The diversity and number of soil animals determine leaf decomposition in the forest

June 6 2016

One oft the research areas: Beech forest in the National park Hainich-Dün, Germany. Credit: Dr. Anett Richter, UFZ/iDiv

Small animals that decompose fallen leaves in the forest form complex food webs and are essential to a functioning ecosystem. A study comprising over 80 forests in Germany and on Sumatra (Indonesia) has now shown that two factors particularly influence this function when examined over larger landscapes: the number of animals and their species diversity. In previous studies, the connection between biodiversity and ecosystem functioning had been investigated mostly in small test areas.

In these small areas, the number of species can be accurately controlled; however species numbers tend to be relatively low and the food webs therefore not very complex. In a new study, researchers have now investigated to which extent the results from such experiments translate to real landscapes. To this end, they collected all of the leaves from an area of ground measuring one square metre in 80 forests in Germany and on Sumatra (Indonesia) in order to examine the animals living there: primarily insects, spiders and snails; a total of over 12,000 individuals from almost 1,200 species. Using this data, they calculated the energy that flows through the food web in the leaf litter. This, in turn, served to gauge the decomposition of the leaves on the forest floor.

The food webs in which the energy stored in the leaves is transformed are highly complex. For example, springtails eat the fallen leaves; they are then eaten by mites, which in turn are hunted by predators such as spiders. By decomposing the fallen leaves in this way, the soil animals (together with fungi and bacteria) play an important role in the forest ecosystem. Without them, the leaves would pile up metres high over just a few years. "The decomposers have the same function in the forest as the waste collection service in our cities," explains study director Ulrich Brose, head of the research group Theory in Biodiversity Science at the German Centre for Integrative Biodiversity Research (iDiv) and Professor at Friedrich Schiller University Jena (Germany).

More is better: a rule for forests in Germany and Indonesia

The study found that the flow of food energy through the leaf litter is especially high if the decomposer community in question is rich in species and individuals. The researchers mainly found these types of communities in near-natural forests with a low degree of management – both in Germany and on Sumatra. "Our findings show that the functioning of natural and complex ecosystems is ultimately determined by simple relationships: the higher the number of individual animals and the higher the species richness, the better the system functions." By contrast, the composition of the animal community and the characteristics of individual species played a subordinate role in the study. These factors had often demonstrated a strong impact on ecosystem functioning in previous experiments. "If fewer species are present on the whole, as tends to be the case in controlled test areas, the impact of individual species is high. In large species communities, however, individual species appear to carry less weight and the simple rule 'more is better' holds true," says Brose. "It was certainly surprising to see that this appears to apply both to forests in Germany and Indonesia," adds the lead author of the study, Andrew Barnes. This, says Barnes, was unexpected as not only the forests themselves but also the management methods in the two regions are very different. Barnes conducted the study at the University of Goettingen, however he has since also moved to the German Centre for Integrative Biodiversity Research (iDiv). The researchers have published their findings in a special issue of the renowned journal *Philosophical Transactions of the Royal Society B*, which is dedicated to biodiversity and ecosystem functioning in dynamic landscapes.

The forest areas where researchers collected samples lay up to 90 kilometres apart on Sumatra and up to 630 kilometres apart in Germany.

They differed further in the degree to which they were used and influenced by humans. The areas investigated on Sumatra ranged from pristine forest regions through to oil-palm monocultures, and in Germany from unmanaged beech forests to heavily exploited conifer forests. The German areas were located in the biosphere reserve Schorfheide-Chorin (Brandenburg), the Swabian Alb Biosphere Reserve (Baden-Wuerttemberg) and the Hainich-Dün region (Thuringia), part of which is a national park. They all form part of the "Biodiversity Exploratories" research platform. The samples from Indonesia were taken within the framework of the Collaborative Research Centre "Ecological and Socio-economic Functions of Tropical Lowland Rainforest Transformation Systems" (University of Göttingen).

More information: Andrew D. Barnes et al. Species richness and biomass explain spatial turnover in ecosystem functioning across tropical and temperate ecosystems, *Philosophical Transactions of the Royal Society B: Biological Sciences* (2016). DOI: 10.1098/rstb.2015.0279

Provided by Friedrich Schiller University of Jena