UNIVERSIDADE FEDERAL DO OESTE DO PARÁ
INSTITUTO DE CIÊNCIAS E TECNOLOGIA DAS ÁGUAS
PROGRAMA DE PÓS-GRADUAÇÃO EM BIODIVERSIDADE

LUIZ SANTANA FRANCO MACEDO

PADRÕES DE NICHO TEMPORAL DE MAMÍFEROS DE MÉDIO E GRANDE PORTE NA AMAZÔNIA ORIENTAL BRASILEIRA

SANTARÉM - PA

2024

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Dissertação apresentada ao Programa de Pós-Graduação em Biodiversidade da Universidade Federal do Oeste do Pará, como requisito para obtenção de grau de Mestre em Biodiversidade.

Orientadora: Dra. Raquel Ribeiro da Silva

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Mestrando

Dedico às minhas filhas Maria Clara e Thaianny Yris, aos meus pais, amigos, familiares e professores.

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"Não estamos preocupados com esperanças ou medos, somente com a verdade que nossa razão nos permite descobrir."

Charles Darwin

RESUMO

O estudo do padrão de atividade dos animais é importante para a compreensão das interações que permitem a coexistência das espécies, sobretudo, a partir da partilha de recursos por meio de sua atividade temporal. O presente estudo analisou o padrão de atividade de mamíferos terrestres de médio e grande porte na Reserva Biológica do Tapirapé, sudeste do Pará, norte do Brasil. Por meio da metodologia das armadilhas fotográficas analisamos o padrão diário e a variação do nicho temporal entre as espécies. Os dados foram coletados entre março de 2016 a julho de 2019. Estimamos os padrões de atividade usando a densidade de kernel, medimos a sobreposição de atividade usando um coeficiente de sobreposição (Δ), também chamado de Dhat, e a significância das comparações da atividade entre pares de espécies foi estimada utilizando o teste Wald (W). Os padrões de atividade das espécies analisadas são consistentes com a literatura, embora tenham ocorrido pequenos desvios. Os registros apontam 12,5% das espécies com padrão de atividade diurna (*D. leporina* e *N. nasua*), padrão de atividade noturna (18,75%; *D. kappleri*, *D. novemcinctus*, *L. tigrinus*), espécies com tendência à atividade diurna (18,75%; *Passalites nemorivagus*, *Dicotyles tajacu*, *Tayassu pecari*), com tendência à atividade noturna (18,75%; *Cuniculus paca*, *Panthera onca*, *Tapirus terrestris*), espécies catemerais (25%; *Leopardus pardalis*, *Mazama americana*, *Priodontes maximus*, *Puma concolor*) e uma espécie com atividade crepuscular (6,25%; *Dasyprocta prymnolopha*). A maioria dos pares intraguilda apresenta segregação temporal e pouca sobreposição de atividades, demonstrando assim menor competição por recursos, otimizando o uso do habitat. A média dos indices de sobreposição entre os carnívoros foi (Δ= 0.55), herbívoros (Δ= 0.53) e onívoros (Δ= 0.34) e os maiores indices de sobreposição par-a-par foi entre *Puma concolor* x *Leopardus pardalis* (Δ= 0.63), *Dicotyles tajacu* x *Tayassu pecari* (Δ= 0.86) e *Dasypus kappleri* x *Dasypus novemcinctus* (Δ= 0.62). Os resultados também apontam que a abundância de presas determina a preferência alimentar e o comportamento de forrageamento dos predadores e otimiza a coexistência de felinos. Este estudo fornece informações importantes sobre o nicho temporal das espécies e ajuda a entender as interações entre táxons e entre presas e predadores que influenciam a estrutura da comunidade de médios e grandes mamíferos terrestres na Amazônia.

Palavras-chave: Armadilhas fotográficas, Padrões de atividade, Mastofauna, Competição, Predação, Guildas tróficas.

ABSTRACT

The study of the activity pattern of animals is important for understanding the interactions that allow the coexistence of species, especially based on the partitioning of resources through their temporal activity. The present study analyzed the activity pattern of medium and large terrestrial mammals in the Tapirapé Biological Reserve, southeast of Pará, northern Brazil. Using camera trap methodology, we analyzed the daily pattern and variation in the temporal niche between species. Data was collected between March 2016 and July 2019. We estimated activity patterns using kernel density, measured activity overlap using an overlap coefficient (Δ), also called Dhat, and the significance of level comparisons of activity between pairs of species was estimated using the Wald (W) test. The records point out 12.5% of the species with a diurnal activity pattern (*D. leporina* and *N. nasua*), a nocturnal activity pattern (18.75%; *D. kappleri*, *D. novemcinctus*, *L. tigrinus*), species with a tendency to diurnal activity (18.75%; *Passalites nemorivagus*, *Dicotyles tajacu*, *Tayassu pecari*), with a tendency to nocturnal activity (18.75%; *Cuniculus paca*, *Panthera onca*, *Tapirus terrestris*), cathemerals species (25%; *Leopardus pardalis*, *Mazama americana*, *Priodontes maximus*, *Puma concolor*) and one species with twilight activity (6.25%; *Dasyprocta prymnolopha*). Most intraguild pairs present temporal segregation and little overlap of activities, thus demonstrating less competition for resources, optimizing habitat use. The average overlap index between carnivores was (Δ= 0.55), herbivores (Δ= 0.53) and omnivores (Δ= 0.34) and the highest pairwise overlap indexes were between *Puma concolor* x *Leopardus pardalis* (Δ= 0.63), *Dicotyles tajacu* x *Tayassu pecari* (Δ= 0.86) and *Dasypus kappleri* x *Dasypus novemcinctus* (Δ= 0.62). The results also indicate that preys abundance determines the food preference and foraging behavior of predators and optimizes the coexistence of felids coexistence. This study provides important information about the temporal niche of species and helps to understand the interactions between taxa and between preys and predators that influence the community structure of medium and large terrestrial mammals in the Amazon.

Keywords: Camera traps, Activity patterns, Wild mammals, Competition, Predation, Trophic guilds.

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LISTA DE ABREVIATURAS E SIGLAS

INMET – Instituto Nacional de Metereologia

IUCN – União Internacional para Conservação da Natureza

REBIOTA – Reserva Biológica do Tapirapé

SISBIO – Sistema de Autorização e Informação em Biodiversidade

UTM – Universal Transversa de Mercator

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1.INTRODUÇÃO GERAL

PADRÕES DE NICHO TEMPORAL DE MAMÍFEROS DE MÉDIO E GRANDE PORTE NA AMAZÔNIA ORIENTAL BRASILEIRA

O que é a pesquisa?

Os mamíferos de médio e grande porte (>1kg) são organismos fundamentais nos processos ecológicos e florestais nos ecossistemas, sendo responsáveis pela manutenção da diversidade de plantas, através da dispersão e predação das sementes, e também da diversidade de espécies animais, por meio das inúmeras relações ecológicas que possibilitam a coexistência das espécies (Terborgh 1990; Dirzo et al. 1991). Os mamíferos apresentam um ciclo diário de atividades com duração de 24 horas (Sousa et al. 2008), caracterizado pela execução de atividades como forrageamento, busca por abrigos, comportamento de corte, repouso, entre outros (Ciocheti 2007) sua atividade é classificada como diurna, noturna, crepuscular (ativo ao amanhecer e/ou entardecer) ou catemeral (ativos ao longo de todo o dia) (Bennie et al. 2014).

Estudar o padrão de atividade das espécies é importante, para a compreensão das interações ecológicas que ocorrem entre os organismos de uma comunidade. Além de ser uma fonte de novas informações sobre a história natural das espécies, este estudo proporciona o conhecimento dos mecanismos que condicionam as partilhas de recursos entre espécies simpátricas (Schoener 1974). No domínio Amazônico brasileiro, mamíferos terrestres de médio e grande porte podem variar o seu padrão de atividade quando submetidos a ambientes distintos, especialmente relacionados à influência antrópica (Scognamillo et al. 2003; Luna 2014) e ao estado de preservação. As espécies podem ser estritamente diurnas ou noturnas até espécies que possuem atividade durante todo o dia (Gómez et al. 2005). Neste estudo, avaliamos os padrões de atividade diária de médios e grandes mamíferos terrestres na Reserva Biológica do Tapirapé que possibilitam a coexistência simpátrica entre pares destas espécies na Amazônia.

Como a pesquisa foi realizada?

Para conhecer e analisar o padrão de atividade dos mamíferos terrestres de médio e grande porte na Reserva Biológica Tapirapé, realizamos um estudo com um total de 356 dias não consecutivos de amostragem utilizando câmeras-trap (Moultrie® M-550 Gen2 e Bushnell®). Instalamos as armadilhas fotográficas ao longo de três trilhas de 5 km de extensão distantes 1 km entre si. Em cada trilha foram instaladas cinco armadilhas fotográficas e a distância entre as armadilhas foi de 1 km. As armadilhas fotográficas são aparelhos compostos por uma câmera digital e sensores de infravermelho (detectam calor) e sensores de movimento, permitindo a realização de registros na fase diurna e noturna do ciclo diário, operando 24 horas/dia. As armadilhas fotográficas foram programadas para registrar as espécies no modo *multishot* (3 fotos sequenciais) com intervalo de 60 segundos entre as fotografias, em caso do animal permanecer em frente ao equipamento. Devido a algumas câmeras apresentarem falhas na configuração do modo foto, estas foram configuradas com a função vídeo com 10s de duração e intervalos de 1min entre eles (em caso do animal permanecer em frente à câmera). As armadilhas fotográficas foram fixadas em árvores a uma altura de 30-50 cm do solo e posicionadas em locais estratégicos, que apresentavam evidência de uso por esses animais como, por exemplo, locais de passagem e pontos de alimentação (Figura 1).

Figura 1. Armadilha fotográfica instalada em árvore na Reserva Biológica do Tapirapé demonstrando a altura e posicionamento da câmera.

A partir dos registros, foi possível determinar o padrão de atividade das espécies e a variação nos padrões de atividades nas comparações par-a-par. O primeiro leva em conta o período de atividade das espécies analisadas de acordo com as fases do dia (Gómez et al. 2005) e a estimativa de densidade de Kernel (Ridout & Linkie 2009). O segundo estima a sobreposição de atividade usando um coeficiente de sobreposição (Δ), também chamado de Dhat (Meredith & Ridout 2021).

Qual a importância da pesquisa?

Os padrões de atividade diária de muitos animais tropicais são bastante conhecidos em termos gerais (Emmons & Feer 1990), mas os detalhes sobre esses padrões precisam ser mais bem descritos. Compreender como espécies simpátricas ou ecologicamente semelhantes coexistem é essencial para o entendimento dos padrões de diversidade e distribuição de espécies.

As diferenças nos ciclos temporais diários apresentados pelas espécies evoluem com mudanças ambientais periódicas (Kronfeld-Schor & Dayan 2003). Algumas variações como iluminação noturna, temperatura, precipitação, competição, predação, disponibilidade de recursos e distúrbios antrópicos interferem nas atividades diárias dos organismos (Chappell 1980, Schwitzer et al. 2007, Di Bitetti et al. 2008, Lambert et al. 2009, Norris et al. 2010).

A predação e a competição, por exemplo, exercem importante papel na modulação dos períodos de atividades das espécies. Espécies de guildas semelhantes, ou seja, que possuem uma grande sobreposição de nicho, podem ser levadas à exclusão competitiva, caso não ajustem seu nicho temporal, espacial ou trófico (Cassini 2005). A competição interespecífica, pode, portanto, selecionar a segregação ou partilha de nicho entre espécies, permitindo sua coexistência, evitando uma competição por interferência e maximizando o aporte energético por meio do forrageamento ótimo (Cozzi et al. 2012).

Além disso, o ritmo de atividade da maior parte das espécies é regulado por processos bioquímicos estimulados pelas variações cíclicas do ambiente, como o fotoperíodo; e suas atividades são reguladas de acordo com a quantidade de luz disponível ao longo do dia (seguindo o ciclo claro e escuro). Deste modo, algumas espécies podem se especializar em um período específico, sendo classificadas de acordo com o período em que se encontram mais ativas – diurnas, noturnas, catemerais ou crepusculares (Bennie et al. 2014). Na Amazônia brasileira, são poucos os estudos que utilizam os padrões de atividade para testar hipóteses sobre sobreposição ou partilha de nicho entre espécies pertencentes a diferentes guildas tróficas (Costa 2022) ou espécies evolutivamente similares (congêneres) (Gonçalves 2023).

Nesse sentido, estudos são necessários para melhor compreender como a composição da comunidade pode influenciar nos padrões de atividade das espécies e a metodologia de estudo por meio de armadilhas fotográficas proporciona excelentes oportunidades para determinar padrões de atividade de espécies simpátricas e como esses padrões de atividade variam no espaço e no tempo.

Pesquisadores Responsáveis

Luiz Santana Franco Macedo e Raquel Ribeiro da Silva

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2. Capítulo Único

Artigo segue o modelo do periódico ***Biota Neotropica***
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Temporal niche patterns of medium and large mammals in the Eastern Brazilian Amazon

Padrões de nicho temporal de mamíferos de médio e grande porte na Amazônia oriental brasileira

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Abstract

The study of the activity pattern of animals is important for understanding the interactions that allow the coexistence of species, especially based on the partitioning of resources through their temporal activity. The present study analyzed the activity pattern of medium and large terrestrial mammals in the Tapirapé Biological Reserve, southeast of Pará, northern Brazil. Using camera trap methodology, we analyzed the daily pattern and variation in the temporal niche between species. Data was collected between March 2016 and July 2019. We estimated activity patterns using kernel density, measured activity overlap using an overlap coefficient (Δ), also called Dhat, and the significance of level comparisons of activity between pairs of species was estimated using the Wald (W) test. The records point out 12.5% of the species with a diurnal activity pattern (*D. leporina* and *N. nasua*), a nocturnal activity pattern (18.75%; *D. kappleri*, *D. novemcinctus*, *L. tigrinus*), species with a tendency to diurnal activity (18.75%; *Passalites nemorivagus*, *Dicotyles tajacu*, *Tayassu pecari*), with a tendency to nocturnal activity (18.75%; *Cuniculus paca*, *Panthera onca*, *Tapirus terrestris*), cathemerals species (25%; *Leopardus pardalis*, *Mazama americana*, *Priodontes maximus*, *Puma concolor*) and one species with twilight activity (6.25%; *Dasyprocta prymnolopha*). Most intraguild pairs present temporal segregation and little overlap of activities, thus demonstrating less competition for resources, optimizing habitat use. The average overlap index between carnivores was (Δ= 0.55), herbivores (Δ= 0.53) and omnivores (Δ= 0.34) and the highest pairwise overlap indexes were between *Puma concolor* x *Leopardus pardalis* (Δ= 0.63), *Dicotyles tajacu* x *Tayassu pecari* (Δ= 0.86) and *Dasypus kappleri* x *Dasypus novemcinctus* (Δ= 0.62). The results also point out that preys abundance determines the food preference and foraging behavior of predators and optimizes the coexistence of felids. This study provides important information about the temporal niche of species and helps to understand the interactions between taxa and between preys and predators that influence the community structure of medium and large terrestrial mammals in the Amazon.

