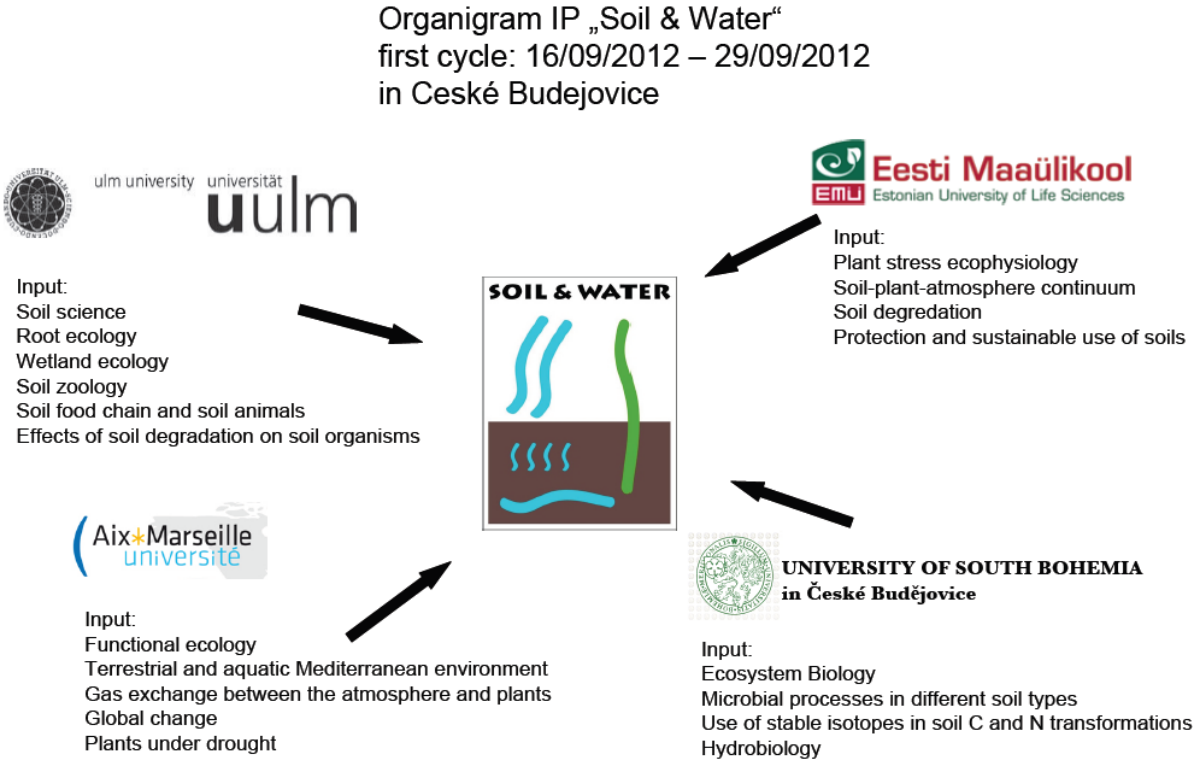
Erasmus Intensive Programme
Soil & Water



Ceske Budejovice (Budweis), Czech Republic

Summer school - September 16th - 29th 2012

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Inhaltsverzeichnis

Summary

Objectives

This Erasmus IP (Intensive Programme) "Soil & Water" consists of an interdisciplinary international teaching course for students from four EU countries. Thematically it unifies the expertise from the following fields: soil science and ecology, plant sciences and zoology. The activity will foster student's knowledge and competence regarding interactions between soils, plants and soil organisms with special emphasis on soil processes and effects of drought and flooding on plants and soil organisms. It will also define major risks of soil degradation. The structure of the IP will be able to establish a link between soil functions and societal needs and expectations.

Target groups

Target groups of this IP are students from advanced undergraduate and graduate levels having teaching curricula focussed on biology and environmental sciences. The IP "Soil & Water" was set up by the Ulm University, which is also the coordinating institution. Besides students from Germany, also participants from the Czech Republic, Estonia and France will be involved.

Main activities

There are several teaching instruments applied in this programme. Teaching courses will be provided by experts from partner universities, who will cover specific fields (i.e. soil development and degradation, soil microbiology, plant-soil interactions, etc.). Field trips and on-site teaching will demonstrate key system elements and main processes related to soil environment and its effects on plants and soil organisms. Seminars elaborated and presented by students will prepare the participants for these subjects and reflect the knowledge gained.

Learning outcome

Students will gain an interdisciplinary insight in different areas of soil science and plant ecology. Participants will obtain 9 ECTS after finishing this course.

Expected outputs

Teaching material created during the IP will be provided via internet and will be available also for succeeding courses. Various dissemination activities are planned and will cover a central web page, an e-learning platform with teaching materials and a discussion forum, a field site guide an a final student report.

Description

Main objectives of the Erasmus sub-programme

This Erasmus IP was designed as an interdisciplinary international teaching course for students. Through its 30 student participants from four EU countries it will substantially increase the volume of student mobility compared to individual exchange. In the perspective of this IP for a total of three years it will significantly contribute to the student mobility in the involved universities from Germany, Czech Republic, Estonia and France. Such enhanced international mobility of bachelor and master students of participating universities will also enhance interests for international exchange grants given by national funding agencies.

The topic of the IP combining soil science, plant sciences, zoology and ecology assures an interdisciplinary character of this activity. Moreover, the applied aspects taught cover also effects of drought and flooding on plants and soil organisms as well as soil degradation. The field trips and involvement of local experts bring about a link to socio-cultural aspects such as human impact and current development under different land use.

The target groups are students from undergraduate and graduate levels. All partner universities have study curricula which are prerequisite for understanding of the study material and lecture content. Mostly, students from biology and environmental sciences will participate in this IP “Soil & water” and contribute from their specific background. Academic personnel involved in the teaching and developing the curricula for this IP established an interdisciplinary network which can sustain beyond this educational cooperation. This activity brings together broad academic competences and will have substantial value for subsequent teaching activities on all sides. Follow-up research activities will also profit from formal and informal contacts between students and academic personnel, as well as from the interdisciplinary level of this IP.

The lectures by participating scientists (see the preliminary programme) will provide an outstanding interdisciplinary overview and process-based knowledge related to soil processes combining soils, plants and soil organisms in relation to environmental problems. The multidisciplinary approach on these subjects including various climatic zones and human effects on an European level is the innovative aspect of this Erasmus Intensive Programme.

Project objectives

Soils provide the basis for plant production and provide numerous ecosystem services ranging from water storage and purification to carbon sequestration. There are continuous interactions between soils and the soil-related biota such as plants, microorganisms and soil fauna. Plant roots fulfil major exchange functions with the biotic and abiotic soil environment. Root systems are designed to secure plant anchoring in the soil and exposed to competitive interactions.

Anthropogenic activities are affecting the below-ground conditions producing several constraints for plant growth. Especially soil compaction increases the soil bulk density and alters soil physical properties such as water permeability and gas exchange. Humans provoke fire hazards, and manipulation of the water table results in changes in soil salinity. In the view of environmental change, extreme weather events, such as drought and flooding are expected to increase in frequency and intensity on the global scale (IPCC 2007); the functioning of soil-related process are bound to be impaired more regularly and severly, therefore impacting on plant productivity.

On this background, the Erasmus Intensive Programme “Soil & Water” aims to provide an interdisciplinary international course for students from four countries to bring together expertise from different geographical and climatic locations in Europe together with different land-use and land-history patterns. The activity has the following objectives in order to foster student's knowledge specifically to a wide range of European environments, and to transmit the state-of-the-art competences in general terms and particular ‘hot’ topics:

- to highlight the interactions between soils, plants and soil organisms
- to provide interdisciplinary insights into soil processes
- to increase the knowledge in relation to plant, with emphasis on elucidating effects of drought and flooding on plants and soil organisms
- to outline major (anthropogenic and natural) threats for soil degradation and its mitigation
- to establish a link between soil functions and societal needs and expectations

In order to fulfil these aims, our Erasmus Intensive Programme will be held in locations of contrasting climatic conditions across Europe. The IP “Soil & Water” will start in Ceske Budejovice, Czech Republic, an appropriate location to demonstrate various sites, ecosystems and interactions in Central Europe. For 2013, this IP is scheduled to take place in Estonia, a country with wet and cold climate on the north-eastern margin of the EU. Finally in 2014, France will host this activity and provide insight on soil topics in relation to the seasonally hot and dry Mediterranean climate.

The establishment of such broad international cooperation will promote general academic competences and has substantial value for subsequent teaching activities on all sides. Academic personnel will get insight into teaching structure and contents at the hosting university. The lectures provided will go beyond the usual range and content of courses in the participating institutions. The lectures can be linked to existing study programmes in biology, environmental sciences and in other curricula at the participating universities.

Research activities will profit from formal and informal contacts between students and academic personnel. The IP has a strong potential to foster co-operation of biological sciences in relation to landscape management, agriculture and forestry, and to transmit this spirit to a generation of young upcoming scientists. Students will gain insight in the relevant curricula and open the opportunity to participate in already existing Erasmus exchange programmes. The IP contributes to the international mobility of bachelor and master students of participating universities and therefore provides them a better international visibility of open positions. Further, exchange experience enhances the chance to qualify for international exchange grants given by national funding bodies such as DAAD.

The proposed lectures by participating scientists will introduce specific topics and provide an outstanding interdisciplinary overview of the process-based knowledge. The programme is unique in the sense of relating soils, plants and soil organisms across a wide range of climate zones and of environmental problems essential to Europe. This is the innovative and multidisciplinary approach of this Erasmus Intensive Programme application.

Introduction in the topic of the IP „Soil & Water“

(Santruckova)

Soil-Water-Interactions

water retention capacity of soil: water doesn't evaporate in the hemisphere or flows back to the groundwater, it is available for plants and organisms

water availability and saturation:

- water is unavailable for plants: wilting .
- -water availability over field capacity: plants suffer of oxygen absence
- -optimum: between wilting point and field capacity

pores within and between aggregates: living space for soil organisms:

- texture of the soil is important
- bacteria need much less space (pores) than plants

soil and aluminium:

- acid rain dissolves Al^{3+} away of stones -> more Al^{3+} content in soil

- fast formation of $Al(OH)_3$ ->. irreversible

- $Al(OH)_3$is toxic for organisms -> inactivation of PO_{4-}, no more available for organisms

- soil is a natural $Al(OH)_3$ source for lake sediment

Basic introductions to Soil-Water-Relations

(Kazda)

Soil-Water-Relations, Nitrogen cycle

soil contains:

- particles of different shape and size

gravel: >2 mm; sand: 2 - 0,063 mm; silt: 0,063 – 0,002 mm; clay: <0,002 mm

- minerals in solution, air in gas shape, water in liquid shape
- solved nutrients (nitrate, NO^{3-}, Ca, K, Mg)

soil has negative charge, and thus binds nutrients: NO^{3-}, Ca^{2+}, $K+$, Mg^{2+}

making nitrogen available for soil, 2 possibilities:

1) through high temperature combustion: NOx -->NO^{3-}. going into the soil

2) NH_3 -> NH_4^+ ->going into the soil -> through nitrification: NO_3^- and release of $2H^+$

NO_3^- goes to groundwater, denitrification follows: N_2O and N_2 are established through NO_3

N_2O is bad for climate, N_2 goes to the atmosphere and is recycled in the cycles mentioned above

consequences of gaining protons: Al^{3+} is getting released and reaches the groundwater

<u>soil-water status as a function of pressure:</u>

3 different conditions of soil:

- saturation: flooded condition
- field capacity: soil moisture 2-3 days after a rain or irrigation, is the amount of water that can be

held in soil before gravity will begin to drain the soil

wilting point: plant will not recover after dry status, is a condition where the soil moisture is at

low level where a plant can’t uptake any water.

suction pressure head . (cm of water):

- that means, when soil is getting dryer, water remains in small capillary -> potential is getting more negative

Ψ is water potential and a measure of water availability in soil

Ψ (osmoses) : osmotic solutes in plant and in water

Ψ. (matrix): difference of particles

-> Ψ .= Ψ . (matrix) + . (osmoses)

data in soil: Ψ

- saturation: 0
- field capacity: -340
- wilting point: < -15000

soil texture and available water:

- the bigger the particles in soil, the higher is the gap between each particle

- sand has lowest porosity, field capacity and thus low wilting point

-.clay has highest porosity, field capacity and highest wilting point

- available water storage capacity is between field capacity and permanent wilting point

plant under declining water supply:

- texture is very important for the availability of water

- problems for plant to get water: water has to go through cell membrane, water movement trough the texture

- water uptake w; water movement Sr; root surface A

- root water potential has to be lower than water potential of the soil

$w=A*((\Psi soil - \Psi root) / \Sigma r)$

Soil biology – definitions and overview

(Wanner)

importance of soil organisms:

- bio-indicators
- important for soil functioning
- informative for reconstruction of habitats

soil is important…

- habitat and basis for organisms (including man!)
- regulates water and nutrient cycle
- archive for natural and cultural history
- source of raw materials, mineral resources

soil animals: location

- mainly restricted to the upper soil layers containing organic matter
- „edaphon“: all soil inhabiting organisms
- epigeic/ epedaphic: organisms restricted to the soil surface
- anecic/ hemiedaphic: organisms moving between soil and soil surface
- endogeic/ euedaphic: organisms living in the soil

Microfauna: protouoa, nematodes

mesofauna: insects, mites

megafauna: mice, earthworms

soil nematoda: very resistant through their cuticle

earthworms: specialized on buffer/alkali soil on buffered (neutral pH) soil

functions of earthworms: turbation and aeration of soil

potworms: specialized on acid soil

Seminar

„Predominant role of water in regulating soil and microbial respiration and their responses to climate change in a semiarid grassland“

(Kask/Krasnov)

definition: Soil respiration is an ecosystem process that releases carbon dioxide from soil via root

respiration, microbial decomposition of litter and soil organic matter, and fauna respiration.

sources of soil respiration: root respiration, decomposition of litter, microbial respiration in

rhizosphere, oxidation of soil organic matter

importance of soil respiration:

- the second largest C exchange pathway between the atmosphere and terrestrial

ecosystems

- sensitive to alterations of temperature and precipitation/water availability

temperature and precipitation:

- effect direct autotrophic and heterotrophic respiratory

- effect indirect the changing of soil temperature, soil water availability and supply of C substrate

conclusions:

- Increased precipitation stimulated soil respiration, microbial biomass and respiration

- Observations indicate that increased precipitation is relatively a much stronger driving

factor than warming in arid and semiarid regions

- The temperate steppe in the arid and semiarid regions of northern China may act as a net

C source under climate warming

Soils and ecosystem dynamics in south Bohemia

(Picek)

His presentation was about the South Bohemia region. Students got basic information about geology, climate and soil types which in South Bohemia are mainly cambisol, gleysol and podzol. He mentioned the local problem of illegal extraction of Moldavites. Moldavites are olive-green or dull greenish vitreous substance possibly formed by a meteorite impact. They are unique, because they can be found only on few places in South Bohemia and Moravia. Thus they are quite valuable in jewelry. Non-legal extraction is very devastating, because tonnes of soil are digged out and so large areas of forests and fields are damaged. Next slides showed the landuse changes during the last two centuries. While in 1840 50% of the land was used as arable land, in 2000 it was only 36,8%. Large percentage of land is used for other purpuses than agriculture or forestry, like building of supermarkets, industrial zones, parking places etc. Still in 1949 most farms were small (small fields, varied mosaic of different crops), in 1978 intensification of agriculture led to huge fields, that lowered the biodiversity due to the end of traditional management.

