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KONFERENCIJA STUDENATA BIOLOGIJE, EKOLOGIJE I ZAŠTITE IVOTNE SREDINE

KNJIGA IZVODA

25-27. novembar 2022.

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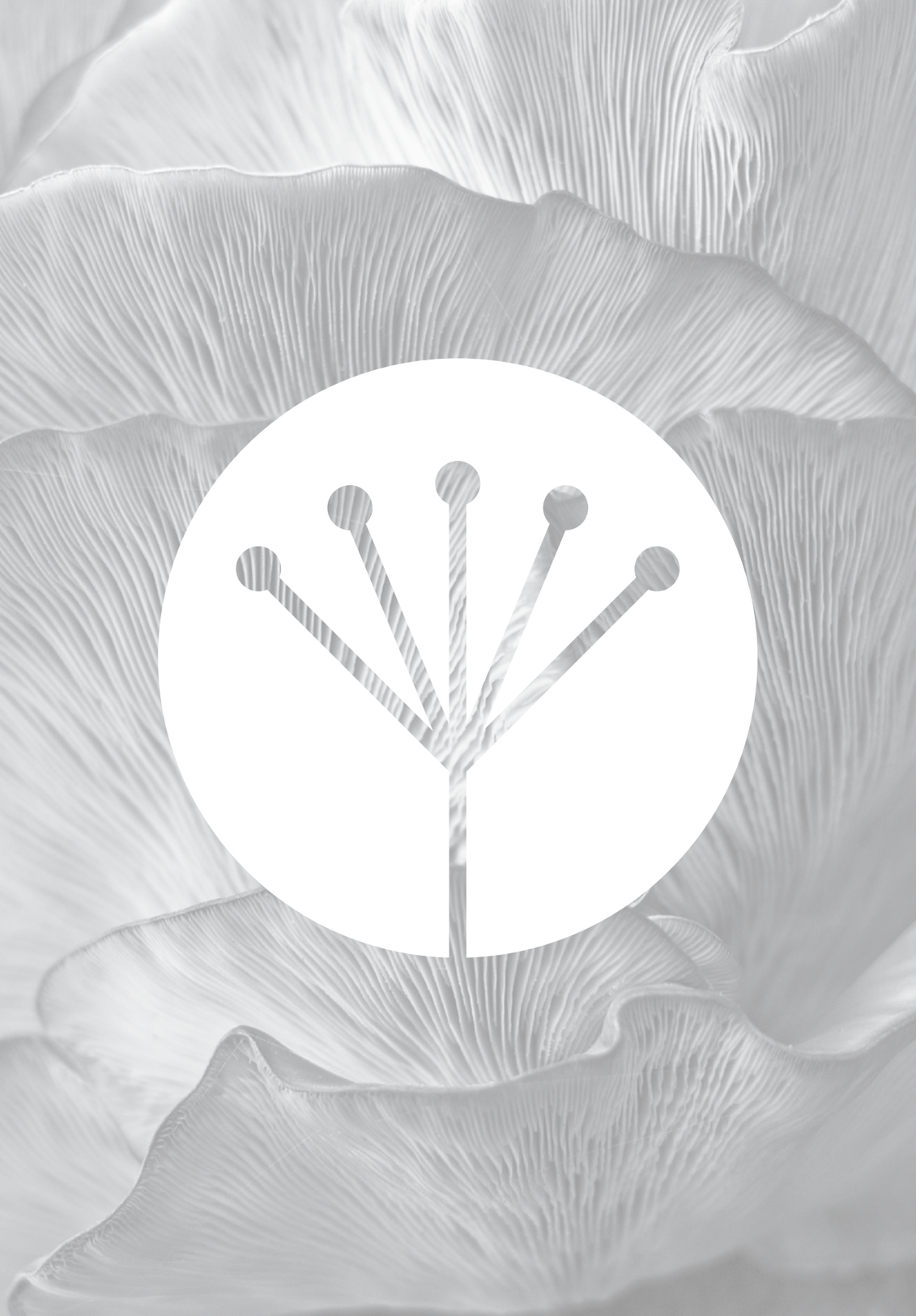


PREDGOVOR

Naučno-istraživačko društvo studenata biologije i ekologije „Josif Pančić“ je neprofitna organizacija civilnog društva pri Departmanu za biologiju i ekologiju, Prirodno-matematičkog fakulteta u Novom Sadu. Društvo je osnovano 1974. godine, na inicijativu studenata i osoblja tadašnjeg Instituta za biologiju, a njihovim zalaganjem i zvanično počelo sa radom 1983. kada je usvojen Statut. Osnovni ciljevi NIDSBE „Josif Pančić” su podsticanje, okupljanje i organizovanje mladih ljudi za bavljenje naučno-istraživačkim radom iz oblasti biologije i ekologije, sprovođenje aktivne zaštite prirode, podsticanje mladih na publikovanje dobijenih rezultata naučno-istraživačkih aktivnosti, kao i razmena iskustava u sprovođenju ovih aktivnosti sa drugim udruženjima. Društvo pruža studentima mogućnost učešća u realizaciji multidisciplinarnih projekata u okviru biologije, ekologije i zaštite životne sredine. Do sada je realizovan veliki broj različitih projekata sa tematikom popularizacije nauke, edukacije, aktivne zaštite prirode i biodiverziteta, kao i očuvanja životne sredine.

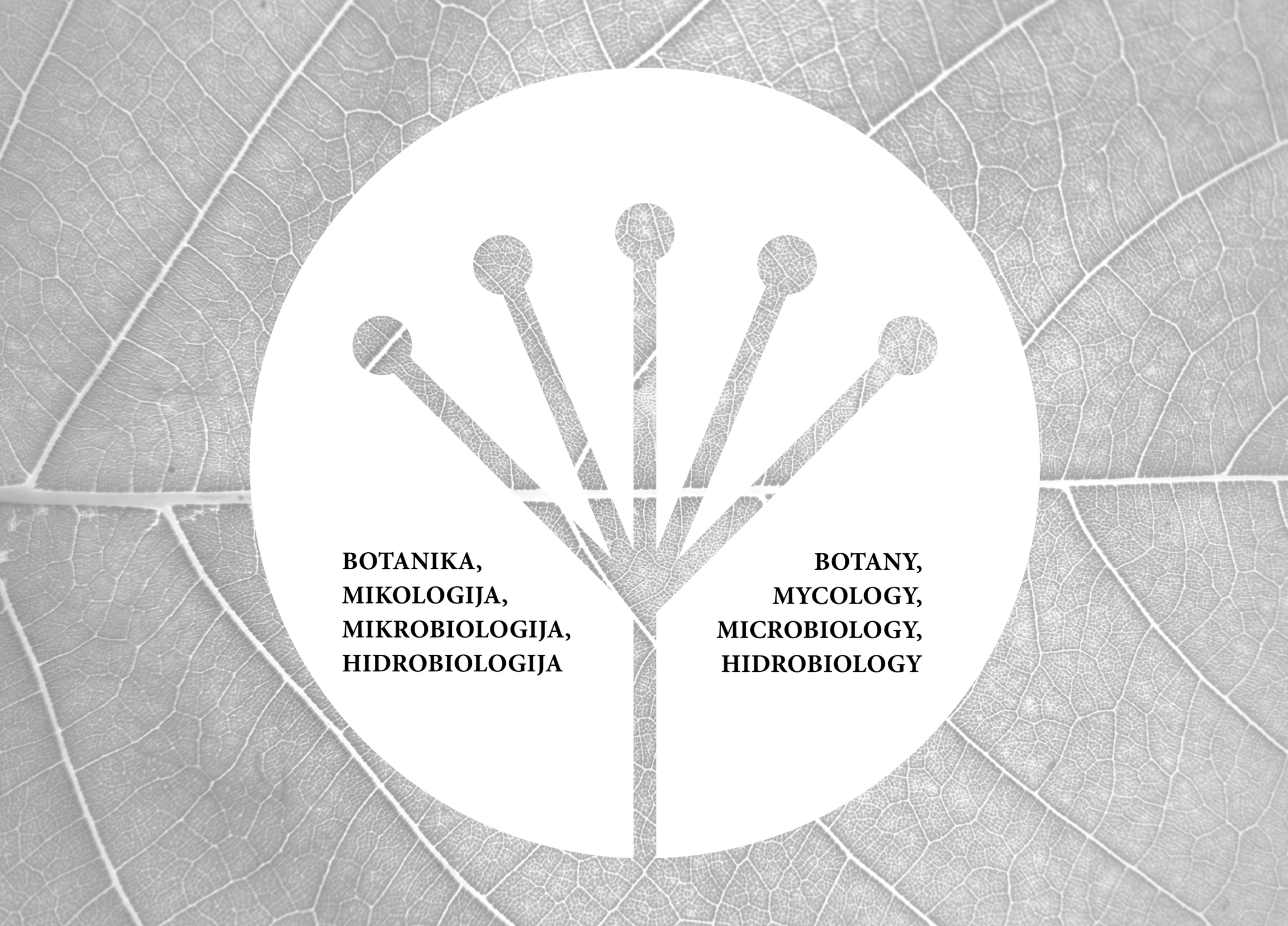
Kako je naučno-istraživački rad i promocija istog bitan deo rada Društva, 2008. godine se organizuje prva konferencija studenata biologije, ekologije i zaštite životne sredine „EkoBioMorfa“ u naselju Belo Blato, opština Zrenjanin. Konferencija je organizovana sa ciljem razvoja naučno-istraživačke ideje i popularizacije iste među studentima iz Srbije i regiona.

