COURSE DATA

DATA SUBJECT

Code: 43274
Name: Impacts on terrestrial environment
Cycle: Master's Degree
ECTS Credits: 3
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2148 - Master's degree in Biodiversity: Conservation and Evolution	Facultat de Ciències Biològiques	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2148 - Master's degree in Biodiversity: Conservation and Evolution	Protection of the diversity of ecosystems	ELECTIVES

COORDINATION

BARRENO RODRIGUEZ M EVA

SUMMARY

The atmosphere is a fascinating mixture of gases, vapors and tiny particles in suspension. Only those substances that produce adverse and harmful effects on plants, animals or materials are pollutants of the atmosphere; those that modify the physical or chemical properties of the environment producing an imbalance that the self-purification systems are unable to overcome. In the last two centuries man has altered the composition of the atmosphere by pouring into it all kinds of compounds that damage living beings and ecosystems. Human intervention has altered some of the main chemical cycles of the biosphere, notably increasing the fluxes of carbon, nitrogen and sulfur or energy exchanges. The geographic dispersion of species and their concentration, as well as their extinction and multiplication, have accelerated. And, above all, we have increased the rate of change.

Plants, lichens, fungi and other plants suffer alterations long before these pollutants can affect human health, and their response is of great value because it is that of a biological system, differentiated for each species or community and, in turn, is a function of the combination, concentration and duration of the pollutants. The harmful effects produced by pollutants can be detected and evaluated using these organisms as bioindicators of the state of alteration of the environment, since they allow prior assessments to be made and risks to be evaluated. They are also essential for making appropriate decisions about areas requiring protection. The main (but not the only) reactions considered in bioindication studies are: 1. Morphological and anatomical changes. 2. Variations in vitality. 3. Variations in

functional response. These reactions can be considered at the cellular/molecular, functional, organism or population and community levels (loss of diversity or changes in floristic composition).

This four-month elective course analyzes atmospheric pollution (AC), physicochemical characteristics, pollutant dispersion and deposition mechanisms (transport at meso-atmospheric and global scales), with special emphasis on climatic and transport conditions in the western Mediterranean basin. The influence of CA on phytocenoses and the different responses of plants to these perturbations or changes in the time series, in order to understand their importance in decision making for Land Use Planning or Conservation of Natural Spaces and Biodiversity in general.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

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Awaken interest in the social and economic application of science.

Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.

Be able to access to information tools in other areas of knowledge and use them properly.

Be able to communicate and disseminate scientific ideas.

Be able to make quick and effective decisions in professional or research practice.

Encourage ethical commitment and environmental awareness.

Favour intellectual curiosity and encourage responsibility for one's own learning.

Stimulate the capacity for critical reasoning and for argumentation based on rational criteria.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.

DESCRIPTION OF CONTENTS

1. Atmospheric dynamics. Climate. Environmental pollution.

1. Atmospheric pollution and the functioning of the biosphere. Plants in ecosystems. Alterations in the floristic composition, structure and function of plant communities. Global change.
2. The atmosphere and pollutants. Primary and secondary pollutants. Acid deposition and photooxidants. Differences between atmospheric pollution and air quality. Atmospheric disturbances in the western Mediterranean Basin. Mediterranean climate and factors that determine it. Convective conditions. Atmospheric dynamics and pollutant transport. Local, regional and long-range transport. Pollutant dispersion in the western Mediterranean and Canary Islands.

