

Horário de atividade e ocupação de roedores caviomorfos em uma
floresta de terra firme Amazônica

Juliana Costa Rennó

Manaus, Amazonas

Julho, 2019

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Orientador: Dr. Wilson Roberto Spironello

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Sinopse

O presente trabalho avaliou a influência do regime de precipitação no horário de atividade e na probabilidade de detecção de quatro espécies de roedores caviomorfos. Testou a importância da quantidade de palmeiras acaules, HAND, distância do desmatamento mais próximo e abundância de predadores nas probabilidades de ocorrência, e das interações interespecíficas na coocorrência de roedores caviomorfos em uma floresta de terra firme na Amazônia Central.

Palavras-chave: roedores caviomorfos, Amazônia Central, armadilhas fotográficas, precipitação, variáveis ambientais, horário de atividade, ocupação.

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Resumo

O comportamento de mamíferos frugívoros, como a distribuição das espécies no tempo e espaço, pode ser alterado como consequência de mudanças nos fatores ambientais abióticos e bióticos. O presente trabalho utilizou registros de armadilhas fotográficas para investigar se a variação nas características ambientais afeta a atividade diária e a ocupação de quatro roedores caviomorfos em uma floresta de “terra firme” na Amazônia Central. Testamos a influência da precipitação no horário de atividade e na probabilidade de detecção dos roedores caviomorfos; a influência da topografia, a abundância de predadores, a quantidade de palmeiras e a distância da área não florestal na probabilidade de ocorrência dos roedores; e também a coocorrência entre espécies semelhantes. O horário de atividade não foi significativamente diferente, mas foi possível notar diferenças na distribuição dos horários de atividade entre os períodos seco e chuvoso.

A covariável período influenciou a probabilidade de detecção de cutia (*Dasyprocta leporina*) e paca (*Cuniculus paca*). A probabilidade de ocorrência de cutiara (*Myoprocta leporina*) foi influenciada positivamente pela distância da área não florestal; a probabilidade de ocorrência de cutia (*D. leporina*) foi influenciada positivamente pela distância vertical da água; a probabilidade de ocorrência de paca (*C. paca*) foi negativamente relacionada pelo número de palmeiras *Astrocaryum sciophilum*; e a probabilidade de ocorrência de rato-de-espinho (*Proechimys* spp.) foi negativamente influenciada pelo número de palmeiras *Astrocaryum acaule*. A probabilidade de detecção de cutiara foi influenciada pela detecção de cutia e vice-versa e ambas se evitaram nos dois períodos. Este estudo fornece respostas relacionadas a partição do tempo e espaço, bem como a influência das características ambientais na proporção de área ocupada de quatro roedores sul-americanos. Informações inerentes a compreensão sobre a contribuição de roedores caviomorfos para o equilíbrio dinâmico da floresta de “terra firme” na Amazônia Central. Estudos como esse podem contribuir no monitoramento da biodiversidade. A longo prazo e associados a estudos ficados na dieta e telemetria podem esclarecer as limitações e a partição de nicho diante de variações ambientais.

Palavras chave: roedores caviomorfos, Amazônia Central, armadilhas fotográficas, precipitação, variáveis ambientais, horário de atividade, ocupação.

Abstract

The behaviour of frugivorous mammals such as time and space distribution can be altered as consequence of changes in abiotic and biotic environmental factors. The present work used Camera-traps records to investigate if variation in environmental characteristics affect the daily activity and occupancy of four caviomorph rodents in a dry land forest in Central Amazonia. We test the influence of precipitation on the activity pattern and detection probability; the influence of topography, predators, palms, distance from non-forest area on the occurrence probability; and the co-occurrence of similar species. The activity pattern was not significant different but differ between dry and rainy periods. The period influenced the detection probability of agouti (*Dasyprocta leporina*) and paca (*Cuniculus paca*). The occurrence probability of acouchy (*Myoprocta acouchy*) was positively influenced by the distance from non-forest area; occurrence probability of agouti (*D. leporina*) was positively influenced by the vertical distance from the water; occurrence probability of paca (*Cuniculus paca*) was negatively influenced by the number of *Astrocaryum sciophilum* palm; and occurrence probability of spiny-rat (*Proechimys* spp.) was negatively influenced by the number of *Astrocaryum acaule* palm. The detection probability of acouchy was influenced by the detection probability of agouti and vice versa and they avoided each other in both periods. This study provides responses related to the partitioning of time and space, as well as the influence of environmental characteristics on the proportion of occupied area of four South American mammals. Information that are inherent to comprehension about the contribution of caviomorph rodents to the dynamic balance of the Central Amazon rainforest. These results and long-term monitoring with studies focusing on diet and telemetry can clarify the limitations and niche partitioning in face of environmental variation.

Keywords: Neotropical mammals, activity pattern, detection, occurrence, probability, camera-trap, precipitation, behaviour, rainforest, environmental characteristics, Central Amazonia

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74 *Dasyprocta leporina* (*D.leporina*)and HAND; acouchy, *Myoprocta acouchy*
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81 plot; A_microcarpa = individuals of *Attalea microcarpa* palm per plot; hand = median
82 of the HAND within a radius of 150 meters around the point of the camera trap;
83 distance = nearest deforestation distance; RAI_ccp = relative abundance of acouchy,
84 agouti and paca predators; rai_rato = relative abundance of spiny rat predator.

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94 Introdução geral

95 A diversidade e coexistência de espécies dentro de uma comunidade biológica
96 dependem do compartilhamento de nicho (Hutchinson 1959; MacArthur and May
97 1972). Investigar a partição de nicho permite entender de forma quantitativa e
98 qualitativa os recursos partilhados e os limites de similaridade entre espécies
99 (MacArthur 1958; Schoener 1974).

100 Mecanismos que diminuam a sobreposição de nicho geralmente permitem
101 espécies similares a viver em simpatria. Segundo Pianka (1973), para que espécies com
102 hábitos semelhantes e que apresentam grande sobreposição em uma dimensão de nicho
103 possam viver em simpatria, estas devem apresentar baixa ou nenhuma sobreposição em
104 outras dimensões do mesmo. Esses mecanismos incluem diferenças na seleção do
105 habitat, dieta e segregação temporal.

106 A distribuição e o compartilhamento de nicho podem ser alterados decorrentes
107 de fatores físicos, como a topografia e precipitação, e biológicos, como predadores e
108 disponibilidade de recursos, e de alterações ambientais (Pianka 2011).

109 A topografia influencia a composição do solo e a estrutura da vegetação
110 (Chauvel et al. 1987; Costa et al. 2005; de Castilho et al. 2006; Schietti et al. 2014)
111 consequentemente, é usada como preditor da distribuição dos animais no ambiente
112 (Nagy-Reis et al. 2017a; Tavares et al. 2019). De fato fatores topográficos foram
113 relacionados a ocupação e detecção de várias espécies animais (Collett et al. 2013;
114 Estevo et al. 2017; Nagy-Reis et al. 2017a).

115 Já o regime de precipitação afeta a fenologia de frutificação de árvores e
116 palmeiras (Smythe 1970; Alencar et al. 1979; Haugaasen and Peres 2005). Por sua vez,
117 a variação na disponibilidade de frutos interfere no comportamento de animais

118 frugívoros (Bergallo and Magnusson 1999; Kissling et al. 2007; Hanya and Aiba 2010;
119 Ferreguetti et al. 2018a). Como no caso dos roedores caviomorfos que apresentaram
120 alterações em suas áreas de vida entre períodos de maior e menor disponibilidade de
121 frutos (Forget 1991; Beck-king and Helversen 1999; Silvius and Fragoso 2003; Dubost
122 and Henry 2006). Outro fator que influenciou a área de vida e também a ocorrência de
123 roedores caviomorfos foi o recurso hídrico (Endries and Adler 2005; Ferreguetti et al.
124 2018b).

125 Alterações antrópicas no ambiente também afetam a fauna em diferentes escalas
126 (Jorge and Peres 2005; Defries et al. 2010), a riqueza e densidade de mamíferos foram
127 positivamente relacionados ao tamanho de fragmentos florestais (Michalski and Peres
128 2007; Jorge 2008). E os horários de atividade dos animais podem variar como resposta a
129 presença humana (Gaynor et al. 2018).

130 Fatores climáticos e características do ambiente foram usados como preditores
131 da densidade, da ocupação e da área de vida de roedores caviomorfos como pacas,
132 cutias, cutiaras e ratos-de-espinho (Dubost 1988; Henry 1999; Dubost and Henry 2006;
133 Ferreguetti et al. 2018a; b; Harmsen et al. 2018). Os roedores caviomorfos tem um
134 papel importante na manutenção da estrutura e ecologia florestal, e.g. foram associados
135 a predação e dispersão de espécies de árvores e palmeiras (Smythe 1970, 1989; Peres
136 and Baider 1997; Silvius and Fragoso 2003). São importantes na cadeia alimentar sendo
137 presas de felinos de pequeno, médio e grande porte (Emmons and Feer 1990; Pratas-
138 Santiago et al. 2016; Santos et al. 2019). Também estão entre os mamíferos mais
139 registrados em armadilhas fotográficas, sendo possível obter informações robustas sobre
140 as espécies utilizando este método de amostragem (Togura et al. 2014; Rocha et al.
141 2016; Pratas-Santiago et al. 2017).

142 Cutiara, cutia, paca e rato-de-espinho são roedores caviomorfos, tem hábito
143 terrestre, usam recursos alimentares semelhantes como frutos e sementes (Emmons and
144 Feer 1990; Forget 1991; Dubost and Henry 2006) consequentemente, compartilham e se
145 sobrepõem em mais de uma dimensão do nicho. Dessa forma a presença de uma espécie
146 semelhante também pode ser um preditor para o uso do habitat (Nagy-Reis et al. 2017a;
147 b). Estudos que avaliaram como a distribuição e compartilhamento de nicho entre esses
148 roedores podem ser influenciados por variações nos fatores físicos e biológicos,
149 incluindo interações, interespecíficas são escassos.

