U N I V E R S I T Y O F S P L I T

UNIVERSITY DEPARTMENT OF MARINE STUDIES

DETAILED PROPOSAL OF THE STUDY PROGRAMME

MARINE FISHERY

(Graduate study)

SPLIT, March, 2020.

GENERAL INFORMATION OF HIGHER EDUCATION INSTITUTION

Name of higher education institution	**University Department of Marine Studies**
Address	**Ruđera Boškovića 37**
Phone	**+385 21 510 190**
Fax	**-**
E.mail	**more@unist.hr**
Internet address	**http://more.unist.hr/**

GENERAL INFORMATION OF THE STUDY PROGRAMME

Name of the study programme	Marine Fishery		
Provider of the study programme	University of Split, University Department of Marine Studies		
Other participants	-		
Type of study programme	Vocational study programme ☐	University study programme ☒	
Level of study programme	Undergraduate ☐	Graduate ☒	Integrated ☐
	Postgraduate ☐	Postgraduate specialist ☐	Graduate specialist ☐
Academic/vocational title earned at completion of study	Master of Science in Marine Fishery		

1. INTRODUCTION

1.1. Reasons for starting the study programme

Marine fishery is a complex economic activity which is not only subjected to the influence of various biotic and abiotic components that affect its functioning and determine its development. Proper management and protection of renewable resources implies taking into account biotechnological, technical, economic, legal and many other aspects. Therefore, when it comes to proper and responsible management and protection of renewable resources of the sea, development of fishing activities, farming, preservation, processing and trading of fish and other marine organisms, education is essential for successful management of all fishery activities. This type of education is possible at the graduate study of Marine Fishery, which educates highly qualified staff trained to work in the field of marine fisheries.

The graduate study of Marine Fishery aims to cover the following issues: methods and activities related to fishing, farming, processing and trading of fish and other marine organisms, as well as methods and management activities, protection and exploitation of marine living resources. The staff trained in this graduate university study can play a prominent role in bodies of state, county, city and municipal administration involved in the marine fishery sector, as well as in the Chamber of Commerce, Chamber of Trades and Crafts and inspection services in the affairs of fishery inspection and in companies engaged in fishing, farming, processing and trading of fish and other marine organisms, their preservation, management and protection of marine living resources. Regarding this and labour market needs, implementation of this study programme is, thus, highly justified.

1.2. Relationship with the local community (economy, entrepreneurship, civil society, etc.)

Acquired knowledge and skills at the graduate study of Marine Fishery derives from a curriculum designed to train students for any type of job in the field of marine fisheries. At the graduate level, theory and practice are combined to help students develop working techniques and to engage in practice and pursue carrier in marine fishery (students are introduced to practical work methods, problems and solutions, they listen lectures from scientists and professionals, meet potential employers, talk to scientists and experts about the latest insights, thereby acquiring competences for future employment).

1.3. Compatibility with requirements of professional organizations

The graduate study programme is based on contemporary scientific findings from the field of ichthyology, integrated coastal zone management, exploitation, management and protection of marine living resources, use of fishing gear, vessels and ports, mariculture, fish processing technology and preservation of marine products, trade of fish and other marine organisms, as well as legislation on marine fisheries.

1.4. Name possible partners outside the higher education system that expressed interest in the study programme

Graduate study of Marine Fishery enables furthering of professional and scientific knowledge acquired at undergraduate studies, thereby being its logical continuation. That is why potential partners outside the higher education system are numerous bodies of state, county, city and municipal administration dealing with marine fisheries, Chamber of Commerce and Chamber of Trades and Crafts, inspection services that check and verify the application of the rules of marine fisheries policy, protection of the sea and its living resources, companies dealing with fishing, farming, processing and trade of fish and other marine organisms, their preservation, management and protection, and also scientific organizations engaged in the exploration of the sea and its living resources.

1.5. Financing

Graduate students of the Marine Fishery study programme are financed through the InteRiV project funds during the timespan of the project.

1.6. Comparability of the study programme with other accredited programmes in higher education institutions in the Republic of Croatia and EU countries

The graduate study programme of Marine Fishery is comparable with the following similar study programmes in the world: West Pomeranian University of Technology in Szczecin, Faculty of Food Science and Fisheries (Zachodniopomorski Uniwersytet Technologiczny w Szczecinie, Wydział Nauk o Zywnosci i Rybactwa); University of Warmia Mazury in Olsztyn, Faculty of Environmental Sciences (Uniwersytet Warminsko Mazurski w Olsztynie, Wydział Nauk o Srodowisku).

1.7. Openness of the study programme to student mobility (horizontal, vertical in the Republic of Croatia, and international)

Student mobility is achieved through the schemes of the Bologna Process and international mobility programmes (especially Erasmus). The graduate study programme of Marine Fishery is open to students' mobility between the respective studies at faculties and departments in the Republic of Croatia and abroad.

1.8. Compatibility of the study programme with the University mission and the strategy of the proposer, as well as with the strategy statement of the network of higher education institutions

The study programme is following strategic commitments of the University Department of Marine Studies which are harmonised with the University of Split 2015-2020 Strategy.

1.9. Current experiences in equivalent or similar study programmes

The study programme of Marine Fishery (in Croatian) was launched in the academic year 1991/1992, as a study of Maritime Fishery Technology, established upon a decision issued by the Ministry of Education and Culture, from June 5, 1991, which operated under the Faculty of Maritime Studies, University of Split. At that time, in addition to fishery, maritime subjects were also studied at Maritime Fishery Technology, because this 4-year university study also comprised a 2-year professional programme of Nautical Studies. Since the academic year 1998/1999 and the establishment of the Department of Marine and Maritime Studies at the University of Split (today's University Department of Marine Studies), the name was changed into the graduate study of Marine Fishery, and as of that time this study programme has been performed at the University Department of Marine Studies at the University of Split containing only fishery courses which enable education of highly qualified university staff for the needs of marine fishery. Accordingly, it can be stated that years of experience in implementing equivalent and similar programmes exist, hence form the fundamentals of the Marine Fishery graduate study programme.

2. DESCRIPTION OF THE STUDY PROGRAMME

2.1. General information

Scientific/artistic area of the study programme	Biotechnical sciences
Duration of the study programme	2 years
The minimum number of ECTS required for completion of study	120 ECTS credits
Enrolment requirements and admission procedure	Those bachelor students who have completed undergraduate studies from various scientific fields such as biotechnical, natural or other related disciplines can be enrolled to the graduate study programme of Marine Fishery. All candidates need to go through admission procedure which does not include entrance classification exams, instead, the ranking list is determined based on general point average and the duration of undergraduate study programme.

2.2. Learning outcomes of the study programme (name 15-30 learning outcomes)

Upon obtaining a degree of Master of Science (MSc) in Marine Fishery student is able:

LO 1. to implement contemporary methods in marine research

LO 2. analyze characteristics of the living world inhabiting the marine environment, as well as complex interrelationships between marine organisms

and their physical environment and relationship between living marine organisms
LO 3. introduce principles and criteria in biological systematics (nomenclature), especially the systematic position of economically significant species
LO 4. apply statistical modelling in marine fishery
LO 5. anticipate the impacts of fishing on the state of populations and fish community structure
LO 6. plan controlled and sustainable exploitation of marine resources
LO 7. apply the principles of rational and sustainable management of renewable marine biological resources
LO 8. apply the principles and methodology of conducting research, from planning to writing and presenting scientific papers in the field of marine fishery
LO 9. apply theoretical knowledge and practical skills to identify and solve complex problems in marine fishery practice
LO 10. design and conduct complex experiments, presentations and interpretation of results and, accordingly, make conclusions and decisions that contribute to quality and sustainability of marine fishery
LO 11. analyze and critically evaluate simulation and experimental results
LO 12. act effectively in fishery processes and activities, both independently and in a team
LO 13. independently organize and manage work processes in the field
LO 14. communicate with experts and the public about marine fishery problems and address possible solutions
LO 15. critically evaluate ethical aspects and responsibilities of the profession and the impact of human activities on the marine environment
LO 16. improve their competences in lifelong learning programmes

2.3. Employment possibilities

Master of Science (MSc) in Marine Fishery after completing his/her graduate study is qualified to work in higher education and scientific institutions engaged in marine research. One can also work in public health institutions and similar institutions engaged in sea-monitoring activities, as well as all other activities in the field of marine fisheries. Moreover, one can work in state, county, city and municipal government bodies and Chamber of Commerce and Chamber of Trades and Crafts in the field of marine fishery, in inspection authorities and coastguard activities related to various aspects of marine fishery and sustainable use of marine living resources, professional fishing trade, farming, processing and trade of fish and other marine organisms and their preservation, design and production of fishing gear, technological design of marine fish farms and other marine organisms, plants for processing and preserving marine products, development of technological requirements for design and construction of fishing vessels. Additionally, they can work as qualified experts and organization managers in national parks and other protected areas of nature, work in ministries, state administrations, fishery cooperatives, museums and vocational high schools for training personnel in the field of marine fishery.

2.4. Possibilities of continuing studies at a higher level

The University Department of Marine Studies, University of Split also delivers a postgraduate programme in Applied Marine Sciences. In addition, students may enrol at related postgraduate studies in the Republic of Croatia and abroad.

2.5. Name lover level studies of the proposer or other institutions that qualify for admission to the proposed study

Enrolment in the graduate study of Marine Fishery is possible after completing undergraduate studies from various scientific fields such as biotechnical, natural or other disciplines related to the graduate study programme of Marine Fishery.

2.6. Structure of the study

Conditions and methods of studying at the graduate study of Marine Fishery are formed according to the Regulations on Studies and the system of study at the University of Split, and possible procedures are elaborated in detail in the Regulations of the University Department of Marine Studies, one of them referring to enrolment requirements for the next study year, regular, i.e. mandatory examination periods and exam dates.

The graduate study of Marine Fishery lasts for two years. It comprises compulsory and elective courses and is based on the active participation of students in all forms of teaching (lectures, tutorials, laboratory exercises, seminars, fieldwork or practical work, etc.). In general, students' obligations include attendance at lectures and exercises, independent study, literature analysis, presentation of seminars, fieldwork and practical work, preparation and defence of diploma thesis, while teachers monitor and evaluate all student activities listed in the programme of each course. Essentially, students are required to acquisit knowledge and skills laid down by the study programme, which is evidenced by passing all the exams and defence of diploma thesis.

2.7. Guiding and tutoring through the study system

The University Department of Marine Studies does neither have a student-teacher nor student-mentor model (except tutoring for the preparation of the diploma thesis), and students can, generaly, contact their graduate study representative who is at their disposal for assistance, advice or support. There is also a Commissioner for Students with Disabilities at the University Department of Marine Studies whose role is to provide equal opportunities for all students with respect to accessibility, quality and successful studying. For all queries regarding their rights related, for instance, to arrangement of teaching or examination adjustments, students may contact their commissioner. If foreign students need any assistance, they can contact Erasmus and ECTS Coordinator at the University Department of Marine Studies.

2.8. List of courses that the student can take in other study programmes

Students of the graduate study Marine Fishery may enrol in courses from other studies with similar programme and learning outcomes, regardless of the specific name of each study course and programme, after the end of InteRiV project.

2.9. List of courses offered in a foreign language as well (name which language)

Delivering courses in the English language is proposed by the graduate study programme of Marine Fishery, i.e., all courses of the graduate study programme of Marine Fishery shall be organized in the English language.

2.10. Criteria and conditions for transferring the ECTS credits

The criteria and conditions for transferring ECTS credits are listed in the Regulations on Studies and the system of study at the University of Split.

2.11. Completion of study

Final requirement for completion of study	Final thesis ☐ Diploma thesis ☒	Final exam ☐ Diploma exam ☐
Requirements for final/diploma thesis or final/diploma/exam	Requirements for registering Diploma thesis are defined in the Guidelines for Thesis Preparation and Defence of Diploma Thesis of the University Department of Marine Studies.	
Procedure of evaluation of final/diploma exam and evaluation and defence of final/diploma thesis	Evaluation process of diploma exam and evaluation and defence of diploma thesis is defined in the Guidelines for Thesis Preparation and Defence of Diploma Thesis of the University Department of Marine Studies.	

2.12. List of mandatory and elective courses available within InteRiV project

List of courses							
Year of study: 1							
Semester: 1							
STATUS	CODE	COURSE	HOURS IN SEMESTER				ECTS
			L	S	E	F	
Mandatory	SMR214	Management of marine living resources	30	15	15	-	5
	SMR412	Applied ichthyology	30	0	30	-	5
	SMB501	Integrated coastal zone management	30	15	0	-	4
	SMR404	Field work					6
	Total		90	30	45	-	20

Elective	SMB209	Marine botany	30	0	30	-	5
	SMR409	Reproduction of marine organisms	30	0	30	-	5
	Total		60	0	60	-	10

List of courses							
Year of study: 1							
Semester: 2							
STATUS	CODE	COURSE	HOURS IN SEMESTER				ECTS
			L	S	E	F	
Mandatory	SMR312	Selectivity and catchability of fishing gears	30	0	30	-	5
	SMR314	Fish population dynamics and stock assessment	30	0	15	-	4
	SMR503	Statistical methods in biotechnology	30	0	30	-	4
	SMR433	Field work					4
	Total		90	0	75	-	17
Elective	SMB505	Microbiology of polluted waters	15	15	0	-	2
	SMR513	Mariculture and environment	30	0	30	-	5
	SMR518	Seafood processing technology	30	15	0	-	3
	SMR519	Adaptation physiology of marine organisms	15	15	0	-	3
	Total		90	45	30	-	13

List of courses							
Year of study: 2							
Semester: 3							
STATUS	CODE	COURSE	HOURS IN SEMESTER				ECTS
			L	S	E	F	
Mandatory	SMR308	Seafood quality assessment	30	10	5	-	4
	SMB503	Methodology of scientific work	15	30	0	-	3
	SMR504	Field work					6
	Total		45	40	5	-	13
Elective	SMR506	Biotechnology and genetics in fisheries and aquaculture	30	0	30	-	4
	SMB510	Climate change and marine ecosystems	15	15	0	-	3
	SMB514	Biology, ecology and population dynamics of cephalopods	15	15	0	-	3
	SMR517	Conservation of marine biodiversity	15	15	0	-	3
	SMR520	Welfare of aquatic laboratory animals	30	15	0	-	4
	Total		105	60	30	-	17

List of courses							
Year of study: 2							
Semester: 4							
STATUS	CODE	COURSE	HOURS IN SEMESTER				ECTS
			L	S	E	F	
Mandatory	SMR529	Diploma thesis					30
	Total						30

2.13. Course description

NAME OF THE COURSE	MANAGEMENT OF MARINE LIVING RESOURCES					
Code	SMR214	Year of study	1			
Course teacher	Alen Soldo, PhD	Credits (ECTS)	5			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			30	15	15	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The aim of this course is to acquire knowledge on proper and sustainable management of marine living resources, with an emphasis on application of fishing management measures in order to prevent intense and uncontrolled fishery exploitation.					
Course enrolment requirements and entry competences required for the course						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- understand social, biological, ecological and economic aspect in fishery - familiarize students with the fishery policies in Croatia and European Union - understand advantages and disadvantages of various fishery input and output controls, as well as fisheries technical measures - understand relationship between EU and Croatian legislative, as well as the purpose of different regulations and the way they operate (controll) in field - explain simple fishery economic model - understand the concept of support in fishery and define different types of economic incentives, including their advantages and disadvantages from the aspect of fishery technology and socio-economic perspective understand the concept of overfishing, determine different types of overfishing and their indicators and understand their consequences					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1. Energy flow, primary production and trophic levels in marine ecosystems. Trophic levels and fishery.** (3 hours) Learning outcomes: Determine elements which affect primary production in the sea, including concepts such as: *upwelling*, trophic level, eco-efficiency, food chains, food webs. Understand the impact of fisheries on intermediate trophic level of the ecosystem and the composition of the exploited communities. **Lecture 2. Species, stock, cohorts. Migration cycle of stock. Dynamic stock balance. Fishing effort. Catchability of fishing gear.** (2 hours) Learning outcomes: Acquire knowledge on the terms - species, stock and cohort (annual class). Understand the importance and the way stock migration cycle is determined. Understand Russel's law on dynamic balance stock and be able to					

	explain concepts of recruitment, growth, natural mortality and fishing mortality. Be able to elaborate concepts: fishing effort, unit of fishing effort and catch per unit effort. Define concepts of catch rate and catchability coefficient of fishing gear. Understand the factors that affect the catchability of fishing gear. **Lecture 3. Actual state of marine living resources at the global level an in the Adriatic.** (2 hours) Learning outcomes: Be familiar with the actual state of the most important elements of global and Croatian fishery. Acquire knowledge on available data regarding the world fish catch and Croatian catch with respect to categories of fishing gear and the most exploited species. Be able to describe the aim and fish consumption in fishery. Understand problems related to reliable fisheries statistics. **Lecture 4. *"Tragedy of the commons"*** (1 hour) Learning outcomes: Understand the concept of the *tragedy of the commons*, provide elaboration of this concept on the example of fisheries. **Lecture 5. Development of the fisheries and fishing techniques. Introduction to fishery regulation measures.** (3 hours) Learning outcomes: Acquire knowledge on history of fishing and fishing techniques. Comprehend the importance of fishing laws and regulations. Understand the social, biological, ecological and economic aspect of fishery. Acquire knowledge on different fishing management measures. **Lecture 6. Input control in fisheries management – fishing effort management.** (3 hours) Learning outcomes: Acquire knowledge on advantages and disadvantages of different input controls in fisheries management – limiting the number of fishing privileges/vessels, size/power of vessels, size/the amount of fishing gear and the amount of time fishing. Determine input controls in fisheries management currently in force in Croatia. Understand the purpose of input control in fisheries management, as well as to recognize circumstances in which these measures are appropriate. **Lecture 7. Output control in fisheries management – catch management.** (3 hours) Learning outcomes: Familiarize with advantages and disadvantages of different output controls in fisheries management (common or individual quota, transferable or non-transferable quota). Be able to define methodology for determining and introducing quota system. Determine output controls in fisheries management currently in force in Croatia. Understand the purpose of output control in fisheries management as well as recognizing circumstances in which these measures are appropriate. **Lecture 8. Fisheries technical measures.** (3 hours) Learning outcomes: Understand the purpose of introducing fisheries technical measures. Know advantages and disadvantages of different technical fisheries measures (spatial-temporal restrictions, closure period, limiting the minimum catch size, defining technical characteristics and design of fishing gear). Determine technical measures in fisheries management which are currently in force in Croatia. Be able to provide critical overview through comparison of two fisheries management methods – one being the minimum catch size and the other referring to technical characteristics and design of fishing gear. Understand the importance of certain biological characteristics of exploiting species (length of sexual maturity, spawning season) for determining technical measures. **Lecture 9. Legal regulations in Croatia and the EU.** (4 hours) Learning outcomes: Acquire knowledge on the most important parts of Croatian Marine Fisheries Act, including the most significant bylaws which regulate fishery in Croatia (with an emphasis on different fisheries management measures). Be familiarized with the most important EU regulations which govern the fishery sector. Understand the relationship between Croatian and EU legislation, as well as the purpose of various regulations and the way they operate (control) in field. **Lecture 10. Economic fishery models. Economic incentives in fishery.** (2 hours)

	Learning outcomes: Be able to explain simple fishery economic model (Graham-Schaefer's curve). Acquire concepts MSY and MEY (maximum sustainable yield and maximum economic yield). Understand the impact of fishing cost reduction and fish price increase on fishery economic model. Understand the concept of support in fishery, be familiarized with different types of economic incentives, their advantages and disadvantages. Understand the impact which support has on the fishing effort and maximum sustainable yield, and consequently on the state of marine living resources. Understand advantages and disadvantages of support from the aspect of fishing technologies and socio-economic aspect. **Lecture 11. *Ecosystem approach to fisheries*. Discard. Overfishing.** (4 hours) Learning outcomes: Recognize different impacts of fishery on habitat and ecosystem. Be familiar with the concepts of by-catch and discards. Be familiar with different types of overfishing (mature fish overfishing, recruit overfishing, ecosystem overfishing) and their benchmarks and understand the consequences of overfishing. **Seminar 1. *Tragedy of the commons* –** (3 hours) Learning outcomes: Understand the concept of the "tragedy of the commons", its cause and consequences, be able to explain it on the example of exploitation of the marine living resources. **Seminar 2. The history of fisheries development and fishing technologies.** (3 hours) Learning outcomes: Be able to define important periods of fisheries development and the most important advances of fishing technologies. Determine different phases of fisheries development on given examples from the world fishery and understand the impact of fisheries development on the exploited resources. **Seminar 3. Fishery regulation.** (3 hours) Learning outcomes: Understand how different measures of fishery regulation affect fishery income, employment and the state of exploited population. Be able to explain ongoing processes on examples from world fishery when imposing regulation measures. **Seminar 4. Marine protected areas (MPA).** (3 hours) Learning outcomes: Understand the effects of creating marine protected areas on fishery income, employment and exploited population, i.e. interactions among economic, social and bio-ecological aspects of fishery. Recognize the advantages and disadvantages of this type of fishery regulation, its consequences and possible effect on local communities. **Seminar 5. Discard issues in marine fishery.** (3 hours) Learning outcomes: Be acquainted with elementary data on quantity, share and content of discards regarding different types of fishery tools (techniques) worldwide. Understand the issue of discards and be able to specify possible solutions. Be familiar with the legislation governing discards (EU level) and understand possible scenarios of its execution in Croatia. **Exercise 1. Regulation on fishing gear and tools in Croatia.** (3 hours) Learning outcomes: Be familiar with all regulative measures regarding fishing tools features applied in Croatian legislation. Know all regulative measures considering mesh size, construction features of fishing gear and tools and their application, including fishery techniques. Understand advantages, disadvantages and implementing possibilities of all regulative measures. **Exercise 2. Regulation of commercial marine fisheries in Croatia.** (3 hours) Learning outcomes: Be familiar with all regulative measures for commercial marine fisheries implemented in Croatian legislation. Be acquainted with regulative measures of space ban, time ban, closure period, minimal catch length etc. Understand advantages, disadvantages and implementing possibilities of all regulative measures. **Exercise 3. Regulation of sports and recreational fishing in Croatia.** (3 hours) Learning outcomes: Be familiar with all measures governing sports and recreational fishing in Croatian legislative (primarily types and amounts of the fishing tool and gear and equipment that fishermen are permitted to use in the sea, sport fishing methods, i.e. recreational fishing techniques).

