

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

1st Year of Graduate Study

Head of Department's Approval

Signature: _____

Date: _____

Rector's Approval

Signature: _____

Date: _____

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Graduate study: Mariculture

LIST OF LECTURERS AND COURSES

1st Year of Study

Winter semester (1st)

No.	Lecturer	Course	L	P	S	ECTS
COMPULSORY COURSES						
1.	Tatjana Dobrosravić, PhD, Assoc. Prof.	Diseases of Cultivated Organism	45	15	10	6
2.	Marina Brailo Šćepanović, PhD, Assoc. Prof.	Mariculture Technology	45	15	15	6
3.	Kruno Bonačić, PhD, Assoc. Prof.	Sustainable Fish Farming	45	30	0	6
4.	Prof. Ana Bratoš Cetinić, PhD	Sustainable Bivalve Molluscs Farming	45	30	0	6
5.	Prof. Branko Glamuzina, PhD	Introduction to Mariculture	30	0	15	3
ELECTIVE COURSES*						
6.	Prof. Ana Bratoš Cetinić, PhD Sanja Grđan, PhD	Developmental Biology of Cultured Invertebrates	30 0	0 30	0 0	3
7.	Prof. Vlasta Bartulović, PhD	Reproductive Biology of Fish	30	5	10	3

* A student enrolls in one (1) elective course worth 3 ECTS credits

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Graduate study: Mariculture

LIST OF LECTURERS AND COURSES

1st Year of Study

Summer semester (2nd)

No.	Lecturer	Course	L	P	S	ECTS
COMPULSORY COURSES						
1.	Tatjana Dobrosravić, PhD, Assoc. Prof.	Physiology of Cultured Organisms	45	10	10	6
2.	Kruno Bonačić, PhD, Assoc. Prof.	Fish Nutrition and Live Feed Culture	45	30	0	6
3.	Prof. Branko Glamuzina, PhD	Mariculture Genetics	30	15	0	3
4.	Marina Brailo Šćepanović, PhD, Assoc. Prof.	Aquaculture Waste Management	30	30	0	3
ELECTIVE COURSES**						
5.	Prof. Katija Vojvodić, PhD	International Business Negotiations	20	20	0	3
6.	Prof. Sanja Tomšić, PhD	Multitrophic Mariculture	30	10	5	3
7.	Prof. Vlasta Bartulović, PhD	Marine Stock Enhancement	30	0	15	3
8.	Prof. Vlasta Bartulović, PhD	Developmental Biology of Fish	30	0	15	3
9.	Prof. Nebojša Stojčić, PhD	Innovation Management	20	10	0	3

** A student enrolls in four (4) elective courses, each worth 3 ECTS credits

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

2nd Year of Graduate Study

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Graduate study: Mariculture

LIST OF LECTURERS AND COURSES

2nd Year of Study

Winter semester (3th)

No.	Lecturer	Course	L	P	S	ECTS
COMPULSORY COURSES						
1.	Tatjana Dobrosravić, PhD, Assoc. Prof. Sanja Grđan, PhD	Diversification of Mariculture	45 0	0 10	0 15	6
2.	Marina Brailo Šćepanović, PhD, Assoc. Prof. Erika Dobrosravić, PhD, Assist. Prof.	Aquaculture Food Safety	10 20	0 30	0 0	3
ELECTIVE COURSES***						
3.	Prof. Sanja Tomšić, PhD	Marine Biologically Active Natural Products	30	10	5	3
4.	Prof. Marijana Pećarević, PhD Josip Mikuš, PhD, Assoc. Prof.	Ecological Monitoring	15 15	0 0	7,5 7,5	3
5.	Prof. Vlasta Bartulović, PhD Sanja Grđan, PhD	Ethical and Socioeconomic Aspects of Aquaculture	30 0	0 0	0 15	3
6.	Barbara Puh, PhD, Assoc. Prof.	Mariculture Marketing - inactive	30	15	0	3
7.	Prof. Marijana Pećarević, PhD, Sanja Grđan, PhD	Aquaculture Adaptation to Global Stressors	30 0	0 15	0 10	3
8.	Josip Mikuš, PhD, Assoc. Prof.	Natural Science Research in the Mediterranean	30	0	15	3
9.	Prof. Marijana Pećarević, PhD	Marine Spatial Planning- inactive	30 0	0 0	0 15	3
10.	Srđan Vujičić, PhD, Assoc. Prof.	Safety at Sea - inactive	45	15	0	3
11.	Prof. Ana Bratoš Cetinić, PhD	Marine and Coastal Ecosystem Services	30	0	15	3
12.	Kruno Bonačić, PhD, Assoc. Prof.	Culture of Ornamental Species	15	45	0	3

*** A student enrolls in seven (7) elective courses, each worth 3 ECTS credits

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Graduate study: Mariculture

LIST OF LECTURERS AND COURSES

2nd Year of Study

Summer semester (4th)

No.	Lecturer	Course	L	P	S	ECTS
COMPULSORY COURSES						
1.	Mentor	Master's Thesis	150	150	0	20
2.	Mentor - advisor	Practical Work and Investigation	75	75	0	10

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Diseases of Cultivated Organism
Semester	1
ECTS points	6
Course status	Compulsory
Course leader	Assoc. Prof. Tatjana Dobroslavić, PhD
Department, room no.	Department of Applied Ecology, D30
Phone	020/445868
e-mail	tatjana.dobroslavic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content The importance of early detection of diseases on farms is of great importance in order to prevent major damages that may occur due to the inability to detect the early symptoms of the disease. Students will learn about the most common diseases of cultivated organisms and the processes of determining the health status of populations in breeding farms and natural habitats, so that the causative agents of diseases can be detected as early and reliably as possible. The procedures for examining sick individuals and taking samples of properly selected organisms will be explained to students. Students will learn about the measures to prevent the spread of disease on breeding farms. The lectures are divided into thematic units: (1) water medium; (2) the immune system; (3) diagnosis; (4) fish diseases; (5) shellfish diseases; (6) crustacean diseases; (7) welfare of cultured organisms; (8) biosecurity.	
Learning outcomes Upon successful completion of the course, students will be able to: - define and describe the most common disease symptoms of cultivated organisms - to recognise the healthy vs. diseased state of cultivated organisms - predict and assess the impact of disease on farm operations - integrate the acquired knowledge into the creation of the farm's biosecurity plan - collect appropriate samples in case of suspected disease - manage the breeding system according to all principles of animal welfare.	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☐ Consultations ☒ Laboratory ☐ Field work ☒ Mentoring ☒ Exams
EXAMINATION METHOD	
☐ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

READING				
Compulsory reading				
1.	Sindermann, C.J. 1990. Principal Diseases of Marine Fish & Shellfish (second edition). Academic Press, 521 pp. (Volume 1: II part; chapters 4, 5, 6, 7: V part; chapter 12)			
Optional reading				
1.	Pavičić, Ž., Ostović, M. 2019. Dobrobit životinja. Naklada Slap, 438 pp. (chapter 9)			
2.	Kristiansen, T.S., Fernö A., Pavlidis, M.A., van de Vis, H. 2020. The Welfare of Fish. Springer, 518 pp. (selected chapters)			
3.	Adams, A. 2016. Fish Vaccines. Springer, 180 pp. (selected chapters)			
4.	MPEDA/NACA. 2003. Shrimp Health Management Extension Manual. MPEDA, Cochin, India, 36 pp. 5. Scarfe,			
5.	Scarfe, A.D., Lee, C.S., O'Bryen, P.J. 2006. Aquaculture Biosecurity: Prevention, Control, and Eradication of Aquatic Animal Disease. Wiley-Blackwell, 182 pp. (selected chapters)			
6.	Scientific and technical papers according to the interests of the students			
LIST OF TOPICS				
No.		Hours		
		L	E	S
1.	Water as a habitat (basic characteristics, biotic and abiotic factors)	2	0	0
2.	Features of disease states (causes, classification, course, symptoms)	2	0	0
3.	Epizootiology	2	0	0
4.	Immune system of aquatic organisms - stress and adaptation	3	0	0
5.	Viral fish diseases	3	1	0
6.	Bacterial fish diseases	3	2	0
7.	Parasites	3	2	0
8.	Fish diseases caused by environmental changes	2	0	0
9.	Fish diseases caused by inadequate feeding	2	0	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

10.	Fungal diseases, diseases caused by protozoa, other diseases	3	1	0
11.	Diseases of shellfish	3	2	0
12.	Diseases of crustaceans	3	2	0
13.	Welfare of farmed organisms	4	0	5
14.	Biosecurity	4	0	5
15.	Therapy and application of medicines in aquaculture, preventive measures against diseases (zoohygienic and zootechnical measures, specific and non-specific immunoprophylaxis), peculiarities of health care depending on the technological system of breeding, keeping the prescribed records in the farm. Taking samples and sending them for examinations.	6	5	0
TOTAL HOURS		45	15	10
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Mariculture technology
Semester	I
ECTS points	6
Course status	Compulsory
Course leader	Marina Brailo Šćepanović, PhD, Assistant professor
Department, room no.	Department of Applied Ecology, Ćira Carića 4, D29
Phone	445-880
e-mail	marina.brailo@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

The course deals with the development and application of various technologies in mariculture. A comparison of algae, bivalve, cephalopods, crustaceans, echinoderms and fish farming systems is given with special respect to hatcheries and grow out systems. The course includes the assessment of various mariculture farming systems (pond, lagoon, flow-trough, cage, recirculation) as well as the classification of the equipment for mariculture facilities. Design, construction, automation and monitoring of mariculture farming systems will be commented. Classes are carried out through lectures and exercises and seminars that follow the topics of lectures. The active participation of the students in the classes is achieved by performing independent exercises and the presentation of seminars with the chosen topic.

Learning outcomes

After successful mastering of a course, students will be able to:

- choose the adequate mariculture system to farm the specific species
- design the adequate mariculture system to farm the specific species
- critically judge the current bottlenecks of mariculture production systems
- invent technological solutions that fit the specific requirements of mariculture production systems

TEACHING MODE

- ☒ Lectures
☒ Seminars and workshops
☒ Exercises
☒ Independent assignments
☒ Multimedia and internet
☐ Distance learning

- ☒ Consultations
☒ Laboratory
☒ Field work
☒ Mentoring
☒ Exams

EXAMINATION METHOD

- ☐ Oral
☒ Written
☒ Partial exam

Other:

READING

Compulsory reading

- | | |
|----|---|
| 2. | Tidwell, J. H. (2012). Aquaculture Production Systems. Oxford: Wiley-Blackwell. |
| 3. | Timmons, M. B., Ebeling, J. M. (2013). Recirculating Aquaculture: Third Edition. New York: Ithaca Publishing Company. |
| 4. | Lucas, J. S. (2012). Aquaculture: Farming Aquatic Animals and Plants. 2. edition. Chichester: Wiley-Blackwell. |
| 5. | Timmons, M. B., Losordo, T. M. (1994). Aquaculture Water Reuse Systems: Engineering Design and Management. Amsterdam: Elsevier. |
| 6. | Avault, J. W. (1998). Fundamentals of Aquaculture: A step-by-step guide to commercial aquaculture. Baton Rouge: AVA Publishing Company Inc. |

Optional reading

- | | |
|-----|--|
| 7. | Lekang O.-I. (2007). Aquaculture Engineering. Oxford: Blackwell Publishing. |
| 8. | Landau, M. (1992). Introduction to Aquaculture, New York: John Wiley & Sons. |
| 9. | Moretti, A., Pedini Fernandez-Criado, M., Vetillart, R. (2005). Manual on hatchery production of seabass and gilthead seabream. Volume 2. Rome: FAO. |
| 10. | Helm, M. M., Bourne, N., Lovatelli, A. (2004). Hatchery culture of bivalves: A practical manual. FAO Fisheries Technical Paper. No. 471. Rome: FAO. |

