

## Structure and Dynamics of Ecological Systems

Course name	Structure and dynamics of ecological systems
Level / Semester	Master 2 Economics and Ecology / Semester 1
Credits	6 ECTS
Instructor(s)	José Montoya (SETE) Christine Perrin (SETE) Claire de Mazancourt (SETE) Jean-Pierre Amigues (TSE) Hervé Philippe (SETE)
Number of lecture hours	30

### OBJECTIVES

The overarching objective of this module is to provide keys into the responses and adaptations of biodiversity and ecosystems to environmental change across several spatial and temporal scales. The underlying processes responsible for biodiversity dynamics, landscape formation and change, and ecosystem structure and dynamics, can operate over long and short temporal scales, and can be of local, regional, or global nature. Given the multifaceted nature of these processes and responses, this module will focus on four interrelated topics:

(i) What are the abiotic and biotic processes shaping landscapes, and how can landscapes be decrypted?

(ii) How do different components of global environmental change affect biodiversity, the structure and dynamics of ecological communities, and the functions and services supported by ecosystems?

(iii) How do evolutionary dynamics affect populations and ecological communities in the face of global environmental change?

(iv) What are the consequences of dramatic changes in the abiotic environment of the planet for biodiversity, and how does biodiversity in turn shape global environmental conditions?

We will adopt a highly integrative methodology through the combination of mathematical theory and modelling, large database analyses, and experimental manipulations.

### LECTURE OUTLINE

#### Course 1 Reading landscapes: from basement to soil *Christine Perrin* 10 h

- ✓ Introduction to the course – the geological cycle (30 mn course)
- ✓ Alteration processes and pedogenesis (1h30 course): How soils are formed, the main different types of soils and their properties.
- ✓ Geomorphology (2h course): How reliefs of Earth are formed and their significance.
- ✓ Cartography and reading maps (2h course + practical): Understanding the different types of maps, scales, their significance and the way to use them appropriately, reading information from aerial / satellite photographs.
- ✓ Reading landscapes (4h fieldwork around Moulis)

**Course 2 The Effects of Global Change on****Ecosystems *José Montoya* 12 h**

- ✓ Introduction to the course, Global Change is more than climate warming (2h course): The different components of past, present, and future global change, and the importance of direct and indirect effects.
- ✓ Universalities and Uncertainties of Climate Change Effects on Ecosystems (4h course + practical): Theoretical and empirical basis on the effects of climate change on the structure, dynamics and functioning of multispecies ecosystems.
- ✓ Habitat Degradation, Loss, and Fragmentation (3h course + practical): Understanding the effects of habitat modifications on species interactions and biodiversity.
- ✓ Overfishing and Carnivore Extinctions (1.5h course): Understanding the ecosystem-level effects of removing top predators in multispecies systems, and to review the current state of the question.
- ✓ Invasive species (1.5h course): Understanding the effects of new invasive species in ecosystems, to predict which species traits predispose invaders to success, and how to model this.

**Course 3 Evolutionary dynamics in Ecosystems *Claire de Mazancourt & Jean-Pierre Amigues*****4h**

- ✓ From population dynamics to evolutionary ecology (2h course + 2h practical): the role of evolutionary dynamics in responses to global changes, invasion dynamics to a simple population dynamics model, short-sightedness of evolutionary dynamics with possibilities of evolutionary collapse; predator-prey Lotka-Volterra model; examples of Easter Island, HIV dynamics, myxomatosis.

**Course 4 An historical and big data perspective *Hervé Philippe* 4h**

- ✓ An overview of the major biogeochemical crises and its impact on biodiversity (2h course): How biodiversity influences global Earth conditions and is shaped itself by these conditions
- ✓ Data errors in big data collection (2h course): How data quality remains of prime importance at the age of data quantity and how data filtering may bias results.

**REQUIREMENTS AND GRADING POLICY**

Due to the pluri-disciplinary nature of this master, attendance at lectures will be required. The course grade will be determined by the performance of the student on assignments (individual or team-based assignments, and/or presentations), and/or a final exam. Due again to the pluri-disciplinary nature of this master, assignments and exams may be different for economics and for ecology students.

**Grading policy for this module:** The module will use a combination of several evaluation methods, including practical write-ups, oral presentations, and written essays.