SOIL ZOOLOGY

Mini project

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Content

Introduction

The soil is alive. The structure of the soil changes during the time and also in short distances.
There are a lot of different species living in this special habitat. Soil fauna are the animals which live in the soil or on the ground. Every taxon has an important function for the soil structure.
There are two different ways to separate the soil fauna. The first one is based on the habitat. Earthworms are anecic animals; they live in and on the soil surface. Epigeic animals are usually found on the soil surface or the litter, for example Coleoptera. Animals, which live only in the soil, are called endogeic, for example Nematodes.
The other way to separate the soil fauna is based on the size of the organisms. The microfauna includes organisms, which are smaller than 0.02 mm, for example Nematodes. They are important for the soil mineralization.
The organisms of the mesofauna are smaller than 2 mm but bigger than an usual organism of the micro fauna, like Collembolan and Acarida. Their main function is the litter decomposition.
The last group is the macrofauna with organisms with the size from 2 mm to 20 mm, for example Arachnids and Coleoptera, which are important for the bioturbation.
The function of the soil fauna is the distribution of organic matter, nutrient cycling, soil formation and many other processes which have a big influence in soil restoration.
In a European forest, you can find between 50.000 and 300.000 organisms in one square meter.
But the number of the soil animals and microorganisms depends on several environmental influences, which impact the soil fauna. The soil fauna is influenced by vegetation, soil type and of cause by the anthropogenic use.

Materials and methods

1. Sampling method

In order to study organisms of the soil meso- and macrofauna two different sampling methods were used. The first method was implemented by pitfall traps.
This kind of trap is a plastic cup buried underground on the top at the soil level. The aim is to collect the soil organisms that fall into the solution. The solution contains water and an additional detergent (soap) for reducing the water surface tension to prevent escaping chances for the animals.

The second method is Tullgren method. Executing this method, the same amount of soil was collected from several plots. To be sure that the amount of soil of every plot is the same a sampling metal ring with a defined volume was used. Afterwards the collected samples dried in

a funnel by light for 48 hours (Figure 1). The purpose is to force the fauna to escape the dryness and to fall into the solution (water with soap) through the grid (2 mm tight).

Figure 1: Right corner: Collecting of soil sample by a sampling ring and setting of pitfall traps.

Left corner: Tulgrenn method, illuminating the soil sample

2. Sampling plots

One of the main aims of the study is to show the differences of the soil fauna between the recently cut meadow and the forest indicating by the richness and the composition of soil communities. Two samples of the meadow soil and 3 samples of the forest soil (lime, spruce and birch forest) were collected around the University of the Life Sciences in Tartu. The figure 2 shows the map with marked collecting spots. Only one exemplar of each spot was investigated because of the limited time of the mini project.

Figure 2: Localization of the sampling plots, A and B: cut meadow, C, D; E: forest, Source Google Maps 201

3. Sorting and identification

For the identification of the animals following equipment was used: microscope, identification kit including several instruments and the identification key. The taxa were determined to the order level. The abundance and the richness are noticed.

4. Data analysis

The different communities are compared by the dissimilarity index of Bray Curtis. As defined by Bray and Curtis, the index of dissimilarity is:

$$BC_{ij} = 1 - \frac{2C_{ij}}{S_i + S_j}$$

Where **Cij** is the sum of the less values for only those species in common between both sites. **Si** is the total number of specimens counted at both sites. The index reduces to 1-2C/2 = 1-C, where the abundances at each site are expressed as a percentage. All the data is analyzed with the software Past.

Results

For each sample, not more than 15 individuals per traps and soil sample were found. As the following graphs show, the meadow has a poor diversity of taxa with a huge proportion of Collembola (more than 70% of total abundance). The percentage left is shared by beetles, spiders, ants and larvae. The Tullgren method demonstrates more diversity.