<table>
<tr><td></td><td colspan="6">Exercise 4. Regulation of small-scale coastal fishing in Croatia. (3 hours)
Learning outcomes: Be familiar with all regulations governing small-scale coastal fishing in Croatia (primarily its purpose, type and the quantity of fishing gear and equipment allowed to use).
Exercise 5. Monitoring of marine living resources. (3 hours)
Learning outcomes: Be familiar with techniques, possibilities and priorities regarding monitoring of marine living resources. Define and describe monitoring projects in the Adriatic, with a particular reference to the latest results and findings. Be familiar with various monitoring methods; understand their advantages and disadvantages.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Student is expected to regularly attend classes, design and give oral presentation of his/her seminar.</td></tr>
<tr><td rowspan="6">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td>3</td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Student is evaluated based on the quality of his/her seminar paper and its presentation, and on the score obtained at the written exam from the theoretical part of the course.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="3">1. Cochrane, K.L., Garcia S.M., 2009. A Fishery Manager’s Guidebook. The Food and Agriculture Organization of the United Nations and Wiley-Blackwell Publishing, 518 p.</td><td></td><td>available online</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">1. Bianchi G., Skjoldal H.R., 2008. The Ecosystem Approach to Fisheries. FAO, 361 p.
2. Iudicello, S., M.L. Weber & R. Wieland. 1999. Fish, Markets and Fishermen: The Economics of Overfishing. Island Press, 205 p.
3. Cunningham S. & T. Bostock. 2006. Successful Fisheries Management: Issues, Case studies, Perspectives. Eburon Publishers, 240 p.
4. Franklin HB. 2008. The Most Important Fish in the Sea - Menhaden and America. Island Press, 280 p.
5. Bailey KM. 2013. Billion-Dollar Fish - The Untold Story of Alaska Pollock. The University of Chicago press, 288 p.
6. Claudet J. 2011. Marine Protected Areas – A Multidisciplinary Approach. Cambridge University Press, 377 p.
7. Kelleher K. 2005. Discards in the world’s marine fisheries. An update. FAO Fish. Tech. Pap., 470: 1-131.
8. Hilbourn R, Hilborn U. 2012. Overfishing – What Everyone Needs to Know. Oxford University Press, 150 p.</td></tr>
<tr><td>Quality assurance methods that</td><td colspan="6">Students' work and competences will be evaluated and graded during the course, as well as at the final exam. During the course, the following will be evaluated:</td></tr>
</table>

ensure the acquisition of exit competences	a) attendance b) activity during class c) knowledge acquired
Other (as the proposer wishes to add)	-

NAME OF THE COURSE	**APPLIED ICHTHYOLOGY**					
Code	SMR412	Year of study	1			
Course teacher	Jure Brčić, PhD	Credits (ECTS)	5			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The objective of this course is to familiarize students with R software environment for statistical computing and graphics. Students will learn how to analyse and visualize ichthyological data (FSA).					
Course enrolment requirements and entry competences required for the course						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- to learn the basics of R programming language for analysing and visualizing ichthyological data; - to be able to model different morphometric relationships; - to be able to model length-weight and length – age relationships; - to be able to determine the length at the first maturity in order to compare it with the length at the first capture.					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1. Introduction to R and RStudio. Data Entry in R. R packages.** (3 hours) Learning outcomes: Understand the purpose of using R programming language for statistical computing and its importance and potential for application in ichthyology. Know the principle of working in R using the RStudio IDE, and the concepts that will be used throughout the lectures. **Lecture 2. Data manipulation in R.** (3 hours) Learning outcomes: Understand the differences between the types of objects in R. The pre-processing of ichthyological data in R. Understand the possibilities and limitations of data manipulation in MS Excel versus R. **Lecture 3. Graphic representation of data in R.** (3 hours) Learning outcomes: Understand the advantages of graphically displaying data. To learn the most important types of graphs used to display ichthyological data (graphical representation of relative growth, length-weight ratio, age and growth, length frequencies, sexual maturation, etc.) **Lecture 4. Biometrics and relative growth.** (3 hours) Learning outcomes: Understand the purpose of determining the morphometric relationships and relative growth of fish. Understand the linear regression models, and their practical application. **Lecture 5. Length weight relationship.** (3 hours) Learning outcomes: Understand the importance of determining the length-weight relationship. Understand the terms positive, negative allometry and isometry. Understand the importance of seasonal fluctuations and phases of disharmony. To understand the concept of fitness and its application in ichthyology. To learn about nonlinear regression. **Lecture 6. Age and growth (I).** (3 hours)					

	Learning outcomes: To learn about methods employed for fish age determination. To learn about different types of otoliths and understand how otolith growth zones are formed. Familiarize with the techniques of otolith pre-treatment before counting annuli. To understand the age reading process. To understand the causes of age estimation errors (objective and subjective), and methods to test the accuracy of assessment (IAPE, CV). To understand the marginal increment analysis. **Lecture 7. Age and growth (II).** (3 hours) Learning outcomes: To understand the Von Bertalanffy Growth Equation. To learn about methods for estimating the parameters of the Von Bertalanffy growth equation. Understand the meaning of each parameter. To understand the relationship between otolith morphometric measures and age of fish. Understand the concept of starting values in non-linear regression. **Lecture 8. The reproductive cycle and fecundity.** (3 hours) Learning outcomes: Understand the difference in fecundity for different fish species. Understand and apply the methods of determining the length of first maturity and the length of sex change in hermaphroditic species. Know the notion of the gonadosomatic index and understand how it gives us insight into the reproductive cycle of the species. Understand the importance of length at first maturity and fishing gear size selection. **Lecture 9. Mortality.** (3 hours) Learning outcomes: Understand different components of mortality - natural, fishing and total mortality, and the term exploitation ratio. Understand and apply the methods of determining total mortality. Acquire knowledge on the methods for determining natural mortality. **Lecture 10.** Species distribution and spatial and temporal regulation of fishing. (3 hours) **Exercise 1.** Introduction to R (4 hours) Learning outcomes: Get familiar with R environment. **Exercise 2.** Data manipulation in R. (4 hours) Learning outcomes: Get familiar with different R packages for data manipulation in R. **Exercise 3.** Data visualization in R. (4 hours) Learning outcomes: Know how to install and run ggplot2 package. Be able to make scatter plot, line graph, bar graph, histogram and box plots using the ggplot2 package. Be able to show a trend line on a scatter plot. Learn how to export graphs in different formats (jpeg, png, tiff) with different settings (resolution, dimensions, etc.). **Exercise 4.** Biometrics and relative growth. (3 hours) Learning outcomes: Learn how to fit a linear regression model in R and to determine linear regression coefficients and their 95% confidence limits. **Exercise 5.** Length-weight relationship (3 hours) Learning outcomes: Know how to install and run an FSA package. Learn how to fit a nonlinear model in R. Be able to linearize the Length-weight model. Determine the initial values for the nonlinear regressions in R. **Exercise 6.** Age and growth (I). (3 hours) Learning outcomes: Know how to determine the accuracy of age reading using the average error index (IAPE) and coefficient of variability (CV) in R. Marginal increment analysis. **Exercise 7.** Age and growth (II). (3 hours) Learning outcomes: Know how to determine the parameters of Von Bertalanffy's growth equation and their confidence limits using the FSA package. Be able to explore models that connect different otolith morphometric measures (length, width, thickness, mass) and age of fish. **Exercise 8.** Reproductive cycle and fecundity. (3 hours) Learning outcomes: Being able to make a logistic model of sexual maturation in R. Know how to calculate gonadosomatic index. **Exercise 9.** Mortality. (3 hours)

	Learning outcomes: Know how to estimate total mortality, catche per unit of effort (CPUE), 'linearized catch curve' method, natural mortality by Pauly's method, Rikhter's and Taylor's method.					
Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work		☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)			
Student responsibilities	Students are required to attend lectures and exercises.					
Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	2
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam	2	Project		(Other)	
Grading and evaluating student work in class and at the final exam	The student is graded based on the results of the written exam.					

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Introductory Fisheries Analysis with R		http://derekogle.com/fishR/examples/oldFishRVignettes.html
	Wickham H, Grolemund G. 2016 R for data science: import, tidy, transform, visualize, and model dana. O'Reilly Media. 552 pp.		https://r4ds.had.co.nz

Optional literature (at the time of submission of study programme proposal)	Field, A., Miles, J. & Field, Z. 2012. Discovering Statistics Using R. Sage Publications, 992 pp. Zuur A.F., Ieno E.N. & Meesters E.H.W.G. 2009. A beginner's guide to R. Springer, New York, 220 pp. Chang, W. 2013. R Graphics Cookbook. O'Reilly Media, 396 pp.
Quality assurance methods that ensure the acquisition of exit competences	Students' work will be evaluated during lectures, as well as at the final exam.
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**INTEGRATED COASTAL ZONE MANAGEMENT**						
Code	SMB501	Year of study	1				
Course teacher	Vedrana Nerlović, PhD	Credits (ECTS)	4				
Associate teachers			L	S	E	F	

		Type of instruction (number of hours)	30	15	0	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	Familiarize students to the modern approach to coastal zone planning and management with a view to the sustainable use and protection of resources. In addition to coastal zone planning, particular attention is paid to the management of the coastal area and its potentials, which strives for synergistic compatibility and reduction of conflicts between different users.					
Course enrolment requirements and entry competences required for the course	Basic knowledge of marine physics, chemistry and biology, marine pollution and marine protection.					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Classes are organized by topic and include complex comprehensive aspects of coastal planning and management in relation to conventional sectoral planning, all with the aim of promoting sustainable economic development, conservation and protection of natural resources, conflict resolution and protection of public safety. Students become acquainted with the activities and procedures of the ICZM and the instruments and financial aspects of the implementation and active involvement of administrative structures and other stakeholders. In particular, infrastructure support to measures for the protection and improvement of space and resources are addressed, as well as the introduction of potentially available financial sources. The specificity and application of ICZM in the Mediterranean is discussed, and in particular, integrated management with a focus on aquaculture and tourism. Critical points, achievements and (r) points in the application of ICZM are also analyzed.					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1. Introduction - definition and goals** A departure from conventional sectoral planning. Introducing the challenges and concepts in ICZM (integrated coastal zone management). **Lecture 2. Basics of landscaping** Physical planning documents. Objectives and principles of spatial plans. Working methods. Contents of spatial plans specificity of plans of municipalities and cities. Detailed landscaping plan. **Lecture 3. Basic features of coastal space** Population pressure and economic growth as vectors of change in coastal space. Features of the island area. Activities and pressures of different users. **Lecture 4. Historical concept of ICZM** Major events in the world, Europe and the Mediterranean. Regulations and initiatives that preceded ICZM. UN Conference on the Human Environment (Stockholm 1972) and UN Conference on the Environment and Development Rio 1992) Principles on the environment, development and social issues. **Lecture 5. UN Regional Programme for the Mediterranean.** Barcelona Conference, MAP I and MAP II. Infrastructural and logistical support for the protection and development of the Mediterranean through an action plan. Protocols, principles and commitments. **Lecture 6. Sustainable development and protection** Definition, starting point, goals and principles of sustainable development. Ecosystem activity management (ecosystem-based management). Application of EBM in the fisheries sector. **Lecture 7. Typical activities in implementing ICZM** Spatial planning. Improving economic development. Preservation and protection of natural resources. Conflict resolution. Protection of public safety. **Lecture 8. ICZM activities and procedures** Segmentation of the coastal zone into separate units (zones) by zones and locations. Creation and content of concept paper. Substrates and their analysis (GIS). Cross-sectoral analysis. Developing a strategy. Transferring strategy into sectoral plans.					

<table>
<tr><td></td><td colspan="6">Lecture 9. Financing of ICZM
Financial needs for the costs of administrative structures and envisaged safeguards. Potential financial resources and available funds: (a) UN bodies and institutions; (b) other sources.
Lecture 10. Instruments for the implementation of ICZM
Regulatory and economic instruments. Financial, technical and administrative needs for the implementation of ICZM. Critical points in the application of ICZM.
Lecture 11. International instruments for the management and protection of the marine area and its living and non-living resources
UN bodies, commissions, associations for the protection of nature and natural resources. Binding and voluntary instruments and international agreements.
Lecture 12. Application of ICZM in the Mediterranean
Protocol. Specificity of Mediterranean coastal and marine space. Activities, pressures and conflicts. Implications for future development and environmental protection.
Lectures 13. Integrated management for the aquaculture sector
Background and necessary assumptions. Data analysis. Zoning criteria for fish and shellfish farms.
Implementation of the zoning process: an example of the ICZM in the Zadar County.
Lecture 14. Environmental impact assessment
EIA for the project assignment. Strategic assessment (SEA) on plans and programs.
OPTIONAL! If students take an elective course on the topic of EIA, then the lecture will be held on the topic "Integral management of marine spaces"
Lecture 15. Integrated coastal zone management - achievements and messages
ICZM concept, approach and functioning. Useful lessons and delicate experiences in the application of ICZM. The ICZM should be used as a template for future coastal planning and management programmes.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☐x lectures
☐x seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">During the semester, each student is required to prepare a seminar on a given topic and present it to colleagues. Students are encouraged to actively participate in discussions.
Attendance is compulsory (a certain number of excused absences is tolerated, no more than 20%).</td></tr>
<tr><td rowspan="6">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>x</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>x</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Oral exam is preceded by successfully prepared and presented seminar paper which is obligatory for all students. The interest shown by active participation in the discussions and the success of the tasks are evaluated.</td></tr>
<tr><td>Required literature (available in the</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
</table>

library and via other media)	1. Cicin-Sain, B. and Knecht, R.W. 1998. Integrated Coastal and Ocean Management: Concepts and Practices. Washington, DC: Islan Press, 517 pp.		
	2. Katavic, I., Herstad, T., Kryvi, H., White, P., Franicevic, V., and Skakelja, N. 2005. Guidelines for marine aquaculture planning, integration and monitoring in Croatia, Project: Coastal Zone Management Plan for Croatia, Zagreb, 2005, 78 pp.		
Optional literature (at the time of submission of study programme proposal)	1. Chua, T. E., 2006. The Dynamics of Integrated Coastal Management.Practical Applications in Sustainable Coastal Development in East Asia, GEF / UNDP / IMO Regional Program on PEMSEA, 486pp. 2. FAO, 1998. Integrated coastal area management and agriculture, forestry and fisheries. FAO Guidelines, Rome, 1998 3. UNEP 1995. Guidelines for Inteegrated Management of Coastal and Marine Areas – With Special Reference to the Mediterranena Basin. UNEP Regional Seas Reports and Studies no.161. Split, Croatia, PAP/RAC (MAP-UNEP). 4. The contribution of science to integrated coastal management, GESAMP, Rep. Stud. (65), 1997. 5. http://www.globaloceans.org/story/icm mgt.html 6. http://www.fao.org/docrep/W8440e/W8440e03.htm 7. www.pap-thecoastcentre.org		
Quality assurance methods that ensure the acquisition of exit competences			
Other (as the proposer wishes to add)	Combined forms of teaching are planned through lectures followed by audio-visual aids in block hours, stimulating discussions and conclusions, with a visit to the specialized agency UNEP / MAP / PAP / RAC in Split. Additional information about the subject (contacting the teacher, informing about the course...). Students receive information about teaching materials, additional literature, student requirements, assessment methods and terms of consultation during the first hour of the class.		

NAME OF THE COURSE	**MARINE BOTANY**					
Code	SMB209	Year of study	1			
Course teacher	Zvjezdana Popović Perković, PhD	Credits (ECTS)	5			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	During the lectures, practical exercises and field work, students will be introduced to the basics of the systematics, biology and ecology of marine benthic algae and marine flowering plants. They will be introduced to the most important representatives of the benthic flora of the Adriatic Sea and the Mediterranean, as well as some of the most important representatives of the benthic algae and seagrasses in the world's seas and oceans. Students will also be familiarized with the composition and anatomy of the most important phytobenthic communities in the Adriatic and the Mediterranean, as well as changes in their composition and distribution that have occurred as a result of marine pollution or the introduction of new species. The course will outline the possibility of exploitation and production of benthic seaweed and flowering plants.					

Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Acquire knowledge of: the basics of systematics, biology and ecology of benthic seaweed and seagrasses; the most important representatives of the benthic flora of the Adriatic Sea and the Mediterranean, including some of the most significant representatives of the benthic algae and seagrasses in the world's seas and oceans; learn about the composition and structure of the most important phytobenthic communities in the Adriatic and the Mediterranean. Present fundamental knowledge of systematics, biology and ecology of benthic seaweed and seagrass.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1.** In the introductory lecture, students will be introduced to: the distribution of life in the sea; division of different zones in the sea with a detailed overview of the benthic zone; the basics of the taxonomic classification of the living world, and the basics of the systematics and nomenclature of living organisms; basics of research on the composition and distribution of benthic flora and vegetation; phytobenthos research methodologies; basics of creating seaweed and sea flowering plants herbarium; learn about the main objectives of phytobenthos studies; brief historical overview of phytobenthic investigation; phytobenthic structure in the world's seas, the Mediterranean and the Adriatic. **Lecture 2.** In the second lecture, a taxonomic group of Cyanobacteria or Cyanophyta (blue-green algae) will be discussed, with particular attention to: basic features of the blue-green algae cell structure; the characteristics of blue-green algae pigments and their role in the production of high-energy compounds; reserve substances in blue-green algae; types of thallus in blue-green algae; cell types of blue-green algae and their characteristics; reproduction of blue-green algae; abundance and distribution of blue-green algae; use of some blue-green algae; systematics of blue-green algae. **Lecture 3.** Students will be introduced to Part 1 of the taxonomic group Rhodophyta (red algae), with particular attention to: the abundance and distribution of red algae on Earth, in the world's seas, the Mediterranean and in the Adriatic; basic features of red algae thallus structure; pigments and chloroplasts in red algae; reserve substances in red algae; cell wall structure in red algae and their potential for exploitation; the mode and types of red algae reproduction; basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of the class Bangiophyceae, and an overview of the algae from the orders Porphyridiales, Rodochaetales, Erythropeltidales and Bangiales; a detailed overview of the reproduction of a species *Porphyra tenera* (order Bangiales) as an example of heteromorphic alternation of generations in the haploid-diploid life cycle of red algae from the class Bangiophyceae. **Lecture 4.** The lecture covers the introduction of part 2 of the taxonomic group Rhodophyta (red algae), with particular attention to: basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of the class Florideophyceae; a detailed overview of the reproduction of the species *Audouinella* (Acrochaetium) *investiens* (order Acrochaetiales) as an example of isomorphic alternation of generations in the haploid-diploid life cycle of red algae from the class Florideophyceae; a detailed overview of the reproduction of the species *Acrosymphyton purpuriferum* (order Gigartinales) as an example of heteromorphic alternation of generations in the haploid-diploid life cycle of red algae from the class Florideophyceae; basic features of the algae from the systematic orders Acrochaetiales, Palmariales, Nemaliales, Batrachospermales, Corallinales and Gelidiales, and presentation of their most significant representatives. **Lecture 5.** Students will be introduced to part 3 of the taxonomic group of Rhodophyta (red algae), with particular attention to: the basic features of algae from the systematic orders Gracilariales, Gigartinales, Rhodymeniales, Bonnemaisoniales and Ceramiales, and presentation of their most important representatives; some phylogenetic relationships between red algae orders.

	Lecture 6. Students will be introduced to Part 1 of the taxonomic group of Heterocontophyta (Phaophyta; brown algae), with particular attention to: the abundance and distribution of brown algae in the world seas, the Mediterranean and the Adriatic; basic features of brown algae thallus structure; pigments and chloroplasts in brown algae; reserve substances of brown algae; cell wall structure in the brown algae and their potential for exploitation; means and types of reproduction in brown algae; basic features (thallus structure, reproduction) of algae from orders Ectocarpales, Sphacelariales and Dictyotales; presentation of their most significant representatives; a detailed overview of the reproduction of the species *Ectocarpus siliculosus* (order Ectocarpales) as an example of alternation of generations in haploid-diploid life cycle of brown algae. **Lecture 7.** Students will be introduced to Part 2 of the systematic section of Heterocontophyta (Phaophyta; brown algae), with particular attention to: the basic features of algae from orders Scytosiphonales, Cutleriales, Dictyosiphonales, Chordariales, Desmarestiales, Sporochnales, Laminariales and Fucales, presentation of their most significant representatives; a detailed overview of the reproduction of *Cutleria multifida* (Red Cutleriales) as an example of heteromorphic alternation of generations in haploid-diploid life cycle of brown algae; some phylogenetic relationships between systematic orders of brown algae. **Lecture 8.** First colloquium (1st test). **Lecture 9.** Students will be introduced to Part 1 of the taxonomic group Chlorophyta (Green Algae), with particular attention to: the abundance and distribution of green algae on Earth, in the world's seas, the Mediterranean and in the Adriatic; basic features of green algae thallus structure; pigments and chloroplasts in green algae; reserve substances in red algae; cell wall structure in green algae; means and types of reproduction in green algae; basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of the class Chlohrophyceae, and overview of the algae from the orders Volvocales, Chlorococcales, Chaetophorales and Oedogoniales; basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of the class Ulvophyceae, and overview of the algae from the order Codiolales. **Lecture 10.** Students will be introduced to Part 2 of the taxonomic group Chlorophyta (Green Algae), with particular attention to: the basic features of multicellular algae from the orders Codiolales and Ulvales (class Ulvophyceae) systematics, including their most important representatives; a detailed overview of reproduction in the species *Ulothrix zonata* (order Codiolales) as an example of heteromorphic alternation of generations in haploid-diploid life cycle of green algae, and in the reproduction of the species *Ulva latuca* (order Ulvales) as an example of isomorphic alternation of generations in haploid-diploid life cycle of green algae; basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of the class Cladophorophycae and the order Cladophorales, presentation of their most significant representatives. **Lecture 11.** Students will be introduced to Part 3 of the taxonomic group Chlorophyta (Green Algae), with particular attention to: basic features (thallus structure, pigments, chloroplasts, reserve substances, reproduction) of Bryopsidophyceae classes (orders Bryopsidales and Halimedales) and Dasycladophyceae (order Dasycladales), including thier most significant representatives. **Lecture 12.** This lecture will cover plants from the taxonomic group Spermatophyta (Magnoliophyta; seed-bearing plants), with particular attention to: the morphology, biology and ecology of the flowering plants of the Adriatic Sea *Posidonia oceanica, Cymodocea nodosa, Zostera marina* and *Zostera noltii*; a detailed overview of reproduction of the species *Posidonia oceanica*; main causes of the loss of seagrass meadow. **Lecture 13.** This lecture will address the impact of abiotic factors in environment regarding the composition and distribution of benthic algae and seagrasses, primarily in the Adriatic, but also in some other seas and oceans. Environmental factors that will be dealt with in detail are light, temperature, salinity, sea movement, physical properties of the substrate, nutrients.

	Lecture 14. This lecture will briefly introduce students to the composition and distribution of deep-sea benthic (demersal) flora and vegetation in the Mediterranean Sea and some of the world's seas, while the main part of the lecture will be focused on Ercegovic's depth distribution of benthic algae and seagrasses in the Adriatic. In addition to the important ecological factors, particular emphasis will be given to the leading taxa of benthic algae and seagrasses which form a part of benthic fauna in the following bionomic stages: supralittoral, eulittoral (midlittoral), upper infralittoral, middle infralittoral, lower infralittoral, eulittoral. **Lecture 15.** Second Colloquium (2nd Test). **Exercise 1** (90 min) Section: Cyanophyta (Blue-green algae) During the introductory exercise, students are introduced to working methods, sampling and processing materials in laboratory and to the instruments required for marine botany exercises. Section: Cyanophyta (Blue-green algae). Brief theoretical introduction, fresh materials and microscopic slides of non-heterocystous cyanobacteria and other specialized cells of the genus Gloeocaps, non-heterocystous filamentous forms and other specialized cells of the genus Spirulina and Lyngby, including filamentous forms with heterocysts and other specialized cells of the genus Rivularia. Learning outcomes: Students will be able to identify and name the organisms and parts of the Cyanophyta cell and master the basic taxonomy within this group based on the theoretical knowledge acquired through lectures and exercises, schematic representations, their own drawings and sketches of microscopic slides at different magnifications. **Exercise 2.** (90 min) Section: Rhodophyta (Red Algae); Class Bangiophyeae. Brief theoretical introduction, fresh materials and microscopic slides of *Bangia atropurpurea* and *Porphyra leucosticta* species. Learning outcomes: Based on the theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, morphology of habitus, basic anatomy and reproductive structures of red algae. **Exercise 3.** (90 min) Section: Rhodophyta (Red Algae); Class Florideophyceae. Brief theoretical introduction, fresh materials and microscopic slides of *Fosliella sp. Liagora sp., Nemalion helminthoides, Lithophyllum sp., Corallina elongata, Titanoderma trochanter*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of red algae. **Exercise 4.** (90 min) Section: Rhodophyta (Red Algae); Class Florideophyceae. Brief theoretical introduction, fresh materials with microscopic slides of *Halymenia floresia, Hypnea musciformis, Peyssonnelia squamaria, Gelidium crinale* and *Gracilaria gracilis*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of red algae. **Exercise 5.** (90 min) Section: Rhodophyta (Red Algae); Class Florideophyceae. Brief theoretical introduction, fresh materials and microscopic slides *of Fauchea repens, Ceramium ciliatum, Antithamnion sp., Womersleyella setacea, Asparagopsis armata / taxiformis*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of red algae.

