Terboven, J., Wright, P. C. and Foley, W. J. 2017. The importance of protein in leaf selection of folivorous primates. *Am. J. Primatol*. 79: 1–13.
Hublin, J. J. and Richards, M. P. 2009. The evolution of hominin diets: Intergrating approaches to the study of palaeolithic subsistence. Berlin: Springer Science & Business Media.
NRC. 2003. Nutrient Requierments of Nonhuman Primates. 2nd Edition Aufl. Washington DC: National Research Council, National Academies Press.
Quintino, E. P. and Bicca-Marques, J. C. 2013. Predation of *Alouatta puruensis* by *Boa constrictor*. *Primates* 54: 325–330.
Shanee, S. 2014. Ranging Behavior, Daily path lengths, diet and habitat use of Yellow Tailed Woolly Monkeys (*Oreonax flavicauda*) at La Esperanza, Peru. In: Defler ,T. R, Stevenson, P. R. (eds) The Woolly Monkey: Behavior, Ecology, Systematics and Captive Research. Springer, New York, pp 169–187.
Shanee, S. and Shanee, N. 2011a. Activity budget and behavioural patterns of free-ranging yellow-tailed woolly monkeys *Oreonax Flavicauda* (Mammalia: Primates), at La Esperanza, northeastern Peru. *Contrib. Zool*. 80: 269–277.
Shanee, S. and Shanee, N. 2011b. Population density estimates of the Critically Endangered yellow-tailed woolly monkeys (*Oreonax flavicauda*) at La Esperanza, Northeastern Peru. *Int. J. Primatol*. 32: 878–888.
Shanee, S. and Shanee, N. 2015. Measuring success in a community conservation project: local population increase in a critically endangered primate, the yellow-tailed woolly monkey (*Lagothrix flavicauda*) at la Esperanza, northeastern Peru. *Trop. Cons. Sci.* 8: 169–186.

UNEXPECTED DIVERSITY: THE POTENTIAL ROLE OF PRIVATELY-OWNED FOREST REMNANTS IN THE CONSERVATION OF THE PRIMATES OF THE HIGHLY-IMPACTED RONDÔNIA CENTER OF ENDEMISM, SOUTHWESTERN BRAZILIAN AMAZONIA

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The Rondônia center of endemism is an important component of Amazonian diversity, with a total area of 675,454 km2, which is mostly (96%) located within Brazil (da Silva *et al.*, 2005). Ongoing deforestation and logging have caused extensive habitat loss and fragmentation within this area, and constitute the main threat to its biodiversity (Gascon *et al.*, 2001). Some 27% of this area is protected, although only 3% is located within strictly protected conservation units (da Silva *et al.*, 2005). The primate diversity of the left margin of the Ji-Paraná River in southwestern Brazilian Amazonia is well known (Ferrari *et al.*, 1996; Gusmão *et al.*, 2014), although data from the right margin, especially from the middle and upper reaches of the river, are still scarce, and mostly outdated (Miranda-Ribeiro, 1914; Allen, 1916; de Vivo, 1985; Iwanaga and Ferrari, 2001). The present study reports on the primate assemblage found in an isolated forest remnant on the right margin of the upper Ji-Paraná River.

The study was conducted in a forest remnant of 543 ha located within a pasture matrix (11°28'08.81" S, 61°21'27.49" W), 229 m a.s.l., in the municipality of Cacoal, Rondônia state, Brazil (Fig. 1). This forest fragment is an area that combines the legal reserves of a number of small- and medium-sized farms. The climate is tropical humid (Aw in Köppen's classification) with a well-defined rainy season between September and May and a mean temperature of 26°C (Alvares *et al.*, 2013).

