

COURSE DESCRIPTION

Principiile Ecologiei Sistemice/ Principles of Systems Ecology

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Universitatea Babeş-Bolyai Cluj-Napoca
1.2. Faculty	Facultatea de Biologie și Geologie
1.3. Department	Departamentul de Taxonomie și Ecologie
1.4. Field	Biology
1.5. Level of study	Master's, 4 semesters
1.6. Degree programme / Qualification	Systems Ecology and Conservation
1.7. Form of education	Full-time

2. Course-related data

2.1. Course title	Principles of Systems Ecology			Course code	BME3101
2.2. Course coordinator	Lect. dr. Cristina Craioveanu				
2.3. Seminar coordinator	Lect. dr. Cristina Craioveanu				
2.4. Year of study	1	2.5. Semester	1	2.6. Type of assessment	Viva voce
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	2	of which: 3.2. course	1	3.3. seminar/ laboratory/ project	1
3.4. Total of hours in the curriculum	126	of which: 3.5. course	14	3.6. seminar/ laboratory	14
Time allocation for individual study (IS) and self-taught activities (ST)					hours
Learning from textbooks, course materials, bibliography, and notes (IS)					20
Additional research in the library, on subject-specific electronic platforms, and on-site					30
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					40
Tutoring (professional guidance)					4
Examinations					4
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				98	
3.8. Total hours per semester				126	
3.9. Number of credits				5	

4. Prerequisites (where applicable)

4.1. curriculum-related	Successful completion of coursework in plant and animal biology (botany and zoology), ecology, and biostatistics.
4.2. skills-related	Proficiency in computer use, including Microsoft Excel, Word, and PowerPoint.

5. Specific conditions (where applicable)

5.1. course-related	Classroom equipped with a multimedia projector and MS Teams.
5.2. seminar/laboratory-related	Classroom equipped with a multimedia projector and MS Teams. Mandatory student attendance at a minimum of 80% of seminars.

6.1. Competencies resulting from the completion of the degree programme (as referred to in the curriculum)

Professional competencies	
Competency code	Competency

PC1	The graduate can analyze ecological data, manage habitats, employ habitat survey techniques, conserve natural resources, develop environmental policy, assess environmental impact, conduct ecological surveys, assess contamination, manage the environmental management system, investigate pollution, ensure compliance with environmental legislation, carry out environmental audits, conduct environmental site assessments, develop environmental remediation strategies, implement environmental protection measures, report on environmental issues, write work-related reports
PC3	The graduate can collect biological data, apply scientific methods, gather experimental data, perform scientific research, collect samples for analysis, perform field research, and perform laboratory tests
PC4	The graduate can conduct ecological research, manage contracts, manage budgets, manage staff, manage contracts, develop scientific research protocols, write scientific papers, seek innovation in current practices
Transversal competencies	
Competency code	Competency
TC1	Working with numbers and measures: calculate probabilities, carry out calculations, interpret mathematical information, process spatial information, working with digital devices and applications

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)

Learning outcomes targeted by the subject		
Competency code	Knowledge and comprehension	Specific academic skills
PC1	1. Graduates identify the main theoretical concepts underlying the inventory and management of natural or anthropized ecosystems, analyze the structure, functions and dynamics of different ecological units; and identify the disruptive factors within.	1. Graduates apply the basic concepts in the field, evaluate the optimal methods for the analysis of the abiotic and biotic environment; and integrates theoretical knowledge with practical skills in interpreting causalities and remedial solutions.
PC3	2. Graduates apply the theoretical principles of basic biological sciences (such as genetics, anatomy, physiology, histology, etc.) in the field of environmental research.	2. Graduates integrate the methods of various biological sciences into the analysis of environmental components
PC4	3. Graduates learn methodologies involved in scientific research in the field of ecology and environmental protection, including project writing, data collection, data processing and interpretation, and finally dissemination of research results.	3. Graduates are able to conduct scientific research from the experimental design phase to the dissemination of results.
TC1	Graduates demonstrate an informed understanding of digital devices and applications and their use in accessing, managing, and communicating academic and professional information.	Graduates effectively use digital devices and applications to collect, process, analyze, and communicate data and information in academic and professional contexts.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. Graduates identify the main theoretical concepts in ecology and analyze the structure, functions, and dynamics of different ecological units.
2. Graduates apply the theoretical principles of ecology to explain the evolution, diversification, and stability of ecosystems.
3. Graduates acquire methodologies for experimental design and data analysis in different areas of ecology, as well as their interpretation.
4. Graduates demonstrate an informed understanding of digital applications and their use in database construction, data analysis, and the production of results suitable for academic communication.
Specific academic skills
1. Graduates apply fundamental concepts in the field and evaluate optimal methods for analyzing different ecosystem components.
2. Graduates integrate ecological data collection methods into the modeling of ecosystem processes.
3. Graduates are able to design a scientific research project from the design phase through to the dissemination of results.

4. Graduates effectively use digital devices and applications to collect, process, analyze, and communicate data and information in academic and professional contexts.