Sa daljim radom Društva i aktivnim sakupljanjem podataka, javlja se potreba za objavljivanjem novih rezultata, zbog čega se nastavlja sa organizacijom narednih konferencija. Na konferencijama koje su usledile, studenti su imali priliku da prezentuju rezultate svojih istraživanja kolegama i stručnjacima iz datih oblasti. Veliki značaj ove konferencije su bile izuzetno plodne diskusije, pri čemu su profesori, stručnjaci za date grupe organizama, davali konstruktivne savete, kako i na koji način studenti mogu da unaprede svoja istraživanja u budućnosti.

Četvrtu po redu „EkoBioMorfu“ Društvo organizuje u novembru 2022. u Novom Sadu. Cilj konferencije je ostao isti, popularizacija naučno-istraživačkog rada među studentima, kao i podsticanje na publikovanje rezultata istraživanja. Tema same konferencije bila je Uloga nevladinih organizacija u zaštiti prirode. Učešće NVO nije predstavljeno kao prioritet kod vladinih organizacija i nadležnih institucija. Iz tog razloga želeli smo da ukažemo na važnost uloge NVO u istraživanju i zaštiti prirode u skladu sa direktivama EU. Statistika pokazuje da 80% ljudi na svetu smatra da je mnogo lakše učestvovati u pozitivnim društvenim promenama uz pomoć NVO, a mi se slažemo sa tim.

Dragi čitaoci, sa ponosom predstavljamo knjigu izvoda sa Četvrte konferencije studenata biologije, ekologije i zaštite životne sredine „EkoBioMorfa 2022“, sa željom da će i u narednim godinama studenti nastaviti ovako vredno da rade i publikuju svoje rezultate.

Urednički tim „EkoBioMorfa 2022“



BOTANIKA, MIKOLOGIJA, MIKROBIOLOGIJA, HIDROBIOLOGIJA

BOTANY, MYCOLOGY, MICROBIOLOGY, HIDROBIOLOGY

ISPITIVANJE UTICAJA EKSTRAKTA VLAŠCA (*ALLIUM SCHOENOPRASUM* L.) I KVERCETINA NA MORFOLOŠKE I FIZIOLOŠKE KARAKTERISTIKE KLIJANACA *ARABIDOPSIS THALIANA*

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Ekstrakt listova vlašca je bogat flavonolima (kemferol, kvercetin i izoramnetin) i flavonolnim glikozidima (kemferol-3-O-glikozid i kvercetin-3-O-glikozid). Ova jedinjenja predstavljaju važnu grupu flanovoida sa širokim spektrom biološke aktivnosti. Cilj ovog istraživanja je da se ispita kako klijanci model biljke *A. thaliana* reaguju na prisustvo ekstrakta vlašca (koncentracije 100 mg/L) i kvercetina (koncentracije 15.11 mg/L) u hranljivoj podlozi. Dužina hipokotila je izmerena petog, sedmog i desetog dana nakon klijanja semena. Na elongaciju hipokotila značajno utiče prisustvo kvercetina u podlozi. Zahvaljući DAB (3,3´- diaminobenzidin) bojenju detektovana je akumulacija H_2O_2 u biljnom tkivu klijanaca *A. thaliana* starosti 10 dana. Ovaj rezultat je u saglasnosti sa povećanom aktivnošću antioksidativnog enzima peroksidaza kod klijanaca koji su rasli na podlozi sa ekstraktom vlašca. Takođe je određena i aktivnost enzima glutation transferaza, koji se dominantno nalazi u citosolu i učestvuje u procesima detoksikacije biljne ćelije. Opisane promene u aktivnosti antioksidativnih enzima klijanaca model biljke na podlozi sa ekstraktom vlašca, usmeravaju nas ka novim koracima u istraživanju sa mogućnošću razvoja potencijalnih bioherbicida.

Ključne reči: ekstrakt, kvercetin, vlašac, *Arabidopsis thaliana*, hipokotil, peroksidaze, DAB, glutation transferaza

Zahvalnica: Ovaj rad je urađen zahvaljujući podršci Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije (Ev.broj 451-03-68/2022-14/200007)

ASSESSMENT OF THE EFFECT OF CHIVE EXTRACT (*ALLIUM SCHOENOPRASUM* L.) AND QUERCETIN ON MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF *ARABIDOPSIS THALIANA* SEEDLINGS

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Chive leaf extract is a rich source of flavonols (kaempferol, quercetin and izorahmentin) and flavonoid glycosides (kaempferol-3-glucoside and quercetin-3-glucoside). These compounds are a very important group of flavonoids that have a broad range of biological activities. The aim of this study is to investigate the response of *Arabidopsis thaliana* to the presence of chive extract (concentration of 100 mg/L) and quercetin (concentration of 15.11 mg/L) in the growth medium. The length of hypocotyl was measured on the 5th, 7th, and 10th day after the germination of seeds. The presence of quercetin in the growth medium significantly effects the elongation of the hypocotyl. Accumulation of H2O2 in the plant tissue of seedlings was detected by DAB staining (3,3'-diaminobenzidine). These results correspond with increased activity of antioxidative enzyme peroxidase in seedlings that grow on the medium with chive extract. The activity of glutathione transferase was also determined. This enzyme is predominantly located in the cytosol and participates in the process of detoxification of plant cells. The described changes in antioxidative enzyme activities in plant model seedlings on growth medium with chive extract guide us towards new steps in research with the possible development of a potential bioherbicide.

Keywords: extract, quercetin, chive, *Arabidopsis thaliana*, hypocotyl, peroxidase, DAB, glutathione transferase

Acknowledgment: This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, contract number 451-03-68/2022- 14/200007

NOVE VRSTE BILJAKA NA TERITORIJI SPOMENIKA PRIRODE „SLAPOVI SOPOTNICE“ ZA 2020., 2021., 2022. GODINU

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Spomenik prirode „Slapovi Sopotnice“ nalazi se u jugozapadnoj Srbiji, na teritoriji opštine Prijepolje, na zapadnim padinama planine Jadovnik. Nalazi se na nadmorskoj visini između 820 i 1245 metara, a prepoznatljivo je po karakterističnim slapovima i vodopadima koje gradi reka Sopotnica. Područje je stavljeno pod zaštitu radi očuvanja morfo-hidroloških vrednosti koje čine 4 kraška vrela, više izvora i 7 bigrenskih terasa preko kojih otiču vrelski vodotoci.

