitos de borda sobre sua abundância. No primeiro capítulo, foi mostrado que tanto fatores históricos (ocorrência de distúrbio histórico) quanto espaciais (gradientes latitudinais) moderam a direção e intensidade de efeitos de borda sobre a riqueza de comunidades em escala global. Além disso, aspectos locais como o tipo de matriz adjacente e a distância para a borda determinam a intensidade desses efeitos. O fato de comunidades tropicais serem mais afetadas por efeitos de borda reforça uma preocupação recorrente de que espécies tropicais são mais sujeitas à mudanças de uso e cobertura do solo (BETTS et al., 2019; ARROYO-RODRÍGUEZ et al., 2020).

Efeitos de borda são complexos, mas não totalmente idiossincráticos, e sua complexidade e variabilidade pode ser entendida de várias formas diferentes. Sínteses globais são particularmente úteis para compreendermos alguns mecanismos subjacentes. No entanto, essas sínteses geralmente tentam explicar efeitos de borda sem considerar importantes mediadores como a distância para a borda, o contraste entre remanescentes florestais e a matriz, e os efeitos relacionados ao fragmento como área e isolamento. Tais limitações potencialmente se devem à pouca disponibilidade de dados brutos na literatura, como abundância em cada ponto de amostragem (PFEIFER et al., 2014). Dessa forma, sínteses futuras devem se beneficiar de estudos com delineamentos aninhados, capazes de incorporar efeitos de área, isolamento e configuração dos fragmentos em múltiplas escalas (WEARN et al., 2019; LASMAR et al., 2021), além de incorporar variações aleatórias devido à identidade do fragmento, transecto, paisagem ou outros fatores aleatórios (SCHIELZETH; NAKAGAWA, 2013; HARRISON et al., 2018). Para isso, devemos amostrar diferentes fragmentos (10+) com mais de um transecto (5+), amostrando também a matriz, compreendendo um gradiente de distância razoável (100+) quando possível, tentando maximizar os usos de solo adjacentes (BOWLER et al., 2022). Embora a intensidade amostral (densidade de amostras) variem em função do táxon estudado (e.g. macrofauna de solo vs. mamíferos e aves), essa amostragem aninhada tende a ser especialmente intensa, garantindo assim a confiabilidade dos modelos obtidos e a extrapolação de variáveis da biodiversidade para a paisagem (EWERS; MARSH; WEARN, 2010).

Além de esclarecer a variação global dos efeitos de borda, este estudo buscou desenvolver um pouco mais a aplicação de modelos nulos espacialmente explícitos para compreender alguns dos mecanismos subjacentes aos efeitos de borda. No segundo capítulo, a disponibilidade de ambientes mais adequados se mostrou um importante preditor da abundância de mamíferos. No entanto, a caça se mostrou o mais importante fator estruturante das populações na reserva amostrada. Incorporar possíveis efeitos geométricos não mudou nenhuma inferência a respeito desses fatores ambientais, indicando que a maior parte das espécies respondem às bordas através de mecanismos ecológicos e não estocásticos. No último capítulo, também observamos que espécies florestais que habitam o núcleo das florestas têm sua sensibilidade determinada por fatores ecológicos. Especificamente, espécies com dietas mais generalistas tiveram maior sensibilidade a borda do que esperado por modelos considerando apenas efeitos de borda geométricos, enquanto que espécies mais especialistas tiveram seus padrões observados mais parecidos com aqueles preditos puramente através dos efeitos de borda geométricos.

É importante destacar que utilizamos metodologias um pouco diferentes ao comparar os dados observados e simulados nos capítulos 2 e 3. Enquanto no capítulo 2 utilizamos os modelos nulos prevendo a probabilidade de ocupação das espécies, no capítulo 3 utilizamos medidas de abundância disponível pelos autores dos estudos. A partir dessa comparação, é possível recomendarmos que a incorporação de modelos nulos seja feita a partir de modelos hierárquicos de ocupação, como no capítulo 2. Primeiramente, a probabilidade de ocupação é a métrica que filosoficamente faz mais sentido, considerando que o modelo resulta em uma superfície de abundância relativa (0-1). Além disso, dados brutos de abundância possuem grande quantidade de zeros devido à baixa detecção das espécies, podendo levar a artefatos metodológicos quando utilizamos diretamente esses dados (e.g. abundâncias locais superestimadas por conta do excesso de zeros neste estudo). Por isso, recomenda-se que pesquisadores interessados em aplicar modelos nulos na ecologia de paisagens e na conservação, o façam considerando os efeitos geométricos na probabilidade de ocupação das espécies, ou incorporando em componentes condicionais de modelos zero-inflado (ZUUR; IENO; ELPHICK, 2010), quando modelos de ocupação não são viáveis.

Nosso modelo de efeitos de borda geométrico está profundamente baseado no tamanho das áreas de vida e, portanto, na teoria metabólica (BROWN et al., 2004). Dessa forma, possui grande potencial de transferabilidade (aplicação de modelos similares em outros sistemas). Por exemplo, a distribuição de biomassa e da abundância entre as espécies da comunidade variam em função dos gradientes globais (WHITE et al., 2007). Nesse sentido, podemos pensar que comunidades com diferentes distribuições de tamanho de corpo respondam de forma diferente a bordas, puramente pelo posicionamento aleatório das áreas de vida, integrando mecanismos em diferentes escalas. Especificamente, comunidades dominadas por espécies de tamanho de corpo maior, terão maior chance de responderem negativamente a bordas (PFEIFER et al., 2017). Por outro lado, comunidades em regiões temperadas tendem a ser mais resilientes às mudanças no uso do solo contemporâneas, potencialmente reduzindo sua resposta às alterações na paisagem (BETTS., 2019). Dessa forma, previsões baseadas na teoria metabólica divergem dos padrões encontrados onde espécies de comunidades tropicais tendem a ser mais afetadas pelas bordas. Assim, o modelo EBG pode ser uma ferramenta útil para entender as respostas das espécies em escalas globais a partir da importância de processos estocásticos. Esperamos que este trabalho incentive a utilização de modelos nulos espacialmente escritos para compreensão da variação espacial das espécies em paisagens fragmentadas. Estudos futuros podem aumentar o realismo dos modelos nulos, incorporando variáveis adicionais, tais como dispersão, permeabilidade da matriz, qualidade de habitat dentro das florestas, além de outros atributos funcionais das espécies como dispersão e possíveis interações interespecíficas.

Identificar os mecanismos que levam à perda de espécies devido à fragmentação de hábitats, incluindo efeitos de borda derivados daquele processo, é importante para desenhar paisagens que maximizem a manutenção da biodiversidade (ARROYO-RODRÍGUEZ et al., 2020). Além disso, a importância da manutenção de grandes porções de habitat para as espécies está amplamente documentada na literatura (GIBSON et al., 2011; BARLOW et al., 2016; GRANTHAM et al., 2020), de forma que a conversão de florestas em usos antrópicos deve ser contida. Frequentes conversões de cobertura do solo levam à criação de novas bordas, potencialmente sujeitando toda área de floresta do mundo à esses efeitos até o final do século XXI (FISCHER et al., 2021). Aqui mostramos que efeitos tendem a ser negativos, especialmente nos trópicos e frequentemente derivado de mecanismos ecológicos, reforçando a necessidade da manutenção de áreas de floresta conservadas.

REFERÊNCIAS

ALMEIDA-GOMES, M. et al. Random placement models explain species richness and dissimilarity of frog assemblages within Atlantic Forest fragments. *Journal of Animal Ecology*, v. 91, n. May 2021, p. 1–12, 2022.

ALMEIDA-GOMES, M.; PREVEDELLO, J. A.; CROUZEILLES, R. The use of native vegetation as a proxy for habitat may overestimate habitat availability in fragmented landscapes. *Landscape Ecology*, v. 31, n. 4, p. 711–719, 2016.

ALMEIDA, D. R. A. et al. Persistent effects of fragmentation on tropical rainforest canopy structure after 20 yr of isolation. *Ecological Applications*, v. 29, n. 6, p. 1–15, 2019.

ANDERSEN, A. N. Responses of ant communities to disturbance: Five principles for understanding the disturbance dynamics of a globally dominant faunal group. *Journal of Animal Ecology*, v. 88, n. 3, p. 350–362, 2019.

ARROYO-RODRÍGUEZ, V. et al. Does forest fragmentation cause an increase in forest temperature? *Ecological Research*, v. 32, n. 1, p. 81–88, 2017.

ARROYO-RODRÍGUEZ, V. et al. Designing optimal human-modified landscapes for forest biodiversity conservation. *Ecology Letters*, v. 23, n. 9, p. 1404–1420, 2020.

ARROYO-RODRÍGUEZ, V. et al. Preserving 40% forest cover is a valuable and well-supported conservation guideline: reply to Banks-Leite et al. *Ecology Letters*, v. 24, n. 5, p. 1114–1116, 2021.

BALMFORD, A. Extinction filters and current resilience: The significance of past selection pressures for conservation biology. *Trends in Ecology and Evolution*, v. 11, n. 5, p. 193–196, 1996. Disponível em: <http://linkinghub.elsevier.com/retrieve/pii/0169534796100264>.

BANKS-LEITE, C. et al. The macroecology of landscape ecology. *Trends in Ecology and Evolution*, v. 37, n. 6, p. 480–487, 2022. Disponível em: <https://doi.org/10.1016/j.tree.2022.01.005>.

BANKS-LEITE, C.; EWERS, R. M.; METZGER, J. P. Edge effects as the principal cause of area effects on birds in fragmented secondary forest. *Oikos*, v. 119, n. 6, p. 918–926, 2010.

BARLOW, J. et al. Anthropogenic disturbance in tropical forests can double biodiversity loss from deforestation. *Nature*, v. 535, n. 7610, p. 144–147, 2016. Disponível em: <http://dx.doi.org/10.1038/nature18326>.

BARTLETT, L. J. et al. Synergistic impacts of habitat loss and fragmentation on model ecosystems. *Proceedings of the Royal Society B: Biological Sciences*, v. 283, n. 1839, 2016.

BATES, D. M. et al. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, v. 67, n. 1, 2015.

BEIER, P.; BURNHAM, K. P.; ANDERSON, D. R. *Model Selection and Inference: A Practical Information-Theoretic Approach*. 2. ed. Colorado: Springer, 2001. v. 65

BENÍTEZ-LÓPEZ, A.; ALKEMADE, R.; VERWEIJ, P. A. The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. *Biological Conservation*, v. 143, n. 6, p. 1307–1316, 2010. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2010.02.009>.

BERNASCHINI, M. L. et al. Are all edges equal? Microclimatic conditions, geographical orientation and biological implications in a fragmented forest. *Agriculture, Ecosystems and Environment*, v. 280, n. October 2018, p. 142–151, 2019. Disponível em: <https://doi.org/10.1016/j.agee.2019.04.035>.

BETTS, M. G. et al. Extinction filters mediate the global effects of habitat fragmentation on animals. *Science*, v. 366, n. 6470, p. 1236–1239, 2019.

BLITZER, E. J. et al. Spillover of functionally important organisms between managed and natural habitats. *Agriculture, Ecosystems and Environment*, v. 146, n. 1, p. 34–43, 2012. Disponível em: <http://dx.doi.org/10.1016/j.agee.2011.09.005>.

BOESING, A. L.; NICHOLS, E.; METZGER, J. P. Land use type, forest cover and forest edges modulate avian cross-habitat spillover. *Journal of Applied Ecology*, v. 55, n. 3, p. 1252–1264, 2018.

BOGONI, J. A.; PERES, C. A.; FERRAZ, K. M. P. M. B. Extent, intensity and drivers of mammal defaunation: a continental-scale analysis across the Neotropics. *Scientific Reports*, v. 10, n. 1, p. 1–17, 2020. Disponível em: <https://doi.org/10.1038/s41598-020-72010-w>.

BOWLER, E. et al. Optimising sampling designs for habitat fragmentation studies. *Methods in Ecology and Evolution*, v. 13, n. 1, p. 217–229, 2022.

BREGMAN, T. P.; SEKERCIOGLU, C. H.; TOBIAS, J. A. Global patterns and predictors of bird species responses to forest fragmentation: Implications for ecosystem function and conservation. *Biological Conservation*, v. 169, p. 372–383, 2014. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2013.11.024>.

BRINCK, K. et al. High resolution analysis of tropical forest fragmentation and its impact on the global carbon cycle. *Nature Communications*, v. 8, 2017.

BROWN, J. H. et al. Toward a metabolic theory of ecology. *Ecology*, v. 85, n. 7, p. 1771–1789, 2004.

CABRAL, J. S.; VALENTE, L.; HARTIG, F. Mechanistic simulation models in macroecology and biogeography: state-of-art and prospects. *Ecography*, v. 40, n. 2, p. 267–280, 2017.

CADENASSO, M. L. et al. A framework for a theory of ecological boundaries. *BioScience*, v. 53, n. 8, p. 750–758, 2003.

CAITANO, B. et al. Edge effects on insects depend on life history traits: a global meta-analysis. *Journal of Insect Conservation*, v. 24, n. 2, p. 233–240, 2020. Disponível em: <https://doi.org/10.1007/s10841-020-00227-1>.

CHASE, J. M. et al. Ecosystem decay exacerbates biodiversity loss with habitat loss. *Nature*, v. 584, n. 7820, p. 238–243, 2020. Disponível em: <http://www.nature.com/articles/s41586-020-2531-2>.

COLEMAN, B. D. On random placement and species-area relations. *Mathematical Biosciences*, v. 54, n. 3–4, p. 191–215, 1981.

COLWELL, R. K. et al. Peaks, plateaus, canyons, and craters: The complex geometry of simple mid-domain effect models. *Evolutionary Ecology Research*, v. 11, n. 3, p. 355–370, 2009.

COLWELL, R. K.; LEES, D. C. The mid-domain effect: Geometric constraints on the geography of species richness. *Trends in Ecology and Evolution*, v. 15, n. 2, p. 70–76, 2000.

COLWELL, R. K.; RAHBEK, C.; GOTELLI, N. J. The mid-domain effect and species richness patterns:what have we learned so far? *The American naturalist*, v. 163, n. 3, 2004.

CONNOLLY, S. R. et al. Process, Mechanism, and Modeling in Macroecology. *Trends in Ecology and Evolution*, v. 32, n. 11, p. 835–844, 2017. Disponível em: <http://dx.doi.org/10.1016/j.tree.2017.08.011>.

CROWLEY, M. A.; CARDILLE, J. A. Remote Sensing's Recent and Future Contributions to Landscape Ecology. *Current Landscape Ecology Reports*, v. 5, n. 3, p. 45–57, 2020.

DA ROSA, C. A. et al. Edge effects on small mammals: Differences between arboreal and ground-dwelling species living near roads in Brazilian fragmented landscapes. *Austral Ecology*, v. 43, n. 1, p. 117–126, 2018.

DA SILVA, D. A. et al. Drivers of leaf area index variation in Brazilian Subtropical Atlantic Forests. *Forest Ecology and Management*, v. 476, n. September, 2020.

DASKALOVA, G. N. et al. Landscape-scale forest loss as a catalyst of population and biodiversity change. *Science*, v. 368, n. 6497, p. 1341–1347, 2020.

DE CARVALHO GUIMARÃES, C. D.; VIANA, J. P. R.; CORNELISSEN, T. A meta-analysis of the effects of fragmentation on herbivorous insects. *Environmental Entomology*, v. 43, n. 3, p. 537–545, 2014.

DE CASSIA BIANCHI, R.; MENDES, S. L.; DE MARCO JÚNIOR, P. Food habits of the ocelot, Leopardus pardalis, in two areas in southeast Brazil. *Studies on Neotropical Fauna and Environment*, v. 45, n. 3, p. 111–119, 2010.

DETOGNE, N. et al. Spatial distribution of buffy-tufted-ear (Callithrix aurita) and invasive marmosets (Callithrix spp.) in a tropical rainforest reserve in southeastern Brazil. *American Journal of Primatology*, v. 79, n. 12, p. 1–11, 2017.

DIDHAM, R. K.; KAPOS, V.; EWERS, R. M. Rethinking the conceptual foundations of habitat fragmentation research. *Oikos*, v. 121, n. 2, p. 161–170, 2012.

DODONOV, P.; HARPER, K. A.; SILVA-MATOS, D. M. The role of edge contrast and forest structure in edge influence: Vegetation and microclimate at edges in the Brazilian cerrado. *Plant Ecology*, v. 214, n. 11, p. 1345–1359, 2013.

DORNELAS, M. et al. A balance of winners and losers in the Anthropocene. *Ecology Letters*, v. 22, n. 5, p. 847–854, 2019.

DRISCOLL, D. A. et al. Conceptual domain of the matrix in fragmented landscapes. *Trends in Ecology and Evolution*, v. 28, n. 10, p. 605–613, 2013. Disponível em: <http://dx.doi.org/10.1016/j.tree.2013.06.010>.

EWERS, R. M.; BANKS-LEITE, C. Fragmentation Impairs the Microclimate Buffering Effect of Tropical Forests. *PLoS ONE*, v. 8, n. 3, 2013.

EWERS, R. M.; DIDHAM, R. K. Confounding factors in the detection of species responses to habitat fragmentation. *Biological Reviews*, v. 81, n. 1, p. 117–142, 2006.

EWERS, R. M.; MARSH, C. J.; WEARN, O. R. Making statistics biologically relevant in fragmented landscapes. *Trends in Ecology and Evolution*, v. 25, n. 12, p. 699–704, 2010. Disponível em: <http://dx.doi.org/10.1016/j.tree.2010.09.008>.

FAHRIG, L. Why do several small patches hold more species than few large patches? *Global Ecology and Biogeography*, v. 29, n. 4, p. 615–628, 2020.

FAHRIG, L. What the habitat amount hypothesis does and does not predict: A reply to Saura. *Journal of Biogeography*, v. 48, n. 6, p. 1530–1535, 2021.

FAHRIG, L. et al. Resolving the SLOSS dilemma for biodiversity conservation: a research agenda. *Biological Reviews*, v. 97, n. 1, p. 99–114, 2022.

FERREGUETTI, Á. C. et al. One step ahead to predict potential poaching hotspots: Modeling occupancy and detectability of poachers in a neotropical rainforest. *Biological Conservation*, v. 227, n. August, p. 133–140, 2018. Disponível em: <https://doi.org/10.1016/j.biocon.2018.09.009>.

FERREGUETTI, Á. C. et al. Don’t shoot! How poaching may affect richness , biomass , and occupancy of non-volant mammals in an Atlantic Forest protected area , Brazil. *Preprint*, v. XX, n. XX, p. 1–20, 2023.

FERREGUETTI, A. C.; TOMAS, W. M.; BERGALLO, H. G. Differences in the Mammalian Habitat Use in a Mosaic of Vegetation Types of an Atlantic Rain-Forest Reserve, Brazil. *Mastozoología Neotropical*, v. 24, n. 2, p. 355–364, 2017.

FERREGUETTI, A. C.; TOMAS, W. M.; BERGALLO, H. G. Patch occupancy and activity pattern of the spotted paca (Cuniculus paca Linnaeus, 1766) in a protected area of the Atlantic Forest, Brazil. *Mammalia*, v. 83, n. 4, p. 363–371, 2019.

FERREGUETTI, Á. C.; TOMÁS, W. M.; BERGALLO, H. G. Density, occupancy, and activity pattern of two sympatric deer (Mazama) in the Atlantic Forest, Brazil. *Journal of Mammalogy*, v. 96, n. 6, p. 1245–1254, 2015.

FILGUEIRAS, B. K. C. et al. Winner–Loser Species Replacements in Human-Modified

Landscapes. *Trends in Ecology and Evolution*, v. 36, n. 6, p. 545–555, 2021. Disponível em: <https://doi.org/10.1016/j.tree.2021.02.006>.

FINDERUP NIELSEN, T. et al. More is less: net gain in species richness, but biotic homogenization over 140 years. *Ecology Letters*, v. 22, n. 10, p. 1650–1657, 2019.

FISCHER, J.; LINDENMAYER, D. B. Landscape modification and habitat fragmentation : a synthesis. *Global Ecology and Biogeography*, v. 16, p. 265–280, 2007.

FISCHER, R. et al. Accelerated forest fragmentation leads to critical increase in tropical forest edge area. *Science Advances*, v. 7, n. 37, p. 1DUMMMY, 2021.

FISKE, I. J.; CHANDLER, R. B. Unmarked: An R package for fitting hierarchical models of wildlife occurrence and abundance. *Journal of Statistical Software*, v. 43, n. 10, p. 1–23, 2011.

FLETCHER, R. J. Multiple edge effects and their implications in fragmented landscapes. *Journal of Animal Ecology*, v. 74, n. 2, p. 342–352, 2005.

FLETCHER, R. J. et al. The role of habitat area and edge in fragmented landscapes: Definitively distinct or inevitably intertwined? *Canadian Journal of Zoology*, v. 85, n. 10, p. 1017–1030, 2007.

FLETCHER, R. J. et al. Is habitat fragmentation good for biodiversity? *Biological Conservation*, v. 226, n. October, p. 9–15, 2018. Disponível em: <https://doi.org/10.1016/j.biocon.2018.07.022>.

FROST, C. M. et al. Community-level net spillover of natural enemies from managed to natural forest. *Ecology*, v. 96, n. 1, p. 193–202, 2015.

FULLER, A. K.; LINDEN, D. W.; ROYLE, J. A. Management decision making for fisher populations informed by occupancy modeling. *Journal of Wildlife Management*, v. 80, n. 5, p. 794–802, 2016.

GASTON, K. J.; CHOWN, S. L.; EVANS, K. L. Ecogeographical rules: Elements of a synthesis. *Journal of Biogeography*, v. 35, n. 3, p. 483–500, 2008.

GAYNOR, K. M. et al. Landscapes of Fear: Spatial Patterns of Risk Perception and Response. *Trends in Ecology and Evolution*, v. 34, n. 4, p. 355–368, 2019. Disponível em: <https://doi.org/10.1016/j.tree.2019.01.004>.

GIBB, H. et al. Climate mediates the effects of disturbance on ant assemblage structure.

Proceedings of the Royal Society B: Biological Sciences, v. 282, n. 1808, p. 20150418–20150418, 2015.

GIBSON, L. et al. Primary forests are irreplaceable for sustaining tropical biodiversity. *Nature*, v. 478, n. 7369, p. 378–381, 2011. Disponível em: <http://dx.doi.org/10.1038/nature10425>.

GOORIAH, L. et al. Synthesis reveals that island species–area relationships emerge from processes beyond passive sampling. *Global Ecology and Biogeography*, v. 30, n. 10, p. 2119–2131, 2021.

GOTELLI, N. J. et al. Patterns and causes of species richness: A general simulation model for macroecology. *Ecology Letters*, v. 12, n. 9, p. 873–886, 2009.

GOTELLI, N. J.; GRAVES, G. R. Front Matter. In: *Null Models in Ecology*. [s.l: s.n.]

GOTELLI, N. J.; MCGILL, B. J. Null versus neutral models: What's the difference? *Ecography*, v. 29, n. 5, p. 793–800, 2006.

GRANTHAM, H. S. et al. Anthropogenic modification of forests means only 40% of remaining forests have high ecosystem integrity. *Nature Communications*, v. 11, n. 1, p. 1–10, 2020. Disponível em: <http://dx.doi.org/10.1038/s41467-020-19493-3>.

HADDAD, N. M. et al. Habitat fragmentation and its lasting impact on Earth ' s ecosystems. *Science Advances*, v. 1, n. March, p. 1–9, 2015a.

HADDAD, N. M. et al. Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science Advances*, v. 1, n. March, p. 1–9, 2015b.

HARPER, K. A. et al. Edge influence on forest structure and composition in fragmented landscapes. *Conservation Biology*, v. 19, n. 3, p. 768–782, 2005. Disponível em: <http://dx.doi.org/10.1111/j.1523-1739.2005.00045.x>.

HARRISON, X. A. et al. A brief introduction to mixed effects modelling and multi-model inference in ecology. *PeerJ*, v. 2018, n. 5, p. 1–32, 2018.

HATFIELD, J. H. et al. Mediation of area and edge effects in forest fragments by adjacent land use. *Conservation Biology*, v. 34, n. 2, p. 395–404, 2020.

HILLEBRAND, H. et al. Biodiversity change is uncoupled from species richness trends: Consequences for conservation and monitoring. *Journal of Applied Ecology*, v. 55, n. 1, p. 169–184, 2018.

IBÁÑEZ, I. et al. Assessing the integrated effects of landscape fragmentation on plants and plant communities: The challenge of multiprocess-multiresponse dynamics. *Journal of Ecology*, v. 102, n. 4, p. 882–895, 2014.

INSTITUTE, T. E. L. *Conservation thresholds for land use planners*. [s.l: s.n.]

JACKSON, H. B.; FAHRIG, L. What size is a biologically relevant landscape? *Landscape Ecology*, v. 27, n. 7, p. 929–941, 2012.

JACKSON, H. B.; FAHRIG, L. Are ecologists conducting research at the optimal scale? *Global Ecology and Biogeography*, v. 24, n. 1, p. 52–63, 2015.

JETZ, W.; RAHBEK, C. Geometric constraints explain much of the species richness pattern in African birds. *Proceedings of the National Academy of Sciences of the United States of America*, v. 98, n. 10, p. 5661–5666, 2001.

KASPARI, M. E.; WEISER, M. The size-grain hypothesis: Do macroarthropods see a fractal world? *Ecological Entomology*, v. 32, n. 3, p. 279–282, 2007.

KEINATH, D. A. et al. A global analysis of traits predicting species sensitivity to habitat fragmentation. *Global Ecology and Biogeography*, v. 26, n. 1, p. 115–127, 2017.

KOTZE, D. J. et al. Effects of habitat edges and trampling on the distribution of ground beetles (Coleoptera, Carabidae) in urban forests. *Journal of Insect Conservation*, v. 16, n. 6, p. 883–897, 2012.

KRISHNADAS, M.; KUMAR, A. N.; COMITA, L. S. Edge effects reduce α-diversity but not β-diversity during community assembly in a human-modified tropical forest. *Ecological Applications*, v. 29, n. 8, p. 1–10, 2019.

LASMAR, C. J. et al. Contrasting edge and pasture matrix effects on ant diversity from fragmented landscapes across multiple spatial scales. *Landscape Ecology*, v. 36, n. 9, p. 2583–2597, 2021.

LAURANCE, W. F. et al. Biomass collapse in Amazonian forest fragments. *Science*, v. 278, n. 5340, p. 1117–1118, 1997.

LAURANCE, W. F. et al. Ecosystem Decay of Amazonian Forest Fragments: a 22-Year Investigation. *Conservation Biology*, v. 16, n. 3, p. 605–618, 2002.

LAURANCE, W. F. et al. Habitat fragmentation, variable edge effects, and the landscapedivergence hypothesis. *PLoS ONE*, v. 2, n. 10, 2007.

LAURANCE, W. F. et al. The fate of Amazonian forest fragments: A 32-year investigation. *Biological Conservation*, v. 144, n. 1, p. 56–67, 2011. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2010.09.021>.

LAURIE, H.; SILANDER, J. A. Geometric constraints and spatial pattern of species richness: Critique of range-based null models. *Diversity and Distributions*, v. 8, n. 6, p. 351–364, 2002.

LINDEN, D. W. et al. Examining the occupancy–density relationship for a low-density carnivore. *Journal of Applied Ecology*, v. 54, n. 6, p. 2043–2052, 2017.

LINDENMAYER, D. B. et al. A s`imple landscape-scale test of a spatially explicit population model: Patch occupancy in fragmented south-eastern Australian forests. *Oikos*, v. 92, n. 3, p. 445–458, 2001.

MACDONALD, Z. G. et al. Distinguishing effects of area per se and isolation from the sample-area effect for true islands and habitat fragments. *Ecography*, v. 44, n. 7, p. 1051–1066, 2021.

MACEDO, L. et al. Atlantic forest mammals cannot find cellphone coverage. *Biological Conservation*, v. 220, n. January, p. 201–208, 2018. Disponível em: <https://doi.org/10.1016/j.biocon.2018.02.018>.

MACKENZIE, D. I. et al. *Occupancy Estimation and Modeling: Inferring Patterns and Dynamics of Species Occurrence: Second Edition*. [s.l: s.n.]

MAGURA, T.; LÖVEI, G. L.; TÓTHMÉRÉSZ, B. Various edge response of ground beetles in edges under natural versus anthropogenic influence: A meta-analysis using life-history traits. *Acta Zoologica Academiae Scientiarum Hungaricae*, v. 65, n. November, p. 3–20, 2019.

MARQUES, M. C. M.; GRELLE, C. E. V. The atlantic forest: History, biodiversity, threats and opportunities of the mega-diverse forest. *The Atlantic Forest: History, Biodiversity, Threats and Opportunities of the Mega-diverse Forest*, n. January, p. 1–517, 2021.

MARSH, C. J. et al. Is β-diversity of Amazonian ant and dung beetles communities elevated at rainforest edges? *Journal of Biogeography*, v. 45, n. 8, p. 1966–1979, 2018. Disponível em: <http://doi.wiley.com/10.1111/jbi.13357>.

MASSOL, F. et al. Island Biogeography of Food Webs. *Advances in Ecological Research*, v. 56, n. February, p. 183–262, 2017.

MENDES, C. B.; PREVEDELLO, J. A. Does habitat fragmentation affect landscape-level temperatures? A global analysis. *Landscape Ecology*, v. 35, n. 8, p. 1743–1756, 2020. Disponível em: <https://doi.org/10.1007/s10980-020-01041-5>.

