

Ecology and Physiology of Aquatic Organisms (250584)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Agroalimentària i Biotecnologia (DEAB)
Credits	6.0 ECTS
Programs	GRAU EN CIÈNCIES I TECNOLOGIES DEL MAR (pla 2018)
Course	2024/25

Main teaching language at each group

- Group 10CA2 Catalan (Q2)

Faculty

Responsible Faculty: Maria Lourdes Reig Puig
Faculty: Olga Maria Felip Arias, Maria Lourdes Reig Puig

Objectives of Education

In this subject, the most relevant aspects of physiology as well as the ecophysiological adaptations of marine and estuarine fish will be addressed, to understand the interactions that species have with their environment and other organisms. Issues related to nutrition, fish growth and reproduction will be addressed, fundamental aspects for the implementation of the ecosystem approach in the management of marine living resources.

1. Know and know how to apply the basic principles and elements that make up a recirculation system in aquaculture, as well as the environmental factors that affect it.
2. Design the hydraulic circuit of a facility including the cultivation units and the water treatment systems.
3. Know how to take technical decisions, in design, management and maintenance of the facility and population, evaluating their consequences on the technical, economic and environmental viability of the aquaculture system

The topics addressed in this matter cover most of the physical, environmental and ecological problems and challenges identified by the scientific community and the social agents that the coastal zone will face in the near future under different development scenarios and climate change.

This course will address the physiological mechanisms of environmental adaptation of aquatic organisms. To this end, the physiological basis of the nervous system will be reviewed, including sensory systems in the marine environment and effector systems, nutrition, endocrine systems, the relationship with water temperature and its metabolic adaptations, circulatory systems, respiratory systems, osmoregulation and ionoregulation and finally nitrogen excretion and pH regulation.

Competencies

Especific

To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.

Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.

Participate and eventually lead multidisciplinary work teams in the field of Marine Sciences and Technologies to respond to the social challenges related to this field.

Evaluate the bio- and geo-diversity of the marine environment, identifying habitats and ecosystems with multidisciplinary criteria.

Evaluate the dynamics of seas and oceans at different scales, identifying water masses and their properties. (Specific competence of Marine Science and Engineering Mention)

Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.

To set, evaluate and propose solutions to the different conflicts of use and exploitation in the marine and coastal environment resources based on scientific and technical criteria.

To set, analyze and optimize the functionality of actions and infrastructures in the marine environment. (Specific competence of the Marine Science and Engineering Mention)

Carry out environmental impact, management and protection studies of the marine environment and adjacent coastal areas, including the corresponding infrastructures and their related impacts.

Carry out operational predictions in the open sea and coastal areas, including the corresponding risk maps. (Specific competence of the Marine Science and Engineering Mention)

Use state-of-the-art mathematical models in the marine field to analyze impacts and interactions with socio-economic activities supported by this environment. (Specific competence of the Marine Science and Engineering Mention)

Apply spatial and cartographic representation techniques for different environments and scales.

Generic

Apply state-of-the-art methods and techniques in oceanography and marine climate, jointly covering the physical, chemical, geological and biological aspects.

Develop a conceptual framework that links the scientific-technological and management aspects for marine resources, explaining the interactions with marine infrastructures and management plans in coastal areas.

Apply knowledge and academic experience to the biotic and abiotic resources of the marine environment, explaining their interactions with the socio-economic activities that take place in it.

Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.

Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	40.02 h	66.70 %
	Medium group	0.0 h	0.00 %
	Laboratory classes	19.98 h	33.30 %
	Guided Activities	0.0 h	0.00 %
Self Study		90.0 h	

Contents

1. Introduction

The subject and its contents will be presented, as well as the practical activities and the evaluation mechanisms.

Specific Objectives

The aim is to understand what the development of the subject will be and what its role is in the curriculum.

2. Nervous system

Nerve integration. Neural signaling. Nerve transmission. Sensory and motor systems.

* Photoreception and Vision: Light in the aquatic environment. Photoreception. Types of photoreceptors.