U saradnji sa Planinarskim klubom „Kamena gora“ 2014. godine započeta su biološka istraživanja u okviru kojih se redovno obavlja i popis flore pomenutog područja. Do 2020. godine na teritoriji Spomenika prirode „Slapovi Sopotnice“ i njegovoj bližoj okolini zabeleženo je prisustvo 541 biljne vrste.

Istraživanja sprovedena 2020. i 2021. godine obuhvatila su letnji aspekt flore, dok je 2022. godine, pored letnjeg, obuhvaćen i ranoprolećni, prolećni i jesenji aspekt. Terenski izlasci uključili su različite tipove staništa: akvatična i ruderalna staništa, sušne i vlažne livade, hrastove i bukove šume i šumske obode.

Za vreme pomenutog perioda floristički spisak Sopotnice obogaćen je za 26 novih vrsta. 2020. godine pronađene su 4 nove vrste, 2021. godine 6 i 2022. godine 16 vrsta. Najveći broj novih vrsta zabeležen je u okviru familija Fabacaeae i Caryophyllaceae. Od ukupnog broja novopronađenih vrsta, njih 2 (*Veratrum nigrum* L., *Euphrasia minima* Jacq. Ex DC.) se nalaze na Prilogu II Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva.

S obzirom da ova dugogodišnja istraživanja svake godine rezultiraju pronalaskom novih vrsta za područje, potreba za daljim nastavkom istraživanja i upotpunjavanjem florističkog spiska Spomenika prirode „Slapovi Sopotnice“ je evidentna.

Ključne reči: flora, Sopotnica

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NEW PLANT SPECIES ON THE TERRITORY OF THE NATURAL MONUMENT ‘’SOPOTNICA FALLS” IN 2020, 2021 AND 2022

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The Natural Monument “Sopotnica Falls” is located in southwestern Serbia, on the territory of the municipality of Prijepolje, on the western slopes of the Jadovnik mountain. It is located at an altitude between 820 and 1245 meters above sea level, and it is recognizable by the characteristic waterfalls that are formed by the Sopotnica river. The area has been placed under protection in order to preserve the morpho-hydrological values, which consist of 4 karst springs, a handful of wellsprings, and 7 bigren terraces over which wellheaded watercourses flow.

In cooperation with the Mountaineering club “Kamena Gora”, biological research started in 2014, within the framework of which a flora census of the mentioned area is also regularly carried out. By 2020, the presence of 541 plant species was recorded on the territory of the Natural Monument “Sopotnica Falls” and its proximate surroundings.

Research conducted in 2020 and 2021 included the summer aspect of the flora, while in 2022, in addition to the summer, the early spring, spring and autumn aspects were also included. The field trips included different types of habitats: aquatic and ruderal habitats, dry and wet meadows, oak and beech forests and forest edges.

During the mentioned period, the floristic list of Sopotnica was enriched by 26 new species. 4 new species were found in 2020, 6 in 2021 and 16 in 2022. The largest number of new species was recorded within the families Fabaceae and Caryophyllaceae. Of the total number of newly discovered species, 2 of them *(Veratrum nigrum* L.., *Euphrasia minima* Jacq. ex DC.) are on Annex II of the Rulebook on declaration and protection of strictly protected and protected wild species of plants, animals and fungi.

Bearing in mind that this long-term research results in the discovery of new species for the area every year, the need for further continuation of the research and completion of the floristic list of the Natural Monument ‘’Sopotnica Falls” is evident.

Keywords: flora, Sopotnica

REZULTATI MIKOLOŠKIH ISTRAŽIVANJA – EDUKATIVNI KAMP „TARA 2021“

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Nacionalni park „Tara” se nalazi na krajnjem zapadu Srbije, obuhvatajući planinsko područje smešteno u laktastoj okuci reke Drine. Pejzažem Tare dominiraju šume sastavljene gotovo isključivo od bukve, jele i smrče (Piceto-Abieto-Fagetum) prošarane planinskim pašnjacima. Prate ih velike količine serpentinita na kojima dominiraju borove šume, dok se po obodima planine javljaju termofilne šume litica i klisura. Tara poseduje veliku raznolikost reljefa koja, uparena sa velikom vlažnošću (maglama) koja dolazi sa Drine predstavlja potencijalno vruću tačku (hot spot) za diverzitet gljiva.

Cilj istraživanja bio je utvrđivanje biološke raznovrsnosti gljiva koje obrazuju krupna plodonosna tela (makromicete) na zaštićenom području. Pojam makromicete obuhvata taksonomski različite pripadnike carstva gljiva iz razdela Ascomycota i Basidiomycota. One čine istaknutu komponentu većine kopnenih ekosistema u kojima obavljaju širok spektar ekoloških uloga kao saprotrofi, mutualistički partneri i paraziti. U ovoj grupi gljiva su i vrste koje su ljudima najpoznatije kao jestive, lekovite i otrovne.

Istraživanje je vršeno na lokalitetima: Mitrovac, Crveni potok, okolina puta ka Banjskoj steni, kanjon reke Dervente i šume oko jezera Kruščica. Gljive su fotografisane na terenu gde je vršena i determinacija, za koju su korišćeni makroskopski taksonomski karakteri i hemijske reakcije na različite reagense, uz pomoć stručne literature.

Ukupno je pronađena 41 vrsta u okviru 22 porodice. Sa stanovišta organoleptičkih svojstava, 14 vrsta su jestive ili dobre jestive, 5 su lekovite, 3 otrovne, dok su ostale nejestive. Značajni nalazi su *Russula cyanoxantha* (Schaeff.) Fr, koja je zaštićena prema Pravilniku o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva; kao i vrsta *Pluteus roseipes* Höhn, koja je u literaturi okarakterisana kao retka u severnoj Evropi.

Mali broj pronađenih vrsta može se objasniti dugim periodom suše koji je prethodio istraživanju, te gljive nisu imale pogodne uslove za formiranje plodonosnih tela. Zarad zaštite populacija makrogljiva koje su prisutne na ovom području, kao i očuvanja njihove brojnosti i raznovrsnosti, potrebno je nastaviti dalja istraživanja.

Ključne reči: Tara, makromicete, Ascomycota, Basidiomycot

RESULTS OF MYCOLOGICAL RESEARCH – EDUCATIONAL CAMP “TARA 2021”

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National Park “Tara” is located in the far west of Serbia, including a mountainous area located along the Drina river. Tara is dominated by forest of fir, spruce and beech (Piceto-Abieto-Fagetum), intersected by mountain pastures, followed by large amounts of sertpentinite dominated by pine forests, while thermophilic forests of cliffs and gorges appear on the mountain’s edges. Because of a great variety of reliefs, combined with high humidity (fogs), coming from the Drina, Tara is a potential hot spot for the diversity of fungi.

The aim of the research was to gather data about the biodiversity of fungi that produce macroscopic fruting bodies (macromycetes) in the protected area. The term macromycetes includes fungi from the divisions Ascomycota and Basidiomycota. They are an important component of most terrestrial ecosystems in which they have a wide range of ecological roles as saprotrophs, mutualistic partners and parasites. This group of mushrooms also includes species that are known to people as edible, medicinal and poisonous.

The research was carried out in the following locations: Mitrovac, Crveni potok, the area around the road to Banjska stena, the canyon of the Derventa river and the forests around Lake Kruščica. Fungi were photographed and identified in the field. Macroscopic taxonomic characteristics and chemical reactions to various reagents were used for identification, with the help of professional literature.

In total, 41 species were found within 22 families. Considering the organoleptic properties, 14 species are edible or good edible, 5 are medicinal, 3 are poisonous, while the rest are inedible. Significant findings are *Russula cyanoxantha* (Schaeff.) Fr, which is protected under the Rulebook of the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Mushrooms; and *Pluteus roseipes* Höhn, which is characterized in the literature as rare in Northern Europe.

The small number of species that have been recorded can be explained by the long period of drought that preceded the research, which prevented the fungi from forming fruiting bodies. Further research is needed for conservation of diversity, as well as for protection of populations of macromycetes of this area.

