

- Márquez-Monter, H., Fuentes-Orozco, R., Correa-Lemus, I. e Becker, I. 1991. Invasive amebiasis in a spider monkey (*Ateles geoffroyi*). Case report and a short review of the literature of amebiasis in non-human primates. *Arch. Invest. Med. (Mex.)* 22: 75–78.
- Monteiro, S. G. 2007. *Parasitologia Veterinária* (UFSM), Santa Maria.
- Pereira, F. V. 2020. Prevalência e distribuição espacial da ocorrência de helmintos em primatas não humanos de vida livre no estado do Rio de Janeiro, Brasil. *Arq. Bras. Med. Vet. e Zootec.* 72: 1705–1712. Website: <https://doi.org/10.1590/1678-4162-11868>.
- Ravetta, A. e Ferrari, S. 2009. Geographic distribution and population characteristics of the endangered white-fronted spider monkey (*Ateles marginatus*) on the lower Tapajós River in central Brazilian Amazonia. *Primates* 50: 261–268. Website: <https://doi.org/10.1007/s10329-009-0146-1>.
- Rondón, S., Cavallero, S., Renzi, E., Link, A., González, C. e D'Amelio, S. 2021. Parasites of Free-Ranging and Captive American Primates: A Systematic Review. *Microorganisms* 9: 2546. Website: <https://doi.org/10.3390/microorganisms9122546>.
- Rosado-García, F. M., Guerrero-Flórez, M., Karanis, G., Hinojosa, M. D. C. e Karanis, P. 2017. Water-borne protozoa parasites: The Latin American perspective. *Int. J. Hyg. Environ. Health* 220: 783–798. Website: <https://doi.org/10.1016/j.ijheh.2017.03.008>.
- Ryan, U. e Hijjawi, N. 2015. New developments in *Cryptosporidium* research. *Int. J. Parasitol.* 45: 367–373.
- Silva, R. T. V. 2021. Partição espacial de nicho por três espécies de primatas amazônicos em um fragmento florestal urbano. Dissertação de mestrado, Universidade Federal de Mato Grosso, Mato Grosso, Brasil.
- Snak A., Silveira Delgado, L. E. e Osaki, S. C. 2019. *Cryptosporidium parvum* in captive primates of Parque Municipal Danilo Galafassi, Paraná, Brazil. *Semin. Cienc. Agrar.* 40: 987–992.
- Verweij, J. J., Vermeer, J., Brien, E. A., Blotkamp, C., Laeijendecker, D., van Lieshout, L. e Polderman, A. M. 2003. *Entamoeba histolytica* infections in captive primates. *Parasitol. Res.* 90: 100–103. Website: <https://doi.org/10.1007/s00436-002-0808-z>.

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MIXED GROUP FORMATION AMONG ATELIDAE (GREY, 1825) SPECIES IN THE SOUTHERN AMAZON

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Introduction

The Amazon rainforest is the most biodiverse tropical forest in the world (Silva et al., 2005). It is severely threatened by anthropogenic activities that cause fragmentation and habitat loss (Montibeller et al., 2020; Gusmão et al., 2021). Many areas within the Amazonian so-called “arc of deforestation”, such as in the state of Rondônia, Brazil (Ferreira et al., 2005), lack information on aspects of their primate populations (Ferrari, 1992; van Roosmalen et al., 2002; Gusmão et al., 2021). Associations between two or more species of platyrrhines can be brief encounters for activities such as feeding, or prolonged encounters lasting from hours to days that may provide advantages to species, including increased foraging efficiency and reduced risk of predation (Pontes, 1997; Stensland et al., 2003; Haugaasen et al., 2009). Some associations between primate species are fairly common, such as mixed groups of robust capuchin monkeys (*Sapajus* spp.) and squirrel monkeys (*Saimiri* spp.) (Pontes, 1997; Haugaasen and Peres, 2009). However, associations involving the Atelidae are less common (Haugaasen et al., 2009; Alves et al., 2015a; Cristóbal-Azkarate et al., 2015). Here we report observations of associations between black-faced black spider monkeys (*Ateles chamek*, Humboldt, 1812), Purús red howler monkeys (*Alouatta seniculus puruensis*, Lönnberg, 1941) and Geoffroy’s woolly monkeys (*Lagothrix lagotricha cana* E. Geoffroy, 1812) in fragmented Amazonian forests in eastern Rondônia, Brazil.

