Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1679-9283
ISSN on-line: 1807-863X
Doi: 10.4025/actascibiolsci.v38i1.29018

Human perception of the conservation and biodiversity state of forest remnants under different levels of urbanization

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ABSTRACT. Human perception of local environmental biodiversity and conservation may provide another dimension to understanding the ecology of urban ecosystems. This perception can vary according to the environmental urbanization level and may contribute towards its conservation. We investigated the relationship between the human perception of the conservation and state of animal richness in urban remnants and level of landscape urbanization, and between the human perception of animal richness and the remnants' area. In addition, we tested the effectiveness of interviews as the means for evaluating animal richness. The subjects' perception of the conservation of remnants did not correlate with the level of urbanization. Richness was reported as high and varied with the remnant's area - indicating maintenance of a possible species-area relationship in the studied landscape - but did not correlate with the level of urbanization. Urbanization can standardize the popular knowledge about conservation. Interviews with local residents proved to bring efficient insights into urban animal richness, especially for primates, and can be supplemented by camera-trapping. Human perception, obtained through interviews, is relevant and useful for the description of ecological aspects of urban regions and supports environmental awareness, actions, research projects, and management for conservation purposes.

Keywords: popular knowledge, anthropization, urban remnants, faunal richness, ethnoecology, species-area relationship.

Percepção humana sobre o estado de conservação e a biodiversidade de remanescentes florestais sob diferentes níveis de urbanização

RESUMO. A percepção humana da biodiversidade e conservação do ambiente possibilita o acesso e entendimento da ecologia dos ecossistemas urbanos. Esta percepção pode variar de acordo com o nível de urbanização do ambiente e colaborar com a sua conservação. Investigamos a relação entre a percepção humana do estado de conservação e da riqueza animal de remanescentes urbanos e o grau de urbanização da paisagem; e entre a percepção humana da riqueza animal dos remanescentes e a sua área. Testamos também a eficácia de entrevistas como via de levantamento da riqueza. A percepção dos sujeitos acerca da conservação das áreas não variou com o nível de urbanização. A riqueza relatada foi alta e variou com a área do remanescente, mas não se relacionou com o nível de urbanização. A urbanização pode padronizar o conhecimento popular e a fauna remanescente pode ser suficientemente generalista e tolerante às pressões antrópicas. As entrevistas se mostraram eficientes para o levantamento da riqueza urbana, especialmente para primatas, podendo ser complementadas por armadilhamento fotográfico. A percepção humana, apreendida por entrevistas, é uma via relevante para a descrição de aspectos ecológicos das regiões urbanizadas e para fundamentar ações de sensibilização ambiental, investigação e manejo para fins de conservação.

Palavras-chave: conhecimento popular, antropização, remanescentes urbanos, riqueza, etnoecologia, relação espécie-área.

Introduction

The human expansion into the environment promotes fragmentation and elimination of native plant formations as well as a reduction of natural resources (Fahrig, 2003), which are conditions that favor landscape urbanization. Urban areas are characterized by dense road meshes, changes in land use, pollution (e.g. sound pollution, Duarte, Vecci, Hirsch, & Young, 2011), climate changes, and deliberate extraction of resources in natural remnants (Baker & Harris, 2007; Gehrt, 2010). Such characteristics of urban areas can lead to the impoverishment of urban vegetation remnants

(Dickman, 1987), both in their structure and biodiversity such as decrease in species' richness (Chiarello, 1999), alterations in density (Umapathy, Hussain, & Shivaji, 2011), genetic diversity of populations (Haag et al., 2010), and communities composition.

In fragmented landscapes, species richness tends to be greater in remnants over large areas given the greater supply of resources (Chiarello, 1999; Michalski & Peres, 2005; Pardini, Souza, Braga-Neto, & Metzger, 2005; Prist, Michalski, & Metzger 2012). In urban ecosystems, species' richness tends to be greater in the most vegetated regions and smaller in urban centers (Savard, Clergeau, & Mennechez, 2000). The portion of fauna that remains in remnants features ecological flexibility and tolerance to disturbances coupled with reproductive capacity in these environments (Baker & Harris, 2007; Pickett et al., 2001). For example, representatives of urban fauna usually feature great food plasticity and the ability to supplement their requirements using areas adjacent to their habitats, such as gardens and parks (Baker & Harris, 2007; Bateman & Fleming, 2012; Snep et al., 2006). Although animals demonstrate ecological flexibility, the urban matrix is hostile and can isolate many species in remnants. Therefore, it is reasonable to assume that the species-area relationship could also be observed in urbanized landscapes (Dickman, 1987).

