



## Information about the subject

**Degree:** Bachelor of Science Degree in Marine Sciences

**Faculty:** Faculty of Veterinary Medicine and Experimental Sciences

**Code:** 270226 **Name:** Bioindicators

**Credits:** 6,00 **ECTS Year:** 0, 2, 3, 4 **Semester:** 1

**Module:** Optional Itinerary: Marine Biology, Optional Itinerary: Marine Biotechnology

**Subject Matter:** Bioindicators **Type:** Elective

**Department:** Oceanography and Environment

**Type of learning:** Classroom-based learning

**Languages in which it is taught:** Spanish

**Lecturer/-s:**

OPM3 [Maria Garcia Sanz](#) (**Responsible Lecturer**)

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## Module organization

### Optional Itinerary: Marine Biology

Subject Matter	ECTS	Subject	ECTS	Year/semester
R+D in Marine Sciences	6,00	R&D in Marine Sciences	6,00	0, 2, 3, 4/1
Biology of Cetaceans	6,00	Cetaceans Biology	6,00	This elective is not offered in the academic year 21/22
Ichthyology	6,00	Ichthyology	6,00	2, 3, 4/1
Aquariology	6,00	Aquariology	6,00	This elective is not offered in the academic year 21/22
Bioindicators	6,00	Bioindicators	6,00	0, 2, 3, 4/1
Protected Areas and Recovery of Species	6,00	Protected Areas and Recovery of Species	6,00	2, 3, 4/1
Clinic and Health of Aquatic Animals	6,00	Clinical Treatment and Healthcare of Aquatic Animals	6,00	0, 2, 3, 4/1

### Optional Itinerary: Marine Biotechnology

Subject Matter	ECTS	Subject	ECTS	Year/semester
Marine Biotechnology	6,00	Marine Biotechnology	6,00	2, 3, 4/1
Instrumental Techniques	6,00	Instrumental techniques	6,00	This elective is not offered in the academic year 21/22



Sea Food Technology	6,00	Sea Food Technology	6,00	0, 2, 3, 4/1
Genetic Engineering	6,00	Gene Techniques	6,00	This elective is not offered in the academic year 21/22
Food Technology	6,00	Food Technology II	6,00	2, 3, 4/1
Food Hygiene and Safety	6,00	Food Hygiene and Safety	6,00	2, 3, 4/1

## Recommended knowledge

No prerequisites.

## Learning outcomes

At the end of the course, the student must be able to prove that he/she has acquired the following learning outcomes:

- R1 The student distinguishes the BIOINDICATOR concept and its application in aquatic systems.
- R2 The student uses the appropriate organism according to the type of environmental alteration.
- R3 The student knows the appropriate sampling techniques depending on the type of indicator to be collected.
- R4 The student is able to write a comprehensible and organized text on different ecological aspects and assess the quality of an ecosystem.
- R5 The student is able to determine through the use of taxonomic keys marine species used as indicators.
- R6 The student extracts qualitative information from the study of organisms.
- R7 The student seeks bibliographic information from different sources and is able to analyze it with a critical and constructive spirit.



## Competencies

Depending on the learning outcomes, the competencies to which the subject contributes are (please score from 1 to 4, being 4 the highest score):

BASIC		Weighting			
		1	2	3	4
CB2	Students are able to apply knowledge to their work in a professional way and have the competences enabling them to state and defend views and opinions as well as perform problem-solving tasks in their field of study.	X			
CB3	Students are able to collect and interpret relevant data (generally in their field of study) and give opinions that involve reflection on relevant social, scientific or ethical issues.			X	
CB4	Command of a foreign language		X		
CB5	Students develop the necessary learning skills to undertake further studies with a high level of autonomy.			X	
GENERAL		Weighting			
		1	2	3	4
CG1	Capacity to analyze and synthesize			X	
CG2	Capacity to organize and plan		X		
CG3	Mastering Spanish oral and written communication			X	
CG5	Knowing and applying Basic ITC skills related to marine science			X	
CG6	Capacity to manage information (capacity to look for and analyze information coming from different types of sources)				X
CG7	Decision making			X	
CG8	Capacity to work in interdisciplinary and multidisciplinary team			X	



CG10	Critical and self-critical capacity				X
CG11	Capacity to learn				X
CG12	Capacity to adapt to new situations	X			
CG16	Capacity to apply theoretical knowledge				X
CG17	Research skills				X
CG18	Sensibility to environmental issues.				X

SPECIFIC		Weighting			
		1	2	3	4
CE1	Knowing and understanding contents, principles and theories related to Oceanography	X			
CE2	Knowing basic sampling techniques of water column, organisms, sediment and sea-bottoms as well as basic techniques of dynamic and structural variable measurement		X		
CE6	Applying marine instrument techniques	X			
CE7	Collecting, assessing, processing and interpreting oceanographic data, following the most recent theories			X	
CE8	Identifying and analyzing new problems and proposing solution strategies		X		
CE9	Knowing how to carry out experiments and measurements both in the laboratory and during sample collection			X	
CE10	Knowing how to use planning, designing and implementing research tools while surveying and assessing results		X		
CE11	Knowing how to do fieldwork and laboratory experiments in a safe and responsible way, promoting teamwork				X
CE22	Practical experience of methods of marine environmental impact assessment			X	