150 Nesse sentido, o presente trabalho analisou como fatores abióticos e biológicos
151 afetaram o padrão de atividade e a ocupação de quatro espécies de roedores
152 caviomorfos em uma floresta tropical de terra firme na Amazônia Central.
153 Investigamos como o regime de precipitação e o período estacional influenciaram o
154 horário de atividade e a probabilidade de detecção das espécies. Além disso, analisamos
155 quais variáveis ambientais afetaram a probabilidade de ocorrência das espécies.
156 Verificamos também a coocorrência testando como a presença de uma espécie
157 influenciou a ocupação de outra, considerando pares de espécies diurna e noturnas.

158 Nossas hipóteses são que a atividade diária e a ocupação das espécies serão
159 influenciadas por fatores abióticos como a precipitação e a topografia e também por
160 fatores biológicos como a quantidade de palmeiras acaules, presença de predadores e
161 relações interespecíficas entre espécies semelhantes. Esperamos que variações no
162 regime de precipitação e nas características ambientais alterem a atividade diária e a
163 ocupação dos roedores caviomorfos.

164 Predizemos que: 1) Diferenças no regime de precipitação irão alterar a
165 distribuição e sobreposição dos horários de atividade e a probabilidade de detecção das

166 quatro espécies de roedores caviomorfos; 2) As probabilidades de ocorrência dos
167 roedores serão influenciadas por uma ou mais das covariáveis: topografia, a quantidade
168 de indivíduos de palmeiras acaules, altura acima da drenagem mais próxima (HAND),
169 abundância relativa de predadores e distância do desmatamento mais próximo; e 3) A
170 presença da espécie dominante (maior peso corporal) influenciará as probabilidades de
171 ocorrência e detecção da subordinada.

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184 Objetivo geral

185 Investigar a influência de fatores abióticos e biológicos no horário de atividade e
186 na ocupação de roedores caviomorfos em uma floresta de terra firme na Amazônia
187 Central.

188 Objetivos específicos

189 Investigar o efeito da variação do regime de precipitação no horário de atividade
190 e na probabilidade de detecção dos roedores caviomorfos.

191 Testar a influência de covariáveis ambientais na probabilidade de ocorrência dos
192 roedores caviomorfos.

193 Analizar a coocorrência de pares de espécies testar se a espécie dominante
194 influencia a ocupação da espécie subordinada e.

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204 Capítulo 1

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243 **Daily activity and occupancy of caviomorph rodents in central Amazonia**244 *Rennó C. Juliana^{*1}, Gonçalves S. L. André¹, Spironello R. Wilson¹*245 *1 Grupo de Estudos de Mamíferos Amazônicos, Instituto Nacional de Pesquisas da
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248

249 The behaviour of frugivorous mammals such as time and space distribution can be altered
250 as consequence of changes in abiotic and biotic environmental factors. The present work
251 used Camera-traps records to investigate if variation in environmental characteristics
252 affect the daily activity and occupancy of four caviomorph rodents in a dry land forest in
253 Central Amazonia. We test the influence of precipitation on the activity pattern and
254 detection probability; the influence of topography, predators, palms, distance from non-
255 forest area on the occurrence probability; and the co-occurrence of similar species. The
256 activity pattern was not significant different but differ between dry and rainy periods. The
257 period influenced the detection probability of agouti (*Dasyprocta leporina*) and paca
258 (*Cuniculus paca*). The occurrence probability of acouchy (*Myoprocta acouchy*) was
259 positively influenced by the distance from non-forest area; occurrence probability of
260 agouti (*D. leporina*) was positively influenced by the vertical distance from the water;
261 occurrence probability of paca (*Cuniculus paca*) was negatively influenced by the number
262 of *Astrocaryum sciophilum* palm; and occurrence probability of spiny-rat (*Proechimys*
263 spp.) was negatively influenced by the number of *Astrocaryum acaule* palm. The
264 detection probability of acouchy was influenced by the detection probability of agouti
265 and vice versa and they avoided each other in both periods. This study provides responses
266 related to the partitioning of time and space, as well as the influence of environmental
267 characteristics on the proportion of occupied area of four South American mammals.
268 Information that are inherent to comprehension about the contribution of caviomorph
269 rodents to the dynamic balance of the Central Amazon rainforest. These results and long-
270 term monitoring with studies focusing on diet and telemetry can clarify the limitations
271 and niche partitioning in face of environmental variation.

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O comportamento de mamíferos frugívoros, como a distribuição das espécies no tempo e espaço, pode ser alterado como consequência de mudanças nos fatores ambientais abióticos e bióticos. O presente trabalho utilizou registros de armadilhas fotográficas para investigar se a variação nas características ambientais afeta a atividade diária e a ocupação de quatro roedores caviomorfos em uma floresta de “terra firme” na Amazônia Central. Testamos a influência da precipitação no horário de atividade e na probabilidade de detecção dos roedores caviomorfos; a influência da topografia, a abundância de predadores, a quantidade de palmeiras e a distância da área não florestal na probabilidade de ocorrência dos roedores; e também a coocorrência entre espécies semelhantes. O horário de atividade não foi significativamente diferente, mas foi possível notar diferenças na distribuição dos horários de atividade entre os períodos seco e chuvoso. A covariável período influenciou a probabilidade de detecção de cutia (*Dasyprocta leporina*) e paca (*Cuniculus paca*). A probabilidade de ocorrência de cutiara (*Myoprocta leporina*) foi influenciada positivamente pela distância da área não florestal; a probabilidade de ocorrência de cutia (*D. leporina*) foi influenciada positivamente pela distância vertical da água; a probabilidade de ocorrência de paca (*C. paca*) foi negativamente relacionada pelo número de palmeiras *Astrocaryum sciophilum*; e a probabilidade de ocorrência de rato-de-espinho (*Proechimys* spp.) foi negativamente influenciada pelo número de palmeiras *Astrocaryum acaule*. A probabilidade de detecção de cutiara foi influenciada pela detecção de cutia e vice-versa e ambas se evitaram nos dois períodos. Este estudo fornece respostas relacionadas a participação do tempo e espaço, bem como a influência das características ambientais na proporção de área ocupada de quatro roedores sul-americanos. Informações inerentes a compreensão sobre a contribuição de roedores caviomorfos para o equilíbrio dinâmico da floresta de terra firme na Amazônia Central. Estudos como esse podem contribuir no monitoramento da biodiversidade. A longo prazo e associados a estudos ficados na dieta e telemetria podem esclarecer as limitações e a participação de nicho diante de variações ambientais.

301

302 Keywords: Neotropical mammals, activity pattern, detection, occurrence,
303 probability, camera-trap, precipitation, behaviour, rainforest, environmental
304 characteristics, Central Amazonia

305

306 **Introduction**

307 The diversity and coexistence of species within a biological community depends
308 on niche partitioning (Hutchinson 1959; MacArthur and May 1972). Niche partition
309 investigation allows a quantitative and qualitative knowledge of shared resources and the
310 limits of similarity between species (MacArthur 1958; Schoener 1974). Time and space
311 distributions and consequently niche partitioning can be altered due to physical factors
312 such as topography and precipitation, and biological factors, such as predators,
313 availability of resources and environmental changes (Pianka 2011).

314 Aspects of the topography such as elevation have influence on soil composition
315 and forest structure (Chauvel et al. 1987; Costa et al. 2005; Schietti et al. 2013) and
316 consequently can be a determinant factor in how species use and are distributed on the
317 environment (Cintra and Naka 2012; Tavares et al. 2019). Elevation and distance from
318 water resource were important elements on the proportion of used areas of birds and
319 mammals (Collett et al. 2013; Estevo et al. 2017; Nagy-Reis et al. 2017).

320 The precipitation regime can affect fruiting phenology of trees like palms and
321 primary species (Smythe 1970; Alencar et al. 1979; Haugaasen and Peres 2005). The
322 variation in availability of fruit can influence frugivorous animals (Bergallo and
323 Magnusson 1999; Kissling et al. 2007; Hanya and Aiba 2010; Ferreguetti et al. 2018a).
324 Caviomorph rodents presented alterations in space use during periods of higher and lower
325 fruit availability (Forget 1991; Beck-king and Helversen 1999; Silvius and Fragoso 2003;
326 Dubost and Henry 2006).

327 Another factor important to the behaviour of species is predators, that can be
328 natural and humans. Small mammals changed the activity pattern in relation to lunar
329 luminosity and the explanation is related to be exposed to felines (Pratas-Santiago et al.
330 2016, 2017). Besides that anthropogenic changes in environment characteristics can
331 affect fauna at different scales (Jorge and Peres 2005; Defries et al. 2010).

332 Studies that relate density, occupancy, and time and space use of caviomorph
333 rodents (e.g., spiny rat (*Proechimys* spp.), acouchy (*Myoprocta acouchy*), agouti
334 (*Dasyprocta leporina*) and paca (*Cuniculus paca*)) demonstrated habitat use and
335 preferences related to climatic factors and environmental characteristics (Dubost 1988;
336 Henry 1999; Ferreguetti et al. 2018a; Harmsen et al. 2018). Caviomorph rodents play an
337 important role in maintaining forest structure and ecology, being responsible for predation

338 and dispersal of tree and palm species (Smythe 1970; Peres and Baider 1997; Silvius and
339 Fragoso 2003). They are important in the food chain, being prey of felids (Emmons 1988;
340 Emmons and Feer 1990; Pratas-Santiago et al. 2016).