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

11.	Scientific and professional papers in accordance with the interests of students			
LIST OF TOPICS				
No.		Hours		
		L	E	S
16.	Microalgae farming systems	3	1	1
17.	Macroalgae farming systems	3	1	1
18.	Bivalve farming systems I	3	1	1
19.	Bivalve farming systems II	3	1	1
20.	Cephalopods farming systems	3	1	1
21.	Crustaceans farming systems	3	1	1
22.	Echinoderms farming systems	3	1	1
23.	Fish farming systems I	3	1	1
24.	Fish farming systems II	3	1	1
25.	Equipment for mariculture facilities	3	1	1
26.	Construction of stationary farming systems	3	1	1
27.	Construction of flow-trough farming systems	3	1	1
28.	Construction of cage farming systems	3	1	1
29.	Construction of recirculation farming systems	3	1	1
30.	Automation and monitoring of mariculture farming systems	3	1	1
TOTAL HOURS		45	15	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Sustainable Fish Farming
Semester	I.
ECTS points	6
Course status	Mandatory
Course leader	assoc. prof. dr. sc. Kruno Bonačić
Department, room no.	Department of applied ecology, D31
Phone	+385 20 445 898
e-mail	kruno.bonacic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE DESCRIPTION	
Course content	
The aim of the course is to familiarise students with the anatomy and morphology of teleosts, the methods of sex determination and differentiation. Students will learn about gametogenesis, reproductive endocrinology and the early developmental stages of fish. The course will provide knowledge on the breeding of marine fish species with a special emphasis on traditional Mediterranean species: sea bass and sea bream. Following global aquaculture trends, students will be introduced to the cultivation of new species through the review and analysis of current scientific publications. The issue of sustainability of fish farming in the context of culture and hatchery technology, nutrition and environmental impacts will be discussed. The course will also analyse economic aspects of farming and current fish markets, as well as the perspectives of global fish aquaculture.	
Learning outcomes	
1. Describe marine fish reproduction and developmental biology of early life stages 2. Describe all aspects of spawning and breeding of economically important marine fish species 3. Differentiate input and output of compounds and materials on a fish farm as well as their interaction with the environment 4. Understand the issue of sustainable development of marine fish aquaculture in an ecological, economic and social context 5. Argue the current state and future development of global fish aquaculture	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☐ Exams
EXAMINATION METHOD	
☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.
READING	
Compulsory reading	
7.	Pavlidis, M.A., Mylonas, C.C. 2011. Sparidae: Biology and Aquaculture of Gilthead Sea Bream and Other Species. Wiley-Blackwell. to page 368
8.	Beveridge, M.C.M., 2004. Cage Aquaculture: Third Edition, Blackwell. to page 368
9.	
Optional reading	
12.	Moyle, P.B., Cech, JR.J.J., 2004. An introduction to ichthyology, Pearson Benjamin Cummings. to page 726

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

13.	Pillay, T.V.R., Kutty, M.N., 2005. Aquaculture: Principles and Practices, second edition, Blackwell Publishing UK. to page 624			
14.	Barnabe, G., 1990. Aquaculture 1 and 2, Ellis Horwood Limited. to page 79			
LIST OF TOPICS				
No.		Hours		
		L	E	S
31.	Course introduction	3	2	0
32.	Oogenesis	3	2	0
33.	Spermatogenesis	3	2	0
34.	Early developmental stages of fish	3	2	0
35.	State and trends of market for farmed marine fish	3	2	0
36.	Sustainability issues in fish farming	3	2	0
37.	Capture-based farming vs domestication	3	2	0
38.	Feeding of farmed fish	3	2	0
39.	Breeding fish in controlled conditions	3	2	0
40.	Sustainable fish farming in marine cages	3	2	0
41.	Sustainable farming in land-based systems	3	2	0
42.	Diversification of fish farming	3	2	0
43.	Environmental impacts of fish farming	3	2	0

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

44.	Economic and social sustainability of fish farming	3	2	0
45.	Global perspectives of fish farming	3	2	0
TOTAL HOURS		45	30	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Sustainable Bivalve Molluscs Farming
Semester	1.
ECTS points	6
Course status	compulsory course
Course leader	Ana Bratoš Cetinić
Department, room no.	Department of Applied Ecology
Phone	+38520445787
e-mail	abratos.@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
The course begins with the fundamentals of shellfish biology, providing students with an understanding of basic morphological and anatomical features, as well as physiological processes. It then explores the ecological aspects of shellfish aquaculture, emphasizing the interactions between cultured species and their environment, and the principles of sustainable farming. Students study the technology of shellfish cultivation, including methods and practices used in hatcheries and grow-out systems. The course also covers the management and conservation of biodiversity within aquaculture, highlighting strategies to maintain ecological balance and protect genetic resources. Specific cultivation practices for oysters and mussels are examined, along with the particular challenges and solutions associated with these species. Disease control and prevention in shellfish farming are addressed, including biosecurity measures and monitoring protocols. The course considers the effects of climate change on shellfish production, analyzing impacts such as temperature fluctuations, ocean acidification, and other environmental stressors. Feeding and nutrition of shellfish are discussed in the context of growth, health, and productivity, along with the distribution and suitability of species used in aquaculture. Finally, students learn about technologies and management strategies designed to minimize negative environmental impacts and promote sustainable practices in shellfish farming.	
Learning outcomes	
Upon successful completion of the course, students will be able to: 1. analyse ecological, biological, and technical factors influencing successful shellfish aquaculture 2. evaluate the sustainability of shellfish farming based on biological, environmental, and economic criteria 3. explain and critically assess key technologies and methods used in the shellfish aquaculture industry 4. design and propose strategies to optimise shellfish production while minimising environmental impacts	

	University of Dubrovnik Department of Applied Ecology Čira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

5. synthesise and integrate data on sustainable shellfish aquaculture, including ecological considerations and market requirements				
TEACHING MODE				
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☒ Distance learning		☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☒ Exams		
EXAMINATION METHOD				
☒ Oral ☒ Written ☒ Partial exam		Other: Click here to enter text.		
READING				
Compulsory reading				
10.	Ana Bratoš Cetinić, Sustainable Shellfish Aquaculture. Internal teaching materials			
11.	Gosling E, Bivalve Molluscs: Biology, Ecology and Culture, Fishing News Books, Blackwell Publishing, 2003, p.p. 1-443.			
12.	FAO, http://www.fao.org/fishery/statistics/programme/publications/all/en , FAO, 2023.			
13.	Smaal, A.C. et al. (Ed.), Goods and services of marine bivalves, Springer Open: Cham. ISBN 978-3-319-96776-9. xxv, 2019, p.p. 1-591.			
Optional reading				
15.	Fitridge I, Dempster T, Guentherb J, de Nysc R., The impact and control of biofouling in marine aquaculture: a review, Biofouling 28(7), 2012, p.p. 649-669.			
16.	McKindsey C.W., Carrying Capacity for Sustainable Bivalve Aquaculture. In: Meyers R.A. (eds) Encyclopedia of Sustainability Science and Technology, Springer, New York, NY. https://doi.org/10.1007/978-1-4419-0851-3_179 , 2023.			
17.				
LIST OF TOPICS				
No.		Hours		
		L	E	S
46.	History and trends in shellfish aquaculture: global and local perspectives	3	2	0
47.	Fundamentals of shellfish biology - morphology	3	2	0
48.	Fundamentals of shellfish biology - anatomy	3	2	0
49.	Fundamentals of shellfish biology - filtration and feeding	3	2	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

50.	Fundamentals of shellfish biology - respiration, circulation, excretion, and osmoregulation	3	2	0
51.	Reproduction, larval development, and growth	3	2	0
52.	Production processes in mariculture: from farming to market	3	2	0
53.	Selection of appropriate aquaculture systems	3	2	0
54.	Site selection for aquaculture	3	2	0
55.	Genetic selection in mariculture: improving production	3	2	0
56.	Shellfish health: disease prevention	3	2	0
57.	Biosecurity	3	2	0
58.	Ecological interactions in shellfish aquaculture	3	2	0
59.	Sustainable mariculture and environmental impact regulation; protection and conservation of marine resources in aquaculture	3	2	0
60.	Regulatory and legal framework in mariculture: CITES and national legislation	3	2	0
TOTAL HOURS		45	30	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Introduction to Mariculture
Semester	1
ECTS points	3
Course status	Compulsory
Course leader	Prof Branko Glamuzina
Department, room no.	Ćira Carića 4
Phone	020 445 741
e-mail	branko.glamuzina@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
Knowledge is provided on the status and perspectives of mariculture globally, within the European Union (EU), and in the Republic of Croatia. It discusses the historical reasons for the decline of traditional fishing, as well as the origins and development of aquaculture worldwide. The status of global aquaculture is examined based on FAO and FEAP analyses from 2025. European, Mediterranean, and Croatian aquaculture are covered in detail, with particular emphasis on future employment opportunities in EU countries. Using a "case study" approach, the curriculum addresses key European aquaculture species relevant to students, such as sea bass, sea bream, oysters, mussels, and other potentially important species. The perspectives of mariculture are considered from ecological, economic, market, and developmental viewpoints. The curriculum includes the following units: (1) Definition, objectives, and history of mariculture; (2) History and status of marine bioresources; fishing and its recent decline; (3) Historical development of mariculture and perspectives on biostock management; (4) The state of mariculture globally, in the European Union, and in the Republic of Croatia; (5) Classification of Mediterranean aquaculture by farming methods and conditions; (6) Typical farmed marine species: fish, shellfish, crustaceans, and other marine organisms; (7) Examples of farming individual aquatic species: sea bass, gilthead sea bream, mussels, European oyster, scallop, and lobster; (8) Economics, finance, and management in aquaculture; (9) Perspectives of mariculture in the Republic of Croatia and the EU.	
Learning outcomes	
After successfully completing the course, students will be able to: - explain basic mariculture concepts and discuss the status of mariculture globally, in the EU, and in the Republic of Croatia; - describe the characteristics and limitations of traditional fisheries, and the development of modern mariculture; - describe and compare different mariculture industries; - demonstrate knowledge of the state of the industry and the characteristics of white marine fish, tuna, oyster, and mussel production as the main Croatian aquaculture sectors; - discuss the perspectives of European and Croatian mariculture.	
TEACHING MODE	
☒ Lectures	☒ Consultations

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Seminars and workshops ☐ Exercises ☒ Independent assignments ☐ Multimedia and internet ☐ Distance learning	☐ Laboratory ☒ Field work ☒ Mentoring ☒ Exams			
EXAMINATION METHOD				
☐ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.			
READING				
Compulsory reading				
14.	SOFIA- Status of world fisheries and aquaculture. FAO, 2021. www.fao.org .			
15.	European Market Observatory for fisheries and aquaculture (EUMOFA). www.eumofa.eu ; FEAP database			
16.	Status of Croatian mariculture. https://ribarstvo.mps.hr/			
Optional reading				
18.	Pillay, T.V.R., Kutty, M.N. 2005. Aquaculture principles and practices. Wiley-Blackwell; 2nd edition, 640 pp			
19.	Scientific and professional articles based on student interests			
20.	Online aquaculture journals: Aquaculture Advocate, etc.			
LIST OF TOPICS				
No.		Hours		
		L	E	S
61.	Definition, goals, and history of mariculture	2	0	0
62.	History and status of marine bioresources; fisheries and their recent decline	2	0	0
63.	Historical development of mariculture and perspectives on bioresource management	2	0	0
64.	Status of mariculture worldwide, in the European Union, and in the Republic of Croatia	2	0	5
65.	Classification of Mediterranean aquaculture by farming methods and conditions	2	0	0
66.	Types of fish cage farming	2	0	0
67.	Farming technologies	2	0	0
68.	Marine hatcheries	2	0	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

69.	Spawning of new species: tuna, eel, cobia, flatfish, cod	2	0	0
70.	New species of marine organisms in farming: fish, shellfish, crustaceans, and other marine organisms	2	0	5
71.	Examples of farming of aquatic organisms: sea bass, gilthead sea bream, mussels, European oyster, spiny lobster, and lobster.	2	0	0
72.	New species and technologies in mariculture.	2	0	0
73.	Modern mariculture and its market potential.	2	0	0
74.	Integration and diversification of mariculture production.	2	0	5
75.	Perspectives on mariculture in the Republic of Croatia and the EU.	2	0	0
TOTAL HOURS		30	0	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Developmental biology of cultured invertebrates
Semester	I
ECTS points	3
Course status	Elective
Course leader	Prof. Ana Bratoš Cetinić
Department, room no.	D32
Phone	020 445 787
e-mail	abratos@unidu.hr
Course assistant/associate	Sanja Grđan, PhD
Department, room no.	A16
Phone	020 445 273
e-mail	sanja.grdjan@unidu.hr
COURSE DESCRIPTION	
Course content	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Students will become familiar with the developmental biology of cultured molluscs (bivalves and gastropods) and echinoderms (sea urchins and sea cucumbers) through this course. Following an introduction to the basic concepts of reproduction, reproductive strategies, gametogenesis, and fertilization, early and late development of molluscs and echinoderms will be addressed in detail.

