

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	BIODIVERZITETA IN EVOLUCIJA
Course title:	BIODIVERSITY AND EVOLUTION

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	vsi	1	1
Earth and Environmental Sciences, Master study 2nd level	all	1	1

Vrsta predmeta / Course type

Obvezni/Mandatory

Univerzitetna koda predmeta / University course code:

MT003

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	20	25			120	9

Nosilec predmeta / Lecturer:

Andraž Čarni
(Asistentka: Eva Turk)

Jeziki /

Predavanja / Lectures:

angleščina, angleščina / Slovenian, English

Languages:

Vaje / Tutorial:

angleščina, angleščina / Slovenian, English

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

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

Prerequisites:

First-cycle Bologna degree or a university degree in the natural sciences.

Vsebina:

- Definicije pojma biodiverziteta
- Elementi biodiverzitete (ekološki, organizmični in genetski)
- Merjenje biodiverzitete, uporaba različnih metod za njeno kvantificiranje
- Razvoj biodiverzitete v preteklosti, nastajanje in izumiranje vrst
- Prostorska razporeditev biodiverzitete, točke z visoko in nizko diverzitetno in razlogi zanje

Content (Syllabus outline):

- The definitions of biodiversity
- Elements of biodiversity (ecological, organismic and genetic)
- Measurement of biodiversity, the use of different methods for its quantification
- Development of biodiversity in the past, the speciation and extinction
- The spatial distribution of biodiversity, hot and cold spots, their causes

- Pomen biodiverzitete za človeštvo, neposreden in posreden pomen
- Vpliv človeka na biodiverziteto, globalne spremembe in izumiranje vrst
- Ohranjanje biodiverzitete, ohranjanje vrst, habitatov
- Biotski odgovori na globalne spremembe
- Genetska variabilnost in mutacija, migracija (genski pretok), naključni genetski zdrs, spol
- Genetska variabilnost in naravna selekcija, dednost, biološki fitnes, adaptacija
- Spolna selekcija
- Fenotipska evolucija in osnove kvantitativne genetike
- Koevolucija
- Koncept vrst in nastanek novih vrst, reproduktivna izolacija
- Otoška biogeografija
- Filogenetika in primerjalne metode (fosilne najdbe, molekularna ura, filogenetske metode, branje filogenetskih dreves, homologije in analogije, rekonstrukcijske analize)
- Makroevolucija (hitrost evolucije, diverzifikacija kladov, adaptivna radiacija, množična izumiranja)

- The importance of biodiversity for mankind, direct and indirect importance
- Human impact on biodiversity, global changes and species extinction
- Preserving biodiversity, conservation of species and habitats
- Biotic responses to global changes
- Genetic variation and mutation, migration (gene flow), random genetic drift, sex
- Genetic variation and natural selection, heritability, fitness, adaptation
- Sexual selection
- Phenotypic evolution and basics in quantitative genetics
- Coevolution
- Species concept and speciation, reproductive isolation
- Island biogeography theory
- Phylogenetics and comparative methods (fossil records, molecular clock, phylogenetic methods, understanding phylogenies; trait reconstruction analyses)
- Macroevolution (pace of evolution, clade diversification, adaptive radiation, mass extinction)

Temeljni literatura in viri / Readings:

- Gaston, J. G., Spicer, J. I. (2004). *Biodiversity: an introduction*. Blackwell Publishing. Chapters: 1 – 6.
- Futuyma, D. J. (2009). *Evolution*. Second Edition. Sinauer Associates Inc. Chapters 1 - 8, 10 - 15, 17 - 19, 22.
- Izbrani članki iz znanstvenih revij. / Selected articles from scientific journals.

