Influence of ants on soil and leaf-litter food webs in two types of rainforests in Sarawak / Malaysia by stable isotope analysis – first outcomes

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Introduction

Ants are very important in tropical soil ecosystems, not only because of their high number of species and individuals, but also due to their importance in ecosystem functioning. We compared the diversity of ants and their role in the food web in two forest types (alluvial- and limestone forest) as a part of a large ecological investigation. We analyzed the trophic positions of ant species to investigate community structure and niche patterns of ants. Here we present some preliminary results of our study.

Fig. 1 Several *Pheidole* species showed little differences in their trophic position. Many species of this genus seem to be omnivores with a mixed diet of seeds and arthropods.

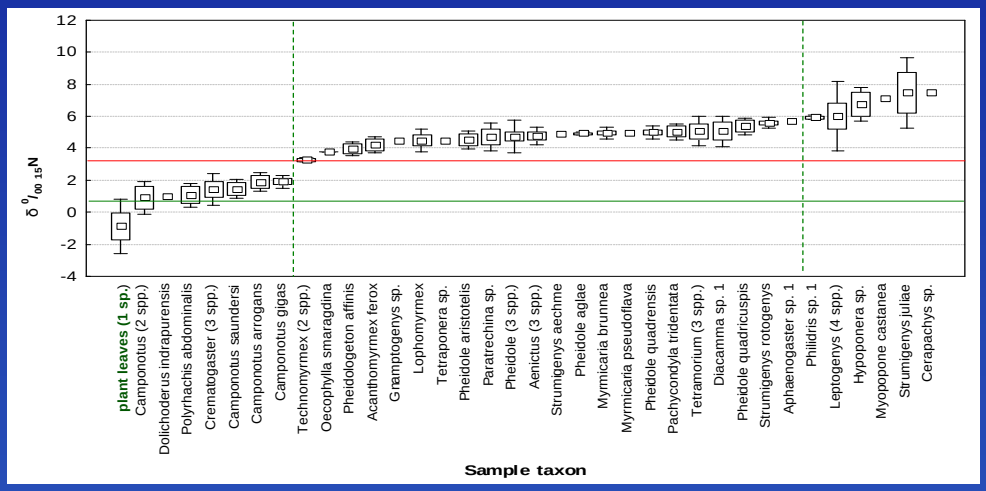


Fig. 2 Measurements of $_{15}N/_{14}N$ ratios of ants of the alluvial forest at Gunung Mulu, Borneo. The base line for leaf-litter is marked with green, that for soil with red. Trophic levels are separated by green dotted lines. Ant comprised species of three trophic levels: trophobiont tending ants, omnivorous species and predators.

