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ÁREA DE USO E SELEÇÃO DE HABITAT DA PREGUIÇA-DE-COLEIRA (*Bradypus torquatus* Illiger, 1811) NO SUL DA BAHIA

NEREYDA ARACY FALCONÍ LÓPEZ

ILHÉUS-BAHIA-BRASIL

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Dissertação apresentada à Universidade Estadual de Santa Cruz, como parte das exigências para obtenção do título de Mestre em Ecologia e Conservação da Biodiversidade.

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Orientadora: Dr. Emerson Viera
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EXTRATO

A preguiça-de-coleira, *Bradypus torquatus,* uma espécie endêmica da Mata Atlântica Brasileira, é considerada vulnerável à extinção devido principalmente a perda de habitat. No sul da Bahia, encontra-se a maior população desta espécie, a qual apresenta a maior divergência genética entre as populações remanescentes. Devido ao seu grau de ameaça, existe uma necessidade premente de adquirir maior conhecimento sobre a ecologia desta espécie nessa região, para que se possa por em prática ações que favoreçam sua conservação. Estudos prévios sobre a ecologia da preguiça-de-coleira mostraram alta variação nos tamanhos das áreas de vida de indivíduos assim como a utilização de áreas perturbadas. No entanto, estudos que busquem entender a seleção de recursos ou habitat por esta espécie são inexistentes e podem trazer conhecimentos adicionais sobre os requerimentos ecológicos desta espécie. Para um melhor entendimento sobre a seleção de habitat, tem sido recomendado analisar este processo em diferentes escalas espaciais, já que algumas preferências não são constantes ao longo das escalas. No presente estudo foram estimadas as áreas de vida de sete indivíduos de preguiça-de-coleira em habitat com diferentes níveis de perturbação e foram identificadas preferências de habitat pela preguiça-de-coleira em quatro escalas espaciais através de coleta de dados espaciais usando radiotelemetria e obedecendo análises hierárquicas propostas por Johnson (1980) . O estudo foi realizado no município de Una, incluindo a Reserva Biológica de Una. Não foi encontrada relação entre os tamanhos de áreas de vida e níveis de perturbação. A preguiça-de-coleira se mostrou mais seletiva nas escalas mais finas (em nível de árvore e manchas florestais), enquanto nas duas escalas maiores (em nível de área de vida e paisagem), a evitação de áreas abertas foi o padrão que se repetiu. Seis dos componentes do habitat parecem ter maior influencia na ocorrência desta espécie, onde o que apresentou maior significância foi o DAP da arvore.

Introdução

A ecologia espacial frequentemente estuda os padrões de utilização do espaço pelos organismos, relacionando-os aos recursos disponíveis no ambiente (Mysterud & Anker, 1998; Horne *et al*., 2008; Powell & Mitchel, 2012; Powell, 2012; Spencer, 2012; Mitchel & Powell, 2012; Moorcroft, 2012). Está inserido no escopo desta o conhecimento da área de vida (‘’home range”) de um organismo e a seleção deste por algum recurso ou hábitat em especial. A área de vida de um animal pode ser definida como a área normalmente utilizada para as atividades do mesmo (Burt, 1943) e existirá ao longo de toda a vida do animal (Powell, 2012). O conceito de área de vida abrange muito mais do que o tamanho do ambiente utilizado por um animal. Encerra também um conjunto de informação sobre os lugares visitados em função dos recursos presentes neste, a fim de incrementar seu *fitness* e sobrevivência (Spenser, 2012). Deste modo, a qualidade e quantidade dos recursos selecionados pelo animal influenciam fortemente a área de vida de um animal. Esta seleção consiste na escolha do indivíduo por um recurso ou componente do ambiente. Um animal é considerado seletivo quando faz uso desproporcional de algum componente em relação à sua disponibilidade (Johnson, 1980).

O uso e seleção de tipos de habitat ou recursos por um animal vão depender das características ecológicas, comportamentais e fisiológicas deste. Desta forma, ao procurar por padrões e tentar identificar os itens selecionados, a escala na qual se analisa pode fazer diferença, uma vez que ao analisar escala maiores pode-se ocultar detalhes de seleção mais finas, em nível de microhabitats e recursos, bem como, ao analisar somente escalas menores pode-se perder informações importantes de padrões mais gerais, em nível de habitat e paisagem, as quais frequentemente embasam tomadas de decisão em conservação (Twes *et al.,* 2004, Morin *et al.,* 2005). Assim, recomenda-se que a seleção do habitat seja abordada em diferentes escalas. Johnson (1980) propôs quatro escalas para o estudo da seleção de recursos. Definindo a primeira, como a seleção do espaço feita ao nível da distribuição geográfica do organismo (primeira ordem); a

segunda, como a seleção feita por indivíduos para alocar sua área de vida dentro de uma paisagem (segunda ordem); a terceira, como a seleção de componentes do habitat dentro da área de uso do animal (terceira ordem) e; a quarta, como a escolha de um item específico dentre os disponíveis no componente do habitat selecionado anteriormente (quarta ordem). Adicionalmente, é possível fazer divisões em escalas mais finas (Kelt *et al.,* 1999; Moura *et al.,* Finlayson *et al.,* 2008).

Informações sobre a ecologia espacial de um animal podem fornecer conhecimentos sobre aspectos extrínsecos e intrínsecos do animal, desde os lugares para forrageio, lugares com maior competição ou presença de predadores e os estado mental do animal como fome e medo podem ser deduzidos (Powell, 2012). E este conhecimento ajuda a identificar os requerimentos básicos para a sua manutenção, o que é essencial no planejamento e execução de ações de conservação *(*Law & Dickman, 1998, Noss, 2002). Em geral, animais mais especializados tendem a ter um uso mais restrito sobre os recursos que se encontram disponíveis no ambiente, isso os faz mais sensíveis às mudanças no seu entorno. Um exemplo de uma grande especialização é a dos folívoros arborícolas, os quais apresentam estratégias físicas, fisiológias e comportamentais como consequência de sua especialização à folivoria e à vida arborícola (Eisenberg, 1978). Assim, o conhecimento das preferências destes animais se faz mais relevante do que animais mais generalistas, já que a diminuição ou perda de recursos chave destes animais pode prejudicar fortemente sua população. Estudos têm mostrado que alguns folívoros arborícolas são afetados pelos tamanhos das florestas na paisagem ou fragmentos (Smith *et al.,* 2013; Pope *et al.* 2004), bem como também pela cobertura do dossel (Anderson *et al.* 2007), pelo grau de perturbação do habitat (Meiselman *et al.,* 2008; Newell 2009), e pela complexidade estrutural da floresta (Giné, 2009; Hoffman, 2012).

A preguiça-de-coleira (*Bradypus torquatus* Illiger,1811), alvo deste estudo, é um animal com folivoria de alto nível. Em geral animais deste gênero (*Bradypus*) apresentam uma dieta constituída de 94 a 99% de folhas (Cassano, 2006; Chiarello, 1998b; Montgomery & Sunquist, 1978). Nos estudos sobre a dieta desta

espécie, encontrou-se que os gêneros de plantas mais consumidos em Santa Teresa, no Espírito Santo foram *Ficus, Micropholis, Mandevilla, Prunus* e Apocianaceae em geral (Chiarello, 1998b). Enquanto no Sul da Bahia, *Eriotheca, Virola, Brosimum* e *Brosimum* foram as mais utilizadas pelas preguiças-de-coleira (Cassano, 2006).

As preguiças-de-coleiras apresentam padrões comportamentais e fisiológicos similares a outros mamíferos folívoros arborícolas. Aparentemente os organismos desta espécie possuem limitações energéticas, consequência de uma dieta pouco calórica e rica em compostos secundários, as quais influenciam estes a terem baixo metabolismo, pelagem densa, letárgicos movimentos, reduzida locomoção diária, áreas de vida pequena, baixo orçamento de atividade e alta cripticidade para evitar gastos de fuga diante ameaças de predação (Chiarello, 1998a; Cassano *et al.* 2010; McNab,1978; Chiarello *et al* 2004), adaptações comuns ao grupo dos mamíferos folívoros arborícolas (Eisenberg,1978; Eisenberg,1983).

As preguiças estão entre as maiores espécies de vertebrados folívoros arborícolas. Estas têm um papel importante na reciclagem de nutrientes, já que apresentam uma taxa elevada de consumo de folhas e que depois devolvem quase a metade do material consumido em fezes, sendo uma fonte de nutrientes e minerais para o sistema (Montgomery & Sunquist, 1975).

Com relação ao uso do habitat, alguns estudos sobre a preguiça-de-coleira têm mostrado que estas podem fazer uso de ambientes perturbados, tais como florestas secundárias e cultivos de cacau sombreado com árvores nativas (Oliver & Santos,1991; Cassano *et al.,* 2011), bem como, em pequena escala, estas usam predominante árvores de grande porte com cipós (Barreto, 2007). Ainda é incipiente o conhecimento sobre a ecologia espacial desta espécie. Apesar de haverem estudos sobre uso de recursos e habitat, ainda não é conhecido como estes animais selecionam, ou se existe de fato seleção, por tipos de habitat ou recursos entre aqueles disponíveis no ambiente.

Atualmente a preguiça-de-coleira é considerada “vulnerável” à extinção nas listas vermelhas nacionais e internacionais de espécies ameaçadas de extinção (IUCN, 2012, Machado *et al.,* 2008). Recentemente, seu status de ameaçada mudou de “espécie ameaçada” para “vulnerável”, devido a um maior conhecimento sobre a sua extensão de ocorrência (Superina *et al.,* 2010). Esta é a única espécie de preguiça endêmica do Brasil e sua distribuição ocorre desde o sul de Rio de Janeiro ate o sul de Sergipe, onde recentemente se incluíram registros (Hirsch & Chiarello, 2011). Atualmente, o planejamento e a execução de ações para a conservação desta espécie tem sido uma preocupação do governo brasileiro, como documentado no Plano de Ação Nacional para a Conservação dos Mamíferos da Mata Atlântica Central – PANMAMAC (ICMBio, 2011). Entretanto, os estudos sobre aspectos ecológicos desta espécie são escassos, principalmente na região do sul da Bahia (Barreto, 2006; Cassano 2008; Cassano *et al.* 2011), a qual aparentemente é mantenedora de parte significativa de suas populações, bem como da população com a maior diversidade genética dentro da espécie (Hirsch & Chiarello, 2011; Oliver & Santos, 1991; Lara-ruiz, 2004; Lara-ruiz *et al*, 2005).

