

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	MOLEKULARNA EKOLOGIJA V NARAVOVARSTVU
<b>Course title:</b>	MOLECULAR ECOLOGY IN NATURE CONSERVATION

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Varstvo okolja in ekotehnologije, 1. stopnja	Modul: Varstvo narave	2. in 3.	/
Environmental Protection and Eco-technologies, 1 <sup>st</sup> level	Module: Nature conservation	2 <sup>nd</sup> and 3 <sup>rd</sup>	/

**Vrsta predmeta / Course type** Modularni predmet / Modular course

**Univerzitetna koda predmeta / University course code:** MEN

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	/	20	10	/	80	5

**Nosilec predmeta / Lecturer:** prof. dr. Elena Bužan, viš. pred. dr. Anja Bubik / Elena Bužan, Ph.D., Full Prof., Anja Bubik, Ph.D., Lecturer

**Jeziki / Predavanja / Lectures:** Slovenski / Slovenian  
**Languages: Vaje / Tutorial:** Slovenski / Slovenian

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

- Opravljen izpit pri predmetu Ekosistemska biologija

**Prerequisites:**

- Passed exam at the course Ecosystem biology

**Vsebina:**

Predmet bo predvsem osredotočen na pridobitev temeljnih znanj s področja evlucijske genetike, ki so potrebna za razumevanje uporabe informacijskih orodij v bioloških znanostih, s poudarkom na naravovarstvu. V uvodnem delu bo predstavljena evolucija in molekularna evolucija; pri slednji se bomo osredotočili na pomembnost polimorfizma na molekularni ravni in nevtralne teorije. Osrednja vsebina predmeta bo obravnavala pomen molekularne ekologije v naravovarstvu in možnost njene uporabe za boljše poznavanje ter dolgoročno ohranitev populacij in vrst, vključno s prikazom nekaterih novejših študij primerov iz slovenskega in širšega evropskega prostora.

**Poglavitne teme:**

- pojem molekularne evolucije
- polimorfizem molekule DNA
- nevtralna teorija
- evlucijske spremembe nukleotidnih zaporedij (modeli, genetske razdalje)
- molekularna filogenetika in filogenetska drevesa

**Content (Syllabus outline):**

The course will focus primarily on acquiring basic knowledge in the field of evolutionary genetics, which is necessary for understanding the use of information tools in biological sciences, with an emphasis on nature conservation. The introductory part will show the evolution and molecular evolution; where the emphasis will be placed on the importance of polymorphism at the molecular level and the neutral theory. The main content of the course will address the importance of molecular ecology in nature conservation and the possibility of its use for better knowledge and long-term conservation of populations and species, including the presentation of some recent case studies from the Slovenian and wider European area.

**Main topics:**

- The concept of molecular evolution
- Polymorphism of DNA molecules
- Neutral theory
- Evolutionary changes in nucleotide sequences (models, genetic distance)
- Molecular phylogenetics and phylogenetic trees

- banke podatkov nukleinskih in proteinskih sekvenc
- uvod v računalniška orodja za delo z nukleotidnimi zaporedji
- izumiranje in genetika
- evolucijska genetika prostoživečih populacij
- genetska diverziteteta in molekularni markerji
- značilnosti genetske diverzitetete: kvantitativna variacija
- evolucija v velikih populacijah; naravna selekcija in adaptacija
- mutacije, migracije in druge interakcije v povezavi s selekcijo
- evolucija v majhnih populacijah
- ohranjanje genetske diverzitetete
- vplivi zmanjševanja velikosti populacije
- parjenje v ožjem sorodstvu in posledice
- genetsko dolgoživa (*viabilna*) populacija
- reševanje taksonomskih negotovosti in opredelitev upravljaljskih enot
- genetika in upravljanje s prostoživečimi populacijami
- novejšje študije primerov uporabe molekularne ekologije v naravovarstvu (v Sloveniji in v širšem alpsko-dinarskem prostoru)

- Databases of nucleic and protein sequences
- Introduction to computational tools for working with nucleotide sequences
- Genetics and extinctions
- Evolutionary genetics of wild populations
- Genetic diversity and molecular markers
- Characterizing genetic diversity: quantitative variation
- Evolution in large-sized populations; natural selection and adaptation
- Mutations, migrations and interactions with selection
- Evolution in small-sized populations
- Maintenance of genetic diversity
- Effects of population size reduction
- Inbreeding and inbreeding depression
- Genetic viable population
- Resolving taxonomic uncertainties and defining management units
- Genetics and the management of wild populations
- Recent case studies of the implementation of molecular ecology in nature conservation (in Slovenia and comparatively also in wider Alpine-Dinaric region)

