Ecosystems conservation and management
Academic Year 2025/2026

Teacher

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Consulting

Send an e-mail and we will make arrangements

Material

(https://gatto.faculty.polimi.it/EcoConsMgt/EcoConsMgt.html)

- E-book Marino Gatto, Renato Casagrandi *Ecosystem Conservation and Management: Models and Application*, Springer, https://doi.org/10.1007/978-3-031-09480-4 It is freely available to registered students.
- Slides, exercises, papers, reports and software on-line. Full list of exercises is also available in the textbook

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Renato Casagrandi

Ecosystem Conservation and Management

Models and Application

Springer

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Schedule/Classroom assignment

Monday 10.15-12.15 in room 16B.3.1
Tuesday 10.15-12.15 in room 9.0.3
Wednesday 14.15-16.15 in room 2.2.4
Thursday 14.15-16.15 in room B.5.2

Streaming

Streaming of lectures might be used in case of need (transportation strike, etc.). The textbook covers all the topics of the course, including exercises.

Tests and exams

Two intermediate tests: Mid November 2025, beginning of January 2026

- First on 1st half of the course,
- Second on 2nd half of the course

The final grade is the average of the grades of the two tests.

Two exams (all course topics): beginning of January 2026 (same day as 2nd test), beginning of February 2026

Intermediate tests and exams will be administered in a room, no exams or tests online.

Registration to tests and exams

Important: you must register **in due time** not only for regular exams but also for the tests by using the exam registration system of the Politecnico. If you want to take the second test, you must register for the first call of January (Primo appello) and choose the option *second test*

NO LATE REGISTRATIONS AFTER THE OFFICIAL DEADLINE WILL EVER BE ACCEPTED!

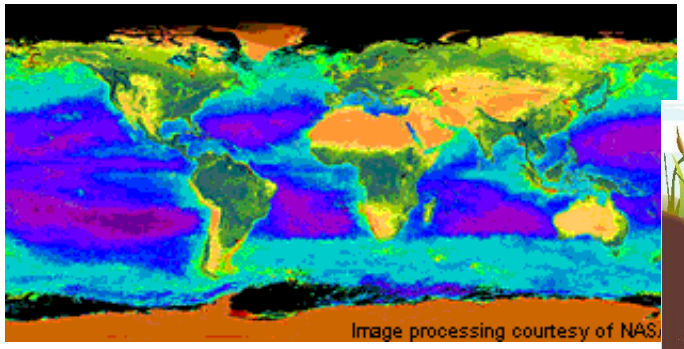
Structure of tests and exams

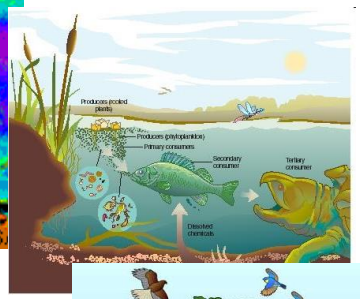
Phase 1 (Conceptual questions)
The questions will be provided to you on a paper form you must fill in. You cannot use any books or notes. Answer the questions before time expires and give back the filled in sheet to the teacher.

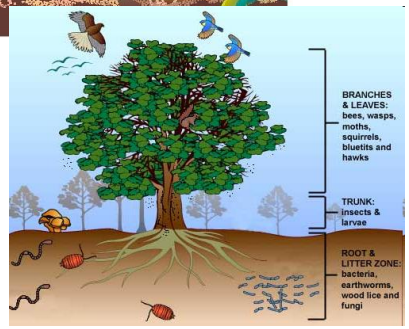
Phase 2 (Exercises)
The text of the exercises will be provided to you on a few paper sheets. You can use books and notes, but you can use no computers, only calculators. Use your own paper for a scratch copy. Once exercises are solved, copy the solution to the provided paper sheets. Before time expires give back the filled in sheets to the teacher. You cannot attach any scratch paper.

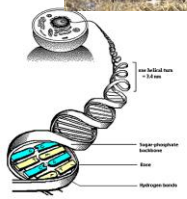
The realm of ecology

- biosphere
- **biomes**
- **ecosystems**
- **communities**
- **populations**
- organisms
- organs
- tissues
- cells
- molecules









The scientific study of the distribution and abundance of organisms and the **interactions** that determine **distribution** and **abundance** (Begon, Townsend & Harper, 2006)

Course description and topics

Course goal: to provide students with the instruments for rationally managing animal and plant populations and ecosystems.

