ECOLOGICAL SEGREGATION BASED ON THE DIET OF THE UNDERSTORY INSECTIVOROUS BIRDS ON THE DECIDUOUS SEASONAL FOREST, GO, BRAZIL.

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INTRODUÇÃO

The biological community can be defined as a set of species that occur in the same place, connected to each other by their relationship to food and other interactions (Ricklefs, 2003). The structure includes all of the ways in which community members interact and relate with each other, and the properties of these interactions that emerge as trophic structure, energy flow, species diversity, relative abundance and stability of the community (Pianka, 1973). One of the more assumptions used to explain patterns in the structuring of communities is interspecific competition (Ricklefs & Travis, 1980), which over evolutionary time can result in phenomena such as character displacement or competitive exclusion. Thus, communities structured by competitive interactions should provide a limit of similarity in the use of resources that can ensure the coexistence of species (MacArthur & Levins, 1967).

All species use food and space, also used by other species, so all species are potentially involved in interspecific competition (Roughgarden & Diamond, 1986). However, despite the certainty of the occurrence of ecological interactions between species, the way in which they affect, and therefore alter the structure of communities is not clear. Studies of overlap in the use of resources and how they are divided among the members of the community help us to clarify the interactions within a community can influence its structure. That is, show how community members can be arranged, or meeting within a space of resources. The position of organisms within communities and overlap between them, with the use of resources, define the ecological niche (Hutchinson, 1959).

OBJETIVOS

In this context the objective of this work is to verify the species of insectivorous birds and day, residents of understory deciduous seasonal forest, divide the food resources, or as separate on diet.

MATERIAL E MÉTODOS

Study Area

The study area is located in the basin of the Paraná River, between the states of Goiás and Tocantins, which is one of the most significant remnants of deciduous seasonal forests of Brazil, within the Cerrado biome. The fragments of deciduous seasonal forests sampled are located in the city of São Domingos, village of Monte Alto, farms Flor do Ermo and São Domingos ($13^0$39'24"S-$46^0$45'10"W).

Guild

In fragments of deciduous seasonal forest birds were caught in the uderstory with mist - nets, placed in linear transects in periods: (1) 2 to 5 September 2003 (450 hours / network), (2) 16 to March 20, 2004 (480 hours / network), and (3) 19 to May 31, 2004 (1449.5 hours / network), 48 species of birds and these were separate species that comprise the guild of insectivorous birds, non - climbing, day and residents of the understory. The nomenclature and classification of the species are in agreement with the Brazilian Committee of ornithological records (2006). The feeding guilds of species were defined according to Motta (1990) and classification of birds according to the stratification in foraging followed Donatelli *et al.*, (2004), being considered insectivorous, species whose diets are composed of 75% or more of insects and other arthropods. Considered as a uderstory species that they forage primarily in intermediate layer of vegetation (ie above ground and below the canopy).

Diet

For analysis of the diet were used stomachs of birds, deposited in the ornithological collection Marcelo Bagno, Department of Zoology, University of Brasilia, and data from literature. Stomach contents were sorted and examined under a stereomicroscope to dissect in the trophic ecology laboratory at the University of São Paulo (USP). Food items were identified with the aid of literature, counted and grouped into categories Food: a)the arthropods were classified, mostly in standard taxonomic order, with adults, larvae and eggs were considered separately, b)the Formicidae and Hymenoptera Parasitica by presenting distinct morphological characteristics of the other Hymenoptera, were

considered in separate categories, similarly, Cicadomorpha within Hemiptera and Curculionidae within Coleoptera, were considered separately, c)the seeds were grouped into a single category, as occurred the identification of only one morphotype. The classification of insects was made as Grimaldi and Engel (2005) and Ruppert *et al.*, (2004).
The counting of items by food category was done according to methodology used by Ribeiro (2001), the minimum number of items per food category estimated by the association between parts of the body similar. Index Food - IA (%) was calculated for each species at least two samples (Ribeiro, 2001), and this provides the importance of each food category in the diet. For the index, first divided the number of stomach samples which were each food category by the total number of samples, or were obtained by frequency of occurrence (FO) for each food category. Then was the frequency of abundance (FA) of each category for each sample stomach, separately, by dividing the number of items in the category by the number of items contained in the sample. With these values, it was estimated the Food index (AI).
For each species it was calculated the magnitude of the food niche (the niche width) by the Simpson index of diversity, and niche overlap of food through the equation of overlapping Pianka, using the program EcoSim (Entsminger and Gotelli, 2001).
Multivariate Analysis
For the sorting of species in relation to diet, a Principal Components Analysis (PCA) and Analysis Group ("Cluster Analysis") based on Euclidean distance of the farthest neighbor. The tests were performed in the MVSP 3.1 (Kovach, 2005).

