

BEHAVIOR PATTERNS OF THE COMMON SLOTH (*Bradypus variegatus* Schinz, 1825) IN URBAN AND NATURAL ENVIRONMENTS IN RIO, PARAÍBA STATE, BRAZIL.

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ABSTRACT

Little is known of the behavioral patterns of the common sloth (*Bradypus variegatus*) in urban environments, when compared to those in nature. In order to compare behavioral patterns in urban and natural environments, and investigate the impact of human intervention and the characteristics of an urban environment on these, sloths inhabiting the “João Pessoa” Square and the “Guaribas” Biological Reserve -“SEMA III”, both in Rio Tinto county, Paraíba State, were observed from April, 2011 to December, 2012 and from March, 2012 to January, 2013, by the "scan sample" and "all occurrences" methods of observation. ‘Resting’ was the most evident behavior in both environments, as a form of reducing energy loss due to the leaf-diet. In the square, sloths often defecated and urinated while hanging from tree branches, possibly in response to anthropogenic interference, manifested by people catching animals while defecating and urinating at the tree-base, and replacing them into the tree. Anthropogenic introduction of new sloths into the square led to an increase in the number of individuals (19 sloths), with the only diet resource comprising nine fig trees, thereby provoking mutual agonistic interaction. Restriction to a limited area within an urban matrix, with the only food-source *Ficus microcarpa* leaves, impeded displacement to natural areas, such as the nearby “SEMA III”, without *Ficus*, but with a variable tree-leaf source, thereby incurring the premise of linking the area on the left side of the square with nine fig-trees, to that on the right with eleven, but without sloths, as a means of at least increasing the home range. A further measure would be Environmental Education activities to change attitudes.

Key words: Behavioral adaptability; Human intervention; Population isolation, common sloths, *Bradypus variegatus*,

INTRODUCTION

Sloths belong to the order Pilosa, and are represented by the families Bradipodidae and Megalonychidae, comprising the genera *Bradypus* and *Choloepus*. The genus *Bradypus* is represented by the species *Bradypus variegatus* (Schinz, 1985), *Bradypus tridactylus* (Linnaeus, 1758), *Bradypus torquatus* (Illiger, 1811), and *Bradypus*

pigmeus (Anderson & Handley, 2000), all of which comprise the commonly known three-fingered sloths (20). Their two main characteristics are the three claws covered by a common tegument, on each of the four paws, whence the name, and the 8-9 cervical vertebrae which give them high neck flexibility for more ample visualization of the environment (17). On the other hand, those belonging to the genus *Choloepus*, known as two-fingered

sloths, are represented by the species *Choloepus didactylus*, Linnaeus, 1978 and *Choloepus Choloepus holffmanni*, Peters, 1858 (11, 25).

Species of the genus *Bradypus* possess three claws on the forelimbs, 5-7 cervical vertebrae, and a prominent muzzle with the presence of a pre-nasal bone (25). All sloths inhabit specific regions in the neotropics, with *Bradypus variegatus*, the most widely spread, occurring from Honduras to Argentina (24, 12). They are sensitive to extreme temperatures, and die when continuously exposed to intense heat (11), whence their distribution is restricted to tropical regions with only slight alterations throughout the year (17). Sloths of the genus *Bradypus* need to climb up to the sunlit tree-canopies in order to regulate their body-temperatures (9). Thus, characteristics of the vegetation can directly influence species ecological strategies (16).

In Brazil, there are also reports of the common sloth inhabiting urban squares and parks. (19,13). In the town of Rio Tinto, groups of sloth are to be found in natural fragments, as well as in squares in urban areas. Where the town is nowadays and prior to forming a township, there was Atlantic Rain Forest together with mangroves. Changes began around 1918, after the arrival of the Lundgren family. They began the building of a town and the installation of the Rio Tinto Cloth Mill. All was accompanied by deforestation, drainage, landfills in areas with mangrove, and the planting of eucalypti (18). Old residents tell of sloths having inhabited clusters of trees in the center of the town for more than 50 years, although they have no idea as to how they arrived, but suppose they became isolated as building expanded, or maybe they were even artificially introduced into these areas through the impossibility of movement to natural fragments.