The types of fauna in urban remnants and implementation of conservation actions for these species may affect adjacent human populations (Azevedo et al., 2012). Local residents may provide insights into which animals are present in the remnants (Gadgil, Berkes, & Folke, 1993). Additionally, their perception regarding the ecological importance of these areas may aid conservation projects (Arjunan, Holmes, Puyravaud, & Davidar, 2006). Local human communities generally have a good grasp of space-temporal changes (Chanda, 1996) and are aware of the main problems affecting the environment as long as these problems impact their quality of life (Almeida, Zem, & Biondi, 2009; Ringrose, Chanda, Nkambwe, & Sefe, 1996). Management of the environment using prevalent local knowledge may enhance the effectiveness of conservation strategies (Berkes, Colding, & Folke, 2000). For example, prevalent opinions about the importance of protected areas and the fauna (Triguero-Mas, Olomi-Sola, Jha, Zorondo-Rodríguez & Reyes-García, 2009) and the eventual population support can sustain and boost conservation actions (Ávila-Najera, Rosas-Rosas, Tarango-Arámbula, Martínez-Montoya, & Santoyo-Brito, 2011).

The prevalent knowledge about the local biodiversity can vary according to the level of landscape urbanization. Residents of urbanized areas generally express ideological movements in favor of its preservation; rural residents generally prefer effective actions (Bandara & Tisdell, 2003). This difference is based, among other things, on the diminished contact of urban citizens with the elements of the natural environment (Berenguer, Corraliza, & Martín, 2005). Thus, experience with nature influences peoples' ways of thinking and feeling about the environment. (Azevedo et al., 2012; Berenguer et al., 2005). Therefore, the understanding of possible differences in the perception of residents about natural resources in their surroundings can be a strong ally to factors considered key to conservation, such as the understanding of human needs and respect for biodiversity (Ancrenaz, Dabek & O'Neil, 2007).

Because humans perceive their surrounding environment, prevalent knowledge may be utilized to access and understand the ecological aspects of urban remnants. In this study we evaluated: i) possible relations between the human perception of the conservation and animal richness state in urban remnants and the degree of landscape urbanization; ii) the possible causality between the human perception of animal richness in the remnants and their area; and iii) the efficiency of interviews as a method of surveying diversity in urban remnants. We hypothesized that: i) the state of conservation of urban forest remnants and their animal diversity are best perceived by people located in less urbanized regions in the city; ii) there is a species-area relationship in urban remnants when animal diversity is reported by local residents. We used interviews to capture the human perception and expected that: i) the values in a perception scale for anthropic impacts in remnants would positively correlate with the percentage of adjacent urban matrix, whereas the reported richness for terrestrial vertebrates would negatively correlate; and ii) the reported richness of terrestrial vertebrates would positively correlate with the remnants' area.

Material and methods

Study area

The study was conducted in the vicinity of forest remnants in the city of Goiânia, Goiás State, Brazil (16°40'S, 49°16'W). The city has approximately 732 km² and 730 m in altitude Instituto Brasileiro de Geografia e Estatística (IBGE, 2012). The territory has approximately 62% of the area occupied by the urban matrix and 38% by a rural matrix (ITCO, 2008). The city has deciduous and semi-deciduous seasonal forests (cerradão, dry forest), pioneer river formations (riparian and gallery forests), savannah formations (*sensu-stricto* cerrado, campo sujo and campo limpo) and areas of ecological tension between savannah and seasonal forest (Ribeiro & Walter, 1998). Thirty-one remnants were randomly and spatially selected (ArcGIS v. 9.3) showing areas distributed within the following ranges: 5-20 ha (n = 8), 20-40 ha (n = 7), 40-100 ha (n = 8), and > 100 ha (n = 8) (Figure 1). The remnants had exclusively forestry formations or showed an association between forest and savannah formations.

Interviews

We interviewed 278 subjects between November 2010 and July 2011. We used semi-structured questionnaires (Annex 1; approved by the Ethics Committee in Research of UFG n° 377/2010) to interview between 3 and 11 residents and/or employees of establishments located in the remnants' vicinities. The inclusion criteria for interviewees were geographic proximity to the remnant and minimum age of 18 years.

Landscape classification

We classified the landscape contained in circular centered buffers with 1 km radius in 28 of the 31 remnants to avoid buffers' overlap. Landscape elements such as residences, roads, industries, stores, artificial ponds, house farms, gardens, and fences were classified as an urban matrix. We recognized these elements during field visits to conduct the interviews. We calculated the percentage of area occupied by the urban matrix present in the buffers (Fragstats v. 4.2).