341 In addition, caviomorph rodents are one of the most recorded mammals in fauna
342 studies with Camera-traps in tropical forest, and it is possible to obtain robust information
343 about the species using this sampling method (Togura et al. 2014; Rocha et al. 2016).
344 These animals have a terrestrial habit, use similar food resources such as fruits and seeds
345 (Emmons and Feer 1990; Forget 1991; Dubost and Henry 2006), therefore they overlap
346 in more than one dimension of the niche. Searching for the influence of physical and
347 biological factors on the behaviour of these rodents can add information for understanding
348 the distribution and partitioning of niche.

349 In this sense, the present study analysed how abiotic and biotic factors affected
350 the activity pattern and the occupancy of *Myoprocta acouchy*, *Dasyprocta leporina*,
351 *Cuniculus paca* and *Proechimys* spp. in a tropical rainforest of Central Amazonia.
352 Specifically, we investigated the influence of precipitation on the activity pattern and on
353 the detection probability of the caviomorph rodents. We test the influence of
354 environmental characteristics on the occurrence probability of caviomorph species. We
355 also verified if the presence of one species influenced the detection and occurrence
356 probability of another throughout co-occurrence analysis considering pairs of species.
357 The hypothesis is that variation in precipitation between dry and rainy periods influence
358 the daily activity and occupancy of the caviomorph rodents. We expect the four rodents
359 would change the activity pattern and also be detected in different locations in order to
360 maximize the nutrients consumed in rainy period. We also propose that environmental
361 characteristics of the forest would influence the place that these caviomorph rodents
362 frequent. We expect that the number of palms, the topography, the distance from the city
363 and the abundance of predators will influence the occurrence of the caviomorph rodents.
364 Besides that, between the diurnal caviomorph rodents, we expect that the presence of the
365 bigger species will influence the detection of the smaller one.

366

367 **Material and methods**

368 **Study area**

369 The present study was carried out in the Adolpho Ducke Forest Reserve (Ducke
370 Reserve) located northwest of the city of Manaus - AM ($59^{\circ} 52' 40''$ and $59^{\circ} 52' 00''$ W,
371 $03^{\circ} 00' 00''$ and $03^{\circ} 08' 00''$ S), in Central Amazonia, Brazil. Ducke Reserve is close to
372 the urban headquarters, where only the eastern boundary is connected to the continuous
373 forest (Ribeiro et al., 1999). The reserve covers an area of 100 km^2 and is part of the
374 Biodiversity Research Program (PPBio). PPBio has a system of trails and permanent plots
375 of the Program of Long-term Ecological Research (PELD / CNPq) (Oliveira et al. 2008)
376 supported by the Ministry of Science and Technology, Innovation and Culture (MCTIC).

377 The climate is tropical humid, with an average temperature of 26°C , relative air
378 humidity between 75-86%, and annual precipitation between 1750 and 2500 mm. The
379 rainy season occurs from November to May and dry season from June to October. The
380 altitude in the reserve varies from 20 to 127 m (Oliveira et al. 2008). A central plateau
381 divides the water bodies of the reserve, to the west the streams and tributaries are
382 tributaries of the Negro River, and to the east streams and tributaries of the Amazon River
383 (Ribeiro et al. 1999).

384 The soil varies with a gradient, that ranges from sandy and poorly drained soils to
385 well-drained richer and clayey soils (Oliveira et al. 2008). The variation is related to
386 different concentrations of clay and soil texture, which reflect changes in vegetation
387 composition (Chauvel et al. 1987; Costa et al. 2005; Schietti et al. 2013). Plateau areas
388 present higher stock biomass and primary productivity (de Castilho et al. 2006).
389 Differences in vegetation influence the distribution of animal species (Cintra and Naka
390 2012; Tavares et al. 2019). The vegetation is dense ombrophilous tropical rainforest
391 composed of four forest types: plateau, campinarana, slope, and valley forests (Ribeiro et
392 al. 1999). There is a great diversity of species, for example, members of the Arecaceae
393 family that contains 15 genera and 45 species, and a great abundance of non-stem palms
394 of the genus *Astrocaryum* spp. and *Attalea* spp. (Ribeiro et al. 1999; Oliveira et al. 2008).

395

396 **Species focus of the study**

397 The focal species of this study are: acouchy, *Myoprocta acouchy* (Erxleben,
398 1777); agouti, *Dasyprocta leporina* (Linnaeus, 1758); paca, *Cuniculus paca* (Linnaeus,
399 1766); and spiny rat of the genus *Proechimys*. These species are terrestrial caviomorph

400 rodents that use similar resources in their diets and consumes mainly fruits and seeds
401 (Forget 1991; Dubost and Henry 2006).

402 Acouchy occurs only in areas of Amazonian lowland rainforest at Guyana,
403 Suriname, French Guiana, and from northern Amazonas to eastern Acre, Brazil. Weigh
404 around 1.0-1.450 g, dark brown in colour, have a short tail with white hairs at the tip, and
405 use forest areas with dense understory (Emmons and Feer 1990; Jorge 2008). Agouti
406 occurs in Brazil, Guyana, French Guiana, Suriname, and Bolivia. Weigh between 4-5.9
407 kg, have a very short tail (Dubost 1988), and a more frequently use areas with denser
408 understory (Emmons and Feer 1990). Paca occurs from Argentina to Mexico (Emmons
409 and Feer 1990; IUCN 2018), weigh approximately 8 kg (Dubost and Henry 2006), and
410 commonly use places near water (Emmons and Feer 1990). Spiny rats of the genus
411 *Proechimys* spp. are distributed throughout South and Central America. They weigh
412 between 0.15-0.55 kg, and are found in dense subsoil forest area (Emmons and Feer
413 1990).

414 Acouchy and agouti, are diurnal rodents, very similar morphologically, bury
415 seeds for consumption in scarce times of food availability, this behaviour makes them
416 important dispersers (Emmons and Feer 1990). Paca and spiny rat of the genus
417 *Proechimys* are also granivorous rodents, but with nocturnal habits (Emmons and Feer
418 1990).

419

420 **Sample design and data collection**

421 The data analysed is part of the Camera-trap database of the Amazonian Mammals
422 Research Group (GPMA) / National Institute of Amazonian Research (INPA) partnership
423 with the Tropical Ecology, Assessment and Monitoring Network (TEAM). During July
424 2016 to February 2017, 30 Camera-traps, model RM45 Reconyx Inc. were installed in
425 Ducke Reserve. Sampling covered a 60 km² area, traps distributed regularly in
426 RAPELD/PPBio plots (Figure 1) 2 km apart, positioned 30-50 cm above the forest floor,
427 programmed to record images without pauses and remained active for 24 hours according
428 to the Photographic Trapping Sampling Protocol (TEAM 2011).

429

430 **Data analysis**

431 The four caviomorph rodents were analysed separately and in pairs, a diurnal pair
432 consisting of acouchy (*Myoprocta acouchy*) and agouti (*Dasyprocta leporina*) and a
433 nocturnal pair of paca (*Cuniculus paca*) and spiny rat (*Proechimys* spp.). The hour of the
434 records was the daily activity data and presence/absence information of the specie in each
435 point of Camera-trap was occupancy data.

436

437 Daily activity

438 The time records were considered independent if they were taken at least one hour
439 apart (Pratas-Santiago et al. 2017). The daily activity analysis was performed with
440 circular statistics in software Oriana 4.0 (Kovach 2011). We used the Rayleigh (Z) test
441 to test the uniformity of the data. The Mardia-Watson-Wheeler test (Batschelet 1981) for
442 significant difference in daily activity of the caviomorph rodents between dry and rainy
443 periods. We also calculated the overlap between the daily activity of diurnal and nocturnal
444 pairs of caviomorph rodents using Overlap package (Meredith and Ridout 2014) in the
445 R software.

446

447 Occupancy

448 The occupancy is the space use of caviomorph rodents as matrices of
449 presence/absence records and can be a function that includes parameters related to
450 detection probability (p) and occurrence probability (ψ) (Mackenzie et al. 2006).
451 Occupancy analyses used Camera-traps records from August 2016 to January 2017, 3
452 months of the dry season (August, September, and October) and 3 months of the rainy
453 season (November, December, and January). For better convergence of the models we
454 grouped the data on 18 occasions of ten days (Togura et al. 2014). To test the correlation
455 between covariates we perform Pearson correlation test and considered correlated
456 coefficients higher than 50% (Legendre and Legendre 1998) (see Supplementary Data 1).

457 As predictors for detection probability and occurrence probability of the
458 caviomorph rodents we used six covariates: (1) Precipitation, average amount of rain in
459 each occasion, data taken from the Climatological Station of the Adolpho Ducke Forest
460 Reserve in Manaus-AM; (2) Period, dry period (August, September and October) and

rainy period (November, December and January); (3) Number of individuals of four palm species from the PPBio database (Costa et al. 2009), *Astrocaryum acaule*, *Astrocaryum sciophilum*, *Attalea attaleoides* and *Attalea microcarpa*, which are common genera from the diets of the four caviomorph rodent (Silvius and Fragoso 2003; Andreazzi et al. 2009); (4) Height above the nearest drainage (HAND) calculated using Terra Hidro 4.2.2 software (INPE 2016) based on the digital elevation model of the Shuttle Radar Topography Mission (SRTM) from *Earth Explorer United States Geological Survey* (USGS). This topographic measure takes into account the accumulation and direction of water flow in the local drainage network for calculation of the algorithm (Rennó et al. 2008). Is the drainage version normalized by the digital elevation model (Nobre et al. 2011). This covariate is related to the availability of water and altitude. In this work, we use the median of HAND within an area of 150 m radius around each Camera-trap point. The 150 m radius measurement was chosen after analysing models with 50 m, 75 m, 100 m, and 150 m ray sizes for each caviomorph rodent; (5) Distance from nearest deforestation represents the distance between a non-forest area and the Camera-trap point, according to data from the Project for Monitoring Deforestation in the Legal Amazon by Satellite (INPE 2016). This covariate was calculated in Qgis software version 2.18.28 (QGIS 2019) and is related to loss of forest cover by anthropic action; and (6) Relative Abundance Index (RAI), number of predator records divided by the number of days of Camera-trap operation at each point in this sampling. Jaguar and puma were considered predators of acouchy, agouti, and paca, and ocelot and margay predators of spiny rat (Emmons and Feer 1990).

