

CONSERVATION

The lowland tapir *Tapirus terrestris* is back to the largest protected area of Cerrado in the state of São Paulo, Brazil

Thiago Ferreira Rodrigues^{1,3}, Roberta Montanheiro Paolino¹, Natalia Fragas Versiani¹, Nielson Aparecido Pasqualotto Salvador¹, Edson Montilha de Oliveira², and Adriano Garcia Chiarello¹

¹Faculdade de Filosofia, Ciências e Letras de São Paulo – Universidade de São Paulo – FFCLRP/USP – Av. Bandeirantes, 3900 – Bairro Monte Alegre, Ribeirão Preto–SP, Brasil, CEP 14040-901.

²Gestor da Estação Ecológica de Jataí, Fundação Florestal do estado de São Paulo, Brasil.

³thiagorodrigues@gmail.com

Abstract

The conservation status of the lowland tapir is critical in the Cerrado biome of Brazil, where local authorities recently classified it as Endangered according to the IUCN standards. It has been estimated that in the last 40 years the Cerrado lowland tapir lost 67% of its population. This study reports the “reappearance” of the lowland tapir in the largest protected area of Cerrado in the state of São Paulo, the Jataí Ecological Station (JES) after a 30 years period with no records. We sampled 105 camera trap locations, half within JES and half in a 2.6 km buffer zone, between April and September of 2013 (3150 camera trap-days). We also actively searched for signs and compiled all lowland tapir records obtained by local staff and other researchers in JES haphazardly in recent years. We logged a total of 10 lowland tapir records, seven from footprints and three from camera traps, in the study area between 2011 and 2013, all within the perimeter of JES. All records were from adults individuals but, unfortunately, it was not possible to individualize them. Our results suggest the presence of one or a few lowland tapirs inhabiting the study area. We failed to find information to clarify whether the lowland tapir has been lurking in the area

for the past 30 years or if it has recolonized JES recently. We therefore urgently recommend further studies to assess the status of this “population”. These are necessary to indicate the most effective conservation actions needed to safeguard its short term persistence and to plan its long term viability in the area.

Introduction

The lowland tapir *Tapirus terrestris* has a key role in mammal communities and in forest structure and dynamics of the Neotropics due to its large size and biomass, and also due to its function as seed predator/disperser (Medici, 2010). Due to its low reproductive rate, high demand for space and poaching, its conservation status is deteriorating, particularly in areas subjected to deforestation and forest fragmentation (Medici *et al.* 2007). The taxon was historically distributed from northern South America southwards to northern Argentina and southern Brazil (Naveda *et al.* 2008). Its current range has been reduced, however, to small and isolated populations due to habitat loss and fragmentation, agriculture and livestock expansion, roads and urban sprawl (Naveda *et al.* 2008). As a result, the lowland tapir is already regionally extinct in the Caatinga biome of Brazil (Medici *et al.* 2012) and occurs only in a few protected areas of Cerrado and the Atlantic Forest, two Brazilian biomes where its conservation status is critical (Medici *et al.* 2012). It has been estimated that 67% of the lowland tapir population inhabiting the Cerrado of Brazil was lost in the last 40 years, a period encompassing approximately three generations (Medici *et al.* 2012). For that reason, improved knowledge about the occurrence and abundance of lowland tapir in the Brazilian Cerrado is considered a conservation priority (Medici *et al.* 2012). Moreover, especially in the state of São Paulo, which is the most populous and is the economic engine of Brazil, the Cerrado was severely reduced, remaining today only 8.5% (210,372 ha) of its original area (2,474,798 ha). Of that number, only 6.5% are in protected areas (Metzger & Rodrigues, 2008) which make the lowland tapir’s conservation in São Paulo particularly alarming (Medici *et al.* 2012).