MICHALSKI, F.; PERES, C. A. Anthropogenic determinants of primate and carnivore local extinctions in a fragmented forest landscape of southern Amazonia. *Biological Conservation*, v. 124, n. 3, p. 383–396, 2005.

MICHALSKI, F.; PERES, C. A. Disturbance-mediated mammal persistence and abundance-area relationships in Amazonian forest fragments. *Conservation Biology*, v. 21, n. 6, p. 1626–1640, 2007.

MURCIA, C. Edge effects in fragmented forests: implications for conservation. *Trends in Ecology & Evolution*, v. 10, n. 2, p. 58–62, 1995.

NEWBOLD, T. et al. A global model of the response of tropical and sub-tropical forest biodiversity to anthropogenic pressures. *Proceedings of the Royal Society B: Biological Sciences*, v. 281, n. 1792, 2014.

NEWBOLD, T. et al. Global effects of land use on biodiversity differ among functional groups. *Functional Ecology*, v. 34, n. 3, p. 684–693, 2020a.

NEWBOLD, T. et al. Tropical and Mediterranean biodiversity is disproportionately sensitive to land-use and climate change. *Nature Ecology and Evolution*, v. 4, n. 12, p. 1630–1638, 2020b.

NORRIS, D. et al. Terrestrial mammal responses to edges in Amazonian forest patches: A study based on track stations. *Mammalia*, v. 72, n. 1, p. 15–23, 2008.

ORDWAY, E. M.; ASNER, G. P. Carbon declines along tropical forest edges correspond to heterogeneous effects on canopy structure and function. *Proceedings of the National Academy of Sciences of the United States of America*, v. 117, n. 14, p. 7863–7870, 2020.

PALMEIRIM, A. F. et al. Ecological correlates of mammal β-diversity in Amazonian land-bridge islands: from small- to large-bodied species. *Diversity and Distributions*, v. 24, n. 8, p. 1109–1120, 2018.

PERALTA, G. et al. Non-random food-web assembly at habitat edges increases connectivity and functional redundancy. *Ecology*, v. 98, n. 4, p. 995–1005, 2017.

PFEIFER, M. et al. BIOFRAG - a new database for analyzing BIOdiversity responses to forest

FRAGmentation. *Ecology and Evolution*, v. 4, n. 9, p. 1524–1537, 2014.

PFEIFER, M. et al. Creation of forest edges has a global impact on forest vertebrates. *Nature*, v. 551, n. 7679, p. 187–191, 2017. Disponível em: <http://dx.doi.org/10.1038/nature24457>.

PFEIFER, M. et al. Tropical forest canopies and their relationships with climate and disturbance: results from a global dataset of consistent field-based measurements. *Forest Ecosystems*, v. 5, n. 1, p. 1–14, 2018.

POTTS, J. R.; HILLEN, T.; LEWIS, M. A. The "edge effect" phenomenon: deriving population abundance patterns from individual animal movement decisions. *Theoretical Ecology*, v. 9, n. 2, p. 233–247, 2016. Disponível em: <http://dx.doi.org/10.1007/s12080-015-0283-7>.

PREVEDELLO, J. A. et al. Rethinking edge effects: The unaccounted role of geometric constraints. *Ecography*, v. 36, n. 3, p. 287–299, 2013.

PREVEDELLO, J. A.; GOTELLI, N. J.; METZGER, J. P. A stochastic model for landscape patterns of biodiversity. *Ecological Monographs*, v. 86, n. 4, p. 462–479, 2016.

PREVEDELLO, J. A.; VIEIRA, M. V. Does the type of matrix matter? A quantitative review of the evidence. *Biodiversity and Conservation*, v. 19, n. 5, p. 1205–1223, 2010.

PÜTTKER, T. et al. Indirect effects of habitat loss via habitat fragmentation: A cross-taxa analysis of forest-dependent species. *Biological Conservation*, v. 241, p. 108368, 2020. Disponível em: <https://doi.org/10.1016/j.biocon.2019.108368>.

PÜTZ, S. et al. Long-term carbon loss in fragmented Neotropical forests. *Nature Communications*, v. 5, n. iDiv, p. 1–24, 2014a.

PÜTZ, S. et al. Long-term carbon loss in fragmented Neotropical forests - supplementary information. *Nature Communications*, v. 5, n. iDiv, p. 1–24, 2014b.

RADWAN, T. M. et al. Global land cover trajectories and transitions. *Scientific Reports*, v. 11, n. 1, p. 1–16, 2021. Disponível em: <https://doi.org/10.1038/s41598-021-92256-2>.

RANGEL, T. F. et al. Modeling the ecology and evolution of biodiversity: Biogeographical cradles, museums, and graves. *Science*, v. 361, n. 6399, 2018.

RANGEL, T. F. L. V. B.; DINIZ-FILHO, J. A. F. Neutral community dynamics, the mid-domain effect and spatial patterns in species richness. *Ecology Letters*, v. 8, n. 8, p. 783–790, 2005.

RIBEIRO, S. E. et al. Edge effects and geometric constraints: A landscape-level empirical test.

Journal of Animal Ecology, v. 85, n. 1, p. 97–105, 2016.

RIES, L. et al. Ecological responses to habitat edges: Mechanisms, models, and variability explained. *Annual Review of Ecology, Evolution, and Systematics*, v. 35, n. 1, p. 491–522, 2004. Disponível em: <http://www.annualreviews.org/doi/10.1146/annurev.ecolsys.35.112202.130148>.

RIES, L. et al. Closing Persistent Gaps in Knowledge About Edge Ecology. *Current Landscape Ecology Reports*, v. 2, n. 1, p. 30–41, 2017.

RIES, L.; SISK, T. D. A predictive model of edge effects. *Ecology*, v. 85, n. 11, p. 2917–2926, 2004.

RIES, L.; SISK, T. D. What is an edge species? The implications of sensitivity to habitat edges. *Oikos*, v. 119, n. 10, p. 1636–1642, 2010.

ROSENBERG, M. S.; ROTHSTEIN, H. R.; GUREVITCH, J. *Effect Sizes: Conventional Choices and Calculations. Handbook of Meta-analysis in Ecology and Evolution*. [s.l: s.n.]

RUFFELL, J.; DIDHAM, R. K. Towards a better mechanistic understanding of edge effects. *Landscape Ecology*, v. 31, n. 10, p. 2205–2213, 2016.

RUSHTON, S. P. et al. Modelling the population dynamics of the Mt. Graham red squirrel: Can we predict its future in a changing environment with multiple threats? *Biological Conservation*, v. 131, n. 1, p. 121–131, 2006.

SALISBURY, C. L. et al. The latitudinal gradient in dispersal constraints: Ecological specialisation drives diversification in tropical birds. *Ecology Letters*, v. 15, n. 8, p. 847–855, 2012.

SÁNCHEZ, E. P.; ARMENTERAS, D.; RETANA, J. Edge influence on diversity of orchids in Andean cloud forests. *Forests*, v. 7, n. 3, p. 2016, 2016.

SANTOS, F. et al. Prey availability and temporal partitioning modulate felid coexistence in Neotropical forests. *PLoS ONE*, v. 14, n. 3, p. 1–23, 2019.

SCHEMSKE, D. W. et al. Is there a latitudinal gradient in the importance of biotic interactions? *Annual Review of Ecology, Evolution, and Systematics*, v. 40, p. 245–269, 2009.

SCHIELZETH, H.; NAKAGAWA, S. Nested by design: Model fitting and interpretation in a mixed model era. *Methods in Ecology and Evolution*, v. 4, n. 1, p. 14–24, 2013.

SCHNEIDER-MAUNOURY, L. et al. Abundance signals of amphibians and reptiles indicate strong edge effects in Neotropical fragmented forest landscapes. *Biological Conservation*, v. 200, p. 207–215, 2016. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2016.06.011>.

SPECTOR, S.; AYZAMA, S. Rapid Turnover and Edge Effects in Dung Beetle Assemblages (Scarabaeidae) at a Bolivian Neotropical Forest-Savanna Ecotone. *Biotropica*, v. 35, n. 3, p. 394–404, 2003.

STEVENS, S. M.; HUSBAND, T. P. Stevens e Husband, 1998.pdf. *Biological Conservation*, v. 85, p. 1–8, 1998.

STRATFORD, J. A.; ROBINSON, W. D. Gulliver travels to the fragmented tropics: Geographic variation in mechanisms of avian extinction. *Frontiers in Ecology and the Environment*, v. 3, n. 2, p. 91–98, 2005.

SVOBODOVÁ, J. et al. Testing mechanistic explanations for mammalian predator responses to habitat edges. *European Journal of Wildlife Research*, v. 57, n. 3, p. 467–474, 2011.

TAMBURELLO, N.; CÔTÉ, I. M.; DULVY, N. K. Energy and the scaling of animal space use. *American Naturalist*, v. 186, n. 2, p. 196–211, 2015.

TSCHARNTKE, T. et al. Landscape moderation of biodiversity patterns and processes - eight hypotheses. *Biological Reviews*, v. 87, n. 3, p. 661–685, 2012.

VETTER, D. et al. Predictors of forest fragmentation sensitivity in Neotropical vertebrates: A quantitative review. *Ecography*, v. 34, n. 1, p. 1–8, 2011.

VIEIRA, M. V. et al. Fair tests of the habitat amount hypothesis require appropriate metrics of patch isolation: An example with small mammals in the Brazilian Atlantic Forest. *Biological Conservation*, v. 226, n. July, p. 264–270, 2018a. Disponível em: <https://doi.org/10.1016/j.biocon.2018.08.008>.

VIEIRA, M. V. et al. Fair tests of the habitat amount hypothesis require appropriate metrics of patch isolation: An example with small mammals in the Brazilian Atlantic Forest. *Biological Conservation*, v. 226, n. July, p. 264–270, 2018b. Disponível em: <https://doi.org/10.1016/j.biocon.2018.08.008>.

WATLING, J. I. et al. Meta-analysis reveals the importance of matrix composition for animals in fragmented habitat. *Global Ecology and Biogeography*, v. 20, n. 2, p. 209–217, 22 mar. 2011. Disponível em: <http://doi.wiley.com/10.1111/j.1466-8238.2010.00586.x>. Acesso em: 15 jul.

2014.

WEARN, O. R. et al. Land-use change alters the mechanisms assembling rainforest mammal communities in Borneo. *Journal of Animal Ecology*, v. 88, n. 1, p. 125–137, 2019.

WHITE, E. P. et al. Relationships between body size and abundance in ecology. *Trends in Ecology and Evolution*, v. 22, n. 6, p. 323–330, 2007.

WILLIAMS-LINERA, G.; DOMINGUEZ-GASTELU, V.; GARCIA-ZURITA, M. E. Microenvironment and Floristics of Different Edges in. *Conservation biology*, v. 12, n. 5, p. 1091–1102, 1998.

WILLIG, M. R.; KAUFMAN, D. M.; STEVENS, R. D. Latitudinal Gradients of Biodiversity: Pattern, Process, Scale, and Synthesis. *Annual Review of Ecology, Evolution, and Systematics*, v. 34, n. November, p. 273–309, 2003.

WILLMER, J. N. G.; PÜTTKER, T.; PREVEDELLO, J. A. Global impacts of edge effects on species richness. *Biological Conservation*, v. 272, n. January, p. 109654, 2022. Disponível em: <https://doi.org/10.1016/j.biocon.2022.109654>.

WILMAN, H. et al. EltonTraits 1 . 0 : Species-level foraging attributes of the world ' s birds and mammals. *Ecology*, v. 95, n. March, p. 2027, 2014. Disponível em: <Ecological Archives E095-178>.

WIMP, G. M. et al. Do edge responses cascade up or down a multi-trophic food web? *Ecology Letters*, v. 14, n. 9, p. 863–870, 2011.

WINKLER, K. et al. Global land use changes are four times greater than previously estimated. *Nature Communications*, v. 12, n. 1, p. 1–10, 2021. Disponível em: <http://dx.doi.org/10.1038/s41467-021-22702-2>.

YOUNGENTOB, K. N. et al. Edge effects influence competition dynamics: A case study of four sympatric arboreal marsupials. *Biological Conservation*, v. 155, p. 68–76, 2012. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2012.05.015>.

ZHANG, M. The use and limitations of null-model-based hypothesis testing. *Biology and Philosophy*, v. 35, n. 2, p. 1–22, 2020. Disponível em: <https://doi.org/10.1007/s10539-020-09748-0>.

ZIPKIN, E. F. et al. Multi-species occurrence models to evaluate the effects of conservation and management actions. *Biological Conservation*, v. 143, n. 2, p. 479–484, 2010. Disponível em: <http://dx.doi.org/10.1016/j.biocon.2009.11.016>.

ZUUR, A. F. et al. *Mixed-effects modeling for ecology with R*. [s.l: s.n.]

ZUUR, A. F.; IENO, E. N.; ELPHICK, C. S. A protocol for data exploration to avoid common statistical problems. *Methods in Ecology and Evolution*, v. 1, n. 1, p. 3–14, 2010.

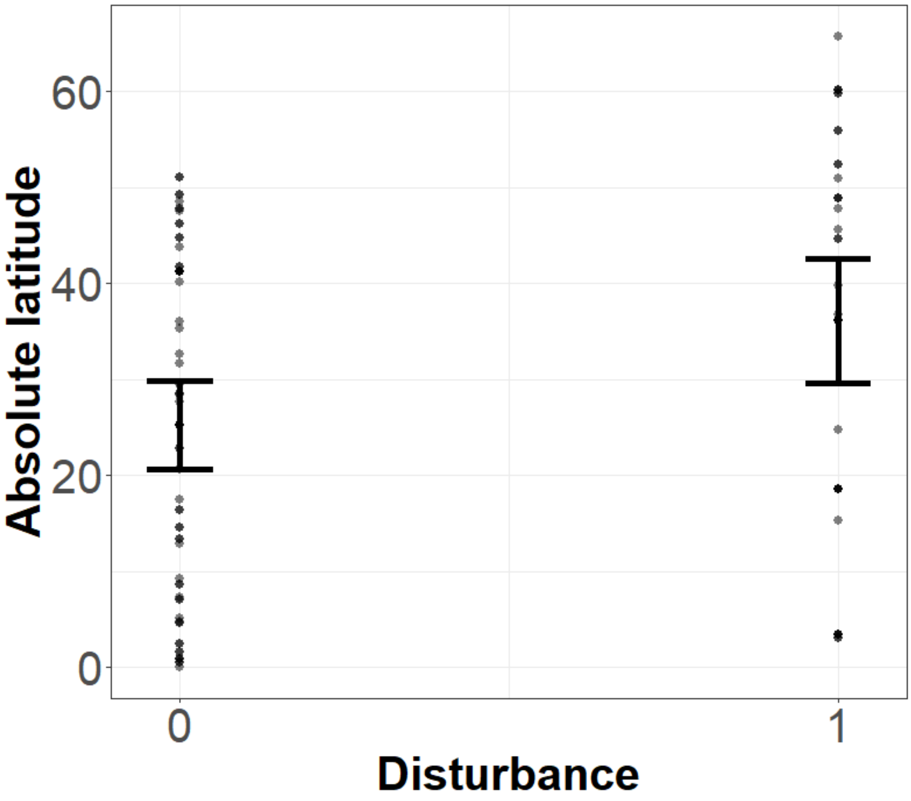
APENDICES

Apendice A: Material suplementar capítulo 1

To investigate possible biases in the observed effect sizes, we checked for a possible correlation between the occurrence of historical disturbance and absolute latitude. We extracted a single response for each study (n= 98) and predicted the presence of historical disturbance as a function of absolute latitude, using a linear model assuming a normal distribution, which was found to be adequate after checking model premises. We found that sites with historical disturbance were located at significantly higher latitudes compared to sites without historical disturbance ($F_{1,96} = 7.13$, $p = 0.01$; Figure S1). In addition, we investigated the distribution of responses across different distances to the edge (Figure S2) and the number of fragments used to obtain the edge effect estimate (Figure S3). We found a positive relation between the number of positive effects and the number of replicates (a = 0.94, CI95 = 0.83, 1.06; b= 1.08 CI95= 1.02, 1.14, $p < 0.05$). In addition, the number of replicates was positively correlated to absolute latitude (a= 1.84, CI95= 1.66, 2.03; b= 1.31, CI95= 1.19, 1.44, $p < 0.05$).

We also present model coefficient estimates for each response variable of the top-ranked models (Table S1), and additional models with ΔAICc <2 . (Table S2). Finally, we present entire candidate model sets with model selection results (Tables S3, S4 and S5).

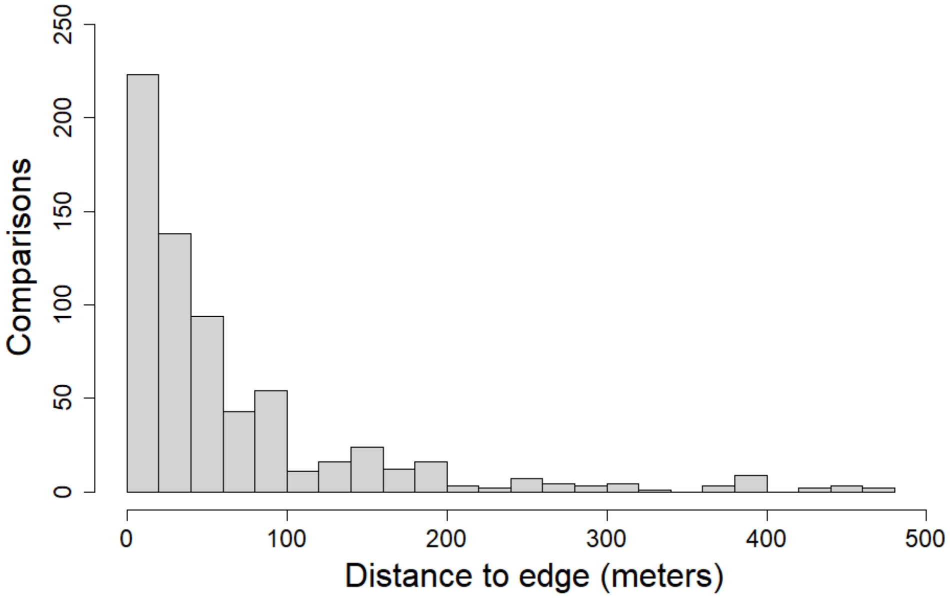
Figure S1 - Mean latitude of sites without historical disturbance and sites with historical disturbance across edge effect studies globally.



Legenda: Sites without historical disturbance (0) and sites with historical disturbance (1).

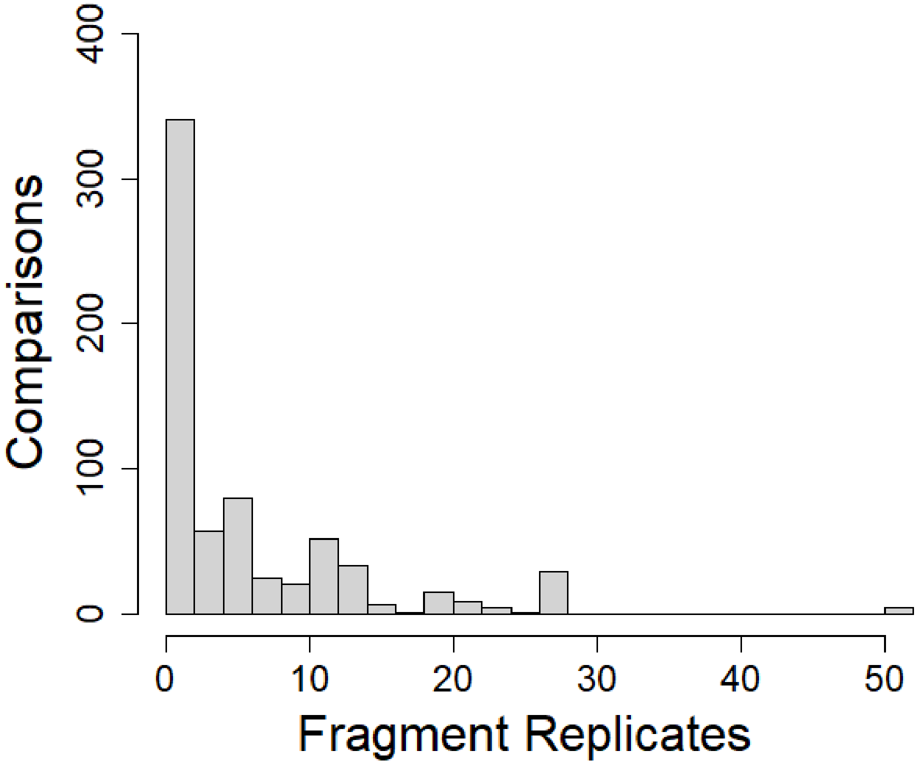
Fonte: O autor, 2023

Figure S2 - Mean latitude of sites without historical disturbance (0) and sites with historical disturbance (1) across edge effect studies globally.



Fonte: O autor, 2023

Figure S3 - Distribution of the number of fragment replicates across edge effect studies globally.



Fonte: O autor, 2023

Table S1 - Parameter estimates (Log Odds: Log odds ratio) of the top-ranked models predicting edge effect direction and magnitude (separately for positive and negative effect sizes).

Dependent	Model	Parameter	Log	Lower	Upper	Variable	Std.	Group	ICC
Direction	Fixed	Intercept	4.46	1.77	7.15	1			
		Taxon [plant]	-1.08	-3.83	1.67	1			
		Taxon [Vert]	-3.98	-7.61	-0.35	1			
		Distance	0.51	0.11	0.9	1			
		Abs. Lat	2.98	1.5	4.46	1			
		Matrix [Soft]	-3.72	-6.85	-0.59	0.96			
	Random	groupNum: study.ID					5.62	195	0.8
		study.ID					2.48	98	0.2
Magnitude of positive effect sizes	Fixed	Intercept	-1.59	-1.8	-1.38	1			
		Abs. Lat	0	-0.2	0.2	0.98			
		Distance	0.25	0.2	0.31	1			
		Minor.obs	-0.31	-0.47	-0.15	1			
		Abs. Lat * Distance	0.11	0.05	0.17	0.93			
	Random	groupNum: study.ID					0.67	134	0.4
		study.ID					0.45	77	0.2
		Residual					0.65		
Magnitude of negative effect sizes	Fixed	Intercept	-2.27	-2.8	-1.74	1			
		Disturbance	-0.12	-0.94	0.71	0.88			
		Distance	0.39	0.19	0.59	0.97			
		Minor.obs	-0.39	-0.68	-0.09	1			
		Disturbance * Distance	-0.56	-0.85	-0.28	0.88			
	Random	groupNum: study.ID					0.94	101	0.4
		study.ID					1.01	63	0.4
		Residual					0.82		

Legenda**:** Matrix: matrix type (hard or soft); Abs. Lat: absolute latitude; MWD: mean water deficit; distance: distance from the plot to the edge, Taxon: taxonomic group (Invertebrate, plant or vertebrate), Minor obs: minimum observed value in each comparison, Variable Wi refers to the sum of AICc weights (wi) of all models in which the respective variable was included; Std Dev: standard deviation values, Group N: number of random effect groups. ICC: interclass correlation coefficient, which indicates the variation of response variable values across random effect levels.

Fonte: O autor, 2023

Table S2 - Parameter estimates (Log Odds: Log odds ratio) of additional selected models (i.e AICc < 2) predicting edge effect direction and magnitude (separately for positive and negative effect sizes)

Response variable	Model component	Parameter	Log Odds	Lower 95CI	Upper 95CI	Variable Wi	Std. Dev.	Group N	ICC
Direction	Fixed	Intercept	4.29	1.65	6.94	1			
		Taxon - plant	-1.17	-3.96	1.62	1			
		Taxon - Vert	-3.69	-7.27	-0.12	1			
		Distance	0.51	0.12	0.9	1			
		Matrix Soft	-3.33	-6.61	-0.04	0.96			
		Abs. Lat	3.26	1.68	4.83	1			
		Matrix * Abs. Lat	-2.04	-4.87	0.8	0.42			
	Random	groupNum: study.ID					5.03	195	0.3
		study.ID					2.96	98	0.5
		Residual					1		
Direction	Fixed	Intercept	4.8	2.05	7.55	1			
		Taxon - plant	-0.98	-3.69	1.73	1			
		Taxon - Vert	-3.77	-7.48	-0.06	1			
		Distance	0.48	0.09	0.88	1			
		Matrix Soft	-5.31	-9.12	-1.5	0.96			
		Abs. Lat	3.34	1.77	4.91	1			
		MWD	0.44	-0.75	1.64	0.65			
		Matrix * MWD	-5.15	-10.22	-0.08	0.36			
	Random	groupNum: study.ID					7.08	195	
		study.ID					0.04	98	
		Residual					1		
Direction	Fixed	Intercept	4.31	1.6	7.01	1			
		Taxon - plant	-1.11	-3.88	1.66	1			
		Taxon - Vert	-3.82	-7.44	-0.2	1			
		Distance	0.5	0.11	0.9	1			
		Matrix Soft	-3.42	-6.72	-0.12	0.96			
		Abs. Lat	3.43	1.77	5.1	1			
		MWD	-0.25	-1.38	0.87	0.65			
		Matrix * abs lat	-2.12	-4.93	0.69	0.42			
	Random	groupNum: study.ID					5.37	195	0.94
		study.ID					2.39	98	0
		Residual					1		

Continuation Table S2

Response variable	Model component	Parameter	Log Odds	Lower 95CI	Upper 95CI	Variable Wi	Std. Dev.	Group N	ICC
Magnitude of positive effect sizes	Fixed	Intercept	-1.32	-1.81	-0.84	1			
		Distance	0.03	-0.12	0.18	1			
		Abs. Lat	0	-0.02	0.01	0.98			
		Minor obs	-0.01	-0.01	0	1			
		MWD	0.11	-0.06	0.28	0.64			
		Distance * Abs. Lat	0.01	0	0.01	0.97			
	Random	groupNum: study.ID					0.67	134	0.43
		study.ID					0.43	77	0.17
		Residual					0.65		
Magnitude of negative effect sizes	Fixed	Intercept	-2.08	-2.73	-1.42	1			
		Distance	0.41	0.18	0.64	0.97			
		Disturbance	-0.12	-1.01	0.77	0.88			
		MWD	-0.11	-0.51	0.29	0.28			
		Minor obs	-0.04	-0.06	-0.01	0.56			
		Distance * Disturbance	-0.58	-0.91	-0.25	0.88			
	Random	groupNum: study.ID					1.05	101	0.3
		study.ID					1.36	63	0.5
		Residual					0.85		
Magnitude of negative effect sizes	Fixed	Intercept	-2.35	-2.81	-1.88	1			
		Distance	0.39	0.18	0.6	0.97			
		Disturbance	-0.05	-0.77	0.68	0.88			
		MWD	-0.03	-0.36	0.29	0.28			
		Minor obs	-0.37	-0.63	-0.11	0.56			
		Distance * Disturbance	-0.54	-0.85	-0.24	0.88			
	Random	Distance * MWD	-0.13	-0.31	0.05	0.27			
		groupNum: study.ID					0.95	101	0.35
		study.ID					1.03	63	0.4
		Residual					0.82		

Legenda: Matrix: matrix type (hard or soft); Abs. Lat: absolute latitude; MWD: mean water deficit; distance: distance from the plot to the edge, Taxon: taxonomic group (Invertebrate, plant or vertebrate), Minor obs: minimum observed value in each comparison, Variable Wi refers to the sum of AICc weights (wi) of all models in which the respective variable was included; Std Dev: standard deviation values, Group N: number of random effect groups. ICC: interclass correlation coefficient, which indicates the variation of response variable values across random effect levels.

Fonte: O autor, 2023

Apendice B: Material suplementar capítulo 2

Table S3 - Model average formulas and tests on precision and spatial auto-correlation.

Species	Model averaged formula	AUC avg	Moran.I
MAME	NDVI_2000m + Near_River + NEAR_Road + Poach + Sim_M_amer	0.94	-0.01
MAGO	Dry ~ NDVI_500m + Near_River + NEAR_Road + Poach	0.97	0.00
CUPA	Dry ~ NDVI_2000m + Near_River + NEAR_Road + Poach + Sim_C.paca	0.95	-0.03
LEPA	Dry + Near_River + NEAR_Road + Poach + pt_EVI + Sim_L_parda	0.68	-0.04
LEWE	Dry ~ dry + EVI_2000m + Near_River + NEAR_Road + Poach + Sim_L_weidii	0.64	-0.05
PUYA	Dry ~ EVI_500m + Near_River + NEAR_Road + Poach + Sim_P_yagua	0.67	-0.01
EIBA	Dry ~ EVI_2000m + Near_River + NEAR_Road + Poach + Sim_E_bar	0.56	0.01

Legenda: AUC: Area under the operator curve: Higher values indicate more precision,; Moran I: Spatial auto correlation indicator: values next to zero indicate low spatial autocorrelation. Species: MAME (*M. americana*) MAGO (*M. gouzabira*) CUPA (*C. paca*); LEPA (*L. pardallis*) LEWE (*L. wiedii*) PUYA (*P. Yaguarundi*); EIBA (*E. barbara*).

Fonte: O autor, 2023

Table S4 - Variables considered to affect occupancy and detection of medium mammals at Vale Natural Reserve between 2013 and 2017.