8. Contents

8.1. Course	Teaching and learning methods	Remarks		
Lectures 1–2: Systems theory: concepts, properties of biological systems; organizational hierarchies				
Lecture 3: Evolution of supra-individual biological systems: evolution, organizational and taxonomic classifications, origin of eukaryotes, origin of multicellularity, origin of sexual reproduction, emergent traits				
Lecture 4: Intraspecific interactions: sexual selection, natural selection, reproductive strategies, intraspecific relationships				
Lecture 5: Sociality: social systems and intra- and interspecific communication; beneficial traits at the individual and population levels				
Lectures 6–7: Population evolution: intraspecific interactions, specific methods for population analysis, density variation, population dynamics, regulation of population size, demographic strategies	Frontal lecturing, interactive methods, use of PowerPoint presentations, videos, and exercises.	Upon students' request and/or for other objective reasons, up to 30% of the total teaching hours may be conducted online or in a blended format.		
Lectures 8–9: Ecosystem evolution: ecological succession, biodiversity, speciation, coevolution, intermediate disturbance hypothesis, interspecific relationships, transect method, quadrat method, parameters used in ecosystem analysis				
Lecture 10: Ecological niche: spatial niche, functional niche, competitive exclusion principle, niche as a "hypervolume," fundamental vs. realized niche, contemporary perspectives on the niche, other theories/concepts of the ecological niche				
Lectures 11–13: Biome and biosphere: evolution at higher levels of organization, theories of global-scale interactions, globalization and global warming issues, elements of astrobiology				
Lecture 14: Consultations: discussions on course topics, guidelines for writing scientific essays, bachelor's/master's thesis in ecology, etc.				
Bibliography				
1) Pásztor, L., Botta-Dukát, Z., Magyar, G., Czárán, T., Meszéna, G., 2016, Theory-Based Ecology: A Darwinian Approach, Oxford University press, 301 pp.				
2) Ovaskainen, O., de Knegt, H.J., del Mar Delgado, M., 2016, Quantitative Ecology and Evolutionary Biology, Oxford University press, 285 pp.				
3) Begon, M., Townsend, C.R., Harper, J.L., 2006, Ecology, from individuals to ecosystems, (4th Ed.), Blackwell Publishing, Malden, 1-738				
4) Botnariuc, N., 1999, Evoluția sistemelor biologice supraindividuale, Edit. Universității din București, București				
5) Botnariuc, N., Vădineanu, A., 1982, Ecologie, Edit. Didact. și Pedagog., București				

6) Meffe, G.K., Carroll C.R. and contributors, 1997, Principles of Conservation Biology, (2nd Ed.), Sinauer Associates Inc. Publishers, Sunderland, Massachusetts		
8.2. Seminar/ laboratory	Teaching and learning methods	Remarks
1. Debate on systems of organization of the living world: organizational hierarchy vs. taxonomic hierarchy		
2. Viewing and discussion of short documentaries illustrating the evolution of multicellularity and sexual reproduction		
3. Exploration of mathematical and game theory models to explain individual behavior and the evolution of sociality		
4. Mathematical modeling of exponential population growth, illustrated with real-life examples		
5. Methods for analyzing intraspecific relationships and their quantification; interpretation of results		
6. Methods for analyzing social organisms and interpretation of data		
7. Quadrat method and mark-recapture method in population analysis; assumptions of mathematical models for population estimation; interpretation of population data		
8. Estimation of population density using the transect method: "eligible" populations, calculation procedures, interpretation		
9. Ecological succession studies; estimation of diversity; diversity and evenness indices; similarity of biotic communities; data analysis, interpretation, and discussion of results		
10. Ecological niche modeling: software, techniques, and methods; critical analysis of selected studies		
11. Methods of theoretical ecology in ecosystem and biome modeling		
12. Case studies; development of scientific research projects		
13. Review		
14. Colloquium		
Bibliography		
1) Ovaskainen, O., de Knecht, H.J., del Mar Delgado, M., 2016, Quantitative Ecology and Evolutionary Biology, Oxford University press, 285 pp.		
2) Battaes, K.P., 2012, Ecologie generală, ghid de lucrări practice, Presa Universitară Clujeană, Cluj-Napoca, 1-152		
3) Henderson, P.A., 2003, Practical methods in ecology, Blackwell Publishing, 1-163		
4) Krebs, C.J., 1999, Ecological Methodology, Wesley Longman Inc.		
5) Rîșnoveanu, G. (ed.), 2010, Caracterizarea sistemelor populaționale, Ars Docendi, Universitatea din București, 1-392		
6) Van Emden, H.F., 2008, Statistics for terrified biologists, Blackwell Publishing, 1-343		

9. Evaluation

Type of activity	9.1 Evaluation criteria	9.2 Evaluation methods	9.3 Percentage in the final grade
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9.4. Course	Students explain the principles of ecology from a systems perspective and select appropriate methods for modeling and data analysis to study specific ecosystem contexts.	Mixed-format multiple-choice exam with short-answer (synthesis) responses.	60%
	Students critically analyze the scientific literature and write an argumentative essay to support a controversial concept in ecology, then evaluate a peer's essay.	Argumentative essay and evaluation	40%
9.5. Seminar/ laboratory	Students develop research strategies based on concrete case examples.	Continuous assessment conducted throughout seminar sessions.	
9.6 Minimum standard for passing			
Participation in minimum 80% of the seminar sessions, writing an argumentative essay, and scoring a minimal 50% of exam points.			

10. SDG labels (Sustainable Development Goals)

		Sustainable Development Generic Label
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Date of entry:
07.04.2026

Signature of course coordinator
Lect. Dr. Cristina Craioveanu

Signature of seminar coordinator
Lect. Dr. Cristina Craioveanu

Date of approval in the department:
10.04.2026

Signature of the head of department
Lect. Dr. Florin Crişan