Approval date: 18/06/2024

COURSE GUIDE

Population and Community Ecology (2001131)

Grado (Bachelor's Degree)	Grado en Biología	Branch	Sciences
Module	Ecología	Subject	Ecología

Year of study	3º	Semester	1º	ECTS Credits	6	Course type	Compulsory course

PREREQUISITES AND RECOMMENDATIONS

- It is recommended to have completed the courses: The Physical Environment, Biostatistics and Biochemistry.
- Computer competences are recommended.

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

- Methodological and numerical bases in Ecology.
- Demography and population dynamics.
- Diversity and biodiversity.
- Interspecific interactions.

SKILLS

GENERAL SKILLS

- CG01 - Organisational and planning skills
- CG02 - Teamwork
- CG04 - Capacity for analysis and synthesis
- CG05 - Knowledge of a foreign language
- CG06 - Critical reasoning
- CG08 - Self-directed learning for continuous professional development
- CG09 - Oral and written communication in the mother tongue
- CG12 - Sensitivity to social and environmental issues
- CG13 - Skills in interpersonal relations
- CG17 - Information management skills
- CG18 - Interdisciplinary teamwork
- CG19 - Ethical commitment
- CG22 - Recognition of diversity and multiculturalism

SUBJECT-SPECIFIC SKILLS

- CE01 - Recognise different levels of organisation in the living system.
- CE05 - Identify organisms
- CE07 - Catalogue, evaluate and manage natural resources
- CE09 - Identifying and using bioindicators
- CE18 - Obtain, handle, conserve and observe specimens
- CE25 - Design models of biological processes
- CE27 - Diagnose and solve environmental problems
- CE28 - Sample, characterise and manage populations and communities
- CE29 - Manage, conserve and restore populations and ecosystems
- CE30 - Develop and apply biocontrol techniques
- CE32 - Assess environmental impact
- CE33 - Obtain information, design experiments and interpret results
- CE35 - Direct, write and execute projects in Biology
- CE43 - Knowing the types and levels of organisation
- CE68 - Understand functional adaptations to the environment
- CE69 - Understand biological cycles
- CE70 - Knowing the physical environment: hydrological, atmospheric and terrestrial
- CE71 - Knowing the structure and dynamics of populations
- CE72 - Understanding Interactions between species
- CE73 - Understanding the structure and dynamics of communities
- CE74 - Knowing the energy flows and biogeochemical cycles in ecosystems

LEARNING OUTCOMES

- **The student will know/understand:**
  - The principles and use of the scientific method, understanding its capabilities and limitations.
  - The key elements in the historical development of ecological thinking.
  - The methods and techniques commonly used in the discipline.
  - The relationships of organisms with the environment.
  - The structure and dynamics of populations, of interactions between species and of biological communities.
- **The student will be able to:**
  - Develop a critical spirit, sustained equally by a thirst for knowledge and curiosity on the one hand and scepticism towards the answers on the other, enabling them to evaluate the hypotheses they are faced with, generate alternative explanations, and suggest procedures for testing them.
  - Use reasoning and intellectual work as opposed to the rote storage of knowledge.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

- **Unit 1. Historical and conceptual introduction.** Historical development of Ecology as a science. Definitions of Ecology. Hierarchical organisation of nature. Emergent properties. Concepts of population, community and ecosystem. The biological, spatial and temporal scale in Ecology.
- **Unit 2. Methodological and numerical bases in Ecology.** The scientific method.

Contrasting hypotheses. Basic concepts of measurement and estimation. Statistical analysis. Observational and experimental studies: strengths and weaknesses. Experimental design. The use of models in Ecology. Definitions and types of models. Measures of population abundance, density and biomass. Census methods.

