TERRESTRIAL PASSERINES IN AN ATLANTIC FOREST REMNANT OF SOUTHERN BRAZIL

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(With 2 figures)

ABSTRACT

Microhabitats of four terrestrial passerines were studied in an Atlantic forest remnant of southern Brazil, in two areas (northern and southern) of the Mata dos Godoy State Park (PG). *Grallaria varia* and *Hylopezus nattereri* showed low abundance and occurred in only one PG area, while *Chamaeza campanisona* and *Corythopis delalandi* were recorded in two. The microhabitats of *C. campanisona*, *G. varia,* and *H. nattereri* had many large trees and a dense understory. *Corythopis delalandi* was in areas having few large trees.

Keywords: microhabitat, terrestrial passerines, vegetation heterogeneity, Atlantic forest, southern Brazil.

RESUMO

Passeriformes de solo em um fragmento de floresta Atlântica no Sul do Brasil

Os microhábitats de quatro passeriformes de solo foram estudados no Parque Estadual Mata dos Godoy, um fragmento de floresta Atlântica no Sul do Brasil. *Grallaria varia* e *Hylopezus nattereri* apresentaram baixa abundância e ocorrência em apenas uma área do PG, enquanto *Chamaeza campanisona* e *Corythopis delalandi* foram registrados nas duas áreas. Os microhábitats de *C. campanisona*, *G. varia* e *H. nattereri* apresentaram muitas árvores de grande porte e um estrato inferior denso. O microhábitat de *C. delalandi* apresentou poucas árvores de grande porte.

Palavras-chave: microhábitat, passeriformes de solo, vegetação heterogênea, floresta Atlântica, sul do Brasil.

INTRODUCTION

Species distribution and diversity in tropical forests can be explained through such factors as abiotic conditions, vegetation complexity, and biological characteristics of each species (Holmes *et al.*, 1979; Blondel, 1985). Some terrestrial passerines (*e.g.*, *Grallaria* sp, *Hylopezus* sp) are highly selective regarding microhabitat, have large territories and low mobility, and avoid second-growth forest, which makes them very sensitive to forest fragmentation (Bierregaard & Lovejoy, 1989; Stouffer & Bierregaard, 1995; Canaday, 1997; Stratford & Stouffer, 1999; Renjifo, 1999).

Microhabitats can be defined as occupied areas presenting specific environmental features that meet the biological needs of given species (Karr, 1990; Stotz *et al.*, 1996). Distribution and abundance of bird species in tropical forest are strongly related to occurrence of their typical microhabitats (*e.g.* Kratter, 1997; Sodhi *et al.*, 1999; Illera, 2001; Bonaccorso & Barreto, 2002).

This paper describes microhabitats of four terrestrial passerines and evaluates their relative

abundance and distribution in an Atlantic forest remnant of southern Brazil.

METHODS

The study was conducted at Mata dos Godoy State Park (PG; 23° 27' S, 51° 14' W; Fig. 1), located 15 km south of Londrina, Paraná state, located in southern Brazil. The northern PG area (NP) (600-610 m asl), is fairly level. The southern PG area (SP) slopes downwards (600-480 m) to the Apertados river. Silveira (1993) and Bianchini *et al.* (2001) pointed out that that the NP vegetation structure is differs substantially from that of the SP. A dense canopy covers the NP, in which the most abundant tree species are *Cabralea canjerana* (Meliaceae), *Euterpe edulis* (Areceae), *Ocotea indecora* (Lauraceae), and *Nectandra megapotamica* (Lauraceae), with but few emergent trees, such as *Aspidosperma polyneuron* (Apocynaceae) and *Sloanea monosperma* (Elaeocarpaceae). Due to the dense upper canopy, the subcanopy receives lower light levels while the understory, which is relatively open, presents short trees and bushes, *e.g.*, such as *Eugenia verrucosa* (Myrtaceae), *Sorocea bonplandii* (Moraceae), *Miconia tritis* (Melastomataceae) and *Piper* sp (Piperaceae). An abandoned path (2 m wide) running through a slightly deforested area leads to the NP entrance.