Past inventories of mammals carried out in the Cerrado of southeastern Brazil have detected *T. terrestris* in only one protected area called Jataí Ecological Station (JES)(Talamoni, 1996), the largest Cerrado remnant in the state of São Paulo (Toppa, 2004). The last published record of tapirs in this area was a skeleton found in the mid-1980s (Talamoni *et al.* 2000). From that time on, the local persistence of the lowland tapir has been questioned, as no new records have been collected by researchers that worked in that area (Mantovani, 2001; Neri, 2004; Prada, 2004; Lyra-Jorge, 2007). In fact, the management plan of JES

treats this species as locally extinct (Leonel *et al.* 2010). Nevertheless, we report here new recent records obtained from footprints and camera traps confirming that *T. terrestris* is “back” to this important protected area of the Brazilian Cerrado after a gap of about 30 years. In light of this report, we recommend some urgent actions and measures to estimate the size of this population and improve its conservation status.

Study area

The study was carried out in the Jataí Ecological Station (JES) (9074 ha) and in the Luiz Antônio Experimental Station (LAES; 1725 ha), which is adjacent to JES (Figure 1) (Leonel *et al.* 2010). These two areas are located in the municipality of Luiz Antônio, in the northeastern region of São Paulo state (21° 30' S, 47° 50' W). According to the Köppen classification, the climate is defined as Aw (tropical humid) (Cepagri, 2014). In JES the predominant vegetation is the Cerradão (60.7%), a subtype of Cerrado that is fully arboreal, followed by areas of Cerrado in regeneration (19.5%) and Semi-deciduous Forest (13.6%). The remaining area is covered by Floodplains, Cerrado *stricto sensu*, Dry Grasslands and plantation of *Eucalyptus* spp. and *Pinus* spp. (Toppa, 2004). Our study area also included a 2.6 km buffer around the perimeter of JES and LAES. In the buffer zone sugarcane and *Eucalyptus* plantations predominate, followed by native vegetation (private reserves) orange plantations and pastures (Shida & Pivello, 2002).

Material and Methods

The data presented in this report was collected as part of an ongoing project focused on the estimation of landscape occupancy by the giant-anteater (*Myrmecophaga tridactyla*). We divided the study area into a grid of 151 squares of 200 ha each (1.4 x 1.4 km) and placed one camera-trap station (Reconyx®, model HC 500) in the centre of these squares. Within the JES and LAES, we systematically sampled 52 squares, since they covered the entire area of these two reserves. In the buffer zone, we randomly sampled 53 squares from the total of 97 squares available. The camera-traps were programmed to monitor 24 h d⁻¹ and to record the date and time of each photograph. Each trap station continuously monitored for 30 days from April to September 2013

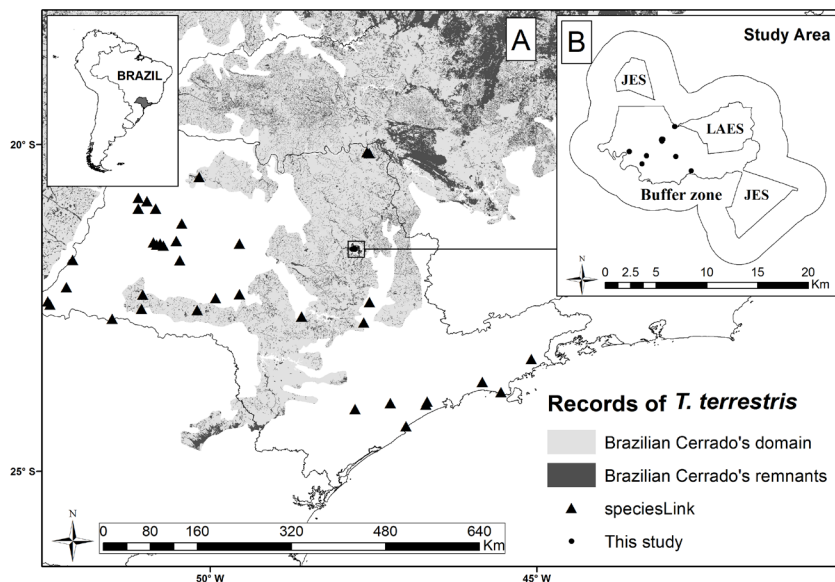


Figure 1. Known distribution of lowland tapir records in the state of São Paulo, southeastern Brazil. **A.** Records available in the speciesLink (2014). **B.** Records obtained or compiled by the present study in Jataí Ecological Station (JES), Luiz Antônio Experimental Station (LAES) and in the 2.6 km buffer zone.