Em geral os estudos com diferentes populações da preguiça-de-coleira mostraram áreas de vida de tamanhos muito variáveis (0,44 a 16,2 há); (Cassano, 2006; Pinder, 1997; Chiarello, 1998; Chiarello *et al*., 2004). Isso pode estar relacionado com as particularidades de cada local. Neste contexto, foi tema do presente estudo avaliar aspectos da ecologia espacial desta espécie, incluindo área de vida e seleção de habitat, em uma paisagem variegada do sul da Bahia. Entendemos como variegada a uma paisagem que apresente uma proporção importante de floresta nativa e onde a conectividade ainda é elevada (Fisher & Lindenmayer, 2007). Além disso, esta região apresenta os maiores fragmentos de remanecentes de Mata Atlântica do nordeste brasileiro e a segunda maior do Brasil (Ribeiro *et al.,* 2009) formando um mosaico composto por florestas em diferentes estágios de regeneração, além de cabrucas e cultivos de seringa (Amorin *et al.,* 2008; Faria *et al.,* 2009; Pardini *et al.,* 2009). Esta dissertação é

composta de um único capítulo que foi escrito em forma de artigo científico, para ser submetido à revista Journal of Zoology.

ARTIGO

Home range and habitat selection by the maned sloth (*Bradypus torquatus* Illiger, 1811) in the northern Bahia, Brazil*

- Artigo científico a ser submetido para a revista Journal of Zoology.
  Autores: Falconi, N. L.; Vieira, E; Baumgarten, J.; Giné, G. A. F.

Home range and habitat selection by maned sloth (*Bradypus torquatus* Illiger, 1811) in the southern Bahia, Brazil

Resumo

Para entender melhor a área de vida devemos considerar os recursos presentes nela. O objetivo do presente estudo foi investigar como as áreas de vida da preguiça-de-coleira (*Bradypus torquatus)* são influenciadas pelas características do hábitat, bem como avaliar a seleção de habitat por estes animais em diferentes escalas espaciais. Sete indivíduos foram capturados e monitorados através de rádio-telemetria desde Maio do 2012 até Outubro do 2013. Foi encontrada uma grande variação entre as áreas de uso, de 0,95 a 27,8 ha (método MPC) e de 0,39 a 21,52 ha (método Kernel fixo). Foi analisada a preferência por tipos de vegetação e atributos de habitat em diferentes escalas. Não encontramos preferência por um tipo de vegetação em especial, entretanto, as preguiças evitaram áreas abertas nas escalas de área de estudo e área de uso. Em escalas menores, as preguiças apresentaram preferência por manchas de floresta com maior densidade de árvores, menor abertura de dossel e maior densidade de folhagem em estratos altos. Além disso, foram preferidas árvores altas, com maior DAP, maior altura da primeira bifurcação, com presença de lianas, bromélias, e emaranhados de lianas (cipós), bem como, com copas conectadas. Um modelo aditivo generalizado mostrou que 58,4% das ocorrências das preguiças foi explicada por nove variáveis, sendo DAP a variável mais relevante. Sendo assim, foi observado que a preguiça-de-coleira pode fazer uso de florestas em diferentes estágios de regeneração assim como cultivos agroflorestais, sempre que estas apresentem estruturas florestais. Contudo, ainda assim, ela mostra preferência por aspectos específicos da floresta, ao se considerar escalas menores.

Palavras-chave: Área de vida, seleção de hábitat, *Bradypus torquatus*, rádio-telemetria, estrutura florestal.

Abstract

For a better understanding of an animal's home range we must consider the resources present in the area. Therefore, our objective was to investigate how the maned sloth's (*Bradypus torquatus*) home ranges are influenced by the habitat's characteristics, as well as to evaluate the habitat selection by these animals in multi-spatial scale. Seven individuals were captured and monitored using radio-telemetry between May 2012 and October 2013. We found a wide variation between home ranges sizes, from 0.95 to 27.8 ha (MPC method) and 0.39 to 21.52 ha (fixed kernel method). We then analyzed the preference for certain types of vegetation and habitat attributes at different scales. We did not find any preference for a particular vegetation type, however the maned sloths avoided open areas at the larger spatial scales. On smaller scales, the sloths showed preference for patches of forest with higher tree density, lower canopy openness, and greater foliage density in the upper strata. Moreover, the sloths preferred large trees with greater DHB, higher first fork bifurcation, presence of lianas, bromeliads, tangles of lianas and connected crowns. A generalized additive model showed that 58.4% of sloth occurrences were explained by six variables; DAP being the most important variable. Thus, it was observed that maned sloths can make use of forests in different stages of regeneration and even agroforests. However, they show preferences for specific aspects of the forest, when smaller scales are considered.

Keywords: Home range, habitat selection, *Bradypus torquatus*, radio-telemetry, forest structure.

Introduction

The home range is the area used by an animal in its normal activities of food gathering, mating, and caring for young (Burt, 1943). A mammal born in its mother's home range and later it has its offspring in its own home range, in this way almost all external and internal factors of the biology of an animal are linked to the home range (Powell, 2012). To locate itself within its home range as well as to find the resources in that space the animal have a cognitive map (Powell, 2003; Powell & Mitchel, 2012). The cognitive map of its home range must allow the animal to make decisions that affect its fitness (Spencer 2012), and is continuously updated according to what it learns about the environment as well as with the changes in resource availability (Powell, 2003; Powell & Mitchel, 2012). So a better understanding of home range must have an approach in animal resources, since these are linked to a place (Mysterud & Anker, 1998; Horne *et al*., 2008; Powell & Mitchel, 2012; Powell, 2012; Spencer, 2012; Mitchel & Powell, 2012; Moorcroft, 2012).

Within the home range, we can find different habitats, and depending on the species, one or more can be preferred or avoided. Habitat selection is the choice of a component of the environment by the animal, which is considered selective when the animal makes disproportionate use of some component relative to its availability (Johnson, 1980). The habitat selection can be studied at different scales according to the organism and the responses obtained can vary according to the spatial scale studied (Meiselman & Doyle, 1996; Kelt *et al.,* 1999; Mysterud & Ankers, 1998; Morin *et al.,* 2005; Moura *et al.* 2005; Finlayson *et al.,* 2007). Johnson (1980) defined four hierarchical orders for the habitat selection analysis. The first refers to the geographic selection of the range of a species (first order), then the selection that determine the home range (second order), the third is the selection for habitat components within the home range (third order) and fourth is the selection for specific item from those available in the habitat component selected previously (fourth order). being possible finer division, or use another kind

of division (Kelt *et al.*, 1999; Moura *et al.,* 2005; Finlayson *et al.,* 2007). As we can see, the concepts of home range and habitat selection can be complementary, providing additional information beyond improving estimates of the extention of the used area (Mysterud & Anker, 1998; Horne *et al*., 2008; Moorcroft, 2012). Such complementary approaches may also lead to insights into behavioral, ecological and physiological patterns (Powell, 1994; Moorcroft, 2012; Powell, 2012; Powell & Mitchell, 2012).

The knowledge of spatial ecology allows us to identify the basic requirements for maintenance of an animal species, which is essential in the planning and execution of conservation actions (Law & Dickman, 1998; Noss *et al.,* 2002). Arboreal folivores (Eisenberg, 1978), can be affected by deforestation and fragmentation of their habitats (Stallings *et al.,* 1994; Pope *et al.,* 2004; Anderson *et al.,* 2007; Smith *et al.,* 2013) once they are animals that live exclusively on areas with forest structure forested areas, as mature forest, secondary forest and even agroforestry presenting forest structure. This is the case of maned sloth (*Bradypus torquatus)*, an arboreal folivore endemic to the Brazilian Atlantic forest, which is classified as vulnerable in Brazilian and international lists of threatened species (IUCN, 2013; Machado *et al.,* 2008). It is threatened mainly by habitat loss and fragmentation (Aguilar & Fonseca, 2008; Chiarello *et al.,* 2004, Oliver & Santos, 1991). This species is confirmed to inhabit isolated remmants of Atlantic forest present from central portion of Rio de Janeiro to southern Sergipe (Hirsch & Chiarello, 2011), this biome today 84 to 89% destroyed (Ribeiro *et al.,* 2009). Given the high forest cover, the region of southern Bahia apparently maintains a significant portion of maned sloth populations, as well as the population with the highest genetic diversity within the species (Hirsch & Chiarello, 2011; Oliver & Santos, 1991; Lara-Ruiz, 2004; Lara-Ruiz *et al.,* 2005).

Some previous behavioral studies have been conducted on this species. These have shown a wide variation in the individual home ranges of maned sloth. Sloths home ranges varied from 0.44 to 5.73 ha in southern Bahia (Cassano, 2006), 1.6 to 10.9 ha in the Espírito Santo state (Chiarello, 1998, Chiarello *et al.,* 2004) and 4.7 to 16.2 ha in Rio de Janeiro (Pinder, 1997). According Chiarello

(2008), these variations in size of home ranges may be related not only to the methodologies used, but also to specific features related to the forest. However, no studies have been conducted to evaluate this influence or habitat selection by this species through use-availability data considering forest structure.

It is known that maned sloth use native forest, as well as can also use shaded cocoa plantations (Cassano *et al.,* 2011), and other types of disturbed habitat (Oliver and Santos, 1991; Chiarello *et al.,* 2004). In the same way, this pattern has been observed in other species of sloths, which besides making use of cocoa crops may also travel great distances in open areas in search of preferred tree species (Vaughan *et al.,* 2007).

In this context, the present study aims to obtain information on aspects of spatial ecology of maned sloth in the southern Bahia, including home range and multi-scale habitat selection. Studies in this region can provide interesting insight into the fitness of maned sloths to habitat characteristics once this region present a mosaic of fragments with remnants and secondary forests in different stages of regeneration, inserted in a matrix of rubber tree plantations and traditional crops of cocoa locally know as ‘cabrucas’ (shaded with native forest) (Faria *et al.,* 2009; Pardini *et al.,* 2009; Amorin *et al.,* 2008). In this way, we aimed to estimate the home range located in different habitat categories and test for differences related to the level of perturbation. Besides that, we intended to identify the habitat characteristics selected at different habitat scales and which of those characteristics are more influential on the occurrence of this species. Considering that resources are more widely dispersed in mature forests, since southern Bahian forest have 458 species of woody (Thomas et al, 2008). And secondary forest or more disturbed areas, used to be the opposite, where some species use to be dominant. We expect higher home range in these areas.

