

ARTIGO



AUTORES:

Ariadina Reis Almeida¹
Daniela Biondi¹

¹ Universidade Federal do Paraná – UFPR,
 Rua XV de Novembro,
 80060-000, Curitiba, PR, Brasil

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Autor correspondente:

Daniela Biondi
 E-mail: dbiondi@ufpr.br

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*A study of the landscape and the occurrence of *Hydrochaerus hydrochaeris* at ‘Tingui’ Municipal Park in Curitiba, State of Parana*

Estudo da paisagem e a ocorrência de capivaras no Parque Municipal Tingui – Curitiba-PR

ABSTRACT: The capybara is a common rodent in areas with influence of water in Curitiba, State of Parana, occurring in several public parks. At ‘Tingui’ Municipal Park, the resident population of capybaras is heterogeneously distributed in the area - the groups remain in a small portion (P2) clustered around a lake during the day. In order to identify environmental factors that influence the presence of these animals in this portion, this study analyzed the landscape quality of the entire area of the park. The analysis of the landscape quality for the resident capybaras of ‘Tingui’ Park was developed using both direct and indirect methods. In the direct method, data were collected on the spot; while in the indirect method, data were collected through cartographic information. The results indicated that the stay of the capybaras in the P2 portion of the park is related to the landscape, once that site presents the highest amount of natural features (lakes, vegetation - tree, shrub and lawn) and few man-made elements (impermeable area, visitation area and roads), which favor their presence.

RESUMO: A capivara (*Hydrochaerus hydrochaeris*) é um roedor comum em áreas com influência de água, ocorrendo em vários parques públicos de Curitiba-PR. No Parque Municipal Tingui, a população de capivaras residentes está distribuída heterogeneamente na área, sendo que os grupos permanecem em uma pequena porção (P2), com esses animais aglomerados ao redor de um lago durante o dia. Com o intuito de identificar quais os fatores ambientais que influenciam a presença dessas capivaras nessa porção, esta pesquisa analisou a qualidade da paisagem de toda a área do parque. A análise da qualidade da paisagem para as capivaras residentes do Parque Tingui foi desenvolvida utilizando-se os métodos direto e indireto. No método direto, a coleta dos dados ocorreu *in loco* e, no indireto, os dados foram coletados por meio de informações cartográficas. Os resultados obtidos indicaram que a permanência das capivaras na porção P2 está relacionada à paisagem com maior quantidade de elementos naturais (lagos, vegetação arbóreo-arbustiva e gramado) e menor quantidade de elementos antrópicos (área impermeável, área de visitação e ruas), características que favorecem a sua presença.

1 Introduction

The expansion of cities onto the natural environment causes great impacts that result in the degradation of urban environmental quality. In order to try to minimize these effects, urban green areas such as squares and public and private parks have been created. According to Dantas and Souza (2004), besides providing balance between preservation and degradation, these areas have the purpose of bringing a little of the natural environment to cities, being an excellent indicator of quality of life.

Most parks in Curitiba have emerged as solutions to curb floods, control irregular occupation of riverbanks and preserve remaining areas (GEISSLER, 2004). Besides the functional objectives that affect human life directly, green areas hold great ecological value while safeguarding the biological identity of regions, preserving the flora and fauna present in urban ecosystems (RODRIGUES et al., 2002; BIONDI; ALTHAUS, 2005; LOBODA; ANGELIS, 2005; ALMEIDA; ZEM; BIONDI, 2009).

The parks in Curitiba are home to countless species of the Brazilian fauna, including capybaras. The capybara (*Hydrochaeris hydrochaeris* Linnaeus, 1766) is the largest living rodent (EMMONS, 1990). It is a species of the Brazilian wild fauna that occurs in Central and South America (EMMONS, 1990) and it can be found all over Brazil. It is a generalist herbivore of the semi-aquatic environment (ALHO; CAMPOS; GONÇALVES, 1987a) that feeds on undergrowth, shrub and aquatic vegetation (QUINTANA; MONGE; MALVÁREZ, 1998; FORERO-MONTAÑA; BETANCUR; CAVELIER, 2003; CREED, 2004). In natural environments, the capybara rests and shelters in areas with plant cover (MONES; OJASTI, 1986). According to Krauer (2009) and Ferraz et al. (2009), most of the capybara population is confined to flat areas with still water, surrounded by undergrowth vegetation.