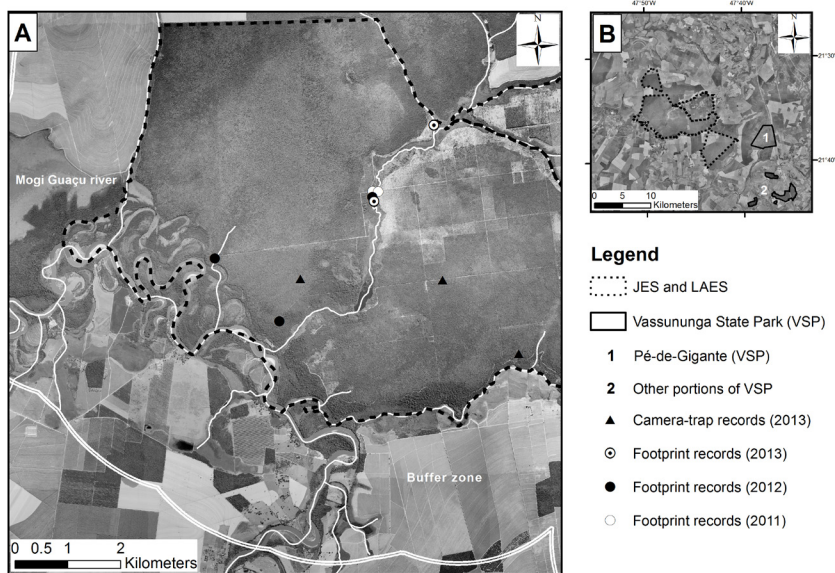


Figure 2. Orthophotography of study area showing: **A.** Location of lowland tapir records in JES. **B.** General view of study area and surrounding landscape, highlighting the proximity with another protected area, the Vassununga State Park (VSP).

(dry season). Our total sampling effort was 3150 camera-trap days, half in JES/LAES and another half in the buffer zone. We fixed camera-traps on tree trunks 40-60 cm above the ground. About half the cameras were deployed on the forest interior and half on unpaved roads or in forest edges. Additionally, we actively searched for signs (footprints, scats, etc.) in the surroundings of each camera trap station during their installation and removal periods. We also compiled



Figure 3. Some records of *T. terrestris* obtained in JES during this study: (A) Right side view of an individual photographed by a camera-trap at 04-07-2013 and (B) another camera-trap picture showing the posterior view of an adult female. C and D: footprint records photographed along unpaved roads of JES.

lowland tapir records (mainly footprints) obtained in JES haphazardly in recent years by one of us (EMO), the manager of JES. We mapped the known distribution of the lowland tapir in the state of São Paulo using data freely available from Species Link Project (2014).

Results and Discussion

We obtained 10 records, seven from footprints and three from camera traps, of *T. terrestris* in the study area between 2011 and 2013, all within the perimeter of JES (Figure 2). Most of these records were in Cerradão or in Semi-deciduous forest formations close to wetland areas or watercourses, corroborating other studies on habitat preferences of this species. The lowland tapir is usually associated with humid forests, rivers or lagoons which are used as refuge, defecation areas, and bathing places or to help the

animal get rid of ectoparasites (Sekizawa *et al.* 2006). No records were registered within the buffer zone or the LAES.

The records obtained in 2013 covered an area of 790 ha (Minimum convex polygon), which is smaller than the average home range of lowland tapir in other areas of the Brazilian Cerrado (Medici *et al.* 2012). The area covered by the records of 2012 is even smaller (252 ha). Therefore there have been three consecutive years (2011-2013) of lowland tapir's records in the study area.