Material and Methods

Our observations were made in forest fragments in eastern Rondônia, Brazil, along the Ji-Paraná River. Habitat in the area is open rainforest (RADAM BRASIL, 1978), with large trees (> 25 m) surrounded by a matrix of pasture. Climate is tropical humid, classified as megathermal Aw with a dry season from May to October, and rainy season from November to April. Average annual precipitation is 1,962 mm, and the average temperature is 26 °C (Alvares et al., 2014).

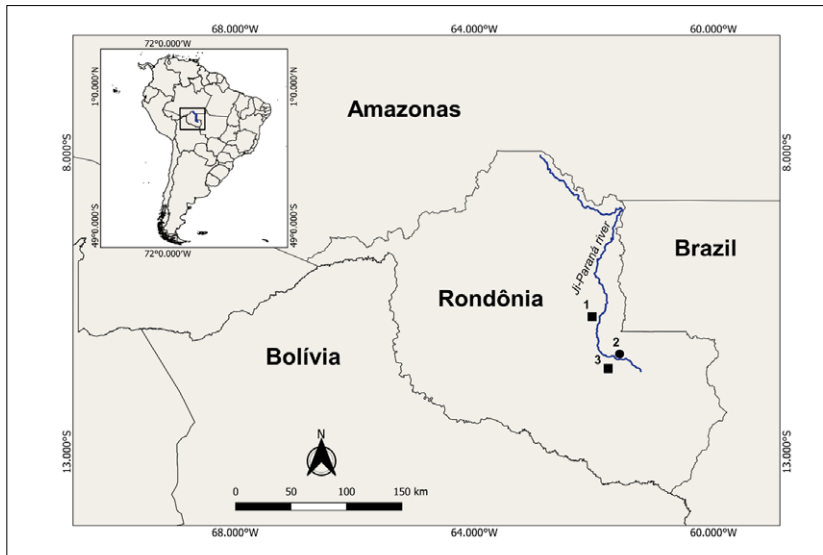


Figure 1. Map of the State of Rondônia with the locations of observations of interspecific associations between primates. Black squares indicate sites with associations between *Ateles chamek* and *Alouatta seniculus puruensis*. The black circle indicates the association between *A. chamek*, *A. s. puruensis* and *Lagothrix lagothricha cana*. The numbers corresponding to the locations are listed in Table 1.