Next part of the presentation informed about the threads to the soil in Czech Republic. It showed that the biggest thread here is soil erosion. Picek informed about the drainage in the past and its consequences and he mentioned the problem of the forestry as well. Natural composition of forests in the Czech Republic would be 40% beech, 20% fir and only 11 % spruce. Current composition is moreless a plantation of spruce, because it is 56% abundant. There are only remains of natural forests in Boubín and Žofín reserves and in the upper parts of Šumava Mts. He spoke about the acidification of the soil and water in the past and about the importance of the wetlands. There are three important wetland areas (Ramsar sites) in South Bohemia region: Sumava peatlands, Trebon peatlands and Trebon fishponds. The biggest threads for wetlands are drainage and eutrophication. In conclusion, the main anthropogenic factors affecting ecosystem dynamics in South Bohemia region are: land use, eutrophication, drainage of soils, soil erosion and compaction, acidification (N and S deposition) and use of pesticides. There are also positive changes: restoration of peatlands (previously drained) and river meandrs, management of meadows, change of land use – e.g. arable soil to permanent grasslands or forests. The discussion was about other types of soil erosion (wind) after the discussion there was a coffee break.

Protection and sustainable use of soils.

(Astover)

It was mainly a theoretical presentation with many definitions. He mentioned the term “sustainable development”. One of the definitions is that it is a mix of social acceptance, ecology and economy. He divided decisions on long term and short term. On some cases he showed that arable land per capita is continuously decreasing – 0 4 ha in 1960 -> 0,2 ha in 2000.

Production in Western Europe countries is now even lower than in 1920. This shows the very low efficiency of soil use. Next part of his presentation was about soil quality. There are so many indicators and no universal quality rating system which means problems when comparing different parts of the world. Some properties of soil are static and some dynamic but it always depends on the time scale. No less important is the spatial scale (global, continental,…regional). For some countries (Czech Republic) there are very detailed soil maps (scale 1:5000). Astover spoke about new ways of getting soil data as well.

Roots and the use of soil water

(Kazda)

Roots functions

Water uptake

Nutrient uptake

Plant anchoring in the soil

Interaction with biotic and abiotic soil environment

Rhizosphere

Definition: The rhizosphere is a close vicinity of roots with various biotic and abiotic interactions.

Root distribution soil

Vertical distribution:

In the top soil is the highest root density the deeper the less roots.

The distribution is different between Hydric, Mesic and Xeric plants.

Why are most of the roots in the upper soil?

- Because when it rains the plant need the roots of the upper soil to use the rain water efficiently.

In dry environments are more roots located in the lower soil horizon. The plant redistributes the water with the hydraulic lift to the environment and the soil surrounding. -> ?Why?

- The water is for the microorganisms. When the plant provides the water for the microorganisms it gets the nutrients. Also keeps the plant her upper roots alive to be prepared when it is raining to compete successful against the other plants.

Root architecture

Roots respond to the supply of nutrients.

Root architecture and soil exploitation

You can distinguish between herringbone and dichotomous root architecture.

Herringbone has one main axis and dichotomous is consecutively divided into two different axes.

The Herringbone root is better for the static supply as for the dynamic nutrient supply where the dichotomous root system is better.

The dichtomous system is preferential for exploitation of resources located in specific soil areas (patches). Therefore roots are clustering in the natural soils, as observed in single-species stands.

Root distribution in mixed stands

When growing together, do both species form common clusters or are their clusters separated?

- They build common clusters because both compete on nutrients -> The roots of both species are mixed.

Changes in soil moisture content during and after the irrigation

As roots are clustered, they utilise water as resource unevenly.

When irrigated, in root free zones an increase of water is recorded earlier than in root clusters. Because the roots sucks the water up needs the water more time to rinse down to the sensor.

The soil moisture content changes over a time span of 24 days. The soil moisture declines faster in soil patches with root cluster. The highest soil water extraction occurs during afternoon because the water potential decreases especially in the roots.

Soil moisture decline is delayed in areas of low rooting intensity.

General view on natural distribution of resources. The Distribution of light and CO_2 concentration in the above ground growing space is according to the predictable gradients.

Below ground: Heterogeneously distributed multiple resources water, nutrients, biology associations are of low predictability. The root distribution follows the gradient of the soil properties and resource distribution in patches.

Root architecture

Clusters of available nutrients accompanied by preferential uptake of the seepage water.

Root clustering is a rule in natural soils for optimized exploitation of aggregated resources.

Introduction to excursion topics " Sumava mountains"

(Santruckova and Urbanova)

Dynamic of mountain Norway spruce forests in the Sumava Mountains

Climate: the mean temperature increase and a shift in rainfall distribution over the years brings drought in the spring. The precipitation changed especially in the spring -> lower precipitation.

Atmospheric pollution: In the last century the S. M. were exposed to heavy atmospheric pollution. Between 1950 and 2000 was a change from very high pollution to very low pollution.

The changes in acid deposition caused significant changes in the soil chemistry. -> rapid decline in pH, nutrient availability and an increase of Al in the soil.

Did spruce trees reply to the changes in environmental conditions?

Isotopic and chemical analysis have shown that the spruce trees in the S. M. are negatively affected by the change in environmental conditions. (The increase of the climate temperature is stressful for the spruce.)

Questions to think about during our trip to S.M.

Which consequences of Kyrill Windstorm in 2007 can you see in the S. M.

Did the storm support the bark beetle attack

What management should be used in the bark beetle affected area.

Seminars:

Progress of forest regeneration after a large-scale die off in the Bavarian Forest National Park

(Burkhardt and Luderer)

Problem: 1993: spread of the Norway spruce bark beetle in small areas

1995/96: climax --> 583 ha died off

Meanwhile 2031 ha are affected by the spruce bark beetle

1997 Epidemy fades away

Goal: To monitor the progress of changes in:

- The density of regeneration
- The tree species composition
- The relative heights
- The damages to individual plants

Some other significant disturbances for the development of forest:

Results showed that the Norway spruce is well adapted

Can re-colonise large disturbed areas (airborne seeds)

Is frost resistent, can cope with the climate of open areas, adapted to the soil conditions

the blossom frequency plays a role

Mast-years can occur rarely

good, that the trees blossomed 1995found out: there‘s a correlation between the Norway spruce cone production and the explosive reproduction of the Norway spruce bark beetle appearance

Blossoming is stimulated by high temperatures and sunlight

beetle population also needs dry and warm years

beetles infest only old trees (50-70 years and older)

Trees can produce seeds before the beetles can kill them

Proper zonation – an essential tool for the future conservation of the Šumava National Park

(Strittmatter and Ternus) Since its establishment the zonation of the Šumava NP has undergone significant changes and currently and for many years has been evaluated as unsatisfactory. Several new zoning arrangements have been proposed over the last couple years, all of which indicate that the most valuable parts of the area (i.e. the core zone or Zone I of the Šumava NP) are still in the same locations. Natural conditions, habitat qualities and occurrence of rare species are stable or only changing slightly in time. But the key question is how a new zonation proposal will respect the need to have zones of sufficient size. Whether or not only the sites of great conservation interest are protected (e.g. only the moors without the surrounding waterlogged forests or only fragments of old growth forests without the surrounding close to nature forests) or also the area immediately surrounding and adjoining these sites is important. If not, we are left with a very fragmented zonation, which could be called “pearls archipelago”. The most valuable parts of the area, the so-called pearls, are strongly threatened, especially if intensive or inappropriate management practices are applied in their surroundings (e.g. clear-cutting of spruce stands affected by bark beetle or changes in water regime due to construction of new roads or extensive maintenance of old ones). But there is also another possibility. The natural islands of highest value can be connected to bigger units by bio-corridors or transition zones with natural or close to natural habitats large enough to be effective. The careful evaluation of the quality and overall potential of the area (zone) is essential. If the species compositions of these areas, status of key components of the ecosystem and the protected phenomena occurrence are in natural or a close to natural state, it is desirable to allow spontaneous development and avoid human intervention. We can assume that the quality of the natural conditions and potential for natural development in the Šumava NP are high. There is a unique opportunity to change a currently unsatisfactory zoning and use it as an effective tool for protecting the Šumava NP.

This paper presents mainly biological arguments, but social and political aspects are also very important and need to be addressed during the negotiation process. A consensus of the opinions of the public, politicians, local representatives, protected area managers, biologists and NGO s is necessary for safe guarding the future of the Šumava NP

Excursion to Sumava Montains, Czech republic

At 9.40 am we arrived at Kvilda, Czech republic, a village located close to the border to Germany (and therefore to the Bavarian forest) where we met our guide. She explained some background information about the national park: It is located on 1000 meters above sea level. There are 3 kinds of forests: natural spruce forest, unnatural spruce forest and mountain mixed forest. It contains no water reservoirs and is separated in managed and unmanaged spots.

Here you can see the map of this region and the route we walked on this day.

Picture 1: Map of the Sumava area

On our first stop we saw two different types of bark beetle traps. There are black boxes that collect the beetles (picture 2), which are used for monitoring and killing of beetles. If used as a wall they can even prevent the beetles to invade new territory (or at least lower the amount of migrating individuals).

The others are wooden tripods coated with poison (picture 3). Both trap types use pheromones to attract the beetles. We think its disputable to use the wooden traps because the poison also kills other animals directly or indirectly by feeding on the dead animals. Also it may be washed into the soil.

There were also some mountain ashes surrounded by fences showing the human interaction to restore the forest (picture 4).

Picture 2: bark beetle traps

Picture 3: poison traps

Picture 4: mountain ash surrounded by fences

Our next stop was near a stack of wood (picture 5). On some wood the foresters cut off the bark, because there were beetles in it. On the rest the beetles already left the tree. This is a method used in managed forests to decimate the amount of bark beetles.

Picture 5: stack of wood

We also saw red stripes on the trees (picture 6) marking the border between first and second zone of the forest (first zone is unmanaged, second zone is managed). At Sumava National Park are many small first zones surrounded by large second zones.

Picture 6: red mark on tree

Then we arrived at the ancient army zone border. Due to the iron curtain no civil person was allowed to cross it, leading to a big area of untouched forest.

Later the guide showed us a placed without dead wood near a place with dead wood (picture 7). The dead wood protects the trees of the red deer. The red deer prefers eating bark of the mountain ash, therefore in the spot without dead wood we saw no ash.

The deer is a problem in this area, because in winter it finds nothing to feed but the bark, leading to immense damage on trees and migration of deer to lower areas. Lower areas are usually managed by foresters that shoot the deer to keep their trees alive. The National Park managers decided to feed the deer in winter and to control population by shooting to prevent the migration.

Picture 7: place with dead wood and regenerating flora

Then we saw the effects of the storm destruction and beetle attack in 2007. The whole landscape was filled with fallen trees (picture 8). The first generation of beetles used them to procreate, the second generation migrated to the still standing trees, which were damaged on the roots by the storm. The park managers had to make a choice: move the fallen trees with big machines and destructing the soil or let nature cure itself. They decided not to intervene.

The bark beetle outbreaks stopped and now the discussion appears if it was the better decision.

Picture 8: slope with dead trees

We also visited the official spring of Vltava river.

After this we stopped at a place where we could compare an area with non-intervention way of protection after wind-throw and an area with the intervention way. On the right side of the path we could see the natural forest which was clustered and contained dead wood. There was no high density and we had a mix of Sorbus and Spruce. At the ground we remark old trees and grasses which showed us that this was the area without intervention. On the left side we could see a cultivated spruce forest without any dead wood or mixed trees (picture 9).

Picture 9: managed and unmanaged forest in comparison

Later we crossed the border to Germany and reached the highest point with a good overview. On the Bavarian side, we have a high diversity. There were ash, grasses and some old trees in hotspots. On this side are also many villages. On the Czech side we have a low diversity: a high density of spruce in large areas.

Then we went deeper down to where once was farmers land: crops, hay and grasslands. Today there is a mixed forest. Due to the agricultural removal of biomass there is a poor soil with low nutrient content.

Then we arrived at a hut near a graveyard (picture 10). The hut has been rebuilt for tourism. The people that were living there had been invited by the landowner in the 18th century to live and work, but have been sent to Germany after the war due to their German roots. In the 70s here was a military base located, but it also isn't existing any more.

Picture 10: rebuilt hut

Now we came to a field of secondary grassland (picture 11), that was partly managed by agricultists in the old days. Also some people digged for peet for heating.

Picture 11: secondary grassland

We visited the the lowest part of the outer forest where moss and hammocks and hallows are located. We also saw many sedges.

The guide explained the damage on trees caused by deer and woodpecker. It can affect up to 100% of the trees in an area and makes the trees highly vulnerable to fungi and beetles.

We reached a managed forest with more beeches and maples. The whole wood is used as firewood, because there is a lack of firewood in the area. By this heavy forest use the nutrients are taken out of the forest leading to a poorer soil.

