COURSE DATA

DATA SUBJECT

Code: 33059
Name: Biogeography
Cycle: Undergraduate Studies
ECTS Credits: 5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1100 - Degree in Biology	Facultat de Ciències Biològiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1100 - Degree in Biology	Complements of biodiversity and conservation	ELECTIVES

COORDINATION

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SUMMARY

The subject of Biogeography deals with the distribution of organisms, looking at how organisms can be integrated into the geographical areas they inhabit. This aspect implies that the theme includes the processes of dispersal and colonization that explain settlement in certain areas. However, permanence depends on intrinsic and extrinsic qualities of organisms, which operate during the two processes mentioned above, and therefore these qualities will also be dealt with. All of these ecological processes are discussed as an explanatory cause of the observed distribution patterns. In addition, the distribution of organisms is also explained from a historical perspective, since their presence or absence in geographical areas depends on their places of origin, geological changes and long-term evolutionary and phylogeographic processes, as well as their disappearance in certain places. Long-term dynamics and phylogenetic origins and extinctions are also discussed. Special attention is given to the biogeography of islands as environments that allow a better understanding of the changes of colonization, extinction and evolution of species. Continental patterns of diversity and ecogeographic rules, and their possible causes, are also discussed, both from ecological and historical perspectives. The distribution of organisms is linked to the dynamism of the distribution area, as this is not static but is related to the increase and decrease of the spaces occupied. These dynamic changes will be greatly influenced by environmental changes, and there is currently a discussion of how global warming may affect the biogeography of organisms, as an applied aspect. In this sense, we will also discuss the major human influence on the dispersal of organisms, so as the derived problems posed by the processes of biological invasions.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Since the presence of organisms in a given geographical area depends on the biotic and abiotic environment in which they are integrated, as well as their phylogenetic history, a prior knowledge of how organisms are able to tolerate environmental conditions and how they have evolved is necessary. This involves understanding the responses to the physical-chemical environment and the organisms with which they share the environment. Therefore, foundations of ecology, zoology, botany, microbiology, physiology, and evolutionary biology, as well as geography and geology, are necessary to recognize the importance of the physical context and its changes in the past.

COMPETENCES / LEARNING OUTCOMES

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Apreciación del rigor, el trabajo metódico, y la solidez de los resultados.

Capacidad de análisis, síntesis y razonamiento crítico.

Capacidad de análisis crítico de textos científicos.

Capacidad de organización, planificación y gestión de la información.

Capacidad de resolución de problemas y toma de decisiones.

Capacidad de utilización de herramientas matemáticas y estadísticas.

Conocer las interacciones entre especies.

Conocer los patrones de distribución geográfica de los organismos y sus causas.

Habilidad para el trabajo en equipo y en contextos multidisciplinares.

Realizar cartografías temáticas.

Saber analizar datos usando herramientas estadísticas apropiadas.

Utilización del lenguaje científico oral y escrito.

DESCRIPTION OF CONTENTS

1. Introduction (2 h)

1.1 The science of biogeography. Biogeographic questions. Inductive and hypothetico-deductive method. Patterns and processes. Experimentation in Biogeography. Related sciences and sub-disciplines.

1.2 History of biogeography. The pre-evolutionary period. The view from the Bible. Lineo and Buffon. Humboldt and the Geography of Plants. Lyell and Geology. Darwin and Wallace, evolution by natural selection, and zoogeography. Sclater and the classification of the world. Hooker. Extensionism and dispersalism. Wegener's continental drift.

2. Patterns (4 h)

2.1 Influence of the physical environment. Relief and anthropic structures. Geological structures, lithology, soil science, hydrology. Climate, atmospheric and oceanic circulation. Temperatures and precipitation.

2.2 Distribution of species and communities. Distribution range, scales, and temporal changes. Types of maps. Interpretation of distribution maps. Georeferenced databases. The niche in space, biotic and abiotic factors, niche models. Distribution-abundance relationship. Sources and sinks. Spatial autocorrelation.

3. Processes (5 h)

3.1 Dispersal and colonization. Basic processes in biogeography. The adaptive value of dispersal. Types of dispersal: long-distance, diffusion, and secular migration. Active and passive dispersal. Anemochory, hydrochory, zoochory. Migrations. Barriers, corridors, filters, stochastic routes. Establishment and expansion.

