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AVIAN COMMUNITY RESPONSE TO URBANIZATION IN THE PAMPEAN REGION, ARGENTINA

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Resumen. – Respuesta de las comunidades de aves a la urbanización en la región Pampeana, Argentina. – En este estudio se compara la abundancia y riqueza de especies entre áreas urbanas y rurales en el sudeste de la provincia de Buenos Aires, Argentina, con el objetivo de analizar la respuesta de las comunidades de aves a la urbanización. Se realizaron conteos mediante transectas fijas de 100 x 50 m, durante la época reproductiva, en barrios suburbanos y periurbanos residenciales, y en áreas rurales. Los barrios suburbanos estuvieron ubicados dentro de la matriz urbana de la ciudad de Mar del Plata, los barrios periurbanos estuvieron localizados en el borde de la ciudad, y las áreas rurales estuvieron localizadas a más de 2 km de los límites de la ciudad. La riqueza de especies fue mayor en los sectores suburbanos y periurbanos que en los rurales. La abundancia fue mayor en los sectores suburbanos que en las áreas rurales. Las comunidades de aves variaron en su composición a lo largo de las áreas relevadas. La Torcaza (*Zenaida auriculata*), la Calandria grande (*Mimus saturninus*) y el Gorrión (*Passer domesticus*) fueron más abundantes en las áreas suburbanas, mientras que la Paloma picazuró (*Columba picazuro*), el Picaflor garganta blanca (*Leucochloris albicollis)* y el Zorzal colorado (*Turdus rufiventris*) fueron más abundantes en las áreas periurbanas. El Chingolo (*Zonotrichia capensis*) y el Misto (*Sicalis luteola*) fueron más abundantes en las áreas rurales. Las especies que anidan en el suelo o vegetación herbácea fueron afectadas negativamente por la urbanización, mientras que aquellas especies que anidan en árboles parecieron ser favorecidas. Las especies que anidan en huecos o estructuras artificiales fueron igualmente abundantes en las áreas urbanas y rurales. Los resultados indican que las áreas urbanas poseen una alta riqueza y densidad de aves, pero este fenómeno se debería a un reemplazo de especies propias de ambientes de pastizal por especies ampliamente distribuidas en la región, adaptadas a las nuevas condiciones impuestas por el hombre.

Abstract. – In this study we compare the bird abundance and richness between urban and rural areas in southeastern Buenos Aires province, Argentina, with the aim to analyze the response of bird communities to urbanization. Bird counts were made using fixed transects of 100 x 50 m during the breeding season in suburban, periurban residential, and rural areas. The suburban areas were located within the urban matrix of Mar del Plata City, periurban areas were located at the city boundaries, whereas rural areas were located at more than 2 km from the city limits. Bird richness was greater in suburban and periurban areas than in rural areas. Bird abundance was greater in suburban areas than in rural areas. Bird communities differed in composition along the areas surveyed. Eared Doves (*Zenaida auriculata*), Chalk-browed Mockingbirds (*Mimus saturninus*) and House Sparrows (*Passer domesticus*) were most abundant in suburban areas, whereas Picazuro Pigeons (*Columba picazuro*), White-throated Hummingbirds (*Leucochloris albicollis*) and Rufous-bellied Thrushes (*Turdus rufiventris*) were most abundant in the periurban areas. Rufous-collared Sparrows (*Zonotrichia capensis*) and Grassland Yellow-Finches (*Sicalis luteola*) were most abundant in rural areas. The species nesting on the ground or in herbaceous vegetation seem to be negatively affected by urbanization, whereas bird species breeding in trees apparently were benefited. Bird species nesting in artificial cavities were equally abundant in urban and rural areas. Results indicates that urban areas have a high bird richness and density, a fact that appears to result from a replacement of species native of grassland ecosystems by

species extensively distributed in the region, newly adapted to the conditions imposed by humans. *Accepted 13 June 2005*.

Key words: Neotropics, homogenization, birds, richness, rural, urban, grassland, conservation.

INTRODUCTION

Related to the world population increase, the advance of urban areas on natural areas is inevitable. For this reason, the analysis of the impact of urbanization on biodiversity is very necessary. At a local level, urbanization development negatively affects bird richness, although some species adapted to the human presence are benefited (Chace & Walsh in press). Generally bird density increases with urban development (Chace & Walsh in press; but see Blair 1996, Leveau & Leveau 2004a).

