

## Dominance of the Eared Dove (*Zenaida auriculata*) in a columbid assemblage in Northern *Paraná*, Southern Brazil

*Dominância da pomba-de-bando (Zenaida auriculata) em uma comunidade de columbídeos no Norte do Paraná, Sul do Brasil*

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### ABSTRACT

I analyzed the density, abundance, and habitat use by columbids in an urban area in Northern *Paraná*, Brazil, from October 2011 to February 2012, using distance sampling along line transects. I found seven columbid species, including *Leptotila rufaxilla* and *L. verreauxi*. These two species are known to inhabit forest environments and had rarely been recorded before in urban areas. *Columbina talpacoti*, *C. picui*, *Columba livia*, and *Patagioenas picazuro* were common, whereas *Zenaida auriculata* had high population density. The abundance of *Z. auriculata* increased, whereas that of other species decreased constantly along the study period. This result was confirmed by the dominance index, which indicated that *Z. auriculata* tends to be the dominant species in this urban area.

**Key words:** Bird. Density. Distance sampling. Urban area.

### RESUMO

Estudou-se a família Columbidae no Norte do Paraná, com a finalidade de explorar os dados de densidade e de abundância e o tipo de contato apresentado por essas espécies em ambiente urbano. Este estudo foi conduzido no período de outubro de 2011 a fevereiro de 2012 e incluiu amostragem por distância em transecções lineares. Os resultados registraram sete espécies de columbídeos na

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*cidade de Apucarana, incluindo registros de Leptotila rufaxilla e Leptotila verreauxi, embora essas espécies, relacionadas a ambientes florestais, raramente tenham sido observadas. Columbina talpacoti, Columbina picui, Columba livia e Patagioenas picazuro foram consideradas espécies comuns, mas Zenaida auriculata apresentou uma elevada densidade populacional na região de estudo. Isso foi ratificado pela alta abundância de uma espécie estudada (Z. auriculata) e o decréscimo rápido registrado para as outras espécies. Além disso, o Índice de Dominância indicou que, na comunidade de Columbidae da área urbana em questão, um único táxon tende a dominar, Z. auriculata.*

**Palavras-chave:** Aves. Densidade. Amostragem por distância. Área urbana.

## INTRODUCTION

The growth of human population and the conversion of natural environments into urban areas have threatened birds worldwide. Some authors consider that urbanization can negatively affect bird richness locally, although some species might be able to adapt and even benefit from human presence (Leveau & Leveau, 2005; Chace & Walsh, 2006). Previous studies also showed a decrease in native bird species richness and an increase of nonnative species richness toward urban centers (McKinney, 2002). As a result, other studies have suggested that urbanization causes homogenization of bird communities in urban areas (Jokimäki *et al.*, 1996; Clergeau *et al.*, 2001), promoting the dominance of a few species (Bezzel, 1985; Clergeau *et al.*, 2001).

Birds recognize their environment by using characteristics of the vegetation or of the habitat in general (Hildén, 1965; Jokimäki & Suhonen, 1998). This should contribute to the permanence of some birds along urban gradients. Particularly, the presence of columbids in urban areas has been notable in many cities in Brazil.

The Columbidae family includes pigeons and doves, with 309 species distributed worldwide, except for the Arctic and Antarctic (Baptista *et al.*, 1997). Brazil is home of 23 species, some of which inhabit forests, but most live in grassy areas (Sick, 1997). Columbids are one of the most successful families of birds in the world, occupying a wide range of habitats, from forests to open areas. Furthermore, some doves may benefit considerably from human presence, and have increased both in range and in density.

Birds are useful models to understand how urbanization affects biodiversity (White *et al.*, 2005), and columbids may persist in áreas modified by human actions. Therefore, I studied how urbanization affected the density, abundance, and habitat use of columbids in the urban environment in *Apucarana*, Northern *Paraná*, Southern Brazil.

## METHODS

### Study area

This study was conducted in *Apucarana*, Northern *Paraná*, Southern Brazil (51°27'39" W; 23°33'03" S; 860m a.s.l.) from October 2011 to February 2012. The city was founded in 1944 and the original vegetation was composed of semi-deciduous seasonal forest, which was devastated by logging and agricultural expansion. Currently, the city has a population of about 122,000 people (Instituto Brasileiro de Geografia e Estatística - IBGE, 2011) distributed in an area of 558km<sup>2</sup> (IBGE, 2002). The climate is mesothermal humid, with mean annual temperature of 20.6°C, varying between 23°C in the summer and 17°C in the winter. Average rainfall in July and August (winter) is 65.5mm, and from October to March (spring and summer), the average is greater than 140mm (Graça *et al.*, 2011).

