

## SHORT COMMUNICATION

### Agonistic interactions in the brown-throated three-toed sloth, *Bradypus variegatus* (Pilosa: Bradypodidae), in an urban environment in Rio Tinto, Paraíba, Brazil

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**Abstract** We report agonistic interactions in a group of 17 brown-throated three-toed sloths inhabiting an urban environment aiming to understand the factors involved. Most of the interactions were observed between adult males (86%), reflecting the greater number of males, and included an event in which two males started the interaction while one of them was copulating. Agonistic interactions between adult females involved a mother that supposedly abandoned its young to participate in the interaction. Agonistic interactions between males could be due to competition for females whereas the female interactions appear to be related to competition for space.

**Keywords:** competition, food resource, offspring, reproduction

**Interações agonísticas em preguiça de três dedos, *Bradypus variegatus* (Pilosa: Bradypodidae), em ambiente urbano em Rio Tinto, Paraíba, Brasil**

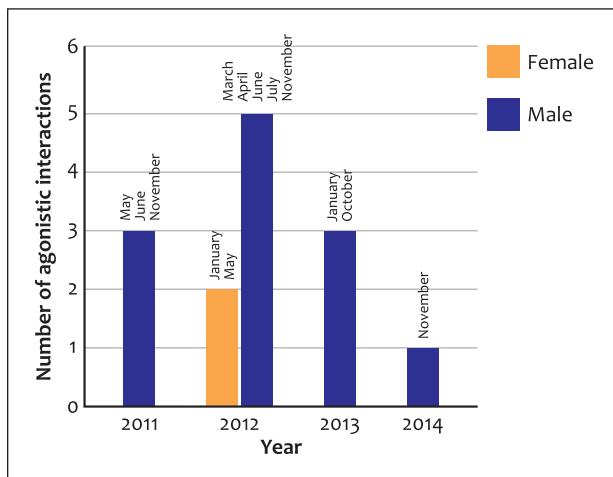
**Resumo** Relatamos aqui as interações agonísticas observadas num grupo de 17 preguiças-comuns habitantes de uma área urbana, visando entender os possíveis fatores envolvidos. A maioria das interações agonísticas foram registradas entre machos adultos (86%), refletindo o maior número de machos, e incluído um evento no qual um dos machos encontrava-se em atividade de cópula. As interações agonísticas entre fêmeas adultas envolveram uma preguiça que supostamente abandonou o seu filhote para participar da interação. As interações agonísticas entre machos poderiam ocorrer devido à competição por fêmeas, enquanto que as interações entre fêmeas parecem estar relacionadas à competição por espaço.

**Palavras-chave:** competição, prole, recurso alimentar, reprodução

The brown-throated three-toed sloth *Bradypus variegatus*, Schinz, 1985 is an arboreal mammal with a solitary social structure (Eisenberg, 1981). The interactions between individuals of this species occur generally during mating and parental care periods (Carvalho, 1960; Montgomery & Sunquist, 1974; Soares & Carneiro, 2002; Bezerra *et al.*, 2008;

Pinheiro, 2008). The interactions between sloths are more frequent in places with higher densities of individuals (Lara-Ruiz & Srbek-Araujo, 2006; Silva *et al.*, 2013).

While agonistic interactions have been previously documented in brown-throated three-toed



**FIGURE 1.** Annual records of the agonistic interactions in the brown-throated sloth in João Pessoa square, Rio Tinto, Paraíba.

sloths, the motivational basis for such interactions remains poorly understood (Beebe, 1926; Ballesteros *et al.*, 2009; Greene, 1989). Beebe (1926) reported agonistic interactions in the genus *Bradypus* living in semi-captivity and considered such interactions as casual events. On the other hand, Greene (1989) described agonistic interactions between two males of brown-throated three-toed sloths in La Selva Biological Station, in Costa Rica, suggesting that such behavior is related to competition for females, food or some other resource. Ballesteros *et al.* (2009) studied males in Viento Solar Natural Reserve in Colombia and associated agonistic interactions between them with territorial defense.