Seminar

Natural development and regeneration of a Central European montane spruce forest, Miroslav Svoboda, Shawn Fraver, Pavel Janda, Radek Bače, Jitka Zenáhlíková (Forest Ecology and Management 260 (2010) 707–714)

The presentation was about the scientific research in Sumava mountains focusing on the past events and conditions influencing the forest aim: reconstruct the disturbance history, Assessment of the role of density dependent mortality in shaping current forest structure, Evaluation of seedling substrate preferences they used the historical data and dendrochronology for reconstructing the history events there were wind-throw (1868), bark beetle outbreak (1870), following cutting, and barkbeetle outbreak the dendrochronological data clearly show increasing growth after wind-throw, barkbeetle outbreaks, and salvage logging Dendrochronology – they took a cores, measured the rings width, after that they did a cross dating – (http://www.ltrr.arizona.edu/skeletonplot/exampleapplication.htm) that means that they put together more chronology (tree rings) curves into one „in the right way“. After this they used the method “boundary line” which is used to find disturbance events in the past in that way that the methods find some unexpected bigger growth (wider rings for some longer period).Ffor searching density dependent mortality they measured position of all alive trees (bigger than some smallest ones) and all dead wood -> they obtained spatial pattern of the forest in which they recognized that the structure is vertically homogeneous, but horizontally heterogeneous and patchy which is also connected with dependent mortality and also has an important role in shaping new forest (but now I am not really sure what they wrote there about the dependent mortality, how much significant results they found..)

They found very big regeneration (seedlings (<20cm height) – 42 781 ha-1, saplings (>20cm) – 11 807 ha-1) and what is really important: the found that most of regeneration is going on dead wood (Sapling 50-80%, seedlings 35-75%) even though that the dead wood substrate covered only 4-9 % of plots area. So that means that dead wood is very very very important for regeneration in these forests :).

They also recognize that Densities significantly decrease with the increasing height

Conclusions:

back to the dead wood:) : Non innervation caused enough dead wood (substrate)

-> Much faster regeneration, Slow regeneration can mean that there is not enough dead wood

Semi-natural forests is very valuable – somewhere can be big biodiversity etc.

-> protection

Infrequent moderate or small disturbances diversify the stand and enhance the structure

that means that the forest is more resistant against disturbance and more diversified

also is important that understanding to the disturbance regime is very important for understanding how protect these forests and also how grow the cultural spruce forests

Bavarian Forest

In the course of our Intensive Program „Soil and Water“ we went on a 2 Day excursion to Sumava Mountains (Czech side) and to the Bavarian Forest (German side). In the following the excursion through the national park “Bavarian Forest” is represented. It is divided into several parts which refer to the different sites we stopped. There our guide explained several things about the plant community, the ecosystem itself and the management measures.

The first stop was at the border of the forest entrance, where our guide told us a few general facts about the NP. He went on to a rather young piece of the forest where no dense canopy is found.

There has been a clear cut in the 80’s. Even if the silver fur and the beech trees are prone to frost in the cold periods of the year, there are still a lot of beech trees growing. This plot shows a typical acid beech forest, where not many other plants are able to deal with the acid conditions.

Picture 1 (left) shows young areas of the forest

Picture 2 (right) shows the affects of clear cutting in the 80's

The second stop was after a short walk where we recognized some tractor traces, which show us, that the forest has always been used even if the last 20 years were without any intervention. There the guide drew a comparison between the natural management during the past years of Sumava Mountains and the Bavarian Forest. Whereas the Sumava Mountain NP has been under constant use by Prince Schwarzenberg (forest industry concerning Norway spruce) the Bavarian forest was controlled and owned by government (less use). As a result we have different starting situations that show diverse ecosystems and require specific managements.

The third stop was in an old part of the forest, where Mr. Muhle explained several facts about lichens and showed examples. As a prove that the part of the forest has to be old, he showed us lichens, which need over 100 years to establish on the thick moss layer. Yellowish lichens with white spots and close contact to the bark are band lichens. Lichens that are green when wet are Pham lichens, which are gathered as an ingredient for perfumes to make it last longer on the skin. An acidophilic species is the *Folliculitis barbae* (beard lichen). The *Hypnum fertili* grows cocoon logs and has been gathered in ancient times to sleep on, since it prevents flies from coming near.

Pictures 3 and 4 show the explanation of lichens by Mr. Muhle

Fourth stop was a very short break to consider some rare fungi species on the dead wood of the silver fir. It needs around three years and wet conditions to grow and begins to spread via spores along with the increasing of deadwood in the forest.

Picture 5 shows a rare fungi species, the *Hericium sp.*

On the fifth stop we were located about 5 km away from the starting point. Close to the spring of the river Moldow there are different weather conditions and micro-/mesoclimate (average temperature: 4°C; average precipitation: 1200-1800 mm/year). On this stops position there were lightly different values (average temperature: 6°C; average precipitation: 800-1000 mm/year). Between 2000 and 2008 bark beetle affected this (mixed) forest. It created a lot of dead wood within a short time and caused a homogenous plant community, whereas in a virgin forest it is heterogeneous. There are no crowns for protection and plants that are prone to frost cannot compete with frost resistant plants. Furthermore we differentiated A*bies alba* and *Picea abies* (fir and spruce). *Abies alba* has upward branches, light reflecting needles and snowflakes under the tree. *Picea abies* has downward brunches, darker reflecting needles and its crown gets bigger in the upper part.

Picture 6 shows a mixed forrest, which was affected by heavy bark beetle afflictions

On the sixth stop roots and damages of trees were the main topic. Most of the root systems have different parts. The lateral parts are for supply of water and nutrients in upper horizons. The deeper parts (sinkers) supply water from deeper layers in case of drought and stabilization. Roots of deeper layers die in case of heavy rain due to water logging (not enough oxygen for root respiration), according to this, trees are easy to uproot (typical problem of spruce whereas silver fir is not affected by this kind of problem). Another point is windstorms. They either break down the trees or they uproot them. Some further problems and dangerous situations are damage or cut off of the small (most important) roots, less water supply and in case of hot weather the water supply breaks down and the tree is damaged but still standing.

Picture 7 shows the root system of a partly uprooted tree

The seventh stop was next to a small, brownish colored stream with foam on its surface. Foam is not always an indicator for bad water quality. In this case it came from decomposition of acid organic material by (phototrophic) microorganisms. The brownish color came from humic acids. Nitrate is also movable in water (eutrophication) and may become toxic for some invertebrates. Scientists found out, that drought became more common after bark beetle infection. Warming rose because more sunlight was able to reach the ground and dead wood became water storage. After the forest died back, nutrients are leached because no plants used/took them. There was high decomposition of soil organic matter and the nutrients were washed in the groundwater. Even small layers of grass are capable of stopping this process. There has to be an organism no matter which size, to consume the nutrients to keep them in the circle and the system. Another point is the decomposition of wood.

The half time of decomposition of a spruce tree is about 25 years. Contact of dead wood with soil and moisture influences and increases decomposition highly. Fungi also influence the speed of decomposition. In three weeks fungi can consume an entire leaf. It can detoxify the litter and wood and the decomposition of complex compounds is more efficient compared to bacteria. Acidification affects the decomposition ratio of bacteria and fungi.

Picture 8 shows a small brownish stream with foam c aused by decomposition on its surface

On the eighth stop we talked about interventions in natural systems such as these national parks, especially about road infrastructures in forests. Workers of the park need to enter the forest and they have to use heavy machinery to manage the forest. On the other hand for example stream flows are changed by roads, which leads to a change of environment and the ecosystem. Roads with stoned bodies are an insuperable border for soil organisms and there is no spreading through the landscape.

The ninth and last stop refers to wet soil and peat bogs. Peat bogs are on places with small watershed and the ground is poor of peaks. The trees do not have such a good quality. Drainages have been installed in a depth about five meters in former times to dry places out and to push tree growth. The phenotype is bonsai-like in real peat bog conditions. To restore the bog ecosystem dams are necessary to stop the water channels. Water Level in peat bogs normally is about 20-25 cm under surface. The channels reach through the ground and a problem at the visited point was that the channels continuously flew around the dams. Therefore there are sometimes soil pipes even in naturally peat bogs. If they are drained, the water escapes through these pipes.

Pictures 9 and 10 show a peat bog once drained by humans in order to make the wet area available for forestry. The dams are a try to redamp the area.

Effect of stress and disturbance on soils. Organic matter recycling

(Baldy)

Soil can be considered as a medium for plant growth, as a recycling system, as a water supply and purification, as a habitat, as an engineering medium, etc.

Among the different horizons present within the soil profile, organic horizons occupy the upper layers of it. These organic horizons constitute the humus layers. Therefore from top to bottom it is possible to find different organic soil horizons: non-fragmented leaves (OL), organic layer including faunal faeces (OH), organo-mineral layer (E or A). These superficial horizons are the most active in a foodweb anf flow of energy perspective. From the decomposition process depends the soil quality and fertility. This leaf litter decomposition is a key process for ecosystem functioning, and it's mainly a biological process.

There is a lack of data about the C sequestration in humus.

Fragmentations and mixing of the horizons create physical and chemical modifications. As a result, humification and mineralization processes occur.

This decomposition process is carried out by different groups including fungi, bacteria, insects, arthropods, etc. According to their respective size, it is possible to distinguish among: microfauna (<0.2 mm, nematods and protozoa), mesofauna (0.2-4 mm, microarthropods and others), macrofauna (> 4mm).

Some of the organisms important for the organic matter decomposition are described below:

Enchytreids (1-5 mm): white small worms feed on soft leaves part living in the OL, OF. Their fecal pellets constitute the mentioned OH horizon.

Earthworms (>5 cm) *Lumbricidae*. In one ha of soil, 2 tons of earthworms can be found. They are considered anecic (they move between horizons). Further than the mixing of horizons, earthworms play an important role because their castings which contains 16 times more N and 30 times more P than the soil itself.

In this organic profile it is also possible to find smaller epigeous earthworms (they remain in top soil layers being possible to find them in OF or OH horizons).

Collembola: microarthropods without wings which can be used as bioindicators of the soil quality (in 1 m^2 we can find > 200.000 collembola).

Acaria (microarthropods). In one 1 m^2 forest soil it is possible to find more than 250.000 individuals. Collembola and Acaria decompose litter from OL and OF horizons and accumulate fecal pellets in OH.

Microrganisms (bacteria and fungi). They play a key role in litter decomposition, being able to mineralize organic matter (C, P, N, cations, etc.).

Leaf litter decomposition is controlled by:

- Leaf litter chemistry (structure and defense compounds, nutrients)
- Environmental conditions (i.e. water content)

For studying litter decomposition, litter bags in situ approach method is used. With mesh size depending on the fauna we wanted to study. We put a certain amount of litter in net bags. Some of the litter bags were retrieved from the field at regular intervals. We determine leaf mass loss during decomposition, and decomposers associated to decomposed leaves, by means of biomass and diversity measurements

Methods for studying the mesofauna:

Berlese funnel mesofauna extraction. Based on the principle that mesofauna escapes from dry litter and falls down to an alcohol solution. After extraction, organisms are counted and identified.

Ergosterol is a fungal biomass indicator: extraction, purification and quantification by HPLC

Microbial catabolic profiles associated to decomposed leaves (based in color changed related to degradation capacity) are also used due to optical density is proportional to degradation capacity of the organism.

Litter secondary metabolites dynamics: terpenoids and phenolics extraction (chromatography and spectrometry).

Do stress and disturbance affect leaf litter decomposition?

Mediterranean terrestrial ecosystem is characterized by a climate with a hot and dry summer, low annual rainfall, violent rainy and windy events, recurrent fires, sols often shallow, and an old anthropogenic pressure. These ecosystems are colonized by plants adapted to these stressed conditions, with special morphology (as scleprophyllous plants are dominant) and special physiology as these plants are producing large amount and diversity of secondary compounds.

Water stress affects to litter decomposition: dry period fungal biomass develop is almost stopped and therefore decomposition is almost stopped. There is a positive linear relation between litter humidity and litter fungal biomass, and this is also visible in the number of individuals of mesofauna which is increased in humid seasons. Mesofauna colonization occurs later than fungi colonization since mesofauna needs fungi to start the process.

In the temperate forest, we observed a continuous dynamics for leaf mass loss and decomposers.

On the opposite, in the shrubland, we observed a discontinuous dynamics, depending on drought periods.

Compost amendments on mediterranean soils are a suitable technic for accelerating the natural recovery process of soils degraded by recurrent fires, by increasing soil fertility. Although, sludge compost contains high quantity of P which can represent an environmental problem.

Compost amendment increases leaf nutrients content but does not affect litter decomposition, fungal biomass and abundance of microarthropods associated with litter. It helps the plants to survive during dry period because it contains more water than soil.

Abiotic stress in forest

(Ninemets)

Water is crucial component for life, especially in plants where it constitutes 50-90% of their mass. Otherwise not all the parts of the plant have the same amount of water. For instance seeds have not so much water content in order to prevent of enzymatic reactions, due to the most of enzymatic reactions take place in presence of water.

Stomata pores are one of the responsible organs in the regulation of the amount of water losses. Species like mosses with a lack of them, are totally dependent of water presence, but they have a high toleration to desiccation.

Vacuole, generally one and with bigger size in plants than animals, maintain stable cellular ion and solute concentrations.

Succulent plants present another adaptation, a high water content buffer, meanwhile other plants are adapted to salty soils.

Plant photosynthesis present a bell shape response, with an optimum point but normally plants in natural environments are subjected to stress, defined as any external influence that constraint specific plant processes. This stress is translated into a reduction of activity and creates a stress response: acclimation which takes place within the species lifetime (phenotypic changes) and adaptation (genotypic changes).

But also plants are subjected to biotic stresses caused by pathogens, infections, diseases, competition, herbivores, etc.

Among the abiotic stress sources we distinguish: temperature, water (drought and flooding) radiation (light availability), chemical influences (pollutants, excess of different minerals), mechanical influences (wind, surface movement), other (electric field, magnetic field)…

Stress in trees

The capacity of fixing C by the plants, is affected by the light level or light leaf exposition decreasing and hydraulic conductivity. As response of low or high light exposition levels, plants develop several characteristics modifying its physiognomy, but this fact is intimately linked with other changes affecting the amount of absorb water (i.e. low sunlight levels $\rightarrow$ promotes the development of bigger leaf surface).

Light can be a limiting factor for plant growth but plants are not able to use all the amount of light they perceive (500-700 $\mu mol.m^{-2}.s^{-1}$). In higher elevations there is more photo inhibition.

For measure the stress non destructive (spectral index, remote sending, visual degree of damage …) and destructive methods (measure of drought, chemical estimation composition, gene expression, …) are used.

In stress situations, there is always a point of no return, which means after the stress the plant cannot be adapted anymore.

Some stress promotes the production of stress hormones and volatiles.

Within the abiotic stress factors we can consider: water stress (draught or flooding), anoxic conditions, nutrients, excess light, mechanical stress…. But forests also are also affected by changes in light, wind, absence or low water retention (sandy soils), etc. Also abiotic factors are responsible of global changes such like global warming (more pronunciation in north altitudes where are concentrated the highest amount of continental land).

As it has been said, forests as ecosystem need to response to multi-stress draught and irradiance situation. High light levels require high index of water (stomata openness is linked to light/water conditions, being more close in the upper canopy). When the stomata are closed in their majority, there is a loss of productivity. Also and directly related with light stress condition, heat stress affects to plant gas exchange.

Stress tolerance: is the capacity of certain plant species to endure the influence of certain stress level; in limiting conditions of light or O_2, two different metabolic routs can take place: Krebs route (in presence of O_2, more energetic: 1 mol glucose = 36 mol ATP) or fermentation (in absence of O_2, less energetic: 1 mol glucose = 2 mol ATP).

In the case of limiting water plant tend to develop strong leaves, limited light increase the light harvesting efficiency, increase the leaf biomass, etc.

Interactions in plant-soil-systems

(Astover)

There is a dual affection between plant and soil, but without soil plants can exist (they are necessary for the organic matter formation), but not vice versa if we consider the soil as medium where plants can be developed, but what they need is the nutrients, water and suitable conditions for root development.

These nutrients are absorbed by roots as ions from the soil water or solution by diffusion, mass flow, and root interception; but also exist other way of “nutrient supply-taken” such like foliar uptake, and mychorrhizal symbiosis (80% plants can form them) where plants can take an 80% of N and 90% of P.

Nutrients have mobility within the soil but also within the plant. According to this we classify them in:

High mobility nutrients like NO^{3-}, sulfate S, B; moderate mobility nutrients: NH_4^+, K, Ca, Mg, Mo; and immobile nutrients: P, Cu, Fe, Mn, Zn.

In the case of nutrient mobility in plants: Ca is not moving along the plant. And in the other hand N, P, K, and Mg are very mobile.

Nutrient availability is dependent on pH. A curious example is the case of some species of hortensia (*Hydrangea*), which can vary its color according with the pH and Al availability (in acid conditions Al is more availability and blue color).

There is an optimal level of nutrients too. Below this optimal nutrient cadences can occur and over it excess situations can occur (toxicity). For example in cereals an excess of N can provoke lodging. In the case of other crops like potato higher quantities of nutrients (i.e. manure) are needed for preserving its yield in time.

Other cultures such as crop rotation affects to the content of soil lactate content to soil lactate. Depends also of the plant (different availability level) some grasses are able to take more than 20% of the P in one year, also Leys and Rye. In the case of K, grasses 40%, Leys too and followed by potato. Problem org farming, there is a limiting possibility of putting back nutrients in soil if there is a high ha of grasslands (problem in long term)

Soil science USA proverb: *Soil is like a bank*.

What is the good indicator of soil quality?: productivity?, biodiversity?....

Seminars

Combined effects of elevated CO2 and natural climatic variation on leaf spot diseases of redbud and sweetgum trees.

“Litter decomposition”

(Baldy)

This was the second part of her lecture to “Soils under drought”

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.

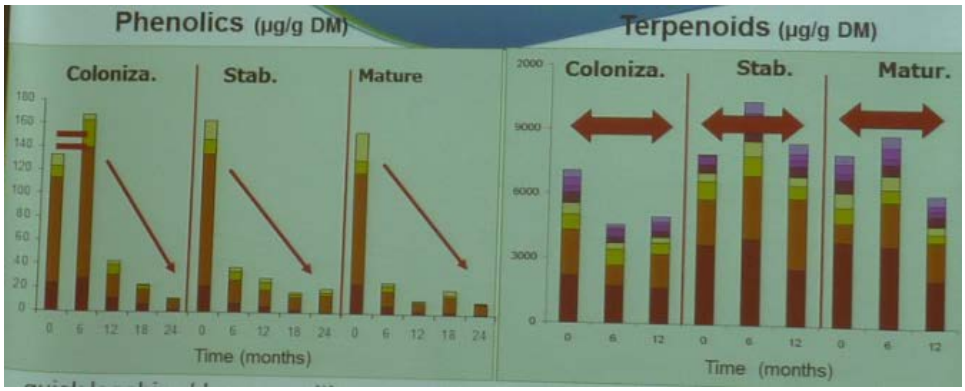
Pinus halepensis is a plant species which produces a high amount of Plant Secondary Metabolites (PSM). There are three ways of release of PSMs: i) volatilization and this way of release is involved in biosphere-atmosphere relationship; ii) leachates and roots exudates and then participate to biotic interactions;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

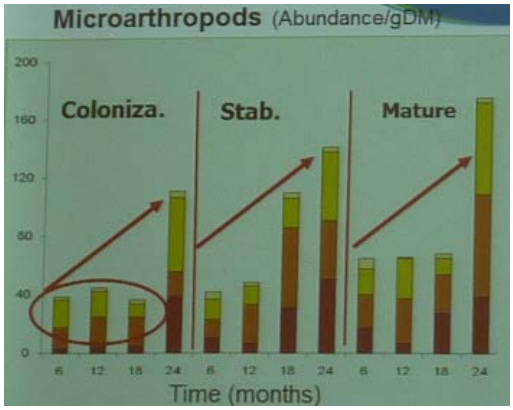
Results of the experiment:



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.

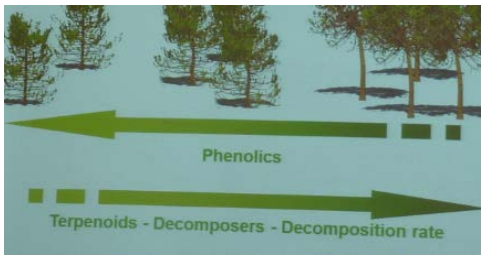
So we can see that the colonization stage is different to the others, maybe terpenoids can be toxic for microorganisms.



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. 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.

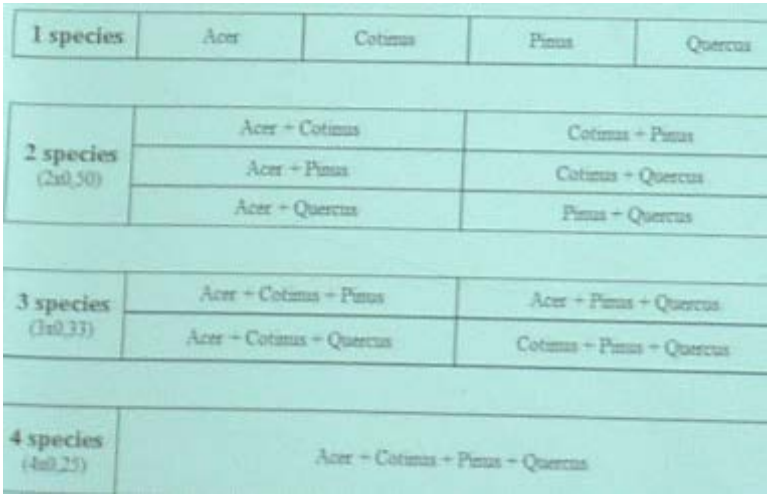
In context to climate change France expect a decrease of 30 % of rainfall, an increase in temperature by + 2.5°C and also intensification of the summer drought till 2100. If 30% less rainfalls summer dry periods will be two months instead of one month, and this will increase the water stress to animals,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



1 species	Acer	Cotinus	Pinus	Quercus
2 species (2x0,50)	Acer + Cotinus	Cotinus + Pinus		
	Acer + Pinus	Cotinus + Quercus		
	Acer + Quercus	Pinus + Quercus		
3 species (3x0,33)	Acer + Cotinus + Pinus	Acer + Pinus + Quercus		
	Acer + Cotinus + Quercus	Cotinus + Pinus + Quercus		
4 species (4x0,25)	Acer + Cotinus + Pinus + Quercus			

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.

Soil organisms

(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 a 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 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 aequeous 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>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

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.

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 countryside, and the interiors were lavishly designed. The Hluboká Castle contained 140 rooms and eleven towers, 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).

Microbal processes in wetlands

(Santruckova)

-What is wetland? Typical processes in wetland

-Interesting question: What do you think is the largest/biggest organism in the world?

Answer: *Armillaria ostyae*

- 1g soil – 1 billion of bacteria

-Microbial processes – elements cycling

Plant growth in wetlands

(Kazda)

- Terminology
- Carbon cycle
- Denitrification
- Fermentation
- Methanogenesis
- Nitrogen cycle
- Methane emissions globally

How are these cycles/processes taking place in nature. What is needed for that, how elements are changing and what is the result of these processes. How are these processes affecting plants and microorganisms.

Excursions to Trebon Basin Biosphere Reserve

This region of 700km^2 in South Bohemia is 1977 declared as Protected Landscape Area by UNESCO. The climate there is moderately warm with a mean annual temperature of 7,8°C and a mean precipitation of 650 mm per year.

During a long time its landscape was modified by human activities like fish-farming, forestry, agriculture and more. Following today 0,1 - 500 ha of the area are unnatural lakes and concretely you can find 460 artificial fishponds, which were built in the 15th and 16th century and interconnected by ditches and canals.

As 13% of the reserve are covered with water, this area is called „the wet meadows“ and the important ecosystems there are wetlands. On the fishpond littoral zones you can find reed and sedges belts, marshes, alder and willow carrs, wet meadows as well as floodplain forests (50% of the area is forest). 10% of the area consists of various types of mires, which form the peatland - peat bogs and acidic fens but there are more bogs than fen. The grasland was managed by regional farmers, who used the wetlands only for hay because it's too wet for normal agriculture. But the management stopped and most of the haylofts disappeared ~1950 because the soil was too wet for modern machines. Pig farms changed the conditions from mesotrophic to eutrophic what is dangerous for rare species there. In the wetlands there is an ecosystem research and therefore they analyze the primary production by decomposition and the carbon balance. Since 1976 years there is mesodynamic data collected.

For the global research in the Czech Repuplic there is a wetland station, where they collect microclimatic parameters. To calculate the flux they use a 3-dimensional sonic anometer as well as an infrared analyzer of CO_2 and water table. They wind speed and with a soil chamber the increasing content of CO_2, CH_4 and carbon. During the last 30 years there was an increase in temperature of 0,1°C per year observed. The concentration of methane is 1,75 ppm and of carbon it is 360 ppm. There are 0,36 ml CO_2 in 1L air and the carbon store in a soil depth of 0 - 80 cm is 53,52 kg/m_2 .This high carbon content due to the humus is visible by the darkness of the soil. To prevent the escape of fish in the ponds they keep the water level high. If the water increases the weather station is able to rise too. For example there was a flood in 2002 which furthermore reduced the nutrient supply and suppressed the origin dominant species *Carex versicaria*.

Trebon fish pond Rozmberg

The Trebon fish pond, the dam Rozmberg. It is the largest fish pond in Czech and was owned by the family Rozmberg in the 16th and 17th century, which died out in 1611. The fish pond was built from 1584 to 1590. The water comes from the rivers of this region and the fish you can find there are carps, the most fished fish, catfish and more rarely pike.

The fish pond holds about 5, 5 m^3 of water and the water surface is 489 ha. The length of the dam, which is filled up with sand, is 2430 m. The average salary fish of the dam Rozmberg is about 800 kg/ha, but still it is not very productive: annually only 350 kg fish are fished there. To empty the pond, the water has to be drained. After that the fish pond is almost empty and the fishermen are able to fish the fish out.

Slavosovice

The Korenova cistirna Slavosovice is a constructed wetland for wastewater treatment. The idea of this system is that the microorganisms clean the waste water under oxygen consumption, so the Bacteria eat the “waste”. In a wastewater treatment plant disadvantage could be the huge amount of electricity demand, but here the water comes to the system by natural flow, so the costs for some pumps are manageable. It is important to know that the water goes through the different tanks by gravitation. A pretreatment is necessary because of the bigger particles of the solid that must be removed. After that the water moves into the second tank, where the bigger particles, which still are in the water, sink to the ground. In the third tank the water flow is stopped for two to three days, because there the sedimentation takes place – small particles settle on the bottom of the tank. Sometimes also some organic matter and nitrogen are taken out by microbial decomposition. The fourth tank divides the water into the fifth and the sixth tank. The ground of these two tanks consists of some layer of clay and plastic so that the water doesn´t go to the groundwater. Later the water flows into a field of plants, which support microorganisms with oxygen and thus accelerate the cleaning of the water. Moreover they are taking some nutrients out of the water. These plants are wetland plants like reed, for example Phragmites, Phalaris etc. In the winter the water-level is increased and left to freeze. The ice and some air between isolates the treatment bed and because of that it does not freeze. If the water- level is not increased, it is not so bad: usually the ice is not that thick so that the water flow is not stopped and the water may flow through the treatment bed anyway. The treatmentefficiency for organic matter is about 82, 2% and for solids about 65%; whereas the efficiency for nitrogen and phosphorus is much lower.

At long last you can say that this excursion taught us a lot about wetlands and the plants and organisms that are living in there. Not only the plants but also the animals must be extremely adapted to much water, for example plants built aerenchyma in their roots. Here you can see again, that water is not only a live donor, the plants and organisms cannot live without, but also some kind of a curse in very large quantities.

Crown space and inherent resource investments and gains – a way to quantitatively express competitiveness

(Reiter)

Plants need source of energy, e.g. light and heat, and matter like CO_2, H_2O and nutrients. They are interacting directly with neighbour plants and indirectly over effects and responses related to resources. To get all resources a plant needs for growing it especially requires space in soil and atmosphere. Plants occupy space for example by increasing their crown volume, for that they have to invest carbon in branches and leafs. Also there are running costs of a large crown volume, like respiratory, transpiratory and nutritional demands. In return space exploitation results in a carbon gain for the plant.

Research from the “Kranzberger Forst”, near Munich, a mixed forest of Norway spruce with groups of European beech showed that these trees exploit space differently. Spruce and beech have different foliage distribution, e.g. more light reaches the lower branches of spruce compared to beech, but the photosynthetic use of the canopy is more or less equal. The volume increment of the sun crown is higher for beech as for spruce, what can be explained by different strategies. As for spruce it is the “sit-and-wait”-strategy and for beech the “foraging”-strategy in terms of branches. Also the investment for branches is less for spruce, because it has evergreen needles which live very long. Space occupation is higher for spruce, also the carbon balance for branches is higher than for beech, because beech has to import more C to shade branches as they return. Spruce has C export on both, sun and shade branches. In contrast to that the carbon balance of the whole profile shows that the spruce has more unproductive branches.