### Bird sampling methods

Four 1-Km transects were established in streets with trees and little vehicle, traffic to reduce noise that could hinder bird sampling. Two transects were

in downtown and two in the southern part of the city. Transects were 300m apart from each other in each part of the city.

Samplings began 30 minutes after sunrise, walking along two transects for approximately 1 hour each day, with 10 sampling points per transect. A total of 40 hours of observation were conducted throughout 20 days. Each transect was walked twice a month. The starting point of the transect route was inverted on half the sampling days, to avoid the influence of daytime.

Transect walks were conducted with a constant speed and slow steps, so that all records, whether visual or aural, were noted (Bibby *et al.*, 1992). Furthermore, the observer measured the perpendicular distance to birds in relation to the transect. The radius of observation was 50m, to avoid urban construction obstructions. Distances were estimated from the point of first record and constrained to a single count for each individual. In addition, the observer recorded the type of record for each individual (visual, aural, or both). Nomenclature followed the *Comitê Brasileiro de Registros Ornitológicos* (2011).

### Data analysis

The Density (D), Number (N) of individuals, and Probability (P) of detection of each species were based on a detection function  $g(x)$  estimated from perpendicular distance, using Distance, version 6.0, release 2 (Thomas *et al.*, 2009). Models were entered in a model selection procedure, with the best model having the minimum Akaike's Information Criterion (AIC). All birds were detected (data filter AIC value  $g(0)=1$ ) in the standard distance sampling to provide reliable estimates of density. Data were modeled in key function half-normal, followed by cosine parameter adjustments. At least 5% of the distances were truncated to facilitate modeling by reducing density bias or improving precision (Buckland *et al.*, 1993). These analyses considered only species with 40 or more records (Burnham *et al.*, 1980).

A species abundance distribution model was built, with Log-transformed species abundance. Then,

a geometric model was adjusted with a simple linear regression. The geometric model is derived from the formula  $n_i = n_1 k^{i-1}$ , where  $n_i$  is the count of the  $i$  most abundant taxon,  $n_1$  is the next most abundant taxon, and  $k$  is a constant. Dominance was addressed using the dominance (D) index and the Simpson (1-D) evenness indices.

In addition, the Kruskal-Wallis test, with a Mann-Whitney *U post-hoc* test was used to compare the medians and determine whether there were differences between the types of record for each species.

## RESULTS

I found seven columbid species in the study area. The average population D was 1,253ind/km<sup>2</sup> for *Zenaida auriculata* (Des Murs, 1847), while the densities of other species ranged from 20ind/km<sup>2</sup> to 36ind/km<sup>2</sup> (Table 1). The abundance (N) was estimated as 125 individuals for *Z. auriculata*. The estimated number of individuals for *Columbina talpacoti* (Temminck, 1811), *Columba livia* Gmelin, 1789, *Columbina picui* (Temminck, 1813), and *Patagioenas picazuro* (Temminck, 1813) were between 2 and 4. The Probability (P) of detection ranged from 41% to 52%, with higher values for *C. livia* (52%), *P. picazuro* (52%), and *C. picui* (50%).

I could only determine the monthly population density for *Z. auriculata*, due to the minimum number of records required, which varied from 887ind/km<sup>2</sup> in October to 1725ind/km<sup>2</sup> in February (Table 2). The probability of detection varied from 39% in January to 53% in December.

The dominance index was 0.796 and the Simpson index was 0.204 ( $n=7$ ). The species abundance distribution model (Figure 1) indicated that the most abundant species was *Z. auriculata* and the least abundant was as *Leptotila rufaxilla* (Richard & Bernard, 1792).

There were differences between types of records for *C. talpacoti* (KW=8.76; DF=8;  $p=0.014$ ), *C. livia* (KW=13.29; DF=8;  $p=0.009$ ), *Z. auriculata*

**Table 1.** Density, Abundance, and Probability of detection estimated for columbids in Northern Paraná, Brazil, 2011-2012. Data were averaged from five months of distance sampling.