2. Impacts and stress factors on plants and lichens. Bioindicators and Biomonitoring Networks.

3. Plant responses to environmental perturbations: resistance, sensitivity, tolerance, buffering. Dose-response. Factors affecting the response of vegetation to pollutants. The rationale for the use of plants to assess quality. Characteristics of plant bioindicators: Bioindicators, Biomonitors, Biosensors and Bioaccumulators. Types of harmful effects: chronic and acute. Synergism, antagonism and addition.
4. Effects of atmospheric pollutants on vascular plants, Mediterranean crops and natural vegetation. Acid deposition and photooxidizing agents. Direct effects: morphological, anatomical, alteration of biodiversity, flora changes in communities. Forest decline" or "Forest stand decline" in the Northern Hemisphere. Types of disturbances in European and North American forests. Methods of recognition of damage in forest stands by acid deposition or by ozone and other pollutants.
5. Effects of atmospheric pollutants on vascular plants, Mediterranean crops and natural vegetation. Acid deposition and photooxidizing agents. Indirect effects. Methods for detecting adverse effects, stress, of pollutants: cellular alterations, chlorophyll fluorescence kinetics, activity of antioxidant substances, etc. Ion leaching.
6. Lichens: Biology. Qualities as atmospheric biosensors. Effects of atmospheric pollutants on direct effects. Indirect effects. Methods and indices (Europe and USDA Service Forest) using lichens as bioindicators of local diversity and regional networks for monitoring environmental alterations of ecosystems and the degree of conservation of natural areas or urban enclaves. Environmental quality and ecological continuity of forests.
7. Methodologies for the quantification of adverse effects of atmospheric pollution and the design of natural spaces.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	20,00
Laboratory	10,00
Total hours	**30,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	2,00
Individual or group project	10,00
Independent study and work	17,00
Preparation of lessons	13,00
Preparation for assessment activities	0,00
Resolution of case studies	3,00
Total hours	**45,00**

TEACHING METHODOLOGY

- Analysis of atmospheric pollution (AC), the physical-chemical characteristics of pollutants, their dispersion and deposition mechanisms (transport at meso-atmospheric and global scales), with special emphasis on climatic and transport conditions in the western Mediterranean basin and Canary Islands. The greenhouse effect and CO2 sinks. UV radiation.

- Biological responses to global change. Types of effects and plant responses, direct or indirect (physiological). Vascular plants and lichens are studied separately due to their different biology and bioindication capacity. Differences in the effects of acid deposition, nitrogen deposition and photooxidants (ozone, PAN) are synthesized, since tropospheric ozone and nitrogen compounds are very directly involved in the changes and/or losses of biodiversity in ecosystems.

- Ecological effects of phenological changes. Impacts on community structure and ecosystem functioning The influence of CA on phytocenoses and the different responses of plants to these perturbations or changes in time series, so that their importance can be understood in decision making for Land Management or Conservation of Natural Spaces and Biodiversity in general.

- Most commonly used methodologies for monitoring the environmental quality of natural areas and the assessment of agricultural productivity. Special emphasis on forest health monitoring programs: pan-European ICP-forests (UN/ECE) and North American FSH-Forest Health Programme (USDA-Forest Service). The European project BioAssess UE-5 on the use of epiphytic plants (mosses and lichens) in the prediction of general biodiversity and the NATO project on Lichens: methods and indices to quantify their local and regional diversity (networks) in the evaluation of environmental alterations of ecosystems and their degree of conservation.

- To provide real examples of Spanish territories and interdisciplinary approaches to the study of these problems.

The methodology to be used will include:

- Lectures given by the professor to provide the fundamental knowledge and the methodology to be used.
- Field trips to study the effects on forests and crops in areas affected by contamination for methodology and observation of effects on natural vegetation. Sampling techniques.
- Discussion seminars, guided by the teacher, among students on the different aspects of topic 7.
- Laboratory practices for quantification of effects on samples and experimental studies related to the field trip.Visit to my fumigation laboratory under controlled conditions. PAN-2000 Fluorimeter (Botany).

- Visits to the Experimental Station of La Peira (Benifaió). OTC chambers and horticultural crops.
- Individual or group face-to-face tutorials with the teacher to outline and review the work done by the students.

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EVALUATION

- Written exercise in an undefined proportion of questions with closed-answer type test, short answer questions, and/or long answer questions (40%).

- Elaboration and defense in oral exposition in class of works carried out by the student (workshops-seminars) (40%).

- Participation in programmed activities and practice reports (20%).

