

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	OKOLJSKI MONITORING
Course title:	ENVIRONMENTAL MONITORING

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Varstvo okolja in ekotehnologije, 1. stopnja	Modul: Ugotavljanje stanja okolja	2. in 3.	/
Environmental Protection and Eco-technologies, 1 st level	Module: Determination of the state of environment	2 nd and 3 rd	/

Vrsta predmeta / Course type Modularni predmet / Modular course

Univerzitetna koda predmeta / University course code: OM

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	/	15	/	10	90	5

Nosilec predmeta / Lecturer: doc. dr. Samar Al Sayegh Petkovšek, prof. dr. Boštjan Pokorny /
Samar Al Sayegh Petkovšek, Ph.D., Assist. Prof., Boštjan Pokorny,
Ph.D, Full Prof.

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: Pogojev ni. **Prerequisites:** No formal prerequisites.

Vsebina: _____ **Content (Syllabus outline):** _____

a) Predstavitev osnovne delitve, namena in zakonskih osnov za izvajanje okoljskih monitoringov ter evidence izvajalcev obratovalnih monitoringov (pridobivanje pooblastil).

b) Predstavitev in definicija okoljskih monitoringov glede na posamezne okoljske segmente (vode, zrak, tla) oziroma vire (hrup, sevanje):

- **vode:** obratovalni monitoring odpadnih vod za industrijske naprave, čistilne naprave in odlagališča; obratovalni monitoring stanja površinskih voda; obratovalni monitoring stanja podzemne vode;
- **zrak:** obratovalni monitoring emisije snovi v zrak iz nepremičnih virov onesnaževanja; monitoring kakovosti zunanjega zraka; monitoring kemičnih snovi v zraku na delovnem mestu;
- **tla:** obratovalni monitoring stanja tal;
- **hrup:** obratovalni monitoring hrupa za vire hrupa;
- **elektromagnetno sevanje in sevanje delcev:** monitoring radioaktivnosti; obratovalni monitoring za vire elektromagnetnega sevanja.

c) Predstavitev biomonitoringov z uporabo bioindikatorskih organizmov in primeri biomonitoringov v vodnih ter kopenskih ekosistemih:

- **vodni ekosistemi:** uporaba različnih vrst bioindikatorskih organizmov kot akumulacijskih bioindikatorjev (npr. ribe, makrofiti) in predstavitev vrednotenja kakovosti površinskih voda (ekološko stanje vodotokov na podlagi bioloških analiz fitobentosa, makrofitov, bentoških nevretenčarjev in rib);
- **kopenski ekosistemi:** uporaba različnih bioindikatorskih organizmov za določitev stanja oziroma onesnaženosti okolja (npr. nevretenčarji, vretenčarji, iglice smreke, tipi ektomikorize, gozdni sadeži (trosnjaki višjih gliv, plodovi lesnatih vrst, jagodičje), drevesne branike, višje rastline in lišaji).

d) Predstavitev humanega biomonitoringa, vključno z monitoringom kakovosti živil živalskega in rastlinskega izvora (zagotavljanje varne hrane).

a) Presentation of types of environmental monitorings, their purposes and legal basis for implementation; list of authorized operational monitoring providers (obtaining authorization).

b) Presentation and definition of different types of environmental monitorings according to environmental compartments (water, soil, air) and sources (noise, radiation):

- **Water:** operational wastewater monitoring for industrial plants, treatment plants and landfills; operational monitoring of the status of surface waters; operational monitoring of groundwater status.
- **Air:** operational monitoring of the emission of substances into the atmosphere from stationary pollution sources; operational monitoring of ambient air quality; monitoring of chemical substances at working place.
- **Soil:** operational monitoring of soil status.
- **Noise:** operational monitoring of noise sources
- **Radiation:** monitoring of radioactivity; operational monitoring of the sources of electromagnetic radiation.

c) Fundamentals and definition of biomonitoring, the use of bioindicator organisms and presentation of biomonitoring carried out in aquatic and terrestrial ecosystems:

- **Aquatic ecosystems:** the use of different types of bioindicator organisms as accumulative bioindicators (e.g. fish, macrophytes) and presentation of the evaluation of the surface water quality (ecological surface water status on the basis of biological analyses of phytobenthos, macrozoobenthos and fish occurrence).
- **Terrestrial ecosystems:** the use of different bioindicator organisms to determine the status or environmental contamination (e.g. invertebrates, vertebrates, spruce needles, types of mycorrhizae, forest fruits (fruiting bodies of higher fungi, wild berries and fruits of woody species), tree rings, higher plants and lichens).

d) Human biomonitoring including monitoring of the quality of foodstuffs of animal and plant origin (ensuring safe food).