Keywords: Camera traps, Activity patterns, Wild mammals, Competition, Predation, Trophic guilds.

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Resumo

O estudo do padrão de atividade dos animais é importante para a compreensão das interações que permitem a coexistência das espécies, sobretudo, a partir da partilha de recursos por meio de sua atividade temporal. O presente estudo analisou o padrão de atividade de mamíferos terrestres de médio e grande porte na Reserva Biológica do Tapirapé, sudeste do Pará, norte do Brasil. Por meio da metodologia das armadilhas fotográficas analisamos o padrão diário e a variação do nicho temporal entre as espécies. Os dados foram coletados entre março de 2016 a julho de 2019. Estimamos os padrões de atividade usando a densidade de kernel, medimos a sobreposição de atividade usando um coeficiente de sobreposição (Δ), também chamado de Dhat, e a significância das comparações da atividade entre pares de espécies foi estimada utilizando o teste Wald (W). Os padrões de atividade das espécies analisadas são consistentes com a literatura, embora tenham ocorrido pequenos desvios. Os registros apontam 12,5% das espécies com padrão de atividade diurna (*D. leporina* e *N. nasua*), padrão de atividade noturna (18,75%; *D. kappleri*, *D. novemcinctus*, *L. tigrinus*), espécies com tendência à atividade diurna (18,75%; *Passalites nemorivagus*, *Dicotyles tajacu*, *Tayassu pecari*), com tendência à atividade noturna (18,75%; *Cuniculus paca*, *Panthera onca*, *Tapirus terrestris*), espécies catemerais (25%; *Leopardus pardalis*, *Mazama americana*, *Priodontes maximus*, *Puma concolor*) e uma espécie com atividade crepuscular (6,25%; *Dasyprocta prymnolopha*). A maioria dos pares intraguilda apresenta segregação temporal e pouca sobreposição de atividades, demonstrando assim menor competição por recursos, otimizando o uso do habitat. A média dos indices de sobreposição entre os carnívoros foi (Δ= 0.55), herbívoros (Δ= 0.53) e onívoros (Δ= 0.34) e os maiores indices de sobreposição par-a-par foi entre *Puma concolor* x *Leopardus pardalis* (Δ= 0.63), *Dicotyles tajacu* x *Tayassu pecari* (Δ= 0.86) e *Dasypus kappleri* x *Dasypus novemcinctus* (Δ= 0.62). Os resultados também apontam que a abundância de presas determina a preferência alimentar e o comportamento de forrageamento dos predadores e otimiza a coexistência de felinos. Este estudo fornece informações importantes sobre o nicho temporal das espécies e ajuda a entender as interações entre táxons e entre presas e predadores que influenciam a estrutura da comunidade de médios e grandes mamíferos terrestres na Amazônia.

Palavras-chave: Armadilhas fotográficas, Padrões de atividade, Competição, Mastofauna, Predação, Guildas tróficas.

Introduction

Understanding how sympatric or ecologically similar species coexist is essential for understanding patterns of species diversity and distribution. Chesson (2000) proposes that species diversity is maintained by stabilizing processes, based on the dynamics of resource use and consumption, where each species is an excellent competitor within a given environment and set of conditions. Organisms in a community can differ in relation to what they consume (trophic niche), where they forage (spatial niche) and in the periods in which they are active (temporal niche), these being the three main dimensions of the niche (Pianka 1974). According to the niche complementarity hypothesis, high overlap in resource utilization in the same dimension can be compensated by low overlap in another (Schoener 1974). Therefore, the reduction of competition and the coexistence of sympatric species is directly related to the differentiation of diet, habitat use or the period of activity of the species (Pianka 1981).

Differences in daily temporal cycles presented by species evolve with periodic environmental changes (Kronfeld-Schor & Dayan 2003). Some variations such as nighttime lighting, temperature, precipitation, competition, predation, resource availability and anthropogenic disturbances interfere with the daily activities of organisms (Chappell 1980, Schwitzer et al. 2007, Di Bitetti et al. 2008, Lambert et al. 2009, Norris et al. 2010). Thus, the activity pattern of a given species is directly linked to the environmental conditions that stimulus for its resting or movement behavior and that influence its daily activity.

The activity rhythm of most species is regulated by biochemical processes stimulated by cyclical variations in the environment, such as photoperiod; and its activities are regulated according to the amount of light available throughout the day (following the light and dark cycle). In this way, some species can specialize in a specific period, being classified according to the period in which they are most active – diurnal, nocturnal, cathemeral or twilight (Bennie et al. 2014).

Despite the sensory restrictions imposed by evolution (Hut et al. 2012, Angielczyk & Schmitz 2014, Wu et al. 2017), where 69% of mammals have nocturnal activities and 20% of them have daytime activities, ecological and environmental aspects can affect the allocation of energy between and within mammalian species during different times of the day (Kronfeld-Schor & Dayan 2003).

Species with a wide geographic distribution, the rodent *Dasyprocta sp*. presented variations in their periods of activity, demonstrating adaptations in this ecological characteristic according to the quality of the habitat (Norris et al. 2010, Ferreguetti et al. 2018), environmental temperature (Cid et al., 2015, Magalhães & Srbek-Araújo 2019), geographic location (climatic variation or food phenology) (Gómez et al. 2005, Brenes &

Javier 2021), and by the presence of competitors and/or predators (Lambert et al. 2009). This ecological plasticity existing in several species of mammals makes them an excellent study group to verify the influence of intrinsic factors (for example: increase in population density, similarity with congeners) and extrinsic factors (environmental degradation, climatic variations, interactions) on their daily behaviors.

Studies already carried out on prey-predator activities indicate that lighter nights seem to inhibit the activity of both predators and prey (De Miranda et al. 2020, Leonard et al. 2020). On the other hand, some species can benefit from nighttime light to increase their activity periods, facilitating foraging and the ability to detect predators (Huck et al. 2017, Pratas-Santiago et al. 2017). This temporal niche adjustment allows prey species to avoid times of day that may increase their predation risk, shaping predator-prey relationships (Castillo-Ruiz et al. 2012), and predators to adjust their activity times to maximize their efficiency in capturing food (Matos-Dias et al. 2018).

Like predation, competition plays an important role in modulating species' activity periods. Species from similar guilds, that is, that have a large niche overlap, can be driven to competitive exclusion if they do not adjust their temporal, spatial or trophic niche (Cassini 2005). Interspecific competition can, therefore, select segregation or niche sharing between species, allowing their coexistence, avoiding interference competition and maximizing energetic input through optimal foraging (Cozzi et al. 2012).

Medium and large mammals have discreet behaviors that make it difficult to see them in their natural habitat. The use of camera traps is an excellent alternative for capturing behaviors and activities over long periods of time, facilitating ecological analyzes of occurrence patterns (de Oliveira et al. 2022), associations between species (Lynam 2013) and their habitats (Norris 2010), as well as on resource sharing (Akkawi et al. 2020). Data like these can be used to understand the processes that shape ecological communities, especially if there is niche overlap between competing species and between predators and preys.

There are several studies that report the activity patterns of terrestrial mammals in different Brazilian biomes (Wolff et al. 2019, Cid et al. 2015). However, most restrict the number of species assessed (Foster et al., 2013, Abreu et al., 2020). In the Brazilian Amazon, there are few studies that use activity patterns to test hypotheses about overlap or niche sharing between species belonging to different trophic guilds (Costa 2022) or evolutionarily similar species (congeners) (Gonçalves 2023).

Studies using activity patterns to test hypotheses about predators and prey is also rare in the Brazilian Amazon (Santos et al. 2020). The present study analyzes the activity patterns of medium and large mammals present in a conservation unit in the eastern Amazon, investigating (1) whether species from the same trophic

guild (herbivores, carnivores, omnivores) present greater temporal niche segregation among themselves, resulting in less interference competition between them. It is expected that intraguild species reduce the competitive effect, differentiating the periods of activity throughout the day, promoting coexistence and local diversity.; (2) predators adjust their activity cycle, balancing it with that of the most abundant preys.

Material and methods

1. Study area

The study was carried out in the Tapirapé Biological Reserve/REBIOTA (5º39' 41.57"S and 50°24'17.14"W) located in the municipality of Marabá, southeast of the State of Pará, Brazil (Figure 1). REBIOTA was created by Decree No. 97,719 of May 5, 1989, covers 103,000 ha, is an important area of integral protection and conservation of biodiversity in the Amazon region used exclusively for research and educational activities. Located in one of the most deforested areas in the State, known as the open diagonal, REBIOTA, together with other conservation units that form the Carajás mosaic, plays an important role in the maintenance and conservation of species in the Amazon domain. The region's climate is tropical and has a marked seasonality, with rainy periods during the months of November to May, and the dry period, which occurs from July to September. The average annual temperature in the sampled area ranges from 23 to 33 °C and average annual precipitation is 2,000 mm. Rainfall and temperature data from REBIOTA between the years 2016 and 2019 were obtained based on records from the meteorological stations of Marabá (PA) - (82562) and Tucuruí - PA - (82361) (INMET 2023) (Figure 2). The vegetation is divided into three types: igapó, terra-firme and floodplain with the formation of a mosaic where open rainforest predominates, with scattered patches of dense rainforest and stretches of dense alluvial rainforest.

2. Data collection

The data used in the present study were collected using camera traps (Moultrie® M-550 Gen2 and Bushnell®), installed without bait, along three 5 km long trails (Trail 1, Trail 2 and Trail 3), on average 1 km apart.

Two criteria were evaluated to determine the locations for installing the cameras: a) trails, tracks or traces of the presence of animals in the location; b) minimum spatial separation of 1000 m between one camera trap and another. The camera traps were programmed to record the species in multishot mode (3 sequential photos) with an interval of 60 seconds between photographs, if the animal remained in front of the equipment. Due to some cameras having flaws in the photo mode configuration, they were configured with the video

function with 10s duration and 1min intervals between them (if the animal remained in front of the camera). The equipment was fixed to trees at a height of 30-50 cm from the ground and checked every 30 days to collect photographic records and change the batteries.

Five data collection campaigns were carried out, one in 2016, in the months of March to May (58 days), the second in 2017, in the months of April to July (80 days), the third in October 2017 to January 2018 (112 days), the fourth campaign was from June to August 2018 (70 days), and finally, the fifth campaign, from June to July 2019 (36 days).

The research was carried out in compliance with all ethical requirements and under license numbers 52979-0 and 52979-1/SISBIO.

3. Data analysis.

The identification of mammal species was carried out using reference guides (Reis et al. 2015, Emmons & Feer 1990, Wilson & Reeder 2005) and consultations with experts (Ribeiro, R., Marinho-Filho, J.S., Gomes, L., Astete, S.; personal communication). The species nomenclature followed the Official List of Brazilian Mammals of the Brazilian Society of Mastozoology (Abreu et al. 2023) and were categorized according to the Red List of Threatened Species of the International Union for the Conservation of Nature and Natural Resources (IUCN 2023).

The number of records was determined by the number of images captured by the cameras throughout the campaigns. We consider as a single record, the records of each species in each camera between intervals of thirty minutes, that is, if the same species has been recorded in the same camera twice or more in an interval of thirty minutes, only one record, the first, was considered an independent record. Species that walk in groups, such as peccaries, coatis and others, were considered as a single record, regardless of the number of individuals present in the photographic record (Ridout & Linkie 2009, Si et al. 2014, Sollmann 2018, Van Berkel 2014, Anile & Devillard 2016).

The activity period of the analyzed species was classified according to the phases of the day, defined by Gómez et al. (2005) who consider: diurnal species (when the number of records is less than 10% during dark periods), nocturnal species (number of records greater than 90% during dark periods), species with diurnal tendencies (between 10% and 30% of records during the dark period), species with a nocturnal tendency (from 70 to 90% of records during dark periods), crepuscular species (at least 50% of observations during twilight periods), cathemeral species (activities regularly distributed among light and dark periods). For the area of this study (latitude and longitude) and the sample period, we calculated the average sunrise and sunset times on the

sampling days. We consider the daytime period to be one hour after sunrise to one hour before sunset, the nighttime period to be one hour after sunset to one hour before sunrise, and the twilight period to be from one hour before and one hour after each sunrise and sunset (Theuerkauf et al. 2003).

The sampling effort was calculated following the formula adopted by Srbek-Araujo & Chiarello (2005), where the number of camera traps is multiplied by the number of days that the cameras operated (1day= 24h). The relative abundance index (RAI) for each species was calculated using the following formula (Srbek-Araujo & Chiarello 2005): RAI = (number of independent captures / sampling effort) x 100.

Activity pattern analyzes have been performed for all mammal species with at least seven independent records (Rowcliff 2014). The activity pattern was estimated by Kernel density, using the "Activity" package (version.1.3.3) (Ridout & Linkie 2009) in the R software (R Core Team 2022).