Data on the occurrence and abundance of primates within the study area were collected by line transect survey (see Peres, 1999), in which trails are walked at a mean velocity of 1.5 km/h. In the present study, the transects were conducted on two pre-existing trails; one 1.1 km in length, and the other, 0.7 km long. During these surveys, each encounter with a primate group was recorded, in which the species was identified and group size determined. Complementary data were collected during an ecological study of *Lagothrix cana* in the fragment, between March and September 2017 (Cavalcante, 2018). This study included 322 hours of behavioral monitoring, during which sightings of other primate species were recorded opportunistically, as well as during the phenological monitoring of seven 250 m trails scattered throughout the fragment. A total of 17.5 km was covered during the phenological surveys. Photographic records were obtained of all primate species, and their identification was confirmed through comparisons with the literature (Mittermeier *et al.*, 2013; Marsh, 2014; Byrne *et al.*, 2016).

Results and Discussion

We recorded 10 primate species during the present study, representing five families (Table 1). *Saimiri ustus* was by far the most abundant species, in terms of both the number of sightings and group size, whereas *Pithecia mittermeieri* was encountered only once during the transect walks. The presence of the small-bodied species, *Aotus nigriceps*, *Plecturocebus bernhardi* and *Mico nigriceps*, was only detected opportunistically, during non-survey fieldwork. These species were also recorded only once during the study. *Aotus nigriceps* has nocturnal habits and the other two species seem to use only the periphery of the study area, which was sampled less systematically during surveys. We thus confirmed the full inventory of primate species expected for this region, on the right margin of the Ji-Paraná River (see Miranda-Ribeiro, 1914; de Vivo, 1985; Iwanaga and Ferrari, 2001). Compared with the previous study of Iwanaga and Ferrari (2001) at Fazenda Mariana, approximately 50 km west of the present study site (Fig. 1), one more species

was recorded here, the nocturnal *A. nigriceps*. There are a number of differences, however, in the composition of this community in comparison with that of the left margin of the Ji-Paraná River (Ferrari *et al.*, 1996; Iwanaga and Ferrari, 2001; Gusmão *et al.*, 2014).

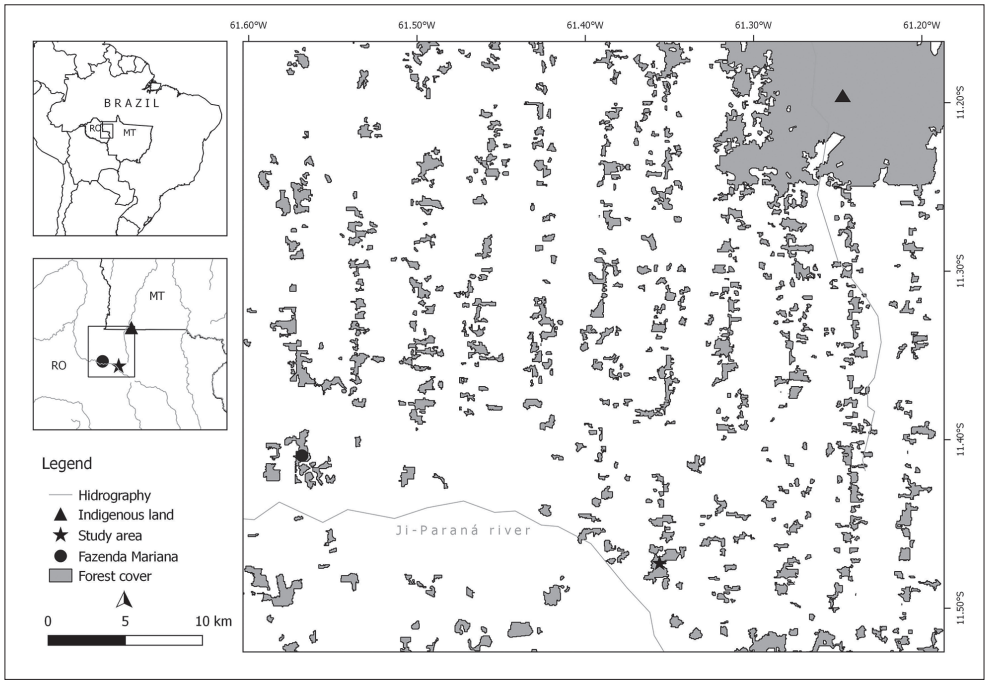

Figure 1. Location of the study area in the municipality of Cacoal, Rondônia, showing Fazenda Mariana (see Iwanaga and Ferrari, 2001) and the Sete de Setembro Indigenous Territory in southwestern Brazilian Amazonia (Mato Grosso and Rondônia).