	Exercise 6. (90 min) Section: Phaeophyta (Brown algae); Class Phaeophyceae. Brief theoretical introduction, fresh materials and microscopic slides *of Halopteris scoparia, Dictyota dichotoma, Dictyopteris polypodioides, Taonia atomaria, Padina pavonica*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of brown algae. **Exercise 7.** (90 min) Section: Phaeophyta (Brown algae); Class Phaeophyceae. Brief theoretical introduction, fresh materials and microscopic slides of *Colpomenia sinuosa, Scytosiphon lomentaria and Asperococcus bulosus*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of brown algae. **Exercise 8.** (90 min) Section: Phaeophyta (Brown algae); Class Phaeophyceae. Brief theoretical introduction, fresh materials and microscopic slides of the species Ectocarpus sp. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of brown algae. **Exercise 9.** (90 min) The process of herbarization and herbarium making. Learning outcomes: Students will be able to independently create their own herbarium with respect to the theoretical knowledge acquired through lectures and exercises. **Exercise 10:** (90 min) Section: Phaeophyta (Brown algae); Class Phaeophyceae. Brief theoretical introduction, fresh materials and microscopic slides of *Cystoseira amentacea var. Spicata, Cystoseira crinitophylla, Cystoseira compressa, Cystoseira corniculata ssp. Laxior, Sargassum vulgare, Fucus virsoides.* Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of brown algae. **Exercise 11.** (90 min) Section: Chlorophyta (Green Algae); Class: Ulvophyceae. Short theoretical basics, fresh materials and microscopic slides of the species *Ulva rigida, Ulva intestinalis, Codium fragile, Codium fragile*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of green algae. **Exercise 12.** (90 min) Section: Chlorophyta (Green Algae); Class: Ulvophyceae. Brief theoretical introduction, fresh materials and microscopic slides of *Caulerpa prolifera, Caulerpa taxifolia, Caulerpa cylindracea, Flabellia petiolata, Halimeda tuna and Valonia utricularis*. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of red algae cells, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of green algae. **Exercise 13.** (90 min) Section: Tracheophyta (Seed) Class: Monocotyledonae. Brief theoretical introduction, fresh materials and microscopic slides of *Posidonia oceanica* and *Cymodocea* nodosa. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and

<table>
<tr><td></td><td colspan="6">student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of seagrass cell structure, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of marine flowering plants.
Exercise 14. (90 min) Section: Tracheophyta (Seed) Class: Monocotyledonae. Brief theoretical introduction, fresh materials and microscopic slides of species: Zostera marina, Zostera noltii and Halophila stipulacea. Learning outcomes: Based on theoretical knowledge acquired through lectures and exercises, schematic presentations, and student's own drawings and sketches of microscopic slides, students will be able to identify and name organisms and parts of seagrass cell structure, and master the basic taxonomy within this group, as well as learn about morphology of habitus, basic anatomy and reproductive structures of marine flowering plants.
Exercise 15. (90 min) Making herbarium and identification of herbarium material, final test.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are required to attend classes, actively participate in the teaching process and pass the exam. Class attendance will be recorded during each class and practical training. The student is allowed one unjustified absence from the practicum and 3 absences from the lecture.</td></tr>
<tr><td rowspan="6">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td>2</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Exams are conducted in the form of written tests (tests) during lectures and the exam periods. The difference between these exams is only in the amount of materials that students need to prepare for the midterm exam. The first colloquium (test 1), is comprised of the first 7 lectures (Introduction, Cyanobacteria, Rhodophyta 1, 2, and 3, Heterocontophyta 1 and 2) and the second colloquium (test 2) encompasses the remaining 6 lectures (Chlorophyta 1, 2 and 3, Spermatophyta, Ecological factors, Vegetation), while the final test taken during exam periods covers the whole material. Examination tests consist of complex questions. In order to pass the exam, a student needs to have more than 50% of questions correctly answered. Passing the 1st colloquium allows student to take the 2nd colloquium, while failure at the 1st colloquium requires the student to take the final test which includes all the material from lectures.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">J.M. Peres, H. Gamulin-Brida. 1973. Biološka oceanografija. Školska knjiga, Zagreb, 493 pp.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study</td><td colspan="6">1. A. Ercegović. 1952. Jadranske cistozire. Fauna i flora Jadrana, Split, 212 pp.
2. C.J. Dawes. 1981. Marine botany. John Wiley & Sons, New York, 628 pp.
3. Z. Popović. 2015. Dodatni nastavni materijali – ppt predavanja i praktikum
4. A. Ercegović. 1949. Život u moru. JAZU, 412 pp.</td></tr>
</table>

programme proposal)	
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course, as well as at the final exam. During classes, the following is evaluated: a) class attendance b) classroom activity c) acquired knowledge
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**REPRODUCTION OF MARINE ORGANISMS**					
Code	SMR409	Year of study	1			
Course teacher	Josipa Ferri, PhD	Credits (ECTS)	5			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Elective	Percentage of application of e-learning	-			
COURSE DESCRIPTION						
Course objectives	The main objective of the course is to familiarize students with the many aspects of the reproduction of marine organisms. Upon completion of the course, students should have a clear understanding of the different forms and strategies of reproduction of marine organisms, the reproductive cycles of fish and other marine organisms, the regulation of fish reproduction (the role of environmental factors and hormones), and the reproductive strategies of captive fish (with emphasis on hormonal therapies that help in addressing disorders in captive fish reproduction).					
Course enrolment requirements and entry competences required for the course	-					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Identify basic reproductive aspects of different marine organisms. Discover the basic stages of the reproductive cycle of fish. Identify two models of sex differentiation in fish and distinguish between gonohorist-differentiated and gonohorist-undifferentiated species. Identify the role of numerous environmental factors on fish breeding. Assess the importance of knowing the reproductive strategies of captive fish. Identify the most common reproductive disorders of captive fish. Identify the causes of fish reproduction disorders and ways to minimize them.					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Generally on the reproduction of marine organisms. (3 hours) Learning outcomes: Identify basic reproductive aspects of different marine organisms. Assess the importance of research of the reproductive biology of species. **Lecture 2:** Diversity of forms and reproduction strategies in fish. (3 hours) Learning outcomes: Identify basic forms and strategies of fish reproduction. Identify the differences between oviparia, ovoviviparia and viviparia and identify examples of species characterized by these strategies, as well as their advantages and disadvantages. Identify the difference between semeloparity and iteroparity and know their advantages and disadvantages. **Lecture 3:** Fish reproductive behavior. (3 hours) Learning outcomes: Identify different forms of fish reproductive behavior. Discover different forms of courtship, from visual recognition, through courtship of males to courtship of females. Discover sex change as a form of reproductive behavior and examples of socially controlled protoandria, protoginia and synchronous hermaphroditism. Identify different forms of parental care, from hiding eggs, keeping					

	eggs, and feeding newly hatched fish. Observe why a lot of male fish care for their offspring. **Lecture 4:** The reproductive cycle of fish. (6 hours) Learning outcomes: Discover the basic stages of the fish reproductive cycle. Identify two models of sex differentiation in fish and distinguish between gonohorist-differentiated and gonohorist-undifferentiated species. Detect the underlying processes during previtellogenesis, vitellogenesis, and final oocyte maturation. Distinguish between perinuclear oocyte stage, cortical alveoli oocyte stage, vitellogenic oocytes and oocytes in the nucleus migration stage and determine which of the stages of oogenesis are significant. Know the role of Leydig and Sertoli cells in the gonads of males. Identify each stage of spermatogenesis. Distinguish between spermatogonia, spermatocysts, spermatocytes and spermatozoa and identify for which of the stages of spermatogenesis are significant. Distinguish between lobular and tubular types of fish testes. Identify different types of gonad development (synchronous, group-synchronous and asynchronous). **Lecture 5:** Regulation of fish reproduction: environmental factors. (3 hours) Learning outcomes: Identify the role of many environmental factors on fish reproduction. **Lecture 6:** Regulation of fish reproduction: hormones. (6 hours) Learning outcomes: Detect reproductive axis in fish. Evaluate the role of hypothalamus and pituitary gland on the process of fish breeding. Differentiate the role of GnRH and GTH hormones. Determine the role of FSH, LH, estradiol, 11-ketotestosterone, and maturation-inducing steroids in the reproductive cycle of male and female fish. **Lecture 7:** Fish reproduction and aquaculture. (3 hours) Learning outcomes: Assess the importance of knowing the reproductive strategies of captive fish. Identify the most common reproductive disorders of captive fish. Identify causes of fish reproductive disorders and ways to minimize them. Assess the three basic types of reproductive disorders of females and the two basic types of reproductive disorders of captive males. Determine the development of hormonal therapies that nullify the reproductive disorders of captive fish and what hormone therapy to use for a particular type of disorder. **Lecture 8:** Reproductive features of other marine organisms. (3 hours) Learning outcomes: Discover the principles of breeding of crabs, cephalopods and bivalves. **Exercise 1:** Methods for investigating the reproductive characteristics of marine organisms. (3 hours) Learning outcomes: Determine how to investigate the reproductive features of marine organisms. Discover the basic principles of all methods of exploring the reproductive characteristics of marine organisms. **Exercise 2:** Investigating the reproductive characteristics of fish - sex and degree of maturation of the gonads. (3 hours) Learning outcomes: Determine the sex and maturity of the gonads of several fish species. Evaluate several different scales by which the degree of maturity of the fish gonads is determined. Calculate the sex ratio to the investigated part of the population of several fish species. **Exercise 3:** Investigating the reproductive characteristics of fish - first sexual maturity and GSI. (3 hours) Learning outcomes: Calculate the time of reaching the first sexual maturity for several fish species. Determine gonadosomatic index values for several fish species (from previously determined body mass and gonad mass). Explain the above reproductive features from the results of several previous studies (from the literature). **Exercise 4:** Investigating the reproductive characteristics of fish - fecundity and oocyte diameter. (3 hours) Learning outcomes: Determine fecundity values for females of several fish species. Measure oocyte diameters from preserved ovaries for several fish species. Find out

<table>
<tr><td></td><td colspan="6">the link between the fecundity and the length of the fish, the age of the fish and the mass of fish gonads.
Exercise 5: Analysis of histological preparations of fish gonads - females. (3 hours)
Learning outcomes: Discover the one-year cycle of female germ cell development. Identify all stages of development of female germ cells.
Exercise 6: Analysis of histological preparations of fish gonads - males. (3 hours)
Learning outcomes: Discover the one-year cycle of male germ cell development. Identify all developmental stages of male germ cells.
Exercise 7: Investigating the reproductive features of crustaceans. (3 hours)
Learning outcomes: Determine the sex and maturity of gonads of several crustaceans. Determine the mass of the gonads and the fecundity of females (if possible) of several crustaceans. Judge how to analyze and explain the results obtained (on a test sample). Discover the results of research from the literature on the reproductive characteristics of crustaceans.
Exercise 8: Investigating the reproductive features of crustaceans - histological preparations. (3 hours)
Learning outcomes: Identify the one-year reproductive cycle of crustaceans.
Exercise 9: Investigating the reproductive features of bivalves. (3 hours)
Learning outcomes: Reveal the reproductive features of several different species of bivalves. Identify research findings from the literature on the reproductive features of bivalves.
Exercise 10: Investigating the reproductive features of bivalves - histological preparations. (3 hours)
Learning outcomes: Identify the one-year reproductive cycle of bivalves. Detect developmental stages during histological preparation analysis.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
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☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are required to attend classes (both lectures and laboratory exercises), actively participate in the teaching process and pass the exam. Class attendance will be recorded on an hourly basis (both lectures and laboratory exercises). Proper attendance to all forms of teaching is a requirement for signature.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
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<tr><td>Written exam</td><td>3</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">In the course of Reproduction of marine organisms, students receive a final grade based on the results of the exam, which consists of coursework completed both in lectures and in laboratory exercises. The exam consists of rounding, supplementing questions, then those to which a descriptive answer should be given, and those to which it is necessary to decide whether a given statement is true or false. The student is required to achieve a minimum score of 61%, and the final grade will be determined according to the criterion: <61% - grade 1 (insufficient), 61% - 70% - grade 2 (sufficient), 71% - 80% - grade 3 (good), 81% - 90% - grade 4 (very good), 91% - 100% - grade 5 (excellent).</td></tr>
<tr><td>Required literature (available in the</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
</table>

library and via other media)	Wootton RJ, Smith C. 2014. Reproductive Biology of Teleost Fishes. Wiley-Blackwell, 496 pages.	-	-
	McMillan DB. 2007. Fish Histology – Female Reproductive Systems. Springer Netherlands, 598 pages.	-	-
	Miller BS, Kendall AW. 2009. Early Life History of Marine Fishes (Chapter 1 – Fish Reproduction). University of California Press, 376 pages.	-	-
	Lukšienė D, Svedäng H. 1997. A review on fish reproduction with special reference to temperature anomalies. Fiskeriverket, 36 pages.	-	-
Optional literature (at the time of submission of study programme proposal)	1. Eddy FB, Handy RD. 2012. Ecological and Environmental Physiology of Fish. Oxford University Press, 264 pages. 2. Farrell A. 2011. Encyclopedia of Fish Physiology (First Edition). Academic Press, 2272 pages. 3. Hill RW, Wyse GA, Anderson M. 2008. Animal Physiology (Second Edition). Sinauer Associates, 770 pages.		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) attendance b) teaching activity c) knowledge acquired		
Other (as the proposer wishes to add)	-		

NAME OF THE COURSE	**SELECTIVITY AND CATCHABILITY OF FISHING GEARS**					
Code	SMR312	Year of study	1			
Course teacher	Jure Brčić, PhD	Credits (ECTS)	5			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	During this course, students will learn about the problem of discarding in the world's marine fisheries. Acquire knowledge about technical characteristics of fishing gears and their selective properties and fish behaviour in relation to fishing gear.					
Course enrolment requirements and entry competences required for the course						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- understand the meaning of by-catch and discards; - understand the reasons for discarding fish and other marine organisms; - understand the basic technical characteristics of the bottom trawls, longlines, gill net, trammel nets and creels/pots; - learn about discard and by-catch levels in recreational and sport fisheries - understand fish behaviour in relation with the fishing gear; - familiarize with different by-catch reduction devices in bottom trawl and other fisheries; - understand the term ghost fishing; - understand the evolutionary effect of selective fishing; - understand the concept of balanced harvesting.					
Course content broken down in	**Lecture 1. Introductory lecture.** (1 hour)					

detail by weekly class schedule (syllabus)	Learning outcomes: A brief overview of the entire course. Introduction to basic characteristics of fishing gears that are going to be discussed in detail. **Lecture 2. How do fish see?** (2 hours) Learning outcomes: Explain the basic structure of the fisheye and light penetration in marine environment. Visual acuity and maximum distance at which fish perceive objects. Explain how netting colour can affect gear catchability. Visual stimulation and by-catch reduction. **Lecture 3. How do fish hear?** (2 hours) Learning outcomes: Explain the process of sound propagation in the sea and the structure of the fish ear. Explain the sources of sound and vibration in the sea. Fish response to sound and the role of sound in the catch process. **Lecture 4. Fish behaviour and bottom trawling.** (3 hours) Learning outcomes: Explain the basic characteristics of bottom trawls. Clarify the behaviour of fish in relation to bottom trawls. Explain the role of light, contrast, colour, ambient temperatures on the catchability of bottom trawls. **Lecture 5. Reduction of by-catches in bottom trawl fisheries.** (4 hours) Learning outcomes: Explain the definition of by-catch and discards. Learn about discarding rates of each fishing gear group in world fisheries. Explain the reasons of discarding. Explain the role of selective panels and selective grids (TED, JTED, NAFTED, etc.). **Lecture 6. The survival of fish after escaping from the fishing gear.** (3 hours) Learning outcomes: Explain ways in which mortality is determined. Explain the factors that cause stress, injury and mortality during fishing. Explain the measures to improve the survival of organisms after escape. **Lecture 7. Fish behaviour and longlines.** (3 hours) Learning outcomes: Explain the basic characteristics of longlines. Explain the role of chemoreception in longline fisheries. Explain the interaction of fish and longlines. Explain technical measures to reduce catches of non-target species and non-target sizes of commercial species in longline fisheries. **Lecture 8. Fish behaviour in creels/pots.** (3 hours) Learning Outcomes: Briefly explain technical characteristics of creels/pots. Fish behaviour in relation to creels/pots. Explain technical measures to reduce catches of non-target species and non-target sizes of commercial species in creels/pots. Explain the problem of ghost fishing in creel/pot fisheries. **Lecture 9. Fish behaviour in gill net and trammel nets.** (3 hours) Learning outcomes: Fish behaviour in relation to gill net and trammel nets. Explain technical measures to reduce catches of non-target species and non-target sizes of commercial species in gill net and trammel nets. Explain the problem of ghost fishing in gill net and trammel net fisheries. **Lecture 10. Fish behaviour in dredge fishing.** (2 hours) Learning outcomes: Briefly explain technical measures to reduce catches of non-target species and non-target sizes of commercial species in dredge fisheries. **Lecture 11. Ecological and evolutionary impact of selective fishing.** (2 hours) Learning outcomes: Explain the problem of multispecies fisheries. Describe how selective fishing can affect the evolution of exploited organisms. Explain the concept of balanced harvesting. **Lecture 12. Legal measures and selective fishing.** (2 hours) Learning outcomes: Explain EU technical measures that promote selective fishing. **Exercise 1. Introduction.** (2 hours) Learning outcomes: Introducing students to the basic concepts and definitions that will be used in the exercises. Understanding the selection process and how it can be described. Explain the terms L25, L50 and L75. Explain the term selection range. Explain the difference between relative and absolute selectivity. **Exercise 2. Selectivity of towed fishing gears** (2 hours) Learning outcomes: Introducing students to different methods of examining selectivity of towed fishing gears. List the advantages and disadvantages of the covered codend method. List the advantages and disadvantages of the pair gear methods.

<table>
<tr><td></td><td colspan="6">Exercise 3. Selectivity of towed fishing gears - planning an experiment. (2 hours)
Learning outcomes: Explain how to select an area where selectivity will be tested. Explain the importance of knowing the length structure of population fished. Explain the importance of knowing the behaviour of fish in relation of fishing gear. What data to collect and how.
Exercise 4. Selectivity of towed fishing gears - factors affecting selectivity. (2 hours)
Learning outcomes: Explain the impact of mesh shape, size, openness, twine thickness on selectivity of fishing gears.
Exercise 5. Analysing selectivity of towed fishing gears - theoretical background. (2 hours)
Learning outcomes: Explain the basic statistical methods used in analysing selectivity of towed fishing gears. Understand the difference between logit, Probit, Gompertz and Richard curves.
Exercise 6. Analysing selectivity of towed fishing gears – hands on. (4 hours)
Learning outcomes: Students will learn how to input, prepare and properly format the data for the analysis.
Exercise 7. Selectivity of towed fishing gears - comparison of the selectivity of diamond and square mesh in Mediterranean trawl fisheries – a case study. (6 hours)
Learning outcomes: To apply the knowledge gained through previous exercises in this case study. Be able to carry out the analysis and determine what species are suitable for the analysis and why. Be able to prepare and properly format the data for further analysis. Analyse the data. Understand the obtained results. Present and interpret the results of the analysis.
Exercise 8. Selectivity of towed fishing gears - hydraulic dredge fishery. (2 hours)
Learning outcomes: To apply the knowledge gained through previous exercises in this case study. Be able to define the data collection protocol and define the steps in the analysis.
Exercise 9. Selectivity of gill net and trammel nets - Planning and designing the experiment. (1 hours)
Learning outcomes: Explain the factors that affect selectivity of gill net and trammel net. To define data collection protocol.
Exercise 10. Selectivity of gill net and trammel nets - theoretical background of statistical analysis of experimental data. (2 hours)
Learning outcomes: Explain the basic statistical methods used in estimating size selection of gill net and trammel nets.
Exercise 11. Selectivity of creels/pots. (5 hours)
Learning outcomes: Know how to analyse the selectivity of gill nets and/or trammel nets. To understand and apply CREELSELECT method in predicting creel/pot size selection for various marine organisms.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are required to attend lectures and exercises.</td></tr>
<tr><td rowspan="3">Screening student work (name the proportion of ECTS credits for each activity so that the total number of</td><td>Class attendance</td><td>2.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
</table>

ECTS credits is equal to the ECTS value of the course)	Tests		Oral exam		(Other)	
	Written exam	2.5	Project		(Other)	
Grading and evaluating student work in class and at the final exam	Report summary of analysis perfromed during excercises is a prerequisit to take the exam. The student is graded based on the results of the written exam.					

	Title	**Number of copies in the library**	**Availability via other media**
Required literature (available in the library and via other media)	-Wileman, D.A., Ferro, R.S.T., Fonteyne, R., Millar, R.B., 1996. ICES manual of methods of measuring the selectivity of towed fishing gears. ICES Coop Res. Rep. 215. -Suuronen, P. 2005. Mortality of fish escaping from fishing gears, FAO Fisheries Technical Paper T478 -Holst, R., Madsen, N., Moth – Poulsen, T. Fonseca, P., Campos, A. Manual for GillNet Selectivity. 43.pp -Eayrs, S., 2007. A Guide to Bycatch Reduction in Tropical Shrimp-Trawl Fisheries. FAO. Rome, 108 pp. -Pérez Roda, M.A. (ed.), Gilman, E., Huntington, T., Kennelly, S.J., Suuronen, P., Chaloupka, M. and Medley, P. 2019. A third assessment of global marine fisheries discards. FAO Fisheries and Aquaculture Technical Paper No. 633. Rome, FAO. 78 pp.		
Optional literature (at the time of submission of study programme proposal)	He, P. 2010. Behavior of Marine Fishes: Capture Processes and Conservation Challenges. Ames, IA: WilleyBlackwell. 375 p.		
Quality assurance methods that ensure the acquisition of exit competences	Students will be evaluated during the lectures and excercises, as well as at the final exam.		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**FISH POPULATION DYNAMICS AND STOCK ASSESSMENT**					
Code	SMR314	Year of study	1			
Course teacher	Jure Brčić, PhD	Credits (ECTS)	4			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	0	15	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	Students will learn the basics of fish population dynamics and methods used in fish stock assessment.					
Course enrolment requirements and						

entry competences required for the course	
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- understand Russell's law of dynamic equilibrium; - understand methods for determining the age of marine organisms ; - understand fish growth; - understand natural and fishing mortality; - understand basic stock assessment methods.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1. Introductory lecture** (3 hours) Learning outcomes: Getting familiar with the material that will be addressed through this course, with a particular emphasis on the importance of understanding population dynamics for the purposes of stock assessment. **Lecture 2. Basic concepts and principles in population** dynamics (2 hours) Learning outcomes: Acquire knowledge on basic concepts and principles that will be used in the following lectures. Getting familiar with different definitions used thorough the course. **Lecture 3. Russell's law of dynamic equilibrium** (2 hours) Learning outcomes: Understand Russell's law of dynamic equilibrium. **Lecture 4. Methods for determining the age of marine organisms** (1 hour) Learning outcomes: Know the basic methods (direct and indirect) used to estimate the age of marine organisms. **Lecture 5. Growth** (1 hour) Learning outcomes: Understand fish growth and how to describe it. **Lecture 6. Mortality** (1 hour) Learning outcomes: Understand the components of mortality – natural vs. fishing mortality **Lecture 7. Calculation of natural and fishing mortality** (2 hours) Learning outcomes: Learn how to use different methods to calculate natural and fishing mortality. **Lecture 8. Biomass estimation methods** (4 hours) Learning outcomes: Learn the basic methods used in fisheries' stock assessment. Understand direct and indirect biomass estimation methods. **Lecture 9. Shaefer and Fox models** (2 hour) Learning outcomes: To learn the working principle of the Shaefer and Fox models (historically the most common models used in fisheries biology), and the advantages and limitations of their application. **Lecture 10. Beverton-Holt Model** (2 hours) Learning Outcomes: To understand Beverton-Holt Model. **Lecture 11. Virtual Population Analysis** (VPA) (2 hours) Learning outcomes: Learn the basics of VPA analysis. **Lecture 12. Assessment of the state of resources through biological and socio-economic indicators** (2 hours) Learning outcomes: Learn how to describe the state of resources through various indicators. **Lecture 13. Ecosystem approach in fisheries (EAF)** (2 hours) Learning outcomes: Familiarize yourself with the principles of ecosystem approach in fisheries. **Lecture 14. Impact of migration on stock assessment** (1 hour) Learning outcomes: Learn the basic types of migration, and the migration characteristics of the major Adriatic species. **Lecture 15. Impact of selectivity on population dynamics** (2 hours) Learning outcomes: Basic understanding of species and size selection in different fishing gears. **Lecture 16. Software used in population dynamics** (1 hour) Learning outcomes: Get acquainted with different types of software used in stock assessment. **Exercise 1. Grouping data into classes** (1 hour) Learning outcomes: Know how to group data into classes (length frequencies). **Exercise 2. Length-weight relationship** (1 hour)

<table>
<tr><td></td><td colspan="6">Learning outcomes: Understand the concept of the Length-weight relationship. To explain the biological meaning of the parameters in the Length-weight relationship equation.
Exercise 3. Determining the age by reading the growth zones on otoliths (2 hours)
Learning outcomes: Understand the method of fish age determination by reading otolith annuli. Apply the method of extracting otoliths from different species of marine fish, and the techniques of otolith pre-processing for the purpose of age reading (grinding and polishing); to know how to determine different growth zones on the treated otoliths, and determine the age of the specimens analysed.
Exercise 4. Von Bertalanffy Growth Equation (2 hours)
Learning outcomes: Understand the Von Bertalanffy's growth equation and its importance in fisheries. To explain the biological significance of the parameters of the Von Bertalanffy growth equation. To describe the relationship between length and age of fish using Von Bertalanffy's growth equation in R.
Exercise 5. Mortality (1 hour)
Learning outcomes: Understand the concepts of natural, fishing and total mortality. Learn to calculate total mortality using Beverton and Holt's Z-equation, to calculate the total mortality from the catch curve, to calculate natural mortality (Pauly 's method, Rikhter and Efan method, Gunderson and Dygert method). To explain the importance of natural and fishing mortality for certain species of fish and other marine organisms.
Exercise 6. Virtual Population Analysis (VPA) (2 hours)
Learning outcomes: Understand the concept of virtual population analysis. To understand and apply Pop Cohort Analysis (PCA). To explain the importance of application of virtual population analysis methods, explain the relationship between natural and fishing mortality at different life stages of fish and other marine organisms.
Exercise 7. Yield Per Recruitment (1 hour)
Learning outcomes: Understand the term recruitment, know how to calculate catch per recruit using Beverton and Holt's model, explain the impact of fishing intensity on catch per recruit. To explain the optimal way to exploit the renewable resources of the sea.
Exercise 8. Estimating the maximum sustainable yield (1 hour)
Learning outcomes: Understand the concept of maximum sustainable yield. Understand how to calculate maximum sustainable yield using the Schaefer and Fox method. Explain the differences between the methods.
Exercise 9. Swept Area Method (2 hour)
Learning outcomes: Know how to evaluate bottom biomass using the “Swept Area Method”. Understand the limitations of applying this method and interpretation of the results.
Exercise 10. 'Traffic light' method (2 hour)
Learning outcomes: Understand the concepts and how to calculate population status indicators (Frequency of occurrence; Biomass index; abundance index; recruitment index etc.)</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are required to attend lectures and exercises.</td></tr>
<tr><td rowspan="2">Screening student work (name the proportion of ECTS credits for each</td><td>Class attendance</td><td>3</td><td>Research</td><td></td><td>Practical training</td><td>2</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
</table>

activity so that the total number of ECTS credits is equal to the ECTS value of the course)	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	
Grading and evaluating student work in class and at the final exam	The student is graded based on the results of the written exam.					