#### Temeljna literatura in viri / Textbooks:

- Richard F., Jonathan D.B., Briscoe D.A. (2010) Introduction to Conservation Genetics. Cambridge University Press.
- Hall B.G. (2007) Phylogenetic trees made easy. Sunderland, Sinauer Associates.
- Relevantni znanstveni članki in publikacije, ki bodo izbrani in predloženi s strani izvajalca predmeta. / *Relevant scientific papers and publications, which will be selected and provided by the lecturer.*

#### Cilji in kompetence:

**Cilj predmeta** je seznanitev študentov z osnovami molekularne ekologije in pridobitev znanja ter razumevanja uporabnosti molekularnih orodij za določanje evolucijske zgodovine in za varstvo populacij ter vrst.

**Splošne kompetence**, ki jih bodo pridobili študentje, so poznavanje in razumevanje molekulske osnove variabilnosti živih bitij, vzorcev in mehanizmov spreminjanja bioloških informacijskih makromolekul, molekularne filogenetike ter evolucije genov.

**Predmetno-specifične kompetence** se nanašajo na znanje o evolucijski teoriji. Študentje bodo sposobni razumevanja posebnosti molekularne evolucije, uporabe bioinformatike v molekularni evoluciji in filogenetiki ter uporabnosti in konkretnih možnosti uporabe molekularne ekologije v naravovarstvu.

#### Objectives and competences:

**The objective** is to introduce students to the basic concepts of molecular ecology and to provide them the knowledge and understanding of the usefulness of molecular tools for determining evolutionary history and conservation of populations and species.

**General competences** of students acquired by the subject are understanding of the molecular basis of variability of living beings, patterns and mechanisms of change of biological macromolecules, molecular phylogenetics, and gene evolution.

**Specific competences** are related to a synoptic knowledge of evolutionary theory. Students will be able to understand specifics of molecular evolution, application of bioinformatics into molecular evolution and phylogenetics, applicability and concrete possibilities of implementation of molecular ecology in nature conservation.

Z obravnavanjem bistvenih problemov v okviru predmeta se bodo študentje seznanili z različnimi raziskovalnimi metodami in tehnikami, ki jim bodo omogočale poglobljanje že obstoječih in pridobivanje novih znanj, razvoj kritične misli ter sposobnost sintetiziranja. Cilj je seznaniti študente s sodobnimi genetskimi pristopi k ohranjanju populacij, ki se uporabljajo v varstveni biologiji. Študenti bodo vešč analize podatkov, pridobljenih z molekularno-genetskimi metodami, ter interpretacije podatkov za varovanje in upravljanje populacij.

By addressing key problems in the course, the students will learn different research methods and techniques that will allow them to acquire new skills, develop critical thinking, and to synthesize data obtained. The aim is to familiarize students with modern genetic methods in conservation biology. Students will be skilled in the analysis of data obtained by the molecular-genetic methods and with the interpretation of data for conservation and management of populations.

#### **Predvideni študijski rezultati:**

**Znanje in razumevanje:** študenti pridobijo vpogled v posebnosti molekularne evolucije in filogenetike. Spoznajo uporabo genetskih metod in podatkov pri varstvu in upravljanju populacij ter vrst.

**Uporaba:** študent je sposoben učinkovito uporabljati pridobljeno znanje s področja molekularne genetike v naravovarstvu.

**Refleksija:** študent je zmožen ovrednotiti pridobljene genetske podatke z namenom varstva naravnih virov, tj. populacij in vrst.

#### **Intended learning outcomes:**

**Knowledge and understanding:** students get an insight into the specific topics of molecular evolution and phylogenetics. They learn how to implement and use genetics methods and data in conservation and management of populations and species.

**Usage:** students are able to effectively use the knowledge obtained in the field of molecular ecology and nature conservation.

**Reflection:** students are able to evaluate obtained genetics data for the aims of conservation of living resources, i.e. populations and species.

#### **Metode poučevanja in učenja:**

**Uporabljene metode poučevanja in učenja:** frontalna oblika predavanj, seminarske vaje, samostojno delo študentov, e-izobraževanje.

