BL/ES325 MEDITERRANEAN ECOSYSTEMS
IES Abroad Granada

DESCRIPTION:
An introduction to the study of Mediterranean-type ecosystems. The course covers the main topics on basic Ecology (abiotic factors, interactions, disturbance, succession, diversity, communities, ecosystems, etc.) while providing a comprehensive picture of the main current ecological problems, such as invasions, global warming, loss of biodiversity, habitat restoration, etc., all in the context of Mediterranean ecology. Three course-related trips complete the course, with field work directly related to the topics offered in the classroom, including in some cases field sampling, collection of data, and a basic *in situ* analysis, in order to draw conclusions.

CREDITS: 3 credits

CONTACT HOURS: 45 hours

LANGUAGE OF INSTRUCTION: English

PREREQUISITES: At least one semester of college-level biology or consent of instructor

ADDITIONAL COST: None

METHOD OF PRESENTATION:
Lectures, case studies, group discussions, and three course-related trips. For each unit, the instructor will provide a general outline of the subject, and later the topic will be approached and discussed with specific texts that the students must read (readings indicated for each unit, see below). List of readings may be slightly modified to incorporate new scholarship on the subject.

REQUIRED WORK AND FORM OF ASSESSMENT:
- Reports on each course-related trip - 45% (15% each)
- Midterm Exam - 20%
- Final Exam - 25%
- Course Participation - 10%

The course-related trip reports have to be a summary of the topics covered during the course-related trip, placing them in the context of ecological theory (that is, topics covered in the lectures). The report should not be a description of what we have seen in the field, nor a journal of the course-related trip. It must contain the ecological processes and patterns analyzed during the journey, integrated in the main body of ecological theory, complemented with the personal discussion and perspective of the student. Extensive note taking during the course-related trips is recommended in order to elaborate the reports. Each course-related trip report must be of a length of ca. 1500 words (±15%). Font: Times 12 or similar, double spaced. First line: Full name of the student. Second line: Course-related trip number and denomination. Third line onward: Content of the report. The report must be uploaded to the Moodle platform, and the student will receive comments with track changes or in printed version. The strict deadline will be indicated in the calendar outline and in the Moodle platform.

Video- or audio-recording of the professor during lectures is strictly forbidden, except in case of force majeure justified by the student´s needs.

LEARNING OUTCOMES:
By the end of the course, students will be able to:
- Analyze the processes that operate in Mediterranean ecosystems, integrating biological scales from the organism to the ecosystem.
- Understand the uniqueness of the Mediterranean ecosystems in the whole of the planet's ecosystems, valuing the integration of biological, geological, paleoecological and historical human processes as drivers for the configuration of our present environment.
- Integrate information from different spatial and temporal scales for landscape and ecosystem interpretation.

- Understand the complexity of biotic interactions, as well as the effect exerted by humans, on the configuration of ecosystems.
- Value the ecological richness of Mediterranean ecosystems and the need to protect and conserve nature in general.

ATTENDANCE POLICY:
Attendance to all lectures is mandatory. Only one lecture may be missed without penalty. Attendance to all three course-related trips is strictly mandatory.

CONTENT:

Unit	Content
Unit 1	**Setting the scene: the physical and climatic scenario.** • What is the Mediterranean Region? Topography and soils. Recent geological history of the Mediterranean Region. The connection with Africa: implications for biota. Determinants of climate in the Mediterranean region. Vicissitudes during the Pleistocene: glaciations and implications for biota. Other Mediterranean-type regions in the world.
Unit 2	**Major ecosystem-types in Mediterranean Europe.** • Determinants of vegetation distribution. Vegetation belts in Mediterranean ecosystems. Major climax forest communities. Arid and semiarid ecosystems. Mediterranean high mountain. Wetlands. Humans as modulators of the landscape: agroecosystems.
Unit 3	**Environmental (abiotic) conditions that determine primary production.** • Light, temperature and water. Intensity and spatial pattern of distribution. Effect on organisms. Seasonality: uncoupling of conditions for growth. Nutrients. Source of nutrients. Spatial and temporal pattern of variation. Association with other organisms (mycorrhizas). Implications of the abiotic environment for plant recruitment and growth.
Unit 4	**Life-history traits and functional attributes in Mediterranean-type ecosystems.** • Evergreenness and sclerophylly. Life forms and their relation to the habitat. Flowering patterns and pollination systems: anemogamous versus zoogamous strategies. Seed dormancy as a way of resistance. Life-history traits in animal species that thrives in Mediterranean-type ecosystems.
Unit 5	**Adaptations of plants and animals to cope with Mediterranean conditions.** • Adaptations to water scarcity. Adaptations to nutrient deficits. Adaptations to high light intensity and ultraviolet radiation. Plant and animal acclimation to environmental conditions.
Unit 6	**Interactions among plants: competition, facilitation and parasitism.** • Plant competition in Mediterranean-type ecosystems: Magnitude and relevance. Allelopathy. From competition to facilitation: two extremes of a gradient. Mechanisms of facilitation. Plants that parasite plants.