REFERENCES

- Ministerio de Medio Ambiente http://www.mma.es/portal/secciones/biodiversidad/ Excelente para todo, proyecto BIOASSESS de Europa http://www.biodiversitymonitoring. ch/english/aktuell/portal.php USDA FOREST SERVICE http://www.fs.fed.us/ ICP-Forest UE http: //www.icp-forests.org/index.htm CREAF-Ecosistemas https://www.creaf.cat/es Biblioteca Jardí Botànic) muy buenos enlaces http://biblioteca.uv. es/castellano/bibliotecas/de_campus/b_botanic/botanico.php Bioclimas y Diagramas bioclimáticos http://www.globalbioclimatics.org/ Atlas Climático Digital de la Península Ibérica, en la que se ofrecen mapas de parámetros climáticos peninsulares que pueden resultar de interés http://www.opengis.uab.es/wms/iberia/index.htm Criterios, planes, espacios naturales, mapas de vegetación, etc. http://tematico.asturias. es/mediambi/siapa/web/cartografia/tematica/vegetacion/ http://tematico.asturias. es/mediambi/siapa/web/espacios/actuacion/index.php http://www.cfnavarra. es/agricultura/informacion_agraria/MapaCultivos/htm/index.htm http://www.navarra. es/home_es/Gobierno+de+Navarra/Organigrama/Los+departamentos/Desarrollo+Rural+y+Medio+Ambiente/ Sistema de información de la vegetación Ibérica y Macaronésica http://www.sivim. info/sivi/ Cartografía de Plantas Països Catalans http://biodiver.bio.ub.es/orca/ Sistema de Información sobre plantas de España http://www.anthos.es/

- Barreno, E. & Pérez-Ortega, S. 2005. The UNESCO-MAB Reserve of Muniellos (Spain, Asturias), an example of high lichen diversity in Europe and the success of conservation strategies. Flora Mediterranea 15: 453-460.

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- Bytnerowicz, A., Sanz, M. J., Arbaugh, M. J., Padgett, P. E., Jones, D. P., and Davila, A., 2005.

Passive sampler for monitoring ambient nitric acid (HNO3) and nitrous acid (HNO2) concentrations. Atmospheric Environment, 39: 2655-2660.

- Giordani P., Calatayud V., Stofer S., et al. (2014). Detecting the nitrogen critical loads on European forests by means of epiphytic lichens. A signal-to-noise evaluation. For. Ecol. Manage. 311, 29-40. (doi: 10.1016/j.foreco.2013.05.048).

- Millán, M. M., Sanz, M. J., Calatayud, V., Palau, J. L., Diéguez, J. J., Pérez-Landa, G., Mantilla, E., Cerveró, J., and Chordá, J. V., 2004. La calidad del aire en las comarcas de Els Ports - Maestrat. Fundación Centro de Estudios Ambientales del Mediterráneo - CEAM. Valencia, España. 408 pp.

- Nash III T.H. 2008 Lichen sensitivity to air pollution. In Lichen Biology, 2nd Ed. (T.H. Nash III ed.), pp. 216-233. Cambridge: Cambridge University Press.

- Recursos botánicos buenos ejemplos y enlaces http://www.bib.ub.edu/recursos-informacio/guies-tematiques/biologia/botanica/ http://www.urjb.csic.es/flora iberica/ (Flora Ibérica) http://herbarivirtual.uib.es/cat-med/index.html (Herbario Virtual Illes Balears) http://tolweb.org/tree/ (Proyecto Tree of Life) Andalucía Guia de plantas Espacios naturales http://waste.ideal.es/listarojaandalucia.htm http://www.juntadeandalucia.es/medioambiente/site/web/ Listas rojas, plantas, etc. http://bioc.org.es/bioc/ http://journals.ku.edu http://www.gbif.org http://www.gbif.es https://www.wsl.ch/en/projects/red-list-of-epiphytic-and-terricolous-lichens.html INFORMES AGENCIAS MEDIOAMBIENTALES: EEA, UNEP https://www.eea.europa.eu/ https://www.eea.europa.eu//publications/status-of-air-quality-in-Europe-2022 https://livereport.protectedplanet.net/chapter-11