Original Investigation

The cacao agroforests of the Brazilian Atlantic forest as habitat for the endangered maned sloth Bradypus torquatus

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ABSTRACT

Sloths are arboreal mammals strictly dependent upon forested habitats. The southern part of the state of Bahia in northeastern Brazil harbors important forest remnants and the highest genetic diversity known for the maned sloth (Bradypus torquatus), an endangered species endemic to the Atlantic forest. Large extents of cacao agroforests (cabrucas) connected to forest patches mitigate the effects of fragmentation in this region. We radio-tracked three maned sloths during 40 months in a cabrucha at the vicinity of Una Biological Reserve, southern Bahia, and estimated their home range using two commonly employed estimators (minimum convex polygon (MCP) and kernel). Overall cabrucas comprised a significant portion of the home range of the three study animals (MCP: 7–100%) and at least a third of the areas of more intensive use (kernel: 27–99%). The tagged sloths used cabrucas more than expected according to the availability of this habitat in their home range and in the surrounding landscape. In addition to the tagged individuals, maned sloths were observed five times in the study area, twice in cabrucas. Eleven tree species present in cabrucas were used as food sources by maned sloths. Results indicate that biologically rich cacao agroforests immersed in a landscape still largely composed of native forests, as is the case here, can provide habitat for the maned sloth. This finding spells good news for the conservation of this species, as southern Bahia is one of the most important strongholds for the maned sloth. However, further actions are necessary to protect the species from local extinction, including active management of protected areas, forest fragments, cabrucas and pastures in an integrated, landscape-level manner.

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Introduction

Land use change is one of the major forces leading to a decrease in wildlife population, reduction of species distribution, and disruption of ecosystem function (Gutzwiller 2002). In recent years, a large number of studies have focused on the importance of the mosaic of habitats to preserve biodiversity, and some studies have suggested that managed environments such as agroforestry systems may play an important role in sustaining vertebrate biodiversity in human-modified landscapes (Rice and Greenberg, 2000; Ricketts, 2001; Schroth and Harvey 2007; Cassano et al. 2009).

The Brazilian Atlantic Forest is a biodiversity hotspot that has been severely fragmented. It is currently reduced to less than 12% of its original extent (Ribeiro et al. 2009). Southern Bahia is a relatively well-preserved part of this biome where over 50% of the land is covered by “forested environments”, mainly traditional cacao plantations (26% of the landscape), secondary growth forest (19%) and primary forests (9%) (Landau et al. 2008); the remaining 46% is covered mainly by pastures and agriculture. In the 1990s, approximately 70% of the 700,000 ha planted with cacao (Theobroma cacao) in this region was cabrucas, traditional plantations established in the shade of native canopy trees (Araújo et al. 1998). However, as a result of the cocoa economic crisis of the late 1980s associated with the infection of a fungus disease (witches’ broom, Moniliophthora perniciosa), traditional cabrucas have increasingly been replaced by pasture or cacao plantations shaded by exotic trees or simply unshaded cacao. At the same time, some cabrucas have been abandoned or received little management. In these cases, tree recovery has resulted in a dense canopy layer (Sambuichi and Haridasan 2007) that, while beneficial for native wildlife, negatively impacts cacao production, making it a non-viable management strategy.

Oliver and Santos (1991) proposed that sloths and other threatened mammals from the Atlantic Forest make use of cabrucas to some extent, and more recent research has shown the importance...
Fig. 1. Land cover in the region of the Una Biological Reserve and Ecoparque de Una (insert, right), northeastern Brazil (left, lines indicate state borders). The study site is located to the east of Una Biological Reserve (circle).

of those areas as corridors or as additional habitat for some mammal species (Moura 1999; Pardini, 2004; Raboy et al. 2004; Pardini et al. 2009). The maned sloth (Bradypus torquatus) is one of the six extant species of sloths and is listed as “endangered” by the IUCN (IUCN 2008). The maned sloth is endemic to the coastal rain forest of eastern Brazil, occurring from the state of Sergipe to Rio de Janeiro (Wetzel and Avila-Pires 1980; Oliver and Santos 1991). The species is separated into three functionally isolated populations, each genetically homogeneous but strongly differentiated from the others, to the extent that the northernmost population in Bahia is considered a distinct evolutionary unit requiring separate management from the southern populations (Lara-Ruiz et al. 2008). Habitat destruction is by far the main threat to the conservation of the maned sloth (Machado et al. 2005; IUCN 2008).