Types of eyes and adaptations to different visual environments underwater. Color vision

* Mechanoreception: Differential characteristics and adaptations of sensory mechanoreceptors in aquatic animals: touch and pressure receptors. Proprioceptors. Ear and balance in vertebrates and invertebrates (statocysts, neuromasts and inner ear).

* Chemoreception: Special characteristics of aquatic chemoreception. Morphology and Physiology of chemoreceptors in aquatic animals. Smell and taste in marine animals.

* Electrosensitivity and electroreception. Conductivity of the aquatic environment. Physiology of electroreceptors in aquatic animals. Electrocytes. Electrical organs

* Locomotion: Special characteristics in the aquatic environment in terms of locomotion. Muscle types, body distribution and physiology of swimming.

* Chromatophores, pigmentation and color changes. Types of pigment cells. Chromatophores and bioluminescence.

* Animal orientation and navigation at sea. Migration of marine animals. Biological rhythms.

Practical activities that will be carried out at the LAB of Vilanova i la Geltrú in relation to the nervous system

Specific Objectives

The goal is to review the basics of the nervous system in order to understand the particularities of aquatic organisms.

The aim is to differentiate the different sensory reception systems in the marine environment in order to determine the different impacts that may affect them.

The aim is to know the main effector systems of aquatic organisms that help them move, blend in with the environment and refer to their movement.

Put into practice the knowledge acquired in the theory sessions

3. Nutrition

* Peculiarities of nutrition in the marine environment. Nutritional and energy requirements.

* Digestive morphology and physiology in invertebrates and fish.

Practical classroom activities in which concepts of nutrition and feeding of aquatic species will be reviewed.

Specific Objectives

The aim is to understand the specific nutritional requirements of aquatic organisms, as well as their digestive morphology and physiology.

Put into practice the knowledge acquired about nutrition

4. Endocrine systems

* Evolution of endocrine systems in marine vertebrates and invertebrates.

* Regulation of reproduction

* Regulation of growth and regeneration of the shell * Control of growth and molting

Specific Objectives

The aim of the course is to review the fundamentals of the endocrine systems of aquatic organisms with special attention to growth and reproduction.

5. Thermal relations with the marine environment. Metabolic adaptations

* Temperature as a metabolic condition. Adaptive strategies

* Poikilotherms and homeotherms

Specific Objectives

The goal is to understand how aquatic organisms adapt to changes in the water temperature regime.

Midterm exam

6. Circulatory systems

* Characteristics of the circulatory system in marine animals

* Distribution and functions of respiratory pigments

Specific Objectives

The aim is to understand the diversity of circulatory systems in aquatic organisms and the role of respiratory pigments.

7. Respiratory systems

- * Characteristics of the respiratory system in marine animals (cutaneous, gill and pulmonary respiration)
 - * Adaptation and acclimatization to hypoxia.
 - * Adaptation to diving
- Calculation of respiratory rates in different conditions

Specific Objectives

The goal is to understand the differences in adaptive strategies for breathing in an oxygen-deficient environment such as aquatic.
The aim is to put into practice the knowledge acquired about the respiratory systems

8. Osmoregulation and ionoregulation

- * Adaptive strategies to the salinity of the marine environment in invertebrates and marine fish. Anatomical and cellular structures involved.
- * Regulation of acclimatization to environmental tonicity and salinity

Specific Objectives

The aim is to understand the adaptations of marine species to salinity.

9. Nitrogen excretion and pH regulation in marine animals

- * Structures involved in excretion
- * Acid-base balance

Specific Objectives

The aim is to understand the mechanisms of excretion of aquatic species.

Other practices

This section will include other practical activities that are related to the contents of the subject. Most of the internships will take place at the LAB in Vilanova i la Geltrú.

Specific Objectives

The aim is to complement with theoretical activities the theoretical knowledge of the subject.

Conferences

There will be several conferences that complement the knowledge of the subject.

Specific Objectives

The aim is to expand the knowledge acquired by students through the participation of experts in different topics related to the subject.