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Spare, P., Venema S.C, 1998. Introduction to tropical fish stock assessment. FAO Fish.Tech.Pap. 306/1 407 p		
Optional literature (at the time of submission of study programme proposal)	Haddon M. Modelling and Quantitative Methods in Fisheries. Chapman & Hall, CRC Press. 433 pp.		
Quality assurance methods that ensure the acquisition of exit competences	Students' work will be evaluated during lectures, as well as at the final exam.		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**STATISTICAL METHODS IN BIOTECHNOLOGY**					
Code	SMR503	Year of study	1			
Course teacher	Željka Trumbić, PhD	Credits (ECTS)	4			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The objective of this course is to habilitate students to use statistical methods common to the field of biology and fisheries. Good knowledge of statistics is important for understanding of the scientific and professional literature, research planning, processing and analyzing the data collected and making valid conclusions based on results. These skills are essential for planning diploma thesis or future scientific / professional work.					
Course enrolment requirements and entry competences required for the course						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Know how to calculate arithmetic mean, common arithmetic mean, central value (median), dominant value (mode), range, variance, standard deviation, coefficient of variation, standard error and confidence intervals using R programming language. Know how to calculate the coefficient of correlation, the coefficient of determination, and determine the coefficients of the linear regression model with the associated confidence limits using the R programming language.					

	Be able to calculate the coefficient of multiple correlation, coefficient of multiple determination, corrected coefficient of multiple determination and determine the coefficients of the multiple linear regression model with the associated confidence limits using the R programming language. Be able to calculate coefficients (with associated confidence limits) of different nonlinear models, with special reference to the relationship of body length and mass and the Von Bertalanffy growth curve using the R programming language. Know how to perform the $\chi 2$ test and the Fischer's exact test using the R programming language. Understand the purpose and prerequisites for conducting parametric tests, know how to perform Leven's test of variance homogeneity, one-way, two-way and paired t-test, and one-way and two-way analysis of variance (ANOVA) and Tukey's post-hoc test using the R programming language. Understand the purpose and prerequisites for conducting non-parametric tests, know how to perform the Mann-Whitney U-test and Kruskal-Wallis test using the R programming language. Be able to determine the Bray-Curtis coefficient of similarity, be able to display results using MDS or dendrogram, and perform ANOSIM and SIMPER analyzes in PRIMER.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1. Purpose and application of basic statistical methods, 'descriptive' vs. 'inferential' statistics** (2 hours) Learning outcomes: Identify basic ideas and purpose of using statistical methods, as well as their importance in scientific research and inference. Understand the difference between descriptive and inferential statistics, their application and specificity. Recognize the potentials and limitations of basic statistical methods. Define the concepts of the null hypothesis and the statistical significance of the results. **Lecture 2. Measures of central tendency and variability** (2 hours) Learning Outcomes: Understand the usage of and define arithmetic means, common arithmetic means ('weighted mean'), central values (median) and dominant values (mode). Understand the purpose and define range, variance, standard deviation and coefficient of variability. Identify the prerequisites that must be met to calculate these measures, as well as their limitations when interpreting results. **Lecture 3. Normal distribution, tests for distribution normality** (2 hours) Learning outcomes: Understand the application and define the concept of normal distribution. Recognize the purpose of distribution testing (whether data follows normal distribution), as well as the importance of this test when testing for differences between sample groups. **Lecture 4. Population and sample, standard error of arithmetic mean, confidence limits** (2 hours) Learning outcomes: Define the concepts of sample and population, standard errors of arithmetic mean and confidence interval. Recognize the importance of correct sampling, as well as the issues associated with sampling of biological populations for fisheries / biological research purposes. Understand the importance of defining standard errors and confidence limits, their importance in interpretation of results based on a sample and the limits in extrapolation of results from a sample level to a population level. **Lecture 5. Correlation and linear regression** (2 hours) Learning Outcomes: Understand the concepts of correlation and linear regression. Describe the least square method and its use in regression analyses. Identify the difference between the coefficient of correlation and the coefficient of determination. Understand the notion of data extrapolation/modelling and limitations in interpreting results of linear regression. **Lecture 6. Multiple linear regression** (2 hours) Learning Outcomes: Understand the concept of multiple linear regression. Recognize different types of multiple linear regression: 'forward', 'backward' and 'stepwise' multiple linear regression. Define the coefficient of multiple correlation and multiple coefficient of determination. **Lecture 7. Nonlinear regression** (2 hours)

	Learning outcomes: Define nonlinear regression and its most common applications in fisheries-biological research (the relationship of body length and mass and Von Bertalanffy's growth curve). **Lecture 8. χ2 test, Fischer's exact test** (2 hours) Learning Outcomes: Understand the application of χ2 and the Fischer's exact test when: i) a comparison of the observed and expected frequencies of one sample under a certain hypothesis (e.g. random frequencies); ii) a comparison of the frequencies of two (Fischer'exact test) or more independent samples (χ2 test). **Lecture 9. t-test, Leven's test of homogeneity of variance** (2 hours) Learning outcomes: Define t-test and recognize prerequisites and instances for its application. Recognize the difference between one-way, two-way and paired t-tests and which test to apply depending on the data available and the requirements of the analysis. Understand the importance of the normal distribution and homogeneity of variance of the data we test, with particular reference to the Leven's test. **Lecture 10. Analysis of variance (ANOVA), Tukey's post-hoc test** (2 hours) Learning Outcomes: Identify the purpose of conducting an analyses of variance (ANOVA). Recognize the difference between one-way and two-way analysis of variance and understand which test to apply depending on the data available and the requirements of the analysis. Understand the importance of normal distribution and homogeneity of variance in the data we test. Understand the purpose and results of Tukey's post-hoc test, and its importance in analyses of variance. **Lecture 11. Analysis of Covariance (ANCOVA)** (2 hours) Learning Outcomes: Explain the purpose of conducting analyses of covariance (ANCOVA). Understand the prerequisites for using this method and be able to interpret the results of the analysis. **Lecture 12. Discriminatory analysis** (2 hours) Learning outcomes: Understand purpose of using discriminant analysis (DA), and the applicability and appropriateness of this method depending on the properties of the data we are testing. Be able to examine the statistical significance of individual independent variables in the model and interpret the results. **Lecture 13. Principal components analysis** (PCA) (2 hours) Learning Outcomes: Understand the application and purpose of using principal component analysis (PCA). Be able to interpret the results of this analysis. **Lecture 14. Parametric vs. non-parametric tests, Mann-Whitney U-test, Kruskal-Wallis test** (2 hours) Learning outcomes: Define the differences, advantages and disadvantages of parametric and non-parametric statistical tests. Recognize the prerequisites for conducting non-parametric tests, especially with respect to parameter tests. Understand the relationship between the t-test and the Mann-Whitney U-test, and their applicability depending on the properties of the data we are testing. Understand the relationship between analysis of variance (ANOVA) and the Kruskal-Wallis test, and their applicability depending on the properties of the data we are testing. Be able to interpret the results of the Kruskal-Wallis test. **Lecture 15. Multivariate Statistical Package PRIMER** (2 hours) Learning outcomes: Explore the features of the statistical package PRIMER used in the analyses of similarity of species abundance / biomass between samples. Know how to determine the Bray-Curtis coefficient of similarity, display the results using MDS or dendrograms, conduct ANOSIM and SIMPER analyzes. **Exercise 1. R programming language for statistical data processing** (1 hour) Learning outcomes: acquire basic knowledge of working with the R programming language for statistical data processing; be able to enter the data or enter data from other sources (EXCEL); get acquainted with the graphical interface (R Studio), and the functions that will be used during the course. **Exercise 2. Measures of central tendency and variability** (2 hours) Learning outcomes: Calculate the arithmetic mean, common arithmetic mean ('weighted mean'), central value (median) and dominant value (mode) of data using R programming language. Determine variance, standard deviation and coefficient of variation using R programming language. **Exercise 3. Normal distribution, tests for distribution normality** (2 hours)

	Learning outcomes: graphically visualize data distribution and test whether data is normally distributed using R programming language. **Exercise 4. Standard error of arithmetic mean, confidence limits** (2 hours) Learning Outcomes: Calculate standard error and determine 95% confidence interval using R programming language. **Exercise 5. Correlation and linear regression** (1 hour) Learning outcomes: Calculate the coefficient of correlation, the coefficient of determination and determine the coefficients of linear regression model with the associated confidence limits using R programming language. **Exercise 6. Multiple linear regression** (1 hour) Learning outcomes: Calculate the coefficient of multiple correlation, the coefficient of multiple determination and the adjusted ('adjusted') coefficient of multiple determination. Determine the coefficients of multiple linear regression model with the associated confidence limits using R programming language. **Exercise 7. Nonlinear regression** (2 hours) Learning outcomes: Calculate coefficients (with associated confidence limits) of different nonlinear equations, with special reference to the relationship of body length and mass and Von Bertalanffy's growth curve using R programming language. **Exercise 8. χ2 test, Fischer's exact test** (1 hour) Learning outcomes: Determine the value of χ2 using R programming language (examples in biology, e.g. testing gender ratios, phenotypes, etc.). **Exercise 9. t-test, Leven's test of homogeneity of variance** (3 hours) Learning outcomes: Determine the value of t statistics and the statistical significance of the results of 'one-way', 'two-way' and 'paired' t-test using R programming language. Perform the Leven's test of homogeneity of variance using R programming language and interpret the results. **Exercise 10. ANOVA, Tukey's post-hoc test** (3 hours) Learning outcomes: Perform one-way and two-way analysis of variance (ANOVA), Tukey's post-hoc test and interpret the results using R programming language. **Exercise 11. Analysis of Covariance (ANCOVA)** (1 hour) Learning Outcomes: Perform covariance analysis (ANCOVA) and interpret the results using R programming language. **Exercise 12. Discriminant Analysis** (2 hours) Learning outcomes: Determine discriminant variables using 'forward', 'backward' and 'stepwise' discriminant analysis using R programming language. **Exercise 13. Principal components analysis** (PCA) (2 hours) Learning Outcomes: Determine principal components and the percentage of the total variance explained by each component using R programming language. **Exercise 14. Mann-Whitney U-test, Kruskal-Wallis test** (2 hours) Learning outcomes: perform Mann-Whitney U-test and Kruskal-Wallis test and interpret their results using R programming language. **Exercise 15. Similarity measures of species abundance / biomass among samples - Multivariate Statistical Package PRIMER** (5 hours) Learning Outcomes: Acquire basic knowledge and understanding of working with the multivariate statistical analysis program PRIMER; interface and data organization; be able to enter data or enter data from other sources (EXCEL); know the layout of the menus and windows and the functions that will be used during the course. Enter the data into a matrix for determining similarity using PRIMER, determine the Bray-Curtis coefficient of similarity, perform standardization and transformation of data in a matrix and display results using MDS and dendrograms. Examine statistical significance of similarities / differences between samples using ANOSIM analysis and determine the contribution of particular types of similarities / differences between samples using SIMPER analysis.	
Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety	☒ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor

	☐ partial e-learning ☐ field work			☐ (other)		
Student responsibilities	It is expected that students will attend classes (lectures and exercises) on a regular basis.					
Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	2
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	
Grading and evaluating student work in class and at the final exam	Final grade will be obtained based on student performance at written exams from practical and theoretical part of the course.					

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Currell, G. & A. Dowman. 2009. Essential mathematics and statistics for science (2nd edition). Wiley-Blackwell, 387 pp.	1	
	Field, A., Miles, J. & Field, Z. 2012. Discovering Statistics Using R. Sage Publications, 992 pp.	1	

Optional literature (at the time of submission of study programme proposal)	Sokal, R.R. & F.J. Rohlf. 1994. Biometry: The principles and practices of statistics in biological research (3rd edition). W. H. Freeman, 880 pp. Zar, J.H. 2009. Biostatistical analysis (5th int'l edition). Prentice Hall PTR, 960 pp. Clarke, K.R. & R.M. Warwick. 2001. Change in marine communities: an approach to statistical analysis and interpretation (2nd edition). PRIMER-E: Plymouth
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) attendance b) active participation c) knowledge acquired
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**MICROBIOLOGY OF POLLUTED WATERS**					
Code	SMB505	Year of study	1			
Course teacher	Marin Ordulj, PhD	Credits (ECTS)	2			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The microbiology of polluted waters focuses on the study of microorganisms which are allochthonous in water. The waters where they are found do not represent their natural environment. The presence of such microorganisms in water indicates microbiological pollution, and the aim of this course is to classify the microbiological or sanitary quality of waters based on the pollution level.					
Course enrolment requirements and	Basic knowledge of General Microbiology and Marine Microbiology					

entry competences required for the course	
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Familiarize with the sources of allochthonous microorganisms and their overview, as well as with characteristics of pathogenic microorganisms most commonly found in polluted waters. Acquire knowledge on indicator organisms, criteria, and standards for water quality assessment. Understand the fate of allochthonous microorganisms upon entering the aquatic environment and the factors which affect their survival. Assess the impact of microbiologically polluted waters on the water-based economic activities.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1.** Know the sources of allochthonous microorganisms: municipal wastewater, atmosphere, soil, animal and fish farms, ballast water. Be able to define different groups of pathogenic microorganisms that enter the aquatic environment from various sources. Provide an overview of pathogenic bacteria, viruses, fungi, protists and other parasites commonly found in polluted waters. (2 hours) **Lecture 2.** Give an overview, including properties of allochthonous pathogenic groups of microorganisms found in eutrophicated waters. Familiarize with the changes the bloom of microorganisms causes in the water environment; understand how microorganisms create hypoxic and anoxic conditions and gain knowledge on the impact such conditions have on water environment. (2 hours) **Lecture 3.** Know different species of cyanobacteria that may be present in bathing waters. Be familiarized with the threats of cyanobacteria found in bathing waters. Know the causes of cyanobacterial blooms in the waters. Habilitate to different species of cyanobacteria that may be present in bathing waters and their negative impact in bathing waters. Know the legislation that governs the quality of bathing waters. (2 hours) **Lecture 4.** Habilitate students to the concept and definition of criteria and standards for water quality and to the review of standards for different types of water (drinking water, rivers, sea, etc.). Define the term and offer definition of the indicator and give an overview of the faecal pollution indicators: coliform bacteria, faecal coliforms (Escherichia coli), faecal streptococci, intestinal enterococci, and anaerobic bacteria. What is the purpose of determining the degree of pollution of different types of water? Explain what happens to microorganisms upon their arrival in the aquatic environment. Habilitate students to the survival of allochthonous microorganisms in the freshwater and marine environment; understand the mechanisms of adaptation and survival. Give an overview of the factors that have a significant impact on the survival of microorganisms: solar radiation (light), temperature, osmotic pressure, pH, nutrients, heavy metals, antagonistic activity of other organisms, and the combined effect of several factors. (2 hours) **Lecture 5.** Learn which information is used to create a beach profile. Acquire knowledge on how to create profile of the public beach. (2 hours) **Lecture 6.** Familiarize with the methods of elimination of potentially pathogenic microorganisms from drinking waters. Know the response of microorganisms to the disinfection methods used to treat drinking water. (2 hours) **Lecture 7.** Analyse which pathogenic microorganisms from pre-treated sources most often enter the aquatic environment and why. Provide an overview of pathogenic bacteria, viruses, fungi, protists and other parasites commonly found in polluted waters. Understand the effect of water treatment procedures on pathogenic microorganisms. Know the regulations for urban wastewater treatments. Know the fate of microorganisms upon their arrival in the aquatic environment. (2 hours) **Lecture 8.** Learn the processes of bioremediation; know which types of microorganisms can be used in the process of bioremediation to remove the negative effect of microbiologically polluted waters. (2 hours) **Lecture 9.** Know how the microorganisms are transported in different waters through ballast water; Know the differences in survival among the specified groups of microorganisms. (2 hours)

	Lecture 10. Know how biosensors can be used to monitor microbiologically polluted waters. Get acquainted with the usage of biosensors for measuring the impact of allochthonous and pathogenic microorganisms in the water. (2 hours) **SEMINARS** Each student creates seminar paper independently on the most important topics. The presentations of the seminars are followed by a discussion.
Format of instruction	☒ lectures ☒ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work ☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	-

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	The exam consists of an oral and a written part. The student is required to orally present a seminar. The final grade is obtained from the average of the grades achieved in oral and written part of the exam.		
Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Tortora, G.J., Funke, B.R., Case, C.L., Johnson, T.R. 2016. Microbiology: an introduction (Vol. 9). San Francisco, CA: Benjamin Cummings. 810 p.		
	Mayer, R.M., Pepper, I.L. and Gerba, C.P. 2000. Environmental Microbiology, Academic Press, 585 p.		
	C. B. Munn - Marine Microbiology: Ecology & Applications, 2nd Edition. 2011 CRC Press		
Optional literature (at the time of submission of study programme proposal)	Ordulj. 2020. Instructional materials (internal script, ppt presentations, etc.).		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course, as well as at the final exam. During the course, the following are evaluated: a) Attendance b) Teaching activity c) Knowledge acquired		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**MARICULTURE AND ENVIRONMENT**		
Code	SMR513	Year of study	1
Course teacher	Vedrana Nerlović, PhD	Credits (ECTS)	5

Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			30	0	30	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The course aims to provide students with the necessary information on the zootechnical and bio-ecological specificities of mariculture as a relevant activity in the coastal area with all rights, obligations and responsibilities regarding social, economic and environmental fulfillment. Knowledge of the zootechnical and bio-ecological characteristics of mariculture is directed towards reconciling the interests of mariculture with other users of coastal and marine space.					
Course enrolment requirements and entry competences required for the course	Basic knowledge in biology, chemistry and physics of the sea, and partially biology and ecology of economically important species.					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- understand global trends which dictate mariculture sector's development; - be able to explain the importance, goals and directions of mariculture; - be able to describe space zoning for mariculture and understand the importance of selecting sites for cage farming; - know to describe the environmental impact of marine fish-farming and understand the importance of monitoring system in mariculture (indicators): - know to explain different types of farming aquatic organisms (marine and terrestrial systems); - understand the concept of breeding environment bearing capacity which limit production capacity; - know to explain the relationship of mariculture and other sectors from the aspect of integrated coastal zone management.					
Course content broken down in detail by weekly class schedule (syllabus)	Classes are organized into thematic units which include changed circumstances, open questions and benefits in light of global processes, the importance of fish in human nutrition, the interaction of hunting and breeding fisheries, spatial premises for long-term sustainable and stable mariculture. The potential impacts of various breeding activities on the environment and the living world, such as impacts on the chemistry of the sea and sediment, impacts on benthic communities and natural ichthyopopulations, are specifically addressed. Of particular interest is the "genetic pollution", that is, the possible detrimental effect of the genetic structure of native populations. Special attention is focused on preventive measures aimed at reducing the negative impacts of mariculture, such as consideration of spatial integration for the purposes of mariculture in the selection of locks, the improvement of zootechnics and environmental monitoring. Bioindicators in mariculture, using genetic methods and managing ecosystem-based mariculture facilities (EBM), are measures that can significantly contribute to its economic viability, social justification and environmental focus. **Lecture 1. Mariculture in the light of global world circumstances** Definition and goals of mariculture. Changed circumstances, open questions and benefits. Fish in the human diet - diseases related to nutrition and nutrition security **Lecture 2. The interaction of fishery and breeding fisheries** Synergistic factors and diversity. Fishing as the biological basis of mariculture. Mariculture for fishing - stocking **Lecture 3. Hydrological and biological basics of mariculture** Relationship of farmed organisms to the changing factors of the marine environment. Stress and effects on farmed organisms. **Lecture 4. Zootechnics in Mariculture** Classification of fish breeding systems and other marine organisms with regard to: (a) the level of control; (b) accommodation of breeding installations); (c) dynamics of water mass change; (d) applied technology and zootechnical solutions; and (d) the					

	species cultivated. Zootechnical measures - the problem of fouling. Medicaments (e.g. antibiotics) and the risk of their application to the environment and human health. **Lecture 5. The impact of mariculture on the environment and the living world** Fundamentals of marine ecosystem functioning. Potential environmental impacts. Impact on water column, sediment and benthic communities. Recovery of marine ecosystems in space and time. **Lecture 6. Organic intake and eutrophication risks due to activities in mariculture** Intake and consequences of organic matter intake by barking and shellfish farming. Analysis of different environmental scenarios due to: (a) high concentration of organic matter; (b) excess nutrients; and (c) phyto and bacterioplankton activity under different organic and inorganic loading conditions **Lecture 7. Breeding capacity. How Many Fish Are Bred?** Limiting factors of intensification in fish and shellfish farming. Production, environmental and sociological capacity. Quantification of nutrients based on hydrological and biological methods. Calculation of the amount of nutrients in water and sediment relative to incorporated nutrients in fish. Influence zones. **Lecture 8. Reduction of negative environmental impacts** Prevention options through the selection of more environmentally friendly composition of nutritional components and the formulation of food and optimization of nutrition. Choosing the best breeding locations. Environmental monitoring (monitoring). **Lecture 9. Possible impacts of cultivation on biodiversity** Defeats and "genetic pollution". Targeting gender and transgenic technology. Possible mitigation using appropriate applied genetics methods. **Lecture 10. Ecosystem-based mariculture - planning and management** Sustainable vs. unsustainable development. Ecosystem-based management implementation principles and procedures. Regulatory and manipulation measures in the ecosystem. Conventional vs. environmentally conscious process management. **Lecture 11. Zoning for mariculture in the context of comprehensive coastal planning and management** Basic features of coastal space, users and conflicts. Terms and concepts. Interaction of sociological, economic and environmental Factors in sustainable management. Indicators for mariculture. Zoning for cage fish farming and shellfish farming online systems. Standards for production areas, repository areas, treatment centers and dispatch centers. **Lecture 12. Potential impact of climate change on mariculture** Predictions - Assessment of vulnerability of the mariculture sector with respect to changes in temperature, salinity, precipitation, and global ocean dynamics. Impact on fish farming dependant communities. Indirect impacts - fish meal as a critical component in intensive carnivorous farming. **Lecture 13. Environmental indicators and monitoring in mariculture (monitoring)** Environmental quality indicators relevant to mariculture: (a) in water; (b) sediment and (c) benthic communities. Principles of monitoring in mariculture. Monitoring of fish farms. Monitoring of bivalve farms. Factors influencing the measurement parameters and the spatial and temporal sampling scale. **Lecture 14. Disorders and diseases in mariculture as a result of ecological and zootechnical changes** Diagnosis of disorders. Breeding disorders prevention methods and techniques. Reducing the risk of disorders and illnesses. Treatment of the diseased organisms in cultivation **Lecture 15. Risks and risk management in mariculture** Origin and types of risks in mariculture. Insurance as a preventive institute. Principles and trends affecting the mariculture insurance market. Risks in caged fish farming. Risks in shellfish production. Experiences and trends in the world and in Croatia.