The occupancy analyses were performed in PRESENCE program (Hines 2006), using single season single species models, since we assumed that the occupancy did not vary during the sampling. Hierarchical models were generated in order to estimate detection probability (ρ) and occurrence probability (ψ), parameters within logistic functions (Mackenzie et al. 2006). We construct null models ($\psi(.)$ $p(.)$) and models where we add a covariate at time within each parameter, considering the principle of parsimony (Mackenzie et al. 2006).

The models were ranked according to Akaike's Information Criterion (AICc) (Burnham and Anderson 2002), the variation of the AICc (ΔAICc) indicates the difference between the best model and the model to be evaluated. Thus, the best model

493 has $\Delta\text{AICc} = 0$ and models with ΔAICc values < 2 are considered adjusted models. The
 494 weight of evidence AICc weight (AICcw) represent the relative likelihood of a model.
 495 The beta coefficient represents the relation between the parameter within each model,
 496 detection probability and occurrence probability) and the covariate best ranked. If the
 497 standard error of the beta coefficient overlaps zero indicates uncertainty about the
 498 influence of the covariate, which may be positive or negative.

499 The models were analysed separately and by steps: 1) we investigated the
 500 influence of precipitation and period in detection probability of each caviomorph rodent;
 501 2) the influence of number of individuals of four palm species in occurrence probability;
 502 3) the influence of environmental covariates on the occurrence probability of caviomorph
 503 rodents s; and 4) finally, models with the best ranked covariates in the previous steps.
 504 The covariates were incorporated one by one per model, for each species, the models
 505 were ranked and this ranking indicate which covariates or combination of covariates best
 506 explained the occupancy of the species at the points sampled (Burnham and Anderson
 507 2004). The importance of each covariate for a given parameter, within the best model
 508 ranked, was analysed through the logistic regression coefficient (Mackenzie et al. 2006).

509

510 Co-occurrence

511 For co-occurrence analyses we used single-season two-species models in program
 512 PRESENCE (Mackenzie et al. 2004). We evaluate if the presence of one specie altered
 513 the occupancy of other, and infer about factors affecting the interaction of caviomorph
 514 rodent pairs. We used models which the presence of a dominant specie influences the
 515 subordinate specie. In the present study the dominant species were those with the highest
 516 body weight (French and Smith 2005; Estevo et al. 2017). The co-occurrence between
 517 pairs of caviomorph rodents were analysed using the parameters: pA = probability of
 518 detecting the dominant; pB = probability of detecting the subordinate; rA = probability
 519 of detecting the dominant when both species are present; rBA = probability of detecting
 520 the subordinate when both species are present and the dominant was detected; rBa =
 521 probability of detecting the subordinate when both species are present and the dominant
 522 was not detected. PHI = interaction factor in relation to occurrence; and DELTA =
 523 interaction factor in relation to detection. We analysed 3 models where we assumed that
 524 the detection probabilities of the species were independent ($pA = rA$ and $pB = rBA =$

525 rBa); models where the probability of detection of the subordinate species was influenced
526 by the presence of the dominant ($p_A = r_A$ and $p_B \neq r_{Ba} = r_{BA}$); and models where each
527 species was influenced by the presence and detection of the other ($p_A \neq r_A$ and $p_B \neq r_{Ba}$
528 $\neq r_{BA}$).

529 The covariates in common that were ranked with $\Delta AIC < 2$ on the single-season
530 occupancy models were incorporated in the co-occurrence analyses. To investigate
531 whether the pair of caviomorph rodents coexist expected under a hypothesis of
532 independence, the species interaction factor (PHI for occurrence; DELTA for detection)
533 were analysed. The index value of 1 indicates that caviomorph rodents co-occur
534 randomly. If the value is lower than 1 indicate that the caviomorph rodents co-occur less
535 than expected by random, and if it is larger than 1, they co-occur more than expected by
536 random (Richmond et al. 2010).

537

538 **Results**

539 **Daily activity**

540 The sampling effort of the daily activity was 77,496 hours, with 846 records of
541 the four caviomorphs rodents (acouchy, agouti, paca, and spiny rat). Records were
542 considered independent with at least one hour apart, the records were analysed in dry and
543 rainy periods (Table 1).

544 The Rayleigh tests indicated non-uniform distributions of daily activity for all
545 species in both periods. Acouchy and agouti had crepuscular/diurnal activity, paca and
546 spiny rat had nocturnal activity. Acouchy presented two distinct peaks of activity, in the
547 early morning and late afternoon. The daily activity of agouti also showed two peaks, but
548 was distributed more steadily throughout the day. Paca and spiny rat presented activity
549 peaks at different times. The change in daily activity between dry and rainy periods was
550 more pronounced for paca. the peak of paca activity in dry period occurred in the middle
551 of the night (0 h) and in the rainy period in the early evening (19 h).

552 The Mardia-Watson-Wheeler test showed that the daily activity of caviomorph
553 rodents between dry and rainy periods was not significantly different (see Supplementary
554 Data SD2).The same test the difference of the daily activity between pair of diurnal
555 (acouchy and agouti) and nocturnal (paca and spiny rat) caviomorph rodents between dry

556 and rainy periods. Also showed a significant difference in daily activity between acouchy
557 and agouti in both dry and rainy periods (see Supplementary Data SD3). In circular
558 analyses the mean lengths of each vector indicate whether the time distribution was
559 concentrated or dispersed. Higher vectors indicate higher concentration of activity hours
560 around the mean angle. In fact, the mean vector for acouchy was higher in the rainy
561 period, and for agouti, paca, and spiny rat in the dry period (see Supplementary Data
562 SD4), these results complement the result of the Mardia-Watson-Wheeler test that
563 showed a significant difference in the pair of diurnal species between dry and rainy
564 periods.

565 The overlap coefficient of daily activity (Δ) for the pairs of caviomorph rodents
566 varied between periods. The overlap of acouchy and agouti was $\Delta = 0.52$ (95% CI: 0.44
567 ± 0.59) in dry period and $\Delta = 0.60$ (95% CI: 0.50 ± 0.66) in rainy period. For paca and
568 spiny rat the overlap was $\Delta = 0.70$ (95% CI: 0.50 ± 0.92) in the dry period and $\Delta = 0.62$
569 (95% CI: 0.42 ± 0.89) in the rainy period.
570

571 Occupancy

572 For occupancy analyses 13 Camera-traps were used as sampling during the rainy
573 period damaged seventeen of the 30. We consider records independent with a 24-hour
574 interval between them. Were analysed 249 records in total for the four caviomorph
575 rodents in both periods (Table 2). The results showed models with the period covariate
576 ranked with $\Delta\text{AIC} < 2$ for all caviomorph rodents. The precipitation covariate appeared
577 with $\Delta\text{AIC} < 2$ on models for acouchy (*Myoprocta acouchy*) and spiny rat (*Proechimys*
578 spp) (Table 3).

579 Each caviomorph rodent was influenced by a different environmental covariate
580 (Figure 4). The results indicates a slight positive influence of the nearest deforestation
581 distance on the occurrence probability of acouchy ($\Delta\text{AIC} = 1.86$ and $\text{AIC}_w = 0.1745$);
582 the topography covariate HAND, had a positive influence on the occurrence probability
583 of agouti ($\Delta\text{AIC} = 0$ and $\text{AIC}_w = 0.7698$); the number of *Astrocarym scipophilum*
584 individuals had a negative influence on the occurrence probability of paca ($\Delta\text{AIC} = 0$ and
585 $\text{AIC}_w = 0.6870$); and the number of *Astrocaryum acaule* individuals had a negative
586 influence on the occurrence probability of spiny rat ($\Delta\text{AIC} = 0$ and $\text{AIC}_w = 0.6172$)
587 (Table 4). The beta coefficients for the relations between the occurrence probabilities and

588 covariates best ranked in the models of the four caviomorph rodents did not overlap zero
589 (Figure 5).

590

591 **Co-occurrence**

592 Were investigated the co-occurrence of the diurnal pair of caviomorph rodents.
593 We tested the detection probability of acouchy and agouti due to the high occurrence
594 probability of these rodents in Ducke Reserve. They occur frequently but they were not
595 homogeneous detected on the Camera-trap points. Were used the parameters: pA =
596 probability of detecting agouti; pB = probability of detecting acouchy; rA = probability
597 of detecting agouti when both species are present; rBA = probability of detecting acouchy
598 when both species are present and agouti was detected; rBa = probability of detecting
599 acouchy when both species are present and agouti was not detected. PHI = interaction
600 factor for occurrence probability; and DELTA = interaction factor for detection
601 probability. Were analysed 3 models where we assumed that the detection probability of
602 acouchy and agouti were independent ($pA = rA$ and $pB = rBA = rBa$); models where the
603 probability of detection acouchy was influenced by the presence of agouti ($pA = rA$ and
604 $pB \neq rBa = rBA$); and models where each species was influenced by the presence and
605 detection of the other ($pA \neq rA$ and $pB \neq rBa \neq rBA$). The period covariate appeared in
606 best-ranked models for detection probability of acouchy and agouti, so it was included in
607 the co-occurrence analysis.

