UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare		
ACADEMIC YEAR	2023/2024		
BACHELOR'S DEGREE (BSC)	BIODIVERISTY AND TECHNOLOGICAL INNOVATION		
INTEGRATED COURSE	CLIMATE CHANGE AND BIODIVERSITY - INTEGRATED COURSE		
CODE	23047		
MODULES	Yes		
NUMBER OF MODULES	3		
SCIENTIFIC SECTOR(S)	ICAR/02, BIO/05, BIO/07		
HEAD PROFESSOR(S)	SARA' GIANLUCA	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	CIRAOLO GIUSEPPE	Professore Ordinario	Univ. di PALERMO
	PARISI MARIA GIOVANNA	Professore Associato	Univ. di PALERMO
	SARA' GIANLUCA	Professore Ordinario	Univ. di PALERMO
CREDITS	9		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	3		
TERM (SEMESTER)	1° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		

TEACHER OFFICE HOURS

CIRAOLO GIUSEPPE

Tuesday	11:00	13:00	Ufficio del Professore (II piano Ed. 8 - blocco "Idraulica")
Thursday	11:00	13:00	Ufficio del Professore (II piano Ed. 8 - blocco "Idraulica")
Friday	9:00	14:00	Per gli studenti del CdS in Biotecnologie e Innovazione Tecnologica, presso le strutture del polo didattico di Trapani. I ricevimenti, su richiesta, possono essere svolti anche su piattaforma teams. Ulteriori o differenti incontri possono essere concordati con il docente

PARISI MARIA GIOVANNA

Monday	10:00	12:00	Viale delle Scienze, Edificio 1690128 Palermo
Tuesday	11:00	13:00	Polo territoriale di TrapaniSedi di svolgimento delle attivita didattiche (Principe di Napoli, TP)Colloquio on line per appuntamento
Wednesday	10:00	12:00	Viale delle Scienze, Edificio 1690128 Palermo

SARA' GIANLUCA

Tuesday	10:00	12:00	Per gli studenti del CdS in Biodiversita e Innovazione Tecnologica, presso le strutture del polo didattico di Trapani o della struttura "Principe di Napoli". I ricevimenti, su richiesta, possono essere svolti anche su piattaforma teams. Ulteriori o differenti incontri possono essere concordati con il docente
Thursday	09:00	12:00	Dipartimento di Scienze della Terra e del Mare, Sezione di Ecologia, Plesso Edificio 16, STANZA 1

DOCENTE: Prof. GIANLUCA SARA'