##### **Oblike dela:**

- predavanja nosilca predmeta
- predavanje gostujočih strokovnjakov iz tujine
- računalniške vaje
- študentski projekt (predstavitev ppt)

##### **Metode dela:**

- razlaga
- dialog, diskusija
- predstavitev in proučevanje praktičnih primerov

#### **Learning and teaching methods:**

**Methods used in teaching and learning:** frontal lectures, tutorials, individual work, e-learning.

##### **Forms of teaching:**

- in-class lectures
- guest lectures by foreign experts
- computer exercises
- student projects (ppt presentation)

##### **Teaching methods:**

- explanation
- discussion, debate
- presentation and discussion on case studies

#### **Materialni pogoji za izvedbo predmeta :**

- računalniška učilnica
- laboratorijska vajalnica
- statistični programi, povezani z vsebino predmeta (prosto dostopni)

#### **Material conditions for subject realization:**

- computer room
- lab room
- statistical programs related to the subject (open access)

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
<p>Pogoj za pristop k izpitu pri predmetu: 80 % prisotnost na seminarskih vajah.</p> <p><b>Končna ocena se sestoji iz treh delov:</b></p> <ul style="list-style-type: none"> <li>• kratko poročilo seminarskih vaj</li> <li>• predstavitev končnega projekta</li> <li>• zaključni izpit</li> </ul> <p>Vprašanja pri pisnem izpitu se nanašajo na snov, podano na predavanjih.</p> <p>Ocenjevalna lestvica:</p> <ul style="list-style-type: none"> <li>▪ zadostno 6: 60–67 %</li> <li>▪ dobro 7: 68–75 %</li> <li>▪ prav dobro 8: 76–83 %</li> <li>▪ prav dobro 9: 84–90 %</li> <li>▪ odlično 10: 91–100 %</li> </ul>	<p style="text-align: center;"><b>20 %</b></p> <p style="text-align: center;"><b>10 %</b></p> <p style="text-align: center;"><b>70 %</b></p>	<p>A prerequisite for access to the final exam: 80% attendance at tutorial (seminar exercise).</p> <p><b>Final evaluation consists of three parts:</b></p> <ul style="list-style-type: none"> <li>• short reports in exercises</li> <li>• presentation of the final project</li> <li>• final exam</li> </ul> <p>Questions for written examination are in relation to material delivered in lectures.</p> <p>Grading scale:</p> <ul style="list-style-type: none"> <li>▪ Sufficient D (6): 60–67%</li> <li>▪ Good C (7): 68–75%</li> <li>▪ Very good B (8): 76–83%</li> <li>▪ Very good B+ (9): 84–90%</li> <li>▪ Excellent A (10): 91–100%</li> </ul>

**Obveznosti študentov:**

80 % prisotnost na seminarskih vajah.

Pisna predstavitev projekta obsega 1.500 do 2.500 besed, projektno poročilo mora biti celovito in mora strokovno predstaviti problem. Potrebna je izvirnost interpretacije in zaključkov, kakovost virov, jezikovna pravilnost in predstavitev naloge skupini oz. ostalim študentom.

**Student's commitments:**

80% attendance at tutorials (seminar exercise).

The written project report should contain 1500 to 2500 words. The document should comprehensively present the problem, and must be recognized by originality of interpretation and conclusions, quality of references used, and linguistic accuracy. Oral presentation to the group is mandatory.

**Reference nosilca predmeta:**

**Pedagoško delo:**

- prodekanja na Univerzi na Primorskem (UP) FAMNIT od leta 2018 najprej
- nosilka predmetov *Varstvena biologija, Evolucijska genetika, Populacijska genetika in Sodobni pristopi v varstveni biologiji* na UP FAMNIT
- nosilka predmeta *Naravne vrednote in njihovo varovanje* na UP FHŠ in UP Turistica
- mentorica dvema raziskovalkama z zaključenim doktoratom, somentorica eni raziskovalki z zaključenim doktoratom, mentorica in somentorica večjemu številu dodiplomskih in magistrskih študentov

**Znanstveno-raziskovalno delo:**

- vodja več projektov s področja varstvene biologije in molekularne ekologije (financerji: ARRS, MKGP)
- vodja več mednarodnih projektov s področja naravovarstva (Obzorje 2020, Interreg)
- članica znanstvenega odbora treh mednarodnih delavnic iz področja ohranjanja biotske raznovrstnosti (Koper, 2008 – 2014)

**Lecturer's references:**

**Pedagogic activities:**

- vice-dean at the University of Primorska (UP) FAMNIT since 2018
- holder of courses *Conservation biology, Evolutionary biology, Population biology, Contemporary approach to conservation biology* at UP FAMNIT
- holder of course *Natural heritage and conservation* at UP FHŠ and UP Turistica
- supervisor of two researchers with defended Ph.D., one co-supervisor of researcher with defended Ph.D., and supervisor of several graduated and master students

