Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2017; 4(9):364-373 **p-ISSN 2348–8883**

(An International Publisher for Academic and Scientific Resources)

Diversity and trophic structure of birds in forest fragments in the metropolitan area of São Paulo, Brazil

Fabio Rossano Dario[1]
[1]PhD by Scuola Superiore Sant'Anna di Studi Universitari e di Perfezionamento, Italy

***Corresponding author**
Fabio Rossano Dario

Article History
Received: 03.08.2017
Accepted: 16.08.2017
Published: 30.09.2017

DOI:
10.36347/sjavs.2017.v04i09.007

Abstract: The diversity of birds is directly correlated with the structure of the forest. The fragmentation of forest, i.e., the disruption in the continuity of forest habitat cover can cause impacts on bird's abundance, species richness, and community dynamics. Any interference with the vegetation produces direct effects on the avifauna through the increase, decrease, or alternation of two key attributes: food and shelter. So, the composition of life in the forest is altered as changes occur in vegetation that directly interferes with the population structure of the avifauna, being those changes natural or anthropic. This study was realized in forest fragments of Atlantic Forest in a metropolitan area of São Paulo, Brazil, to analyze the groups of birds that were affected by the forest fragmentation in different stages of ecological succession and the results showed alterations in the diversity and density of bird's species, principally among specialist species.

Keywords: Birds, Ecological succession, Forest fragments, Trophic structure, Diversity

INTRODUCTION

The Atlantic Forest is one of the most important biodiversity hotspots; originally covering over 1.3 million km^2, distributed along the Brazilian coastal, and is the most threatened Brazilian biome. This important biome harbors a high diversity of species, with several endemic and threatened species [1]. Deforestation dates to colonial times from agriculture and urban settlements [2].

The Atlantic Forest has an extremely diverse and unique mix of vegetation and forest types. It has spectacular bird diversity, with over 930 species, about 15 percent of which are found nowhere else [3]. This avifauna is a highly endangered community: 68 % of the species are rare and there are 23 endemic genera [4]. Because most of the region's forests have been cleared during 500 years of exploitation, many species are now threatened, and future extinctions seem inevitable, considering that only 7 % of the original forest remains [5, 6].

Among the many factors thought to contribute to the high bird species richness in the Neotropics is the high diversity of habitat and microhabitat types, some of which are unique to tropical regions [7, 8]. The increase in structural complexity of the vegetation on various vertical levels makes new forms of occupancy of the environment possible [9]. The increase in the number of bird species is principally due to the increase of both the new food guilds and the number of species in the existing guilds [10].

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) [11].

The main objective of this study was to analyze the groups of birds that were affected by the forest fragmentation in a metropolitan area, using birds as ecological indicator in three sites: forest fragments in three different stages of ecological succession: initial, medium and advance stages.

MATERIAL AND METHODS

Study site

The study was carried in 18 forest fragments of Ombrophilous Dense Forest at Atlantic Forest, situated in the municipalities of Barueri, Jandira and Itapevi, in the western the metropolitan area of São Paulo, Brazil, between the latitude 23^{o}29'S to 23^{o}34'S and longitude 46^{o}51'W to 46^{o}58'W, between 750 and 850 meters of altitude. The climate of the region is the Cwa type according to Köppen's classification. The annual average rainfall is over 1,400mm, concentrated in the

summer. The annual medium temperature ranges is 20°C.

Three different natural environments were studied: forest fragments in initial stage of ecological succession; forest fragments in medium stage of ecological succession; and forest fragments in advanced stage of ecological succession. The vegetal community of these 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 eight meters. Seven fragments were studied with areas varying between 0.2 and 4.6 hectares. The estimated basal area was 9.57 $m^2.ha^{-1}$ and densities ranging from 900 to 1,100 $trees.ha^{-1}$. A low species diversity was observed, H = 2.91 nats ind^{-1}.

The most important arboreal species in density and relative frequency were *Alchornea glandulosa, Gochnatia polymorpha, Piptadenia gonoacantha, Schinus terebinthifolius, Lithraea molleoides, Trema micrantha, Cecropia pachystachya, Cupania vernalis, Parapiptadenia rigida, Senna multijuga, Myrsine ferruginea, Croton floribundus, Croton urucurana, Casearia sylvestris, Luehea divaricata, Tapirira guianensis, Anadenanthera colubrina* and *Zanthoxylum riedelianum.*

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 eight and 14 meters. Ten fragments were studied with areas varying between 1.2 and 12.4 hectares. The estimated basal area was 21.18 $m^2.ha^{-1}$ and densities ranging from 1,100 to 1,300 $trees.ha^{-1}$. A high species diversity was observed, H = 3.56 nats ind^{-1}.