As little is known of behavior patterns of the common sloth in urban

environments, it is of extreme importance to understand how similar or distinct these are from those in nature. Thus, the aim was to investigate patterns in urban and natural environments together, taking into consideration the impact of anthropogenic intervention and the characteristics of the urban environment itself. With this in mind, the following hypotheses were elaborated: 1) are there differences in the frequency of behavior manifestation in urban and natural environments; and 2) the type of habitat and human intervention in the urban environment has an influence on behavior and the number of individuals in the area.

MATERIAL AND METHODS

Study areas

The study was restricted to 'João Pessoa' square (0.6°4'23.29"S) and the Guaribas Biological Reserve – SEMA III (35°04'30.54"W), both located in Rio Tinto county, on the northern coast of Paraíba State, in northeastern Brazil. The square, the main point of reference for feasts and commemorations in the town, and surrounded by houses, bars, sidewalks and a church, contains 20 fig trees of the species *Ficus microcarpa*, distributed on the extreme right (11 trees) and extreme left (9 trees), separated one from the other by a street that splits the square in half. The square itself is bordered by sidewalks that are part of the remaining streets in the center of the town. The sloths inhabit the 9 trees located on the left side of the square. On the other hand, the Guaribas Biological Reserve is a Federal Conservation Unit for Integrated Protection, which is divided into three areas, viz., SEMA I, with 673,64 ha, SEMA II with 3.016,09 ha, both located in Mamanguape county, and SEMA III with 338,82 ha and located in Rio Tinto county. SEMA III possesses a matrix under strong anthropogenic pressure, through limitation to the south by the urban zone of Rio Tinto county, to the north and east by a road that gives access to the BR-101 highway, with

surrounding sugar-cane plantations, and to the west by rural properties (Figure 1).

Data collection

Data collection in João Pessoa Square was from April, 2011 to December, 2012, and in SEMA III during the period March, 2012 to January, 2013. The weekly four-hour observation sessions in the square took place every other day, in morning or afternoon shifts. In SEMA III, each session lasted 8 hours, and was divided in two shifts, one in the morning and the other in the afternoon, during one day of the week.

‘Resting’, ‘moving’, ‘feeding’, ‘self-grooming’, ‘agonistic interaction’, and ‘defecating|urinating’ were taken into consideration, when recording behavior patterns (Table 1). With the exception of agonistic interaction, scan sampling was the method used (1) when observing behavior, with recordings every 5 minutes. The ‘all occurrences’ observation method (1) was applied in the case of agonistic interaction, with registration of the duration of each conflict, and the number of individuals involved and their respective sex.

