



DIVERSITY AND TROPHIC STRUCTURE OF BIRD'S COMMUNITY IN ATLANTIC RAINFOREST FRAGMENTS IN DIFFERENT STAGES OF ECOLOGICAL SUCCESSION

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INTRODUCTION

The Atlantic Rainforest is one of the principal Brazilian biome and is formed by dense tropical forests and associated ecosystems, as restinga and mangrove. Originally extended over 1 million square kilometers along the coast of the Atlantic Ocean, from the parallel 5°30'S to 30°00'S.

The forest fragments with high biodiversity, high taxes of endemism and high anthropics pressures, are called hotspots. The Atlantic Rainforest is the most deforested Brazilian hotspots and is now designated as World Biosphere Reserve, which contains a large number of highly endangered species. The Atlantic Rainforest has been extensively devastated since colonial times for the agricultural activities and urban settlements, being the remnant estimated less than 10% of the original forest and that is often broken into island biogeography (MacArthur & Wilson, 1967).

The birds are considered the most important bioindicators of the quality of ecosystems because they are sensible to the alterations of the environment. The birds were group together according to their alimentary diet and to their forest layers, classifying those species that present feeding and similar biotope in distinct ecological groups (guilds) (Blondel, 2003).

OBJECTIVES

The main objective of this study was to analyze the groups of birds that were affected by the forest fragmentation and the isolation degree of these areas, using birds as ecological indicator in three sites: pasture and forest fragments in two different stages of ecological succession (initial and medium stages).

MATERIAL AND METHODS

The study was carried out in Atlantic Rainforest areas, situated in Southeastern Brazil, Anchieta city, State of Espírito Santo, located at latitude 20°44'S to 20°47'S and longitude 40°35'W to 40°43'W, along the seasons of 2008. The climate of the region is the Aw type according to Köppen's classification. The annual average rainfall is over 1,400mm (concentrated in the summer). The annual medium temperature ranges is 23°C.

Three different natural environments were studied: 1) Pastures, composed of a wide variety of gramineous species, such as brachiaria (*Brachiaria decumbens* Stapf); characterized by extensive areas destined to the creation of cattle; 2) Forest fragments in initial stage of ecological succession; and 3) Forest fragments in medium stage of ecological succession. The vegetal community of these two fragments is part of a forest subjected to human interference.

The forest fragments in initial stage of ecological succession have only one stratum with trees varying in average height between two and four meters. The most important species were *Trema micrantha* (L.) Blume, *Schinus terebinthifolius* Raddi, *Gochnatia polymorpha* (Less) Cabr., *Byrsonima sericea* D.C., *Zeyheria tuberculosa* (Vell.) Bur., *Casearia sylvestris* Sw., *Baccharis dracunculifolia* D.C., *Cecropia pachystachya* Trec., *Vernonia polyanthes* Less, *Xylopia sericea* St. Hill., and *Davilla rugosa* Poir (It is a very common vine in the edges of the forest fragments).

In the forest fragments in medium stage of secondary regeneration are recognizable three vertical strata of the vegetation: herbaceous stratum, understorey and canopy stratum. The canopy stratum is composed of the crowns of large sized trees, with sparse trees varying in average height between 10 and 16m. Among the species recorded, the most important were *Gochnatia polymorpha*, *Byrsonima sericea*, *Pera glabrata* (Sch.) Baill., *Luehea grandiflora* Mart. & Zucc., *X. sericea*, *Protium heptaphyllum* March., *Alchornea*

triplinervia (Spreng.) M. Arg., *Inga laurina* (Sw.) Willd., *Guapira opposita* (Vell.) Reitz and *Tapirira guianensis* Aubl. The understorey is characterized by the dominance of shrubs between 0.80 and 5m tall and the outstanding species in this stratum are of the families Melastomataceae, Euphorbiaceae, Fabaceae, Caesalpiniaceae and Myrtaceae. The herbaceous stratum (generally until 0.80m tall) is predominated by ferns, terrestrial bromeliads and herbs as heliconias. The trees shelter a higher diversity of epiphytic plants such as bromeliads, orchids, aroids and cacti, mosses, lichens and vines. This dendricola vegetation is an outcome of saturated atmosphere of humidity. The marsh vegetation appears on poorly drained soil forming low terrains.