Since maned sloths are specialized arboreal folivores, we also expected a high level of selection at the scales of this study and a high sensitivity to disturbed areas. Whereas the structure of the forest will be modificated with smaller trees, more gaps and so on. In any way, this new knowledge might help in making

decisions on action plans for the conservation for the maned sloth, as part of the Brazilian National Plan of Action for the Conservation of Mammals of the Central Atlantic (ICMBio, 2011).

Materials and methods

Study area

Research was conducted in remnants of Atlantic Forest from Una Biological Reserve (Rebio-Una) and neighboring farms, located in northeastern Brazil, southern Bahia state, municipality of Una (39 ° 18 'to 39 ° 00 W, 15 ° 23' to 15 ° 03 'S) (Fig. 1). In this region, a Southern Bahian Wet Forest originally dominated (Thomas, 2003), with canopy height between 25 and 30 meters and abundant epiphytes and woody lianas (Amorin *et al*., 2008). The weather has an average rainfall around 2000 mm/year, with no regular dry season (Mori *et al.*, 1983), and annual temperature between 24 to 25 º C (Mori *et al.*, 1983). In this region, occur the largest forest fragments of Atlantic Forest from northern of Brazil. And the study area (Una and neighbor municipalities) have 25.78% of cacao agroforest,19.02% of secondary forest, 8.88% of mature forest and 5% of lands with other classes of cover (Landau et al., 2008). At the moment Atlantic Forest contain less than 16% of the original area (Ribeiro *et al.,* 2009). The forest fragments are embedded in a matrix of disturbed environments, but with forest structure, such as shaded cocoa plantations and secondary forests in initial state (Pardini *et al*., 2009).

Data collection

Seven individuals, six females and one male, were captured (Table 1) with physical immobilization following the technique used in previous studies (Chiarello, 1998 b; Chiarello *et al*., 2004; Cassano 2008; Cassano *et al.,* 2011) between May 2011 and March 2012. The sloths were fitted with ball-chain collars attached to VHF radiotransmitters (TW3SM, model, Biotrack Ltd.), weighting 30 g (<1% of the

weight of the animals). After biometrics data collection and tagging, four sloths were immediately released in the same tree where they had been captured. Three maned sloths (BT171, BT323 and BT033) were translocated to a forest remnant because those were found in villages next to the reserve, in order to ensure their safety. Another animal was also captured, an infant male (BT133) but the collar fell off early (less then three months after release), so we did not considered it for analysis.

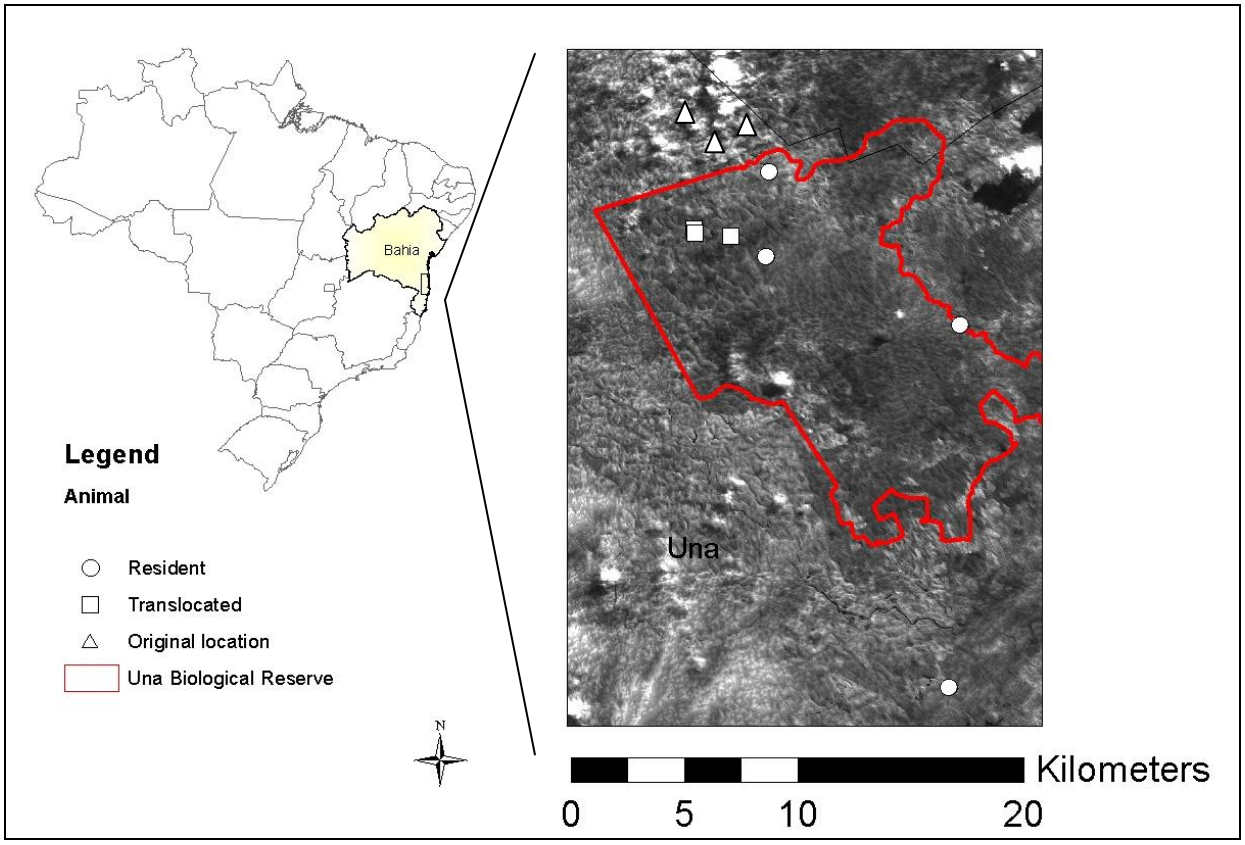

Figure 1 Location of the Una Biological Reserve in Bahia state, northeastern Brazil, with the indication of the geographic position of the seven *B. torquatus,* residents (BT122, BT163, BT182, BT393) and translocated with their original location (BT171, BT323, BT033) BT individuals radio-tracked in the Una's municipality. Dark gray areas indicate forest habitats.

Seven days after being released with transmitters, the animals were radiotracked and found by homing in on the animal method (Mech, 1983) with the aid of a receptor (TR-4,Telonics) coupled to an antenna of three elements (Yagi Telonics). Data was collected one to three locations (fixes) per week for each individual, during 8 to 17 months totalizing 23 to 50 recorded fixes per animal (Table 4). Sloths were always found in trees, thereby each tree used by the animals was marked with a flagging and its geographic position was recorder with Global Position System equipment (GPSMAP 60CSX, Garmin). Then, in order to obtain more geographic precision of the locations, we mapped these trees and obtained their geographic position, as detailed in Giné et al. (2012), by measuring angles and distances between the marked trees and mapping using the GPS TrackMaker 13.8 program (Ferreira Jr., 1998). The geographic coordinate was taken directly by GPS for trees over 50 m away from other trees. For each tree marked, the following measures were taken: circumference at breast height (CBH), tree height, height of the first mean fork, presence of lianas, presence of tangled lianas, presence of bromeliads and connected crowns. Also, 100 m^2 plots were established surrounding each measured tree, all the measures mentioned previously were taken for each tree inside. In plots, the density of trees (trees number per 100 m^2), canopy opening (analyzed by Gap Light Analyzer program 2.0 (Frazer *et al.,* 1999) and vertical structure of vegetation were estimated. Tree measures were taken in the center of the plot for the canopy opening and the vertical structure of vegetation. For the last one measurement we used a 3 m pole to allow a vertical sighting that helps to estimate the foliage density (in percentage) at each stratum (0-10m, 10-15m, 15-20m, 20-25m and more than 25m), modification of Hubbell e Foster (1986). All these measures were also repeated at random locations. For such locations we randomized points into the home range corresponding to the same number of marked trees used by the sloths. Then we chose the closest tree and established 100-m^2 plots as explained previously.

Data analysis

Home ranges were estimated using only one location per week for each individual to increase independence between successive locations, as was made in previous studies (Cassano, 2006). The home range was estimated using the 100% Minimum Convex Polygon method (MPC) (Mohr, 1947) and the 95% fixed kernel estimator (Worton, 1989) with bandwidth (h) estimated by Least Square Cross Validation (LSCV). The core area sizes were estimated by fixed kernel method based on 50% of the utilization distribution. These analyses were made using Home Range Tools (HRT) (Rodgers *et al*, 2007) extension of the program Arc GIS 9.3 (Environmental Systems Research, 2008). To check if the home range stabilized we examined a cumulative curve of home range size by MPC method in relation to the sample size for each animal using animal movement extension, v.2.04 (Hooge & Eichenlaub, 1997) of ArcView GIS program, version 3.2 (Environmental Systems Research, Inc. 1999). And to check the independence of the fixes we calculated the Schoener ‘s Index for each individual.

We used a Mann-Whitney test to test if the home range sizes varied according to habitat disturbance. For that we categorized the individual home ranges in two groups, regarding their location in less and more perturbed areas. Less disturbed areas were those with more than 50% forest cover consisting of late secondary or mature forest and more disturbed areas were those with more than 50% of forest cover consisting of initial stages of secondary forests or forested crops.

Habitat selection analysis was made in four scales: second order as the selection that determine the home range, third order as the use of habitats types within the home range, fourth order as the choice of a specific item (patch) from the available in the habitat selected in the third scale (suggested by Johnson,1980). Besides that we divided these scales still more finely, by adding a fifth order which refers to the trees used within the patch selected (as suggested by Hoffman, 2012).

Table 1. Description of habitat categories of used and available for maned sloth (*Bradypus torquatus*) within the home ranges and study areas (third and second order respectively).