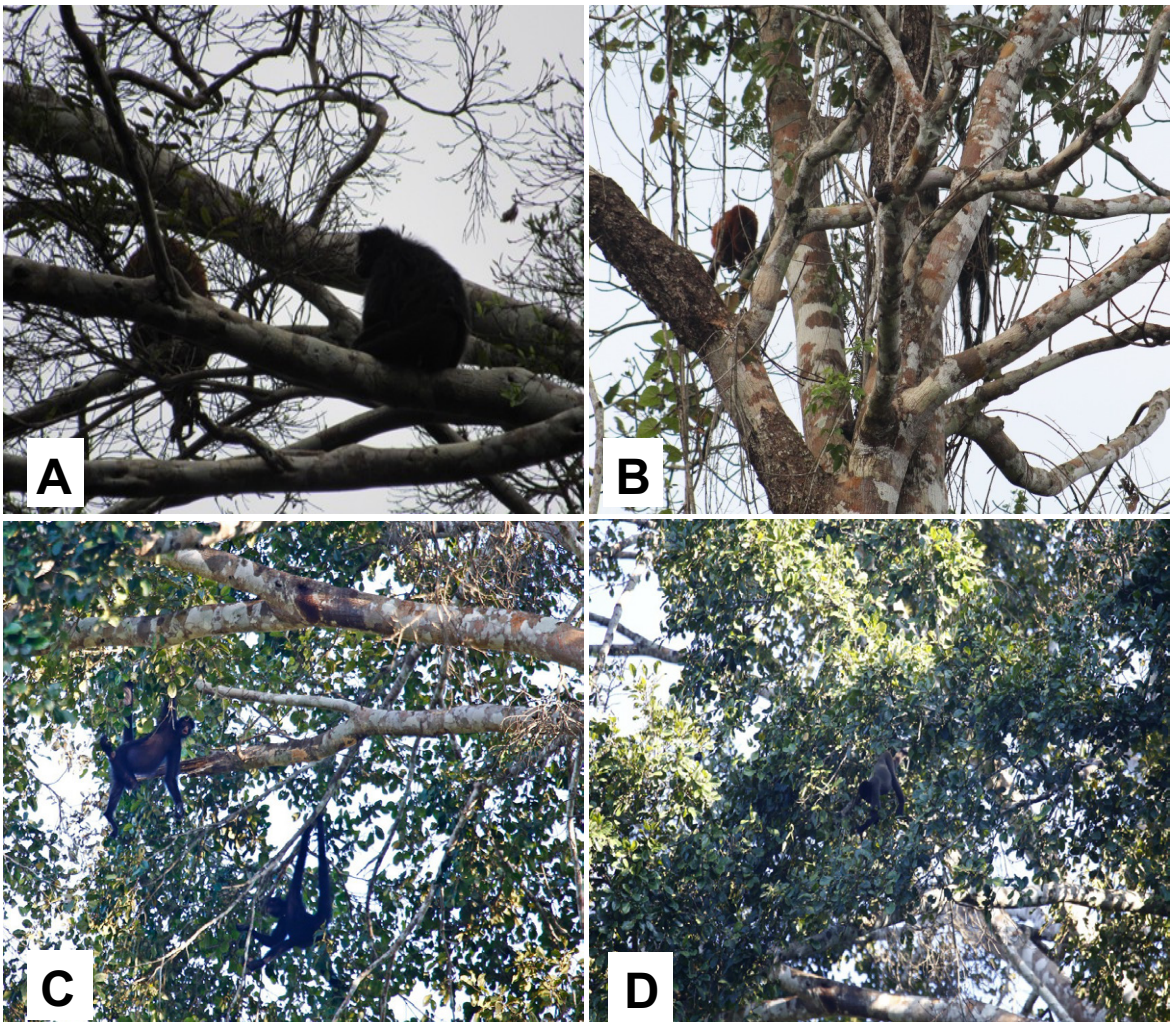


Figure 2. Individuals of *Ateles chamek* and *Alouatta seniculus puruensis* in association photographed in a forest remnant in (A) Ji-Paraná and (B) Rolim de Moura, Rondônia, Brazil. (C and D): Association between *A. seniculus puruensis*, *A. chamek* and *Lagothrix lagothricha cana* in Cacoal, Rondônia. Photos: L.G.A.G. and C.A.T.

Table 1. Associations between *Ateles chamek*, *Alouatta seniculus puruensis*, and *Lagothrix lagotricha cana* recorded in the state of Rondônia, Brazil.