Although almost 90% of Argentina inhabitants live in cities (National Census 2001), very little is known about the effects of urbanization on bird communities. Only two studies exist: Feninger (1984) studied the bird communities of urban parks of Buenos Aires, and recently Leveau & Leveau (2004a) studied the abundance and distribution of bird communities along a gradient of Mar del Plata City. However, in the Neotropical region there is a lack of studies comparing bird communities between urban and rural temperate areas. On the other hand, in the Northern Hemisphere, most studies deal with comparisons of urban with native or nearly native areas, like forest fragments or arid environments (Beissinger & Osborne 1982, Mills *et al.* 1989, Blair 1996, Yaukey 1996, Tomialojc 1998). Studies that compare urban and grassland areas are scarce; see Sodhi (1992) and Bock *et al.* (1999) for the breeding season.

During the last century, the Pampean region suffered a conversion of native grassland to pastures and cultivated fields in a rate that range between 40 and 80% (Viglizzo *et al.* 2001). As for the urban environments, the knowledge of the effects of agriculture on bird communities in this region is very poor (see Leveau & Leveau, 2002, 2004b).

To examine the impact of urbanization on Pampean bird communities, we compared the abundance and richness of bird species along an urban-rural gradient of Mar del Plata City and surroundings.

METHODS

The study was conducted in Mar del Plata City (38º00'S, 57º34'W) and nearby rural areas of the southeastern part of Buenos Aires province, Argentina. Mar del Plata has 562 901 inhabitants (National Census 2001), a mean annual temperature of 14ºC and a mean annual precipitation of 920 mm. The study areas in Mar del Plata City were three forested suburban areas (located within the urban matrix): "Los Troncos" (169 ha, 7 transects), "Pinos de Anchorena" (18 ha, 4 transects), and "Parque Luro" (32 ha, 5 transects); two forested periurban areas (located at the city boundaries): "Grosellar" (54 ha, 7 transects), and "Bosque Peralta Ramos" (216 ha, 7 transects). The percentage cover of trees, shrubs and lawn was greater in the periurban areas than the suburban areas, whereas the opposite pattern was registered for the percentage cover of buildings and asphalt (see Leveau & Leveau 2004a). A major part of plant species in the sites surveyed are exotic and ornamental. In the rural areas we conducted 15 transects on 2 secondary roads, located at more than 2 km from Mar del Plata City. The rural transects were covered by 26% of cultivated fields (wheat and soybean), 18% of pastures, 26% of tree plantations (dominated by *Eucalyptus* sp. and *Pinus* sp.), 19% of small farmlands (including 7% of buildings),

TABLE 1. Mean abundance (individuals/0.5 ha) of the bird species registered along the urban-rural gradient in central Argentina. Kruskal-Wallis *H* test were made for bird species registered in more than 10% of counts. Bold characters indicate significant differences among sectors (Tukey test, $P < 0.05$). *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

