

## FOREST BIRD COMMUNITIES IN THE TIBAGI RIVER HYDROGRAPHIC BASIN, SOUTHERN BRAZIL

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**Resumo.** Comunidades de aves foram avaliadas em um gradiente altitudinal (1120–335 m) da bacia hidrográfica do rio Tibagi (24.530 km<sup>2</sup>) no sul do Brasil. Uma floresta estacional semidecidual ocorre no norte desta bacia (uma área de temperatura mais alta) enquanto uma floresta mista temperada chuvosa ocorre no sul (uma área de temperatura mais baixa). Um censo das comunidades de aves foi realizado durante um ano em três locais por contagens pontuais mensais de distância ilimitada: Parque Estadual Mata dos Godoy (PG), Parque Ecológico da Klabin (PK) e Reserva Natural Tarumã (RT). A riqueza de espécies foi estatisticamente similar nos três locais estudados (130, 119, e 118 espécies de aves;  $\chi^2 = 0.73$ ,  $df = 2$ ,  $P < 0.5$ ) embora a similaridade em espécies tenha sido relativamente baixa (índice de Sørensen): 0.59, 0.66 e 0.78. A inclinação da curva da abundância relativa acumulada das espécies (a estatística-Q) mostrou valores similares para PG ( $Q = 30.8$ ) e RT ( $Q = 29$ ) enquanto que em PK ela foi mais alta ( $Q = 37.9$ ); a distribuição da abundância relativa acumulada das espécies em PK é, portanto, diferente daquelas encontradas em PG e RT. A abundância relativa média foi similar in PG ( $0.23 \pm 0.03$  SE) e RT ( $0.23 \pm 0.02$  SE) enquanto que em PK ela foi mais alta ( $0.17 \pm 0.02$  SE). Apesar da similaridade na distribuição da abundância relativa, PG e RT tiveram um baixo valor no índice de Morisita-Horn (0.44). A biomassa total estimada por ponto amostrado foi muito maior em PG (3.88 kg) do que em PK (1.24 kg) e RT (1.62 kg). Talvez uma mais constate disponibilidade de frutos ao longo do ano no norte, de temperatura mais amena, permita uma maior biomassa de frugívoros (em geral espécies grandes) em PG do que em RT. Diferença na disponibilidade de artrópodos entre a floresta estacional semidecidual e a floresta mista temperada chuvosa está supostamente relacionada à maior biomassa de Thamnophilidae (papa-formigas típicos) no norte da bacia, enquanto Furnariidae e Formicariidae (papa-formigas de solo) tiveram maior biomassa no sul da bacia. Paralelamente à diferença altitudinal, outros fatores (biogeográficos, por exemplo) certamente também tem influência na distribuição de aves na bacia do rio Tibagi.

**Resumen.** Comunidades de aves fueron evaluadas en un gradiente de altitud (1120–335 m) de la cuenca hidrográfica del río Tibagi (24.530 km<sup>2</sup>) al sur del Brasil. Una floresta estacional semidecidual se encuentra al norte de esta cuenca (una región de temperatura más alta) mientras que una floresta mixta temperada pluvial se encuentra al sur (región de temperatura más baja). Un censo de las comunidades de aves fue realizado durante un año en tres locales por medio de contages puntuales mensuales de distancia ilimitada. Uno en el Parque Estadual "Mata dos Godoy" (PG), otro en el Parque Ecológico de la reserva Klabin (PK) y el otro en la "Reserva Natural Tarumã" (RT). La riqueza en especies fue estadísticamente similar en los tres locales estudiados (130, 119, e 118 especies de aves;  $\chi^2 = 0.73$ ,  $df = 2$ ,  $P < 0.5$ ) a pesar de que la semejanza en especies haya sido relativamente baja (índice de Sørensen): 0.59, 0.66 e 0.78. La inclinación de la curva de abundancia relativa acumulada en especies (la estadística-Q) mostró valores similares para PG ( $Q = 30.8$ ) y RT ( $Q = 29$ ) mientras que en PK ella fue más alta ( $Q = 37.9$ ); la distribución de la abundancia relativa acumulada en especies en PK es, por lo tanto, diferente de aquellas encontradas en PG y RT. La abundancia relativa media fue semejante en PG ( $0.23 \pm 0.03$  SE) y RT ( $0.23 \pm 0.02$  SE) mientras que en PK ella fue más alta ( $0.17 \pm 0.02$  SE). A pesar de la semejanza en la distribución de la abundancia relativa, PG e RT tuvieron un bajo valor en el índice de Morisita-Horn (0.44). La biomasa total estimada por punto de muestreo fue mucho mayor en PG (3.88 kg) que en PK (1.24 kg) y en RT (1.62 kg). Tal vez una disponibilidad mas constante de frutos durante el año al norte, con temperatura más amena, permita una mayor biomasa de frugívoros (en general especies grandes) en PG con relación a RT. La diferencia en la disponibilidad de artrópodos entre la floresta estacional semidecidual y la floresta mixta temperada pluvial está supuestamente relacionada a la mayor biomasa de Thamnophilidae (Chocas y semejantes) al norte de la cuenca, mientras que Furnariidae e Formicariidae (Tovacas de suelo) tuvieron mayor biomasa al sur de la cuenca. Haciendo paralelo a la diferencia de altitud, otros factores (biogeográficos, por ejemplo) ciertamente también tienen influencia en la distribución de las aves de la cuenca del río Tibagi.