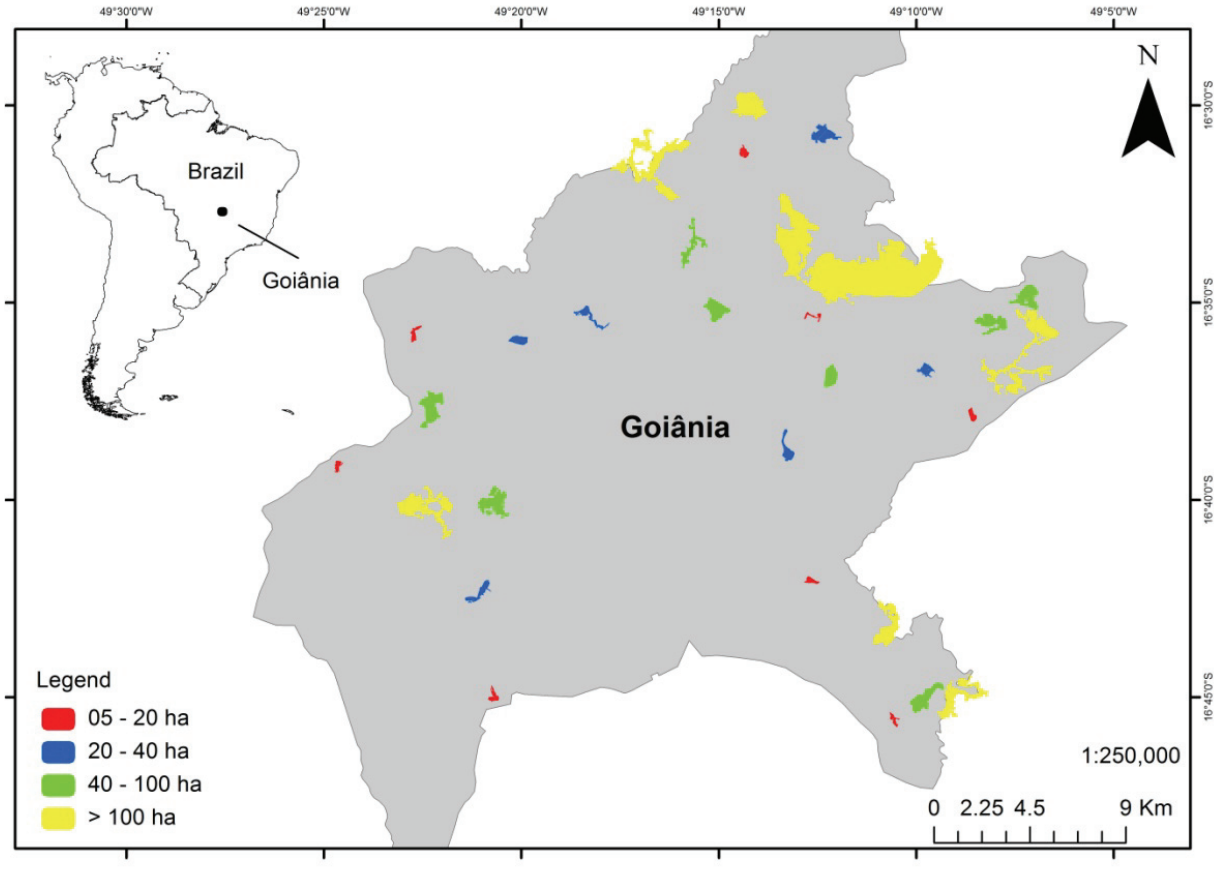

Figure 1. Remnants (n = 31) in the landscape of Goiânia, Goiás, Brazil distributed in four area classes (ha) as described. Source: created by Grande, T. O.

Data analysis

Scale of human perception

We applied a scale of subject's perception of the level of remnants conservation adapted from Bishop, Hrdy, Teas, & Moore (1981). The answers to questions no. 1 to 5 were quantified and grouped into categories of impact intensity with weights from 0 (no impact) to 4 (high impact) (Table 1). The following methodology was applied to each remnant and those five questions: gross frequency of positive responses in each category was multiplied by its respective weight; these values were added and divided by the number of respondents from each remnant resulting in an average per question. The averages of the five questions were added obtaining one value per remnant. The range of variation in the scale was from 0 to 20, with values distributed in four degrees of perceived impact: light (4 to 0), moderate tending to light (9 to 5), moderated tending to high (14 to 10), and high (15 to 20).

Reported animal richness

The answers to questions 6.1 and 7.1 were added per remnant to obtain the reported richness for vertebrates. Only one account was recorded when a primate species was reported in both questions (6.1 and 7.1). Additionally, we added answers to question 4.1 to the richness of animals that were not reported in question 6.1 in the same questionnaire. Answers that designated broad taxonomic groups or contained any possibility of confusion were excluded from this quantification, which considered only reports that ensured identification at the species or morphospecies level. We used scientific articles, lists of species, and regional technical reports to verify the scientific names of the reported species (Bérnils & Costa, 2012; Bonvicino, Oliveira, & D'Andrea, 2008; Brasil, 2007; Naturae, 2004; Reis, Perachi, Pedro, & Lima, 2011; Turtle Taxonomy Working Group, 2014; Wilson & Reeder, 2005; Wikiaves, 2015).

Efficiency of interviews

We evaluated the assertiveness of richness reported in the interviews by comparing these reports with the richness of medium to large mammals sampled through camera-trapping by Neves (2012) in remnants 1 to 11, between July and September 2011, and with the primate richness sampled through playback by Grande (2012), between November 2010 and July 2011, in all remnants evaluated in this study.