Bird species	Nest site	Sectors			*H*
		Suburban	Periurban	Rural	
Spotted Tinamou (*Nothura maculosa*)	Ground	0.00 ± 0.00	0.00 ± 0.00	0.13 ± 0.52	
Chimango Caracara (*Milvago chimango*)	Trees	0.19 ± 0.54	0.57 ± 0.85	0.27 ± 0.59	2.51
Southern Lapwing (*Vanellus chilensis*)	Ground	0.00 ± 0.00	0.00 ± 0.00	0.07 ± 0.26	
Rock Dove (*Columba livia*)	Buildings	1.13 ± 2.71	0.00 ± 0.00	0.00 ± 0.00	
Picazuro Pigeon (*Columba picazuro*)	Trees	1.56 ± 2.07	**3.29 ± 1.86**	0.30 ± 0.62	19.07***
Spot-winged Pigeon (*Columba maculosa*)	Trees	0.13 ± 0.34	0.00 ± 0.00	0.00 ± 0.00	
Eared Dove (*Zenaida auriculata*)	Trees	**4.56 ± 2.66**	1.21 ± 1.42	0.40 ± 0.74	24.22***
Picui Ground-Dove (*Columbina picui*)	Trees	0.00 ± 0.00	0.00 ± 0.00	0.40 ± 0.91	
Monk Parakeet (*Myiopsitta monachus*)	Trees	0.31 ± 0.87	0.00 ± 0.00	0.00 ± 0.00	
Glittering-billed Emerald (*Chlorostilbon aureoventris*)	Trees	0.13 ± 0.34	0.21 ± 0.58	0.00 ± 0.00	
White-throated Hummingbird (*Leucochloris albicollis*)	Trees	0.00 ± 0.00	**0.86 ± 0.86**	0.00 ± 0.00	24.15***
Rufous Hornero (*Furnarius rufus*)	Trees	**0.94 ± 1.01**	**0.93 ± 0.83**	0.13 ± 0.35	10.22**
Wren-like Rushbird (*Phleocryptes melanops*)	Herbaceous vegetation	0.00 ± 0.00	0.00 ± 0.00	0.07 ± 0.26	
Small-billed Elaenia (*Elaenia parvirostris*)	Trees	0.00 ± 0.00	0.14 ± 0.36	0.00 ± 0.00	
White-crested Tyrannulet (*Serpophaga subcristata*)	Trees	0.00 ± 0.00	0.07 ± 0.27	0.00 ± 0.00	
Tropical Kingbird (*Tyrannus melancholicus*)	Trees	0.19 ± 0.40	0.07 ± 0.27	0.00 ± 0.00	
Fork-tailed Flycatcher (*Tyrannus savana*)	Trees	0.00 ± 0.00	0.00 ± 0.00	0.30 ± 0.80	
Great Kiskadee (*Pitangus sulphuratus*)	Trees	0.50 ± 0.63	0.79 ± 0.98	0.07 ± 0.26	7.51*
Rufous-bellied Thrush *(Turdus rufiventris*)	Trees	0.75 ± 1.07	**1.43 ± 0.76**	0.13 ± 0.35	18.91***
Chalk-browed Mockingbird (*Mimus saturninus*)	Trees	0.69 ± 0.95	0.21 ± 0.80	0.20 ± 0.56	6.01*
Crested Myna (*Acridotheres cristatellus*)	Trees	0.00 ± 0.00	0.21 ± 0.80	0.00 ± 0.00	
House Wren (*Troglodytes aedon*)	Cavities	**1.25 ± 0.86**	**1.21 ± 1.12**	0.20 ± 0.56	13.65**
White-rumped Swallow (*Tachycineta leucorrhoa*)	Cavities	0.25 ± 0.58	0.00 ± 0.00	0.00 ± 0.00	
House Sparrow (*Passer domesticus*)	Cavities	**4.94 ± 3.11**	1.00 ± 0.96	3.07 ± 4.28	13.21**
Pipit (*Anthus* sp.)	Ground	0.00 ± 0.00	0.00 ± 0.00	0.20 ± 0.78	
Hooded Siskin (*Carduelis magellanica*)	Trees	0.19 ± 0.75	0.29 ± 0.83	0.33 ± 0.62	2.01

TABLE 1. Continued.

Bird species	Nest site	Sectors			*H*
		Suburban	Periurban	Rural	
European Greenfinch (*Carduelis chloris*)	Trees	0.13 ± 0.34	0.43 ± 0.94	0.33 ± 1.05	0.63
Tropical Parula (*Parula pitiayumi*)	Trees	0.00 ± 0.00	0.14 ± 0.36	0.00 ± 0.00	
Rufous-collared Sparrow (*Zonotrichia capensis*)	Ground	0.38 ± 1.03	0.71 ± 0.83	**3.40 ± 3.40**	16.52***
Blue-and-Yellow Tanager (*Thraupis bonariensis*)	Trees	0.44 ± 1.32	0.00 ± 0.00	0.00 ± 0.00	
Grassland Yellow-Finch (*Sicalis luteola*)	Ground	0.00 ± 0.00	0.00 ± 0.00	1.87 ± 2.85	16.07***
Great Pampa-Finch (*Embernagra platensis*)	Herbaceous vegetation	0.00 ± 0.00	0.00 ± 0.00	0.13 ± 0.52	
Double-collared Seedeater (*Sporophila caerulescens*)	Herbaceous vegetation	0.00 ± 0.00	0.00 ± 0.00	0.13 ± 0.52	
Bay-winged Cowbird (*Agelaioides badius*)	Trees	0.00 ± 0.00	0.50 ± 0.49	0.73 ± 2.84	6.07*
Screaming Cowbird (*Molothrus rufoaxilliaris*)	Parasitic	0.00 ± 0.00	0.00 ± 0.00	0.13 ± 0.52	
Shiny-Cowbird (*Molothrus bonariensis*)	Parasitic	0.50 ± 0.89	0.14 ± 0.53	0.40 ± 0.63	2.82
Total species		20	21	24	

