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Commentary

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Taxonomic and Functional Trait Diversity of Summer Spiders (Araneae) in Riparian Zones of Native and Exotic Forests of a Subtropical System

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Introduction

Change in land use and replacement of native forest by anthropic activities are among the main causes of biodiversity loss worldwide. At the hydrographic basin scale, creation of dams and conversion of riparian forests for agriculture, pasture, and silviculture cause disturbance either in the industrialized or in the developing countries. Therefore, the functionality of riparian disturbed areas depends on their ability to act as secondary habitats for the species pool. In that sense, habitat complexity in these areas is a keystone factor influencing population dynamics and community organization of terrestrial arthropods because it supports species richness and abundance. For instance, the development of forest understory diversity can increase plant complexity, which in turn can harbor more species of arthropods like spiders.

Spider assemblages may respond to environmental changes (e.g. plant and litter structure) in the riparian zones. Also, the lateral distribution of riparian vegetation can influence the diversity of arthropod communities, and consequently, the food resource for spider community. In this way, more food availability (arthropods) may increase web builder spider biomass and diversity near the stream's watercourse bank. The dispersion and density of predators like spiders can be associated to the variation of emergent arthropods in the areas of the streams. Therefore, besides prey availability, spiders can respond to environmental changes by alterations in plant and litter structure, which can drive changes in local or regional diversity.

Changes in the environment may influence the taxonomic and the functional diversity of spiders in riparian forests. A functional trait is a physiological, morphological, phonological or behavioral (in animals) characteristic influencing the fitness of individuals. Studies have highlighted that more open and warmer habitats in forest ecosystems can favor the establishment of larger-bodied spiders. Reasons for this pattern can be associated to resource use (larger spiders prey on larger food), desiccation resistance (dry and hot conditions favoring large-bodied individuals) and competitive skills (larger species may be superior competitors). Here, we aim to study the distribution of spider assemblages in a native forest and in an exotic forest (silviculture) in a subtropical system of Brazil. To our knowledge, it is the first study addressing the functional response of spiders in exotic forest plantations in this system. Based on known spider responses to disturbance, we expect 1) To observe marked differences in species composition between forest types based mainly on the selection of large-bodied spiders in the more open exotic forest; 2) A lower richness, abundance, and functional diversity in the exotic forest due to their lower habitat heterogeneity and complexity; 3) A higher taxonomic and functional diversity in habitats near the water (lateral gradient variation), due to the presence of more microhabitat diversity.

Functional Traits on Forests

Functional traits were selected based on body size, foraging method, circadian activity, and vertical stratification. The traits were measured only on adult spiders. Body length was measured to the nearest 0.5 millimeter under stereo microscope with a digital caliper and a millimetric paper by the same person. The other traits were binary and based on Cardoso et al. classification. Foraging method was separated in hunters or web builders and the trait is associated with the type of prey and niche space. Circadian activity was divided in two binary variables: diurnal (0 and 1) or nocturnal (0 and 1); species hunting in different times of day or seasons probably are not sharing resources. Some families could present both types of this trait. Vertical stratification was classified in two binary variables: Soil (0 and 1) and vegetation (0 and 1) and it could be expected that species showing both characteristics are more resistant to habitat. The sampling design applied in our study resulted in different sampling efforts for the spider and the environmental variables. Soil and luminosity had one measurement in each distance from the watercourse (18 replicates), while litter biomass and spider diversities had three measurements in each distance (54 replicates). Therefore, to avoid missing values in the analyzes, we averaged the litter biomass measurements and pooled the spider diversity data in each distance, resulting in three measurements of each variable (5 m, 25 m and 45 m) in each one of the six sites (three riparian zones in native forest and three in exotic forest). At the end, the distribution of the plots in the three distances formed subgroups within the groups of the six riparian zones characterizing a nested sampling design. All following analyzes were performed in the R-studio environment.

Corroborating our first hypothesis, assemblage composition of exotic forest was mainly described by an increase of active hunter species with larger body and diurnal activity. Specifically, hunter species were associated with an increase in luminosity in the exotic forest. Our second hypothesis was partially corroborated. Richness was lower in the exotic forest and associated with higher luminosity and acid soils; abundance was also lower and associated with an increase of leaves' biomass in the litter. On the other hand, multivariate functional diversity indices did not vary between the forest types. The premise of our third hypothesis was invalidated since there was not an environmental lateral gradient based on the measured explanatory variables. This pattern reflected on the lack of significant variation in the response variables along the distances from the water course.

Spider richness responded to the exotic plantation conditions associated with low canopy cover (more luminosity) and high amount of pines ssp. leaves in the soil, which increased its acidity. On the other hand, higher abundance was associated with lower biomass of leaves in the litter. In fact, the three explanatory variables are causally linked to the vegetation structure of the forest. Exotic plantation had lower understory plant diversity and complexity, and one dominant tree on the canopy, which produces a litter with higher leave biomass and lower heterogeneity on the litter structure and heterogeneity, and on the establishment of other plant species. Arthropod predator species richness was found to be higher in natural forests compared to open habitats in South Africa showing higher luminosity can be a limitation to spider richness found a peak of spider richness at 55% of canopy openness along an environmental gradient in the Czech Republic suggesting extreme values of luminosity, and therefore temperature, would prevent spider occurrence.

Functional diversity on Vegetation

Richness and abundance we found were like those registered in the same region of our study during the summer with the same sampling effort (54 pitfall traps). The authors registered 194 individuals of 21 morph species in native forests and 14 morphospecies in eucalyptus plantations. However, those authors did not find differences in mean richness or abundance between the native and plantation forests. On the other hand, in the semi-deciduous Atlantic forest of Argentina it was also found higher richness in the native forest compared to middle-aged pine plantations associated with the cover of litter, grasses and herbaceous vegetation.

Our results suggest the exotic forest would be acting as an environmental filter for regional spider diversity. The filtering process in the exotic plantation can be favoring the occurrence of hunter spiders with bigger body size and resistance to drought like corinnidae, dipluridae and ctenidae. In fact, few species were abundant on the plantation, and there was a perceptive decrease in the occurrence of small web builder species. In opposition, the native forest showed mainly spider species with smaller body size, web building trait, and nocturnal activity. In this habitat, there was higher abundance of amaurobiidae and linyphiidae. Amaurobiids are sensitive to environmental disturbances and weave tube and sheet webs, and their occurrence was already associated to native forest areas in the same region of our study and in the piedmont forest of northwestern Argentina. Areas of the native forest showed more web builders probably due to the higher litter heterogeneity and lower luminosity and temperature. On the other hand, this pattern is contrary to the one found in forest steppes of Hungary where web builders were associated with pine forests and open habitats.