Cilji in kompetence:

Namen predmeta je seznaniti študente s koncepti biodiverzitete in evolucije. Biodiverziteta je raznolikost življenja in se odraža na vseh nivojih organizacije živih organizmov: genetskem, organizmičnem in ekološkem. Poznavanje biodiverzitete bomo razdelili na samo poznavanje pojma biodiverzitete, njene zgodovine in procesov, ki so pripomogli k njenemu nastanku, prostorske razporeditve biodiverzitete, vplivov človekovih aktivnosti na biodiverziteto in možnostmi za

Objectives and competences:

The purpose of the course is to acquaint students with the concepts of biodiversity and evolution. Biodiversity is the variety of life and is reflected at all levels of organization of living organisms: genetic, organismic and ecological. Students will learn about the basic concepts of biodiversity, measurement of biodiversity, its history and processes that have contributed to its occurrence, spatial distribution of biodiversity, impacts of human activities on biodiversity and the possibilities for its

njeno ohranjanje. Pri predmetu bomo študente seznanili s tem, kako podnebne spremembe in druge okoljske spremembe, ki so posledica delovanja človeka, vplivajo na biodiverzitetu. Cilj predmeta je poznavanje biodiverzitete, načinov za njeno vrednotenje, procesov pomena za človeško družbo in načinov za njeno ohranjanje. Drugi del predmeta bo pojasnil osnovne pojme v evolucijski biologiji, predstavil mehanizme, ki poganjajo evolucijo. Študentom bomo razložili odnose med gensko variabilnostjo, dednostjo, biološkim fitnessom ter naravno in spolno selekcijo v kontekstu evolucije in adaptacij. Predstavili jim bomo znanja fenotipske evolucije in osnove kvantitativne genetike (teoretično in računsko). Prestavljeni jim bodo različni koncepti vrst in mehanizmi, ki vodijo do nastanka novih vrst. Seznanili se bodo z metodami za računanje filogenetskih dreves in njihovo interpretacijo, tako teoretično kot praktično. Prestavili jim bomo primere koevolucije vrst. Seznanili jih bomo s primerjalnimi metodami, makroevolucijskimi vzorci in načini proučevanja daljne preteklosti.

conservation. They will also learn how climate change and other environmental changes caused by human activities, impact biodiversity on Earth. The aim is for students to develop an understanding of biodiversity, ways of its evaluation, processes, importance for human society and the ways of its conservation. The second part of the course will cover the basic concepts in evolutionary biology and basic mechanisms of evolutionary change. Students will learn the relationships between genetic variation, heritability, fitness, natural and sexual selection in the context of adaptations and evolutionary change. They will learn about phenotypic evolution and the basics of quantitative genetics (theoretically and computative). They will get familiar with different species concepts, causes and patterns of speciation. They will learn how two (or more) species reciprocally affect each other's evolution. They will further learn how to reconstruct phylogenetic trees and to understand phylogenies. Students will learn about comparative methods, macroevolutionary patterns and how scientists investigate deep history.

Predvideni študijski rezultati:

- Razumevanje temeljnih elementov biodiverzitete, in sicer ekoloških (populacije, niše, habitati, ekosistemi, krajine, biomi), organizmičnih (osebki, populacije, vrste, rodovi, družine, redovi in kraljestva) ter genetskih (nukleotidi, geni, kromosomi, osebki in populacije).
- Poznavanje procesov preteklosti, ki so privedli do biodiverzitete oz. so jo v preteklosti spreminjali (adaptacija in organska evolucija, speciacija). Poznavanje teh procesov je pomembno za razumevanje današnjega stanja biodiverzitete in njenega razvoja v prihodnje.
- Glede na to, da biodiverziteteta ni enakomerno razporejena po prostoru, se bodo študenti seznanili s prostorsko razporeditvijo biodiverzitete, z območji,

Intended learning outcomes:

- Understanding the fundamental elements of biodiversity, namely ecological (population, niches, habitats, ecosystems, landscapes, biomes), organismic (individuals, populations, species, genera, families, orders and kingdoms) and genetic (nucleotides, genes, chromosomes, individuals, and populations).
- Knowledge of processes in the past, which led to the present biodiversity or influenced its changes in the past (adaptation and organic evolution, speciation, phylogenetic systematics).
- Knowledge of these processes is important for understanding the present state of biodiversity and its development in the future.
- Given that biodiversity is not evenly distributed through space, the students

kjer je visoka in nizka biodiverziteteta ter vzroki zanjo, prostorskimi gradienti biodiverzitetete in mehanizmi, ki jo povzročajo.