It was not possible to discriminate individuals from the photographs, however all pictures show single individuals, all of them adults. In two of the photographs the posterior part of the animal is clearly portrayed; its genitals seem to be of a female (Figure 3, B). Individual discrimination of lowland tapirs through camera traps pictures is possible but prone to errors, as evidenced by Oliveira-Santos *et*

al. (2009). Similarly, the low number of footprint and the small variation observed in the morphometric measurements of the recorded footprints (Figure 3, C and D) prevented us from estimating the number of individual present in the study area. As with photographs, though, no footprints of young or juvenile individuals were recorded. Put together, the collected information indicates the presence of one or, in the best scenario, just a few adult lowland tapirs inhabiting the study area. We don't know if this event is a recent recolonization or if the lowland tapir has been lurking in some inaccessible areas of JES for the last 30 years. In fact there are relatively large portions of JES, particularly in the north and northwest that are not crossed by internal roads or trails, which hampers the access of researchers. The last survey of medium and large mammals carried out in JES (Lyra-Jorge, 2007), for example, employed a sampling effort three times higher (6039 trap-days) than ours (1560 trap-days within the JES) but did no record the species.

Although JES has an area of 9,074 ha, Paula *et al.* (2010) argue that protected areas of 10,000 ha might not be large enough to sustain a viable population of lowland tapirs since such an area would support a population of approximately 50 individuals (without home-range overlap). Without further ecological data, habitat preferences, population density and availability of food resources, it is dangerous to advance that JES would be too small to hold a viable population of lowland tapirs. Apart from having typical habitat for the lowland tapir, the vegetation of JES contains several genera of plants that are known to be used as food sources by this species, such as *Ficus* sp., *Psychotria* sp., *Senna* sp., *Psidium* sp., *Rollinia* sp. and *Annona* sp. (Toppa, 2004; Talamoni, 2009). In theory, the area potentially available for lowland tapirs in JES is larger than that effectively encompassed by the perimeter of this protected area. In the buffer zone of the study area, for example, we mapped the existence of 3336 ha of native vegetation. Further, some areas of *Eucalyptus* and *Pinus* mixed with Cerrado in regeneration, which is characteristic of the LAES, might have some potential, at least as low quality habitat, for this species (Bocchiglieri, 2010). Additionally, nearby there is another protected area, the Vassununga State Park (2,054 ha) that could be reached through existing riverine forests surrounding the Mogi-Guaçu river, which traverses both reserves (Figure 2). This functional connectivity with Vassununga State Park might be further improved in the near future. The São Paulo Forest Institute (Instituto Florestal) is currently studying the possibility of purchasing a private area of native vegetation close to Pé-de-Gigante fragment (1700 ha) that could be added to the JES area (Figure 2). This potential expansion would certainly improve the degree of protection afforded to the lowland tapir in the whole region. Similarly, Noss *et al.* (2003) showed that agricultural landscapes surrounding

protected areas contribute to this species maintenance elsewhere.

In light of our records and the paucity of data on lowland tapir in the study region we urge the need for further studies. Given the uncertainty over the size of this population, we advocate the use of techniques and methods that bring no risk to this individuals/population. Some good alternatives include further sampling effort with camera traps placed in specific areas where detection is higher. Another approach that might be tried concurrently is the use of non-invasive techniques such DNA extraction from fecal samples to assess genetic diversity and population size (Sanches *et al.* 2009, Tokumoto *et al.* 2011). New and promising alternatives to estimate population size, such as the Random Encounter Models (Rowcliffe *et al.* 2008) or the Footprint Identification Technique (Jewell & Alibhai, 2012) might also be tried, but experimentally at first, as they are still being tested or improved. Monitoring should also start as soon as possible. One relatively easy alternative for doing this, based on camera trap of footprint data or both, could be occupancy estimation (Mackenzie *et al.* 2006), since it would also help uncover the key landscape variables for this tapirs. As these information becomes available, we could then plan both short term and long term actions to safeguard its persistence and viability, respectively, in this important Cerrado remnant.

Acknowledgement

We thank São Paulo Research Foundation (FAPESP 2011/22449-4) for financial support. We are also grateful to Instituto Florestal and Fundação Florestal, both in the state of São Paulo, and International Paper (Brazil) for providing necessary support to make this study possible. We are all grateful to Sonia Talamoni for clarifying the history of the early records of lowland tapir in study area and Aurelio Fontes for helping with spatial analysis and mapping.