The species studied by Grande (2012) and Neves (2012) can be considered representatives of cinegetic fauna and are suitable for this comparison because of their reliable identification by the subjects' reports.

Table 1. Relative (%) and absolute (n) frequencies of the interviewees' answers about the perception of parameters related to the degree of remnants conservation in the landscape of Goiânia, Goiás State, Brazil.

Parameter	Categories	Weight	Frequency (%)
	Not evaluated/do not know	0	1.1 (n = 3)
	Well preserved	1	24.1 (n = 67)
1. Degree of conservation	Low degree of impact	2	20.1 (n = 56)
	Median degree of impact	3	39.6 (n = 110)
	High degree of impact	4	15.1 (n = 42)
	Not evaluated/do not know	0	5.8 (n = 16)
	It does not occur	1	46.0 (n = 128)
2. Occurrence of fire	Yes, but frequency was not identified	2	3.6 (n = 10)
	Yes, at low frequency	3	27.0 (n = 75)
	Yes, at high frequency	4	17.6 (n = 49)
	Not evaluated/do not know	0	0 (n = 0)
	Does not use/use without causing impact	1	72.7 (n = 202)
3. Use of the remnant	Yes, but the use was not identified	2	0.4 (n = 01)
	Yes, usage causing little impact	3	13.7 (n = 38)
	Yes, usage causing high impact	4	13.3 (n = 37)
	Not evaluated/do not know	0	6.8 (n = 19)
	There is no hunting	1	75.2 (n = 209)
4. Occurrence of hunting	Yes, but hunted group/species were not identified	2	2.5 (n = 7)
	Yes, hunted group was identified	3	5.8 (n = 16)
	Yes, hunted species were identified	4	9.7 (n = 27)
	Not evaluated/do not know	0	5.0 (n = 14)
	There is no wood removal	1	79.1 (n = 220)
5. Removal of wood	Yes, but species were not identified	2	5.8 (n = 16)
	Yes, species or purposes were identified	3	6.1 (n = 17)
	Yes, species and purposes were identified	4	4.3 (n = 12)

Statistical analysis

The Spearman correlations were applied to verify if there were associations between i) the perception scale value of the degree of conservation of remnants and the reported richness of terrestrial vertebrates, and the percentage of the adjacent urban matrix. We used a simple linear regression to determine causality between ii) the reported richness of vertebrates and remnants' area (Statistica v. 8.0). The percentage of remnants in which the presence of animals was detected by both Grande (2012) and Neves (2012), and reported by the subjects, was calculated to verify the interviews' efficiency.

Results

Around 72% (n = 202) of subjects stated not using the areas (or using without causing impacts), whereas the few reports of use were evenly divided between impactful and less impactful activities (Table 2). The majority of respondents reported the degree of remnants conservation as median (39%, n = 110) or good (24%, n = 67) (Table 1). The perception of the occurrence of fires was reported by almost half of the subjects (48%, n = 134), of which, 34% (n = 46) indicated it in high frequency mainly in the dry season of the previous year. Most of the subjects reported no observation of hunting practice in the remnants (75%, n = 209); however, few subjects reported hunting of capybara, paca, armadillo, and birds (15%, n = 43) (Annex 2). The removal of wood was reported as non-existent by 79% (n = 220) of the subjects against only 10% (n = 29) reporting which trees are commonly removed and their purposes. The main tree species reported as removed, guatambu and angico, were used as tools and fence material and firewood. Animal richness was reported through 68 species/morphospecies of terrestrial vertebrates, of which 44% (n = 30) were mammals, 42% (n = 29) were birds, and 13% (n = 09) were reptiles (Annex 2).

Considering all remnants, the scalar values of human perception were normally distributed between 5.4 and 11.8, i.e. interviewees demonstrated the perception about anthropic impacts at the moderate, tending to high degree, or moderate tending to light degree. Contrary to expectations, both scalar values (n = 28; rho =-0.30; p = 0.12) and reported richness (n = 28; rho = -0.05; p = 0.76) per remnants did not significantly correlate with the percentage of urban matrix in the landscape. However, as expected, the variations in the reported species richness among remnants were not explained by chance ($F_{1.29}$ = 10.87; p < 0.002), indicating an area effect on the remnants' diversity perceived by the subjects. However, this area effect explained the variation in reported richness in only 27% of remnants (r^2 = 0, 27; y = 1.72 + 0.20*x; p < 0.01).

Table 2. Types of usages of remnants in the landscape of Goiânia, Goiás State, Brazil reported by interviewees and the level of caused impact. *Activities considered a type of work.