PREREQUISITES	The student is expected to have basic knowledge of Chemistry, Oceanography, Biochemistry, Botany, Zoology and also of adaptive mechanisms of biological systems and adaptation to natural selection pressure.
LEARNING OUTCOMES	MODULE 1 – HYDROLOGY AND CLIMATE CHANGE. The course will be focused on the learning of basic concepts of atmospheric physics and climatology and their connection with the main cycles that regulate life on earth, such as hydrological, energy, and carbon cycles. Starting from the study of processes such as the greenhouse effect and global warming due to the increased emission of climate-altering gases into the atmosphere, it will also be possible to investigate the main effects of current and expected climate change on previous cycles and on the biosphere. MODULE 2 - BIOLOGICAL RESPONSES: The student gathers knowledge on the impact of climate change on different species, both in marine and terrestrial environments, and understanding of the dynamics and bidirectional interactions between climate and biodiversity. Learning is focused on understanding of adaptive mechanisms (at gene, molecular, cellular and systemic scales) under the pressure of factors such as microevolution and phenotypic plasticity in relation to impressions induced by climate change to elucidate the evolutionary dynamics of cells and species in their natural contexts. At the end of the course the student will be able to evaluate the cross-link between the components of biodiversity and the effects of climate change. MODULE 3 - ECOLOGICAL RESPONSES: Knowledge and comprehension. Acquisition of basic theoretical knowledge related to the effects of environmental change driven by anthropogenic factors from global to local scale on ecological responses of all elements of the ecological hierarchy. Gaining basic knowledge at undergraduate level on ecological principles useful to investigate the ecosystem's response under anthropogenic pressure in order to increase skills when proposing impact analyses, multiscale monitoring protocols, mitigation and adaptation solutions in a context of global change and multiple stressors. EXPECTED LEARNING OUTCOMES At the end of the course, the student will have knowledge of basic hydrological processes and how climate change processes affect the hydrological cycle. They will have knowledge of the effects of high temperature stress and of the acclimatization strategies of marine and terrestrial species to increasing temperatures and of the states of alteration of homeostasis induced by environmental stressors. They will have knowledge of the effects of climate change on transversal ecological responses, along the ecological hierarchy, from organism to ecosystem. They will have knowledge of basic notions regarding the physical, biological and ecological principles that regulate the response of ecosystems to human action in order to propose analyses, monitoring protocols and solutions to alleviate anthropic pressure and adopt mitigation solutions and direct adaptation to change. Acquisition of a specialized scientific language. ABILITY TO APPLY KNOWLEDGE AND UNDERSTANDING. The student will be able to use the main hydro-climatic quantities to set up a hydrological and energy balance, will be able to interpret the main atmospheric processes and identify the signs of climate change. They will have the ability to autonomously use the acquired knowledge which is preparatory for a biotechnological training. Ability to process data, to describe the state of the environment according to the species present. They will have knowledge of the effects of environmental perturbations on the biological cycle and on fitness as well as the main biochemical, genetic and phenotypic acclimatization strategies and in particular. Acquisition of reading and analysis of ecological processes also in relation to anthropic alterations. AUTONOMY OF JUDGMENT. The student will be able to interpret the data necessary for the formalization of a hydro-climatic study by identifying possible changes deriving from climate change. They will have the ability to interpret data personally and to make a conscious assessment of the level of integration of the animal component in natural or altered systems. Will have the ability to evaluate and interpret the effects of climate change on ecological responses. COMMUNICATION SKILLS. The student will acquire the ability to communicate problems related to the subject of the course. Will be able to hold conversations on hydrological, climatological and climate change related topics. They will be able to hold conversations on biological issues in a context of climate change and have adequate communication skills and tools with reference to the presentation of the results of ecological studies. LEARNING CAPACITY. The student will increase their learning skills deriving from the complex analysis of the atmospheric system and its modifications deriving from global warming and climate change and interactions with the biosphere. They will have scientific and technical preparation and with a high degree of autonomy further studies for the application of animal biotechnology. They will have adequate skills for the autonomous deepening of further skills, with reference to: consultation of bibliographic material, consultation of databases and other online information, basic cognitive tools for the continuous

	updating of climatic-by-effect-related knowledge. Upon successful completion of this course, students should be able to: • Identify the direct and indirect effects of climate change on ecological systems. • Apply ecological knowledge to critically evaluate the impacts of climate change on resource conservation and management. • Formulate a research proposal on questions related to the ecology of climate change. • Communicate scientific findings in written, oral and visual presentations.
ASSESSMENT METHODS	Coursework and final oral test. The student will be evaluated based on the level of knowledge of the subjects and the ability to link between them, the clarity and the use of a specialised scientific language. Quality and continuity to the lessons will be also assessed. Assessment criteria -assessment: excellent, grade: 30 - 30 cum laude, excellent knowledge of the topics of the course, excellent use of language, excellent analytical capacity, ability to apply knowledge to problem solving; - assessment: very good, grade: 26-29, good knowledge of the topics of the course, correct use of language, good analytical capacity, ability to apply knowledge to problem solving; - assessment: good, grade: 24-25, good knowledge of the main topics of the course, correct use of language, limited ability to autonomously apply knowledge to problem solving; - assessment: satisfactory, grade: 21-23, partial knowledge of the topics of the course, satisfactory use of language, limited ability to autonomously apply knowledge to problem solving; - assessment: sufficient, grade: 18-20, minimal knowledge of the main topics of the course and of technical language, scarce ability or inability to autonomously apply knowledge to problem solving; - assessment: fail, insufficient knowledge of the topics of the course.
TEACHING METHODS	Lectures

MODULE
ECOLOGICAL EFFECTS

Prof. GIANLUCA SARA'

SUGGESTED BIBLIOGRAPHY

Pusceddu A., Sarà G., Viaroli P. 2020. Ecologia. UTET
Lee Hannah 2021. Climate Change Biology 3rd Edition. Academic Press
Materiale didattico fornito da docente

AMBIT	10703-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24

EDUCATIONAL OBJECTIVES OF THE MODULE

MODULE 3 - ECOLOGICAL RESPONSES. Acquisition of basic theoretical knowledge related to the effects of environmental change driven by anthropogenic factors from global to local scale on ecological responses of all elements of the ecological hierarchy. Gaining basic knowledge at undergraduate level on ecological principles useful to investigate the ecosystem's response under anthropogenic pressure in order to increase skills when proposing impact analyses, multiscale monitoring protocols, mitigation and adaptation solutions in a context of global change and multiple stressors.