Extending the basic ecological notions to quantitatively study
(a) the **spatial distribution** of organisms,
(b) the effect of **uncertainties**, disturbances and in general stochasticities,
(c) the **impact of humans** on ecosystems and its **rational management**,
(d) the interaction between **ecosystem management and human health**.

Application to several problems concerning ecosystems conservation and management. In particular:
(a) evaluate the **likelihood of population decline and extinction** (risk analysis);
(b) estimate the chance of success for the **reintroduction of locally extinct species**;
(c) calculate the **speed of invasion of alien species**;
(d) estimate the **impact of habitat erosion and destruction** on population and community viability;
(e) estimate the impact of **human harvesting** on populations viability and assess **optimal harvesting regulations**;
(f) assess the **likelihood of establishment of diseases that are due to parasites**, both micro and macro, that live in our common environment.

Course description and topics

Course goal: to provide students with the instruments for rationally managing animal and plant populations and ecosystems.

Topics

First half of the course

Species and populations threatened by extinction:

– The causes of extinction: review. Local extinction, global extinction, extinction in the wild.

– Analysis of the main extinction mechanisms and quantitative approaches for evaluating the extinction risk. Allee effect and depensation. Genetic deterioration. Fundamentals of population genetics. Hardy-Weinberg law. Genetic drift and the Sewall Wright model. Extinction thresholds.

– Demographic and environmental stochasticity. Extinction probability in small populations. Stochastic models of populations driven by environmental variability. Quasi-extinction thresholds. Extinction vortices. Population viability analysis (PVA). Review of the main PVA software tools.

Course description and topics

Populations in spatially explicit landscapes:
– The importance of space in ecology. Habitat loss and fragmentation as important mechanisms of extinction. The problem of alien species invasion.
– Dispersal in animals and plants. Diffusion as a way to describe dispersal. Diffusion equation in limited and unlimited habitat. Adding demography to diffusion: the reaction-diffusion equation. Speed of colonization and invasion. Critical reserve dimension.
– Habitat fragmentation and the metapopulation concept. Various metapopulation models. The Levins boolean model. Incorporating habitat loss and environmental catastrophes. Persistence boundaries in metapopulations. Spatially explicit metapopulation models. Ecological corridors.

End of first half

Course description and topics

Second half of the course

Sustainabilty of biomass harvesting and its management:

– The overexploitation and depletion of biological renewable resources. Examples from forestry and fisheries. The tragedy of the commons. Open access and the consequences of not regulating the exploitation of renewable resources. Different management goals.

– The dynamics of harvested populations. The concept and measure of harvesting effort. Different regulation policies: exclusive, nonexclusive, economic. Production curves. Maximum sustainable yield. Schaefer's model.

– Principles of bioeconomics. Gordon's analysis. Bionomic equilibrium and the effect of the opportunity cost. Socioeconomic impacts of various regulation policies. The bioeconomic optimum.

– The management of age-structured populations. The optimal rotation period in forest management. The effect of the discount rate. Fish populations with constant recruitment. The problem of optimal effort and mesh size. Beverton and Holt's analysis. The eumetric mesh size and eumetric production curves. Bioeconomic considerations.

Course description and topics

Parasite and disease ecology:

– Ecology and public health. Emerging and reemerging diseases. Zoonoses. Parasitism and its importance for population regulation. Microparasites and macroparasites. Parasitoids.

– Dynamics of diseases caused by microparasites. Various transmission mechanisms: direct, water and airborne, environmental, vertical. Susceptible, exposed, infected and recovered individuals. Incidence and prevalence. Diseases with permanent and temporary immunity. SI and SIR models. The regulation of Malthusian populations. The basic reproduction number of a microparasitic disease. Vector-borne diseases. Ross-MacDonald model. Water-borne diseases. SIB models. Vaccination and culling policies.

– Dynamics of diseases caused by macroparasites. Anderson and May's model for the dynamics of hosts and parasites. Distribution of parasite burden inside a host and the clumping parameter. The basic reproduction number of a macroparasitic disease.

– Parasitoids and hosts. Nicholson and Bailey's model. Biological control of alien and noxious organisms.

End