- **Unit 3. Abundance and distribution of species.** Ecological factors: conditions and resources. Types of response of organisms. Liebig's law of minimum and Shelford's law of tolerance. Interaction between factors. Physiological optimum and ecological optimum. Concept of ecological niche. Spatial distribution of populations. Electromagnetic radiation in aquatic and terrestrial environments. Thermal characterisation in terrestrial and aquatic ecosystems. Thermoregulation. Ecological thermal rules. Fluctuations and rhythms.
- **Unit 4. Demography and population dynamics.** Concept of population. Demographic parameters. Types of life cycles. Life tables. Life expectancy. Generation time. Survival curves. Net reproduction rate, intrinsic rate of increase and finite rate of increase. Reproductive value. Population dynamics of discrete and continuous generations. Population growth models: density-independent and density-dependent. Stochastic models. Matrix models. Life cycle patterns. r and K strategies.
- **Unit 5. Metapopulations.** Concepts of metapopulation and local population or demo. Colonisation, immigration and extinction. Target effect and rescue effect. Metapopulation dynamics. Applications in species conservation biology.
- **Unit 6. Competition.** Definition of competition. Types of competition. Principle of competitive exclusion. Lotka and Volterra model. Tilman's model of competition. Dynamic properties of interaction. Mechanisms of stable coexistence: independent and fluctuation-dependent. Factors that promote coexistence: environmental heterogeneity.
- **Unit 7. Antagonistic interactions.** Predator-prey system. Holling's functional responses and constraints. Numerical responses. Lotka and Volterra model and alternative models. Dynamic properties of the interaction. Defensive mechanisms of animal prey. Predator strategies. Predator-prey co-evolution: Red Queen Hypothesis. Herbivory. Overcompensation hypothesis. Defensive mechanisms of plants. Parasitism. Parasitoidism. Biological control of pests.
- **Unit 8. Mutualism and other types of positive relationships.** Definition of mutualism. Types of mutualism. Similar relationships: facilitation and commensalism. Dean's model of mutualism. Structure and stability of mutualistic networks.
- **Unit 9. Diversity and biodiversity.** Concept of community. Diversity and biodiversity: definitions and measurements. Models of abundance distribution and species diversity: the logarithmic series; the lognormal model; MacArthur's broken-rod model; geometric series model. Patterns of diversity in space: alpha, beta and gamma diversities. Determinants of local diversity. Intermediate disturbance hypothesis. Global biodiversity gradients: explanatory hypotheses.
- **Unit 10. Biogeography and metacommunities.** Relationship between specific richness and area. The theory of island biogeography: MacArthur and Wilson's model. Colonisation, immigration and extinction. Metacommunity concepts. Niche selection and mass effect. Metacommunity dynamics. The Unified Neutral Theory of Biodiversity and Biogeography. Applications in the conservation biology of natural areas.

PRACTICAL SYLLABUS

- **Practice 1 (laboratory).** Interaction analysis of ecological factors. Design and execution of a continuous experimental study with plants where students will take their own data, analyse them and draw the relevant conclusions.
- **Practice 2 (field).** Abundance and spatial distribution of two woody plants of the arid Mediterranean scrub. A field trip will be made to analyse the distribution of sagebrush (Artemisia barrelieri) and broom (Retama sphaerocarpa), as well as the interaction

between them.
- **Practice 3 (laboratory).** Thermal stratification in aquatic systems. A laboratory simulation of the cycle of a monomictic lake (stratification-mixing) will be carried out using an aquarium.

RECOMMENDED READING

ESSENTIAL READING

- **Theory:**
  - Begon, M. and Townsend, C.R. 2021. Ecology. From individuals to ecosystems, 5th ed. Wiley.
  - Begon, M., Howarth, R.W. and Townsend, C. 2014. Essentials of Ecology. 4th ed. Wiley.
  - Krebs, C.J. 2008. Ecology. The experimental analysis of distribution and abundance, 6th ed. Pearson.
  - Krohne, D.T. 2001. General ecology. Brooks/Cole.
  - Margalef, R. 1986. Ecología. Ediciones Omega.
  - Mittelbach, G.G. and McGill, B.J. 2019. Community ecology, 2nd ed. Oxford University Press.
  - Molles, M. 2013. Ecología. Conceptos y aplicaciones. 3rd ed. McGraw-Hill, Interamericana.
  - Odum, E.P. and Barret, G.W. 2006. Fundamentos de Ecología. 5th ed. Thomson.
  - Piñol, J. and Martínez-Vilalta, J. 2006. Ecología con números. Lynx.
  - Ricklefs, R. and Relyea, R. 2014. Ecology. The economy of nature. 7th ed. W.H. Freeman and Co.
  - Rockwood, L.L. 2015. Introduction to population ecology. 2nd ed. Wiley Blackwell.
  - Rodríguez, J. 2016. Ecología. 4th ed. Pirámide.
  - Sher, A.A. and Molles, M. 2022. Ecology. Concepts and Applications. 9th ed. McGraw-Hill.
  - Smith, T.M. and Smith, R.L. 2015. Elements of Ecology. 9th ed. Pearson.
  - Stiling, P.D. 2012. Ecology. Global insights & applications. McGraw-Hill.
  - Stiling, P.D. 2015. Ecology. Global insights & applications. 2nd ed. McGraw-Hill.
- **Practicals:**
  - Guisande, C., Vaamonde, A. and Barreiro, A. 2011. Tratamiento de datos con R, STATISTICA Y SPSS. Ediciones Díaz de Santos, S.A.
  - Hawkins, D. 2014. Biomeasurement: A Student's Guide to Biostatistics. 3rd ed. Oxford University Press.
  - Holmes, D., Moody, P. and Dine, D. 2016. Research methods for the biosciences. 3rd ed. Oxford University Press.
  - Quinn, G.P. and Keough, M.J. 2002. Experimental design and data analysis for biologists. Cambridge University Press.
  - Sokal, R.R. and Rohlf, F.J. 2012. Biometry. 4th ed. W.H. Freeman and Co.

COMPLEMENTARY READING

RECOMMENDED LEARNING RESOURCES/TOOLS

- Simulation software (populations, interactions, etc.): https://cbs.umn.edu/populus/download-populus
- Simulation software (island biogeography): http://virtualbiologylab.org/ModelsHTML5/IslandBiogeography/IslandBiogeography.html

TEACHING METHODS

- MD01 - Lección magistral/expositiva
- MD02 - Sesiones de discusión y debate
- MD03 - Resolución de problemas y estudio de casos prácticos
- MD04 - Prácticas de laboratorio y/o clínicas y/o talleres de habilidades
- MD05 - Prácticas de campo
- MD06 - Prácticas en sala de informática
- MD07 - Seminarios
- MD08 - Ejercicios de simulación
- MD09 - Análisis de fuentes y documentos
- MD10 - Realización de trabajos en grupo

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

- The assessment of the level of acquisition of general and specific competences by students will be carried out continuously throughout the academic period by means of the following procedures:
  - **SE1. Assessment of the level acquired through theory classes: 50% of the final grade.** Theoretical knowledge will be assessed by means of an exam consisting of multiple-choice questions, essay and reasoning questions, and problem solving, which will take place during the time scheduled for the ordinary final exam. At least **5 out of 10 is required** to pass this exam. The course will not be passed if this requirement is not met in the ordinary assessment.
  - **SE2. Assessment of the level acquired during the laboratory activities, field practicals and/or computer practicals: 30% of the final grade**. The evaluation of practical 1 "Interaction analysis of ecological factors" will be carried out by means of the oral presentation of a team work **(20% of the final grade of the course)**. Unjustified failure to attend more than two classes of practice 1 will make it impossible for the student to present the corresponding work, thus forfeiting 20% of the final grade of the course. Each unjustified absence below those mentioned above will subtract 0.25 points out of 10 from the final mark for the team work. In addition, there will be an exam on the contents of all the practicals of the course **(10% of the final grade of the course)**, which will take place during the time scheduled for the ordinary final exam. At least a **5 out of 10 is required** to pass this exam. The course will not be passed if this requirement is not met in the ordinary assessment.
  - **SE3. Assessment of the level acquired through seminars, problem classes and/or tutorials: 15% of the final grade.** Various assessment tests will be carried out during the course, such as seminars, questionnaires, submission of exercises and/or other assignments through PRADO or specific virtual tools (Kahoot, etc.).
  - **SE4. Assessment of the student's attendance, attitude and relevant participation in all planned training activities: 5% of the final grade.**

EXTRAORDINARY EXAMINATION DIET

- Those students who do not pass the course in the ordinary assessment may recover all or part of the course through a comprehensive exam, which will include a theoretical exam of knowledge and problem solving and an exam on the contents of all the practices of the course, equivalent in format and weight in the final grade to those of the ordinary exam, and which will take place during the time scheduled for the extraordinary final exam. At least a **5 out of 10 in each part (theoretical and practical) will be required** to pass this exam. Grades for seminars, attendance or any other activity related to continuous assessment will be retained, with their relative contribution to the final grade, for the extraordinary exam of the current academic year.
- However, those students who wish only the grade obtained in the exams of the extraordinary examination to be considered, thus renouncing the continuous assessment, must **communicate this by e-mail and in advance of the extraordinary examination** to the lecturer responsible. In this case, the final grade will result only from the student's performance in an exam, which will consist of a theoretical and a practical part, with a contribution to the final grade of **85% of the theoretical part and 15% of the practical part**. At least a **5 out of 10 in each part (theoretical and practical) will be required** to pass this exam.

SINGLE FINAL ASSESSMENT (evaluación única final)

- Students who are unable to follow the continuous assessment method due to work, health, disability, mobility programmes or any other duly justified reason that prevents them from following the continuous assessment system may apply for a single final assessment. To request the single assessment, the student, in the first two weeks of the course, or in the two weeks following his/her enrolment if this has taken place after the start of the course, will request it, through the electronic procedure, to the Director of the Department, alleging and accrediting the reasons for not being able to follow the continuous assessment system as indicated in Article 6, point 2 and Article 8 in the Regulations on Evaluation and Grading of Students of the University of Granada of 9 November 2016. http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes/
- This **single final assessment** on the total content of the programme will result only from the student's performance in an exam. This exam will consist of a theoretical and a practical part, equivalent to those of the extraordinary call, with a contribution to the final grade of **85% of the theoretical part and 15% of the practical part.** At least a **5 out of 10 in each part (theoretical and practical) will be required** to pass this exam.

ADDITIONAL INFORMATION

Información de interés para estudiantado con discapacidad y/o Necesidades Específicas de Apoyo Educativo (NEAE): Gestión de servicios y apoyos (https://ve.ugr.es/servicios/atencion-social/estudiantes-con-discapacidad).

SOFTWARE LIBRE

- R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.