Temeljna literatura in viri / Textbooks:

Obvezni: izbrani znanstveni članki, ki so dostopni na spletu:

- Al Sayegh Petkovšek S., Kopusar N., Kryštufek B., 2015. Small mammals as biomonitors of metal pollution: a case study in Slovenia. *Environmental monitoring and assessment*, 186:4261-4274.
- Al Sayegh Petkovšek S., Kopusar N., 2013. Deževniki kot kazalniki onesnaženosti tal. *Acta Silvae et Ligni*, 101:1-12.
- Poličnik H., 2013. Uporaba epifitskih lišajev kot kazalnikov kakovosti zraka ob izbranih testnih odsekih cest v Sloveniji. *Acta Silvae et Ligni* 101: 13-22.
- Al Sayegh Petkovšek S., 2013. Forest biomonitoring of the largest Slovene thermal power plant with respect to reduction of air pollution. *Environmental monitoring and assessment*, 185:1809-1823.
- Al Sayegh Petkovšek S., Pokorny B., 2013. Lead and cadmium in mushrooms from the vicinity of two large emission sources in Slovenia. *Science of the total environment*, 443:944-954.
- Al Sayegh Petkovšek S., Mazej Z., Pokorny B., 2012. Heavy metals and arsenic concentrations in ten fish species from the Šalek lakes (Slovenia): assessment of potential human health risk due to fish consumption. *Environmental monitoring and assessment*, 184:2647-2662.
- Pokorny, B., 2006. Roe deer (*Capreolus capreolus* L.) antlers as an accumulative and reactive bioindicator of lead pollution near the largest Slovene thermal power plant. *Vet. Arhiv*, 76: S131–S142.
- Pokorny, B., 2006. Retrospektivni biomonitoring onesnaženosti ekosistemov Šaleške doline s svincem in fluoridi z uporabo rogovja srnjakov. *Zb. Gozd. Lesar.*, 80: 65–80.

Priporočeni:

- Wiersma J.B., 2004. *Environmental monitoring*. CRC Press, USA.
- Aritola J.F., Pepper I.L. in sod., 2004. *Environmental monitoring and characterization*. Elsevier Academic Press, San Diego.
- Markert B.A., Breure A.M., Zechmeister H.G. (Eds), 2003. *Bioindicators & biomonitors: Principles, concepts and applications*. Elsevier, Amsterdam.
- Relevantna zakonodaja (glej prilogo) / Relevant law- and bylaw documents.

Cilji in kompetence:

- seznanitev z zakonodajo, ki določa okoljske monitoringe in zavezanca za izvajanje okoljskega monitoringa;
- seznanitev z metodami spremljanja stanja in onesnaženosti vodnih ter kopenskih ekosistemov (fizikalno-kemijske, biološke metode);
- poznavanja različnih vrst/tipov okoljskih monitoringov;
- poznavanje različnih vrst in nivojev bioindikacije, razumevanje prednosti uporabe posameznih vrst bioindikacije; seznanitev s principi uporabe različnih bioindikatorskih organizmov;
- poznavanje prednosti in slabosti biomonitoringa v primerjavi s kemijskimi monitoringi;
- seznanitev s primeri dobre prakse na področju izvajanja biomonitoringov;
- seznanitev z metodami izvajanja humanega biomonitoringa;
- prenos teoretičnega znanja v prakso.

Objectives and competences:

- to acquaint with legislation for implementation of environmental monitorings and subjects which are obliged to implement such monitorings;
- to acquaint with methods for monitoring the status and pollution of aquatic and terrestrial ecosystems (physico-chemical, biological methods);
- to acquire the knowledge of different types of environmental monitorings;
- to acquire the knowledge of different types and levels of biomonitoring; to understand the principles and benefits of using various types of bioindication and bioindicator organisms;
- to acquire the knowledge of the advantages of biomonitoring compared to chemical monitoring;
- to acquaint with examples of good practice in the implementation of biomonitoring;
- to acquaint with human biomonitoring and its methods;
- to transfer theoretical knowledge into the practice.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

- razumevanje vrednotenja antropogenih vplivov na okolje;
- razumevanje pomena izvajanja okoljskih monitoringov;
- poznavanje zakonodaje, vrst in metodologije izvajanja različnih okoljskih monitoringov;
- razumevanje pomena bioindikacije;
- poznavanje vrst in nivojev bioindikacije;
- poznavanje uporabe različnih bioindikatorskih organizmov.

