COURSE SYLLABUS

Phylogeograpghy and Numerical Analysis in Ecology

1. Data about the program

1.1 Higher education institution	Babeș-Bolyai University
1.2 Faculty	Faculty of Biology and Geology
1.3 Doctoral school	Integrative Biology
1.4 Field of study	Biology
1.5 Study cycle	Doctorate
1.6 Study program / Qualification	Doctoral training / PhD in Biology

2. Course data

2.1 Name and code of discipline	Phylogeography and numerical analysis in ecology (BDR1105)						
2.2 Teacher responsible for lectures	Mihai Pușcaș / Dan Gafta						
2.3 Teacher responsible for seminars	Mihai Pușcaș / Dan Gafta						
2.4 Year of study	I	2.5 Semester	I	2.6. Type of evaluation	C	2.7 Course framework	O

3. Estimated total time of teaching activities (hours per semester)

3.1 Hours per week	4	Out of which: 3.2 Lectures	2	3.3 Seminars / Laboratory classes	2
3.4 Total hours in the curriculum	48	Out of which: 3.5 Lectures	24	3.6 Seminars / Laboratory classes	24
Allocation of study time:					
Study supported by textbooks, other course materials, recommended bibliography and personal student notes					31
Additional learning activities in the library, on specialized online platforms and in the field					31
Preparation of seminars / laboratory classes, topics, papers, portfolios and essays					21
Tutoring					18
Examinations					26
Other activities: -					

3.7 Individual study (total hours)	127
3.8 Total hours per semester	175
3.9 Number of credits	7

4. Preconditions (where applicable)

4.1 Curriculum	• Genetics / Biogeography (undergraduate level) • Biostatistics (undergraduate level)
4.2 Competences	• Tabular calculations and graph production in electronic spreadsheets

5. Conditions (where applicable)

5.1 Conducting lectures	Logistic support (digital video projector)
5.2 Conducting seminars / laboratory classes	Logistic support (computer running under Windows 10 for each student) Access of students to the online platform Microsoft Teams Software for numerical analysis (R) Real and simulated datasets in electronic format Mandatory participation in at least 80% of the seminars

6. Specific competences acquired

Professional competences	• Knowledge and understanding of the general principles on the concepts of biodiversity, its levels of organization • Knowledge and understanding of spatial distribution patterns of intraspecific biodiversity and its determinants; • Knowledge of the main areas of refugia and post-glacial migration routes for the flora and fauna of Europe, with a focus on biomes in Romania; • Correct use of the concepts of intraspecific biodiversity, glacial refugia, endemism • Ability to choose the adequate type of numerical analysis according to the logical hypothesis and the types of available variables • Ability to perform numerical analyses, to interpret the outputs correctly and to validate the results • Ability to use the numerical analyses within the framework of the deductive method to be applied in ecological studies
Transversal competences	• Use of theoretical notions in solving practical problems of conservation of intraspecific biodiversity and its implications in the management of protected areas • Developing the capacity of using the numerical analyses in the ecologic management of biodiversity and natural habitats • Using the acquired knowledge in new circumstances • Applying the theoretical knowledge to practical problems

7. Course objectives (based on the acquired competencies grid)

7.1 The general objective of the course	• Knowledge and understanding of the organization of intraspecific diversity, its geographical distribution and its phylogenetic, phylogeographic and historical significance • Acquiring the ability of using the numerical analyses in the context of ecological studies
7.2 Specific objectives	• Understanding the general principles regarding the organization and spatial structuring of biological diversity; • Understanding the meanings of the main factors involved in the distribution of intraspecific biological diversity; • Identifying and characterizing the main important biogeographical regions that functioned as areas of refugia during the glacial periods for Europe's biodiversity; • Understanding the ecological and historical factors that have conditioned the current distribution of intraspecific biological diversity in Europe and Romania; • Developing the capacity to achieve inter, intra and multidisciplinary correlations in the context of the complexity of the field of biodiversity study; • Using the generalised, linear (mixed)/additive models for revealing relationships between bio-ecological variables • Employing different methods of multivariate analyses for the classification and ordination of ecological communities on the basis of their biological traits and/or environmental variables