The most important arboreal species in density and relative frequency were *Piptadenia gonoacantha, Anadenanthera colubrina, Hirtella hebeclada, Cupania vernalis, Casearia sylvestris, Machaerium villosum, Guarea guidonia, Luehea divaricata, Machaerium aculeatum, Zanthoxylum riedelianum, Parapiptadenia rigida, Senna multijuga, Inga edulis, Lonchocarpus guilleminianus, Ocotea puberulla, Copaifera langsdorffii, Bauhinia forficata* and *Tapirira guianensis.*

In the forest fragment in advanced 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 22 meters. Only a fragment with approximately 26 hectares was studied in this stage of ecological succession. The estimated basal area was 32.13 $m^2.ha^{-1}$ and densities ranging from 700 to 900 $trees.ha^{-1}$. A high species diversity was observed, H = 3.87 nats ind^{-1}.

The most important arboreal species in density and relative frequency were *Hirtella hebeclada, Machaerium villosum, Guarea guidonia, Casearia gossypiosperma, Machaerium aculeatum, Pera glabrata, Lonchocarpus guilleminianus, Inga laurina, Rollinia sylvatica, Colubrina glandulosa Trichilia claussenii, Ocotea puberulla, Nectandra megapotamica* and *Handroanthus chrysotrichus.*

The understorey is characterized by the dominance of shrubs between 0.80 and 4.00 meters tall and the outstanding species in this stratum are of the families Melastomataceae, Rubiaceae, Fabaceae, Euphorbiaceae and Myrtaceae. The herbaceous stratum (generally until 0.80 meters tall) is predominated by terrestrial bromeliads, herbs as heliconias and ferns as *Dycksonia sellowiana,* endemic and threatened of extinction. 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.

Bird surveys

The method used to sample the avifauna specimens was the technique of observations per point-counts developed by Blondel *et al.* [12]. 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.

The observations were realized in the first hours after the dawn and during the twilight. The samplings were accomplished in 72 days during all four seasons in the years 2006 to 2010 (in a total of 480 hours distributed in 1.440 samples). The duration of each point census as 20 minutes. 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 Sigrist [13] and Sick [14]. To the scientific nomenclature and taxonomic order was used the new systematic list of CBRO [15]. 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 by Willis [16]. This study was limited to trace the similar relationships of feeding habitats and preferred foraging strata in the vegetation for the following found guilds: aerial insectivores, canopy frugivores, canopy omnivores, carnivores, detritivores, edge insectivores, edge omnivores, edge seed-eater, nectar and insect eaters, riparian carnivores, swamp omnivores, trunk and twig insectivores, understory frugivores, and understory insectivores.

To characterize the bird community in the sites was calculated the Shannon-Weaver diversity index (H') [17], where H' max is the maximum diversity possible in the sample.

RESULTS AND DISCUSSION

Taking into account 480 hours of observations, it was possible to register a total of 179 species of birds distributed in 46 families and 22 orders. The most representative order in number of species was Passeriformes, with 87 species distributed in 19 families.

A total of 70 bird species was recorded in the forest fragments in initial stage of ecological succession, and this site was characterized by low diversity. The Shannon-Weaver diversity index H' presented a value of 2.31. In this anthropic environment, edge omnivores and edge insectivores, both with 16 species were the most representative guilds. Understory frugivores' species have little importance, because the understory is inexpressive, and this show that habitat degradation within fragments may be an important determinant of the ability of individual species to persist in them, and it is clearly important to separate the effects of habitat alteration essentially from those of patch size and isolation. [18] However, small isolated fragments with secondary vegetation can play a key role in the dispersal process, serving as sleeping, resting and feeding areas [19].

In the forest fragments in medium stage of ecological succession were registered a total of 126 species of birds and the Shannon-Weaver diversity index H' presented a value of 3.35. According to results, edge omnivores and edge insectivores, were the most representative's guilds respectively with 24 and 20 species. Other representative guilds were understory insectivores and carnivores, respectively with 16 and 11 species.

In the forest fragments in advanced stage of ecological succession were registered a total of 141 species of birds and the Shannon-Weaver diversity index H' presented a high value of 3.59, suggesting high equitability. This fact was already expected, since it is common in mature forests with great vertical heterogeneity[20, 21]. According to results, edge omnivores and understory insectivores were the most representative's guilds respectively with 29 and 22 species. The number of forest species of birds registered in this site (n = 73) in comparation with com edge species (n = 49), show that fragment size, distance from the reserve and forest quality is also responsible for the differences.

Several authors have reported declines in overall species diversity and abundance with decreasing patch size or increasing isolation of forests fragments [22, 23, 24]. The increase in the number of forest species of birds, from forest fragments in initial stages to the forest fragments in more advanced stages (from 17 to 73 birds species) is the result of the better vegetation structure in the more advanced stages. This fact is because the forest fragments in more advanced stages are the most important centers of colonization of forest species [25, 26].

Some species have a higher capacity for dispersal than others[27]. Among the 12 species of hummingbirds observed visiting the flowers, two of these species were registered in the forest fragments in initial stages, however, five 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, trunk and twig insectivores, canopy omnivores and canopy frugivores. The significant presence of these guilds is in reason of the vertical structure of these forest fragments in medium and advanced stages of ecological succession, with three strata of the vegetation: herbaceous stratum, understorey and canopy stratum [28].

Among the characteristics of landscape structure that may affect local extinction and colonization, the overall amount of favorable habitat may be the main factor, but distance between forests fragments, increased amount of edge, and negative biotic effects associated with fragmentation may also play prominent roles [29].

The good environmental also is responsible to occurrence of mixed flocks of birds and bird species follow army-ant swarms that were registered only in forest fragments in medium and advanced stages of ecological succession. Mixed flocks are groups of species that forrage 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 [30, 31].

Table-1: Number of bird species in different guilds and in different natural environments.

Guilds	Number of species	Environments/Number of species		
		Initial stage	Medium stage	Advanced stage
Aerial insectivores	4	2	4	4
Canopy frugivores	10	2	6	9
Canopy omnivores	3	-	1	3
Carnivores	16	6	11	13
Detritivores	1	1	1	1
Edge insectivores	24	16	20	16
Edge omnivores	37	16	24	29
Edge seed-eater	9	7	8	4
Nectar and insect eaters	13	3	8	11
Riparian carnivores	8	4	6	5
Swamp omnivores	9	4	8	6
Trunk and twig insectivores	10	2	7	9
Understory frugivores	10	1	6	9
Understory insectivores	25	6	16	22
Total	**179**	**70**	**126**	**141**

Table-2: List of the bird species in different natural environments grouped into trophic guilds.

GUILDS/Family/Taxon names	**English name**	**Environments**		
		Initial stage	**Medium stage**	**Advanced stage**
AERIAL INSECTIVORES				
Apodidae				
Tachornis squamata	Fork-tailed Palm-Swift		X	X
Hirundinidae				
Pygochelidon cyanoleuca	Blue-and-white Swallow	X	X	X
Progne tapera	Brown-chested Martin	X	X	X
Progne chalybea	Gray-breasted Martin		X	X
CANOPY FRUGIVORES				
Cracidae				
Penelope obscura	Dusky-legged Guan		X	X
Psittacidae				
Diopsittaca nobilis	Red-shouldered Macaw			X
Psittacara leucophthalmus	White-eyed Parakeet	X	X	X
Pyrrhura frontalis	Maroon-bellied Parakeet			X
Forpus xanthopterygius	Blue-winged Parrotlet	X	X	X
Brotogeris tirica	Plain Parakeet		X	X
Brotogeris chiriri	Yellow-chevroned Parakeet		X	
Pionopsitta pileata	Pileated Parrot			X
Pionus maximiliani	Scaly-headed Parrot		X	X
Amazona aestiva	Turquoise-fronted Parrot			X
CANOPY OMNIVORES				
Ramphastidae				
Ramphastos toco	Toco Toucan		X	X
Ramphastos vitellinus	Channel-billed Toucan			X
Ramphastos dicolorus	Red-breasted Toucan			X
CARNIVORES				
Accipitridae				
Gampsonyx swainsonii	Pearl Kite		X	X
Elanus leucurus	White-tailed Kite		X	X
Harpagus diodon	Rufous-thighed Kite			X
Accipiter striatus	Sharp-shinned Hawk	X	X	X
Rostrhamus sociabilis	Snail Kite			X
Heterospizias meridionalis	Savanna Hawk		X	

Rupornis magnirostris	Roadside Hawk	X	X	X
Geranoaetus albicaudatus	White-tailed Hawk		X	
Buteo brachyurus	Short-tailed Hawk	X	X	X
Tytonidae				
Tyto furcata	American Barn Owl			X
Strigidae				
Megascops choliba	Tropical Screech-Owl			X
Asio clamator	Striped Owl			X
Falconidae				
Caracara plancus	Southern Caracara	X	X	X
Milvago chimachima	Yellow-headed Caracara	X	X	X
Falco sparverius	American Kestrel	X	X	
Falco femoralis	Aplomado Falcon		X	X
DETRITIVORES				
Cathartidae				
Coragyps atratus	Black Vulture	X	X	X
EDGE INSECTIVORES				
Ardeidae				
Bubulcus ibis	Cattle Egret	X		
Cuculidae				
Crotophaga ani	Smooth-billed Ani	X	X	X
Guira guira	Guira Cuckoo	X	X	X
Strigidae				
Athene cunicularia	Burrowing Owl	X	X	
Caprimulgidae				
Nyctidromus albicollis	Common Pauraque		X	
Hydropsalis parvula	Little Nightjar			X
Furnariidae				
Furnarius rufus	Rufous Hornero	X	X	X
Tyrannidae				
Hirundinea ferruginea	Cliff Flycatcher			X
Serpophaga subcristata	White-crested Tyrannulet		X	X
Myiarchus swainsoni	Swainson's Flycatcher		X	X
Myiarchus ferox	Short-crested Flycatcher	X	X	X
Pitangus sulphuratus	Great Kiskadee	X	X	X
Machetornis rixosa	Cattle Tyrant	X	X	X
Myiodynastes maculatus	Streaked Flycatcher	X	X	X
Megarhynchus pitangua	Boat-billed Flycatcher		X	X
Myiozetetes similis	Social Flycatcher	X	X	X
Tyrannus melancholicus	Tropical Kingbird	X	X	X
Tyrannus savana	Fork-tailed Flycatcher	X	X	
Empidonomus varius	Variegated Flycatcher	X	X	X
Pyrocephalus rubinus	Vermilion Flycatcher	X		
Fluvicola nengeta	Masked Water-Tyrant	X	X	
Arundinicola leucocephala	White-headed Marsh Tyrant		X	
Knipolegus lophotes	Crested Black-Tyrant	X	X	
Satrapa icterophrys	Yellow-browed Tyrant			X
EDGE OMNIVORES				
Tinamidae				
Crypturellus parvirostris	Small-billed Tinamou		X	X
Columbidae				
Patagioenas picazuro	Picazuro Pigeon	X	X	X
Tityridae				
Pachyramphus polychopterus	White-winged Becard			X
Rhynchocyclidae				
Tolmomyias sulphurescens	Yellow-olive Flycatcher		X	X
Tyrannidae				

Camptostoma obsoletum	Southern Beardless-Tyrannulet	X	X	X
Elaenia flavogaster	Yellow-bellied Elaenia	X	X	X
Elaenia parvirostris	Small-billed Elaenia		X	
Elaenia mesoleuca	Olivaceous Elaenia			X
Vireonidae				
Cyclarhis gujanensis	Rufous-browed Peppershrike	X	X	X
Vireo olivaceus	Red-eyed Vireo		X	X
Vireo chivi	Chivi Vireo			X
Cariamidae				
Cariama cristata	Red-legged Seriema	X		
Turdidae				
Turdus leucomelas	Pale-breasted Thrush		X	X
Turdus rufiventris	Rufous-bellied Thrush	X	X	X
Turdus amaurochalinus	Creamy-bellied Thrush		X	X
Mimidae				
Mimus saturninus	Chalk-browed Mockingbird	X	X	X
Passerellidae				
Zonotrichia capensis	Rufous-collared Sparrow	X	X	X
Icteridae				
Chrysomus ruficapillus	Chestnut-capped Blackbird	X		
Pseudoleistes guirahuro	Yellow-rumped Marshbird	X	X	
Molothrus bonariensis	Shiny Cowbird	X		
Thraupidae				
Pipraeidea melanonota	Fawn-breasted Tanager			X
Tangara sayaca	Sayaca Tanager	X	X	X
Tangara palmarum	Palm Tanager	X	X	X
Tangara cayana	Burnished-buff Tanager		X	X
Nemosia pileata	Hooded Tanager			X
Conirostrum speciosum	Chestnut-vented Conebill	X	X	X
Hemithraupis ruficapilla	Rufous-headed Tanager			X
Tachyphonus coronatus	Ruby-crowned Tanager		X	X
Trichothraupis melanops	Black-goggled Tanager		X	X
Tersina viridis	Swallow Tanager			X
Dacnis cayana	Blue Dacnis	X	X	X
Saltator similis	Green-winged Saltator			X
Thlypopsis sordida	Orange-headed Tanager			X
Cardinalidae				
Piranga flava	Hepatic Tanager		X	
Fringillidae				
Euphonia chlorotica	Purple-throated Euphonia		X	X
Euphonia violacea	Violaceous Euphonia		X	
Passeridae				
Passer domesticus	House Sparrow	X		
EDGE SEED-EATER				
Columbidae				
Columbina talpacoti	Ruddy Ground-Dove	X	X	X
Columba livia	Rock Pigeon	X		
Zenaida auriculata	Eared Dove	X	X	X
Thraupidae				
Sicalis flaveola	Saffron Finch	X	X	
Volatinia jacarina	Blue-black Grassquit	X	X	X
Sporophila lineola	Lined Seedeater		X	
Sporophila caerulescens	Double-collared Seedeater	X	X	X
Fringillidae				
Spinus magellanicus	Hooded Siskin		X	
Estrildidae				
Estrilda astrild	Common Waxbill	X	X	

NECTAR AND INSECT EATERS				
Trochilidae				
Phaethornis pretrei	Planalto Hermit		X	X
Phaethornis eurynome	Scale-throated Hermit			X
Eupetomena macroura	Swallow-tailed Hummingbird	X	X	X
Aphantochroa cirrochloris	Sombre Hummingbird		X	
Florisuga fusca	Black Jacobin			X
Colibri serrirostris	White-vented Violetear			X
Chlorostilbon lucidus	Glittering-bellied Emerald		X	
Thalurania glaucopis	Violet-capped Woodnymph			X
Leucochloris albicollis	White-throated Hummingbird	X	X	X
Amazilia versicolor	Versicolored Emerald		X	X
Amazilia fimbriata	Glittering-throated Emerald		X	X
Amazilia lactea	Sapphire-spangled Emerald			X
Thraupidae				
Coereba flaveola	Bananaquit	X	X	X
RIPARIAN CARNIVORES				
Ardeidae				
Tigrisoma lineatum	Rufescent Tiger-Heron		X	X
Butorides striata	Striated Heron	X	X	X
Ardea cocoi	Cocoi Heron		X	
Ardea alba	Great Egret	X	X	X
Syrigma sibilatrix	Whistling Heron	X	X	
Egretta thula	Snowy Egret	X		X
Alcedinidae				
Chloroceryle amazona	Amazon Kingfisher			X
Chloroceryle americana	Green Kingfisher		X	
SWAMP OMNIVORES				
Anatidae				
Dendrocygna viduata	White-faced Whistling-Duck		X	
Amazonetta brasiliensis	Brazilian Teal		X	X
Anas bahamensis	White-cheeked Pintail			X
Rallidae				
Aramides cajaneus	Gray-necked Wood-Rail	X	X	X
Pardirallus nigricans	Blackish Rail		X	X
Gallinula galeata	Common Gallinule	X	X	
Charadriidae				
Vanellus chilensis	Southern Lapwing	X	X	X
Scolopacidae				
Tringa solitaria	Solitary Sandpiper		X	
Jacanidae				
Jacana jacana	Wattled Jacana	X	X	X
TRUNK AND TWIG INSECTIVORES				
Picidae				
Picumnus cirratus	White-barred Piculet	X	X	X
Melanerpes candidus	White Woodpecker		X	X
Melanerpes flavifrons	Yellow-fronted Woodpecker		X	X
Veniliornis spilogaster	White-spotted Woodpecker		X	
Colaptes campestris	Campo Flicker	X	X	X
Celeus flavescens	Blond-crested Woodpecker		X	X
Dryocopus lineatus	Lineated Woodpecker			X
Campephilus robustus	Robust Woodpecker		X	X
Dendrocolaptidae				
Sittasomus griseicapillus	Olivaceous Woodcreeper			X
Lepidocolaptes angustirostris	Narrow-billed Woodcreeper			X

UNDERSTORY FRUGIVORES				
Tinamidae				
Crypturellus tataupa	Tataupa Tinamou			X
Columbidae				
Patagioenas cayennensis	Pale-vented Pigeon		X	X
Leptotila verreauxi	White-tipped Dove		X	X
Leptotila rufaxilla	Gray-fronted Dove		X	X
Trogonidae				
Trogon surrucura	Surucua Trogon			X
Rhynchocyclidae				
Mionectes rufiventris	Gray-hooded Flycatcher		X	
Tyrannidae				
Lathrotriccus euleri	Euler's Flycatcher	X	X	X
Turdidae				
Turdus flavipes	Yellow-legged Thrush		X	X
Turdus albicollis	White-necked Thrush			X
Thraupidae				
Thlypopsis sordida	Orange-headed Tanager			X
UNDERSTORY INSECTIVORES				
Cuculidae				
Piaya cayana	Squirrel Cuckoo	X	X	X
Tapera naevia	Striped Cuckoo		X	X
Nyctibiidae				
Nyctibius griseus	Common Potoo			X
Bucconidae				
Malacoptila striata	White-chested Puffbird		X	X
Thamnophilidae				
Dysithamnus mentalis	Plain Antvireo		X	X
Thamnophilus ruficapillus	Rufous-capped Antshrike	X	X	X
Thamnophilus caerulescens	Variable Antshrike	X	X	X
Mackenziaena severa	Tufted Antshrike			X
Pyriglena leuconota	White-backed Fire-eye			X
Drymophila ferruginea	Ferruginous Antbird			X
Drymophila malura	Dusky-tailed Antbird	X	X	X
Conopophagidae				
Conopophaga lineata	Rufous Gnateater		X	X
Furnariidae				
Certhiaxis cinnamomeus	Yellow-chinned Spinetail			X
Synallaxis ruficapilla	Rufous-capped Spinetail		X	X
Synallaxis spixi	Spix's Spinetail	X	X	X
Syndactyla rufosuperciliata	Buff-browed Foliage-gleaner			X
Lochmias nematura	Sharp-tailed Streamcreeper			X
Rhynchocyclidae				
Todirostrum cinereum	Common Tody-Flycatcher		X	X
Tyrannidae				
Phyllomyias fasciatus	Planalto Tyrannulet		X	X
Myiophobus fasciatus	Bran-colored Flycatcher		X	
Troglodytidae				
Troglodytes musculus	Southern House Wren	X	X	
Parulidae				
Setophaga pitiayumi	Tropical Parula		X	X
Geothlypis aequinoctialis	Masked Yellowthroat			X
Basileuterus culicivorus	Golden-crowned Warbler		X	
Myiothlypis leucoblephara	White-browed Warbler			X

CONCLUSIONS

The composition of avifauna in the forest is altered as changes occurred in vegetation. These changes, that can be both natural and anthropic, directly interfere with the population structure of the birds. As predicted, the total number of area-sensitive bird's species was positively associated with stages of ecological succession of the forests fragments. The size, level of isolation, shape, and neighboring landscape of a forest fragment can all affect the bird community, but even a small isolated forests fragment will probably support low bird diversity. The integrity and complexity of a forest are the factors that influence the composition, abundance and probably the functions of the assembly of different bird's species. In that way, in forest environments, where a vertical stratification of resources occurs, these species are distributed occupying a high diversity of trophic niches. They occupy different heights of the forest and a great diversity of bird species distributed among different trophic guilds, which means ecosystems relatively balanced and of great biological value.

