Main course information	
Academic subject	Ecology
Degree course	Master's degree in Biological Science
Degree class	L-13
ECTS credits (CFU)	9
Compulsory attendance	Yes
Teaching language	Italian
Accademic Year	2019/2020

Professor/Lecturer	
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Tutorial time/day	Monday-Wednesday-Friday 9-11

Course details	Pass-fail exam/Exam with mark out of 30	SSD code	Type of class
	Exam with mark out of 30	BIO/07	Lecture & workshop

Teaching schedule	Year	Semester
	III	II

Lesson type	CFU/ECTS	Lessons (hours)	CFU/ECTS lab	Lab hours	CFU/ECTS tutorial/workshop	Tutorial/workshop hours
	8,5	68			0,5	6

Time management	Total hours	Teaching hours	Self-study hours
	225	74	151

Academic Calendar	First lesson	Final lesson
	March	June

Syllabus	
Course entry requirements	Basic knowledge in mathematics, physic, chemistry, botanic, zoology, physiology and biochemistry.
Expected learning outcomes (according to Dublin Descriptors) (it is recommended that they are congruent with the learning outcomes contained in A4a, A4b, A4c tables of the SUA-CdS)	
Knowledge and understanding	To acquire knowledge on the relationships between the organisms and the environment. To acquire knowledge on the ecological systems (populations, communities and ecosystems) through an holistic view for which interactions between abiotic and biotic components play a determinant role in the functioning and regulation of the systems themselves.
Applying knowledge and understanding	Application of acquired knowledge for a professional growth aimed to the management of the ecological systems (populations, communities and ecosystems) and to the conservation of the functions and services in order to maintain the life on the planet.
Making informed judgements and choices	Acquisition of autonomy in the evaluation and interpretation of experimental data and of examined studies as well as in the evaluation of the many and variable interactions between factors and between components in the ecosystems.
Communicating knowledge and understanding	Acquisition of the scientific terminology related to the ecology and the structure and functioning of the ecosystems with the aim to understand the relative topics and to be able to communicate the scientifc knowledge.
Capacities to continue learning	Acquisition of the critical and speculative capacity in dealing with the topics and issues of the ecology, promoting the desire of knowledge and an autonomous learning even through consultation of books, scientific pubblications, partecipation to conferences and workshops as well as exploring the web.

Syllabus	
Course content	**Introduction to the ecology.** Self-organization of living systems: from cells to ecosystems. The systemic vision of the life and the interaction among different components. Reductionism and holism. Stability of the ecological systems: function of resistance and function of resilience. Regulation and control mechanisms: feed-back and component redundancy (omotassi congenerica). The models in ecology. The biosphere and the Gaia hypothesis. **The organisms and the environment.** The physical environment. Sun radiation. Energetic balance and greenhouse effect. Climate and climatic elements. Energetic transfer through atmosphere and hydrosphere. Biome distribution. Aquatic environment. Physico-chemical properties of the water. Water distribution on the earth. Use of the water and food impact. The cycle of the water among sea, land and air. Physico-chemical parameters in aquatic environment (density, light, temperature, pressure, gas, dissolved substances). Terrestrial environment. Water balance. Support structure. Sun radiation and plant coverage. The soil: pedogenesis, profile and horizons. Soil texture. Water in the soil. Ionic exchange and soil fertility. Soil, climate and vegetation. Adaptation of the organisms to the environment. Ecocline and ecotype. Rule of Bergman, rule of Allen, rule of Glocer. Liebig law and Shelford law. Ecological valence. Ecological niche. **Populations (Demoecology).** Popolation structure: abundance and density. Organism distribution. Drivers for aggregation and drivers for isolation. Dispersion of the organisms over the habitat. Emigration and migration. Daily and seasonal migrations. Pyramids of age. Natality and mortality. Popolation dynamic. Esponential growth. Istantaneous growth rate. Demographic factors. Survival and natality age-specific (fecundity). Survival and mortality curves. Life tables. Life cycle models. Resources allocation between growth and reproduction. Life strategies: costs, benefits and trade-off. Maturity, parity and fecundity. Environmental condition and life cycle. r-k strategy continuum. Grime model for plant species. Population fluctuations and regulation. Density-dependent factors. Density, intraspecific competition and relative effect. Logistic growth. Carrying capacity. Allee effect. Density-independent factors. Human population growth (demographic transition). **Species interactions.** Types of species interactions. Ecological and evolutive effects. Coevolution: Red Queen hypothesis. Intraspecific competition. Principle of competitive exclusion. Ecological effect of the competition. Manipulation experiments. Competitive release. Evolutive effect of the competition. Lotka-Volterra competition model. Predation. Prey-predator cycles. Lotka-Volterra predation model. Functional responses of predators. Numerical and aggregative responses of predators. Multiple steady stages in the prey-predator interactions. Theory of the optimal foraging. Theorem of the marginal value. Strategies of the predators and strategies of the prey. Parassitism: strategies of parasitic and strategies of the hosts. Mutualism. Types of mutualism interactions. Lotka-Volterra mutualism model. **Community (Sinecology).** Number of species and relative abundances. Diagrams rank-abundance. Indices of species richness, dominance, diversity, evenness. Key species and functional groups. Physical structure, stratification, zonation and borders of community. Ecotone and margin effect. Similarity index. Trophic web and direct and indirect interactions between the species. Bottom-up and top-down control in the trophic web. Trophic cascade. The role of competition and predation in the trophic web. Dinamics of community. Ecological succession. Changes in the ecosystem characteristics during the succession. Intermediate disturbance hypothesis. **Landscape**. Disturbance events and habitat fragmentation. Environmental patches. Connectivity and role of ecological corridors. Biogeography of the islands. Area-species curve. Rate of immigration and rate of extinction. Area and distance effects. Metapopulation. Dinamic of metapopulation. Rate of colonization and rate of extinction. Area and distance effects. **Energetic of ecosystem**. Ecological efficiency of photosynthesis. Primary productivity. Drivers of primary productivity in land and aquatic ecosystems. Auxiliary energy. Measure of the primary productivity. Relative primary productivity (P/B) and turnover (B/P) of producers. Secondary production and net production of the community. Dissipative processes in the food chains. Ecological efficiencies: consumption, assimilation and production. Trophic efficiency and rule of 10%. Energy and length of food chains. Ecological piramids: numbers, biomass and energy. Food

	chains of grazing and food chains of dead organic matter. Terrestrial and aquatic trophic webs. Energetic classification of the ecosystems. **Cycle of the matter.** Decomposition and nutrient cycles. Drivers of the decomposition. Immobilization and mineralization. Humus. Time and place of decomposition in terrestrial and aquatic ecosystems. Biogeochemical cycles. Types of biogeochemical cycles. Carbon cycle. Cybernetic control of carbon cycle. Greenhouse effect and consequence on the climate. Nitrogen cycle: fixation, ammonification-nitrification and denitrification. Anaerobic Ammonium Oxidation. Phosphorus cycle. Eutrophication. Sulfur cycle. Microbial cycle of sulfur. Connection to nitrogen cycle in oceanic sediments. Anoxigen photosynthesis and chemosynthesis. Oxigen cycle. Biological origin, atmospheric transformation and earth crust. Ozone and hole in the ozone layer. Connection among cycles. **Biodiversity.** Distribution of the biological diversity. Goods and ecosystem services. Drivers of diversity increase and loss. Rate of extinction and species vulnerability. Bioaccumulation and biomagnification. Linear processes of human activities contrasted with cyclical processes of the nature. **Workshop 1:** Classification and representation of ecological data. Measure of position and measure of dispersion. Use of Excel for the descriptive analysis of the samples. Histogram of frequency of biological and ecological data. **Workshop 2:** Analysis of the distribution in the habitat: method of casual square, distance measures and first minor distance method. Estimate of population abundance: method of capture-marking-recapture, swiping method and swept-area method. **Workshop 3:** Analysis of alfa diversity. Measure of species richness by means of Margalef index. Measure of dominance using Simpson index. Measure of the diversity by means of Shannon-Wiener index and Simpson indices. Measure of evenness with the Pielou index. Use of Excel to measure the different indices.
Course books/Bibliography	Smith T.M. & R.L. Smith. Elementi di Ecologia. PEARSON Benjamin Cummings. Odum P. & G.W. Barrett. Fondamenti di Ecologia. Piccin Nuova Libraria S.p.A.
Notes	The student is invited to deepen some topics by means of the available PDF.
Teaching methods	Lectures and seminars by means of Power Point.
Assessment methods (indicate at least the type written, oral, other)	Oral examination.
Evaluation criteria (Explain for each expected learning outcome what a student has to know, or is able to do, and how many levels of achievement there are	Learning capacity. In addition to the acquisition of concepts, the ability to make connections among the various ecological systems according to an holistic point of view is evaluated. Ability to apply knowledge and understanding. The knowledge of environmental data collection, experimental studies and ecological models is an essential requirement to be positively evaluated during the examination. Autonomy of judgment. Knowing how to interpret experimental data and case studies as well as trends in ecological models shows maturity in the preparation and is positively judged. Communication skills. Knowing how to communicate the contents of ecology in a clear and scientifically correct way is essential to decision-making and is considered fundamental for the positive outcome of the examination.
Further information	