Universidad Zaragoza

Academic Year/course: 2022/23

25268 -

Syllabus Information

Academic Year: 2022/23
Subject: 25268 -
Faculty / School: 201 - Escuela Politécnica Superior
Degree: 571 - Degree in Environmental Sciences
ECTS: 6.0
Year:
Semester: Second Four-month period
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The general objective of the course is to gain knowledge of the functioning of aquatic ecosystems, mainly epicontinental, which will allow the necessary actions to be taken for their management, conservation and restoration, within the framework of current regulations. This will make it possible to:

a) address the scientific study of aquatic systems;

b) apply techniques, tools and protocols for assessing the environmental integrity of aquatic ecosystems in accordance with current regulations, mainly ecological quality indices, biotic indices such as macroinvertebrates (IBMWP, etc.) and trophic status (chlorophyll) and conservation status of water bodies (ECELS).

c) to develop professional, scientific and social skills in relation to the challenges of conservation and management of water and the ecosystems it generates.

This course aims to treat the different types of aquatic ecosystems with equal weight. Using the division of water masses proposed in the context of the Water Framework Directive and ratified in Royal Decree 817/2015.

Special attention will be paid to the SDGs - Agenda 2030 on Sustainable Development (https://www.un.org/sustainabledevelopment/es/) directly or indirectly related to the subject:

GOAL 4: QUALITY EDUCATION
4.7 By 2030, ensure that all learners acquire the knowledge and skills necessary to promote sustainable development, including through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and the contribution of culture to sustainable development.
4.c By 2030, significantly increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially the least developed countries and small island developing States.
GOAL 6: CLEAN WATER AND SANITATION
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing the release of chemicals and hazardous materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
6.4 By 2030, significantly increase the efficient use of water resources in all sectors and ensure sustainability of freshwater withdrawals and supplies to address water scarcity and significantly reduce the number of people suffering from water scarcity
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation, where appropriate
6.6 By 2020, protect and restore water-related ecosystems, including forests, mountains, wetlands, rivers, aquifers, and lakes
6.a By 2030, scale up international cooperation and capacity-building support to developing countries in water and sanitation activities and programmes, such as water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6.b Support and strengthen the participation of local communities in improving water and sanitation management.
OBJECTIVE 7: AFFORDABLE AND CLEAN ENERGY
7.a By 2030, increase international cooperation to facilitate access to clean energy research and technology, including renewable sources, energy efficiency, advanced and cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean technologies.
GOAL 13: CLIMATE ACTION
13.1 Strengthen resilience and adaptive capacity to climate-related risks and natural disasters in all countries
13.2 Mainstream climate change action into national policies, strategies and plans
13.3 Improve education, awareness and human and institutional capacity for climate change mitigation, adaptation, mitigation and early warning
GOAL 14: MARINE LIFE
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including

marine debris and nutrient pollution
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action to restore them in order to restore the health and productivity of oceans

14.3 Minimise and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels
14.4 By 2020, effectively regulate fisheries exploitation and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices, and implement science-based management plans to rebuild fish stocks in the shortest time possible, at least to levels that can produce the maximum sustainable yield consistent with their biological characteristics
14.5 By 2020, conserve at least 10% of coastal and marine areas, in accordance with national laws and international law and on the basis of the best available scientific information
14.a Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Criteria and Guidelines on the Transfer of Marine Technology of the Intergovernmental Oceanographic Commission, in order to improve ocean health and enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
14.c Enhance the conservation and sustainable use of the oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of the oceans and their resources, as recalled in paragraph 158 of the document "The Future We Want".
GOAL 15: LIFE OF TERRESTRIAL ECOSYSTEMS
15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and the services they provide, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide essential benefits for sustainable development
15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect threatened species and prevent their extinction
15.7 Take urgent action to stop poaching and trafficking of protected species of flora and fauna and address the illegal demand and supply of wildlife products
15.8 By 2020, take measures to prevent the introduction of invasive alien species and significantly reduce their impacts on terrestrial and aquatic ecosystems and control or eradicate priority species
15.9 By 2020, integrate ecosystem and biodiversity values in national and local planning, development processes, poverty reduction strategies and accounting
15.a Mobilise and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems 15.c Increase support for the conservation and sustainable use of biological diversity and ecosystems
15.c Increase global support for combating poaching and trafficking of protected species, in particular by increasing the capacity of local communities to promote sustainable livelihood opportunities