<table>
<tr><td>Format of instruction</td><td colspan="3">☐x lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">During the semester, each student is required to write a seminar paper on a given topic and present it to other students.
Attendance is compulsory (a certain number of justified absences is tolerated, no more than 20%). Students are required to attend classes.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>3</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>x</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>x</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">The exam consists of a written test and an oral exam. The overall grade is determined upon students' course engagement, which includes active participation at lecture discussions and the quality of seminar preparation and presentation.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="3">Bogut, I., Horvath, L. Adamek, Z., Katavic, I. 2006. Aquaculture. University of Osijek, Mostar and Split, 523 p.
Barnabe, G. (1994). Biological basis of fish culture. In: Aquaculture - biology and ecology of cultured species, Barnabe, G. (ed), Elis Horword Limited, 227-372.
2. Beveridge, M.C.M. (1996). Cage aquaculture. Fishing News Books, Blackwell, Oxford, 351p.
3. Black, K.D. (1998). The environmental interactions associated with fish culture. In: Biology of farmed fish. Black, K.D. and A.D. Pickering (eds), Shefield Academic Press, 285-326.
4. FAO, 2008. Understanding and applying risk analysis in aquaculture. (Eds) Bondad-Rerantaso, M.G., Arthur, J.R. and Subasinghe, R.P. FAO Tech. Paper No. 519, 304pp.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">1. Barnabe, G. (1994). Biological basis of fish culture. In: Aquaculture - biology and ecology of cultured species, Barnabe, G. (ed), Elis Horword Limited, 227-372.
2. Beveridge, M.C.M. (1996). Cage aquaculture. Fishing News Books, Blackwell, Oxford, 351p.
3. Black, K.D. (1998). The environmental interactions associated with fish culture. In: Biology of farmed fish. Black, K.D. and A.D. Pickering (eds), Shefield Academic Press, 285-326.
4. FAO, 2008. Understanding and applying risk analysis in aquaculture. (Eds) Bondad-Rerantaso, M.G., Arthur, J.R. and Subasinghe, R.P. FAO Tech. Paper No. 519, 304pp.
5. GFCM, 2010. Indicators for sustainable development of Aquaculture. GFCM CAQ Working Group Report on Aquaculture Sustainability, Athens, Greece, April 14-17, 2010.</td></tr>
</table>

	6. Gezelius, S.S. and Raagjaer, J. (eds.), 2008. Making Fisheries Management Work. Implementation of sustainable fishing policies. Springer, 235pp. 7. Ottolenghi, F., Silvestri, C., Giordano, P., Lovatelli, A., New, M.B. (2004). Capture-based aquaculture. The fattening of eels, groupers, tunas and yellowtails. Rome, FAO, 385p. 8. Hindisyde, N.T. Ross, L.G. Badjeck, M-C. And Allison, E.H., 2008. The effect of climate change on world aquaculture: a global perspective. Department for International Development (DIFID), 151pp. 9. Pillay, T.V.R. (1992). Aquaculture and environment. Oxford, Fishing News Books, Blackwell, 189p. 10. UNEP / MAP-CP / RAC, 2009. Sustainable Fisheries in the Mediterranean, 143 pp. Available also at: www. cprac.org 11. Selected articles from scientific and professional journals
Quality assurance methods that ensure the acquisition of exit competences	
Other (as the proposer wishes to add)	Students receive information about teaching materials, additional literature, student requirements, assessment methods and terms of consultation at the end of the class. Combined forms of teaching are planned through lectures followed by audio-visual aids in block hours, stimulating discussions and conclusions with seminar work, demonstration and auditorium demonstrations.

NAME OF THE COURSE	**SEAFOOD PROCESSING TECHNOLOGY**					
Code	SMR518	Year of study	1			
Course teacher	Vida Šimat, PhD	Credits (ECTS)	3			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	15	0	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The main objective of this course is to enable students to understand and implement the proper ways of handling fish and fishery products from catch to the table and selecting suitable methods of conservation and implementation of good manufacturing practices during various processes of conservation of fishery products.					
Course enrolment requirements and entry competences required for the course	Competence in applying knowledge of inorganic and organic chemistry and biochemistry and basic microbiology.					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Explain the principles of individual technological processes for the conservation and processing of fishery products - analyze post-mortem changes affecting the quality and shelf life of fishery products - analyze the impact of technological processes on the quality and shelf life of fishery products					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Introductory Lecture, Status and Trends in Fisheries, Fish Structure and Composition (3 hours) **Lecture 2:** Post-mortem changes on fish meat. (3 hours) **Lecture 3:** Degradation of raw materials and products. (2 hours) **Lecture 4:** Ice in Fisheries. (3 hours) **Lecture 5:** Fish preservation using low temperatures (cooling and freezing). (4 hours)					

<table>
<tr><td></td><td colspan="6">Lecture 6: Fish preservation using high temperatures. Production of canned fish. (3 hours)
Lecture 7: Fish preservation by drying. Fish preservation by smoking. (3 hours)
Lecture 8: Fish preservation by marinating. Fish preservation by salting. (3 hours)
Lecture 9: Preservation technologies of invertebrates and algae (3 hours)
Lecture 10: Packaging materials and methods for fishery products (3 hours)

SEMINARS
Through seminars, each student independently implements a technological process for a product, and actively discusses and explains with the teacher and colleagues the defense procedures in production, the choice of packaging materials and packaging methods, and key points in the production process. The student is required to prepare the material discussed at the seminars. The teacher evaluates the student's participation in the seminar (demonstrated knowledge, understanding, problem-solving ability, reasoning, discussion activity, etc.).</td></tr>
<tr><td>Format of instruction</td><td colspan="3">×☐ lectures
×☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">×☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Students responsibilities</td><td colspan="6">Students are required to attend classes (lectures and exercises), to actively participate in the teaching process and pass the exam (colloquiums). The presence in the classroom will be recorded (lectures and exercises). A student is allowed one unexcused absence from exercises and two absences from lectures. Field exercises are obligatory. The omission is justified in the case of certain activities at the University for which it is necessary to have a written confirmation. Delay in classes (lectures and exercises) will also be recorded; three delays will be counted as one unexcused absence. 100% presence in the class will be rewarded with two points at the colloquium.</td></tr>
<tr><td rowspan="6">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0,5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Field exercises</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>2,00</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>0,5</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">The course material is divided into two parts. Students take this unit separately through one written exam with 25 points and a defense of seminar paper with 75 points. At least 60% is required to be considered as one unit. The score is unique and is awarded according to the total number of points:
> 90 points - excellent (5)
76 - 89 points - very good (4)
63 - 75 points - good (3)
50 - 62 points - sufficient (2)
<50 student did not satisfy.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="3">Sikorski ZE. (1990). Seafood: resources, nutritional composition and preservation, CRC Press, Inc. Boca Raton, Florida, SAD.</td><td></td><td colspan="2">Teacher</td></tr>
<tr><td colspan="3">Gokoglu, N., Yerlikaya, P. (2015) Seafood Chilling, Refrigeration and Freezing_ Science and Technology-Wiley-Blackwell , UK</td><td></td><td colspan="2">Teacher</td></tr>
</table>

	Ozogul Y. (2020). Innovative technologies in seafood processing. CRC Press, Boca Raton, Florida, SAD.		Teacher
	Bremner, H.A., (2002). Safety and qualtiy issues in Fish Processing, CRC Press, Inc. Boca Raton, Florida, SAD.		Teacher
Optional literature (at the time of submission of study programme proposal)	1. Tewari G., Juneja VK. (2007). Advances in thermal and non-thermal food preservation. Blackwell Publishing Ltd. Oxford, UK. 2. Huss, H.H., Ababouch, L., Gram, L. (2003). Assessment and Management of Seafood Safety and Quality. Fao Fisheries Technical Paper 444, Food and Agriculture Organization of the United Nations, Rome. 3. Lee R., Lovatelli A., Ababouch L. (2008) Bivalve depuration: fundamental and practical aspects FAO, Rome, Italy. 4. Devahastin S. (2011). Physicochemical aspects of food engineering and processing. CRC Press, Inc. Boca Raton, Florida, SAD.		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course, as well as at the final exam. During the course, he / she is evaluated through class attendance, teaching activities, acquired knowledge and exams.		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**ADAPTATION PHYSIOLOGY OF MARINE ORGANISMS**					
Code	SMR519	Year of study	1			
Course teacher	Josipa Ferri, PhD	Credits (ECTS)	3			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning	-			
COURSE DESCRIPTION						
Course objectives	The purpose of the course is to acquaint students with the responses of marine organisms to changed living conditions, since physiological adaptive mechanisms are crucial for the survival of organisms when altering abiotic and biotic factors.					
Course enrolment requirements and entry competences required for the course	-					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Adopt osmoregulatory mechanisms in crustaceans and fish. Distinguish osmoregulatory mechanisms between freshwater and marine fishes. Adopt the mechanisms of anoxia survival. Describe the impact of temperature changes on crustaceans, molluscs and fish. Know the role of antifreeze protein and the reasons for the disappearance of respiratory pigment (hemoglobin) in polar fish. Explain the link between stress and individual hormones and clarify the impact of stress on crustaceans and fish. Adopt the physiological mechanisms of fish in reproduction systems - the importance of bioenergy, environmental temperature, oxygen demand, salinity tolerance.					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1.** Osmoregulation of crustaceans and fish. (3 hours) Learning outcomes: Adopt osmoregulatory mechanisms in crustaceans and fish. Differentiate adaptations of organisms in brackish and freshwater environment. Know the role of excretory organs in the osmoregulation of crustaceans. Distinguish osmoregulatory mechanisms between freshwater and marine fishes. **Lecture 2.** Respiratory adjustments. (3 hours)					

<table>
<tr><td></td><td colspan="6">Learning outcomes: Adopt mechanisms in respiratory adjustment processes. Know the basic principles of respiration for crustaceans, molluscs and fish. Adopt the mechanisms of anoxia survival.
Lecture 3. Temperature and adjustments. (3 hours)
Learning outcomes: Describe the impact of temperature changes on crustaceans, molluscs and fish. Distinguish between ectoderm and endoderm fish. Clarify adaptations of organisms to low and elevated temperatures. Know the role of antifreeze protein and the reasons for the disappearance of respiratory pigment (hemoglobin) in polar fish.
Lecture 4. Stress of aquatic organisms. (3 hours)
Learning outcomes: Adopt concepts such as homeostasis, allostasis, and what are compensatory and chronic stress responses. Explain the link between stress and individual hormones and clarify the impact of stress on crustaceans and fish.
Lecture 5. Fish physiology in breeding systems. (3 hours)
Learning outcomes: Adopting the physiological mechanisms of fish in breeding systems - the importance of bioenergy, environmental temperature, oxygen demand, salinity tolerance.

The topics of the seminar depend on the interests of the students, and besides the topics suggested by the teacher, students can choose other topics that are content related to the subject of the course. The seminars demand the active participation of all students by answering the questions at the end of the seminar, where the teacher has the role of moderator, while the student who prepared the seminar should be ready to answer any questions that may arise from the discussion. The aim of the seminar papers is to analyze in detail some specific physiological adaptation and to link theoretical knowledge with practical problems (e.g. in reproduction systems).</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Proper attendance at lectures and seminars.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">The examination is taken in writing and consists of the material from the lectures. The exam consists of rounding, supplementing questions, then those to which a descriptive answer should be given, and those to which it is necessary to decide whether a given statement is true or false. The student is required to achieve a minimum score of 61% on the exam. The final grade will be determined by the criterion: <61% - grade 1 (insufficient), 61% - 70% - grade 2 (sufficient), 71% - 80% - grade 3 (good), 81% - 90% - grade 4 (very good), 91% - 100% - grade 5 (excellent). To enter the final grade in the index, the student is required to do a seminar paper.</td></tr>
<tr><td>Required literature (available in the</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
</table>

library and via other media)	Farrell A. 2011. Encyclopedia of Fish Physiology (First Edition). Academic Press, 2272 pages.	-	-
Optional literature (at the time of submission of study programme proposal)	Eddy FB, Handy RD. 2012. Ecological and Environmental Physiology of Fish. Oxford University Press, 264 pages.		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) attendance b) teaching activity / seminar presentation c) knowledge acquired		
Other (as the proposer wishes to add)	-		

NAME OF THE COURSE	**SEAFOOD QUALITY ASSESSMENT**					
Code	SMR308	Year of study	2			
Course teacher	Vida Šimat, PhD	Credits (ECTS)	4			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	10	5	-
Status of the course	Mandatory	Percentage of application of e-learning	-			
COURSE DESCRIPTION						
Course objectives	The aim of this course is to analyze all the dangers and compounds that arise in the post-mortem muscle of fishery products and other marine organisms, since its assessment, application and analysis help evaluating the shelf life of the product and control the safety and quality of fishery products in the food chain of marine origin.					
Course enrolment requirements and entry competences required for the course	Completed course in Seafood processing technology					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Analyze the hazards of fishery products that pose a risk to the consumer. - Analyze specific compounds / quality parameters for a specific product. - Explain the risks of individual products based on the characteristics of the product itself (NaCl, aw, pH, temperature). - Estimate the shelf life of an individual product using relevant sensory, microbiological, biochemical and chemical methods. - Assess the risks in the fisheries supply chain.					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Trends and problems in the production of fishery products, the concept of food quality. (2 hours) **Lecture 2:** The spoilage of fishery products. (2 hours) **Lecture 3:** Post-mortem changes on fish meat. (6 hours) **Lecture 4:** Phase of bacterial degradation of fish. (2 hours) **Lecture 5:** Sensory evaluation of fish quality. (2 hours) **Lecture 6:** Chemical indicators of fish freshness and spoilage. (2 hours) **Lecture 7:** Volatile amines. (2 hours) **Lecture 8:** Biogenic amines. (2 hours) **Lecture 9:** Histamine. (2 hours) **Lecture 10:** Fat changes, fat degradation. (2 hours) **Lecture 11:** Changes in the physical properties of fish meat. (2 hours) **Lecture 12:** Posthumous changes in crab meat. Quality criteria for bivalve molluscs. (2 hours)					

<table>
<tr><td></td><td colspan="6">Lecture 13: Practical application and usefulness of quality parameters in practice, risk assessment. (2 hours)
Exercise 1. Lab exercise. Sensory evaluation of fishery products. (2 hours)
Exercise 2. Lab exercise. Quality assessment of finished fishery products. (3 hours)
Exercise 3. Lab Exercise. Determination of TVB-N and TMA-N. (2 hours)
Exercise 4. Lab Exercise. Measurement of the degree of lipid oxidation in food produced during processing and / or storage by determining the secondary products of lipid oxidation, e.g. malondialdehyde (MDA) by thiobarbituric acid test or TBARS (thiobarbituric acid reactive substances) or TBK (thiobarbituric acid) (2 hours).
Exercise 5. Visit to the Laboratory for Food Quality Control of Animal Origin, Veterinary Institute in Split, determination of histamine. (4 hours)
Exercise 6. Familiarity with the applicable legislation and standards implemented for quality management purposes. (2 hours)</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☒ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are required to attend classes (both lectures and exercises), actively participate in the teaching process and pass the exam (see the Exam section). Class attendance will be recorded every hour (lectures and exercises). Student is allowed one unjustified absence from practice and 2 absences from class. Absence is justified in the event of illness or a specific activity on the Department, and a written confirmation is required. Delays in teaching (lectures and exercises) will also be recorded, with three delays counting as one unjustified absence. 100% attendance will be awarded with 2 points.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td>0.5</td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td>2</td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Students are required to take a midterm exam in order to be eligible to take the exam. The course material is divided into two parts. Students take this unit separately through two written tests, each of which yields 50 points, and each consisting of coursework and lectures. At least 50% is required to be considered as one unit. If a student passes the exam several times, the average of all previously achieved results is taken as a result (example: first exam A: 15 points (33.3%); second exam A: 30 points (66.7%)); Exam score A: (15 + 30) / 2 = 22.5 points (50%)). At the end of the semester, if a student is satisfied with the grade, he or she is enrolled in the index, otherwise he or she may be held liable for a higher grade.
> 90 points - excellent (5)
76 - 89 points - very good (4)
63 - 75 points - good (3)
50 - 62 points - sufficient (2)
<50 student did not satisfy.</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
</table>

	Havranek, J., Kalit Tudor, M. i sur. (2014). Sigurnost hrane od polja do stola. MEP .do.o., Zagreb	-	1
	Bremner HA. (2002). Safety and quality issues in Fish Processing, CRC Press, Inc. Boca Raton, Florida, SAD.	-	1
	Borresen T. (2008). Improving seafood products for the consumer, Woodhead Publishing Ltd., Cambridge, England.	-	1
	Martinez, I., James, D., Loreal, H. (2005) Application of modern analytical techniques to ensure seafood safety and authenticity. FAO, Rome, Italy.	-	-
Optional literature (at the time of submission of study programme proposal)	1. Official Methods of Analysis of AOAC International, (2000). 2. Duraković, S. (2002). Moderna mikrobiologija namirnica, Udžbenici Sveučilišta u Zagrebu, Zagreb. 3. Garfield, FM. (2000). Quality Assurance for Analytical Laboratories, AOAC International, Gaithersburg, Md. 4. Mortimer, SE., Wallace CA., Cassianos, CA. (2001). HACCP, Blackwell Science, Oxford. 5. Turčić, V. (2000). HACCP i higijena namirnica, Zagreb. 6. Juran, MJ. (1999) Planiranje i analiza kvalitete: od razvoja proizvoda do upotrebe 3. izd., Mate, Zagreb. 7. Petz, B. (1997). Osnove statističke metode za nematematičare, 3. izd., Naklada Slap.		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course, as well as at the final exam. During the course, the following are evaluated: a) Attendance b) teaching activity c) knowledge acquired		
Other (as the proposer wishes to add)	-		

NAME OF THE COURSE	**METHODOLOGY OF SCIENTIFIC WORK**					
Code	SMB503	Year of study	2			
Course teacher	Mirela Petrić, PhD	Credits (ECTS)	3			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			15	30	0	-
Status of the course	Mandatory	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	The main objectives of the course are to familiarize students with the methodology of scientific work from planning research to writing and presenting scientific work.					
Course enrolment requirements and entry competences required for the course						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Know the components of scientific or critical thinking: empiricism, rationalism, and skepticism. Knowing how to ask a good scientific question or how to define a problem, different types of questions. Understand the following processes: choosing a research topic, gathering information, reading scientific papers, making notes (data bank), how to start research, designing an experiment, presenting results. Know the parts of the scientific work: what is written in the introduction, material and methods, results, discussion, summary, how to cite literature, draft work, calendar, writing order, draft version and final version, writing style.					
Course content broken down in	**Lecture 1.** Definition of science; scientific and critical thinking.					

detail by weekly class schedule (syllabus)	The definition of science, the concept of reliable knowledge, which is a scientific method, scientific or critical thinking. **Lecture 2.** Empiricism, rationalism, skepticism. Components of scientific or critical thinking: empiricism, rationalism and skepticism. **Lecture 3.** Observing phenomena or processes in nature. Problems with perception, logical thinking and reasoning; perception and measurement, science and senses. **Lecture 4.** Problem definition (asking questions). How to ask a good scientific question or how to define a problem, different types of questions. **Lecture 5.** Information gathering (problem research). Sources of information (literature, conversations, own observations, experience). **Lecture 6.** Hypothesis. The most important features of a well-established hypothesis, an alternative hypothesis, a null hypothesis. **Lecture 7.** Hypothesis testing. Experiment, observation, models. **Lecture 8.** Making a scientific prediction. What form of prediction, Ockham principle. **Lecture 9.** Experiment. Causal link, main elements of the experiment (dependent and independent variable, control, replication), experimental data (descriptive, numerical), design and execution of the experiment. **Lecture 10.** Analysis of results. Statistical methods in results analysis, decision making, notion of statistical significance. **Lecture 11.** From hypothesis to scientific theory. Confirmed hypothesis, published hypothesis, multifaceted hypothesis, scientific fact, scientific theory, inductive and deductive reasoning. **Lecture 12.** Scientific research planning. Choosing a research topic, gathering information, reading scientific papers, making notes (data bank), how to start research, designing an experiment, presenting results. **Lecture 13.** Writing a scientific paper. Parts of scientific work: what is written in the introduction, material and methods, results, discussion, abstract, how to cite literature, draft work, calendar, writing order, draft version and final version, writing style. **Lecture 14.** Presentation of scientific results. Oral and poster presentation. **Lecture 15.** Publication of scientific results. Publication process, types of papers and journal types. **SEMINARS** Seminars consist of exercises and assignments that students must complete, followed by discussion on the topic. Listed below are exercises and tasks to be performed (the brackets indicate the approximate duration of each exercise). Exercise 1: Ways People Get to What They Believe it is the 'Truth' (20 ') Exercise 2: Different Types of 'Truth' (20 ') Exercise 3: Different Types of Evidence (20 ') Exercise 4: Observing and Analyzing Evidence (60 ') Exercise 5: Using Sensory Perception, Logical Thinking, and Inference (90 ') Exercise 6: Observing Nature Events and Describing the Observed (30 ') Exercise 7: Describing and Identifying Nature Proofs (60 ') Exercise 8: Problem Defining or Asking Questions (30 ') Exercise 9: Describing phenomena based on observations and / or past experience and hypothesizing (45 ') Exercise 10: Exploring problems (collection and information) (120') Exercise 11: Making Predictions Using a Causal Relationship (30 ') Exercise 12: The Ockham Principle (15 ') Exercise 13: Designing and Performing an Experiment (120 ')

	Exercise 14: Designing and Planning an Experiment (30 ') Exercise 15: Replication Experiment: Data Analysis (60 ') Exercise 16: Searching and Studying Literature (120 ') Exercise 17: Writing a Scientific Paper (120 ') Exercise 18: Presentation of Work (120 ') Note: Some exercises that take longer can be converted to homework.
Format of instruction	☒ lectures ☒ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work ☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	Attendance is compulsory (a number of excused absences are tolerated in accordance with Course teacher).