Key processes related to embryonic development will be explained, including cleavage, blastulation, gastrulation, formation of germ layers, coelom formation, and organogenesis, with emphasis on differences between protostome and deuterostome development.

Larval development and metamorphosis during later stages will also be covered, as well as regeneration processes in echinoderms (e.g., visceral and nervous systems).

Lectures are organized into thematic units: Introduction to developmental biology; Reproduction and fertilization; Early development of molluscs and echinoderms; Late development of molluscs and echinoderms; Early and late development of crustaceans.

Learning outcomes

After successfully completing the course student will be able to:

- Analyze processes in developmental biology
- Identify key stages of embryonic and larval development
- Evaluate differences in morphogenesis between molluscs and echinoderms
- Analyze biological challenges and potential applications of developmental mechanisms in mariculture

TEACHING MODE

☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☐ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☐ Field work ☐ Mentoring ☐ Exams
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EXAMINATION METHOD

☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.
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READING

Compulsory reading

17.	Wanniger, A., Evolutionary–developmental Biology of Invertebrates Vol.2. Lophotrochozoa (Spiralia). Wanniger, A. (ed.) , Springer-Verlag. Vienna (odabrana poglavlja), 2015, p.p. 1-289.
18.	Arnone, M. I., Byrne, M., Martinez, P. , Evolutionary–developmental Biology of Invertebrates Vol 6. Deuterostomia. Wanniger, A. (ed.) , Springer-Verlag Wien (odabrana poglavlja), 2015, p.p. 1-214.
19.	

Optional reading

21.	Selected scientific papers
22.	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

23.				
LIST OF TOPICS				
No.		Hours		
		L	E	S
76.	Introduction – Developmental Biology	P	V	S
77.	Reproduction and reproductive strategies in molluscs	2	0	0
78.	Gametogenesis and fertilization in molluscs	2	2	0
79.	Reproduction and reproductive strategies in echinoderms	2	2	0
80.	Gametogenesis and fertilization in echinoderms; sea urchins as a model organism	2	2	0
81.	Embryonic development: Protostomia and Deuterostomia; types of cleavage	2	4	0
82.	Molluscs – cleavage, blastulation, gastrulation, and germ layer formation; morphogenesis	2	0	0
83.	Molluscs – organogenesis	2	0	0
84.	Molluscs – larval development, metamorphosis, and growth	2	2	0
85.	Echinoderms – cleavage, blastulation, gastrulation, and germ layer formation	2	2	0
86.	Echinoderms – organogenesis	2	4	0
87.	Echinoderms – larval development, metamorphosis, and growth	2	4	0
88.	Crustaceans – reproduction, embryonic and larval development	2	4	0
89.	Regeneration – current knowledge and potential applications	2	2	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

90.	Environmental effects on early and late development	2	0	0
TOTAL HOURS		30	30	0
OTHER RELEVANT INFORMATION				
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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Reproductive biology of fish
Semester	I
ECTS points	3
Course status	Elective
Course leader	Prof. Vlasta Bartulović, PhD
Department, room no.	Department of Applied Ecology, D 33
Phone	020/445863
e-mail	vlasta@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
During the course, students will learn about the different ways teleosts reproduce and how to determine their sex. Ovarian structure will be analyzed and oogenesis, testicular structure, and spermatogenesis will be described. Students will become familiar with the endocrine and environmental control of reproduction. Fish behavior, including migration, territoriality, and spawning site selection, will be explained. In addition, social interaction among individuals will be analyzed, including sexual selection and care of offspring. Unusual forms of reproduction and reproduction in fisheries and aquaculture will also be covered.	
Learning outcomes	
Upon completion of the course, students will be able to: - explain the stages of gametogenesis - describe the endocrine control of reproduction - discuss the causes of disorders of gametogenesis - analyze the sexual behavior of different groups of fish.	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☐ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☐ Field work ☐ Mentoring ☒ Exams
EXAMINATION METHOD	
☐ Oral ☒ Written	Other: Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Partial exam				
READING				
Compulsory reading				
20.	Wootton, R.J. & Smith, C. 2015. Reproductive biology of teleost fishes. John Wiley & Sons, Ltd. West Sussex, UK, 472 str. (selected chapters)			
Optional reading				
24.	Kunz, Y.W. 2004. Developmental biology of teleost fishes. Springer, Dordrecht, Netherlands, 636 str. (selected chapters)			
25.	Moyle, P.B., Cech, JR.J.J. 2004. An introduction to ichthyology. Pearson Benjamin Cummings, San Francisco, 726 str. (selected chapters)			
26.	Scientific and professional papers in accordance with the interests of students			
LIST OF TOPICS				
No.		Hours		
		L	E	S
91.	Different modes of reproduction in teleosts	2		2
92.	Sex determination in fish	2		
93.	Ovary structure and oogenesis	2	3	
94.	Ovary structure and oogenesis	2		
95.	Testicular structure and spermatogenesis	2	2	
96.	Endocrinology of reproduction	2		
97.	Endocrinology of reproduction	2		
98.	Environmental control of reproductive cycles	2		
99.	Migrations, territoriality, and selection of spawning sites	2		1
100.	Migrations, territoriality, and selection of spawning sites	2		1

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

101.	Sexual selection	2		1
102.	Parental care	2		1
103.	Unusual forms of reproduction	2		1
104.	Reproduction and evolution	2		1
105.	Reproduction in fisheries and aquaculture	2		2
TOTAL HOURS		30	5	10
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Physiology of cultivated organisms
Semester	2
ECTS points	6
Course status	Compulsory
Course leader	Assoc. Prof. Tatjana Dobroslavić, PhD
Department, room no.	Department of Applied Ecology, D30
Phone	020/445868
e-mail	tatjana.dobroslavic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	The content of the course covers the physiological processes of cultured organisms and their adaptation to changing culture conditions. In aquaculture, stress control and organism adaptation to new conditions is an important factor affecting production results and animal welfare. In addition to aquaculture, the ability of organisms to adapt to new conditions is also important in the natural environment, especially in light of climate change. The curriculum includes the following units: (1) physiological processes in organisms; (2) metabolism; (3) nutritional physiology; (4) hormonal regulation; (5) physiology of

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

reproduction; (6) neurophysiological basis of stress; (7) response to stress; (8) adaptive mechanisms. Laboratory exercises include comparative anatomy and physiology of cultured organisms and analysis of histological preparations of selected tissues and organs.

Learning outcomes

Upon successful completion of the course, students will be able to:

- describe physiological processes in the body
- explain the neurophysiological mechanisms that control feeding and reproductive behaviour
- Identify and describe the major types of stressors that affect the body
- observe the changes induced by the action of various stressors on organisms in culture, the effects of stressors on the organism
- explain the basic mechanisms of the organism's response to the action of harmful factors (stressors) from the environment
- explain the mechanism of adaptation (adaptation) of the organism in newly created situations
- analyse and present simple physiological results and write a report after completing the laboratory task.

TEACHING MODE

- | | |
|---|---|
| ☒ Lectures
☒ Seminars and workshops
☒ Exercises
☒ Independent assignments
☒ Multimedia and internet
☐ Distance learning | ☐ Consultations
☒ Laboratory
☐ Field work
☒ Mentoring
☒ Exams |
|---|---|

EXAMINATION METHOD

- | | |
|--|-------------------------------------|
| ☐ Oral
☒ Written
☒ Partial exam | Other:
Click here to enter text. |
|--|-------------------------------------|

READING

Compulsory reading

- | | |
|-----|---|
| 21. | Evans, D.H., Claiborne, J.B., Currie, S. 2014. The Physiology of Fishes; fourth edition. Taylor & Francis Group, 453 pp. (Chapters: 11, 12, 13, 14) |
|-----|---|

Optional reading

- | | |
|-----|---|
| 27. | Lucu, Č. 2012. Fiziologija prilagodbe životinja u vodenom okolišu. Profil International, 244 pp. |
| 28. | Saleuddin, S., Mukai, S. 2017. Physiology of molluscs Volume 1 A Collection of Selected Reviews. Apple Academic Press Inc, 933 pp. |
| 29. | Iwama, G. K., Pickering, A.D., Sumpter, J.P., Schreck, C.B. 2011. Fish Stress and Health in Aquaculture. Cambridge University Press, 290 pp. |
| 30. | Solan, M., Whiteley, N. 2016. Stressors in the Marine Environment: Physiological and Ecological Responses; Societal Implications. Oxford Press, 384 pp. |
| 31. | Scientific and technical manuscripts in accordance with student's interests |

LIST OF TOPICS

No.		Hours		
		L	E	S

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

106.	Introductory lecture - Biological molecules	2	0	0
107.	Water as a biological medium	2	0	2
108.	Gas exchange	4	0	0
109.	Heart and circulatory system	3	0	0
110.	Neurons and the nervous system	3	2	0
111.	Osmoregulation	3	0	0
112.	Physiology of reproduction	4	2	2
113.	Muscular system	3	2	0
114.	Sensory system	2	0	0
115.	Digestion and metabolism	4	2	0
116.	Structure and functions of important endocrine glands - hormonal control	4	0	0
117.	The influence of environmental factors on the physiology of cultured organisms - stress and stress control	3	0	6
118.	Chemical stressors	2	0	0
119.	Respiratory system and adaptations of respiration	3	0	0
120.	Adaptation to temperature fluctuations	3	2	0
TOTAL HOURS		45	10	10

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

OTHER RELEVANT INFORMATION
Click here to enter text.