## Assessment system for the acquisition of competencies and grading system

Assessed learning outcomes	Granted percentage	Assessment method
R1, R2, R3, R4	45,00%	Written test with theoretical and practical questions
R4, R6, R7	35,00%	Delivery of guided assignments, whose objectives and contents will be proposed by the teacher
R2, R3, R5, R6	10,00%	Laboratory test
R1, R2, R4, R7	10,00%	Oral presentation

### Observations

#### MENTION OF DISTINCTION:

According to Article 22 of the Regulations governing the Evaluation and Qualification of UCV Courses, the mention of "Distinction of Honor" may be awarded by the professor responsible for the course to students who have obtained, at least, the qualification of 9 over 10 ("Sobresaliente"). The number of "Distinction of Honor" mentions that may be awarded may not exceed five percent of the number of students included in the same official record, unless this number is lower than 20, in which case only one "Distinction of Honor" may be awarded.

## Learning activities

The following methodologies will be used so that the students can achieve the learning outcomes of the subject:

- M1 Teacher presentation of contents, analysis of competences, explanation and in-class display of skills, abilities and knowledge.
- M2 Group work sessions supervised by the professor. Case studies, diagnostic tests, problems, field work, computer room, visits, data search, libraries, on-line, Internet, etc. Meaningful construction of knowledge through interaction and student activity.



- M3 Activities carried out in spaces with specialized equipment.
- M4 Supervised monographic sessions with shared participation.
- M5 Application of multidisciplinary knowledge.
- M6 Personalized and small group attention. Period of instruction and/or guidance carried out by a tutor to review and discuss materials and topics presented in classes, seminars, readings, papers, etc.
- M8 Set of oral and/or written tests used in initial, formative or additive assessment of the student.
- M9 Group preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical , practical and/or small-group tutoring sessions. Work done on the university e-learning platform ([www.plataforma.ucv.es](http://www.plataforma.ucv.es) )
- M10 Student's study: Individual preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical, practical and/or small-group tutoring sessions. Work done on the university e-learning platform ( [www.plataforma.ucv.es](http://www.plataforma.ucv.es) ).



## IN-CLASS LEARNING ACTIVITIES

	LEARNING OUTCOMES	HOURS	ECTS
ON-CAMPUS CLASS M1	R1, R2, R3, R4	30,00	1,20
PRACTICAL CLASSES M2	R2, R3, R4, R5, R6, R7	10,00	0,40
LABORATORY M3	R2, R3, R5, R6	10,00	0,40
SEMINAR M4	R1, R3, R6	3,00	0,12
GROUP PRESENTATION OF ASSIGNMENTS M5	R4, R6, R7	2,00	0,08
TUTORIAL M6	R1, R2, R3, R4, R5, R6, R7	3,00	0,12
ASSESSMENT M8	R1, R2, R3, R4, R5, R6, R7	2,00	0,08
<b>TOTAL</b>		<b>60,00</b>	<b>2,40</b>

## LEARNING ACTIVITIES OF AUTONOMOUS WORK

	LEARNING OUTCOMES	HOURS	ECTS
GROUP WORK M9	R4, R6, R7	20,00	0,80
INDEPENDENT WORK M10	R1, R2, R3, R4, R6, R7	70,00	2,80
<b>TOTAL</b>		<b>90,00</b>	<b>3,60</b>





## Description of the contents

Description of the necessary contents to acquire the learning outcomes.

### Theoretical contents:

Content block	Contents
1. Introduction	Definition of indicator, environmental indicator and, biological indicator. Potentiality of biological indicators. Concept of bioindicator. Characteristics of bioindicators. Concept of biomarker. Characteristics of biomarkers. Advantages and disadvantages of the use of biological indicators. Selection of biological indicators. Concept of biotic indice. Types of biotic indices. Strengths and weaknesses of biotic indices.
2. Aquatic organisms as indicators of environmental changes	Bioindicator species of different parameters: light, dissolved oxygen, hydrodynamism, substrate nature, salinity, temperature, environmental stress, environmental health, contaminants agents. Biomarkers.
3. The Water Framework Directive and Marine Strategy Framework Directive	Objectives of DMA. Biological Indicators. Ecological status. Reference conditions. Environmental Quality Ratio (EQR). Representation and classification of ecological status. The Marine Strategies as tool for management of marine environment
4. Biological indicators based in macroalgae	Effect of nutrients on the algal community. Marine algae as indicators of environmental quality. Biotic indexes based on macroalgae. Rhodophyta Ratio/Phaeophyta. Index of Cheney. CARLIT Index. Macroalgal bioassays to evaluate the spatial extent of fish farm effluents. PR1: Application of the CARLIT Index
5. Biological indicators based in seagrasses	Bases for the design of indicators. Biotic indexes based on seagrasses. Multivariate indexes: POMI. CYMOX. Zostera marina as indicator of health ecosystem. PR2: Study of indicator variables in marine angiosperms.