References

- Bocchiglieri, A. (2010). Mamíferos de médio e grande porte em uma área alterada no Cerrado: estrutura da comunidade, sobreposição de nicho e densidade. Tese de doutorado. Universidade de Brasília, Brasília, Brasil.
- Cepagri (2014). Clima dos municípios paulistas. www.cpa.unicamp.br/outras-informacoes/clima_muni_279.html [accessed 20 June 2014].
- Jewell, Z. & Alibhai, S. (2012) Identifying endangered species from footprints. SPIE Newsroom. Doi: 10.1117/2.1201212.004636.
- Leonel, C., Thomaziello, S., Oliveira, E. D. (2010). Plano de Manejo da Estação Ecológica do Jataí – SP 334p.
- Lyra-Jorge, M. C. (2007). Avaliação de qualidade de fragmentos de cerrado e floresta semidecídua na região

- da bacia do rio Mogi-Guaçu com base na ocorrência de mamíferos. Doutorado. Universidade de São Paulo, São Paulo.
- Mackenzie, D. L., Nichols, J. D., Royle, J. A., Pollock, K. H., Bailey, L. L., Hines, J. E. (2006) *Occupancy Estimation and Modeling – Inferring Patterns and Dynamics of Species Occurrence*, 1st Ed., Elsevier, USA.
- Mantovani, J. E. (2001). Telemetria convencional e via satélite na determinação da área de vida de três espécies de carnívoros da região nordeste do Estado de São Paulo. Doutorado em Ecologia e Recursos Naturais. Universidade Federal de São Carlos, São Carlos.
- Medici, E.P., Desbiez, A.L.J., Gonçalves da Silva, A., Jerusalinsky, L., Chassot, O., Montenegro, O.L., Rodríguez, J.O., Mendoza, A., Guse, V.B., Pedraza, C., Gatti, A., Oliveira-Santos, L.G.R., Tortato, M.A., Ramos Jr., V., Reis, M.L., Landau-Remy, G., Tapia, A. & Morais, A.A. (2007). Lowland Tapir (*Tapirus terrestris*) Population and Habitat Viability Assessment (PHVA): Final Report. IUCN/SSC Tapir Specialist Group (TSG) and IUCN/SSC Conservation Breeding Specialist Group (CBSG), Sorocaba, São Paulo, Brazil.
- Medici, E. P. (2010). Assessing the viability of lowland tapir populations in a fragmented landscape. Thesis. University of Kent Canterbury, United Kingdom.
- Medici, E. P. *et al.* (2012) Avaliação do risco de extinção da Anta brasileira, *Tapirus terrestris*, no Brasil. In: Numero temático: Avaliação do Estado de Conservação dos Ungulados, Biodiversidade Brasileira Ano II, nº 3, p. 103-116.
- Metzger, J. P. & Rodrigues, R. R. (2008). Mapas-síntese das diretrizes para conservação e restauração da biodiversidade no estado de São Paulo. In: Secretaria de Estado do Meio Ambiente. Diretrizes para a conservação e restauração da biodiversidade no estado de São Paulo, pp. 133-139. São Paulo: Secretaria de Estado do Meio Ambiente, Brasil.
- Naveda, A., de Thoisy, B., Richard-Hansen, C., Torres, D.A., Salas, L., Wallace, R., Chalukian, S. & de Bustos, S. (2008). *Tapirus terrestris*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. www.iucnredlist.org [accessed 20 June 2014].
- Neri, F. M. (2004). Ecologia e Conservação de Catetos, *Tayassu tajacu* (Artiodactyla, Tayassuidea) em duas áreas do Nordeste do Estado de São Paulo. Doutorado em Ecologia e Recursos Naturais. Universidade Federal de São Carlos, São Carlos.