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance		Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	2	Project		(Other)	

Grading and evaluating student work in class and at the final exam	The exam is in the form of a written test. The overall grade is influenced by the students' commitment and performance in completing tasks and exercises, as well as their activity and contribution to the discussions.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Šolić, M: Uvod u znanstveni rad, CD s nastavnim materijalima koji uključuje PPT prezentacije i skripte i opise vježbi	/	/

Optional literature (at the time of submission of study programme proposal)	1. McMillan, V.E. 1997. Writing Papers in the Biological Sciences. Bedford Books, Boston, pp 197. 2. Katz, M.J. 2009. From Research to Manuscript. Springer, pp 205.
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) attendance b) teaching activity c) knowledge acquired
Other (as the proposer wishes to add)	/

NAME OF THE COURSE	**BIOTECHNOLOGY AND GENETICS IN FISHERIES AND AQUACULTURE**					
Code	SMR506	Year of study	2			
Course teacher	Željka Trumbić, PhD	Credits (ECTS)	4			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	0	30	-

Status of the course	Elective	Percentage of application of e-learning	
COURSE DESCRIPTION			
Course objectives	The objective of this course is to introduce students to the basics of biotechnology with a focus on marine (blue) biotechnology. During the lecture, basic techniques of gene manipulation, marine organisms as sources of high molecular compounds and producers of physiologically active substances will be discussed, as well as genetically modified and transgenic organisms in aquaculture.		
Course enrolment requirements and entry competences required for the course			
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Understand the main areas of application of biotechnology. Comprehend new methods of genome and protein research and principles of producing high-value compounds from marine organisms. Acquire the understanding of principles and use of marine organisms and mechanisms of action of their active compounds as biopesticides and bioherbicides.		
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Introduction, definitions and a historical overview of biotechnology. (2 hours) Learning outcomes: Define and understand the concept of biotechnology. Historical review of the development of biotechnology as a science. **Lecture 2:** Classification of biotechnology - Blue, Green, White and Gray. (2 hours) Learning outcomes: Explain and adopt major areas of biotechnology application. **Lecture 3:** Division of biotechnological processes by biochemical reactions and by type of biocatalyst. (2 hours) Learning outcomes: Comprehend the division of biotechnological processes. **Lecture 4:** Basic principles of genome and proteome research. (2 hours) Learning outcomes: Comprehend new methods of genome and protein research. **Lecture 5:** General scheme of the microbial process; microbial cell as bioreactor. (2 hours) Learning outcomes: Comprehend microbial processes in cells. **Lectures 6 and 7:** Recombinant DNA technology. Cloning of plant and animal cells. (4 hours) Learning outcomes: Comprehend the principles of recombinant DNA technique, cloning. **Lecture 8:** Fundamentals of transgenetics. (2 hours) Learning outcomes: Comprehend the principles and applications of transgenetics **Lecture 9:** Genetically modified and transgenic organisms in aquaculture. Problems of growing transgenic fish. (2 hours) Learning outcomes: Comprehend the importance of the organisms thus obtained and their role in aquaculture. **Lecture 10:** Marine organisms as sources of natural products (invertebrates, sponges and algae). (2 hours) Learning outcomes: Comprehend the principles of producing high-value compounds from these organisms. **Lecture 11:** Continuous cultivation of algae in aquaculture (micro, mini and macro algae). (2 hours) Learning outcomes: Comprehend the principles of algae selection, outdoor pool cultivation and photobioreactors (Dunaliella salina, Spirulina sp.). **Lecture 12:** Algae as energy producers (biofuels - biodiesel). (2 hours) Learning outcomes: Familiarity with the processes of producing biofuels from algae. **Lectures 13 and 14:** Other products from marine organisms (drugs, enzymes, bimaterials, biosensors, biopesticides). (4 hours) Learning outcomes: Familiarity with the processes for obtaining the products listed. **Lecture 15:** Production of biopesticides (marine sponges) and bioherbicides (coral reef organisms). (2 hours)		

<table>
<tr><td></td><td colspan="6">Learning outcomes: Comprehend the principles for the use of marine organisms and the mechanisms of action of their active compounds as biopesticides and bioherbicides.
EXERCISES:
Learning outcomes: Comprehend the principles of bioreactor operation and analytical extraction of active substances from marine organisms.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">The student is expected to attend practical courses (exercises). The teacher evaluates the student's participation during class (demonstrated knowledge, understanding, problem-solving ability, reasoning, etc.) The goal of the exercises is to familiarize the student with the work of the bioreactor, methods of sampling and sample preparation, sample analysis, standardization and presentation of results. At the end of all the exercises, the student is required to take a midterm. Students who do not complete all the exercises and do not take the midterm exam will have to enroll next year. During the semester, the work of each student will be monitored, and the teacher can consult with the students who fall behind during class.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Students' competences will be evaluated and graded during the course as well as at the final exam. During the class, the following will be evaluated: a) class attendance, b) independent work and activity in class, and c) acquired knowledge. Students' knowledge is tested by a written exam.
Knowledge assessment: Knowledge assessment is done by a written exam. The exam duration is 60 minutes. The exam is scored, and a final grade is formed based on all evaluated activities. To pass the exam, the questions must be answered with an accuracy of at least 60%.
Assessment: The final grade is formed on the basis of the total scores achieved according to the following key:
70 - 81 points sufficient (2)
82 - 93 points good (3)
94 - 105 points very good (4)
106 - 120 points excellent (5)
Successful completion of the course requires: fulfilling all teaching obligations (attending and actively participating in lectures) and completing exercises and passing a midterm exam. The total grade consists of the results of the final written exam, exercise exams, and the presence and active participation during class.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="3">Beaumont, A.R. and Hoare, K. 2003. Biotechnology and genetics in fisheries and aquaculture. Blackwell science Ltd.158pp.</td><td></td><td></td></tr>
</table>

	Dunham, Rex A. 2004. Aquaculture and fisheries biotechnology: genetic approaches. CABI Publishing.372 pp.		
Optional literature (at the time of submission of study programme proposal)	1. Fenical, W. And Jensen P. (1993). Advances in Marine biotechnology. Vol.I: Pharmaceutical and Bioactive Natural products. (Attaway, D. and Zaborsky, O. Eds.) Plenum Press.		
Quality assurance methods that ensure the acquisition of exit competences	Students' work and competences will be evaluated and graded during the course as well as at the final exam. During the course, the following will be evaluated: a) attendance b) activity during class c) knowledge acquired		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**CLIMATE CHANGE AND MARINE ECOSYSTEMS**					
Code	SMR510	Year of study	2			
Course teacher	Maja Krželj, PhD	Credits (ECTS)	3			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning	-			
COURSE DESCRIPTION						
Course objectives	The objective of the course is to introduce students to global and regional climate change and impact these changes have on marine ecosystems.					
Course enrolment requirements and entry competences required for the course	-					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- to know the causes of climate change on a global and regional scale - to analyse the impacts of climate change on a global and regional level - to link climate change to changes occurring in marine ecosystems - to predict the effects of climate change on populations and composition of marine organisms' communities - to assess the potential and actual effects of climate change on living marine resources - to analyse problems and solutions related to the impact of climate change on marine ecosystems					
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Introduction. The concept of climate system, climate and mechanisms of climate change. **Lecture 2:** The causes of climate change: natural and anthropogenic. The role of CO_2 and other greenhouse gases in the atmosphere and in oceans. **Lecture 3:** Recorded changes in climate system at various spatial and temporal scales and their effects on ecosystems. Trends and oscillations of the atmosphere and the sea. **Lecture 4:** Global warming. Glacier melting and sea level rise. Possible trends in sea warming and ecosystem impact. Negative effects on the marine ecosystem. **Lecture 5:** Marine organisms as indicators of changes in the ecosystem. Population fluctuations, migration, changes in habitats and areas. **Lecture 6:** Climate change in the northern hemisphere, the Mediterranean and the Adriatic Sea.					

<table>
<tr><td></td><td colspan="6">Lecture 7: Potential effects of climate change on marine fisheries (socio-economic element). Conferences, resolutions, strategies, plans and programmes for climate change mitigation and adaptation.
Seminar 1: Calculation of carbon footprint and greenhouse gas emissions; Renewable energy sources (2 hours)
Seminar 2: Documentary movie (2 hours)
Seminar 3: Education, media, economics, climate financing and sustainable development (2 hours)
Seminar 4: Climate change impact assessments, vulnerability and climate change assessment (2 hours)
Seminar 5: Discussion (2 hours)
Seminar 6: PAP / RAC Visit (3 hours)
Seminar 7: Student presentations (3 hours)</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☒ seminars</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">-</td></tr>
<tr><td rowspan="6">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Students will be evaluated and graded during the course as well as at the final exam. During the course, attendance at classes, seminars and visits, seminar work, seminar activity and acquired knowledge are evaluated. It is necessary to meet all teacher's requirements (class attendance and individual presentation of seminar work) in order to pass the exam.
To pass the exam, the questions must be answered with an accuracy of at least 60%.
The grade on the exam is formed on the basis of the achievement achieved by the following scoring: 60 - 70 sufficient (2), 71 - 80 good (3), 81 - 90 very good (4), 91 - 100 excellent (5).</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="3">Marine Ecosystems and Global Change (2010) M Barange, JG Field, RP Harris, EE Hofmann, RI Perry, FE Werner. Oxford University Press, 440 p.</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Aquatic Ecosystems in a Changing Climate (2018) DP Hader, K Gao. CRC Press, 318 p.</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Climate Change Impacts on Marine Ecosystems (2012)
SC Doney, M Ruckelshaus, JE Duffy, JP Barry, F Chan, CA English, HM Galindo, JM Grebmeier, AB Hollowed, N Knowlton, J Polovina, NN Rabalais, WJ Sydeman, LD Talley. Annual Review of Marine Science 4819:11-37.</td><td></td><td colspan="2"></td></tr>
</table>

	Impacts of Climate Change on Marine Organisms and Ecosystems (2009) AS Brierley, MJ Kingsford. Current Biology 19 (14): R602-R614.		
	Climate Change and Costal Ecosystems: Long-Term Effects of Climate and Nutrient Loading on Trophic Organization (2014) RJ Livingston. CRC Press, 572 p.		
Optional literature (at the time of submission of study programme proposal)	-		
Quality assurance methods that ensure the acquisition of exit competences	The lectures and seminars are designed to be interactive and encourage active student participation in the classroom through questions and comments, thus enabling continuous monitoring of students' work.		
Other (as the proposer wishes to add)	Consultation times and exam dates will be published on the website of the University Department of Marine Studies. Inspection of the exam documentation/and or consultations can be made in office hours. Students can contact Course teacher by email.		

NAME OF THE COURSE	**BIOLOGY, ECOLOGY AND POPULATION DYNAMICS OF CEPHALOPODS**					
Code	SMB514	Year of study	2			
Course teacher	Svjetlana Krstulović Šifner, PhD	Credits (ECTS)	3			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	Students are introduced to the biological and ecological characteristics of cephalopods and the dynamics of their populations, with reference to the cephalopods of the Adriatic Sea. They also learn about cephalopod systematics, the economic importance and annual production of cephalopods, the ways and methods of their capture, reproductive biology (reproductive system, maturation of gonads, reproduction, fertilization, egg laying and care for offspring, embryonic development, juvenile phase) and reproductive strategies of cephalopods. In addition, they gain new insights into the dynamics of Cephalopod populations and methods for determining their age, with reference to the age determination using statoliths. Students are introduced to the biological and ecological characteristics of teutofauna in the Adriatic Sea and the biology, ecology and dynamics of populations of economically important species in the Adriatic Sea. In addition, they gain knowledge on the latest researches on the deep-sea teutofauna of the Adriatic Sea.					
Course enrolment requirements and entry competences required for the course	-					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- acquire knowledge about the reproductive characteristics of different groups of cephalopods, reproductive organs and sexual products, define basic reproductive strategies, ways and place of depositing eggs, care to their offspring, characteristics of embryonic development;					

	- understand dynamics of the growth and mortality of cephalopods; learn how biotic and abiotic factors influence their growth and mortality rate; - define basic biological characteristics of economically significant cephalopod species. - get acquainted with the recent status of stocks of cephalopods in the Adriatic - acquire knowledge on the impact of increased fishing pressure cepahalopod populations.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1** (3 hours). Introduction. Systematics of cephalopods Learning outcomes: Introduction to the content of the course, plan of lectures, literature and all obligations students have to fulfil for a successful mastering of the course and acquiring of the final grade. During the introduction lecture students will be acquainted with the ways of taking exams and the grading system. Identify and advance the knowledge about the systematics of cephalopods with the short overview of all extinct and today's groups of cephalopods. **Lecture 2** (3 hours). Commercial importance and annual production of cephalopods. Tools and methods for fishing cephalopods Learning outcomes: Analyse commercial importance of cephalopods in the world's fisheries and get acquainted with groups and species that make the majority in the total world catch including the catches of the Mediterranean and the Adriatic Sea; familiarize with fishing trends and causes of changes in size and distribution of the exploited stocks; get acquainted with tools and methods for fishing cephalopods in the world's oceans and seas including the Mediterranean and the Adriatic Sea. **Lecture 3** (3 hours). Reproductive biology of cephalopods. Reproductive strategies of cephalopods Learning outcomes: Be able to define the most important reproductive strategies of cephalopods; familiarize with the reproductive characteristics of different cephalopod groups, reproductive organs and sexual products, reproduction period and modes, ways and places of depositing eggs, parental care and characteristics of their embryonic development; the features and main representatives of basic reproductive strategy types. **Lecture 4** (3 hours). Population dynamics: growth, age and mortality of cephalopods. Methods for age and growth determination. Learning outcomes: Learn about basic characteristics of the growth and mortality dynamics in cephalopods. Acquire knowledge on important biotic and abiotic factors and how they affect growth and mortality of this group of organisms; introduce students to current methods used in age determination of cephalopods, their advantages and disadvantages; be able to explain the methodology of the most frequently used methods for age determination using hard structures, especially the method of age determination using statoliths. **Lecture 5** (3 hours). Cephalopods of the Adriatic Sea. Deep-sea teutofauna of the Adriatic Sea Learning outcomes: Be able to define basic biological characteristics of commercially important species; familiarize with the recent stock assessment of these species in the Adriatic Sea and influence of the increasing fishing pressure on the state of their populations; provide accounts for all families and genera of cephalopods which inhabit the Adriatic Sea; familiarize with previous scientific researches and findings about this group of organisms in the Adriatic Sea; be able to describe recent studies of the deep-sea teutofauna in the Adriatic Sea including basic biological characteristics of the found species. **SEMINARS** Themes of seminars depend upon student's interest. Besides the themes proposed by the lecturer, students are encouraged to select themes of their interest, related to the content of the course *Biology, ecology and population dynamics of cephalopods*. Students are expected to actively participate at seminars through discussion and answering the questions after seminar presentation. The teacher acts as a moderator and the student who presents the seminar needs to answer the questions that may arise from the discussion. General learning outcomes are:

<table>
<tr><td></td><td colspan="6">

familiarize with the characteristics of the class Cephalopods; their biological and ecological role, population dynamics and commercial importance;
gain insight into the state of commercially important stocks of cephalopods, potential of their further exploitation and measures that have been or should be taken for proper and sustainable management of their stocks;
understand the basic principles of different abiotic and biotic factors influencing cephalopod populations;
familiarize with the reproductive characteristics of cephalopods, particularities of the different groups within the class, as well as with the influence of certain reproductive strategies regarding the recent estimate of their populations;
develop autonomy in research and collecting information for seminar preparation; following specific guidelines on how to write seminar paper;
deliver a good presentation of the seminar;
actively participate in discussion and offer objective, critical review of one own’s and someone else's work.

</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students are expected to regularly attend lectures and seminars and actively participate through questions, remarks and comments, which means they need to prepare before teaching sessions through out-of-class studying of the material presented at lectures and seminars.
The main task of the seminars is to acquire substantial knowledge about the selected teaching content and students should be able to present seminar before teacher and other colleagues. This will prepare them for independent, active and creative work which is expected of them after the study completion.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">The examination is taken in writing and consists of the material from the lectures. The written tests are solved by choosing the right answer(s) among the offered options or by inserting missing words/definitions.
Students who have not passed the written test must another exam which can be in written or oral. Students who wish to improve their grade may also, in agreement with the teacher, arrange another written or oral exam.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="3">Boyle PR (1983) Cephalopod life cycles. Volume 1. Species Accounts. Academic Press London</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Boyle PR (1987) Cephalopod life cycles. Volume 2. Comparative Reviews. Academic Press London</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3">Caddy JF (ed) (1983) Advances in assessment of world cephalopod resources. FAO Fisheries Tech. Paper 231: 1- 452</td><td></td><td colspan="2"></td></tr>
</table>

	Nesis K (1987) Cephalopods of the world. T.H.F. Publications Inc.		
Optional literature (at the time of submission of study programme proposal)	Jereb P, Ragonese S, Boletzky Sv (1991) Squid age determination using statoliths. Proceedings of the international workshop held in the Istituto di technologia della pesca e del pescato N.T.R. – I.T.P.P. Special publication, No.1: 1-127 Jereb P., Roper C.F.E. (2005) Cephalopods of the world. Vol. 1, Chambered Nautiluses & Sepioids. FAO Species Catalogue for Fishery Purposes No. 4, Vol. 1 Jereb P., Roper C.F.E. (2011) Cephalopods of the world. Volume 2, Myopsid and Oegopsid Squids. FAO Species Catalogue for Fishery Purposes No. 4, Vol. 2 Roper CFE, Sweeney MJ, Nauen CE (1984) FAO species catalogue. Vol. 3. Cephalopods of the world. An annotated and illustrated catalogue of species of interest to fisheries. FAO Fish. Synop., (125), Vol. 3		
Quality assurance methods that ensure the acquisition of exit competences	Students will be evaluated and graded during the course and at the final exam. During the course, the following is to be evaluated: a) attendance b) activity during lectures c) acquired knowledge		
Other (as the proposer wishes to add)	-		

NAME OF THE COURSE	**CONSERVATION OF MARINE BIODIVERSITY**					
Code	SMR517	Year of study	2			
Course teacher	Zvjezdana Popović Perković, PhD	Credits (ECTS)	3			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning	-			
COURSE DESCRIPTION						
Course objectives	By learning about the basic characteristics and processes which influence biodiversity in marine ecosystems, students will gain practical and theoretical knowledge for understanding the issues of active and passive principles of biodiversity conservation. Students also learn about the factors that influence the loss of biodiversity (special focus on the Mediterranean and the Adriatic Sea), and about possible solutions for its conservation.					
Course enrolment requirements and entry competences required for the course	-					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Acquire knowledge on: - the consequences of human activities that endanger individual species, their habitats and communities (littoralisation, maritime transport, hydro-construction, catch and breeding of marine organisms) and their mechanisms of action (direct and indirect); - the biological and ecological traits of endangered species (distribution, growth, reproduction, role in the ecosystem, elements which threaten them and methods of protection (legislation)). - Familiarize with the legal framework for addressing marine protection (Convention on the Law of the Sea, Convention on Biological Diversity, Code of Conduct for Responsible Fisheries, The Barcelona Convention). - Understand ecological isolation as an evolutionary mechanism in the emergence of new species.					
Course content broken down in	**Lecture 1.** Introduce students to the requirements for obtaining a signature, examination procedure and interpretation of the grading system, and the course					

detail by weekly class schedule (syllabus)	content. Introduction to the course. Mechanisms that endanger individual species, their habitats and their living communities. Learning outcomes: The student must understand the concept of biodiversity and temporal patterns of biodiversity (speciation and extinction of species). The student also must acquire the knowledge on consequences of human activities which threaten certain species, their habitats and living communities (littoralisation, maritime transport, hydro-construction, catch and breeding of marine organisms) and learn about the mechanisms of their action (direct and indirect). The student must understand the principle of sustainable development, that is, the measures of reasonable use of resources for their conservation. **Lecture 2.** International organizations, conventions, programmes and plans in the field of marine protection. IUCN Red List of threatened species. Learning outcomes: The student must be familiar with leading international programmes and plans that address sea issues (FAO, IMO, UNESCO, UNEP; WWF, IUCN, Natura 2000). Be familiarized with the legal framework addressing marine protection (Convention on the Law of the Sea, Convention on Biological Diversity, Code of Conduct for Responsible Fisheries, The Barcelona Convention). The student must be habilitated to the contents of the IUCN Red List, the categories and the criteria for threatened species. **Lecture 3.** Protection of biodiversity of the Mediterranean and Croatia. Overview of endangered species and lower systematic categories of flora and fauna in the Mediterranean and Adriatic. Learning outcomes: Familiarize with national organizations, programmes and plans, as well as legislation and byelaws (Environmental Protection Act, Nature Protection Act, regulations) which govern marine environment. The student must know the criteria for classifying taxa into strictly protected and protected taxa, and how to handle such taxa. The student must know the Ordinance on the level of compensation for damage caused by prohibited activities on protected animal taxa (OG 84/96). The student must know categories and criteria listed in the Red Book of the Republic of Croatia. **Lecture 4.** Ecology of endangered flora species in the Mediterranean and Adriatic. Learning outcomes: Acquire knowledge on biology and ecology of endangered plant species (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them and ways of protection (legislation). **Lecture 5.** Ecology of endangered animal species in the Mediterranean and Adriatic: from Protozoa to Mollusca. Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, the mechanisms that threaten them, and methods of protection (legislation)). **Lecture 6.** Ecology of endangered animal species in the Mediterranean and Adriatic: Mollusca and Anellida. Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them, and methods of protection (legislation)). **Lecture 7**. Ecology of endangered animal species in the Mediterranean and Adriatic: from Arthropods to Echinoderms. Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, the mechanisms that threaten them, and methods of protection (legislation)). **Lecture 8.** Ecology of endangered fauna species in the Mediterranean and Adriatic: from Echinoderms to Acrania. Learning outcomes: Acquire knowledge on biology and ecology of the endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them and methods of protection) (Regulation on Sea Cucumber Protection (Official Gazette 76/98)).

<table>
<tr><td></td><td colspan="6">Lecture 9. Ecology of endangered animal species in the Mediterranean and Adriatic: Cyclostomata and Chondrichthyes.
Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them, and methods of protection (Red list of Marine Fish of Croatia)).
Lecture 10. Ecology of endangered animal species in the Mediterranean and Adriatic: Osteichties.
Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above group (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them, and methods of protection (Red list of Marine Fish of Croatia)).
Lecture 11. Ecology of endangered animal species in the Mediterranean and Adriatic: Reptilia and Aves.
Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them and methods of protection) (Regulation on the protection of certain species of reptiles - Reptilia).
Lecture 12. Ecology of endangered animal species in the Mediterranean and Adriatic: Mammalia.
Learning outcomes: Acquire knowledge on biology and ecology of endangered species from the above groups (distribution, growth, reproduction, role in the ecosystem, mechanisms that threaten them and methods of protection) (ACCOBAMS (The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area), Ordinance on Mammal Protection (Mammalia) (OG 31/95).
Lecture 13. Movie The tree of life.
Learning outcomes: Understand the concept of biodiversity (taxonomic, genetic and ecosystem variability), and the processes of speciation and species extinction. Understand weather changes across fossil discoveries. Understand ecological isolation as an evolutionary mechanism in the emergence of new species. Understand Darwin's theory of evolution and natural selection. According to Darwin's theory, variations within species occur by chance and the survival or extinction of organisms is determined by their ability to adapt to the environment. Understand Haeckel's recapitulative theory - ontogeny is parallel to phylogeny.
Lectures 14 and 15. Film The end of the line.
Learning outcomes: Understand the impact of fishing on the reduction of marine biodiversity (overfishing and by-catch) on the case of north Atlantic cod and Atlantic bluefin tuna; learn about the importance of protecting endangered species and the socio-economic context.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Students who have attended at least 80% of classes during the semester and have prepared and delivered seminar paper successfully have the right to take the test.</td></tr>
<tr><td rowspan="4">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is</td><td>Class attendance</td><td>0,5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1,5</td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
</table>

equal to the ECTS value of the course)	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam	Students' work will be evaluated and graded during the course (class attendance, class activity, preparation and presentation of seminar work). Students who have attended at least 80% of classes during the semester are eligible to get the signature. There are no classic exams. The final grade makes up 75% of the design and presentation of the seminar paper and 25% attendance and activity. The evaluation of the seminar paper encompasses independence in research, ability to analyse and synthesize problems, with a particular focus on structuring material, presentation of the topic (visual and speaking skills), ability to transfer knowledge, critical review of one's own and work of others.		
Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Norse, E.A. 1993. Global marine biological diversity: A strategy for building conservation and decision making. Island Press, Washington D.C.000. Global biodiversity - Earth's living resources in the 21st century. World Conservation Press, Cambridge.		1
Optional literature (at the time of submission of study programme proposal)	Radović, J. 2000. An overview of the state of biological and landscape diversity of Croatia with the protection strategy and action plans. Ministry of Environmental Protection and Physical Planning, XVIII: 158 pp. UNEP World Conservation Monitoring Centre. 2 Gaston, K.J. (ed.). 1996. Biodiversity: A Biology of Numbers and Difference. IUCN: Svjetski crveni popis biljaka i životinja (www.redlist.org). Državni zavod za zaštitu prirode. 2004. Crveni popis ugroženih biljaka i životinja RH. Nybakken, J. W.E. 1997. Marine biology: An ecological approach. B. Cummings LTD Wilson, E.O. 1992. The diversity of life. Penguin books, London.		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course, as well as at the final exam. During the course, the following is evaluated: a) attendance b) activity during class c) knowledge acquired		
Other (as the proposer wishes to add)	-		

NAME OF THE COURSE	**WELFARE OF AQUATIC LABORATORY ANIMALS**					
Code	SMR520	Year of study	2			
Course teacher	Mirela Petrić, PhD	Credits (ECTS)	4			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30	15	0	-
Status of the course	Elective	Percentage of application of e-learning				
COURSE DESCRIPTION						
Course objectives	Laboratory and experimental animals are animals used for scientific or educational purposes. Proper care and use of laboratory animals requires scientific and professional judgment based on knowledge of their physical, physiological and ethological needs. Personnel working with these animals must be properly educated and trained in activities such as conducting experiments, designing experiments and projects, caring for and killing animals. Animals must also be provided with an environment and care that takes into account all their needs (e.g. diet, temperature, light, water quality, population density etc.), allowing them to grow and reproduce. The course is designed to introduce students to the principles of animal welfare					

	science, with emphasis on aquatic laboratory animals, since upon study completion they can find employment in animal breeding facilities, animal supplies manufactures, animal testing facilities and also be involved in preparation of biological products.
Course enrolment requirements and entry competences required for the course	Acquired knowledge in zoology, animal physiology and ethology.
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Upon completion of the course, students should clearly: - state national and EU laws and guidelines relating to the regulation of the use of animals in scientific research; - state the legal framework of the course for working with laboratory animals; - explain basic concepts in the anatomy and physiology of aquatic laboratory animals; - assess the welfare of animals used for research, breeding and educational purposes; - give a critical review of the link between animal care and behavior; - organize a laboratory for working with aquatic laboratory animals; - plan and conduct the experiment properly.
Course content broken down in detail by weekly class schedule (syllabus)	The mark (*) indicates the number of scheduled lessons: - **Lecture 1.** Animal ethics (*2): critical review of questions about human attitude - what is acceptable, what is not acceptable; differences between wild and domestic animals and those used for scientific purposes; different views on human duties to animals; who makes the decisions; knowledge of basic ethical principles of animal use. - **Lecture 2.** Animal welfare (*5): definition of animal welfare; welfare assessment; the differences between animal welfare and animal rights; approaches to well-being; the need to use animals for scientific and educational purposes; the Five Freedom principles and the 3R principles - Replacement, Reduction, Refinement; ways to improve well-being. - **Lecture 3.** History of animal research (*2): a historical overview of animal research in the world and in Croatia. - **Lecture 4.** Laboratory animals legislation (*3): competent authorities in the field of protection of animals used for scientific purposes in the Republic of Croatia; legal documents with knowledge of the legal regulations in the field of protection of animals used for scientific purposes in the Republic of Croatia and the EU. - **Lecture 5.** Biology of aquatic laboratory animals (*4): taxonomy of aquatic laboratory animals; analysis of integumental, skeletal, muscular, respiratory, nervous and reproductive system as well as behavior analysis; importance of fish and cephalopods as a model organism. **- Lecture 6.** Acquisition and placement of animals (*2): knowledge of how to properly procure, transport and import laboratory animals. - **Lecture 7.** Housing care (*2): basic principles for housing, keeping and caring for animals in captivity, that is, housing for laboratory animals; the link between animal care and behavior. - **Lecture 8.** Diseases and health monitoring (*2): health risks in working with laboratory animals (zoonoses, allergies and injuries); examination of diseases in aquatic laboratory animals; basic principles of health care and disease control. - **Lecture 9.** Recognition of pain, suffering and stress (*2): current knowledge of nociception in fish and cephalopods; physiological parameters of aquatic laboratory animals; assessment of pain and stress and animal behavior as an indicator of animal welfare. - **Lecture 10.** Anesthesia, analgesia and euthanasia (*2): the main anesthetics used in working with aquatic laboratory animals; factors to consider before, during and after anesthesia with regard to the planned experiment, proper handling of the animals; methods of killing an animal.