An example for interference competition is crown shyness as a form of direct interaction between plants. Gaps between the beech crowns can be lead back to branches breaking each other. Spruce show less signs of crown shyness because their branches are softer and don’t break of so easy.

The main plant growth in spruce affects the trunk, whereas beeches grow mainly by enlarging their branches. Below ground the available resources can not be observed, neither how they are accessed, it's only possible to measure the root system or to have a look at above ground growth.

Soil degradation

(Reintam)

The distribution of the land shows that there is not enough land for everything. Land is splitted into 51% of ice, snow, desert and mountains which is not suitable for agriculture and construction. 11% of land is arable land and 10% is used as pasture. Remaining 28% are tropical forest, dry land and forests. The land is needed for human food and animal feeding.

Soil degradation is defined as the loss of quality and productivity, through the loss of nutrients, the breaking down of soil structure, toxicity, pollution or covering by constructions. In the last fifty years 13 % of cropland and 4% of pasture land were lost, also it's predicted that in Europe until the year 2030 20 Mha of agricultural land will be lost, because there is no protective directive.

The main threats to soil are erosion, decline in organic matter, pollution, compaction, acidification, desertification, salinization, soil sealing, decline in soil biodiversity and floods and landslides. Soil erosion is the process by which material is removed from the earth's surface by water, wind, ice, snow or other. The natural loss of soil amounts 1 t/ha*year, in fact the loss of soil in Europe today is 6 t/ha*year and worldwide even 20 t/ha/year.

Water erosion can be classified into raindrop, sheet, rill, gully and channel erosion. Two examples of water erosion are maize fields and bank erosion from boats. Wind erosion appears mainly at sandy soils whose particles can be easily blown away. Yearly economic loss for erosion in Europe amounts to 53 €/ha. Causes for erosion can be inappropriate agricultural practices, deforestation, overgrazing, forest fires, construction activities, tourism and extreme sport. Erosion can be prevented by leaving the ground cover untouched. Another part of soil degradation mainly in alpine and Mediterranean regions are landslides of highly erodible soil or clay based-sub-soil because of intense and abundant precipitation.

The covering of the soil surface with an impervious material or the changing of its nature is called soil sealing. For example the covering by roofs, buildings, mining, waste and ash deposits make the soil impermeable.

Soil contamination is most frequently composed out of heavy metals in different shape and mineral oil. Also diffuse sources pollute soil through the atmospheric deposition of acidifying and eutrophying compounds or potentially harmful chemicals. Contaminants as well can be deposed from flowing water or eroded soil itself or the direct application of substances like pesticides, sewage, sludge, fertilizers and heavy metal containing manure. These sources are brought in by industrial plants, no longer in operation, past industrial accidents and improper municipal and industrial waste disposal, e.g. wastewater.

Salinization is the accumulation of salts on or near the surface of the soil, which makes it an completely unproductive soil. Factors for it are inappropriate irrigation, increase of water table and drought events.

The 27 member states of the EU store about 79 t of carbon. 45% of European soils contain only 0 – 2 % organic carbon. Again 45% have medium content of organic matter. The decline of organic matter can be caused by cultivation, deep ploughing, overgrazing, soil erosion and forest fires.

Experimental climate change

(Reiter)

Definitions around climate change:

Steady state is a stable concentration that is never changing and is independent of time (coin game “head – you win, tails – I lose”)

We speak of a dynamic equilibrium when forward and reverse reaction occurs at equal rates

Pseudo-steady-state or quasi-steady-state is a state that changes so slowly, that it can be considered stable

To simulate global change there are different methods for temperature studies. Electronical heat-resistance ground cables, as well as greenhouses, vented and unvented field chambers and overhead infrared lambs are possibilities to raise temperature and study the consequences.

The increase of global temperature can be observed by measuring the leafing date, which tend to be earlier each year. A warming of 0,3 – 6,0°C increases significantly the rate of soil respiration, the net N mineralization and the aboveground plant productivity. In future there should be more research, especially long term experiments, whole ecosystem warming and gradient studies for the southern hemisphere.

Observations regarding climate change are worse than expectations, so experiments are underestimating the extend of change.

Experiments can be arranged in laboratory or in the field in different set ups. In comparison to chamber-experiments the temperature in field changes and also the light is influenced by clouds, reflection, etc. Therefore the conditions in field are never stable, but full of changes. The three main set ups in field are phytotrosses, open tops and FACE (free artificial carbon experiments), of which FACE is the best method for establishing natural conditions. A problem of FACE is for example that the ozone distribution is not constant.

There are several systems for precipitation manipulation experiments. All of which are influenced by abiotic factors like water diffusion, greenhouse effect and light.

Climate change is multifactorial.

Seminar

Soil organic matter from pioneer species and its implications to phytostabilization of mined sites in the Sierra de Cartagena (Spain)

C.J.M. Ottenhof , A´ . Faz Cano , J.M. Arocena , K.G.J. Nierop , J.M. Verstraten , J.M. van Mourik (Chemosphere 69 (2007) 1341–1350)

Water-table management in lowland UK peat soils and its potential impact on CO2 emission

C. Kechavarzi , Q. Dawson, P. B. Leeds-Harrison , J. SzatyŁowicz & T. Gnatowski (Soil Use and Management, December 2007, 23, 359–367)

Responses of soil microbial communities to water stress: results from a meta-analysis

Stefano Manzoni, Joshua P. Schimel and Amilcare Porporato (Ecology, 93(4), 2012, pp. 930–938)

Decomposition of ^{13}C-labelled plant material in a European 65±

40° latitudinal transect of coniferous forest soils: simulation of climate change by translocation of soils

Pierre Bottnera, Marie-Madeleine Couteauxa, Jonathan M. Anderson, Björn Berg,

Georges Billès , Tom Bolger, Hervé Casabianca, Joan Romanyá, Pere Rovira (Soil Biology & Biochemistry 32 (2000) 527±543)

Excursion to Low Austria

Line in the text means a stop along the way for learning, questions and explanations.

Hengstberg – agricultural landscape, dominates wine production.

Here we met our guide – dr Leitgeb, who works in BFW (engl. Governmental Science Centre of Forest).

This place is interesting because of loess landscape, which is used for grapes growing. Loess is a sediment formed by the accumulation of wind-blown particles. But because of loess, the erosion problem of soil is very wide spread.

There is also considerately little forest (not managed any more) inside loess area, which is really important, because it provides ecological services: helps against erosion and provides habitat for forest species (higher biodiversity). Forest texture consists of sand and gravel; as a result, the soil is dry. Shrub – *Legustrum vulgar*.

Here, we also met tree species: *Aesculus hippocastanum*, birch, Scots Pine (*Pinus sylvestris)*, *Clematis vitalba*, *Robinia pseudoacacia*. Precipitation is low here, below 500 mm.

Timber of (introduced) *Robinia* is used for piles which help grapes to grow, because the wood is resistant to decomposition. *Robinia* can fix N from the air, as a result is a successful pioneer species.

gravel – habitat of solitary bees (red species list)

hollows between loess – channels of water erosion

vine roots are very deep => can tolerate drought

ground water have stable isotope C^{13} => can distinguish proportion of how much water plants have from precipitation and how much from ground water

plants are growing better on the hill, because of cold air coming down from the hill and staying there

Bee-eater (*Meropidae*) nests in gravel – these birds are under protection

Important difference:

Wasps – feeds their offspring with animal proteins

solitary bees – feeds their offspring with pollen

here we see an artificial basin to store water (prevents water from going down)

gully erosion – loess is not very stable

quality of wine could decrease if there would be droughts => plants in stress => it is reflected in flavor => wine is a good indicator of climate change

here we see strange machines, that looks like 1,5 m posts, which make noise to disturb grape-eating birds

- white wine is typical for this area

- here farmers usually don't use fertilization

- copper in the soil from pesticide – not in the wine

Dürnstein city – old houses, monastery and castle.

Here is Donau river, which is different now (compared to previous time): shape of the river is different (more straight), divided into many reservoirs above and below-steam to produce electricity. But at Dürrenstein still free stream present.

going up to the hill, fist through the city, then through a forest

- we are on the hill called Dry Rock. Rock consist of silica minnerals. There is almost no soil horizon here => nothing holds water

- some birch trees (*Carpinus betulus*)

- Beeches are a bit down (there the air was warmer). The higher up the mountain, the dryer it will be

- Previously, there was wood extraction, but not anymore, because it is too difficult to pass

- Several enzymes are needed to completely decompose wood: legninase and cellulase. They are produced by fungi and bacteria. There are only one species known, which can digest cellulose without help of symbiotic bacteria - naval shipworm (*Teredo navalis).*

a lot of litter on the low-slope – natural re-distribution of nutrients.

here we can see *Taxus baccata* – have red poisoned fruits (slow birds distribution). It was used for bows in times past => therefore very seldom in forests today. Have male and female trees.

Lamium sp is growing here, because it prefers places with high N concentration

trees, which are situated down the valley are higher. Reasons: water flows away and huge amount of leaves are going down by wind

now we are 300 m above sea level

reached the top of the mountain. Name of the place: Kreuzung Volelbergsteig, 542 m, N 48°24.536 /15°31.657

At the upper level of the hill it is very dry => we can see *Vaccinium sp* shrubs, also *Deschampsia cespitosa, Pinus sylvestris*. indicating low nutrient levels due to litter re-distribution down the slope

Fagus sylvatica is dying because of water limitations.

- here is a castle Burgruine Dürnstein, 324m above the sea level, N 48°23.865 / 15°31.279

Arrival to the dining place, which was organized by Dr Leitgeb, who is a wine-grower as well. He was very kind and everyone got an opportunity to taste last and this year's wine. Also, he did a little excursion to the cellar, where wine is fermenting (preparing).

Soil degradation and soil compaction

(Reintam)

In the 1st Mrs. Reintam's lecture she was talking about a lot of different types of degradation of the soil, among others, soil compaction. In this (2nd) lecture she enlarged this type of soil degradation.

In different types of ecosystems soil compaction can be detected, but mainly it is problem of cultivated soil.

The very 1st problem discussed was how to detect soil compaction. It can be done during wet period of the year by equipment, which is based on measuring of water potential. It can be done in this way because soil compaction has several effects on the soil: a) it create a crust on the top of the soil, so it is much harder for water to penetrate the soil (a lot of water flow down the field), so there is less water in the soil --> higher water potential. b) There is also in the soil smaller ratio big pores: small pores (it changes soil texture), so there isn't enough space for water and in addition the water is held in the soil stronger --> higher water potential. Of course, there is also higher bulk density in compacted soil.

There was some interesting information about fertilizers. The research compared degree of soil compaction (in the scale 1 --> 6) against fertilization. They found out, that fertilization has no effect on plant production in heavily compacted soil (5,6) compared to less compacted soil (1 - 4).

So, what to do with soil compaction?

using organic fertilizers

decrease frequency of crossing through the field - multifunctional tractors

growing intercrop-plants

deep-rooted plants

...

Effects of soil degradation on soil organisms

(Wanner)

In the beginning of the lesson Mr. Wanner mentioned, that (briefly): a) Primary and secondary succession of soil organisms is not as predictable as plant succession, b) disturbance increases biodiversity because of reduction of dominant species, c) there are in succession two important theories: Intermediate disturbance hypothesis (some disturbance fosters biodiversity since there is no competitive exclusion) and Metapopulation theory (several populations from different habitats are combined to a network).

Than he was also speaking about 3 main topics - post mining areas, military training areas, and tightly connected to these areas, prescribed burning. In **post mining areas** biodiversity and dynamics in soil was quite high 10 years after the mining had been finished. Many protozoa (e.g., testate amoebae) are found there. This is important because these two organismic groups are linked to soil formation and soil fertility. They are also rapidly growing and they react to different conditions --> = bioindicators. **Military training areas** were in the past periodically damaged and left to free succession. So there are in these areas very rich habitats, we can observe free succession and find a lot of protected species. Fires were in the past normal part of "habitat (nature) management", but nowadays they are usually not tolerated. So, in Germany **prescribed burning** is applied only on small areas and a permission from government is required. Wanner et al. found in their research, that (briefly): a) quality and size of fire is the most important factor, b) there is in the soil among soil microfauna no succession (with respect to a temporal replacement of species).

Seminars

Organic farming and soil degradation

(Presentation was based on the paper: Soil Organic matter and biological soil quality indicators after 21 years of organic and conventional farming, written by Andreas Fließbach, Hans-Rudolf Oberholzer, Lucie Gunst, Paul Mäder)

What is organic farming?

crop rotation, livestock and green manure, species resistant to diseases and adapted to local conditions

strict limits on chemical pesticides and synthetic fertilizers

raising livestock in free-range providing them with organic feed

Bio-Dynamic organic farming

practice where soil, plants and animals are considered as a whole, constituting a self-sustaining system

Alternative variant where:

- chemical fertilizers are totally replaced by microbial nutrient givers such as bacteria, algae, fungi

- composting, green manuring, crop rotations

Ways of soil degradation

Soil degradation: “loss of soil productivity and losses in soil quality due to human activity”

decrease of organic matter and biodiversity

compaction

erosion

soil sealing

salinization

pollution

flooding

desertification

The experiment

based on 4 farming systems + control (nonfert):

bio-dynamic composted: farmyard composted manure + slurry

bio-organic rotted: farmyard manure + slurry

conventional stacked: farmyard manure + slurry

mineral: conventional without manure

all under crop rotation during 3 different periods for 21 years and 2 fertilization intensities (reduced and normal)

Results

Organic Carbon and total nitrogen:

decreasing with time for all the systems

bigger decrease in organic carbon in the unfertilized control plots

higher losses of organic carbon in systems without manure

higher values of nitrogen for bio-dynamic composted plots

Soil acidity (pH):

In the beginning non significant differences among treatments pH = 6,31

2nd period: non-significant differences (pH>0,5) in pH but higher pH values for bio-dynamic composted plots

3rd period: mineral plots present the bigger decrease in pH

Conclusions

Soil organic matter positive affected by manure amendment

Biological parameters of soil quality were enhanced in organic farming systems, presenting better results for bio-dynamic composted plots

Microbial activity were enhanced in organic treatments

Influence of soil quality on the growth of *Folsomia candida* (Willem) (Collembola)

(Presentation was based on the paper from Satoshi Kaneda, Nobuhiro Kaneko)

Short description of collembola:

length: 0,1-17mm

habitat: litter of soil layer

food: bacteria, pollen, dead plant material, soil minerals, algae

Hypothesis:

Increased growth with higher microbial biomass

Examination of the relationship between collembolan growth and soil quality indicators

Experiment 1: "mixed soil experiment"

Overlaying organic layer of forest soil removed (depth 5 cm)

Suspensions: mix soil and sand

25% sand, rest soil

50% sand, rest soil

100% soil

Experiment 2: "natural soil experiment"

Overlaying organic layer of forest soil removed (depth 5 cm)

Soils collected from 7 sites

Conclusions

Collembolan growth clearly influenced by soil quality, but response different between experiment 1 and 2.