The overlapping of species' activity periods was used to verify whether species of the same trophic guild (herbivores, carnivores, omnivores) have less temporal overlap between them, restricting their activity times as a way of avoiding direct competition, and to verify whether predators adjust their activity periods with that of their prey, especially the most abundant. To determine trophic guilds, we adopted the diet classification presented in Paglia et al. (2012). Three trophic guilds were defined, represented by: (I) carnivores: *Leopardus pardalis*, *Leopardus tigrinus*, *Panthera onca*, *Puma concolor*. (II) herbivores: *Cuniculus paca*, *Dasyprocta leporina*, *Dasyprocta prymnolopha*, *Dictoyles tajacu*, *Mazama americana*, *Passalites nemorivagus*, *Tapirus terrestris*, *Tayassu pecari*, and (III) omnivores: *Dasypus novemcinctus*, *Dasypus kappleri*, *Nasua nasua*, *Priodontes maximus*.

The degree of overlap in activity patterns between pairs of species was estimated using the overlap coefficient Δ, using the "Overlap" package (Meredith & Ridout 2014). The overlap coefficient Δ (also called Dhat), results from the intersection between the density functions estimated for two species and provides a value that varies between 0 (no overlap) to 1 (identical activity patterns or complete overlap) (Ridout & Linkie 2009, Linkie & Ridout 2011). As recommended by Meredith & Ridout (2014), we used Dhat4 when the number of records was greater than 50. Species whose number of records was less than 50 were evaluated using the Dhat1 overlap index. When $\Delta < 0.50$, the temporal overlap was defined as "low". Activity overlap was considered to be "moderate" if $0.50 \geq \Delta < 0.70$ and "high" when $\Delta \geq 0.70$. The significance of comparisons of activity levels between pairs of species was estimated using the Wald test (Meredith & Ridout 2014). All analyzes were performed using the R 4.2.1 program (R Core Team 2022).

Results

We obtained a total of 844 independent records (n) of 20 species of medium and large mammals, belonging to six orders and 11 families, with a sampling effort of 2.850 traps/day. The species with the highest number of independent records (n ≥ 7) were *Dasyprocta leporina* (Linnaeus 1758), *Cuniculus paca* (Linnaeus 1766), *Dicotyles tajacu* (Linnaeus 1758) and *Mazama americana* (Erxleben 1777), and with a smaller number of independent records (n ≤ 7) were *Cerdocyon thous* (Linnaeus 1766), *Herpailurus yagouaroundi* (Geofroy 1803), *Myrmecophaga tridactyla* (Linnaeus 1758), *Procyon cancrivorus* (Cuvier 1798) and *Leopardus tigrinus* (Schreber 1775) (Table 1).

Table 1. List of species (Abreu et al. 2023), popular name, number of independent records (**n**) and threat category (IUCN 2023) of medium and large mammals recorded between 2016 and 2019 in the Tapirapé Biological Reserve (Marabá/PA). Threat Categories: **DD**: Data Deficient; **LC**: Least-concern; **NT**: Near threatened; **VU**: Vulnerable; **EN**: Endangered.

Order	Family	Species	Common name	n	IUCN
Artiodactyla	**Cervidae**	*Mazama americana* (Erxleben 1777)	Red Brocket	108	**DD**
	Cervidae	*Passalites nemorivagus* (F. Cuvier 1817)	Amazonian brown deer	34	**LC**
	Tayassuidae	*Tayassu pecari* (Link 1795)	White-lipped Peccary	54	**VU**
	Tayassuidae	*Dicotyles tajacu* (Linnaeus 1758)	Collared Peccary	119	**LC**
Carnívora	**Canidae**	*Cerdocyon thous** (Linnaeus 1766)	Crab-eating Fox	2	**LC**
	Procyonidae	*Nasua nasua* (Linnaeus 1766)	Coati	18	**LC**
	Procyonidae	*Procyon cancrivorus** (Cuvier 1798)	Crab-eating Raccoon	2	**LC**
	Felidae	*Herpailurus yagouaroundi** (Geofroy 1803)	Jaguarundi	2	**LC**
	Felidae	*Leopardus pardalis* (Linnaeus 1758)	Ocelot	17	**LC**
	Felidae	*Leopardus tigrinus* (Schreber 1775)	Northern Tiger Cat	7	**VU**
	Felidae	*Panthera onca* (Linnaeus 1758)	Jaguar	14	**NT**
	Felidae	*Puma concolor* (Linnaeus 1771)	Puma	14	**LC**
Cingulata	**Chlamyphoridae**	*Priodontes. Maximus* (Kerr 1792)	Giant Armadillo	10	**VU**
	Dasypodidae	*Dasypus kappleri* (Krauss 1862)	Greater Long-nosed Armadillo	13	**LC**
	Dasypodidae	*Dasypus novemcinctus* (Linnaeus 1758)	Nine-banded Armadillo	13	**LC**
Perissodactyla	**Tapiridae**	*Tapirus terrestris* (Linnaeus 1758)	Lowland Tapir	36	**VU**
Pilosa	**Myrmecophagidae**	*Myrmecophaga tridactyla** (Linnaeus 1758)	Giant Anteater	4	**VU**
Rodentia	**Cuniculidae**	*Cuniculus paca* (Linnaeus 1766)	Paca	143	**LC**
	Dasyproctidae	*Dasyprocta leporina* (Linnaeus 1758)	Red-rumped Agouti	209	**LC**
	Dasyproctidae	*Dasyprocta prymnolopha* (Wagler 1831)	Black agouti	25	**LC**

(*) Species were not included in the activity pattern analysis because they did not have a number of independent records n ≥ 7.

Analysis of the daily activity pattern demonstrated that species present differences in relation to activity periods. The activity patterns and classification of each of the 16 species analyzed (Table 2) details the periods of the day in which each species is more or less active in the study area (Figure 3). Armadillo species (*D. kappleri* and *D. novemcinctus*) and a felid (*L. tigrinus*) were the only ones with a nocturnal activity pattern. *D. leporina* and *N. nasua* were only classified as diurnal. Four species present activities distributed regularly throughout the

day (*L. pardalis*, *M. americana*, *P. maximus* and *P*. concolor). Three species showed a pattern with a tendency towards nocturnal activity, these being *C. paca*, *P. onca* and *T. terrestris*. Three other species were classified as having a tendency towards a diurnal activity pattern (*P. nemorivagus*, *D. tajacu* and *T. pecari*). Only *D. prymnolopha* was classified as having a twilight activity pattern (50% of records in twilight periods).

Table 2. Species, percentage of records per period and classification of activity times. (**D**) Daytime; (**N**) Nocturnal; (**C)** Cathemeral); (**TW**) Twilight; (**NT**) Night Trend; (**DT)** Diurnal Trend.

Species	Twilight %	Daytime %	Nocturnal %	Activity patterns
*Cerdocyon thous**	0	100	0	*
Cuniculus paca	18.88	19.58	61.53	**NT**
Dasyprocta leporina	30.14	66.5	3.34	**D**
Dasyprocta prymnolopha	56	44	0	**TW**
Dasypus kappleri	7.69	0	92.3	**N**
Dasypus novemcinctus	0	0	100	**N**
Leopardus pardalis	23.52	29.41	47.05	**C**
Leopardus tigrinus	28.57	0	71.42	**N**
Mazama americana	23.14	25	51.85	**C**
Passalites nemorivagus	11.76	73.52	14.7	**DT**
*Myrmecophaga tridactyla**	25	75	0	*
Nasua nasua	5.5	94.44	0	**D**
Panthera onca	7.14	21.42	71.42	**NT**
Dicotyles tajacu	15.12	68.9	15.96	**DT**
Priodontes maximus	30	20	50	**C**
*Procyon cancrivorus**	0	0	100	*
Puma concolor	42.85	28.57	28.57	**C**
*Herpailurus yagoauroundi**	0	50	50	*
Tapirus terrestris	13.88	13.88	72.22	**NT**
Tayassu pecari	11.11	68.52	20.37	**DT**

(*) Species were not included in the activity pattern analysis because they did not have a number of independent records $n \geq 7$.

Practically all species analyzed showed bimodal activity peaks, with the exception of *D. kappleri* (7pm-5am), *D. tajacu* (7am-6pm), *P. nemorivagus* (6am - 5pm) and *T. pecari* (7am - 6pm), that demonstrate that they are active for a long and continuous period of the day. *Priodontes maximus* presents three peaks of activity at widely spaced times (1 am, 1 pm and 6 pm). The carnivores (*P. concolor*, *P. onca*, *L. pardalis* and *L. tigrinus*) showed activity peaks that varied between midnight and 6 am and another peak, varying between 6 pm and 8 pm. The big cats (*P. onca* and *P. concolor*) divide their activities into two periods - between 3 and 5 am and between 6 and 8 pm, while the small cats (*L. pardalis* and *L. tigrinus*) are more active between 00- 6am and from 7pm. Curiously, *L. pardalis* showed a peak of activity at midday (Figure 3a). Among the herbivores that present two peaks of activity throughout the day, we can separate those that have nocturnal tendencies and are most active between 1 am and 4 am and from 6 pm to 10 pm (*C. paca*, *T. terrestris*), a twilight species - *D.*

prymnolopha - with peaks at 7am and 6 pm, a diurnal species, *D. leporina*, with a peak of activity between 6am and 10am and another around 6pm., and a cathemeral species (*M. americana*), with two activity peaks (5am and 6pm) (Figure 3b). Among the omnivores with a bimodal activity pattern, we highlight *D. novemcinctus*, most active at 4am and 10pm, and *N. nasua*, very active during the day, with peaks at 8am and 3pm (Figure 3c).

Temporal overlap estimates revealed a variation in overlap indices between the species compared. Among carnivores, overlap indices varied between Δ1= 0.42 and Δ1= 0.62 (Figure 4). For herbivore guild, these indices ranged from Δ1= 0.32 to Δ4= 0.86 (Figure 5) and among omnivores, ranged from Δ1 = 0.05 to Δ1 = 0.62 (Figure 6).

In the carnivore guild (Figure 4), the highest rates of temporal overlap occurred between *P. onca* and *L. pardalis* [Δ1= 0.62 (CI: 0.39 - 0.84)] and *P. concolor* and *L. pardalis* [Δ1= 0.62 (CI: 0.40 - 0.84)]. When smaller cats are compared (*L. pardalis* x *L. tigrinus*), the temporal overlap reduces by half [Δ1=0.52 (CI: 0.24 - 0.79)], just like between the big cats *P. onca* and *P. concolor* [Δ1= 0.55 (CI: 0.32 - 0.79)]. Between *P. onca* and *L. tigrinus*, a top predator and a mesopredator, the overlap index was [Δ1= 0.57 (CI: 0.33 - 0.82)]. The lowest overlap rate among carnivores was observed between *L. tigrinus* and *P. concolor* [Δ1= 0.42 (CI: 0.30 - 0.84)]. All overlaps between species within each guild, with their respective indices and degree of significance are detailed in supplementary material one (Table 1S).

Herbivores, in general, show low rates of overlap in relation to the period of activity (Table 1S, figure 5 a, b, c, d, e). Three pairs from the herbivore guild showed the highest rates of temporal overlap, showing the temporal sharing of space use and little variation in the activity pattern between species. The species with the greatest temporal overlap were *C. paca* and *T. terrestris* [Δ1= 0.80 (CI: 0.69 - 0.90)] (Table 1S, Figure 5a), *D. leporina* and *D. prymnolopha* [Δ1= 0.76 (CI: 0.63 - 0.89)] (Figure 5b) and *D. tajacu* and *T. pecari* [Δ4= 0.86 (CI: 0.76 - 0.96)] (Table 1S, Figure 5d).

Five pairs of herbivores showed low rates of temporal overlap (Table 1S, Figure 5a), being *D. leporina* and *C. paca* [Δ4= 0.32 (CI: 0.25 - 0.40)], *D. prymnolopha and C. paca* [Δ4= 0.46 (CI: 0.35 - 0.58)] and *T. terrestris* and *P. nemorivagus* [Δ1= 0.36 (CI: 0.20 - 0.52)] (Table 1S, Figure 5e). Two pairs of species presented moderate overlapping rates, these being *M. americana* and *P. nemorivagus* [Δ1= 0.52 (CI: 0.38 - 0.65)] and *M. americana* and *T. terrestris* [Δ1= 0.67 (CI: 0.54 - 0.80)] (Table 1S, Figure 5e).

Among the omnivorous species (Table 1S, Figure 6), two pairs of species presented rates greater than 50% in relation to the use of space throughout the day: the armadillos *D. kappleri* and *D. novemcinctus* [Δ1=

0.62 (CI: 0.37 - 0.87)] and *P. maximus* and *D. kappleri* [Δ1= 0.51 (CI: 0.26 - 0.75)]. The pairs *N. nasua* and *D. kappleri* [Δ1= 0.05 (IC: 0.06 - 0.17)] and *N. nasua* and *D. novemcinctus* [Δ1= 0.05 (IC: 0.05 - 0. 17)] presented the lowest rates of overlap between omnivores. *P. maximus* and *D. novemcinctus* also showed a low overlap index [Δ1= 0.46 (CI: 0.26 - 0.75)] evidencing the sharing of space use and little temporal overlap of activity. Likewise, *N. nasua* and *P. maximus* showed a low overlap rate [Δ1= 0.36 (CI: 0.12 - 0.59)], with temporal overlap occurring only in some periods of the day. These species show a greater peak of overlap between 12:00 and 18:00.

Predators and Prey

Supplementary Material two (Table 2S) presents the overlap coefficients between predators (big cats) and their possible prey present in the study area. Based on overlap indices and relative abundance indices, we suggest that some species may be main or secondary prey for each predator. *P. onca* (Table 2S, Figure 7) has a moderate rate of overlap with several herbivores (*C. paca* [Δ1 = 0.69], *M. americana* [Δ1 = 0.65], *P. maximus* [Δ1 = 0.65] and *T. terrestris* [Δ1 = 0.68]). However, *C. paca* and *M. americana* are the locally most abundant species, which converge in activity times with the jaguar, being classified as main and secondary prey, respectively.