	- **Lecture 11.** Training in the handling of laboratory animals (*2): levels of training in the handling of laboratory and experimental animals; legal frameworks for laboratory animals; entities registered for training in the field of protection of animals used for scientific purposes in the Republic of Croatia. - **Lecture 12.** Laboratory animal science organizations (*2): the activities of laboratory animal welfare organizations. - **Seminar 1.** Good laboratory practice (*5): basic principles of good laboratory practice in aquatic laboratory animals; organizing laboratories for work and keeping logs and records of work; proper planning and execution of experiments. - **Seminar 2.** Video demonstration of standard procedures in fish and cephalopods (*5): standard procedures in fish and cephalopods - collection, handling, initial visual inspection, non-invasive procedure, anesthesia, human euthanasia and section. - **Seminar 3.** Group work - 'Problem based learning tutorial' (*5): group discussions on hypothetical research scenarios in aquatic laboratory animals; assessment of the severity of procedures performed on animals for the purposes of various studies.
Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work ☐ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☒ seminar
Student responsibilities	The course is organized in the form of lectures and seminars (PowerPoint presentations, educational films). Students are required to attend all forms of teaching (lectures and seminars), actively participate in the teaching process and pass the exam. Attendance in all forms of teaching will be recorded. The student is allowed 3 absences from the class. Delays in all forms of teaching will also be recorded, with 3 delays counted as one unjustified absence. 100% attendance will be awarded with 2 points.

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1,5	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam	2,5	Project		(Other)	

Grading and evaluating student work in class and at the final exam	At the end of the course, a final grade is obtained by passing the written exam. The exam consists of the material given at lectures and seminars. The exam consists of three groups of questions: rounding, supplementing and describing. Evaluation and final rating: 91% - 100%: grade 5 (excellent); 81% - 90%: grade 4 (very good); 71% - 80%: grade 3 (good); 61% - 70%: grade 2 (sufficient); <61%: grade 1 (inadequate).

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Appleby MC, Mench JA, Olsson IAS, Hughes BO. 2011. Animal welfare. CAB International, Oxon UK.	1	/
	Zakon o zaštiti životinja - NN 135/06, 37/13, 102/17, 32/19	/	https://www.nn.hr/
	Pravilnik o zaštiti životinja koje se koriste u znanstvene svrhe – NN 55/13, 39/17, 116/19	/	https://www.nn.hr/

	Directive 2010/63/EU On Protection Of Animals Used For Scientific Purposes.	/	http://ec.europa.eu/environment/chemicals/lab_animals/pdf/guidance/directive/en.pdf
Optional literature (at the time of submission of study programme proposal)	1. Guidance - Animal Welfare Bodies And National Committees. Available: http://ec.europa.eu/environment/chemicals/lab_animals/pdf/guidance/animal_welfare_bodies/en.pdf 2. Guidance - Education And Training Framework. Available: http://ec.europa.eu/environment/chemicals/lab_animals/pdf/guidance/education_training/en.pdf 3. Petrić M. 2016. Interna skripta – predavanja iz kolegija Dobrobit vodenih laboratorijskih životinja. Sveučilište u Splitu. 4. Petrić M. 2016. Dodatni nastavni materijal - ppt predavanja i seminara iz kolegija Dobrobit vodenih laboratorijskih životinja. 5. Šuman L. 2011. Uvod u znanost o laboratorijskim životinjama. Sveučilište u Rijeci. Dostupno s: http://lsuman.digitaledition.org. 6. Šuman L. 2018. Uvod u znanost o laboratorijskim životinjama. Sveučilište u Rijeci. Hrvatsko društvo za znanost o laboratorijskim životinjama.128 pp.		
Quality assurance methods that ensure the acquisition of exit competences	The lectures and seminars are designed to be interactive and encourage active student participation in the classroom through questions and comments, thus enabling continuous monitoring of students' work. Analysis of exam success.		
Other (as the proposer wishes to add)	Consultation times and exam dates will be published on the website of the University Department of Marine Studies. Inspection of the exam documentation/and or consultations can be made in office hours. Students can contact me by email at mirela.petric@unist.hr. Additionally, students are expected to read the material obtained, actively participate in classes, and contact the teacher in case they have any difficulty with the course material or wish to properly prepare for the exam.		

3. STUDY PERFORMANCE CONDITIONS

3.1. Places of the study performance

Buildings of the constituent part (name existing, under construction and planned buildings)	
Identification of building	Three faculties building (Zgrada tri fakulteta)
Location of building	Ruđera Boškovića 37, 21000 Split, Croatia
Year of completion	2015
Total square area in m^2	29 500 m^2

3.2. List of teachers and associate teachers

Course	Teachers and associate teachers
Adaptation physiology of marine organisms	Josipa Ferri, PhD

Applied ichthyology	Jure Brčić, PhD
Biology, ecology and population dynamics of cephalopods	Svjetlana Krstulović Šifner, PhD
Biotechnology and genetics in fisheries and aquaculture	Željka Trumbić, PhD
Climate change and marine ecosystems	Maja Krželj, PhD
Conservation of marine biodiversity	Zvjezdana Popović Perković, PhD
Field work	-
Fish population dynamics and stock assessment	Jure Brčić, PhD
Integrated coastal zone management	Vedrana Nerlović, PhD
Management of marine living resources	Alen Soldo, PhD
Mariculture and environment	Vedrana Nerlović, PhD
Marine botany	Zvjezdana Popović Perković, PhD
Methodology of scientific work	Mirela Petrić, PhD
Microbiology of polluted waters	Marin Ordulj, PhD
Reproduction of marine organisms	Josipa Ferri, PhD
Seafood processing technology	Vida Šimat, PhD
Seafood quality assessment	Vida Šimat, PhD
Selectivity and catchability of fishing gears	Jure Brčić, PhD
Statistical methods in biotechnology	Željka Trumbić, PhD
Welfare of aquatic laboratory animals	Mirela Petrić, PhD

3.3. Curriculum vitae of the course teacher

First and last name and title of teacher	Jure Brčić, PhD, Assistant professor
The course he/she teaches in the proposed study programme	Fish population dynamics and stock assessment; Selectivity and catchability of fishing gears; Applied ichtyology
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37, 21000 Split, Hrvatska
Telephone number	+385 21 510 197
E-mail address	jure.brcic@unist.hr
Personal web page	https://www.bib.irb.hr/pregled/znanstvenici/315884
Year of birth	1983
Scientist ID	315884
Research or art rank, and date of last rank appointment	Research associate (20.10.2016.)
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Assistant professor (09.02.2017.)
Area and field of election into research or art rank	Biotechnology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split
Date of employment	01.05.2009.
Name of position (professor, researcher, associate teacher, etc.)	Assistant professor
Field of research	Biotechnology

Function	Assistant professor
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	University of Split
Place	Split, Croatia
Date	24.04.2015.
INFORMATION ON ADDITIONAL TRAINING	
Year	01.07.2011—01.07.2013
Place	Ancona, Italy
Institution	CNR ISMAR
Field of training	Fishing gear technology
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English (5)
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	NA
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	NA
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	NA
Authorship of university/faculty textbooks in the field of the course	NA
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	NA
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	NA
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	NA
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	NA
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	NA

Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	NA

First and last name and title of teacher	Josipa Ferri, PhD, Associate professor
The course he/she teaches in the proposed study programme	Reproduction of marine organisms, Adaptation physiology of marine organisms
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	+385 21 510199
E-mail address	josipa.ferri@unist.hr
Personal web page	-
Year of birth	1983
Scientist ID	288546
Research or art rank, and date of last rank appointment	Senior research associate
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Associate professor
Area and field of election into research or art rank	Biotechnical sciences, agronomy
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, University Department of Marine Studies
Date of employment	2006
Name of position (professor, researcher, associate teacher, etc.)	Associate professor
Field of research	Ichthyology
Function	Head of the University Department of Marine Studies
INFORMATION ON EDUCATION – Highest degree earned	
Degree	Associate professor
Institution	University of Split, University Department of Marine Studies
Place	Split
Date	2018
INFORMATION ON ADDITIONAL TRAINING	
Year	-
Place	-
Institution	-
Field of training	-
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English, 4
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	-

Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	-
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	Physiology of marine organisms and Fisheries biology and ecology at the undergraduate study programme of Marine Fishery
Authorship of university/faculty textbooks in the field of the course	-
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	Ferri, Josipa; Bartulin, Karmen; Škeljo, Frane. Variability of otolith morphology and morphometry in eight juvenile fish species in the coastal eastern Adriatic // Croatian journal of fisheries. Ribarstvo, 76 (2018), 3; 91-98. Ferri, Josipa; Brčić, Jure; Škeljo, Frane; Sršen, Lidija; Uvodić, Anja. A preliminary study on the age and growth of the argentine, *Argentina sphyraena* (Actinopterygii: Osmeriformes: Argentinidae) from the eastern Adriatic Sea // Acta Ichthyologica et Piscatoria, 47 (2017), 4; 365-369. Škeljo Frane; Brčić, Jure; Vuletin, Vedran; Ferri, Josipa. Age and growth of the axillary wrasse, *Symphodus mediterraneus* (L.) from the eastern Adriatic Sea. // Marine biology research. 11 (2015), 7; 780-784. Ferri, Josipa; Stagličić, Nika; Matić-Skoko, Sanja. The black scorpionfish, *Scorpaena porcus* (Scorpaenidae): could it serve as reliable indicator of Mediterranean coastal communities' health?. // Ecological indicators. 18 (2012); 25-30. Matić-Skoko, Sanja; Ferri, Josipa; Kraljević, Miro; Pallaoro, Armin. Age estimation and specific growth pattern of boxlip mullet, *Oedalechilus labeo* (Cuvier, 1829) (Osteichthyes, Mugilidae) in the eastern Adriatic Sea. // Journal of applied ichthyology. 28 (2012), 2; 182-188.
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	-
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	-
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences?	-
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	-
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation	-

organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Svjetlana Krstulović Šifner, PhD, Full professor
The course he/she teaches in the proposed study programme	Biology, ecology and population dynamics of cephalopods
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37, 21000 Split
Telephone number	021 510-196
E-mail address	ssifner@unist.hr
Personal web page	
Year of birth	1968
Scientist ID	239145
Research or art rank, and date of last rank appointment	Scientific advisor
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Full professor
Area and field of election into research or art rank	Biotechnical sciences
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, University Department of Marine Stiudies
Date of employment	01/02/2009
Name of position (professor, researcher, associate teacher, etc.)	Professor
Field of research	Fisheries
Function	
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	University of Zagreb, Faculty of Science
Place	Zagreb
Date	26/11/2004
INFORMATION ON ADDITIONAL TRAINING	
Year	
Place	
Institution	
Field of training	
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English, 5
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	Italian, 3
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	French, 2
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name	A number of teaching courses at undergraduate, graduate and postgraduate level at the University of Split

title of course, study programme where it is/was offered, and level of study programme)	
Authorship of university/faculty textbooks in the field of the course	
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	**Krstulović Šifner, S.,** Lijović, S., Isajlović, I., Petrić, M., Vrgoč, N. (2015) Distribution and abundance of bobtail squids (family Sepiolidae) in bottom trawling catches of the Northern and Central Adriatic Sea. Zbornik radova 50. hrvatskog i 10. međunarodnog Simpozija agronoma. Urednik: Pospišil, M., Agronomski fakultet Zagreb, 375-378. **Krstulović Šifner, S**., Damjanović T., Isajlović I. (2018) Distribution, length-weight relationships and reproductive characteristics of *Sepia orbignyana*, Férussac, 1826 in the Northern and Central Adriatic Sea. *Cahiers de Biologie Marine*, 59(1): 43-51. **Krstulović Šifner, S.**, Bošnjak, D., Petrić, M. (2018) New Information on Deep-Sea Cephalopod *Ancistroteuthis lichtensteinii* (Cephalopoda: Onychoteuthidae) in the Adriatic Sea. *Turkish Journal of Fisheries and Aquatic Science*, 18(7): 837-844. Quetglas, A., Valls M., Capezzuto, F., Casciaro, L., Cuccu, D., González, M., Ikica, Z., **Krstulović Šifner, S.**, Lauria, V., Lefkaditou, E., Peristeraki, P., Piccinetti, C., Vidoris, P., Keller, S. (2019) Long-term spatiotemporal dynamics of cephalopod assemblages in the Mediterranean Sea. *Scientia Marina*, 83S1: 33-42. Ikica Z., Pešić A., Marković O., Joksimović A., **Krstulović Šifner S.** (2019) Distribution and abundance of Horned Octopus (*Eledone cirrhosa* Lamarck 1798) (Cephalopoda: Octopoda) in south-east Adriatic Sea. *Studia Marina*, 32(2): 44-51.
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	EU-MEDITS Programme: Mediterranean international bottom trawl survey, EU (DG XIV) (ongoing) Discatch: Pilot project on catch and discard composition including solutions for limitation and possible elimination of unwanted by-catches in trawl net fisheries in the Mediterranean, EU MARE/2012/24 Lot 2 project (ended in 2015) FAIRSEA: Fisheries in the Adriatic Region – a shared ecosystem approach, Interreg Italy_Croatia (ongoing)
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	Methodological-psychological-didactic-pedagogical group of competences obtained throughout the formal education.
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course	Appraised with high grades in student questionnaires carried out at the University of Split in all teaching years of the course.

described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Maja Krželj, PhD, Assistant professor
The course he/she teaches in the proposed study programme	Climate change and marine ecosystems
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	+385 21 510193
E-mail address	maja.krzelj@unist.hr
Personal web page	-
Year of birth	1980
Scientist ID	288583
Research or art rank, and date of last rank appointment	Research associate
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Assistant professor
Area and field of election into research or art rank	Biotechnical sciences
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, University Department of Marine Studies
Date of employment	2015.
Name of position (professor, researcher, associate teacher, etc.)	Assistant professor
Field of research	Marine ecology, marine pollution, changes in the marine ecosystem, climate change
Function	Head of the Graduate Study of Marine Fishery ERASMUS and ECTS coordinator Head of the Committee for Quality Improvement
INFORMATION ON EDUCATION – Highest degree earned	
Degree	Assistant professor
Institution	University of Split, University Department of Marine Studies
Place	Split
Date	
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD in Marine Biology and Ecology
Institution	Polytechnic University of Marche
Place	Ancona Italy
Date	09.02.2010.
INFORMATION ON ADDITIONAL TRAINING	
Year	
Place	
Institution	
Field of training	
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English, 4

Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	Italian, 5
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	Marine Biology and Ecology, General Biology, Methods in Biological Oceanography and Marine Pollution at Undergraduate Studies of Marine Fishery; Fundamentals of Ecology, Biological Oceanography and Marine Pollution at Undergraduate Studies of Marine Biology and Technology; Ecotoxicology, Marine Pollution and Marine Ecology at Graduated Studies of Ecology and Marine Protection.
Authorship of university/faculty textbooks in the field of the course	-
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	Di Camillo, CG, Ponti M, Bavestrello G, Krzelj M, Cerrano C. (2018) Building a baseline for habitat-forming corals by a multi-source approach, including Web Ecological Knowledge. Biodiversity and Conservation, 27 (5):1257-1276. Martin, CS; Giannoulaki, M; De Leo, F; Scardi, M; Salomidi, M; Knitweiss, L; Pace, ML; Garofalo, G; Gristina, M; Ballesteros, E; Bavestrello, G; Belluscio, A; Cebrian, E; Gerakaris, V; Pergent, G; Pergent-Martini, C; Schembri, PJ; Terribile, K; Rizzo, L; Ben Souissi, J; Bonacorsi, M; Guarnieri, G; Krželj, M; Macic, V; Punzo, E; Valavanis, V; Fraschetti, S. (2014) Coralligenous and maërl habitats: predictive modelling to identify their spatial distributions across the Mediterranean Sea. Scientific Reports, 4, 5073; DOI:10.1038/srep05073. Appiotti, F; Krželj, M; Russo, A; Ferretti, M; Bastianini, M; Marincioni F. (2014) A multidisciplinary study on the effects of climate change in the northern Adriatic Sea and the Marche region (central Italy). Regional Environmental Change, 14:2007-2024. DOI: 10.1007/s10113-013-0451-5. Russo, A; Carniel, S; Sclavo, M; Krželj, M (2012) Climatology of the Northern-Central Adriatic Sea. Modern Climatology, 177-212. Krželj, M (2011) Klimatske promjene zabilježene na Sjevernom Jadranu. Book of Proceedings 3rd International Marine Science Conference, 147-153. Krželj, M. Utjecaj klimatskih promjena na morski okoliš. // Paediatria Croatica. Supplement. 54 (2010) ; 18-23.
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	-
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	Interreg project WATERCARE - Water management solutions for reducing microbial environment impact in coastal areas, Interreg V-A Italy-Croatia CBC Programme 2014-2020
The name of the programme and the volume in which the main teacher passed exams	INTERIV “Internationalization of the study programs of Marine Fisheries and Naval Navigation at the University of Split, UP.03.1.1.02.0046

in/acquired the methodological-psychological-didactic-pedagogical group of competences	"Teaching Process and Competitions of Teachers in Higher Education"
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Vedrana Nerlović, PhD, Assistant professor
The course he/she teaches in the proposed study programme	Mariculture and environment; Integrated coastal zone management
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	00385 21 491504
E-mail address	vedrana.nerlovic@unist.hr
Personal web page	
Year of birth	1973
Scientist ID	242442
Research or art rank, and date of last rank appointment	Assistant professor
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	3.2.2017.
Area and field of election into research or art rank	Natural science, interdisciplinary natural sciences
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, Department of Marine studies
Date of employment	18.9.2017
Name of position (professor, researcher, associate teacher, etc.)	Assistant prof.
Field of research	Aquaculture, mariculture, ICZM
Function	
INFORMATION ON EDUCATION – Highest degree earned	
Degree	Assistant prof.
Institution	University of Pula
Place	Center for Marine research, Rovinj
Date	3.2.2017.
INFORMATION ON ADDITIONAL TRAINING	
Year	2019.
Place	Split
Institution	University of Split
Field of training	Didactic - pedagogical course (2019)
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian

Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English – very good
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	French - good
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	
Authorship of university/faculty textbooks in the field of the course	
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	1. Perić, Lorena; Stinga Perusco, Victor; Nerlović, Vedrana. Differential response of biomarkers in the native European flat oyster Ostrea edulis and the non-indigenous Pacific oyster Crassostrea gigas co-exposed to cadmium and copper. // Journal of experimental marine biology and ecology. 523 (2020) 2. Spagnolo, A.; Auriemma, R.; Bacci, T.; Balković, Ivan; Bertasi, F.; Bolognini, L.; Cabrini, M.; Cilenti, L.; Cuicchi, C.; Cvitković, Ivan; Despalatović, Marija; Grati, F.; Grossi, L.; Jaklin, Andrej; Lipej, L.; Marković, O.; Mavrič, B.; Mikac, Barbara; Nasi, F.; Nerlović, Vedrana; Pelosi, S.; Penna, M.; Petović, S.; Punzo, E.; Santucci, A.; Scirocco, T.; Strafella, P.; Trabucco, B.; Travizi, Ana; Žuljević, Ante. Non-indigenous macrozoobenthic species on hard substrata of selected harbours in the Adriatic sea. // Marine pollution bulletin. 147 (2019) 3. Travizi, Ana*; Balković, Ivan; Bacci, T.; Bertasi, F; Cuicchi, C.; Flander-Putrle, V.; Grati, F.; Grossi, L.; Jaklin, Andrej; Lipej, L.; Mavrič, B.; Mikac, Barbara; Marusso, V.; Montagnini, L.; Nerlović, Vedrana; Penna, M.; Salvalaggio, V.; Santelli, A.; Scirocco, T.; Spagnolo, A.; Trabucco, B.; Vani, D. Macrozoobenthos in the Adriatic Sea ports: Soft-bottom communities with an overview of non-indigenous species.. // Marine pollution bulletin. 147 (2019) 4. Nerlović, Vedrana; Perić, Lorena; Slišković, Merica; Jelić Mrčelić, Gorana. The invasive *Anadara transversa* (Say, 1822) (Mollusca: Bivalvia) in the biofouling community of northern Adriatic mariculture areas. // Management of Biological Invasions. 9 (2018) , 3; 239-251 5. Perić, Lorena; Nerlović, Vedrana; Žurga, Paula; Žilić, Luka; Ramšak, Andreja. Variations of biomarkers response in mussels *Mytilus galloprovincialis* to low, moderate and high concentrations of organic chemicals and metals. // Chemosphere. 174 (2017)
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	

Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	1. Interiv project, 2. workshop: 2019: „Unaprjeđenje znanja i vještina za provedbu Društveno Korisnog Učenja“, University of Split; 3. 2019 EURASTiP CAPACITY BUILDING FORESIGHT WORKSHOP, Kuala Lumpur
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	Interiv project
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Marin Ordulj, PhD, Assistant professor
The course he/she teaches in the proposed study programme	Microbiology of polluted waters
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	+385 21 510 192
E-mail address	marin.ordulj@unist.hr
Personal web page	
Year of birth	1981
Scientist ID	288572
Research or art rank, and date of last rank appointment	Research Associate, 2012
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Assistant Professor, 2015
Area and field of election into research or art rank	Biology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University Department of Marine Studies
Date of employment	2006
Name of position (professor, researcher, associate teacher, etc.)	Assistant Professor
Field of research	Marine microbial ecology
Function	
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	Applied Marine Science
Place	Split
Date	2012