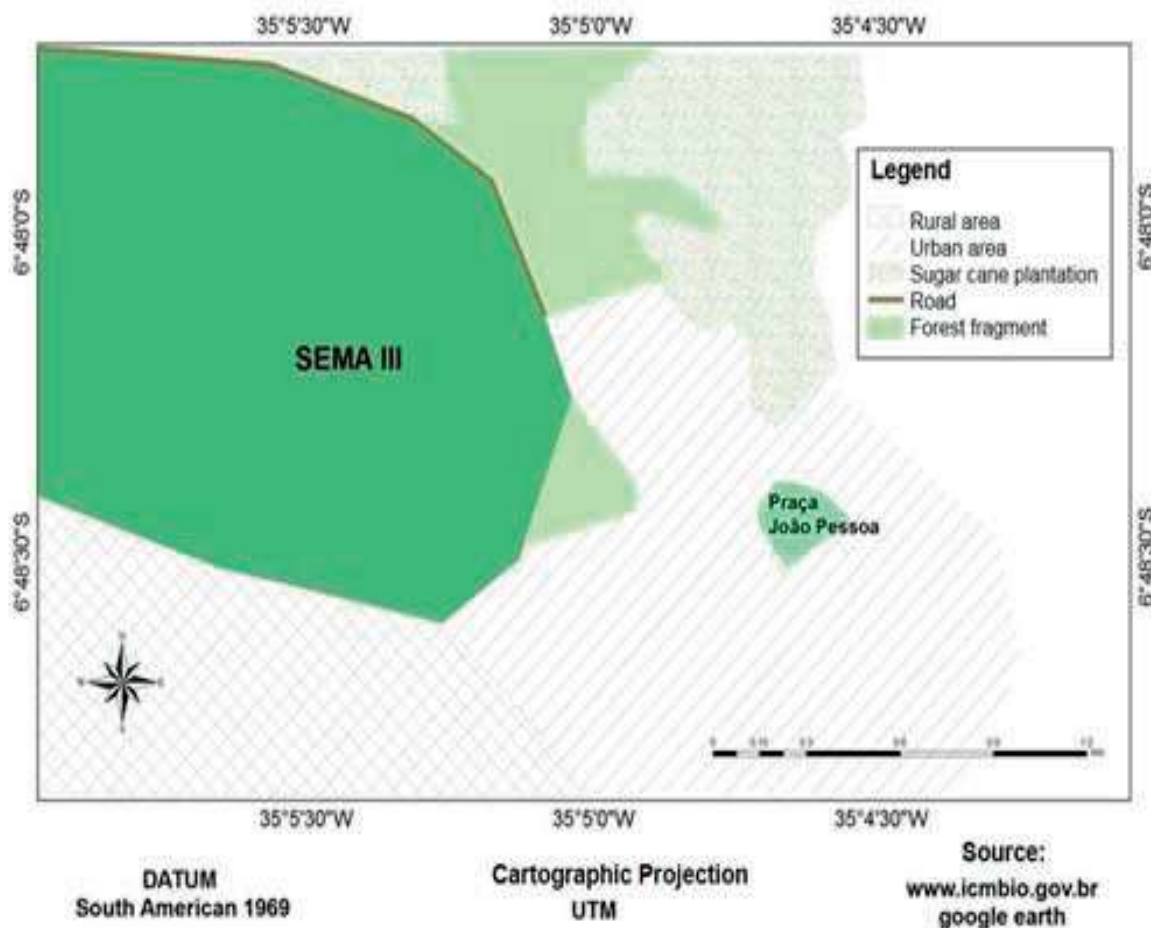


Figure 1: Location of study areas, “SEMA III” and ‘João Pessoa’ square.

Table 1: Description of behavior displayed by the common sloth in the “João Pessoa” Square and “Guaribas” Biological Reserve (SEMA III).

Behavior	Description
Resting	Without movement, individuals remain seated, lying down, hanging, or with the open front and hind limbs supported by the substrate.
Moving	Any vertical or horizontal movement is with alternative placement of the pelvic and thoracic limbs supported on the substrate, with alternate combination of the right thoracic limb and the left pelvic, and then the left thoracic and the right pelvic, the same also occurring during displacement among branches.
Feeding	Sloths transfer leaves to the mouth with the aid of one of the limbs, or reach for them by stretching the neck.
Self-grooming	Seated, lying down, or hanging head down and held by the claws, with quick and repetitive movements using the claws of one of the thoracic limbs, or alternating these movements with the claws of both thoracic limbs on the fur.
Agonistic Interaction	One of the thoracic limbs is raised, with display of the claws, while at the same time the body is held firmly onto the substrate by the three others. The free claw is used to forcefully hit, pull and squeeze any part possible part of the opponent's body. The victim may vocalize.
Defecating and/or Urinating	The animal descends from the canopy to the base of the tree. With the forelimbs grasping the trunk, and the hindlimbs giving ground support, it begins to defecate or urinate.

The Direct Counting Method (DCM) was used, when estimating the average number of sloths observed in each environment. This consists of counting all the individuals observed in an area of known size (3, 20). All the fig-tree canopies were placed under observation, and as the animals were perceived, the fact was instantly recorded. Individuals were differentiated by the color of the fur or by patches thereon. Males were distinguished from females by a black patch on the back, the so-called ‘speculum’ (25). As to age, youngsters comprised offspring under the mother’s care and small-sized juveniles, and adults those of large size, with or without the ‘speculum’.