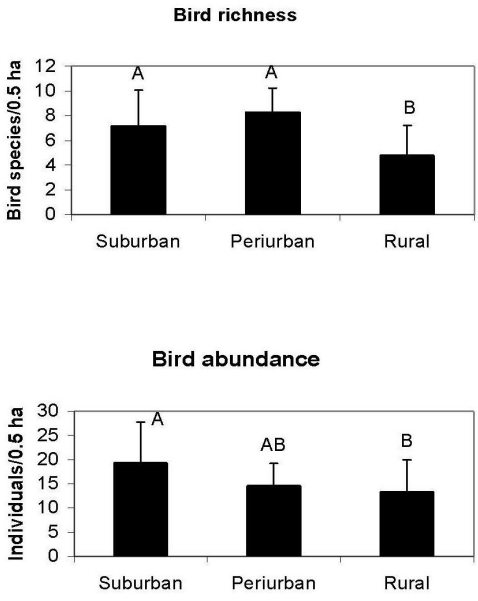

FIG. 1. Mean richness, abundance, and standard deviations for the bird assemblages along the urban-rural gradient in central Argentina. Different letters indicate significant differences among sectors by posterior analysis using LSD test ($P < 0.05$).

and 11% of marshlands.

During the spring of 2003, all birds seen or heard, except those that flew high without hunting activity, were registered during a single visit, between 06:00 and 9:00 h, along fixed transects (100 x 50 m), separated by 200 m. Bird counts were conducted on good days, without strong wind or rain.

The bird species registered in this study were grouped according their nest substrate: trees, ground or herbaceous vegetation, and artificial cavities or buildings, based on bibliographic information (de la Peña 1988, 1989) and personal observations. Then was made a Chi-square test (Zar 1999), comparing the number of individuals of each category in suburban, periurban and rural areas. Brood parasite species, Shiny-Cowbird (*Molothrus bonariensis*) and Screaming Cowbird (*Molothrus rufoaxillaris*), were not included in the analysis.

Bird abundance (individuals/transect) and bird richness were compared along the urban-rural gradient using ANOVA, with posterior analysis using parametric LSD test due to the assumptions of normality and homoscedasticity of data were meet (Zar 1999). For the species registered in more than 10% of counts, non-parametric Kruskal-Wallis test, with posterior analysis using non-parametric Tukey test (Zar 1999), were conducted because the data did not reach the assumptions of normality and homoscedasticity.

RESULTS

A total of 36 bird species were registered: 20 in the suburban areas, 21 in the periurban areas, and 24 in rural areas (Table 1). Bird richness varied among the three sectors of the gradient ($F_{2,42} = 7.65$, $P < 0.01$; Fig. 1). Bird richness in suburban and periurban areas was greater than in rural areas (LSD test, $P < 0.05$). Bird abundance also varied among the three sectors ($F_{2,42} = 3.36$, $P < 0.05$; Fig. 1). In the suburban areas were registered a greater abundance than in rural areas (LSD test, $P < 0.05$).

Of the 15 bird species registered in more than 10% of counts, 11 had significant differences in their abundances among the three sectors (Table 1). Picazuro Pigeons (*Columba picazuro*), White-throated Hummingbirds (*Leucochloris albicollis*) and Rufous-bellied Thrushes (*Turdus rufiventris)* were more abundant in the periurban areas than in suburban and rural ones (Tukey test, $P < 0.05$). Eared Doves (*Zenaida auriculata)* and House Sparrows (*Passer domesticus)* were more abundant in suburban areas than in periurban and rural areas (Tukey test, $P < 0.05$). Rufous Horneros *(Furnarius rufus*) and House Wrens (*Troglodytes aedon*) were more abundant in suburban and periurban areas, whereas Rufous-collared Sparrows (*Zonotrichia capensis*) were more abundant in rural areas than in suburban and periurban