COURSE INFORMATION	
Course name	Fish Nutrition and Live Feed Culture
Semester	II.
ECTS points	6
Course status	Mandatory
Course leader	assoc. prof. dr. sc. Kruno Bonačić
Department, room no.	Department of applied ecology, D31
Phone	+385 20 445 898
e-mail	kruno.bonacic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
The course will enable students to acquire theoretical and practical knowledge in the field of fish nutrition, which will cover ingredients for the preparation of feed mixtures, formulations and feed production processes, an overview of nutrients and other compounds that are introduced through feeding, nutritional needs of various life stages of farmed fish as well as mechanisms of digestion, absorption and metabolism of nutrients and other compounds. Furthermore, various feeding regimes for certain economically important farmed species will be discussed. The culture of organisms that serve as live feeds for the early developmental stages of fish, including microalgae, rotifers, Artemia, copepods and others, will be covered.	
Learning outcomes	
1. Understand which ingredients are used in fish feed formulations and why 2. Describe the production processes of fish feeds 3. Explain the importance of certain nutrients and other compounds that are introduced through feeding 4. Understand the nutritional needs of various life stages of farmed fish 5. Plan feeding regimens for various types of fish 6. Grow different organisms that are used as live feeds and use them to feed early developmental stages of fish	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises	☒ Consultations ☒ Laboratory ☒ Field work

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Mentoring ☐ Exams			
EXAMINATION METHOD				
☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.			
READING				
Compulsory reading				
22.	Athithan, S., Felix, N., Venkatasamy, N. 2013. Fish Nutrition and Feed Technology A Teaching Manual. Daya Publishing House - A division of - Astral International. to page 285			
23.	Holt, G.J. 2011. Larval Fish Nutrition. John Wiley & Sons, Inc.. to page 435			
24.				
Optional reading				
32.	Hardy, R.W., Kaushik, S.J. 2021. Fish Nutrition; 4th edition. Elsevier. to page 922			
33.	Ajiboye, O.O., Yakubu, A.F., Adams, T.E., Olaji, E.D., Nwogu, N.A. 2011. A review of the use of copepods in marine fish larviculture. Reviews in Fish Biology and Fisheries 21: 225–246.			
34.	Lee, C.S., O'Bryen, P.J., Marcus, N.H. 2005. Copepods in Aquaculture. (C.-S. Lee, P. J. O'Bryen, & N. H. Marcus, Eds.) Ames, Iowa, USA, Blackwell Publishing Professional. to page 288			
35.				
LIST OF TOPICS				
No.		Hours		
		L	E	S
121.	Course introduction	3	2	0
122.	Structure and development of the digestive system in fish	3	2	0
123.	Nutritional requirements of different developmental stages	3	2	0
124.	Nutrients - protein	3	2	0
125.	Nutrients - lipids and carbohydrates	3	2	0
126.	Vitamins, minerals and other nutrients	3	2	0

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

127.	Digestion, absorption and metabolism of nutrients	3	2	0
128.	The role of gut flora in digestion and its modulation	3	2	0
129.	Feed ingredients and formulations	3	2	0
130.	The composition and formulation process of compound feeds	3	2	0
131.	Methods of analysis of feed and fish tissue composition	3	2	0
132.	Feeding marine fish in a cage farm	3	2	0
133.	Feeding marine fish in land-based systems	3	2	0
134.	Live feed culture	3	2	0
135.	Feeding marine fish in a hatchery	3	2	0
TOTAL HOURS		45	30	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Mariculture genetics
Semester	II
ECTS points	3
Course status	Compulsory
Course leader	Prof Branko Glamuzina
Department, room no.	Ćira Carića 4
Phone	020 445 741
e-mail	branko.glamuzina@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
The course aims to provide knowledge of the genetics of cultured organisms, with a focus on marine species cultivated in the Mediterranean. Students will be trained to apply genetic methods to improve commercial mariculture production of Mediterranean fish and shellfish species. The curriculum includes the following units: (1) Qualitative and quantitative genetics; (2) Genetic selection and breeding programmes; (3) Genome manipulation in aquaculture, including polyploidy and hybridisation; (4) Triploidy in marine fish; (5) Triploidy in shellfish; (6) Production of tetraploid organisms, with examples from sea bass and oysters; (7) Androgenesis and gynogenesis; (8) Sex manipulation in culture; (9) GMO technology and the application of genetically modified organisms in aquaculture; (10) Perspectives on genetic improvements in Mediterranean mariculture.	
Learning outcomes	
After successfully completing the course, the student will be able to: - present knowledge in the field of genetics of organisms in cultivation necessary for the theoretical development of genetic projects aimed at improving production in mariculture; - apply genetic methods to improve commercial mariculture production of marine organisms; - produce triploid individuals of oysters, sea bass, and other marine organisms; - distinguish all methods of improving the cultivation of aquatic organisms and justify their implementation.	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☐ Laboratory ☒ Field work ☐ Mentoring ☐ Exams
EXAMINATION METHOD	
☒ Oral ☒ Written	Other: Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☐ Partial exam				
READING				
Compulsory reading				
25.	Tave, D. 1993. Genetics for Fish Hatchery Managers, 2nd ed. Van Nostrand Reinhold, Springer, US, 418 pp.			
26.	Tave, D. 1999. Inbreeding and brood stock management. Fisheries Technical Paper, No. 392. FAO, 122 pp.			
27.	Dunham i sur., 2001. Review of the Status of Aquaculture genetics. https://www.fao.org/3/ab412e/ab412e03.htm			
Optional reading				
36.	Kirpichnikov, V.S. 1981. Genetic Bases for Fish Selection. Springer Berlin Heidelberg, 412 str. (selected chapters)			
37.	Internet sources: www.aquamedia.org ; www.fao.org			
38.	Scientific and professional journals: Aquaculture Advocate Magazine, Fish farmer, etc.			
LIST OF TOPICS				
No.		Hours		
		L	E	S
136.	Fundamentals of applied genetics: history of domestication	2	1	0
137.	Selection and breeding programmes	2	1	0
138.	Genome manipulation in mariculture: polyploidy and hybridisation	2	1	0
139.	Hybridisation of marine fish: the example of groupers	2	1	0
140.	Hybridisation in aquaculture: examples of successful hybrid fish in culture and Mediterranean experiences	2	1	0
141.	Genome manipulation in aquaculture: overview and Mediterranean experiences	2	1	0
142.	Sea bass triploidy: induction and breeding characteristics of triploid fish	2	1	0
143.	Sea bream triploidy: induction and breeding characteristics of triploid fish	2	1	0
144.	European oyster triploidy: induction and breeding characteristics of triploid shellfish	2	1	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

145.	Production of tetraploid organisms in aquaculture: cases of sea bass and oysters	2	1	0
146.	Androgenesis and gynogenesis in mariculture	2	1	0
147.	Sex manipulation in aquaculture: the example of sea bass	2	1	0
148.	Perspectives on traditional genetics and genome manipulation in EU aquaculture	2	1	0
149.	GMO technology: history, application in agriculture, and examples of different species	2	1	0
150.	Application of GMOs in aquaculture: examples of Atlantic salmon and zebrafish	2	1	0
TOTAL HOURS		30	15	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Aquaculture waste management
Semester	II
ECTS points	3
Course status	Compulsory
Course leader	Marina Brailo Šćepanović, PhD, Assistant professor
Department, room no.	Department of Applied Ecology, Ćira Carića 4, D29
Phone	445-880
e-mail	marina.brailo@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	The course deals with the problem of waste in aquaculture and the possibilities of its removal. Technological solutions for the reduction of wastewater from recirculating aquaculture systems, aquaponics, municipal wastewater treatment and constructed wetlands are compared. The course also

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

includes the assessment of new processes for nitrogen and phosphorus waste removal, biofloc systems, integrated multitrophic aquaculture and composting of solid waste from aquaculture systems. Classes are carried out through lectures and exercises that follow the topics of lectures. The active participation of the students in the classes is achieved by performing independent exercises on chosen topic.

Learning outcomes

After successful mastering of a course, students will be able to:

- choose the adequate aquaculture system to farm the specific species with special regards to waste reduction
- compare wastewater treatment in aquaculture to other technologies
- invent new technological solutions for liquid waste management in aquaculture production system
- critically judge the current bottlenecks of solid waste management in aquaculture production systems

TEACHING MODE

- | | |
|---|---|
| ☒ Lectures
☒ Seminars and workshops
☒ Exercises
☒ Independent assignments
☒ Multimedia and internet
☐ Distance learning | ☒ Consultations
☒ Laboratory
☒ Field work
☒ Mentoring
☒ Exams |
|---|---|

EXAMINATION METHOD

- | | |
|--|--------|
| ☐ Oral
☒ Written
☒ Partial exam | Other: |
|--|--------|

READING

Compulsory reading

- | | |
|-----|---|
| 28. | Tidwell, J. H. (2012). Aquaculture Production Systems. Oxford: Wiley-Blackwell. |
| 29. | Timmons, M. B., Ebeling, J. M. (2013). Recirculating Aquaculture, Third Edition. New York: Ithaca Publishing Company. |
| 30. | Avnimelech, Y. (2015). Biofloc Technology: A Practical Guidebook, 3.izd. Baton Rouge: World Aquaculture Society. |

Optional reading

- | | |
|-----|--|
| 39. | Somerville, C. et al. (2014). Small-scale aquaponic food production: Integrated fish and plant farming. Fisheries and Aquaculture Report No. 589. Rome: FAO. |
| 40. | Malus, D., Vouk, D. (2012). Priručnik za učinkovitu primjenu biljnih uređaja za pročišćavanje sanitarnih otpadnih voda. Zagreb: Sveučilište u Zagrebu, Građevinski fakultet. |
| 41. | Rajeswari, C., Padmavathy P., Aanand, S. (2018). Composting of fish waste: A review. International Journal of Applied Research, 4(6), 242-249. |
| 42. | Costigan, E. M. (2022). Nutrient Removal from Recirculating Aquaculture System Water. Electronic Theses and Dissertations. 3639. Orono: University of Maine. |
| 43. | Scientific and professional papers in accordance with the interests of students |

LIST OF TOPICS

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

No.		Hours		
		L	E	S
151.	Municipal wastewater treatment I	2	2	0
152.	Municipal wastewater treatment II	2	2	0
153.	Mechanical filtration in aquaculture	2	2	0
154.	Biological filtration in aquaculture	2	2	0
155.	Wastewater treatment in recirculated aquaculture systems	2	2	0
156.	Wastewater treatment in aquaponics	2	2	0
157.	Wastewater treatment in constructed wetlands	2	2	0
158.	New processes for nitrogen waste removal	2	2	0
159.	New processes for phosphorus waste removal	2	2	0
160.	<i>Biofloc</i> systems	2	2	0
161.	<i>Aquamimicry</i> systems	2	2	0
162.	Integrated multitrophic mariculture I	2	2	0
163.	Integrated multitrophic mariculture II	2	2	0
164.	Composting of solid waste from aquaculture systems I	2	2	0
165.	Composting of solid waste from aquaculture systems II	2	2	0
TOTAL HOURS		30	30	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	International Business Negotiations
Semester	Summer
ECTS points	3
Course status	Elective
Course leader	Katija Vojvodić, Full Professor
Department, room no.	Faculty of Economics and Business, Lapadska obala generala Nojka Marinovića 7, Dubrovnik, C-8
Phone	+385 20 445 935
e-mail	katija.vojvodic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
1. The nature of business negotiations. Business negotiation process. Principles and techniques of negotiations. 2. Introduction to international business negotiation. Features of international business negotiation. 3. The specific features of international negotiations. International business negotiation outcomes. 4. The impact of culture on international business negotiations. 5. Communication and international business negotiation. 6. Specific features of negotiating in different parts of the world. 7. Characteristics and examples of international negotiations in Europe. Case studies of selected European countries. 8. Characteristics and examples of international negotiations in North and Latin America. Case studies of selected countries in the Americas. 9. Characteristics and examples of international negotiations in Africa. Case studies of selected African countries. 10. Characteristics and examples of international negotiations in Asia and Australia. Case studies of Australia and selected Asian countries.	
Learning outcomes	
1. To analyse the basic concepts and elements of the business negotiation process. 2. To compare and evaluate the key principles and techniques of business negotiations. 3. To critically assess and differentiate the strategies and tactics used in international business negotiations. 4. To evaluate the impact of culture on the process and outcomes of international business negotiations. 5. To analyse and compare the distinctive features of negotiating in different parts of the world, and apply them correctly in the international business negotiation contexts.	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☒ Distance learning	☒ Consultations ☐ Laboratory ☐ Field work ☒ Mentoring ☒ Exams
EXAMINATION METHOD	
☒ Oral ☒ Written	Other: Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Partial exam				
READING				
Compulsory reading				
31.	Ghauri, P. N., Ott, U. F., Rammal, H. G., International Business Negotiations, Edward Elgar Publishing, 2020.			
32.	Garten, F., The International Manager, CRC Press - Taylor & Francis Group, 2015.			
Optional reading				
44.	Karsaklian, E., The Intelligent International Negotiator, Business Expert Press, 2014.			
45.	Katz, L., Principles of Negotiating International Business, Booksurge Publishing, 2008.			
LIST OF TOPICS				
No.		Hours		
		L	E	S
166.	Introduction to business negotiations.	2	2	0
167.	Introduction to international business negotiations.	2	2	0
168.	Communication and international business negotiations.	2	2	0
169.	The impact of culture on international business negotiations.	2	2	0
170.	International business negotiations in Europe.	2	2	0
171.	International business negotiations in North America and Australia.	2	2	0
172.	International business negotiations in Latin America.	2	2	0
173.	International business negotiations in Asia.	2	2	0
174.	International business negotiations in Africa and the Middle East.	2	2	0
175.	Comparative approaches to international business negotiations.	2	2	0
TOTAL HOURS		20	20	0
OTHER RELEVANT INFORMATION				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Multitrophic mariculture
Semester	Summer semester (1 st)
ECTS points	3
Course status	Elective
Course leader	Prof. Sanja Tomsic, PhD
Department, room no.	Department of applied ecology, D 26
Phone	020 445 767
e-mail	sanja.tomsic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
This course covers key trends in mariculture technology, with a focus on Integrated Multi-Trophic Aquaculture (IMTA) concept in marine environment, and the integration of complementary species across different trophic levels to achieve mutual environmental and economic benefits. It emphasizes knowledge transfer in precision aquaculture and sustainable production systems, including the selection and evaluation of species based on their ecological roles, adaptability to integrated conditions, and economic potential. The course also addresses applications in the food industry and blue biotechnology within global and European contexts. Special attention is given to the analysis of life stages of cultured species as a foundation for advanced expertise in mariculture. Additionally, it examines the interaction of abiotic, biotic, and zootechnical factors, including spatial, reproductive, and nutritional aspects, in order to assess and optimize the economic performance of selected species.	
Learning outcomes	
Upon successful completion of the course, student will be able to: - Define the potential for selecting new species for integration into multitrophic mariculture systems - Determine trophic interactions that enable nutrient flow and transfer among species in IMTA systems - Design theoretical models of integrated production with maximized nutrient utilization efficiency - Apply knowledge in selecting novel IMTA species for use in the food industry and biotechnology research - Evaluate economically viable and ecologically sustainable strategies for food production in integrated mariculture systems	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☒ Exams
EXAMINATION METHOD	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.
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READING