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost uporabe relevantne nacionalne in evropske zakonodaje;
- sposobnost sodelovanja pri načrtovanju in izvajanju okoljskih monitoringov;
- sposobnost načrtovanja in izvedbe biomonitoringov;
- sposobnost vrednotenja rezultatov in poročil okoljskih monitoringov in biomonitoringov.

Knowledge and understanding:

- understanding of evaluation of anthropogenic impacts on the environment;
- understanding of the importance of implementation of environmental monitoring;
- knowledge of legislation, different types and methodology of environmental monitorings;
- understanding of the types and levels of bioindication;
- knowledge of the use of different bioindicator organisms.

Transferable / key skills and other attributes:

- ability to use relevant national and European legislation;
- ability to participate in planning of environmental monitorings and in their implementation;
- ability to prepare and implement biomonitorings
- ability to evaluate the results and reports of environmental monitorings and biomonitorings.

Metode poučevanja in učenja:

Predavanje, seminarska naloga, terenske vaje.

Learning and teaching methods:

Lectures, seminar paper, fieldwork.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

<p>Pisni izpit. Seminarska naloga.</p> <p>Vprašanja pri pisnem izpitu se nanašajo na snov, podano na predavanjih.</p> <p>Ocenjevalna lestvica:</p> <ul style="list-style-type: none"> ▪ zadostno 6: 60–67 % ▪ dobro 7: 68–75 % ▪ prav dobro 8: 76–83 % ▪ prav dobro 9: 84–90 % ▪ odlično 10: 91–100 % 	<p>80 % 20 %</p>	<p>Written examination. Seminar paper.</p> <p>Questions for written examination are in relation to material delivered in lectures.</p> <p>Grading scale:</p> <ul style="list-style-type: none"> ▪ Sufficient D (6): 60–67% ▪ Good C (7): 68–75% ▪ Very good B (8): 76–83% ▪ Very good B+ (9): 84–90% ▪ Excellent A (10): 91–100%
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Materialni pogoji za izvedbo predmeta :

Predavalnica z multimedijско opremo.

Material conditions for subject realization:

Classroom with the multimedia equipment.

Obveznosti študentov:

- obvezna udeležba na terenskih vajah
- pozitivno ocenjena seminarska naloga

Student's commitments:

- Mandatory participation in the fieldwork
- Positively rated seminar paper

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

Pedagoško delo:

- nosilka predmetov *Projektno delo v biologiji in ekologiji* ter *Bioindikacija in biomonitoring* na Naravoslovno-matematični fakulteti Univerze v Mariboru;
- nosilka predmeta *Uvod v okoljske tehnologije* na Visoki šoli za varstvo okolja.

Raziskovalno in strokovno delo:

(i) okoljski monitoringi ob prometnicah, (ii) monitoringi učinkovitosti ukrepov za zmanjšanje povoza divjadi, (iii) ocene tveganja za okolje z uporabo receptorskih organizmov (npr. mali sesalci, ptice pevke), (iv) bioindikacija onesnaženosti vodnih ekosistemov z uporabo rib in bioindikacija kopenskih ekosistemov z uporabo deževnikov, malih sesalcev, iglic smreke in trosnjakov višjih gliv, (v) raziskave biotske pestrosti izbranih skupin (višje glive, žuželke), (vi) raziskave vplivov vojaške dejavnosti na okolje, (vii) raziskave vpliva onesnaženega zraka (prašnih delcev) na zdravje ljudi

Izbrane strokovne publikacije:

Obratovalni monitoring na osrednjem vadišču Slovenske vojske OSVAD, Postojna (2016-2018); vodja projekta: **Al Sayegh Petkovšek S.**

Al Sayegh Petkovšek S., Vrbič Kugonič N., Rošer Drev A., 2018. Okoljski monitoring v času obratovanja za hitro cesto Koper-Izola, zaključno poročilo. Eurofins ERICo Slovenija.

