Daily report: Saturday, September 22th 2012

8:30 am – 9:40 am: Lecture to “Litter decomposition” by Dr. Virginie Baldy

This was the second part of her lecture to “Soils under drought” on Friday, September 21th.

In the French Mediterranean region you can see a land use change after an abandonment of agriculture. This abandoned land is colonized by Aleppo pine (*Pinus halepensis Mill*.) which is an expansionist species. In 1980, 180 000 ha were colonized by this species, compared to 36000 ha at the end of the XIXth century.

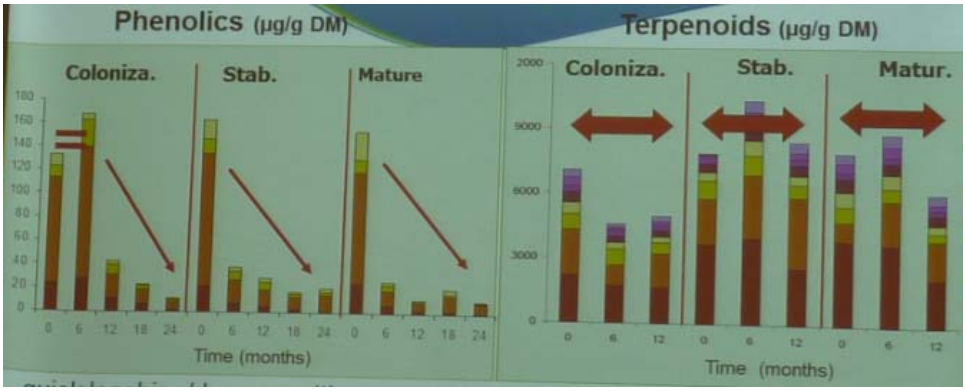
Pinus halepensis is a plant species which produces a high amount of Plant Secondary Metabolites (PSM). There are three ways of release of PSMs: i) volatilization and this way of release is involved in biosphere-atmosphere relationship; ii) leachates and roots exudates and then participate to biotic interactions; iii) leaf litter decomposition and then participate to biogeochemical cycles.

We compared the dynamics of PSM amount and diversity during needle decomposition in three successional stages of *P. halepensis*: colonization stage (~10 years old), stabilization stage (~30 years old) and mature stage (>60 years old, mixed forest).

The chemical diversity of *P. halepensis* varied according to organs like roots or needles and successional stage, especially between colonization and mature stages.

We performed a leaf litter decomposition experiment during 30 months in the three pine forests, and we determined leaf litter mass loss, phenolics and terpenoids litter contents, microbial and micrarthropods dynamics. We sampled litter bags every 6 months after rain.

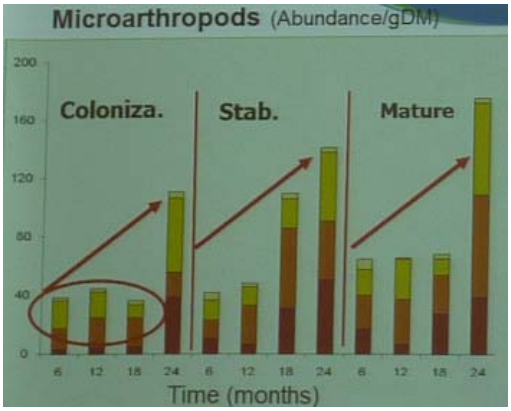
Results of the experiment:



We observed a quick leaching or/and decomposition of phenolics during decomposition but for the colonization stage phenolics remained stable longer compared to stabilization and mature stages.

We observed a slower decomposition of litter terpenoids compared to the phenolics, and a lower amount of terpenoids in litter from colonization stage forest compared to the two others stages.

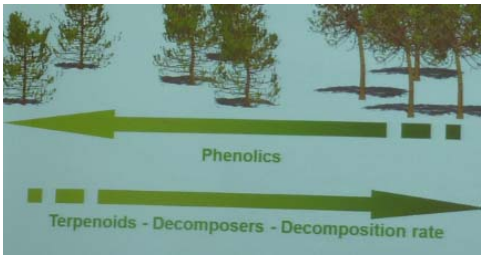
So we can see that the colonization stage is different to the others, may be terpenoids can be toxic for microorganisms.



Dynamics of decomposers: We observed an increase of abundance of microarthropods during the process whatever the stage, and less organisms associated to decomposed leaves for colonization stage.

We observed a negative correlation between fungal biomass and phenolic index during decomposition. The more phenols, the fewer fungi associated to leaves.

Leaf mass loss was less important for colonization stage.