1.2. Context and importance of this course in the degree

This is a fourth-year optional subject that will give students who take it a certain specialisation in aquatic environments. It is a subject that, like its predecessor in the old plan now in extinction (River Ecosystems), draws on the knowledge acquired in previous courses, both in the same branch of ecology, as well as in basic subjects. Knowledge of chemistry, physics, mathematics, geology, botany, zoology and other more specific subjects such as hydrogeology, environmental toxicology, water pollution and the management of flora, fauna and natural spaces will be reviewed and applied. Of course, all of this is based on the foundation previously laid in the second year of the degree with the subjects Ecology I and II.

1.3. Recommendations to take this course

It is recommended to have taken and passed the subjects of module 1: Interpretation of the Environment as a System.

2. Learning goals

2.1. Competences

Basic competences:

CB1. That students have demonstrated possession and understanding of knowledge in the area of environmental sciences that starts from the basis of general secondary education, and is usually found at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.

CB3. Students have the ability to gather and interpret relevant data (usually within the environmental sciences) in order to make judgements that include reflection on relevant social, scientific or ethical issues.

CB4. Students are able to transmit information, ideas, problems and solutions to both specialist and non-specialist audiences.

CB5. That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

Specific competences:

CE1. Ability to interpret the environment as a complex system: identification of the factors, processes and interactions that make up any type of environment. This involves fundamental knowledge of all systems (hydrology, soil science, meteorology and climatology, zoology, botany, geology, society and territory, etc.), understanding their constitution and fundamental processes (physics, chemistry and biology) and their interactions (ecology).

Ability for multidisciplinary analysis of the indicators and evidence of an environmental problem or situation, with the capacity for qualitative and quantitative interpretation of data from different specialities, the ability to relate the analysis to theoretical models and awareness of the temporal and spatial dimensions of the environmental processes involved.

CE3. Mastery of the procedures, languages and techniques necessary for the interpretation, analysis and evaluation of the environment. This implies knowledge of mathematical foundations, statistical procedures and programmes, cartography and geographic information systems, instrumental analysis systems in the environment or the bases of environmental engineering.

CE4. Ability to assess the resources and constituents of the environment in economic, social, legal and ecological terms. This includes knowledge of economics and legislation.

SC5. Competence to prepare a diagnosis of the environmental situation in a given context, whether natural, rural or urban, based on the interpretation of all the systems of the environment, the analysis of all the relevant indicators of the situation, the assessment of its resources and constituents and the consideration of foreseeable impacts or changes.

Ability to prospectively establish a scenario of future evolution of the current situation diagnosed and propose the relevant corrective measures.

SC7. Ability to prepare and present the reports corresponding to the diagnosis made.

SC8. Competence in the preparation, management, monitoring and control of environmental plans and projects in areas such as the exploitation of resources in the context of sustainable development, planning and integrated land management, rural development plans, plans for the restoration and conservation of the natural environment, waste management, treatment of contaminated soils, environmental information systems.

CE9. Mastery of criteria, regulations, procedures and techniques of environmental and quality management systems. This includes the ability to identify and assess environmental costs; management of water supply and treatment systems; energy optimisation with the use of clean and renewable technologies; management of air quality and purification of atmospheric emissions; integrated management of health, hygiene and prevention of occupational risks.

Ability to draw up environmental reports and audits and to design and manage environmental information systems.

CE11. Ability to design and apply environmental indicators and sustainability strategies.

CE12. Ability to design and coordinate environmental awareness and education initiatives aimed at the general public or at specific areas (school, university, workers or employers in a sector, etc.),

university, workers or employers in a sector, etc.).