This study aimed to understand the factors involved with agonistic interactions between brown-throated three-toed sloths in an urban environment. We observed agonistic interactions between sloths in João Pessoa Square, in the city of Rio Tinto, on the northern coast of Paraíba, Brazil (6°48'30.29"S, 35°4'38.87"W). João Pessoa square has streets, a church, bars, restaurants, and houses, and is the main place for festivals and celebrations. In this place, 17 sloths (14 males and three females) inhabit a group of eight fig trees (Moraceae: *Ficus microcarpa* Linnaeus 1781) with connecting canopies, occupying an area of 0.26 ha surrounded by an urbanized landscape (Pedrosa & Castro, 2014).

The observations for recording agonistic interactions covered the period from April 2011 to December 2014. These observations were conducted in the morning (from 8:00 hr to 12:00 hr) and afternoon (from 13:00 hr to 17:00 hr) and also occurred occasionally outside these times. The agonistic interactions were recorded by the method of observation "All Occurrences" (Altmann, 1974). This method consists in recording the behaviors at the moment they occur, identifying the individuals

involved and the postures adopted during the interactions. These interactions were more common between males compared to females, reflecting the greater number of males occupying the fig trees (FIG. 1).

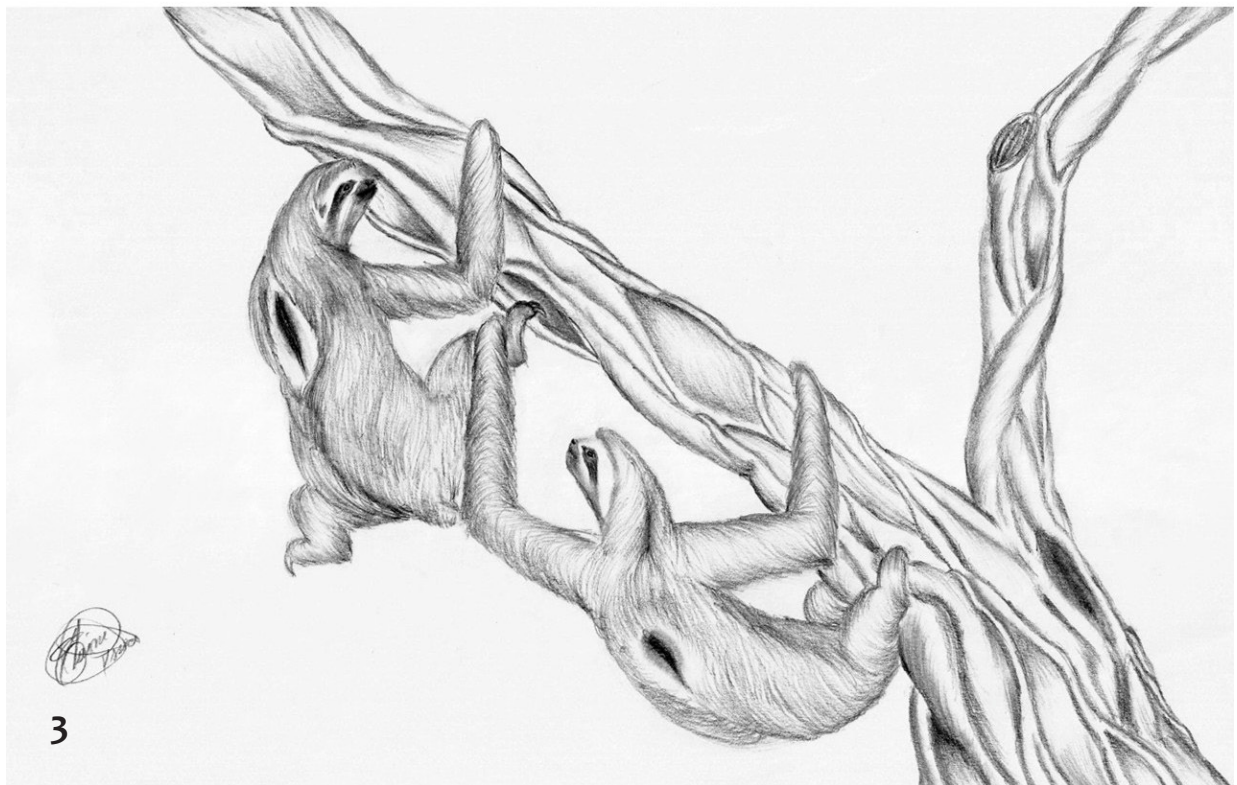
In the period from April 2011 to December 2012, 672 hours of sampling effort were carried out. During this period, we recorded 10 episodes (three in 2011 and seven in 2012) of agonistic interactions. Two episodes were registered between adult females (20%) and eight between adult males (80%). The episodes of agonistic interactions between females occurred in the months of January and May 2012. Those between males occurred in the months of May, June, and November 2011, as well as March, April, June, July, and November 2012. In a second observation period (from May 2013 to December 2014), 640 hours of sampling effort were carried out. We recorded four episodes of agonistic interactions (three in 2013 and one in 2014), all of them between adult males, in January (1 episode) and October (2 episodes) 2013, and in November 2014 (FIG. 1).

