UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze Economiche, Aziendali e Statistiche
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	STATISTICS AND DATA SCIENCE
SUBJECT	ENVIRONMENTAL BIOMONITORING
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	21031-Attività formative affini o integrative
CODE	01662
SCIENTIFIC SECTOR(S)	BIO/03
HEAD PROFESSOR(S)	NASELLI FLORES LUIGI Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	98
COURSE ACTIVITY (Hrs)	52
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	ENVIRONMENTAL BIOMONITORING - Corso: NATURAL AND ENVIRONMENTAL SCIENCE ENVIRONMENTAL BIOMONITORING - Corso: SCIENZE DELLA NATURA E DELL'AMBIENTE
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**NASELLI FLORES LUIGI** Monday 10:30 11:30 Studio del docente, Via Archirafi, 28 - I piano Wednesday 10:30 11:30 Studio del docente, Via Archirafi, 28 - I piano Friday 10:30 11:30 Studio del docente, Via Archirafi, 28 - I piano

DOCENTE: Prof. LUIGI NASELLI FLORES

PREREQUISITES	Good high-school mathematical skills and basic knowledge of general Ecology can be helpful to fruitfully attend the course.
LEARNING OUTCOMES	Acquiring knowledge and comprehension abilities: The goals of the class is to get critical and normative tools aimed at (i) identifying and selecting the most suitable bioindicators in the different ecosystems and in accordance to the purposes of biomonitoring, (ii) selecting most significant environmental parameters and (iii) to choice the most suitable sampling frequency. Setting of biomonitoring protocols sized both on the environmental characteristics of the ecosystems and on the biological traits of target organisms. Ability to apply knowledge and comprehension: Ability to autonomously build a biomonitoring protocol sized on specific environmental features to be investigated. Ability to illustrate both graphically and orally the results achieved. Judgement autonomy: The course is aimed at developing a basic knowledge, rooted on the actual European and Italian normative framework, to evaluate the implications deriving from the selection of variables and the general results achieved through a monitoring program. Ability to analyse the results coming from a biomonitoring assessment. Communication skills: The course will promote the ability to explain and sustain operative choices according to the legal context and to the environmental features. In addition, the ability to underline the importance and the necessity to monitor and control environmental characteristics even in (apparently) unimpacted ecosystems. Learning skills: The course is aimed at offering the theoretical tools to autonomously develop a biomonitoring protocol in different ecosystems/habitat, also through the use of specialised scientific literature.
ASSESSMENT METHODS	A written exam is scheduled at the end of the course, eventually integrated by 2-3 specific questions. The exam is addressed toward evaluating the ability to determine the ecological status of a given ecosystem through the choice and the analysis of selected biondicators. The test allows to demonstrate i) a basic knowledge on the selection of bioindicators (which grants a score ranging from 18 to 23), ii) a deeper knowledge on how to use autoecological (populations, including their phenotypic plasticity) and sinecological (community) knowledge to perform an environmental assessment (which grants a score ranging between 24 and 27), and iii) a capacity to make projection on future ecological scenarios (which grants a score ranging between 28 and 30 with honours).
EDUCATIONAL OBJECTIVES	According to the "manifesto" of the degree course "Scienze della Natura e dell'ambiente" the final target of the course "Biomonitoraggio ambientale" is to give to students a good knowledge on contents and methods pertaining environmental control through a biological assessment. The goal is to reach the basic knowledge to program and develop biomonitoring tools sized on the different ecosystem typologies.
TEACHING METHODS	Frontal lectures (40 h) and practice exercise in the classroom and in the field (16 h).
SUGGESTED BIBLIOGRAPHY	Articoli selezionati dal docente saranno forniti all'inizio del corso. Gli articoli consentiranno agli studenti di approfondire tutte le conoscenze acquisite in aula. La lista degli articoli e' modificata/aggiornata anno per anno in relazione alle nuove conoscenze acquisite. Libro suggerito: D'Alelio D, 2020. La microgiungla del mare. Le meraviglie del plancton, dal Mediterraneo all'Oceano globale. Prefazione di Telmo Pievani. Ulrico Hoepli Editore, Milano. Papers from scientific literature selected by the teacher will be given to students at the beginning of the course. The papers will allow the students to deepen all the knowledge received in the classroom. The list of papers is updated year by year. Suggested Textbook: D'Alelio D, 2020. La microgiungla del mare. Le meraviglie del plancton, dal Mediterraneo all'Oceano globale. Prefazione di Telmo Pievani. Ulrico Hoepli Editore, Milano.

SYLLABUS

Hrs	Frontal teaching
4	Introduction to the course. Definitions and protocols. How to analyse different matrices: soil, water, air. Analysis of the general features of the different ecosystems.
4	Identification of factors determining spatial and temporal heterogeneity in an ecosystem. Development of a sampling protocol tailored on ecosystem features.

SYLLABUS

Hrs	Frontal teaching
4	Collecting and analysing data: number transformation and normalization. How to show data on a graph. Temporal series and XY graphs. Correlation coefficients and the significance. Analysis of data variability.
4	Defining trophic state of an aquatic ecosystem. Main descriptors of trophic state. Introducing phytoplankton. Italian laws: 152/99. European Directive 2000/60: Water Framework Directive. Methods and measurements of the main trophic state parameters: total phosphorus, chlorophyll a concentration, Secchi depth.
4	Spatial zonation of an ecosystem. Introducing spatial heterogeneity in an aquatic ecosystem: effect of light extinction and temperature gradients. Effets of Light and Temperature on the biological structure of an aquatic ecosystem. Peculiarities of Mediterranean aquatic ecosystems.
4	Growth strategies of natural populations. C-S-R strategies. Morphological traits of phytoplankton. Measuring the main size and morphological descriptors of phytoplankton. Morpho-functional approach. Relationships between morphological features and environmental characteristics.
4	Relationships between resource availability (light and nutrients) and dominant phytoplankton shapes. Synthetic environmental descriptors: zmix/zeu ratio. Relationships between phytoplankton morphology and environmental parameters.
4	Introducing biodiversity and its use in the environmental biomonitoring. Intermediate Disturbance Hypothesis. How to measure biological diversity: alpha, beta and gamma diversity. Similarity indices. Diversity indices for finite and infinite populations. Shannon Index computation and its ecological meaning.
4	Harmful Algal Blooms (HAB). Main algal toxins. Ecological conditions favouring HAB. Early warning procedures. Case studies on Sicilian ecosystems.
4	River ecology. River Continuum Concept. Autotrophy and Heterotrophy in lotic ecosystems. Ecological classification of rivers and use of macroinvertebrate as bioindicators. Benthic diatoms as biological indicators. IBE and its suitability to monitor rivers. Other indices.

Hrs	Practice
8	Lab on data manipulation and their graphic rendering. Graphic methods to identify growth strategies. Use of bioindicators to identify the ecological state of an aquatic ecosystem.
8	Field sampling methods. Development of a sampling protocol. Data acquisition in biomonitoring programs. Counting phytoplankton and assessing its biomass. How to use morpho-functional descriptors in ecological state assessments.