Material and methods

Study site

The maned sloths were monitored in a cabrucas located at the Cabana da Serra Farm (15°11′20″S; 39°2′33″W) in the municipality of Una, in the lowlands of southern Bahia, Brazil. The study site is located near the Una Biological Reserve and the Private Reserve Ecoparque de Una, and is crossed by the Maruim River (Fig. 1). Approximately 67% of the land encompassed by Una Biological Reserve and its buffer zone (extending 10 km beyond the Reserve’s borders) is covered by primary and secondary forests (Instituto de Estudos Socioambientais do Sul da Bahia, unpublished data). Shaded cacao plantations and rubber tree plantations account for 60% of the cultivated land and represent the main crops in the Una Biological Reserve buffer zone (Araújo et al. 1998).

Average annual temperature is 24–25 °C, and annual precipitation is 1600–2000 mm (Gouvêa 1969). The vegetation in the study area is tropical lowland rainforest (Oliveira-Filho and Fontes 2000). The mature humid forest at Una Biological Reserve is characterized by a canopy 25–30 m tall, high abundance of epiphytes and vines, and clearly defined strata (Amorim et al. 2008). In the cabrucas, the understory of original forest is replaced by cacao shrubs, tree canopy density is lower than in mature forests, epiphytes are usually reduced to canopy layer and vines are minimal (Alves 1990, 2005; Sambuichi 2006; Sambuichi and Haridasan 2007; Cassano et al. 2009). Traditional cacao agroforests exhibit great variation in vegetation diversity and structure as a consequence of both tree diversity of the original forest and the agroforest management (Sambuichi 2006). The cabrucas where the study was conducted has well-developed canopy strata, although it is lower and thinner than that of mature forests. Barreto and Cassano (2007) found 30 trees (11 species) with a DBH > 10 cm in 0.1 ha, most were early successional species. Inga edulis, Tapirira guianensis and Senna muitijuga, for example, together comprised over 50% of the trees. The cacao plantation where the study was conducted received little manage-
Estimates of home range size (in hectares, ha) of the three radio-collared maned sloths based on minimum convex polygon (MCP) and kernel methods and the corresponding

Table 1

Data collection

Three maned sloths inhabiting the *cabrucas*, an adult female and two of its infants, were tracked with telemetry equipment (radio collars model TW-3 from Biotrack Ltd., a Telonics TR-4 receiver and a three-element Yagi antenna from Wildlife Material) between October 2004 and February 2008. These radio collars weigh less than 80 g (<2% of the adult body weight) and have not caused injuries, scars, or any other known problems to tagged individuals in the 10+ years we have been studying these animals (Chiarello 1998a,b; Chiarello et al. 2004; Lara-Ruiz and Chiarello 2005; Lara-Ruiz et al. 2008). The two cubs were tagged while they were still carried by the adult female, but data on home range were collected for these individuals only after they separated (i.e., became independent) from the mother.

The sloths were located two to three times a month; consecutive sightings were separated by at least 1 week. Every tree in which the animals were seen was mapped. To minimize location errors, two methods were used for mapping trees. When used trees were between 10 and 50 m to each other the position of these trees were mapped using compass and measuring tapes. We avoided using the GPS in these circumstances as distances were generally smaller than the GPS error. Later the geographic coordinates (recorded by a Garmin Etrex 12 channel GPS) of at least three trees located at the periphery of the area used by each animal were used as a geographic reference to plot these trees on a map using ArcMap 9.2 Program. Trees located more than 50 m from the nearest used tree had their coordinates recorded directly by the GPS.

Information on sloth diet was collected during observations of feeding behavior of the three individuals inhabiting the *cabrucas* (Correa et al. 2006 and C.R. Cassano, personal observation) and also from previous research developed in a mature forest remnant at Ecoparque de Una (Cassano 2005 and C.R. Cassano, personal observation). We searched botanical inventories carried out in southern Bahia and compile information on plant species present in *cabrucas* of this region that are known to be used as source of food by maned sloths.