Habitat categories	Description
Mature forest / old secondary forest	Mature forest: forest with minimal anthropogenic effects to the point of not affect significantly its original structure. Old secondary forest: physiognomy dominant for tree, forming a closed canopy and relatively uniform in size and may have emergent trees, average height greater than 12 m, emerging species occurring with varying degrees of intensity, broad flat upper canopy, epiphytes present in many species and with great abundance, DHB greater than 18 cm, usually woody vines, litter abundant and biological diversity due to the very large structural complexity, herbaceous, shrubby and especially trees, understory usually less significant than in the middle stage.
Intermediate secondary forest/ young secondary forest	Intermediate secondary forest: physiognomy dominant for tree or shrub over herbaceous, can constitute differentiated strata, the average height from 5-12 m, tree cover ranging from open to closed, with the possible occurrence of emerging individuals, DBH 8-18 cm, appearing epiphytes with larger numbers of individuals and species in relation to early stage, climbers, when present, predominantly woody litter present, varying in thickness according to the seasons and location, significant biological diversity, this understory. young secondary forest: physiognomies herbaceous / shrub with an average height of less than 5 m, DBH less than 8 cm; epiphytes, if any, are represented mainly by lichens, mosses and ferns, with low diversity; creepers, if present, are usually herbaceous, litter, when existing form a thin layer little decomposed, continuous or not, biological diversity variable with few tree species, and may have seedlings of other species characteristic stages; abundant pioneer species, absence of understory.
Forested crops	*cabruca:* cocoa crops shaded by native trees. Jackfruit plantations: areas of jackfruit (*Artocarpus heterophyllus)* trees, which are large-sized trees (growing to about 25 meters). In the study area included only small areas.
Open areas	Included areas without forest cover such as pastures y monocultures.

Table 2. Description of structural variables of the patches used and available for maned sloths (*Bradypus torquatus*). (fourth order).

Measured variable	Description	Unit
Trees density	Number of trees within the patch with a circumference at breast height (CBH) larger than 10 cm.	Trees per 100m²
Canopy openness	Percentage of canopy openness estimated for a photo analyzed by Gap Ligth Analizer program. We took tree pictures for each plot and used the mean as a final data.	Openness (%)
Vertical structure of vegetation	Visually estimation, modification from Hubbell e Foster (1986). where we used a stick which projecting helps to estimate the height and estimate a percentage for foliage (including branches and leaves) in each stratum. We made tree measures for each patch and used the mean as a final data. The same methodology was used for all habitat categories.	Foliage density (%)

Table 3. Description of tree attributes used and available for maned sloth (*Bradypus torquatus*). (fifth order).

Measured variable	Description	Unit	Categories
DBH	Only considered trees with more than 10 cm of circumference at breast height (CBH) measuring at 1.3 m of the ground. DBH was calculated as: DAP = CAP / π	Centimeters	<10; 10-20; >30.
Tree heigh	Visual estimated by using a stick of 3 meters that helps with the height estimation. Measures were made by the same observer.	Metres	<12; 12-18; >18.
height of the first mean fork	Estimation of the mean fork closer to the ground, measuring like tree height. For trees without woody branch we consider the same to the tree height, as well with the broken ones.	Metres	<7; 7-10>10.
lianas presence	Presence of lianas in the tree with diameter above 1 cm.	-	present; absent.
tangled lianas presence	Presence of tangled lianas in the tree.	-	present; absent
bromeliads	Presence of bromeliads with more of 20 cm of basal area in the tree.	-	Present; absent.
number of connected crowns	Tree crowns touching by crowns of other trees.	-	Connected; not connected

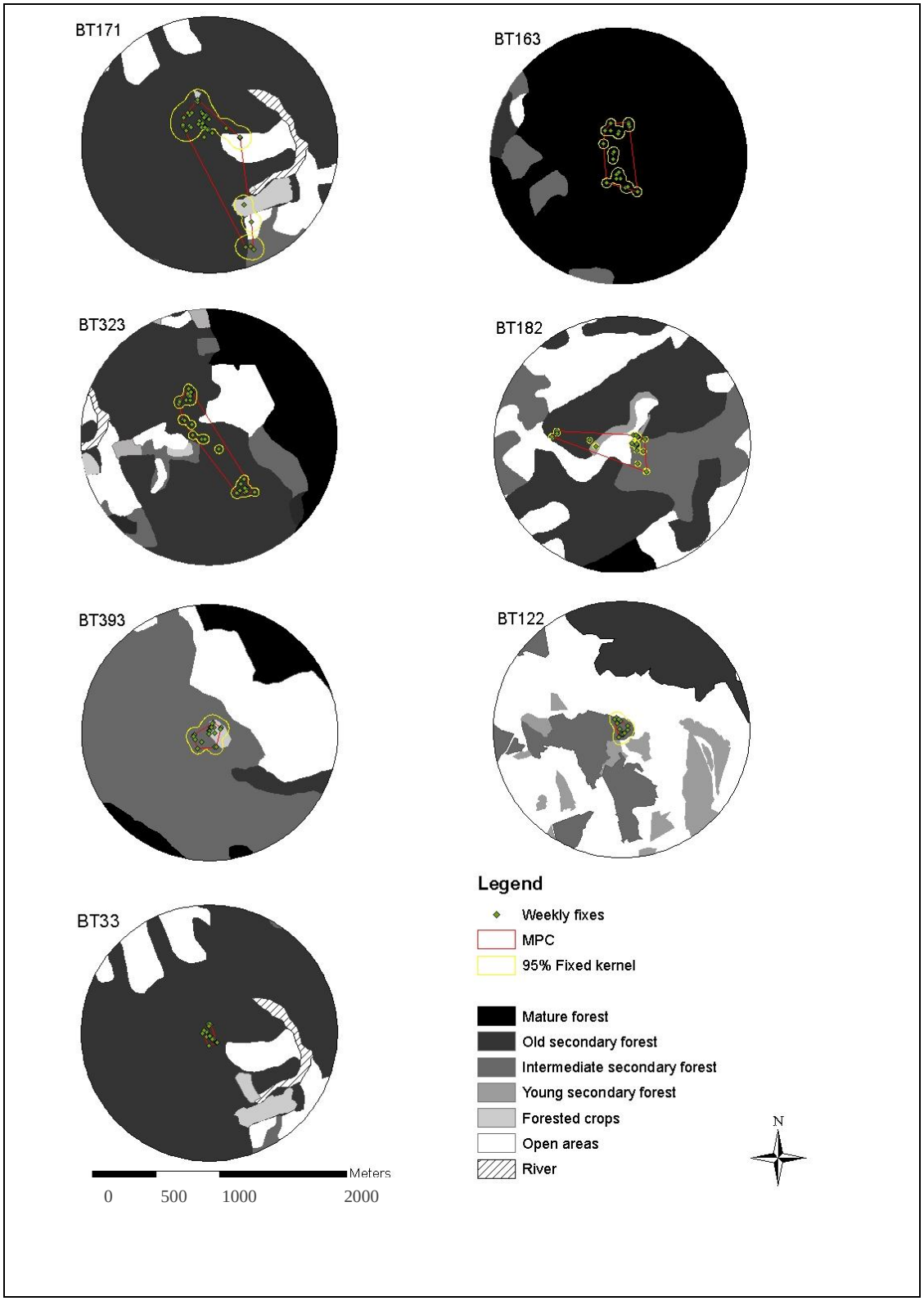

Figure 2 Vegetation types (habitat) present within of the study areas delimited by circular buffers of radius equal to 1000m around the center of each maned sloth's home range radiotracked in southern Bahia.

In order to delimit the area to be analyzed in the second order scale, a buffer of 1000-m radius around the center of each sloth's home range was plotted. This radius was based on the distance from the center of the home range to the more distant location of a tracked sloth (Fig. 2), as this analysis look for the animal choose to locate its home range in the landscape. Habitat selection analysis were made from the home range estimated by 95% fixed kernel methodology and using the habitat categories explained in the table 2, for the second and third order. We compared the proportions of area of each habitat category within the animals home range with those available in the buffer area (second order), the proportion of locations in habitat categories with the proportion of area of those in the home ranges (third order). Then compared the relative frequency of the measured structural variables (Table 3) of used plots compared to random ones in the home range (fourth order). And the relative frequency of the attributes (table 4) measured from the trees used by sloths compared to the other trees within the same plot (fifth order).

Habitat selection analysis were made using Resource Selection v.1. (RSW) program for Windows (Leban, 1999). We employed $\chi 2$ tests to detect any resource used disproportionately to its availability (Neu *et al*. 1974) and Bonferroni confidence intervals were used to identify whether the use was higher or lower than the availability (Byers *et al.* 1984). Finally, we used generalized additive models (GAM) to explain which of all these factors might explain better the presence of the sloths. For this analysis we used 'mgcv' package (Wood, 2011) for R environment (R Development Core Team, 2011). In this case, we considered the data of locations as occurrence and the randomly selected points as measured absence points.

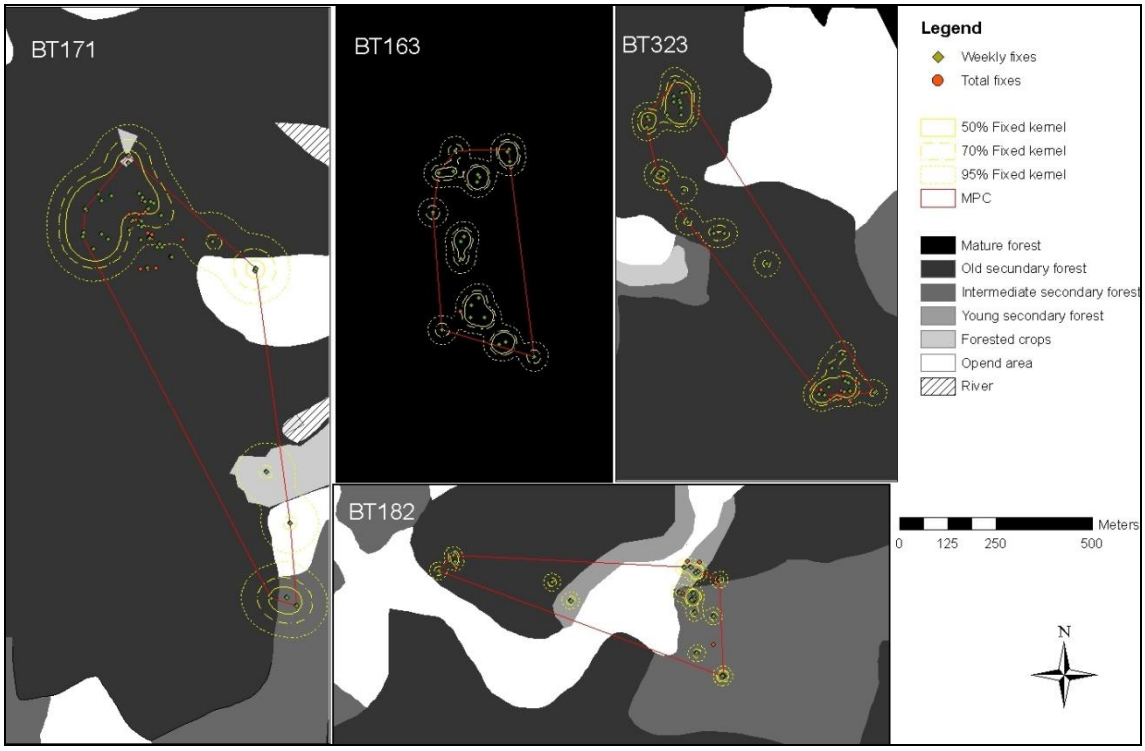

Figure 3 Home range by 100% MPC and 95%, 70% and 50% Fixed kernel for four *B. torquatus* individuals (BT171, BT163, BT323, and BT182).