Course work

The course work consists of designing a poster on a topic chosen by the student. The poster will be displayed and presented in a poster session, in the same way as in a scientific conference.

Specific Objectives

The aim of the activity is to be able to search for, summarize and graphically express information on a topic chosen by the student. The activity serves to introduce students to the world of scientific dissemination. Peer assessment aims to develop critical thinking and the ability to assess peer activity.

Final exam

Teaching Methodology

The subject consists of 2.3 hours per week of face-to-face classes in the classroom (large group) and 1.2 hours per week with half of the students (medium group).

2.3 hours are dedicated to theoretical classes in large groups, in which the teachers explain the basic concepts and materials of the subject, present examples and do exercises.

1.2 hours (medium group) are dedicated to solving problems with greater interaction with students.

Practical exercises are carried out in order to consolidate the general and specific learning objectives. The rest of the weekly hours are devoted to laboratory practices and other activities.

Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment and guided learning activities and bibliography.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

Grading Rules

() The evaluation calendar and grading rules will be approved before the start of the course.*

The qualification of the subject is obtained from the grades of continuous evaluation. The continuous evaluation consists of doing both individual and group activities of an additive and formative nature, carried out during the course (inside the classroom and outside it). This subject includes two exams (partial and final), the corresponding practical activities (laboratory and other activities) and course work (poster).

The exams have a weight of 55% of the subject, of which 40% corresponds to the partial and 60% to the final). The assessment tests consist of a part with questions about concepts associated with the learning objectives of the subject in terms of knowledge or comprehension, and a set of application exercises.

The qualification of practical activities represents 30% of the total of the subject and is calculated by the average of the activities of this type.

The qualification of the poster represents 15% of the total of the subject and is obtained by evaluation of the teacher and by evaluation in pairs (classmates).

Re-evaluation (RE)

Grading criteria and admission to the re-evaluation (Re):

Students failed at the ordinary assessment who have regularly sat the assessment tests of the failed subject will have the option to sit a re-evaluation test in the period set in the academic calendar. Students who have already passed a subject may not sit the re-evaluation test of a subject, nor may students who are graded as non-submitted or who have not handed in all the exercises/problems (Pr) and assignments and reports (Tr).

The re-evaluation (RE) will consist of a single exam covering the entire course content. The maximum mark for the re-evaluation will be five (5.0) and the final mark for the course will be the maximum mark between the continuous assessment and the re-evaluation exam, i.e. $\text{MAX}(\text{Ordinary assessment/RE})$.

The non-attendance of a student summoned to the re-evaluation test, held in the fixed period, may not give rise to the taking of another test at a later date. Extraordinary assessments will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorised by the corresponding Head of Studies, at the request of the teacher responsible for the subject, and will be held within the corresponding teaching period.

Test Rules

Criteria of qualification and of admission to the re-evaluation: The students that have failed the ordinary evaluation and that have tried regularly the proofs of evaluation of the subject will have the option to realise a proof of re-evaluation in the period fixed in the academic calendar. Students who have already passed it or students who have qualified as not presented will not be able to take the re-assessment test for a subject. The maximum grade in the case of taking the re-assessment exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the set period may not lead to the performance of another test at a later date. Extraordinary assessments will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.

Office Hours

The hours of attention to the students will be defined in function of the schedules of the asignatura. In any case, it will always be possible to request a personalized attention session by request by e-mail to the person who coordinates the subject.

Bibliography

Basic

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- Eckert, D.; Randall, D. Augustine, G. [Fisiología animal : mecanismos y adaptaciones](#). Madrid, [etc.]: Interamericana-McGraw-Hill, 1991. ISBN 9788476154380.
- Sherwood, L.; Klandorf, H.; Yancey, P.H. [Animal physiology: from genes to organisms](#). 2nd ed., Int. ed. Pacific Grove, Calif.: Brooks/Cole, 2013. ISBN 9781111988715.
- Willmer, P.; Stone, G.; Johnston, I. [Environmental physiology of animals](#). 2nd ed. Malden (Mass.): Blackwell Science, 2005. ISBN 1405107243.
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