8. Content

8.1 Lectures	**Teaching methods**	**Comments**
Introduction in phylogeography: concepts, methods, discipline development and the main historical stages that marked this field	Presentation and discussions	
Quaternary climate variations and their implications for the current distribution of biomes; The concept of glacial refugia	Presentation and discussions	
Molecular techniques used in phylogeographic studies	Presentation and discussions	
Basics of population genetics. Genetic diversity: interpretations of its spatial distribution	Presentation and discussions	
Phytohistorical considerations: Quaternary glaciations and phylogeography of plant species in Romania	Presentation and discussions	
Phylogeographic patterns of Carpathian animal species implications for conservation	Presentation and discussions	
Generalised linear (mixed) models	Presentation and discussions	
Generalised additive models	Presentation and discussions	
Classification and regression trees	Presentation and discussions	
Non-hierarchical cluster analysis	Presentation and discussions	
Redundancy analysis based on ecological distances	Presentation and discussions	
Non-metric multi-dimensional scaling	Presentation and discussions	
8.2 Seminars / laboratory classes	**Teaching methods**	**Comments**
Journal Club exercises, using representative articles of phylogeography	Case studies and exercises	
Spatio-temporal information (geographical, historical) on macroclimatic variations and their interpretation; analysis of the concept of glacial refugia and its importance for various groups of organisms	Case studies and exercises	
Notions of methods used in phylogeography: genetic markers (mitochondrial DNA in animals, chloroplastic DNA, mitochondrial DNA in plants, nuclear DNA, perspectives)	Case studies and exercises	
Analysis and interpretation of various patterns of intraspecific diversity: identification of glacial refugia and postglacial colonization routes	Case studies and exercises	
Analysis and interpretation of various current patterns of intraspecific diversity for dominant and key species of Romania's major ecosystems (I): the plant world	Case studies and exercises	
Analysis and interpretation of various current patterns of intraspecific diversity for dominant and key species of Romania's major ecosystems (II): the animal world	Case studies and exercises	
Performing generalised linear (mixed) models with real data	Case studies and exercises	
Performing generalised additive models with real data	Case studies and exercises	
Performing classification and regression trees with real data	Case studies and exercises	
Performing non-hierarchical cluster analyses with real data	Case studies and exercises	
Performing the redundancy analysis with real data	Case studies and exercises	
Performing the non-metric multi-dimensional scaling with real data	Case studies and exercises	
Bibliography:		

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- Avise JC, Arnold J, Ball RM, Bermingham E, Lamb T, Neigel JE *et al* (1987). Intraspecific phylogeography: the mitochondrial DNA bridge between population genetics and systematics. *Annu Rev Ecol Syst* **18:** 489-522.
- Bhagwat SA, Willis KJ (2008). Species persistence in northerly glacial refugia of Europe: a matter of chance or biogeographical traits? J Biogeogr 35: 464-482.
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- Legendre P., Legendre L., 2012. Numerical Ecology. 3rd edition. Elsevier, Amsterdam.
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9. Aligning the contents of the discipline with the expectations of the epistemic community representatives, professional associations and standard employers operating in the program field

- The content of the course aims at practical aspects related to the distribution and conservation of biodiversity in Romania and Europe, having an applicative character
- The course has a content similar to those of other European universities, with updated information, and is adapted to different skill levels of doctoral students
- The course content is focused on practical issues related to the numerical analysis and bio-ecological data modelling
- Along with the activities planned for the practical works, the doctoral students have the possibility to propose the adaptation of the given classes to the topics of their doctoral theses.

10. Examination

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final grade
10.4 Lectures	Assessment of knowledge	Interview	50%
10.5 Seminars / laboratory classes	Assessment of the acquired expertise and abilities	Testing queries Practical test on a PC	50%
10.6 Minimum performance standard			
• Knowledge of 50% of the information contained in the course • Acquisition of 60% of the skills practiced during seminars			

Date of issue	Signature of the teacher responsible for lectures	Signature of the teacher responsible for seminars
30.07.2024	Prof. dr Mihai Pușcaș Conf. dr. Dan Gafta	Prof. dr Mihai Pușcaș Conf. dr. Dan Gafta

Date of approval by the doctoral school council

Signature of the doctoral school director