FOREST ECOLOGY

Seminars Guide

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<u>Seminar 1:</u> Introduction to Forest Ecology. Basic terminology and definitions

Objective: Revision of basic concepts, clarify the basic dependencies and relationships.

<u>Topics:</u>

Ecology: is the scientific study of interactions among organisms and their environment, such as the interactions organisms have with each other and with their abiotic environment.

Community (biocenosis): is an assemblage or associations of populations of two or more different species occupying the same geographical area. Biocenosis = zoocenosis + phytocenosis + microbiocenosis.

Ecosystem: is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.

- concepts related to ecosystem **– habitat, biotop, geobiocenosis, structure of forest ecosystem, dynamic of forest ecosystem.....**

Biome: biomes are climatically and geographically defined as contiguous areas with similar climatic conditions on the Earth, such as communities of plants, animals, and soil organisms,[1] and are often referred to as ecosystems. Some parts of the earth have more or less the same kind of abiotic and biotic factors spread over a large area, creating a typical ecosystem over that area. Such major ecosystems are termed as biomes. Biomes are defined by factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needleleaf), plant spacing (forest, woodland, savanna), and climate.

- Presentation of zonobiome **- Temperate deciduous forests (temperate broad-leaf forests)** – middle Europe
- Presentation of orobiome **- Spruce montane forests** – middle Europe

References:

Thomas P.A., Packham J.R., 2007: Ecology of Woodlands and Forests. Description, Dynamics and Diversity. Cambridge. 528 s.

<u>Seminar 2:</u> Development of forests of Middle Europe in Holocene, human impact

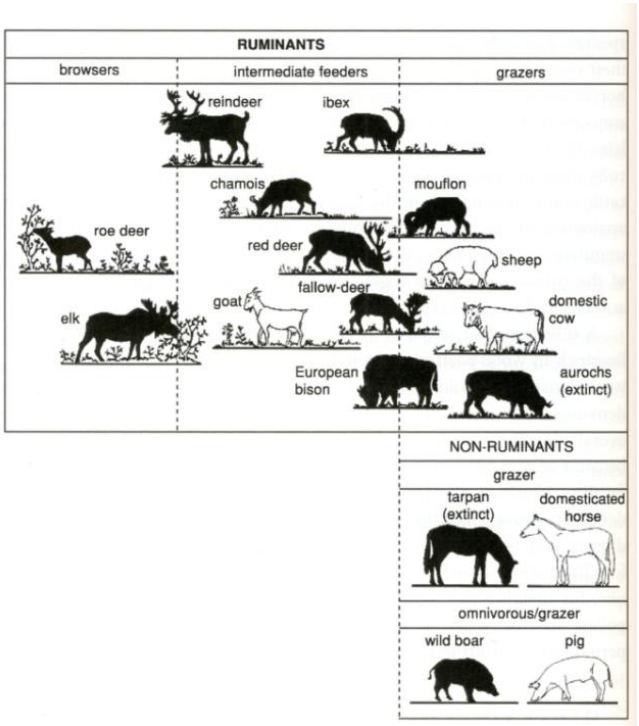
Objective: Defining basic historical periods during the Holocene, focusing on changes in species composition of trees and types of forest ecosystems caused by the dynamics of natural conditions (climate, soil, biotic factors) and the influence of man.

<u>Topics:</u>

1. The definition of the historical period of the **Holocene**

2. **The Vera hypothesis** - How open were European primeval forests?

3. Documentary film: Planet Earth – Seasonal Forests



References:

Vera F., 2000: Grazing Ecology and Forest History. CABI *Publishing.* 506 pp.

<u>Seminar 3:</u> Primary production of forest ecosystems - a function of abiotic factors

Objective: Revision of basic concepts related to the climate in forest ecosystems and the factors affecting of primary production, including knowledge of photosynthesis.

<u>Topics:</u>

Basic factors influencing the process of photosynthesis:
1. Light: solar radiation

- **Solar constant**: is the amount of incoming solar electromagnetic radiation per unit area.

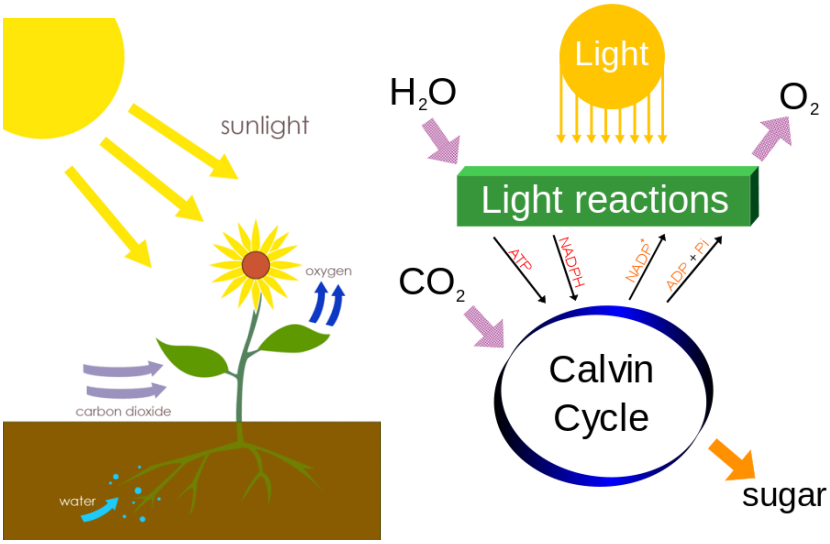
- **Photosynthetically active radiation** (PAR): designates the spectral range (wave band) of solar radiation from 400 to 700 nanometers that photosynthetic organisms are able to use in the process of photosynthesis.

- **The compensation point:** is the amount of light intensity on the light curve where the rate of photosynthesis exactly matches the rate of respiration.

2. Temperature:
Temperature limit for assimilation in higher plants:
minimum 1 - 5 °C
optimum 20 - 30 °C
maximum 40 - 50 °C (mainly 30 - 40 ºC)

3. Nutrients: main biogenic elements are **N, P, K, Ca, Mg.** Is necessary for photosynthesis **C**.

4. O_2: 21% (by volume of the atmosphere)
5. CO_2: 0.03 /0.04/ % (by volume of the atmosphere)



Seminar 4: Biodiversity in forest ecosystems

Objective: Example assessment of local biodiversity of selected forest stands in model group of small mammals

P1 – spruce monoculture (105 years), P2 – mixed forest (*Fagus sylvatica*, *Abies alba*, *Picea abies*) (125 years), P3 – spruce monoculture (30 years), P4 – beech monoculture (40 years). NTP – number of traps and trap nights

Identified species	P1		P2		P3		P4	
	Ind.	rA	Ind.	rA	ks	rA	Ind.	rA
Apodemus flavicollis	23	**1,28**	23		9		19	
Apodemus sylvaticus	4	*	1		8		4	
Myodes glareolus	5		4		23		2	
Microtus arvalis	1		0		0		0	
Sorex araneus	1		0		0		1	
Total number of ind.	34		28		40		26	
NTP	1800		1440		1800		1800	
H´	**1,004**							
E	**0,628**							

Total number of small mammals – 128 ind. * - fill in the blank boxes

Procedure: calculation of basic ecological characteristics of populations and communities

1.) *Relative abundance:*
rA = n/NTP . 100; n = number of individuals, NTP – number of traps and trap nights
rA = 23/1800 . 100
rA = **1,28** pro *Apodemus flavicollis* (see table)

2.) *Dominance:*
D = n_i/n . 100 (%); n_i – number of individuals of one species, n – number of individuals of all species
D = 23/34 . 100 = **67,7%** for *Apodemus flavicollis*

Eudominantní: > 10%, dominantní 5-10%, subdominantní 2-5%, recedentní 1-2%, subrecedentní < 1% (Losos et al. 1984).

3.) *Diversity*

- $H' = H' = - \Sigma (n_i/n). \ln(n_i/n)$

Procedure of calculation - H´:

	$n_i/n \; . \; \ln (n_i/n)$
Apodemus flavicollis	0,677 . ln 0,677 = - 0,264
Apodemus sylvaticus	0,118 . ln 0,118 = - 0,252
Myodes glareolus	0,147 . ln 0,147 = - 0,282
Microtus arvalis	0,029 . ln 0,029 = - 0,103
Sorex araneus	0,029 . ln 0,029 = - 0,103

Σ - 1,004; as in the formula – Σ, convert the sign of the result + ,it means that the result is **H´= 1,004** (for plot P1 – see table)

4.) *Evenness*

E = H´/lnS (S = total number of species)

E = 1,004/ln5 = 1,004/1,61 = **0,628** (for plot P1 – see table)

Seminar 5: Water cycle in forest ecosystems

Objective: Presentation practical examples of changes in the water regime in the forest ecosystem. Repetition and practice basic terms associated with moisture regime in forest ecosystems. Calculations of selected parameters of moisture regime.

1. Basic concepts

Water balance – a water balance equation can be used to describe the flow of water in and out of a system.

The revenue component of the water balance

- precipitation vertical and horizontal
- water inflow surface and subsurface

Expenditure components of the water balance

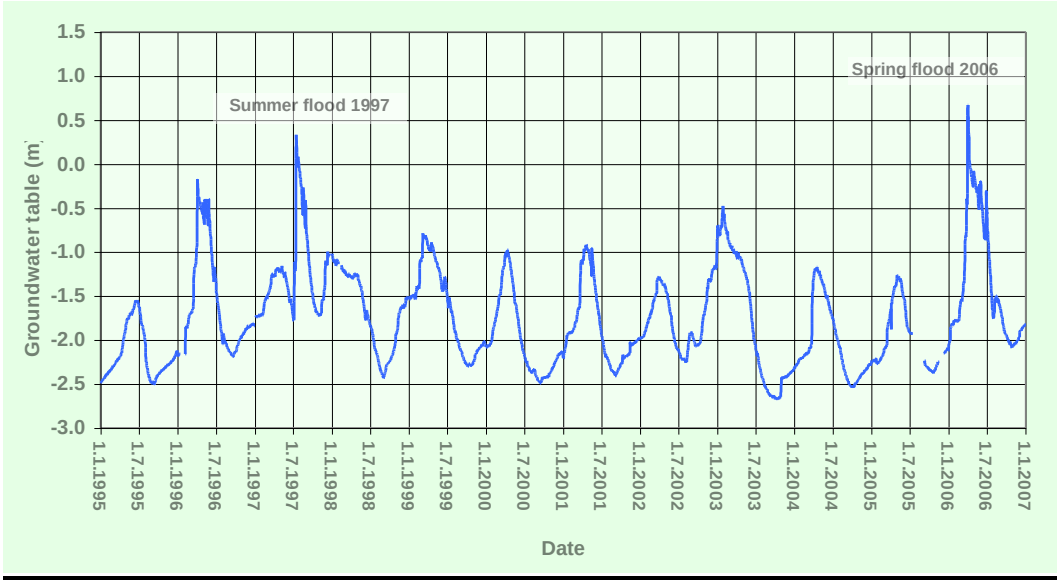
- evaporation (physical vapor)
- transpiration (evaporation physiological)
- drainage of surface and subsurface
- interception

Calculation of water balance:
a) long-term: precipitation = evaporation + drain + infiltration
b) short-term: **R = N – I – A – ET – Z**

R - changes in soil water content, N – precipitation, I – interception, A – drain, ET – evapotranspiration, Z – infiltration

2. A case study of the water regime of floodplain forests in South Moravia

Ranšpurk - an example of the dynamics of the natural water regime



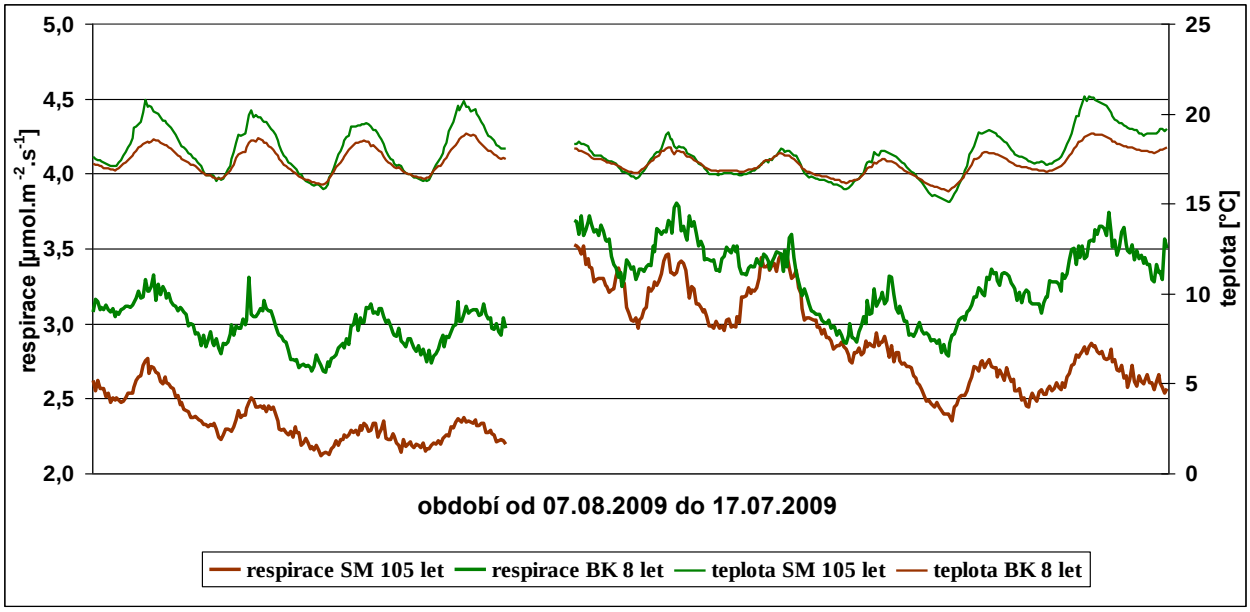
Seminar 6: Biogeochemical cycles of nutrients

