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Litter arthropod community and its impact on decomposition – A contribution to restoration biodiversity in rainforestation systems, Leyte; Philippines

Diplomarbeit
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7. Summary

As a part of an island rehabilitation program, rainforestation farming systems in Leyte (Philippines) first were established in 1992, in co-operation of the GTZ[26], the DENR[27] and several departments at ViSCA. Rainforestation systems apply to create a sustainable land use system on the basis of natural forest ecosystems. A number of different ecosystem studies contribute to the development of a holistic approach, which provide for a further development of this land use system. The present study focused on the question of decomposition in these rainforestation systems, which results from the interrelation between decomposer biota, their habitat and litter material.

The goal of this study was to supply further knowledge about the role of the arthropod community in this process at two different rainforestation sites, (the demonstration farm at ViSCA and the rainforestation farm in Punta) and a secondary forest at ViSCA. For this purpose arthropod groups in the litter layer were caught with pitfall traps (PT) and extracted from leaf litter samples by a tullgren funnel (TF) device. The assignment of taxonomic groups to life characteristics and their ecological service illustrates the way in which arthropods have an influence on decomposition. Collembolans, oribatid mites and dipterans represent dominant groups of smaller arthropod in the litter layer, which show an influence on decomposition as they belonging to the detritivore-microbivore dietary type. Specific variation of the occurrence of Oribatidae and Diptera occurred between the ViSCA sites and the rainforestation farm in Punta, because of different soil moisture regime. Corresponding to the diverse habitat structure of the secondary forest ants appear in higher numbers. Generally, the structures of the humus profile at the secondary forest show an influence on an even distribution of the arthropod community. Similarly, the structure and probably the microclimate control the dominant occurrence of smaller oribatid mites at the rainforestation farm in Punta. Spiders and ants represent dominant larger arthropods in the litter layer. They probably play an important role in regulating the detritivore-microbivore groups at all sites.

The faunal effect on decomposition was measured by a modified litterbag method. Natural litter material was collected at each site and exposed for a period of 134 days in two different types of litterbags. Bags with a 10 mm mesh-width allowed access to the entire assemblage of decomposer biota including arthropods and microorganisms (MO). Litterbags with a fine mesh of 250 µm excluded the majority of arthropods from litter inside the bags. The difference between the percentage of decomposition achieved in 10 mm litterbags and 250 µm litterbags was defined as *faunal effect.*

[26] Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Germany
[27] Department of Environment and Natural Resources, Tacloban, Philippines

The percentage of decomposition achieved in the secondary forest was higher than in both rainforestation systems, which supports the suggestion that decomposition in former degenerated areas are lower than in regenerated areas. Decomposition obtained by excluding the majority of fauna was much lower throughout all sites, which supports the role of arthropods as important vectors of decomposition measured under field conditions.
Direct impact of fauna on decomposition was detected by baited lamina tests, which were used to assess the faunal feeding activity. Plastic stripes served as carrier for baits. These stripes were inserted into the soil and exposed for 11 to 13 days. The feeding activity at the rainforestation sites was distinctively higher than at the secondary forest. Feeding activity measured at the investigated sites implies that direct impact of arthropods on decomposition in rainforestation systems is higher than in the secondary forest.
Analysis of organic nutrient compounds of litter material (before and after exposition inside litterbags) collected at the investigated sites supported an interpretation of the exertion of *indirect influence* on decomposition carried by arthropods. The C/N ratio of litter material between 250 µm and 10 mm litterbags at the secondary forest decreased in the wide mesh-bags. This fact indicates a stimulatory effect of the fauna, which probably graze on microbial tissues in the secondary forest. A similar result could be achieved at the rainforestation farm in Punta.
Although diplopods (giant millipede and giant pill millipede) were recorded in negligible numbers, faecal pellets of these animals clearly covered huge areas of the forest floor at both of the rainforestation sites. This fact led to the suggestion that this group is more important than number of caught individuals would predict. As a consequence ecological functions like primary decomposition and humification were demonstrated on the basis of a morphological examination and chemical analysis of diplopod faecal pellets, which were collected at each site. The results confirmed the importance of diplopods for primary decomposition and humification for all investigated sites.
To explain decomposition as a matter of an ecological process, site-specific composition and structure of vegetation were recorded and humus profiles were classified for the investigated sites. Although humus profile and vegetation structure turned up to be site-specific rainforestation systems generally show a sparser leaf canopy and a less developed humus profile than the secondary forest. Therefore, the latter is accompanied by a diverse heterogeneous structure of microhabitats, which indicates a long time of regeneration.

As a consequence, the study indicates that a range of mainly indirect influences of arthropods on decomposition in the secondary forest result in more enhanced decomposition, than found in the rainforestation systems. These indirect influences are mainly an assemblage of interrelations between arthropods and MO. Rainforestation systems appear to show a site-specific, but different situation in this context for the direct impact of arthropods in this systems were assessed to be higher than in the secondary

forest. Assumable millipedes and giant pill millipedes play a decisive role for primary decomposition throughout all examined forest ecosystems, whereas, small oribatide mites probably take on a regulatory function of decomposer fungi at the rainforestation farm in Punta.

The development of sustainable forest farm systems depends on basic knowledge about tropical forest ecology and specifically the contribution of arthropods to the process of decomposition, which still is at a poor level of definition. This study provides a further step in the approach to gather more information about restoration biodiversity and its role for the development of soil fertility in rainforestation systems. The restoration of soil fertility is an important basis for a sustainable food security. Improvements of rainforestation systems require detailed information about ecological services of litter arthropods like decomposition (and soil fertility) upon which agricultural methods are modified as close as possible to the natural situation. This is of crucial importance for the restoration of degraded areas by rainforestation systems that build a buffer zone around the primary forest, protect the biodiversity, maintain the water cycle and stabilise small farmers income (Margraf & Milan, 1998). As a consequence, understanding of restoration biodiversity and the process of decomposition contributes to the restoration of food security and therefore an appreciation of degraded areas by rainforestation systems. Until this study, arthropods in the leaf litter of rainforestation farms have not been grouped according to ecological functions, nor have been related to the process of decomposition or the structural diversity of the habitat. With this mind this study provided a further step to additional studies on this subject and a case for long-term investigation for the improvement of rainforestation farming systems. Further studies in rainforestation systems are required to establish the relevance of associations between arthropods and MO for the decomposition of litter as well as the identification and examination of keystone species.