**Scientific and research work:**

- leader of several projects on conservation biology and molecular ecology (funders: ARRS, MKGP)
- leader of several international projects in the field of nature conservation (H2020, Interreg)
- member of the Scientific Committee at three international workshops on biodiversity conservation (Koper, 2008–2014)

<p><b>Strokovno delo in izbrane strokovne publikacije:</b></p> <ul style="list-style-type: none"> <li>• več kot 10 objavljenih strokovnih in poljudnih člankov s področja varovanja biotske raznovrstnosti in molekularne ekologije</li> <li>• več kot 15 intervjujev o ohranjanju narave in pomenu genetike</li> </ul> <p><b>Priznanja in nagrade:</b></p> <ul style="list-style-type: none"> <li>• <i>Glasnik znanosti</i> za odličnost v raziskovanju (2007).</li> <li>• <i>Primoski um</i> za prenos znanstvenih spoznanj h končnim uporabnikom (2009).</li> </ul>	<p><b>Professional work, selected professional publications:</b></p> <ul style="list-style-type: none"> <li>• More than 10 published professional and popular papers on biodiversity conservation and molecular ecology</li> <li>• More than 15 interviews about nature conservation and role of genetics</li> </ul> <p><b>Awards:</b></p> <ul style="list-style-type: none"> <li>• Award for scientific achievement, the <i>Sciences Herald</i> (2007)</li> <li>• Award the <i>Mind of Primorska</i> for the transfer of the scientific achievements to the end-users (2009)</li> </ul>
<p><b>Izbrani znanstveni članki / Selected scientific papers:</b></p> <p>Iacolina L., Corlatti L., <b>Bužan E.</b>, Safner T., Šprem N., 2018. Hybridisation in European ungulates: an overview of the current status, causes, and consequences. <i>Mammal review</i>, 49:45-59.</p> <p><b>Bužan E.</b>, Zupan S., Jugovic J., 2017. Changes in rodent communities as consequence of urbanization and inappropriate waste management. <i>Applied ecology and environmental research</i>, 15:573-588.</p> <p>Kalan K., Ivović V., Glasnović P., <b>Bužan E.</b>, 2017. Presence and potential distribution of <i>Aedes albopictus</i> and <i>Aedes japonicus japonicus</i> (Diptera: Culicidae) in Slovenia. <i>Journal of medical entomology</i>, 64:1510-1518.</p> <p>Kalan K., Šušnjar J., Ivović V., <b>Bužan E.</b>, 2017. First record of <i>Aedes koreicus</i> (Diptera, Culicidae) in Slovenia. <i>Parasitology research</i>, 116:2355-2358.</p> <p>Duh D., Potušek S., <b>Bužan E.</b>, 2017. The impact of illegal waste sites on a transmission of zoonotic viruses. <i>Virology journal</i>, 14, A134:1-7.</p> <p>Šprem N., <b>Bužan E.</b>, 2016. The genetic impact of chamois management in the Dinarides. <i>The Journal of wildlife management</i>, 80:783-793.</p> <p>Ivović V., Kalan K., Zupan S., <b>Bužan E.</b>, 2015. Illegal waste sites as a potential microfoci of Mediterranean leishmaniasis: first records of <i>Phlebotomine</i> sand flies (Diptera: Psychodidae) from Slovenia. <i>Acta veterinaria</i>, 65:348-357.</p> <p><b>Bužan E.</b>, Bryja J., Zemanová B., Kryštufek B., 2013. Population genetics of chamois in the contact zone between the Alps and the Dinaric Mountains: uncovering the role of habitat fragmentation and past management. <i>Conservation Genetics</i>, 14:401-412.</p> <p><b>Bužan E.</b>, Pagès M., Michaux J., Kryštufek B., 2011. Phylogenetic position of the Ohiya rat (<i>Srilankamys ohiensis</i>) based on mitochondrial and nuclear gene sequence analysis. <i>Zoologica scripta</i>, 40:545-553.</p> <p><b>Bužan E.</b>, Förster D.W., Searle J.B., Kryštufek B., 2010. A new cytochrome b phylogroup of the common vole (<i>Microtus arvalis</i>) endemic to the Balkans and its implications for the evolutionary history of the species. <i>Biological journal of the Linnean Society</i>, 100:788-796.</p> <p><b>Bužan E.</b>, Kryštufek B., Bryja J., 2010. Microsatellite markers confirm extensive population fragmentation of the endangered Balkan palaeoendemic Martino's vole (<i>Dinaromys bogdanovi</i>). <i>Conservation Genetics</i>, 11:1783-1794.</p>	