Area	Area size (ha)	Event	Year	Locality	Latitude	Longitude	Method
Area 1	76.6	Event 1	2022	Ji-Paraná	10°44'32.4"S	62°01'53.1"W	Linear Transect
Area 1	76.6	Event 2	2022	Ji-Paraná	10°44'26.1"S	62°01'52.7"W	Linear Transect
Area 2	261	Event 3	2020	Cacoal	11°21'45.0"S	61°34'16.5"W	Opportunistic observation
Area 3	24.8	Event 4	2019	Rolim de Moura	11°36'13.9"S	61°45'44.8"W	Opportunistic observation

We observed the association events during a field expedition to a 76.6 ha forest fragment in the city of Ji-Paraná. We carried out 30 hours of line transect samples following standardized methodology (Peres, 2009). We also made opportunistic observations in a 261-ha fragment in the city of Cacoal and a 24.8 ha fragment in Rolim de Moura, Rondônia. During observations we recorded the behavior of each species, their height in the trees and the distance between the species with the aid of an optical range finder (NORM, model LR0600P) with binocular accuracy. We identified species through photographic records and compared them with diagnoses and illustrations available in the literature (Lima et al., 2015).

Results

On 28 March 2022 at 15:30h in Ji-Paraná, we observed one individual of *Ateles chamek* and one individual of *Alouatta seniculus puruensis* (Figure 1) eating leaves of a *Ficus* sp. (Moraceae). Both individuals were on the same tree branch, at a height of 25 m, and at a distance of ~1 m from each other. Two days later in the same area, at 9:10h, we observed two individuals of *A. chamek* and one *A. s. puruensis* at a height of 30 and 25 m, respectively. On this occasion, the species kept a distance of five meters from each other, while foraging on the leaves of an *Attalea speciosa* (Arecaceae).

We observed another association in the municipality of Rolim de Moura, on 10 February 2019 at 16:00h. During this event we observed one individual of *Ateles chamek* and one *Alouatta seniculus puruensis* foraging in the same tree at a height of 20 m, and at a distance of ~1 m from each other. In another event, on 23 March 2020 at 15:30h in the municipality of Cacoal, five individuals of *Ateles chamek*, three of *A. s. puruensis* and three of *Lagothrix lagotricha cana*, were observed feeding on *Ficus* sp. at a height of 25 m (Table 1).

Discussion

Interspecific associations involving *Ateles* are generally rare (Haugaasen and Peres, 2009; Alves et al., 2015a; Rosero et al., 2019). In the Guaporé Biological Reserve, Rondônia, associations between *Ateles chamek*, *Sapajus apella*, and *Pithecia mittermeieri* have been reported

(Alves et al., 2015a). Pontes et al. (1997) reported associations between *Ateles belzebuth* and *Alouatta seniculus* on Maracá Island, in the northeast of the Brazilian Amazon. However, based on association events described in different studies (Pontes, 1997; Haugaasen and Peres, 2009; Cristóbal-Azkarate et al., 2015; Rosero et al., 2019), this is the first report describing association between *A. chamek* and *A. s. puruensis*.

In the wake of forest fragmentation and habitat loss, species may adapt their ecological and behavioral responses to survive in these altered environments (Schwitzer et al., 2011; Marsh et al., 2013). Reduced habitat availability leads to increased opportunities for inter-specific encounters during daily activities, thus increasing the chance of associations (Rosero et al., 2019). *Ateles chamek*, *Alouatta seniculus puruensis* and *Lagothrix lagotricha cana* are all classified as Endangered on the IUCN Red List (2022). More studies are needed about the ecological niche of each species, as well as the consequences of fragmentation and habitat loss on interspecific associations.