The aquatic environment is of great importance for the preservation of this species because, besides presenting reproductive behavior preferably in the water, these animals also find shelter there when running away from predators. According to Herrera (1987) and Ojasti (1996), this landscape element exercises strong influence on the formation and

maintenance of social groups (HERRERA 1987; OJASTI, 1996).

Because it is a generalist species, the capybara is able to survive in a wide range of types of climates and vegetation, and it adapts to different foods and environmental conditions (ALHO, 1986; PEREIRA; ESTON, 2007; TIM, 2009). Capybaras are tolerant animals that profit with the environmental changes caused by human development (VERDADE; FERRAZ, 2006). In Curitiba, capybaras can be found in several public parks such as “Tingui” Municipal Park. The capybara population of this area seems to dwell on only one region – the center north of the park.

Several researches analyze the relation between landscape and fauna. One way of studying this animal/area interaction is the use of landscape ecology, an important branch of Ecology in the study of a given region (FORMAN; GODRON, 1986; METZGER, 2001). Landscape ecology enables the study of several components for the understanding of landscape as a whole; through it, the landscape can be broken up into smaller units, which are analyzed individually and as a group. According to Rempel et al. (2008), with the exercise of dividing and clustering, it is possible to obtain the integration of information and the diagnosis of a region. This branch of Ecology allows, for instance, the study of a given landscape quality and fragility; in this case, the methods applied can use information gathered directly in the field or use materials that represent the studied area, such as maps, photos, drawings, etc. (HARDT, 2000).

Considering the heterogeneous distribution of the capybara population in “Tingui” Municipal Park, the purpose of this research was to analyze the factors that influence the preference of capybaras for certain regions. To this end, methods that assess the landscape quality were utilized.

2 Material and Methods

“Tingui” Park was the area studied, a City Preserve (IAP, 2008) located in the northeast of Curitiba, in the watershed of Barigui River, 25° 23’ 43” S and 49° 18’ 15” O geographical coordinates. It is 0.38 km² large, corresponding to 0.09% of the city

area and 0.03% of the watershed area (IPARDES, 2004) (Figure 1).

The park area is distributed in the following typologies: 30% conservation area, 23% circulation area (paved trail), 12% infrastructure area (playground, barbecue kiosks, sports courts, gym equipment, parking lot, etc.), 23% lake area, 2.5% park maintenance area (municipal police and accommodation for employees and materials) and

8.5% riparian vegetation area (CURITIBA, 2009). The park also holds the Ukrainian Memorial, built in 1995 in honor of Ukrainian immigration in Brazil.

The park is 2,182 m long and from 66 to 333 m wide, forming an elongated structure from north to south. Barigui River borders the east and south limits of the park, while Fredolin Wolf and Jose do Valle streets contour the north and west limits, respectively.



Figure 1. Location of 'Tingui' Municipal Park.

According to Köppen's climate classification, the area is located in the Cfb climatic type, with humid temperate (or subtropical) climate, mesothermal, with no dry season, with mild summers and winters with frequent frost and occasional snowfall. East winds with 2.1 m s^{-1} annual average speed are predominant. Temperature means of $20.94 \text{ }^{\circ}\text{C}$ in summer and $13.77 \text{ }^{\circ}\text{C}$ in winter. Annual average rainfall of $1,563.30 \text{ mm}$ and average relative humidity of 80.81% (IPPUC, 2012).

The analysis of landscape quality for the dwelling capybaras in 'Tingui' Park was developed through direct and indirect methods. For the direct method, data collection occurred on the spot, and for the indirect one, data were collected by means of cartographic information.

When applying the direct method, the whole park area was covered in order to view the capybaras present in the place (Figure 2). During the surveys, which occurred in 2009, 2010 and 2011, the geographical coordinates where the animals were viewed were recorded and plotted on maps.

In the indirect method, the "Use of 'Tingui' Municipal Park" map (granted by the management plan - Plano de Manejo (CURITIBA, 2009) divided in area units represented by 242 grids of $50 \times 50 \text{ m}$ (Figure 2). In order to organize better the information and detailing of the entire extension of 'Tingui' Park, the area was stratified, along its length, in six parts (1 to 6). The analytical variables of the park were based on the predominance of existing components in landscape or landscaping typology.