3.2. Speciation and extinction. The concept of species. Causes of speciation. Geography of speciation. Diversification. Allopatric speciation. Vicariance vs. dispersal. Sympatric speciation. Adaptive radiation. Parapatric and peripatric speciation. Microevolution and macroevolution. Extinction: causes. Historical contingency. Extinction-speciation relationship.

3.3 Paleogeography, paleoclimatology, and biogeographic dynamics Continental drift and plate tectonics. Paleozoic and Mesozoic. Paleomaps and paleobiogeography. Separation of Pangea. Paleoclimates. Biomes and biogeographic regions in the past. Sea level changes. Major extinctions. Paleogene and Neogene. The Messinian crisis. Biotic interchange. Quaternary. Glaciations: causes and detection. Changes in temperature, precipitation, and sea level. Glacial/interglacial biogeographic cycles in vegetation (pollen) and marine benthos (foraminifera, coral reefs). Refugia. Changes from the Pleistocene to the Holocene. Human impact. Postglacial recolonization. Extinctions of the Pleistocene megafauna.

4. Historical and evolutionary biogeography (4 h)

4.1. Endemism, provincialism and disjunction. Endemic and cosmopolitan organisms. Types of endemisms according to origin (autochthonous, allochthonous), taxonomy or geography (relicts) and age (palaeo-endemisms, neo-endemisms). Patterns in the distribution of endemisms. Provincialism: hierarchical

classification of the world. Kingdoms, regions, provinces and sectors. Transition zones, Wallace's line. Biogeographic classification of oceans and coastal areas. Disjunctions, boreoalpine and amphitropical. Maintenance of regions.

4.2. Historical reconstruction of lineages and their biogeography. Taxonomy and systematics. Phylogenetic systematics or cladistics. Cladograms and cladogenesis. Hennig's progression rule and centers of origin. The panbiogeography of Croizat. Brundin's phylogenetic biogeography. Cladistic or vicariance biogeography. Taxon-area cladograms. Parsimony analysis of endemicity (PAE), dispersal-vicariance analysis (DIVA), and BioGeoBears. Molecular phylogeny and phylogeography. Comparative phylogeography.

5. Ecological biogeography (5 h)

5.1. Island biogeography. Species-area relationship. Differences between insular and continental areas. MacArthur and Wilson's theory of dynamic equilibrium. Rescue, target and small island effects. Testing and data contrary to the theory. Diamond's assembly patterns and rules. The model of Lomolino. Equilibrium and disequilibrium. Modifications of the theory: energy, geological dynamics, and speciation. Dynamics of isolated populations. Reserves: the SLOSS debate. Minimum viable population and area. Metapopulations and metacommunities.

5.2. Evolution of island communities. Increased niche breadth. Loss of unnecessary traits. The island's rule. The taxonomic cycle.

5.3. Macroecology. Range size: effects of organism type and geographic area. Ecogeographic rules: Rapoport, Bergmann and the size-temperature rule (TSR), Allen, Jordan, Gloger, Lack. Latitudinal patterns of marine and continental diversity. Explanatory factors: temporal (historical and evolutionary), spatial (area), productivity, abiotic stress, and biotic interactions.

6. Conservation biogeography (6 h)

6.1 Effects of global warming. Climate change: observations and predictive models. Phenological effects. Changes in spatial distribution: latitudinal and altitudinal. Climate tracking capability. Implications for conservation. Species distribution models.

6.2 Biological invasion processes. Impacts on biodiversity. Terminology: exotic, non-native, introduced, and invasive. The invasion process: transport, establishment, expansion, and impact. Types of dispersal of alien species according to anthropogenic influence. Traits of invasive species and ecosystems susceptible to invasion. Management of invasive species.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	6,00
Theory	24,00
Laboratory	18,00

Computer classroom practice	2,00
Total hours	**50,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	18,00
Preparation of lessons	10,00
Preparation for assessment activities	22,00
Resolution of case studies	5,00
Total hours	**75,00**