In all recordings of agonistic interactions, claws were used to assault the individual and, in some cases, vocalizations were emitted by the individual that was being assaulted. Two sloths showed their claws when they were close to each other preceding physical contact, which involved slaps and tugs, using the forelimb claws on the body or limbs of the other individual, causing loss of balance and often resulting in its fall (FIG. 2–3).

The vocalizations during agonistic interactions are high-pitched with very short duration between one and the other, not more than five seconds. In some cases, in the interactions between males, the individuals showed behaviors of harassment on the part of the aggressor, and of flight on the part of the one assaulted.

We recorded in detail the agonistic interactions between two adult males that occurred on November 9, 2014. We designated them male A and male B for identification during the interaction. Early in the morning, male A embraced a female from behind, similar to the posture described by Bezerra *et al.* (2008) for the copulation behavior. The male A realized the presence and approximation of the male B. Male A left the female and moved towards the male B. The two males stood in front of each other displaying their claws. Male A vocalized while male B displayed right claw. The two males simultaneously displayed the claws of the upper limbs. Male A approached and pushed male B down. Soon after, they split and displayed their claws. Male A displayed its claws again and finally it moved towards the female.

A new episode of agonistic interaction occurred the following day (15 hours after the last episode



**FIGURE 2–3.** Agonistic interactions between male brown-throated three-toed sloths in João Pessoa square, Rio Tinto, Paraíba: **2.** Display of claws preceding physical aggression and **3.** Physical aggression with tugs on hind limb (Sketches: Elaine Pessoa Pedrosa).



described above). Male B approached male A, who was close to the female. Male A came towards male B, and the two remained still facing each other, displaying their claws, engaging in one more physical contact and emitting vocalizations. Two minutes after the males separated, male B moved to another fig tree. Male A remained still for 1 min, displayed its claws, and after male B moved out of view, male A moved towards the female and spent the entire morning at her side. The whole event lasted 42 min, beginning at 7:40 hr and ending at 8:22 hr. On the next day, there were no agonistic interactions, only the emission of vocalizations, but it was not possible to identify the sloth that emitted them. Vocalizations continued until the fourth day of consecutive observations, but there were no agonistic interactions.

During one of the episodes involving females, which occurred on 1 January 2012, it was possible to observe agonistic interactions between a mother (female C) and another female (D). Before we observed the agonistic interaction, a young sloth (with the umbilical cord still attached) had fallen on the floor next to the same fig tree. The young sloth vocalized, but the mother (female C) did not come down from the fig tree to rescue it.

Physical attacks between females C and D lasted about 10 min and were followed by the display of claws by both females. A third female (E) approached and hit the mother (female C) with its claws of the forelimb. Female D moved away, and the female E stayed and exchanged attacks to the mother (female C) for about 2 min. The mother (female C) moved quickly among the branches of the fig trees, went to the canopy of the next fig tree, and female E went in the opposite direction.

The staff of Área de Proteção Ambiental da Barra do Rio Mamanguape (APA) tried to return the young sloth to its mother for three consecutive days, but all attempts failed. The staff of APA took the young sloth to the Centro de Triagem de Animais Silvestres (CETAS/IBAMA).

The urban environment of João Pessoa square isolated sloths to the eight fig trees, making it nearly impossible for them to migrate to nearby forest fragments, and thus resulting in a high density of individuals at this site. Lara-Ruiz & Srbek-Araujo (2006) and Silva *et al.* (2013) observed that interactions between individuals were more frequent in conditions of high densities. Pedrosa & Castro (2014) studied the behavior of brown-throated three-toed sloths in natural (at Biological Reserve Guaribas) and urban (João Pessoa square) environments and observed that agonistic interactions, although less frequent than other behaviors, were recorded just in the urban environment. The environment of João Pessoa square could promote a

higher frequency of encounters and agonistic interactions between them.