**Abstract.** Forest bird communities were evaluated along an elevation gradient (1120–335 m) of the Tibagi river hydrographic basin (24530 km<sup>2</sup>) in southern Brazil. A seasonal semi-deciduous forest occurs in the north of this basin (a warmer area) while a mixed temperate rain forest occurs in the south (a cooler area). Bird communities were censused during one year in three sites by monthly unlimited distance point counts: Mata dos Godoy State Park (GP), Klabin Ecological Park (KP), and Tarumã Natural Reserve (TR). Species richness was statistically similar in the three sites (130, 119, and 118 bird

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species;  $\chi^2 = 0.73$ ,  $df = 2$ ,  $P < 0.5$ ) although there was relatively low species similarity (Sørensen index): 0.59, 0.66, and 0.78. The slope of the cumulative species relative abundance curve (the  $Q$ -statistic) showed similar values for GP ( $Q = 30.8$ ) and TR ( $Q = 29$ ) while in KP it was higher ( $Q = 37.9$ ); the distribution of the cumulative species relative abundance in KP is, therefore, different from those in GP and TR. The mean relative abundance was similar in GP ( $0.23 \pm 0.03$  SE) and TR ( $0.23 \pm 0.02$  SE) and was higher than in KP ( $0.17 \pm 0.02$  SE). Despite a similarity in the distribution of relative abundance, GP and TR had small values of the Morisita-Horn Index (0.44). The total biomass estimated per sampled point was much higher in GP (3.88 kg) than in KP (1.24 kg) and TR (1.62 kg). Perhaps more constant fruit availability throughout the year in the warmer north permits a higher biomass of frugivores (in general larger species) in GP than in TR. Difference in arthropods availability between the seasonal semi-deciduous forest and the mixed temperate rain forest are supposedly related to the higher biomass of *Thamnophilidae* (typical antbirds) in the north of basin, while *Furnariidae* and *Formicariidae* (ground antbirds) had higher biomass in the south of basin. Beside the altitudinal difference, other factors (biogeographical, for instance) certainly also have influences in the distribution of the birds in the Tibagi river basin. Accepted 06 June 2002.

*Key words:* Forest bird communities, altitudinal difference, relative abundance, biomass, hydrographic basin, southern Brazil.

## INTRODUCTION

Habitats typically change along gradients of altitude and latitude causing differences in the abundance and distribution of birds (Karr 1990). One of the best examples of an altitudinal gradient in the Neotropics was shown by Terborgh (1971, 1977), studying forest birds in the Peruvian Andes, but others have been published recently for the Chilean Andes (Estades 1997) and Costa Rica (Young *et al.* 1998). Reynaud (1998) showed for French Guyana that even in a hydrographic basin, where altitudinal difference between the mouth of the river and its source is not very great, bird communities may change substantially. Holmes (1990) suggested that studies of abundance and distribution of birds along these gradients are one of the major goals of ecology.

In previous papers, we described differences in bird community and biogeographical origins composition along the Tibagi river hydrographic basin (24530 km<sup>2</sup>) Paraná State, southern Brazil (Anjos & Schuchmann 1997, Anjos *et al.* 1997; Fig. 1a). The Tibagi river flows from 1120 m at 25°18'S to 335 m at 22°50'S, resulting in a warmer climate in the north than the south. Two kinds of forest are found in the Tibagi basin, mixed temperate rain forest in the cooler south and seasonal semi-deciduous forest in the warmer north. Qualitative samplings in non-standardized areas of these forests showed that in seasonal semi-deciduous forest higher numbers of bird species with high body mass (*Tinamidae* and *Psittacidae* for example) occur than in mixed temperate rain forest (Anjos *et al.* 1997). However, the total species numbers in these forest types seemed similar.

Comparing quantitative data from bird communities of three standardized areas (north, center and south) in the Tibagi river hydrographic basin, the que-

stions in this study are: (1) How does species richness differ in standardized areas of the seasonal semi-deciduous forest and mixed temperate rain forest?; (2) How similar are the distributions of species relative abundance in these bird communities?; (3) How total biomass of the bird communities differ among the three sites?

## STUDY AREA

Three sites in the Tibagi basin were selected for this study (Fig. 1b): Mata dos Godoy State Park (23°07'S, 49°49'W; 656 ha; 650 m a.s.l.), Klabin Ecological Park (24°20'S, 50°35'S; 1000 ha; 730 m a.s.l.), and Tarumã Natural Reserve (25°15'S, 50°0'W; 840 ha; 980 m a.s.l.). All these areas are protected; Godoy and Tarumã by the State of Paraná and Klabin by the employer Klabin. Before they became protected, these areas were farms on which the owners controlled hunting and logging; so, game bird populations and vegetation composition are well represented. Actually, those three sites are the only large relatively undisturbed areas and the best examples of forests in the north, center and south of the Tibagi basin. Even so, large birds of prey such as *Harpia harpyja*, which probably occurred in 1930 in Godoy State Park (Westcott, pers. com.), are almost extinct in Paraná (Straube 1995).

The Mata dos Godoy State Park (GP) located in the northern Tibagi basin, is covered by a seasonal semi-deciduous forest. *Aspidosperma polyneuron* (Apocynaceae), an emergent tree reaching heights of 35 m, *Euterpe edulis* (Arecaceae), *Galesia intergrifolia* (Phytolaccaceae), *Cabralea canjerana* (Meliaceae), and *Ficus glabra* (Moraceae) are the most common trees in such seasonal semi-deciduous forests. The mean annual temperature is 20.6°C (means of 17.7°C during