Compulsory reading

33.	FAO (2022) Guidelines for Integrated Multi-Trophic Aquaculture (IMTA) – Sustainable Development Goals for Aquaculture. Rome: FAO Fisheries and Aquaculture Technical Paper.
34.	European Aquaculture Technology and Innovation Platform (EATiP) (2017).

Optional reading

46.	Chopin, T. 2013. Aquaculture , Integrated Multi-trophic (IMTA). In: Christou, P., Savin, R., Costa-Pierce, B.A., Misztal, I., Whitelaw, C.B.A. (eds) Sustainable Food Production. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-5797-8_173
47.	Troell, M., Halling, C., Neori, A. 2009. Integrated mariculture: asking the right questions In: Aquaculture in the Ecosystem, Springer. Aquaculture, 226(1-4):69-90
48.	Chopin, T. Buschmann, T.A., Halling, C., Troell, M., Kautsky, N., Neori, A., Kraemer, G.P., Zertuche-González, J.A., Yarish, C., Neefus, C. 2001. Integrating seaweeds into marine aquaculture systems: a key toward sustainability. Journal of Phycology, 37(6):975–986
49.	Granada, L., Sousa, N., Lopes, S., Lemos, M.F.L. 2015. Is integrated multitrophic aquaculture the solution to the sectors’ major challenges? – a review. Reviews in Aquaculture, 8(3):283-300

LIST OF TOPICS

No.		Hours		
		L	E	S
176.	Traditional forms of IMTA systems worldwide – historical overview	2		
177.	Development of integrated mariculture systems in the modern era	2	2	1
178.	Current knowledge and practices in the Mediterranean and Adriatic regions	2		1
179.	Biotechnological characteristics of IMTA systems	2	2	
180.	Multitrophic interactions	2		1
181.	Primary cultured organisms	2	1	1

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

182.	Secondary products – extractive inorganic phase	2	1	
183.	Secondary products – extractive organic phase	2	1	
184.	Aquaculture technology	2		1
185.	Potential for the development of IMTA systems in the Adriatic	2	1	
186.	Application of IMTA products in various industries	2		
187.	Application of IMTA products in biomedicine	2	2	
188.	Global trends	2		
189.	Financial structure and market aspects	2		
190.	Multitrophic mariculture and the environment	2		
TOTAL HOURS		30	10	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Marine stock enhancement
Semester	II
ECTS points	3
Course status	Elective
Course leader	Prof. Vlasta Bartulović, PhD
Department, room no.	Department of Applied Ecology, D 33
Phone	020/445863
e-mail	vlasta@unidu.hr
Course assistant/associate	Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Department, room no.	Click here to enter text.		
Phone	Click here to enter text.		
e-mail	Click here to enter text.		
COURSE DESCRIPTION			
Course content			
During the course, students will learn about the main fishing species and their distribution, as well as their population structures in space and time. They will receive basic information on fishing gear and fishing techniques, as well as the impact of fishing on natural communities and on socioeconomics. Students will become familiar with ways to sustainably manage marine stocks and restore shellfish, crustaceans, echinoderms and fish stocks.			
Learning outcomes			
Upon completion of this course, students will be able to: - analyze the main groups of fish and invertebrates that are commercially caught in the sea - discuss population structure in space and time - identify and discuss different fishing gears and techniques - analyze the impact on the community - discuss the socio-economic impact of fishing - discuss stock enhancement practices.			
TEACHING MODE			
☒ Lectures ☒ Seminars and workshops ☐ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning		☐ Consultations ☐ Laboratory ☐ Field work ☒ Mentoring ☒ Exams	
EXAMINATION METHOD			
☐ Oral ☒ Written ☒ Partial exam		Other: Click here to enter text.	
READING			
Compulsory reading			
35.	Jennings, S., Kaiser, M.J., Reynolds, J.D. 2013. Marine fisheries ecology, Blackwell publishing company, 417 p. (selected chapters)		
Optional reading			
50.	Leber, K.M., Kitada, S., Blankenship, H.L., Svasand, T. 2004. Stock enhancement and sea ranching. Developments, pitfalls and opportunities. Blackwell publishing, 562 p. (selected chapters)		
51.	Bell, J.D., Rothlisberg, P.C., Munro, J.L., Loneragan, Nash, W.J. Ward, R.D., Andrew, N.L. 2005. Advances in Marine biology vol 49. Restocking and stock enhancement of marine invertebrate fisheries. Elsevier, Ltd., 374 p. (selected chapters)		
52.	Scientific and professional papers in the field of stock enhancement		

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

LIST OF TOPICS				
No.		Hours		
		L	E	S
191.	Exploited species and their distribution	2		
192.	Exploited species and their distribution	2		1
193.	Population structures in space and time	2		
194.	Population structures in space and time	2		2
195.	Fishing gear and techniques	2		
196.	Impacts of fishing on natural communities	2		2
197.	Impacts of fishing on socio-economics	2		2
198.	Possibilities for sustainable management of marine stocks	2		
199.	Recovery of marine invertebrate stocks - bivalve molluscs	2		
200.	Recovery of marine invertebrate stocks - bivalve molluscs	2		2
201.	Recovery of marine invertebrate stocks - crustaceans	2		2
202.	Recovery of marine invertebrate stocks - echinoderms	2		2
203.	Recovery of fish stocks	2		
204.	Recovery of fish stocks	2		

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

205.	Recovery of fish stocks	2		2
TOTAL HOURS		30	0	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Developmental biology of fish
Semester	II
ECTS points	3
Course status	Elective
Course leader	Prof. Vlasta Bartulović, PhD
Department, room no.	Department of Applied Ecology, D 33
Phone	020/445863
e-mail	vlasta@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content During the course, students will learn about different types of fish eggs, their shapes, number, and size in different groups. The parts of the egg will be analyzed: Yolk, shell, membrane, and micropyle. Students will learn about the different types of sperm in fish and their basic structure. Fertilization in fish and the developmental processes that follow will be covered, namely blastulation, gastrulation, neurulation, hatching from the egg, and the development of reproductive organs and organ systems.	
Learning outcomes After this course, students will be able to: - explain the differences between the various types of fish eggs - explain the structure of fish spermatozoa - describe the process of fish fertilization - discuss the process of embryonic development	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☒ Independent assignments	☐ Consultations ☒ Laboratory ☐ Field work ☐ Mentoring

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Multimedia and internet ☐ Distance learning	☒ Exams		
EXAMINATION METHOD			
☐ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.		
READING			
Compulsory reading			
36.	Kunz, Y.W. 2004. Developmental biology of teleost fishes. Springer, Dordrecht, Netherlands, 636 p. (selected chapters)		
Optional reading			
53.	Moyle, P.B., Cech, JR.J.J. 2004. An introduction to ichthyology. Pearson Benjamin Cummings, San Francisco, 726 str. (selected chapters)		
54.	Wootton, R.J., Smith, C. 2015. Reproductive biology of teleost fishes. John Wiley & Sons, Ltd. West Sussex, UK, 472 str. (selected chapters)		
55.	Scientific and professional papers in accordance with the interests of students		
LIST OF TOPICS			
No.	Hours		
	L	E	S
206.	2	0	1
207.	2	0	1
208.	2	0	1
209.	2	0	1
210.	2	0	1
211.	2	0	1
212.	2	0	1
213.	2	0	1

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

214.	Ectodermal derivatives	2	0	1
215.	Hatching	2	0	1
216.	Development of the eye	2	0	1
217.	Mesodermal derivatives	2	0	1
218.	Mesodermal derivatives	2	0	1
219.	Entoderm and its derivatives	2	0	1
220.	Viviparity	2	0	1
TOTAL HOURS		30	0	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Diversification of mariculture
Semester	I.
ECTS points	6
Course status	Compulsory
Course leader	Assoc. Prof. Tatjana Dobrosravić, PhD
Department, room no.	D30
Phone	020445868
e-mail	tatjana.dobroslavic@unidu.hr
Course assistant/associate	Sanja Grđan, PhD
Department, room no.	A16
Phone	020445732
e-mail	sanja.grdjan@unidu.hr
COURSE DESCRIPTION	
Course content	
Diversification of marine aquaculture is an important aspect of further development of this growing industry. Global stressors in marine ecosystems, e.g. seawater temperature rise, overfishing, pollution of coastal areas etc., are contributing to the need of culturing new species in marine aquaculture, as well as to the adaptation of marine aquaculture techniques and diversification of market products. In this course students will get familiar with factors that need to be considered when introducing new species to marine aquaculture production such as market preferences, duration of life cycle, growth rate and minimal technical requirements for successful rearing. Potential new species for each group of culturing organisms will be assessed in detail, as well as difficulties that could occur during their introduction to culturing systems. Student will learn about latest trends in aquaculture industry, with emphasize on importance of culturing species on lower trophic level and herbivorous/omnivorous fish species. Thematic units to be covered: Introduction to the diversification of aquaculture production, Diversification of culturing macroalgae, Diversification of culturing bivalves and gastropods, Diversification of culturing cephalopods, Diversification of culturing crustaceans, Diversification of culturing cephalopods, Diversification of culturing fish.	
Learning outcomes	
After successful completion of course, students will be able to: - explain importance and need for diversification of marine aquaculture production - define biological-ecological factors important for selection of new species - recognize difficulties and suggest solutions when introducing new species to production - analyze up-to-date successful examples of diversification for each group of organisms - suggest potential new species for culturing, recommend	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☐ Independent assignments	☒ Consultations ☒ Laboratory ☐ Field work ☐ Mentoring