Statistical analysis

Non-parametric distribution of behavior frequencies was obtained by Shapiro-Wilk normality testing. Due to the characteristics of the sample, the Kruskal-Wallis test, followed by the Dunn test, were applied to check for significant differences (5%) in frequencies of manifesting a certain behavior both in the same environment and between environments. Analyses were carried out with the BioEstat 5.3 program.

RESULTS

Although sloth behavioral patterns were alike in urban and natural environments, some behaviors were more displayed in one or the other. In the urban

area (João Pessoa Square), of a total of 1.384 behavioral records, 'resting' was the most predominant (50%), followed by 'moving' (22,5%), 'sel-grooming' (13,7%), 'feeding' (12,7%), 'agonistic interaction' (0,8%), and finally, 'defecating and/or urinating' (0,3%). According to the Kruskal-Wallis test ($H=9,243$; $p=0,0262$), there were significant differences in the behavior frequencies, 'resting' and 'feeding' (Figure 2). As regards 'defecating and/or urinating', there were differences, in that some individuals did so while hanging only by the forelimbs from the ends of branches. As regards 'agonistic interactions', this only occurred between two individuals of the same sex, as two males ($N=6$) or two females ($N=4$). At the onset, threatening was with the claws. During combat the claws of the forelimbs were used for tugging the opponent's body or limbs, with the aim of toppling from the branch. Some encounters were accompanied by shrill vocalization on the part of the victim, of short duration, no longer than five seconds. This occurred between one attack and the other.

Differences between behavior frequencies were also apparent in the natural environment (SEMA III). Of a total of 867 recordings, 'resting' was the most in evidence (86,5%), followed by 'moving' (7,2%), 'feeding' (4,0%) and 'self-grooming' (2,3%) (Figure 2). 'Agonistic interactions' and 'defecating and/or urinating' were not observed, probably due to the number of recordings being less than those obtained in the urban area. According to Kruskal-Wallis behavior testing ($p=0,0011$; $H=16,1545$), the difference between 'resting' and all the others registered behaviors was significant.

The number of sloths in the urban environment (João Pessoa Square) varied throughout the study due to births, deaths and the introduction of new sloths by residents of the micro-region of Mamanguape-Rio Tinto. At the beginning of the research in 2011, thirteen individuals

were counted, comprising ten adult males, two adult females and an offspring. During the same year, two females and two males, all adults, were introduced, two animals, a female and a male, both adults, died, there were four births, five offspring fell, four of which died and one was sent to the Center of Wildlife Selection (CETAS), thus fourteen sloths, all told. In 2012, there were five introductions, of which only one female and two adult males were identified, three births – one died and two were sent to the CETAS -, which gave a total of nineteen at the end of the survey. Of the adults that died, two were encountered dead in the fig-tree canopies and the respective offspring found fallen on the ground in the square. Births in the square, between 2011 and 2012, occurred in the months of April, May, June, July and December.

Twenty-eight individuals were counted in the natural environment (SEMA III). By the presence or absence of the speculum it was possible to identify fifteen females, eight males and five offspring. Births occurred in the months of August and December, 2012, all of which were encountered together with the mothers. Although there were no records of any offspring having died during the year, the dead body of an adult, this in an advanced stage of decomposition, was found.

DISCUSSION

The high 'resting' frequencies, in both environments, is a species characteristic, due to its low metabolism and a diet composed of leaves which contain a low energetic rate (12). For Cassano (2006), sloth inertness at certain times of the day could be related to body temperature control, since behavioral thermoregulation is a common characteristic among individuals of the order Pilosa, having been described for giant anteaters (4) and sloths of the family Bradypodidae (16,6).