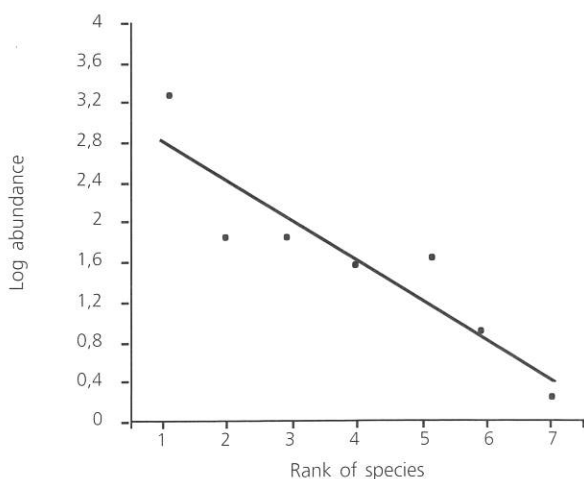
Species	D (ind/km <sup>2</sup> )	D CV*	N	p	P CV**
<i>Columbina talpacoti</i> (Temminck, 1811) Ruddy Ground Dove	36	0.15	4	0.41	0.05
<i>Columbina picui</i> (Temminck, 1813) Picui Ground Dove	20	0.1	2	0.5	0.1
<i>Columba livia</i> Gmelin, 1789 Rock Dove	31	0.16	3	0.52	0.16
<i>Patagioenas picazuro</i> (Temminck, 1813) Picazuro Pigeon	25	0.19	2	0.52	0.19
<i>Zenaida auriculata</i> (Des Murs, 1847) Eared Dove	1,253	0.04	125	0.42	0.04

**Note:** \*D CV indicates Coefficients of Variation of Density. \*\*P CV indicates Coefficient of variation of Probability of Detection. D: Density; N: Number; P: Probability.

**Table 2.** Monthly Density and Probability of detection for *Zenaida auriculata* in Northern Paraná, Brazil, 2011-2012.

Months	D (ind/km <sup>2</sup> )	D CV*	p	P CV**
October	887	0.06	0.40	0.06
November	1045	0.07	0.43	0.07
December	1202	0.05	0.53	0.04
January	1646	0.05	0.39	0.05
February	1725	0.07	0.41	0.07

**Note:** \*D CV indicates Coefficients of Variation of Density. \*\*P CV indicates Coefficient of Variation of Probability of detection. D: Density; P: Probability.

**Figure 1.** Species abundance distribution of columbid species in Apucarana (PR), Brazil, from October 2011 to February 2012.

**Note:** The slope of the line follows the abundance and number of species plotted, according to a descending sequence from the most abundant *Zenaida auriculata* to the least abundant species *Leptotila rufaxilla*. The geometric model ( $k=0.583$ ,  $p<0.001$ ).

( $KW=12.52$ ;  $DF=8$ ;  $p=0.002$ ), and *Leptotila verreauxi* Bonaparte, 1855 ( $KW=9.91$ ;  $DF=8$ ;  $p=0.049$ ). *C. talpacoti* was more likely to be recorded by visual ( $MW=2$ ;  $DF=8$ ;  $p=0.032$ ) or both ( $MW=0$ ;  $DF=8$ ;  $p=0.008$ ) than aural alone. The same was observed for *C. livia*, with higher likelihood of being recorded by aural record ( $MW=0$ ;  $DF=8$ ;  $p=0.008$ ), or both ( $MW=0$ ;  $DF=8$ ;  $p=0.008$ ), and for *Z. auriculata* (aural record:  $MW=0$ ;  $DF=8$ ;  $p=0.008$ ; and both:  $MW=0$ ;  $DF=8$ ;  $p=0.008$ ). *L. verreauxi* was more likely to be recorded by aural record or both ( $MW=2.5$ ;  $DF=8$ ;  $p=0.048$ ) than visually ( $MW=2.5$ ;  $DF=8$ ;  $p=0.048$ ). The type of record did not differ for other species, such as *C. picui* ( $KW=3.91$ ;  $DF=8$ ;  $p=0.149$ ), *P. picazuro* ( $KW=103$ ;  $DF=8$ ;  $p=0.605$ ), and *L. rufaxilla* ( $KW=4.31$ ;  $DF=8$ ;  $p=0.472$ ).

## DISCUSSION

*Zenaida auriculata* was the dominant species in the columbid assemblages. Some species well adapted to urban ecosystems were common, but few records were obtained for *L. verreauxi* and *L. rufaxilla*, which are forest dwelling species.

The density and abundance of *Z. auriculata* were significantly higher than for other columbids (Table 1). High populations of this species have already been observed in Argentina, Colombia, Uruguay, Bolivia, and Southeast Brazil (Bucher &

Ranvaud, 2006). The factors that contribute to the increased population of *Z. auriculata* are the availability of seeds, areas for colonial breeding and water.

*Columbina picui* was common and occurred throughout all study period. This species also seems to be common year round in another city Londrina (PR) (Westcott *et al.*, 2002). *Patagioenas picazuro* was common too. This species inhabits gallery forest and Caatinga, but its range has expanded due to deforestation (Sick, 1997) and has also occupied urban areas (Baptista *et al.* 1997). The non-native *C. livia* was commonly found in the crevices of residential roofs along transects. This can be explained by the fact that this species is the ancestor of feral pigeons. Feral pigeons were domesticated in the past and then returned to a wild state, in which they frequently use slits of rock faces for nesting (Baptista *et al.* 1997). *C. talpacoti* seems to adapt easily to live in the city (Sick, 1997). Although it is a native species of open areas, it is the most abundant bird in large cities, such as *Rio de Janeiro*.