Impact	Use
High	Provision of monkeys*, cattle settings, cleaning the inside area*, as a pathway, fishing, removing vines and wood, interior surveillance*, dog training*
Low	Eating fruits, leisure, sightseeing, removing fallen wood, removing fallen seeds, collecting water for animals*, supervision*, cleaning the freshwater source channel*, trail maintenance*, patrolling*, caring for the park*, inspecting*, for educational, medicinal, and sanitary (bathroom) uses
None	Preventing pollution, nature observation, preservation, reforestation, monitoring*

Approximately half of the records of richness sampled through camera-trapping (Neves, 2012) did not have matching accounts in the interviews (Annex 2). However, when accounts matched, the agreement between them was predominantly high (≥ 50%). The medium to large mammals with matching accounts were: red brocket (*Mazama americana*), South American coati (*Nasua nasua*), common fox (*Cerdocyon thous*), giant anteater (*Myrmecophaga tridactyla*), southern tamandua (*Tamandua tetradactyla*), paca (*Cuniculus paca*), and capybara (*Hydrochoerus hidrochaeris*). The interviews' data showed almost total matching with the primate richness assessed through the playback technique (Grande, 2012) indicating high level of assertiveness (≥ 90%) for *Alouatta caraya*, *Sapajus libidinosus*, and *Callithrix penicillata* (Annex 2).

Discussion

This study investigated the relationship between the human perception of the conservation and state of animal richness in urban remnants and level of landscape urbanization, and between the human perception of animal richness and the remnants' area. The human perception of environmental conservation demonstrated in the interviews indicates that most people adopted an optimistic stand regarding the health of remnants by judging the degree of destruction as medium and indicating that there is no pressure from hunting and deforestation. Most subjects claimed not using the remnants; some used them (e.g. for holding cattle) but do not recognize this usage and even consider the remnant well preserved. These results may indicate that most local residents do not feel as part of the environment or responsible for its

disturbance. It is still possible that the optimistic stand in relation to environment conservation is based on a desire to not be responsible for the degradation or not be compromised with the reported account. Conversely, the reports of fire events were provided by most interviewees with considerable accuracy. The accuracy of this information can be explained by fire events being eventual, noteworthy and oblivious to the participation or choice of subjects.

The reports about animal richness are detailed and reflect the way subjects understand this environmental aspect. The reported fauna consisted of mainly mammals and birds; perhaps because these are groups are easily viewed and identified by the local population, or even because they have some use as food or medicine (Silva & Freire, 2010). Some reports were disregarded because the species has confusing common names (e.g. amphisbaena, blind-snake, and double-headed snake) or because different species have the same common name (e.g. "sloth" can designate the folivorous *Bradypus* sp. or the lizard-sloth *Polychrus acutirostris*). The animals mostly reported as targets of hunting (capybara, paca, armadillo, and birds) indicate that, although neglected, this anthropic pressure exists in the urbanized environment, which points to the need for increased inspection and investigation regarding the purpose of this practice (sports, meat consumption). This need also applies to the pressure of wood removal. Even in an urban context, which theoretically provides resource subsistence options for the population, the predatory use of natural resources in remnants can be established as a persistent and harmful pressure.

Despite the different levels of anthropogenic pressure upon the remnants inferred here from the percentage of surrounding urban matrix, this anthropization gradient is not reflected in the perception of subjects who predominantly perceived impacts as moderate. This result may indicate that residents of urbanized regions, despite the heterogeneous distribution of urban elements in the landscape, are not sensitized to environmental problems in their neighborhood and, therefore, do not notice them. Although opinions about certain aspects of biodiversity can vary significantly between residents from rural and urban areas (Azevedo et al., 2012), urbanization is a strong modifier of the lifestyle of citizens and their understanding of nature, which extends beyond the environment's physical consequences. Even residents of rural areas can drift away from the surrounding natural elements and incorporate urban elements, such as technology, bureaucratic obligations, and material dependence on commercial centers in cities, in their routine. These factors could contribute to the subjects' lack of attention to nature and explain the deficiency in their perceptions of areas with varying degrees of anthropization.

We also refute the hypothesis that reported animal richness negatively relates to landscape urbanization. It is possible that urbanization exerts an influence on the reported richness up to a threshold that was not identified in this study. Although it is known that rural community residents best recognize animals because they have more chances to observe them in their natural habitat, most urban community residents do not see wild animals outside zoos (Azevedo et al., 2012), and that cities generally have the largest forest remnants in peripheral regions (rural areas), it would be expected that the biodiversity reports would correlate with the urbanization gradient. However, it is possible that the advance in urbanization standardizes population knowledge and changes the way residents perceive biodiversity. We corroborate the causality between the reported animal richness and remnant areas. Potential diversity suggested by interviews is in good agreement with the actual diversity provided by camera trapping demonstrating how the interviews were useful to indicate actual richness. Despite the expected biological impoverishment caused by urbanization (Dickman, 1987), which lead to the predominance of generalist species, such as several listed in Annex 2, this result indicates that the species-area relationship is maintained in studied urban forestry relicts. This result also indicates that the area is an important vector of richness in the urban environment.