INFORMATION ON ADDITIONAL TRAINING	
Year	
Place	
Institution	
Field of training	
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English; 4
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	Teaching general Microbiology, Marine microbiology, Microbiology of polluted waters at University Department of Marine Studies. Teaching General microbiology at Faculty of Chemistry and Technology at University of Split
Authorship of university/faculty textbooks in the field of the course	Microbial Community Ecology of the Adriatic Sea, 2016
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	1. Mladen Šolić, Danijela Šantić, Stefanija Šestanović, Natalia Bojanić, Slaven Jozić, Ana Vrdoljak, Marin Ordulj, Grozdan Kušpilić. Temperature and phosphorus interacts in controlling the picoplankton carbon flux in the Adriatic Sea: an experimental vs. field study. // Environmental microbiology, 27 (2019), 17;469-2484 doi:10.1111/1462-2920.14634. 2. Danijela Šantić, Vedrana Kovačević, Manuel Bensi, Michele Giani, Ana Vrdoljak Tomaš, Marin Ordulj, Chiara Santinelli, Stefanija Šestanović, Mladen Šolić, Branka Grbec. Picoplankton Distribution and Activity in the Deep Waters of the Southern Adriatic Sea. // Water, 11 (2019), 8; 1655, 21 doi:10.3390/w11081655 3. Šolić, Mladen; Šantić, Danijela; Šestanović, Stefanija; Bojanić, Natalia; Ordulj, Marin; Jozić, Slaven; Vrdoljak, Ana. The effect of temperature increase on microbial carbon fluxes in the Adriatic Sea: an experimental approach. // FEMS microbiology, ecology, 94 (2018), 10; 1-14. doi:10.1093/femsec/fiy169 4. Jozić, Slaven; Vukić Lušić, Darija; Ordulj, Marin; Frlan, Erina; Cenov, Arijana; Diković, Sonja; Kauzlarić, Vesna; Fiorido Đurković, Lara; Stilinović Totić, Jasmina; Ivšinović, Danijela et al. Performance characteristics of the temperature-modified ISO 9308-1 method for the enumeration of *Escherichia coli* in marine and inland bathing waters. // Marine Pollution Bulletin, 135 (2018), 150-158 doi:10.1016/j.marpolbul.2018.07.002 5. Jozić, Slaven; Milanković, Katarina; Brajčić, Tea; Šolić, Mladen; Šantić, Danijela; Ordulj, Marin. The effect of intravalvular liquid loss on changes in Escherichia coli levels in live, refrigerated mussels (*Mytilus galloprovincialis*). // Journal of aquatic food product technology, 26 (2017), 4; 491-500 doi:10.1080/10498850.2016.1214655

Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	5.0

First and last name and title of teacher	Mirela Petrić, PhD, Associate Professor
The course he/she teaches in the proposed study programme	Welfare of aquatic laboratory animals, Methodology of scientific work
GENERAL INFORMATION ON COURSE TEACHER	
Address	University of Split, Department of Marine Studies, Ruđera Boškovića 37, 21000 Split, Croatia
Telephone number	+385 21 510 194
E-mail address	mirela.petric@unist.hr
Personal web page	/
Year of birth	1980
Scientist ID	288550
Research or art rank, and date of last rank appointment	16.11.2018.
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	29.3.2019.
Area and field of election into research or art rank	Biotechnical Sciences, Agronomy
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, Department of Marine Studies
Date of employment	1.9.2006.
Name of position (professor, researcher, associate teacher, etc.)	Associate Professor
Field of research	Marine invertebrates
Function	/
INFORMATION ON EDUCATION – Highest degree earned	

Degree	PhD
Institution	University of Split, Department of Marine Studies
Place	Split
Date	22.11.2011.
INFORMATION ON ADDITIONAL TRAINING	
Year	/
Place	/
Institution	/
Field of training	/
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English - 2
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	/
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	/
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	General Zoology; Undergraduate Study Marine Biology and Ecology; University of Split, Department of Marine Studies
Authorship of university/faculty textbooks in the field of the course	/
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	Petrić, Mirela; Ponte, Giovanna; Mladineo, Ivona; Fiorito, Graziano. Procedure of hemolymph sampling in Octopus vulgaris / Laboratory Animals in Scientific Research / Erhardt, Julija ; Lang Balija, Maja; Lazarus, Maja; Švob Štrac, Dubravka (ur.). Zagreb: Croatian Laboratory Animal Science Association, 2018. str. 44-44
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	/
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	/
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	/
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	/
Results of student evaluation taken in the last five years for the course that is comparable to the course	average grade 5.0 (last 2 years – course has been taught; evaluation organizer is University of Split)

described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Zvjezdana Popović Perković, PhD, Assistant professor
The course he/she teaches in the proposed study programme	Marine botany; Conservation of marine biodiversity
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	+385 21 510 195
E-mail address	zvjezdana.popovic@unist.hr
Personal web page	-
Year of birth	1982
Scientist ID	344221
Research or art rank, and date of last rank appointment	2014
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	1 April, 2014
Area and field of election into research or art rank	Biotechnology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University Department of Marine Studies
Date of employment	1 April, 2014
Name of position (professor, researcher, associate teacher, etc.)	Assistant professor
Field of research	Marine biotechnology
Function	Head of Marine Ecology and Protection programme
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	University of Split
Place	Split
Date	December 2012
INFORMATION ON ADDITIONAL TRAINING	
Year	-
Place	-
Institution	-
Field of training	-
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English 5
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	German 4
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	-
COMPETENCES FOR THE COURSE	

Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	1. Marine Botany, Marine biology and technology at University of Split, undergraduate studies 2. Marine Botany, Marine biology and ecology at University of Split, undergraduate studies 3. Marine Botany, Marine Fisheries and at University of Split, graduate studies 4. Protected Marine Areas, Marine ecology and protection at University of Split, graduate studies, 5. Ecology of underwater communities, Marine biology and ecology at University of Split, undergraduate studies 6. Protected Marine Areas, Applied Marine Sciences at University of Split and University of Dubrovnik, doctoral studies
Authorship of university/faculty textbooks in the field of the course	-
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	1. Phenolic content of brown algae (Phaeophyceae) species: Extraction, Identification and Quantification 2. Biological potential of three Adriatic brown seaweeds 3. Influence of extraction mode on the content of phenolics, pigments and antioxidant potential of brown algae extracts
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	-
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	Professional project: “Students learn about civic engagement - socially beneficial learning in environment and nature protection”
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	1. Faculty of Philosophy, University of Split; CIRCO – Centre for Lifelong Learning Research and Development, Split – “Development and improvement of pedagogical competences of University teachers” 2. Training - developing skills and methods for working with young people, Deutsche Gesellschaft fur Umwelterziehung (DGU) and SUNCE
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	-
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	2018/2019 - Marine botany, grade 4,8 / 5 2018/2019 - Marine protected areas, grade 4,8 2017/2018 - Marine protected areas, grade 4,2 2016/2017 - Ecology of benthic communities, grade 4,5 2016/2017 - Marine botany, grade 4,3 2015/2016 - Marine botany, grade 4,4 2014/2015 - Marine botany, grade 4

First and last name and title of teacher	Alen Soldo, PhD, Full professor
The course he/she teaches in the proposed study programme	Management of marine living resources
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37, Split, Croatia
Telephone number	021510191

E-mail address	soldo@unist.hr
Personal web page	
Year of birth	1970
Scientist ID	243634
Research or art rank, and date of last rank appointment	scientific advisor, 2013
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	full professor tenure, 2018
Area and field of election into research or art rank	Biotechnology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split
Date of employment	2006
Name of position (professor, researcher, associate teacher, etc.)	full professor tenure
Field of research	Biotechnology
Function	Head of Postgraduate Doctoral Study “Applied Marine Sciences”
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	Faculty of Agronomy, University of Zagreb
Place	Zagreb
Date	2004
INFORMATION ON ADDITIONAL TRAINING	
Year	
Place	
Institution	
Field of training	
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English, 5
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	Italian, 2
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme where it is/was offered, and level of study programme)	Fishing tools and techniques, Fishing vessel and fishing harbor exploitation, catchability, selectivity and design of fishing tools, Underwater research techniques at undergraduate Marine Fishery and selectivity and catchability of fishing gears and Sport and recreational marine fishing at the graduate study Marine Fisheriy
Authorship of university/faculty textbooks in the field of the course	Cetinić , Perica; Soldo, Alen. Ribarski brod i luka – tehnologija iskorištavanja. 2010. Književni krug Split
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	Šimat, Vida; Bogdanović, Tanja; Krželj, Maja; Soldo, Alen; Maršić Lučić, Jasna. Differences in chemical, physical and sensory properties during shelf life assessment of wild and farmed gilthead sea bream (*Sparus aurata*, L.). // Journal of applied ichthyology. 28 (2012), 1; 95-101.

	Dulčić, Jakov; Soldo, Alen. New finding of crested oarfish *Lophotus lacepede* (Lophotidae), in the Adriatic Sea. // Cybium. 32 (2008), 1; 93-94. Dulvy, Nick; Baum, Julia; Clarke, Shelley; Compagno, Leonard J.V.; Cortes, Enric; Domingo, Andres; Fordham, Sonja; Fowler, Sarah; Francis, Malcolm; Gibson, Claudine; Martinez, Jimmy; Musick, Jack; Soldo, Alen; Stevens, John; Valenti, Sarah. You can swim but you can't hide: the global status and conservation of oceanic pelagic sharks and rays. // Aquatic Conservation. 18 (2008), 5; 459-482. Morey, Gabriel; Soldo, Alen; Riera, Francisco; Serena, Fabrizio. Records of *Carcharinus limbatus* and *C. plumbeus* (Chondrichthyes: Carchariniidae) from off the Balearic Islands (NW Mediterranean). // Cybium. 32 (2008), 3; 195-200. Soldo, Alen; Lučić, Davor; Jardas, Ivan. Basking shark (*Cetorhinus maximus*) occurrence in relation to zooplankton abundance in the eastern Adriatic Sea. // Cybium. 32 (2008), 2; 103-109.
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	2009. - Regulation and Allowable Level of Exploitation of Sport Fishing in the Adriatic 2011. - Regulation and Allowable Level of Exploitation of Sport Fishing in the Adriatic 2012. - Synergic effects of sport fishing on total economy with special overview on touristic revenue 2012. - Evaluation of tuna catches in sport and recreational fisheries with special overview on temporal and spatial scale and length and age structure of tuna in the Adriatic out of purse seine season 2014. - Comparison of competitive and non-competitive sport fishing
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences?	
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	- Annual award for Marine Sciences Promotion by Ministry of Maritime Affairs, Transport and Infrastructure of Croatia - Award for science and research in biotechnology of the University of Split 2017
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	

First and last name and title of teacher	Vida Šimat, PhD, Associate professor
The course he/she teaches in the proposed study programme	Seafood processing technology Seafood quality assessment
GENERAL INFORMATION ON COURSE TEACHER	
Address	R. Boškovića 37, 21000 Split
Telephone number	+385-21-510-192
E-mail address	vida@unist.hr
Personal web page	http://more.unist.hr/Organizacija/Imenik/tabid/633/agentType/View/PropertyID/1184/Default.aspx
Year of birth	1980
Scientist ID	288561
Research or art rank, and date of last rank appointment	Senior scientific associate 18.9.2015.
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Associate professor 2.3.2018.
Area and field of election into research or art rank	Biotechnical Sciences, Food Technology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University of Split, Department of Marine Studies
Date of employment	September 1st, 2006.
Name of position (professor, researcher, associate teacher, etc.)	Associate professor
Field of research	Food quality and safety
Function	
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	Faculty of Food Technology and Biotechnology, University of Zagreb
Place	Zagreb
Date	December 22nd, 2010.
INFORMATION ON ADDITIONAL TRAINING	
Year	2009
Place	Lyngby, Denmark
Institution	National Institute of Aquatic Resources, Technical University of Denmark
Field of training	Biogenic amines in seafood (+HPLC training)
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English (2)
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme	At undergraduate and graduate levels of the Study "Marine Fisheries", undergraduate and graduate study “Food technology“ and the Inter-university PhD study, "Applied Marine Sciences” at University of Split.

where it is/was offered, and level of study programme)	Undergraduate Marine fishery • Preservation and processing of seafood (lectures and exercises) • Hygiene in the seafood industry (lectures, exercises, seminars, training) Graduate Study of Marine Fisheries • Quality assessment of seafood products (lectures, exercises, training) • Seafood products (lectures and exercises) Undergraduate and graduate study “Food technology“ • Seafood processing technology • Quality and safety of seafood Doctoral study • Technology and processing of seafood products
Authorship of university/faculty textbooks in the field of the course	Šimat V, Generalić Mekinić I. 2020. Advances in Chilling. In: Ozogul Y (ed.), Innovative Technologies in Seafood Processing, CRC Press, London, UK, pp. 424.
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	http://bib.irb.hr/lista-radova?autor=288561
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	1) Associate on the project: "Investigation of bioactive compounds from Dalmatian plants: their antioxidant, enzyme inhibition and health properties", University of Split, Faculty of Chemistry and Technology. 2015-2019, Croatia 2) Projects Principal investigator: "Hyperspectral detector of parasite Anisakis spp. in fish fillets", University of Split. 2014-2015, Croatia 3) Projects Principal investigator: Bio-protective cultures and bioactive extracts as sustainable combined strategies to improve the shelf-life of perishable Mediterranean food. PRIMA, H2020. 2020-2023.
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	
PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	Evaluation organizer: University of Split Average grade for previously mentioned courses in 2018/2019 was >4.8

First and last name and title of teacher	Željka Trumbić, PhD, Assistant professor

The course he/she teaches in the proposed study programme	Biotechnology and genetics in fisheries and aquaculture, Statistical methods in biotechnology
GENERAL INFORMATION ON COURSE TEACHER	
Address	Ruđera Boškovića 37
Telephone number	00 385 21 510194
E-mail address	ztrumbic@unist.hr
Personal web page	
Year of birth	1981
Scientist ID	315895
Research or art rank, and date of last rank appointment	Research associate - 20.10.2016.
Research-and-teaching, art-and-teaching or teaching rank, and date of last rank appointment	Assistant professor - 01.04.2017.
Area and field of election into research or art rank	Biotechnical sciences/Biotechnology
INFORMATION ON CURRENT EMPLOYMENT	
Institution where employed	University Department of Marine Studies, University of Split
Date of employment	01.04.2017.
Name of position (professor, researcher, associate teacher, etc.)	Assistant professor
Field of research	Functional genomics of marine organisms
Function	Teaching and research staff
INFORMATION ON EDUCATION – Highest degree earned	
Degree	PhD
Institution	University Postgraduate Interdisciplinary Doctoral Study of Molecular biosciences (Josip Juraj Strossmayer University of Osijek, University of Dubrovnik and Ruđer Bošković Institute, Zagreb)
Place	Zagreb
Date	15.09.2015.
INFORMATION ON ADDITIONAL TRAINING	
Year	2017
Place	Roscoff, France
Institution	Biological Station in Roscoff (CNRS, UPMC)
Field of training	Summer school Marine Ecological & Evolutionary Genomics
Year	2011. and 2013.
Place	Stirling, United Kingdom
Institution	Institut of Aquaculture, University of Stirling
Field of training	Research visit for the purpose of completing PhD project entitled Development and application of a DNA microarray for gene expression profiling in captive Atlantic Bluefin Tuna (*Thunnus thynnus* L., 1758). Funded by Fellowship for Doctoral Students, Croatian Science Foundation (2011) and ERASMUS student placement Life Long Learning Program (2013).
MOTHER TONGUE AND FOREIGN LANGUAGES	
Mother tongue	Croatian
Foreign language and command of foreign language on a scale from 2 (sufficient) to 5 (excellent)	English, 4
COMPETENCES FOR THE COURSE	
Earlier experience as course teacher of similar courses (name title of course, study programme	Compulsory courses:

where it is/was offered, and level of study programme)	• Embriology and Genetics of Marine Organisms II (undergraduate study of Marine Fishery, Department of Marine Studies, 3rd year) • Genetics (undergraduate study Marine Biology and Technology, Department of Marine Studies, 3rd year) Elective courses: • Population Genetics of Marine Organisms (undergraduate studies of Marine Fishery, Marine Biology and Ecology and Marine Biology and Technology, Department of Marine Studies, 3rd year) • Biotechnology and Genetics in Fisheries and Aquaculture (graduate studies of Marine Ecology and Protection and Marine Fishery, Department of Marine Studies, 2nd year)
Authorship of university/faculty textbooks in the field of the course	
Professional, scholarly and artistic articles published in the last five years in the field of the course (5 works at most)	• Bušelić I, Trumbić Ž, Hrabar J, Vrbatović A, Bočina I, Mladineo I. 2018. Molecular and cellular response to experimental *Anisakis pegreffii* (Nematoda, Anisakidae) third-stage larval infection in rats. Frontiers in Immunology, 9:2055. doi: 10.3389/fimmu.2018.02055. • Mladineo I, Trumbić Ž, Hrabar J, Vrbatović A, Bušelić I, Ujević I, Roje-Busatto R, Babić I, Messina C. 2018. Efficiency of target larvicides is conditioned by ABC-mediated transport in the zoonotic nematode *Anisakis pegreffii*. Antimicrobial Agents and Chemotherapy, pii: AAC.00916-18. doi: 10.1128/AAC.00916-18. • Šegvić-Bubić T, Grubišić L, Trumbić Ž, Stanić R, Ljubković J, Maršić-Lučić J, Katavić I. 2017. Genetic characterization of wild and farmed European seabass in the Adriatic Sea: assessment of farmed escapees using a Bayesian approach. ICES Journal of Marine Science, 74(1): 369–378. • Trumbić Ž, Bekaert M, Taggart JB, Bron JE, Gharbi K, Mladineo I. 2015. Development and validation of a mixed-tissue oligonucleotide DNA microarray for Atlantic bluefin tuna, *Thunnus thynnus* (Linnaeus, 1758). BMC Genomics. 16:1007. doi:10.1186/s12864-015-2208-7. • Lepen Pleić I, Bušelić I, Trumbić Ž, Bočina I, Šprung M, Mladineo I. 2015. Expression analysis of the Atlantic bluefin tuna (Thunnus thynnus) pro-inflammatory cytokines, IL-1β, TNFα1 and TNFα2 in response to parasites *Pseudocycnus appendiculatus* (Copepoda) and Didymosulcus katsuwonicola (Digenea). Fish & Shellfish Immunology, 45(2): 946–954.
Professional and scholarly articles published in the last five years in subjects of teaching methodology and teaching quality (5 works at most)	
Professional, science and artistic projects in the field of the course carried out in the last five years (5 at most)	Angel – *Anisakis* spp: genomic epidemiology (funded by Croatian Science Foundation, no .5576, principal investigator prof. Ivona Mladineo, PhD, DVM).
The name of the programme and the volume in which the main teacher passed exams in/acquired the methodological-psychological-didactic-pedagogical group of competences	

PRIZES AND AWARDS, STUDENT EVALUATION	
Prizes and awards for teaching and scholarly/artistic work	
Results of student evaluation taken in the last five years for the course that is comparable to the course described in the form (evaluation organizer, average grade, note on grading scale and course evaluated)	Elective 2nd year graduate course: • Biotechnology and Genetics in Fisheries and Aquaculture The course has been running for two years at the graduate study Marine Fishery, Department of Marine Studies, University of Split. Average score achieved in this period = 4.8 (grading scale 1 – 5, five indicating top best score) according to the annual poll conducted by the Office for Quality Ensurance, University of Split.

3.4. Optimal number of students

Considering the enrolment quota, with respect to spatial conditions, equipment and the number of full-time teachers at the University Department of Marine Studies, the optimal number of students per year is 10, as planned by the InteRiV project.

3.5. Estimate of costs per student

Average annual cost of the graduate university study programme of Marine Fishery per student is financed and allocated from the InteRiV project funds during the timespan of the project.

3.6. Plan of procedures of study programme quality assurance

In keeping with the European standards and guidelines for internal quality assurance in higher education institutions (according to "Standards and Guidelines of Quality Assurance in the European Higher Education Area") on the basis of which the University of Zagreb defines procedures for quality assurance, the proposer of the study programme is obliged to draw up a plan of procedures of study programme quality assurance.
Documentation on which the quality assurance system of the constituent part of the University is based:
• Strategic document of the University Department of Marine Studies
• Quality Assurance Policy of the University Department of Marine Studies
• Quality Assurance and Enhancement Handbook of the University Department of Marine Studies
• Annual work plans of the Quality Enhancement Committee of the University Department of Marine Studies and annual activity reports about the work of Quality Enhancement Committee of the University Department of Marine Studies
Description of procedures for evaluation of the quality of study programme implementation: • Fore each procedure the method needs to be described (most often questionnaires for students or teachers, and self-evaluation questionnaire), name the body conducting evaluation (constituent part, university office), method of processing results and making information available, and timeframe for carrying out evaluation • If procedure is described in an attached document, name the document and the article.

Evaluation of the work of teachers and part-time teachers	Student evaluation of teaching is carried out by the Quality Enhancement Centre of the University of Split in cooperation with the Quality Enhancement Committees at the constituents. The procedure consists of informing students and teachers, interviewing students through questionnaires, analysing and submitting the results of questionnaires, improving quality measures. The procedure is described in detail in the *Regulations on procedure of study programmes evaluation at the University of Split*. Analysing surveys and submitting results is the responsibility of the Quality Assurance Office of the University of Split. Summary results for the university constituents are submitted to the Head of the Department and to the Head of the Quality Assurance Committee.
Monitoring of grading and harmonization of grading with anticipated learning outcomes	The first cycle of the University Department of Marine Studies re-accreditation encompasses detailed implementation programmes for graduate courses in Marine Fishery, containing basic information about courses, objectives, anticipated learning outcomes, general description and other information that students need. Among other things, the Quality Enhancement Committee is also responsible for harmonizing procedures related to learning outcomes and assessment system.
Evaluation of availability of resources (spatial, human, IT) in the process of learning and instruction	Evaluation of the availability of resources is partly carried out through questionnaires for student evaluation of professional and administrative services and other aspects of student life, and partly through a evaluation survey of the study programme as a whole. The Quality Assurance Office in collaboration with the Quality Assurance Committee carries out the evaluation. The data is processed, and results are submitted by the University Quality Office.
Availability and evaluation of student support (mentorship, tutorship, advising)	The University Department of Marine Studies does not have a student-teacher or student-mentor model (except for tutoring during the preparation of the diploma thesis), However, students can contact head of their study programme for assistance, advice or support. Also, students may contact teachers during office hours determined at the beginning of academic year, but there is no formal way of evaluating the quality of students' support.
Monitoring of student pass/fail rate by course and study programme as a whole	The Quality Enhancement Centre at the University of Split carries out the analysis of the success of the study programme. The analysis is carried out through a questionnaire completed by the university constituents that are then submitted to the Quality Enhancement Centre. The analysis for the previous

	year is carried out once a year at the beginning of the academic year. Head of the Quality Enhancement Centre presents the results of the conducted analysis and proposes improvement measures to the Senate of the University of Split.
Student satisfaction with the programme as a whole	The Quality Enhancement Centre at the University of Split has defined the procedure for conducting the evaluation of the entire study. Questionnaire for student evaluation of the whole study programme is being conducted upon defence of diploma thesis through web-based platform EvaSys. The aim of the survey is to examine students' opinion about different study aspects, and to identify what they were least satisfied with in order to make positive changes in terms of quality of content and performance of the study programme. Data analysis is performed by the Quality Office of the University of Split that submits the results to the Head of the Department and the Head of the Quality Enhancement Committee.
Procedures for obtaining feedback from external parties (alums, employers, labour market and other relevant organizations)	Feedback on quality of study programmes is also given through opinions of the members of the Association of former students of the University Department of Marine Studies at the University of Split - Alumni MORE Split, in addition to survey results addressed to employers, according to the *Quality Assurance and Enhancement Handbook* of the University Department of Marine Studies.
Evaluation of student practical education (where this applies)	There is no official form of student training evaluation.
Other evaluation procedures carried out by the proposer	-
Description of procedures for informing external parties on the study programme (students, employers, alums)	The activities of the University Department of Marine Studies are being published on its website and in the journal *Universitas* (monthly issued supplement of the newspaper ‘Slobodna Dalmacija’ on the University of Split). Also, the Association of Graduate Students of the University Department of Marine Studies at the University of Split - Alumni MORE Split after obtaining a diploma degree connects, establishes and maintains connection between the University Department of Marine Studies and its students and employers.