6. Biological indicators based in phytoplanktonic organisms

Effect of nutrients on the phytoplankton community. Phytoplanktonic Indicators. PHYMED index. Control and monitoring of HABs. PR3: Calculation of indices based on phytoplankton communities.

7. Biological indicators based on benthic macrofauna

Benthic organisms as bioindicators of ecological health of oceans. Marine invertebrates as indicators of climate change. Sea urchin as indicators of rocky and coral reefs state. Mussels as sentinel organisms: Mussel Watch. . Biotic indexes based on benthic macrofauna: AMBI, BENTIX, BOPA, BO2A, MEDOCC, ITI. PR4: Calculation of marine biotic indices based on benthic macrofauna.

8. Biological indicators based marine vertebrates

Sharks as bioindicators of pollution and trophic changes in marine ecosystems. The behavior of fish as biomarkers for the presence of environmental stressors. Species " flag " as environmental bioindicators: sea turtles. Seabirds as sentinels of ocean health . Cetaceans as bioindicators of the health of the oceans.

## Organization of the practical activities:

	Content	Place	Hours
PR1.	Practical work in IMEDMAR. CARLIT index application.	Marine station	4,00
PR2.	Laboratory. Study of indicator variables in seagrasses	Laboratory	8,00
PR3.	Laboratory. Biotic index calculation based on phytoplankton communities	Laboratory	2,00
PR4.	Informatic. Biotic index calculation based on benthic macrofauna	Computer	4,00



## Temporary organization of learning:

Block of content	Number of sessions	Hours
1. Introduction	3,00	6,00
2. Aquatic organisms as indicators of environmental changes	4,00	8,00
3. The Water Framework Directive and Marine Strategy Framework Directive	2,00	4,00
4. Biological indicators based in macroalgae	4,00	8,00
5. Biological indicators based in seagrasses	8,00	16,00
6. Biological indicators based in phytoplanktonic organisms	3,00	6,00
7. Biological indicators based on benthic macrofauna	4,00	8,00
8. Biological indicators based marine vertebrates	2,00	4,00



## References

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## Addendum to the Course Guide of the Subject

Due to the exceptional situation caused by the health crisis of the COVID-19 and taking into account the security measures related to the development of the educational activity in the Higher Education Institution teaching area, the following changes have been made in the guide of the subject to ensure that Students achieve their learning outcomes of the Subject.

**Situation 1: Teaching without limited capacity** (when the number of enrolled students is lower than the allowed capacity in classroom, according to the security measures taken).

In this case, no changes are made in the guide of the subject.

**Situation 2: Teaching with limited capacity** (when the number of enrolled students is higher than the allowed capacity in classroom, according to the security measures taken).

In this case, the following changes are made:

### 1. Educational Activities of Onsite Work:

All the foreseen activities to be developed in the classroom as indicated in this field of the guide of the subject will be made through a simultaneous teaching method combining onsite teaching in the classroom and synchronous online teaching. Students will be able to attend classes onsite or to attend them online through the telematic tools provided by the university (videoconferences). In any case, students who attend classes onsite and who attend them by videoconference will rotate periodically.

In the particular case of this subject, these videoconferences will be made through:

Microsoft Teams

Kaltura



### **Situation 3: Confinement due to a new State of Alarm.**

In this case, the following changes are made:

#### **1. Educational Activities of Onsite Work:**

All the foreseen activities to be developed in the classroom as indicated in this field of the guide of the subject, as well as the group and personalized tutoring, will be done with the telematic tools provided by the University, through:

Microsoft Teams

Kaltura

Explanation about the practical sessions:

- Practical sessions of macroalgae and benthic macrofauna will be carried out online through TEAMS.

in the case of marine angiosperms, laboratory practices will be worked theoretically, providing data obtained in campaigns from previous years and developing the POMI / CARLIT index for different sampling stations. In the case of phytoplankton we will work with audiovisual material available on the web to study the different techniques of phytoplankton analysis.



## 2. System for Assessing the Acquisition of the competences and Assessment System

### ONSITE WORK

#### Regarding the Assessment Tools:

The Assessment Tools will not be modified. If onsite assessment is not possible, it will be done online through the UCVnet Campus.

The following changes will be made to adapt the subject's assessment to the online teaching.

Course guide		Adaptation	
Assessment tool	Allocated percentage	Description of the suggested changes	Platform to be used

The other Assessment Tools will not be modified with regards to what is indicated in the Course Guide.

#### Comments to the Assessment System: