SYLLABUS

1. General data

1.1 Institute	University Babes-Bolyai
1.2 Faculty	Biology and Geology
1.3 Department	Hungarian Department of Biology and Ecology
1.4 Study domain	Biology
1.5 Level	Master degree studies/ 4 semester/with presence
1.6 Study programme / Calcification	Terrestrial and aquatic ecology/Researcher

2. Data on course

2.1 Name of the course	Biogeography of Europe and Romania						
2.2 Holder of the course activity	Associate prof. dr. Keresztes Lujza						
2.3 Holder of the seminary work	Associate prof. dr. Keresztes Lujza						
2.4 Study year	1	2.5 Semester	2	2.6. Evaluation	E	2.7 Regime of the course	Ob.

3. Estimated total time (ours per semester)

3.1 Numbers of ours per week	4	From which: 3.2 courses	2	3.3 seminary work	2
3.4 Total hours in curriculum	126	From which: 3.5 courses	28	3.6 seminary work	28
Distribution of time					hours
Study from textbooks, course supports, bibliography and notes					8
Additional documentation in libraries, specialized electronic platforms and in the field					8
Preparation of seminars/homework's, papers, portfolios and essays					12
Tutorial					14
Examinations					16
Other activities: ex. field work					12

3.7 Total individual study hours	70
3.8 Total hours per semester	126
3.9 Number of credits	5

4. Preconditions (where applicable)

4.1 of curriculum	knowledge on taxonomy and general biogeography
4.2 of skills	it is not the case

5. Conditions (where applicable)

5.1 Course development	Classroom equipped with laptop, video, projector, and appropriate software and programs, Power Point, Multimedia, Programmes
5.2 Seminary development	idem

6. Specific skills aquired

Professional skills	• Time and space analyses of molecular diversity • The origin and evolution of Europe's biodiversity • The role of molecular biogeography in conservation biology • Integration of interdisciplinary disciplines
Transversal skills	• Learning advanced methods in the field of Biology • Development of interdisciplinary creative thinking • Application of theoretical knowledge in the practice of biodiversity conservation

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

7.1 The general obiective of the discipline	The general objective of the discipline is the interdisciplinary approach of the spatial projection of biodiversity, with the presentation of the main historical and geological processes that have contributed to the current biodiversity structure. Phylogeography is one of the youngest integrative disciplines that contributes to a better understanding of the evolution and structuring of the present biodiversity, using methods to investigate genealogical lines between populations using different molecular makers. The main role of phylogeography is to establish the links between the historical evolution of populations, such as population expansion, the bottle-neck effect, secular migration phenomena, vicariance with the current spatial structure (biogeography) of species and populations, which we will discuss in detail within the discipline.
7.2 Specific obiectives	The specific objectives of the discipline is to present the most widespread methods in phylogeography, with the approach of current topics. The discipline is divided into two separate but interconnected chapters, through an integrative approach. In the first part we present the most important analytical tools using in modern phylogeography, the spatial-temporal distribution of genes and the most important historical and geological factors that are the cause of these structures. The second part is intended to be a brief introduction to molecular biogeography, with selected case studies that contribute to a better visualization of current genetic structures of biodiversity of Europe. The ultimate goal of the course will be a better understanding of the speciation process, extinctions, and the effects of continental past events or glaciations on current biodiversity in the face of ongoing major changes in the environment.

8. Contents

8.1 Course	Teaching method	Observations
1. The premises of the appearance of phylogeography. The past, present and future of phylogeographic research. Getting started and current concepts. The connection of the discipline with biogeography, paleobiology or ecology.	The course will be presented using multimedia tools	2 hours
2. Molecular evolution. Mutations. Evolutionary models.	idem	idem
3. Methods of highlighting phylogeographic processes: methods based on mitochondrial DNA, data analysis, processes of genetic differentiation of populations, link with current environmental changes	idem	idem
4. Methods for highlighting phylogeographic processes: methods based on mitochondrial or nuclear DNA, detect MRCA, NCPA analysis, phylogenetic reconstructions	idem	idem
5. Genetic structure of populations, genetic variability, bottle-neck effect, historical demographic processes, evolutionary patterns.	idem	idem
6. Coalescence theory and application in phylogeographic research, assessment of divergence time.	idem	idem
7. Comparative phylogeography, repetitive processes. Discussion of case studies.	idem	idem
8. Genetic diversity of populations in the Carpathian area. The emergence and evolution of biodiversity in the Carpathian area.	idem	idem
9. Paradigmatic phylogeographic structuring of populations in the alpine (Carpathian) biogeographic region. Case studies.	idem	idem
10. Paradigmatic phylogeographic structuring of populations in the continental biogeographic region. Case studies.	idem	idem
11. Paradigmatic phylogeographic structuring of populations in the Pannonian biogeographic region. Case studies	idem	idem
12. Paradigmatic phylogeographic structuring of populations in the steppe biogeographic region. Case studies.	idem	idem
13. Paradigmatic phylogeographic structuring of populations in the Pontic biogeographic region. Case studies.	idem	idem
14. Application of phylogeography methods in conservative biology: conservative biogeography.	idem	idem