Keywords: Tara, macromycetes, Ascomycota, Basidiomycota

SZAMÁRTEJ TERMELÉSE ÉS FELHASZNÁLÁSI LEHETŐSÉGEI

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Napjainkban egészséges es természetes életmódot keresve az emberek egyre több tradicionális gyógyszert és ételt fedeznek fel újra. Ezek egyike a szamártej, amelynek a kozmetikai és gyógyászati hatása évezredek óta ismert, ezért egyre szélesebb és gyakoribb a használata.

A tej egy összetett oldat, több száz alkotóelemmel, amelyek fehérjékre, zsírokra, szénhidrátokra, ásványi anyagokra és vitaminokra oszthatók. A szamártej kémiai összetételét tekintve leginkább a kancatejhez és az anyatejhez hasonlít, jelentősen eltér a tehén, juh és kecsketejtől.

Az őshonos balkáni szamár a páratlanujjú patások (*Perissodactyla*) rendjéhez vagyos lófélék (*Equidae*) családjához tartozik, amelyet a Balkán-félsziget dombos és hegyvidéki területén tenyésztenek.

A kutatás célja a zasavicai szamárfarmról kézi fejéssel nyert balkáni fajtájú szamarak elegytejének kémiai összetételének, valamint higiéniai megfelelőségének meghatározása. Azzal a szándékkal, hogy többet tudjon meg a szamártej nutritiv tulajdonságairól.

A kutatott szamárfarm Mácsva északi részen Zaszavica nevezetű faluban található. Maga a farm a Zaszavica Speciális rezervátum része, és a védett terület kezelőjének a tulajdonában áll.

Kulcsszavak: szamár, tej, élelmiszer

DONKEY MILK PRODUCTION AND USAGE POSSIBILITIES

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Nowadays, in search of a healthy and natural lifestyle, people are rediscovering more and more traditional medicines and foods. One of these is donkey milk, the cosmetic and medicinal effects of which have been known for thousands of years, which is why it is being used more and more frequently.

Milk is a complex solution with hundreds of components that can be divided into proteins, fats, carbohydrates, minerals and vitamins. In terms of its chemical composition, donkey milk is most similar to mare milk and human/breast milk, and is significantly different from cow milk, sheep milk and goat milk.

The native Balkan donkey belongs to the Equidae family which is in the order of odd-toed ungulates (Perissodactyla), which is bred in the hilly and mountainous areas of the Balkan Peninsula.

The aim of the research is to determine the chemical composition and hygienic suitability of the mixed milk of Balkan donkeys obtained by hand milking from the donkey farm in Zasavica. With the intention of learning more about the nutritional properties of donkey milk.

The researched donkey farm is located in the village of Zasavica in the northern part of Mačva. The farm itself is part of the Zasavica Special Reserve and is owned by the manager of the protected area.

Keywords: donkey, milk, food

ISPITIVANJE FOTOTROFNIH MIKROORGANIZAMA U BIOFILMOVIMA ULAZNE ZONE PETNIČKE PEĆINE U RAZLIČITIM SEZONAMA

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Fototrofni mikroorganizmi, cijanobakterije i alge, pored vodenih nastanjuju i brojna druga staništa, od kojih se mnoga, kao na primer pećine, smatraju ekstremnim za njihov život. U ovim staništima fototrofi se razvijaju na osvetljenim mestima (ulazna zona pećina ili mesta u blizini veštačkog osvetljenja u unutrašnjosti turističkih pećina). Biofilm koji formiraju fototrofi se lako uočava na zidovima pećina, različitim pećinskim strukturama i sedimentu usled često izrazite obojenosti.

Fototrofi u pećinama Srbije se aktivno istražuju sa različitih aspekata (diverzitet vrsta, otkriće novih taksona za nauku, karakteristike biofilma, konzervacija pećina, itd.), a samo jedno istraživanje do sada se odnosilo na njihovu sezonsku dinamiku u okviru ulazne zone pećina. Kako je ulaz u pećinu zona koja je pod uticajem spoljne klime, praćenje karakteristika biofilma kao i promenljivih ekoloških faktora daje detaljniji uvid u zavisnost sastava zajednice fototrofa od abiotičkih faktora.

Petnička pećina je već nekoliko puta bila predmet istraživanja u kojima je fokus bio na fototrofnim mikroorganizmima ulazne zone (epiliti i endoliti). Ipak, u ovoj pećini do sada nije sprovedeno ni jedno istraživanje koje se fokusira na sezonsku dinamiku. Cilj ovog istraživanja je sezonsko (2021-2022) ispitivanje i praćenje fototrofnih biofilmova koji se razvijaju na zidovima ulazne zone Petničke pećine. U ovom radu će biti prikazani rezultati istraživanja iz dve sezone.

Pozicije mesta uzorkovanja, karakteristike biofilma, ekološki parametri (temperatura, relativna vlažnost, intenzitet svetlosti), kao i pH i vlažnost supstrata su beleženi/mereni i upoređivani za različite sezone. Izgled biofilma tokom odabranih sezona je bio veoma različit: tokom jeseni biofilm je bio izrazito suv, dok je tokom leta bio veoma vlažan. Ovo koreliše sa merenim ekološkim parametrima i uslovima izvan pećinskog ulaza, jer su tokom uzorkovanja u letnjem periodu zabeležene obilne padavine i intenzivnije prokapne vode.

Cyanobacteria i Chlorophyta su glavne grupe fototrofa dokumentovane u svežim uzorcima biofilma. Cyanobacteria, koje su činili predstavnici sve tri morfološke grupe (kokoidna, homocitna i heterocitna) su dominirale u većini uzoraka u obe sezone. Među najzastupljenijim taksonima su kokoidne forme, kao što su predstavnici rodova *Chroococcus, Gloeocapsa, Gloeothece,* što se slaže i sa rezultatima prethodnih istraživanja sprovedenih u ovoj pećini. Na nekim tačkama uzorkovanja određeni taksoni su dominirali u biofilmu, kao što je slučaj sa *Gloeobacter violasceus* i *Geitleria calcarea.* U nekoliko uzoraka dominirale su Chlorophyta, gde se posebno istakao takson *Desmococcus olivaceus.*

Ključne reči: Cyanobacteria, alge, biofilm, pećina, sezonska dinamika

EXAMINATION OF PHOTOTROPHIC MICROORGANISMS IN BIOFILMS FROM THE ENTRANCE ZONE OF PETNICA CAVE IN DIFFERENT SEASONS

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Phototrophic microorganisms, Cyanobacteria and algae, can be found in various habitats beside water, among which are many extreme ones, such as caves. Those specific habitats host phototrophs at illuminated places (entrance zone or areas around artificial lights inside the show caves). In general, phototrophic biofilms in caves are usually easily spotted on cave walls, cave formations and sediment, due to their colorful appearance.

Phototrophs are actively explored in Serbian caves from different aspects (diversity of species, describing new taxa for science, biofilm characteristics, cave conservation, etc.), and only one study so far (according to published data) focused on their seasonal dynamics within the cave entrance zone. Since cave entrances are influenced by external climate, monitoring of biofilm characteristics, as well as ecological parameters, contribute to wider knowledge that refer to dependence of phototrophic community composition on abiotic factors.

Petnica Cave has been visited several times for the purpose of exploring phototrophic microorganisms (epiliths and endoliths) from the entrance zone. However, so far, no study on seasonal dynamics was conducted. The aim of this study was to examine phototrophic biofilms from the selected sampling sites at the entrance zone of Petnica Cave, seasonally (2021-2022). For the purpose of this work, results from two seasons are shown.

Positions of sampling sites in the cave, biofilm characteristics, ecological parameters (temperature, relative humidity, light intensity), as well as substrate pH and moisture were recorded/measured and compared among seasons. Appearance of biofilms in the selected seasons significantly differed: during autumn biofilms were really dry, while during summer they were highly moistened. This was correlated to the measured ecological parameters and external conditions, since the time of sampling in the summer period was characterized with heavy rainfall and intense presence of seeping water.