Data analysis

Home ranges were estimated using HawthsTools, for ArcMap 9.2. For comparative purposes, home ranges were calculated using two methods: the minimum convex polygon (MCP) using 100% of locations, and fixed kernel using 95% of locations. Because of its ease of calculation, many investigators use MCP to describe home ranges, and we therefore present these analyses to facilitate comparison with other studies. However, the kernel method provides a more detailed home range map, identifying areas of intensive use (Powell 2000) through concentric contour lines (95, 50, 20, 10 and 5%) indicating the probability of finding an animal in a given region of its range (i.e., the utility density distribution, Powell (2000)). The bandwidth (h) chosen for fixed kernel was 15 m, which we considered as a good approximation of the perception radius (Powell 2000) of this species (see also Montgomery and Sunquist 1975). Scaling factor used was 10^8 and raster cell size was 10 due to the small areas under analysis.

Interpretation of aerial photographs provided by Instituto de Estudios Socioambientais do Sul da Bahia (unpublished data) was used as an initial source for the land cover of the region. However, this method did not discriminate *cabrucas* from secondary logged forest, due to similarities in canopy structure between these two vegetation types. We therefore modified the original maps using field observations in order to delimitate more accurately the extent of *cabrucas* in the study site. The home ranges (MCP and kernel) were clipped from the land cover map using the intersect function from ArcMap 9.2. We then calculate the proportion of *cabrucas* falling within each home range using the resulting shape file.

We used contingency tables (Chi-square goodness-of-fit-tests) complemented by residual analysis to assess if the radio-collared sloths used the habitats according to their availabilities. First, we contrasted the number of location fixes on each major habitat type inside the MCPs (swamp/ pasture, *cabrucas*, early secondary forest and late secondary forest) with the expected frequencies of fixes based on the availability of these habitats in the MCPs. We pooled the swamp with pasture as all fixes falling in pasture were in fact in the very edge between pasture and swamp vegetation. In a second Chi-square we contrasted the observed frequency of fixes with the expected value based on habitat availability in a buffer area surrounding the home ranges of the three sloths. To calculate the width of this buffer area we measured the largest distances between fixes inside each individual home range and averaged them. The resulting width (487 m) encompassed an area of 214.7 ha (6.8 times larger than the combined area of the three MCPs). Although this wide buffer may include land-use types differing from the immediate study area, a narrower band would not be representative of the larger landscape context. These tests were performed using BioEstat version 5.0, a free statistical software available at Instituto de Desenvolvimento Sustentável Mamirauá (http://www.mamiraua.org.br).

Results

Monitoring time for individual sloths ranged from 12 to 40 months. A total of 199 locations of the three radio-collared maned sloths were recorded (Table 1). Both MCP and kernel methods indicated that the adult female (BT464) had the smallest home range, followed by the male juvenile (BT162) and the female juvenile (BT065) (Fig. 2). The *cabrucas* comprised the majority of home range of the mother and the male juvenile and a significant proportion of the home range of the female juvenile (Table 1). The latter individual stayed in the *cabrucas* tract where it was born during the first year of study. Subsequently, it used a mix of land-use types including secondary forest, the border of a swamp vegetation and another tract of *cabrucas*.

Table 1

<table>
<thead>
<tr>
<th>Study animal</th>
<th>Sex/age</th>
<th>Number of fixes</th>
<th>MCP (ha)</th>
<th>Kernel (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>BT464</td>
<td>Female/adult</td>
<td>116</td>
<td>0.44 (90)</td>
<td>0.49 (86)</td>
</tr>
<tr>
<td>BT065</td>
<td>Female/juvenile</td>
<td>58</td>
<td>0.72 (70)</td>
<td>17.59 (7)</td>
</tr>
<tr>
<td>BT162</td>
<td>Male/juvenile</td>
<td>25</td>
<td>2.28 (100)</td>
<td>2.28 (100)</td>
</tr>
</tbody>
</table>

^a Based on the total number of fixes (years 1, 2 and 3, plus nine fixes from the forth year). Annual number of fixes were year 1 = 47; year 2 = 31 and year 3 = 29.

^b Based on the total number of fixes (years 1 and 2). Annual number of fixes were year 1 = 31 and year 2 = 27.
Fig. 2. Minimum convex polygon (MCP) home ranges of the tree radio-tracked animals showing the main land cover types as well as opportunistic sightings of other maned sloths (dotted circles).