For some species, the interview reports and camera-trapping registries coincided, validating the reliability of the information provided by subjects and the ability of interviews to capture an accurate assessment of diversity. Beyond these species, the study by Neves (2012) also recorded the presence of the tapeti rabbit (*Sylvilagus brasiliensis*) and a third species of armadillo (*Cabassous unicinctus*), which could coincide with the reports of "rabbit" and "armadillo" in our study, however, these were disregarded because of identification difficulties. For those animals whose records did not coincide, we assume that the interviews could capture a fauna portion that is not sampled by methods such as camera-trapping; these methods may be complementary, such as in cases of restrictions on time or resources in fauna surveys of medium and large urban mammals. Interviews regarding primates resulted in positive assertions when compared with

the records produced by playback, indicating that this taxonomic group, at least in the urban environment, reliably reflects the prevalent opinions and can be adequately sampled by interviews.

The conservation of urban remnants to maintain local biodiversity is essential in anthropized landscapes. In some remnants, the number of vertebrate species was considerably high (n = 30) suggesting that ecological and inventory studies could reveal a diverse fauna in the studied landscape. Remnants, though small, can be used as shelters for many species (Calaça, Melo, De-Marco-Junior, Jácomo, & Silveira, 2010) and also as stepping-stones between more favorable adjacent areas, a situation which favors the movement of species in the landscape as well as their long-term persistence (Chiarello & Melo, 2001). The loss of green areas as a result of urbanization challenges us to provide/insert nearby nature into the urban matrix (Yli-Pelkonen & Kohl, 2005).

It becomes imperative to work in cooperation with communities that coexist with local species to achieve urban environment conservation (Campbell-Smith, Simanjorang, Leader-Williams, & Linkie, 2010; Lescureux & Linnell, 2010). Such cooperation can help residents to better understand the real value of conservationist efforts (Triguero-Mas et al., 2012) and to improve both the environment and their quality of life, for example through understanding the benefits of a diverse and balanced environment. The collection of information about the conservation of remnants through their adjacent human populations proved to be a valuable tool, potentially useful in developing future strategies of urban management or conservation (Benites & Mamede, 2008). Communities closest to remnants are in a unique position to provide information on the occurrence/frequency of species (Baker & Harris, 2007) and biodiversity aspects perceived by individuals in daily contact with nature.

Conclusion

Subjects generally position themselves in an isolated and independent manner from the ecological condition of an urban environment. The anthropization gradient was not reflected in the environmental perception of subjects, indicating the low sensitivity of residents in urbanized region to environmental issues. Animal diversity reported by individuals was rich and included reports of hunting in the urban context. The reported animal richness did not negatively correlate with the landscape urbanization. The causality between the reported animal richness and remnant areas indicates that interviews may serve as indicators of actual richness, and that species-area relationship remains in forest urban relicts. Interviews and camera-trapping may be complementary methods in urban fauna surveys, particularly the interviews as an assertive sampling method for primates. The incorporation of a sociological component in ecologic studies should be aspects associated with the biodiversity conservation in urban ecosystems.

Acknowledgements

This study was supported by the National Conselho Nacional de Desenvolvimento Científico e Trcnológico (CNPq). We thank the Graduate Program in Ecology and Evolution at the Universidade Federal de Goiás, Brazil. Alencar, R. M.; Costa, U. Q.; Neves, K.; and Neto, G. F. S. provided crucial assistance in the field. We also thank the collaboration of residents of Goiânia, who were willing to participate in the interviews.

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Received on August 27, 2015.
Accepted on February 16, 2016.

APPENDIX

Annex 1. Semi-structured questionnaire applied to residents from adjacencies of study remnants (n = 31) in the landscape of Goiânia, Goiás, Brazil (approved by the Ethics Committee of Research from UFG n° 377/2010).

1 - How do you evaluate the remnant destruction?
Intense ( ) Median ( ) Light ( ) Well-preserved ( )
2 - Has the remnant been caught on fire? Y ( ) N ( )
2.1 - If yes, is it frequent? Y ( ) N ( )
2.2 - If yes, when was the last time?
3 - Do you use the remnant? Y ( ) N ( )
3.1 - If yes, with what purpose?
4 - Do you know if anyone uses the remnant for hunting? Y ( ) N ( )
4.1 - If yes, which animals are hunted?
5 - Do you know if anyone uses the forest to remove wood? Y ( ) N ( )
5.1 - If yes, which are the most extracted species and what are their uses?
6 - Have you ever seen animals in the forest? Y ( ) N ( )
6.1 - If yes, which one?
7 - Have you ever seen primates in the forest? Y ( ) N ( )
7.1 - If yes, which ones?

Annex 2. List of species reported by interviewees ihe adjacencies of study remnants (n = 31) in the landscape of Goiânia, Goiás, Brazil, including the number of hunting reports (Hunt), remnants where the occurrence of animals was reported (Rem), and their presence registered by camera-trapping (CT) (Neves, 2012) and playback (PB) (Grande, 2012), as well as assertiveness (Ass) compared between these methods.