In contrast, the SP canopy foliage is not dense, and the trees *Chrysophyllum gonocarpum* (Sapotaceae), *Campomanesia xanthocarpha* (Myrtaceae), and *Parapiptadenia rigida* (Fabaceae) are common. Emergent trees are rare, perhaps because of frequent tree falls on the steep slopes. Gaps (where *Chusquea* sp [Poaceae] and *Celtis iguanaea* [Ulmaceae] are quite abundant) are much more common in SP than they are in NP. Even outside the gaps, the SP sub-canopy, which exceeds in density that of the NP, shows high abundance of *Nectandra megapotamica* (Lauraceae), *Alseis floribunda* (Rubiaceae), *Matayba elaeagnoides* (Sapindaceae), *Lonchocarpus muehlbergianus*

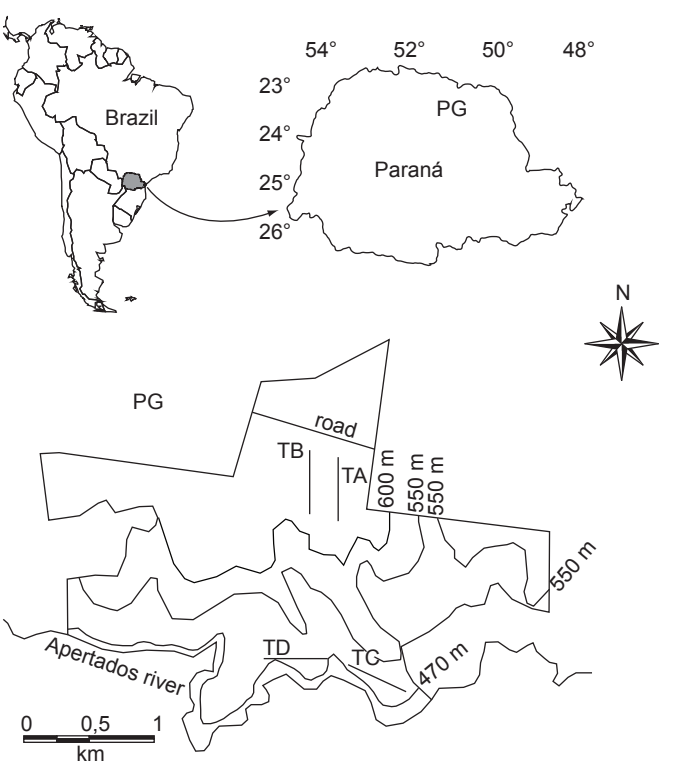

Fig. 1 — Location of Mata dos Godoy State Park (PG) and the four transects: TA and TB (northern area), and TC and TD (southern area).

(Fabaceae), *Eugenia verrucosa* (Myrtaceae), and *Trichilia cassareti* (Meliaceae). Running along the Apertados river is a 50-100 m wide floodplain, which overflows (usually from November to February) for short periods.

The method of point counts and unlimited distance (Blondel *et al.*, 1970) was used to measure abundance of terrestrial passerines in September-December 2001 (only one observer, L. dos Anjos, employed this method in the field). Two 0.5 km transects were drawn (TA and TB) 300 m apart in NP, and two others in SP (TC and TD), each of which were located 100 m from the river (Fig. 1). In each transect, five points were determined, 100 m apart and sequentially numbered (1 to 5). Each transect was sampled monthly; 40 point counts were performed in each PG area during four months. The sampling point sequence was always the same (1, 3, 5, 2, 4). Sampling began at dawn at the first point, and finished about 3 h later at the last point (num. 4). Sampling required 20 min at each point, with a 15 min break between sampling points. Vocalization of each species was considered as one contact. Relative abundance of terrestrial passerines at the NP and SP was expressed by an index of point abundance (IPA), which is the total number of contacts of each species divided by the total number of points sampled (40). Differences in species abundances between the two sites were tested for significance by using Chi-square tests. To avoid counting the same individual or group more than once, a standard form was used to order to locate and map the counted individuals.

Microhabitat sampling, conducted from October 2001 to October 2002, consisted of measuring nine variables on 10 m radius circular-plots (0.031 ha) along the same transects used for point counts. Intensive searches were made in each PG area; 264 h field observations were made in NP, and 312 h in SP. Once detected (aurally or visually), a terrestrial passerine individual's location was considered the circular-plot center point and represented one sample of the microhabitat. For each circular plot, the following variables were recorded: 1) leaf litter; 2) ferns; 3) bamboo thickets; 4) shrubs (woody-stemmed < 1 m in height); 5) herbs; 6) gaps; 7) tangles on the ground; 8) small trees with 5 cm diameter-at-breast-height (dbh); and 9) large trees with above 30 cm dbh. Each variable was measured using a semi-quantitative scale (0, 1, and 2). All variables excepting the last were rated as follows: 0) absent; 1) vegetation variable occupied 10% of the circular plot; 2) vegetation variable occupied more than 10% of the circular plot. For large trees, ratings on the semi-quantitative scale were three: 0) absence of large trees; 1) presence of up to three large trees in the circular plot; 2) more than three large trees in the circular plot.

Principal component analysis (PCA) was used to determine relationships between vegetation variables, which in turn yielded useful descriptors of the terrestrial passerine microhabitats.