The frequency with which the three sloths were located in each vegetation type was significantly different from expected (Chi-square goodness-of-fit test: $\chi^2 = 111.517; \text{d.f.} = 3; p < 0.0001$). The residuals showed that swamp/pastures and early secondary forests were used less than expected, cabrucas were used more than expected and the late secondary forests were used according to their availability within the home range’s area (Table 2). Similarly, the frequency of fixes differed significantly from the expected value based on availability of habitat in the buffer area (Chi-square goodness-of-fit test: $\chi^2 = 119.001; \text{d.f.} = 3; p < 0.0001$) and the residuals showed the same pattern found in the previous analysis (Table 2).

Sloths were observed feeding on leaves of six tree species from cabrucas and on 11 plant species (10 trees and one vine) from mature forests at the Ecoparque de Una (Table 3). Five of the 10 tree species found in mature forests and four of the six species found in cabrucas at Una have also been previously recorded in other cabrucas from southern Bahia by Sambuichi (2002, 2006) and Sambuichi and Haridasan (2007). Most trees used as food in the mature forest are considered shade tolerant, i.e., indicative of late successional phases, while the opposite was observed for tree species consumed solely in cabrucas (Table 3).

Discussion

This is the first unequivocal confirmation of the use of a cacao agroforest by maned sloths based on field observation of wild individuals. Both kernel and residual analyses suggested that cabrucas was actively selected by maned sloth, providing both feeding and resting trees. Indeed, the range of the adult female (BT464) was relatively small, and was comprised almost entirely of cabrucas. Nevertheless she was actively reproducing, indicating the availability of both sufficient food resources and sexually mature males in her home range. Our limited sample of 199 observations in a single cabrucas limits our ability to conclude that maned sloths area able to exploit cabrucas throughout their range. However, we observed no evidence that using cabrucas was detrimental to the sloths, and we believe that these areas potentially represent high-quality sloth habitat. Sloths have been reported in cabrucas region of Urucuca, Santa Maria Eterna (Oliver and Santos 1991) and Una municipalities (C.R. Cassano, personal observation) suggesting that cabrucas in a wider area of southern Bahia might similarly represent usable habitat for maned sloths.

Because the plant species consumed by maned sloths are found in a wider sample of cabrucas in the region (Sambuichi 2002, 2006; Sambuichi and Haridasan 2007) sloths should be able to forage in many of southern Bahia’s cabrucas. Although they feed from many abundant trees (Inga edulis, Tapirira guianensis and Senna multiflora) the kernel analysis demonstrates that the availability of many relatively rare species (Ficus clusiaefolia, Cecropia hololeuca, Ocotea pretiosa) may be the key to the survival of maned sloths in these habitats. That single trees have significant influences on patterns of
Fig. 3. Home range (kernel method) of the three tagged animals showing the land cover types. The concentric contours (kernels) represent from outside in, 95, 50, and 5% of the utility density distribution. See Methods for details.

Table 2
Results of two residual analyses on habitat preferences of the three radio-collared maned sloths. In the first analysis (“MCP”), the number of fixes found inside the home ranges (minimum convex polygons – MCP) (“observed”) was contrasted with the expected number based on the proportion of vegetation types available in the MPCs (“expected”). In the second analysis (“Buffer”), the frequency of fixes was contrasted with the expected number based on habitat availability in the buffer surrounding the MCPs (buffer area). See Methods for details.

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>MCP Observed</th>
<th>MCP Expected</th>
<th>Residual p</th>
<th>Buffer Observed</th>
<th>Buffer Expected</th>
<th>Residual p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swamp/pasture</td>
<td>12</td>
<td>62</td>
<td>&lt;0.01</td>
<td>12</td>
<td>58</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cabruca</td>
<td>123</td>
<td>30</td>
<td>&lt;0.01</td>
<td>123</td>
<td>26</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Early secondary forest</td>
<td>7</td>
<td>36</td>
<td>&lt;0.01</td>
<td>7</td>
<td>40</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Late secondary forest</td>
<td>57</td>
<td>71</td>
<td>ns&lt;sup&gt;a&lt;/sup&gt;</td>
<td>57</td>
<td>75</td>
<td>ns&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>199</td>
<td></td>
<td>199</td>
<td>199</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> ns: not significant (p > 0.05).
habitats used by sloths (Vaughan et al. 2007) and primates (Williams-Guillén et al. 2006; Oliveira et al. 2010) in similar agroforestry systems suggest that our results may be generalized beyond our study population.