Objective: Following the information from the lectures will be presented the results of research cycle of carbon and nitrogen through the case study of spruce and beech stand on Drahanská vrchovina Highlands (research stationary "Rájec").

Stand characteristics in the present study:

Forest cover	Age	Tree species composition
Spruce monoculture	105	SM 100
Mixed forest	125	BK 55, SM 45
Beech monoculture	125	BK 100

An example of the respiration rate and soil temperature at the site:



<u>Seminar 7:</u> Ecological stability and presentation of selected major biotic interactions in forest ecosystems - application in forest management

Objectives:

1. Presentation importance of biotic interactions for forest ecosystem functioning and management of forests (selected examples).
2. Discussion of selected Reports well illustrating the problem of ecological stability of the forest ecosystems.

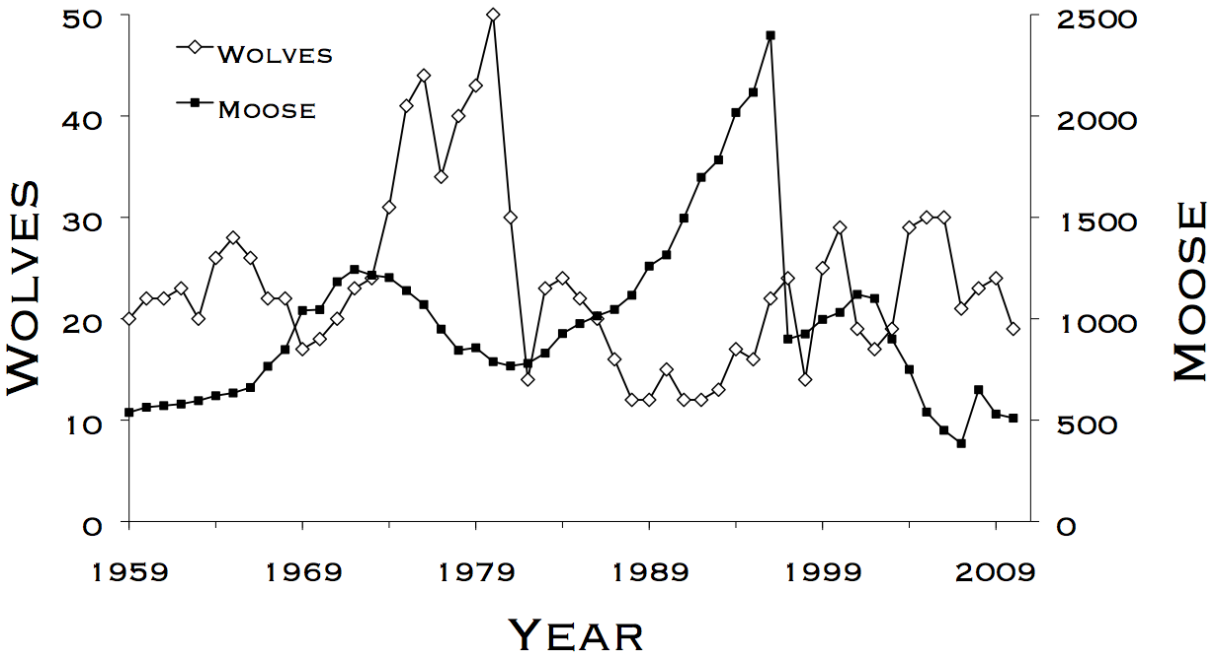
<u>Case studies:</u>

1. The issue of ecological stability of natural (climax) spruce forests vs. spruce monocultures (Šumava Mt. case study).

2. Autoregulation mechanisms of forest ecosystems – system of predator – prey

3. Biotic interactions as the basis of life strategies of plants and animals (r, K, C, S strategy)

Fig.: Predator-prey population dynamic in boreal forests (wolf and moose example)



