Factors determining the spatio-temporal distribution of ants in an Andean tropical forest

Justine Jacquemin

In tropical forests, ants are numerous, diversified and ecologically important, being present from forest floor to upper canopy and exploiting a wide variety of diets. Nearly half of the ant species are directly in contact with the ground stratum, including the leaf-litter and the underlying soil, for nesting or foraging. The main factors known to influence ant distribution and abundance can be environmental (e.g. heterogeneous distribution of microhabitat size, nutrient availability, microclimate, soil properties) or biotic (e.g. inter- and intraspecific competition, prey availability). Some of these factors, such as leaf-litter volume or prey availability, may also vary seasonally. Also, the Ecuadorian Andes are known as being a hotspot of biodiversity for a large array of organisms, but it was not documented until now if this is also the case for ants.

The general aim of the PhD project was to identify, by both descriptive and experimental approaches, the factors determining the structure of a ground-dwelling ant assemblage at a small-spatial scale and its temporal variation in an evergreen premontane tropical forest of the Ecuadorian Andes.

In the descriptive part of the project, we studied both horizontal (along a transect) and vertical (across ground layers) species diversity and distribution of ground-dwelling ants. To attempt to explain the observed patterns, we measured a series of environmental factors varying at small spatial scale and/or seasonally: canopy openness, leaf-litter quantity, slope, and a series of soil physico-chemical properties (e.g. texture). The ant assemblage richness appeared to be at least as high as in the Amazonian Basin, with up to 33 species per m². The heterogeneity of species spatial distribution at small spatial scale was high, with distinct species composition (average Jaccard index = 0.2 ± 0.08 SD) and abundance (up to 40 fold) in contiguous plots. We observed a strong seasonal effect on the ant assemblage structure. The higher ant diversity and abundance found at the surface and in the mineral soil during the dry season suggested a seasonal peak of activity on the ground surface and the seasonal migration of drought-sensitive species downwards in the soil. Ant diversity was related to distinct environmental factors according to the ground layer considered. We found strong correlations between litter amount and dominant ant distribution in the leaf-litter layer, while we found no correlation with any factor in the soil layer. The low amount of negative association between dominant species suggested a low interspecific competition.

In the experimental part of the project, our aim was to identify experimentally the relative importance of habitat size *vs.* prey availability in structuring the leaf-litter ant assemblage. We studied the response of various ant trophic groups to an increased nutrient availability which boosted the decomposition of their leaf-litter habitat and enhanced the abundance of their prey. Bottom-up effect on the ant fauna (and other predaceous arthropods) regarding species composition and dominance was also studied. Stable isotope analysis was used to distinguish trophic groups among ants and mesofauna. Ants responded differentially according to their trophic group: despite increased prey availability, predatory species were negatively affected by nutrient supply, while other ant trophic group densities did not change. Our results showed that predatory ants are limited by habitat size rather than by prey availability, and that these ants are more affected by habitat loss than their prey, other ant trophic groups and other macrofauna taxa. Furthermore, a taxonomic shift occurred within each ant trophic group, leading to the replacement of dominant genera in fertilized plots.

As a conclusion, our results emphasize the importance of distinguishing layers among the ground matrix, since both ant faunas and their response to environmental factors vary vertically and seasonally. The distribution of ground-dwelling ants was only weakly explained by both the environmental factors measured and by biotic interactions, at a small spatial scale. Also, our results emphasize the importance of distinguishing trophic groups among the ant assemblage, since the response of these groups under changing conditions was different. In this regard, stable isotope analysis was a useful tool for investigating the trophic ecology of various leaf-litter taxa, and it was successfully used for the first time to assess the diet of leaf-litter ants and their position in the Brown Food Web relative to other taxa. Also, the isotopic approach allowed us to increase the knowledge about the biology of a rare and cryptic ant species, by revealing its top-predatory position. The outstanding local species richness that we observed confirms that the Ecuadorian Andes are also a biodiversity hotspot for ants.

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