REFERENCES

1. Myers N, Mittermeier RA, Mittermeier CG, Fonseca GAB, Kent J. Biodiversity hotspots for conservation priorities. Nature. 2000; 403: 853-858.
2. Dean WB. With Broadax and Firebrand: the Destruction of the Brazilian Atlantic Forest. University of California Press; 1995.
3. Duffy JE. Biological diversity in the Atlantic forest. In: J. Cutler (ed.) Encyclopedia of Earth. Cleveland; 2007.
4. Goerck JM. Patterns of rarity in the birds of the Atlantic forest of Brazil. Conservation Biology. 1997; 11: 112-118.
5. Brooks T, Tobias JA, Balmford A. Deforestation and bird extinctions in the Atlantic Forest. Animal Conservation. 1999; 2: 211-222.
6. Tabarelli M, Pinto LP, Silva JMC, Hirota M, Bedê L. Challenges and opportunities for biodiversity conservation in the Brazilian Atlantic forest. Conservation Biology. 2005; 19: 695-700.
7. Karr J. Seasonality, resource availability, and community diversity in tropical bird communities. American Naturalist. 1976; 110: 973-994.
8. Terborgh J. Causes of tropical species diversity. Proc. XVII Int. Omithol. Conar. 1980; 1978: 955-961.
9. Terborgh J, Robinson SK, Parker III TP, Munn C, Pierpont N. Structure and organization of an Amazonian forest bird community. Ecological Monographs. 1990; 60: 213-238.
10. Willson MF. Avian community organization and habitat structure. Ecology Monographs. 1974; 55: 1017-1029.
11. Blondel J. Guilds or functional groups: does it matter? Oikos. 2003; 100 (2): 223-231.
12. Blondel J, Ferry C, Frochot B. La méthode des indices ponctuels d'abondance (I.P.A.) ou des relevés d'avifaune par "stations d'écoute". Alauda. 1970; 38: 55-71.
13. Sigrist T. Birds of Brazil: an artistic view. São Paulo: Avis Brasilis Editora; 2006.
14. Sick H. Ornitologia brasileira. Rio de Janeiro: Nova Fronteira; 1977.
15. CBRO. Comitê Brasileiro de Registros Ornitológicos. Lista das aves do Brasil, 2015. Retrieved from http:/www.cbro.org.br.
16. Willis EO. The compositions of avian communities in remanescents woodlots in southern Brazil. Papéis Avulsos de Zoologia. 1979; 33: 1-25.
17. Tramer EJ. Bird species diversity: components of Shannon's formula. Ecology Monographs. 1969; 50 (2): 927-929.
18. Stouffer PC, Bierregaard Jr. RO. Use of Amazonian forest fragments by understory insectivorous birds. Ecology. 1995; 76: 2429-2445
19. Opdam P. Metapopulation theory and habitat fragmentation: a review of holarctic breeding bird studies. Landscape Ecology. 1991; 5: 93-106.
20. MacArthur RH, MacArthur JW. On bird species diversity. Ecology. 1961; 42: 594-598.
21. MacArthur RH, MacArthur JW, Preer J. On bird species diversity. II. Prediction of bird census from habitat measurements. The American Naturalist. 1962; 96: 167 - 174.
22. Willis EO. The composition of avian communities in remanescents woodlands in southern Brazil. Papéis Avulsos de Zoologia. 1979; 33: 1-25.
23. Laurance WF. Comparative responses of five arboreal marsupials to tropical forest fragmentation. Journal of Mammalogy. 1990; 71: 641-653.
24. Newmark WD. Tropical forest fragmentation and the local extinction of understory birds in the eastern Usambara Mountains, Tanzania. Conservation Biology. 1991; 5: 67-78.
25. Bierregaard Jr. RO, Lovejoy TE, Kapos V, Santos AA, Hutchings R. The biological dynamics of tropical rainforest fragments. BioScience. 1992; 42: 859-866.
26. Dario FR. Interactions between vegetation and avifauna in Amazon forest. Asian Journal of Biological and Life Sciences. 2013; 2: 190- 195.
27. Wiens JA. The Ecology of Bird Communities. Cambridge, Cambridge University Press; 1994.
28. Barlow J, Peres CA, Henriques LMP, Stouffer PC, Wunderle JM. The responses of understorey birds to forest fragmentation, logging and wildfires: An Amazonian synthesis. Biological Conservation. 2006; 128: 182-192.
29. Robinson SK, Thompson III FR, Donovan TM, Whitehead DR, Faaborg J. Regional forest fragmentation and the nesting success of migratory birds. Science. 1995; 267: 1987-1990.
30. Powell GVN. Structure and dynamics of

interspecific flocks in a Neotropical mid-elevation forest. Auk. 1979; 96:375–390.

31. Powell GVN. Sociobiology and adaptive significance of interspecific foraging flocks in the Neotropics. Ornithological Monographs. 1985; 36: 1013-1021.