The method used to sample the avifauna specimens was the technique of observations per point - counts developed by Blondel *et al.*, (1970). The location of the points used for this census was randomly chosen and was representative of the whole areas: for each sample, the point was sorted independently among previously determined points covering the whole areas. The points were marked at least 200 meters apart to avoid over - representation of species with long - range voices according to Vielliard (2000).

The observations were realized in the first hours after the dawn and during the twilight. The samplings were accomplished in 12 days in all four seasons of the year of 2008 (in a total of 60 hours distributed in 180 samples). The duration of each point census as 20 minutes according to Vielliard (2000) proposals for tropical environments.

The birds' identification was visual and mainly through the bird vocalization. The birds that overflying the areas without to perch on tree was not analyzed, because their dependence to the places were unlikely. The bibliographical material used to the avifauna identification was Schauensee (1982) and Sick (1997). To the scientific nomenclature and taxonomic order was used the new systematic list proposed by Sibley & Monroe Jr. (1993). To determine if the samples were enough, were plotted the accumulated number of species against the total number of hours of observation. Since the curve reached a plateau, it was possible to conclude that the samples were enough for the registration of most species existent in each site.

The birds species recorded in the census were assigned in distinct ecological groups (guilds). The classification of the species in agreement with the respective guilds was based on that proposed for Atlantic Rainforest bird communities by Willis (1979) with additions based on personal field observations. This study was limited to trace the similar relationships of feeding habitats and preferred foraging strata in the vegetation for the following found guilds: understory insectivores, understory omnivores, edge insectivores, edge omnivores, canopy insectivores, canopy omnivores, canopy frugivores, nectar and insect eaters, trunk and twig insectivores, diurnal carnivores, nocturnal carnivores, riparian carnivores, swamp omnivores, aerial insectivores and edge seed - eater.

For each species in each different site was calculated the Point Abundance Index (PAI), that was calculated by dividing the number of contacts for each species by the total number of points sampled (Blondel *et al.*, 1970). To characterize the bird community in the sites was calculated the Shannon

- Weaver diversity index (H') (Tramer, 1969), where H' max is the maximum diversity possible in the sample.

RESULTS AND DISCUSSION

Taking into account 60 hours of observations, it was possible to register a total of 122 species of birds distributed in 34 families and 13 orders. The most representative order in number of species was Passeriformes, with 64 species distributed in nine families.

A total of 28 bird species was recorded in the pastures, and this site was characterized by low diversity. The Shannon - Weaver diversity index H' presented a value of 2.72. In this anthropic environment without arboreal vegetation, edge seed - eater was the most representative guild, with 11 species and 35.8% of the contacts, and the most important species were *Sporophila caerulea* (Vieillot, 1823), *Volatinia jacarina* (Linnaeus, 1766), *Molothrus bonariensis* (Gmelin, 1789), *Sicalis flaveola* (Linnaeus, 1766), *Sicalis luteola* (Sparrman, 1789), *Columbina talpacoti* (Temminck, 1811), and *Columba picazuro* (Temminck, 1813).

In the forest fragments in initial stage of ecological succession were registered a total of 47 species of birds and the Shannon - Weaver diversity index H' presented a value of 3.44. *Guiraca guiraca* (Gmelin, 1788), *Crotophaga ani* (Linnaeus, 1758), *Columbina talpacoti*, *Fluvicola nengeta* (Vieillot, 1824), *Pitangus sulphuratus* (Linnaeus, 1766), *Tyrannus melancholicus* (Vieillot, 1819), *Furnarius rufus* (Gmelin, 1788), *Mimus saturninus* (Lichtenstein, 1823), *Sporophila caerulea*, and *Troglodytes aedon* (Vieillot, 1808) were the species of birds most abundant in this site. Therefore, the most representative guilds were edge omnivores and edge insectivores, respectively with 17 and 11 species, corresponding to 37.1 and 24.2% of the contacts.