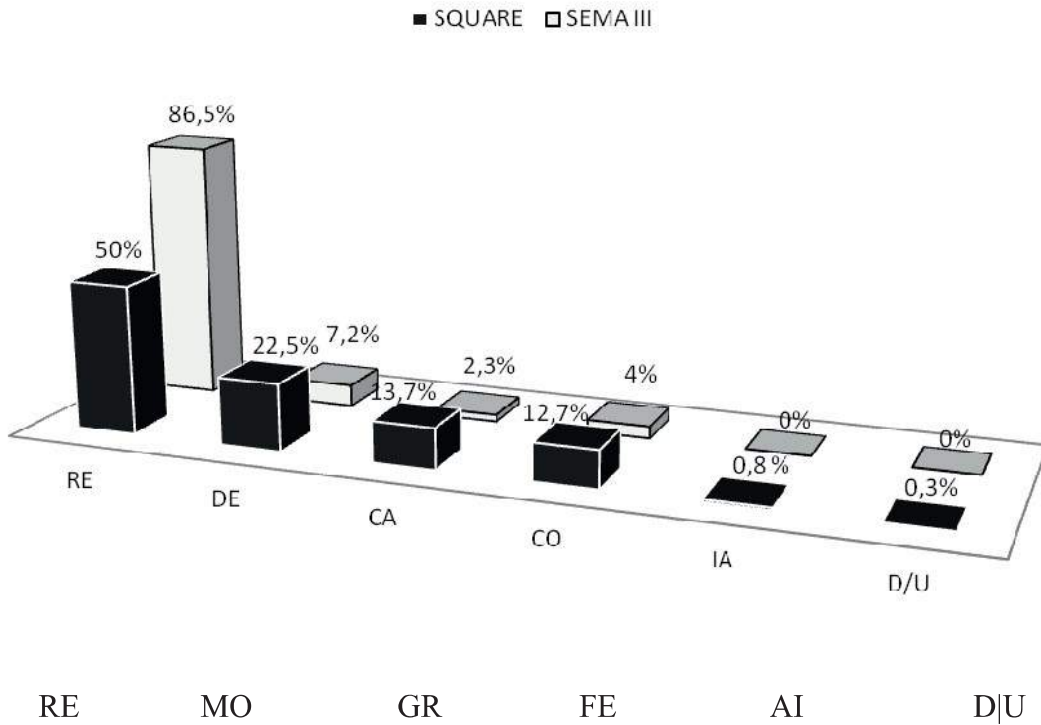


Figure 2: Frequency (%) of behavior displayed by sloths in João Pessoa Square and in SEMA III. RE=resting; MO=moving; GR= self-grooming; FE= feeding; AI= agonistic interactions; D/U= defecating and/or urinating.

In this study, agonistic interactions were only recorded in the urban environment. In a natural environment, this type of behavior is rare among sloths of the species *Bradypus variegatus*, due to its social structure, characterized as being composed of solitary individuals (20). According to Eisenberg (1981), the species social structure is noncontiguous. Even though agonistic interactions are rare, sloths are not considered as completely solitary, as they are prone to encounters with other individuals in nature, where interaction has been registered between individuals of the genus *Bradypus*, during periods of coupling, parental care (14,22) and agnostic encounters (2,10). It is presumed that agonistic interaction registered in the urban area (João Pessoa Square) is connected with high sloth-population density, whence the greater possibility of encounters between individuals, leading to competition for

food and sexual partners. The use of claws in agonistic interaction is not only exclusive for *Bradypus variegatus*, but also occurs among anteaters of the species *Myrmecophaga tridactyla* (21) and *Tamandua tetradactyla* (23). In the former these are used bent during combat (10).

Sloths defecate and urinate every seven or eight days (16). This is a consequence of the slow passage of food through the digestive tract, the interval between ingestion and defecation lasting 150 hours (8). Generally the common sloth chooses a particular tree to defecate and urinate at the base. These trees can be considered as a 'mode', since this is where they are most often to be found and where they concentrate the greater part of their activities (15). As was shown here, in the urban environment, individuals were observed to defecate and urinate hanging from the ends of the branches of the fig trees, a possible change in behavior due to

human interference, since on the various occasions in which individuals were encountered defecating or urinating at the base of the tree, they were picked up and placed in the upper branches.