Table 1. Sighting rates; mean, minimum and maximum group size; and opportunistic records of the platyrrhine species recorded in an isolated forest remnant in Cacoal on the upper Ji-Paraná River in Rondônia, Brazil.

Family	Species	Linear Transect			Opportunistic sightings
		Sightings per 10 km surveyed	Mean group size (individuals ± SD)	Minimum-maximum group size	
Atelidae	*Alouatta puruensis*	0.37	5 ± 1.22	3-6	X
	Ateles chamek	0.58	5.1 ± 1.12	4-7	X
	Lagothrix cana	0.66	5.7 ± 1.09	5-8	X
Cebidae	*Sapajus apella*	1.32	8.3 ± 1.60	6-12	X
	Saimiri ustus	1.39	15.4 ± 3.80	6-23	X
Pithecidae	*Plecturocebus bernhardi*	-	-	-	X
	Chiropotes albinasus	0.32	1.66 ± 0.57	1-2	X
	Pithecia mittermeieri	0.07*	-	-	-
Callitrichidae	*Mico nigriceps*	-	-	-	X
Aotidae	*Aotus nigriceps*	-	-	-	X

***Single sighting**

Although *Pithecia mittermeieri* was confirmed in the area, the single sighting during the linear transects indicates that this species occurs at a very low density, as observed at Fazenda Mariana (Iwanaga and Ferrari, 2001). By contrast, *Chiropotes albinasus*, despite having a low density, was sighted frequently during the monitoring of *Lagothrix cana* (Cavalcante, 2018), possibly due to its more extensive ranging behavior.

The apparently low density of howlers (*Alouatta*) in comparison with the other atelids (*Lagothrix* and *Ateles*) is surprising, given the relative tolerance of howlers to anthropogenic impact (Bicca-Marques, 2003), although this does appear to be typical of the occurrence of *Alouatta* in the study region (Iwanaga and Ferrari, 2001; Iwanaga and Ferrari, 2002a). Given the level of impact, and the small size

of the fragment, the results of the present study reinforce the conclusion that the principal pressure on the atelid populations in the Amazon region is hunting (Peres, 1990; Iwanaga and Ferrari, 2002b), and that even relatively small fragments, such as that found at the present study site, can support a high primate species richness.

Three of the primate species recorded in the present study are listed as endangered by the IUCN (2017). These species include the two atelines (*Lagothrix cana* and *Ateles chamek*), and the pitheciine *Chiropotes albinasus*. As the study area is part of the "arc of deforestation" of the southern Amazon basin (Michalski *et al.*, 2008), the confirmation of the presence of these species in forests outside protected areas is an important advance for conservation. The present study area, like Fazenda Mariana, is in the vicinity of the Sete de Setembro Indigenous Land, and the creation of corridors connecting these privately-owned areas with larger tracts of more continuous forest may be an essential conservation strategy in this region (da Silva *et al.*, 2005).

While the present study upholds the differences between the primate assemblages of the opposite margins of the Ji-Paraná River, and confirms its role as a geographic barrier for some species (Ferrari *et al.*, 1996; Gusmão *et al.*, 2014; this study), the absence of *Lagothrix cana* from the left margin is still enigmatic, not only because of its large body size (Ayres and Clutton-Brock, 1992), but also because of the species' apparent ecological resilience (Cavalcante, 2018, this study). As suggested previously, interspecific competition may play an important role in the zoogeography of these taxa (Iwanaga and Ferrari, 2001, 2002b). At Fazenda Mariana, Iwanaga and Ferrari (2001) found clear niche overlap, in particular with *Ateles chamek*. However, far more detailed ecological and behavioral data will be needed to evaluate these processes more conclusively. The high primate diversity found at both sites discussed here, and the fact that the atelines appear to be relatively abundant in this region's forest remnants (Iwanaga and Ferrari, 2001; Gusmão *et al.*, 2014), highlight the potential of privately-owned habitats to contribute to the development of effective conservation strategies for these species in the southwestern Amazon basin. Further research is needed, however, to verify the prospective role of these fragments for conservation at the landscape level. A quantitative and numerical evaluation of the fragments of the region, and their connectivity, will be essential to determine the real potential of these areas for primate conservation over the long term.