- Noss, A.J., Cuéllar, R.L., Barrientos, J., Maffei, L., Cuéllar, E., Arispe, R., Rómiz, D. & Rivero, K. (2003). A Camera trapping and radio telemetry study of lowland tapir (*Tapirus terrestris*) in Bolivian Dry Forest. *Tapir Conservation* 12: 24–32.
- Oliveira-Santos, L. G. R., Zucco, C. A., Antunes, P. C., Crawshaw Jr, P. G. (2009) Is it possible to individually identify mammals with no natural markings using camera-traps? A controlled case-study with lowland tapirs. *Mammalian Biology*.
- Paula, G. C. R., Antunes, A. Z., Vilela, F. E. S. P., Arzola, F. A. R. D. P., Eston, M. R. (2010). Ocorrência e conservação da anta (*Tapirus terrestris* Linnaeus, 1758) na floresta do morro grande, SP, Brasil. *Rev. Inst. Flor.* v. 22, n. 1, p. 51-60.
- Prada, C. S. (2004). Atropelamento de vertebrados silvestres em uma região fragmentada do nordeste do estado de São Paulo: quantificação do impacto e análise de fatores envolvidos. Doutorado em Ecologia e Recursos Naturais. Universidade Federal de São Carlos, São Carlos.
- Rowcliffe, J. M., Field, J., Turvey, S. T. & Carbone, C. (2008) Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology*, 45, 1228–1236.
- Sanches, A., Figueiredo, M.G., Hatanaka, T., Paula, F.F.P., Silveira, L., Jácomo, A.T., Galetti, P.M., Jr. 2009. Microsatellite loci isolated from the lowland tapir (*Tapirus terrestris*), one of the largest Neotropical mammal. *Conservation Genetics Resources* v.1, n.1, p. 115-117
- Sekizama, M. L., Lima, I. P., Rocha, V. J. (2006). Ordem Perissodactyla. In: Reis, N. R., Peracchi, A. L., Pedro, W. A., Lima, I. P.(eds). *Mamíferos do Brasil*, pp. 277-281. Londrina, Brasil.
- Shida, C. N. & Pivello, V. R. (2002). Caracterização fisiográfica e de uso das terras da região de Luiz Antônio e Santa Rita do Passa Quatro, SP, com o uso de sensoriamento remoto e SIG. *Investigaciones Geográficas. Boletim Del Instituto de Geografia, UNAM. Boletim* v.49, p. 27-42.
- SpeciesLink Project (2014). *Tapirus terrestris*. www.splink.org.br/ [accessed 13 March 2014].
- Talamoni, S. A. (1996). Ecologia de uma comunidade de pequenos mamíferos da Estação Ecológica de Jataí, Município de Luís Antônio, SP. Tese de Doutorado. Universidade Federal de São Carlos. Brasil.
- Talamoni, S. A., Motta-Junior, J. C., Dias, M. M. (2000). Fauna de mamíferos da Estação Ecológica do Jataí e da Estação Experimental de Luiz Antônio. In: Estação Ecológica de Jataí. Vol I., J. E. Santos e J. S. R. Pires (eds.), pp. 317-329. RIMA Editora, São Carlos.
- Talamoni, S. A., & Assis, M. A. C. (2009). Feeding habit of the Brazilian tapir, *Tapirus terrestris* (Perissodactyla: Tapiridae) in a vegetation transition zone in south-eastern Brazil. *Zoologia (Curitiba)*, 26(2), 251-254.
- Tokumoto, P. M., Godoi, T. G., Galetti, M., Sanches, A. (2011). Perspectivas para estudos populacionais não invasivos de antas (*Tapirus terrestris*): comparação do sucesso de amplificação de DNA fecal no Cerrado e Pantanal. *Anais do X Congresso de Ecologia do Brasil*, 16 a 22 de setembro de 2011, São Lourenço, MG.
- Toppa, R. H. (2004). Estrutura e diversidade florística das diferentes fisionomias de Cerrado e suas correlações com o solo na Estação Ecológica de Jataí, Luiz Antônio, SP. Tese de Doutorado, Universidade Federal de São Carlos, São Carlos, SP, Brasil.