Cyanobacteria and Chlorophyta are the main groups of phototrophs that were detected in fresh biofilm samples. Cyanobacteria were absolutely dominant in the majority of samples in both seasons and were represented with all three morphological forms, coccoid, simple trichal and heterocytous. Among the most frequently encountered taxa are representatives of coccoid genera such as *Chroococcus, Gloeocapsa, Gloeothece,* which is in accordance with previous research that was performed in this cave. At some sampling sites certain taxa dominated, such as *Gloeobacter violasceus* and *Geitleria calcarea.* In a few samples Chlorophyta were abundant, more precisely taxon *Desmococcus olivaceus*.

Keywords: Cyanobacteria, algae, biofilm, cave, seasonal dynamics

ISTRAŽIVANJE FITOPLANKTONA ŠODROŠA U NOVOM SADU, KRAJEM 2021. I PRVOM POLOVINOM 2022. GODINE

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Šodroš je rukavac Dunava koji razdvaja Ribarsko i Kameničko ostrvo i predstavlja značajno stanište za ptice, kao i prirodno mrestilište riba. Cilj istraživanja bio je zabeležiti prisutne rodove fitoplanktona na ovom području i odrediti njihovu relativnu brojnost, s težnjom da se postavi podloga za buduća detaljnija istraživanja i analize.

Istraživanje je sprovedeno kroz 4 terenska izlaska, krajem 2021. i prvom polovinom 2022. godine i to u novembru, martu, maju i junu mesecu. Uzorci vode zahvaćeni su planktonskom mrežicom promera 65μm, na oko 2 metra od obale plaže Šodroš u jutarnjim časovima. Zahvaćeni uzorak je potom pretočen u flakon zapremine 60 mL, te fiksiran Lugolovim rastvorom do postizanja boje konjaka. Tokom terenskih izlazaka u 2022. na licu mesta zabeleženi su i temperatura vode, elektroprovodljivost i ukupna rastvorena čvrsta supstanca. Svetlosnom mikroskopijom, metodom transekta na pripremljenom preparatu, određena je procentualna zastupljenost pojedinih razdela fitoplanktona u uzorku. Relativna brojnost rodova algi određena je na osnovu posmatranja 10 preparata iz pojedinačnog uzorka, dodeljivanjem vrednosti (+ - 4) u odnosu na učestalost pojavljivanja u datim preparatima. Procentualna zastupljenost razdela i relativna brojnost rodova određivani su za uzorke prikupljene tokom terenskih izlazaka u 2022. godini, dok su za Novembar 2021. evidentirani samo prisutni rodovi.

Tokom celokupnog istraživanja zabeleženo je ukupno 18 rodova algi. U novembru 2021. godine zabeleženo je 12 rodova algi. Najveći broj taksona zabeležen je u junskom terenskom izlasku, sa ukupno 14 rodova, gde je najveću relativnu brojnost (3) pokazao rod *Aulacoseira* sp. Najveću procentualnu zastupljenost u uzorku pokazao je razdeo Bacillariophyta (93%). 12 rodova zabeleženo je u maju, od kojih su rodovi *Asterionella* sp. i *Dinobryon* sp. pokazali najveću relativnu brojnost (2). Najbrojniji razdeo bio je Bacillariophyta (55%). U martovskom terenskom izlasku zabeležen je nešto manji broj taksona (8). Najveću relativnu brojnost (2) pokazali su rodovi *Trachelomonas* sp., *Asterionella* sp. i *Dinobryon* sp. Najveću procentualnu zastupljenost imao je razdeo Euglenophyta (46%).

Iako dobijeni podaci predstavljaju dobar temelj i daju okvirnu sliku o zajednici fitoplanktona u pomenutom rukavcu Dunava tokom prve polovine godine, u budućim istraživanjima potrebno je inkorporirati više terenskih izlazaka i u jesenjim i zimskim mesecima. Istraživanje bi moglo biti poboljšano i određivanjem biomase i apsolutne brojnosti taksona, čime bi mogli biti dobijeni detaljniji zaključci o dinamici fitoplanktonske zajednice Šodroša i njegovom ekološkom statusu.

Ključne reči: Dunav, fitoplankton, relativna brojnost

PHYTOPLANKTON RESEARCH OF ŠODROŠ, NOVI SAD, AT THE END OF THE YEAR 2021 AND THE FIRST HALF OF 2022

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Šodroš is a branch of the Danube that separates „Ribarsko ostrvo” and „Kameničko ostrvo” and represents an important habitat for birds, as well as a natural breeding ground for fish. The aim of the research was to record the phytoplankton genera present in this area and determine their relative abundance, with the aim of laying the groundwork for more detailed research and analysis in the future.

The research was conducted through 4 field trips - at the end of 2021 and during the first half of 2022 - in November, March, May and June. The water samples were captured with a plankton net of 65 μm diameter at about 2 meters from the coast of Šodroš beach in the morning hours. The attainted sample was then poured into a 60 mL phial and fixed with Lugol’s solution until it reached the color of cognac. During the field trips in 2022 - water temperature, electrical conductivity, and total dissolved solids were also recorded on site. The percentage representation of certain divisions of phytoplankton in the sample was determined by light microscopy, using the transect method on the prepared preparation. The relative abundance of algae genera was determined based on the observation of 10 preparations from a single sample, by assigning values (+ - 4) in relation to the frequency of occurrence in the given preparations. The percentage representation of phyla and the relative abundance of genera were determined for samples collected during the field trips in 2022, while for November 2021 only the present genera were recorded.

During the entire research, a total of 18 genera of algae were recorded. In November 2021 a total of 12 genera were recorded. The largest number of taxa was recorded in the June field trip, with a total of 14 genera, where the genus *Aulacoseira* sp. showed the highest relative abundance (3). The division Bacillariophyta (93%) showed the highest percentage representation in the sample. 12 genera were recorded in May, of which the genera *Asterionella* sp. and *Dinobryon* sp. showed the highest relative abundance (2). The most numerous division was Bacillariophyta (55%). A slightly smaller number of taxa (8) was recorded in the March field trip. The genera *Trachelomonas* sp., *Asterionella* sp. and *Dinobryon* sp. showed the highest relative abundance (2). The phylum Euglenophyta had the highest percentage representation (46%).

Although the obtained data represents a good foundation and provides an approximate picture of the phytoplankton community in the above mentioned Danube branch during the first half of the year, in future studies it is necessary to incorporate more field trips in the autumn and winter months. The research could be improved by determining the biomass and absolute abundance of taxa, which could lead to more detailed conclusions about the dynamics of the phytoplankton community of Šodroš and its ecological status.

Keywords: Danube, phytoplankton, relative abundance

UTJECAJ DABROVIH BRANA NA ZAJEDNICU MAKROZOOBENTOSA I KAKVOĆU VODE

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Euroazijski dabar (*Castor fiber* Linnaeus, 1758) zaštićena je vrsta, koja početkom 20. stoljeća nestaje s područja Hrvatske. Od 1996. do 1998. godine, provodila se reintrodukcija ove vrste u pogodna staništa na području države. Euroazijski dabar naziva se „inženjerom ekosustava", jer mijenja stanište u kojem živi. Gradi brane na mjestima gdje mu je potrebna veća razina vode za kretanje, čime stvara akumulacijska jezera koja podržavaju složene hranidbene mreže i postaju dom brojnim vrstama. Cilj projekta je proučiti utjecaj dabrovih brana na vodu i zajednicu makrozoobentosa u neposrednoj blizini brana i uz posljedično nastala akumulacijska jezera. Uzorci su prikupljeni na lokalitetima Grabovac Krnjački i Prodin Dol, u ožujku i travnju 2021. godine. Na svakom od lokaliteta uzeti su uzorci makrozoobentosa i vode na tri postaje: kontrola, akumulacijsko jezero i nizvodno od dabrovih brana. Prilikom uzorkovanja procijenjen je sastav supstrata. Dio fizikalno-kemijskih parametara vode izmjeren je *in situ* (temperatura vode, pH, provodljivost, otopljeni kisik i zasićenje kisikom), a dio je analiziran u limnološkom laboratoriju (nitrati, nitriti, fosfati, alkalitet). Prisutnost dabra na lokalitetima potvrđena je pomoću foto zamki, procjenom dobro održavanog izgleda brane i tragova obitavanja. Dabar je gradnjom brana izmijenio izgled staništa na istraživanim lokalitetima stvarajući akumulacijska jezera te neposredno uništavajući vegetaciju. U akumulacijskim jezerima zabilježena je i najviša provodljivost vode, a većinu sedimenta činio je argilal, dok je na kontrolnim točkama prevladavao mezolital i mikrolital. Determinacijom jedinki makrozoobentosa utvrđeno je da su najzastupljeniji pripadnici reda Diptera, porodica Chironomidae zbog njihovog brzog prilagođavanja na širok raspon različitih okolišnih uvjeta.

