



ACADEMIC YEAR 2023/2024

General information	
Academic subject	ENVIRONMENTAL AND MARINE TOXICOLOGY integrated exam of MANAGEMENT AND RECOVERY TECHNIQUES OF PROTECTED MARINE SPECIES
Degree course	Animal Science L38
Academic Year	III year
European Credit Transfer and Accumulation System (ECTS)	2
Language	Italian
Academic calendar (starting and ending date)	II semester: 26/02/2024 - 14/06/2024
Attendance	Mandatory

Professor/ Lecturer	
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Virtual headquarters	Microsoft Teams plataform (Code: mj6qar3)
Tutoring (time and day)	Tuesday: 13: 00-15: 00; Wednesday: 13: 00-15: 00 by appointment via email

Syllabus	
Learning Objectives	The teaching aims to explain the hazards associated with the exposure of aquatic ecosystems and protected marine species (sea turtles, cetaceans, pinnipeds, pelagic birds) to various xenobiotic pollutants of natural and anthropic origin (including drugs), contaminating the environment and the relative trophic chains, in order to protect the health and well-being of the subject species and global biodiversity. The teaching also aims to provide the student with a full and mature understanding of the importance of a rigorous knowledge of the mechanisms, restrictions, prohibitions and operative/organizational models prescribed by the current legislation ruling the diffusion of xenobiotics of anthropogenic origin in aquatic ecosystems.
Course prerequisites	Students should possess knowledge and competence regarding the anatomy, histology, cytology, physiology, immunology, pathology and pathophysiology of higher animals, including reptiles and birds, as well as knowledge and competence relating to the physiology, immunology, pathology and pathophysiology of these animals, from a molecular, cellular, organs and systems point of view. Furthermore, knowledge and competence regarding structural and functional characteristics of the most common pathogens of higher animals (bacteria and parasites) are required, along with knowledge and competence in chemistry and biochemistry. Finally, knowledge and competence related to the basic knowledge of the subject would be appropriate.
Contents	<ul style="list-style-type: none"> • Introduction to aquatic toxicology • Interactions between environmental factors and toxicity • Causes of contamination of the aquatic environment • Sources of pollution and transport in the environment • Metals, metalloids and organometallic compounds • Inorganic (including the causes of eutrophication) and organic pollutants

	<ul style="list-style-type: none"> • Drug residues • Nanomaterials • Ionizing radiations • Bioavailability of xenobiotics in the aquatic environment • Uptake of xenobiotics in the aquatic environment: trophic chains • Bioindicators, biomarkers • Distribution and accumulation of xenobiotics in aquatic species • Mechanisms of detoxification and excretion • Effects on organisms: oxidative stress, effects on membranes, apoptosis and necrosis, neurotoxicity, immunotoxicity, effects on reproduction, genotoxicity, teratogenesis, carcinogenesis, behavioural effects • Effects on populations: epidemiology, demographic effects, population genetics • Effects on communities and aquatic ecosystems • Marine protected species: hints of biology, trophic chains, routes of exposure to xenobiotics, risks for Mediterranean populations • Mass stranding • Petroleum • Algal biotoxins
Books and bibliography	<ul style="list-style-type: none"> • Vos J.G., Bossart G.D., Fournier M., O'Shea T. Toxicology of Marine Mammals, Taylor & Francis, 2003 • Gupta R.C. "Veterinary Toxicology, Second Edition: Basic and Clinical Principles". Academic Press-Elsevier, 2nd Edition (2012) • Nikinmaa M. "An introduction to aquatic toxicology". Academic Press-Elsevier (2014) • Gupta R.C. "Biomarkers in toxicology". Academic Press-Elsevier (2014) • Gulland F.M.D., Dierauf L.A., Whitman K.L. CRC Handbook of Marine Mammal Medicine, Third Edition. CRC Press, Taylor & Francis Group (2018)
Additional materials	<ul style="list-style-type: none"> • Material provided by the teacher consisting of the PDF version of the power point presentations shown during the lessons (made accessible online via Google Drive immediately after the end of the teaching period).

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
50	8	10	32
ECTS			
2	1	1	
Teaching strategy			
<p>Lectures are taken in a classroom and supported by a power point presentation and, where applicable, live demonstration. In order to facilitate student learning and make it as meaningful as possible, the topics of each lecture are problematized and contextualized with situations from real everyday life. Possible curiosities and/or questions of students are taken as the starting point for further in-depth discussion of a topic.</p> <p>On a regular basis, students will be asked to organize themselves in groups of 2 to 3 each and asked to write an essay on a topic indicated by the teacher, which they will then discuss in the classroom with their own power point presentation.</p>			