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☐ Multimedia and internet ☐ Distance learning	☒ Exams			
EXAMINATION METHOD				
☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.			
READING				
Compulsory reading				
37.	Fotadar, R.K., Phillips, B.F. 2011. Recent Advances and New Species in Aquaculture. Wiley-Blackwell, 416 pp. (selected chapters)			
38.	Mustafa, S., Shapawi, R. 2015. Aquaculture ecosystems. Adaptability and Sustainability. Wiley-Blackwell, 400 pp. (selected chapters)			
39.	Moksness, E., Kjorsvik, E., Olsen, Y. 2004. Culture of Cold-Water Marine Fish. Blackwell			
Optional reading				
56.	Leung, P., Lee, C., O'Bryen, P. 2007. Species and System Selection for Sustainable Aquaculture. Blackwell Publishing, 528 pp. (selected chapters)			
57.	Harvey, B., Soto, D., Carolsfeld, J., Beveridge, M., Bartley, D. M. 2016. Planning for aquaculture diversification: the importance of climate change and other drivers. FAO Fisheries and Aquaculture Proceedings No 47. FAO, 166 pp.			
58.	Scientific and technical papers			
LIST OF TOPICS				
No.	Hours			
	L	E	S	
221.	Introduction – growing industry and diversification of marine aquaculture.	3	0	0
222.	Global stressors. Adaptation of production processes. Diversification of market products.	3	0	3
223.	Technological and biological factors to be considered.	3	0	2
224.	Socioeconomic factors to be considered.	3	0	1
225.	Macroalgae – present production. Biological and ecological traits important for production.	3	2	2
226.	Macroalgae – future perspective and difficulties in culturing new species.	3	0	1
227.	Bivalves - present production. Biological and ecological traits important for production. Future perspective and difficulties in culturing new species.	3	2	2

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

228.	Marine gastropods - present production. Biological and ecological traits important for production.	3	0	0
229.	Marine gastropods - future perspective and difficulties in culturing new species	3	2	0
230.	Cephalopods - present production. Biological and ecological traits important for production	3	0	0
231.	Cephalopods - . future perspective and difficulties in culturing new species.	3	0	1
232.	Crustaceans - present production. Biological and ecological traits important for production. Future perspective and difficulties in culturing new species.	3	2	1
233.	Fish - present production. Biological and ecological traits important for production	3	0	0
234.	Fish - Future perspective and difficulties in culturing new species 1	3	2	2
235.	Fish - Future perspective and difficulties in culturing new species 2	3	0	0
TOTAL HOURS		45	10	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Aquaculture food safety
Semester	III.
ECTS points	3
Course status	Compulsory
Course leader	Marina Brailo Šćepanović, PhD, Associate professor
Department, room no.	Department of Applied Ecology, Ćira Carića 4, D29
Phone	445-880
e-mail	marina.brailo@unidu.hr
Course assistant/associate	Erika Dobrosłavić, PhD, Assistant professor
Department, room no.	Department of Applied Ecology, Ćira Carića 4, D29
Phone	445-880
e-mail	erika.dobroslavic@unidu.hr
COURSE DESCRIPTION	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

Course content	
The course deals with aquaculture products and their quality and safety. A comparison of product quality assessment methods and food preservation procedures is given. The course includes the assessment of various prerequisite programs (GMP, GHP, SSOP, HACCP) and quality management (ISO 9000, 14000, 22000). Traceability, certification and welfare in production of aquaculture products will also be commented. Classes are carried out through lectures and exercises that follow the topics of lectures. The active participation of the students in the classes is achieved by performing independent exercises on chosen topic.	
Learning outcomes	
After successful mastering of a course, students will be able to: – choose an adequate quality assessment method for aquaculture product – choose an adequate preservation procedure for aquaculture product – organize the implementation of the GHP and HACCP plan in aquaculture production system – design a traceability chain in aquaculture production system recommend appropriate certification of the aquaculture product	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☒ Exams
EXAMINATION METHOD	
☐ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.
READING	
Compulsory reading	
40.	Ryder, J., Karunasagar, I., Ababouch, L. eds. 2014. Assessment and management of seafood safety and quality: current practices and emerging issues. FAO Fisheries and Aquaculture Technical Paper No. 574. Rome, FAO, 432 pp. (selected chapters)
41.	Huss, H.H., Dillon, M., Derrick, S. Grimsby, A. 2005. Guide to Seafood Hygiene Management: Accessing the European and American Market. UK: Humber Institute of Food & Fisheries, 76 pp.
42.	Basic legislation governing this area at national and EU level
Optional reading	
59.	Segner, H., Reiser, S., Ruane, N., Rösch, R., Steinhagen, D., Vehanen, T. 2019. Welfare of fishes in aquaculture. FAO Fisheries. and Aquaculture Circular No. 1189. Budapest, FAO
60.	Carvalho, E.D., Silva David G.S., Silva R.J. 2014. Health and Environment in Aquaculture. Intech, Rijeka, Croatia. 414 pp. (selected chapters)

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

61.	Bremner, A. 2002. Safety and quality issues in Fish Processing. Woodhead Publishing Limited, Cambridge, UK, 507 pp. (selected chapters)			
62.	Huss, H.H. 1995. Quality and quality changes in fresh fish. FAO Fisheries Technical Paper, 348, 203 pp.			
63.	Scientific and professional papers in accordance with the interests of students			
LIST OF TOPICS				
No.		Hours		
		L	E	S
236.	Importance of quality and product safety standards in aquaculture	2	2	0
237.	Aquaculture national and EU legislation	2	2	0
238.	Foodborne diseases	2	2	0
239.	Biological hazards associated with aquaculture products	2	2	0
240.	Chemical hazards associated with aquaculture products	2	2	0
241.	Basic characteristics of fish meat	2	2	0
242.	Basic characteristics of meat of crabs, shellfish and cephalopods	2	2	0
243.	Food preservation techniques	2	2	0
244.	Quality assessment	2	2	0
245.	Good manufacturing practice (GMP) and good hygiene practice (GHP)	2	2	0
246.	SSOP-standard sanitary operating procedures	2	2	0
247.	HACCP system	2	2	0

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

248.	Quality systems in aquaculture	2	2	0
249.	Traceability in aquaculture	2	2	0
250.	Certification in aquaculture	2	2	0
TOTAL HOURS		30	30	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Marine biologically active natural products
Semester	Winter semester (2 nd)
ECTS points	3
Course status	Elective
Course leader	Prof. Sanja Tomsic, PhD
Department, room no.	Department of applied ecology, D 26
Phone	020 445 767
e-mail	sanja.tomsic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	The course provides a comprehensive introduction to biologically active compounds derived from marine organisms (marine natural products – MNPs). Core topics include natural organic compounds produced by marine organisms as sources of pharmaceuticals, as well as the origins of modern and traditional medicines with significant potential in contemporary healthcare. Its aim is to provide students with broad knowledge of classes of secondary metabolites originating from marine macro- and microorganisms, along with their potential applications in the pharmaceutical, cosmetic, and food industries. Additionally, the course addresses interdisciplinary approaches (biology–ecology–chemistry) to analyzing interactions within marine communities and their applications in ecology, biology, biotechnology, biomedicine, and various industries.
Learning outcomes	Upon successful completion of the course, student will be able to: - Define various roles of chemical interactions between marine organisms and their environment - Interpret chemically mediated interactions in the marine environment and explain how they influence the abundance and distribution of organisms and metabolites

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

- Classify the main groups of producers of bioactive compounds in the marine environment
- Relate methods for detection, screening, isolation, and synthesis of marine-derived bioactive compounds
- Support the hypothesis that marine environments are rich sources of novel bioactive compounds

TEACHING MODE

- | | |
|---|---|
| ☒ Lectures
☒ Seminars and workshops
☒ Exercises
☒ Independent assignments
☒ Multimedia and internet
☐ Distance learning | ☒ Consultations
☒ Laboratory
☒ Field work
☒ Mentoring
☒ Exams |
|---|---|

EXAMINATION METHOD

- | | |
|---|-------------------------------------|
| ☒ Oral
☒ Written
☒ Partial exam | Other:
Click here to enter text. |
|---|-------------------------------------|

READING

Compulsory reading

- | | |
|-----|---|
| 43. | Fattorusso, E., Gerwick, W.H., and Taglialatela-Scafati, O. 2012. Handbook of Marine Natural Products, Springer Dordrecht, pg, 1452 (selected chapters) |
| 44. | Kiyota, H. 2021. Marine Natural Products, Springer Nature Singapore Pte, pg, 517 (selected chapters) |

Optional reading

- | | |
|-----|---|
| 64. | Chopin, T. 2013. Aquaculture , Integrated Multi-trophic (IMTA). In: Christou, P., Savin, R., Costa-Pierce, B.A., Misztal, I., Whitelaw, C.B.A. (eds) Sustainable Food Production. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-5797-8_173 |
| 65. | Troell, M., Halling, C., Neori, A. 2009. Integrated mariculture: asking the right questions In: Aquaculture in the Ecosystem, Springer. Aquaculture, 226(1-4):69-90 |
| 66. | Chopin, T. Buschmann, T.A., Halling, C., Troell, M., Kautsky, N., Neori, A., Kraemer, G.P., Zertuche-González, J.A., Yarish, C., Neefus, C. 2001. Integrating seaweeds into marine aquaculture systems: a key toward sustainability. Journal of Phycology, 37(6):975–986 |
| 67. | Granada, L., Sousa, N., Lopes, S., Lemos, M.F.L. 2015. Is integrated multitrophic aquaculture the solution to the sectors’ major challenges? – a review. Reviews in Aquaculture, 8(3):283-300 |

LIST OF TOPICS

No.		Hours		
		L	E	S
251.	Blue biotechnology and marine resources	3	1	
252.	Bioactive compounds from the sea – marine natural products	2		1

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

253.	Marine ecosystems and biodiversity	2		1
254.	Marine organisms producing secondary metabolites	2		1
255.	Chemical ecology in the marine environment	2	1	
256.	Sampling, detection, and isolation of bioactive compounds	2		
257.	Biosynthesis of secondary metabolites	1		1
258.	Overview of approved drugs of marine origin	1		
259.	Pharmacological activity of bioactive compounds from marine organisms	3	2	
260.	Major producers of natural compounds – overview across taxonomic groups	2	3	
261.	Marine toxins – biomedical potential	2		
262.	Symbioses and microbial communities	3	2	
263.	Metagenomics and other -omics approaches	2		1
264.	Cell culture vs. aquaculture	2	1	
265.	Traditional use of marine-derived bioactive compounds	1		
TOTAL HOURS		30	10	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Ethical and Socioeconomic Aspects of Aquaculture
Semester	I
ECTS points	3
Course status	Elective
Course leader	Prof. Vlasta Bartulović, PhD
Department, room no.	D33
Phone	020445863
e-mail	vlasta.bartulovic@unidu.hr
Course assistant/associate	Sanja Grđan, PhD
Department, room no.	A16
Phone	020445272
e-mail	sanja.grdjan@unidu.hr
COURSE DESCRIPTION	
Course content	
The aim of the course is to enable students to recognize, analyze, and evaluate ethical and socioeconomic aspects of aquaculture in the context of sustainable food production. Students will develop an understanding of ethical principles and challenges involving producers, consumers, the environment, and farmed organisms.	
Learning outcomes	
After successfully completing the course, the students will be able to: - Apply fundamental ethical principles in food production - Evaluate current ethical issues in aquaculture - Analyze social and economic impacts of aquaculture at local and global levels - Identify positive aspects and plan production accordingly - Implement farm management plans to reduce risks of negative impacts - Apply current guidelines and legislation to ensure proper production	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☐ Laboratory ☐ Field work ☐ Mentoring ☐ Exams
EXAMINATION METHOD	
☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

READING				
Compulsory reading				
45.	Lam, M. et al. (2022). <i>Seafood Ethics, Policy and Governance</i> . Wiley.			
46.	Olawumi, F. (2012). <i>Biotechnical & Socioeconomic Factors Affecting Aquaculture Production</i> .			
47.				
Optional reading				
68.	Bunting, S. W. (2013). <i>Principles of Sustainable Aquaculture</i> . Routledge.			
69.	EU legislation			
70.	Scientific and technical papers			
LIST OF TOPICS				
No.		Hours		
		L	E	S
266.	Introduction to ethical issues in food production	2	0	0
267.	Food Ethics Council and key ethical principles	2	0	0
268.	Ethical issues in aquaculture	2	0	0
269.	Ethical issues in production processes	2	0	1
270.	Ethical issues in transport, processing, and marketing	2	0	2
271.	Environmental impacts	2	0	2
272.	Role of consumers	2	0	2
273.	Genetically modified organisms	2	0	1
274.	Ethical regulations and legislation	2	0	1
275.	Socioeconomic aspects (global and local)	2	0	0
276.	Positive and negative socioeconomic impacts	2	0	1

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

277.	Evaluation of impacts at local level	2	0	1
278.	Production planning aligned with ethical and socioeconomic aspects	2	0	0
279.	Introduction to ethical issues in food production	2	0	2
280.	Food Ethics Council and key ethical principles	2	0	2
TOTAL HOURS		30	0	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Mariculture Marketing
Semester	III
ECTS points	3
Course status	Elective
Course leader	Barbara Puh, PhD, Assoc. Prof.
Department, room no.	
Phone	
e-mail	
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
Through examples of the latest trends in the application of marketing in mariculture, students will cover the following topics through lectures and exercises: concept and definition of marketing, market research, market segmentation, consumer behaviour, target audience, marketing information system (MIS), marketing mix (4P), strategic planning and SWOT analysis, product management, product positioning, brand creation strategy, application of marketing to specific mariculture products, internet marketing, 21st century global marketing and social responsibility and marketing ethics.	
Learning outcomes	
After successfully completing the course, students will be able to:	
- define and understand the basic concepts of marketing, - recognise the criteria for market segmentation and selection of target segments,	

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

- analyse and compare market products/services, distribution, prices and promotions,
- anticipate processes related to decision-making on marketing strategy,
- distinguish between ethical and socially responsible aspects of marketing activities and
- evaluate the latest scientific and professional knowledge.