Puma concolor, a species classified as cathemeral, has overlap rates above 50% with most herbivores (Table 3S, Figure 8). However, the highest overlap rates occur with *M. americana* (Δ1 = 0.70*)* and *D. prymnolopha* (Δ1 = 0.66). Despite the high level of overlap between *P. concolor* and *D. prymnolopha*, we classified *D. leporina* (Δ1 = 0.57*)* as its secondary prey, based on its high relative abundance (RAI - 7.33).

The two smaller felids, *L. pardalis* and *L. tigrinus* share bigger rates of overlap with the same prey species (Table 4S and 5S). By classifying the primary and secondary prey for each of these felids, we verified not only the overlap index, but also the relative abundance and size of the prey, so that the probability of these carnivores capturing prey smaller than themselves is higher than capturing larger prey. Thus, *L. pardalis* has as its main prey, *C. paca* (Δ1 = 0.73) and, as a secondary prey, *D. novemcintus* (Δ1 = 0.55) (Table 4S, Figure 9), although it has greater temporal overlap with *P. maximus* (Δ1 = 0.72) (Table 4S, Figure 9). The other felid, *L. tigrinus*, has *D. novemcinctus* (Δ1 = 0.82) as its main prey and *C. paca* (Δ1 = 0.64) as its secondary prey (Table 5S, Figure 10).

Discussion

Our prediction about species belonging to the same guild showing greater temporal niche segregation was corroborated for most intraguild species pairs. Among carnivores, interspecific overlap rates were moderate, indicating low competition. Among herbivores, the highest overlapping rates were found between species of different sizes, which indicates trophic segregation (by food items), even though there is spatial and temporal similarity. Herbivores of similar size, such as agoutis and deer, presented moderate overlap coefficients, indicating that there is temporal segregation for species with other similar niche dimensions. Among omnivores, temporal overlap rates were also low, indicating temporal sharing in the use of space and dissimilarities in other dimensions of the niche.

Our data are also congruent with the second hypothesis raised in this study, that predators would present greater temporal overlap with more abundant prey, regardless of the energetic gain provided by large prey. The food preference of a species is determined by the cost used to obtain its food and the energy gain provided by the food (Schoener 1971). In fact, in the study area (REBIO Tapirapé), where there are high levels of abundance of smaller prey, such as pacas and agoutis, predators seem to adjust their foraging activities in order to reduce the energetic cost of chasing, capturing and prey manipulation.

We analyzed the activity patterns of mammal species belonging to the same trophic guild in a preserved tropical forest to determine whether trophic similarities influence the way species interact temporally. It was expected that there would be greater temporal separation between predators in the same guild, which have greater competitive interaction (Di Bitetti et al. 2010). The present study found that predators of similar sizes, such as the jaguar and the puma, have little temporal overlap and that they separate their activities into different periods of the day, with the former tending to be nocturnal and the latter more active throughout the day.

Other studies indicate that there is little evidence of competitive interactions between these two sympatric species, indicating that coexistence mechanisms are linked to segregation in activity periods and/or preys types (Harmsen et al. 2009, Foster et al. 2010, Foster et al. 2013). Previous studies indicate that the food niche of *P. concolor* is associated with smaller prey that are more difficult to detect, while *P. onca* takes advantage of primary food niches (Karanth & Sunquist 1995, Polisar et al. 2003). In fact, the present study found evidence of a probable dietary separation between these two large carnivores, demonstrating that the jaguar has greater temporal overlap with larger herbivores such as deer, tapir, giant armadillo (Azevedo 2008) (Figure 7) and *P. concolor* can adjust its period of activity in order to capture and feed on smaller prey, such as agoutis and armadillos (Figure 8). The temporal moderate overlap between these two species may result from the temporal

overlap with *M. americana*, one of the most energetically profitable and preferred prey of both big cats. Among smaller felids (*L. pardalis* and *L. tigrinus*), we observed moderate but significant degrees of overlap, which may be related to the consumption of similar prey (*C. paca* and *Dasypus spp*.), since these species can be classified as cathemeral and nocturnal, respectively, segregating the use of space at different times, but consuming prey that have activity schedules congruent with their own (Figures 9 and 10).

The activity pattern analysis showed a moderate temporal overlap between *L. pardalis* and the two largest top predators, *P. onca* and *P. concolor* (Δ1=0.62). An important factor that can contribute to smoothing the temporal overlap and coexistence between these three species is the sharing of food items. For Massara et al. (2018) in well-preserved areas, such as our study area, which has sufficient food resources (tapirs, pacas, agoutis, peccaries, peccaries, armadillos, etc.), the use of the habitat in sympatry by *L. pardalis* and by the two largest predators *P. onca* and *P. concolor*, occurs because there is greater availability of food, benefiting these species while reducing the competitive effect between them. Oliveira et al. (2010) suggests that these felids present differential use of food resources, based mainly on the size of the preys, as a way of avoiding competition. Although these three species present a high degree of temporal overlap with *C. paca*, demonstrating a great similarity in diet (Dias et al. 2018), we believe that there is no interference competition, as pacas and agoutis are the most abundant species in the region, not being a limiting resource to cause high levels of competition between predators. This suggests that prey availability is more important than competition in determining predator activity times (Botts et al. 2020).

The small carnivore recorded in this study, *L. tigrinus*, a nocturnal species, showed moderate temporal overlap with *P. onca* (Δ1=0.57), low with *P. concolor* (Δ1=0.42) and moderate, but significant, with *L. pardalis* (Δ1=0.52). *L. tigrinus* is a small felid in relation to the others, which can reduce competition with other species, as its diet consists of small mammals and birds (Emmons 1987, Oliveira 2005). However, at REBIO Tapirapé, *L. pardalis* and *L. tigrinus* show high temporal overlap with medium-sized prey, such as pacas and armadillos, respectively (Figures 9 and 10). These preys were the most consumed, in terms of biomass, by *L. pardalis* in other preserved areas in the Atlantic Forest (Bianchi et al. 2010). Despite a possible competitive interaction between the two species, *L. tigrinus* appears to adjust its activity schedules with nocturnal prey, such as armadillos and pacas, overlapping its activity periods after 6pm, with *L. pardalis*, which is cathemeral.

The temporal overlap analysis indicated that the herbivore guild presented the highest rates of temporal overlap between species (Figure 5). The high temporal overlap between *D. tajacu* and *T. pecari* (Δ=0.86) may be related to the evolutionary aspects of these species, which have adapted in a similar way to the

environment and have similar dimensions of their niches (Luiz 2008). Previous studies have found that the main food sources for *D. tajacu* and *T. pecari* are fruits, seeds and nuts that fall from trees (Bodmer 1991, Keuroghlian & Eaton 2008) in addition to roots and leaves (Olmos 1993, Desbiez et al. 2009). However, these species use strategies to avoid competition and thus promote coexistence, mainly in relation to the use of habitats and the food resources used (Schoener 1974). One of the strategies is the way of foraging, while *D. tajacu* carries out deep excavations in the soil, *T. pecari* forages by excavating only the first centimeters of the soil layer and the humus layer (Kiltie & Terborgh 1983). The other strategy is related to the spatial use of the habitat (Keuroghlian & Eaton 1993) and the need for food, *D. tajacu* is more generalist (Kiltie 1982, Sicuro & Oliveira 2002) and concentrates its activities in places where there is greater availability of succulent species, leaves, roots and tubers, while *T. pecari* has the ability to forage harder foods and is a specialist in the consumption of palm endocarps such as the species *Attalea maripa* (Fragoso 1999).

Similarly, the high temporal overlap between *C. paca* and *T. terrestris* (Δ=0.80) demonstrates that these species overlap their activities at certain periods of the day, mainly between two peak times (00:00h-06:00-00: 00:00 and 18:00-00:00). However, in addition to the differences in body size, *C. paca* is a medium-sized species and *T. terrestris* is a large species, their diets are very different, which reduces competition for resources between them. Previous studies demonstrate that *T. terrestris* has a general diet and can feed on inflorescences, herbaceous plants, shrubs and palm trees, as well as leaves, shoots and young branches, fruits and even tree bark (Emmons & Feer 1990, Bachand et al. 2009), while *C. paca* are frugivorous animals, specialists in fleshy fruits and excellent seed dispersers, solitary and nocturnal (Eisemberg & Redford 1999, Jax et al. 2015). Of the mammals studied here, the paca showed a difference in its activity pattern in relation to other studies already carried out. While in other studies *C. paca* presented a predominantly nocturnal pattern (Michalski & Norris 2011, Bravo & Sontín 2012, Moreno & Irineo 2013), in the present study, this species presents an activity pattern with a nocturnal tendency. This species had a significant number of records during the diurnal phase (n=28). The paca is one of the most abundant mammals and one of the main prey of all felines presents in REBIO Tapirapé. As verified by Vallejo-Vargas (2020), trophic regulation between carnivores and herbivores in the neotropical region is carried out by herbivores (prey). Therefore, it is likely that the change in the foraging behavior of *C. paca* in the study area is related to greater predation by nocturnal carnivores (Sovie et al. 2019).

Another hypothesis for the behavioral modification of the paca is the high population density, which stimulates intraspecific competitive interactions. The congeneric species *D. leporina* and *D. prymnolopha* showed high temporal overlap (Δ=0.76). *D. leporina* presented a diurnal pattern and *D. prymnolopha* presented a

crepuscular pattern. These species have very similar habits and niches, demonstrating that the temporal overlap between them highlights the competition for food and space at the same time at certain times of the day, mainly between 6:00 am and 6:00 pm. Agouti are normally diurnal in habit, however, they can revert to nocturnal or twilight activity when subjected to extreme human interference or predation (Meritt Jr 1983), which is not the case in the region of this study. The area of the present study, being a conservation unit, has a large availability of food resources for these rodents, in addition to low anthropogenic impact, which can directly influence reducing the competitive impact between these two species. For these two species, reducing competitive interference appears to be more important than avoiding predators. Studies indicate that preys abundance conditions predators preferences (Botts et al. 2020, Foster et al. 2013), thus, the present study suggests that both *D. leporina* and *D. prymnolopha*, based on their abundance and predators feeding preferences, may be important preys for *P. concolor* and *L. pardalis*. However, *D. leporina* distributes its activities throughout the day, reducing competition with *D. prymnolopha*, although this behavioral plasticity increases the probability of encountering its predators, which also distribute their activities throughout the same period (Figures 5b, Figure 8 and Figure 9).

M. americana and *P. nemorivagus* showed moderate temporal overlap (Δ=0.52). *M. americana* showed a distribution of its activity at different times of the day, being a cathemeral species, as already pointed out by Gómez et al. (2005), while *P. nemorivagus* was classified as a diurnal species, with the largest number of records occurring during this period, which is corroborated by the study carried out by Espinosa & Salvador (2017). Apparently, the reduction in competition between these two species determines their periods of activity more than the presence of predators, since in the region studied, and the combination of overlapping activity and relative abundance points to *M. americana* as the main prey of *P. concolor* (Botts et al. 2020). At REBIO Tapirapé, we believe that the high abundance of deer is related to changes in the food preferences of big cats. Other studies indicate the preference of large carnivores for peccaries, peccary and cervids (Rueda et al. 2013), with *D. tajacu* and *T. pecari* being the most consumed prey. However, in this region of the Amazon, neither *P. onca* nor *P. concolor* showed high temporal overlap with Tayassuidae.

M. americana and *T. terrestris* presented a moderate overlapping index (Δ=0.67), showing a temporal sharing in their periods of activity. In our study, the two species, even if differently, are active during the night and at dawn, periods where there is greater temporal overlap (00:00h-06:00h and 19:00-24:00h). The different diet between these two species is a factor that reduces competition between them. *M. americana* has a diet basically made up of fruits, fungi and plants, while the diet of *T. terrestris*, as previously mentioned, is much

more varied, including different types of plants, as well as leaves, shoots and young branches, fruits and even bark. of trees (Emmons & Feer 1990, Bachand et al. 2009). Differently, there was low temporal overlap between *T. terrestris* and *P. nemorivagus* (Δ=0.36). In addition to the differences in their activity patterns with *P. nemorivagus* (diurnal tendency) and *T. terrestris* (nocturnal tendency), these species temporally segregate their niches and also present differences in their dietary requirements, a fact that reduces competition between them.

For the omnivores guild, the greatest temporal overlap found in this study was between the nocturnal species *D. kappleri* and *D. novemcinctus* (Δ1=0.62), occurring mainly at two different times (00:00h-06:00h and 19:00h-00:00h). For Feijó et al. (2018) the overlap that occurs between these two species is linked to evolutionary factors, as the two are phylogenetically close, which means that they have very similar habits. Aspects of the natural history of *D. kappleri* indicate the preference for primary habitats, little tolerance to anthropogenic changes, nocturnal and solitary habits and a diet composed of insects, small vertebrates and occasionally vegetable matter (Szeplaki et al. 1988, Röeh 2007). The coexistence between *D. kappleri* and *D. novemcinctus* may be related to the restricted use of *D. kappleri's* habitat and its ability to excavate tunnels deeper than those excavated by *D. novemcinctus*.

The low and equal overlap rates between *N. nasua* and *D. kappleri* and *N. nasua* and *D. novemcinctus* (Δ1=0.05) indicate that these species temporally segregate their activities. This temporal segregation between these pairs of species is related to their respective activity patterns (nocturnal for *D. kappleri* and *D. novemcinctus* and diurnal for *N. nasua*). For Nodari (2016), the segregation between these species may also be related to the diet they present. *N. nasua* consumes mainly foods of plant origin, followed by invertebrates and small vertebrates (Gatti et al. 2006, Hirsch 2009, Nodari 2016), while *D. novemcinctus* has a diet based on foods of animal origin, mainly composed of invertebrates (Sikes 1990), but can consume plants, carrion, eggs and small vertebrates (Anacleto 2007, Loughry et al. 2014). It is worth mentioning that in addition to the activity pattern, the diet of *D. kappleri* is similar to that of *D. novemcinctus* (Barreto et al. 2013), which directly influences the low temporal overlap between *N. nasua* and *D. kappleri*.