TEACHING METHODOLOGY

The module consists of theoretical classes, seminars, tutorials, computer practicals and field practicals. The **theory** classes, with 22 hours, will be mainly taught in a hybrid type of expository teaching, that is, with some short participatory activities intertwined between the lectures. The two-hour **seminars** will consist of lectures by external experts on a particular topic of research in biogeography. The practicals in the **computer room** (2h) will consist of a brief presentation by the teacher of the topic to be covered and the practical use of computer programs to carry out statistical calculation or modelling exercises by the student, guided by the teacher and with discussion of the results. The practical field module (18 h) will take place in a natural space (if possible at Monfragüe National Park) for several days. After brief theoretical presentations by the teachers, the students will carry out activities to study organisms in their environment, including both the spatial distribution of terrestrial vertebrates and invertebrates as well as plants. In any case, the results obtained will be briefly discussed and it will be explained how to analyze them later for the preparation of a report of the activities and on the analysed data. In the group **tutorials** (6 h) we will discuss how the evaluation will be, giving examples and presenting the possibilities of choice as well as their pros and cons, and resolving doubts about it. There will also be presentations of oral works by students and both the content and formal aspects of them will be discussed so that students will have information on how to improve them. Finally, the organization of the field trip will be explained in another group tutorial, doubts will be resolved and the activities to be carried out will be discussed, as well as the way to evaluate them and what the students must deliver at the end of them.

EVALUATION

The student will be evaluated on both their theoretical and practical knowledge. The theoretical part includes the knowledge from theoretical classes, computer practicals, tutorials and seminars, as well as from continuous assessment activities suggested by the teacher and/or discussed in the classroom. For this theoretical part, **25%** of the final grade will be evaluated with a **multiple-choice** exam that will be eliminatory (a minimum of 4 points out of 10 must be obtained in order to be evaluated for the subject as a whole in the corresponding call). Another **10%** will be obtained from the **continuous assessment** and participation activities suggested by the teacher (exercises, comments, questions) and carried out by the students individually or collectively depending on each case. The rest of the theoretical part, **40%** of the final grade, will be evaluated either with a **written exam** with open questions, or with an **oral presentation** of a work, with questions from the teaching staff about aspects of the work or about theory classes. Overall, the theoretical part therefore constitutes 75% of the final grade from these three types of assessment

activities.

The evaluation of practical field activities will be a **25%** of the final mark. This includes the development of practicals in the strict sense, problem solving, and work resulting from the tasks described therein, set out in a **report** of practicals elaborated from data collected by the student himself in the field trip.

It will be necessary to obtain at least 40% of the maximum grade of each of the parts (theory and practice) separately in order to obtain the final grade. If this value is not achieved in one of the parts, the overall grade will be a fail corresponding to the minimum grade obtained in both parts (calculated on a maximum of 10 points).

REFERENCES

- Ladle, R. & Whittaker, R.J., 2011. Conservation Biogeography. Oxford Univ. Press
- Lomolino, M. V. Riddle, B. R. and Whittaker, R. J. 2017. Biogeography, 5th Edition. Sinauer.
- Whittaker, R.J. and Fernández Palacios, J.M. 2007. Island Biogeography. Oxford Univ. Press
- Brown, J. H., 1995. Macroecology. University of Chicago Press, Chicago.
- Cox, C. B. & Moore, P. D., 1980. Biogeography: an ecological and evolutionary approach. Blackwell, Oxford.
- Fernández-Palacio, J. M. y Morici, C. (Editores). 2004. Ecología Insular. AEET y Excmo. Cabildo Insular de La Palma. Rumagraf
- Hengeveld, R., 1990. Dynamic biogeography. Cambridge University Press, Cambridge.
- MacDonald, G., 2003. Biogeography. Introduction to space, time and life. Wiley, NY.
- Meaza G. (Ed.), 2000. Metodología y práctica de la Biogeografía. Ediciones Serbal, Barcelona
- Myers, A.A. & Giller, P.S., (Eds.), 1988. Analytical Biogeography. Chapman & Hall, London.
- Rosenzweig, M. L., 1995. Species diversity in space and time. Cambridge University Press, Cambridge.

- Spellerberg, I. F. & Sawyer, J.W.D., 1999. An introduction to applied biogeography. Cambridge University Press, Cambridge.