TEACHING MODE

- | | |
|--|---|
| ☒ Lectures
☐ Seminars and workshops
☒ Exercises
☒ Independent assignments
☒ Multimedia and internet
☐ Distance learning | ☐ Consultations
☐ Laboratory
☐ Field work
☐ Mentoring
☒ Exams |
|--|---|

EXAMINATION METHOD

- | | |
|---|-------------------------------------|
| ☐ Oral
☒ Written
☐ Partial exam | Other:
Click here to enter text. |
|---|-------------------------------------|

READING

Compulsory reading

- | | |
|-----|--|
| 48. | Kotler, P., Armstrong, G, Wong, V. and Saunders, J. 2020. Principles of Marketing 8th European edn, Harlow: Pearson Education Limited, 720 pp. |
|-----|--|

Optional reading

- | | |
|-----|--|
| 71. | Scientific and professional works in accordance with the interests of students |
|-----|--|

LIST OF TOPICS

No.		Hours		
		L	E	S
281.	Concept and Definition of Marketing	2	1	0
282.	Market Research	2	1	0
283.	Market Segmentation	2	1	0
284.	Consumer Behaviour	2	1	0
285.	Target Audience and Consumer Groups	2	1	0
286.	Marketing Information System (MIS)	2	1	0
287.	Marketing Mix (4Ps)	2	1	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

288.	Strategic Planning and SWOT Analysis	2	1	0
289.	Marketing Management	2	1	0
290.	Defining the Product: What is a Product?	2	1	0
291.	Product Positioning	2	1	0
292.	Branding Strategy	2	1	0
293.	Marketing Applications for Specific Mariculture Products	2	1	0
294.	Marketing in the Internet Age	2	1	0
295.	21st Century Global Marketing: Corporate Social Responsibility and Marketing Ethics	2	1	0
TOTAL HOURS		30	15	0
OTHER RELEVANT INFORMATION				
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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Aquaculture adaptation to global stressors
Semester	I
ECTS points	3
Course status	Elective
Course leader	Prof. Marijana Pećarević, PhD
Department, room no.	D28
Phone	020445861
e-mail	marijana.pecarevic@unidu.hr
Course assistant/associate	Sanja Grđan, PhD
Department, room no.	A16
Phone	020445732
e-mail	sanja.grdjan@unidu.hr
COURSE DESCRIPTION	
Course content	
Within this course students will gain knowledge about global stressors, impacts they have on marine aquaculture, and learn adaptation and mitigation strategies. Climate change, global warming, local extreme weather events like heatwaves, ocean acidification, sea level rise and potential effect of multiple stressors will be lectured in detail. Students will get to know aquaculture adaptation strategies to now-and future projections of changes in the ecosystem, including change of fish feed, relocation, diversification of production, applying genetic methods based on epigenetic adaptation mechanisms. Local mitigation possibilities and methods will be explained with a case-study method. Thematic units to be covered: Global changes and stressors, Impact of global changes on aquaculture, Adaptation and mitigation strategies, Research, monitoring and policies.	
Learning outcomes	
After successfully completing the course, the students will be able to: - define global stressors, explain the cause of occurrence and understand the impacts on the marine ecosystem - understand and explain the difference between global stressors and their impact on aquaculture at global and regional scale - assess and analyse the impact of target stressors on aquaculture production - identify suitable strategies for aquaculture adaptation to global stressors - recommend and apply the optimal adaptation or mitigation strategy on a regional example - design and conduct research and/or monitoring in a particular area	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☒ Exercises	☒ Consultations ☒ Laboratory ☐ Field work

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☐ Mentoring ☒ Exams			
EXAMINATION METHOD				
☒ Oral ☒ Written ☐ Partial exam	Other: Click here to enter text.			
READING				
Compulsory reading				
49.	Phillips, B.F. & Perez-Ramirez, M. (eds.) 2017. Climate change impacts on Fisheries and Aquaculture. Wiley-Blackwell, pp 1048 (selected chapters)			
50.	Barrange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. (eds.). 2018. Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options (Fao Fisheries and Aquaculture Technical Paper), pp. 628 (selected chapters)			
51.				
Optional reading				
72.	Rota, A., Abila, R. 2015. How to do Fisheries, aquaculture and climate change. IFAD, pp 33.			
73.	Scientific and technical papers			
74.				
LIST OF TOPICS				
No.		Hours		
		L	E	S
296.	Global changes and global stressors. Impact on global and regional level.	2	0	0
297.	Climate change. Global warming. Marine heatwaves. Sea-level rise.	2	3	0
298.	Ocean acidification – carbonate chemistry.	2	4	0
299.	Ocean acidification – impact on biology and ecology of organisms.	2	3	0
300.	Impact of multiple stressors on marine ecosystems.	2	0	1
301.	Positive and negative impact of global changes on aquaculture – present and future projections.	2	0	0
302.	Importance of aquaculture in mitigation of consequences of global changes.	2	0	1

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

303.	Adaptation and mitigation strategies – Diet and nutrition. Relocation.	2	0	0
304.	Adaptation and mitigation strategies – Diversification of cultured species. Epigenetic mechanisms.	2	0	0
305.	Adaptation and mitigation strategies – regional and local level approach.	2	0	1
306.	Scientific research related to aquaculture and global changes.	2	0	1
307.	Monitoring – importance, present and future monitoring	2	0	0
308.	Impact of global stressors on aquaculture in Croatia.	2	0	0
309.	Policies, legislative – EU.	2	0	0
310.	Policies, legislative – RH.	2	0	0
TOTAL HOURS		30	10	5
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Natural Science Research in the Mediterranean
Semester	III
ECTS points	3
Course status	Elective
Course leader	Josip Mikuš
Department, room no.	Department of Applied Ecology, D25
Phone	020/445-864
e-mail	josip.mikus@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE DESCRIPTION	
Course content	
The course provides an overview of natural science research in the Mediterranean, from the earliest monitoring of the region's natural and environmental features in ancient times to contemporary research and projects. Lectures offer a brief history of the world's seas and oceans, with particular emphasis on research periods in the Mediterranean, as well as physical, chemical, and biological oceanographic studies of marine ecosystems. The course also covers scientific research expeditions, marine research institutions, prominent researchers, a brief overview of fisheries and biological research, the history of marine organism cultivation, and a special review of natural science research in the Adriatic Sea.	
Learning outcomes	
After successfully completing the course, students will be able to: - present knowledge about the history of oceanographic research in the seas and oceans - distinguish the importance of certain periods in the development of natural science research in the Mediterranean - notice the importance of the role of researchers and institutions in the scientific research process - understand the importance of scientific and biotechnological projects in modern research on marine ecosystems - critically assess the possibility and importance of applying the results of scientific research in marine ecosystems.	
TEACHING MODE	
☒ Lectures ☒ Seminars and workshops ☐ Exercises ☐ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☐ Consultations ☐ Laboratory ☐ Field work ☒ Mentoring ☐ Exams
EXAMINATION METHOD	
☐ Oral ☒ Written ☐ Partial exam	Other: Click here to enter text.
READING	
Compulsory reading	
52.	Dulčić, J., Kršinić, F. 2012. Povijest prirodosnanstvenih istraživanja Jadranskog mora. Hrvatska akademija znanosti i umjetnosti, Institut za oceanografiju i ribarstvo, Split, 211 pp.
53.	Groebe, C. (Ed.) 2013. Places, People, Tools: Oceanography in the Mediterranean and Beyond. Proceedings of the Eighth International Congress for the History of Oceanography. Pubblicazioni della Stazione Zoologica Anton Dohrn, IV. Giannini Editore: Napoli. ISBN 978-88-7431-621-2. 494 pp.
Optional reading	
75.	Rozwadowski, H. M. 2019. Vast Expanses: A History of the Oceans. Reaktion Book, London, UK, 269 pp. ISBN: 978 1 78023 997 2
76.	Zore-Armanda, M. 2013. Early investigation of the Adriatic, Mediterranean and Red Sea based at the City of Pola. In: Groebe, C. (Ed.) Places, People, Tools: Oceanography in the Mediterranean and Beyond. Proceedings of the Eighth International Congress for the

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

	History of Oceanography. Pubblicazioni della Stazione Zoologica Anton Dohrn, IV: 409-419.			
77.	Research and review papers in accordance with the interests of students.			
LIST OF TOPICS				
No.		Hours		
		L	E	S
311.	The role and significance of the Mediterranean Sea in the development of the earliest civilisations.	2	0	1
312.	Overview of the exploration of the world's seas and oceans, with particular emphasis on periods of exploration in the Mediterranean Sea.	2	0	1
313.	Scientific research in the Mediterranean Sea up to the Challenger expedition.	2	0	1
314.	Scientific research in the Mediterranean Sea from the Challenger expedition to the present.	2	0	1
315.	Marine research institutions in the Mediterranean.	2	0	1
316.	International Commission for the Scientific Exploration of the Mediterranean (CIESM).	2	0	1
317.	Notable researchers in the Mediterranean Sea.	2	0	1
318.	Overview of fisheries and biological research in the Mediterranean Sea.	2	0	1
319.	Overview of the history of aquaculture in the Mediterranean Sea.	2	0	1
320.	Research in the Adriatic Sea from ancient times to the nineteenth century.	2	0	1
321.	Research in the Adriatic Sea in the nineteenth century.	2	0	1
322.	Research in the Adriatic Sea in the twentieth and twenty-first centuries.	2	0	1
323.	Notable researchers and scientific research institutions in the Adriatic.	2	0	1

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

324.	Climate change and anthropogenic impacts in the context of scientific research in the Mediterranean Sea in the twenty-first century.	2	0	1
325.	EU scientific research programmes on the marine and coastal environment in the Mediterranean Sea region.	2	0	1
TOTAL HOURS		30	0	15
OTHER RELEVANT INFORMATION				
Click here to enter text.				