608

609 The results indicate that detection probability of agouti in the absence of acouchy
610 (pA) was different from the detection probability of agouti when acouchy was present
611 (rA); the detection probability of acouchy in the absence of agouti (pB) was different
612 from the detection probability of acouchy when both were present and agouti was
613 detected (rBA), and when both were present and agouti was not detected (rBa). The co-
614 occurrence analysis also allowed us to infer about the interaction factors for detection
615 (DELTA). The DELTA was lower than 1 on dry period and rainy period (Tables 6)
616 indicating that acouchy and agouti avoided each other in both periods.

617

Discussion

618 Similar patterns of daily activity were described for caviomorph rodents in
619 tropical forests (Norris et al. 2010; Blake et al. 2012; Pratas-Santiago et al. 2017;
620 Ferreguetti et al. 2018a). Although, our results showed that precipitation regime (rainy
621 and dry periods) affected the daily activity of the rodents in different intensities. The time
622 distribution and the overlap of daily activity of caviomorph rodents changed between dry
623 and rainy periods

624 In the Amazon there is a seasonal difference in precipitation regime that is related
625 to tree phenology, with higher quantities of fruits during rainy periods (Alencar et al.
626 1979; Haugaasen and Peres 2005). The seasonal variation in food availability caused
627 changes in caviomorph rodents home range (Beck-king and Helversen 1999; Silvius and
628 Fragoso 2003) and influenced the reproductive stages of rodents linked to fruiting periods
629 (Bergallo and Magnusson 1999; Dubost and Henry 2006 2017). In this sense, the
630 variations in daily activity overlaps from caviomorph rodents in this study may be related
631 to changes in the time strategy and energy allocation between periods of different
632 availability of food resources.

633 In addition to seasonality, other factors may alter the activity pattern of animal
634 species and should be investigated. For example, lunar activity (Michalski and Norris
635 2011; Pratas-Santiago et al. 2016, 2017) and the influence of human impacts were related
636 to changes in the activity pattern of different mammal species in six continents (Gaynor
637 et al. 2018).

638 The higher detection probability of the rodents in the rainy period indicates they
639 were more recorded by the Camera-traps during this period. This fact can be related to
640 the higher activity of the animals in more productive times with greater diversity and food
641 availability , corroborating other studies that evidenced the influence of seasonality on
642 the use area of caviomorph rodents (Forget 1991; Dubost and Henry 2017).

643 The occurrence probability of acouchy was positively influenced by the distance
644 from the nearest deforestation, the covariate referring to anthropic influence. This result
645 corroborates a study by Emmons and Feer (1990), who describe areas of primary forest
646 as acouchy habitat. As well as Jorge (2008) that showed the negative influence of areas
647 modified by fragmentation on the density of acouchy, suggesting that acouchy
648 preferentially use mature forest areas.

649 The occurrence probability of agouti was positively influenced by the height
650 above the nearest drainage, HAND. This covariate refers to both water resources and
651 altitude, a higher area more distant from the outcrops of water will have a higher HAND
652 value. The positive relationship between HAND and the occurrence probability of agouti
653 suggests a higher occurrence of agouti in higher areas, in the plateaus (Ferreira et al.,
654 2008). Plateaus are areas with higher productively at Ducke Reserve (de Castilho et al.
655 2006), and agouti was related with higher fruit availability areas (Dubost and Henry 2006,
656 Ferreguetti et al. 2018a), facts that can explain this result.

657 The occurrence probability of paca had a negative relation with the quantity of
658 *Astrocaryum sciophilum*, and a negative relationship was also found for spiny rat and the
659 quantity of *Astrocaryum acaule*. These results are unexpected as palm trees are important
660 resources for caviomorph rodents (Silvius and Fragoso 2003, Andreazzi et al. 2009), and
661 the four species of non-stem palms used in this study represent a proxy for food
662 availability (Smythe 1978; Adler 1995; Silvius and Fragoso 2003). A possible
663 explanation for the inverse result could be related to the type of environment, as the
664 composition of palms at Ducke Reserve varies along the topographic gradient, which is
665 associated with changes in soil characteristics (Costa et al. 2005; Schietti et al. 2014). For
666 example, *Astrocaryum sciophilum* is an understory palm specie that occurs on well-
667 drained soils, such as plateau and slope areas, at high altitudes (Kahn and de Castro 1985),
668 whereas paca is often associated with water, which is located in low altitudes (Emmons
669 and Feer 1990; Ferreguetti et al. 2018b). *Astrocaryum acaule* is often found in the
670 understory of transition areas of the forest, associated with poorly drained soils near water
671 bodies (Kahn and de Castro 1985) and also associated with disturbed areas (Ribeiro et al.
672 1999). Spiny rats occur in mature forests (Emmons and Feer 1990) and were positive
673 correlated with trees (Endries and Adler 2005). In this sense, the environmental
674 characteristics seems to be an explanation for the negative correlations between the
675 caviomorph rodents and the palms species.

676 Our results on the influence of environmental characteristics on the occurrence
677 probability of caviomorph rodents add to the importance of topography in the home range
678 for animals (Cintra and Naka 2012; Tavares et al. 2019). They also corroborate studies
679 that related habitat quality and anthropic influence on species distribution (Norris et al.
680 2010; Peres 2011).

681 The results of the co-occurrence analysis for the pair of diurnal species provided
682 evidence for a co-dependent pattern between acouchy and agouti, where the presence of
683 agouti influenced the detection probability of acouchy and vice versa. The interaction
684 factors of the species related to detection (DELTA) were lower than that of the dry and
685 rainy periods, indicating that species avoided each other in both periods. The DELTA in
686 the dry period was even lower than in the rainy period, which indicates higher segregation
687 of the species in the dry period.

688 The overlap in acouchy and agouti daily activities was slightly higher and the
689 species avoided each other less in space in the rainy period. An explanation for this result
690 may be related to the greater availability of resources in the rainy period. Studies have
691 shown that the fruiting of tree species was related to the rainy season (Alencar et al. 1979;
692 Haugaasen and Peres 2005), and fruits and seeds are important items in the acouchy and
693 agouti diet (Forget 1991; Dubost and Henry 2006). Thus, this result may indicate that a
694 greater overlap in daily activity and space of these species is correlated with greater
695 availability of resources.

696 The influence of environmental factors and interspecific interactions on the co-
697 occurrence of congeners of birds and felines indicated that the influence of environmental
698 factors was stronger than the interspecific relationships (Estevo et al. 2017; Nagy-Reis et
699 al. 2017). Our results, however, showed an influence of the interspecific relations in the
700 co-occurrence of acouchy and agouti, even though they were not congeners.

701 Considering that acouchy and agouti avoided themselves in time and space use,
702 associated with the fact that they share food items, there is evidence of niche partitioning.
703 This indicates that competition limits the species in the use of time and space, being more
704 evident in the dry period, a period with less available resources.

705 Variation in precipitation, environmental covariates, and interspecific relations
706 influenced the daily activity and occupancy of acouchy, agouti, paca, and spiny rat in a
707 dry land forest in central Amazonia. These results contribute to the understanding of the
708 distribution, partitioning, and limitations of temporal and spatial niche similarities
709 required for the survival of these caviomorph rodents. Such information is relevant to
710 management plans and conservation of these rodents in protected areas, forest fragments,
711 and areas under anthropic pressure.

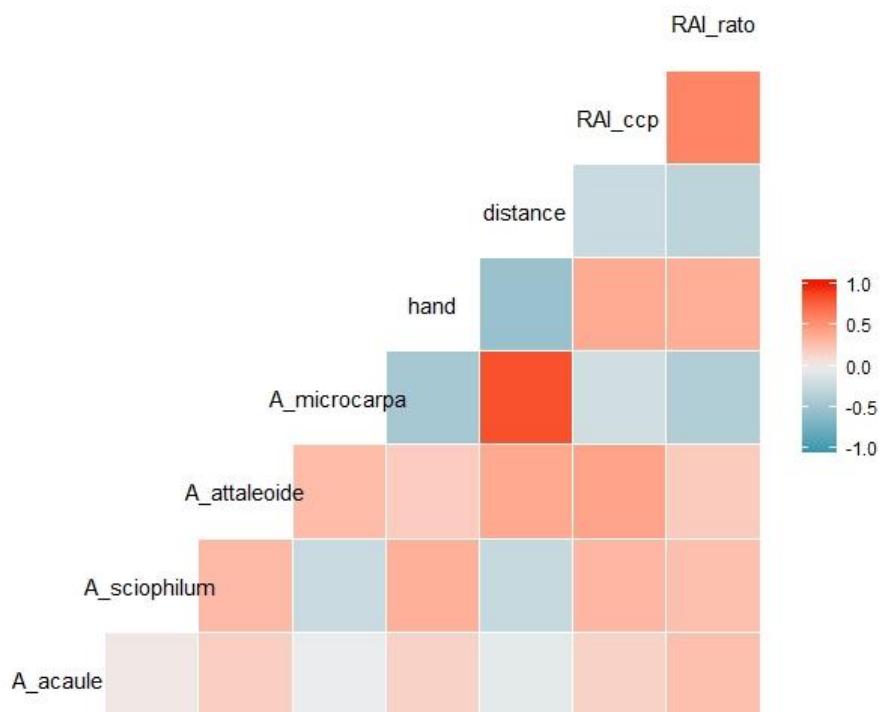
712

713 **Supplementary Data**

714 Supplementary Data SD1. Graph of the Pearson correlations among the covariates
 715 used in occupancy models. A_acaule = individuals of *Astrocaryum acaule* palm per plot;
 716 A_sciophilum = individuals of *Astrocaryum sciophilum* palm per plot; A_attaleoide =
 717 individuals of *Attalea attaleoides* palm per plot; A_microcarpa = individuals of *Attalea*
 718 *microcarpa* palm per plot; hand = median of the HAND within a radius of 150 meters
 719 around the point of the Camera-trap; distance = nearest deforestation distance; RAI_ccp
 720 = relative abundance of acouchy, agouti, and paca predators; rai_rato = relative
 721 abundance of spiny rat predator.