The characterization of variables was done in the following way:

- L – landscape comprising the entire lake part;
- Vt/s – landscape comprising the trees and shrubs vegetation;
- Ll – landscape comprising the whole lawn area;
- R – landscape comprising the entire river part;
- IA – landscape comprising the whole impermeable area, such as pavements and constructions;
- VA – landscape comprising all the visitation area, including the park infrastructure such as sports courts, paved trails, bridges, decks, facilities and the Ukrainian Memorial;
- St – landscape comprising all the paved part that contours the north and west limits of the park, as well as Jose do Vale St., which crosses the south of 'Tingui' Park.

Variables L, Vt/s, Ll and R are the natural elements that support the survival of animals, while variables VA, IA and St are the anthropic elements that interfere with the biological activities of capybaras. Each variable proportion was charted for all 242 grids, as shown in Figure 3.

The indirect method also involved the analysis of the five existing islands in the area studied. For each island, variables were characterized as follows:

- A - area;
- PC – plant cover;
- VB – forest with visual barrier between animals and households;
- DL – distance from the islands margins to the lawn;



Figure 2. View of a group of capybaras at 'Tingui' Municipal Park, 2009. Source: Ariádina M.R. Almeida (2009).

- DH – distance from the islands to the households;
- St – distance from the islands to Jose do Valle St.;
- CAP – use of the island by the capybaras, through the recording of faeces or viewing of animals.

Data obtained through the direct method were recorded in *Excel* spreadsheet and plotted on map with *ArcGis 9.3* software. Data collected through the indirect method were processed by multivariate analysis with *Statgraphics Plus 5.1* software, making use of correlation analysis (Pearson’s coefficient) for the islands. The proportions of variables frequencies

