UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Ecology

2526-2-E1301Q087

Aims

**
The course is divided into a theoretical component (5 ECTS credits) and a laboratory component (1 ECTS credit, MANDATORY FOR ALL STUDENTS).**

This course aims to introduce the main fields of investigation in ecology. Students will be presented with the key questions ecologists seek to answer, as well as the methods used to address ecological questions. Particular emphasis will be placed on processes at the population, community, and ecosystem levels. Both terrestrial and aquatic systems will be considered.

Applied knowledge and understanding:
The course will provide in-depth insight into the main concepts and theories that guide ecological research.

Independent judgement:
Students will develop the ability to collect and interpret ecological data.

Communication skills:
The course aims to equip students with the ability to effectively and appropriately communicate, using discipline-specific language, the concepts learned during the course.

Learning skills:
By the end of the course, students should be able to independently deepen their understanding of the topics covered, including through the consultation of relevant scientific literature.

Contents

Definitions of ecology, Autoecology–Synecology, Unitary organisms, Modular organisms, Populations,

Metapopulations, Communities, Ecosystems, Biomes, Biosphere, Ecological factors: conditions and resources, Population dynamics, Predation, Symbiosis and mutualism, Coprophages, Parasitism, Intraspecific competition, Demography, Communities, Primary and secondary succession, Climax, Energy flow in ecosystems, Biogeochemical cycles, Island biogeography theory, Nature conservation, Climate, Biomes, Lovelock's Gaia hypothesis

Detailed program

Course introduction, Examination methods, Definitions of ecology (as proposed by Haeckel, Krebs, Begon, Odum), Hierarchical levels of ecological organization, Autoecology and Synecology, Unitary organisms, Modular organisms (freely branching, rhizomatous and stoloniferous, shrub-forming, persistent multi-branched), Modular organisms: ramet and genet, Populations, Metapopulations, Source and sink populations, Communities, Ecosystems, Biomes, Biosphere, Biosphere 2, Ecological factors: abiotic and biotic, Conditions and resources, Definition of limiting factor, Biological success in relation to ecological factors (three models: temperature, pH, toxic substances, trace elements such as copper and sodium chloride), Consumable and exhaustible resources: essential resources, perfectly substitutable resources, complementary resources, antagonistic resources, Q10 temperature coefficient, Physiological time (example: grasshopper), Acclimatization (example: Cryptopygius antarcticus, role of glycerol in butterflies, Antarctic fish), Allen's Rule, Bergmann's Rule, Hibernation, Torpor, Living at high temperatures (estivation, plant transpiration, behavioral modification in desert iguanas, temporary disruption of homeostatic processes such as body temperature fluctuation in ground squirrels), Hydrothermal vents (e.g., Alvinella pompejana, vestimentiferans), Use of stalked eyes as heat receptors, Role of whale falls in vent ecosystems, Nitrogen excretion strategies (ammonia, urea, uric acid), Evolutionary adaptations (advantageous and disadvantageous variants), Role of temperature in competitive success between species, Role of pH, Documentary screening: An Inconvenient Truth and The President's Island, Survival strategies in adverse conditions: cryptobiosis, diapause, cyclic migration, one-time migration (e.g., eels, sturgeons), Migration with birth and death in the same location (e.g., Vanessa atalanta), Raunkiaer's classification (plant adaptations to unfavorable seasons), Biological forms of plants: phanerophytes, chamaephytes, hemicryptophytes, geophytes, therophytes, Definition of ecological niche, Fundamental and realized niche (example: Planaria gonocephala and Planaria montenegrina), Gause's Competitive Exclusion Principle, Guilds, Ecological equivalents, Ecological niche shaped by biotic and abiotic factors (example: barnacles), Population dynamics, Capture-mark-recapture method (Peterson method), Population density (N), Natality (B), Mortality (D), per capita birth rate (b), per capita death rate (d), dN/dt = rN, J-shaped growth curve in r-strategists (theoretical and real), Growth constant r, Logistic growth equation dN/dt = rN((K-N)/K), K-strategists, Carrying capacity K, Growth equation with minimum viable population: dN/dt = rN((K-N)/K)((N-M)/N), Constant M, Example: Alpine ibex growth curve, Competition for limited shared resources (alpha and beta competition coefficients), Example: Asterionella and Synedra, Diatom competition example, Zero-growth isoclines (stable and unstable equilibria), Predation, Prey equation, Predator equation, Zero-growth isoclines for predator-prey systems, Symbiosis and mutualism (examples: cleaner fish, clownfish and anemone, protandry and protogyny, mutualism between plants and ants, plants and beetles, gut mutualists, coral-algae symbiosis), Saprophytes (decomposers and detritivores), Coprophagy, Burying beetles, Parasitism, Definitions (Leuckart, Crofton), Aggregated parasite distribution, Classification by size and host contact location, Monoxenous and heteroxenous cycles, Strategies to facilitate encounter between parasite and host, Origin of parasitic life forms, Levels of parasite organization (infrapopulation, metapopulation, suprapopulation, infracommunity, component community, compound community), Intraspecific competition (examples: acacia trees, fighting fish), Effects of overcrowding on deer survival, Competition and unpredictability in environmental variation, Intermediate disturbance hypothesis, Fugitive species and highly competitive species (reproductive potential C and equilibrium E*), Example: brown algae and bivalves, Priority effect in competition, Paradox of the plankton, Ghost of competition past, Food preference, Optimal foraging theory, Functional response types I, II, and III, Demography, Lx (survivorship), Mx (fecundity), R? (net reproductive rate), Age distribution in stable environments, Communities, Grazing and detritus food chains, Community structure attributes, Species richness indices (Monk, Menhinick, Margalef), Relative abundance, Rank-abundance diagrams, Dominance indices (Simpson), Shannon diversity index (H'), Evenness index (J), Keystone species, Species interactions within communities, Zonation, Similarity indices (Sorensen), Percent similarity (SP), Succession (pioneer and late-successional species), Primary and

secondary succession, Case study: volcanic lava flows, Climax (monoclimax and polyclimax), Energy flow in ecosystems, First and second laws of thermodynamics, Gross and net primary production, Respiration, Net community productivity, Secondary production, Measuring gross/net production and respiration (light-dark bottle method with numerical examples), Depth-related variation in respiration and productivity in the ocean, Ecological pyramids of numbers, biomass, and energy, Inverted pyramids, Biogeochemical cycles: Carbon cycle, Phosphorus cycle, Eutrophication, Nitrogen cycle, Case study: Lake Orta pollution, Island biogeography theory, Immigration rate as a function of resident species, Extinction rate and species number, Experimental support for the theory, Parks as ecological islands, Nature conservation, Extinction of the dodo and its ecological consequences, Management of plant and animal resources, Maximum sustainable yield, Fixed and variable quota systems, Harvesting effort, Regulated fisheries (e.g., Norway lobster), Climate, Solar radiation, Earth's motion, surface shape and structure, Solar and thermal radiation, Maritime and altitudinal effects, Continental and maritime bioclimates, Climographs, Biomes: Arctic tundra, Alpine tundra, Coniferous forests (taiga, montane forests), Temperate forests, Grasslands (steppe), Savannas (biomass variation with fire and water), Deserts, Tropical rainforests, and finally Lovelock's Gaia hypothesis.

Prerequisites

A general knowledge of zoology is required; it is recommended that students take the zoology exam before enrolling in the ecology course.

Teaching form

Lectures are supported by PowerPoint presentations, videos, and class discussions.

Textbook and teaching resource

Teaching material includes:

PowerPoint presentations in PDF format, available on the e-learning platform
Recommended textbook: Elements of Ecology, Thomas Smith & Robert Smith, Ninth Edition, Pearson
Slides and supplementary materials available on the e-learning platform
Videos accessible through the e-learning platform

Semester

First semester

Assessment method

Assessment method: written examination

The written exam is designed to evaluate the achievement of the course’s intended learning outcomes in line with the Dublin Descriptors.

The exam consists of 30 questions:

28 multiple-choice questions (only one correct answer)

2 open-ended questions

Each correct multiple-choice answer is worth 1 point. No points are awarded for incorrect or unanswered questions.

The multiple-choice section primarily assesses knowledge and understanding of ecological concepts, while the open-ended questions are aimed at evaluating the student's ability to apply knowledge, demonstrate critical thinking, and express ideas with appropriate scientific language.

Office hours

Meetings by appointment. To schedule, please contact: paolo.galli@unimib.it

Sustainable Development Goals

QUALITY EDUCATION | REDUCED INEQUALITIES | SUSTAINABLE CITIES AND COMMUNITIES | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION | LIFE BELOW WATER | LIFE ON LAND