Variable	Occupancy/ Detectability	Type	Fixed/ Random	Obtained from	Scales
NDVI	Occu	Site	Fixed	Median pixel value across 4 year sampling period	30m pixel, 200m, 500m. 1km, 2km
EVI	Occu	Site	Fixed		
Near_River	Occu	Site	Fixed	Local authority shapefiles and RGB and SRM imagery	NA
Near_Road	Occu	Site	Fixed	RGB Imagery and local authority maps	NA
Sim_ab	Occu	Site	Fixed	Random placement model	NA
Precipitation	Occu	Season	Fixed	Season accumulated precipitation	NA
Poach	Occu	Site/ season	Fixed	Collected data (Ferrenguetti et al., 2020)	NA
SiteID	Occu/DET	Site	Random	NA	NA
SeasonID	Occu/Det	Season	Random	NA	NA
SpeciesID	Det	Species	Random	NA	NA

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_M_amer indicates geometric edge effect predictions for *Mazama americana,* and other 'Sim' variables refer to predictions for other species. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors.

Fonte: O autor, 2023

Table S5 - Candidate models predicting occupancy of *Mazama Americana* across Vale Natural Reserve

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
NDVI_500m + Near_River + Near_Road + Poach	6	0.49	5415.14	0	0.13	0.13
Near_River + Near_Road + Poach	5	0.49	5415.29	0.15	0.12	0.24
NDVI_500m + Near_River + Near_Road + Poach + Sim_M_amer	7	0.50	5415.62	0.48	0.10	0.34
Near_Road + Poach	4	0.48	5416.77	1.63	0.06	0.40
Near_River + Near_Road + Poach + Sim_M_amer	6	0.49	5416.95	1.82	0.05	0.45
NDVI_500m + Near_River + Near_Road + Poach	7	0.49	5417.18	2.04	0.05	0.49
dry + NDVI_500m + Near_River + Near_Road + Poach	7	0.49	5417.19	2.06	0.04	0.54
Near_River + Near_Road + Poach	6	0.49	5417.32	2.18	0.04	0.58
dry + Near_River + Near_Road + Poach	6	0.49	5417.36	2.22	0.04	0.62
NDVI_500m + Near_Road + Poach	5	0.49	5417.58	2.45	0.04	0.66
NDVI_500m + Near_River + Near_Road + Poach + Sim_M_amer	8	0.50	5417.67	2.54	0.04	0.69
dry + NDVI_500m + Near_River + Near_Road + Poach + Sim_M_amer	8	0.50	5417.70	2.57	0.03	0.73
Near_Road + Poach + Sim_M_amer	5	0.48	5418.72	3.59	0.02	0.75
Near_Road + Poach	5	0.48	5418.78	3.64	0.02	0.77
dry + Near_Road + Poach	5	0.48	5418.81	3.67	0.02	0.79
Near_River + Near_Road + Poach + Sim_M_amer	7	0.49	5419.00	3.86	0.02	0.81
dry + Near_River + Near_Road + Poach + Sim_M_amer	7	0.49	5419.05	3.91	0.02	0.82
dry + NDVI_500m + Near_River + Near_Road + Poach	8	0.49	5419.26	4.12	0.02	0.84
NDVI_500m + Near_Road + Poach + Sim_M_amer	6	0.49	5419.30	4.16	0.02	0.85
dry + Near_River + Near_Road + Poach	7	0.49	5419.40	4.26	0.01	0.87
NDVI_500m + Near_Road + Poach	6	0.49	5419.61	4.48	0.01	0.88
dry + NDVI_500m + Near_Road + Poach	6	0.49	5419.63	4.49	0.01	0.90
dry + NDVI_500m + Near_River + Near_Road + Poach + Sim_M_amer	9	0.50	5419.78	4.64	0.01	0.91
NDVI_500m + Near_River + Poach	5	0.48	5420.54	5.41	0.01	0.92
Near_Road + Poach + Sim_M_amer	6	0.48	5420.75	5.61	0.01	0.92
dry + Near_Road + Poach + Sim_M_amer	6	0.48	5420.78	5.65	0.01	0.93
dry + Near_Road + Poach	6	0.48	5420.84	5.71	0.01	0.94
dry + Near_River + Near_Road + Poach + Sim_M_amer	8	0.49	5421.11	5.97	0.01	0.95
NDVI_500m + Near_Road + Poach + Sim_M_amer	7	0.49	5421.34	6.21	0.01	0.95
dry + NDVI_500m + Near_Road + Poach + Sim_M_amer	7	0.49	5421.36	6.23	0.01	0.96
dry + NDVI_500m + Near_Road + Poach	7	0.49	5421.67	6.53	0.00	0.96
NDVI_500m + Near_River + Poach + Sim_M_amer	6	0.48	5422.08	6.95	0.00	0.97
Near_River + Poach	4	0.47	5422.38	7.24	0.00	0.97
NDVI_500m + Near_River + Poach	6	0.48	5422.57	7.44	0.00	0.97
dry + NDVI_500m + Near_River + Poach	6	0.48	5422.58	7.45	0.00	0.98
dry + Near_Road + Poach + Sim_M_amer	7	0.48	5422.83	7.69	0.00	0.98
NDVI_500m + Poach	4	0.47	5423.04	7.90	0.00	0.98
dry + NDVI_500m + Near_Road + Poach + Sim_M_amer	8	0.49	5423.42	8.29	0.00	0.98
Poach	3	0.47	5423.52	8.39	0.00	0.98

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
NDVI_500m + Near_River + Poach + Sim_M_amer	7	0.48	5424.13	8.99	0.00	0.99
dry + NDVI_500m + Near_River + Poach + Sim_M_amer	7	0.48	5424.15	9.01	0.00	0.99
Near_River + Poach	5	0.47	5424.39	9.26	0.00	0.99
dry + Near_River + Poach	5	0.47	5424.43	9.30	0.00	0.99
Near_River + Poach + Sim_M_amer	5	0.47	5424.45	9.31	0.00	0.99
dry + NDVI_500m + Near_River + Poach	7	0.48	5424.63	9.49	0.00	0.99
NDVI_500m + Poach	5	0.47	5425.05	9.92	0.00	0.99
dry + NDVI_500m + Poach	5	0.47	5425.06	9.93	0.00	0.99
NDVI_500m + Poach + Sim_M_amer	5	0.47	5425.07	9.94	0.00	0.99
Poach	4	0.47	5425.52	10.39	0.00	0.99
dry + Poach	4	0.47	5425.55	10.42	0.00	1.00
Poach + Sim_M_amer	4	0.47	5425.56	10.43	0.00	1.00
dry + NDVI_500m + Near_River + Poach + Sim_M_amer	8	0.48	5426.21	11.07	0.00	1.00
dry + Near_River + Poach	6	0.47	5426.46	11.33	0.00	1.00
Near_River + Poach + Sim_M_amer	6	0.47	5426.48	11.34	0.00	1.00
dry + Near_River + Poach + Sim_M_amer	6	0.47	5426.51	11.38	0.00	1.00
dry + NDVI_500m + Poach	6	0.47	5427.09	11.96	0.00	1.00
NDVI_500m + Poach + Sim_M_amer	6	0.47	5427.10	11.97	0.00	1.00
dry + NDVI_500m + Poach + Sim_M_amer	6	0.47	5427.11	11.98	0.00	1.00
dry + Poach	5	0.47	5427.57	12.43	0.00	1.00
Poach + Sim_M_amer	5	0.47	5427.58	12.44	0.00	1.00
dry + Poach + Sim_M_amer	5	0.47	5427.60	12.47	0.00	1.00
dry + Near_River + Poach + Sim_M_amer	7	0.47	5428.56	13.42	0.00	1.00
dry + NDVI_500m + Poach + Sim_M_amer	7	0.47	5429.16	14.02	0.00	1.00
dry + Poach + Sim_M_amer	6	0.47	5429.63	14.50	0.00	1.00
NDVI_500m + Near_Road + Sim_M_amer	5	0.07	5588.76	173.63	0.00	1.00
Near_Road + Sim_M_amer	4	0.06	5589.51	174.37	0.00	1.00
NDVI_500m + Near_River + Near_Road + Sim_M_amer	6	0.07	5590.52	175.38	0.00	1.00
NDVI_500m + Near_Road + Sim_M_amer	6	0.07	5590.79	175.66	0.00	1.00
dry + NDVI_500m + Near_Road + Sim_M_amer	6	0.07	5590.83	175.70	0.00	1.00
Near_River + Near_Road + Sim_M_amer	5	0.06	5591.47	176.33	0.00	1.00
Near_Road + Sim_M_amer	5	0.06	5591.52	176.39	0.00	1.00
dry + Near_Road + Sim_M_amer	5	0.06	5591.56	176.43	0.00	1.00
NDVI_500m + Sim_M_amer	4	0.05	5592.56	177.43	0.00	1.00
NDVI_500m + Near_River + Near_Road + Sim_M_amer	7	0.07	5592.56	177.43	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road + Sim_M_amer	7	0.07	5592.60	177.47	0.00	1.00
dry + NDVI_500m + Near_Road + Sim_M_amer	7	0.07	5592.88	177.74	0.00	1.00
Near_River + Near_Road + Sim_M_amer	6	0.06	5593.50	178.36	0.00	1.00
dry + Near_River + Near_Road + Sim_M_amer	6	0.06	5593.54	178.40	0.00	1.00
dry + Near_Road + Sim_M_amer	6	0.06	5593.59	178.46	0.00	1.00
NDVI_500m + Near_River + Sim_M_amer	5	0.05	5594.23	179.09	0.00	1.00
NDVI_500m + Sim_M_amer	5	0.05	5594.58	179.44	0.00	1.00
dry + NDVI_500m + Sim_M_amer	5	0.05	5594.62	179.48	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
dry + NDVI_500m + Near_River + Near_Road + Sim_M_amer	8	0.07	5594.66	179.53	0.00	1.00
Sim_M_amer	3	0.04	5594.88	179.74	0.00	1.00
dry + Near_River + Near_Road + Sim_M_amer	7	0.06	5595.58	180.45	0.00	1.00
NDVI_500m + Near_River + Sim_M_amer	6	0.05	5596.26	181.12	0.00	1.00
dry + NDVI_500m + Near_River + Sim_M_amer	6	0.05	5596.30	181.16	0.00	1.00
dry + NDVI_500m + Sim_M_amer	6	0.05	5596.65	181.51	0.00	1.00
Near_River + Sim_M_amer	4	0.04	5596.83	181.69	0.00	1.00
Sim_M_amer	4	0.04	5596.88	181.74	0.00	1.00
dry + Sim_M_amer	4	0.04	5596.92	181.78	0.00	1.00
NDVI_500m + Near_Road	4	0.03	5597.97	182.84	0.00	1.00
dry + NDVI_500m + Near_River + Sim_M_amer	7	0.05	5598.34	183.20	0.00	1.00
Near_River + Sim_M_amer	5	0.04	5598.84	183.71	0.00	1.00
dry + Near_River + Sim_M_amer	5	0.04	5598.88	183.75	0.00	1.00
dry + Sim_M_amer	5	0.04	5598.93	183.80	0.00	1.00
Near_Road	3	0.02	5599.27	184.14	0.00	1.00
NDVI_500m + Near_Road	5	0.03	5599.99	184.85	0.00	1.00
NDVI_500m + Near_River + Near_Road	5	0.03	5600.01	184.88	0.00	1.00
dry + NDVI_500m + Near_Road	5	0.03	5600.03	184.89	0.00	1.00
NDVI_500m	3	0.02	5600.73	185.60	0.00	1.00
dry + Near_River + Sim_M_amer	6	0.04	5600.91	185.78	0.00	1.00
Near_River + Near_Road	4	0.02	5601.10	185.96	0.00	1.00
Near_Road	4	0.02	5601.27	186.14	0.00	1.00
dry + Near_Road	4	0.02	5601.31	186.18	0.00	1.00
NDVI_500m + Near_River + Near_Road	6	0.03	5602.04	186.91	0.00	1.00
dry + NDVI_500m + Near_Road	6	0.03	5602.06	186.92	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road	6	0.03	5602.08	186.95	0.00	1.00
NDVI_500m	4	0.02	5602.73	187.60	0.00	1.00
dry + NDVI_500m	4	0.02	5602.77	187.64	0.00	1.00
NDVI_500m + Near_River	4	0.02	5602.79	187.66	0.00	1.00
Near_River + Near_Road	5	0.02	5603.11	187.98	0.00	1.00
dry + Near_River + Near_Road	5	0.02	5603.16	188.02	0.00	1.00
dry + Near_Road	5	0.02	5603.33	188.19	0.00	1.00
~ 1	2	-	5603.47	188.34	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road	7	0.03	5604.13	188.99	0.00	1.00
dry + NDVI_500m	5	0.02	5604.79	189.65	0.00	1.00
NDVI_500m + Near_River	5	0.02	5604.81	189.67	0.00	1.00
dry + NDVI_500m + Near_River	5	0.02	5604.85	189.71	0.00	1.00
dry + Near_River + Near_Road	6	0.02	5605.18	190.05	0.00	1.00
Near_River	3	0.00	5605.39	190.26	0.00	1.00
~1	3	0.00	5605.46	190.32	0.00	1.00
dry	3	0.00	5605.50	190.36	0.00	1.00
dry + NDVI_500m + Near_River	6	0.02	5606.88	191.74	0.00	1.00
Near_River	4	0.00	5607.40	192.26	0.00	1.00
dry + Near_River	4	0.00	5607.44	192.30	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
dry	4	0.00	5607.50	192.36	0.00	1.00
dry + Near_River	5	0.00	5609.45	194.32	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_M_amer indicates geometric edge effect predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O Autor, 2023

Table S6 - Candidate models predicting occupancy of Mazama Gouzobira across Vale Natural Reserve;

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
Poach + pt_EVI	4	0.50	5969.68	-	0.15	0.15
Near_River + Poach + pt_EVI	5	0.50	5970.57	0.88	0.09	0.24
Poach + pt_EVI + Sim_M_gouza	5	0.50	5970.57	0.88	0.09	0.33
Near_Road + Poach + pt_EVI	5	0.50	5971.50	1.81	0.06	0.39
Poach + pt_EVI	5	0.50	5971.64	1.96	0.05	0.45
dry + Poach + pt_EVI	5	0.50	5971.72	2.03	0.05	0.50
Near_River + Poach + pt_EVI + Sim_M_gouza	6	0.50	5971.99	2.31	0.05	0.55
Near_Road + Poach + pt_EVI + Sim_M_gouza	6	0.50	5972.21	2.53	0.04	0.59
Near_River + Poach + pt_EVI	6	0.50	5972.54	2.86	0.03	0.62
Poach + pt_EVI + Sim_M_gouza	6	0.50	5972.54	2.86	0.03	0.66
Near_River + Near_Road + Poach + pt_EVI	6	0.50	5972.55	2.87	0.03	0.69
dry + Near_River + Poach + pt_EVI	6	0.50	5972.61	2.93	0.03	0.73
dry + Poach + pt_EVI + Sim_M_gouza	6	0.50	5972.63	2.94	0.03	0.76
Near_Road + Poach + pt_EVI	6	0.50	5973.47	3.79	0.02	0.78
dry + Near_Road + Poach + pt_EVI	6	0.50	5973.54	3.86	0.02	0.80
dry + Poach + pt_EVI	6	0.50	5973.69	4.01	0.02	0.82
Near_River + Near_Road + Poach + pt_EVI + Sim_M_gouza	7	0.50	5973.85	4.16	0.02	0.84
Near_River + Poach + pt_EVI + Sim_M_gouza	7	0.50	5973.98	4.30	0.02	0.86
dry + Near_River + Poach + pt_EVI + Sim_M_gouza	7	0.50	5974.07	4.38	0.02	0.87
Near_Road + Poach + pt_EVI + Sim_M_gouza	7	0.50	5974.20	4.51	0.02	0.89
dry + Near_Road + Poach + pt_EVI + Sim_M_gouza	7	0.50	5974.28	4.59	0.01	0.90
Near_River + Near_Road + Poach + pt_EVI	7	0.50	5974.54	4.85	0.01	0.92
dry + Near_River + Poach + pt_EVI	7	0.50	5974.60	4.92	0.01	0.93
dry + Near_River + Near_Road + Poach + pt_EVI	7	0.50	5974.61	4.92	0.01	0.94
dry + Poach + pt_EVI + Sim_M_gouza	7	0.50	5974.62	4.93	0.01	0.95
dry + Near_Road + Poach + pt_EVI	7	0.50	5975.53	5.85	0.01	0.96
Near_River + Near_Road + Poach + pt_EVI + Sim_M_gouza	8	0.50	5975.85	6.17	0.01	0.97
dry + Near_River + Near_Road + Poach + pt_EVI + Sim_M_gouza	8	0.50	5975.93	6.25	0.01	0.97
dry + Near_River + Poach + pt_EVI + Sim_M_gouza	8	0.50	5976.07	6.38	0.01	0.98
dry + Near_Road + Poach + pt_EVI + Sim_M_gouza	8	0.50	5976.28	6.60	0.01	0.99
dry + Near_River + Near_Road + Poach + pt_EVI	8	0.50	5976.61	6.93	0.00	0.99
dry + Near_River + Near_Road + Poach + pt_EVI + Sim_M_gouza	9	0.50	5977.95	8.27	0.00	0.99
Near_River + Poach	4	0.48	5979.22	9.54	0.00	0.99
Poach	3	0.48	5980.38	10.70	0.00	0.99
Near_River + Poach + Sim_M_gouza	5	0.48	5980.90	11.21	0.00	1.00
Near_River + Poach	5	0.48	5981.18	11.50	0.00	1.00
dry + Near_River + Poach	5	0.48	5981.19	11.51	0.00	1.00
Near_River + Near_Road + Poach	5	0.48	5981.20	11.51	0.00	1.00
Poach + Sim_M_gouza	4	0.48	5981.97	12.29	0.00	1.00
dry + Poach	4	0.48	5982.32	12.64	0.00	1.00
Poach	4	0.48	5982.32	12.64	0.00	1.00
Near_Road + Poach	4	0.48	5982.44	12.75	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
Near_River + Near_Road + Poach + Sim_M_gouza	6	0.48	5982.84	13.15	0.00	1.00
Near_River + Poach + Sim_M_gouza	6	0.48	5982.87	13.18	0.00	1.00
dry + Near_River + Poach + Sim_M_gouza	6	0.48	5982.87	13.19	0.00	1.00
dry + Near_River + Poach	6	0.48	5983.17	13.48	0.00	1.00
Near_River + Near_Road + Poach	6	0.48	5983.17	13.49	0.00	1.00
dry + Near_River + Near_Road + Poach	6	0.48	5983.18	13.49	0.00	1.00
dry + Poach + Sim_M_gouza	5	0.48	5983.93	14.24	0.00	1.00
Poach + Sim_M_gouza	5	0.48	5983.93	14.25	0.00	1.00
Near_Road + Poach + Sim_M_gouza	5	0.48	5984.03	14.35	0.00	1.00
dry + Poach	5	0.48	5984.28	14.60	0.00	1.00
dry + Near_Road + Poach	5	0.48	5984.39	14.71	0.00	1.00
Near_Road + Poach	5	0.48	5984.39	14.71	0.00	1.00
dry + Near_River + Near_Road + Poach + Sim_M_gouza	7	0.48	5984.82	15.13	0.00	1.00
Near_River + Near_Road + Poach + Sim_M_gouza	7	0.48	5984.82	15.14	0.00	1.00
dry + Near_River + Poach + Sim_M_gouza	7	0.48	5984.86	15.17	0.00	1.00
dry + Near_River + Near_Road + Poach	7	0.48	5985.17	15.48	0.00	1.00
dry + Poach + Sim_M_gouza	6	0.48	5985.90	16.22	0.00	1.00
dry + Near_Road + Poach + Sim_M_gouza	6	0.48	5986.00	16.31	0.00	1.00
Near_Road + Poach + Sim_M_gouza	6	0.48	5986.01	16.32	0.00	1.00
dry + Near_Road + Poach	6	0.48	5986.36	16.68	0.00	1.00
dry + Near_River + Near_Road + Poach + Sim_M_gouza	8	0.48	5986.82	17.14	0.00	1.00
dry + Near_Road + Poach + Sim_M_gouza	7	0.48	5987.99	18.30	0.00	1.00
pt_EVI + Sim_M_gouza	4	0.09	6142.84	173.15	0.00	1.00
Near_River + pt_EVI + Sim_M_gouza	5	0.09	6144.64	174.96	0.00	1.00
pt_EVI + Sim_M_gouza	5	0.09	6144.80	175.11	0.00	1.00
dry + pt_EVI + Sim_M_gouza	5	0.09	6144.82	175.14	0.00	1.00
Near_Road + pt_EVI + Sim_M_gouza	5	0.09	6144.90	175.22	0.00	1.00
pt_EVI	3	0.07	6145.10	175.41	0.00	1.00
Near_River + pt_EVI + Sim_M_gouza	6	0.09	6146.61	176.93	0.00	1.00
dry + Near_River + pt_EVI + Sim_M_gouza	6	0.09	6146.64	176.96	0.00	1.00
Near_River + Near_Road + pt_EVI + Sim_M_gouza	6	0.09	6146.72	177.04	0.00	1.00
dry + pt_EVI + Sim_M_gouza	6	0.09	6146.80	177.11	0.00	1.00
Near_River + pt_EVI	4	0.07	6146.86	177.18	0.00	1.00
Near_Road + pt_EVI + Sim_M_gouza	6	0.09	6146.87	177.19	0.00	1.00
dry + Near_Road + pt_EVI + Sim_M_gouza	6	0.09	6146.90	177.22	0.00	1.00
pt_EVI	4	0.07	6147.04	177.36	0.00	1.00
dry + pt_EVI	4	0.07	6147.07	177.38	0.00	1.00
Near_Road + pt_EVI	4	0.07	6147.15	177.46	0.00	1.00
dry + Near_River + pt_EVI + Sim_M_gouza	7	0.09	6148.63	178.94	0.00	1.00
Near_River + Near_Road + pt_EVI + Sim_M_gouza	7	0.09	6148.71	179.03	0.00	1.00
dry + Near_River + Near_Road + pt_EVI + Sim_M_gouza	7	0.09	6148.74	179.05	0.00	1.00
Near_River + pt_EVI	5	0.07	6148.82	179.14	0.00	1.00
dry + Near_River + pt_EVI	5	0.07	6148.85	179.17	0.00	1.00
dry + Near_Road + pt_EVI + Sim_M_gouza	7	0.09	6148.89	179.20	0.00	1.00
Near_River + Near_Road + pt_EVI	5	0.07	6148.93	179.25	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICcWt	CumWt
dry + pt_EVI	5	0.07	6149.03	179.34	0.00	1.00
Near_Road + pt_EVI	5	0.07	6149.11	179.42	0.00	1.00
dry + Near_Road + pt_EVI	5	0.07	6149.13	179.45	0.00	1.00
dry + Near_River + Near_Road + pt_EVI + Sim_M_gouza	8	0.09	6150.74	181.05	0.00	1.00
dry + Near_River + pt_EVI	6	0.07	6150.82	181.14	0.00	1.00
Near_River + Near_Road + pt_EVI	6	0.07	6150.91	181.22	0.00	1.00
dry + Near_River + Near_Road + pt_EVI	6	0.07	6150.93	181.25	0.00	1.00
dry + Near_Road + pt_EVI	6	0.07	6151.11	181.42	0.00	1.00
dry + Near_River + Near_Road + pt_EVI	7	0.07	6152.92	183.24	0.00	1.00
Sim_M_gouza	3	0.01	6163.63	193.95	0.00	1.00
1	2	-	6164.72	195.03	0.00	1.00
Near_Road + Sim_M_gouza	4	0.01	6165.43	195.75	0.00	1.00
Sim_M_gouza	4	0.01	6165.58	195.89	0.00	1.00
dry + Sim_M_gouza	4	0.01	6165.61	195.93	0.00	1.00
Near_River + Sim_M_gouza	4	0.01	6165.68	196.00	0.00	1.00
Near_Road	3	0.00	6166.37	196.69	0.00	1.00
1	3	0.00	6166.64	196.96	0.00	1.00
dry	3	0.00	6166.68	196.99	0.00	1.00
Near_River	3	0.00	6166.72	197.04	0.00	1.00
Near_Road + Sim_M_gouza	5	0.01	6167.39	197.71	0.00	1.00
dry + Near_Road + Sim_M_gouza	5	0.01	6167.43	197.74	0.00	1.00
Near_River + Near_Road + Sim_M_gouza	5	0.01	6167.49	197.81	0.00	1.00
dry + Sim_M_gouza	5	0.01	6167.57	197.88	0.00	1.00
Near_River + Sim_M_gouza	5	0.01	6167.64	197.96	0.00	1.00
dry + Near_River + Sim_M_gouza	5	0.01	6167.68	197.99	0.00	1.00
Near_Road	4	0.00	6168.32	198.63	0.00	1.00
dry + Near_Road	4	0.00	6168.35	198.67	0.00	1.00
Near_River + Near_Road	4	0.00	6168.38	198.70	0.00	1.00
dry	4	0.00	6168.62	198.94	0.00	1.00
Near_River	4	0.00	6168.67	198.98	0.00	1.00
dry + Near_River	4	0.00	6168.70	199.02	0.00	1.00
dry + Near_Road + Sim_M_gouza	6	0.01	6169.40	199.71	0.00	1.00
Near_River + Near_Road + Sim_M_gouza	6	0.01	6169.47	199.78	0.00	1.00
dry + Near_River + Near_Road + Sim_M_gouza	6	0.01	6169.50	199.82	0.00	1.00
dry + Near_River + Sim_M_gouza	6	0.01	6169.65	199.96	0.00	1.00
dry + Near_Road	5	0.00	6170.31	200.63	0.00	1.00
Near_River + Near_Road	5	0.00	6170.34	200.66	0.00	1.00
dry + Near_River + Near_Road	5	0.00	6170.38	200.69	0.00	1.00
dry + Near_River	5	0.00	6170.66	200.98	0.00	1.00
dry + Near_River + Near_Road + Sim_M_gouza	7	0.01	6171.49	201.80	0.00	1.00
dry + Near_River + Near_Road	6	0.00	6172.35	202.67	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_M_gouza indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O Autor, 2023.

Table S7 - Candidate models predicting occupancy of *Cuniculus paca* across Vale Natural Reserve.