Most tree species eaten by maned sloths in cabrucas are shade intolerant species, a probable consequence of the tree species composition of these systems in general. In cacao plantations established under the shade of native trees, climax trees of the canopy layer undergo gradual loss, being replaced by pioneer, early secondary growth or exotic species (Rolim and Chiarello 2004; Sambuichi and Haridasan 2007). On the other hand, the majority of trees consumed by maned sloths in forest remnants are shade tolerant species, which are probably more abundant there than in cabrucas (Sambuichi and Haridasan 2007; Pardini et al. 2009). Although detailed dietary studies comparing maned sloths in cabrucas with native forests are still lacking, this finding suggests that maned sloths might be able to adapt their diet according to local differences in tree species composition and abundance. This corroborates previous studies on feeding preferences of maned sloths carried out in other region of the Atlantic forest (Chiarello 1998a) and suggests that this endangered sloth might thrive in a broader diversity of habitats than was previously thought. In fact the maned sloths do not seem to be different from the other sloths in this respect. Such adaptability may result in part for the apparent ability of sloths to tolerate a variety of plant feeding deterrents (Cork and Foley 1991), from trees found in primary and secondary forests (Chiarello 1998a), a trait other sloth species apparently share (Montgomery and Sunquist 1975; Chiarello 2008).

As more information on habitat and diet preferences accumulates, the more it appears that sloths in general are flexible species (Vaughan et al. 2007; Chiarello 2008). A recent study in Costa Rica demonstrated, for example, that two other sloth species, the three-toed sloth (Bradypus variegatus) and the two-toed sloth (Choloepus hoffmanni), are also able to use cocoa landscape as habitat (Vaughan et al. 2007). Vaughan et al. (2007) also observed that sloths (mainly Choloepus hoffmanni) can routinely venture into relatively open pastures in search of preferred food trees. Although this fact doubtless stress the behavioral plasticity of sloths and their high capacity of adaptation to disturbed places, it should be regarded as exceptional in the light of what is known about the natural history of sloths (Montgomery and Sunquist 1975; see Chiarello 2008, for a recent review) which, in turn, derives from its anatomy strongly adapted to arboreal life (Goffart 1971). Further, sloths are very vulnerable to predation by mammalian carnivores when on the ground (Vaughan et al. 2007, pers. obs.). Being a strictly arboreal species, maned sloths need high densities of shade and, perhaps more importantly, uninterrupted connectivity between trees crowns of the canopy layer. We have observed that maned sloths might cross small canopy gaps, but mainly when adjacent tree crowns are sufficiently close to each other. Larger gaps might hamper movements because sloths never jump as primates do and are very reluctant to use the ground as a substrate to pass from tree to tree (Chiarello et al. 2004; Chiarello 1998b). We strongly believe therefore that low canopy connectivity might be a major hindrance for maned sloths in cabrucas. The tree densities in cabrucas from southern Bahia are at least half that found in forest remnants of this region, although it is generally much lower than that. Sambuichi (2006) recorded, for example, densities varying from 47 to 355 individuals/ha in cabrucas of southern Bahia as compared to 596 to 988 individuals/ha in native forests of the region (Martini et al. 2007). Tree densities approaching 300 trees/ha are characteristics of little-managed cabrucas but much lower tree densities are recommended to increase cacao productivity in traditional agroforests (25–30 tree/ha according to Alvim (1972)). It is therefore critically important to investigate what is the maximum tolerance to tree thinning for maned sloths.

Very likely, the survival of maned sloth is also dependent upon the existence and proximity of forests tracts, as has been observed in other forest specialists (Faria et al. 2006, 2007; Moura 2008; Raboy et al. 2008; Pardini et al. 2009), including the golden-headed-lion-tamarin (Leontopithecus chrysomelas) (Dietz et al. 1995; Raboy et al. 2004). In agricultural landscapes, the distribution and richness of large mammals is affected by the presence of forest tracts, for example, through the gradual loss of species with increasing distance from forest (Bali et al. 2007), or through the availability of more species in forest fragments (Daily et al. 2003; Harvey et al. 2006). What if these native forest tracts provide feeding trees in lean times of the year, or function as source habitats for surplus individuals for sloths? These and other possibilities should be investigated in future studies to better frame our results.