In conclusion we observed more phenolics, less terpenoids, less decomposers and a lower decomposition rate for the colonization stage Dr. Baldy also mentioned that terpenoids can be an important carbon source for decomposers.

On the second half of the lecture Dr. Baldy illustrated a long-term experiment which is made in South France near Marseille. It is called Oak Observatory at OHP and examines dynamics, functioning and biodiversity of Mediterranean submitted to climate change. Its aim is to manipulate ecosystems to understand its functioning. This a multidisciplinary observatory site where astronomy, physics and environment

come together. The Dr. Baldy's team studies the impact of plant communities change on leaf litter decomposition in Mediterranean area. Preliminary experiments are conducted in the OHP concerning plant communities' change in anticipation of climate change. In context of climate change they study experimentally the effect of rainfall decrease on *Quercus pubescens* forest diversity and functioning, using a rain exclusion device. They study in 95 ha of forest which is not used for 70 years. *Quercus pubescens* is a dominant tree species in France, not only under Mediterranean climate. Two crossed gateways of 40 m long are the installation of the experiment. There are two levels of gateways: one in 3.50 m and one in 0.8 m for studying forest from the soil to the canopy without disturbing the ecosystem.

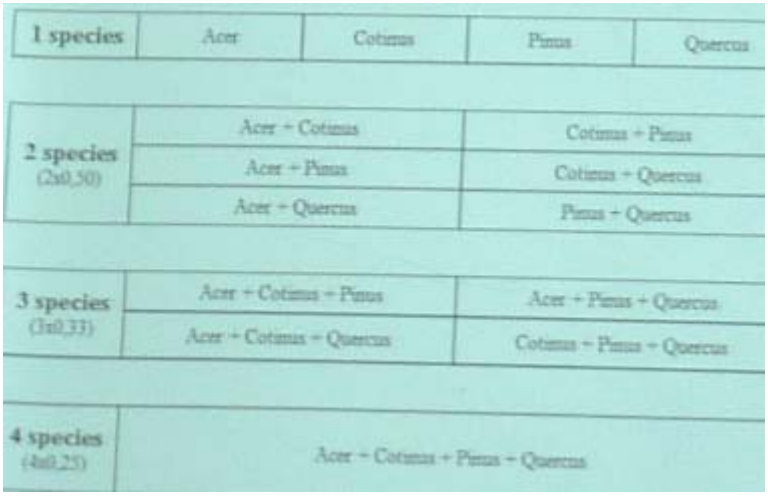
In context to climate change France expect a decrease of 30 % of rainfall, an increase in temperature by + 2.5°C and also intensification of the summer drought till 2100. If 30% less rainfalls summer dry periods will be two months instead of one month, and this will increase the water stress to animals, plants and soil.

Researchers of the observatory developed a dynamic rain exclusion device to cover a part of the experimental site when it's raining.

Researchers hypothesize that litter-mixing have positive effects on decomposition. If plant species number and chemical diversity increase, also resources diversity increases and this leads to an increase of soil biodiversity, taxonomic and functional diversity. These increases lead to more efficient decomposition process. So you can say in a conclusion: more the number of species chemically diverse are present in the mixture more the decomposition is efficient.

To confirm or invalidate these hypotheses, an experiment bases on one- year decomposition with mono-, bi-, tri- and tetra specific mixtures was performed. Three species are found naturally in the oak forest: *Acer monspessulanum, Quercus pubescens* and *Cotinus coggygria*. One species is added in anticipation of a possible rise in latitude with global change: *Pinus halepensis*.

They are 15 modalities of litter mixing which you can see in the following table:



Results showed that leaf litter decomposition varied according to species: from 26% for *Quercus* to 60% for *Cotinus* of leaf mass remaining after 10 months of decomposition. Moreover, leaf litter mixing affected the breakdown efficiency. *Acer* had a positive effect on decomposition of all other species in two species mixture. *P. halepensis* decomposition rate was always higher in mixture with all other species compared to monospecific mixture and this rate increased with the species number in mixture. *Q. pubescens* and *P. halepensis* showed opposite effects, as *Q. pubescens* favoured *P. halepensis* decomposition whereas *P. halepensis* slowed down *Q. pubescens* decomposition.

10.00 am Lecture to “soil organisms” by Dr. Manfred Wanner

Dr. Manfred Wanner started with the problems of studying soil organisms. He mentioned that soil is a mixture of solid, liquid and gaseous environments and therefore it is not that easy as to study organisms in an homogenous environment. Furthermore the population densities of soil organisms can be extremely high, disperse and variable. Because of all those problems we need many different methods to study soil organisms and to get information about the living in the soil.