Ključne riječi: euroazijski dabar, akumulacijsko jezero, fizikalno-kemijski parametri, Hrvatska

IMPACT OF BEAVER DAMS ON THE MACROINVERTEBRATES COMMUNITY AND WATER QUALITY

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The Eurasian beaver (*Castor fiber* Linnaeus, 1758) is a protected species, which disappeared from Croatia at the beginning of the 20th century. From 1996 to 1998, the reintroduction of this species was carried out in suitable habitats across the country. This species is called an "ecosystem engineer" because it changes the habitat in which it lives. It builds dams in places where a higher level of water is needed for moving, thus creating beaver ponds that support complex food webs and become a habitat for numerous species. The goal of the project is to investigate the impact of beaver dams on water and the macroinvertebrates community – right next to the dams and by the ponds. We collected samples at two locations Grabovac Krnjački and Prodin Dol, in March and April of 2021. At thatlocations, we took macroinvertebrates and water samples at three stations: control, beaver pond and downstream of the beaver dams. During sampling, we evaluated the composition of the substrate. Part of the physical and chemical parameters of the water were measured *in situ* (water temperature, pH, conductivity, dissolved oxygen and oxygen saturation), and partwere analyzed in the limnology laboratory (nitrates, nitrites, phosphates, alkalinity). The presence of beavers at the locations was confirmed using a camera trapping method, by assessing the well-maintained appearance of the dam and traces of habitation. While buildingdams, beavers changed the habitat in the sampled localities by creating ponds and directly destroying the vegetation. The highest water conductivity was also recorded in the ponds, andmost of the sediment was argillal, while mesolithal and microlithal were prevailing at the control station. Among identified macroinvertebrates, the dominant individuals belong to theChironomidae (Diptera) - due to their fast adaptation to a wide range of different environmental conditions.

Keywords: Eurasian beaver, beaver pond, physical and chemical parameters, Croatia

PROCENA STANJA REKE SOPOTNICE NA OSNOVU ISTRAŽIVANJA MAKROZOOBENTOSNE ZAJEDNICE

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Kratkoročno istraživanje sastava zajednice bentosnih makroinvertebrata reke Sopotnice izvršeno je u periodu od 16. do 18. jula 2022. godine. Odabrana su 4 lokaliteta (Ribnjak, Gornji vodopadi, tok reke iznad Gornjih vodopada i Donji vodopadi), na kojima su zabeležene koordinate, tip podloge i pristupljeno je uzimanju sredinskih parametara (temperatura, pH vrednost i elektroprovodljivost). Uzorkovanje je vršeno trominutnom „kick and sweep“ metodom, mrežom promera okaca 1 mm, i to uzimanjem nekoliko poduzoraka u skladu sa procenjenim brojem mikrostaništa. Odmah po uzorkovanju obavljeno je prosejavanje sitom promera 0,5 mm i čišćenje uzoraka koji su potom konzervirani u 96% alkoholu za potrebe identifikacije i prebrojavanja jedinki.

Većina organizama u uzorku identifikovana je do nivoa familije, dok je nekoliko identifikovano do nivoa roda ili vrste. Evidentirano je prisustvo 19 familija, koje su dalje razvrstane u 10 redova, 6 klasa i 3 razdela. Najveći broj familija zabeležen je na lokalitetu Donji vodopadi (16), a pomenuti lokalitet se ujedno odlikovao i najvećim brojem jedinki u uzorku. Na Ribnjaku je ujedno zabeležen i najmanji broj taksona, gde je i antropogeni uticaj na prirodno stanište i najvidljiviji.

Tokom reke Sopotnice evidentno je prisustvo familija koje se javljaju u izuzetno čistim vodama kao što su Perlidae, Perlodidae i Heptageniidae. Ipak, prisustvo familija u okviru klase Hirudinea, te familija Lumbricidae, ukazuju na izvestan nivo organskog opterećenja.

Na osnovu zabeleženog prisustva familija i sume njihovih skorova tolerancije, za sva 4 lokaliteta pristupljeno je izračunavanju BMWP (eng: Biological Monitoring Working Party) indeksa čija vrednost (50-90) ukazuje na visok kvalitet vode. Za detaljniji i sveobuhvatniji uvid u sastav makrozoobentosne zajednice i kvalitet vode neophodno je vršiti dugogodišnja istraživanja i to u više sezona tokom godine.

Ključne reči: Sopotnica, ekološka procena kvaliteta, makrozoobentos

ASSESSMENT OF THE RIVER SOPOTNICA (SERBIA) BASED ON THE MACROINVERTEBRATES ASSEMBLAGES

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The river Sopotnica rises on the Jadovnik mountain at 1,150 meters above sea level, and flows into the Lim river. It is characterized by a fast and turbulent flow, and the height difference between the source and mouth is 685 meters. Along its entire course, the river flows over several birge terraces, creating distinctive falls and waterfalls.

A short-term survey of the composition of the benthic macroinvertebrate community of the Sopotnica River was carried out in the period from July 16 to 18, 2022. 4 locations were selected (Ribnjak, Upper Waterfalls, the course of the river above Upper Waterfalls and Lower Waterfalls), where coordinates and substrate type were recorded, as well as the environmental parameters (temperature, pH value and electrical conductivity). Sampling was carried out by the three-minute “kick and sweep” method, with a mesh diameter of 1 mm, and by taking several sub-samples in accordance with the estimated number of microhabitats. Immediately after sampling, sieving with a sieve of 0.5 mm diameter and sorting of the samples were carried out. The animals were then preserved in 96% alcohol for the purposes of identification and quantitative analysis.

Most of the organisms in the sample were identified to the family level, while a few were identified to the genus or species level. The presence of 19 families was recorded, which were further classified into 10 orders, 6 classes and 3 divisions. The largest number of families was recorded at the Lower Waterfalls sampling site (16), where the largest number of individuals in the sample was also recorded. The smallest number of taxa was recorded at Ribnjak (8), where the strongest anthropogenic influence on the natural habitat was evident.

Along the river Sopotnica, presence of the families – such as Heptagenidae, Perlodidae and Perlidae – which usually appear in very clean waters was evident. However, the presence of families of the class Hirudinea, as well as the Oligochaeta family Lumbricidae, point out to a certain level of organic enrichment.

Based on the recorded presence of the families and the sum of their tolerance scores, the BMWP (Biological Monitoring Working Party) index was calculated for all 4 locations. It’s value (50-90) indicates a high quality of water. For a more detailed and comprehensive insight into the community composition of macrozoobenthos and water quality, it is necessary to carry out long-term research including several seasons throughout the year.