Pedagogic activities:

- Holder of courses *Bioindication and biomonitoring and Project work in biology and ecology* at the University of Maribor;
- Holder of course *Introduction to the environmental technologies* at Environmental Protection College.

Main research and professional activities:

(i) Environmental monitoring along main roads and highways; (ii) Monitoring of the effectiveness of mitigation measures for reducing traffic related mortality of wildlife; (iii) Ecological risk assessment (with the use of small mammals and passerine birds); (iv) Bioindication of terrestrial ecosystems and water ecosystems (with the use of earthworms, small mammals, Norway spruce needles, macrofungi, fish); (v) Studies of biodiversity of different taxa (macrofungi, insects); (vi) Studies of impacts of military activities on the environment; (vii) Assessment of health effects of polluted air (dust particles).

Selected professional publications:

Operational monitoring of military training area of the Slovenian Army (OSVAD), Postojna (2016-2018); project leader: **Al Sayegh Petkovšek S.**

Al Sayegh Petkovšek S., Vrbič Kugonič N., Rošer Drev A., 2018. Operational environmental monitoring for the Highway Koper-Izola. Final report, Eurofins ERICo Slovenia.

Izbrani znanstveni članki / Selected scientific papers:

Al Sayegh Petkovšek S., Kopušar N., **Pokorny B.**, Tome D., Kryštufek B., 2017. Prehod kovin iz tal v tkiva izbranih vrst prostoživečih živali: primer Velikega Vrha = Transfer of metals from soil to tissues of selected free-living animals: a case study for Veliki Vrh. *Acta silvae et ligni*, 114:1-20.

Al Sayegh Petkovšek S., Kopušar N., Kryštufek B., 2015. Small mammals as biomonitors of metal pollution: a case study in Slovenia. *Environmental monitoring and assessment*, 186:4261-4274.

Al Sayegh Petkovšek S., Kopušar N., Tome D., Kryštufek B., 2015. Risk assessment of metals and PAHs for receptor organisms in differently polluted areas in Slovenia. *Science of the total environment*, 532:404-414.

Al Sayegh Petkovšek S., Kopušar N., 2013. Deževniki kot kazalniki onesnaženosti tal = Earthworms as bioindicator organisms of soil pollution. *Acta silvae et ligni*, 101:1-12.

Al Sayegh Petkovšek S., 2013. Forest biomonitoring of the largest Slovene thermal power plant with respect to reduction of air pollution. *Environmental monitoring and assessment*, 185:1809-1823.

Al Sayegh Petkovšek S., **Pokorny B.**, 2013. Lead and cadmium in mushrooms from the vicinity of two large emission sources in Slovenia. *Science of the total environment*, 443:944-954.

Al Sayegh Petkovšek S., Mazej Z., **Pokorny B.**, 2012. Heavy metals and arsenic concentrations in ten fish species from the Šalek lakes (Slovenia): assessment of potential human health risk due to fish consumption. *Environmental monitoring and assessment*, 184:2647-2662.

Al Sayegh Petkovšek S., **Pokorny B.**, 2011. Pregled vsebnosti Cd, Hg, Pb in As v trosnjakih evropskih vrst gliv iz gozdne krajine = Cd, Hg, Pb, and As in European species of wild growing forest landscape fungi: a review. *Zbornik gozdarstva in lesarstva*, 94:3-20.

Al Sayegh Petkovšek S., Poličnik H., Ramšak R., Mavec M., **Pokorny B.**, 2010. Ecological remediation of the Šoštanj thermal power plant with respect to sustainable development of the Šalek Valley, Slovenia. *Thermal science*, 14:773-782.

Al Sayegh Petkovšek S., Tome D., **Pokorny B.**, 2010. Ocena tveganja zaradi prehoda svinca (Pb) iz tal prek prehranjevalne verige v male sesalce (na primeru pehotnih strelišč) = Risk assessment of lead contamination for small mammal food chains (case study for shooting ranges). *Zbornik gozdarstva in lesarstva*, 91:13-30.

Mazej Z., **Al Sayegh Petkovšek S.**, **Pokorny B.**, 2010. Heavy metal concentrations in food chain of lake Velenjsko jezero, Slovenia: an artificial lake from mining. *Archives of environmental contamination and toxicology*, 58:998-1007.