Universitat Autònoma de Barcelona

2020/2021

Spatial Ecology

Code: 42915
ECTS Credits: 6

Degree	Type	Year	Semester
4313774 Land Ecology and Biodiversity Management	OB	0	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Joan Pino Vilalta

Email: Joan.Pino@uab.cat

Use of Languages

Principal working language: spanish (spa)

Prerequisites

The course is based on a minimum knowledge of geographic information systems (GIS) and spatial analysis. An introductory course on GIS tools is recommended for those students lacking basic knowledge on theses subjects

There are online courses, such as the offered by the University of Alcalá de Henares (www.geogra.uah.es/gisweb/). On the other hand, the course will use the MiraMon software as basic GIS tool. Students of this course can have a free copy of the software through the website www.miramon.cat. Complementary MiraMon courses are regularly offered on the same website.

Objectives and Contextualisation

The spatial component is an essential element to understand the ecological processes at the population, community or landscape scales. It is of great relevance for terrestrial ecology and for the management and conservation of biodiversity. Evidence of this is the development, during the last decades, of the ecology of metapopulations, metacommunities and landscapes. These provide a theoretical framework for the analysis of species colonization and extinction and for understanding the effects of habitat fragmentation and of ecological connectivity loss on populations and communities.

Despite the importance of this spatial component, it is little considered in terrestrial ecology (and general ecology) courses, largely due to the historical scarcity of spatial data and methodological difficulties in their treatment. However, in recent years we have witnessed a revolution of methods and tools for the analysis of spatial processes, and the development of environmental map servers and spatially explicit biodiversity databases, many of them with online access. This opens a range of opportunities at both scientific and professional levels in terrestrial ecology and biodiversity management.

In line with these changes, the new degrees of biological and environmental sciences have incorporated courses of cartographic analysis in their curricula, which have significantly improved students' competencies for the treatment and analysis of spatial ecological processes. Therefore, we believe that the development of a spatial analysis module that combines advanced concepts and methods, shaped through a selection of case studies, is particularly appropriate.

Therefore, a mixed course is proposed, with theoretical and practical contents specified in a set of case studies. The first part will be devoted to the presentation of concepts of key spatial processes of disciplines

such as metapopulation, metacommunity and landscape ecology. This theoretical part will be completed with a complete set of spatial analysis tools, including databases and geographic information systems (GIS). These tools will be used in a series of case studies and in a course work.

Competences

- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Deal with the theory and practice of sustainable management and use of biodiversity and of terrestrial and aquatic biotic resources.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Know and correctly apply the basic theoretical concepts and the main tools of spatial ecology.

Learning Outcomes

1. Create and manage geo-referenced databases in GIS environments.
2. Describe the structure of a quantitative model and its main potential advantages and limitations, as well as its application to the solving of a particular problem and the premises on which it is based.
3. Develop spatially explicit models of ecological processes, such as metapopulation behaviour and ecological connectivity.
4. Develop specific methods of spatial analysis and interpolation.
5. Integrate different layers of information on environments using a common (spatial) reference system and apply this to solving a complex problem.
6. Integrate spatial ecology concepts into the analysis of ecological patterns and processes.
7. Know and apply the main tools used to evaluate the state of conservation of biodiversity in the territory and the main biotic and abiotic factors that determine it.
8. Know and correctly apply the main tools for the spatial analysis of data offered by GIS.

Content

Course contents will be structured in the following groups*:

Basic concepts:

- Spatial ecology: introduction and applications
- Patterns of distribution and spatial variation of ecological data. Spatial position concepts, heterogeneity, trend surface and spatial autocorrelation.
- Key ecological processes in space ecology. Dispersal and ecological connectivity.
- Population dynamics in a spatial context. Metapopulations
- Ecology of interactions in a spatial context. Metacommunities
- Spatial patterns and processes at landscape scale: diversity, fragmentation and dynamics of spots

Tools and methods:

- Geographic information systems (GIS): application to the spatial analysis of patterns and processes
- The MiraMon GIS: fundamentals and basic applications for spatial ecology
- Spatial pattern analysis using PASSAGE and MiraMon
- Analysis of metapopulations dynamics and connectivity using RAMAS and CONEFOR
- Analysis of landscape spatial pattern using FRAGSTATS
- Analysis of spatial correlation and interpolation using PASSAGE and MiraMon
- Spatial modelling with MaxEnt and MiraMon

Study cases:

- Analysis of species distribution patterns
- Metapopulation modelling

- Analysis of landscape spatial structure and change
- Development of landscape connectivity models
- Modeling and interpolation of spatial data

Course work:

Focused on some topics of spatial ecology and data provided by the professor

*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.

Methodology

The teaching methodology* aims to achieve student training objectives that include both the acquisition of knowledge and training for continue studying (the so-called academic and professional skills). A set of learning strategies will be combined so that the student has an especially active role throughout his training process. Practical strategies are the predominant, in line with the focus of the subject.

1) Directed activities

- Lectures. At the beginning of the course, a small number of lectures or lectures will be taught to present the basic concepts of the subject. They will be supported by PowerPoint presentations and various teaching material that will be delivered to the students at the beginning of the course.
- Classroom practices. Aimed at the presentation of the tools and methods of analysis and spatial modelling proposed.
- Sessions of problems and exercises. Focused on different methodologies of spatial analysis, by means of the resolution of the diverse study cases.
- Preparation of a course work. Carried out in class and focusing on some aspect and data of spatial ecology provided by the teacher.
- Presentation of the course work. Students will present the result of their course work in groups.
- Exam.