CE13. Ability to design environmental information systems.

Generic competences

GC1. Understanding and mastery of the fundamental knowledge of the area of study and the ability to apply this fundamental knowledge to the specific tasks of an environmental professional.

GC2. Communication and argumentation, oral and written, of positions and conclusions.

GC3. Ability to solve problems, generic or characteristic of the area through the interpretation and analysis of relevant data and evidence, the issuing of relevant evaluations, judgements, reflections and diagnoses, with appropriate consideration of scientific, ethical or social aspects.

GC4. Capacity for consistent decision-making.

GC5. Capacity for critical reasoning (analysis, synthesis and evaluation).

GC6. Ability to apply theoretical knowledge to the analysis of situations.

GC7. Mastery of computer applications related to the field of study, as well as the use of the Internet as a means of communication and source of information.

GC8. Ability to organise and plan work independently and to manage information.

GC9. Ability to work in teams, in particular interdisciplinary and international teams characteristic of work in this field.

GC10. Ability to lead, to organise work teams and fundamental interpersonal relationship skills.

GC11. Ability to communicate, argue and negotiate both with specialists in the area and with non-experts in the field.

GC12. Ethical commitment in all aspects of professional performance.

GC13. Capacity for autonomous learning and self-evaluation.

GC14. Creativity, initiative and entrepreneurial spirit.

GC15. Ability to adapt to new situations.

GC17. Sensitivity towards environmental issues.

2.2. Learning goals

Describe and argue the ecological functioning (physico-chemical, biological processes...) of the different aquatic systems.

Identify the relationships established between the levels of the trophic chain in the different aquatic ecosystems.

Demonstrate ability in the handling of the main methodologies for sampling, determination and analysis of organisms from aquatic ecosystems for their application in indices of ecological quality and trophic state.

Express ideas and concepts of aquatic ecology correctly orally and in writing.

Identify and describe the main impacts affecting aquatic ecosystems.
These learning outcomes are aligned with Sustainable Development Goals 4, 6, 7, 12, 14 and 15, indicated in the subject objectives. By achieving them, students will have acquired the theoretical and practical knowledge necessary to promote

sustainable development in relation to aquatic ecosystems.

2.3. Importance of learning goals

The learning outcomes obtained will enable an understanding of epicontinental aquatic ecosystems, their environmental problems and management, conservation and restoration actions. Knowledge of the functioning of aquatic ecosystems, highlighting the understanding of the relationships established between the different levels of the trophic chain, will lead to knowledge-based management advice. All this with reference to current legislation, in particular the Water Framework Directive.

All this implies the acquisition of knowledge and the ability to address issues related to the targets associated with the SDGs developed in the objectives of this guide.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

This subject offers the possibility of continuous assessment, for which attendance to at least 80% of the face-to-face activities is established. In this case, the assessment activities will be:

A written test, at the end of the theory and practice programme of the course. The test may include short answer and essay questions. The test will assess the practical and theoretical content of the subject (70% of the mark).

Preparation of a report on each practical (25%). The report of each practical will be carried out in a group and will include the following sections: introduction and objectives; methodology; results; discussion and conclusions.

Analysis and presentation of scientific work (5%). Students will individually analyse and summarise a scientific text related to the subject and will present it in class.

All students have the right to participate in the overall written and face-to-face exam at the end of the course according to the EPS exam calendar. For those who do not pass the subject in the continuous assessment, those who have not attended the activities or those who want to increase their marks.

The overall assessment test will consist of the following activities:

Preparation of a general report on the internship as a whole (15%). The general practical report will include the following sections: introduction and objectives; methodology; results; discussion and conclusions.

To demonstrate that the practical knowledge has been acquired in the laboratory, a written test will be carried out (15%).

A written and face-to-face test at the end of the course according to the EPS exam calendar (70% of the mark). Each test may include short answer and essay questions. The test will assess the practical and theoretical content of the subject.

The evaluation criteria for both types of evaluation are as follows:

Correct and fluent expression of concepts related to limnology.