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Covariates correlation



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731 Supplementary Data SD2. Mardia-Watson-Wheeler test to infer for differences between
 732 daily activity of each species of rodents between dry and rainy periods.

Mardia-Watson-Wheeler test	w	p
Period (dry_rainy)		
<i>Myoprocta acouchy</i>	1.85	0.39
<i>Dasyprocta leporina</i>	0.4	0.81
<i>Cuniculus paca</i>	3.47	0.17
<i>Proechimys</i> spp.	0.33	0.84

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735 Supplementary Data SD3. Mardia-Watson-Wheeler test to infer the differences
 736 between daily activity of the pairs of rodent species between dry and rainy periods.

Mardia-Watson-Wheeler test	w	p
<i>M. acouchy_D. leporina</i>		
Dry	117.2	<0.05*
Rainy	63.23	<0.05*
<i>C.paca_Proechimys</i> spp.	w	p
Dry	1.56	0.45
Rainy	2.27	0.32

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738

739 Supplementary Data SD4. Mean lengths of the daily activity of rodent species in
 740 dry and rainy periods.

Length of Mean Vector		
(r)	Dry	Rainy
<i>Myoprocta acouchy</i>	0.172	0.218
<i>Dasyprocta leporina</i>	0.561	0.528
<i>Cuniculus paca</i>	0.753	0.719
<i>Proechimys</i> spp.	0.744	0.665

741

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763 **Figure Legends**

764 Figure 1 - Reference map of the study area (a and b), illustrate the location and access
765 of the Ducke Reserve. The map on the right (c) illustrates the distribution of the traps and
766 the HAND covariates and distance from the nearest deforestation (PRODES).

767

768 Figure 2 - Distribution of daily activity of the four species of caviomorph rodents. A
769 = distribution and overlap of daily activity of the diurnal species pair (*M. acouchy* and *D.
770 leporina*) in the dry period; B = distribution and overlap of the daily activity of the
771 nocturnal species pair (*C. paca* and *Proechimys* spp.) in the dry period; C = distribution
772 and overlapping of the dual activity schedules of diurnal species (*M. acouchy* and *D.
773 leporina*) in the rainy period; D = distribution and overlapping of the daily activity of
774 nocturnal species (*C. paca* and *Proechimys* spp.) in the rainy period.

775

776 Figure 3 - Beta untransformed estimates coefficients and AICw for the parameter
777 detection probability with the period covariate for paca, *Cuniculus paca* (*C. paca*); agouti,
778 *Dasyprocta leporina* (*D. leporina*); acouchy, *Myoprocta acouchy* (*M. acouchy*) and spiny
779 rat *Proechimys* spp. (*Proechimy* spp).

780

781 Figure 4 - Graphs of the relationships between the parameter occurrence probability
782 and the environmental covariates best ranked in the fourth step of the analysis for each
783 rodent. (a) Occurrence probability of *Myoprocta acouchy* and distance from the nearest
784 deforestation in meters; (b) Occurrence probability of *Dasyprocta leporine* and height
785 above the nearest drainage (HAND); (c) Occurrence probability of *Cuniculus paca* and
786 individuals of *Astrocaryum sciophilum* in the plot; (d) Occurrence probability of
787 *Proechimys* spp. and individuals of *Astrocaryum acaule* in the plot.

788

789 Figure 5 - Untransformed Estimates of coefficients for covariates (Beta's) and AICw
790 of the relationship between the occurrence probabilities of the four species of caviomorph
791 rodents with the respective covariates best ranked in the models. Paca, *Cuniculus paca*
792 (*C.paca*) and individuals of *Astrocaryum sciophilum* per plot; agouti, *Dasyprocta*
793 *leporine* (*D. leporina*) and HAND; acouchy, *Myoprocta acouchy* (*M. acouchy*) and

794 nearest deforestation distance; and spiny rat *Proechimys* spp. (*Preochimys* spp.) and
795 individuals of *Astrocaryum acaule* per plot.

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1001 Tables

1002 Table 1 - Number of independent picture records (one-hour interval between
 1003 records) of the four species of caviomorph rodents, in the dry (N_dry), and rainy
 1004 (N_rainy) and total (N_total) periods, in the Ducke Reserve, Amazonas, Brazil. These
 1005 records were used in the daily activity analysis.

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Species	N_dry	N_rainy	N_total
(<i>Myoprocta acouchy</i>)	274	202	476
(<i>Dasyprocta leporina</i>)	151	148	299
(<i>Cuniculus paca</i>)	14	21	35
(<i>Proechimys</i> spp.)	23	13	34
Total	462	386	846

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1008

1009 Table 2 - Number of independent picture records (one-hour interval between
 1010 records) of the four species of caviomorph rodents, in the dry (N_dry), and rainy
 1011 (N_rainy) and total (N_total) periods, in the Ducke Reserve, Amazonas, Brazil. Used in
 1012 occupancy analysis.

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Species	N_dry	N_rainy	N_total
<i>Myoprocta acouchy</i>	65	68	133
<i>Dasyprocta leporina</i>	36	53	89
<i>Cuniculus paca</i>	2	11	13
<i>Proechimys</i> spp.	7	7	14
Total	110	139	249

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1020 Table 3 - Single season single species models of occupancy used to verify the influence
 1021 of precipitation and period on the detection probability of the caviomorph rodents (first
 1022 step). N_par. = number of parameters; Model_lik. = model likelihood; $\psi(\cdot)\rho(\cdot)$ = null
 1023 model.

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<i>Myoprocta acouchy</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2^*loglik$
$\psi(\cdot)\rho(\cdot)$	280.96	0	0.5366	2	1	276.96
$\psi(\cdot)\rho(\text{precipitation})$	282.45	1.49	0.2548	3	0.4747	276.45
$\psi(\cdot)\rho(\text{period})$	282.85	1.89	0.2086	3	0.3887	276.85
<i>Dasyprocta leporina</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2^*loglik$
$\psi(\cdot)\rho(\text{period})$	277.48	0	0.6425	3	1	271.48
$\psi(\cdot)\rho(\text{precipitation})$	279.8	2.32	0.2014	3	0.3135	273.8
$\psi(\cdot)\rho(\cdot)$	280.31	2.83	0.1561	2	0.2429	276.31
<i>Cuniculus paca</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2^*loglik$
$\psi(\cdot)\rho(\text{period})$	93.88	0	0.8495	3	1	87.88
$\psi(\cdot)\rho(\text{precipitation})$	98.48	4.6	0.0852	3	0.1003	92.48
$\psi(\cdot)\rho(\cdot)$	99.01	5.13	0.0653	2	0.0714	95.01
<i>Proechimys spp.</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2^*loglik$
$\psi(\cdot)\rho(\cdot)$	102.67	0	0.5005	2	1	98.67
$\psi(\cdot)\rho(\text{precipitation})$	103.6	0.93	0.3144	3	0.6281	97.6
$\psi(\cdot)\rho(\text{period})$	104.6	1.99	0.1851	3	0.3697	98.66

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1034 Table 4 - Table with the sinlge-season single species models of the fourth step of
 1035 the analyses, for inference on the occupancy of the four species of rodent cavimorfes. Ψ
 1036 = probability of occurrence; ρ = probability of detection. Where period = period; distance
 1037 = nearest deforestation distance; hand = height above the nearest drainage; rai_predator
 1038 = relative abundance of predator; and the number of palm individuals from each palm
 1039 species = *Astrocaryum sciophilum*, *Astrocaryum acaule*, *Attalea attaleoides*, and *Attalea*
 1040 *microcarpa*. N_par. = number of parameters of each model; Model_lik. = Model
 1041 likelihood.

<i>Myoprocta acouchy</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2*\loglik$
$\psi(\cdot)\rho(\cdot)$	280.96	0	0.4423	2	1	276.96
$\psi(\text{distance})\rho(\text{period})$	282.82	1.86	0.1745	4	0.3946	274.82
$\psi(\text{Attalea microcarpa})\rho(\text{period})$	283.82	2.86	0.1059	4	0.2393	275.82
$\psi(\text{Astrocaryum acaule})\rho(\text{period})$	284.51	3.55	0.075	4	0.1695	276.51
$\psi(\text{Attalea attaleoides})\rho(\text{period})$	284.6	3.64	0.0717	4	0.162	276.6
$\psi(\text{Astrocaryum sciophilum})\rho(\text{period})$	284.78	3.82	0.0655	4	0.1481	276.78
$\psi(\text{hand})\rho(\text{period})$	284.79	3.83	0.0652	4	0.1473	276.79
<i>Dasyprocta leporina</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2*\loglik$
$\psi(\text{hand})\rho(\text{period})$	274.32	0	0.7698	4	1	266.32
$\psi(\text{Astrocaryum acaule})\rho(\text{period})$	279.15	4.83	0.0687	4	0.0894	271.15
$\psi(\text{Attalea attaleoides})\rho(\text{period})$	279.25	4.93	0.0654	4	0.085	271.25
$\psi(\text{Astrocaryum sciophilum})\rho(\text{period})$	279.47	5.15	0.0586	4	0.0762	271.47
$\psi(\cdot)\rho(\cdot)$	280.31	5.99	0.0385	2	0.05	276.31
<i>Cuniculus paca</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2*\loglik$
$\psi(\text{Astrocaryum sciophilum})\rho(\text{period})$	91.85	0	0.687	4	1	83.85
$\psi(\text{rai_predator})\rho(\text{period})$	95.57	3.72	0.1069	4	0.1557	87.57
$\psi(\text{hand})\rho(\text{period})$	95.81	3.96	0.0949	4	0.1381	87.81
$\psi(\text{distance})\rho(\text{period})$	95.87	4.02	0.0921	4	0.134	87.87
$\psi(\cdot)\rho(\cdot)$	99.01	7.16	0.0192	2	0.0279	95.01
<i>Proechimys spp.</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2*\loglik$
$\psi(\text{Astrocaryum acaule})\rho(\text{period})$	99.7	0	0.6172	4	1	91.74
$\psi(\text{distance})\rho(\text{period})$	102.55	2.81	0.1514	4	0.2454	94.55

$\psi(\cdot)\rho(\cdot)$	102.67	2.93	0.1426	2	0.2311	98.67
$\psi(\text{rai_predator})\rho(\text{period})$	103.62	3.88	0.0887	4	0.1437	95.62

1042 Table 5 - Table with single season two species models ranked lower for co-
 1043 occurrence of pairs of diurnal species, agouti (*Dasyprocta leporina*) and acouchy
 1044 (*Myoprocta acouchy*). N_par. = number of parameters of each model; Model_lik. =
 1045 Model likelihood.