Bibliography* 1. Avise JC (2000): Phylogeography. Harvard University Press. 2. Avise JC (2004): Molecular Markers, Natural History, and Evolution, Sinauer Associates, Sunderland, Massachusetts. 3. Freeland JR, Molecular Ecology. Chichester (England): John Wiley & Sons, Ltd, 2005 4. Felsenstein, J. (2004): Inferring Phylogenies. Sinauer Associates, Sunderland, Massachusetts. 5. Ladle, R., Whittaker, R. (2011): Conservation Biogeography. Wiley-Blackwell. 6. Lomolino, M., Riddle, B., Brown, J. (2005): Biogeography. Third Edition. Sinauer Associates, Sunderland, Massachusetts. 7. Forró L. (2007): A Kárpát-medence állatvilágának kialakulása. Magyar Természettudományi Múzeum, Budapest. All books are available in the Zoology Library of the Faculty of Biology and Geology, as well as the personal library of Lujza Keresztes		
8.2 Seminary	Teaching methods	Observations
1. Overview of molecular taxonomy and phylogeography methods. DNA isolation techniques, PCR, RFLP, sequencing. Practice of DNA isolation, methods, kits used.	Seminary work will be organized using laptops and phylogeography programmes, multimedia tools	2 hours
2. PCR and choice of primers, loci used in phylogeography.	idem	idem
3. Electrophoresis and cloning, discussion of sequencing methods, control of PCR products by gelatin electrophoresis.	idem	idem
4. Molecular analysis. Correction and control of sequencing chromatograms received from analysis laboratories, using specific programs.	idem	idem
5. Analysis of sequences received or downloaded from the international database based on specific programs, maintenance and correction of genetic bases, building the library of DNA sequences.	idem	idem
6. Use of international genetic banks (NCBI, BOLD, etc.). Application of the BLAST program. Data collection for taxonomic or phylogenetic analysis.	idem	idem
7. Basic principles applied in the proper joining of sequences, recommended programs. Verification, attachment and correction of sequences downloaded from international genetic bases.	idem	idem
8. Phylogeographic methods: methods based on the analysis of genetic distance, methods based on the analysis of sequences. Substitution models in the case of nucleotide sequences, the issue of evaluation of genetic distances. Presentation of statistical analysis programs (eg MEGA), using different evolution models or different parameters. The issue of the gap.	idem	idem

9. Building a tree based on genetic distances: neighbor-joining by using programs (eg MEGA). Editing phylogenetic trees, ordering.	idem	idem
10. Methods based on the principle of parsimony, basic principles, possibilities and restrictions in genetic analysis. Calculations based on parsimony and the effects of adjusting the selected parameters.	idem	idem
11. Maximum-Likelihood methods: principles of use in phylogenetic evaluations, evaluation and selection of parameters (based on the ModelTest program).	idem	idem
12. Maximum-Likelihood methods: principles of use in phylogenetic evaluations (application of the PhylML program). Comparison of phylogeographic hypotheses with the results obtained with the ML method.	idem	idem
13. Bayesian methods, statistical programs, applicability.	idem	idem
14. Presentation and discussion of selected case studies using nucleotide sequences downloaded from international databases, presentation the phylogeography analyses results, commets.	idem	idem

Bibliography*:

1. Avise JC (2000: Phylogeography. Harvard University Press.
2. Avise JC (2004): Molecular Markers, Natural History, and Evolution, Sinauer Associates, Sunderland, Massachusetts.
3. Freeland JR, Molecular Ecology. Chichester (England): John Wiley & Sons, Ltd, 2005
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9. Corroborating the contents of the discipline with the expectations of the representatives of the epistemic community, professional associations and representative employers in the field related to the program

• The content of the discipline is in accordance with other national university curriculum and abroad.
• Graduates of this course can use their knowledge gained in the laboratory work, in education, in the environmental departments of public institutions (profile ministries) and local (county and municipal councils), Environmental Agencies, Administration of the Romanian Waters, Environmental Guard, National and Natural Parks Administrations or other types of protected areas, various biological laboratories (ecotoxicology laboratories, clinical laboratories), etc. They can be integrated into private companies / NGOs or NGOs that offer environmental consulting services or biotechnology services. At the same time, the notions specific to the course constitute a starting point towards the higher level of training, represented by

the master's and doctoral programs, in the field of biology and ecology.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Methods of evaluation	10.3 Percent from the final note
10.4 Course	Creativity in accruing new knowledge	Oral examination	50%
	Active participation to the course (80%)		
10.5 Seminary work	Presentation of the result of individual projects	Oral examination	50%
	Participation in 100% to seminary discussions		
10.6 **Minimum performance standards**			
• Presentation at the final exam is possible only after a 80% attendance at the course and 100% at the seminary activities. Only those who have passed all the partial exams participate in the final exam, and the final mark for the practical exam is higher than 5. • In case of motivated absences it is possible to visit the material outside the mandatory hours every week on Friday, between 10 am and 1 pm. • Plagiarism during practical and theoretical exams entails the exclusion of the student from the exam Final note – 50% theory + 50% seminary work			

Date of completion:	Signature of the course holder	Signature of the seminary
20.02.2023	associate prof. dr. Keresztes Lujza	associate prof. dr. Keresztes Lujza

Date of approval in the department	Signature of the department director
22.02.2023	associate prof. dr. László Zoltán