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SLICING AND RESTORING NATURE: ANT COMMUNITY ECOLOGY IN THE ATLANTIC FOREST

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Abstract We record leaf litter ant species richness along a latitudinal gradient in the Atlantic Forest based on systematic surveys in 26 regularly spaced localities, covering almost 20º of latitude, and use this information to describe the response of different leaf-litter ant functional groups to the gradient. Applying null morphological models and other statistical tools to a matrix of 18 morphological measurements taken from workers of 540 Atlantic Forest ant species, we recognize sixteen guilds. Mapping pest ants on this scheme, all pest species belong to just two guilds that include also representatives with no economic importance. The main quality shared by pest ants, either urban or agricultural, is the preferred impacted habitats they occupy.
Key Words Hymenoptera, survey, guilds, community structure, pest species.

INTRODUCTION

Ants are a diverse, abundant, and important component of tropical habitats. Leaf-litter ants comprise a large fraction of tropical ant species, but relatively little information is available on their ecology and biology. A little more than 30 ant species belonging mostly to three Formicidae subfamilies, Formicinae, Myrmicinae and Dolichoderinae, are recognized as pests dispersed by human commerce. We investigate hereby whether these ants belong to the same ecological guild and if they compete among themselves and with other ant species for resources.

MATERIALS AND METHODS

We developed an approach to define the number and composition of guilds in taxa that show high levels of morphological diversity, incorporating ecologically relevant traits, rather than merely relying on taxonomic grouping and/or non-comparable qualitative behavior information (Silva and Brandão, 2010 and references). First, we assessed the importance of morphology in community structure using morphological null models. Next, we proposed a guild classification based on morphological variables, and finally we employed a species co-occurrence null model to assess community structure.

The 26 Atlantic rainforest sites are along slopes on the coastal mountains of the Serra do Mar range, and are inside representative conservation units of the Atlantic Forest system, between 700 and 1000 m a.s.l., in mature forests classified as Lower Montane Rain Forest. The protocol for the leaf-litter ant sampling was adapted from Agosti and Alonso (2000),

The ants of all samples were sorted and up to three workers of each morphospecies in each sample were mounted. When possible, specimens were identified to species by comparing them to taxonomic descriptions and material identified by specialists in the Museu de Zoologia da Universidade de São Paulo Formicidae collection. Specimens not identified to species were given a code for each distinct morphospecies.

To illuminate the structure of co-occurring leaf-litter ant species in finer detail, we first constructed a morphological data set comprising the Atlantic Forest leaf-litter ant fauna in each locality and applied morphological null model analysis to assess the morphological structure of communities at local scales. We tested for non-random patterns of morphological structure using random body size and shape distributions drawn from the regional species pool. Then, the morphological matrix was submitted to a Principal Component Analysis to indentify species groups with similar sets of morphological traits (guilds). Finally, species co-occurrence analyses were performed within each locality and guild.

We estimated the number of species remaining to be sampled using the First-order Jackknife estimator (incidence based). Sampling efficiency was then estimated as the number of species accumulated by sampling,

relative to the total number estimated to be present within each assemblage. The species richness estimator and standard deviations (SDs) associated with these estimates were calculated using EstimateS version 7.5.2.

To describe the morphology of each species, we used 18 quantitative characters assumed to be related to prey size and foraging behavior.

RESULTS

Our analysis indicates significant tendency towards constant proportion of species in guilds and that the division of leaf-litter ants into guilds is based mainly on microhabitat distribution in the leaf-litter, body size and shape, eye size, and phylogeny. Different Atlantic Forest areas have the same leaf-litter ant guilds. The guild proportionality assembly rule was confirmed for most guilds, suggesting that there are guild-specific limitations on species coexistence within assemblages. Our results imply that there are more compartments than indicated in previous models, particularly among cryptic species (confined to soil and litter) and tropical climate specialists. In addition, the results showed that some guilds are taxonomically-aligned groups, due to the strong relationship between morphology and taxonomy.

Pest ants belong to three different subfamilies, indicating at least three distinct origins for ¨pest¨ behavior; moreover, the fact that several genera are involved, elevates further the number of origins of this behavior. Pest ants were identified in two guilds, the fungus growers and the medium-sized generalists, which encompass all urban pest ants. Interestingly, in both cases,"pest" behavior is a quality linked to the more "derived" taxa, which occupy, moreover, habitats impacted by human action. In the case of urban ant species, our data show that in natural environments, they seldom coexist at the local scale, suggesting competition among them.

CONCLUSIONS

The leaf-litter ant fauna of the Brazilian Atlantic Forest shows non-random patterns of local species co-occurrences. This assemblage structure shows similarity in guild representation across the Atlantic Forest sites examined here. On small spatial scales (at 1-m^2), the distribution of leaf-litter ant species reflects the influence of biotic interactions and abiotic filters, i.e., community assembly processes. From a community-level perspective (at each site), there is evidence that competition among species leads to differential distribution of species' functional traits, most commonly, leading to morphological divergence.

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