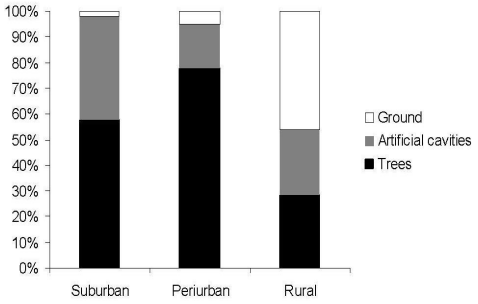

FIG. 2. Proportion of bird species nesting in trees, on the ground or in herbaceous vegetation, or in artificial cavities or buildings in suburban, periurban and rural areas of central Argentina.

ones (Tukey test, $P < 0.05$). Great Kiskadees (*Pitangus sulphuratus*) were more abundant in suburban and periurban areas, Chalk-browed Mockingbirds (*Mimus saturninus*) were more abundant in suburban areas, Grassland Yellow-Finches (*Sicalis luteola*) were registered only in rural areas, and Bay-winged Cowbirds (*Agelaioides badius*) were not registered in suburban areas, although these bird species did not show significant differences among sectors (Tukey test, $P > 0.05$). Chimango Caracara (*Milvago chimango*), Hooded Siskins (*Carduelis magellanica*), European Greenfinches (*Carduelis chloris*) and Shiny Cowbirds did not show significant differences among sectors (Table 1).

According to nest sites, significant differences were found between suburban, periurban and rural areas (Chi-square = 234.20, df = 4, $P < 0.001$). In the suburban and periurban areas, more bird species nested in trees, whereas in the rural areas, more bird species nested on the ground or in herbaceous vegetation (Fig. 2). Bird species that nested in artificial cavities were equally abundant in both areas (Fig. 2).

DISCUSSION

Bird richness was greater in urbanized than in rural areas. This could be related to three factors: 1) the proportion of trees, shrubs and lawn is greater in urban than in rural areas, thus probably offering more food and nesting places due to a higher habitat complexity; 2) nest predation may be lower in urban than other areas (Gering & Blair 1999); and 3) humans may feed birds in urban areas thus attracting some species and, in addition, watering of vegetation there may increase primary productivity (Blair 1996). On the other hand, Sodhi (1992) did not find significant differences in bird richness between urban and rural areas, but his results are not comparable to this study because he compared the total number of bird species in each site.

Bird abundance was greater in suburban areas, in agreement with studies in the Northern Hemisphere (Emlen 1974, Beissinger & Osborne 1982, Mills *et al.* 1989, Sodhi 1992). However, most of these studies compared urban areas with native habitats. In addition, counting birds along transects limited to 50 m in width may have underestimated bird abundance in rural areas.

Periurban areas were important for the species such as the Picazuro Pigeon and the Rufous-bellied Thrush that require an important tree cover, and species such as the White-throated Hummingbird that require a diversity of ornamental plants (Leveau & Leveau 2004a). On the other hand, the species that forage on the ground and use the food resources indirectly supplied by humans (like the Eared Dove, the House Sparrow and the Chalk-browed Mockingbird) were more abundant in suburban areas. Granivorous species like the Rufous-collared Sparrow and the Grassland Yellow-Finch were more abundant in rural areas, possibly influenced by grain density and nest site availability.

Our results suggest that urban areas represent a serious threat for the survival of grassland birds (Sodhi 1992, Bock *et al.* 1999, Haire *et al.* 2000, Leveau & Leveau 2004a).

On the other hand, urbanization favors the expansion of species that nest in trees and have a broad trophic niche, like the Rufous-bellied Thrush. Birds species nesting in holes such as the House Sparrow were similarly abundant in rural and urban areas, as mentioned by Sodhi (1992), and this could be related to the presence of human buildings in rural areas (Cordero 1993).

CONCLUSIONS

In this study, urban areas had a greater bird richness and abundance than rural areas. However, most birds species present in urban areas are extensively distributed in the region, therefore their conservation value is low. These bird species nest in trees, taking advantage of the new conditions imposed by humans through tree plantation. On the other hand, those bird species that nest on the ground or in herbaceous vegetation are negatively impacted by urbanization. In this way, grassland species are replaced by other birds adapted to wooded and urbanized areas.

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