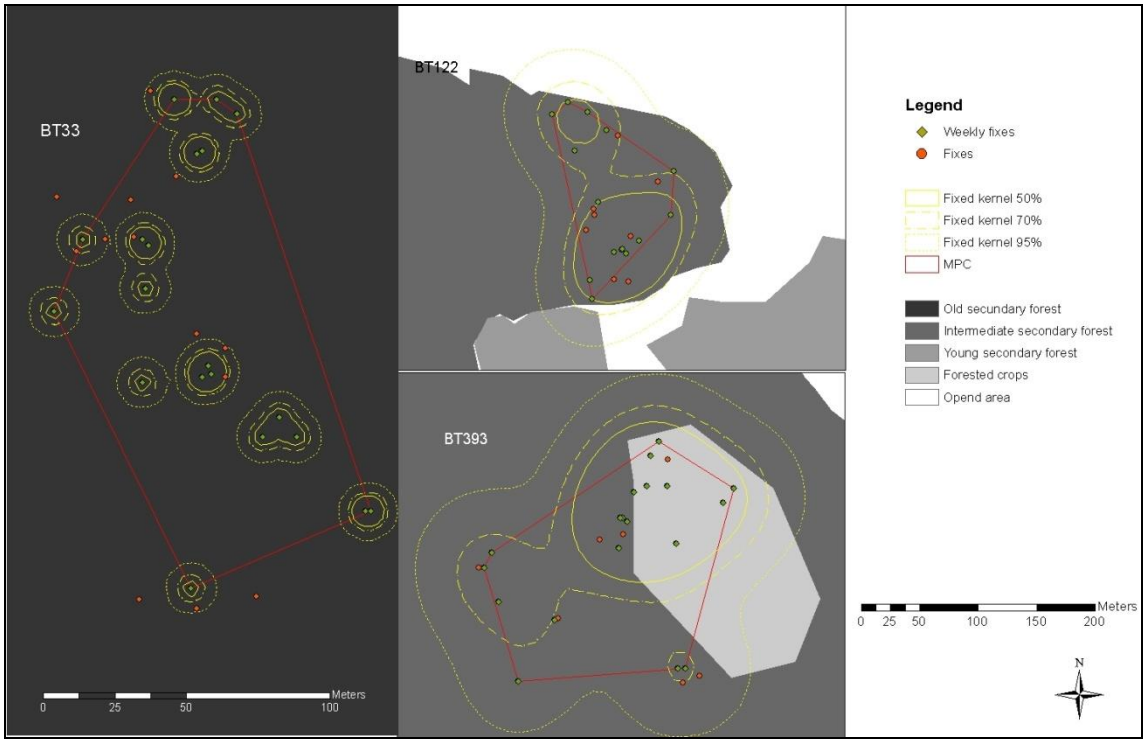

Figure 4 Home range by 100% MPC and 95%, 70% and 50% Kernel for three *B. torquatus* individuals (BT33, BT122, and BT393).

Results

Home range

The home range calculated by the MPC method based on seven individuals, had a mean ± SD of 9.89 ± 9.52 ha. Considering the 95% kernel fixed the mean ± SD was value was 6.88 ± 6.95 ha. The home range cumulative curves stabilized for most individuals, except BT171 and BT182, whose curves suggested that home range would continue increasing. See appendix A.

With the exception of the individual BT393, the sloths showed more than one core area and those were throughout the home range. For 70% the mean was 2,8 2 (ha) ± 2,79 SD and for 50% 1,58 (ha) ±1,39 SD. We did not observe a significant effect of habitat category on the home range sizes (U = 9, df = 1, p = 0,289)

Table 4. General information of the captured maned sloths and radio-tracking sample in southern Bahia, Brazil. Estimates of home ranges using minimum convex polygon (MPC) method and 95% Fixed kernel. And the value of Schoener's Index for each individual of maned sloth.

Animal	Sex[1] / Age	Treatment	Monitoring Period	Fixes (Weekly)	MPC (ha)	95% Fixed kernel (ha)	50% Fixed kernel (ha)	Schoener's Index[3]
BT171	F/adult	Translocated	May2011-Dec2011	23(23)	27,8	21,52	4,61	0,11
BT163	M/Sub-adult	Resident	Jun2011-Jan2012	24(23)	10,64	6,89	1,54	**1,89**
BT323	F/Sub-adult	Translocated	Jul2011-Ago2012	50(34)	13,71	6,59	1,35	0,21
BT393[2]	F/adult	Resident	Dec2011-Out2012	36(24)	2,92	7,14	1,53	1,3
BT182	F/adult	Resident	Jan2012-Out2012	43(21)	11,5	2,35	0,43	1,26
BT033	F/Sub-adult	Translocated	Mar2012-Out2012	41(21)	1,09	0,39	0,86	0,1
BT122	F/adult	Resident	Apr2012-Out2012	34(18)	0,95	3,32	0,78	0,59

[1]The age classification was in base of Lara- Ruiz (2004).[2]This was a female with an offspring.

[3]Schoener's Index considerer independence if the value is less 1.6 or more than 2.4.

Habitat Selection

The results indicated similar habitat selection at the two highest scales analyzed (second and third orders, Fig. 5). The habitat selection analysis at the buffer scale (second order) showed that the use of vegetation types by sloths was different from random (x^2 = 306.2, d.f. = 3, p < 0.0001). Sloths preferred intermediate-young secondary forest and forested crops, avoiding open areas. The use of mature forest did not differ from the available. At home range scale (third order) the analysis indicated that sloths apparently do not prefer any vegetation types. Nonetheless they avoided open areas (x^2 =25.8, d.f. = 3, p < 0.0001).

At the scale of patches of forest within their home ranges (fourth order), the sloths preferred patches with higher density of trees, avoided densities less than 20 individuals per 100 m² (x^2 = 449.3, d.f. = 2, p < 0.0001). Canopy opening between 10% and 20% was preferred with the avoidance of values smaller than 10% and greater than 20% (x^2 = 90.3, d.f. = 2, p < 0.0001)

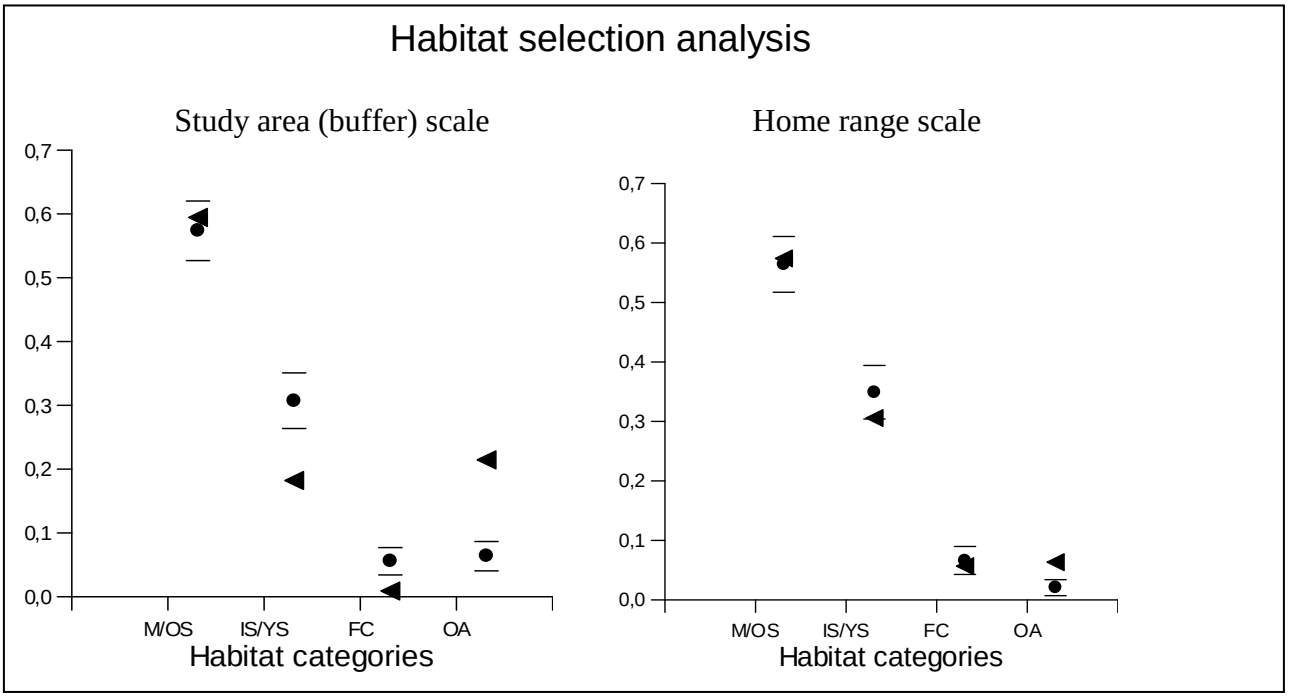

Figure 5 Habitat selection analysis by χ2 tests at study area scale (second order) and home range scale (third order) for *B. torquatus*. Proportion used is indicated by circles, and proportion available by triangles, Bonferroni's intervals are indicated by horizontal lines. Codes: Mature forest and old secondary forest (M/OS), intermediate and young secondary forest (IS/YS) forested crops (cocoa shade plantation and jacks fruit plantation are included; FC), and open areas (including monocultures; OA).