SYLLABUS

Hrs	Frontal teaching
2	COURSE PRESENTATION Why are ecologists concerned with climate change? The ecology of organisms in a climatic context
4	THE ECOLOGICAL SIGNIFICANCE OF THE DISTURBANCE What is the disturbance How the disturbance works The characteristics of the disturbance Multiple stressors Come si propaga il disturbo lungo la gerarchia ecologica
4	CLIMATE FACTORS SEEN FROM AN ECOLOGICAL POINT OF VIEW IN AQUATIC HABITAT Temperature increase Acidification Deoxygenation and hypoxia Desalination Sea level rise Extreme events Interaction between drivers Increased frequency of disease
2	CLIMATE FACTORS SEEN FROM AN ECOLOGICAL POINT OF VIEW IN TERRESTRIAL HABITATS Temperature increase Rainfall Drought Storm
4	THE EFFECTS ON THE ECOLOGICAL RESPONSES Organisms Populations Community & Biodiversity Ecosystem & functioning
3	THE EFFECTS ON THE RELATIONSHIP BETWEEN BIODIVERSITY AND FUNCTIONING Climate change and the biodiversity-functioning relationship (BEF) Climate Change and Community Assembly Rules (CAFE)
3	THE EFFECTS ON THE PROVISION OF ECOSYSTEM SERVICES Provision services Regulatory services Cultural services Support Services
2	Testing Activities Test in progress - development Test in progress – correction altogether Closing the course and final considerations

MODULE
HYDROLOGY AND CLIMATE CHANGE

Prof. GIUSEPPE CIRAOLO

SUGGESTED BIBLIOGRAPHY	
AMBIT	10703-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24
EDUCATIONAL OBJECTIVES OF THE MODULE	

MODULE
EFFECTS UPON ORGANISMS

Prof.ssa MARIA GIOVANNA PARISI

SUGGESTED BIBLIOGRAPHY	
Dispense (PDF) relative al programma svolto durante il corso. Monitoraggio biologico: teoria e applicazioni: bioindicatori e biomarcatori per Valutazione della qualità ambientale e dell'esposizione umana A cura di M.E. Conti. Boston: WIT Press, 2008. 228 pp.	
AMBIT	10703-Attività formative affini o integrative
INDIVIDUAL STUDY (Hrs)	51
COURSE ACTIVITY (Hrs)	24
EDUCATIONAL OBJECTIVES OF THE MODULE	
Student acquires knowledge on the impact of climate change on different species, both in marine and terrestrial environments, and understands the dynamics and bidirectional interactions between climate and biodiversity. In line with modern enabling technologies, the course aims to validate molecular and cellular biomarkers for the planning of biotechnological interventions Learning is focused on understanding the adaptive mechanisms (at gene, molecular, cellular and systemic scales) under the impetus of factors such as microevolution and phenotypic plasticity in relation to climate change-induced pressures to clarify the evolutionary dynamics of populations and species in their natural contexts. At the end of the course the student will be able to evaluate the cross-link between the components of biodiversity and the effects of climate change	

SYLLABUS

Hrs	Frontal teaching
3	structure and function of biological systems, from the cellular level to that of organisms, as well as fundamental skills and techniques in the various fields of biotechnology in relation to global worming
4	Concept of bioindicator and its importance as a tool for the analysis of ecosystem complexity. Animal models. Bioindication at different levels of biological organization
3	consequences of the phenotypic plasticity available to animals, exame of physiological responses of free-living animals in their natural habitats
8	Metabolic products, responses in terms of induction/inhibition of protein synthesis, enzymatic responses. Biomarkers of genotoxicity, histopathological and morphological alterations, behavioral biomarkers. Use of biomarkers to highlight the stress syndrome in sentinel organisms and their appropriate use in biomonitoring programs
3	symbiosis, fecundity, dispersal, and/or resistance to stresses caused by pathogens and environmental changes. The spread of some symbionts and reduction in the host genetic diversity.
3	Emerging infectious diseases (EIDs), especially those with zoonotic potential, growing threat to global health, economy, and safety. The influence of global warming and geoclimatic variations on zoonotic disease epidemiology
4	Cellular and Molecular Biotechnology and Biosensors for Monitoring. Areas of applicability of devices: monitoring of environmental pollutants that tend to biomagnify within food chains with consequent impact on human health