The observed interactions between adult males in João Pessoa square suggest that agonistic behaviors could involve competition for mates. As already proposed by Greene (1989), agonistic interactions between two males of brown-throated three-toed sloths can be due to, among other factors, competition for females. The months in which agonistic interactions between males were mostly recorded correspond to the portion of the year (March to October and November) in which males of *B. variegatus* are seen to be sexually active, according to studies performed in north-eastern Brazil (Gilmore *et al.*, 1994; Gilmore & Costa, 1995; Bezerra *et al.*, 2008). However, considering that our sampling effort was not similar for all months during the four years of study, we cannot discard the possibility that interactions among males occur throughout the year.

In the natural environment, home range sizes recorded for *B. variegatus* ranged from 0.9 to 1.4 ha (Chiarello, 2008), while in João Pessoa square the home range size does not exceed 0.2 ha (Pedrosa, 2013). Little is still known about the agonistic interactions between female sloths, but in João Pessoa square such interactions could occur due to competition for space. Female brown-throated three-toed sloths provide parental care to their young for approximately six months (Montgomery & Sunquist, 1974). After this period, sloth mothers use other parts of the home range to avoid competition with their offspring (Montgomery & Sunquist, 1978). At João Pessoa square, mothers are hindered from migrating to nearby forest fragments and there are no trees for their offspring to leave following separation. These conditions of the urban environment could also lead to the abandonment of young sloths. This is consistent with Pedrosa (2013) who found that all offspring were rejected by the mothers before the end of the period of parental care. The abandonment of young sloths appears to be a strategy of the mothers to allocate energy for the next reproductive cycle, as the physiological cost during the reproductive period can influence survival and future reproduction (Hussel, 1972; Moreno, 1989). The mating and parental care periods can influence a host of attributes, such as territory extent and spacing (von Hardenberg *et al.*, 2000), the level of aggression or affiliative behaviors (Cavigelli & Pereira, 2000).

In our study, agonistic interactions seemed to be influenced by different factors in male and female sloths. Agonistic interactions between males occurred mainly during mating periods, and these interactions appeared to be due to competition for mates. On the other hand, agonistic interactions between females occurred in periods in which there

were females with young sloths and were apparently due to dispute for space. Nevertheless, considering our sampling effort, we cannot exclude other variants, which could be associated to agonistic behaviors in both male and female brown-throated three-toed sloths.

### ACKNOWLEDGEMENTS

The authors express their gratitude to anonymous reviewers for their comments and suggestions; to the Brazilian Federal Agency for the Support and Evaluation of Graduate Education (CAPES) for granting a scholarship to the first author; and to the staff of Área de Proteção Ambiental da Barra do Rio Mamanguape (APA) for transporting the young sloth to Centro de Triagem de Animais Silvestres (CETAS/IBAMA). This study was developed under SISBio/IBAMA permit number: 32731.