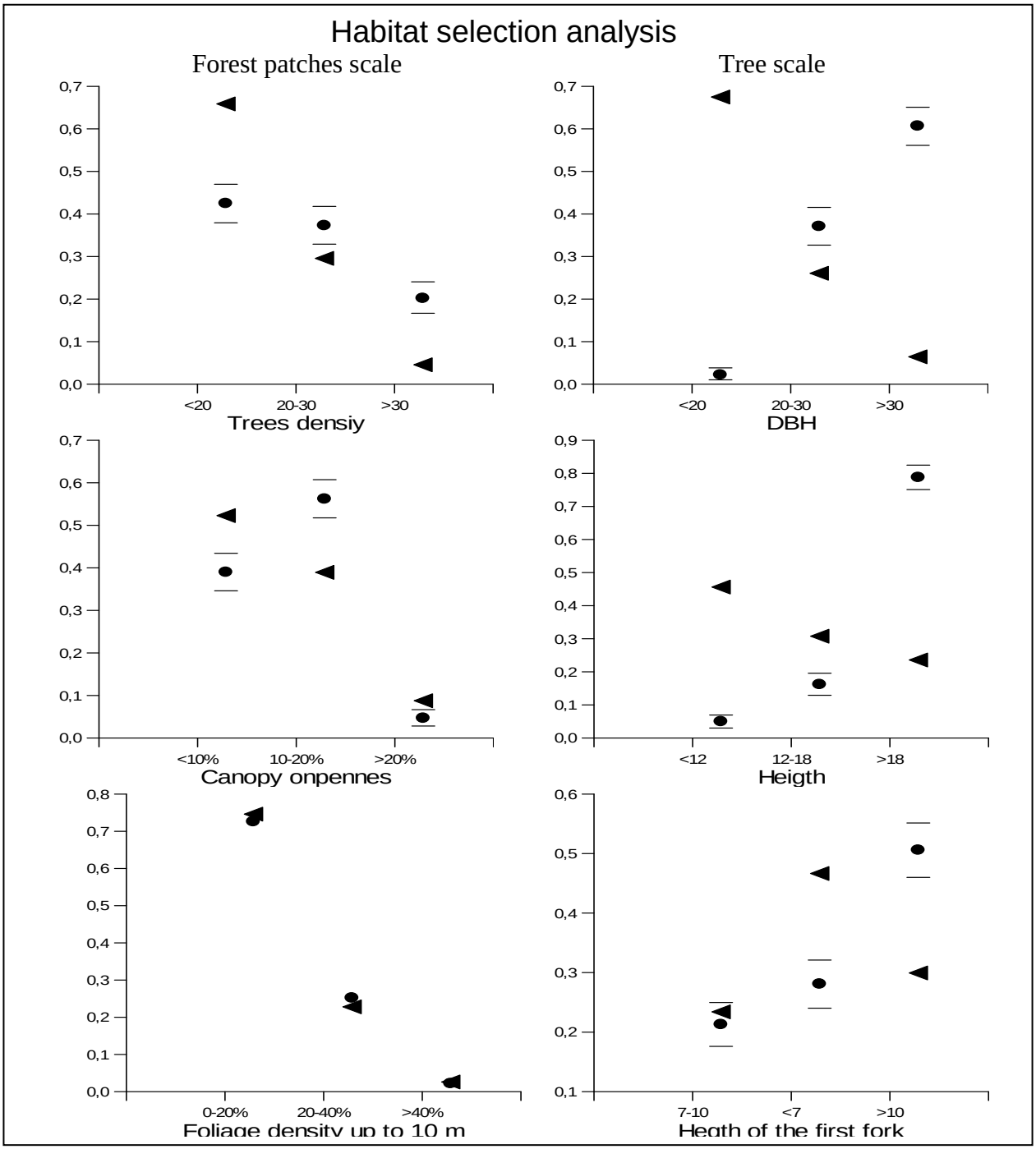

Fig. 6. Habitat selection analysis by χ2 tests at forest patches scale (fourth order) and tree scale (fifth order) for *B. torquatus*. Proportion used (Circles), proportion available (triangles), Bonferroni's intervals (lines).

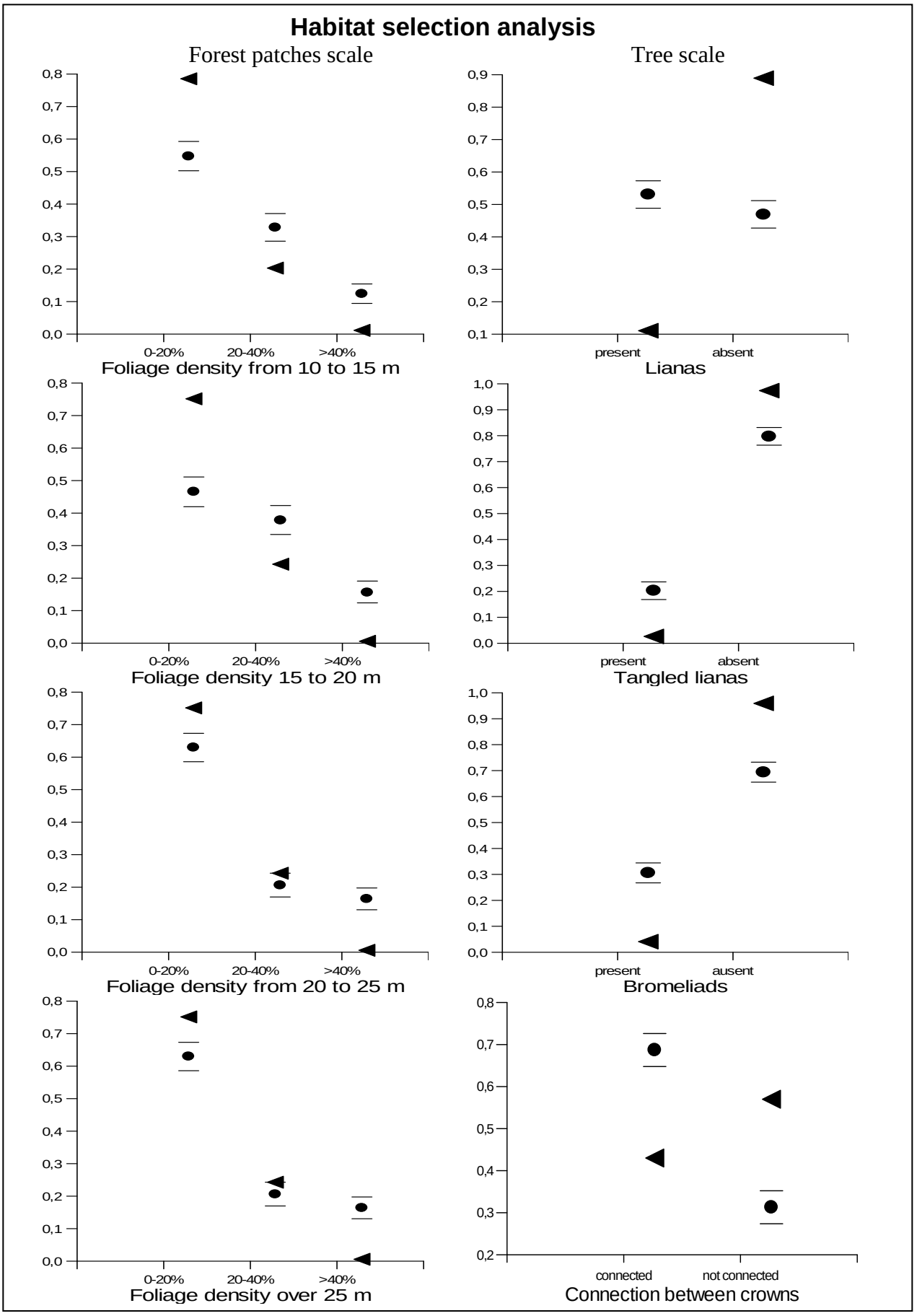

Fig. 7. Habitat selection analysis by χ2 tests at forest patches scale (fourth order) and tree scale (fifth order) for *B. torquatus*. Proportion used (Circles), proportion available (triangles), Bonferroni's intervals (lines).

The sloth preference for forest patches changed slightly according to the vertical structure of vegetation. Sloths preferred forest patches with more cover in the strata above 10 m. No preferences were detected for changes in foliage density in the stratum less than 10 m for either chi-square (x^2 = 2.6, d.f. = 2, p = 0.2596). On the other hand, patches with foliage density higher than 20% in the strata between 10 to 20 meters were preferred (10-15 m: x^2 = 878.5, d.f. = 2, p < 0.0001; 15-20m: x^2 = 2883.4, d.f. = 2, p < 0.0001) and those with foliage density less than 20% in this strata were avoided. At strata higher than 20 m, only patches with foliage density higher than 40% were preferred (20-25 m: x^2 = 3082.6, d.f. = 2, p < 0.0001; >25 m: x^2 =6071.4, d.f. = 2, p < 0.0001).

At the scale of trees selection (fifth order), sloths preferred trees with DBH greater than 20 cm (x^2 =3677.7, d.f. = 2, p < 0.0001). The trees with more than 18 m in height were preferred and the shorter ones were avoided (x^2 =1205.7, d.f. = 2, p < 0.0001). Sloths preferred trees with the first fork over 10 m whereas those with the first fork less than 7 m were avoided (x^2 =154.8, d.f. = 2, p < 0.0001). The sloths preferred trees with the occurrence of lianas, tangled lianas and bromeliads (x^2 =1254.2, d.f. = 1, p < 0.0001; x^2 = 847.1, d.f. = 1, p < 0.0001, x^2 =1293.7, d.f. = 1, p < 0.0001). Finally, the crowns connected were preferred and those not connected were avoided (X^2 = 188.5, d.f. = 1, p < 0.0001).

According with the experimental design, we hypothesized that the maned sloth occurrence will be affect by: (1) habitat type, (2) structural characteristics and (3) tree attributes. To test the effect of these variables on occurrence we used as a initial model a generalized additive model (GAM) including all the variables used for our habitat selection analysis, here the fixes (trees) were considered as occurrence data and the random points (trees) as not occurrence.