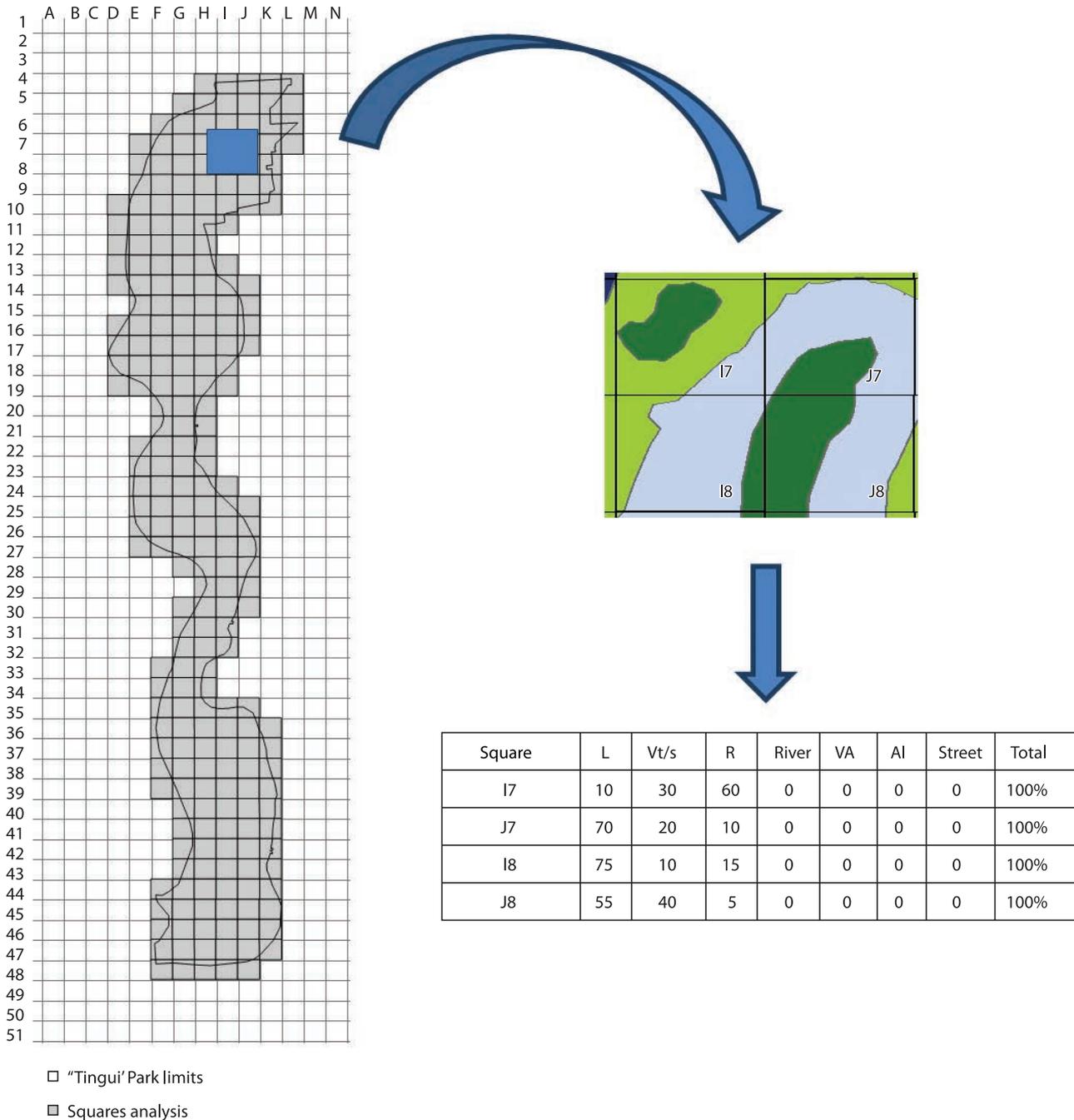


Figure 3. Indirect method for the analysis of the landscape quality of 'Tingui' Municipal Park, State of Parana.

were compared through the Chi-square test at 5% significance level.

3 Results and Discussion

Capybaras were viewed in parts 1 (P1), 2 (P2), 4 (P4) and 6 (P6) of the area studied; however, only P2 presented a greater number of views (Figure 4).

All of the parts (P1 to P6) in the park comprise the water element as artificial or natural lake. As capybaras are semiaquatic animals and, therefore, possess morphological adaptations to dwell on environments under the influence of water, it was expected that groups of animals would be found throughout all parts of the park; nevertheless, the great majority of animals remained, most of the time, in P2.

A group of capybaras consisting of adult animals and cubs were seen in both P1 and P6, in each subarea. In P2, several groups consisting of adult animals and cubs were viewed on lawns around the lake and in the islands. While in P4, only one male adult animal was observed in the vegetation in Barigui River banks, probably a lonely animal that was moving between groups of other subareas. Therefore, probably only P1, P2 and P6 are occupied by the same group of capybaras.

Out of the 242 grids analyzed, 54 are in P1, 44 in P2, 31 in P3, 32 in P4, 37 in P5 and 44 in P6 (Figure 4). The sum of the proportions and the percentage of each variable studied in the different parts analyzed are described in Table 1.

The trees and shrubs vegetation and lawn are landscape elements in P1 and P6 in this analysis, since they were the two variables that presented the highest values (P1: Vt/s 26.1% and Ll 36.3%; P6: Vt/s 37.8% and Ll 28.7%), and the difference between variables was not significant (P: $\chi^2 = 1.66$ and P2: $\chi^2 = 1.17$).

In P3, P4 and P5, the trees and shrubs vegetation presented greater significant value among the seven variables (P3-53.9%; P4-52.2% and P5-47.6%) and, therefore, it is the landscape element that best represents these six subareas.

P2 is the area that showed the natural elements L (25.7%), Vt/s (32.2%) and Ll (26.8%) in greater proportions and better distributed in the park,

once the difference between the three elements was not significant ($\chi^2 = 0.86$). In addition, the sum of variables with negative impact on the survival of capybaras (VA, IA and St) present the smallest values (11.8%), when compared to the other five parts of the park (P1-22.7%; P3-17.7%; P4-22.4%; P5-18.2%; P6-14.7%).

According to some authors (HERRERA; MAC DONALD, 1989; KRAUER, 2009), it is the presence of water, forest and undergrowth vegetation that guarantees the presence of capybaras in a given environment. In this context, all subareas have the same potential to shelter groups of capybaras, once they have lakes, trees and shrubs vegetation and lawn. However, the lake, which is the most important landscape element for capybaras, is better represented only in P1, P2 and P6, subareas where at least one group of animals was viewed.

The landscape elements that represent P1 and P6 are Vt/s and Ll; while in P2 the elements are L, Vt/s and Ll. Moreover, it is in P2 that the adverse landscape elements to the dwelling of capybaras (IA, VA and St) are found in smaller proportion. Therefore, this is the area that holds the best conditions for capybaras and, hence, it is the region in 'Tingui' Park that houses the greatest amount of social groups.

There are other factors that negatively influence the animals: in P1, Fredolin Wolf Ave. serves as the north barrier, what can influence the moving of animals upstream Barigui River, besides representing a greater risk of trampling. In P6, it is Jose do Valle St. that can interfere with the moving of capybaras to other parts of the park, besieging the animals to a smaller area. These negative influences, added to the landscape elements of P1 and P6 subareas and the facts that will be discussed subsequently, may be responsible for the smaller amount of capybaras found in the areas aforementioned.

The islands exhibit quite important landscape for the understanding of the heterogeneous distribution of animals along the park. A forested island serves as a hideaway; according to Pereira and Eston (2007), the forest is important so that female adult animals and cubs can be protected against predators, besides guaranteeing the balance of body temperature during warmer seasons. There is only one island in P1

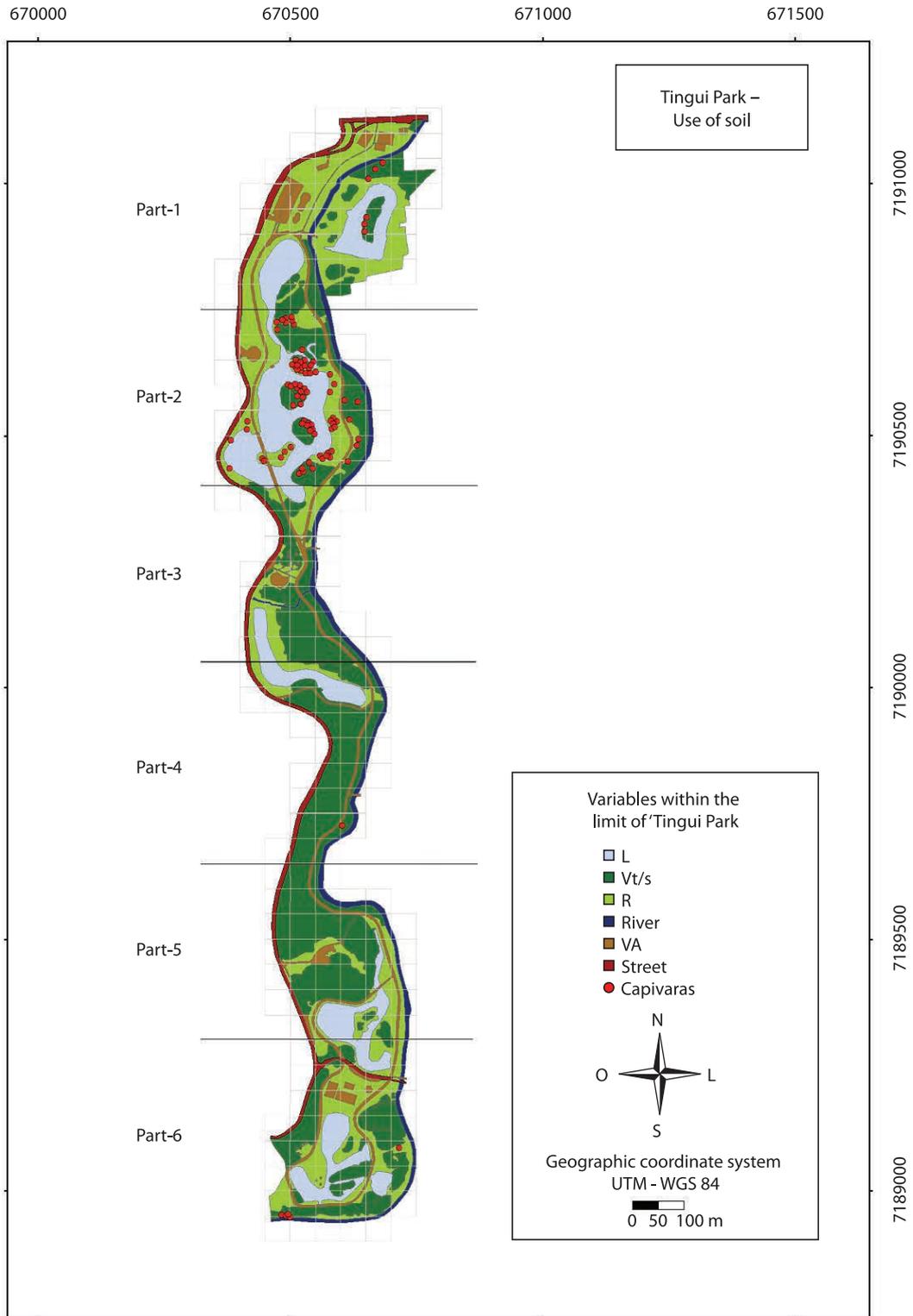


Figure 4. Indirect Method for the analysis of the quality of the landscape of the Tingui Park-PR. Fonte: Ariádina M R Almeida (2011).

and P6 (each); there are two islands in P2; there is only one in P5, covered just by undergrowth vegetation; and there are no islands in P3 and P4. The calculation of the variables analyzed in each

island is described in Table 2 and the correlation between the seven variables is shown in Table 3.

As shown in Table 3, the variables that influence the presence of capybaras in the islands are those

Table 1. Sum and percentage of the variables analyzed in ‘Tingui’ Park, State of Parana.

Variables	Parts of ‘Tingui’ Park											
	P1		P2		P3		P4		P5		P6	
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%
L	677	12.5	1,132	25.7	175	5.6	275	8.6	335	9	640	14.5
Vt/s	1410	26.1	1,418	32.2	1,670	53.9	1,670	52.2	1,760	47.6	1,661	37.8
LI	1961	36.3	1,180	26.8	512	16.5	385	12	765	20.7	1,262	28.7
R	127	2.4	152	3.5	195	6.3	152	4.8	170	4.5	190	4.3
VA	312	5.8	220	5	192	6.2	163	5.1	280	7.6	307	7
IA	643	11.9	138	3.2	173	5.6	315	9.8	210	5.7	95	2.1
St	270	5	160	3.6	183	5.9	240	7.5	180	4.9	245	5.6

Table 2. Values of the variables studied in the islands of ‘Tingui’ Park, State of Parana.

Parts of ‘Tingui’ Park	Island	Variables						
		A (m ²)	PC	VB	DL (m)	DH (m)	St (m)	CAP
P1	1	2,211.6	100	0	17.5	40.6	1,650	100
P2	2	2,341.3	100	100	16	160.7	1,298	100
P2	3	1,870.7	100	100	13.4	115	1,226	100
P5	4	1,769.1	33.3	0	6	97.6	56	100
P6	5	898.3	100	100	3.3	131.1	212	0

Classification of values: PC (33.3 = lawn; 100 = lawn + shrub + tree); VB (0 = absence; 100 = presence); CAP (0 = absent; 100 = present).

Table 3. Person’s correlation between the variables of the islands in ‘Tingui’ Park, State of Parana.

Variables of the islands	A	PC	VB	DL	DH	St	CAP
A	1						
PC	0	1					
VB	0	0.6	1				
DL	0.9	0.5	-0.1	1			
DH	0	0.1	0.8	-0.3	1		
St	0.7	0.7	0	1	-0.3	1	
CAP	0.9	-0.3	-0.4	0.7	-0.3	0.5	1

that present high correlation coefficient; which are the area of the island (A), with a value of 0.9, and the distance from the island to the lawn (DL), with a value of 0.7.

The distance to the lawn shows a positive correlation with the occurrence of animals in the islands, that is, the further the margin of the island from the lawn, the greater the probability of capybara occurrence in that island. The area of the islands also follows the same principle: the larger the area, the greater the probability of finding capybara there. This situation is enhanced if, in one part of the park there is more than one island, as it is the case of P2, which holds two islands, with the area of one of them (island 2) greater than the area of any other island.

These results indicate that P2 is the part of park that presents the best environment for

capybaras, since it presents greater amount of landscape elements – lake, trees and shrubs vegetation, and lawn – that are fundamental to the behavioral, alimentary and reproductive necessities of capybaras. In addition, variables uniformly distributed allow animals to use the water, the forest and the lawn without having to move long distances and being exposed to eventual risks. It is also the part of ‘Tingui’ Park that presents the lowest negative pressure on animals, because variables VA, IA and St show smaller proportions. Furthermore, it is the region that comprises the greater number of islands with characteristics that favor the dwelling of capybaras in P2. It is due to all these factors that animals are found in greater number in this area of ‘Tingui’ Park.

4 Conclusions

The concentration of capybaras in the P2 part of 'Tingui' Municipal Park is related to the presence of islands, better distribution and quality of the landscape elements: lake, trees and shrubs vegetation and lawn. In this part of the park, the landscape presents smaller proportion of anthropic elements, which is a favorable aspect to the presence of capybaras.

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