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<i>D. leporina</i> _ <i>M. acouchy</i>	AIC	ΔAIC	AICweight	N_par.	Model_lik.	$-2^*\loglik$
pA≠rA and pB≠rBA≠rBa + period	562.81	0	0.5943	9	1	544.81
pA≠rA and pB≠rBA≠rBa	564.74	1.93	0.2264	8	0.381	548.74
pA=rA and pB≠rBA=rBa + period	566.38	3.57	0.0997	9	0.1678	548.38
pA=rA and pB=rBA=rBa + period	567.7	4.89	0.0515	9	0.0867	549.7
pA=rA and pB=rBA=rBa	568.92	6.11	0.028	8	0.0471	552.92
pA=rA and pB≠rBA=rBa	1426.41	863.6	0	8	0	1410.41

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1067 Table 6 - Table with the results of probabilities of occurrence (psi) and detection
 1068 (p and r) in the co-occurrence analysis between agouti (*Dasyprocta leporina*) and acouchy
 1069 (*Myoprocta acouchy*).
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<i>D. leporina _ M. acouchy</i>	Probabilities
psiA	0.86
psiBA	0.9
psiBa	1
Dry	
pA	0.4752
rA	0.4053
pB	0.688
rBA	0.5029
rBa	0.6424
Rainy	
pA	0.5776
rA	0.5072
pB	0.769
rBA	0.6043
rBa	0.7306
PHI	0.9849
DELTA dry	0.8584
DELTA rainy	0.9067

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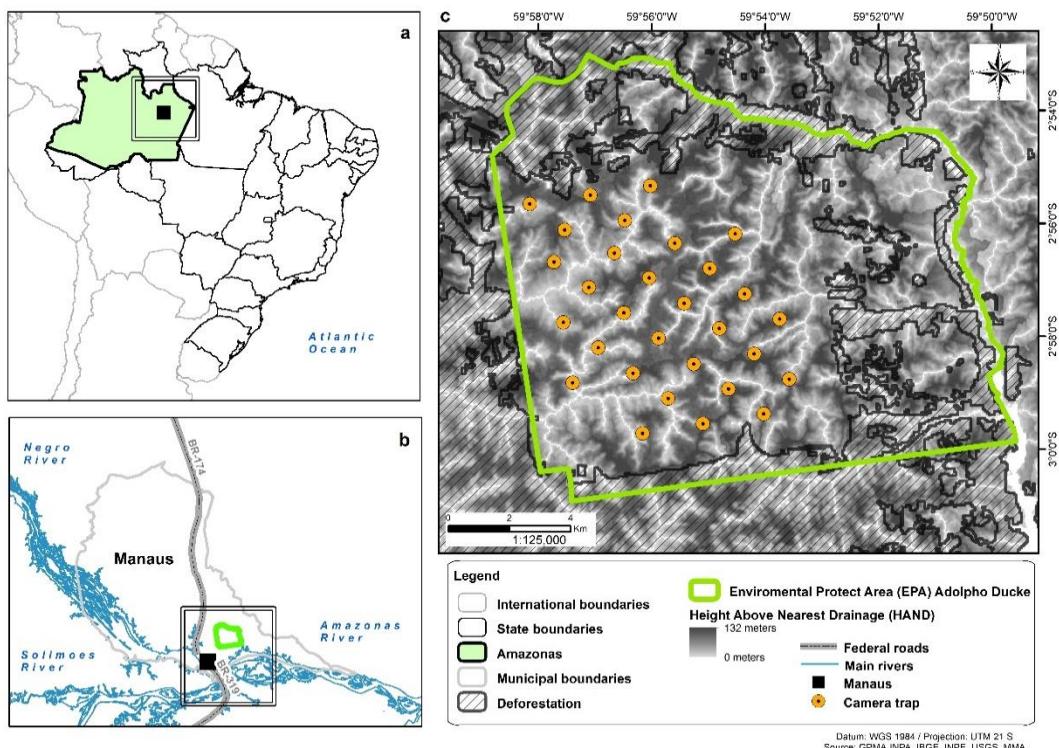
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1078 Figure 1