The choice for a GAM was for the presence of non- linear relations, and a binomial family for the presence of binomial data. The link function was logit and we used the DHB variable as smooth term function, since they had distinct variances.

Table 6. Proposed model for the occurrence of maned sloth (*B. torquatus*) in southern Bahia, number of estimated model parameter (K), the difference between each model and the model with lowest AIC (ΔAIC), and Akaike weight (wi).

Dependent variable	Smooth term	Explanatories variables	K	ΔAIC	Wi
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + crowns + trees_density + o_canopy + Habitat + VC5_10 + VC10_15 + VC15_20 + VC20_25 + VC25_30 + VC30_35	14	17	0.985
Occurrence	~ s(DHB)	+lianas + tangledlianas + Bromeliads + crowns + trees_density + o_canopy + Habitat + VC5_10 + VC10_15 + VC15_20 + VC20_25 + VC25_30	13	6.62	0.001
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + trees_density + o_canopy + Habitat + VC5_10 + VC10_15 + VC15_20 + VC20_25 + VC25_30	12	3.32	0.001
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + trees_density + o_canopy + Habitat + VC10_15 + VC15_20 + VC20_25 + VC25_30	11	1.73	0.0004
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + trees_density + Habitat + VC10_15 + VC15_20 + VC20_25 + VC25_30	10	0	0.0003
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + trees_density + Habitat + VC10_15 + VC15_20 + VC20_25	9	0.25	0.0002
Occurrence	~ s(DHB)	+ lianas + tangledlianas + Bromeliads + trees_density + Habitat + VC10_15 + VC15_20	8	0.08	0.0002
Occurrence	~ s(DHB)	+ tangledlianas + Bromeliads + trees_density + Habitat + VC10_15 +VC15_20	7	0.68	0.0001
Occurrence	**~ s(DHB)**	**+ tangledlianas + Bromeliads + trees_density + Habitat + VC10_15**	**6**	**1.37**	**0.0001**
Occurrence	~ s(DHB)	+ tangledlianas + trees_density + Habitat + VC10_15	5	7.98	0.010

The collinearity was tested for all variables and the DHB showed a collinearity with height of the tree (r = 0.74) as well the height of the first fork with the height of the trees (r = 0.60). So we chose to keep only the variable DHB in the analysis, considering that this variable would be more important for the animal.

The best model that explain the occurrence was: ocurrence ~ s(DHB) + tangledlianas + bromeliads + trees_density + Habitat + VC10_15 . This model did not have not significant difference with the model with the lowest AICc, since the ΔAICc was lowest than 2 (Burnham & Anderson, 2002). And it presented less variables that suggest that the other variables did not increase the significance of the model since are not to relevant for the maned sloth occurrence. This model presented a deviance = 58.4% and six explanatory variables (DHB size, presence

of tangled lianas and bromeliads in trees, density of trees and vegetal cover between 10 to 15 m in patches and the habitat category) (Table 7).

Table 7. Explanatories variables of the selected generalized additive model. Codes: Intermediate and young secondary forest (IS/YS) forested crops (cocoa shade and jacks fruit with forested structure are included) (FC) open areas (included monocultures) (OA). Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-2.18264	0.44543	-4.900	9.58e-07 ***
Tangledlianas	1.95428	0.53741	3.636	0.000276 ***
Bromelads	2.05935	0.83755	2.459	0.013940 *
trees_density	0.05419	0.01816	2.985	0.002839 **
Habitat_IS/YS	-0.73164	0.46118	-1.586	0.112632
Habitat_FC	-4.45060	1.65312	-2.692	0.007097 **
Habitat_OA	4.18736	1.23015	3.404	0.000664 ***
VC10_15	0.03870	0.01097	3.529	0.000417 ***
s(DHBL)	2.363	3.038	99.38	<2e-16 ***

Discussion

Our results showed that the home ranges of the seven maned sloths tracked, varied widely from animal to animal. These widely variations of the home range sizes that we recorded, 0.95 to 27.8 ha per maned sloth, were also observed in previous studies with this species, but with lower amplitude: 0.44 to 16.2 ha/individual; (Cassano, 2006, Pinder, 1997, Chiarello, 1998; Chiarello *et al.,* 2004). Such high variation is a common pattern reported by studies about sloths in general: *B.variegatus, B. torquatus and Choloepus hoffmanni*, (0.5 to 10.8 ha/individual; Chiarello, 2008).

A wide variation in home range sizes of arboreal folivores species is a commonly observed pattern. For example, such pattern is reported for the bamboo rat (*Kannabateomys amblyonyx*) (0.016 - 0.153 ha; Stallings *et al.,* 1994), the tree hyrax (*Dendrohyrax arboreus*) (0.059 - 0.283 ha; Milner & Harris, 1999), the Lumholtz's tree-kangaroo (*Dendrolagus lumholtzi*) (1.01-339.14 ha; Newell,1999), the greater glider (*Petauroides volans*) (1.26-4.10 ha ha; Pope *et al.,* 2004), the

north american porcupines (*Erethizon dorsatum*) (1.5 - 58.8 ha; Morin *et al*, 2005), and the thin-spined porcupine (*Chaetomys subspinosus*) (0.34-5.85 ha; Fernandez-Giné, 2009), among others. These studies indicate a wide home range variation, even considering the effects of sex and methodological differences on it. This variation may be in response to the shifting of foraging area, to avoid its over use (Spencer, 2012) or also be related to other factors, such as possible mate or the increase of predator pressure. In the present study, if we do not consider the home range calculated for a sloth that seemed to be dispersing after translocation management, 27.8 ha for BT171, we would have a range of 0.95 to 13.71 ha. Such variation would be more similar to the previous studies on this species. Considering that the sloths BT171 and BT033 were translocated in similar local patches, our results indicated that some individuals could remain in a small area after translocation, and establish their home range quickly (i.e. Bt033 and BT323), whereas other ones may disperse and not establish a definite home range in a short-term period (i.e. BT171).

The influence of sex in home range sizes could not be analyzed, because only one male was radiotracked. Apparently the Individual adults and subadults showed the same home range size pattern, suggesting that age did not influence markedly in the home range size. In addition to that, we did not find any relation between home range sizes and level of disturbance of vegetation. Apparently this influence was not sufficiently strong for driving shifts in the home range sizes. So, the mainly cause of the inter-individual variation in home range size is still unclear, but may be related to the distribution of the used resources.

In general it is expected that arboreal folivores have small home ranges as a part of their adaptations to live close to the limit of their energy budget (Eisenberg, 1978). In fact, our results confirmed that maned sloths can find all the basic requirements for their survival in small forest areas, stabilizing their home ranges in small patches, similar to results observed in other studies (Cassano, 2006, Pinder, 1997, Chiarello, 1998; Chiarello *et al.,* 2004). Core areas probably present high

density of critical resources (Powell, 2003), considering that the concentration of resources in these areas enables the animal to stay in a small area without the need to spend energy exploring farther. Curiously, we observed that the core areas of animals with smaller home ranges (BT122 and BT393) were located in intermediate secondary forests and in a jackfruit *Artocarpus heterophyllus* (Moraceae) plantation. This suggests that these disturbed areas might be offering suitable resources for these animals, once maned sloth can eat shade and not shade tolerant tree species as well (Cassano, 2006; Barreto, 2007; Chiarello, 2008). And also these areas would present adequate forest structures for maned sloths. The jackfruit is a large-sized introduced tree that may present a great availability of shelter and possible food sources. Even though we do not have records of sloths feeding on this species, it belongs to the Moraceae family, which is regularly eaten by the sloths (Chiarello, 2008), and its leaves are moderately consumed by a sympatric and selective arboreal folivore from this region, the thin-spined-porcupine *Chaetomys subspinosus* (Giné et al., 2010). Moreover, the sloth BT393 was frequently found on this tree, so jackfruits probably provide some kind of resource, such as shelter or food. The several core areas associated to larger home ranges can be related to the composition of the forest, as well as the modifications in supply sources and animal necessities at that moment (Powell *et al.,* 2012).

Home ranges estimated with MPC were larger than kernel when the fixes were more scattered. This may be due to the different sensitivity of each method to outliers (Kernohan *et al.,* 2001; Powell, 2003). Most of the animals stabilized their home ranges after seven months, except the translocated BT171 and a resident animal BT182. These last two cases may be due to insufficient locations to stabilize their home ranges or else to occasional sallies outside the area (Powell, 2003). Although we applied the same time lag used in previous studies with this species (Cassano, 2006), most of animal localizations were correlated. Nevertheless the time intervals differ among species as well as the conditions of the study (Kernohan et al, 2001), and the poor displacement related to the center

of the home range can be another cause. Since the time lag sometimes is not realistic for some studies and its accuracy level may be irrelevant depending on the objectives (Kernohan *et al.,* 2001), as the present study we continue with the analysis. Considering that we are also taking a habitat selection approach and not focusing exclusively on the home range sizes.

The maned sloth selection at the larger scales of this study was partially unexpected. This species preferred more perturbed areas and was indifferent to the less disturbed ones. On the other hand, open areas were avoided as expected for this arboreal animal (Eisenberg, 1978; Chiarello *et al,* 2004; Cassano, 2006). This preference for young to intermediate secondary forest and forested crops to set up their home range, suggests that these animals are not only disturbance-adapted but also that these disturbed habitats offer structures that favor the establishment of these animals. Mature forest may not have been selected because this forest type probably has less concentration of resources, resulting in higher cost for the sloths in exploring this environment. In contrast, secondary forest habitats may have complex structures and provide additional resources such as lianas and pioneer species (Faria *et al.,* 2009). Another important factor may be the species consumed by the maned sloth including some abundant although some relative rare species as *Ficus clusiaefolia, Cecropia hololeuca, Ocotea pretiosa* were meanly consumed in a study in the same region (Cassano *et al.*, 2011). Considering that shaded cacao plantations and secondary forest in this region usually present these species, this may favor the preference for these habitat categories.

At the home range scale (third order), we only identified avoidance of open areas and the use of the remaining categories did not differ from their available proportion. So maned sloths did not seem be specific at this scale, since they used any forested habitat. Only the open area avoidance occurred in both scales (second and third scales), such pattern suggests that the maned sloth is more selective at the scale which refers to the selection of the animal's home range

(second order). That may be due to the presence of the structures and food that may be widely dispersed along the mature forest, secondary forest and agroforestry system. And a constant avoidance for open areas regardless the scale.