	Traditional lessons are accompanied by practical lessons that take place, depending on the specific activity to be carried out, in a classroom (e.g.: documentary films followed by group discussion), in a laboratory (e.g.: performing simple screening tests for residues detection); they also require each student to be actively involved in the execution and / or discussion of the topics covered by the exercise.
Expected learning outcomes	
Knowledge and understanding on:	<p>The teaching provides students with knowledge and understanding of the following topics:</p> <p>The teaching provides students with knowledge and understanding of the following topics:</p> <ul style="list-style-type: none"> • principles that regulate the interaction of xenobiotics with protected species living in aquatic environments that are exposed to these substances (sea turtles, cetaceans, pinnipeds, pelagic birds); • factors that contribute to determining and influencing the type and intensity of the effects resulting from the xenobiotic-organism interaction; • main national and community legislative references governing the release of xenobiotic substances in aquatic environments and their impact on the resident species; • processes of interaction and origin of the various xenobiotic substances; • principles that regulate the movement of pollutants along the trophic chains; • trophic biology of protected aquatic species that originates their exposure to toxic pollutants.
Applying knowledge and understanding on:	<p>The knowledge and understanding acquired by students by mean of this teaching will turn into:</p> <ul style="list-style-type: none"> • conscious, responsible and virtuous approach to the activities linked to production and industrial practices that imply or could imply the spread of toxic xenobiotics in aquatic environments and the exposure of protected animal species to the aforementioned substances, whether of natural and/or anthropic origin, concomitant with contamination of the trophic chains of the target species
Soft skills	<ul style="list-style-type: none"> • <i>Making informed judgments and choices</i> <p>The knowledge and understanding acquired by students by mean of this teaching will enable them to make the following judgements:</p> <ul style="list-style-type: none"> • prediction of the behaviour of a xenobiotic after spreading in the aquatic environment and exposure of target species, as well as prediction of how the intervention of certain factors may change its behaviour and the biological response arising from it; • prediction and recognition of the situations where the risk of animal exposure to toxic xenobiotics of natural or anthropogenic origin may be present; • choice and adoption of the most appropriate remedial actions in case of animal exposure to toxic xenobiotics (to the extent of what the professional figures formed by this bachelor's degree course are allowed to do). • <i>Communicating knowledge and understanding</i> <p>By this teaching, students will learn a technical vocabulary that will be useful in their professional activity after graduation in order to:</p> <ul style="list-style-type: none"> • communicate with rescue centres veterinarians (e.g.: reporting effects observed in intoxicated or otherwise critical aquatic wildlife casualties); • communicate with the Public Veterinary Service of Animal Health in case of reporting distressed or dead subjects of target species;

	<ul style="list-style-type: none"> • Moreover, by means of this teaching, students will learn how to fill in the documentation (either paper or digital) required by authorities in case of reporting, rescuing or death of target protected species. • <i>Capacities to continue learning</i> <p>This teaching provides a background knowledge that will enable the future professional figures formed by this bachelor's degree course to keep up with the continuous changes occurring in environmental new pollutants and legislation, as well as in the fate and movement of and in the exposure to xenobiotics of natural and anthropogenic origin.</p> <p>This teaching provides a background knowledge that will enable the future professional figures</p> <ul style="list-style-type: none"> • to foresee and recognize the risk situations of contamination of aquatic ecosystems and of the protected target species with toxic xenobiotic substances of natural or anthropic origin; • to provide for the collection of samples to be examined during environmental health checks to determine any compliance with current regulations on the release of xenobiotics into the environment; • to be able to provide for the collection of samples to be examined during dangerous situations or mortality of protected aquatic species (in consultation with the official veterinary staff).
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Assessment and feedback	
Methods of assessment	<p>Knowledge and skills acquired by students are verified by oral examination focusing on at least three different topics of the program. During the examination procedure, students will be evaluated for their knowledge and understanding of the principles and mechanisms that regulate the interaction of xenobiotics with living systems, as well as for their ability to apply their knowledge to identify and resolve professional issues. Students will also be evaluated for their ability to understand and use proper technical vocabulary when reading or communicating. The essays prepared by the students during the classes will be taken into consideration in the final mark.</p>
Evaluation criteria	<ul style="list-style-type: none"> • <i>Knowledge and understanding (1 to 8 points)</i> • to know the concepts and principles underlying the interaction of toxic substances with living organisms. • to know the problems that can derive from the interaction of drugs and toxic substances with marine species. • to know the origin and the modalities of formation of the various toxic substances and the principles that regulate the movement of pollutants along the marine trophic chains. • <i>Applying knowledge and understanding (1 to 8 points)</i> • having understood how it is possible to intervene to reduce the exposure of marine protected species to toxic substances of natural or anthropic origin and / or reduce the contamination of food chains, as well as assist the staff in the marine protected species rescue centers • <i>Communicating knowledge and understanding (1 to 3 points)</i> • critical reasoning skills on the study carried out. • ability to autonomously formulate one's own opinion • <i>Communication skills (1 to 3 points)</i> • ability to discursively organize one's knowledge. • ability to present one's reasoning effectively and linearly. • ability to use specialist vocabulary competently

	<ul style="list-style-type: none"> • be able to discuss about the prevention of infectious diseases in wildlife with other technicians • <i>Capacities to continue learning (1 to 8 points)</i> • To improve his knowledge of the topics through advanced courses and training periods in marine protected species rescue centers
Criteria for assessment and attribution of the final mark	<p>Knowledge and skills acquired by students are verified by oral examination focusing on at least three different topics of the program.</p> <p>During the examination procedure, students will be evaluated for their knowledge and understanding of the principles and mechanisms that regulate the interaction of xenobiotics with living systems, as well as for their ability to apply their knowledge to identify and resolve professional issues. Students will also be evaluated for their ability to understand and use proper technical vocabulary when reading or communicating. The essays prepared by the students during the classes will be taken into consideration in the final mark, expressed as thirtieths.</p>
Additional information	