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
Near_River + Near_Road + Poach + Sim_C.paca	6	0.49	2399.19	0	0.17	0.17
Near_River + Near_Road + Poach + pt_NDVI + Sim_C.paca	7	0.49	2399.20	0.01	0.17	0.34
Near_River + Poach + pt_NDVI + Sim_C.paca	6	0.49	2399.84	0.65	0.12	0.46
Near_River + Near_Road + Poach + Sim_C.paca	7	0.49	2401.14	1.95	0.06	0.53
Near_River + Near_Road + Poach + pt_NDVI + Sim_C.paca	8	0.49	2401.16	1.97	0.06	0.59
Near_River + Poach + Sim_C.paca	5	0.48	2401.17	1.97	0.06	0.65
dry + Near_River + Near_Road + Poach + Sim_C.paca	7	0.49	2401.28	2.09	0.06	0.71
dry + Near_River + Near_Road + Poach + pt_NDVI + Sim_C.paca	8	0.49	2401.31	2.11	0.06	0.77
Near_River + Poach + pt_NDVI + Sim_C.paca	7	0.49	2401.79	2.60	0.05	0.82
dry + Near_River + Poach + pt_NDVI + Sim_C.paca	7	0.49	2401.94	2.75	0.04	0.86
Near_River + Poach + Sim_C.paca	6	0.48	2403.10	3.91	0.02	0.88
dry + Near_River + Poach + Sim_C.paca	6	0.48	2403.25	4.05	0.02	0.91
dry + Near_River + Near_Road + Poach + Sim_C.paca	8	0.49	2403.25	4.06	0.02	0.93
dry + Near_River + Near_Road + Poach + pt_NDVI + Sim_C.paca	9	0.49	2403.29	4.09	0.02	0.95
dry + Near_River + Poach + pt_NDVI + Sim_C.paca	8	0.49	2403.91	4.71	0.02	0.97
dry + Near_River + Poach + Sim_C.paca	7	0.48	2405.20	6.00	0.01	0.97
Near_River + Poach + pt_NDVI	5	0.48	2405.73	6.54	0.01	0.98
Near_River + Near_Road + Poach + pt_NDVI	6	0.48	2405.88	6.69	0.01	0.99
Near_River + Poach + pt_NDVI	6	0.48	2407.67	8.48	0.00	0.99
dry + Near_River + Poach + pt_NDVI	6	0.48	2407.82	8.62	0.00	0.99
Near_River + Near_Road + Poach + pt_NDVI	7	0.48	2407.83	8.64	0.00	0.99
dry + Near_River + Near_Road + Poach + pt_NDVI	7	0.48	2407.98	8.78	0.00	1.00
dry + Near_River + Poach + pt_NDVI	7	0.48	2409.77	10.57	0.00	1.00
Near_River + Near_Road + Poach	5	0.47	2409.86	10.66	0.00	1.00
dry + Near_River + Near_Road + Poach + pt_NDVI	8	0.48	2409.94	10.75	0.00	1.00
Near_River + Poach	4	0.46	2411.43	12.24	0.00	1.00
Near_River + Near_Road + Poach	6	0.47	2411.79	12.60	0.00	1.00
dry + Near_River + Near_Road + Poach	6	0.47	2411.94	12.74	0.00	1.00
Near_River + Poach	5	0.46	2413.35	14.16	0.00	1.00
dry + Near_River + Poach	5	0.46	2413.50	14.31	0.00	1.00
dry + Near_River + Near_Road + Poach	7	0.47	2413.89	14.69	0.00	1.00
dry + Near_River + Poach	6	0.46	2415.44	16.24	0.00	1.00
Poach + pt_NDVI + Sim_C.paca	5	0.46	2416.01	16.82	0.00	1.00
Poach + pt_NDVI	4	0.45	2416.93	17.74	0.00	1.00
Near_Road + Poach + pt_NDVI + Sim_C.paca	6	0.46	2417.48	18.29	0.00	1.00
Poach + pt_NDVI + Sim_C.paca	6	0.46	2417.95	18.75	0.00	1.00
dry + Poach + pt_NDVI + Sim_C.paca	6	0.46	2418.09	18.90	0.00	1.00
Near_Road + Poach + pt_NDVI	5	0.45	2418.45	19.26	0.00	1.00
Poach + pt_NDVI	5	0.45	2418.86	19.66	0.00	1.00
dry + Poach + pt_NDVI	5	0.45	2419.01	19.81	0.00	1.00
Near_Road + Poach + pt_NDVI + Sim_C.paca	7	0.46	2419.43	20.24	0.00	1.00
dry + Near_Road + Poach + pt_NDVI + Sim_C.paca	7	0.46	2419.58	20.39	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + Poach + pt_NDVI + Sim_C.paca	7	0.46	2420.04	20.85	0.00	1.00
Near_Road + Poach + pt_NDVI	6	0.45	2420.38	21.19	0.00	1.00
dry + Near_Road + Poach + pt_NDVI	6	0.45	2420.53	21.34	0.00	1.00
dry + Poach + pt_NDVI	6	0.45	2420.94	21.75	0.00	1.00
dry + Near_Road + Poach + pt_NDVI + Sim_C.paca	8	0.46	2421.55	22.36	0.00	1.00
dry + Near_Road + Poach + pt_NDVI	7	0.45	2422.48	23.29	0.00	1.00
Poach + Sim_C.paca	4	0.42	2430.24	31.04	0.00	1.00
Near_Road + Poach + Sim_C.paca	5	0.43	2431.18	31.98	0.00	1.00
Poach + Sim_C.paca	5	0.42	2432.16	32.96	0.00	1.00
dry + Poach + Sim_C.paca	5	0.42	2432.30	33.11	0.00	1.00
Near_Road + Poach + Sim_C.paca	6	0.43	2433.11	33.92	0.00	1.00
dry + Near_Road + Poach + Sim_C.paca	6	0.43	2433.26	34.07	0.00	1.00
dry + Poach + Sim_C.paca	6	0.42	2434.24	35.05	0.00	1.00
dry + Near_Road + Poach + Sim_C.paca	7	0.43	2435.21	36.02	0.00	1.00
Poach	3	0.41	2435.49	36.30	0.00	1.00
Near_Road + Poach	4	0.41	2436.34	37.15	0.00	1.00
Poach	4	0.41	2437.40	38.21	0.00	1.00
dry + Poach	4	0.41	2437.54	38.35	0.00	1.00
Near_Road + Poach	5	0.41	2438.26	39.07	0.00	1.00
dry + Near_Road + Poach	5	0.41	2438.41	39.21	0.00	1.00
dry + Poach	5	0.41	2439.46	40.27	0.00	1.00
dry + Near_Road + Poach	6	0.41	2440.34	41.15	0.00	1.00
pt_NDVI + Sim_C.paca	4	0.08	2566.01	166.82	0.00	1.00
Near_Road + pt_NDVI + Sim_C.paca	5	0.08	2566.90	167.70	0.00	1.00
Near_River + pt_NDVI + Sim_C.paca	5	0.08	2567.57	168.38	0.00	1.00
pt_NDVI + Sim_C.paca	5	0.08	2567.93	168.74	0.00	1.00
dry + pt_NDVI + Sim_C.paca	5	0.08	2568.06	168.87	0.00	1.00
Near_River + Near_Road + pt_NDVI + Sim_C.paca	6	0.08	2568.28	169.09	0.00	1.00
Near_Road + pt_NDVI + Sim_C.paca	6	0.08	2568.83	169.64	0.00	1.00
dry + Near_Road + pt_NDVI + Sim_C.paca	6	0.08	2568.96	169.77	0.00	1.00
Near_River + pt_NDVI + Sim_C.paca	6	0.08	2569.51	170.31	0.00	1.00
dry + Near_River + pt_NDVI + Sim_C.paca	6	0.08	2569.64	170.45	0.00	1.00
dry + pt_NDVI + Sim_C.paca	6	0.08	2570.00	170.81	0.00	1.00
Near_River + Near_Road + pt_NDVI + Sim_C.paca	7	0.08	2570.23	171.04	0.00	1.00
pt_NDVI	3	0.06	2570.32	171.13	0.00	1.00
dry + Near_River + Near_Road + pt_NDVI + Sim_C.paca	7	0.08	2570.37	171.17	0.00	1.00
dry + Near_Road + pt_NDVI + Sim_C.paca	7	0.08	2570.91	171.72	0.00	1.00
Near_River + pt_NDVI	4	0.06	2571.57	172.38	0.00	1.00
dry + Near_River + pt_NDVI + Sim_C.paca	7	0.08	2571.59	172.40	0.00	1.00
Near_Road + pt_NDVI	4	0.06	2571.90	172.71	0.00	1.00
pt_NDVI	4	0.06	2572.23	173.03	0.00	1.00
dry + Near_River + Near_Road + pt_NDVI + Sim_C.paca	8	0.08	2572.33	173.14	0.00	1.00
dry + pt_NDVI	4	0.06	2572.36	173.17	0.00	1.00
Near_River + Near_Road + pt_NDVI	5	0.06	2573.00	173.81	0.00	1.00
Near_River + pt_NDVI	5	0.06	2573.49	174.30	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + Near_River + pt_NDVI	5	0.06	2573.63	174.43	0.00	1.00
Near_Road + pt_NDVI	5	0.06	2573.82	174.63	0.00	1.00
dry + Near_Road + pt_NDVI	5	0.06	2573.96	174.76	0.00	1.00
dry + pt_NDVI	5	0.06	2574.28	175.09	0.00	1.00
Near_River + Near_Road + pt_NDVI	6	0.06	2574.94	175.75	0.00	1.00
dry + Near_River + Near_Road + pt_NDVI	6	0.06	2575.07	175.88	0.00	1.00
dry + Near_River + pt_NDVI	6	0.06	2575.56	176.37	0.00	1.00
dry + Near_Road + pt_NDVI	6	0.06	2575.89	176.70	0.00	1.00
dry + Near_River + Near_Road + pt_NDVI	7	0.06	2577.02	177.83	0.00	1.00
Near_River + Sim_C.paca	4	0.03	2581.99	182.80	0.00	1.00
Near_River + Near_Road + Sim_C.paca	5	0.03	2582.31	183.12	0.00	1.00
Near_River	3	0.01	2582.97	183.78	0.00	1.00
Near_River + Near_Road	4	0.02	2583.90	184.71	0.00	1.00
Near_River + Sim_C.paca	5	0.03	2583.91	184.72	0.00	1.00
dry + Near_River + Sim_C.paca	5	0.03	2584.05	184.86	0.00	1.00
Sim_C.paca	3	0.01	2584.16	184.96	0.00	1.00
Near_River + Near_Road + Sim_C.paca	6	0.03	2584.24	185.05	0.00	1.00
dry + Near_River + Near_Road + Sim_C.paca	6	0.03	2584.38	185.18	0.00	1.00
Near_Road + Sim_C.paca	4	0.02	2584.77	185.58	0.00	1.00
Near_River	4	0.02	2584.88	185.69	0.00	1.00
dry + Near_River	4	0.01	2585.01	185.82	0.00	1.00
1	2	-	2585.25	186.06	0.00	1.00
Near_River + Near_Road	5	0.02	2585.82	186.63	0.00	1.00
dry + Near_River + Near_Road	5	0.02	2585.96	186.76	0.00	1.00
dry + Near_River + Sim_C.paca	6	0.03	2585.98	186.79	0.00	1.00
Sim_C.paca	4	0.01	2586.06	186.87	0.00	1.00
dry + Sim_C.paca	4	0.01	2586.20	187.00	0.00	1.00
dry + Near_River + Near_Road + Sim_C.paca	7	0.03	2586.33	187.14	0.00	1.00
Near_Road	3	0.00	2586.41	187.22	0.00	1.00
Near_Road + Sim_C.paca	5	0.02	2586.69	187.50	0.00	1.00
dry + Near_Road + Sim_C.paca	5	0.02	2586.83	187.64	0.00	1.00
dry + Near_River	5	0.02	2586.93	187.74	0.00	1.00
1	3	0.00	2587.14	187.95	0.00	1.00
dry	3	0.00	2587.27	188.08	0.00	1.00
dry + Near_River + Near_Road	6	0.02	2587.89	188.70	0.00	1.00
dry + Sim_C.paca	5	0.01	2588.12	188.93	0.00	1.00
Near_Road	4	0.00	2588.32	189.13	0.00	1.00
dry + Near_Road	4	0.00	2588.45	189.26	0.00	1.00
dry + Near_Road + Sim_C.paca	6	0.02	2588.76	189.57	0.00	1.00
dry	4	0.00	2589.18	189.99	0.00	1.00
dry + Near_Road	5	0.00	2590.37	191.18	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_C.paca indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Table S8 - Candidate models predicting occupancy of Leopardus pardallis across Vale Natural Reserve.

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + pt_EVI + Sim_L_parda	5	0.09	3 187.74	-	0.18	0.18
dry + Poach + pt_EVI + Sim_L_parda	6	0.09	3 188.75	1.00	0.11	0.29
dry + Near_River + pt_EVI + Sim_L_parda	6	0.09	3 189.14	1.40	0.09	0.38
dry + Near_Road + pt_EVI + Sim_L_parda	6	0.09	3 189.70	1.96	0.07	0.45
dry + pt_EVI + Sim_L_parda	6	0.09	3 189.78	2.04	0.07	0.51
dry + Near_River + Poach + pt_EVI + Sim_L_parda	7	0.09	3 190.03	2.29	0.06	0.57
dry + Near_Road + Poach + pt_EVI + Sim_L_parda	7	0.09	3 190.72	2.97	0.04	0.61
dry + Poach + pt_EVI + Sim_L_parda	7	0.09	3 190.80	3.06	0.04	0.65
dry + Near_River + Near_Road + pt_EVI + Sim_L_parda	7	0.09	3 191.15	3.40	0.03	0.69
dry + Near_River + pt_EVI + Sim_L_parda	7	0.09	3 191.20	3.45	0.03	0.72
dry + Near_Road + pt_EVI + Sim_L_parda	7	0.09	3 191.76	4.02	0.02	0.74
dry + pt_EVI	4	0.07	3 191.77	4.02	0.02	0.77
dry + Near_River + Near_Road + Poach + pt_EVI + Sim_L_parda	8	0.09	3 192.04	4.30	0.02	0.79
dry + Poach + pt_EVI	5	0.07	3 192.07	4.33	0.02	0.81
dry + Near_River + Poach + pt_EVI + Sim_L_parda	8	0.09	3 192.10	4.36	0.02	0.83
dry + Near_Road + Poach + pt_EVI + Sim_L_parda	8	0.09	3 192.79	5.04	0.01	0.84
dry + Near_River + Near_Road + pt_EVI + Sim_L_parda	8	0.09	3 193.21	5.47	0.01	0.86
dry + Near_Road + pt_EVI	5	0.07	3 193.37	5.63	0.01	0.87
dry + Near_River + pt_EVI	5	0.07	3 193.54	5.79	0.01	0.88
dry + Near_Road + Poach + pt_EVI	6	0.07	3 193.69	5.95	0.01	0.89
dry + Near_River + Poach + pt_EVI	6	0.07	3 193.70	5.96	0.01	0.90
dry + pt_EVI	5	0.07	3 193.78	6.04	0.01	0.90
dry + Poach + pt_EVI	6	0.07	3 194.11	6.36	0.01	0.91
dry + Near_River + Near_Road + Poach + pt_EVI + Sim_L_parda	9	0.09	3 194.13	6.39	0.01	0.92
pt_EVI + Sim_L_parda	4	0.06	3 194.24	6.50	0.01	0.93
Poach + pt_EVI + Sim_L_parda	5	0.06	3 195.15	7.41	0.00	0.93
dry + Near_River + Near_Road + pt_EVI	6	0.07	3 195.19	7.45	0.00	0.94
dry + Near_River + Near_Road + Poach + pt_EVI	7	0.08	3 195.38	7.64	0.00	0.94
dry + Near_Road + pt_EVI	6	0.07	3 195.41	7.66	0.00	0.94
dry + Near_River + pt_EVI	6	0.07	3 195.57	7.82	0.00	0.95
Near_River + pt_EVI + Sim_L_parda	5	0.06	3 195.66	7.92	0.00	0.95
dry + Near_Road + Poach + pt_EVI	7	0.07	3 195.75	8.00	0.00	0.95
dry + Near_River + Poach + pt_EVI	7	0.07	3 195.75	8.01	0.00	0.96
Near_Road + pt_EVI + Sim_L_parda	5	0.06	3 196.19	8.45	0.00	0.96
pt_EVI + Sim_L_parda	5	0.06	3 196.31	8.56	0.00	0.96
Near_River + Poach + pt_EVI + Sim_L_parda	6	0.07	3 196.45	8.70	0.00	0.96
dry + Poach + Sim_L_parda	5	0.06	3 196.55	8.81	0.00	0.97
dry + Sim_L_parda	4	0.05	3 196.57	8.83	0.00	0.97
dry + Near_River + Poach + Sim_L_parda	6	0.06	3 196.91	9.16	0.00	0.97
Near_Road + Poach + pt_EVI + Sim_L_parda	6	0.06	3 197.11	9.36	0.00	0.97

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + Near_River + Sim_L_parda	5	0.06	3 197.22	9.48	0.00	0.97
Poach + pt_EVI + Sim_L_parda	6	0.06	3 197.23	9.49	0.00	0.98
dry + Near_River + Near_Road + pt_EVI	7	0.07	3 197.24	9.50	0.00	0.98
dry + Near_River + Near_Road + Poach + pt_EVI	8	0.08	3 197.45	9.71	0.00	0.98
Near_River + Near_Road + pt_EVI + Sim_L_parda	6	0.06	3 197.65	9.90	0.00	0.98
Near_River + pt_EVI + Sim_L_parda	6	0.06	3 197.74	9.99	0.00	0.98
pt_EVI	3	0.04	3 198.15	10.41	0.00	0.98
dry + Near_Road + Poach + Sim_L_parda	6	0.06	3 198.26	10.52	0.00	0.98
dry + Near_Road + Sim_L_parda	5	0.05	3 198.26	10.52	0.00	0.98
Near_Road + pt_EVI + Sim_L_parda	6	0.06	3 198.27	10.52	0.00	0.98
Poach + pt_EVI	4	0.05	3 198.33	10.59	0.00	0.99
Near_River + Near_Road + Poach + pt_EVI + Sim_L_parda	7	0.07	3 198.44	10.70	0.00	0.99
Near_River + Poach + pt_EVI + Sim_L_parda	7	0.07	3 198.54	10.79	0.00	0.99
dry + Poach + Sim_L_parda	6	0.06	3 198.59	10.85	0.00	0.99
dry + Sim_L_parda	5	0.05	3 198.60	10.86	0.00	0.99
dry + Near_River + Near_Road + Poach + Sim_L_parda	7	0.06	3 198.73	10.99	0.00	0.99
dry + Near_River + Poach + Sim_L_parda	7	0.06	3 198.96	11.22	0.00	0.99
dry + Near_River + Near_Road + Sim_L_parda	6	0.06	3 199.02	11.28	0.00	0.99
Near_Road + Poach + pt_EVI + Sim_L_parda	7	0.06	3 199.20	11.46	0.00	0.99
dry + Near_River + Sim_L_parda	6	0.06	3 199.27	11.52	0.00	0.99
Near_River + Near_Road + pt_EVI + Sim_L_parda	7	0.06	3 199.74	11.99	0.00	0.99
Near_Road + pt_EVI	4	0.04	3 199.74	12.00	0.00	0.99
Near_River + pt_EVI	4	0.04	3 199.93	12.18	0.00	0.99
Near_Road + Poach + pt_EVI	5	0.05	3 199.94	12.20	0.00	0.99
Near_River + Poach + pt_EVI	5	0.05	3 199.96	12.22	0.00	0.99
pt_EVI	4	0.04	3 200.19	12.45	0.00	0.99
dry + Poach	4	0.04	3 200.22	12.48	0.00	0.99
dry + Near_Road + Sim_L_parda	6	0.05	3 200.30	12.56	0.00	1.00
dry + Near_Road + Poach + Sim_L_parda	7	0.06	3 200.32	12.58	0.00	1.00
Poach + pt_EVI	5	0.05	3 200.39	12.65	0.00	1.00
Near_River + Near_Road + Poach + pt_EVI + Sim_L_parda	8	0.07	3 200.55	12.81	0.00	1.00
dry + Near_River + Near_Road + Poach + Sim_L_parda	8	0.06	3 200.81	13.06	0.00	1.00
dry + Near_River + Near_Road + Sim_L_parda	7	0.06	3 201.08	13.33	0.00	1.00
dry + Near_River + Poach	5	0.04	3 201.16	13.42	0.00	1.00
dry + Near_Road + Poach	5	0.04	3 201.38	13.64	0.00	1.00
Near_River + Near_Road + pt_EVI	5	0.04	3 201.57	13.82	0.00	1.00
dry	3	0.03	3 201.57	13.83	0.00	1.00
Near_River + Near_Road + Poach + pt_EVI	6	0.05	3 201.63	13.89	0.00	1.00
Near_Road + pt_EVI	5	0.04	3 201.80	14.06	0.00	1.00
Near_River + pt_EVI	5	0.04	3 201.98	14.24	0.00	1.00
Near_Road + Poach + pt_EVI	6	0.05	3 202.02	14.28	0.00	1.00
Near_River + Poach + pt_EVI	6	0.05	3 202.03	14.29	0.00	1.00
dry + Poach	5	0.04	3 202.25	14.51	0.00	1.00
dry + Near_River + Near_Road + Poach	6	0.05	3 202.45	14.71	0.00	1.00
Poach + Sim_L_parda	4	0.03	3 202.61	14.87	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + Near_Road	4	0.03	3 202.63	14.89	0.00	1.00
Sim_L_parda	3	0.02	3 202.73	14.99	0.00	1.00
dry + Near_River	4	0.03	3 202.91	15.17	0.00	1.00
Near_River + Poach + Sim_L_parda	5	0.04	3 202.99	15.25	0.00	1.00
dry + Near_River + Poach	6	0.04	3 203.20	15.46	0.00	1.00
Near_River + Sim_L_parda	4	0.03	3 203.42	15.67	0.00	1.00
dry + Near_Road + Poach	6	0.04	3 203.43	15.68	0.00	1.00
dry	4	0.03	3 203.59	15.84	0.00	1.00
Near_River + Near_Road + pt_EVI	6	0.04	3 203.64	15.90	0.00	1.00
Near_River + Near_Road + Poach + pt_EVI	7	0.05	3 203.72	15.98	0.00	1.00
dry + Near_River + Near_Road	5	0.03	3 204.06	16.32	0.00	1.00
Near_Road + Poach + Sim_L_parda	5	0.03	3 204.31	16.56	0.00	1.00
Near_Road + Sim_L_parda	4	0.02	3 204.41	16.67	0.00	1.00
dry + Near_River + Near_Road + Poach	7	0.05	3 204.50	16.76	0.00	1.00
dry + Near_Road	5	0.03	3 204.65	16.91	0.00	1.00
Poach + Sim_L_parda	5	0.03	3 204.67	16.93	0.00	1.00
Sim_L_parda	4	0.02	3 204.78	17.04	0.00	1.00
Near_River + Near_Road + Poach + Sim_L_parda	6	0.04	3 204.80	17.06	0.00	1.00
dry + Near_River	5	0.03	3 204.94	17.19	0.00	1.00
Near_River + Poach + Sim_L_parda	6	0.04	3 205.07	17.32	0.00	1.00
Near_River + Near_Road + Sim_L_parda	5	0.03	3 205.20	17.45	0.00	1.00
Near_River + Sim_L_parda	5	0.03	3 205.48	17.74	0.00	1.00
dry + Near_River + Near_Road	6	0.03	3 206.10	18.36	0.00	1.00
Poach	3	0.01	3 206.10	18.36	0.00	1.00
Near_Road + Poach + Sim_L_parda	6	0.03	3 206.38	18.64	0.00	1.00
Near_Road + Sim_L_parda	5	0.02	3 206.47	18.73	0.00	1.00
Near_River + Near_Road + Poach + Sim_L_parda	7	0.04	3 206.89	19.15	0.00	1.00
Near_River + Poach	4	0.02	3 207.06	19.31	0.00	1.00
Near_Road + Poach	4	0.02	3 207.27	19.53	0.00	1.00
Near_River + Near_Road + Sim_L_parda	6	0.03	3 207.27	19.53	0.00	1.00
1	2	-	3 207.58	19.83	0.00	1.00
Poach	4	0.01	3 208.15	20.41	0.00	1.00
Near_River + Near_Road + Poach	5	0.02	3 208.34	20.60	0.00	1.00
Near_Road	3	0.00	3 208.63	20.89	0.00	1.00
Near_River	3	0.00	3 208.93	21.18	0.00	1.00
Near_River + Poach	5	0.02	3 209.12	21.38	0.00	1.00
Near_Road + Poach	5	0.02	3 209.33	21.59	0.00	1.00
1	3	0.00	3 209.61	21.87	0.00	1.00
Near_River + Near_Road	4	0.01	3 210.08	22.33	0.00	1.00
Near_River + Near_Road + Poach	6	0.02	3 210.42	22.68	0.00	1.00
Near_Road	4	0.00	3 210.68	22.93	0.00	1.00
Near_River	4	0.00	3 210.97	23.23	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_L_parda indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O autor, 2023.

Table S9 - Candidate models predicting occupancy of Leopardus Wiedii across Vale Natural Reserve.

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
Poach	4	0.07	2 455.55	-	0.11	0.11
EVI_2000m + Poach	5	0.08	2 456.23	0.68	0.08	0.19
Near_River + Poach	5	0.07	2 456.50	0.95	0.07	0.26
dry + Poach	5	0.07	2 456.69	1.13	0.06	0.32
EVI_2000m + Near_River + Poach	6	0.08	2 456.96	1.41	0.05	0.37
Near_Road + Poach	5	0.07	2 457.37	1.81	0.04	0.42
dry + EVI_2000m + Poach	6	0.08	2 457.38	1.83	0.04	0.46
Poach + Sim_L_weidii	5	0.07	2 457.51	1.95	0.04	0.50
EVI_2000m + Near_Road + Poach	6	0.08	2 457.53	1.98	0.04	0.55
dry + Near_River + Poach	6	0.08	2 457.66	2.10	0.04	0.58
EVI_2000m + Near_River + Near_Road + Poach	7	0.08	2 458.08	2.53	0.03	0.62
dry + EVI_2000m + Near_River + Poach	7	0.08	2 458.14	2.58	0.03	0.65
Near_River + Near_Road + Poach	6	0.08	2 458.25	2.69	0.03	0.67
EVI_2000m + Poach + Sim_L_weidii	6	0.08	2 458.31	2.76	0.03	0.70
Near_River + Poach + Sim_L_weidii	6	0.07	2 458.50	2.95	0.03	0.73
dry + Near_Road + Poach	6	0.07	2 458.51	2.96	0.03	0.75
dry + Poach + Sim_L_weidii	6	0.07	2 458.66	3.10	0.02	0.78
dry + EVI_2000m + Near_Road + Poach	7	0.08	2 458.70	3.14	0.02	0.80
EVI_2000m + Near_River + Poach + Sim_L_weidii	7	0.08	2 459.06	3.51	0.02	0.82
dry + EVI_2000m + Near_River + Near_Road + Poach	8	0.09	2 459.27	3.72	0.02	0.83
Near_Road + Poach + Sim_L_weidii	6	0.07	2 459.31	3.76	0.02	0.85
dry + Near_River + Near_Road + Poach	7	0.08	2 459.42	3.86	0.02	0.87
dry + EVI_2000m + Poach + Sim_L_weidii	7	0.08	2 459.47	3.92	0.02	0.88
EVI_2000m + Near_Road + Poach + Sim_L_weidii	7	0.08	2 459.63	4.08	0.01	0.90
dry + Near_River + Poach + Sim_L_weidii	7	0.08	2 459.67	4.12	0.01	0.91
EVI_2000m + Near_River + Near_Road + Poach + Sim_L_weidii	8	0.08	2 460.20	4.64	0.01	0.92
Near_River + Near_Road + Poach + Sim_L_weidii	7	0.08	2 460.24	4.69	0.01	0.93
dry + EVI_2000m + Near_River + Poach + Sim_L_weidii	8	0.08	2 460.25	4.70	0.01	0.94
dry + Near_Road + Poach + Sim_L_weidii	7	0.08	2 460.48	4.92	0.01	0.95
dry + EVI_2000m + Near_Road + Poach + Sim_L_weidii	8	0.08	2 460.81	5.26	0.01	0.96
dry + EVI_2000m + Near_River + Near_Road + Poach + Sim_L_weidii	9	0.09	2 461.40	5.85	0.01	0.97
dry + Near_River + Near_Road + Poach + Sim_L_weidii	8	0.08	2 461.43	5.87	0.01	0.97
1	3	0.04	2 463.12	7.57	0.00	0.97
EVI_2000m	4	0.04	2 463.91	8.36	0.00	0.98
dry	4	0.04	2 464.20	8.65	0.00	0.98
Near_River	4	0.04	2 464.73	9.17	0.00	0.98
Sim_L_weidii	4	0.04	2 464.76	9.21	0.00	0.98
dry + EVI_2000m	5	0.05	2 465.01	9.45	0.00	0.98
Near_Road	4	0.04	2 465.01	9.45	0.00	0.98
Poach	3	0.03	2 465.14	9.58	0.00	0.98

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
EVI_2000m + Near_River	5	0.05	2 465.34	9.79	0.00	0.98
EVI_2000m + Near_Road	5	0.05	2 465.38	9.83	0.00	0.98
EVI_2000m + Poach	4	0.04	2 465.79	10.24	0.00	0.99
dry + Near_River	5	0.04	2 465.82	10.27	0.00	0.99
EVI_2000m + Sim_L_weidii	5	0.04	2 465.83	10.27	0.00	0.99
dry + Sim_L_weidii	5	0.04	2 465.86	10.31	0.00	0.99
Near_River + Poach	4	0.04	2 466.08	10.53	0.00	0.99
dry + Near_Road	5	0.04	2 466.10	10.55	0.00	0.99
Near_River + Sim_L_weidii	5	0.04	2 466.43	10.87	0.00	0.99
dry + EVI_2000m + Near_River	6	0.05	2 466.45	10.89	0.00	0.99
dry + EVI_2000m + Near_Road	6	0.05	2 466.49	10.94	0.00	0.99
dry + Poach	4	0.03	2 466.50	10.95	0.00	0.99
EVI_2000m + Near_River + Poach	5	0.04	2 466.51	10.96	0.00	0.99
Near_River + Near_Road	5	0.04	2 466.59	11.04	0.00	0.99
Near_Road + Sim_L_weidii	5	0.04	2 466.61	11.06	0.00	0.99
EVI_2000m + Near_River + Near_Road	6	0.05	2 466.72	11.16	0.00	0.99
Near_Road + Poach	4	0.03	2 466.93	11.38	0.00	0.99
dry + EVI_2000m + Sim_L_weidii	6	0.05	2 466.94	11.38	0.00	0.99
Poach + Sim_L_weidii	4	0.03	2 467.07	11.51	0.00	0.99
EVI_2000m + Near_Road + Poach	5	0.04	2 467.07	11.52	0.00	0.99
dry + EVI_2000m + Poach	5	0.04	2 467.17	11.61	0.00	0.99
EVI_2000m + Near_Road + Sim_L_weidii	6	0.05	2 467.31	11.76	0.00	0.99
EVI_2000m + Near_River + Sim_L_weidii	6	0.05	2 467.32	11.77	0.00	0.99
dry + Near_River + Poach	5	0.04	2 467.46	11.91	0.00	0.99
dry + Near_River + Sim_L_weidii	6	0.05	2 467.54	11.98	0.00	1.00
EVI_2000m + Near_River + Near_Road + Poach	6	0.05	2 467.61	12.05	0.00	1.00
dry + Near_River + Near_Road	6	0.04	2 467.70	12.15	0.00	1.00
dry + Near_Road + Sim_L_weidii	6	0.04	2 467.73	12.17	0.00	1.00
Near_River + Near_Road + Poach	5	0.04	2 467.81	12.25	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road	7	0.05	2 467.84	12.28	0.00	1.00
EVI_2000m + Poach + Sim_L_weidii	5	0.04	2 467.85	12.30	0.00	1.00
dry + EVI_2000m + Near_River + Poach	6	0.04	2 467.91	12.36	0.00	1.00
Near_River + Poach + Sim_L_weidii	5	0.04	2 468.06	12.50	0.00	1.00
Near_River + Near_Road + Sim_L_weidii	6	0.04	2 468.26	12.71	0.00	1.00
dry + Near_Road + Poach	5	0.04	2 468.31	12.76	0.00	1.00
dry + EVI_2000m + Near_Road + Sim_L_weidii	7	0.05	2 468.43	12.88	0.00	1.00
dry + EVI_2000m + Near_River + Sim_L_weidii	7	0.05	2 468.44	12.89	0.00	1.00
dry + Poach + Sim_L_weidii	5	0.04	2 468.44	12.89	0.00	1.00
dry + EVI_2000m + Near_Road + Poach	6	0.04	2 468.46	12.91	0.00	1.00
EVI_2000m + Near_River + Poach + Sim_L_weidii	6	0.04	2 468.60	13.04	0.00	1.00
EVI_2000m + Near_River + Near_Road + Sim_L_weidii	7	0.05	2 468.71	13.16	0.00	1.00
Near_Road + Poach + Sim_L_weidii	5	0.03	2 468.85	13.30	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road + Poach	7	0.05	2 469.02	13.47	0.00	1.00
EVI_2000m + Near_Road + Poach + Sim_L_weidii	6	0.04	2 469.15	13.60	0.00	1.00
dry + Near_River + Near_Road + Poach	6	0.04	2 469.21	13.65	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + EVI_2000m + Poach + Sim_L_weidii	6	0.04	2 469.24	13.69	0.00	1.00
dry + Near_River + Near_Road + Sim_L_weidii	7	0.05	2 469.38	13.83	0.00	1.00
dry + Near_River + Poach + Sim_L_weidii	6	0.04	2 469.46	13.90	0.00	1.00
EVI_2000m + Near_River + Near_Road + Poach + Sim_L_weidii	7	0.05	2 469.71	14.15	0.00	1.00
Near_River + Near_Road + Poach + Sim_L_weidii	6	0.04	2 469.77	14.22	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road + Sim_L_weidii	8	0.05	2 469.84	14.29	0.00	1.00
dry + EVI_2000m + Near_River + Poach + Sim_L_weidii	7	0.04	2 470.01	14.46	0.00	1.00
dry + Near_Road + Poach + Sim_L_weidii	6	0.04	2 470.25	14.69	0.00	1.00
dry + EVI_2000m + Near_Road + Poach + Sim_L_weidii	7	0.04	2 470.56	15.01	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road + Poach + Sim_L_weidii	8	0.05	2 471.14	15.58	0.00	1.00
dry + Near_River + Near_Road + Poach + Sim_L_weidii	7	0.04	2 471.19	15.64	0.00	1.00
1	2	-	2 472.64	17.09	0.00	1.00
EVI_2000m	3	0.00	2 473.41	17.85	0.00	1.00
dry	3	0.00	2 473.95	18.40	0.00	1.00
Near_River	3	0.00	2 474.23	18.68	0.00	1.00
Sim_L_weidii	3	0.00	2 474.26	18.70	0.00	1.00
Near_Road	3	0.00	2 474.51	18.96	0.00	1.00
dry + EVI_2000m	4	0.01	2 474.73	19.17	0.00	1.00
EVI_2000m + Near_River	4	0.01	2 474.81	19.26	0.00	1.00
EVI_2000m + Near_Road	4	0.01	2 474.86	19.31	0.00	1.00
EVI_2000m + Sim_L_weidii	4	0.01	2 475.30	19.75	0.00	1.00
dry + Near_River	4	0.00	2 475.55	20.00	0.00	1.00
dry + Sim_L_weidii	4	0.00	2 475.58	20.03	0.00	1.00
dry + Near_Road	4	0.00	2 475.83	20.28	0.00	1.00
Near_River + Sim_L_weidii	4	0.00	2 475.90	20.35	0.00	1.00
Near_River + Near_Road	4	0.00	2 476.08	20.53	0.00	1.00
Near_Road + Sim_L_weidii	4	0.00	2 476.09	20.54	0.00	1.00
dry + EVI_2000m + Near_River	5	0.01	2 476.15	20.60	0.00	1.00
EVI_2000m + Near_River + Near_Road	5	0.01	2 476.17	20.62	0.00	1.00
dry + EVI_2000m + Near_Road	5	0.01	2 476.19	20.64	0.00	1.00
dry + EVI_2000m + Sim_L_weidii	5	0.01	2 476.64	21.08	0.00	1.00
EVI_2000m + Near_Road + Sim_L_weidii	5	0.01	2 476.76	21.21	0.00	1.00
EVI_2000m + Near_River + Sim_L_weidii	5	0.01	2 476.77	21.22	0.00	1.00
dry + Near_River + Sim_L_weidii	5	0.01	2 477.24	21.69	0.00	1.00
dry + Near_River + Near_Road	5	0.00	2 477.42	21.86	0.00	1.00
dry + Near_Road + Sim_L_weidii	5	0.00	2 477.43	21.87	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road	6	0.01	2 477.52	21.96	0.00	1.00
Near_River + Near_Road + Sim_L_weidii	5	0.00	2 477.72	22.17	0.00	1.00
dry + EVI_2000m + Near_Road + Sim_L_weidii	6	0.01	2 478.11	22.56	0.00	1.00
dry + EVI_2000m + Near_River + Sim_L_weidii	6	0.01	2 478.12	22.57	0.00	1.00
EVI_2000m + Near_River + Near_Road + Sim_L_weidii	6	0.01	2 478.14	22.59	0.00	1.00
dry + Near_River + Near_Road + Sim_L_weidii	6	0.01	2 479.07	23.52	0.00	1.00
dry + EVI_2000m + Near_River + Near_Road + Sim_L_weidii	7	0.01	2 479.51	23.95	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_L_weidii indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O autor, 2023

Table S10 - Candidate models predicting occupancy of Puma yaguarundi across Vale Natural Reserve.

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
NDVI_500m + Near_Road + Poach	6	0.11	2 392.27	-	0.21	0.21
NDVI_500m + Near_River + Near_Road + Poach	7	0.11	2 393.60	1.33	0.11	0.31
NDVI_500m + Near_Road + Poach + Sim_P_yagua	7	0.11	2 394.18	1.92	0.08	0.39
dry + NDVI_500m + Near_Road + Poach	7	0.11	2 394.36	2.09	0.07	0.47
Near_Road + Poach	5	0.09	2 394.60	2.33	0.06	0.53
NDVI_500m + Poach	5	0.09	2 395.10	2.84	0.05	0.58
NDVI_500m + Near_River + Near_Road + Poach + Sim_P_yagua	8	0.11	2 395.57	3.31	0.04	0.62
dry + NDVI_500m + Near_River + Near_Road + Poach	8	0.11	2 395.70	3.44	0.04	0.66
dry + NDVI_500m + Near_Road + Poach + Sim_P_yagua	8	0.11	2 396.29	4.03	0.03	0.69
Near_River + Near_Road + Poach	6	0.09	2 396.34	4.08	0.03	0.71
Poach	4	0.08	2 396.37	4.10	0.03	0.74
Near_Road + Poach + Sim_P_yagua	6	0.09	2 396.49	4.23	0.03	0.76
dry + Near_Road + Poach	6	0.09	2 396.68	4.41	0.02	0.79
NDVI_500m + Near_River + Poach	6	0.09	2 396.72	4.45	0.02	0.81
NDVI_500m + Poach + Sim_P_yagua	6	0.09	2 396.79	4.52	0.02	0.83
dry + NDVI_500m + Poach	6	0.09	2 397.18	4.92	0.02	0.85
dry + NDVI_500m + Near_River + Near_Road + Poach + Sim_P_yagua	9	0.11	2 397.69	5.43	0.01	0.86
Poach + Sim_P_yagua	5	0.08	2 398.01	5.74	0.01	0.87
Near_River + Poach	5	0.08	2 398.26	5.99	0.01	0.88
Near_River + Near_Road + Poach + Sim_P_yagua	7	0.09	2 398.29	6.02	0.01	0.89
dry + Poach	5	0.08	2 398.44	6.17	0.01	0.90
dry + Near_River + Near_Road + Poach	7	0.09	2 398.44	6.17	0.01	0.91
NDVI_500m + Near_River + Poach + Sim_P_yagua	7	0.09	2 398.46	6.20	0.01	0.92
dry + Near_Road + Poach + Sim_P_yagua	7	0.09	2 398.59	6.32	0.01	0.93
dry + NDVI_500m + Near_River + Poach	7	0.09	2 398.81	6.54	0.01	0.94
dry + NDVI_500m + Poach + Sim_P_yagua	7	0.09	2 398.88	6.61	0.01	0.95
NDVI_500m + Near_Road + Poach	5	0.08	2 399.16	6.89	0.01	0.95
Near_River + Poach + Sim_P_yagua	6	0.08	2 399.95	7.68	0.00	0.96
dry + Poach + Sim_P_yagua	6	0.08	2 400.09	7.82	0.00	0.96
dry + Near_River + Poach	6	0.08	2 400.34	8.07	0.00	0.97
dry + Near_River + Near_Road + Poach + Sim_P_yagua	8	0.09	2 400.40	8.13	0.00	0.97
NDVI_500m + Near_River + Near_Road + Poach	6	0.08	2 400.48	8.22	0.00	0.97
dry + NDVI_500m + Near_River + Poach + Sim_P_yagua	8	0.09	2 400.57	8.30	0.00	0.98
NDVI_500m + Near_Road + Poach + Sim_P_yagua	6	0.08	2 401.06	8.79	0.00	0.98
dry + NDVI_500m + Near_Road + Poach	6	0.08	2 401.21	8.95	0.00	0.98
Near_Road + Poach	4	0.06	2 401.50	9.23	0.00	0.98
NDVI_500m + Poach	4	0.06	2 401.99	9.72	0.00	0.98

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
dry + Near_River + Poach + Sim_P_yagua	7	0.08	2 402.04	9.77	0.00	0.99
NDVI_500m + Near_River + Near_Road + Poach + Sim_P_yagua	7	0.08	2 402.44	10.18	0.00	0.99
dry + NDVI_500m + Near_River + Near_Road + Poach	7	0.08	2 402.55	10.28	0.00	0.99
dry + NDVI_500m + Near_Road + Poach + Sim_P_yagua	7	0.08	2 403.13	10.86	0.00	0.99
Near_River + Near_Road + Poach	5	0.07	2 403.24	10.97	0.00	0.99
Poach	3	0.05	2 403.27	11.00	0.00	0.99
Near_Road + Poach + Sim_P_yagua	5	0.07	2 403.38	11.11	0.00	0.99
dry + Near_Road + Poach	5	0.06	2 403.54	11.28	0.00	0.99
NDVI_500m + Near_River + Poach	5	0.06	2 403.59	11.32	0.00	0.99
NDVI_500m + Poach + Sim_P_yagua	5	0.06	2 403.65	11.39	0.00	0.99
dry + NDVI_500m + Poach	5	0.06	2 404.03	11.76	0.00	0.99
dry + NDVI_500m + Near_River + Near_Road + Poach + Sim_P_yagua	8	0.08	2 404.52	12.26	0.00	1.00
Poach + Sim_P_yagua	4	0.05	2 404.89	12.62	0.00	1.00
Near_River + Poach	4	0.05	2 405.14	12.88	0.00	1.00
Near_River + Near_Road + Poach + Sim_P_yagua	6	0.07	2 405.17	12.90	0.00	1.00
NDVI_500m + Near_Road	5	0.06	2 405.18	12.91	0.00	1.00
dry + Near_River + Near_Road + Poach	6	0.07	2 405.29	13.03	0.00	1.00
dry + Poach	4	0.05	2 405.29	13.03	0.00	1.00
NDVI_500m + Near_River + Poach + Sim_P_yagua	6	0.07	2 405.32	13.06	0.00	1.00
dry + Near_Road + Poach + Sim_P_yagua	6	0.07	2 405.44	13.17	0.00	1.00
dry + NDVI_500m + Near_River + Poach	6	0.06	2 405.64	13.38	0.00	1.00
dry + NDVI_500m + Poach + Sim_P_yagua	6	0.06	2 405.71	13.44	0.00	1.00
Near_River + Poach + Sim_P_yagua	5	0.05	2 406.81	14.55	0.00	1.00
dry + Poach + Sim_P_yagua	5	0.05	2 406.93	14.66	0.00	1.00
NDVI_500m + Near_River + Near_Road	6	0.06	2 407.11	14.84	0.00	1.00
dry + Near_River + Poach	5	0.05	2 407.19	14.92	0.00	1.00
NDVI_500m + Near_Road + Sim_P_yagua	6	0.06	2 407.24	14.97	0.00	1.00
dry + Near_River + Near_Road + Poach + Sim_P_yagua	7	0.07	2 407.24	14.97	0.00	1.00
dry + NDVI_500m + Near_Road	6	0.06	2 407.26	14.99	0.00	1.00
dry + NDVI_500m + Near_River + Poach + Sim_P_yagua	7	0.07	2 407.39	15.12	0.00	1.00
NDVI_500m	4	0.04	2 407.91	15.64	0.00	1.00
Near_Road	4	0.04	2 408.53	16.26	0.00	1.00
dry + Near_River + Poach + Sim_P_yagua	6	0.05	2 408.87	16.60	0.00	1.00
NDVI_500m + Near_River + Near_Road + Sim_P_yagua	7	0.06	2 409.16	16.90	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road	7	0.06	2 409.21	16.94	0.00	1.00
dry + NDVI_500m + Near_Road + Sim_P_yagua	7	0.06	2 409.34	17.07	0.00	1.00
1	3	0.03	2 409.81	17.54	0.00	1.00
NDVI_500m + Near_River	5	0.04	2 409.92	17.65	0.00	1.00
NDVI_500m + Sim_P_yagua	5	0.04	2 409.97	17.70	0.00	1.00
dry + NDVI_500m	5	0.04	2 409.98	17.71	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
Near_Road + Sim_P_yagua	5	0.04	2 410.52	18.26	0.00	1.00
Near_River + Near_Road	5	0.04	2 410.60	18.33	0.00	1.00
dry + Near_Road	5	0.04	2 410.60	18.33	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road + Sim_P_yagua	8	0.06	2 411.28	19.01	0.00	1.00
Near_River	4	0.03	2 411.86	19.60	0.00	1.00
dry	4	0.03	2 411.86	19.60	0.00	1.00
Sim_P_yagua	4	0.03	2 411.86	19.60	0.00	1.00
NDVI_500m + Near_River + Sim_P_yagua	6	0.04	2 412.00	19.73	0.00	1.00
dry + NDVI_500m + Near_River	6	0.04	2 412.01	19.74	0.00	1.00
NDVI_500m + Near_Road	4	0.03	2 412.01	19.74	0.00	1.00
dry + NDVI_500m + Sim_P_yagua	6	0.04	2 412.05	19.79	0.00	1.00
Near_River + Near_Road + Sim_P_yagua	6	0.04	2 412.60	20.34	0.00	1.00
dry + Near_Road + Sim_P_yagua	6	0.04	2 412.61	20.34	0.00	1.00
dry + Near_River + Near_Road	6	0.04	2 412.68	20.42	0.00	1.00
NDVI_500m + Near_River + Near_Road	5	0.03	2 413.92	21.66	0.00	1.00
dry + Near_River	5	0.03	2 413.93	21.67	0.00	1.00
Near_River + Sim_P_yagua	5	0.03	2 413.93	21.67	0.00	1.00
dry + Sim_P_yagua	5	0.03	2 413.93	21.67	0.00	1.00
NDVI_500m + Near_Road + Sim_P_yagua	5	0.03	2 414.05	21.78	0.00	1.00
dry + NDVI_500m + Near_Road	5	0.03	2 414.06	21.80	0.00	1.00
dry + NDVI_500m + Near_River + Sim_P_yagua	7	0.04	2 414.10	21.83	0.00	1.00
dry + Near_River + Near_Road + Sim_P_yagua	7	0.04	2 414.70	22.44	0.00	1.00
NDVI_500m	3	0.01	2 414.74	22.47	0.00	1.00
Near_Road	3	0.01	2 415.38	23.11	0.00	1.00
NDVI_500m + Near_River + Near_Road + Sim_P_yagua	6	0.03	2 415.97	23.70	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road	6	0.03	2 415.99	23.73	0.00	1.00
dry + Near_River + Sim_P_yagua	6	0.03	2 416.02	23.75	0.00	1.00
dry + NDVI_500m + Near_Road + Sim_P_yagua	6	0.03	2 416.12	23.86	0.00	1.00
1	2	-	2 416.66	24.39	0.00	1.00
NDVI_500m + Near_River	4	0.01	2 416.74	24.47	0.00	1.00
dry + NDVI_500m	4	0.01	2 416.78	24.51	0.00	1.00
NDVI_500m + Sim_P_yagua	4	0.01	2 416.79	24.52	0.00	1.00
Near_Road + Sim_P_yagua	4	0.01	2 417.36	25.09	0.00	1.00
dry + Near_Road	4	0.01	2 417.42	25.15	0.00	1.00
Near_River + Near_Road	4	0.01	2 417.43	25.17	0.00	1.00
dry + NDVI_500m + Near_River + Near_Road + Sim_P_yagua	7	0.03	2 418.05	25.78	0.00	1.00
dry	3	0.00	2 418.68	26.42	0.00	1.00
Near_River	3	0.00	2 418.70	26.43	0.00	1.00
Sim_P_yagua	3	0.00	2 418.70	26.43	0.00	1.00
dry + NDVI_500m + Near_River	5	0.01	2 418.79	26.53	0.00	1.00

Model formula	K	R^2	AICc	ΔAICc	AICc Wt	Cum Wt
NDVI_500m + Near_River + Sim_P_yagua	5	0.01	2 418.80	26.53	0.00	1.00
dry + NDVI_500m + Sim_P_yagua	5	0.01	2 418.84	26.57	0.00	1.00
dry + Near_Road + Sim_P_yagua	5	0.01	2 419.41	27.15	0.00	1.00
Near_River + Near_Road + Sim_P_yagua	5	0.01	2 419.42	27.15	0.00	1.00
dry + Near_River + Near_Road	5	0.01	2 419.49	27.22	0.00	1.00
dry + Near_River	4	0.00	2 420.74	28.47	0.00	1.00
dry + Sim_P_yagua	4	0.00	2 420.74	28.47	0.00	1.00
Near_River + Sim_P_yagua	4	0.00	2 420.75	28.49	0.00	1.00
dry + NDVI_500m + Near_River + Sim_P_yagua	6	0.01	2 420.87	28.61	0.00	1.00
dry + Near_River + Near_Road + Sim_P_yagua	6	0.01	2 421.49	29.23	0.00	1.00
dry + Near_River + Sim_P_yagua	5	0.00	2 422.81	30.54	0.00	1.00

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_P_yagua indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O autor, 2023

Table S11 - Candidate models predicting occupancy of *Eira barbara* across Vale Natural Reserve.

Model formula	K	R^2	R2	ΔAICc	AICc Wt	Cum Wt
1	2	0.06		2653.87	1.00	-1324.91
EVI_2000m	3	0.11	0.01	2654.18	0.86	-1324.05
EVI_2000m + Near_River	4	0.15	0.01	2654.64	0.68	-1323.25
Near_River	3	0.19	0.00	2654.68	0.67	-1324.30
EVI_2000m + Near_Road	4	0.22	0.01	2655.61	0.42	-1323.74
1	3	0.24	0.00	2655.65	0.41	-1324.78
Near_Road	3	0.26	0.00	2655.77	0.39	-1324.84
Poach	3	0.29	0.00	2655.85	0.37	-1324.88
Sim_E_bar	3	0.31	0.00	2655.87	0.37	-1324.89
EVI_2000m + Near_River + Near_Road	5	0.33	0.01	2655.88	0.37	-1322.83
dry	3	0.35	0.00	2655.91	0.36	-1324.91
EVI_2000m + Sim_E_bar	4	0.37	0.01	2655.95	0.35	-1323.91
EVI_2000m	4	0.39	0.01	2655.98	0.35	-1323.92
EVI_2000m + Poach	4	0.41	0.01	2656.18	0.31	-1324.02
dry + EVI_2000m	4	0.43	0.01	2656.24	0.31	-1324.05
EVI_2000m + Near_River	5	0.45	0.01	2656.46	0.27	-1323.13
Near_River	4	0.46	0.01	2656.48	0.27	-1324.17
Near_River + Near_Road	4	0.48	0.00	2656.54	0.26	-1324.20
EVI_2000m + Near_River + Poach	5	0.49	0.01	2656.56	0.26	-1323.17
Near_River + Poach	4	0.51	0.00	2656.59	0.26	-1324.22
EVI_2000m + Near_River + Sim_E_bar	5	0.52	0.01	2656.68	0.25	-1323.23
dry + EVI_2000m + Near_River	5	0.54	0.01	2656.71	0.24	-1323.25
Near_River + Sim_E_bar	4	0.55	0.00	2656.71	0.24	-1324.29
dry + Near_River	4	0.57	0.00	2656.73	0.24	-1324.30
EVI_2000m + Near_Road + Sim_E_bar	5	0.58	0.01	2657.35	0.18	-1323.57
EVI_2000m + Near_Road	5	0.59	0.01	2657.43	0.17	-1323.61
Near_Road	4	0.60	0.00	2657.57	0.16	-1324.71
EVI_2000m + Near_Road + Poach	5	0.61	0.01	2657.61	0.15	-1323.70
Poach	4	0.61	0.00	2657.65	0.15	-1324.75
Sim_E_bar	4	0.62	0.00	2657.66	0.15	-1324.76
dry + EVI_2000m + Near_Road	5	0.63	0.01	2657.69	0.15	-1323.74
dry	4	0.64	0.00	2657.70	0.15	-1324.78
EVI_2000m + Near_River + Near_Road	6	0.65	0.02	2657.73	0.15	-1322.71
Near_Road + Poach	4	0.66	0.00	2657.76	0.14	-1324.81
EVI_2000m + Poach + Sim_E_bar	5	0.67	0.01	2657.76	0.14	-1323.77
EVI_2000m + Sim_E_bar	5	0.68	0.01	2657.77	0.14	-1323.78
EVI_2000m + Near_River + Near_Road + Poach	6	0.68	0.01	2657.78	0.14	-1322.74
Near_Road + Sim_E_bar	4	0.69	0.00	2657.79	0.14	-1324.82
Poach + Sim_E_bar	4	0.70	0.00	2657.79	0.14	-1324.82
dry + Near_Road	4	0.71	0.00	2657.83	0.14	-1324.84
dry + Poach	4	0.72	0.00	2657.91	0.13	-1324.88

Model formula	K	R^2	R2	ΔAICc	AICc Wt	Cum Wt
dry + Sim_E_bar	4	0.72	0.00	2657.93	0.13	-1324.89
EVI_2000m + Near_River + Near_Road + Sim_E_bar	6	0.73	0.01	2657.93	0.13	-1322.81
dry + EVI_2000m + Near_River + Near_Road	6	0.74	0.01	2657.97	0.13	-1322.83
EVI_2000m + Poach	5	0.75	0.01	2658.00	0.13	-1323.89
dry + EVI_2000m + Sim_E_bar	5	0.75	0.01	2658.02	0.13	-1323.91
dry + EVI_2000m	5	0.76	0.01	2658.05	0.12	-1323.92
dry + EVI_2000m + Poach	5	0.77	0.01	2658.25	0.11	-1324.02
Near_River + Near_Road	5	0.78	0.01	2658.36	0.11	-1324.08
EVI_2000m + Near_River + Poach	6	0.78	0.01	2658.40	0.10	-1323.05
Near_River + Poach	5	0.79	0.01	2658.41	0.10	-1324.10
Near_River + Near_Road + Poach	5	0.79	0.01	2658.46	0.10	-1324.12
EVI_2000m + Near_River + Poach + Sim_E_bar	6	0.80	0.01	2658.51	0.10	-1323.11
EVI_2000m + Near_River + Sim_E_bar	6	0.81	0.01	2658.52	0.10	-1323.11
Near_River + Sim_E_bar	5	0.81	0.01	2658.53	0.10	-1324.16
dry + Near_River	5	0.82	0.01	2658.55	0.10	-1324.17
dry + EVI_2000m + Near_River	6	0.82	0.01	2658.55	0.10	-1323.12
Near_River + Near_Road + Sim_E_bar	5	0.83	0.01	2658.59	0.09	-1324.19
Dry + Near_River + Near_Road	5	0.83	0.00	2658.62	0.09	-1324.20
dry + EVI_2000m + Near_River + Poach	6	0.84	0.01	2658.64	0.09	-1323.17
Near_River + Poach + Sim_E_bar	5	0.84	0.00	2658.66	0.09	-1324.22
dry + Near_River + Poach	5	0.85	0.00	2658.66	0.09	-1324.22
dry + EVI_2000m + Near_River + Sim_E_bar	6	0.86	0.01	2658.76	0.09	-1323.23
dry + Near_River + Sim_E_bar	5	0.86	0.00	2658.78	0.09	-1324.29
EVI_2000m + Near_Road + Poach + Sim_E_bar	6	0.86	0.01	2659.11	0.07	-1323.41
EVI_2000m + Near_Road + Sim_E_bar	6	0.87	0.01	2659.18	0.07	-1323.44
dry + EVI_2000m + Near_Road + Sim_E_bar	6	0.87	0.01	2659.43	0.06	-1323.57
EVI_2000m + Near_Road + Poach	6	0.88	0.01	2659.45	0.06	-1323.57
dry + EVI_2000m + Near_Road	6	0.88	0.01	2659.52	0.06	-1323.61
Near_Road + Poach	5	0.88	0.00	2659.57	0.06	-1324.68
EVI_2000m + Poach + Sim_E_bar	6	0.89	0.01	2659.59	0.06	-1323.65
Near_Road + Sim_E_bar	5	0.89	0.00	2659.60	0.06	-1324.69
Poach + Sim_E_bar	5	0.89	0.00	2659.60	0.06	-1324.69
dry + Near_Road	5	0.90	0.00	2659.64	0.06	-1324.71
EVI_2000m + Near_River + Near_Road + Poach	7	0.90	0.02	2659.65	0.06	-1322.62
dry + EVI_2000m + Near_Road + Poach	6	0.90	0.01	2659.70	0.05	-1323.70
EVI_2000m + Near_River + Near_Road + Poach + Sim_E_bar	7	0.91	0.02	2659.71	0.05	-1322.66
dry + Poach	5	0.91	0.00	2659.71	0.05	-1324.75
Near_Road + Poach + Sim_E_bar	5	0.91	0.00	2659.71	0.05	-1324.75
dry + Sim_E_bar	5	0.92	0.00	2659.73	0.05	-1324.76
EVI_2000m + Near_River + Near_Road + Sim_E_bar	7	0.92	0.02	2659.79	0.05	-1322.69
dry + EVI_2000m + Near_River + Near_Road	7	0.92	0.02	2659.83	0.05	-1322.71
dry + Near_Road + Poach	5	0.93	0.00	2659.83	0.05	-1324.81
dry + EVI_2000m + Poach + Sim_E_bar	6	0.93	0.01	2659.85	0.05	-1323.77
dry + EVI_2000m + Sim_E_bar	6	0.93	0.01	2659.85	0.05	-1323.78

Model formula	K	R^2	R2	ΔAICc	AICc Wt	Cum Wt
dry + Near_Road + Sim_E_bar	5	0.93	0.00	2659.86	0.05	-1324.82
dry + Poach + Sim_E_bar	5	0.94	0.00	2659.86	0.05	-1324.82
dry + EVI_2000m + Near_River + Near_Road + Poach	7	0.94	0.01	2659.88	0.05	-1322.74
dry + EVI_2000m + Near_River + Near_Road + Sim_E_bar	7	0.94	0.01	2660.03	0.05	-1322.81
dry + EVI_2000m + Poach	6	0.95	0.01	2660.08	0.04	-1323.89
Near_River + Near_Road + Poach	6	0.95	0.01	2660.29	0.04	-1324.00
EVI_2000m + Near_River + Poach + Sim_E_bar	7	0.95	0.01	2660.37	0.04	-1322.98
Near_River + Near_Road + Sim_E_bar	6	0.95	0.01	2660.42	0.04	-1324.06
dry + Near_River + Near_Road	6	0.95	0.01	2660.45	0.04	-1324.07
dry + Near_River + Poach	6	0.96	0.01	2660.49	0.04	-1324.10
Near_River + Poach + Sim_E_bar	6	0.96	0.01	2660.49	0.04	-1324.10
dry + EVI_2000m + Near_River + Poach	7	0.96	0.01	2660.50	0.04	-1323.05
dry + Near_River + Near_Road + Poach	6	0.96	0.01	2660.54	0.04	-1324.12
Near_River + Near_Road + Poach + Sim_E_bar	6	0.97	0.01	2660.54	0.04	-1324.12
dry + EVI_2000m + Near_River + Poach + Sim_E_bar	7	0.97	0.01	2660.61	0.03	-1323.11
dry + Near_River + Sim_E_bar	6	0.97	0.01	2660.61	0.03	-1324.16
dry + EVI_2000m + Near_River + Sim_E_bar	7	0.97	0.01	2660.62	0.03	-1323.11
dry + Near_River + Near_Road + Sim_E_bar	6	0.97	0.01	2660.68	0.03	-1324.19
dry + Near_River + Poach + Sim_E_bar	6	0.98	0.00	2660.74	0.03	-1324.22
EVI_2000m + Near_Road + Poach + Sim_E_bar	7	0.98	0.01	2660.96	0.03	-1323.28
dry + EVI_2000m + Near_Road + Poach + Sim_E_bar	7	0.98	0.01	2661.21	0.03	-1323.41
dry + EVI_2000m + Near_Road + Sim_E_bar	7	0.98	0.01	2661.28	0.02	-1323.44
Near_Road + Poach + Sim_E_bar	6	0.98	0.00	2661.54	0.02	-1324.62
dry + EVI_2000m + Near_Road + Poach	7	0.98	0.01	2661.55	0.02	-1323.57
EVI_2000m + Near_River + Near_Road + Poach + Sim_E_bar	8	0.98	0.02	2661.59	0.02	-1322.54
dry + Near_Road + Poach	6	0.99	0.00	2661.65	0.02	-1324.68
dry + Near_Road + Sim_E_bar	6	0.99	0.00	2661.68	0.02	-1324.69
dry + Poach + Sim_E_bar	6	0.99	0.00	2661.68	0.02	-1324.69
dry + EVI_2000m + Poach + Sim_E_bar	7	0.99	0.01	2661.69	0.02	-1323.64
dry + EVI_2000m + Near_River + Near_Road + Poach	8	0.99	0.02	2661.76	0.02	-1322.62
dry + Near_Road + Poach + Sim_E_bar	6	0.99	0.00	2661.80	0.02	-1324.75
dry + EVI_2000m + Near_River + Near_Road + Poach + Sim_E_bar	8	0.99	0.02	2661.83	0.02	-1322.66
dry + EVI_2000m + Near_River + Near_Road + Sim_E_bar	8	0.99	0.02	2661.90	0.02	-1322.69
dry + Near_River + Near_Road + Poach	7	0.99	0.01	2662.39	0.01	-1323.99
Near_River + Near_Road + Poach + Sim_E_bar	7	1.00	0.01	2662.39	0.01	-1324.00
dry + EVI_2000m + Near_River + Poach + Sim_E_bar	8	1.00	0.01	2662.48	0.01	-1322.98
dry + Near_River + Near_Road + Sim_E_bar	7	1.00	0.01	2662.52	0.01	-1324.06
dry + Near_River + Poach + Sim_E_bar	7	1.00	0.01	2662.59	0.01	-1324.10
dry + Near_River + Near_Road + Poach + Sim_E_bar	7	1.00	0.01	2662.64	0.01	-1324.12
dry + EVI_2000m + Near_Road + Poach + Sim_E_bar	8	1.00	0.01	2663.07	0.01	-1323.28
dry + Near_Road + Poach + Sim_E_bar	7	1.00	0.00	2663.64	0.01	-1324.62

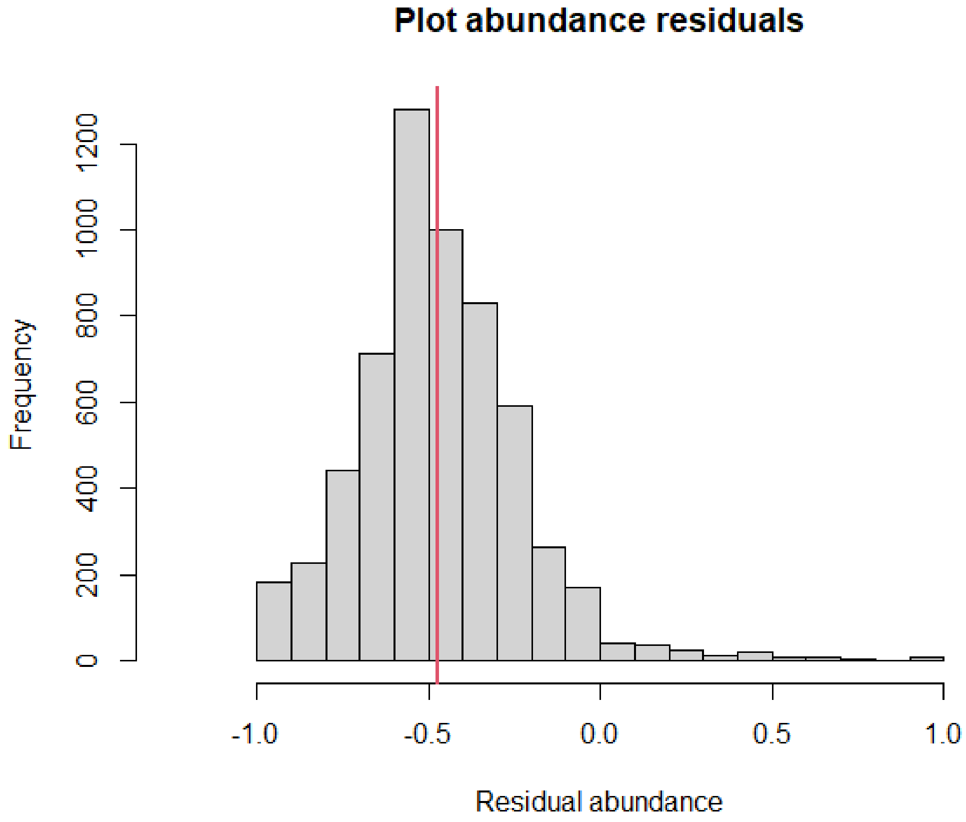
Model formula	K	R^2	R2	ΔAICc	AICc Wt	Cum Wt
dry + EVI_2000m + Near_River + Near_Road + Poach + Sim_E_bar	9	1.00	0.02	2663.72	0.01	-1322.54
dry + Near_River + Near_Road + Poach + Sim_E_bar	8	1.00	0.01	2664.51	0.00	-1323.99

Legenda: Near road indicates the distance to the nearest road, Near river indicates the distance to the nearest river, Sim_P_yagua indicates geometric edge effect model predictions. Poach refers to the density of the poacher. EVI, NDVI refers to the averaged vegetation index considering the sampling period and different spatial scales (30m pixel, 200m, 500m, 1000m, 2000m). Dry indicates the effect of the dry/wet season. Det indicates the predictors of detection probability, and Occ the occupancy predictors. K refers to the number of variables used, wi refers to the weight of evidence for the model, and Cum wi refers to the cumulative weight of evidence considering the model and all better fitting models.

Fonte: O autor, 2023

Apendice C: Material suplementar capítulo 3

Figure S4 - Distribution of plot abundance residuals.



Fonte: O autor, 2023

Table S12 - Candidate models explaining residual differences between observed and predicted abundance (Observed minus predicted) of forest core species.

Model Formula	K	AICc	DAICc	AICc Wt	Cum Wt
~ DietCat + EI	8	- 1 783.99	-	0.13	0.13
~ DietCat + EI + spec.Diet	9	- 1 783.52	0.47	0.10	0.23
~ DietCat + EI + spec.Diet	9	- 1 782.01	1.98	0.05	0.28
~ DietCat + EI + HR + spec.Diet	10	- 1 781.97	2.02	0.05	0.32
~ DietCat	7	- 1 781.83	2.16	0.04	0.37
~ DietCat + EI + HR + EI*HR	10	- 1 781.81	2.18	0.04	0.41
~ EI + HR	7	- 1 781.72	2.28	0.04	0.45
~ DietCat + EI + HR + spec.Diet + HR*spec.Diet	11	- 1 781.71	2.28	0.04	0.49
~ DietCat + EI + spec.Diet + EI*spec.Diet	10	- 1 781.37	2.63	0.03	0.53
~ DietCat + EI + HR + spec.Diet + EI*spec.Diet	11	- 1 781.36	2.63	0.03	0.56
~ DietCat + HR	8	- 1 781.30	2.69	0.03	0.59
~ DietCat + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	12	- 1 781.16	2.83	0.03	0.62
~ DietCat + EI + DietCat*EI	10	- 1 780.40	3.59	0.02	0.65
~ DietCat + EI + HR + spec.Diet + EI*HR	11	- 1 780.26	3.73	0.02	0.67
~ DietCat + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	12	- 1 780.03	3.96	0.02	0.68
~ EI + HR + EI*HR	8	- 1 779.98	4.01	0.02	0.70
~ DietCat + EI + HR + DietCat*EI	11	- 1 779.93	4.07	0.02	0.72
~ DietCat + spec.Diet	8	- 1 779.85	4.14	0.02	0.73
~ DietCat + HR + spec.Diet	9	- 1 779.76	4.23	0.02	0.75
~ EI + HR + spec.Diet	8	- 1 779.72	4.28	0.02	0.76
~ HR	6	- 1 779.59	4.40	0.01	0.78
~ DietCat + HR + spec.Diet + HR*spec.Diet	10	- 1 779.44	4.55	0.01	0.79
~ DietCat + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	12	- 1 779.39	4.60	0.01	0.80
~ DietCat + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	13	- 1 779.18	4.81	0.01	0.82
~ EI + HR + spec.Diet + EI*spec.Diet	9	- 1 779.05	4.94	0.01	0.83
~ EI + HR + spec.Diet + HR*spec.Diet	9	- 1 778.86	5.13	0.01	0.84
~ DietCat + EI + spec.Diet + DietCat*EI	11	- 1 778.42	5.57	0.01	0.84
~ DietCat + EI + HR + spec.Diet + DietCat*EI	12	- 1 778.38	5.61	0.01	0.85
~ DietCat + EI + HR + DietCat*EI + EI*HR	12	- 1 778.29	5.70	0.01	0.86
~ EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	10	- 1 778.25	5.74	0.01	0.87
~ DietCat + EI + HR + spec.Diet + DietCat*EI + HR*spec.Diet	13	- 1 778.12	5.87	0.01	0.87
~ DietCat + ForStrata + EI	11	- 1 778.10	5.89	0.01	0.88
~ DietCat + EI + spec.Diet + DietCat*EI + EI*spec.Diet	12	- 1 778.01	5.99	0.01	0.89
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet	13	- 1 777.99	6.00	0.01	0.89
~ EI + HR + spec.Diet + EI*HR	9	- 1 777.98	6.01	0.01	0.90
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet + HR*spec.Diet	14	- 1 777.78	6.21	0.01	0.91
~ HR + spec.Diet	7	- 1 777.59	6.40	0.01	0.91

Model Formula	K	AICc	DAICc	AICc Wt	Cum Wt
~ DietCat + ForStrata + EI + HR	12	- 1 777.59	6.40	0.01	0.92
~ EI + HR + spec.Diet + EI*HR + HR*spec.Diet	10	- 1 777.15	6.84	0.00	0.92
~ EI	6	- 1 777.12	6.87	0.00	0.92
~ EI + HR + spec.Diet + EI*HR + EI*spec.Diet	10	- 1 777.09	6.90	0.00	0.93
~ EI + spec.Diet	7	- 1 776.98	7.01	0.00	0.93
~ ForStrata + EI + HR	10	- 1 776.77	7.22	0.00	0.94
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR	13	- 1 776.74	7.25	0.00	0.94
~ HR + spec.Diet + HR*spec.Diet	8	- 1 776.69	7.30	0.00	0.94
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + HR*spec.Diet	14	- 1 776.50	7.49	0.00	0.95
~ EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	11	- 1 776.28	7.71	0.00	0.95
~ EI + spec.Diet + EI*spec.Diet	8	- 1 776.24	7.75	0.00	0.95
~ DietCat + ForStrata + EI + spec.Diet	12	- 1 776.12	7.87	0.00	0.95
~ DietCat + ForStrata + EI + HR + spec.Diet	13	- 1 776.04	7.95	0.00	0.96
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet	14	- 1 776.00	8.00	0.00	0.96
~ DietCat + ForStrata	10	- 1 775.95	8.04	0.00	0.96
~ DietCat + ForStrata + EI + HR + EI*HR	13	- 1 775.88	8.12	0.00	0.96
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	15	- 1 775.79	8.21	0.00	0.96
~ DietCat + ForStrata + EI + HR + spec.Diet + HR*spec.Diet	14	- 1 775.74	8.25	0.00	0.97
~ DietCat + ForStrata + EI + spec.Diet + EI*spec.Diet	13	- 1 775.46	8.53	0.00	0.97
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*spec.Diet	14	- 1 775.42	8.57	0.00	0.97
~ DietCat + ForStrata + HR	11	- 1 775.40	8.60	0.00	0.97
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	15	- 1 775.18	8.81	0.00	0.97
~ (1 + Edge.Influence | ID.sp.pid)	5	- 1 775.17	8.83	0.00	0.98
~ ForStrata + EI + HR + EI*HR	11	- 1 775.03	8.97	0.00	0.98
~ spec.Diet	6	- 1 774.96	9.03	0.00	0.98
~ ForStrata + EI + HR + spec.Diet	11	- 1 774.77	9.22	0.00	0.98
~ ForStrata + HR	9	- 1 774.69	9.30	0.00	0.98
~ DietCat + ForStrata + EI + DietCat*EI	13	- 1 774.50	9.49	0.00	0.98
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR	14	- 1 774.33	9.66	0.00	0.98
~ ForStrata + EI + HR + spec.Diet + EI*spec.Diet	12	- 1 774.08	9.91	0.00	0.98
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	15	- 1 774.05	9.94	0.00	0.98
~ DietCat + ForStrata + EI + HR + DietCat*EI	14	- 1 773.99	10.00	0.00	0.99
~ DietCat + ForStrata + spec.Diet	11	- 1 773.98	10.01	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + HR*spec.Diet	12	- 1 773.92	10.07	0.00	0.99
~ DietCat + ForStrata + HR + spec.Diet	12	- 1 773.85	10.14	0.00	0.99
~ DietCat + ForStrata + HR + spec.Diet + HR*spec.Diet	13	- 1 773.49	10.50	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	15	- 1 773.45	10.54	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	13	- 1 773.28	10.71	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	16	- 1 773.20	10.79	0.00	0.99

Model Formula	K	AICc	DAICc	AICc Wt	Cum Wt
~ ForStrata + EI	9	- 1 773.06	10.93	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR	12	- 1 773.02	10.97	0.00	0.99
~ DietCat + ForStrata + EI + ForStrata*EI	14	- 1 772.79	11.20	0.00	0.99
~ ForStrata + HR + spec.Diet	10	- 1 772.69	11.30	0.00	0.99
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI	14	- 1 772.52	11.47	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI	15	- 1 772.45	11.55	0.00	0.99
~ ForStrata + EI + spec.Diet	10	- 1 772.36	11.63	0.00	0.99
~ DietCat + ForStrata + EI + HR + DietCat*EI + EI*HR	15	- 1 772.35	11.64	0.00	0.99
~ DietCat + ForStrata + EI + HR + ForStrata*EI	15	- 1 772.26	11.74	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	13	- 1 772.20	11.80	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + HR*spec.Diet	16	- 1 772.14	11.85	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	13	- 1 772.11	11.88	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + EI*spec.Diet	15	- 1 772.10	11.89	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet	16	- 1 772.05	11.94	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet + HR*spec.Diet	17	- 1 771.80	12.19	0.00	1.00
~ ForStrata + HR + spec.Diet + HR*spec.Diet	11	- 1 771.80	12.19	0.00	1.00
~ ForStrata + EI + spec.Diet + EI*spec.Diet	11	- 1 771.59	12.40	0.00	1.00
~ ForStrata + EI + HR + ForStrata*EI	13	- 1 771.53	12.46	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	14	- 1 771.31	12.68	0.00	1.00
~ ForStrata	8	- 1 771.13	12.86	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + ForStrata*EI	15	- 1 770.81	13.18	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR	16	- 1 770.80	13.19	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI	16	- 1 770.71	13.28	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + HR*spec.Diet	17	- 1 770.52	13.47	0.00	1.00
~ DietCat + ForStrata + EI + HR + ForStrata*EI + EI*HR	16	- 1 770.43	13.56	0.00	1.00
~ ForStrata + spec.Diet	9	- 1 770.38	13.61	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + HR*spec.Diet	17	- 1 770.38	13.62	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet	17	- 1 770.05	13.94	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + ForStrata*EI + EI*spec.Diet	16	- 1 769.93	14.06	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet	17	- 1 769.87	14.12	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	18	- 1 769.80	14.19	0.00	1.00
~ ForStrata + EI + HR + ForStrata*EI + EI*HR	14	- 1 769.67	14.32	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	18	- 1 769.61	14.38	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI	14	- 1 769.52	14.47	0.00	1.00

Model Formula	K	AICc	DAICc	AICc Wt	Cum Wt
~ DietCat + ForStrata + EI + DietCat*EI + ForStrata*EI	16	- 1 769.12	14.88	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR	17	- 1 768.88	15.11	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + HR*spec.Diet	15	- 1 768.66	15.34	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet	15	- 1 768.60	15.39	0.00	1.00
~ DietCat + ForStrata + EI + HR + DietCat*EI + ForStrata*EI	17	- 1 768.58	15.42	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + HR*spec.Diet	18	- 1 768.57	15.42	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet	18	- 1 767.93	16.07	0.00	1.00
~ ForStrata + EI + ForStrata*EI	12	- 1 767.90	16.10	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	16	- 1 767.79	16.21	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR	15	- 1 767.66	16.33	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	19	- 1 767.65	16.34	0.00	1.00
~ ForStrata + EI + spec.Diet + ForStrata*EI	13	- 1 767.16	16.83	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + ForStrata*EI	17	- 1 767.14	16.86	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI	18	- 1 767.03	16.96	0.00	1.00
~ DietCat + ForStrata + EI + HR + DietCat*EI + ForStrata*EI + EI*HR	18	- 1 766.95	17.04	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + HR*spec.Diet	16	- 1 766.82	17.18	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet	18	- 1 766.78	17.22	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet	19	- 1 766.70	17.29	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + HR*spec.Diet	19	- 1 766.69	17.30	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet	16	- 1 766.66	17.33	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	20	- 1 766.42	17.58	0.00	1.00
~ ForStrata + EI + spec.Diet + ForStrata*EI + EI*spec.Diet	14	- 1 766.15	17.84	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	17	- 1 765.84	18.15	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR	19	- 1 765.40	18.59	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + HR*spec.Diet	20	- 1 765.08	18.91	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + EI*spec.Diet	20	- 1 764.70	19.30	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	21	- 1 764.41	19.58	0.00	1.00

Legenda: HR: log10 of home range in hectares, DietCat: Herbivorous, Omnivores or Carnivores, spec.Diet: Diet specialization index, ForStrata: Predominant foraging stratum; Interaction terms are indicated with “*”; K: Number of model parameters, wi model weight of evidence and its cumulative sum.

Fonte: O Autor, 2023.

Table S13; Candidate models explaining variation in differences between observed and predicted abundance according to Geometric edge effets model considering all species.

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt
~ DietCat + EI	8	- 857.05	-	0.16	0.16
~ DietCat + EI + spec.Diet	9	- 856.16	0.89	0.10	0.26
~ DietCat + EI + spec.Diet + EI*spec.Diet	10	- 856.04	1.01	0.10	0.36
~ DietCat + EI + HR	9	- 855.07	1.98	0.06	0.42
~ DietCat + EI + HR + spec.Diet	10	- 854.18	2.87	0.04	0.45
~ DietCat + EI + DietCat*EI	10	- 854.07	2.98	0.04	0.49
~ DietCat + EI + HR + spec.Diet + EI*spec.Diet	11	- 854.05	3.00	0.04	0.52
~ DietCat + EI + HR + EI*HR	10	- 853.88	3.17	0.03	0.56
~ EI + HR	7	- 853.44	3.61	0.03	0.58
~ EI	6	- 853.18	3.87	0.02	0.61
~ DietCat + EI + spec.Diet + DietCat*EI	11	- 853.14	3.91	0.02	0.63
~ DietCat + EI + HR + spec.Diet + EI*HR	11	- 853.00	4.05	0.02	0.65
~ DietCat + ForStrata + EI	11	- 852.96	4.09	0.02	0.67
~ DietCat + EI + spec.Diet + DietCat*EI + EI*spec.Diet	12	- 852.53	4.52	0.02	0.69
~ DietCat + EI + HR + spec.Diet + HR*spec.Diet	11	- 852.46	4.59	0.02	0.70
~ DietCat + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	12	- 852.24	4.81	0.01	0.72
~ EI + HR + EI*HR	8	- 852.19	4.87	0.01	0.73
~ DietCat + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	12	- 852.09	4.96	0.01	0.74
~ DietCat + EI + HR + DietCat*EI	11	- 852.09	4.96	0.01	0.76
~ DietCat + ForStrata + EI + spec.Diet	12	- 852.01	5.04	0.01	0.77
~ DietCat + ForStrata + EI + spec.Diet + EI*spec.Diet	13	- 851.97	5.08	0.01	0.78
~ EI + spec.Diet	7	- 851.64	5.41	0.01	0.79
~ EI + HR + spec.Diet	8	- 851.45	5.60	0.01	0.80
~ DietCat	7	- 851.44	5.61	0.01	0.81
~ EI + spec.Diet + EI*spec.Diet	8	- 851.43	5.62	0.01	0.82
~ DietCat + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	12	- 851.25	5.80	0.01	0.83
~ EI + HR + spec.Diet + EI*spec.Diet	9	- 851.18	5.87	0.01	0.84
~ DietCat + EI + HR + spec.Diet + DietCat*EI	12	- 851.15	5.90	0.01	0.85
~ DietCat + ForStrata + EI + HR	12	- 851.03	6.03	0.01	0.86
~ DietCat + EI + HR + DietCat*EI + EI*HR	12	- 850.60	6.45	0.01	0.86
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet	13	- 850.54	6.51	0.01	0.87
~ DietCat + spec.Diet	8	- 850.42	6.63	0.01	0.87
~ DietCat + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	13	- 850.28	6.77	0.01	0.88
~ EI + HR + spec.Diet + EI*HR	9	- 850.19	6.86	0.01	0.88
~ ForStrata + EI	9	- 850.03	7.02	0.00	0.89
~ DietCat + ForStrata + EI + DietCat*EI	13	- 850.00	7.05	0.00	0.89
~ DietCat + ForStrata + EI + HR + spec.Diet	13	- 850.00	7.05	0.00	0.90
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*spec.Diet	14	- 849.97	7.09	0.00	0.90
~ DietCat + ForStrata + EI + HR + EI*HR	13	- 849.88	7.18	0.00	0.91
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR	13	- 849.70	7.36	0.00	0.91
~ EI + HR + spec.Diet + HR*spec.Diet	9	- 849.67	7.38	0.00	0.92

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt
~ ForStrata + EI + HR	10	- 849.62	7.43	0.00	0.92
~ DietCat + HR	8	- 849.49	7.56	0.00	0.92
~ DietCat + EI + HR + spec.Diet + DietCat*EI + HR*spec.Diet	13	- 849.41	7.65	0.00	0.93
~ EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	10	- 849.33	7.72	0.00	0.93
~ EI + HR + spec.Diet + EI*HR + EI*spec.Diet	10	- 849.21	7.84	0.00	0.93
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI	14	- 849.02	8.03	0.00	0.94
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR	14	- 848.85	8.20	0.00	0.94
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet + HR*spec.Diet	14	- 848.72	8.33	0.00	0.94
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet	14	- 848.72	8.33	0.00	0.94
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + EI*spec.Diet	15	- 848.46	8.59	0.00	0.95
~ DietCat + ForStrata + EI + ForStrata*EI	14	- 848.44	8.62	0.00	0.95
~ DietCat + HR + spec.Diet	9	- 848.41	8.64	0.00	0.95
~ EI + HR + spec.Diet + EI*HR + HR*spec.Diet	10	- 848.40	8.65	0.00	0.95
~ ForStrata + EI + HR + EI*HR	11	- 848.39	8.66	0.00	0.95
~ ForStrata + EI + spec.Diet	10	- 848.36	8.70	0.00	0.96
~ DietCat + ForStrata + EI + HR + spec.Diet + HR*spec.Diet	14	- 848.27	8.78	0.00	0.96
~ ForStrata + EI + spec.Diet + EI*spec.Diet	11	- 848.19	8.86	0.00	0.96
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	15	- 848.15	8.90	0.00	0.96
~ DietCat + ForStrata + EI + HR + DietCat*EI	14	- 848.08	8.98	0.00	0.96
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	15	- 848.00	9.05	0.00	0.97
~ (1 + Edge.Influence | ID.sp.pid)	5	- 847.98	9.07	0.00	0.97
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + HR*spec.Diet	14	- 847.94	9.11	0.00	0.97
~ HR	6	- 847.93	9.12	0.00	0.97
~ ForStrata + EI + HR + spec.Diet	11	- 847.62	9.43	0.00	0.97
~ DietCat + ForStrata + EI + spec.Diet + ForStrata*EI	15	- 847.44	9.61	0.00	0.97
~ ForStrata + EI + HR + spec.Diet + EI*spec.Diet	12	- 847.41	9.64	0.00	0.97
~ EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	11	- 847.36	9.69	0.00	0.98
~ DietCat + ForStrata	10	- 847.33	9.72	0.00	0.98
~ DietCat + ForStrata + EI + spec.Diet + ForStrata*EI + EI*spec.Diet	16	- 847.23	9.82	0.00	0.98
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	15	- 847.09	9.96	0.00	0.98
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI	15	- 847.01	10.04	0.00	0.98
~ DietCat + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	15	- 846.91	10.14	0.00	0.98
~ DietCat + HR + spec.Diet + HR*spec.Diet	10	- 846.70	10.35	0.00	0.98
~ DietCat + ForStrata + EI + HR + DietCat*EI + EI*HR	15	- 846.59	10.46	0.00	0.98
~ DietCat + ForStrata + EI + HR + ForStrata*EI	15	- 846.50	10.55	0.00	0.98
~ spec.Diet	6	- 846.45	10.60	0.00	0.98
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet	16	- 846.45	10.60	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR	12	- 846.38	10.67	0.00	0.99
~ DietCat + ForStrata + spec.Diet	11	- 846.25	10.80	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	16	- 846.18	10.87	0.00	0.99
~ HR + spec.Diet	7	- 845.93	11.12	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + HR*spec.Diet	12	- 845.83	11.22	0.00	0.99

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt
~ ForStrata + EI + ForStrata*EI	12	-845.76	11.29	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR	16	-845.55	11.50	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*spec.Diet + HR*spec.Diet	13	-845.54	11.51	0.00	0.99
~ DietCat + ForStrata + HR	11	-845.46	11.59	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet	13	-845.44	11.61	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI	16	-845.43	11.62	0.00	0.99
~ ForStrata + EI + HR + ForStrata*EI	13	-845.31	11.74	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + HR*spec.Diet	16	-845.25	11.80	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet	17	-845.22	11.83	0.00	0.99
~ DietCat + ForStrata + EI + DietCat*EI + ForStrata*EI	16	-845.20	11.85	0.00	0.99
~ DietCat + ForStrata + EI + HR + ForStrata*EI + EI*HR	16	-845.03	12.02	0.00	0.99
~ ForStrata	8	-844.77	12.29	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*spec.Diet + HR*spec.Diet	17	-844.62	12.43	0.00	0.99
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet	17	-844.62	12.43	0.00	0.99
~ ForStrata + EI + HR + spec.Diet + EI*HR + HR*spec.Diet	13	-844.57	12.48	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet	12	-844.25	12.81	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + ForStrata*EI	17	-844.17	12.88	0.00	1.00
~ HR + spec.Diet + HR*spec.Diet	8	-844.16	12.89	0.00	1.00
~ ForStrata + HR	9	-844.11	12.94	0.00	1.00
~ ForStrata + EI + spec.Diet + ForStrata*EI	13	-844.07	12.98	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR	17	-843.97	13.08	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + HR*spec.Diet	17	-843.79	13.26	0.00	1.00
~ ForStrata + EI + HR + ForStrata*EI + EI*HR	14	-843.76	13.29	0.00	1.00
~ DietCat + ForStrata + EI + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet	18	-843.73	13.32	0.00	1.00
~ ForStrata + EI + spec.Diet + ForStrata*EI + EI*spec.Diet	14	-843.73	13.32	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + HR*spec.Diet	17	-843.69	13.36	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + EI*HR + EI*spec.Diet + HR*spec.Diet	14	-843.57	13.48	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	18	-843.40	13.65	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI	14	-843.31	13.74	0.00	1.00
~ DietCat + ForStrata + EI + HR + DietCat*EI + ForStrata*EI	17	-843.26	13.79	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet	18	-843.21	13.84	0.00	1.00
~ ForStrata + spec.Diet	9	-843.11	13.94	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet	15	-842.92	14.13	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	18	-842.80	14.25	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + HR*spec.Diet	13	-842.53	14.52	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + HR*spec.Diet	18	-842.21	14.84	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI	18	-842.16	14.89	0.00	1.00

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt
~ ForStrata + HR + spec.Diet	10	-842.10	14.95	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR	15	-841.76	15.29	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet	19	-841.72	15.33	0.00	1.00
~ DietCat + ForStrata + EI + HR + DietCat*EI + ForStrata*EI + EI*HR	18	-841.64	15.41	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + HR*spec.Diet	15	-841.50	15.55	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	19	-841.39	15.66	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	16	-841.05	16.00	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet	16	-840.91	16.14	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR	19	-840.57	16.49	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + HR*spec.Diet	19	-840.40	16.65	0.00	1.00
~ ForStrata + HR + spec.Diet + HR*spec.Diet	11	-840.32	16.73	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + HR*spec.Diet	16	-839.94	17.11	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*spec.Diet + HR*spec.Diet	20	-839.89	17.16	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + EI*spec.Diet	20	-839.80	17.25	0.00	1.00
~ ForStrata + EI + HR + spec.Diet + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	17	-839.04	18.01	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + HR*spec.Diet	20	-838.80	18.25	0.00	1.00
~ DietCat + ForStrata + EI + HR + spec.Diet + DietCat*EI + ForStrata*EI + EI*HR + EI*spec.Diet + HR*spec.Diet	21	-837.98	19.08	0.00	1.00

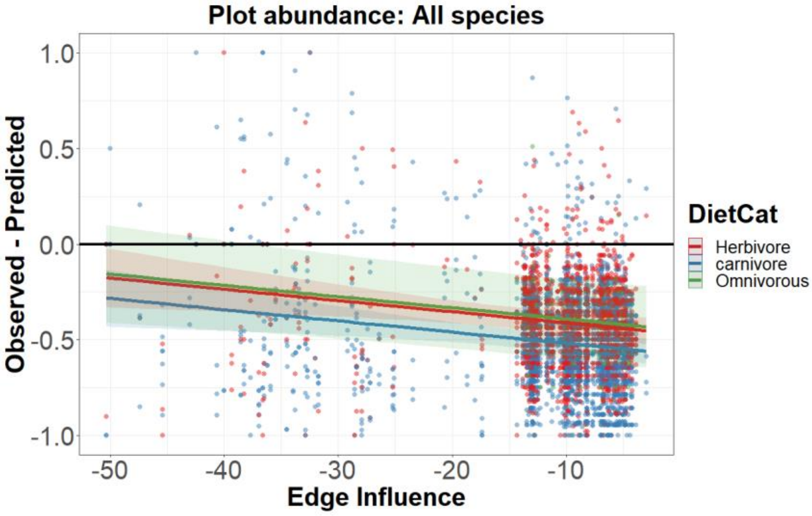
Table S 14: Candidate models explaining residual differences between observed and predicted edge sensitiveness of Forest core spcies

Modnames	K	R2	AICc	ΔAICc	AICc Wt	Cum Wt
~ spec.Diet	3	0.31	- 5.94	-	0.50	0.50
~ HR + spec.Diet	4	0.33	- 3.93	2.01	0.18	0.69
~ DietCat + spec.Diet	5	0.36	- 2.42	3.53	0.09	0.77
~ HR	3	0.19	- 1.51	4.43	0.05	0.83
~ HR + spec.Diet + HR:spec.Diet	5	0.33	- 0.94	5.00	0.04	0.87
~ DietCat	4	0.24	- 0.64	5.30	0.04	0.91
~ ForStrata + spec.Diet	6	0.37	0.46	6.40	0.02	0.93
~ DietCat + HR + spec.Diet	6	0.36	0.71	6.65	0.02	0.94
~ DietCat + HR	5	0.28	0.94	6.88	0.02	0.96
~ 1	2	-	1.85	7.79	0.01	0.97
~ ForStrata + HR + spec.Diet	7	0.39	3.29	9.23	0.00	0.98
~ ForStrata + HR + spec.Diet + ForStrata:HR	9	0.54	3.64	9.58	0.00	0.98
~ DietCat + HR + spec.Diet + DietCat:HR	7	0.38	3.73	9.67	0.00	0.98
~ DietCat + HR + DietCat:HR	6	0.28	4.05	9.99	0.00	0.99
~ ForStrata + HR + ForStrata:HR	8	0.45	4.27	10.21	0.00	0.99
~ DietCat + HR + spec.Diet + HR:spec.Diet	7	0.36	4.31	10.25	0.00	0.99
~ ForStrata + HR	6	0.26	5.03	10.97	0.00	1.00
~ DietCat + ForStrata + spec.Diet	8	0.40	6.49	12.43	0.00	1.00
~ DietCat + HR + spec.Diet + DietCat:HR + HR:spec.Diet	8	0.39	6.99	12.93	0.00	1.00
~ ForStrata + HR + spec.Diet + HR:spec.Diet	8	0.39	7.26	13.20	0.00	1.00
~ ForStrata	5	0.08	7.70	13.64	0.00	1.00
~ DietCat + ForStrata	7	0.27	8.06	14.00	0.00	1.00
~ ForStrata + HR + spec.Diet + ForStrata:HR + HR:spec.Diet	10	0.54	8.33	14.27	0.00	1.00
~ DietCat + ForStrata + HR	8	0.32	10.26	16.20	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet	9	0.41	10.70	16.64	0.00	1.00
~ DietCat + ForStrata + HR + ForStrata:HR	10	0.49	11.69	17.63	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata:HR	11	0.55	13.25	19.19	0.00	1.00
~ DietCat + ForStrata + HR + DietCat:HR	9	0.32	14.55	20.49	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat:HR	10	0.42	15.08	21.03	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + HR:spec.Diet	10	0.41	15.64	21.58	0.00	1.00
~ DietCat + ForStrata + HR + DietCat:HR + ForStrata:HR	11	0.49	16.89	22.83	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata:HR + HR:spec.Diet	12	0.56	19.39	25.33	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat:HR + ForStrata:HR	12	0.55	19.51	25.45	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat:HR + HR:spec.Diet	11	0.44	19.72	25.66	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat:HR + ForStrata:HR + HR:spec.Diet	13	0.56	26.57	32.51	0.00	1.00

Legenda: EI: Edge influence calculated from local landscape on 2km radius around the sampling point; HR: log10 of home range in hectares, DietCat: Herbivorous, Omnivores or Carnivores, spec.Diet: Diet specialization index, ForStrata: Predominant foraging stratum; Interaction terms are indicated with “*”; K: Number of model parameters, wi model weight of evidence and its cumulative sum.

Fonte: O autor

Figure S5: Residual difference between observed and predicted (Observed minus predicted) abundance at the plot level



Legenda: Edge influence metric is minimum (left) in areas near edges and maximum (zero) in interior portions of forests. Red line and dots indicate Herbivores species; Blue line and point indicate Carnivore species; Green line and dots indicate Omnivorous species.

Fonte: O autor, 2023

Table S15: Candidate models explaining variation in residual differences between predicted and observed edge sensitivity (Observed minus predicted) Considering all species.

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt	R2
~ ObsCat + spec.Diet	5	- 5.34	-	0.19	0.19	0.52
~ ObsCat + HR	5	- 5.34	0.002	0.19	0.38	0.52
~ ObsCat + HR + spec.Diet	6	- 5.26	0.079	0.18	0.56	0.55
~ ObsCat + spec.Diet + ObsCat*spec.Diet	7	- 3.85	1.492	0.09	0.64	0.57
~ ObsCat + HR + spec.Diet + ObsCat*spec.Diet	8	- 2.53	2.818	0.05	0.69	0.59
~ ObsCat + HR + spec.Diet + HR*spec.Diet	7	- 2.52	2.823	0.05	0.74	0.55
~ ForStrata + ObsCat + spec.Diet	8	- 2.18	3.160	0.04	0.77	0.58
~ ForStrata + ObsCat + HR + spec.Diet	9	- 1.51	3.829	0.03	0.80	0.61
~ ForStrata + ObsCat + HR	8	- 1.31	4.031	0.02	0.83	0.57
~ ForStrata + ObsCat + spec.Diet + ObsCat*spec.Diet	10	- 1.01	4.328	0.02	0.85	0.64
~ DietCat + ObsCat + HR	7	- 0.57	4.777	0.02	0.87	0.53
~ ObsCat + HR + ObsCat*HR	7	- 0.56	4.785	0.02	0.88	0.53
~ DietCat + ObsCat + spec.Diet	7	- 0.41	4.936	0.02	0.90	0.53
~ ObsCat + HR + spec.Diet + ObsCat*HR	8	0.31	5.654	0.01	0.91	0.56
~ DietCat + ObsCat	6	0.36	5.707	0.01	0.92	0.48
~ DietCat + ObsCat + HR + spec.Diet	8	0.63	5.974	0.01	0.93	0.55
~ ObsCat	4	0.72	6.060	0.01	0.94	0.40
~ ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	9	0.82	6.165	0.01	0.95	0.59
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	11	1.37	6.711	0.01	0.95	0.65
~ DietCat + ObsCat + spec.Diet + ObsCat*spec.Diet	9	1.55	6.891	0.01	0.96	0.58
~ ForStrata + ObsCat + HR + spec.Diet + HR*spec.Diet	10	1.66	7.001	0.01	0.97	0.61
~ DietCat + ObsCat + HR + DietCat*HR	8	2.38	7.726	0.00	0.97	0.53
~ ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	10	3.00	8.341	0.00	0.97	0.60
~ ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	9	3.34	8.684	0.00	0.98	0.56
~ ForStrata + ObsCat + HR + ForStrata*HR	11	3.67	9.016	0.00	0.98	0.63
~ DietCat + ObsCat + HR + spec.Diet + HR*spec.Diet	9	3.80	9.144	0.00	0.98	0.56
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR	9	3.80	9.146	0.00	0.98	0.56
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR	12	3.96	9.299	0.00	0.98	0.67
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	10	4.00	9.341	0.00	0.98	0.59
~ DietCat + ForStrata + ObsCat + spec.Diet	10	4.10	9.443	0.00	0.99	0.59
~ ForStrata + ObsCat + HR + ObsCat*HR	10	4.31	9.655	0.00	0.99	0.59
~ ForStrata + ObsCat	7	4.66	10.003	0.00	0.99	0.47
~ DietCat + ForStrata + ObsCat + HR	10	4.82	10.165	0.00	0.99	0.58
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR	11	4.86	10.201	0.00	0.99	0.62
~ DietCat + ObsCat + HR + ObsCat*HR	9	5.23	10.568	0.00	0.99	0.54

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt	R2
~ DietCat + ForStrata + ObsCat	9	5.38	10.718	0.00	0.99	0.54
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	12	5.44	10.785	0.00	0.99	0.65
~ DietCat + ForStrata + ObsCat + HR + spec.Diet	11	5.87	11.216	0.00	1.00	0.61
~ DietCat + ForStrata + ObsCat + spec.Diet + ObsCat*spec.Diet	12	5.98	11.319	0.00	1.00	0.65
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	10	6.13	11.468	0.00	1.00	0.57
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet	11	6.65	11.994	0.00	1.00	0.60
~ ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	11	6.84	12.180	0.00	1.00	0.60
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR	10	7.08	12.419	0.00	1.00	0.56
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	13	7.73	13.077	0.00	1.00	0.67
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	11	7.84	13.182	0.00	1.00	0.59
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	12	8.43	13.771	0.00	1.00	0.63
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR	11	8.56	13.906	0.00	1.00	0.58
~ DietCat + ObsCat + HR + DietCat*HR + ObsCat*HR	10	8.71	14.051	0.00	1.00	0.54
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	14	8.96	14.302	0.00	1.00	0.70
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	13	8.98	14.325	0.00	1.00	0.66
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	12	9.49	14.836	0.00	1.00	0.62
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + HR*spec.Diet	12	9.59	14.931	0.00	1.00	0.61
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	13	9.63	14.976	0.00	1.00	0.65
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR	12	9.92	15.261	0.00	1.00	0.61
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	11	10.63	15.978	0.00	1.00	0.56
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	12	10.77	16.109	0.00	1.00	0.60
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR	11	10.79	16.137	0.00	1.00	0.56
~ ForStrata + ObsCat + HR + ForStrata*HR + ObsCat*HR	13	10.89	16.236	0.00	1.00	0.64
~ DietCat + ForStrata + ObsCat + HR + ForStrata*HR	13	11.36	16.704	0.00	1.00	0.64
~ DietCat + ForStrata + ObsCat + HR + ObsCat*HR	12	11.59	16.931	0.00	1.00	0.60
~ spec.Diet	3	12.06	17.404	0.00	1.00	0.16
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR	14	12.11	17.456	0.00	1.00	0.67
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	13	12.71	18.057	0.00	1.00	0.63
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR	14	13.08	18.427	0.00	1.00	0.67
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR	13	13.37	18.716	0.00	1.00	0.62

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt	R2
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet	14	13.48	18.819	0.00	1.00	0.66
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	12	13.53	18.877	0.00	1.00	0.57
~ ForStrata + spec.Diet	6	13.71	19.055	0.00	1.00	0.28
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	14	13.77	19.112	0.00	1.00	0.66
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	15	13.99	19.335	0.00	1.00	0.70
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	13	14.24	19.579	0.00	1.00	0.61
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	14	14.40	19.738	0.00	1.00	0.66
~ HR + spec.Diet	4	14.45	19.789	0.00	1.00	0.16
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	13	15.20	20.545	0.00	1.00	0.60
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ObsCat*HR	13	15.97	21.316	0.00	1.00	0.60
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ForStrata*HR	14	16.02	21.362	0.00	1.00	0.64
~ HR	3	16.32	21.662	0.00	1.00	0.06
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	15	16.42	21.765	0.00	1.00	0.68
~ 1	2	16.52	21.867	0.00	1.00	-
~ ForStrata + HR + spec.Diet	7	16.59	21.933	0.00	1.00	0.28
~ DietCat + spec.Diet	5	17.03	22.373	0.00	1.00	0.16
~ HR + spec.Diet + HR*spec.Diet	5	17.07	22.411	0.00	1.00	0.16
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	15	17.07	22.416	0.00	1.00	0.68
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	14	17.63	22.974	0.00	1.00	0.63
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	15	17.66	23.005	0.00	1.00	0.67
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR	14	18.10	23.441	0.00	1.00	0.62
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR	15	18.12	23.461	0.00	1.00	0.67
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	14	18.19	23.538	0.00	1.00	0.62
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	15	18.85	24.189	0.00	1.00	0.66
~ DietCat	4	18.97	24.317	0.00	1.00	0.06
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	16	19.00	24.338	0.00	1.00	0.71
~ ForStrata + HR	6	19.40	24.739	0.00	1.00	0.17
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	16	19.43	24.771	0.00	1.00	0.70
~ ForStrata	5	19.52	24.864	0.00	1.00	0.11
~ DietCat + HR + spec.Diet	6	19.65	24.991	0.00	1.00	0.16
~ ForStrata + HR + spec.Diet + HR*spec.Diet	8	19.68	25.027	0.00	1.00	0.28
~ DietCat + ForStrata + spec.Diet	8	19.80	25.147	0.00	1.00	0.28
~ ForStrata + HR + spec.Diet + ForStrata*HR	10	19.87	25.212	0.00	1.00	0.39

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt	R2
~ DietCat + ForStrata + ObsCat + HR + ForStrata*HR + ObsCat*HR	15	20.07	25.415	0.00	1.00	0.65
~ DietCat + HR	5	20.67	26.012	0.00	1.00	0.08
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	15	21.35	26.695	0.00	1.00	0.64
~ DietCat + HR + spec.Diet + DietCat*HR	7	22.31	27.658	0.00	1.00	0.17
~ DietCat + ForStrata	7	22.45	27.793	0.00	1.00	0.17
~ ForStrata + HR + ForStrata*HR	9	22.55	27.893	0.00	1.00	0.29
~ DietCat + HR + spec.Diet + HR*spec.Diet	7	22.60	27.944	0.00	1.00	0.16
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR	16	22.82	28.163	0.00	1.00	0.68
~ DietCat + ForStrata + HR + spec.Diet	9	23.07	28.410	0.00	1.00	0.28
~ DietCat + HR + DietCat*HR	6	23.16	28.507	0.00	1.00	0.09
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	16	23.23	28.573	0.00	1.00	0.67
~ ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	11	23.60	28.941	0.00	1.00	0.39
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	16	23.70	29.041	0.00	1.00	0.67
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	16	24.49	29.832	0.00	1.00	0.66
~ DietCat + ForStrata + HR	8	24.70	30.043	0.00	1.00	0.18
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	17	25.06	30.401	0.00	1.00	0.71
~ DietCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	8	25.15	30.498	0.00	1.00	0.17
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	17	25.48	30.827	0.00	1.00	0.70
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet	17	25.51	30.855	0.00	1.00	0.70
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ForStrata*HR + ObsCat*HR	16	25.53	30.873	0.00	1.00	0.65
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR	10	26.51	31.855	0.00	1.00	0.28
~ DietCat + ForStrata + HR + spec.Diet + HR*spec.Diet	10	26.61	31.950	0.00	1.00	0.28
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR	12	27.68	33.022	0.00	1.00	0.39
~ DietCat + ForStrata + HR + DietCat*HR	9	27.90	33.239	0.00	1.00	0.19
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	17	28.16	33.506	0.00	1.00	0.68
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	17	28.64	33.984	0.00	1.00	0.68
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR	17	28.81	34.154	0.00	1.00	0.68
~ DietCat + ForStrata + HR + ForStrata*HR	11	29.26	34.602	0.00	1.00	0.30
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + HR*spec.Diet	11	29.80	35.144	0.00	1.00	0.29
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	18	31.65	36.993	0.00	1.00	0.71

Model Formula	K	AICc	DAICc	AICcWt	Cum Wt	R2
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	18	31.69	37.033	0.00	1.00	0.71
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	13	32.03	37.369	0.00	1.00	0.40
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR	13	32.09	37.429	0.00	1.00	0.40
~ DietCat + ForStrata + HR + DietCat*HR + ForStrata*HR	12	33.36	38.699	0.00	1.00	0.30
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*spec.Diet	18	34.75	40.095	0.00	1.00	0.68
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	14	36.82	42.165	0.00	1.00	0.40
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	19	39.04	44.387	0.00	1.00	0.71
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	19	39.08	44.418	0.00	1.00	0.71
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	20	46.88	52.223	0.00	1.00	0.71

Legenda: EI: Edge influence calculated from local landscape on 2km radius around the sampling point; HR: log10 of home range in hectares, DietCat: Herbivorous, Omnivores or Carnivores, spec.Diet: Diet specialization index, ForStrata: Predominant foraging stratum; Interaction terms are indicated with “*”; K: Number of model parameters, wi model weight of evidence and its cumulative sum.

Fonte: O autor

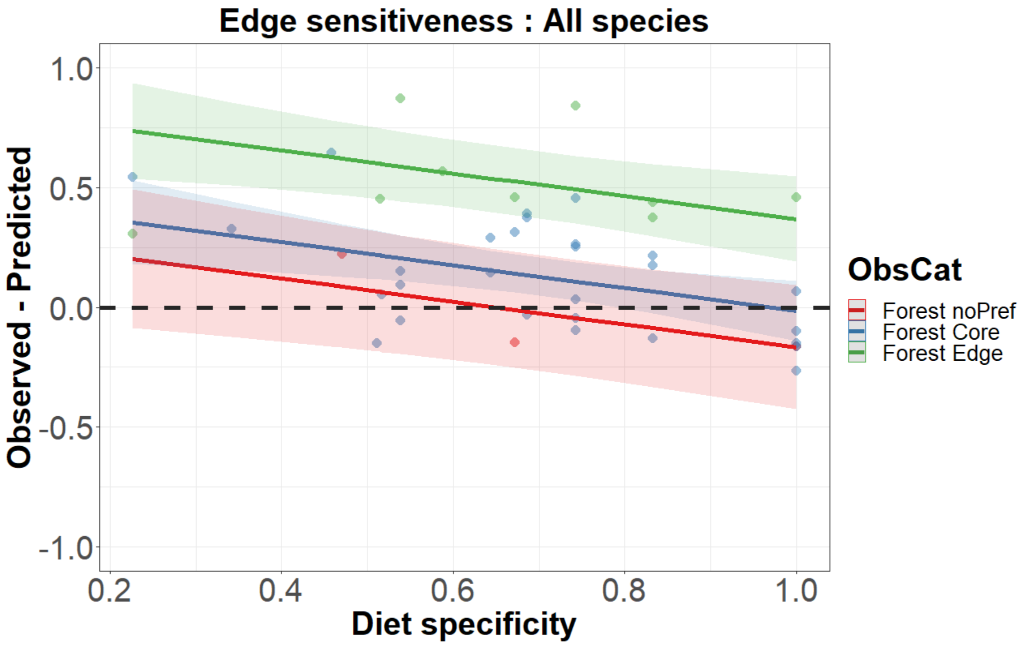
Table S16: Coefficients from the best model describing Edge sensitivity residuals of all species as a function of observed habitat prefferences across edge Influence gradient and diet specializaion.

Parameter	Coefficient	CI_low	CI_high	p
(Intercept)	0.13	0.05	0.21	0.00
ObsCat Edge	0.38	0.22	0.54	0.00
ObsCat noPref	-0.15	-0.41	0.10	0.23
Spec.Diet	-0.10	-0.16	-0.03	0.01

Legenda:ObsCat indicates habitat preference across edge influence gradient. Species diet specialization; CI Low Indicate lower confidence interval considering alfa=0.05.

Fonte: O autor, 2023

Figure S6: Residual difference between observed and predicted (Observed minus predicted) species' edge sensitivity as a function of diet specialization for all species species with different observed edge response.



Legenda: forest edge (green), forest core (blue) and forest with no preference (red).

Fonte: O autor, 2023.

Table S17: Candidate models predicting residual differences in edge driven fragmentation impact (observed minus predicted), considering forest core species.

Model Formula	K	R2	AICc	DAICc	AICcWt	CumWt
~ DietCat	3	0.22	-18.02	-	0.22	0.22
~ DietCat + spec.Diet	3	0.21	-17.80	0.22	0.20	0.42
~ HR + spec.Diet	4	0.27	-17.20	0.82	0.15	0.56
~ HR + ObsEs	4	0.26	-16.78	1.24	0.12	0.68
~ ObsEs + spec.Diet	4	0.22	-15.50	2.53	0.06	0.74
~ HR + ObsEs + spec.Diet	5	0.28	-14.80	3.22	0.04	0.79
~ HR + spec.Diet + HR*spec.Diet	5	0.27	-14.26	3.77	0.03	0.82
~ HR + ObsEs + HR*ObsEs	5	0.27	-14.09	3.93	0.03	0.85
~ 1	2	-	-13.71	4.32	0.03	0.87
~ ObsEs	3	0.07	-13.17	4.85	0.02	0.89
~ DietCat + spec.Diet	5	0.22	-12.30	5.73	0.01	0.91
~ DietCat + HR	5	0.21	-12.18	5.84	0.01	0.92
~ HR + ObsEs + spec.Diet + HR*ObsEs	6	0.29	-11.79	6.23	0.01	0.93
~ ForStrata + spec.Diet	6	0.29	-11.70	6.32	0.01	0.94
~ HR + ObsEs + spec.Diet + HR*spec.Diet	6	0.28	-11.54	6.48	0.01	0.95
~ DietCat + HR + spec.Diet	6	0.28	-11.35	6.67	0.01	0.95
~ ForStrata + HR	6	0.27	-10.85	7.18	0.01	0.96
~ DietCat + HR + ObsEs	6	0.27	-10.83	7.19	0.01	0.97
~ DietCat	4	0.06	-10.26	7.77	0.00	0.97
~ ForStrata + HR + spec.Diet	7	0.34	-10.25	7.77	0.00	0.98
~ DietCat + ObsEs + spec.Diet	6	0.22	- 9.23	8.79	0.00	0.98
~ DietCat + HR + DietCat*HR	6	0.22	- 9.09	8.94	0.00	0.98
~ ForStrata + HR + ObsEs	7	0.31	- 8.83	9.19	0.00	0.98
~ DietCat + ObsEs	5	0.11	- 8.74	9.29	0.00	0.98
~ DietCat + HR + ObsEs + spec.Diet	7	0.30	- 8.44	9.58	0.00	0.99
~ HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	7	0.29	- 8.23	9.79	0.00	0.99
~ ForStrata + ObsEs + spec.Diet	7	0.29	- 8.20	9.82	0.00	0.99
~ DietCat + HR + spec.Diet + HR*spec.Diet	7	0.28	- 7.79	10.23	0.00	0.99
~ DietCat + HR + spec.Diet + DietCat*HR	7	0.28	- 7.78	10.24	0.00	0.99
~ DietCat + HR + ObsEs + HR*ObsEs	7	0.27	- 7.55	10.47	0.00	0.99
~ DietCat + HR + ObsEs + DietCat*HR	7	0.27	- 7.31	10.72	0.00	0.99
~ ForStrata + HR + ObsEs + spec.Diet	8	0.35	- 6.63	11.39	0.00	1.00
~ ForStrata	5	0.04	- 6.49	11.53	0.00	1.00
~ ForStrata + HR + spec.Diet + HR*spec.Diet	8	0.34	- 6.35	11.67	0.00	1.00
~ ForStrata + HR + ObsEs + HR*ObsEs	8	0.32	- 5.35	12.67	0.00	1.00
~ ForStrata + ObsEs	6	0.10	- 5.15	12.87	0.00	1.00
~ ForStrata + HR + ForStrata*HR	8	0.31	- 5.02	13.00	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + HR*ObsEs	8	0.30	- 4.74	13.28	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR	8	0.30	- 4.48	13.54	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + HR*spec.Diet	8	0.30	- 4.47	13.55	0.00	1.00
~ DietCat + ForStrata + spec.Diet	8	0.29	- 4.15	13.87	0.00	1.00

~ DietCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	8	0.28	- 3.81	14.21	0.00	1.00
~ DietCat + HR + ObsEs + DietCat*HR + HR*ObsEs	8	0.27	- 3.60	14.43	0.00	1.00
~ DietCat + ForStrata + HR	8	0.27	- 3.30	14.72	0.00	1.00
~ ForStrata + HR + spec.Diet + ForStrata*HR	9	0.37	- 3.17	14.85	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs	9	0.36	- 2.61	15.41	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + HR*spec.Diet	9	0.35	- 2.24	15.78	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet	9	0.35	- 2.21	15.81	0.00	1.00
~ DietCat + ForStrata	7	0.11	- 1.73	16.29	0.00	1.00
~ ForStrata + HR + ObsEs + ForStrata*HR	9	0.33	- 1.24	16.79	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs	9	0.31	- 0.59	17.43	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	9	0.31	- 0.38	17.65	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	9	0.30	- 0.32	17.70	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	9	0.30	- 0.06	17.97	0.00	1.00
~ DietCat + ForStrata + ObsEs + spec.Diet	9	0.29	0.19	18.21	0.00	1.00
~ DietCat + ForStrata + ObsEs	8	0.15	0.81	18.83	0.00	1.00
~ DietCat + ForStrata + HR + DietCat*HR	9	0.27	0.89	18.91	0.00	1.00
~ ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	10	0.38	1.59	19.61	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR	10	0.37	1.76	19.79	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	10	0.36	2.28	20.30	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet	10	0.36	2.35	20.37	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + HR*spec.Diet	10	0.35	2.64	20.66	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR	10	0.35	2.69	20.71	0.00	1.00
~ ForStrata + HR + ObsEs + ForStrata*HR + HR*ObsEs	10	0.33	3.42	21.44	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + HR*ObsEs	10	0.32	3.80	21.82	0.00	1.00
~ DietCat + ForStrata + HR + ForStrata*HR	10	0.31	4.18	22.21	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR	10	0.31	4.23	22.25	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	10	0.31	4.47	22.49	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR	11	0.38	6.75	24.77	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	11	0.38	7.14	25.17	0.00	1.00

~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	11	0.37	7.17	25.20	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs	11	0.37	7.38	25.40	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*spec.Diet	11	0.36	7.87	25.89	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR	11	0.36	7.87	25.90	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + HR*spec.Diet	11	0.35	8.20	26.22	0.00	1.00
~ DietCat + ForStrata + HR + DietCat*HR + ForStrata*HR	11	0.34	8.70	26.73	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + ForStrata*HR	11	0.33	8.99	27.01	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + HR*ObsEs	11	0.32	9.33	27.36	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR	12	0.39	12.55	30.57	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	12	0.39	12.80	30.83	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR	12	0.38	13.03	31.06	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	12	0.38	13.43	31.45	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	12	0.37	13.59	31.61	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	12	0.37	13.68	31.70	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	12	0.36	14.17	32.19	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + ForStrata*HR	12	0.35	14.66	32.68	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + ForStrata*HR + HR*ObsEs	12	0.34	14.94	32.97	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	13	0.40	19.74	37.77	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR	13	0.39	19.75	37.77	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	13	0.39	19.99	38.01	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	13	0.39	20.00	38.03	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	13	0.37	20.67	38.69	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + ForStrata*HR + HR*ObsEs	13	0.35	21.78	39.80	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs	14	0.40	28.00	46.02	0.00	1.00

~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	14	0.40	28.05	46.07	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	14	0.39	28.26	46.28	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs + HR*spec.Diet	15	0.40	37.62	55.64	0.00	1.00

Legenda: Obs Es: Observed edge sensitivity. HR: log10 of home range in hectares, DietCat: Herbivorous, Omnivores or Carnivores, spec.Diet: Diet specialization index, ForStrata: Predominant foraging stratum; Interaction terms are indicated with “*”; K: Number of model parameters, wi model weight of evidence and its cumulative sum.

Fonte: O autor, 2023.

Table S18: Candidate models predicting residual differences in edge driven fragmentation impact (observed minus predicted), considering All species.