RESULTADOS

The guild is composed of 16 species. *Knipolegus franciscanus* is a species registered in the area, but that was not sampled in mist nets, and probably belong to this guild. Was excluded from the analysis due to lack of data on it, being considered for restricted distribution. Of these 16 species was not possible to obtain the composition of the diet of *Nonnula rubecula* and *Synallaxis scutata* and therefore discarded from the analysis.
In the total diet of 14 species examined were found 22 types of food items. The largest rate of insects consumed were Coleoptera (41% of all arthropods consumed, adding to larvae of Coleoptera Curculionidae and adults) and Formicidae (about 21% of total), two groups that are among the most abundant in entomofauna tropical (Janzen & Schoener, 1968), is very frequent in the diet of insectivorous neotropical birds (Chapman & Rosenberg, 1991, Poulin *et al.*, 992, Chesser, 1995; Ribeiro, 2001). Coleoptera and Formicidae were 60% of the diet of the birds examined by Poulin *et al.*, (1994), and in this work. The food categories most significant in the separation between the species were Hymenoptera, including Formicidae, Coleoptera and Hemiptera. Similarly, these categories were recorded by Rotenberry (1980) as the most consumed by five species of birds in the reproductive period. The first two principal components explained 75% of the total variation of data.
In two analysis of ordination, was formed three groups: (1) formed by *Taraba major*, more foreign species, *Basileuterus hypoleucus* and *Furnarius rufus*, with high rates of food ants, (2) formed by *Myiobius atricaudus*, *M. barbatus* and *Galbula ruficauda*, with high proportions of Hymenoptera other than Formicidae in their diets, this group is composed exclusively of species that catch the insects in flight by air maneuvers (Fitzpatrick, 1980; Karr & Brawn, 1990; Remsen & Robinson, 1990; Blake & Loiselle, 1991), and (3) with the remaining larger group of species with high rates of food Coleoptera. The other two groups are formed by species, in most cases, seeking the insects in the foliage, mainly through the maneuver known as glean (Karr & Brawn, 1990; Remsen & Robinson, 1990; Blake & Loiselle, 1991).

In cluster analysis, the species most similar in diet were *Furnarius rufus* and *B. hypoleucus* (Euclidean distance between the two = 17.37), *Formicivora grisea* and *Thamnophilus punctatus* (19.03) and *Casiornis rufus* and *Eucometis penicillata* (21.31). *Furnarius rufus* also showed low amplitude in the food items, due to the high rate of food Formicidae, and *B. hypoleucus*. Sick (1997) cites that the first kind also take advantage of flock of termites. For both species, the results suggest by the bibliography is opportunism in catching prey, and bonded available at certain times, more than a specialization. *Formicivora grisea* and *Thamnophilus punctatus* showed more than 70% of the diet is composed of Coleoptera. *Formicivora melanogaster* is ranked next, with high proportions of Coleoptera, even lower than those found in the previous species and includes Hymenoptera Parasitica and eggs of insects, food items not present in the diet of other family members. In other studies using cluster analysis, on the diet, congeners tend to be ordered so close (eg Sherry 1984), and that this can happen either by occupying similar habitats and strata, as being phylogenetically close (Karr & James, 1975).

Another pair of species with similar diet consists of *Eucometis penicillata* and *Casiornis rufus*. Species are also morphologically similar and both are predominantly active foraging, looking for prey in the foliage, with *E. penicillata* may forage in the soil (Sick, 1997). These species are ecologically very similar and possibly there is intense competition between them, unless the resources used to be abundant or that there is some divergence in another dimension of resource use. In species with similar diets, perhaps the size of prey is important in the ecological segregation. With the results found here, the two species can be considered equivalent ecological (Beaver & Baldwin, 1975).

The species that forage using the tactic of "glean"are considered active foraging (Eckhardt, 1979) and probably spend more energy to find the food than to capture it. Already the birds that get stuck in the air, maneuvering through the air ("fly - catchers"), passively looking for food and therefore spend more energy in capturing the prey than to find it (Eckhardt, 1979). Thus, in models of optimal foraging, the species that forage actively in vegetation, were more general, while foraging in the air would be more restricted diet, then more specialized (Schoener, 1969). The results found here, on the scale food, do not support the hypotheses proposed by Eckhardt (1979). The insect species that collect in the leaves both had high levels of food diversity (*Ca-*

siornis rufus, *Basileuterus flaveolus* and *Eucometis penicillata*), but also exhibited low food diversity (*Taraba major*, *Formicivora grisea*, *Furnarius rufus*, *F. melanogaster* and *Thamnophilus punctatus*). The same applies to the guild of species that collect the prey in flight, where both species were recorded with a wide variety food (*Galbula ruficauda* and *Leptopogon amaurocephalus*) and species with smaller amplitude of the diet (eg *Myiobius* and *Lathrotriccus euleri*).

The species was considered more general *Casiornis rufus*, fairly common in Central Brazil (Sick, 1997), occurring in more open formations of the Cerrado, to borders and clearings of forest formations. *Eucometis pencillata* also demonstrated high food diversity, although lower than the previous species. Perhaps this plasticity in relation to food decreases the effects of competition between the two species. *Basileuterus flaveolus* and *Galbula ruficauda* showed high levels of food diversity and close. These species are considered generalists.

CONCLUSÃO

In the deciduous seasonal forest of São Domingos, GO, there are about 17 species of insectivorous birds, non - climbing, day and residents of the understory. Since one *Knipolegus franciscanus* is considered a distribution restricted to this type of vegetation. Regarding the composition of the diet, the 14 species examined fall into 3 main sub - groups, examining the tactics of foraging of the species formed a sub - group - based diet offers the same tactic of foraging. The species with the greatest overlap and for which there may be intense competition, provided that the resources used are abundant or that there is some divergence in another line of resource use, are *Formicivora grisea* and *Thamnophilus punctatus* and between *Eucometis penicillata* and *Casiornis rufus*. If for some reason the food resources have low availability, the food overlap can lead to selection of behaviors or characteristics that increase the interspecific ecological segregation.

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