### Table 3

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Feeding trees</th>
<th>Other cabrucas</th>
<th>Successional phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mature forest&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Cabrucas&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Anacardiaceae</td>
<td>Tapirra guianensis</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td>Burceaceae</td>
<td>Tetragastris catuaba</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td>Cecropiaceae</td>
<td>Cecropia hololeuca</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Dalbergia frutencens</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td>Dialium guianense</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td></td>
<td>Inga edulis</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td>Machaerium sp. (vine)</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td></td>
<td>Macrolobium latifolium</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td></td>
<td>Senna multiflora</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td>Lauraceae</td>
<td>Ocotea pretiosa</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Eriotheca globosa</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td>Moraceae</td>
<td>Ficus classifolia</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td></td>
<td>Brosimum guianense</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td></td>
<td>Brosimum rubescens</td>
<td>x</td>
<td>x</td>
<td>SI</td>
</tr>
<tr>
<td>Myristiceae</td>
<td>Virola gardneri</td>
<td>x</td>
<td>x</td>
<td>SI</td>
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<tr>
<td>Myrtaceae</td>
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<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td>Urticaceae</td>
<td>Coussapoa pachyphilla</td>
<td>x</td>
<td>x</td>
<td>ST</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

<sup>a</sup> Cassano (2006); <sup>b</sup> This study and Correia et al. (2006); <sup>c</sup> Sambuchi (2002, 2006) and Sambuchi and Haridasan (2007); <sup>d</sup> Classified by expert taxonomists with experience in the region (Eduardo Mariano Neto, André Amorim, Jomar Gomes Jardim and André Mauricio de Carvalho).
Given the severe reduction in the original extent of the Brazilian Atlantic forest (Ribeiro et al. 2009), understanding how maned sloth use human-modified landscape is essential to prioritize areas and actions for the conservation of this endangered species. Our results, although limited in scope, suggest that existing habitat for this species in southern Bahia is, in fact, greater than the area covered solely by primary and late secondary forest remnants, which together account for approximately 28% of southern Bahia (“Litoral Sul da Bahia” – Landau et al. 2008). Since cabrucas cover a quarter of the landscape, the area available to maned sloth in this landscape could exceed 50%, but only if cabrucas are managed with both productivity and wildlife conservation in mind. However, cabrucas vary widely in the diversity and density of tree cover (Sambuichi 2006; Schroth and Harvey 2007). Moreover, the presence of large tracts of primary forest, certainly contributes for the existence of a relatively healthy wildlife in cabrucas of southern Bahia (Faria et al. 2007; Cassano et al. 2009), making them very different from biologically poorer cabrucas of eastern Brazil, such as those found, for example, in the state of Espírito Santo (Rolim and Chiarello 2004).

Southern Bahia likely harbors the largest and genetically most diverse population of maned sloths (Chiarello and Lara-Ruiz 2004; Lara-Ruiz et al. 2008). This, alongside the findings presented here, indicate that the cacao region of southern Bahia has great potential to support perhaps the most viable populations of maned sloth. Nevertheless, deforestation, selective logging, the thinning and impoverishment of trees in the cabrucas, as well as their conversion into non-agroforest systems (Johs 1999; Sambuichi and Haridasa 2007), might undermine the expectation of long term survival of this species. These practices must be reverted or at least better controlled particularly in the buffer zones of forest reserves and corridors. Canopy shade management within the cabrucas should, for example, consider the maintenance of canopy connectivity, tree species of conservation interest as well as key tree species for fauna (see Cassano et al. 2009) and Oliveira et al. (2010) for species recommendation. Additionally, forest cover in private lands should achieve at least the minimum amount mandated by the Brazilian environmental legislation (20% of the property’s area). Otherwise the policy makers and society as a whole must be aware that not all cacao plantations can be regarded as a “green” economic alternative.

Acknowledgements

We would like to thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. Fundação O Boticário de Proteção à Natureza, Conservation International Brazil and Seeds of Biodiversity, Brazil for the logistic support. Fundação Biodiversitas, Belo Horizonte. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. Fundação O Boticário de Proteção à Natureza, Conservation International Brazil and Seeds of Biodiversity, Brazil for the logistic support. Fundação Biodiversitas, Belo Horizonte. We would like to thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support. We thank the Instituto de Estudos Socioambientais do Sul da Bahia for the logistic support.

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