The hypothesis was refuted by the experiment 2.

Growth rate lower at sites were microbial biomass was higher and fungi dominated the soil.

"Hot spots" on a new soil surface – How do testate amoeba settle down?

(Presentation was based on the paper from Manfred Wanner, Michael Elmer)

Short description of testate amoeba:

habitat: in soils, leaf litter, peat bogs, near/in fresh water

heterothrophic organisms

build up quickly biomass

Is there a successful colonization process?

Colonization after circa 8 months

>90% uncovered, sandy substrate

testate amoeba: only few species with low density

covered vs. uncovered patches

covered: higher density of micro-fauna, different taxa and 10 times higher abundances of testate amoeba

Conclusions

Small-scaled colonization patterns are linked to small vegetation patches

No obviously influence by any large-scaled environmental gradients

Main factor: presence of organic matter

Role of substrate moisture unclear

Species diversity and metal accumulation in oribatid mites (Acari, Orbatida) of forests affected by a metallurgical plant

(Presentation was based on a paper from Andrei S. Zaitsev, Nico M. van Straalen)

This paper is about the metal accumulation in oribatid mites. Oribatid mites are very numerous in soils and play an important role in detrital food web. The scientist hypothesized that community structure and diversity of oribatid mites is linked to metal pollution. With respect to this, the potential of the mites for bioindication for heavy metal pollution was evaluated. They observed seasonal differences in species appearance and density as well as influences of landscape. The accumulation of metals was very high in mites, though the differences between individuals were extremely high. Zinc accumulation was linked to feeding type, so species feeding only on fungi accumulated Zn more than other species.

In fact, the most polluted site had the highest species richness and density although it was the most polluted site. That leads to the conclusion that metal contamination may not be the leading factor for oribatid species density and diversity. There is some potential for bioindication, but not with respect to heavy metals.

Résumé of Erasmus IP „Soil and Water“

The morning of Day 13 began with a summary of the Erasmus IP ‘Soil and Water’ by Prof. Kazda. In this summary he repeated the lecture topics (soil science, plant ecology, microbiology, degradation, nature protection) and the associated excursions, in which we discussed the human impact, nature protection and their relation to climate change.

The aim of the alteration of lectures and excursions was to give the students experience with nature and not just theoretical knowledge. This was definitely a success, because in this way we didn't just discuss but also see the aftermath of human impact and the drift from natural landscape to cultural landscape.

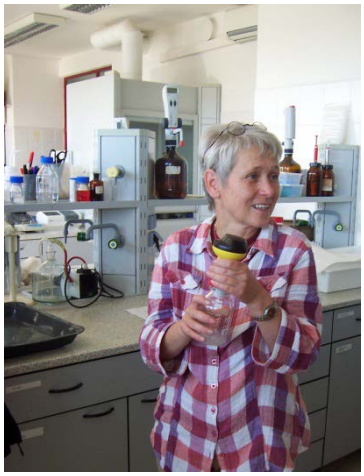
The topics and aims of the lectures were these:

- Interactions between soils, plants and soil organisms
- Interdisciplinary insight into soil processes
- Effects if drought and flooding on plants and soil organisms
- Plant stress and ecosystem response
- Soil degradation and its mitigation
- Environmental problems on European level
- Link between soil functions, economy and society

After this introduction by Prof. Kazda, all the teachers came to the front for a résumé of the whole two weeks.

The students told each teacher what they found most interesting and important of their lectures and what they missed or rather would have liked more detailed. One of the improvements the students asked for was for example more practical work regarding to soil organisms and better guidance for the students' presentations.

Tour through the faculty



After these two hours of conclusion the students were divided into three groups for a guided tour by the Czech teachers through the biological faculty. We visited the biological and molecular biological laboratories and were shown some methods especially used for soil biology. The highlight of the tour was the mass spectrometer whose functions were explained properly.

Presentations by the students

In the afternoon, after some ERASMUS information about studying and working in foreign countries by Dr. Wrangell, Dmitrii presented his self-made video of the Sumava-mountains/Bavarian forest. After that students from Estonia, France, Germany and Czech Republic presented slideshows about their hometowns and why one should come to there for an ERASMUS semester.

In the evening all teachers and students met in the restaurant Budarka to celebrate their last common evening with Czech food and drinks.

Day report of Erasmus Intensive Program course: "Soil and Water"

September 16th -29th 2012

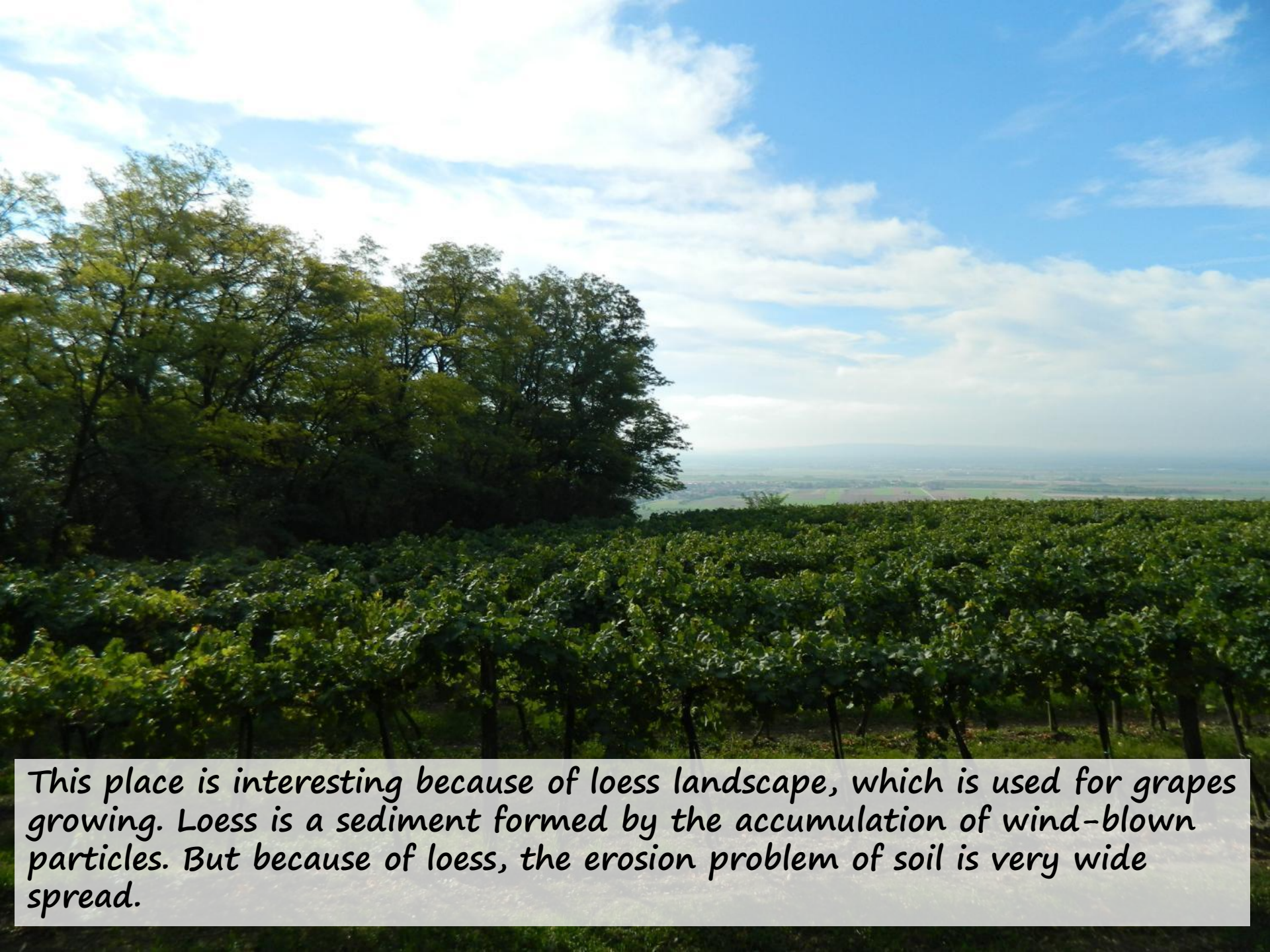
26.09.12 (11th day)

Prepared by Dmitrii Krasnov and Valentina Zolotarjova

7:30 – departure from Mercury Centre. We are going to visit Low Austria today!

10:05 – arrival to Hengstberg – agricultural landscape, dominates wine production.

Here we met our guide – dr Leitgeb, who works in BFW (engl. Governmental Science Centre of Forest).



This place is interesting because of loess landscape, which is used for grapes growing. Loess is a sediment formed by the accumulation of wind-blown particles. But because of loess, the erosion problem of soil is very wide spread.

There is also considerately little forest (not managed any more) inside loess area, which is really important, because it provides ecological services: helps against erosion and provides habitat for forest species (higher biodiversity).

Forest texture consists of sand and gravel; as a result, the soil is dry. Shrub – *Legustrum vulgarium.*

Here, we also met tree species: *Aesculus hippocastanum*, birch, Scots Pine (*Pinus sylvestris*), *Clematis vitalba*, *Robinia pseudoacacia*. Precipitation is low here, about 500 mm.

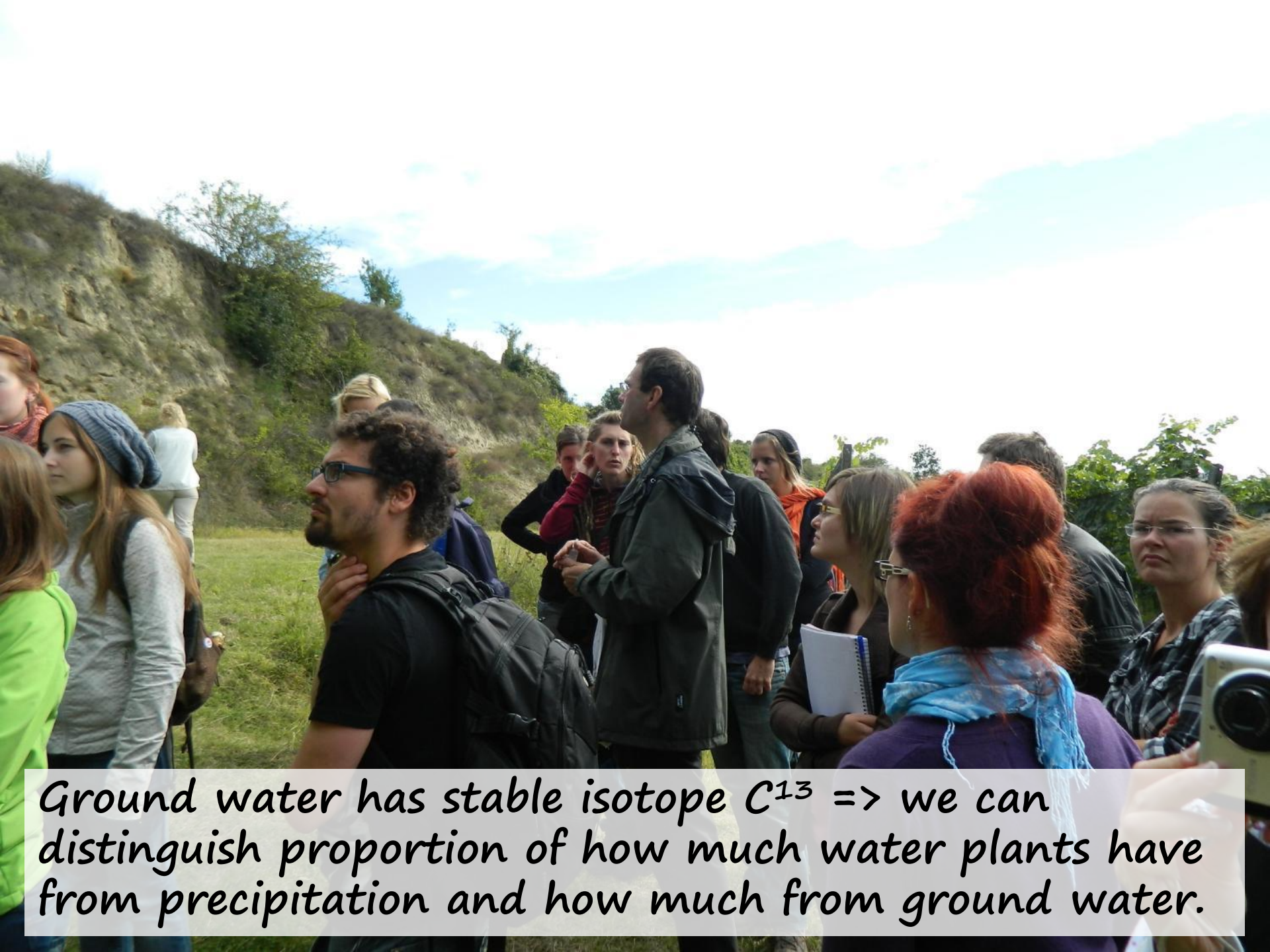
Timber of *Robinia* (was introduced) is used for piles which help grapes to grow, because the wood is resistant to decomposition. *Robinia* can fix N from the air, as a result is successful pioneer species.