2) Supervised activities

- Completion of the course work started in class. It will be completed outside the classroom with teacher supervision
- Tutoring. During the course work, students must arrange a tutoring session with the teacher for the preliminary evaluation of the work. They may also arrange additional consultation tutorials.

3) Autonomous activities

- Personal study. From the materials taught in class and the additional materials provided by the teacher.

*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classroom practises	6	0.24	7, 2, 5, 6
Course work	6	0.24	7, 5, 6
Course work presentation	1	0.04	7, 2, 5, 6

Exam	1	0.04	7, 2, 5, 6
Lectures	6	0.24	6
Sessions of problems and exercises	15	0.6	3, 8, 7, 1, 2, 4, 5, 6
Type: Supervised			
Course work completion	20	0.8	7, 2, 5, 6
Tutorial sessions	5	0.2	3, 8, 7, 1, 2, 4, 5, 6
Type: Autonomous			
Personal study	53	2.12	3, 8, 7, 1, 2, 4, 5, 6

Assessment

Evaluation activities are the following*:

Delivery and oral defense of works (50% of the grade). The subject has an eminently practical nature, which must be translated into an especially important weight of evaluation activities related to this part. This evaluation will be carried out through a work partly developed under the direction of the teacher and partly outside the classroom, with supervision of the latter. Students will be organized in groups of 4-5 people and choose a topic related to space ecology and proposed by the teacher. The work will include a tutoring with the teacher, which will be the subject of a first formative evaluation. Subsequently, the work will be presented in class and delivered to the teacher in memory form for evaluation. The final grade of the work will be obtained from the preliminary tutoring (30% of the grade), the presentation in class (30%) and the memory (40%).

Exam (30% of the grade). It can include three types of questions:

- Short answer questions aimed at assessing whether the key conceptual objectives have been achieved, although there may be some more aimed at attitudinal or methodological values.
- Problems or exercises with numerical calculation, intended to evaluate the achievement of methodological objectives.
- Questions that imply a complex answer with the development of a topic or the approach of a method of analysis. We want to assess whether the student is able to explain and relate processes or complex concepts.

Class attendance and active participation (20% of the grade). Due to the eminently practical nature of the subject, regular class attendance and active participation are very important, and will be subjected to continuous evaluation throughout the course.

Definition of "approved": A student with an average grade equal to or greater than 5 will be considered approved
Definition of "not evaluated": A student will not be considered for evaluation if the evaluation of all the evaluation activities carried out does not allow him to reach the overall rating of 5 if he had obtained the highest score in all of them.

*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Class attendance and active participation	20	35	1.4	3, 8, 7, 1, 2, 4, 5, 6

Delivery and oral defense of works	50	1	0.04	3, 8, 7, 1, 2, 4, 5, 6
Exam	30	1	0.04	2, 5, 6

Bibliography

References:

Fortin, M.J. & Dale M. Spatial Analysis. A guide for ecologists. Cambridge University Press, Cambridge (2005).

Maestre, F., Escudero, A. & Bonet , A. Introducción al Análisi de Datos en Ecología. Universidad Rey Juan Carlos, Madrid (2008).

Collinge, S. K. Ecology of Fragmented Landscapes. Baltimore, MD: Johns Hopkins University Press (2009).

Collinge, S. (2010) Spatial Ecology and Conservation. Nature Education Knowledge 3(10):69

Elith, J., Phillips, S. J., Hastie, T., Dudík, M., Chee, Y. E. and Yates, C. J. (2011), A statistical explanation of MaxEnt for ecologists. Diversity and Distributions, 17: 43-57.

Forman, R. T. T. & Godron, M. Landscape ecology. New York, NY: Wiley (1986).

Hanski, I. & Gilpin, M. E. eds. Metapopulation Biology. San Diego, CA: Academic Press (1997).

Holyoak, M., Leibold, M. A. et al. eds. Metacommunities: Spatial Dynamics and Ecological Communities. Chicago, IL: University of Chicago Press (2005).

Leibold, M. A., Holyoak, M. et al. (2005). The metacommunity concept: a framework for multi-scale community ecology. Ecology Letters 7, 601-613.

Pickett, S. T. A. & White, P. S. The ecology of natural disturbance and patch dynamics. New York, NY: Academic Press (1985)

Saura, S. & J. Torné (2009). Conefor Sensinode 2.2: a software package for quantifying the importance of habitat patches for landscape connectivity. Environmental Modelling & Software 24: 135-139

Tilman, D. & Kariava, P. eds. Spatial ecology: the role of space in population dynamics and interspecific interactions. Princeton, NJ: Princeton University Press (1997)

Turner, M. G. ed. Landscape heterogeneity and disturbance. New York, NY: Springer-Verlag (1987)

Links:

www.umass.edu/landeco/research/fragstats/fragstats.html

www.passagesoftware.net/

www.conefor.org/

www.miramon.cat

https://biodiversityinformatics.amnh.org/open_source/maxent/