



LICHENS AS A TOOL FOR INTERPRETATION OF ENVIRONMENTAL CHANGES AND MANAGEMENT

cE3c 2016 Advanced Course - <http://ecofun.fc.ul.pt/Activities/lichens-course>

11-15 July 2016 | 4 days lectures and lab classes + one day field excursion

With this course, we aim at providing the participants with the basics of lichen biology and ecology, biomonitoring and data analysis methods to allow the use of lichens for the interpretation of the environmental conditions and the development of a responsible scientific-based environmental management.

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Location: Universidade de Lisboa, Faculdade de Ciências, Departamento de Biologia vegetal

Schedule: 9:00-17:30 (36h)

Lichens are amongst the most sensitive organisms to environmental changes at the ecosystem level. Some of the most important drivers of global change, like climate, pollution and eutrophication are factors to which lichen communities respond in only a few years and lichen physiology in few weeks. Therefore, by “reading” lichens we can obtain useful information about the status of the environment and its changes over time and space.

Since the nineteenth century, observations based on changes in lichen community composition and species frequency have been used for biomonitoring purposes. Currently, new approaches based on

functional diversity and lichen physiological response are being developed. Functional diversity has a wide geographic applicability and high inter-comparison potential and has proven to better predict impacts at the ecosystem level than total diversity measures. Newly developed physiological methods allow us to assess lichen's response to the rapidly changing environmental conditions. Moreover, the link between physiological mechanisms, functional diversity and ecological impacts provides a trustable base for the development of environmental policies.

Six modules identify the main themes of the course, ranging from basic knowledge on lichen symbiosis to data collection and interpretation. The course will be organized in lectures, lab experiences, lichen identification and a one-day excursion to apply biomonitoring methods.

A brief description of the modules structure is given. The modules are sequential and thus attending all is mandatory.

Module 1 (*Lichen biology and ecology*) This module intends to give the basic knowledge on lichen biology and their ecology:

- Introduction to lichen symbiosis, with highlights on the role of each partner.
- The ecological role of lichens and their role in ecosystem functioning.
- From the deserts to the poles: strategies for lichen survival in extreme environmental conditions.
- Lichens in the context of global change: key features that make them excellent ecological indicators of air pollution and climate change.

Module 2 (*Systematic*) The module will cover basic lichen structure and techniques needed for lichen determination (lab class) to provide students with basic skills on lichen identification:

- Morphology and anatomy: photobionts, growth forms, sexual and vegetative reproduction strategies.
- Determination methods based on morphological and chemical characteristics.
- Introduction to the most common lichen genus, available floras and online keys.
- Identification of lichen specimens: macro- and microscopic characters (preparation and observation of samples); chemistry and determination keys.

Module 3 (*Ecophysiology*) This module will focus on modern approaches in lichen ecophysiology to assess the impact of environmental stress drivers on lichen functioning:

- Lichen physiological response to environmental changes.
- What should we measure? Selecting parameters to assess cause and/or effect of human-induced environmental disturbances.
- Case studies from laboratory and field.
- Integration of molecular, physiological and ecological techniques.

Module 4 (*Using lichen functional diversity: from topsoil to trees*) This module offers an overview on the use of lichen functional diversity as an indicator of global change drivers:

- Functional diversity, what does that mean? A review of definitions and components, including chemical and life-history traits.
- Why is functional diversity so important? The link to ecosystem functioning and the response to environmental changes.
- Case studies with biological soil crusts and epiphytic lichens.

Module 5 (*Biomonitoring*) This module aims to give an overview on the main methodological approaches using lichens as biomonitors:

- What to measure? Standard sampling methods based on biodiversity and bioaccumulation.
- How to measure? When to use transplants or *in situ* lichens in biomonitoring studies. When to use total diversity or functional diversity.

- Different problems ask for different approaches: case-studies of different environmental problems (in urban, natural and industrial areas) and the link with human health.

Module 6 (*Data analysis and interpretation*) This module gives students basic notions on how to analyze and interpret data collected according to previous modules:

- Theory and practical examples will be given.
- Emphasis on GIS interpretation of results in space.

Excursion One-day field excursion to Mediterranean cork-oak woodlands to: test the acquired knowledge on species; and to apply the biomonitoring methods: the standard European method for air pollution and the method for biological soil crusts.

ECTs: This course can have recognition of 6 ECTs for FCUL PhD students enrolling in it as part of their first doctoral year. For FCUL PhD students only requiring 5 ECTs recognized in their specific PhD programs the excursion is not mandatory and the certificate will be on 'Topics in Lichens as a tool for interpretation of environmental changes and management'.

Location: Departamento de Biologia vegetal (FCUL)

Nº (min, max) students: 10 – 18

Minimum formation: “Licenciatura” (bachelor) in Biology, Natural Science or related areas

Directed to: PhD or MSc students in Ecology, Environmental Studies, Geography or related areas, and postdocs and other professionals working in related topics

Fee: free for 1st year PhD students in the Doctoral programme in Biology (FCUL), Biodiversity, Genetics and Evolution (UL; UP) and Biology and Ecology of Global Changes (UL, UA); 20 € for PhD students from institutions of the PEERS network (cE3c, CFE); 100 € for FCUL Master students and unemployed; 150 € for BTI, BI and other PhD students; 200 € for Professional and postdocs.

Deadline for applications: May 31st, 2016

→ Candidates should send a short CV to lichenscourse@fc.ul.pt