At finer scales, the studied sloths become more selective. They preferred patches with high density of trees, such selection may be because more trees represent more resources for food and shelter. The preference for a more closed canopy and greater coverage at higher strata (10 to 20 meters) may favor the shelter, the animals locomotion and the regulation of body temperature (Montgomery & Sunquist, 1978; Urbani & Bosque, 2007). Such preferences can also be related to pathways presence and also protection for the predators. Throughout the study three vestiges of maned sloths were found (killed by an unknown predator), which suggests a predator pressure in the region is high. Thus the vegetation cover can provide protection against the terrestrial predation that is probably high, since wild felids (*Puma concolor, Leopardus pardalis, Herpailurus yaguaroundi, Leopardus pardalis, L. tigrinus, L. wiedii*) are present in the area (MMA, 1997).
Maned sloths preferences for trees with DHB greater than 20 cm, height above 18 m and a height of the first mean fork higher than 10 m indicate the preference for large-sized trees. This could be because some trees used as a source of food and shelters are species of large size (Cassano, 2006). The same pattern seems to occur in more disturbed areas such as shaded cocoa plantation, where this species generally use native remaining trees (Barreto, 2007). The preference for lianas may be because some species are food sources for sloths (Chiarello, 1997b) and also because these plants may favor their movement (Barreto, 2007; Motgomery e Sunquist 1978) as well as the connect tree crowns. While tangled lianas and bromeliads may be optimal shelters and potential hiding places from predators.

In general, the preference at different scales was congruent but the patterns where clear at finer scales. Analyses at different spatial scale are important to detect

specific structural aspects of forest relevant for the sloths, as can be for studies with other animals. In other way, it is possible that larger scale evaluation would not indicate the quality or presence of these aspects occurring on a smaller scale (Twes *et al.,* 2004). As we discussed previously, maned sloths were more selective in finer scales, whereas the larger scales seemed to be indicating only avoidance of open areas. They presented preferences for habitat attributes independent of the vegetation type. A clear example is the preference for large sized trees even within areas where these trees are not the most abundant ones, such as secondary forest.

The generalized additive models (GAM) that we used indicated that six variables explained more than a half (deviance=58.4%) of the probability of the maned sloth occurrence, by using the same variables explained previously. While all variables can have an effect on the occurrence, these six were shown to be more meaningful, being present at different scales of the habitat. The maned sloths seemed to be more affected by trees DHB which is a characteristic at tree scale like the presence of tangled lianas and bromeliads, so half of the variables included in the GAM were related to the finer scale evaluated. That suggests that this scale can be more essential than the bigger ones for the maned sloth. At the scale of patch, tree density and vegetation cover at 10 to 15 m were the aspects that were more significant for the maned sloth occurrence. If we relate these variables with those in the finer scale, we can infer that the large trees selected by the maned sloths would be located in patches with high tree density of trees and dense understory. Finally, adding habitat categories, which is related to a larger scale, habitats seemed be important too. Nevertheless open areas seemed to be influencing more than the other habitat categories. Thus, sloths occurrence is more probable at large trees associated with tangled lianas and bromeliads within a dense forest patch with dense understory, occurring in a habitat with forest structure.

This study showed that maned sloths are not very sensitive to disturbed habitats at larger scales (such as forest sub-types immersed in a, forest landscape). Such pattern contradicted what we expected for a very specialized arboreal folivore. On the other hand, studies with other arboreal folivores showed that they can adapt to secondary forest as a result of the presence of pioneer species that are food sources (Chiarello, 1999; Giné *et al.,* 2010). Additionally, sloth species has shown that they are well adapted to disturbed habitats where they cross open areas to reach to some tree patches (Vaugan *et al.,* 2007). However, we detected habitat preferences at finer scales, thus suggesting that they may be more influenced by specific components within the habitat where they live. Moreover, for the complete understanding of the use and selection of habitats by the maned sloth, it is very important to include diet and behavior patterns, as a relevant aspect in spatial ecology (Moorcroft, 2012).

Implications for conservation

As the maned sloth status have been recently changed as a consequence of the new knowledge of this specie, this study look for continue understanding the characteristic of this animal. Thus, as we suspected with previous studies (Cassano *et al.*, 2011) we believe that the maned sloth is not as sensitive to a disturbance, where can even prefer more disturbed area at least in southern Bahia. And believe that maned sloth can be maintained within any habitat that presents structures which promote and enable the occurrence of sloth, as provide some emergent trees, relatively high density of vegetation and vegetal cover are maintained. Of course dietary requirements must be considered.

As it is pointed out the fragmentation process can be more prejudicial (Aguilar & Fonseca, 2008; Superina *et al.,* 2010) as these animals avoid open areas, where they are vulnerable and the resources that they need are rare or not present. Moreover in southern Bahia region maned sloth seems use the landscape as a integrate area with the exception of the open area, but that can be a consequence of particular characteristic of the region so must be carefully

generalizing in other landscapes. Continue with these reflections, maned sloth populations can be maintained since these minimum requirements be attend.

Conservation strategies, such as the establishment of biological corridors that include some of the preferred forest components in the areas with more abrupt differences between remnants and matrix will mitigate the fragmentation problem. And the preservation of areas with high tree density and also with large-sized trees could help in the maintenance of *B. torquatus* populations especially in the areas like southern Bahia.

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CONCLUSÕES GERAIS

A preguiça-de-coleira apresentou preferências mais acentuadas a escalas espaciais menores do que as maiores. Na escala que se refere ao local onde o animal escolhe estabelecer sua área de vida, a preguiça-de-coleira teve preferência por florestas secundárias e cultivos florestados, provavelmente devido à presença de espécies pioneiras, e evitou áreas abertas. Enquanto na escala referida à seleção de componentes dentro da área de vida, a preguiça-de-coleira não mostrou preferência por nenhum tipo de vegetação florestada e também evitou áreas abertas.

Nas escalas mais finas, foi encontrada preferência por características especificas da estrutura florestal, assim como por atributos específicos das árvores. Nestas escalas, o tamanho da árvore, a presença de emaranhados de cipós e bromélias, assim como a densidade de árvores e a densidade de folhagem no estrato de 10 a 15 metros parecem influenciar mais a ocorrência desta espécie.

A seleção do habitat pelos atributos encontrados parece estar relacionada com aspectos da ecologia comportamental de animais folívoros e sua necessidade de sobreviver com as limitações locomotoras e fisiológicas existentes, pois a escolha de tais atributos parece favorecer o deslocamento, servir de abrigo, e possivelmente de alimento (como algumas espécies de árvores e lianas), além de ajudar a ocultar-se de potenciais predadores.

Os resultados deste estudo geraram informações que poderão ser utilizados em estratégias para a conservação da espécie. Este reforça a idéia de que as preguiça-de-coleira evitam áreas abertas logo são animais que são vulneráveis a perda de habitat e isolamento durante o processo de desmatamento seguido de fragmentação. Por fim, sugerimos que alguns componentes da floresta preferidos por esta espécie, que possam favorecer a conexão entre fragmentos florestais, sejam incluídos em planos de ação e no estabelecimento de corredores ecológicos.

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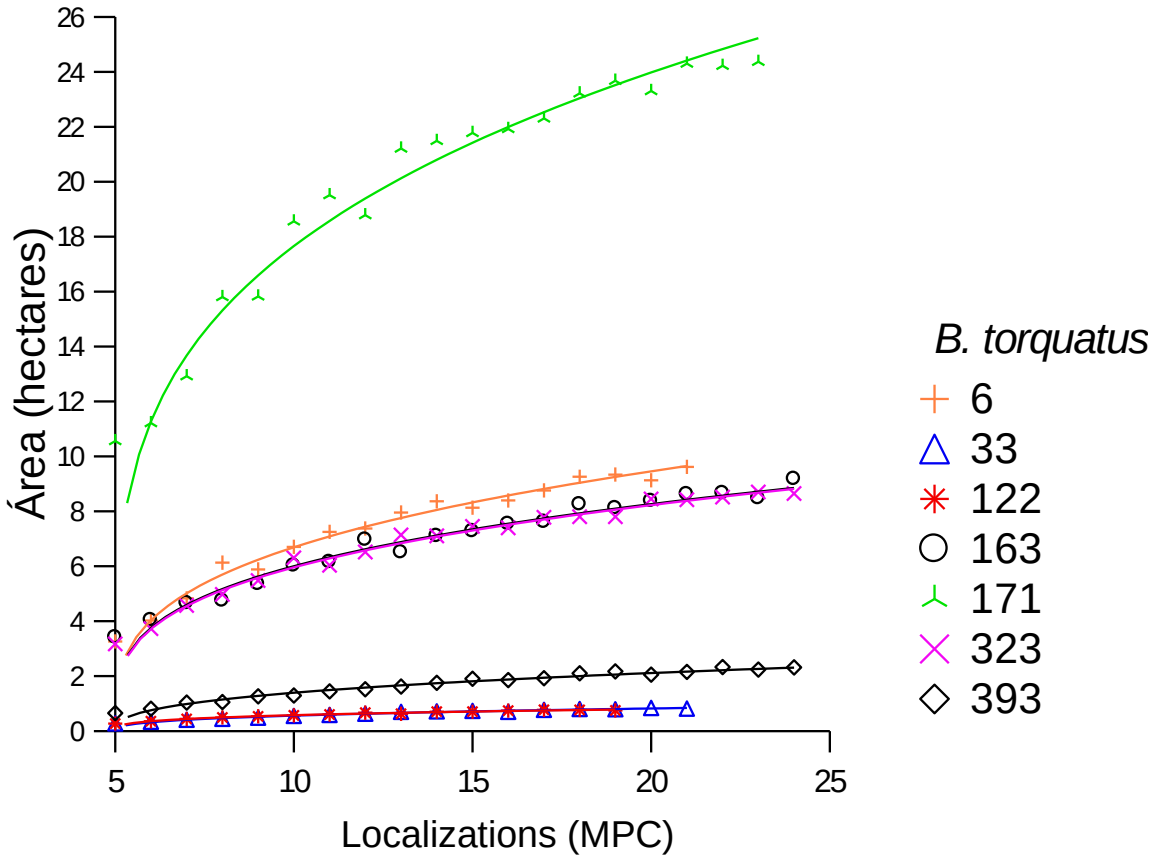
Apendix A


Área (hectares)
Localizations (MPC)
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B. torquatus
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