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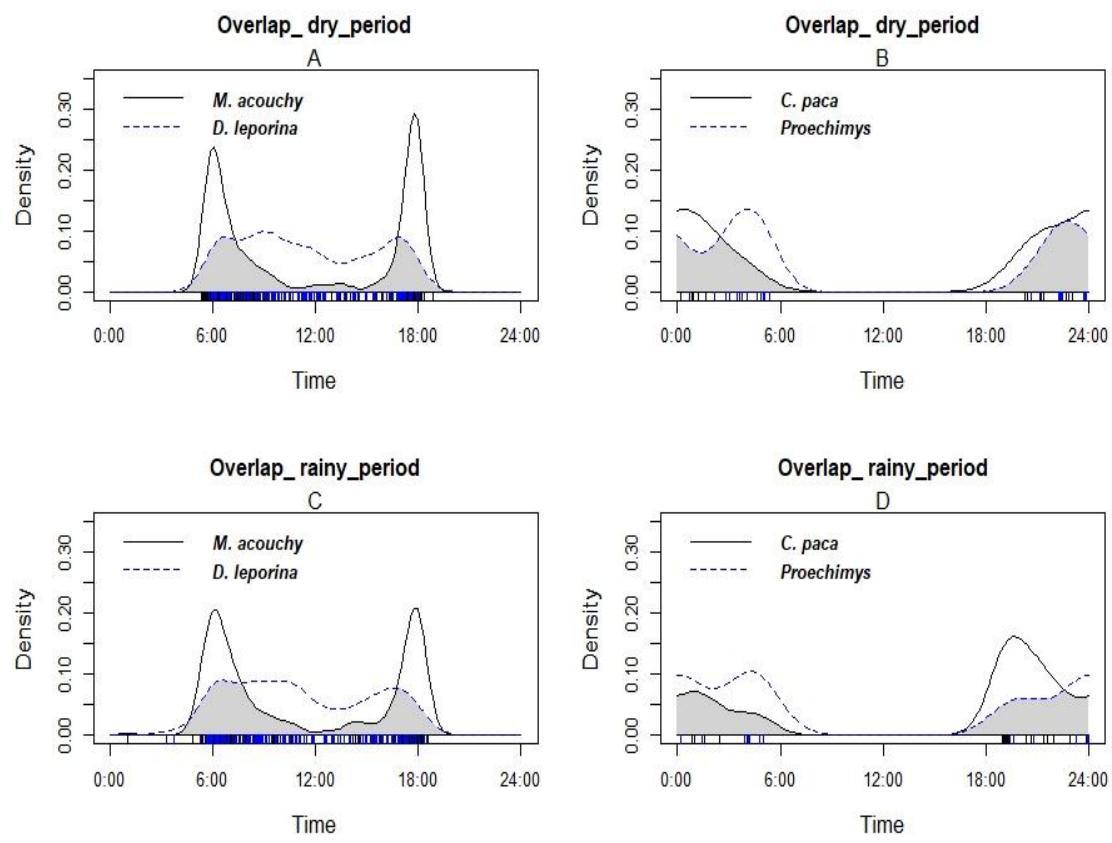
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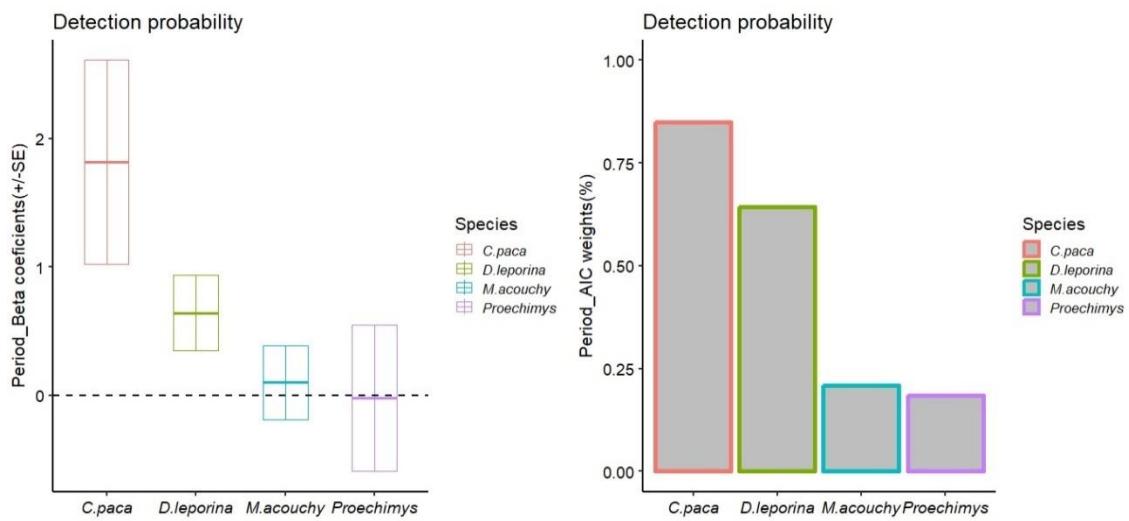
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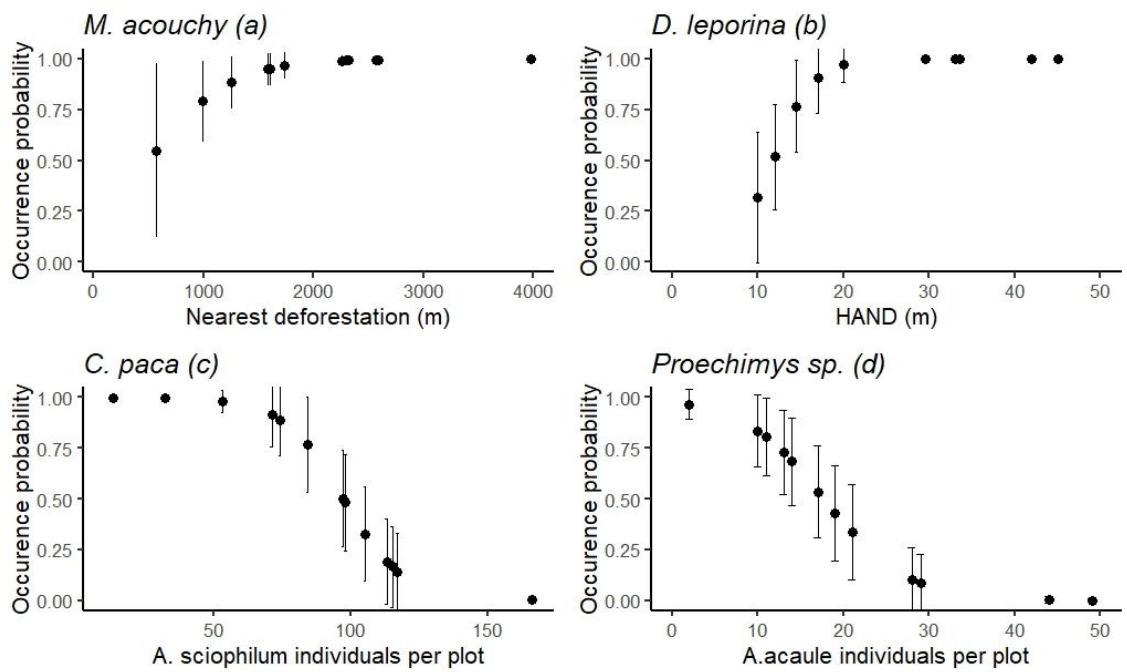
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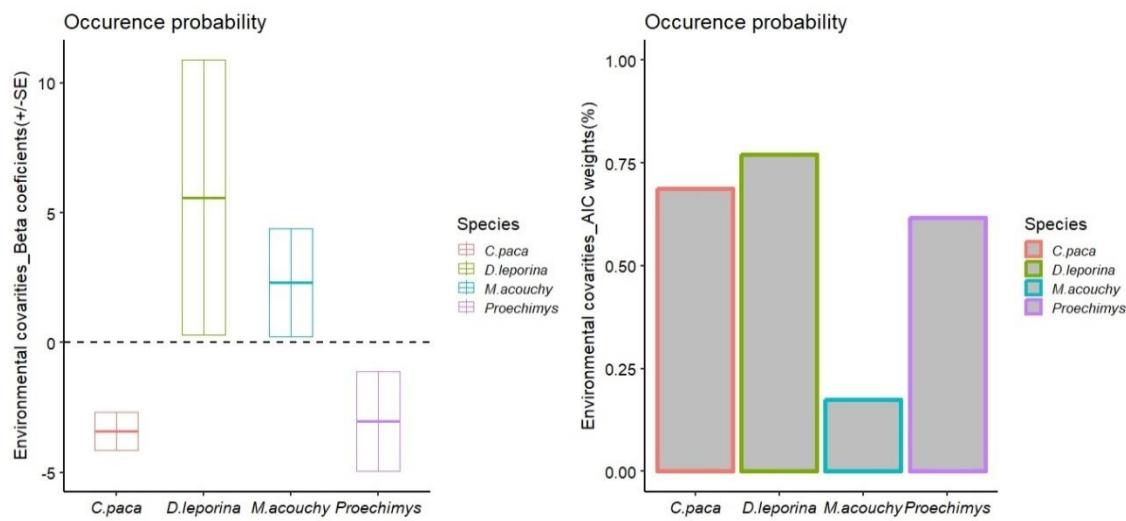
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1154 Figure 5



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1176 Conclusão

1177 Os resultados obtidos neste estudo mostraram tendência para a influência da
1178 variação de precipitação no comportamento dos roedores caviomorfos. Houve mudança
1179 no pico de atividade dos roedores entre os períodos seco e chuvoso, alteração do pico de
1180 atividade de pacá (*Cuniculus paca*) entre os períodos. A covariável período também
1181 influenciou a probabilidade de detecção dos roedores caviomorfos, corroborando
1182 parcialmente com nossas previsões que sugeriram que alterações ambientais
1183 relacionadas a diferenças de precipitação podem ser importantes no uso e, consequente,
1184 compartilhamento de recursos entre as espécies de roedores cavimorfos na área
1185 estudada. Cada espécie de roedor caviomorfo foi influenciada por pelo menos uma das
1186 covariáveis ambientais. A sobreposição de cerca de 50% nos horários de atividade,
1187 junto com os de coocorrência, sugerem que as espécies de roedores cutia e cutiara se
1188 evitam no espaço, indicando a existência de nichos temporal e espacial entre elas.

1189 Os resultados podem ser vistos como uma contribuição na investigação da
1190 influência da precipitação na alteração do ambiente, e como essa variação pode
1191 interferir nos padrões ecológicos relacionados a limitação das semelhanças dessas
1192 espécies. Onde a longo prazo inferências referentes a influência da precipitação e
1193 variáveis ambientais no comportamento das espécies diante da sazonalidade possam ser
1194 feitas. As quais serão úteis em discussões e tomadas de decisão em planos de manejo e
1195 conservação das espécies estudadas em áreas com diferentes pressões antrópicas e
1196 ambientais na Amazônia.

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BRASIL
 GOVERNO FEDERAL

PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA

ATA DA DEFESA PÚBLICA DA
 DISSERTAÇÃO DE MESTRADO DO
 PROGRAMA DE PÓS-GRADUAÇÃO EM
 ECOLOGIA DO INSTITUTO NACIONAL
 DE PESQUISAS DA AMAZÔNIA.

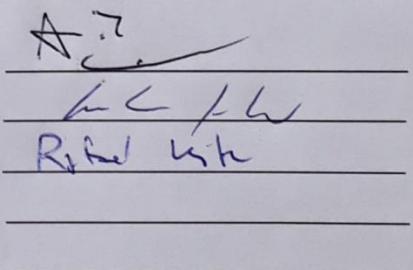
Aos 15 dias do mês de julho do ano de 2019, às 14h00min, no Auditório da Biblioteca, Campus I, INPA/ALEIXO. Reuniu-se a Comissão Examinadora de Defesa Pública, composta pelos seguintes membros: o(a) Prof(a). Dr(a). **Adrian Paul Ashton Barnett**, do Instituto Nacional de Pesquisas da Amazônia – INPA, o(a) Prof(a). Dr(a). **Marcelo Gordo**, da Universidade Federal do Amazonas - UFAM, e o(a) Prof(a). Dr(a). **Rafael do Nascimento Leite**, do Instituto Nacional de Pesquisas da Amazônia – INPA, tendo como suplentes o(a) Prof(a). Dr(a). Albertina Pimentel Lima, do Instituto Nacional de Pesquisas da Amazônia – INPA, e o(a) Prof(a). Dr(a). William Ernest Magnusson, do Instituto Nacional de Pesquisas da Amazônia – INPA sob a presidência do(a) primeiro(a), a fim de proceder a arguição pública do trabalho de **DISSERTAÇÃO DE MESTRADO** de **JULIANA COSTA RENNÓ**, intitulado: " HORÁRIO DE ATIVIDADE E OCUPAÇÃO DE ROEDORES CAVIOMORFOS EM UMA FLORESTA DE TERRA FIRME AMAZÔNICA", orientado(a) pelo(a) Prof(a). Wilson Roberto Spironello, do Instituto Nacional de Pesquisas da Amazônia – INPA.

Após a exposição, o(a) discente foi arguido(a) oralmente pelos membros da Comissão Examinadora, tendo recebido o conceito final:

APROVADO(A) REPROVADO(A)
 POR UNANIMIDADE POR MAIORIA

Nada mais havendo, foi lavrada a presente ata, que, após lida e aprovada, foi assinada pelos membros da Comissão Examinadora.

Prof(a).Dr(a). ADRIAN PAUL ASHTON BARNETT
 Prof(a).Dr(a). MARCELO GORDO
 Prof(a).Dr(a). RAFAEL DO NASCIMENTO LEITE
 Prof(a).Dr(a). ALBERTINA PIMENTEL LIMA
 Prof(a).Dr(a). WILLIAM ERNEST MAGNUSSON


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