The ability to relate the concepts acquired in practice and those of theory.

Interpretation in the field and in the laboratory of ecological processes occurring in aquatic ecosystems.

The ability to integrate and synthesise information.

In relation to the SDGs, their assessment is carried out in all the activities of the subject.
The success rate in the subject in the last three years is 100% (academic year 18-19), 100% (academic year 19-20) and 100% (academic year 20-21).

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this assignment is based on the following:

- Theory sessions that will consist of participatory lectures.

- Practical sessions that will consist of field and lab work with material provided by the teacher.

- Field trips: There will be 3 field trips in which organisms will be observed, in situ experiments will be carried out and samples will be taken, which will later be analysed in the laboratory. These field trips will include visits to a river, a lagoon and a marine reserve.

In relation to the SDGs, all the learning activities of the subject allow to achieve the learning outcomes related to the SDGs.

This subject includes theory and practise sessions where several targets of SDG 4, 6, 7, 14, 15 are approach.

4.2. Learning tasks

The program offered to achieve the expected results include the next learning activities:

Theory sessions: Lectures introduce the main concepts and lines of the subject. In addition, most difficult issues will be reviewed thoroughly. Bibliography and auto-evaluation tools are provided. Readings and instructions for all practical exercises will be provided on the course website (moodle).

Practical sessions: Practical classes form part of the required activities for this course. If you miss a lecture or tutorial through illness or some other serious reason, it is your responsibility to attend an equivalent class from another stream. Some content and activities will not be available except by physically attending the classes, and missing material will disadvantage you in the course assessment.

4.3. Syllabus

Theoretical Programme The theoretical programme is as follows:

1. Introduction. Limnology. World water cicle, primary and secondary production. Main aquatic ecosystems in Aragon.

2. Resources and factors; distribution, abundance and availability of basic elements for life. Factors, resources and sub-products relating to organism activity in ecosystems. Autoecological limitations relating to abundance; resources and other varying factors. Asymptotic yield of resources. Limiting resources. Significance of metabolic sub-products in ecosystems. Importance of the vertical axis in the organisation of material space. Gradients of redox in nature.

3. Fluvial systems and physical-chemical characteristics. The basin as a hydrological unit. Continental waters. Typology. The water cycle. Composition. Water flow. Substratum. Light and temperature. Dissolved gas. Inorganic carbon and pH regulation.

4. Fluvial systems and biological characteristics. The dynamics of nutrients. Phosphorous as a limiting nutrient. Use of dissolved and particulate organic matter. Fluvial biofilm. Microbial loop. Consumers; shredders, collectors, grazers, predators. Integration of different factors along the river. The "river continuum concept." Variation of food chain characteristics along a fluvial gradient. Mediterranean rivers. Eutrophication. Micro-contaminants.

5. Fluvial systems: Impacts. Invasive species. Eutrofication. Pollutants. Hydrological regime pertubation. Restoration of ecossystems.

6. Lake systems: Estructure and organization of abiotic factors. Dynamics. Depth profile. Stratification. Trophic state. Ligth extintion law.

7. Lake systems: Biotic factors. Organisms. Main biological traits.

8. Lake systems: Transition waters and lagoons. Dynamics. Depth profile. Stratification. Trophic state. Biotic factors. Organisms. Main biological traits.

9. Lake systems: Causes of degradation and eutrophication.

10. Reservoirs: dynamics and organisms. Impact. Taxonomical and functional diversity shift.

11. Oceanic ecosystem: littoral, benthic and pelagic zones.

12. Oceanic ecosystem: Food chain. Communities.

13. Oceanic ecosystem: Main impacts.

14. The EU Water Framework Directive. Waterbodies tipologies following the Real Decreto 817/2015. Ecological Status. Nueva Cultura del Agua Foundation.

Practical Programme

The practical programme is as follows:

? Practical case study: interpretation, summary and presentation of a scientific article

? Primary production and predation. The importance of "bottom-up" and "top-down" controls within the food chain.