Similarly, with a distinct pattern of activity, *N. nasua* (daytime) and *P. maximus* (nocturnal) showed a low rate of temporal overlap (Δ1=0.36). In addition to the differences in their activity patterns, the diet of *P. maximus* is very different from that presented by *N. nasua* and directly influences the low competition for resources between these species. The species *P. maximus* has a diet based on ants and termites (Nascimento 2021) but can include other food items, such as plant material (Anacleto & Marinho-Filho 2001), as well as insects, spiders, earthworms, larvae, snakes and carrion (Nowak 1999).

The temporal overlap indices between *P. maximus* and *D. kappleri* (Δ1=0.51) and between *P. maximus* and *D. novemcinctus* were low (Δ1=0.46), indicating that these species, despite little temporally sharing the same space, demonstrate little overlap of activity. This overlap occurred most intensely between 00:00 and 06:00 and with less intensity after 18:00. Despite sharing food items in their diets, as already highlighted in studies carried out (Sikes 1990, Anacleto & Marinho-Filho 2001, Anacleto 2007, Loughry et al. 2014, Nodari 2016, Nascimento 2021), these species, due to their respective diets, do not they present intense competition for food resources.

Conclusions

This study presents important information on the activity patterns of terrestrial mammal fauna in the Amazon. The results obtained indicate that species from different trophic guilds, in addition to presenting different activity patterns, adjust their daily behavior, mainly by temporally segregating their activities, thus indicating that temporal segregation is a crucial adaptive strategy for the coexistence of species in ecological communities, minimizing competition for resources and optimizing habitat use.

The results also indicate that prey abundance determines the feeding preferences and foraging behavior of predators. New studies on diet should be carried out to verify whether there is a relationship between abundance, activity pattern and diet as suggested in our results.

The information generated by this research deepens our knowledge on the relationships between medium and large mammals in the Amazon and their activity periods, and contributes to future actions aimed at the conservation of these species, which are important for the maintenance and balance of ecosystems, such as supporting public policies in the definition of protected areas, creating ecological corridors and monitoring human actions that directly impact the existence of these species. Furthermore, the data can be used to monitor the health of ecosystems and monitor the responses of fauna to environmental changes, including climate changes, such as the extreme droughts we have witnessed in recent years in the Amazon.

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Authors' Contribution

Raquel Ribeiro da Silva: Formal Analysis; Investigation; Methodology; Writing - original draft, review and editing.

Luiz Santana Franco Macedo: Formal Analysis; Investigation; Methodology; Writing - original draft, review and editing.

Conflicts of interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

Ethics

The research was carried out in compliance with all ethical requirements and under license numbers 52979-0 and 52979-1/SISBIO.

Data availability

Data relating to this research are available at https://doi.org/10.6084/m9.figshare.26300437.v3

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Figures and captions

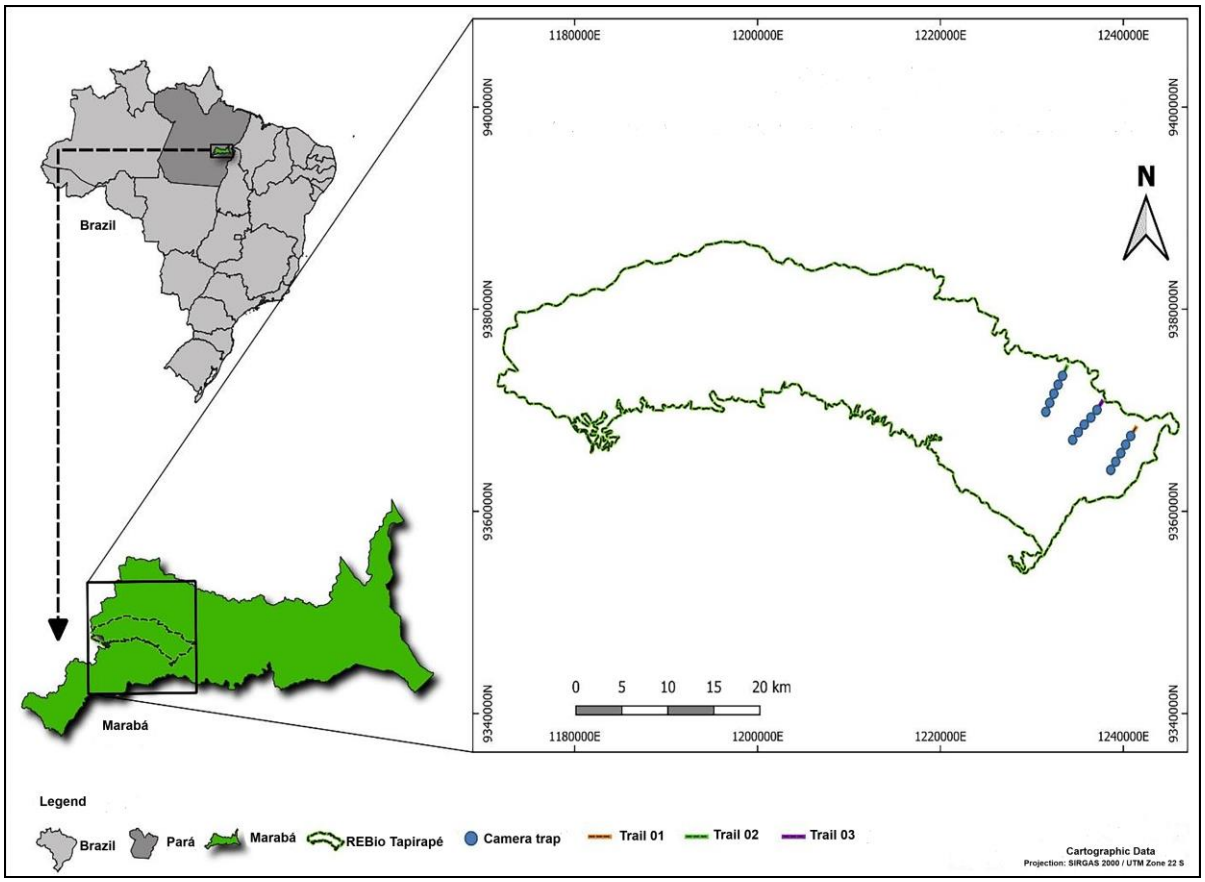

Figure 1. Study area in the Tapirapé Biological Reserve - Marabá, PA. Trails and sampling points for medium and large mammals, using camera traps during the years 2016 to 2019.

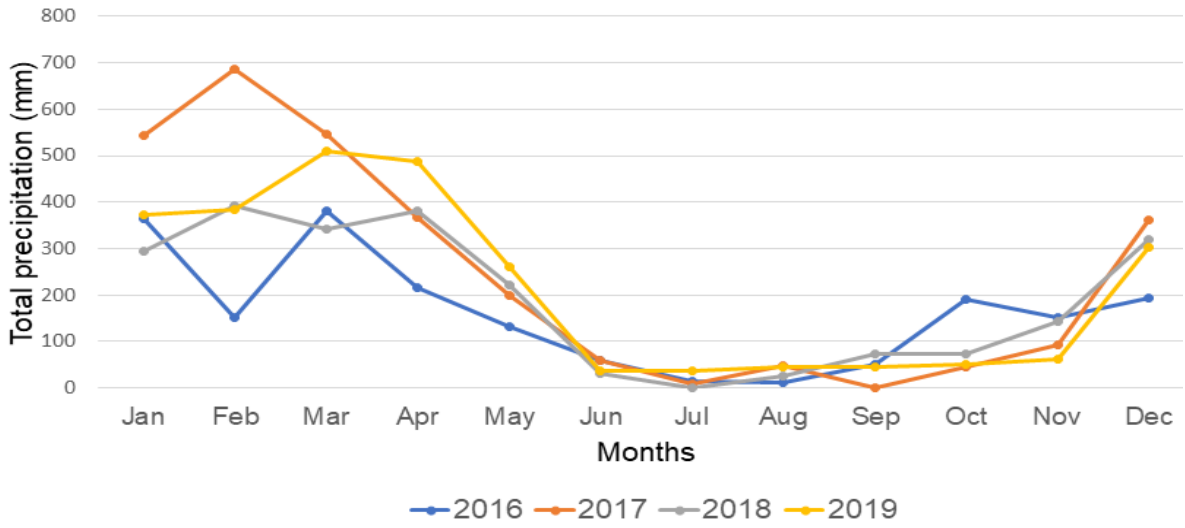

Figure 2. Total monthly precipitation in the region of Marabá – PA, where the Tapirapé Biological Reserve is located, during the years 2016 to 2019. Source (INMET - http://www.inmet.gov.br).

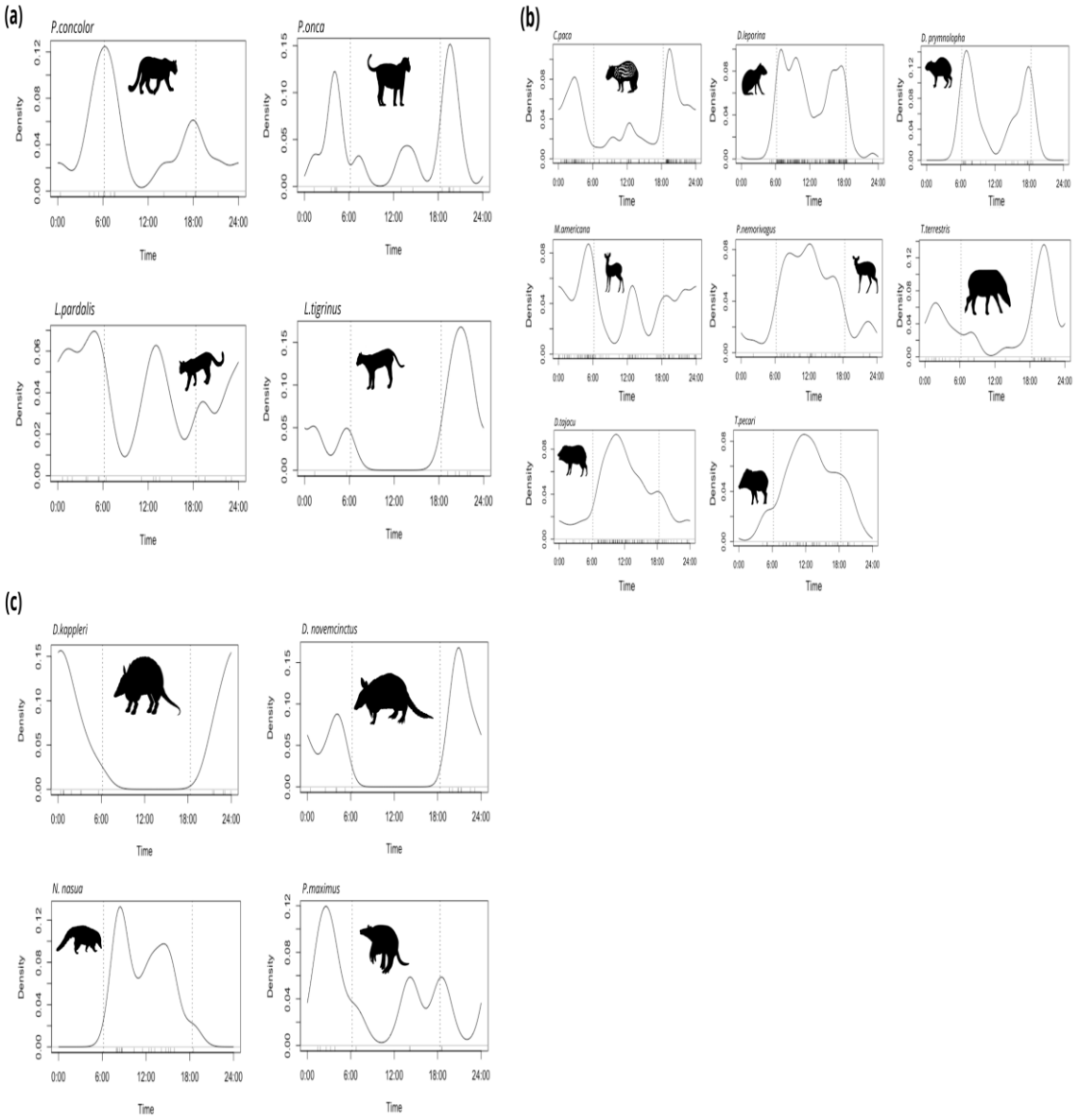

Figure 3. Kernel density graphs representing the daily activity patterns of medium and large mammals in the Tapirapé Biological Reserve between the years 2016 and 2019. (a) carnivores, (b) herbivores and (c) omnivores. The vertical lines represent the average sunrise and sunset times.

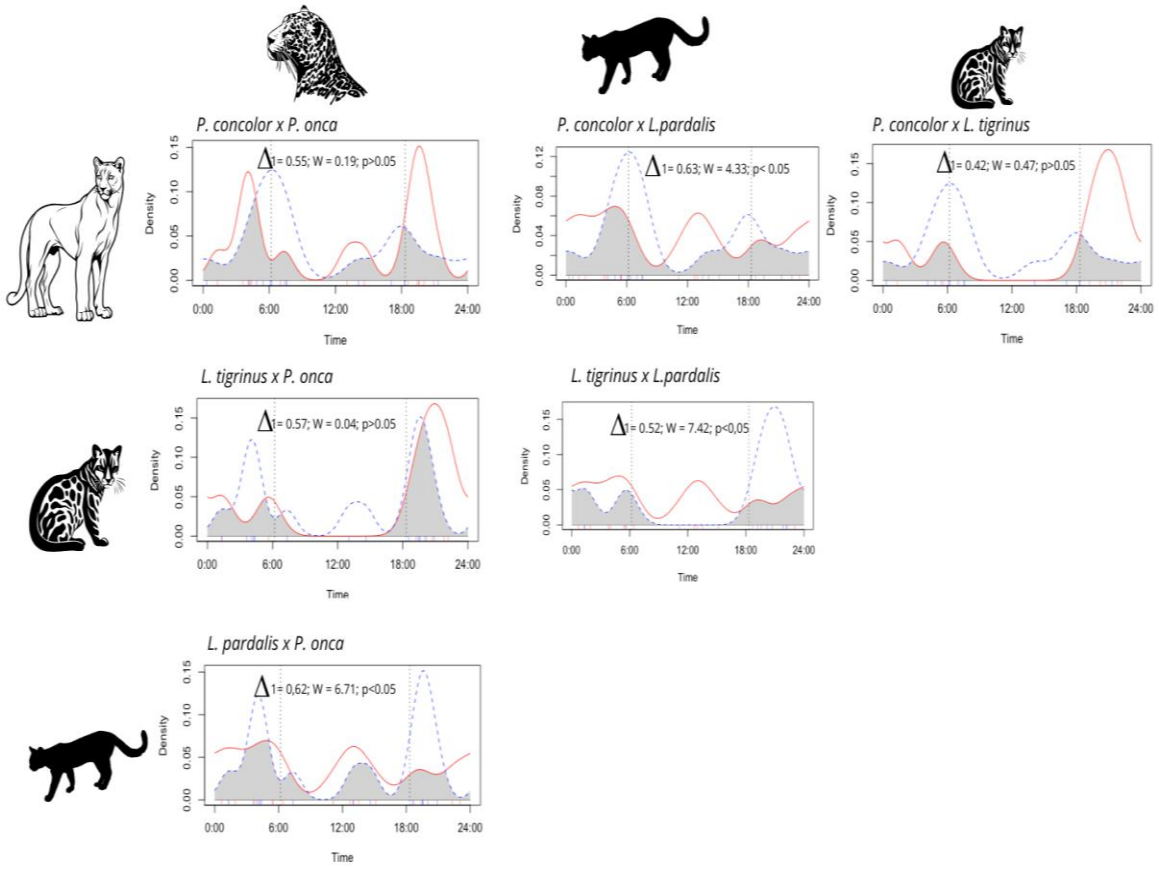

Figure 4. Kernel density graphs representing the overlap of activities between medium and large carnivores in the Tapirapé Biological Reserve between the years 2016 and 2019. Values of (**Δ**), (**W**) and (**p**). The vertical lines represent the average sunrise and sunset times.

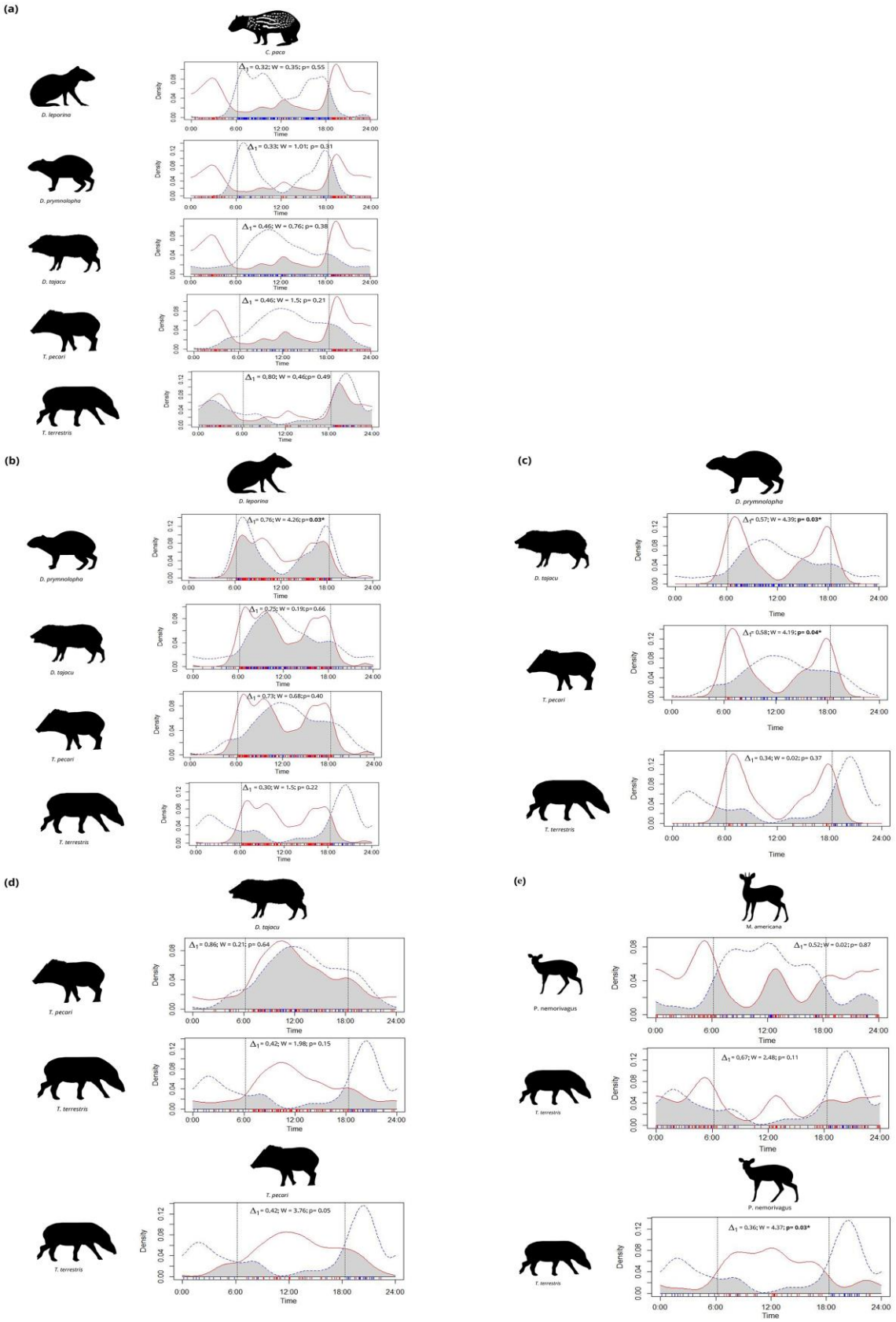

Figure 5. Kernel density graphs that represent the overlap of activities between medium and large herbivores in the Tapirapé Biological Reserve between the years 2016 and 2019. Values of (**Δ**), (**W**) and (**p**) The vertical lines represent the average sunrise and sunset times.

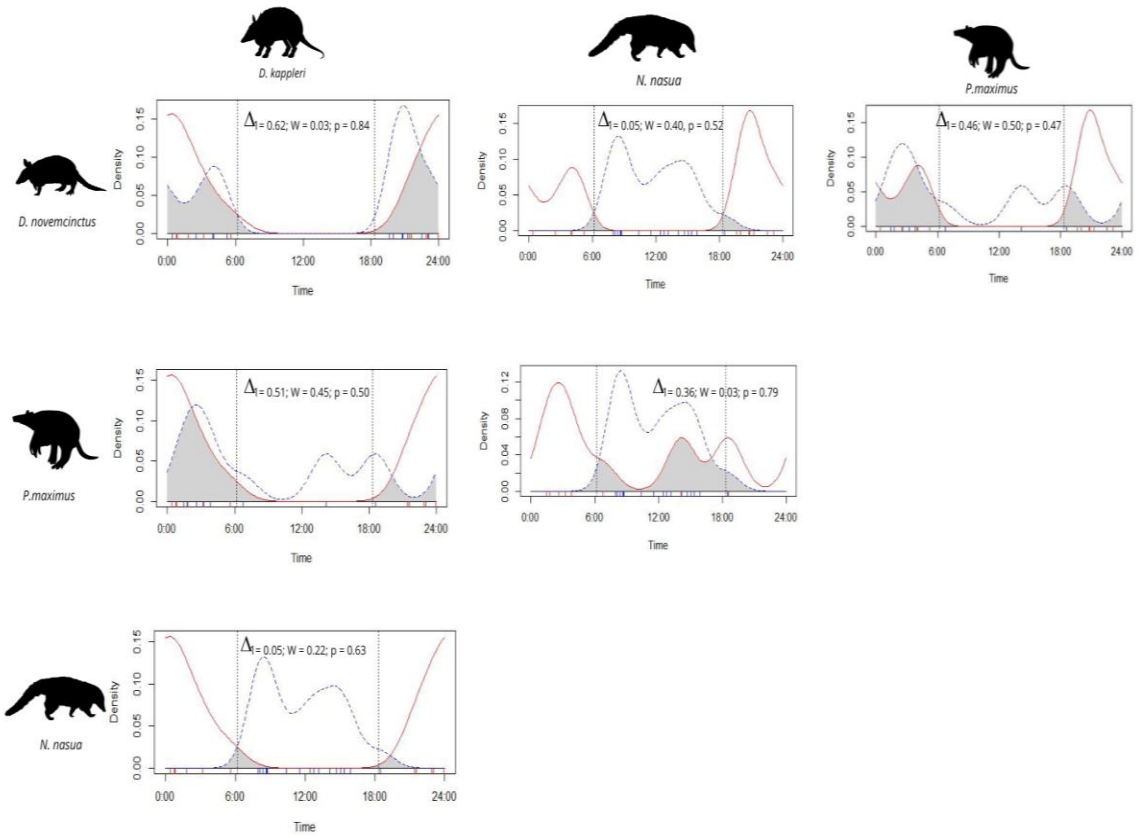

Figure 6. Kernel density graphs representing the overlap of activities between medium and large omnivores in the Tapirapé Biological Reserve between the years 2016 and 2019. Values of (**Δ**), (**W**) and (**p)**. The vertical lines represent the average sunrise and sunset times.

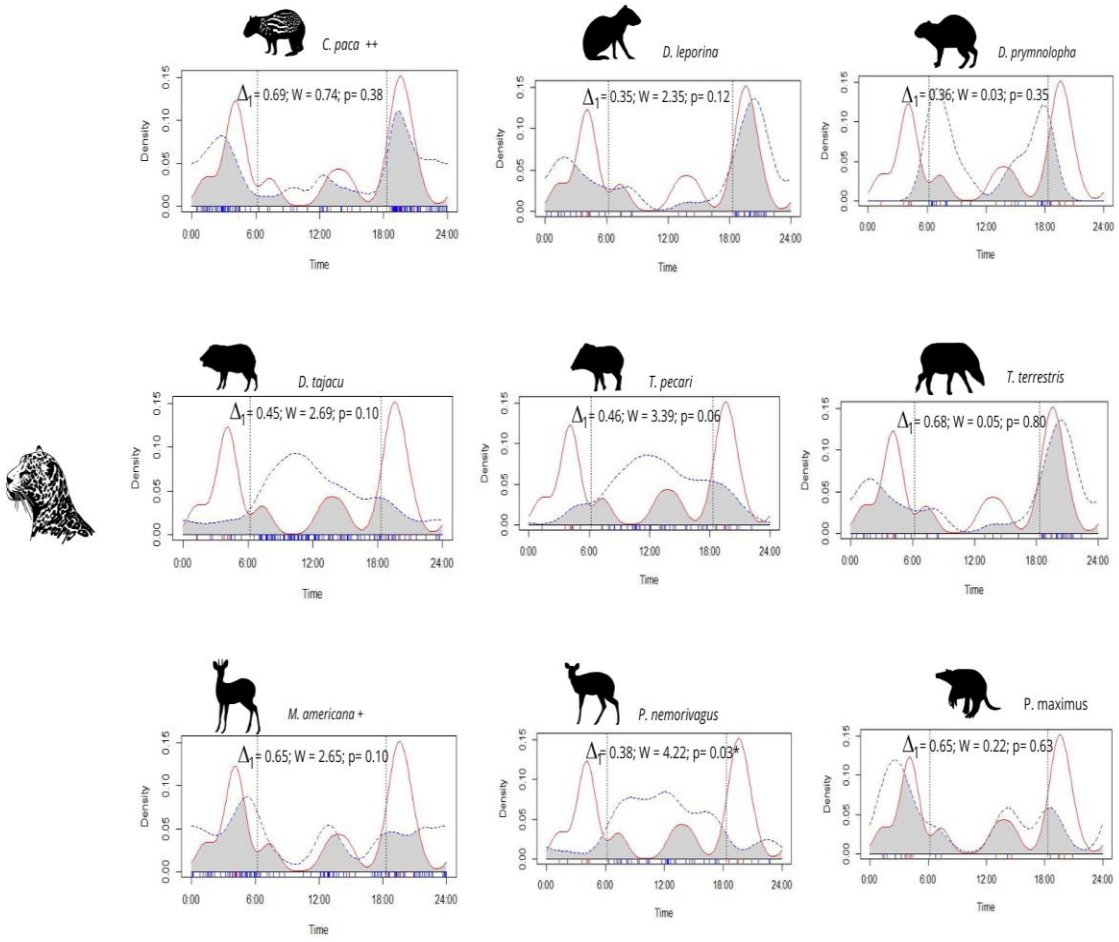

Figure 7. Kernel density graphs representing the overlap of activities between *P. onca* and its medium and large prey in the Tapirapé Biological Reserve between the years 2016 and 2019. Values of (**Δ**), (**W**) and **(p).** (++) Main prey and (+) Secondary prey. The vertical lines represent the average sunrise and sunset times.