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References

- Alvares, C. A., Stape, J. L., Sentelhas, P. C., Gonçalves, J. D. M. and Sparovek, G. 2014. Köppen's climate classification map for Brazil. *Meteorol. Z.* 22(6): 711–728.
- Alves, S. L., Ravetta, A. L., Paim, F. P., Messias, M. R., Calouro, A. M. and Rylands, A. B. 2015a. Avaliação do Risco de Extinção de *Ateles chamek* (Humboldt, 1812) no Brasil. Processo de avaliação do risco de extinção da fauna brasileira. ICMBio/MMA, Brasília.
- Alves, S. L., Bicca-Marques, J. C., Calouro, A. M. and Rylands, A. B. 2015b. Avaliação do Risco de Extinção de *Alouatta puruensis* Lönnberg, 1941 no Brasil. Processo de avaliação do risco de extinção da fauna brasileira. ICMBio/MMA, Brasília.
- Cristóbal-Azkarate, J., Urbani, B. and Asensio, N. 2015. Interactions of howler monkeys with other vertebrates: A review. In: *Howler Monkeys: Behavior, Ecology, and Conservation*, M. M. Kowalewski, P. A. Garber, L. Cortés-Ortiz, B. Urbani and D. Youlatos (eds.), pp.141–164. Springer, New York.
- Ferrari, S. F. 1992. New data on the distribution of primates in the region of the confluence of the Jiparaná and Madeira rivers in Amazonas and Rondônia, Brazil. *Goeldiana Zool.* 11: 1–12.
- Gusmão, A. C., Evangelista-Vale, J. C., Pires-Oliveira, J. C., Barnett, A. A. and da Silva, O. D. 2021. New records and modelling the impacts of climate change on the black-tailed marmosets. *PLOS One* 16(9): e0256270.
- Haugaasen, T. and Peres, C. A. 2009. Interspecific primate associations in Amazonian flooded and unflooded forests. *Primates* 50(3): 239–251.
- IUCN. 2022. The IUCN Red List of Threatened Species. Version 2022-1. Website: <https://www.iucnredlist.org/>. Accessed 20 July 2022.
- Lima, M. L., Raices, D. S. L., Martins, J. V. F., Sampaio, R., Laranjeira, T. O. and Constantino, P. A. L. 2015. *Monitoramento da Biodiversidade: Região 5 – Guia de Identificação de Espécies Alvo de Aves e Mamíferos*. ICMBio/MMA, Brasília.
- Marsh, L. K. 2014. A taxonomic revision of the saki monkeys, *Pithecia* Desmarest, 1804. *Neotrop. Primates* 21(1): 1–165.
- Montibeller, B., Kmoch, A., Virro, H., Mander, Ü. and Uuemaa, E. 2020. Increasing fragmentation of forest cover in Brazil's Legal Amazon from 2001 to 2017. *Sci. Rep.* 10(1): 1–13.
- Peres, C.A. 1999. General guidelines for standardizing line-transect surveys of tropical forest primates. *Neotrop. Primates* 7(1): 11–16.
- Pontes, A. R. M. 1997. Habitat partitioning among primates in Maracá island, Roraima, northern Brazilian Amazonia. *Int. J. Primatol.* 18(2): 131–157.
- RADAMBRASIL. 1978. Geologia; geomorfologia, pedologia, vegetação, uso potencial da terra. Vols. 1–34. Departamento Nacional de Produção Mineral, Brasília.
- Rosero, P. M., Shanee, S., Burneo, S., Fuentes, N., Cortés, F. A., Obando, M. and Tirira, G. 2019. Prolonged inter-specific association between *Ateles fusciceps fusciceps* and *Alouatta palliata aequatorialis* (Atelidae) in a forest fragment in North Western Ecuador. *Neotrop. Primates* 25(1): 11–20.
- Silva, J. M. C., Rylands, A. B. and Fonseca, G. A. B. 2005. The Fate of the Amazonian Areas of Endemism. *Conserv. Biol.* 19(3): 689–94.
- Schwitzer, C., Glatt, L., Nekaris, K. A. I. and Ganzhorn, J. U. 2011. Responses of animals to habitat alteration: an overview focussing on primates. *End. Species Res.* 14: 31–38.
- Stensland, E., Angerbjorn, A. and Berggren, P. 2003. Mixed species groups in mammals. *Mammal Rev.* 33(3–4): 205–223.
- van Roosmalen, M. G. M., van Roosmalen, T. and Mittermeier, R. A. 2002. A taxonomic review of the titi monkeys, genus *Callicebus* Thomas, 1903, with the description of two new species, *Callicebus bernhardi* and *Callicebus stephennashi*, from Brazilian Amazonia. *Neotrop. Primates* 10: 1–52.