

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Odzivi na stres v morskem okolju
<b>Course title:</b>	Stress Responses in Marine Environment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Ekotehnologije, 3. stopnja		1	1
Ecotechnologies, 3 <sup>rd</sup> cycle		1	1

**Vrsta predmeta / Course type** Izbirni / Elective

**Univerzitetna koda predmeta / University course code:** EKO3-761

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	15			15	105	5

*\*Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

**Nosilec predmeta / Lecturer:** Doc. dr. Andreja Ramšak  
Prof. dr. Alenka Malej  
Prof. dr. Valentina Turk

**Jeziki / Predavanja / Lectures:** slovenski/angleški - Slovene/English  
**Languages: Vaje / Tutorial:** slovenski/angleški - Slovene/English

**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

Zaključen študij druge stopnje naravoslovne ali tehniške smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor).

**Prerequisites:**

Completed second level studies in natural sciences or engineering or completed second level studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview).

**Vsebina:**

Uvod v obalne morske ekosisteme in ekosisteme rečnih izlivov v morje.  
Vplivi človeka na obalna območja in uporabo virov, okoljski indikatorji in shema DPSIR.  
Onesnaženje v morskem okolju in kvaliteta obalnih voda (viri in vplivi onesnaženja, monitoring).  
Poznavanje ekološkega stresa v morskih organizmih, ki ga sprožijo različni okoljski dejavniki, in pomen na nivoju osebnosti, populacije in vrste.  
Uvod v glavne mehanizme odziva na stres na celičnem nivoju zaradi abiotičnih stresnih dejavnikov (toplota, mraz, slanost, hipoksija, suša)

**Content (Syllabus outline):**

Introduction to estuarine and coastal marine ecosystem.  
Human influences on the coastal zones and resource use, environmental indicators and DPSIR framework.  
Marine pollution and coastal water quality (sources and impacts of pollution, monitoring).  
Understanding the ecological stress evoked in marine organisms by different environmental factors and its meaning for individual, population, species level.  
Introduction to main stress-induced mechanisms at

v morskih organizmih (npr. mehkužci in ribe; pomembni v prehrani ljudi).  
 Toksične spojine kot stresni dejavnik in odziv na molekularnem nivoju v morskih organizmih.  
 Genetsko pogojen odgovor na stres (mikroevolucija, odpornost in toleranca na toksične spojine).  
 Terensko delo: zbiranje in beleženje podatkov o fizikalno-kemijskih parametrih, nabiranje primernih organizmov, morfologija in prilagoditve v školjkah kot modelnih organizmih.  
 Vpliv dejavnikov onesnaženja na mikrobno združbo v obalnih morskih ekosistemih in ekosistemih rečnih izlivov v morje.  
 Proučevanje odzivov mikroorganizmov na različne oblike onesnažil in posledice le-teh na biogeokemične cikle v obalnih morjih.

cellular level due to abiotic stress factors (heat, cold, salinity, hypoxia, drought) in marine organisms (e. g. mollusc and fish; important in human consumption).  
 Toxic substances as stress factors and response at molecular level in marine organisms.  
 Genetically dependent response to stress (microevolution, resistance and tolerance to toxic substances).  
 Field work: Practical work on field to collect and record data on physico-chemical parameters, collection of organisms of interest, morphology and adaptations in mussels as model organism.  
 The impact of pollution on microorganisms from coastal marine and estuarine ecosystems.  
 Understanding the response of marine microbial communities to environmental perturbations, and different contaminants, and consequent impacts on the biogeochemical cycles in the coastal marine environments.

#### Temeljni literatura in viri / Readings:

Castro P. & M.E. Huber, 2005. Marine Biology, 5<sup>th</sup> edition, 452 pp.  
 Claude Amiard-Triquet, Jean-Claude Amiard and Philip S. Rainbow. 2012. Ecological biomarkers: indicators of ecotoxicological effects, edited by, Boca Raton, FL, USA, CRC Press, ISBN 978-1-4398-8017-3.  
 C. J. Sinderman, 2006. Coastal Pollution. Effects on Living Resources and Humans. CRC Press, Taylor & Francis Group, ISBN 0849396778  
 Solan, M. and Whitley, N., (eds), 2016, Stressors in the Marine Environment: Physiological and ecological response; societal implications, 1st edition, ISBN-13:978-0198718833.  
 A. Lowe, S. Harris and P. Ashton, 2004. Ecological Genetics: Design, Analysis, and Application, Blackwell Publishing, ISBN: 1405100338  
 D.L. Kircham (Ed): Processes in microbial ecology (2012). Oxford University Press Inc, New York  
 D. White, J. Drummond, C. Fuqua (Eds): The physiology and biochemistry of prokaryotes. (2012) 4<sup>th</sup> ed. Oxford University Press Inc, New York  
 C. Munn (Ed): Marine microbiology: Ecology and Applications. (2011). 2nd Ed. Garland Science, Taylor & Francis Group, UK

#### Cilji in kompetence:

Cilj predmeta je pripraviti študenta na raziskovalno delo na področju odziva na stres v morskem okolju.

##### Kompetene:

Izbira in načrtovanje ustreznih pristopov za reševanje okoljskih problemov v morskem okolju.  
 Izdelava scenarijev zaradi posledic onesnaževanja za morske organizme, združbe in morsko okolje  
 Izbira ustreznih metodologij za meritve škodljivih učinkov onesnaženja (stres) na morske organizme in združbe  
 Razvoj novih tehnik in pristopov za oceno stresa v

#### Objectives and competences:

The aim of the course is to prepare a student for research work in the field of stress response in the marine environment.

