Spring semester, 2018-2019

Cooordinator	**Nina Pakharkova**
Credits	3 ECTS (required course), 54 in-class hours
Lecturers	**Nina Pakharkova** (Siberian Federal University, Russia)
Level	BSc
Host institution	**Siberian Federal University**, School of Ecology and Geography
Course duration	February 22 – May 26, 2019

Summary

The course is committed to examine the interaction processes between plants and their population with the habitat in different aspects (ecological plant physiology, population ecology and plant communities).

Target student audiences

Second year BSc students in ecology and environmental management

Prerequisites

Required courses (or equivalents):

- Anatomy and Morphology of Plants,
- General Ecology,

Goals and objectives

The discipline is designed to provide students with an insight into relations between plant and environment, basic principles and mechanisms of interaction between living organisms and the habitat at different levels of biological systems lay-out, impact of various factors on plants, phytocoenosis development systems.

The tasks assignment:

- Studying of theoretical basics of plant ecology (characteristics of interaction between environment and plants, causes of changes in flora species composition affected by human activities, phytocoenosis sustainability mechanisms; impact of environment factors on plant organism and its sustainability limits, adaptation to environment stress stimulus; environmental principles of rational use of plant resources).
- Developing knowledge and expertise for using cutting edge approaches of observatory, experimental and theoretical plant ecology.

Desired course outcomes:

«Plant Ecology» course discipline is entitled to develop professional knowledge regarding environmental impact on plants and their functional role in biosphere.

After completing the course, the student shall:

- develop familiarity with theoretical basics of plant ecology;
- be able to use cutting edge approaches of observatory, experimental and theoretical plant ecology.

Overview of sessions and teaching methods

The course includes classroom exercises and distant learning organized by means of electronic education technologies. Classroom exercises are based on interactive technologies such as business-case role play, round-table and mini-conferences discussions. Regional specification and characteristics of plant growth and evolution shall be considered in details by the example of Altitudinal zonation and Arctic region.

Course workload

The table below summarizes course workload distribution:

Activities	**Learning outcomes**	**Assessment**	**Estimated workload (hours)**
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools	Class participation	36
Moderated in-class discussions	Environment as Stress Factor: Stress Physiology of Plants	Class participation and preparedness for discussions	10
In-class assignments for group work	Ecology of Ecosystems	Class participation and preparedness for assignments	8
Independent work			
Preparation of a presentation for discussion at the seminar	The ability to competently and effectively present the material to the audience and enter into a discussion on topical issues of plant ecology	Presentation quality	54
Discussion of presentations on the e-learning course forum		creative and active contribution to discussion	
Reading and discussion of assigned papers for seminars and preparation for lectures Tests	Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature	Class participation, creative and active contribution to discussion	
Total			***108***

Grading

The students' performance will be based on the following:

- Level of preparedness for participation in class discussions and seminars (20 %) (from 100 % for active participation and demonstrated familiarity with the course readings to 0 % for completely ignoring in-class discussions);
- Contribution to seminar group assignments (20 %) (from 100% for clearly demonstrated input to 0 % for non-participation);
- Interactive e-course lectures (10%)
- Control testing (10%)
- Quality of the individual presentation (20%)
- Contribution to common project presentation (20%)

Course schedule

Lectures:

1. The effect of abiotic factors on plants (2 hours).
Ecological and physiological optima. The boundaries of tolerance. Stress, adaptation and acclimatization.
2. Light and plants (2 hours).
Amount of radiation and radiation balance. Light in the plant community. Photoperiodism and seasonality. Plants are long and short day. Red light signal in plant communities. Photophilous, shade-tolerant and shady plants. Relative light content and compensation point of plants.
3. The temperature regime of plants (2 hours).
Thermophilic and cryophilic plants. Temperature conditions in different phases of ontogenesis. Cold and frost resistance. Resistance to overheating. Ecology of fires.
4. The water regime of plants (2 hours).
Water potential and transpiration. Water shortage response. Xerophytes, mesophytes, hygrophytes and hydrophytes.
5. Mineral nutrition of plants (2 hours).
The value of macro- and microelements for plants. Signs of excess and lack of individual elements. Soil nutrient availability.
6. The interaction of plants with other organisms (2 hours).
Competition, predation, parasitism, allelopathy, symbiosis, protocooperation, commensalism, amensalism. Plant-plant, plant-animal, plant-fungus, plant-microorganism interactions.
7. Plant productivity (2 hours).
The concept of productivity. Primary production. Gross and net primary production. Methods of accounting for primary production in terrestrial ecosystems.
8. Areas of plants (2 hours).
Types of habitats, extent, natural breaks in habitats, population density of habitats, geographical relationships between habitats, climatic floristic zones, spectra of habitat types. Plant distribution, migration opportunities, modification, reduction of habitats. Biodiversity and the functioning of phytocenoses.
9. Ecology of vegetation (2 hours).
The structure of plant communities. The formation and dynamics of plant communities. Classification of vegetation types. The spatial structure of vegetation.
10. Vegetation of Earth biomes (2 hours).
Subarctic and arctic vegetation. Boreal forests. Deciduous forests of the temperate zone. Steppes and prairies. An area of winter-green forests of the Mediterranean climate. Humid tropical flat forests.
11. Features of alpine plants (2 hours).
Alpine vegetation of the highlands of the temperate zone. Mountain forests of the temperate zone. Vegetation of the highlands of the tropics and subtropics.
12. Features of introduced plants (2 hours).

Acclimatization of introduced plants. Competition with native species. Basic principles of introduction.
13. Air pollution and plants (2 hours).
Gas resistance of plants (types of resistance, mechanisms). Routes of toxic substances from the air to plants. Metabolic disorders under the influence of toxicants. The role of plants in the purification of the air.
14. Water pollution and plant (2 hours).
Features of aquatic and coastal plants. Plants are the first link of trophic chains of water bodies. Routes of toxic substances from the aquatic environment to plants.
15. Soil pollution and plant (2 hours).
Organic and inorganic toxicants in the soil. Routes of toxic substances from the soil into plants. Endo- and exomycorrhiza.
16. Phytoremediation in different environments (2 hours).
Phytoremediation of the air of cities (woody and shrubby plants) and enclosed spaces (indoor plants). Phytoremediation of water bodies (filter plants). Phytoremediation of the soil (battery plants).
17. Plants in artificial ecosystems (2 hours).
Features of plant growth in agroecosystems. Positive and negative aspects of monoculture. Plants in urban ecosystems. Features ruderal flora. Urban landscaping problems.
18. Mathematical modeling in plant ecology (2 hours).
Functional growth analysis. Classes of models, the main stages of their construction, mathematical tools involved at different stages of modeling. Mathematical methods for constructing models: differential equations, calculus of variations, cellular automata, neural networks, "organism" models.

Moderated in-class discussions
1. The limiting factor. Strategies for adapting plants to stress (2 hours).
2. The interaction of environmental factors. The boundaries of tolerance (2 hours).
3. The effect of abiotic environmental factors on plant photosynthesis (2 hours).
4. Carbon balance in different types of vegetation (2 hours).
5. The ecological importance of the most important micro- and macroelements for plants (2 hours).

In-class assignments for group work
1. Phenology and biological timing (2 hours).
2. Plants of the Krasnoyarsk Territory (2 hours).
3. The role of plants in artificial ecosystems (2 hours).
4. Plant ecology and environmental protection (2 hours).

Literature
Plant Ecology. E-D Schulze et al. (2019) Springer. Berlin, Germany ISBN 978-3-662-56231-4 ISBN 978-3-662-56233-8 (eBook) https://doi.org/10.1007/978-3-662-56233-8