Main course information	
Academic subject	Marine ecology
Degree course	Master's degree in Environmental Biology
Degree class	LM-6
ECTS credits (CFU)	6
Compulsory attendance	Yes
Teaching language	Italian
Accademic Year	2019/2020

Professor/Lecturer	
Name & Surname	Gianfranco D'Onghia
email	gianfranco.donghia@uniba.it
Tel.	080-5442228
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

Teaching schedule	Year	Semester
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Lesson type	CFU/ECTS	Lessons (hours)	CFU/ECTS lab	Lab hours	CFU/ECTS tutorial/workshop	Tutorial/workshop hours
	6	48	0	0	0	0

Time management	Total hours	Teaching hours	Self-study hours
	150	48	102

Academic Calendar	First lesson	Final lesson
	October	January

Syllabus	
Course entry requirements	Basic knowledge in physic, chemistry, botanic, zoology, ecology.
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 factors and components of the marine environment. To acquire knowledge on the adaptation and specialization of marine organisms (benthos, plankton, nekton) with respect to different ecosystemic conditions. To acquire knowledge on the marine biodiversity, structure and functioning of marine ecosystems. To acquire knowledge on the intraspecific and interspecific processes which regulate structure and dynamic of marine populations and communities, even in relation to human activities.
Applying knowledge and understanding	Application of acquired knowledge for a professional growth aimed to the management of the marine environment and its biodiversity in a eco-friendly and sustainable way.
Making informed judgements and choices	Acquisition of autonomy in the evaluation and interpretation of experimental data and of examined studies, functional to the application of management and conservation measures of the marine environment with respect to the various anthropogenic pressures.
Communicating knowledge and understanding	Acquisition of the scientific terminology related to the marine ecology 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 marine 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 MARINE ENVIRONMENT. The oceans: extension and volume. Physico-chemical parameters of the water. Salinity, temperature, light, pressure. Compensation depth of carbonate. Geomorphology of the marine bottom. Oceanic deposit sediment. Movement of the sea: currents, tides and wave. Comparison between marine and terrestrial ecosystems. Evolution, three-dimensionality and connectivity in the marine environment. The producers and the food chains in the marine ecosystems. ADAPTATION AND SPECIALIZATION OF THE MARINE ORGANISMS. Structure, dispersion and locomotion. Metabolism and nutrition. Density and viscosity of the marine waters and buoyancy adaptation of plankton and nekton. Main adaptation to temperature (tolerance limits), salinity (osmoregulation) and oxygen scarcity (respiratory system). Adatpation to air exposure. Adaptation to pressure and absence of light. Bioluminescence. Sound, electric and mechanic reception systems. Support structures and bioconstructions. Biotoxins in the sea. MARINE BIODIVERSITY. Measure of the biodiversity. Biodiversity gradients. Biodiversity and stability/functioning of the ecosystems. Hypotheses and models on the biodiversity conservation. Biodiversity hot-spot. Main causes of biodiversity loss. BENTHOS. Classification of the benthos. Benthic bionomics and biocenoses. Zonation of the benthos. Plans of phytal and aphytal systems. Role of the physico-chemical and biological factors. Communities of hard and soft substrates. Biocenoses of particular ecological and conservation importance. PLANKTON. Characteristics and classification of plankton: functional, dimensional and taxonomic. Distribution of the plankton. Plankton organisms. Inverse relation between size and abundance. Global distribution of the plankton. Migration of the plankton. Successions in the planktonic communities. Plankton paradox. Light, nutrients and life cycles as factors explaining the dynamic of the plankton communities. Influence of the meio-fauna to the plankton composition. Anthropogenic activities, eutrophication and algal bloom. NEKTON. Nekton organisms: characteristics and adaptations. Geographic and bathymetric distribution of the nekton. Species and populations of the nekton. Invertebrates: cefalopods and crustaceans. Cartilaginous and teleost fishes. Analysis of sexual maturity in cefalopods, crustaceans, cartilaginous and teleost fishes. Xeronekton: reptiles, birds and mammals. Life cycles, food, reproduction and behaviour. Nekton migrations. Migratory triangle of Harden-Jones. Role of nekton in the trophic web. Match-mismatch hypothesis. Direct and indirect effects in the trophic webs. Human predation on the nekton by means of fishing. "Fishing down marine food webs". ECOSYSTEM FUNCTIONING. Life and development strategies. Evolutive constraints and environmentl drivers. Resistance forms. Supply side ecology. Primary productivity. Secondary production. Metabolism and detritus production. Particulate organic matter (POM), dissolved organic matter (DOM) and correlated processes. Microbial loop and viral shunt. Carbon flows. Pelagic-benthic coupling and benthic boundary layer. Trophic webs: grazing and dead organic matter. Bottom-up, top-down and wasp-waist controls. Key species and trophic cascading. Goods and ecosystem services. DEEP SEA ECOSYSTEMS. Physico-chemical conditions of deep sea. Biodiversity. Trofic webs and organisms. Adaptation to: low temperature, absence of light, food scarcity and low densities. Bio-ecological features across the bathymetric gradient. Biodiversity hot-spot: submarine canyons; seamounts; cold-water corals; hydrotermal vents; cold seep; whale carcass. Abyssal plan. Hypoxic and anoxic systems (dead zones). Deep Hypersalin Anoxic Basins. MEDITERRANEAN. Origin. Geomorphology, hydrography and biology. Biodiversity. Anthropogenic pressures. Hypoxic and anoxic zones in the Mediterranean. Eutrophication. Marine litter. Fishery and aquacolture. Non Indigenous Species (NIS). Climate change and effects on the organisms and ecosystems. Management measures and ecosystem approach. Barcelona Convenction. EU Marine Framework Strategy Directive. ECOSISTEMS OF CORAL REEFS AND POLAR ECOSYSTEMS. Tropical coral reefs. Biodiversity. Symbiosis between zooxanthellae and corals. Limiting factors. Coral bleaching. Trophic webs and ecosystem functioning. Arctic and antarctic ecosystems. Sympagic communities. Biodiversity and endemisms. Trophic webs and ecosystem functioning.

Course books/Bibliography	Danovaro R., 2019. Biologia marina, Biodiversità e funzionamento degli ecosistemi marini. Seconda edizione. De Agostini Scuola SpA. UTET. Castro P., Huber M.E., 2011. Biologia Marina. McGraw-Hill. Nybakken J.W., 1977. Marine Biology. An ecological approach. Addison-Wesley Educational Publishers Inc.
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 marine ecosystems 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 marine 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	