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References

Allen, J. A. 1916. Mammals collected on the Roosevelt Brazilian Expedition, with field notes by Leo E. Miller. *Bull. Am. Mus. Nat. Hist.* 35: 559–610.

Alvares, C.A., Stape, J. L., Sentelhas, P. C., de Moraes, G., Leonardo, J. and Sparovek, G. 2013. Köppen's climate classification map for Brazil. *Meteorol. Z.* 22: 711–728.

Ayres, J. and Clutton-Brock, T. 1992. River boundaries and species range size in Amazonian primates. *Am. Nat.* 140: 531–537.

Bicca-Marques, J. C. 2003. How do howler monkeys cope with habitat fragmentation? In: *Primates in fragments*, Marsh, L. K. (ed.), p.283–303. Kluwer Academics/Plenum, New York.

Byrne, H., Rylands, A. B., Carneiro, J. C., Alfaro, J. W. L., Bertuol, F. and da Silva, M. N., *et al.* 2016. Phylogenetic relationships of the New World titi monkeys (*Callicebus*): first appraisal of taxonomy based on molecular evidence. *Front. Zool.* 13: 1–26.

Cavalcante, T. 2018. Influência da disponibilidade e consumo de frutos no comportamento agonístico e espaçamento interindividual de macacos barrigudos (*Lagothrix cana*). MSc Thesis, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil.

da Silva, J. M. C., Rylands, A. B. and da Fonseca, G. A. 2005. The fate of the Amazonian areas of endemism. *Conserv. Biol.* 19: 689–694.

de Vivo, M. 1985. On some monkeys from Rondônia, Brasil (Primates: Callitrichidae, Cebidae). *Pap. Avulsos Zool.* 36: 106–110.

Ferrari, S., Iwanaga, S. and Silva, J. 1996. Platyrrhines in Pimenta Bueno, Rondônia, Brazil. *Neotrop. Primates*. 4: 151–153.

Gascon, C., Bierregaard Jr, R. O., Laurance, W. F. and Rankin-de-Merona, J. 2001. Deforestation and forest fragmentation in the Amazon. In: *Lessons from Amazonia: The ecology and conservation of a fragmented forest*, Bierregaard Jr, R. O., Gascon, C., Lovejoy, T. E. and Mesquita, R. (eds.), p.22–30. Yale University Press, New Haven, Connecticut.

Gusmão, A. C., Crispim, M. A., Ferronato, M. L. and Junior, J. S. S. 2014. Primatas da Reserva Particular do Patrimônio Natural Água Boa, Cacoal, Rondônia, Brasil. *Neotrop. Primates*. 21: 207–209.

IUCN. 2017. The IUCN Red List of Threatened Species. Version 2017-3. (http://www.iucnredlist.org). Accessed 20 December 2017.

Iwanaga, S. and Ferrari, S. F. 2001. Party size and diet of syntopic atelids (*Ateles chamek* and *Lagothrix cana*) in southwestern Brazilian Amazonia. *Folia Primatol.* 72: 217–227.

Iwanaga, S. and Ferrari, S. F. 2002a. Geographic distribution of red howlers (*Alouatta seniculus*) in southwestern Brazilian Amazonia, with notes on *Alouatta caraya*. *Int. J. Primatol.* 23: 1245–1256.

Iwanaga, S. and Ferrari, S. F. 2002b. Geographic distribution and abundance of woolly (*Lagothrix cana*) and spider (*Ateles chamek*) monkeys in southwestern Brazilian Amazonia. *Am. J. Primatol.* 56: 57–64.

Marsh, L. K. 2014. A taxonomic revision of the saki monkeys, *Pithecia* Desmarest, 1804. *Neotrop. Primates*. 21: 1–165.