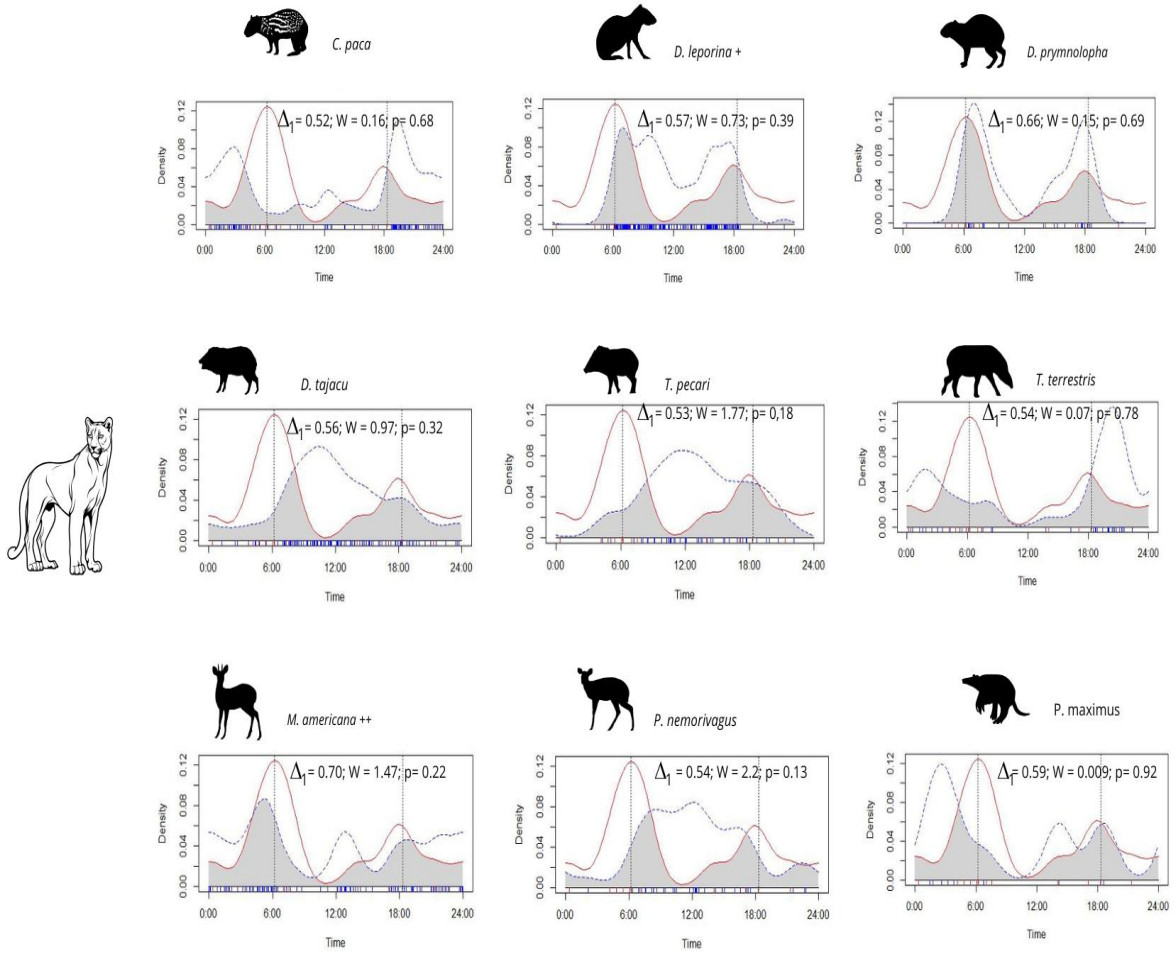

Figure 8. Kernel density graphs representing the overlap of activities between *P. concolor* and its medium and large prey in the Tapirapé Biological Reserve between 2016 and 2019. Values of (**Δ**), (**W**) and (**p**). (++) Main prey and (+) Secondary prey. The vertical lines represent the average sunrise and sunset times.

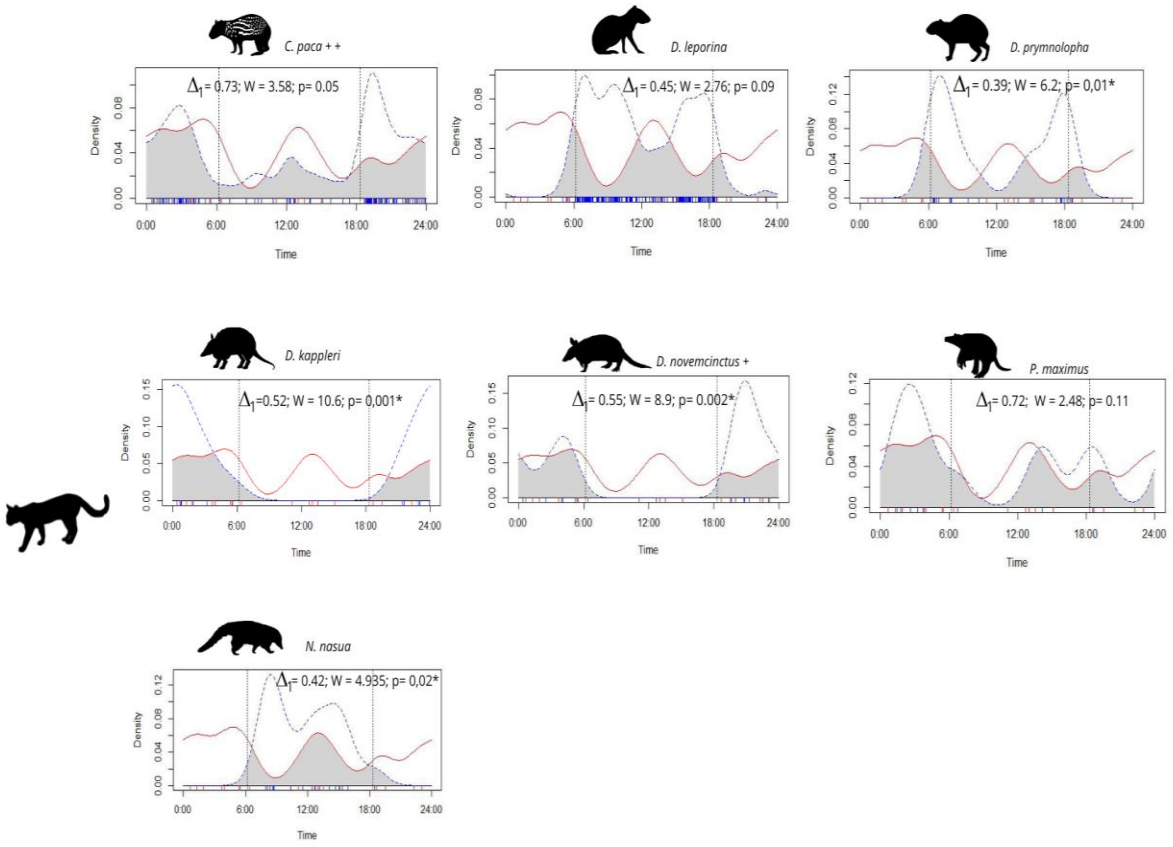

Figure 9. Kernel density graphs representing the overlap of activities between *L. pardalis* and its medium and large prey in the Tapirapé Biological Reserve between 2016 and 2019. Values of (**Δ**), (**W**) and (**p**). (++) Main prey and (+) Secondary prey. The vertical lines represent the average sunrise and sunset times.

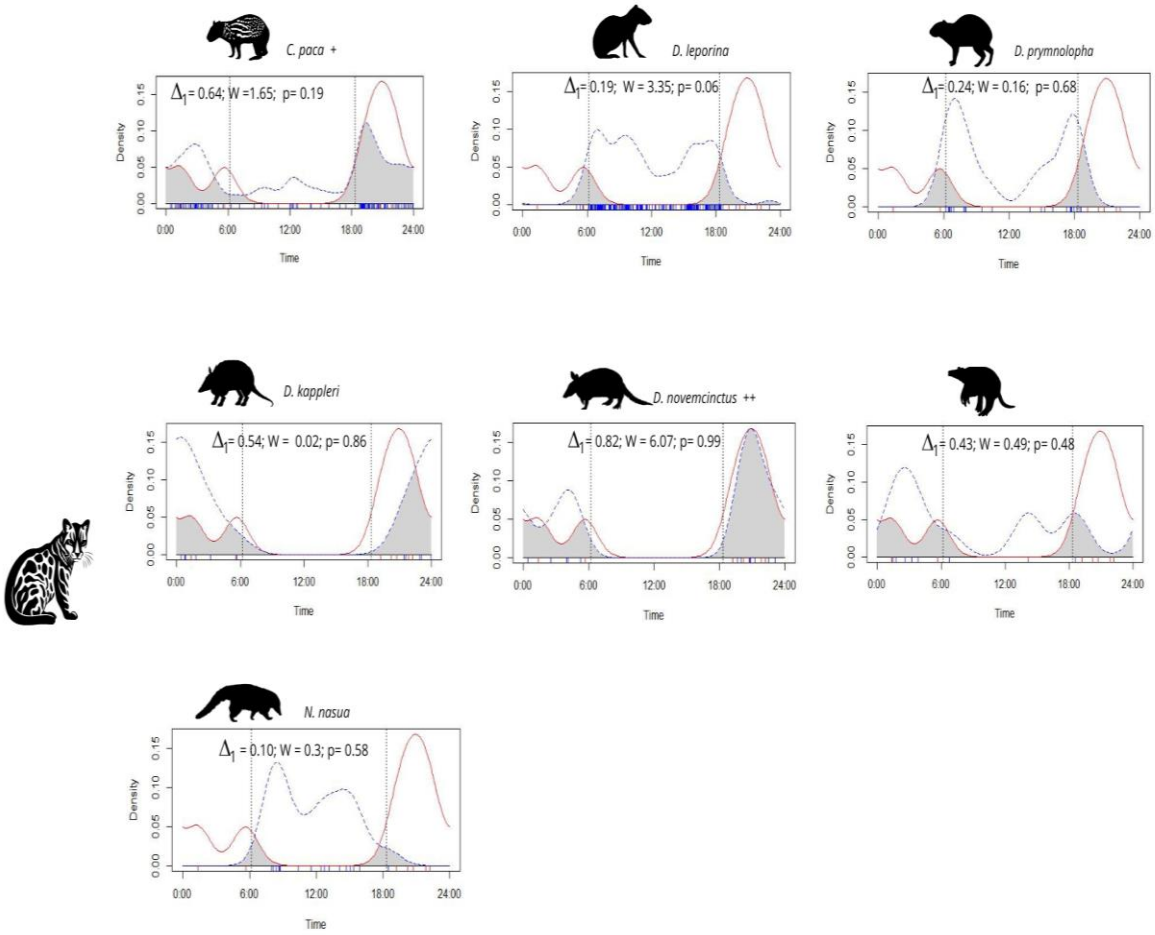

Figure 10. Kernel density graphs representing the overlap of activities between *L. tigrinus* and its medium and large prey in the Tapirapé Biological Reserve between the years 2016 and 2019. Values of (**Δ**), (**W**) and (**p**). (++) Main prey and (+) Secondary prey. The vertical lines represent the average sunrise and sunset times.

Supplementary material one

Table 1S. Comparison of activity patterns between pairs of species of medium and large mammals belonging to the guilds of carnivores, herbivores and omnivores, recorded in the Tapirapé Biological Reserve between the years 2016 and 2019, the overlap coefficients, relative abundance index (RAI) , confidence interval (CI), Wald test (W) and significance level (p) and probable ecological interaction. The underlined RAI corresponds to the relative abundance of the underlined species in the same line.

Guild	Species 1	Species 2	Overlap coefficient	RAI (%)	CI	W	p	Interaction
Carnivores	*P. onca*	*P. concolor*	0.55	0.49	0.32 – 0.79	0.19	0.66	
	P. onca	*L. pardalis*	0.62	0.59	0.39 – 0.84	6.71	**0.009***	**Competition**
	P. onca	*L. tigrinus*	0.57	0.24	0.33 – 0.82	0.04	0.83	
	P. concolor	*L. pardalis*	0.62	0.49	0.40 – 0.84	4.33	**0.03***	**Competition**
	P. concolor	*L. tigrinus*	0.42	0.24	0.30 – 0.84	0.47	0.48	
	L. pardalis	*L. tigrinus*	0.52	0.59	0.24 – 0.79	7.42	**0.006***	**Competition**
Herbivores								
	C. paca	*D. leporina*	0.32	5.01	0.25 – 0.40	0.35	0.55	
	C. paca	*D.prymnolopha*	0.33	0.87	0.21 – 0.45	1.01	0.31	
	C. paca	*D. tajacu*	0.46	4.17	0.36 – 0.56	0.76	0.38	
	C. paca	*T. pecari*	0.46	1.89	0.35 – 0.58	1.5	0.21	
	C. paca	*T. terrestris*	0.80	1.26	0.69 – 0.90	0.46	0.49	
	D. leporina	*D.prymnolopha*	0.76	7.33	0.63 – 0.89	4.26	**0.03***	**Competition**
	D. leporina	*D. tajacu*	0.75	4.17	0.67 – 0.82	0.19	0.66	
	D. leporina	*T. pecari*	0.73	1.89	0.63 – 0.82	0.68	0.40	
	D. leporina	*T. terrestris*	0.30	1.26	0.18 – 0.43	1.5	0.22	
	D. prymnolopha	*D. tajacu*	0.57	0.87	0.41 – 0.72	4.39	**0.03***	**Competition**
	D. prymnolopha	*T. pecari*	0.58	1.89	0.42 – 0.78	4.19	**0.04***	**Competition**
	D. prymnolopha	*T. terrestris*	0.34	1.26	0.18 – 0.50	0.02	0.87	
	D. tajacu	*T. pecari*	0.86	4.17	0.76 – 0.96	0.21	0.64	
	D. tajacu	*T. terrestris*	0.42	1.26	0.29 – 0.55	1.98	0.15	
	T. pecari	*T. terrestris*	0.42	1.89	0.28 – 0.56	3.76	0.05	
	M. americana	*P. nemorivagus*	0.52	3.78	0.38 – 0.65	0.02	0.87	
	M. americana	*T. terrestris*	0.67	1.26	0.53 – 0.80	2.48	0.11	
	P. nemorivagus	*T. terrestris*	0.36	1.19	0.20 – 0.52	4.37	**0.03***	**Competition**
Omnivores								
	D. kappleri	*D.novemcinctus*	0.62	0.45	0.33 – 0.87	0.03	0.84	
	D. kappleri	*P. maximus*	0.51	0.35	0.26 – 0.75	0.45	0.50	
	D. kappleri	*N. nasua*	0.05	0.63	0.06 – 0.17	0.22	0.63	
	D. novemcinctus	*P. maximus*	0.46	0.45	0.22 – 0.69	0.5	0.47	
	D. novemcinctus	*N. nasua*	0.05	0.63	0.05 – 0.17	0.4	0.52	
	P. maximus	*N. nasua*	0.36	0.35	0.11 – 0.59	0.06	0.79	

Supplementary material two

Table 2S. Comparison of activity patterns of *Panthera onca* and its possible prey, recorded in the Tapirapé Biological Reserve between 2016 and 2019, overlap coefficients, relative abundance index (RAI), confidence interval (CI), Wald test (W), significance level (p) and probable preferred prey.