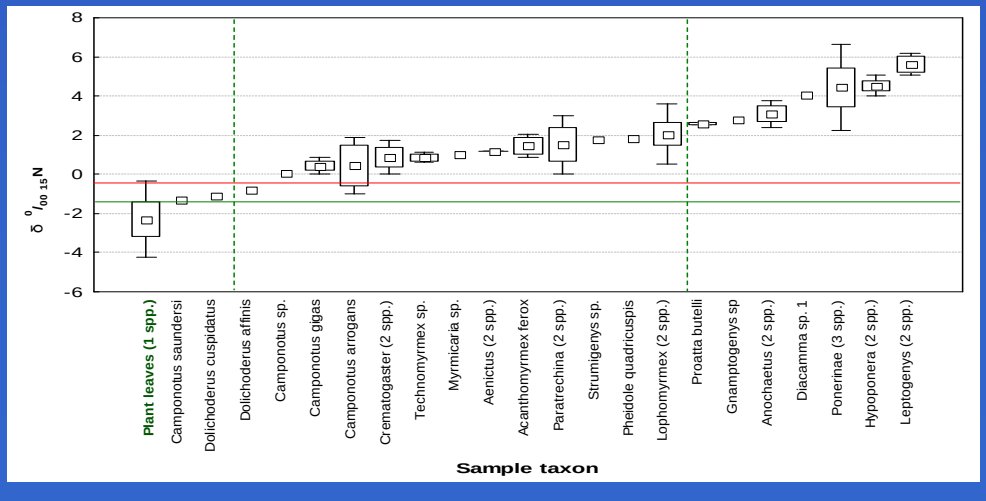
Methods

This study was conducted in Gunung Mulu National Park, in the north-eastern part of Sarawak/ Malaysia on Borneo. Assessment of diversity and specimen numbers was done with Winkler bags according to the ALL Protocol for the study of leaf litter ants (Agosti and Alonso 2000). For the analysis of stable isotope patterns specimens (n = 156) were dried in an electric drying apparatus and later stored in dry NaCL (Pfeiffer & Dyckmans in prep.). Isotope ratios of N (delta$_{15}$N) of soil invertebrates and their potential food sources and predators were analysed with an isotope mass spectrometrometer (Delta Plus with Conflo III interface, Finnigan MAT) and a NA1110 element analyser (CE -Instruments).

Diversity and individual numbers

After evaluation of only 11 samples we found 117 species of ants, 67 in alluvial forest and 83 species in limestone forest. Species accumulation curves showed still no species saturation (Fig 3). Species number per m² in limestone forest (20 species) was significantly higher than in alluvial forest (13 species/ m²; t-test; t = 3.83; p > 0.002). The number of ant individuals was higher in the limestone forest (434 ants / m²) than in the alluvial forest (257 individuals / m²).

Fig. 4 Measurements of $_{15}N/_{14}N$ ratios of ant species of the limestone forest at Gunung Mulu, Borneo. The base line for leaf-litter is marked with green, that for soil with red. Trophic levels are separated by green dotted lines.



Discussion

Our data demonstrate that ants occupy a wide range of trophic positions in the soil food web and thus are crucial for ecosystem functioning in tropical forests. All functional group of ants were present in both kind of forests. Ant genera showed different patterns of trophic radiation among their species, with *Pheidole* exhibiting only a narrow range of trophic niches, compared to the large radiation of *Strumigenys*. Delta values for N of soil and leaf litter differed largely between forest types making a correction of delta-values for species necessary in direct comparisons.

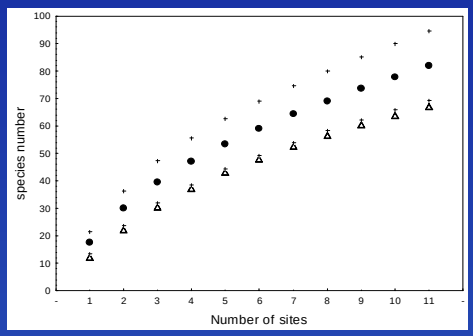


Fig. 3 Species accumulation curves of the alluvial (Δ)- and limestone forest (●) sites. For limestone forest, 95 % confidence intervals were added (+). The curves show still no species saturation.

Results: Food web

The $_{15}N/_{14}N$ ratios of ants in two forest types (49 species involved) varied strongly; spanning over nearly 9 $\delta_{15}N$ units (0.2 to 8.8 ‰ $\delta_{15}N$) in alluvial forest (Fig. 2) and over 8 $\delta_{15}N$ units (-1.2 to 6.9 ‰ $\delta_{15}N$) in limestone forest (31 species involved, Fig. 4). As on average trophic levels differ by 3.4 δ $_{15}N$ units (Minagawa and Wada 1984), we can conclude that ants cover three trophic levels in both types of forests; they comprise primary consumers (possibly via honeydew from trophobionts) as well as high level predators. While several *Pheidole* species showed little separation in their trophic position in alluvial forest, species of genus *Strumigenys* covered a much broader range (Fig. 1). The three most important subfamilies of ants showed a significant difference in their delta N values in both kind of forests (ANOVA alluvial forest (af): n=93 F=27.1 p<0.001; limestone forest (lf): n=45 F=35.0 p<0.001). Formicinae af: 2.4 (SD=1.4) lf: 0.5 (SD=1.2); Myrmicinae af: 4.8 (SD=1.1) lf: 1.8 (SD=1.2); Ponerinae af: 5.8 (SD=0.7) lf: 4.3 (SD=1.4).

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