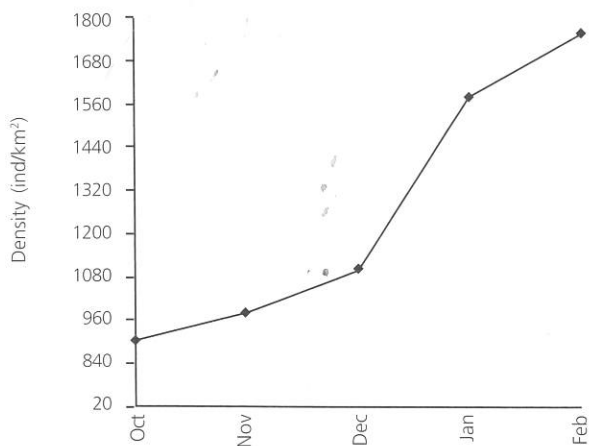
Members of the genus *Leptotila* have been recorded in urban areas. *Leptotila verreauxi* and *L. rufaxilla* were only observed in one transect near a small forest fragment. These species are typically found in forests and forest edges (Baptista *et al.* 1997), which might explain why they were only noted in this area. A previous study (Lopes & Anjos, 2006) found 10 columbid species during 1 year near the study area, including *Columbina squammata* (Lesson, 1831), *Patagioenas cayennensis* (Bonnaterre, 1792), and *Geotrygon montana* (Linnaeus, 1758) that were not found in this study. The area sampled by those authors is a mosaic of buildings, with many trees, grasses, and a 10 ha forest fragment. This mixed environment might have contributed to the greater diversity of columbids.

Avian abundance and diversity in urban ecosystems varies along the seasons and even from year to year (Savard, 1978; Savard *et al.*, 2000). The density of *Zenaida auriculata* increased in December, coinciding with the summer (Figure 2). A previous study recorded breeding peaks from February

to May and from August to November for this species in Southeastern Brazil (Menezes *et al.*, 1998; Ranvaud *et al.*, 2001). In this study, many individuals were recorded collecting nest materials in all months, but mainly in November, and juveniles were recorded in December and January.

The abundance of *Z. auriculata* was very high, whereas the abundance of others is decreasing rapidly and constantly (Figure 1). The results for the dominance index also indicate that this tends to be the dominant species in the assemblage. Moreover, the Simpson index is closer to zero than one, which indicates both low diversity and evenness. A similar result was found in Mexico City, where bird communities were dominated by a few generalist species in urban areas, with intense anthropogenic disturbances (Ortega-Álvarez & MacGregor-Fors, 2009), and in La Paz, where the urban community was dominated by a few species, such as *Z. auriculata* (Villegas & Garitano-Zavala, 2010).

*Z. auriculata*, *C. talpacoti*, and *C. livia* were most often recorded by visual record. Vocalizations of Brazilian columbids are limited to territorial calls (Sick, 1997), but wild male pigeons often vocalize to call a missing female, and *C. livia* has mating calls. The two *Leptotila* species were only recorded using aural records, although the result for *L. rufaxilla* was not significant. *C. picui* and *P. picazuro* were recorded frequently by all types of record.



**Figure 2.** Monthly density changes in *Zenaida auriculata* in an urban area of Apucarana (PR), Brazil, October 2011 to February 2012.

Despite some columbids being well adapted to urban environments, my results show that species from this family, which are originally from forest environments, are restricted to areas within the city with tree. Areas with small forest remnants were scarce in the studied area, being increasingly converted into urban and agricultural areas. This process can promote the dominance of species such as *Z. auriculata*, which throughout the years has increased its population in Northern Paraná. The large supply of food from wastage of grain production, specifically from plantations and crop transportation, the availability of sites for shelter and reproduction, and the capacity of this species to colonize new areas, gives *Z. auriculata* advantages that make it an opportunistic species, increasing its population.

Studies investigating the consequences of increased populations of *Z. auriculata* and how to control it are necessary for this region. In addition, maintaining remnants of natural vegetation in and around urban areas, as well as planting a varied flora are also important for the conservation of biodiversity, and preventing species loss in urban ecosystems.

## ACKNOWLEDGEMENTS

I thank Evelyn Bispo da Silva for helping with the samplings. Luiz dos Anjos provided helpful comments, and João Marques da Silva and Andrea Larissa Boesing provided statistical advice.

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Received on: 23/1/13

Final version on: 4/7/13

Approved on: 6/8/13