Leaf-litter ant communities in two types of rainforest in Borneo (Sarawak/Malaysia)

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Introduction

Especially in the tropics ants are very important inhabitants of soil and leaf litter, not only because of their high numbers in individuals and species, but also because of their different herbivore, carnivore and detrivore food spectra. Ants are crucial for ecosystem functioning because of their role as major bioturbators and mutualists. In our study we analyzed the litter and soil ant communities in two different tropical forest types and the influence of soil types on ants. As a preliminary result here we present the comparison between alluvial and limestone forest.

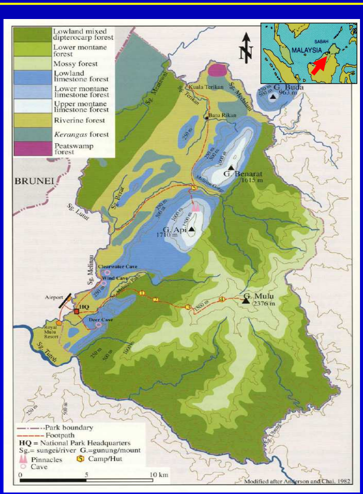

Fig. 1 Gunung Mulu National Park (3°56`-4°16`N, 114°47`-115°00`E) in Sarawak, Malaysia (after Hazebroek 2001)

Study site

This study was conducted in Gunung Mulu National Park (size: 544 km², Fig. 1) which is situated in the north-eastern part of Sarawak/ Malaysia on Borneo. Geologically it is a very rich area, resulting in a diverse array of different forest types. Of all these forests, we concentrated our efforts on limestone and alluvial forests (Fig. 2 and 3). Limestone forest is covering limestone hills and mountains and it is the most diverse and best conserved forest of its type of the region. Areas around the major rivers are covered by regularly flooded alluvial forest.

Fig. 2 Alluvial forests are drained by lots of small creeks.

Fig. 3 Limestone hills are covered by a special type of forest.

Methods

According to the ALL Protocol for the study of leaf litter ants, we established transect lines in limestone and alluvial forests with 20 sampling points at each site (Agosti & Alonso 2000). At every sampling point, one pitfall trap was set and soil and leaf litter samples of 1m² were collected for extraction by Winkler-bags. We compared several ecological parameters (soil structure, exposition) of the two forests. Ant identification was done in the lab with Hashimoto (2004) and Pfeiffer (2003- 2007).

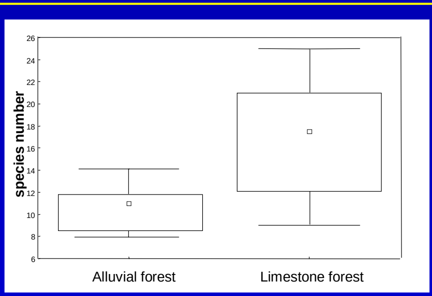

Fig 4. Species numbers found per m² forest floor (U-test, p< 0,05, U=89, n=6)

Species richness

Up to now we have evaluated six plots of each forest type. By the Winkler method we found 75 species of ants altogether (40 species in alluvial forest, 51 in limestone forest). In limestone forest, more species per m² were found than in alluvial forest (Fig. 4). Only 16 species were found in both kinds of forests resulting in a low ß-diversity (Sørensen-index: =0,36). *Recurvidris browni* (Fig. 5) was a common species restricted to alluvial forest. With pitfall traps, we collected 30 species, 23 from limestone forest (2 species per trap) and 26 from alluvial forest (3 species per trap)

Fig. 5 *Recurvidris browni* was a typical species of alluvial forest.

Forest habitat comparison

In alluvial forest a thin layer of topsoil covered a thick layer of rather unfertile clay. In limestone forest under this layer of topsoil, there was limestone with cracks and cavities. The layer of leaf litter was significantly mightier in limestone forest (U-test, p< 0,001, U=69,5 n=20). In the soil of limestone forest, there were much more root development (U-test, p< 0,001, U=24,6, n=20). The canopy openness in the alluvial forest was significantly lower than in limestone forest (U-test, p< 0,002, U=89, n=20).

Fig. 6 *Aenictus* sp. is evacuating its brood to a higher place.

Flood Survival strategies

Several times a year, the alluvial forest is flooded (Fig. 7), so its inhabitants need strategies to survive these events. Some ants (e.g. *Aenictus* sp.) managed this by evacuating their whole nest to a higher place, like a tree or a large rock (Fig. 6). Other ants, especially smaller species (e.g. *Pheidole tjibodana*), survived inside their submerged nests inside the leaf litter. Their nest was sealed with clay so that water could not harm the nest inhabitants and their brood. Another flood survival strategy included nesting on higher places that were never flooded. Since these places seemed to be quite rare, ants nesting there had to tolerate the vicinity of nests of other species, for example, we observed *Odontomachus* sp. nesting near to several small Myrmicines.

Fig. 7 Alluvial forest during a flooding event

Discussion

In alluvial forest, less species were extracted from soil and leaf litter, while more ant species were caught by pitfall traps than in limestone forest. This result might be influenced by the structure of the leaf litter layer in both forest types. In alluvial forest, it was quite thin and compact, thus allowing only few ants to forage between the litter. So more ants foraged on the litter surface and were more commonly trapped with pitfall traps.

Conclusions

In Gunung Mulu National Park (Sarawak/ Malaysia) we compared ant communities of leaf-litter and soil of alluvial and limestone forest to assess the impact of different soil and vegetation types. Species richness and diversity was higher in limestone forest than in alluvial forest. Regularly floods in alluvial forest seem to allow only the existence of well adapted species, while limestone forests have a well drained topsoil layer that offered better conditions for ants.

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