Class/Order	Family	Species	Popular name	Reports	Hunt	Rem	CT	Ass (CT)	PB	Ass (PB)
Mammalia										
Artiodactyla	Cervidae	*Mazama gouazoubira*	Brown brocket	4		6, 16, 31	3, 4, 7, 8, 9, 11	0%	-	-
		Mazama americana	Red brocket	16	1	3, 4, 5, 6, 7, 8, 15, 16, 20, 21, 23, 24, 26, 31, 32	7, 8, 9, 11	50%	-	-
		Ozotocerus bezoarticus	Pampas deer	1		30	-	-	-	-
	Tayassuidae	*Tayassu pecari*	White-lipped peccary	1		15	8	0%	-	-
		Pecari tajacu	Collared peccary	4	3	11, 16, 23	5, 7, 8	0%	-	-
Carnivora	Procyonidae	*Nasua nasua*	South american coati	75		1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 15, 16, 19, 20, 21, 22, 23, 26, 28, 30, 31, 32	2, 3, 5, 6, 7, 9, 10, 11	75%	-	-
		Procyon cancrivorus	Crab-eating raccoon	4		25, 29, 31, 32	11	0%	-	-
	Mustelidade	*Lontra longicaudis*	Neotropical otter	6		5, 17, 22, 28	9	0%	-	-
		Galictis vittata	Greater grison	5		2, 18, 22, 24, 32	-	-	-	-
		Eira barbara	Tayra	8		2, 4, 6, 8, 25, 32	-	-	-	-
	Canidae	*Cerdocyon thous*	Common fox	11		4, 6, 20, 24, 28, 30, 32	4, 6, 9, 11	50%	-	-
		Chrysocyon brachyurus	Maned wolf	20		4, 5, 6, 7, 11, 15, 23, 30, 31, 32	-	-	-	-
		Lycalopex vetulus	Hoary fox	51	1	2, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32	-	-	-	-
	Felidae	*Puma concolor*	Puma	5		5, 6, 22, 32	8, 11	0%	-	-
		Panthera onca	Jaguar/Jaguar black	5		15, 31, 32	-	-	-	-
		Leopardus tigrinus	Oncilla	17		6, 7, 8, 15, 16, 21, 22, 28, 29, 30, 32	-	-	-	-
		Leopardus pardalis	Ocelot	7		6, 16, 22, 28, 30, 32	-	-	-	-
Cingulata	Dasypodidae	*Dasypus novemcinctus*	Nine-banded armadillo	1		32	4, 5, 6, 9	0%	-	-
		Euphractus sexcinctus	Yellow armadillo	3		15, 23, 32	2, 6	0%	-	-
Didelphimorphia	Didelphidae	*Didelphis albiventris*	White-eared opossum	19		2, 3, 12, 17, 18, 21, 24, 27, 28, 29, 31, 32	1, 4, 5, 6, 7, 11	0%	-	-

Continue...

...continuation

Class/Order	Family	*Species*	Popular name	Reports	Hunt	Rem	CT	Ass (CT)	PB	Ass (PB)
Pilosa	Myrmecophagidae	*Myrmecophaga tridactyla*	Giant anteater	33		1, 4, 5, 6, 10, 11, 15, 20, 22, 23, 28, 30, 31, 32	3, 4, 7, 8	25%	-	-
		Tamandua tetradactyla	Southern tamandua	11		2, 7, 9, 10, 15, 23, 31, 32	2, 9, 11	50%	-	-
Primates	Cebidae	*Sapajus libidinosus*	Brown capuchin monkey	154		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32	3, 6, 7	100%	3, 4, 5, 7, 8, 10, 11, 13, 15, 16, 19, 22, 23, 25, 27, 28, 30, 31, 32	100%
	Atelidae	*Alouatta caraya*	Black howler monkey	105		4, 5, 7, 8, 11, 12, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32	-	-	3, 7, 8, 12, 17, 18, 21, 22, 25, 26, 27, 28, 29, 31, 32	93%
	Callithrichidae	*Callithrix penicillata*	Black-tufted-ear marmoset	175		1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32	-	-	1, 2, 4, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32	96%
Rodentia	Cuniculidae	*Cuniculus paca*	Paca	23	8	2, 6, 7, 11, 12, 15, 18, 21, 22, 26, 30, 31, 32	2, 6	100%	-	-
	Hydrochaeridae	*Hydrochoerus hydrochaeris*	Capybara	64	21	2, 4, 5, 6, 7, 8, 10, 11, 12, 15, 16, 17, 18, 20, 21, 22, 23, 26, 28, 30, 31, 32	11	100%	-	-
	Caviidae	*Cavia aperea*	Brazilian guinea pig	4		17, 27	-	-	-	-
	Erethizontidae	*Coendou prehensilis*	Brazilian porcupine	15		2, 6, 7, 12, 17, 20, 22, 31	-	-	-	-
	Dasyproctidae	*Dasyprocta azarae*	Azara's agouti	18	1	5, 8, 9, 18, 19, 22, 25, 26, 31, 32	-	-	-	-
Birds										
Anseriformes	Anhimidae	*Anhima cornuta*	Horned screamer	8		21, 22, 28	-	-	-	-
Cariamiformes	Cariamidae	*Cariama cristata*	Red-legged seriema	25		2, 6, 8, 9, 13, 15, 16, 17, 18, 20, 22, 23, 25, 26, 29, 30, 32	-	-	-	-
Cathartiformes	Cathartidae	*Coragyps atratus*	American black vulture	2		12, 21	-	-	-	-
Charadriiformes	Charadriidae	*Vanellus chilensis*	Southern lapwing	4		1, 18, 24, 25	-	-	-	-
Columbiformes	Columbidae	*Zenaida auriculata*	Eared dove	2		28	-	-	-	-
		Columbina talpacoti	Ruddy ground dove	3	1	24, 25, 28	-	-	-	-
		Leptotila verreauxi	White-tipped dove	3		21, 22, 28	-	-	-	-
Cuculiformes	Cuculidae	*Piaya cayana*	Common squirrel-cuckoo	1	1	24	-	-	-	-
Falconiformes	Falconidae	*Herpetotheres cachinnans*	Laughing falcon	1		28	-	-	-	-
		Caracara plancus	Southern caracara	2		24, 25	-	-	-	-
Galbuliformes	Bucconidae	*Monasa nigrifrons*	Black-fronted nunbird	1		17	-	-	-	-