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ HR + ObsEs	4	0.34	-35.67	-	0.30	0.30
~ HR + ObsEs + HR*ObsEs	5	0.35	-33.70	1.97	0.11	0.42
~ HR + ObsEs + spec.Diet	5	0.34	-33.13	2.54	0.09	0.50
~ ObsCat + HR + ObsEs	6	0.38	-32.51	3.16	0.06	0.56
~ ObsCat + HR	5	0.32	-32.03	3.64	0.05	0.61
~ DietCat + HR + ObsEs	6	0.37	-31.94	3.73	0.05	0.66
~ ObsEs	3	0.22	-31.48	4.19	0.04	0.70
~ HR + ObsEs + spec.Diet + HR*ObsEs	6	0.35	-30.95	4.72	0.03	0.73
~ HR + ObsEs + spec.Diet + HR*spec.Diet	6	0.34	-30.46	5.21	0.02	0.75
~ ObsEs + spec.Diet	4	0.25	-30.44	5.23	0.02	0.77
~ ObsCat + HR + ObsEs + HR*ObsEs	7	0.38	-29.58	6.09	0.01	0.78
~ ObsCat + HR + ObsEs + spec.Diet	7	0.38	-29.57	6.10	0.01	0.80
~ ObsCat + HR + spec.Diet	6	0.33	-29.46	6.21	0.01	0.81
~ DietCat + HR + ObsEs + HR*ObsEs	7	0.38	-29.42	6.24	0.01	0.83
~ DietCat + HR + ObsEs + DietCat*HR	7	0.37	-29.17	6.50	0.01	0.84
~ DietCat + HR + ObsEs + spec.Diet	7	0.37	-29.00	6.67	0.01	0.85
~ ObsCat + HR + spec.Diet + ObsCat*spec.Diet	8	0.41	-28.68	6.99	0.01	0.86
~ ObsCat + spec.Diet + ObsCat*spec.Diet	7	0.36	-28.65	7.01	0.01	0.87
~ HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	7	0.36	-28.60	7.07	0.01	0.87
~ ForStrata + HR + ObsEs	7	0.36	-28.51	7.16	0.01	0.88
~ ObsCat + ObsEs	5	0.25	-28.03	7.64	0.01	0.89
~ ObsCat + spec.Diet	5	0.25	-27.82	7.84	0.01	0.90
~ ObsCat + HR + ObsCat*HR	7	0.35	-27.73	7.94	0.01	0.90
~ DietCat + ObsCat + HR + ObsEs	8	0.40	-27.72	7.95	0.01	0.91
~ ObsCat + HR + ObsEs + ObsCat*HR	8	0.40	-27.63	8.04	0.01	0.91
~ ObsCat + HR + spec.Diet + HR*spec.Diet	7	0.34	-27.47	8.20	0.01	0.92
~ ObsCat + ObsEs + spec.Diet	6	0.29	-27.15	8.52	0.00	0.92
~ DietCat + ObsCat + HR	7	0.34	-26.96	8.70	0.00	0.93
~ ObsCat + HR + ObsEs + spec.Diet + HR*spec.Diet	8	0.38	-26.86	8.81	0.00	0.93
~ DietCat + ObsEs	5	0.23	-26.85	8.82	0.00	0.93
~ ObsCat	4	0.18	-26.77	8.90	0.00	0.94
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet	9	0.43	-26.76	8.91	0.00	0.94
~ DietCat + HR + ObsEs + DietCat*HR + HR*ObsEs	8	0.38	-26.57	9.10	0.00	0.94
~ ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs	8	0.38	-26.45	9.22	0.00	0.95
~ DietCat + HR + ObsEs + spec.Diet + HR*ObsEs	8	0.38	-26.31	9.36	0.00	0.95
~ HR	3	0.11	-26.29	9.38	0.00	0.95
~ ObsCat + ObsEs + spec.Diet + ObsCat*spec.Diet	8	0.37	-26.25	9.42	0.00	0.95

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + HR + ObsEs + HR*ObsEs	8	0.37	-26.18	9.49	0.00	0.96
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR	8	0.37	-26.04	9.63	0.00	0.96
~ DietCat + HR + ObsEs + spec.Diet + HR*spec.Diet	8	0.37	-25.94	9.73	0.00	0.96
~ ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	9	0.41	-25.48	10.19	0.00	0.96
~ ForStrata + HR + ObsEs + spec.Diet	8	0.36	-25.38	10.29	0.00	0.97
~ spec.Diet	3	0.09	-25.31	10.36	0.00	0.97
~ DietCat + ObsEs + spec.Diet	6	0.25	-25.05	10.62	0.00	0.97
~ ObsCat + HR + spec.Diet + ObsCat*HR	8	0.35	-24.84	10.83	0.00	0.97
~ HR + spec.Diet	4	0.14	-24.78	10.89	0.00	0.97
~ DietCat + ObsCat + HR + ObsEs + DietCat*HR	9	0.40	-24.74	10.93	0.00	0.97
~ ObsCat + HR + ObsEs + ObsCat*HR + HR*ObsEs	9	0.40	-24.49	11.18	0.00	0.97
~ DietCat + ObsCat + HR + spec.Diet	8	0.35	-24.47	11.20	0.00	0.98
~ DietCat + ObsCat + HR + DietCat*HR	8	0.35	-24.44	11.23	0.00	0.98
~ DietCat + ObsCat + HR + ObsEs + spec.Diet	9	0.40	-24.41	11.26	0.00	0.98
~ DietCat + ObsCat + HR + ObsEs + HR*ObsEs	9	0.40	-24.37	11.30	0.00	0.98
~ ForStrata + ObsEs	6	0.24	-24.34	11.33	0.00	0.98
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR	9	0.40	-24.27	11.40	0.00	0.98
~ ForStrata + ObsCat + HR	8	0.34	-24.09	11.58	0.00	0.98
~ ForStrata + ObsCat + HR + ObsEs	9	0.39	-23.83	11.84	0.00	0.98
~ 1	2	-	-23.78	11.89	0.00	0.98
~ ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	9	0.39	-23.73	11.94	0.00	0.98
~ DietCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	9	0.38	-23.44	12.23	0.00	0.98
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	9	0.38	-23.26	12.41	0.00	0.99
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs	10	0.43	-23.26	12.41	0.00	0.99
~ DietCat + ForStrata + HR + ObsEs	9	0.38	-23.25	12.42	0.00	0.99
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	10	0.43	-23.22	12.45	0.00	0.99
~ ForStrata + ObsEs + spec.Diet	7	0.27	-23.18	12.49	0.00	0.99
~ DietCat + ObsCat + ObsEs	7	0.26	-22.91	12.76	0.00	0.99
~ ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	10	0.43	-22.84	12.83	0.00	0.99
~ ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs	9	0.37	-22.82	12.85	0.00	0.99
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	9	0.37	-22.69	12.98	0.00	0.99
~ HR + spec.Diet + HR*spec.Diet	5	0.14	-22.54	13.13	0.00	0.99
~ DietCat + ObsCat	6	0.20	-22.53	13.14	0.00	0.99
~ ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	9	0.37	-22.43	13.24	0.00	0.99

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	10	0.42	-22.39	13.28	0.00	0.99
~ ForStrata + HR + ObsEs + spec.Diet + HR*spec.Diet	9	0.36	-22.23	13.44	0.00	0.99
~ DietCat + ObsCat + spec.Diet + ObsCat*spec.Diet	9	0.36	-22.16	13.51	0.00	0.99
~ DietCat + ObsCat + spec.Diet	7	0.25	-22.11	13.56	0.00	0.99
~ DietCat + ObsCat + HR + spec.Diet + HR*spec.Diet	9	0.36	-22.07	13.60	0.00	0.99
~ DietCat + ObsCat + HR + ObsCat*HR	9	0.36	-21.81	13.86	0.00	0.99
~ DietCat + HR	5	0.13	-21.79	13.88	0.00	0.99
~ DietCat + ObsCat + HR + ObsEs + ObsCat*HR	10	0.41	-21.78	13.89	0.00	0.99
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR	9	0.36	-21.77	13.90	0.00	0.99
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR	10	0.40	-21.22	14.45	0.00	0.99
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + HR*spec.Diet	10	0.40	-21.20	14.47	0.00	0.99
~ DietCat + ObsCat + HR + ObsEs + DietCat*HR + HR*ObsEs	10	0.40	-21.17	14.50	0.00	0.99
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*spec.Diet	10	0.40	-21.09	14.58	0.00	0.99
~ DietCat + ObsCat + ObsEs + spec.Diet	8	0.29	-21.05	14.62	0.00	0.99
~ ForStrata + ObsCat + HR + spec.Diet	9	0.35	-21.04	14.63	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs	10	0.40	-20.91	14.76	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs	10	0.40	-20.83	14.84	0.00	1.00
~ DietCat + HR + spec.Diet	6	0.17	-20.81	14.86	0.00	1.00
~ ForStrata + HR	6	0.16	-20.71	14.96	0.00	1.00
~ ForStrata + ObsCat + spec.Diet + ObsCat*spec.Diet	10	0.39	-20.59	15.08	0.00	1.00
~ DietCat + spec.Diet	5	0.10	-20.39	15.28	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	10	0.39	-20.33	15.34	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + HR*ObsEs	10	0.39	-20.31	15.36	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet	10	0.39	-20.25	15.42	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + HR*ObsEs	10	0.39	-20.24	15.43	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet	11	0.44	-20.18	15.49	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	11	0.44	-20.13	15.54	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR	10	0.38	-19.93	15.74	0.00	1.00
~ DietCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	10	0.38	-19.86	15.81	0.00	1.00
~ ForStrata + ObsCat + spec.Diet	8	0.27	-19.85	15.82	0.00	1.00
~ ForStrata + spec.Diet	6	0.14	-19.74	15.93	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + HR + ObsEs + spec.Diet	10	0.38	-19.71	15.96	0.00	1.00
~ ForStrata + ObsCat + ObsEs	8	0.26	-19.64	16.03	0.00	1.00
~ DietCat	4	0.02	-19.62	16.05	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	11	0.44	-19.60	16.06	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	11	0.43	-19.42	16.25	0.00	1.00
~ ForStrata + HR + ObsEs + ForStrata*HR	10	0.38	-19.33	16.34	0.00	1.00
~ DietCat + ObsCat + ObsEs + spec.Diet + ObsCat*spec.Diet	10	0.38	-19.32	16.35	0.00	1.00
~ DietCat + HR + DietCat*HR	6	0.13	-19.27	16.40	0.00	1.00
~ ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	11	0.43	-19.09	16.58	0.00	1.00
~ ForStrata + ObsCat + HR + ObsCat*HR	10	0.37	-19.08	16.59	0.00	1.00
~ ForStrata + HR + spec.Diet	7	0.19	-19.03	16.64	0.00	1.00
~ ForStrata + ObsCat	7	0.19	-18.97	16.70	0.00	1.00
~ DietCat + ForStrata + ObsEs	8	0.25	-18.88	16.79	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR	10	0.37	-18.85	16.81	0.00	1.00
~ DietCat + ObsCat + HR + DietCat*HR + ObsCat*HR	10	0.37	-18.75	16.92	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	11	0.42	-18.72	16.95	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + HR*spec.Diet	10	0.36	-18.56	17.11	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet	11	0.42	-18.55	17.12	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	10	0.36	-18.50	17.17	0.00	1.00
~ ForStrata + ObsCat + ObsEs + spec.Diet	9	0.30	-18.42	17.25	0.00	1.00
~ DietCat + HR + spec.Diet + HR*spec.Diet	7	0.17	-18.23	17.44	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + ObsCat*HR + HR*ObsEs	11	0.42	-18.22	17.45	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ObsCat*HR	11	0.42	-18.20	17.46	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + DietCat*HR + ObsCat*HR	11	0.42	-18.19	17.48	0.00	1.00
~ DietCat + HR + spec.Diet + DietCat*HR	7	0.17	-18.14	17.52	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR	11	0.41	-18.00	17.66	0.00	1.00
~ ForStrata	5	0.04	-17.88	17.79	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR	10	0.35	-17.67	18.00	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	11	0.41	-17.52	18.15	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs	11	0.40	-17.44	18.23	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	11	0.40	-17.43	18.24	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	11	0.40	-17.40	18.27	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + ObsCat + ObsEs + spec.Diet + ObsCat*spec.Diet	11	0.40	-17.39	18.28	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs + HR*spec.Diet	11	0.40	-17.28	18.39	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*spec.Diet	11	0.40	-16.95	18.72	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + HR*ObsEs	11	0.40	-16.86	18.81	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet	12	0.45	-16.73	18.94	0.00	1.00
~ DietCat + ForStrata + ObsEs + spec.Diet	9	0.27	-16.68	18.99	0.00	1.00
~ ForStrata + HR + spec.Diet + HR*spec.Diet	8	0.20	-16.47	19.20	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs	11	0.39	-16.47	19.20	0.00	1.00
~ ForStrata + HR + ObsEs + ForStrata*HR + HR*ObsEs	11	0.39	-16.47	19.20	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs	11	0.39	-16.46	19.21	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	12	0.45	-16.31	19.36	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs	12	0.45	-16.15	19.52	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR	11	0.39	-16.14	19.53	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	12	0.44	-16.09	19.58	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet	12	0.44	-16.05	19.62	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*spec.Diet	11	0.38	-16.03	19.64	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	12	0.44	-16.03	19.64	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	11	0.38	-15.99	19.68	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	12	0.44	-15.88	19.79	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR	11	0.38	-15.71	19.96	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	12	0.44	-15.68	19.99	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR	11	0.38	-15.53	20.14	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR	11	0.38	-15.49	20.18	0.00	1.00
~ DietCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	8	0.17	-15.10	20.57	0.00	1.00
~ ForStrata + ObsCat + HR + ForStrata*HR	11	0.37	-15.04	20.63	0.00	1.00
~ DietCat + ForStrata + HR	8	0.17	-14.92	20.75	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	12	0.42	-14.67	21.00	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet	11	0.36	-14.60	21.07	0.00	1.00
~ ForStrata + HR + ForStrata*HR	9	0.23	-14.60	21.07	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR	11	0.36	-14.51	21.16	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ObsCat*HR + HR*ObsEs	12	0.42	-14.36	21.31	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + DietCat*HR + ObsCat*HR + HR*ObsEs	12	0.42	-14.26	21.41	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*spec.Diet	12	0.42	-14.25	21.42	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs	12	0.42	-14.14	21.53	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR	12	0.42	-14.14	21.53	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR	12	0.42	-14.10	21.57	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR	12	0.41	-13.77	21.90	0.00	1.00
~ DietCat + ForStrata + ObsCat	9	0.21	-13.76	21.91	0.00	1.00
~ DietCat + ForStrata + spec.Diet	8	0.15	-13.75	21.92	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet	9	0.21	-13.63	22.04	0.00	1.00
~ DietCat + ForStrata + ObsCat + ObsEs	10	0.28	-13.42	22.25	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	12	0.41	-13.41	22.26	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet	12	0.41	-13.40	22.27	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + HR*ObsEs	12	0.41	-13.33	22.34	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	12	0.40	-13.30	22.37	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	12	0.40	-13.22	22.45	0.00	1.00
~ DietCat + ForStrata	7	0.06	-13.12	22.55	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ForStrata*HR	12	0.40	-12.98	22.69	0.00	1.00
~ DietCat + ForStrata + ObsCat + spec.Diet	10	0.27	-12.95	22.72	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + ForStrata*HR	12	0.40	-12.84	22.83	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	12	0.40	-12.82	22.85	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	12	0.40	-12.72	22.95	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	13	0.46	-12.68	22.99	0.00	1.00
~ DietCat + ForStrata + ObsCat + spec.Diet + ObsCat*spec.Diet	12	0.39	-12.64	23.03	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	13	0.45	-12.38	23.29	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	13	0.45	-12.35	23.32	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	12	0.39	-12.35	23.32	0.00	1.00
~ ForStrata + HR + spec.Diet + ForStrata*HR	10	0.25	-12.29	23.38	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs	13	0.45	-12.29	23.38	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	12	0.39	-12.01	23.66	0.00	1.00
~ DietCat + ForStrata + HR + DietCat*HR	9	0.18	-11.92	23.75	0.00	1.00
~ ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	13	0.45	-11.88	23.79	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	12	0.38	-11.86	23.81	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	13	0.45	-11.71	23.96	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*ObsEs	13	0.45	-11.71	23.96	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	13	0.45	-11.67	24.00	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	12	0.38	-11.61	24.06	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + HR*spec.Diet	12	0.38	-11.58	24.09	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	13	0.44	-11.53	24.14	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	13	0.44	-11.48	24.19	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet	13	0.44	-11.47	24.20	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsCat*HR	12	0.38	-11.46	24.21	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR	12	0.37	-11.24	24.43	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR	12	0.37	-11.21	24.46	0.00	1.00
~ DietCat + ForStrata + ObsCat + ObsEs + spec.Diet	11	0.30	-10.99	24.68	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + HR*spec.Diet	10	0.22	-10.63	25.04	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR	10	0.22	-10.46	25.21	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ObsCat*HR	13	0.43	-10.36	25.31	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*spec.Diet	13	0.42	-10.19	25.48	0.00	1.00
~ ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	13	0.42	-10.08	25.59	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs	13	0.42	-9.93	25.74	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*ObsEs	13	0.42	-9.87	25.80	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs + HR*spec.Diet	13	0.42	-9.87	25.80	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	13	0.42	-9.82	25.85	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*spec.Diet	13	0.41	-9.44	26.23	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR	13	0.41	-9.44	26.23	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + HR*ObsEs	13	0.41	-9.39	26.28	0.00	1.00
~ ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	11	0.27	-9.16	26.51	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + ForStrata*HR + HR*ObsEs	13	0.41	-9.09	26.58	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs	13	0.41	-8.97	26.70	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + ForStrata*HR	13	0.40	-8.85	26.82	0.00	1.00
~ DietCat + ForStrata + ObsCat + ObsEs + spec.Diet + ObsCat*spec.Diet	13	0.40	-8.85	26.82	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	13	0.40	-8.78	26.89	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + HR*ObsEs	13	0.40	-8.74	26.93	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	14	0.47	-8.57	27.10	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR	13	0.40	-8.54	27.13	0.00	1.00
~ ForStrata + ObsCat + HR + ForStrata*HR + ObsCat*HR	13	0.40	-8.52	27.15	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR	13	0.40	-8.50	27.17	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	14	0.46	-8.23	27.44	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	13	0.39	-8.06	27.61	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet	14	0.46	-8.05	27.62	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	14	0.46	-7.91	27.76	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	14	0.46	-7.90	27.76	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR	13	0.39	-7.86	27.81	0.00	1.00
~ DietCat + ForStrata + HR + ForStrata*HR	11	0.24	-7.78	27.89	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	14	0.46	-7.73	27.94	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ObsCat*HR	13	0.39	-7.62	28.05	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	14	0.45	-7.56	28.11	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	14	0.45	-7.55	28.12	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ForStrata*HR	13	0.38	-7.19	28.48	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + HR*spec.Diet	13	0.38	-7.15	28.52	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	14	0.45	-6.92	28.75	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	14	0.45	-6.89	28.78	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + HR*spec.Diet	11	0.22	-6.80	28.87	0.00	1.00
~ DietCat + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	14	0.44	-6.73	28.94	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet	14	0.44	-6.69	28.98	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ObsCat*HR + HR*ObsEs	14	0.43	-5.93	29.74	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ObsCat*HR	14	0.43	-5.88	29.79	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR	12	0.28	-5.87	29.80	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR	14	0.43	-5.70	29.97	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + ObsCat*HR	14	0.43	-5.56	30.11	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + DietCat*HR + ForStrata*HR + HR*ObsEs	14	0.43	-5.49	30.18	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs + HR*spec.Diet	14	0.42	-5.41	30.26	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*ObsEs + HR*spec.Diet	14	0.42	-5.09	30.57	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + HR*ObsEs + HR*spec.Diet	14	0.42	-4.95	30.72	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ForStrata*HR	14	0.42	-4.95	30.72	0.00	1.00
~ DietCat + ForStrata + HR + DietCat*HR + ForStrata*HR	12	0.26	-4.78	30.89	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*spec.Diet	14	0.41	-4.71	30.96	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs	14	0.41	-4.71	30.96	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	14	0.41	-4.46	31.21	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	14	0.41	-4.42	31.25	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + HR*spec.Diet	14	0.41	-4.24	31.43	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR	14	0.41	-4.19	31.48	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR	14	0.41	-4.14	31.53	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ForStrata*HR	14	0.40	-3.99	31.68	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	14	0.40	-3.95	31.72	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	14	0.40	-3.95	31.72	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR	14	0.40	-3.66	32.01	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	15	0.47	-3.63	32.04	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	15	0.47	-3.42	32.25	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR	14	0.39	-3.25	32.41	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	15	0.46	-3.09	32.58	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	15	0.46	-3.07	32.60	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	15	0.46	-3.03	32.63	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*spec.Diet	15	0.46	-2.92	32.75	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	15	0.46	-2.90	32.77	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs	15	0.46	-2.87	32.80	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet	15	0.46	-2.87	32.80	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	15	0.46	-2.71	32.96	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	15	0.46	-2.64	33.03	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR	13	0.30	-2.62	33.05	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	13	0.30	-2.17	33.50	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	15	0.45	-1.75	33.92	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	15	0.44	-1.16	34.51	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*spec.Diet	15	0.44	-1.01	34.66	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ObsCat*HR + HR*ObsEs	15	0.43	-0.93	34.74	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs	15	0.43	-0.86	34.81	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR	15	0.43	-0.83	34.84	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	15	0.43	-0.73	34.94	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ForStrata*HR	15	0.43	-0.63	35.04	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs	15	0.43	-0.61	35.06	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + ObsCat*HR + HR*ObsEs	15	0.43	-0.44	35.23	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR	15	0.43	-0.40	35.27	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	15	0.43	-0.38	35.29	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR	15	0.42	0.08	35.75	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + HR*ObsEs	15	0.42	0.14	35.81	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + HR*ObsEs + HR*spec.Diet	15	0.42	0.24	35.91	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR	15	0.42	0.29	35.96	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + HR*spec.Diet	15	0.41	0.65	36.32	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ForStrata*HR + ObsCat*HR	15	0.41	0.92	36.59	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	15	0.41	0.96	36.63	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	15	0.41	1.01	36.68	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet	16	0.48	1.51	37.18	0.00	1.00
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	16	0.47	1.91	37.58	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	16	0.47	2.02	37.69	0.00	1.00
~ DietCat + ForStrata + HR + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	14	0.30	2.18	37.85	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	16	0.47	2.41	38.08	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	16	0.47	2.49	38.16	0.00	1.00
~ DietCat + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	16	0.47	2.50	38.17	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	16	0.46	2.60	38.27	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs	16	0.46	2.70	38.37	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	16	0.46	2.72	38.39	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*spec.Diet	16	0.46	2.72	38.39	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	16	0.46	2.73	38.40	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*ObsEs	16	0.46	2.77	38.44	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + ObsCat*HR	16	0.44	4.37	40.04	0.00	1.00
~ DietCat + ForStrata + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs + HR*spec.Diet	16	0.44	4.42	40.09	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	16	0.44	4.42	40.09	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ForStrata*HR + HR*ObsEs	16	0.44	4.53	40.20	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + HR*ObsEs + HR*spec.Diet	16	0.44	4.58	40.25	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*ObsEs	16	0.44	4.58	40.25	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*spec.Diet	16	0.44	4.64	40.31	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR	16	0.43	4.76	40.43	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + DietCat*HR + ForStrata*HR + ObsCat*HR	16	0.43	5.00	40.67	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*spec.Diet	16	0.43	5.07	40.74	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*ObsEs	16	0.43	5.19	40.85	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs	16	0.42	5.60	41.27	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR	16	0.42	5.73	41.40	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	16	0.42	5.87	41.54	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	17	0.48	7.32	42.98	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	17	0.48	7.63	43.30	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet	17	0.48	7.63	43.30	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	17	0.48	7.71	43.38	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	17	0.48	7.81	43.48	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet	17	0.47	8.22	43.89	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	17	0.47	8.38	44.05	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet	17	0.47	8.54	44.21	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	17	0.47	8.55	44.22	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	17	0.47	8.58	44.25	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	17	0.46	8.89	44.55	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ForStrata*HR + ObsCat*HR	17	0.45	9.70	45.37	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + HR*ObsEs + HR*spec.Diet	17	0.45	10.02	45.69	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR	17	0.44	10.33	46.00	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs	17	0.44	10.33	46.00	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR	17	0.44	10.35	46.02	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	17	0.44	10.37	46.04	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*ObsEs + HR*spec.Diet	17	0.44	10.38	46.05	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + ForStrata*HR + ObsCat*HR + HR*ObsEs	17	0.44	10.38	46.05	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + HR*ObsEs + HR*spec.Diet	17	0.44	10.72	46.39	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*spec.Diet	17	0.43	10.91	46.58	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	18	0.48	13.94	49.61	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	18	0.48	14.05	49.72	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	18	0.48	14.06	49.73	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	18	0.48	14.30	49.96	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	18	0.48	14.38	50.05	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	18	0.48	14.41	50.08	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet	18	0.47	14.77	50.44	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	18	0.47	14.80	50.47	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs	18	0.47	14.94	50.61	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	18	0.47	15.24	50.91	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR	18	0.46	16.18	51.85	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*spec.Diet	18	0.45	16.23	51.90	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*ObsEs	18	0.45	16.46	52.13	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + HR*ObsEs + HR*spec.Diet	18	0.45	16.63	52.30	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*spec.Diet	18	0.45	16.90	52.57	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*ObsEs	18	0.44	16.96	52.63	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	19	0.49	20.83	56.50	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	19	0.49	20.93	56.60	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	19	0.49	21.06	56.73	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	19	0.48	21.39	57.06	0.00	1.00
~ ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	19	0.48	21.72	57.39	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	19	0.48	21.92	57.59	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs	19	0.48	22.06	57.73	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet + HR*spec.Diet	19	0.47	22.18	57.85	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*spec.Diet	19	0.46	23.50	59.17	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + HR*ObsEs + HR*spec.Diet	19	0.46	23.54	59.21	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*ObsEs	19	0.46	23.61	59.28	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet	20	0.50	28.76	64.43	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	20	0.49	28.96	64.63	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	20	0.49	29.04	64.71	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	20	0.49	29.04	64.71	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	20	0.48	30.10	65.77	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + HR*ObsEs + HR*spec.Diet	20	0.46	31.62	67.29	0.00	1.00

Model Formula	K	R2	AICc	DAICc	AICcWt	Cum.Wt
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs	21	0.50	37.88	73.55	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*spec.Diet	21	0.50	37.88	73.55	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	21	0.49	38.08	73.75	0.00	1.00
~ DietCat + ForStrata + ObsCat + HR + ObsEs + spec.Diet + DietCat*HR + ForStrata*HR + ObsCat*HR + ObsCat*spec.Diet + HR*ObsEs + HR*spec.Diet	22	0.50	48.07	83.74	0.00	1.00

Legenda: Obs Es: Observed edge sensitivity. HR: log10 of home range in hectares, DietCat: Herbivorous, Omnivores or Carnivores, spec.Diet: Diet specialization index, ForStrata: Predominant foraging stratum; Interaction terms are indicated with “*”; K: Number of model parameters, wi model weight of evidence and its cumulative sum.

Fonte: O autor, 2023

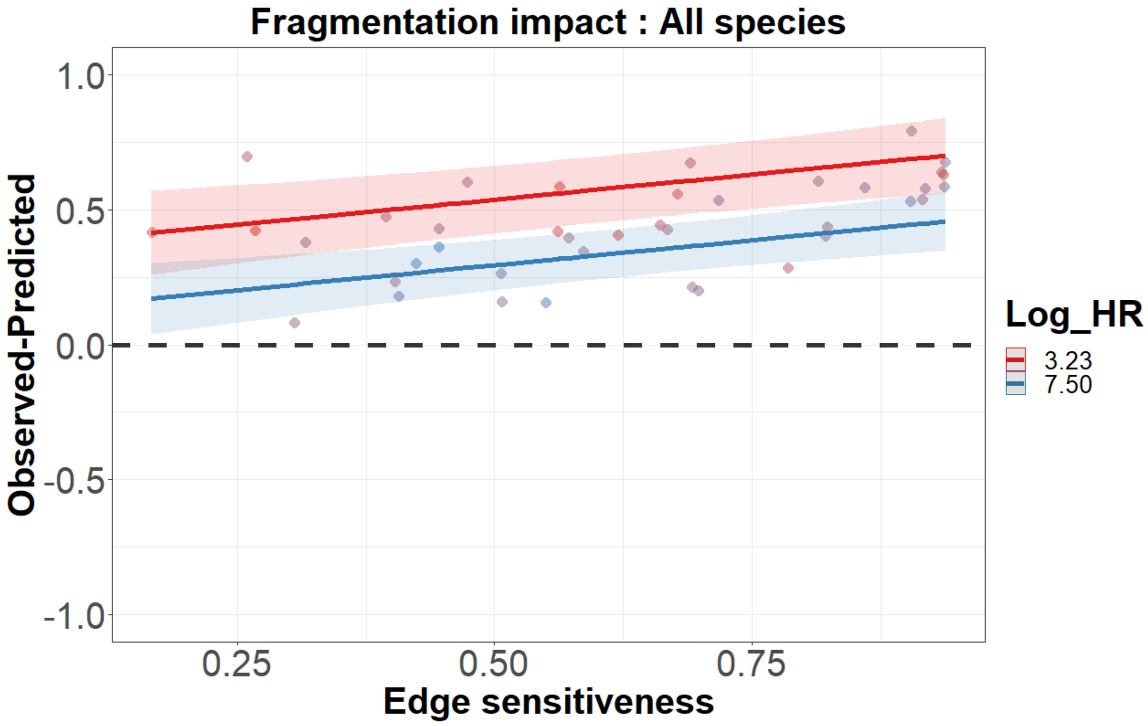
Table S19: Coefficients of the best model predicting Differences in Edge-driven fragmentation impact across all species in our dataset

Parameter	Coefficient	CI	Lower CI95	Upper CI95	p
(Intercept)	0.44	0.95	0.39	0.49	0.00
HR	- 0.06	0.95	- 0.11	- 0.01	0.01
Obs_ES	0.08	0.95	0.04	0.13	0.00

Legenda: HR: Log10 of species home range; Obs_ES: Observed edge sensitivity; Lower CI95: lower bound of confidence interval considering alfa=0.05.

Fonte: O autor, 2023

Figure S7: Fragmentation impact residual difference between observed and predicted fragmentation impact of all species.



Legenda: the smallest home range in red (HR= 10^3.23 ≈ 1 500m ² = 0.0015 Km2) and largest in blue (HR = 10 ^ 7.5 ≈ 31 000km2)

Fonte: O autor, 2023