### REFERENCES

- Altmann, J. 1974. Observational study of behavior: sampling methods. *Behavior* 49: 227–267. <https://doi.org/10.1163/156853974X00534>
- Ballesteros, J., K. Reyes & J. Racero. 2009. Estructura poblacional y etología de *Bradypus variegatus* en fragmento de bosque seco tropical, Córdoba – Colombia. *Revista MVZ Córdoba* 3: 1812–1819. <https://doi.org/10.21897/rmvz.341>
- Beebe, W. 1926. The three-toed sloth *Bradypus cuculliger cuculliger*. *Zoologica* 7: 1–67.
- Bezerra, B. M., A. S. Souto, L. G. Halsey & N. Schiel. 2008. Observation of brown-throated three-toed sloths: mating behaviour and the simultaneous nurturing of two young. *Journal of Ethology* 26: 175–178. <https://doi.org/10.1007/s10164-007-0038-z>
- Carvalho, C. T. 1960. Notes on the three-toed sloth, *Bradypus tridactylus*. *Mammalia* 24: 155–156. <https://doi.org/10.1515/mamm.1960.24.1.152>
- Cavigelli, S. A. & M. E. Pereira. 2000. Mating season aggression and fecal testosterone levels in male ring-tailed lemurs (*Lemur catta*). *Hormones and Behavior* 37: 246–255. <https://doi.org/10.1006/hbeh.2000.1585>
- Chiarello, A. G. 2008. Sloth ecology: an overview of field studies. Pp. 269–280 in: *The biology of the Xenarthra* (S. F. Vizcaíno & W. J. Loughry, eds.). University Press of Florida, Gainesville.
- Eisenberg, J. F. 1981. *The mammalian radiations: an analysis of trends in evolution, adaptation, and behavior*. The University of Chicago Press, Chicago. 610 pp.
- Gilmore, D. P., C. P. Costa, A. Cabral, D. P. F. Duarte, I. Montgomery & C. A. Wilson. 1994. Further studies on reproductive function in three-toed sloth *Bradypus tridactylus*. *Medical Science Research* 22: 255–256.
- Gilmore, D. P. & C. P. Costa. 1995. The three-toed sloth in biomedical research: an update on the reproductive and endocrine systems. *Medical Science Research* 23: 579–581.
- Greene, H. W. 1989. Agonistic behavior by three-toed sloths, *Bradypus variegatus*. *Biotropica* 21: 369–372. <https://doi.org/10.2307/2388289>
- Hussel, D. T. J. 1972. Factors affecting clutch size in arctic passerines. *Ecological Monographs* 42: 317–364. <https://doi.org/10.2307/1942213>
- Lara-Ruiz, P. & A. Srbek-Araujo. 2006. Comportamento potencialmente reprodutivo da preguiça-comum, *Bradypus variegatus* (Xenarthra, Bradypodidae): observações de campo. *Edentata* 7: 44–46. <https://doi.org/10.1896/1413-4411.7.1.44>
- Moreno, J. 1989. Variation in daily energy expenditure in nesting northern wheatears (*Oenanthe oenanthe*). *The Auk* 106: 118–125. <https://doi.org/10.2307/4087752>
- Montgomery, G. & M. Sunquist. 1974. Contact-distress calls of young sloths. *Journal of Mammalogy* 55: 211–213. <https://doi.org/10.2307/1379274>
- Montgomery, G. & M. Sunquist. 1978. Habitat selection and use by two-toed and three-toed sloths. Pp. 329–359 in: *The ecology of arboreal folivores* (G. G. Montgomery, ed.). Smithsonian Institution Press, Washington.
- Pedrosa, E. P. 2013. Padrão comportamental, área de vida e estrutura populacional da preguiça-comum (*Bradypus variegatus*) em ambiente natural e urbano na cidade de Rio Tinto, Paraíba. Monografia, Universidade Federal da Paraíba, Paraíba. 32 pp.
- Pedrosa, E. P. & C. S. S. Castro. 2014. Behavior patterns of the common sloth (*Bradypus variegatus* Schinz, 1825) in urban and natural environments in Rio Tinto, Paraíba State, Brazil. *Brazilian Journal of Ecology* 1–2: 114–122.
- Pinheiro, S. D. 2008. Comportamento alimentar da preguiça comum *Bradypus variegatus* (Schinz, 1825) (Xenarthra, Bradypodidae) no parque centenário de Barra Mansa, RJ. Dissertação de Mestrado, Universidade Federal de Juiz de Fora, Juiz de Fora. 122 pp.
- Silva, S. M., C. L. Clozato, N. Moraes-Barros & J. S. Morgante. 2013. Towards a standard framework to describe behaviours in the common-sloth (*Bradypus variegatus* Schinz, 1825): novel interactions data observed in distinct fragments of the Atlantic forest, Brazil. *Brazilian Journal of Biology* 73: 527–531. <https://doi.org/10.1590/S1519-69842013000300010>
- Soares, C. & R. Carneiro. 2002. Social behavior between mothers × young of sloths *Bradypus variegatus* Schinz, 1825 (Xenarthra: Bradypodidae). *Brazilian Journal of Biology* 62: 249–252. <https://doi.org/10.1590/S1519-69842002000200008>
- von Hardenberg, A., P. Bassano, A. Peracino & S. Lovari. 2000. Male alpine chamois occupy territories at hotspots before the mating season. *Ethology* 106: 617–630. <https://doi.org/10.1046/j.1439-0310.2000.00579.x>

Received: 31 August 2016; Accepted: 24 April 2018