COURSE INFORMATION	
Course name	Safety at Sea
Semester	3
ECTS points	3
Course status	Elective
Course leader	Srđan Vujičić, PhD, Assoc. Prof.
Department, room no.	Faculty of Maritime studies
Phone	
e-mail	srđjan.vujcic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	Learning objectives are to develop an understanding of the international system of safety of navigation, including the most important maritime conventions. Furthermore, the objective is also to pass to students a working knowledge and give them basic training in safety at sea. International maritime safety, security and pollution prevention system, search and rescue, maritime casualties, safety equipment and appliances, distress communication, abandoning ship and survival at sea, firefighting procedures.
Learning outcomes	Implement good practices by abiding by all respective laws and regulations
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☐ Independent assignments ☒ Multimedia and internet	☐ Consultations ☐ Laboratory ☒ Field work ☐ Mentoring ☐ Exams

	University of Dubrovnik Department of Applied Ecology Čira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
		F04-12

☐ Distance learning				
EXAMINATION METHOD				
☐ Oral ☒ Written ☐ Partial exam		Other: Click here to enter text.		
READING				
Compulsory reading				
54.	Zec, D., Safety at sea, university textbook, published by Faculty of Maritime Studies Rijeka, Rijeka 2001.			
55.	IMO: SOLAS Covention			
56.	IMO: IAMSAR Manual Volume III, Edition 2019			
57.	IMO: ISM Code, Edition 2018			
58.	STCW Convention			
Optional reading				
78.	Lifesaving appliance regulation (SOLAS) - IMO model course 7.01 (3.3.1.(1.1.))			
79.	Organization of Fire and Abandon ship drills - IMO model course 7.01 (3.3.2.(2.1)) Fire Fighting and Abandon ship Imo model courses (2.03 i 1.23 i STCW Code Section A-VI/2 and A-VI/3) Maintenance of LSA, FF and other safety system - IMO model course 7.01 (3.3.3.(3.1)) STCW Code Section A-VI/3) Imo model courses (2.03 i 1.23)			
80.	Preparation of contingency plans for response to emergencies - IMO model course 7.01 (3.4.1.(1.1.))			
81.	Preparation of contingency plans for response to emergencies - IMO model course 7.01 (3.4.1.(1.1.)) Control fire-fighting, Fire detection and fixed fire-extinguishing equipment - IMO model course 2.03 and STCW Code section A-VI/3			
82.	IMO Search and Rescue procedures at Sea (IAMSAR manual) Basic GMDSS Survival at sea			
83.	Purpose and handling with LSA - Imo model courses 1.23 STCW Code Section A-VI/2 IMO Search and Rescue procedures at Sea (IAMSAR manual) IMO Model Course 1.08 and STCW regulation			
LIST OF TOPICS				
No.		Hours		
		L	E	S
326.	Introduction: Concept and Significance of Maritime Safety and Safety Culture	3	1	
327.	Mandatory Standards and Regulations of the International Maritime Organization (IMO)	3	1	
328.	Concept of Maritime Accidents and Ship Inspection (Port State/Flag State Control)	3	1	
329.	National and International Manuals for Maritime Search and Rescue (IAMSAR)	3	1	

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

330.	Methods and Resources for Search and Rescue (SAR) at Sea	3	1	
331.	Essential Communication Equipment in Distress	3	1	
332.	International Lists, Search and Rescue, Communication Procedures (Midterm Exam 1)	3	1	
333.	Analysis of Maritime Accidents, Rescue Procedures and Measures, Abandon Ship Procedures	3	1	
334.	Personal Life-Saving Appliances (Description and Handling), Fieldwork	3	1	
335.	Collective Life-Saving Appliances (Description and Handling), Fieldwork	3	1	
336.	Hazards in Handling Life-Saving Systems, Fieldwork	3	1	
337.	Shipboard Fire Protection: Fire-Resisting Divisions, Bulkheads and Doors	3	1	
338.	Shipboard Fire Protection: Fixed Fire-Extinguishing Systems and Personal Equipment	3	1	
339.	Personal Safety and Social Responsibility: Interpersonal Relations, Teamwork, Fatigue Management, Communication, and Measures to Prevent Violence and Harassment on Board	3	1	
340.	Evaluation, Discussion and Review (Midterm Exam 2)	3	1	
TOTAL HOURS		45	15	0
OTHER RELEVANT INFORMATION				
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	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

COURSE INFORMATION	
Course name	Marine and Coastal Ecosystem Services
Semester	3.
ECTS points	3
Course status	elective course
Course leader	Ana Bratoš Cetinić
Department, room no.	Department of Applied Ecology
Phone	+38520445787
e-mail	abratos.@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	The course explores ecosystem services, including provisioning, regulating, cultural, and supporting services, with a focus on the unique characteristics of marine and coastal ecosystems. It provides an understanding of essential ecosystem functions such as coastal protection, climate regulation, biodiversity conservation, and bioproductivity. The course examines the impacts of human activities on marine and coastal ecosystems, analysing negative effects such as pollution, overfishing, urbanization, and climate change. Sustainable management of marine and coastal ecosystems is addressed through an overview of methods, strategies, and policies for the protection and restoration of threatened ecosystems, highlighting the role of communities and local initiatives. Students will also study the economic value of ecosystem services, including fisheries, tourism, coastal protection, and overall ecosystem health, with emphasis on methods for assessing both market and non-market values. The course further investigates the effects of climate change on marine environments, including sea-level rise, ocean acidification, changes in species migration, and alterations in ecosystem structure, as well as ecosystem adaptation and mitigation strategies. Finally, it covers policies and international frameworks for marine ecosystem protection, providing an overview of national and global regulations, international agreements such as CITES, and practical applications for conservation and ecosystem restoration.
Learning outcomes	1. Analyse and critically evaluate the multifaceted role of marine and coastal ecosystems in providing ecosystem services, including ecological functions, economic benefits, and cultural values. 2. Assess and predict the consequences of human activities on the resilience, sustainability, and service-providing capacity of marine and coastal ecosystems.

	University of Dubrovnik Department of Applied Ecology Čira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

3. Design, justify, and propose effective strategies for the conservation, restoration, and sustainable management of marine and coastal ecosystems.
4. Integrate, synthesise, and interpret scientific and socio-economic data on ecosystem services to inform evidence-based decision-making for environmental protection and sustainable development.
5. Evaluate, compare, and prioritise the economic, social, and ecological dimensions of policies and management approaches aimed at safeguarding marine and coastal ecosystems.

TEACHING MODE

☒ Lectures ☒ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☒ Distance learning	☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☒ Exams
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EXAMINATION METHOD

☒ Oral ☒ Written ☒ Partial exam	Other: Click here to enter text.
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READING

Compulsory reading

59.	Groot, R. et al. (2010). Chapter 1: Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. The Economics of Ecosystems and Biodiversity (TEEB). Ecological and Economic Foundation, 9-40.
60.	UNEP-WCMC (2011). Marine and coastal ecosystem services: Valuation methods and their application. UNEP-WCMC Biodiversity Series No. 33.
61.	Drakou E. G. et al. (2017). Marine and coastal ecosystem services on the science–policy–practice nexus: challenges and opportunities from 11 European case studies. International Journal of Biodiversity Science, Ecosystem Services & Management, 13(3), 51-67.
62.	Smaal, A.C. et al., ur., (2019). Goods and services of marine bivalves, Springer Open: Cham.

Optional reading

84.	Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Washington DC: Island Press.
85.	Haines-Young, R., Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. U: Raffaelli D, Frid, C., ur., Ecosystem Ecology. Cambridge: Cambridge University Press. A New Synthesis. Ecological Reviews, 110-139.
86.	Costanza, R. et al. (2017). Twenty years of ecosystem services: How far have we come and how far do we still need to go? Ecosystem services, 28, 1-16.
87.	Martin, C. L. et al. (2016). A systematic quantitative review of coastal and marine cultural ecosystem services: Current status and future research. Marine Policy, 74, 25-32.

LIST OF TOPICS

No.		Hours		
		L	E	S

	University of Dubrovnik Department of Applied Ecology Ćira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

341.	Ecosystem services: definition and classification.	2	0	1
342.	Overview of marine and coastal ecosystems: structure and function.	2	0	1
343.	Ecological services: climate regulation, water purification, and coastal protection.	2	0	1
344.	Economic services: fisheries, mariculture, tourism, and biotechnology.	2	0	1
345.	Cultural and recreational values of marine and coastal areas.	2	0	1
346.	Assessment of ecosystem service values: methods and tools.	2	0	1
347.	Impacts of human activities and pressures on ecosystem services.	2	0	1
348.	Coastal zone management: conflicts of interest.	2	0	1
349.	Examples of degradation and loss of ecosystem services.	2	0	1
350.	Restoration of degraded marine and coastal ecosystems.	2	0	1
351.	The blue economy and sustainable use of marine resources.	2	0	1
352.	The role of mariculture in providing and affecting ecosystem services.	2	0	1
353.	Legislative frameworks and conservation policies for marine and coastal ecosystems in the European Union and Croatia.	2	0	1
354.	Participatory management and the role of local communities.	2	0	1
355.	Integration of ecosystem service data into decision-making.	2	0	1
TOTAL HOURS		30	0	15

	University of Dubrovnik Department of Applied Ecology Čira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

OTHER RELEVANT INFORMATION
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COURSE INFORMATION	
Course name	Culture of ornamental species
Semester	III.
ECTS points	3
Course status	Mandatory
Course leader	assoc. prof. dr. sc. Kruno Bonačić
Department, room no.	Department of applied ecology, D31
Phone	+385 20 445 898
e-mail	kruno.bonacic@unidu.hr
Course assistant/associate	Click here to enter text.
Department, room no.	Click here to enter text.
Phone	Click here to enter text.
e-mail	Click here to enter text.
COURSE DESCRIPTION	
Course content	
Lectures will cover types of aquariums, methods of setup and technological solutions both for private and public aquaria as well the reproduction of species in captivity for sale or conservation purposes and the market for ornamental aquatic vertebrates, invertebrates and plants. Practical classes will allow students to learn first-hand about the design, establishment, stocking, start-up and maintenance of their own aquarium within the University's Aquaculture Laboratory. Furthermore, they will have the opportunity to visit and participate in the daily tasks of a public aquarium, where they will get to know more about the equipment and processes involved in its successful operation.	
Learning outcomes	
6. List the equipment necessary for the successful operation of freshwater and marine home and public aquariums 7. Describe the process and importance of spawning organisms in captivity for the purposes of sale on the ornamental species market or for conservation 8. Understand the world market of ornamental species 9. Apply the acquired knowledge to design, establish and maintain their own aquarium	
TEACHING MODE	
☒ Lectures ☐ Seminars and workshops ☒ Exercises ☒ Independent assignments ☒ Multimedia and internet ☐ Distance learning	☒ Consultations ☒ Laboratory ☒ Field work ☒ Mentoring ☐ Exams

	University of Dubrovnik Department of Applied Ecology Čira Carića 4, 20000 Dubrovnik phone: 00 385 20 445 861, e-mail: akvakultura@unidu.hr	Form
	Course Implementation Plan for the Academic Year 2026/2027	F04-12

EXAMINATION METHOD				
☒ Oral ☒ Written ☒ Partial exam		Other: Click here to enter text.		
READING				
Compulsory reading				
63.	Andrews, B., Ornamental fish farming, 2011. to page 524			
64.				
65.				
Optional reading				
88.	Pouil, S., Tlusty, M.F., Rhyne, A.L., Metian, M., 2020. Aquaculture of marine ornamental fish: overview of the production trends and the role of academia in research progress, Rev Aquacult. 1217-1230			
89.	Biondo, M.V., Burki., R.P., 2020. A Systematic Review of the Ornamental Fish Trade with Emphasis on Coral Reef Fishes—An Impossible Task, Animals.			
90.	Andrews, C., 1990. The ornamental fish trade and fish conservation, Journal of Fish Biology. 37-59			
LIST OF TOPICS				
No.		Hours		
		L	E	S
356.	Course introduction	1	0	0
357.	Types of aquariums	1	0	0
358.	Technological solutions in hobby aquaristics	1	1	0
359.	Technological solutions in commercial aquaristics	1	1	0
360.	Ornamental fish	1	2	0
361.	Ornamental invertebrates	1	2	0
362.	Ornamental aquatic plants	1	2	0
363.	Breeding and culture of ornamental species	2	3	0

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	Course Implementation Plan for the Academic Year 2026/2027	F04-12

364.	Market for ornamental species	2	3	0
365.	Starting-up your own aquarium	0	8	0
366.	Maintaining your own aquarium	0	15	0
367.	Role of aquaristics in conservation	1	1	0
368.	Sustainability of the ornamental species market	1	1	0
369.	Designing a public aquarium	1	3	0
370.	Activity of a public aquarium	1	3	0
TOTAL HOURS		15	45	0
OTHER RELEVANT INFORMATION				
Click here to enter text.				