? The quality of water ecosystems. Ecological status index; macroinvertebrates and chlorophyll. Field trip and practicals.

? Population census in nature. The effect of protection in natural aquatic ecosystems.

? Visits to a variety of aquatic ecosystems undergoing restoration projects.

4.4. Course planning and calendar

The indicative timetable of the different learning activities developed in the course is shown below:

Type of activity / Week	1	2 (1)	3 (2)	4 (3)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Face-to-face activity																				*60*
Theory	2	2	2	2	2	2	2	2	2		2	2	2	2	2					28
Laboratory practicals			2		2		2	2	2				2		2					14
Practical field trips				6							3				6					15
Evaluation																	3			3
Non-attendance activity																				*90*
Individual work	3	4	4	1	3	3	3	4	4	7	2	4	3	6		7	8			66
Group work				1	3	3	3				3	3	3	2		3				24
TOTAL	5	6	8	10	10	8	10	8	8	7	10	9	10	10	10	10	11	0	0	*150*

(1) Friday 10 February will be Monday timetable.
(2) Friday 17 February will follow Monday timetable
(3) Friday 24 February will follow Monday timetable

4.5. Bibliography and recommended resources

BB Dodds, Walter K. Freshwater ecology : concepts and environmental applications of limnology / Walter K. Dodds and Matt R. Whiles. 2nd ed. Burlington (Massachusetts) : Academic Press, cop. 2010

BB Lampert, Winfried. Limnoecology / Winfried Lampert, Ulrich Sommer. 2nd ed. Oxford [etc.] : Oxford University Press, 2010 (reimp. 2007)

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BB Sevilla H., M.L., Guadarrama, R. Elementos de ecología marina. Madrid : Instituto Politécnico Nacional, 2005 [Comentario del profesor: libro electrónico]

BB Wetzel, R.G. (2001). Limnology: lake and river ecosystems. San Diego: Academic Press, 3rd. ed.

BC Allan, J. David. Stream ecology : structure and function of running waters / J. David Allan, María M. Castillo. 2nd ed. Dordrecht (Países Bajos) : Springer, cop. 2007

BC Conceptos y técnicas en ecología fluvial / edición a cargo de Arturo Elosegi, Sergi Sabater. Bilbao : Fundación BBVA, 2009

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BC Margalef, Ramón. Ecología / Ramón Margalef. 10a reimp. Barcelona : Omega, cop. 2005

BC Oscoz, J., Galicia D., Miranda R. (2011): Identification guide of freshwater macroinvertebrates of Spain. Springer

BC Tait, R.V. Elementos de ecología marina : curso preparatorio / R.V. Tait. 2ª ed. Zaragoza : Acribia, D.L. 1986

BC Thomas, C.R. (1997). Identifying marine phytoplakton. Florida: Academic Press

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American Rivers (2002). The ecology of dam removal. A summary of benefits and impacts. Washington: American Rivers
[https://www.americanrivers.org/wp-content/uploads/2016/05/EcologyOfDamRemovalcf24.pdf]

Bangqi Hu, Z.Y., et al.: Sedimentation in the Three Gorges Dam and the future trend of Changjiang (Yangtze River) sedimer Hydrol. Earth Syst. Sci. 13 (2009), pp. 2253-2264
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[https://www.sciencedirect.com/science/article/pii/S0169534707002765]

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https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_e
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Sabater, S., Elosegui, A. (2009). Conceptos y técnicas en ecología fluvial. Barcelona: Fundación BBVA
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Sabeter, S., Elosegui, A. (2013). River Conservation: Challenges and Opportunities. Bilbao: Fundación BBVA
[http://www.fbbva.es/TLFU/microsites/river/river_conservation.html]

Streble, H., Krauter, D. (1987). Atlas de los microorganismos de agua dulce: la vida en una gota de agua: libro de clasificac ilustraciones. Barcelona: Omega
[https://es.slideshare.net/TheLolCore/atlas-de-los-microorganismos-de-agua-dulce]

The updated recommended bibliography can be consulted in:http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=25268