RESULTS

Four terrestrial passerines were recorded in PG: *Chamaeza campanisona*, *Grallaria varia*, *Hylopezus nattereri* (all three Formicariidae), and *Corythopis delalandi* (Tyrannidae). Only *C. campanisona* was recorded in both areas during the point-count sampling period, being more abundant in SP (IPA = 0.275) than in NP (IPA = 0.125); however, the difference was not significant ($\chi^2_1 = 2.25$; $P = 0.13$). *Grallaria varia* (IPA = 0.100) was recorded only in NP, while *H. nattereri* (IPA = 0.125) and *C. delalandi* (IPA = 0.175) were recorded only in SP (Table 1).

The data from species records in the two PG areas during microhabitat sampling were similar to results from the point-count samples, except for *C. delalandi,* which was also recorded in NP. *Chamaeza campanisona* was present in 34 samples, *G. varia* in 9 samples, *H. nattereri* in 10 samples, and *C. delalandi* in 37 samples (Table 2).

The combination of all microhabitat samples of birds species (90; Table 2) is shown in Fig. 2. The first two principal components explained 61.5% of the variation (eigenvalues axis 1 = 4.40; eigenvalues axis 2 = 1.15). Principal-component one (PC1) explained 48.7% of the variation, with high positive loadings for leaf litter (PC1 = + 0.86), ferns (PC1 = + 0.81), bushes (PC1 = + 0.73), herbs (PC1 = + 0.86), tangles (PC1 = + 0.70), and large trees (PC1 = + 0.71). Principal- component two (PC2) explained 12.7%, with high positive loadings for bamboo thickets (PC2 = + 0.59) and gaps (PC2 = + 0.70). The variables derived from the PCA indicate that the microhabitats of *C. campanisona*, *G. varia,* and were similar and characterized

TABLE 1
Contact numbers, relative abundance (IPA) of the four terrestrial passerines in the northern (NP) and southern (SP) areas of the Mata dos Godoy State Park.

Terrestrial Passerines	Number of contacts		Relative abundance	
	NP	SP	NP	SP
Chamaeza campanisona	5	11	0.125	0.275
Grallaria varia	4	0	0.100	0
Hylopezus nattereri	0	5	0	0.125
Corythopis delalandi	0	7	0	0.175

TABLE 2
Number of microhabitat samples of the four terrestrial passerines in the northern (NP) and southern (SP) areas of the Mata dos Godoy State Park.

Terrestrial Passerines	Number of microhabitat samples	
	NP	SP
Chamaeza campanisona	14	20
Grallaria varia	10	0
Hylopezus nattereri	0	9
Corythopis delalandi	13	24

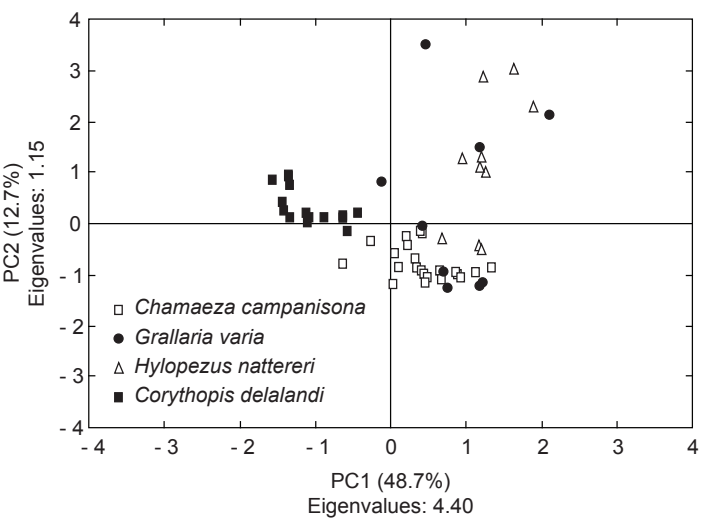

Fig. 2 — Mean principal component (PC) values for the two PCs used in microhabitat characterization of the four terrestrial Passerines.

by abundance of larger trees and heterogeneous understory with ferns, bushes, herbs, tangles, and leaf litter, and, in the case of *H. nattereri*, also influenced by the presence of bamboo thickets and gaps. *C. delalandi* microhabitat was characterized by lower abundance of these variables.

DISCUSSION

The most significant variable derived from the PCA of the Formicariidae species microhabitat was abundance of large trees with consequently lower light levels in the subcanopy and understory, the latter of which is relatively open, with no type

of vegetation dominant. This microhabitat provides both foraging and nesting sites (Cody, 1981; Willson & Comet, 1996), especially for terrestrial passerines that walk on the forest floor and catch prey from the ground (Willis, 1992; Ridgely & Tudor, 1994). Besides abundance of large trees, gaps and bamboo thickets also characterize the *H. nattereri* microhabitat, which closely fits the habitat descriptions of Whitney *et al.* (1995) and Stotz *et al.* (1996). In contrast, the *C. delalandi* microhabitat was characterized by lower large-tree abundance and low-density understory, a result closely fitting microhabitat descriptions of Ridgely & Tudor (1994), who noted that *C. delalandi* tolerates disturbed environments and is frequently found in small fragments, the latter observation also having being made by Burke & Nol (1998). In addition, *C. delalandi* has also been found in river-edge habitats (Silveira, 1993; Bianchini *et al.*, 2001).

Comparisons of the microhabitat and vegetation described by Silveira (1993) and by Bianchini *et al.* (2001) suggest that restricted distribution and low abundance of *G. varia* and *H. nattereri* can be related to specific vegetation characteristics (Holmes *et al.*, 1979; Cody, 1981; Sodhi *et al.*, 1999). In the present study, *Grallaria varia* was registered only in the northwestern area of PG, next to transect TB and the abandoned road. A dense canopy plus an open and shady understory occurs in this area, as previously observed by Silveira (1993) and Bianchini *et al.* (2001), and the large eyes of *Grallaria varia* suggest adaptation to shady sites (Sick, 1997). Furthermore, small pools of water are found next to the abandoned road, mainly during the rainy season, and this species has a habit of bathing in forest pools (Sick, 1997), as well as foraging inside forest edges (Ridgely & Tudor, 1994). It was observed doing both along the margins of the abandoned road.

Hylopezus nattereri was strongly influenced by occurrence of bamboo thickets, found only in SP. This steep-sloped area presents tree falls and natural gaps (Silveira, 1993; Bianchini *et al.*, 2001), which give rise to bamboo-thicket development (Tabarelli & Mantovani, 1999).

Small, disturbed forest fragments are characterized by structural vegetation changes, usually along their edges. Gaps increase in these areas, providing good conditions for higher abundance of light-dependent plant species, such as bamboo (Tabarelli *et al.*, 1999). This would suggest that *H. nattereri* could be present in disturbed environments in which bamboo is a common colonizer. However, Stotz *et al.* (1996) stated that despite occurrence of *H. nattereri* in bamboo microhabitats, this species is highly sensitive to disturbed environments, confirmed by its absence in our observations in disturbed areas having bamboo (Anjos *et al.*, 2004).

Since terrestrial birds (*e.g.*, *G. varia* and *H. nattereri*) are specialized for certain environments, they are more sensitive to habitat fragmentation (Stouffer & Bierregaard, 1995; Stotz *et al.*, 1996; Stratford & Stouffer, 1999; Renjifo, 1999), and thus restricted to areas where their microhabitats occur. Göerck (1997) used geographic distribution, habitat specificity, and population size as parameters to determine vulnerability degrees for Atlantic forest birds. By this index, *G. varia* and *H. nattereri* in PG can be classified as rare, by reason of their low abundance and microhabitat specificity. Atlantic forest fragmentation in northern Paraná has resulted in several forest remnants, only a few of which have similar vegetation characteristics to those of PG, which suggests why *G. varia* and *H. nattereri* are also rare in these areas and may be quite vulnerable to extinction, as a result of microhabitat loss in northern Paraná.

The SP of PG is characterized by higher leaf litter abundance, diversity and abundance of deciduous tree species, and higher humidity through its proximity to the Apertados river (Bianchini *et al.*, 2001). These features benefit terrestrial invertebrates by ensuring prey availability (Petit & Petit, 1996; Robinson, 1998; Burke & Nol, 1998; Anjos, 2002), which in turn could be implicated in the high abundance of *C. campanisona* in SP. Prothonotary Warblers (*Protonotaria citrea*) is another songbird that, according to Petit & Petit (1996), selects humid habitats because they offer high arthropod abundance.

In addition to what was registered in the point count data, *C. delalandi* was also registered in NP along the abandoned road in the one of its microhabitats. Other factors, such as interspecific or intraspecific competition, could induce some individuals to colonize slightly different microhabitats. Another biological explanation could be annual variation. But it is also possible that by using the point count method this species was simply overlooked in that PG area.

In short, the results indicate that terrestrial passerines in PG show different relationships between their microhabitats, on one hand, and distribution and abundance on the other. In *Grallaria varia* and *H. nattereri,* distribution and abundance were based on specific microhabitat characteristics. Both *C. campanisona* and *C. delalandi* were recorded in the two PG areas, suggesting that these species are more generalized. Furthermore, their microhabitats also presented different features, as shown in Fig. 2.

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