COURSE GUIDE

Population and Community Ecology

Last updated date: 16/06/2021
Fecha de aprobación: 16/06/2021

Grado (Bachelor's Degree)	Bachelor's Degree in Biology	**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 taken 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 - Capacidad de organización y planificación
- CG02 - Trabajo en equipo
- CG04 - Capacidad de análisis y síntesis
- CG05 - Conocimiento de una lengua extranjera
- CG06 - Razonamiento critico
- CG08 - Aprendizaje autónomo para el desarrollo continuo profesional
- CG09 - Comunicación oral y escrita en la lengua materna
- CG12 - Sensibilidad por temas de índole social y medioambiental
- CG13 - Habilidades en las relaciones interpersonales
- CG17 - Capacidad de gestión de la información
- CG18 - Trabajo en equipo interdisciplinar
- CG19 - Compromiso ético
- CG22 - Reconocimiento a la diversidad y multiculturalidad

SUBJECT-SPECIFIC SKILLS

- CE01 - Reconocer distintos niveles de organización en el sistema vivo.
- CE05 - Identificar organismos
- CE07 - Catalogar, evaluar y gestionar recursos naturales
- CE09 - Identificar y utilizar bioindicadores
- CE18 - Obtener, manejar, conservar y observar especimenes
- CE25 - Diseñar modelos de procesos biológicos
- CE27 - Diagnosticar y solucionar problemas ambientales
- CE28 - Muestrear, caracterizar y manejar poblaciones y comunidades
- CE29 - Gestionar, conservar y restaurar poblaciones y ecosistemas
- CE30 - Desarrollar y aplicar técnicas de biocontrol
- CE32 - Evaluar el impacto ambiental
- CE33 - Obtener información, diseñar experimentos e interpretar los resultados
- CE35 - Dirigir, redactar y ejecutar proyectos en Biología
- CE43 - Saber los tipos y niveles de organización
- CE68 - Comprender las adaptaciones funcionales al medio
- CE69 - Conocer los ciclos biológicos
- CE70 - Conocer el medio físico: hídrico, atmosférico y terrestre
- CE71 - Conocer la estructura y dinámica de poblaciones
- CE72 - Conocer las Interacciones entre especies
- CE73 - Entender la estructura y dinámica de comunidades
- CE74 - Conocer los flujos de energía y ciclos biogeoquímicos en los ecosistemas

LEARNING OUTCOMES

- **The learner 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 and energy spectrum. Light in aquatic and terrestrial environments. Thermal radiation. Thermal characterisation of the atmosphere, oceans and continental water masses. 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. Predation: 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.
- **SEMINARS:** Preparation and presentation of a topic related to the theory and practical programme.

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 C.R. Townsend (2021) Ecology. From individuals to ecosystems, 5th 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.
  - Molles, M. (2013) Ecología. Conceptos y aplicaciones. 3rd ed. McGraw-Hill, Interamericana.
  - Odum, E.P. and G.W. Barret (2006) Fundamentos de Ecología. 5th ed. Thomson, México.
  - Piñol, J. and J. Martínez-Vilalta (2006) Ecología con números. Lynx.
  - Ricklefs, R. and R. Relyea (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.
  - Stiling, P.D. (2012) Ecology. Global insights & applications. McGraw-Hill.
  - Stiling, P.D. (2015) Ecology. Global insights & applications. 2nd ed. McGraw-Hill.
  - Begon, M., R.W. Howarth and C. Townsend (2014) Essentials of Ecology. 4th ed. Wiley.
- **Practicals:**
  - Guisande, C., Vaamonde, A. and Barreiro, A. (2011) Tratamiento de datos con R, STATISTICA Y SPSS.
  - Holmes, D., Moody, P. and Dine, D. (2016) Research methods for the biosciences. 3rd ed. Oxford University Press.
  - Hawkins, D. (2014) Biomeasurement: A Student's Guide to Biostatistics. 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.
  - Piñol, J. and J. Martínez-Vilalta (2006) Ecología con números. Lynx.

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:
  - **Attendance, attitude and participation of the student: 5% of the final grade.**
  - **Theoretical exams of knowledge and problem solving: 50% of the final grade.** At least a 5 out of 10 is required to pass this exam, both in the ordinary and extraordinary assessment sessions. The course will not be passed if this requirement is not met.
  - **Evaluation of practical activities: 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 seminar (**20% of the final grade of the course**). Unjustified failure to attend more than two classes of experimental design practice 1 will make it impossible for the student to present the corresponding seminar, thus forfeiting 20% of the final grade for the course. Each unjustified absence below those mentioned above will subtract 0.25 points out of 10 from the final grade of the seminar. In addition, there will be an exam on the contents of all the practices of the subject (**10% of the final grade of the course**). In order to pass the course, a minimum grade of 5 out of 10 must be obtained in this practical exam. The grades of the practical exam and the theory exam will not be kept from one course to the next.
  - **Continuous assessment theory tests and student attendance, attitude and participation: 15% of the final grade.** Various assessment tests will be carried out during the course, such as questionnaires, submission of exercises and/or other tasks through PRADO or specific virtual tools (Kahoot, etc.).

EXTRAORDINARY EXAMINATION DIET

- **Global exam** on the total content of the course syllabus, which will comprise **85% of the theoretical part and 15% of the practical part**: on-site exam.
- However, those who have passed either of the two exams (theory or practical) with a mark equal to or higher than 5 in the ordinary assessment session may request to keep the mark of that exam for the extraordinary assessment session by sending an e-mail to the teacher responsible for their group. The calendar of ordinary and extraordinary exams for the 2021-22 academic year can be consulted on the website of the Degree in Biology: http://grados.ugr.es/biologia/pages/infoacademica/convocatorias

SINGLE FINAL ASSESSMENT (evaluación única final)

- Students who are unable to follow the continuous assessment method for reasons of 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 their enrolment if this has occurred 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 consist of **a theoretical and a practical part, which will compute 85% and 15% of the final grade, respectively.** In order to pass the course, a minimum grade of 5 out of 10 in the overall exam will be a prerequisite