Unit	Content
Unit 7	**Interactions with animals.** • Animals as predators: Vertebrate herbivores, invertebrate herbivores, and seed predators. Defense mechanisms in plants: chemical defense, physical defense, and associational resistance. Adaptations to high herbivore pressure. Animals as pollinators and animals as seed dispersers: from predation to mutualism.
Unit 8	**Disturbance and succession in Mediterranean-type ecosystems.** • Disturbance regimes: Magnitude, frequency, and recurrence. Herbivores, fire and drought as a source of disturbance in Mediterranean-type ecosystems. Coping with fire: plant and animal traits to survive in fire-prone ecosystems. Types of succession: primary and secondary; allogenic and autogenic. Synchronic and diachronic models. Role of abiotic and biotic factors in succession. Organisms traits linked to successional scenarios. Succession and climax. Critics to the climax.
Unit 9	**Biodiversity of the Mediterranean region.** • Measurements of biodiversity. Hot spots of biodiversity. Present day biodiversity in the Mediterranean region. Rate of endemism. Paleohistorical causes of high biodiversity in the Mediterranean region. Global and regional patterns of diversity. Redundancy and biodiversity. The decline of biodiversity in recent times. Biological invasions. Consequences of biological invasions for local biota.
Unit 10	**Global change and Mediterranean-type ecosystems.** • Causes of global change. Consequences of global change on climatic parameters: predictions for the Mediterranean area. Consequences of global change on the biota: mechanism of action. Biota with higher risk under global change. Impact of climate change in Mediterranean-type ecosystems.

COURSE-RELATED TRIPS:

- **Wetlands and oak forests from Southwestern Spain; Atlantic coast and Strait of Gibraltar area.** Localities visited: Los Alcornocales Natural Park (Cádiz province), Laguna de Fuente de Piedra (wetland), Laguna de La Janda (wetland), Atlantic coast (area between Barbate and Strait of Gibraltar). Although Mediterranean-type ecosystems are all characterized by a hot, dry summer, rainfall may vary within a wide range, with sites close to semi-desertic conditions and others where autumn to spring rainfall reaches high values. This is the case of the SW of the Iberian Peninsula, where we can find the rainiest places in Spain, reaching values close to tropical forests in some spots. Oak forests here reach the highest complexity. In the area there are also abundant wetlands where birdlife flourishes. Besides, the proximity to the Strait of Gibraltar, which is a main passage for migratory birds flying to and from Sub-Saharan Africa, makes this region a very important one for birdlife. During the trip we will work on topics related to determinants of oak forest distribution, relevance of wetlands in the context of Mediterranean-type ecosystems, fauna associated to wetlands (including comments on local animal species extinction and reintroduction programs), or habitat management for fauna conservation. We will also address topics in plant ecology such as pollination and pollination systems, and other mutualistic plant-animal interactions. Special attention will be paid to the role of humans as modifiers of the Mediterranean-type ecosystems since ages, with a (very) possible visit to a cave with pre-historic rock paintings.
- **Badland area of Guadix basin, Sierra de Baza Natural Park, and Cabo de Gata Natural Park.** In the Guadix basin the field work will be related to plant-plant interaction and facilitation with special emphasis in dry environments. We will analyze the spatial relationship between two common species in the area, a shrub (*Retama sphaerocarpa*) and a scrub (*Artemisia barrelieri*). The results will be discussed in the context of the competition-facilitation gradient, and other examples will be also discussed *in situ*. At Sierra de Baza Natural Park we will study species interactions and cascade consequences at ecosystem level: connections between the mistletoe, Thrushes, and the juniper. Cabo de Gata is a semi-desert area that

limits with the Mediterranean Sea at the SW corner of the Iberian Peninsula (province of Almería). Bedrock, proximity to the sea, orography and aridity creates an ecosystem dominated by bushes and very often salt-resistant species (halophytes). A coastal marsh with a rich bird life will be also visited. Topics of paleoecology, adaptations to dry and salty conditions, and relevance of littoral marshes for animal populations (particularly birds) will be discussed. The region is also an important area of volcanic origin, whose relevance will be discussed.

- **Sierra de Huétor Natural Park**. Ecology of regeneration after fire. The field work will be related to disturbance and succession (fire ecology), including aspects of plant dispersal and plant defense against herbivores. The dynamics of regeneration after fire will be analyzed in a burnt area, considering the two main disturbance agents: fire (high intensity, low frequency) and herbivores (low intensity, high frequency). Students will sample the recruitment of the main shrubs and trees. With the data collected and a few simple calculations the successional trends of the community will be discussed, and their consequences for management.

†Timing and places visited during each course-related trip may change slightly depending on weather conditions and time schedule. Specific mandatory readings for each trip will be provided through the course.

REQUIRED READINGS:

- Blondel J., Aronson J., Bodiou J-Y and Boeuf G. (2010). Setting the scene. Pp. 1-22 in: *The Mediterranean region. Biological diversity in space and time* (2nd ed.). Oxford University Press. Chapter 1.
- Blondel J., Aronson J., Bodiou J-Y and Boeuf G. (2010). Life history and terrestrial ecosystem functioning. Pp. 165-185 in: *The Mediterranean region. Biological diversity in space and time* (2nd ed.) Oxford University Press. Chapter 8.
- Médail F (2008). Mediterranean. Pp. 2296-2308 in: *Encyclopedia of Ecology*. Elsevier.
- Moreno G. and Pulido F.J. (2009). The functioning, management and persistence of Dehesas. Pp. 127-160 in: Rigueiro-Rodríguez et al. (eds.), Agroforestry in Europe: current status and future prospects. Springer.
- Thompson J.D. (2005). The biogeography and ecology of endemism. Pp. 38-66 in: *Plant evolution in the Mediterranean*. Oxford University Press. Chapter 2.

*Additional specific, mandatory readings may be provided through the course for each unit.