References:

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<u>Seminar 8:</u> The Role of Forests in Global Ecology

Objective: Discussion of the global problems of forest ecosystems on the example of selected cases.

<u>Topics:</u>

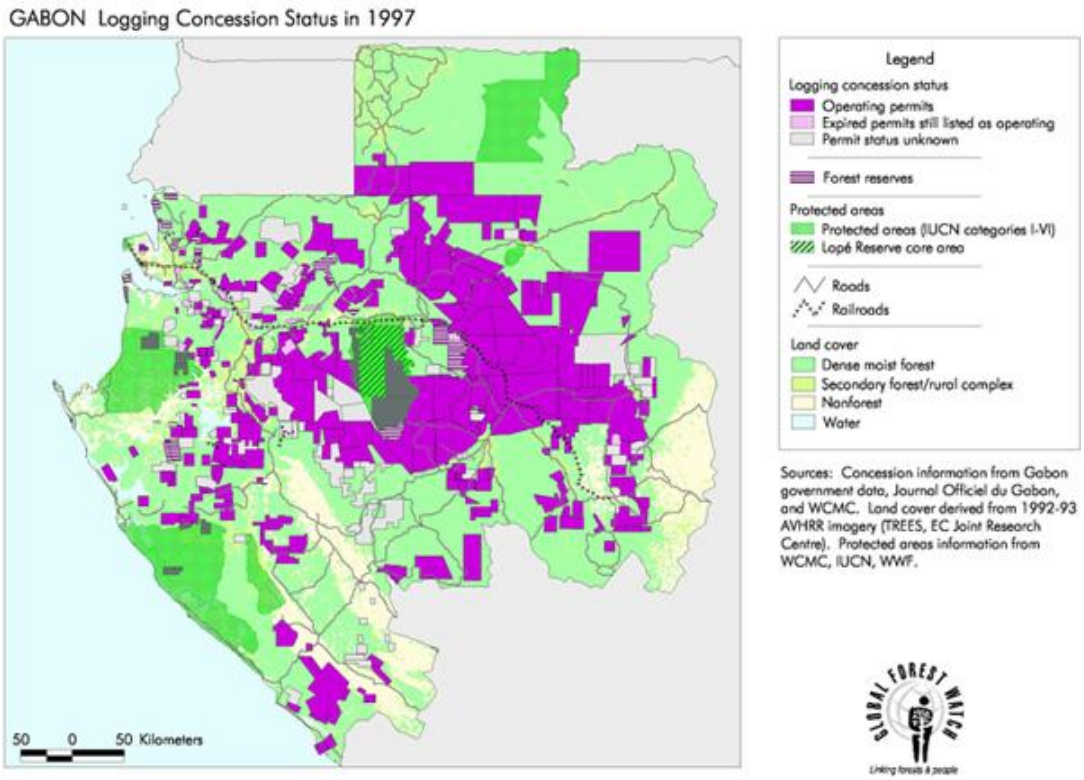
1. **The function of forests in the context of global climate change**

2. **Exploitation of the world's forests and biodiversity –** case studies from Amazon (cultivation of soybeans, cattle breeding) and Indonesia (oil palm plantations)

3. **International trade in valuable timber**

4. **The sustainability of the world's forests –** protection of pristine forests, certification, selective logging and its consequences, forest land cultivation (Terra Preta), carbon fixation.

Example unsustainable exploitation of tropical forests-based timber concessions (Gabon, West Africa)



References:

ANONYMOUS, 2010. Global Forest Resources Assessment 2010. Main report. FAO Forestry Paper 163. FAO, Rome. 378 pp.

ANONYMOUS, 2012. State of the World´s Forests 2012. Food and Agriculture Organization of the United Nations, Rome. 60 pp.