There are different types of soil organisms, one group are the endogenic and the other are the epigeic organisms, this terms explain if the soil organisms live deep in the soil or in one of the top layers.

Now Dr. Wanner introduced different methods to study soil organisms.

1. Litterbags

Litterbags are used for decomposition studies. Litterbags can vary in their mesh size so you can exclude organisms of different sizes and see what effect they have for the decomposition. The weight loss shows how big the influence of each species is.

2. Pitfall traps

Pitfall traps are often just simple yoghurt pots which are put into the soil filled with water and alcohol. The soil organisms fall into the pot and are caught. This method shows only the activity density and not the population density.

3. Eclector traps

The eclector trap looks like a tent. It bases on the phototrophic reaction of diptera. They fly into the trap and the larvae can be indirectly counted.

4. Exhaustors

The exhaustor is used with the mouth to catch arthropods which are mobile. The method is based on the creation of a vacuum.

5. Formalin/ Mustard

This is a method that is used to collect earthworms. A water suspension of e.g., mustard powder is put several times on the same defined area which is chosen before. Trying to escape the repellent the earthworms come to the soil surface and can be caught.

6. Octet Method

This method follows the same idea as the Formalin. Instead of a water suspension, electricity is used in a defined area. The earthworms try to escape the electricity and come to the soil surface.

7. Coring method

The animals in a defined soil core (sampled by means of a soil corer) can be counted to estimate the population density.

8. Berlese-Tullgren extraction

A funnel is provided with soil (e.g., the above mentioned soil core with a defined volume and area) and the soil organisms which are in it. Then the soil is carefully heated /illuminated from above and the soil organisms try to escape the heat/light and follow a gradient of temperature and moisture, falling eventually in a vessel filled with a fixative, e.g., alcohol (however, often a mixture of different chemicals is used as preservative). This method is used mainly for soil micro-arthropods (e.g., springtails, mites).

9. MacFadyen extraction and Kempson extraction

These two methods are, in principle, comparable to the Berlese-Tullgren extraction. There is a gradient in heat and moisture. However, the MacFayden method is used for medium sized arthropods and the Kempson extraction for larger soil animals.

11. Baermann funnel

The Baermann funnel is very similar to the Berlese method but designed for small organisms living in an aqueous environment (e.g., nematodes, enchytraeids, tardigrades). A funnel is filled with water and the soil is placed above it. Then the soil gets carefully heated up and the animals follow the gradient, accumulating at the bottom/the (water-filled) end of the funnel (provided with a clamped flexible tube).

Dr. Wanner told us at last the (time-consuming) hand sorting is still the best method but you need experts for soil organisms to get good results.

<u>10.45 am: start of the practical work</u>

We examined soil organisms in the laboratory using dissecting microscopes. We counted the individuals of each species and wrote it into a chart. For the

determination of the species we got special keys for springtails, arthropods and spiders.

Fig. 1: Spider under a dissecting microscope

11.45 am: collecting the results

We collected the results of each group at the blackboard and added them. The results were partial not as we expected that is because we counted all in all not enough individuals. We had not enough time to discuss the results in detail, because of the excursion to the castle in the afternoon. However, these practical exercises were quite helpful for a better understanding of the previously discussed methods to study soil organisms.

2.00 -5.00 pm: Visit of the Hluboká Castle (Hluboká nad Vltavou, South Bohemia).

The Hluboká Castle is a beautiful neo-gothic palace, redesigned in the XIX century in the Tudor style, inspired by the Windsor Castle, as his English garden. It has been built on a promontory above the Vltava River, in the region of Ceske Budjovice. Its appearance has been marked by four reconstructions over the last centuries, and the last rebuilding has been performed by the Schwarzenberg family.

This castle was originally founded as a guarding castle by the Czech King Premysl Otakar II of Bohemia, in the mid XIII century. After being “royal property, this castle has been owned by several aristocratic families. In the XVII century, the Protestant family Malovec of Malovice lost the property, and the Emperor Ferdinand II of Habsburg gave it as a war compensation to a Spanish general. Later, in 1661, Jan Adolf I of Schwarzenberg bought Hluboká Castle, which stayed the property of this family until 1947, where it was nationalised by a special law : *lex Schwarzenberg*.

During the XVIII century, Jan Adolf II of Schwarzenberg and his spouse Princess Eleonore, rebuilt the castle and its contryside, and the interiors were lavishly designed. The Hluboká Castle contained 140 rooms and eleven towels, which the main one is 60 m tall. The facade of the main entrance is dominated by the Schwarzenberg family motto “NIL NISI RECTUM” (Nothing but the right).