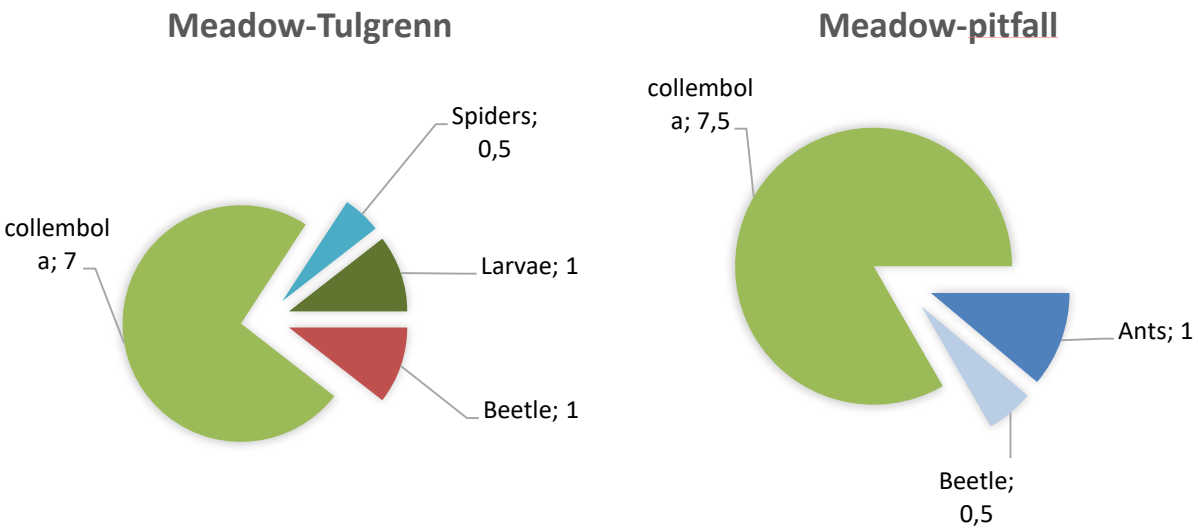
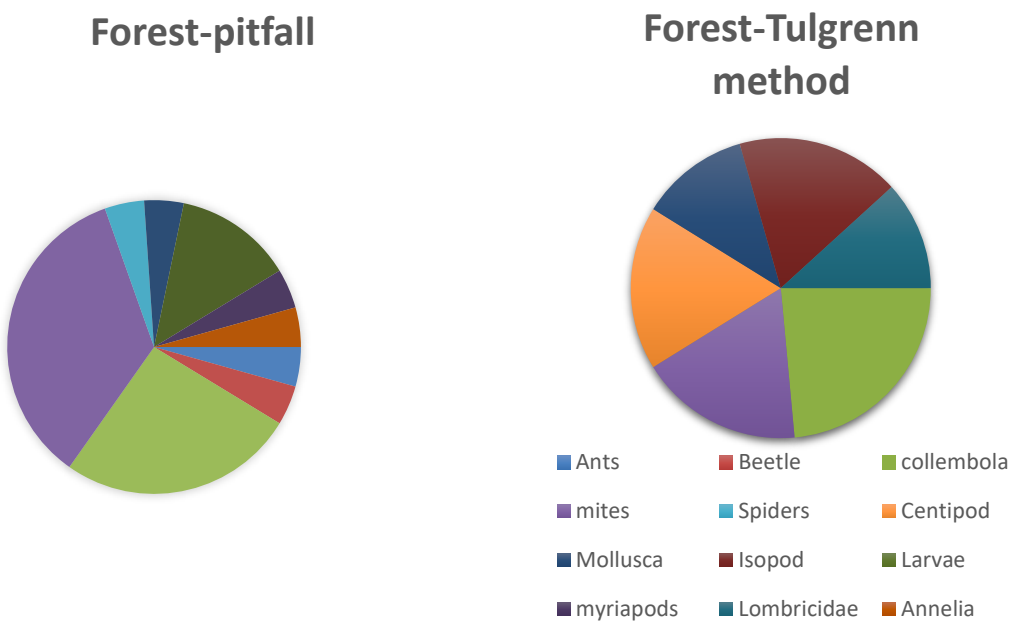


Figure 2: Abundance relation in taxa collected in the cut meadow: on the right by pitfall trap and on the left by the Tullgren's method

Otherwise, for the forest a relative big diversity of taxa (9 and 6) is observed in contrast of the meadow sample. A significant proportion of mites and collembola were found in the pitfall traps followed by spiders, larvae, myriapods, annelids, mollusca. Such results are observed for the other with myriapods, beetles and spiders who are missing.