Sloths inhabiting an urban environment, e.g., João Pessoa Square, undergo strong anthropogenic influence, due to the structure of the environment, and the introduction of new sloths on the part of local residents. Thus the number of animals is altered, not only by natural factors, but also through human intervention. The results show that, although there is reproduction among resident sloths, offspring do not reach the adult phase, as they die before weaning or immediately after birth. The females of *Bradypus variegatus* go through a period of parent care for 6 months (14), when weaning occurs, whereupon they, by themselves, change their habitat by moving to another place, to so avoid competition for resources with their own offspring. (16). As, in the João Pessoa Square, there is no way for the mothers to leave a fig tree to their offspring, they share all the 9 trees, not only with these, but also with other females and males, since isolation in a restricted urban area makes displacement, following the parent-care phase, impossible. Thus, precocious abandonment of offspring is extremely likely, as plainly apparent by the number of corpses encountered throughout the period of research.

CONCLUSIONS

The characteristics of the urban environment exert a direct influence on behavior frequency, as is the case of the sloths that inhabit the isolated urban environment of João Pessoa Square, and which are restricted to the canopies of fig trees and surrounded by an urbanized matrix, with the consequential hindrance in displacement to a natural environment. Furthermore, the diet is restricted to fig tree leaves, making it more difficult to

adapt the sloth to a natural areas, such as the Guaribas ReBio (SEMA III), without fig trees, but with a variety of others. In this perspective are necessary studies to investigate this aspect. The main forms of anthropogenic interference in an urban environment are the introduction of new individuals, and the direct contact of people with sloths, with the resultant change in habitual behavior, as, for example, defecating and urinating while hanging from tree-branches.

The obtained data point to the need for intervention to improve the quality of life of sloths in this urban environment. The introduction of a suspended rope bridge linking the nine fig trees on the right side of the square to the eleven located on the left, where there are no sloths, is an apparent way of increasing the living area, thereby facilitating sloth movement from one side to the other, and thus reduce competition. There is the need for implanting Environment Education activities amongst the community that use the square, as well as in the public schools of Rio Tinto. A further prerogative is to distribute pamphlets containing information on the behavior of sloths, with a view to changing attitudes, in the sense of not catching the animals when they are defecating and urinating at the tree-base, and not introduce individuals from the natural environment into an area with fig trees as the only food resource.

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RESUMO

Pouco se conhece do padrão comportamental da preguiça em ambientes urbanos em comparação com o do ambiente natural. Com o objetivo de investigar o padrão comportamental em ambientes urbano e natural, a influência das intervenções humanas e as características do ambiente urbano, preguiças que habitam a Praça João Pessoa e a ReBio Guaribas (SEMA III), Rio Tinto, Paraíba foram observadas de 04/2011 à 12/2012 e 03/2012 à 01/2013 pelos métodos de observação “varredura instantânea” e “todas as ocorrências”. O repouso foi o comportamento mais exibido pelas preguiças em ambos ambientes, estratégia para reduzir a perda de energia frente a sua dieta. Na Praça, algumas preguiças defecam e/ou urinam penduras nos galhos das figueira, uma mudança de comportamento em resposta à interferência antrópica, pois as pessoas pegam as preguiças quando essas estão na base das figueiras defecando e/ou urinado e as coloca de volta à árvore. As introduções antrópicas de novas preguiças na Praça levaram a um aumento no número de indivíduos (19 preguiças) que dispõem de apenas 9 figueiras para usar, promovendo interações agonísticas entre as preguiças. A dieta restrita as folhas de *Ficus microcarpa* limita uma translocação para áreas naturais como a SEMA III onde não há essa espécie de planta. Assim, faz-se necessário uma ligação das 9 figueiras do lado esquerdo da Praça com as 11 figueiras do lado direito, que não têm preguiças, para aumentar a área de vida, bem como implantações de ações de Educação Ambiental visando sensibilizar as pessoas para mudança de atitudes.

Palavras chave: Adaptabilidade comportamental; Intervenção antrópica; Isolamento populacional, Preguiça-comum; *Bradypus variegatus*.

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