Continue...

...continuation

Class/Order	Family	*Species*	Popular name	Reports	Hunt	Rem	CT	Ass (CT)	PB	Ass (PB)
Galliformes	Cracidae	*Crax fasciolata*	Bare-faced curassow	2		22, 27	-	-	-	-
		Penelope superciliaris	Rusty-margined guan	4		22, 27, 30, 31	-	-	-	-
Guiformes	Rallidae	*Gallinula galeata*	Common gallinule	1		27	-	-	-	-
Passeriformes	Icteridae	*Icterus pyrrhopterus*	Variable oriole	1		28	-	-	-	-
		Icterus jamacaii	Campo troupial	1		22	-	-	-	-
	Thraupidae	*Sicalis flaveola*	Saffron finch	1		24	-	-	-	-
		Volatinia jacarina	Blue-black grassquit	1		25	-	-	-	-
	Passeridae	*Passer domesticus*	House sparrow	1		25	-	-	-	-
	Tyrannidae flycatchers	*Pitangus sulphuratus*	Great kiskadee	2	1	1, 18, 24	-	-	-	-
	Furnariidae	*Furnarius rufus*	Rufous hornero	4		18, 22, 28	-	-	-	-
Pelecaniformes	Ardeidae	*Tigrisoma lineatum*	Rufescent tiger heron	1		21	-	-	-	-
Psittaciformes	Psittacidae	*Forpus xanthopterygius*	Blue-winged parrotlet	1		21	-	-	-	-
		Brotogeris chiriri	Yellow-chevroned parakeet	8	1	9, 12, 18, 21, 22, 24, 25	-	-	-	-
		Ara ararauna	Blue-and-yellow macaw	21		12, 13, 15, 17, 18, 21, 22, 25, 26, 27, 28	-	-	-	-
Tinamiformes	Tinamidae	*Nothura maculosa*	Spotted nothura	2		25, 28	-	-	-	-
		Crypturellus undulatus	Undulated tinamou	8		21, 22, 25, 28, 30, 31	-	-	-	-
		Crypturellus sp.	Tinamou	6		17, 19, 25, 27 28	-	-	-	-
		Rhynchotus rufescens	Red-winged tinamou	10		7, 15, 17, 20, 21, 27, 28	-	-	-	-
Reptilia										
Testudinata	Testudinidae	*Chelonoidis* sp.	Tortoise	2	1	8, 9, 17	-	-	-	-
Squamata	Iguanidae	*Iguana iguana iguana*	Iguana	1		24	-	-	-	-
	Colubridae	*Spilotes pullatus*	Caninana	1		28	-	-	-	-
	Elapidae	*Micrurus* sp.	True coral snake	1		32	-	-	-	-
	Boidae	*Eunectes murinus*	Green anaconda	2		2, 32	-	-	-	-
		Boa constrictor	Boa	6		15, 27, 28, 29, 32	-	-	-	-
	Viparidae	*Crotalus durissus*	South American rattlesnake	2		25, 32	-	-	-	-
		Bothrops sp.	Pitvipers Jararacussu/	5		25, 28, 32	-	-	-	-
	Teiidae	*Tupinambis* sp.	Tegu	24		4, 5, 8, 21, 22, 24, 25, 26, 27, 28, 32	-	-	-	-