On the upper part of the hill there is a layer of gravel from the river Danube under the loess layers.


loess walls are – habitat of solitary bees (red-list species)

hollows between loess – channels of water erosion


vine roots are very deep => can tolerate drought



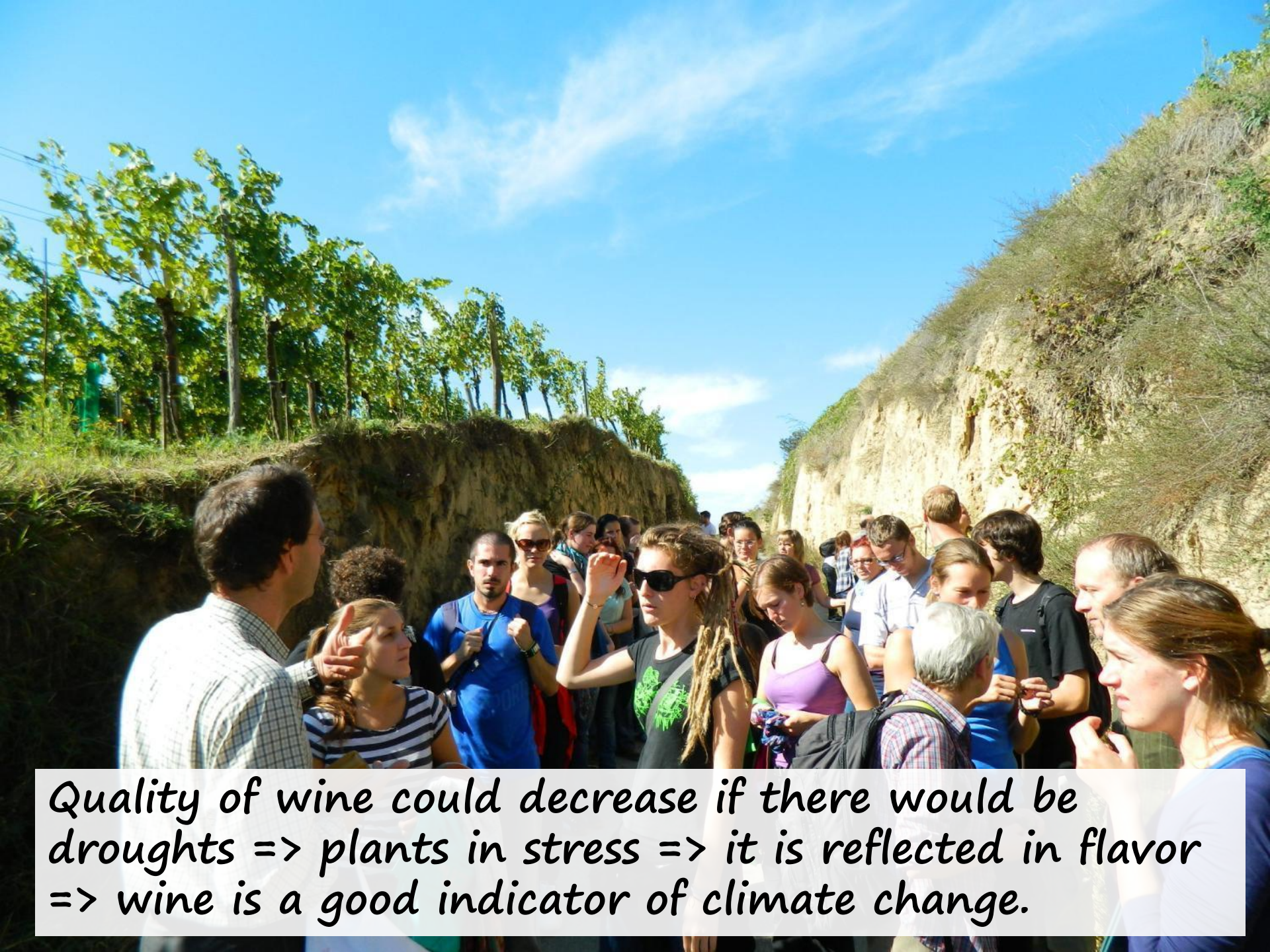
Ground water has stable isotope C^{13} => we can distinguish proportion of how much water plants have from precipitation and how much from ground water.

Plants are growing better on the hill, because of cold air coming down from the hill and staying there.

Bee-eater (*Meropidae*) nests in gravel – these birds are under protection.


gully erosion – loess is not very stable


Here we see an artificial basin to store water
(prevents water from going down).

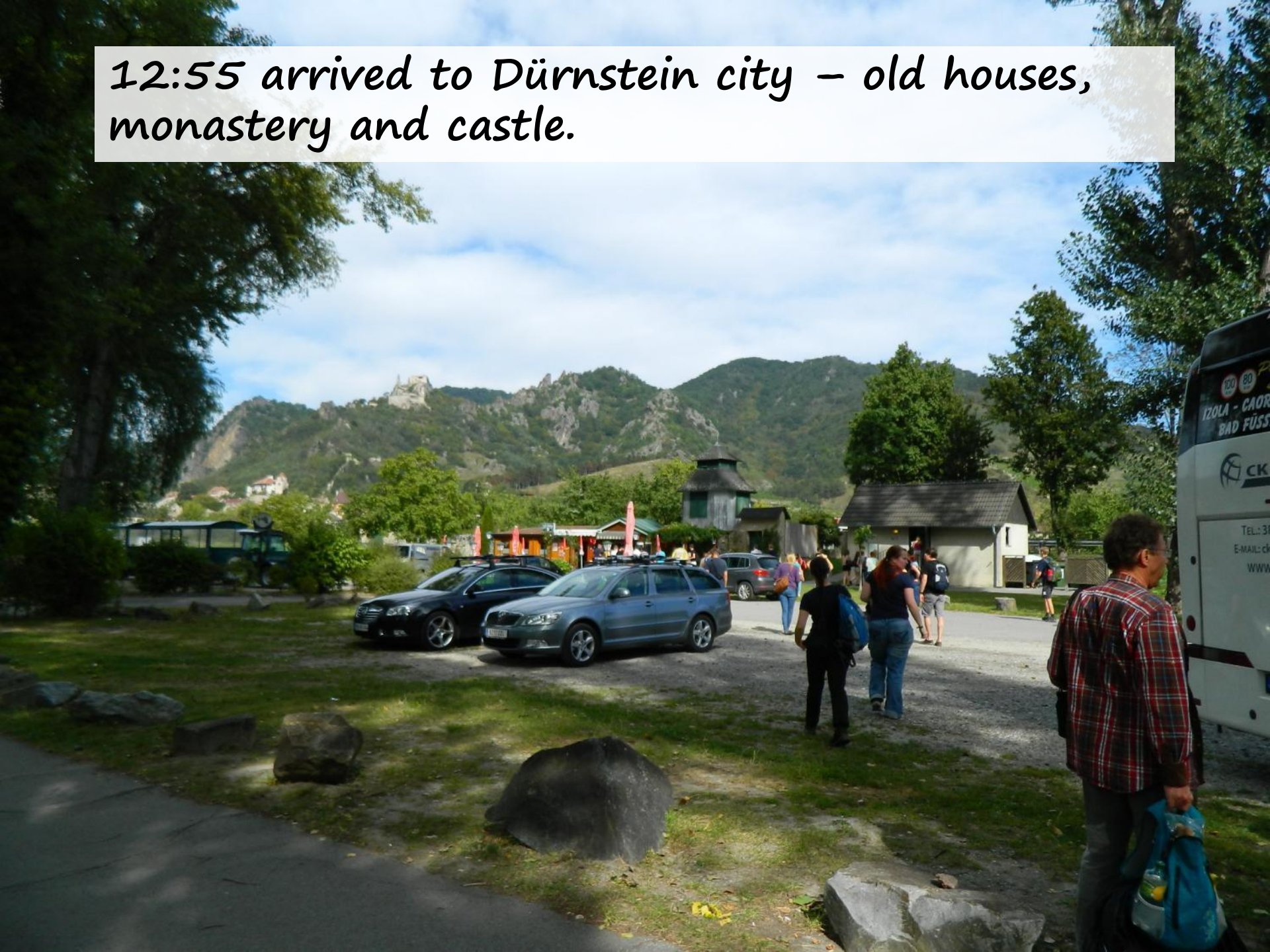


Quality of wine could decrease if there would be droughts => plants in stress => it is reflected in flavor => wine is a good indicator of climate change.

White wine is typical for this area.
Here farmers usually don't use fertilization
Copper in the soil from pesticide – not in the wine

12:16 to the bus

12:55 arrived to Dürnstein city – old houses, monastery and castle.

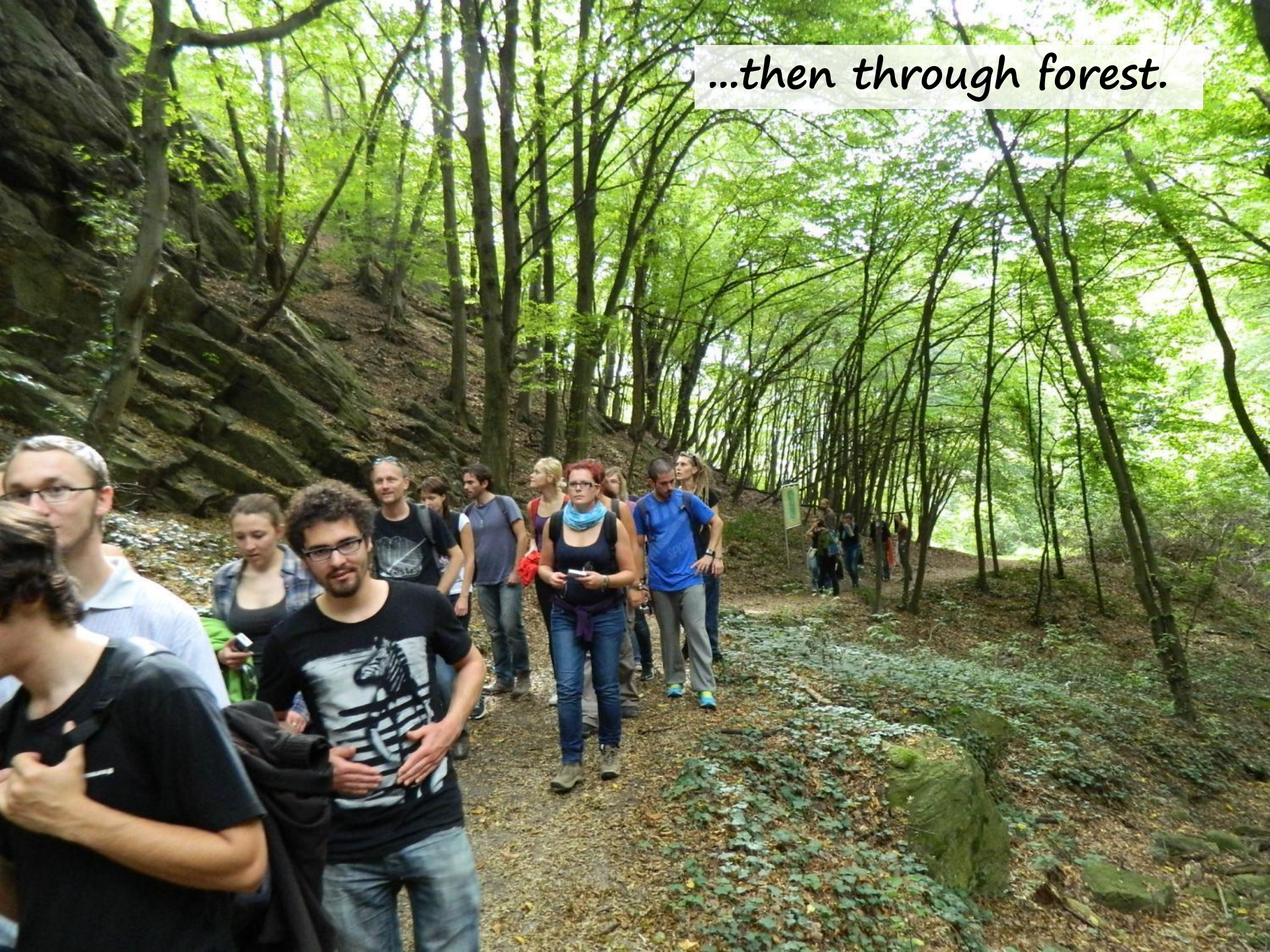


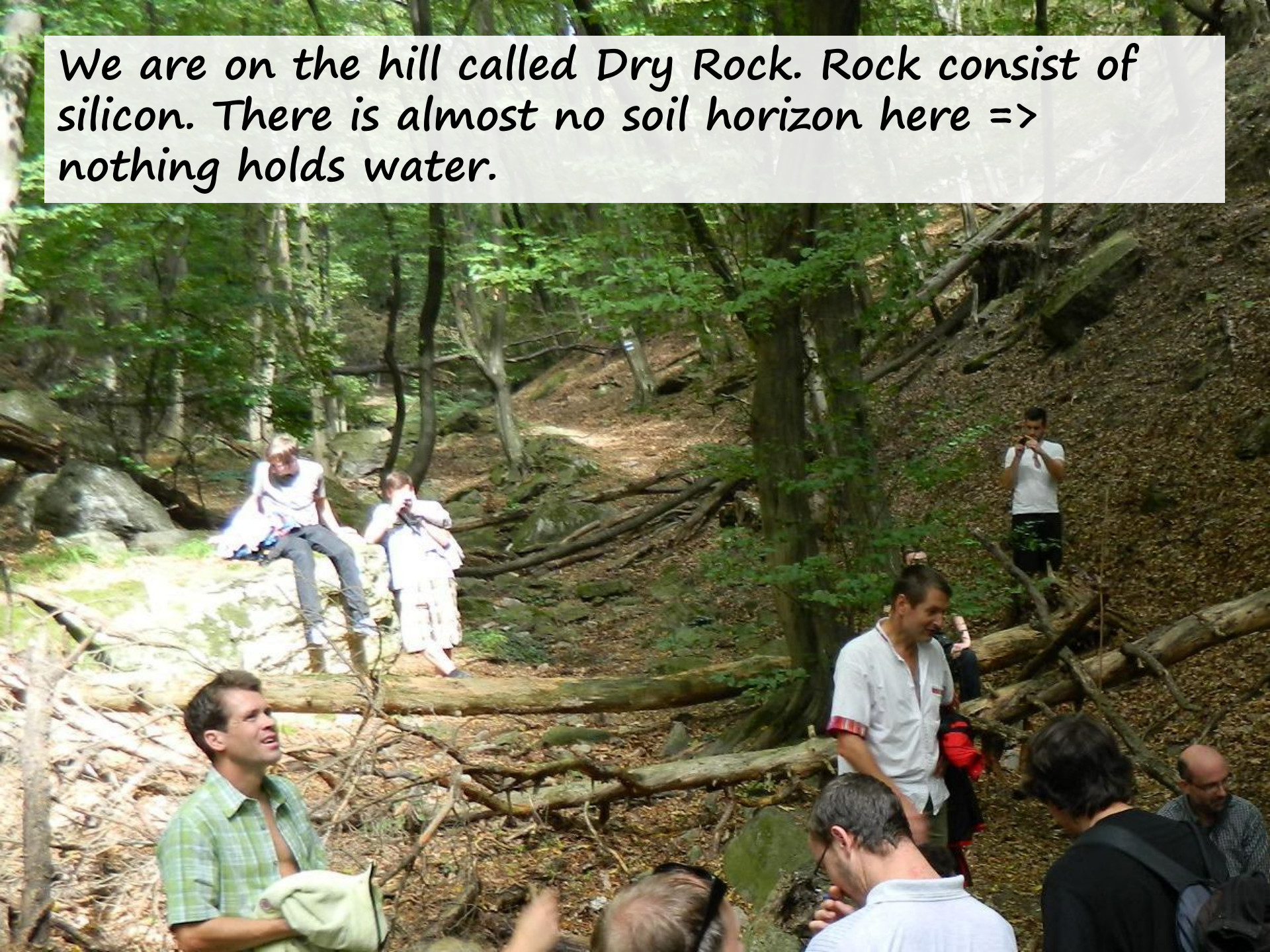

AUTODOPRAVA
Break till 13:05

Here is Donau river, which is different now (compared to previous time): shape of the river is different (more straight), divided into many reservoirs to produce electricity.


going up the hill...