Keywords: Sopotnica, ecological quality assessment, macrozoobenthos

УЛОГАТА НА СТРУКТУРАТА НА ЗАЕДНИЦИТЕ НА МАКРОИНВЕРТЕБРАТИТЕ И АЛГИТЕ КАКО ВЕТУВАЧКИ ИНДИКАТОР ЗА ОБНОВУВАЊЕ НА ЕКОСИСТЕМОТ: СТУДИЈА НА СЛУЧАЈ НА КАМЕНИЧКА РЕКА (СЕВЕРНА МАКЕДОНИЈА)

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Алгите и макроинвертебратите се многу чувствителни на промените во водната средина и затоа често се користат при определување на еколошкиот одговор на различни водни тела кои се под притисок. Овде претставуваме студија на случај спроведена на Каменичка Река во период од Септември 2020 до Мај 2022. По внесувањето на отпаден руднички материјал од истекот на јаловинатана рудникот „САСА“ во Каменичка Река, извршена е детална анализа на структурата на алгите и макроинвертебратите; истражувањата опфатија анализи на пролетно-есенската динамика во нивната структура две години по инцидентот, со цел да се процени дали мерките за санација за чистење на јаловината од водотекот биле успешни. Примероците од алги и макроинвертебрати беа колекционираниод 12 претходно одреденилокациина Каменичка Река. За време на првото земање на примероци (по истекувањето на јаловината), согледавме многу мал диверзитет на алги и макроинвертебрати во реката, а на некои локации од земените примероци алгите и микроинвербратите беа тотално исчезнати имплицирајќи дека силата на истекувањето била смртоносна за живите организми. Последователните анализи по мерките за санација открија јасна и недвосмислена, постепена, чекор по чекор последователна реколонизација, подобрување на составот и бројноста на заедниците, што рефлектира враќање на природните заедници и услови во Каменичка река, кои најверојатно постоеле пред истекувањето на отпадниот материјал.

Само една година по катастрофата, Каменичка река беше реколонизирана од голем број таксони на цијанобактерии, алги и макроинвертебрати (претставени со лесно прилагодливи видови акватични инсекти). Возаедницата на макроинвертебрати доминираа видови како што се *Prosimulium sp.*, *Tipula maxima* Poda, 1761, *Baetis rhodani* (Pictet, 1843), *Rhyacophila fasciata* Hagen, 1859, *Hydropsyche instabilis* (Curtis, 1834) и *Hydropsyche incognita* Pitsch, 1993. Оваа студија ги демонстрира фазите на обновување на екосистемот следени преку диверзитетот на алгите и микроинвербратите, истакнувајќи ја нивната важност како „систем за рано предупредување“ за состојбата на екосистемот.

Клучни зборови: микроинвербрати, алги, Каменичка Река, Северна Македонија

ROLE OF MACROINVERTEBRATE AND ALGAE COMMUNITY STRUCTURES AS A PROMICING INDICATOR FOR ECOSYSTEMRECOVERY: A CASE STUDY ON KAMENICKA REKA RIVER (NORTH MACEDONIA)

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Algae and macroinvertebrates are quite sensitive to the changes in the aquatic environment, and therefore they are often utilised in the determination of the ecological response of different waterbodies under pressure. Here we present a case study conducted on the Kamenicka River during the period from September 2020 to May 2022. After the introduction of waste mine material from a pulp leakage of "SASA" mine into the Kamenicka River, a detailed analysis of the algae and macroinvertebrate structure was undertaken; the surveys included analyses of the spring-autumn dynamics in their structure for two years after the incident, aiming to assess if the remediation measures for cleaning up the pulp tailings from the watercourse were successful. Algae and macroinvertebrate samples were collected from 12 previously identified sampling sites on Kamenicka River. During the first sampling (after the pulp leakage), we have detected extremely low algae and macroinvertebrate diversity in the river, and at some sampling points the algae and macroinvertebrate communities were completely "washed out" implying that the force of the leakage itself was lethal for living organisms. The follow-up analyses after the remediation measures have disclosed clear and unequivocal gradual, step-by-step successive recolonization, remediation and improvement of the communities composition and abundance, reflecting a gradual return of the natural communities and conditions in Kamenicka River, which had probably existed before the dangerous tailings leakage event.

Only one year after the hazardous event, Kamenicka River was already recolonized by many cyanobacteria, algae and macroinvertebrate taxa (presented with easily adaptable aquatic insect species). The macroinvertebrate community was dominated by species such as *Prosimulium sp.*, *Tipula maxima* Poda, 1761, *Baetis rhodani* (Pictet, 1843), *Rhyacophila fasciata* Hagen, 1859, *Hydropsyche instabilis* (Curtis, 1834), and *Hydropsyche incognita* Pitsch, 1993. This study demonstrates the stages of recovery of the ecosystem followed through the algae and macroinvertebrate diversity, highlighting their importance as an "early warning system" for the ecosystem condition.

Keywords: macroinvertebrates, algae, Kamenička River, North Macedonia

НОВИ ПОДАТОЦИ ЗА ПОЈАВАТА НА ПОТОЧНИОТ РАК AUSTROPOTAMOBIUS TORRENTIUM (SCHRANK 1803) ВО ПРЕДЛОГ НАТУРА 2000 ПОДРАЧЈЕТО МАЛЕШЕВСКИ ПЛАНИНИ (РЕПУБЛИКА МАКЕДОНИЈА)

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Република Северна Македонија е кандидат за пристапување кон Европската Унија и имплементацијата на мрежата Натура 2000 се смета за обид за ефикасна заштита и долгорочен опстанок на загрозените видови. Според ЕУ директивата за хабитати, слатководниот декаподен рак (*Austropotamobius torrentium*) претставува еден од видовите кои се од голем интерес во државата, наведени во Анекс II на оваа директива.

Ова истражување има за цел да донесе нови информации за дистрибуцијата на овој вид во Р. Северна Македонија, поконкретно за предложеното Натура 2000 подрачје - Малешевски Планини.

Во текот на истражувањето, единки на поточниот рак беа регистрирани на 12 локалитети користејќи ја „Kick net sampling" методата која што вклучува потреси на каменото дно, подводната вегетација и други тврди супстрати во водата со помош на механички удар, како и со рачно пребарување. Присуството на поточниот рак се истражуваше вдолж случајно избрани трансекти и по фаќањето, единките беа избројани и по одредувањето на нивниот пол и зрелоста, тие веднаш потоа беа вратени во своето природно живеалиште.

Резултатите добиени од теренските истражувања на територијата на Малешевските Планини покажаа дека поточниот рак е присутен на речиси сите испитувани локалитети, додека најдобро сочувани популации на видот беа забележани на каменитото дно на Рамна (околу 7 единки), Амбариска (околу 12 единки) и Клепалска Река (околу 24 единки), како и во Пехчевскиот (околу 5) и Спиковскиот водопад (околу 6).

Забележани беа антропогени влијанија значајни за опстанокот на поточниот рак кои произлегуваат од испуштањето на отпадни води, земјоделството, индустријата, рударството и производството на електрична енергија (изградба на мали хидроелектрани).

Ова истражување ја истакнува важноста на водните екосистеми за предлог Натура 2000 подрачјето Малешевски Планини и нивната способност да обезбедат соодветни хабитати клучни за одржување на добри популации од овој вид. Исто така, служи како значаен придонес за познавањата на дистрибуцијата на поточниот рак во Р. Северна Македонија.

Клучни зборови: *Austropotamobius torrentium*, Малешевски Планини, дистрибуција, Република Северна Македонија

NEW DATA ON THE OCCURRENCE OF THE STONE CRAYFISH AUSTROPOTAMOBIUS TORRENTIUM (SCHRANK 1803) IN THE PROPOSED NATURA 2000 AREA MALESHEVSKI PLANINI (REPUBLIC OF MACEDONIA)

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The Republic of North Macedonia presents a candidate country for EU accession and implementation of the Natura 2000 network has been considered an effective attempt at efficient protection and long-term survival of threatened species. According to the EU Habitats Directive, the freshwater decapod crustacean (*Austropotamobius torrentium*) presents species of community interest in the country, listed in the Annex II of this Directive.

This study aims to provide new information about the distribution of this species in the Republic of North Macedonia, more specifically in the proposed Natura 2000 area, Malesevski Planini.

During the investigation, stone crayfish specimens were collected on 12 localities using Kick net sampling which included shaking the stones, underwater vegetation and other hard substrates in the water with mechanical impact, as well as by manual search. The crayfish abundance was analyzed along randomly selected river transects and upon capture, the specimens were counted and data regarding their sex and maturity was gathered subsequently before returning them to their natural habitat.

The results obtained from the field research showed the presence of the species in nearly all researched sites. The best-preserved populations of the species were observed on the rocky bottom of Ramna Reka River (cir. 7 individuals), Ambarska Reka River (cir. 12 individuals), and Klepalska Reka River (cir. 24 individuals), as well as the Pehchevo (cir. 5) and Spikovo (cir. 6) waterfalls.