In the forest fragments in medium stage of ecological succession were registered a total of 86 species of birds and the Shannon - Weaver diversity index H' presented a high value of 3.89. According to results, edge omnivores were the most representative guild with 28 species and 50.2% of the contacts. Other representative guilds were edge insectivores and nectar and insect eaters, respectively with 14 and six species, corresponding to 16.4 and 8.0% of the contacts. The bird guilds correlated in this site are according to same pattern of areas studied by other authors (Willis, 1979; Yabe & Marques, 2001; Dário, 2008), with predominance of omnivorous and insectivorous species. The most abundant species were *Pitangus sulphuratus*, *Tyrannus melancholicus*, *Elaenia flavogaster* (Thunberg, 1822), *Thraupis sayaca* (Linnaeus 1766), *Turdus rufigiventris* (Vieillot, 1818), *Thamnophilus caeruleus* (Vieillot, 1816), *Manacus manacus* (Linnaeus, 1766), *Synallaxis ruficapilla* (Vieillot, 1819), *Turdus amaurochalinus* (Cabanis, 1851), *Coereba flaveola* (Linnaeus, 1758), *Thraupis palmarum* (Wied - Neuwied, 1821) and *Conirostrum speciosum* (Temminck, 1824).

Among the six species of hummingbirds observed visiting the flowers, both *Eupetomena macroura* (Gmelin, 1788) and *Amazilia fimbriata* (Gmelin, 1788) due to its frequency and visiting behavior were considered, together with *Coereba flaveola*, as the dominant species of the nectar and insect

eaters' guild. Both were registered in the forest fragments in initial and medium stages, however, the other species of hummingbirds were only observed in the forest fragments in more advanced stage of ecological succession. This fact also happened for the guilds understory insectivores, understory omnivores, canopy omnivores, and canopy frugivores. The presence of these guilds is in reason of the vertical structure of these forest fragments, with three strata of the vegetation: herbaceous stratum, understory and canopy stratum. Others examples of good environmental quality are the occurrence of mixed flocks of birds and bird species follow army - ant swarms, e.g. *Pyriglena leucoptera* (Vieillot, 1818). Mixed flocks are groups of species that forage while move around through the understory, middle growth and through the canopies. These groups are very important in the diagnosis of the environmental quantity, because they reflect the coevolution adaptive of outlying species in relation to nuclear species. Mixed - species flocking birds may increase foraging efficiency and protection from predation. Probably both factors interplay and confer advantages to the species (Thiollay, 1999).

The results of diversity of birds are similar to the results obtained by Allegrini (1997) in different Atlantic Rainforest areas in the State of São Paulo. The author obtained a value of H' 3.95 in medium stage of natural regeneration and H' 3.45 in initial stage of natural regeneration.

CONCLUSION

The size of the forest fragments and the vegetable structure are directly related with the diversity of birds' species and number of guilds. Edge omnivores were the most representative guild in the forest fragments. The great abundance of omnivorous birds should be directly correlated to the great readiness of fruits. The great diversity of birds and guilds, quite common in the humid tropical forests, is attributed to the vertical strata of the vegetation and the understory presence.

Great part of the species registered in this study demonstrates ecological and behavioral plasticity under anthropogenic pressure in their habitats, besides has wide geographical distribution (most of the edge species e.g. *Pitangus sulphuratus*, *Columbina talpacoti*, *Elaenia flavogaster*, *Mimus saturninus*, *Tyrannus melancholicus*, *Thraupis sayaca*, *Sporophila caerulescens*, *Turdus rufiventris*). These are known as synanthropic bird species, in other words, they amplify their geographical distribution as the original vegetation is removed. These adjustments of synanthropic populations seem to be within the range of natural plasticity of the species. Among the main pre - requisites for

synanthropism are general ecological, demographic and behavioral plasticity, particularly a wide spectrum of habitat and diet requirements (Luniak, 1996).

The occurrence of great amount of synanthropic bird species denotes the adjustment of wild animal populations to specific conditions of anthropic environment. The global expansion of agriculture and urbanization destroys natural habitats but also creates new ecological niches.

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