EFFECTS OF LITTER TYPE AND DEPTH ON ARTHROPOD DIVERSITY IN A TROPICAL DRY FOREST

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Abstract: Because plant litter provides nutrients and structural habitat for arthropods, we hypothesized that arthropod abundance and diversity would increase with the depth, quality, and structural heterogeneity of litter. We compared two litter types, non-grass and grass, at two depths. We predicted that: 1) deeper litter would support higher abundance, biomass and diversity of arthropod species, and 2) non-grass leaf litter, which apparently provides greater structural complexity, would have a higher diversity of arthropods than grass litter. We found that grass litter had a significantly higher arthropod biomass than leaf litter, but there were no other significant differences among depths and litter types, in arthropod abundance, richness, or diversity.

Key Words: plant litter, arthropod, diversity

INTRODUCTION

Forest litter provides both structural habitat and nutrients for arthropods. Prior to leaf fall, deciduous trees resorb some of their nutrients, but structural defenses and some chemical defenses persist, probably reducing digestibility by litter arthropods. We expected grass litter to have more nutrients and fewer chemical and structural defenses, and thus have higher quality than non-grass ("leaf") litter. However, we also expected leaf litter to support a higher diversity of arthropod species than grass litter, by providing a more complex physical structure. Thus, we predicted that: 1) deeper litter would support higher abundance and biomass and diversity of arthropod species, and 2) leaf litter, which apparently provides greater structural complexity, would have a higher diversity of arthropods than grass litter.

METHODS

The overstory of our study site along the Serena El Pizote-La Martilla trail, northwest of the OTS research station in Palo Verde National Park, Costa Rica, was dry-deciduous forest. In the understory there were several small (up to 25 m^2) patches dominated by grass. We tested two litter types, grass and deciduous leaf, at two depths, deep and shallow, including four replicates of each of the four treatments (leaf shallow, leaf deep, grass shallow, grass deep) for a total of 16 sites. "Grass sites" were in grass dominated patches, while "leaf sites" were in understory areas without grass.

On the afternoon of 7 January 2006, we set pitfalls at eight sites. At each site, we placed three pitfalls roughly 1 m apart in a triangular formation. Pitfalls were 50 mm centrifuge tubes filled with 20 ml of a detergent/table salt and water mixture, and

set flush with the ground. We installed pitfalls at the remaining eight sites on the morning of 9 January.

On the morning of 10 January 2006, we collected pitfalls and measured the length and width of each litter patch and estimated the average litter depth (taken at 3 random points), at each site. We sorted samples to order and morphotype, and measured the length and width of each arthropod. We indexed individual biomass by multiplying length by width, and used this biomass proxy for each morphotype in the calculation of the Simpson's diversity index. We trapped arthropods from two sets of 24 pitfalls over a 40 hour period, and estimated abundance and biomass using numbers of arthropods per hour.

Using three two-way ANOVAs, we evaluated the effects of litter type and litter depth on numbers, biomass, and species richness. We used three *a priori* linear contrasts to determine differences in diversity between litter treatments. We used JMP 5.0.1 for all analyses.

RESULTS

We collected 1,153 total arthropods distributed among 54 morphotypes. We found ten total orders: Arachnida, Blattaria, Coleoptera, Diptera, Hemiptera, Hymenoptera, Isoptera, Microcorpyphia, Neuroptera, and Orthoptera. Grass litter had a higher arthropod biomass than leaf litter ($F_{1,14}$=4.77, P=0.05), but there was no effect of litter depth on biomass ($F_{1,14}$=0.54, P=0.48). There was no effect of the interaction between litter depth and litter type on biomass ($F_{1,14}$=0.40, P=0.54).

The ANOVA for Simpson's diversity index was not significant overall ($F_{3,12}$=0.77, P=0.53), nor was there a significant effect of litter type ($F_{1,14}$=0.00, P=0.10) or litter depth ($F_{1,14}$=2.10, P=0.17). Furthermore, we found no interaction between litter type and depth ($F_{1,14}$=0.22, P=0.65) nor any difference in our linear contrasts between leaf-shallow and grass-shallow ($F_{1,12}$=0.75, P=0.11), or leaf-deep and grass-deep ($F_{1,12}$=0.11, P=0.75). Based on a power analysis, we could have detected a difference of 1.0 in Simpson's diversity index with a probability of 0.90.

The ANOVA for abundance was not significant overall ($F_{3,12}$=0.80, P=0.52). Nor was abundance significantly affected by litter type ($F_{1,14}$=0.29, P=0.60), litter depth ($F_{1,14}$=0.17, P=0.69), or their interaction ($F_{1,14}$=1.96, P=0.19).

DISCUSSION

Arthropod biomass was greater in grass litter, which we suggest may be due to greater nutrient availability. However, our results did not support our hypotheses for differences in arthropod diversity, numbers, or species richness across litter types and depths. The similarity in arthropod communities across litter type and depth has at least two plausible explanations: 1) at the end each wet season deciduous leaf litter falls, reducing the dominance of grass litter in grass patches, or 2) even if grass litter tends to generate distinct arthropod communities, these local communities would be surrounded by a much larger litter arthropod community characteristic of deciduous tree litter. Thus, migration of individuals across the boundaries of grass patches would tend to

homogenize the litter arthropod community in space, blurring the distinction between grass patches and the surrounding habitat.

LITERATURE CITED

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