In the following graphs, no difference can be noticed between the two methods, in deed less taxon was found with the Tulgrenn method. Also, a better equitability of kind of organisms is highlighted for the second method.



According to the figure created by the software a significant dissimilarity between the communities of the cut meadow and the forest soil can be clearly seen. Also, the heterogeneity of the communities can be evaluated.

Discussion

Initially, it was expected to find differences in both environments; cut meadow and forest, based on previous reports (Decaens, 2010) and on the observations made during sampling. The most obvious difference between the meadow and forest places, in this case, was the high disturbance of the meadow surface environment caused by the constant and recent transit of the mower, possibly being the main reason for the low diversity in the cut meadow, especially in the surface (pitfall trap).
However, additional factors could have influenced these results. The sampling points in the forest did

Figure 5: Dissimilarity between the forest community and the meadow community (Software Past), NMDS (Non-metric multidimensional scale)

present different plant species, while the meadow was mainly populated by only one grass specie. The diversity of plants affects the diversity of fauna in a direct and indirect way. Depending on the quality of the litter, soils tend to be more diverse in areas with a better litter quality (easy degradation) (Sauvadet *et al*., 2017). Additionally, different plant sizes mean more strata and so: more diversity. Plants tend to have specific communication (secondary metabolites): repelling or attracting animals, therefore, a higher diversity of plant species consequently leads to an increasing possibility of ecological interactions. It is well known that plants drive the diversity of microbes in the soil, in this sense; plants do regulate all the trophic nets based on microbes (Decaens, 2010).
The soil resources (organic and mineral nutrients, water, etc.) are expected to be higher in the soil of the forest, and if so, it could be associated with a higher biodiversity. However, in our case, no soil parameters were measured and that is why there is not much to analyze.
The sampling method will always influence the results of the fauna diversity (Tuf, 2015). In our case, the pitfall traps were more diverse than the direct soil sampling in the forest, but not in the meadow, showing the capability of this sampling method to show strong disturbances; in this case the mower.

Collembola was the most common group among the sites and sampling methods. This group is widely distributed in the soils of the whole planet and in our case it shows that as group, its presence is not

affected by disturbances, plant species or possible sources differences. However, inside the group the diversity is high and there are many collembolan species with diverse functions and interactions, which are very useful as bio indicators (Rusek, 1998); suggesting a more specific identification for future experiments in order to get more information of the different environments.

Mites were found only in the forest; which was possible because of the high sensitivity of these animals to human disturbances as agricultural practices or contamination with no recover capacity of the communities; even after recovery efforts. However, this group of insects are very resilient to natural changes of the ecosystems; being one of the first active species after ice melting at the end of the winter (Gan, 2013). Even though the identification in this experiment was very general, mite group was associated to the less distributed places, showing a high potential as a general bio indicator, even at group level.

Conclusion

First of all, the experiment was very efficient. It shows a general overview of the soil fauna using simple and cheap methods. But there are some improvements that could make the methods more precise.

To avoid the over flooding by rain it is important to build a roof over the pitfall traps. Enlarging the trapping period from 18 h to 72 h as well as the illuminating period up to 48h could possibly raise the number of caught animals, which can impact the results. To be more random it is highly recommended to set up more pitfall traps in the several spots. In the described experiment, the identification was only occurred to the high taxa and focused on the meso- and macro fauna, but to specify the results it would be interesting to analyze the animals on the species level and to characterize the micro fauna.

References

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