...through the city...

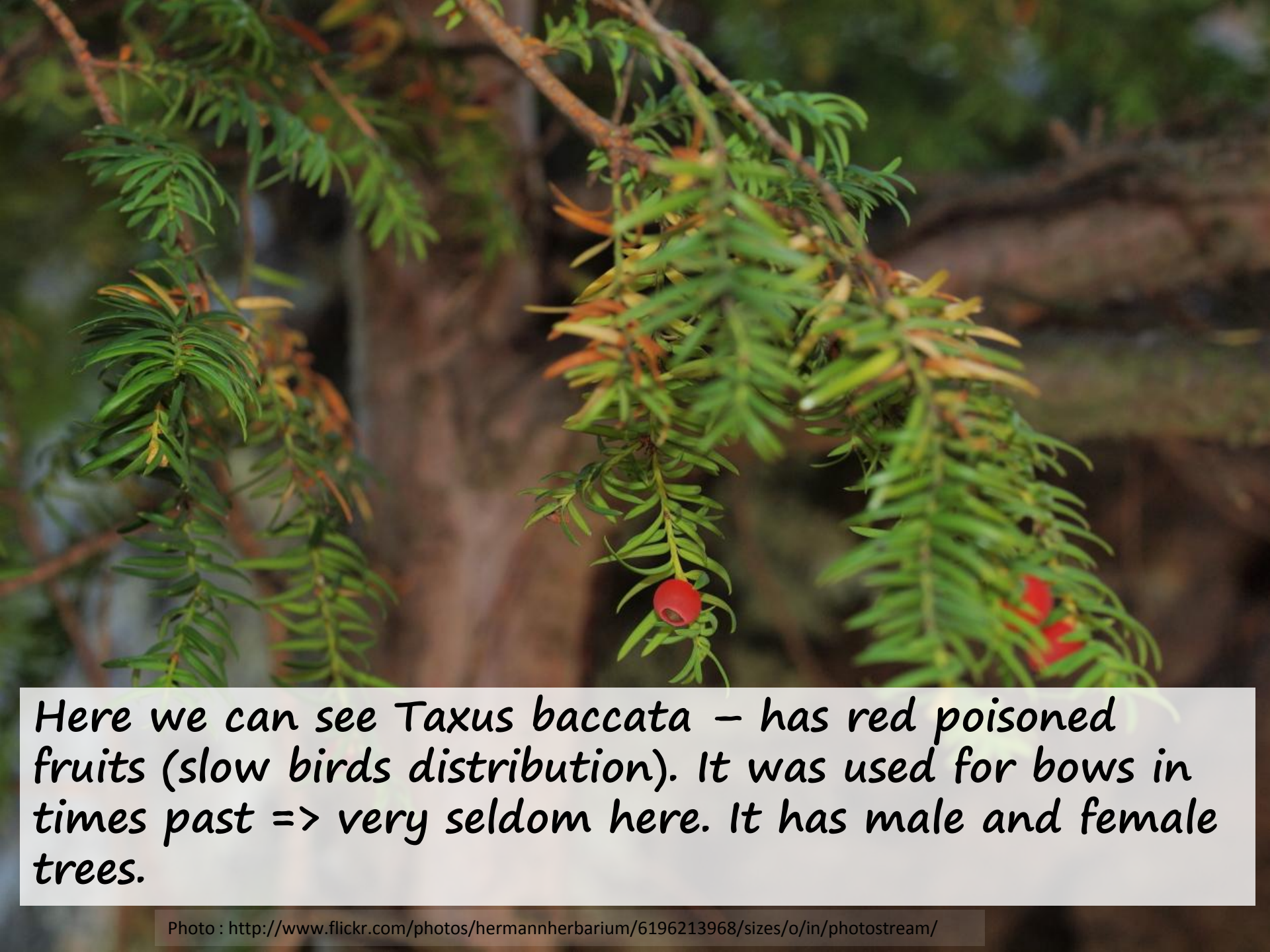

...then through forest.


We are on the hill called Dry Rock. Rock consist of silicon. There is almost no soil horizon here => nothing holds water.

Several enzymes are needed to completely decompose wood: legninase and cellulase. They are produced by fungi and bacteria.


And somewhere in the world there are species,
that can digest cellulose... (Teredo navalis).

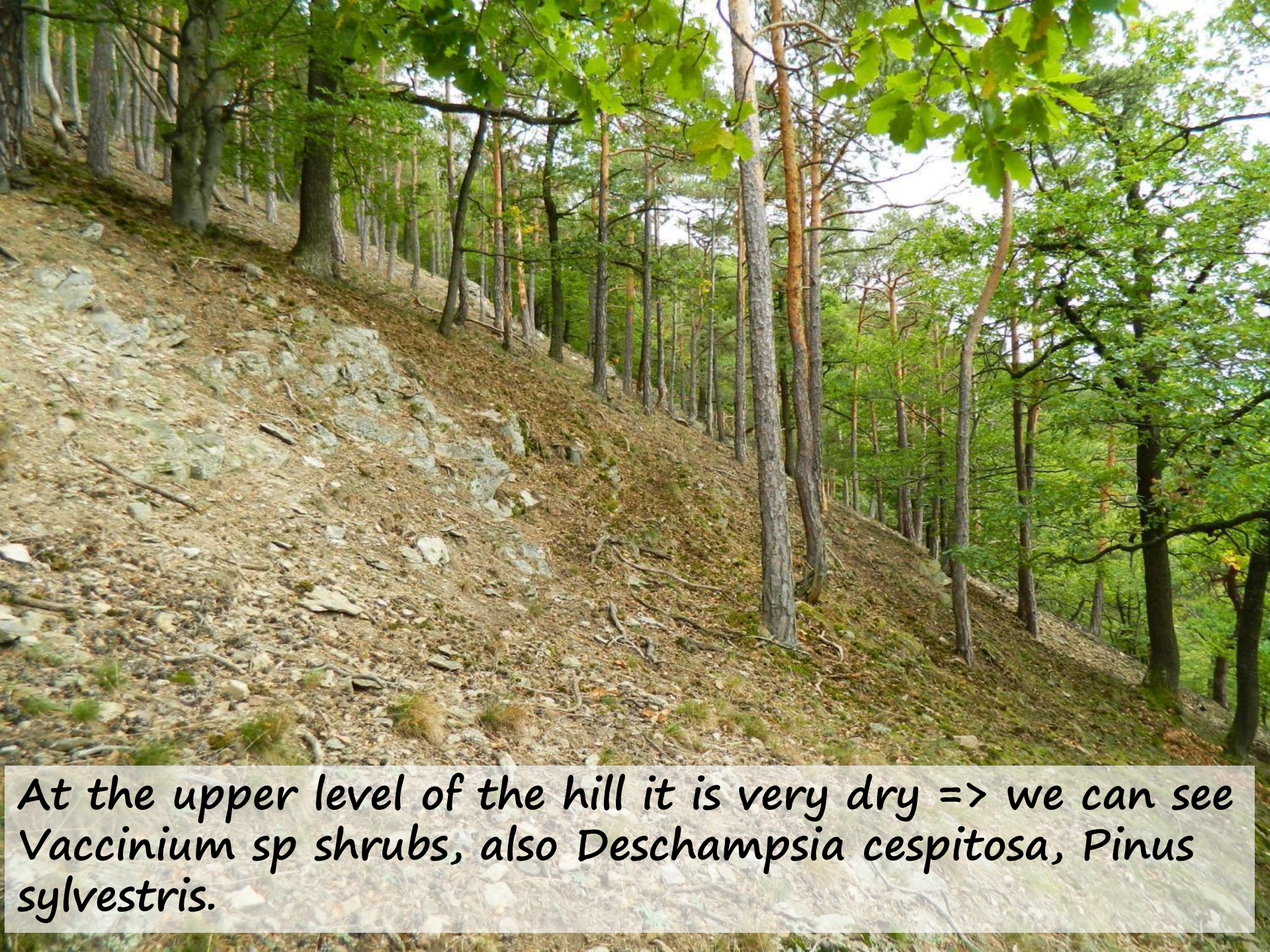
a lot of litter on slope – natural distribution of nutrients.



Here we can see Taxus baccata – has red poisoned fruits (slow birds distribution). It was used for bows in times past => very seldom here. It has male and female trees.

Photo : http://www.flickr.com/photos/hermannherbarium/6196213968/sizes/o/in/photostream/

14:50 reached the top of the mountain. Name of the place: Kreuzung Volelbergsteig, 542 m, N 48°24.536 / 15°31.657



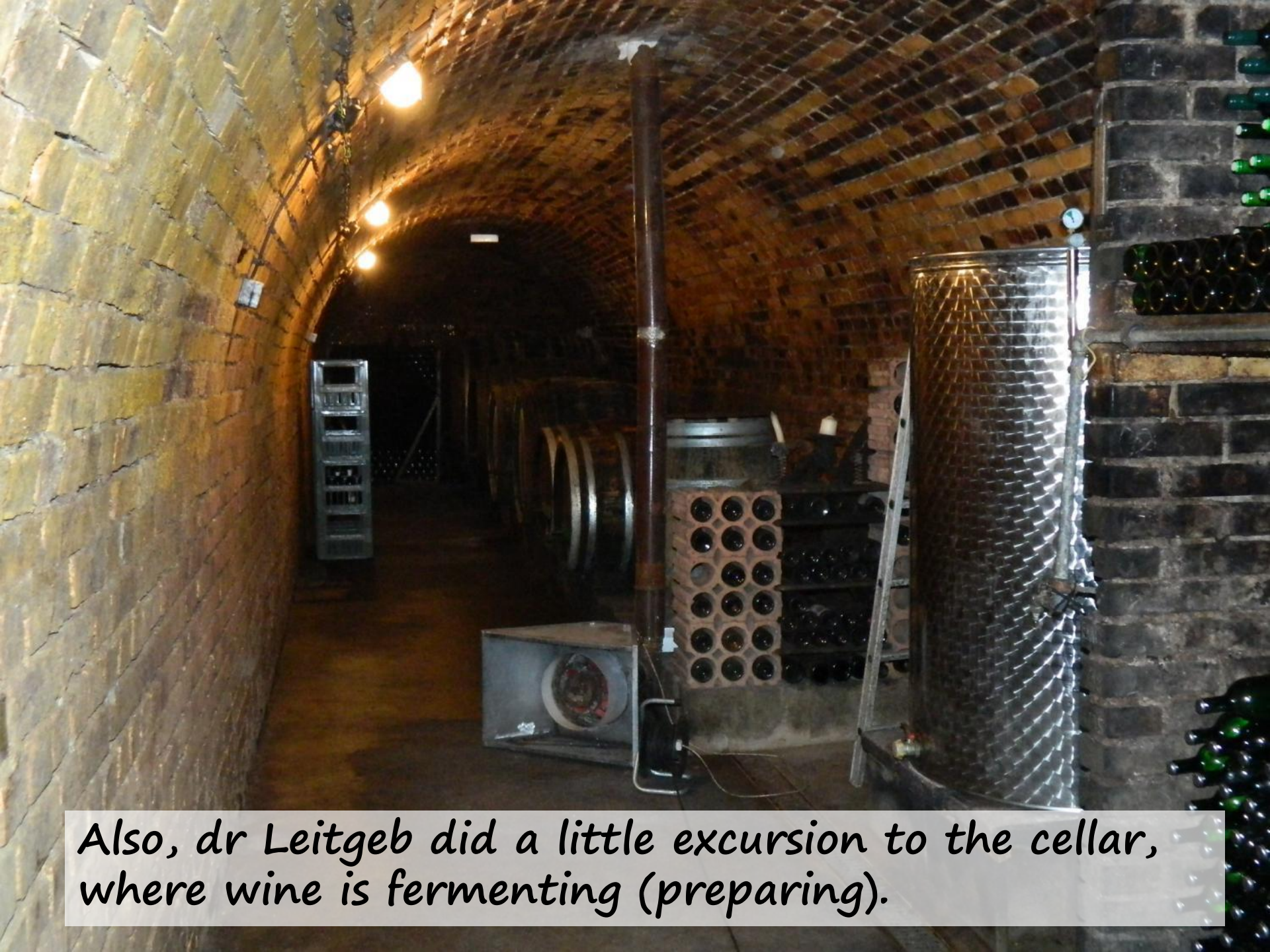
At the upper level of the hill it is very dry => we can see Vaccinium sp shrubs, also Deschampsia cespitosa, Pinus sylvestris.

Here is a castle Burgruine Dürnstein, 324m above the sea level, N 48°23.865 / 15°31.279


16:30 departure from Dürnstein

17:00 arrival to the dining place, which was organized by dr Leitgeb, who is a wine-grower as well.

He was very kind and everyone got an opportunity to taste last and this year's wine.



Also, dr Leitgeb did a little excursion to the cellar, where wine is fermenting (preparing).

19:30 departure