##### Competences:

Selection and planning appropriate approaches to solving environmental problems in the marine environment.  
 Creation of scenarios due to the consequences of pollution for marine organisms, communities and the marine environment  
 Selection of appropriate methodologies to measure

morskem okolju  
Načrtovanje in usklajevanje timskega dela s strokovnjaki različnih znanstvenih disciplin

the harmful effects of pollution (stress) on marine organisms and communities  
Development of new techniques and approaches for evaluation the stress in the marine environment  
Planning and coordinating teamwork with experts from various disciplines

**Predvideni študijski rezultati (izidi):**

Razumeti stresni odziv, povzročen s toksičnimi spojinami v morskem okolju.  
Razumeti povezavo med mehanizmi stresa na molekularnem nivoju in njihovo povezavo med višjimi organizacijskimi nivoji organizma do populacije.  
Razumeti vpliv onesnažil na delovanje specifičnih mikroorganizmov in celotno mikrobno združbo (proučevanja na nivoju združbe in na nivoju celice)-  
Razvoj kritičnega mišljenja in analitskega pristopa za reševanje kompleksnih problemov onesnaženja v morskem okolju (povezovanje znanja iz ustreznih disciplin).

**Intended learning outcomes:**

Understand stress response caused by toxic substances in the marine environment.  
Understand relationship between stress mechanisms at molecular level and its connection with higher organisational level of organism and to population  
Understanding the impact of pollution on the function and composition of marine microbial community (investigations on the community and single-cell level).  
Development of critical thinking and analytical approach to solve complex problems of pollution in the marine environment.

**Metode poučevanja in učenja:**

Terenko delo, predavanja, seminar, konzultacije

**Learning and teaching methods:**

Field work, lectures, seminar, consultation

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Ustni izpit	50%	Oral exam
Seminar	50%	Seminar

**Reference nosilca / Lecturer's references:**

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*, ISSN 0045-6535. [Print ed.], 2017, vol. 174, str. 554-562, ilustr. <http://www.sciencedirect.com/science/article/pii/S0045653517301601>, doi: [10.1016/j.chemosphere.2017.01.138](https://doi.org/10.1016/j.chemosphere.2017.01.138). [COBISS.SI-ID [4231247](https://www.cobiss.si/id/4231247)]

TSANGARIS, Catherine, MOSCHINO, Vanessa, STROGYLOUDI, Evangelia, COATU, Valentina, RAMŠAK, Andreja, ABU ALHAIJA, Rana, CARVALHO, Susana, FELLINE, Serena, KOSYAN, Alisa, LAZAROU, Yiota, HATZIANESTIS, Ioannis, OROS, Andra, TIGANUS, Daniela. Biochemical biomarker responses to pollution in selected sentinel organisms across the Eastern Mediterranean and Black Sea. *Environmental science and pollution research international*, ISSN 0944-1344. [Print ed.], 2016, vol. 23, št. 2, str. 1789-1804, ilustr. <https://www.researchgate.net/publication/308750968> Erratum to Biochemical biomarker responses to pollution in selected sentinel organisms across the Eastern Mediterranean and the Black Sea, doi: [10.1007/s11356-015-5410-x](https://doi.org/10.1007/s11356-015-5410-x). [COBISS.SI-ID [3596879](https://www.cobiss.si/id/3596879)],

KOGOVSŠEK, Tjaša, VODOPIVEC, Martin, RAICICH, Fabio, SHIN-ICHI, Uye, MALEJ, Alenka. Comparative analysis of the ecosystems in the northern Adriatic Sea and the Inland Sea of Japan : can anthropogenic

pressures disclose jellyfish outbreaks?. *Science of the total environment*, ISSN 0048-9697, 2018, vol. 626, str. 982-994. <http://dx.doi.org/10.1016/j.scitotenv.2018.01.011>, doi: [10.1016/j.scitotenv.2018.01.011](https://doi.org/10.1016/j.scitotenv.2018.01.011). [COBISS.SI-ID [4618831](#)],

BALASUBRAMANIAN, Mukundh Narayanan, RAČKI, Nejc, GONÇALVES, José, KOVAČ, Katarina, TUŠEK-ŽNIDARIČ, Magda, TURK, Valentina, RAVNIKAR, Maja, GUTIÉRREZ-AGUIRRE, Ion. Enhanced detection of pathogenic enteric viruses in coastal marine environment by concentration using methacrylate monolithic chromatographic supports paired with quantitative PCR. *Water research*, ISSN 0043-1354. [Print ed.], 2016, vol. 106, str. 405-414, doi: [10.1016/j.watres.2016.10.020](https://doi.org/10.1016/j.watres.2016.10.020). [COBISS.SI-ID [4037967](#)],

MCDONALD, Karlie S., TURK, Valentina, MOZETIČ, Patricija, TINTA, Tinkara, MALFATTI, Francesca, HANNAH, David M., KRAUSE, Stefan. Integrated network models for predicting ecological thresholds: Microbial and carbon interactions in coastal marine systems. *Environmental Modelling & Software*, ISSN 1364-8152. [Print ed.], 2017, vol. 91, str. 156-167, ilustr. <https://authors.elsevier.com/a/1UZyr4sKhE9jiq>, doi: [10.1016/j.envsoft.2017.01.017](https://doi.org/10.1016/j.envsoft.2017.01.017). [COBISS.SI-ID [4241999](#)],