Michalski, F., Peres, C. A. and Lake, I. R. 2008. Deforestation dynamics in a fragmented region of southern Amazonia: evaluation and future scenarios. *Environ. Conserv.* 35: 93–103.

Miranda-Ribeiro, A. 1914. História Natural: Zoologia. Mamíferos. Comissão de Linhas Telegráficas Estratégicas de Mato Grosso ao Amazonas, Anexo 5: 1–49.

Mittermeier, R. A., Wilson, D. E. and Rylands, A. B. 2013. *Handbook of the mammals of the world: primates*. Lynx Edicions, Barcelona.

Peres, C. A. 1990. Effects of hunting on western Amazonian primate communities. *Biol. Conserv.* 54: 47–59.

Peres, C. A. 1999. General guidelines for standardizing line-transect surveys of tropical forest primates. *Neotrop. Primates*. 7: 11–16.

AGGRESIVE ENCOUNTER BETWEEN *LAGOTHRIX FLAVICAUDA* AND *NASUA NASUA* AT EL TORO, AMAZONAS, PERU.

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Hélène Meunier
Martine Vercauteren

Introduction

Interaction between primates and other animals vary depending on their ecological relationship - primates behaving differently with competitors, mutualists, predators and preys. Aggressive interactions may occur with competitors, predators and prey (de Resende et al. 2004). The yellow-tailed woolly monkey (*Lagothrix flavicauda*: Atelidae) is one of the largest-bodied Neotropical primate species, and is endemic to northern Peru, in a small portion of the 'Tropical Andes biodiversity hotspot'. They live in montane cloud forests between 1,500 and 2,700 m. a.s.l., in multimale multifemale groups (up to 23 individuals). They are diurnal and arboreal, mainly omnivorous – with a diet including fruits, leaves, insects, petioles and other plant parts (Shanee, 2014).

The South American Coati (*Nasua nasua:* Procyonidae) is a medium-sized and gregarious carnivore commonly found throughout Neotropical forests (Alves-Costa et al., 2004). Juveniles and females live in groups (up to 30 individuals) while adult males are solitary (Beisiegel, 2001). They are semiarboreal (Haugaasen and Peres, 2008), mainly insectivorous-frugivorous and play an important role in seed dispersal and forest regeneration (Alves-Costa et al. 2004).

We report here an interaction between *N. nasua* and *L. flavicauda* in "El Toro" (05°40'83.2"S, 77°55'02.0"W), located 5 km north of the village of La Esperanza, northern Peru. The site encompasses approximately 700 ha of disturbed montane cloud forest with pastures and agriculture, between 1,800 and 2,400 m. a.s.l. Both species are common at the site (Shanee and Shanee, 2015).

Observations

On 27 April 2016, during behavioral follows we observed a sub-group of *L. flavicauda* (one adult male and five adult females) encounter a solitary male *N. nasua* in a stationary position in the understory (~7m). The focal animal (an adult female) approached the coati (to within 5 meters) near to the alpha male who was nearest the coati (~4 meters). The rest of the sub-group were in another tree behind the alpha male. All individuals in the sub-group observed the stationary coati, which did not stir from its initial position. The alpha male was the first to vocalize, followed by the females. When the coati did not respond, the male rapidly approached it, to within two meters, shaking branches in its direction to chase it away. Finally, the coati left the tree to move away. A few seconds later the monkeys stopped vocalizing, but the alpha male continued to look in the direction in which the coati had left. After the encounter, the focal individual continued to forage in epiphytes about 6 meters from the alpha male defending the sub-group from the intruder. The entire encounter lasted approximately 3 minutes. We believe this is the first record of an aggressive encounter between *L. flavicauda* and *N. nasua*. With both species sharing the same habitat, they probably encounter each other regularly and possibly compete for food and territory. Similar interactions have been observed between *Cebus apella* and *N. nasua* when feeding in the same area (de Resende, 2004). Further surveys of *N. nasua* habits at the study site could shed light on potential resource competition and home range overlap with *L. flavicauda*.