Predator	Prey	Overlap coefficient	RAI (%) Predator	RAI (%) Prey	CI	W	p	Predation
P. onca	*C. paca*	0.69	0.49	5.01	0.52 – 0.86	0.74	0.38	**Main prey**
	D. leporina	0.35	0.49	7.33	0.15 – 0.54	2.36	0.12	
	D. prymnolopha	0.36	0.49	0.87	0.14 – 0.57	0.03	0.85	
	D. tajacu	0.45	0.49	4.17	0.25 – 0.65	2.69	0.10	
	M. americana	0.65	0.49	3.78	0.46 – 0.84	2.65	0.10	**Secondary prey**
	P. nemorivagus	0.38	0.49	1.19	0.15 – 0.60	4.22	0.03*	
	P. maximus	0.65	0.49	0.35	0.42 – 0.88	0.22	0.63	
	T. pecari	0.46	0.49	1.89	0.25 – 0.68	3.39	0.06	
	T. terrestris	0.68	0.49	1.26	0.50 – 0.87	0.05	0.80	

Table 3S. Comparison of activity patterns of *Puma concolor* and its possible prey, recorded in the Tapirapé Biological Reserve between 2016 and 2019, overlap coefficients, relative abundance index (RAI), confidence interval (CI), Wald test (W), significance level (p) and probable preferred prey.

Predator	Prey	Overlap coefficient	RAI (%) Predator	RAI (%) Prey	CI	W	p	Predation
P.concolor	*C. paca*	0.52	0.49	5.01	0.30 – 0.73	0.16	0.68	
	D. leporina	0.57	0.49	7.33	0.39 – 0.76	0.73	0.39	**Secondary prey**
	D. prymnolopha	0.66	0.49	0.87	0.46 – 0.85	0.15	0.69	
	D. tajacu	0.66	0.49	4.17	0.38 – 0.74	0.97	0.32	
	M. americana	0.70	0.49	3.78	0.51 – 0.89	1.47	0.22	**Main prey**
	P. nemorivagus	0.54	0.49	1.19	0.35 – 0.74	2.28	0.13	
	P. maximus	0.59	0.49	0.35	0.33 – 0.85	0.009	0.92	
	T. pecari	0.53	0.49	1.89	0.33 – 0.73	1.77	0.18	
	T. terrestris	0.54	0.49	1.26	0.32 – 0.77	0.072	0.78	

Table 4S. Comparison of the activity patterns of *Leopardus pardalis* and its possible prey, recorded in the Tapirapé Biological Reserve between the years 2016 and 2019, overlap coefficients, relative abundance index (RAI), confidence interval (CI), Wald test (W), significance level (p) and probable preferred prey.

Predator	Prey	Overlap coefficient	RAI (%) Predator	RAI (%) Prey	CI	W	p	Predation
L.pardalis	*C. paca*	0.73	0.59	5.01	0,57 – 0,89	3,58	0.05	**Main prey**
	D. leporina	0.45	0.59	7.33	0.28 – 0.61	2.76	0.09	
	D. prymnolopha	0.39	0.59	0.87	0.21 – 0.58	6.20	0.01*	
	D. kappleri	0.52	0.59	0.45	0.34 – 0.71	10.68	0.001*	
	D. novemcinctus	0.55	0.59	0.45	0.33 – 0.77	8.91	0.002*	**Secondary prey**
	N. nasua	0.42	0.59	0.63	0.22 – 0.61	4.93	0.02*	
	P. maximus	0.72	0.59	0.35	0.50 – 0.93	2.48	0.11	

Table 5S. Comparison of the activity patterns of *Leopardus tigrinus* and its possible prey, recorded in the Tapirapé Biological Reserve between the years 2016 and 2019, overlap coefficients, relative abundance index (RAI), confidence interval (CI), Wald test (W), significance level (p) and probable preferred prey.

Predator	Prey	Overlap coefficient	RAI (%) Predator	RAI (%) Prey	CI	W	p	Predation
L. tigrinus	*C. paca*	0.64	0.24	5.01	0.41 – 0.87	1.65	0.19	**Secondary prey**
	D. leporina	0.19	0.24	7.33	0.01 – 0.38	3.35	0.06	
	D. prymnolopha	0.24	0.24	0.87	0.01 – 0.47	0.16	0.68	
	D. kappleri	0.54	0.24	0.45	0.23 – 0.85	0.02	0.86	
	D. novemcinctus	0.82	0.24	0.45	0.59 – 1.05	6.07	0.99	**Main Prey**
	N. nasua	0.10	0.24	0.63	0.06 – 0.27	0.30	0.58	
	P. maximus	0.43	0.24	0.35	0.13 – 0.72	0.49	0.48	

Attachments

Comentários à coordenação do PPGBEES:

Trabalho bem executado, com análises que demonstram adequadamente os padrões de atividade e relações interespecíficas na localidade. Comentários pontuais no arquivo da dissertação visando proporcionar maior clareza à algumas informações.

Avaliação final do projeto de dissertação de mestrado

I - Aprovada (X)

Aprovada: indica que o revisor aprova a dissertação sem ou com correções. Na existência de correções, estas devem ser indicadas nos comentários à coordenação e/ou no próprio documento da dissertação.

Nome do membro da banca: Adriana Bocchiglieri
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Comentários à coordenação do PPGBEES:

Prezados membros da Coordenação do PPGBEES,

A dissertação em questão apresenta contribuições relevantes para a compreensão dos padrões de atividade e das interações ecológicas entre mamíferos na região amazônica.

Avaliação Geral

A Amazônia, uma das maiores e mais biodiversas florestas tropicais do mundo, abriga uma rica fauna de mamíferos de médio e grande porte, portanto, compreender os padrões de nicho temporal desses animais é importante para entender as dinâmicas ecológicas e para a conservação dessas espécies. Só com este contexto já se justifica a importância do trabalho.

Além disso, o estudo também tem grande mérito, dado o cenário da falta de dados sobre nicho temporal dos mamíferos amazônicos, e da dificuldade de observação em uma floresta densa como a Amazônica. Adicionalmente, os dados pré-existentes também carecem de falta de estudos de longa duração, o que ressalta a importância de um estudo longo como este.

A introdução está bem escrita e referenciada, discute os mecanismos ecológicos que permitem a coexistência de diferentes espécies, com foco na importância das dimensões de nichos tróficos, espaciais e temporais. Ele destaca como essas dimensões ajudam a reduzir a competição e promover a coexistência entre as espécies, permitindo que elas utilizem os recursos de maneira diferente. A hipótese de complementaridade de nicho é mencionada, ressalta a influência de fatores ambientais, e identifica lacunas de pesquisa na área.

A análise de dados apresentou escolhas adequadas para o tema de estudo, considerando os avistamentos independentes e a dinâmica de grupo. Foram calculadas as abundâncias relativas (RAI), sobreposição de atividade entre as espécies (Dhat), estimativa da densidade do kernel e a significância estatística com teste de Wald.

A discussão está bem escrita e a hipótese de que espécies pertencentes ao mesmo grupo trófico exibiram maior segregação temporal de seus nichos foi corroborada para a maioria dos pares intraguilda analisados. Em geral, os resultados indicam que a segregação temporal é uma estratégia adaptativa crucial para a coexistência de espécies em comunidades ecológicas, minimizando a competição por recursos e otimizando o uso do habitat.

Sugestões e Recomendações

1. Estudar o padrão de atividade das espécies é importante, para a compreensão das interações ecológicas, mas seria importante destacar que essas informações podem subsidiar políticas públicas como a definição de áreas protegidas e a criação de corredores ecológicos, gestão de UCs, fiscalização de caça e melhoria das sinalizações de rodovias. Além disso, o conhecimento sobre os horários de atividade pode auxiliar na gestão de conflitos entre humanos e animais, como a redução de ataques a plantações e criações. Outra aplicação prática destes dados seria utilizar os padrões de atividade como indicadores da saúde dos ecossistemas e para monitorar as respostas da fauna às mudanças ambientais, inclusive mudanças climáticas, como as secas extremas que estamos presenciando nos últimos anos na Amazônia.

2. Visto que, apesar dos avanços nos estudos, ainda há muito a ser descoberto sobre as interações entre essas espécies e o ambiente, o estudo traz compreensão desses padrões, que podem subsidiar a conservação da biodiversidade amazônica e o desenvolvimento de estratégias de manejo mais sustentáveis. Neste sentido, sugiro o uso dos dados para testar perguntas e relações entre as mudanças climáticas e os padrões de atividade em próximos estudos.

3. Na Introdução geral, o parágrafo abaixo traz termos de pouca compreensão pro leitor leigo, sugiro reescrever alterando os termos em negrito:

"A partir dos registros, foi possível determinar o padrão de atividade das espécies e a variação nos padrões de atividades nas ***comparações pareadas.*** O primeiro leva em conta o período de atividade das espécies analisadas de acordo com as fases do dia (Jiménez et al. 2010) e a estimativa de densidade de Kernel (Ridout & Linkie 2009). O segundo estima o grau de sobreposição de atividade entre pares de espécies usando um ***coeficente de sobreposição*** (Meredith & Ridout 2021)."

Avaliação final do projeto de dissertação de mestrado

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Reprovada: indica que a dissertação não é adequada

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Comentários à coordenação do PPGBEES:

Na dissertação fiz alguns comentários que demandam correções pelo discente.

Avaliação final do projeto de dissertação de mestrado

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IV - Reprovada ( )

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Comentários à coordenação do PPGBEES:

Aprovação com correção:
Após uma cuidadosa leitura da dissertação apresentada pelo aluno, pontuo aqui diversas coisas que precisam melhorar. De maneira geral a dissertação não evoluiu substancialmente comparado ao documento que foi apresentado para a sua qualificação de mestrado. Erros e comentários que fiz durante a sua qualificação de mestrado (setembro de 2023) ainda estão presentes no documento. Não menos importante o resumo da dissertação necessita de melhorias assim a história em geral do manuscrito. Gostaria de ressaltar aqui que o trabalho possui mérito, porém não foi incorporado, da qualificação até a presente defesa, muitos dos apontamentos feitos plea banca de qualificação. O aluno apresenta uma quantidade de dados que já era notável na época de sua qualificação, mas não discute os resultados apresentados de forma adequada até o presente momento. Sinto que falta uma história a ser contada para que o trabalho seja e tenha mérito como uma dissertação.
Tratando-se de uma dissertação de um único capítulo, e que o mesmo já foi submetido para a revista Biota Neotropica, vejo que muito do que foi apresentado na sua introdução está contido no artigo científico, gerando uma redundância no documento. E por se tratar de um único capítulo, vejo que o mesmo deveria estar muito melhor acabado. As tabelas precisam de melhorias, assim como apresentação de 10 figuras é demasiada para qualquer manuscrito. O tópico da discussão precisa ser melhorado substancialmente e acredito que os revisores irão apontar as mesmas coisas que foram apontadas por mim no documento em DOCX. Não menos importante as figuras apresentadas no manuscrito enviado para a biota neotropica estão em português enquanto deveriam estar todos em inglês. As referências bibliográficas do manuscrito submetido para a revista estão completamente fora de formato, com fontes e tamanhos diferentes e fora do requisitado pela revista. Acredito que o aluno pode melhorar consideravelmente o documento principalmente porque a dissertação será consultada por outros alunos dentro e fora da instituição.

Reforço que as correções devem ser feitas para depósito final na PPGBEES.

Avaliação final do projeto de dissertação de mestrado

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Nome do membro da banca: Ricardo Siqueira Bovendorp

Data: 02/09/2024

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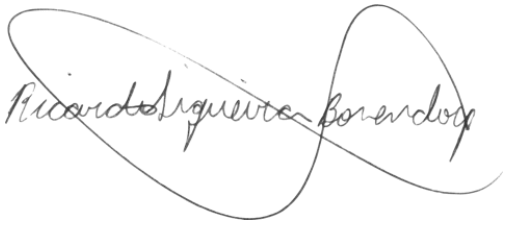

Comentários à coordenação do PPGBEES:

O artigo submetido à Biota Neotropica trata de descrever o padrão de atividade de mamíferos de médio e grande porte em uma floresta na Amazônia. Na primeira parte, uma comparação par-a-par é realizada dentro de potenciais "guildas". Na segunda parte, compara-se o padrão de atividade de predadores e de suas *possíveis* presas. Eu fiz comentários ao longo do texto, que encaminho junto com meu parecer.

Minha primeira sugestão é a remoção da segunda parte. Assim o artigo ficará mais enxuto e a história menos confusa. Aliás, o texto é muito prolixo. Precisa encurtar e ir direto ao ponto em muitas passagens.

Os autores precisam reavaliar qual é a novidade do trabalho. Pelo meu conhecimento não tão profundo sobre o tema, alguns trabalhos têm utilizado armadilhas fotográficas para registrar a atividade dos animais em florestas tropicais. A diferença é que aqueles trabalhos possuem hipóteses claras, normalmente focadas em poucos grupos de animais, ou tentando entender efeito de alguma externalidade sobre o comportamento animal. Repensar o trabalho pode ajudar a definir o que realmente é de interesse dos autores, já que descrever por descrever não parece ser o melhor caminho para os dados.

Resultados
Os gráficos mostram comparações entre espécies dentro da mesma família ou até do mesmo gênero, mas toda a discussão é feita sobre diferenças (ou similaridades) dentro de guildas.
Isso não faz sentido.

Há muitas comparações par-a-par, em inúmeros (e cansativos) gráficos. Dá a impressão de que faltam questões mais sólidas a serem respondidas. Para a estimativas dos p-valores, vocês consideraram corrigir os valores obtidos para evitar inflar o erro do tipo I?

Discussão e conclusões
A Discussão é muito, muito extensa. Como não há hipóteses a priori, qualquer resultado parece comprovar qualquer coisa. Eu realmente não consegui entender a sua linha de raciocínio. Suas conclusões falam em resultados para a conservação. Mas parecem ser palavras ao vento. Como vocês pretendem utilizar isso para conservação?

Por último, o inglês precisa de muitos ajustes.

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