- Poznavanje pomena biodiverzitetete za človeštvo, njena »vrednost« v širokem smislu; njena neposredna in posredna vrednost in povezava med biodiverziteteto in delovanjem ekosistemov. Posebej bomo izpostavili tudi negativen človekov vpliv na izginjanje vrst in ekosistemov (habitatov) ter načinov za ohranjanje biodiverzitetete.
- Poznavanje pojmov in principov v moderni evolucijski biologiji: mehanizmov, ki poganjajo evolucijo, pomen genske variabilnosti, dednosti, biološkega fitnesa, naravne in spolne selekcije v kontekstu evolucije in adaptacij.
- Poznavanje osnov fenotipske evolucije ter kvantitativne genetike (teoretično in računsko).
- Poznavanje konceptov vrst, mehanizmov in vzorcev nastanka novih vrst.
- Razumevanje filogenetike, poznavanje metod za rekonstrukcijo in interpretacijo filogenetskih dreves.
- Poznavanje primerjalnih metod in metod za raziskovanje daljne preteklosti.
- Sposobnost samostojnega zbiranja vsebin o biodiverziteti in evoluciji ter in njihovo smiselno povezovanje in artikulirano predstavljanje drugim v pisni in ustni obliki (seminar).
- Poznavanje izbranih programskih orodij in aplikacij za analizo rezultatov ter raziskovalnih trendov v evolucijski biologiji.

will learn about the spatial distribution of biodiversity, its hot and cold spots and causes for their appearance, gradients of biodiversity and the mechanisms that drive it.

- Knowing the importance of biodiversity for humanity, its "value" in a broader sense; its direct and indirect value and the link between biodiversity and functioning of ecosystems. Specifically, we will highlight the negative human impact on the loss of species and ecosystems (habitat), and methods for the conservation of biodiversity.
- Understanding of fundamental principles in modern evolutionary biology: mechanisms of evolutionary change, importance of genetic variation, heritability, fitness, natural and sexual for evolution and adaptation.
- Understanding basics of phenotypic evolution and quantitative genetics (theoretically and computative)
- Knowledge of species concept, causes and patterns of speciation.
- Understanding phylogenetics, knowing how to reconstruct phylogenetic trees and caution in their interpretation.
- Knowledge of comparative methods, macroevolutionary patterns and methods for inference of the past processes.
- Skills in reading and interpreting literature on theoretical aspects of biodiversity and evolutionary biology, as well as summarizing and presenting these in written and oral forms (seminar).
- Knowledge of selected software tools and applications for results analysis and knowledge of research trends in evolutionary biology.

Metode poučevanja in učenja:

- Predavanja
- Računalniški laboratorij (R, GeneBank)
- Seminar

Learning and teaching methods:

- Lectures
- Computer laboratory (R, GeneBank)
- Seminar

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment

<ul style="list-style-type: none"> • Izpit (ustni) • Seminarska naloga 	80% 20%	<ul style="list-style-type: none"> • Exam (oral) • Written paper
--	--------------------------	--

Reference nosilca / Lecturer's references:

1. **Čarni, A.**, Matevski, V., Juvan, N., Kostadinovski, M., Košir, P., Marinšek, A., Paušič, A., & Šilc, U. (2015). Transition along gradient from warm to mesic temperate forests evaluated by GAMM. *Journal of Plant Ecology*, rtv069.
2. Marinšek, A., **Čarni, A.**, Šilc, U., & Manthey, M. (2015). What makes a plant species specialist in mixed broad-leaved deciduous forests?. *Plant Ecology*, 1-11.
3. Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J. P., Raus, T., **Čarni, A.**, ... & Chytrý, M. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science*, 19, 3-264.
4. Valjavec, M. B., Zorn, M., & **Čarni, A.** (2018). Bioindication of human-induced soil degradation in enclosed karst depressions (dolines) using Ellenberg indicator values (Classical Karst, Slovenia). *Science of the Total Environment*, 640, 117-126.
5. Bátori, Z., Vojtkó, A., Keppel, G., Tölgyesi, C., **Čarni, A.**, Zorn, M., ... & Valjavec, M. B. (2020). Anthropogenic disturbances alter the conservation value of karst dolines. *Biodiversity and Conservation*, 29(2), 503-525.