Anthropogenic influence threatening the survival of the stone crayfish was identified, including discharge of wastewater, agricultural processes, local industries, mining and electricity production (construction of small hydroelectric power plants) etc.

The present study highlights the importance of the water ecosystems in the proposed Natura 2000 area Malesevski Planini and their capability in providing suitable habitats crucial for obtaining good populations of this species. It also serves as a valuable contribution to the knowledge of the stone crayfish distribution in R. North Macedonia.

Keywords: Austropotamobius torrentium, Malesevski Planini, distribution, R. North Macedonia

KONDICIONI INDEKS I MORFOMETRIJA DAGNJE *MYTILUS GALLOPROVINCIALIS* L. U BOKOKOTORSKOM ZALIVU U PERIODU DECEMBRA

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U Jadranskom moru dagnja *Mytilus galloprovincialis* je široko rasprostranjena i zastupljena u komercijalnom uzgoju. Jedan od načina procene celokupnog zdravlja organizma je određivanje kondicionog indeksa. Sezonske varijacije u vrednostima kondicionog indeksa zavise od polnog ciklusa, prisutnosti hrane kao i od promena ekoloških faktora sredine.

Cilj ovoga istraživanja je predstaviti kondicioni indeks dagnji u toku zimskog perioda, morfometriju (tradicionalnu i geomterijsku), dužinsko-težinske odnose i odnos polova na 8 lokacija u Bokokotorskom zalivu, uporediti kondicioni indeks i morfološke parametre po lokalitetima i prodiskutovati rezultate na osnovu literaturnih podataka. Uzorkovanje je vršeno na sedam lokaliteta, uzgajališta dagnji (Ljuta, Orahovac 1, COGImar, Risan, Sveta Neđelja, Obala Đuraševića, Kalardovo), na osmom lokalitetu (IBM) dagnje su uzorkovane iz prirodne populacije. Ukupan broj analiziranih jedinki sa svih lokaliteta je 239. Prilikom obrade, uzimani su morfometrijski karakteri: širina, visina i dužina ljušture. Karakteri ukupna mase, mase mokrog mesa i masa ljušture su mereni vagom. Geometrijska morfometrija merena je u programima TpsDig i MorphoJ. Pol je determinisan vizuelno na osnovu boje gonada. Kondicioni indeks je računat na osnovu mase mokrog mesa i ukupne mase školjkaša po (Almeida i sar., 1999). Najveći kondicioni indeks zabeležen je na lokalitetu COGImar, a najmanji na lokalitetu IBM u prirodnoj populaciji. Najveće vrednosti ukupnih masa i dimenzija jedinki zabeležene su na Obali Đuraševića, najmanje na lokalitetu Orahovac 1. Posmatranjem dužinsko-težinskih odnosa populacija utvrđeno je da najpravilniji odnos dužinskog rasta i mase imaju populacije iz Risna i COGImar.

Rezultati pokazuju da je proces rasta i razvića dagnji uslovljen velikim brojem varirajućih sredinskih faktora koji uključuju sastav hrane, salinitet, temperaturu vode kao i antropogene faktore. COGImar ima znatno veće vrednosti zbog multitrofičkog načina uzgoja jer dagnje imaju više hrane; Obala Đuraševiča u zimskom periodu ima najpovoljnije vrednosti temperature i saliniteta u odnosu na ostala uzgajališta.

Ključne reči: dagnja, kondicioni indeks, morfometrija, sredinski faktori, rast, komercijalni uzgoj

CONDITIONAL INDEX AND MORPHOMETRY OF MUSSEL *MYTILUS GALLOPROVINCIALIS* L. IN BOKA KOTORSKA BAY IN DECEMBER

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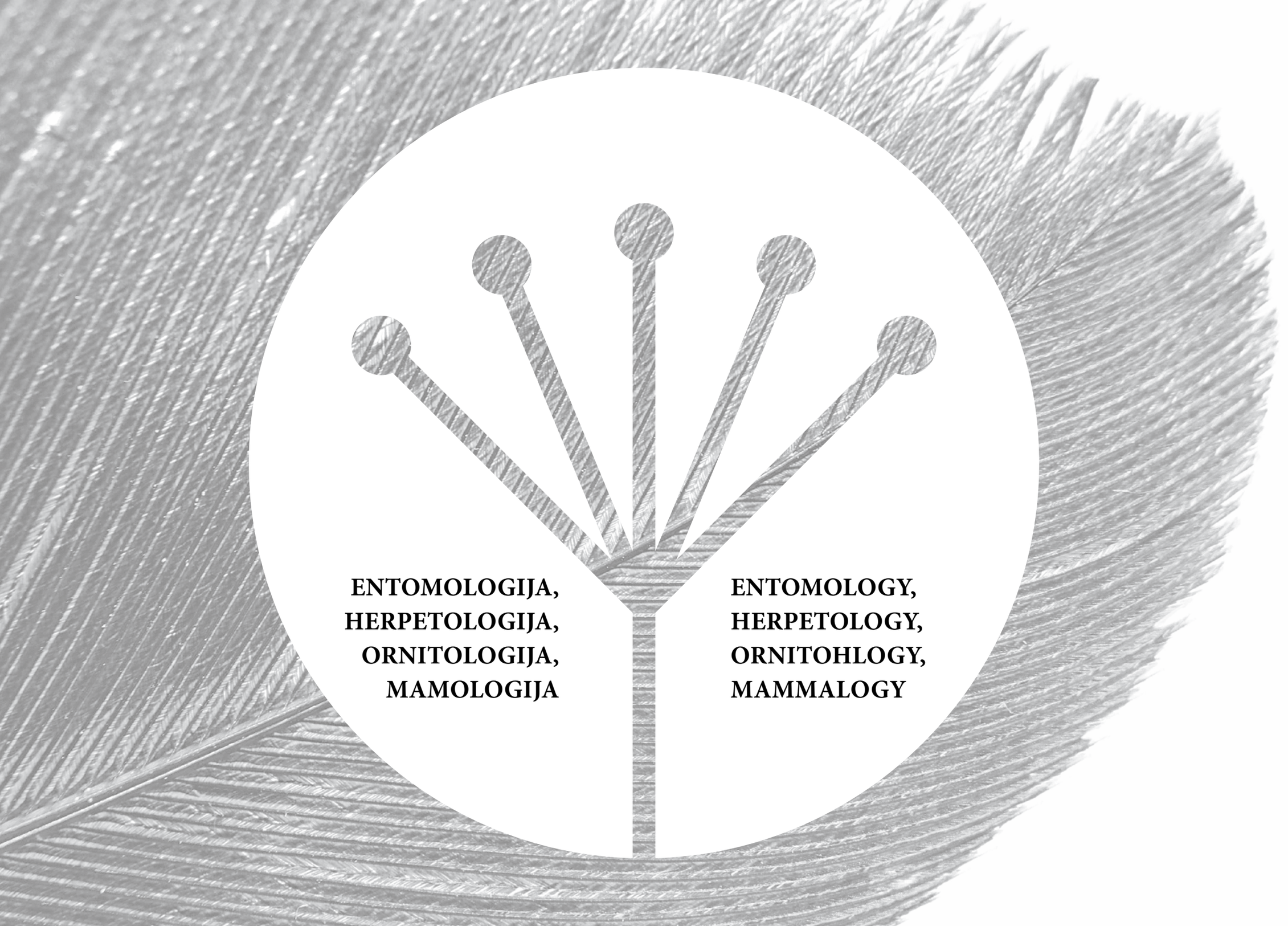
In the Adriatic Sea mussel *Mytilus galloprovincialis*is widespread and frequent in commercial cultivation. One way to assess the overall health of the body is to determine the condition index. Seasonal variations in the values of the condition index depend on the sexual cycle, the presence of food as well as changes in ecological environmental factors.

The aim of this study is to present a condition index of mussels during the winter period, morphometrics (traditional and geometric), length-weight relationship and the sex ratio at 8 locations in the Bay of Kotor, compare condition index and morphological parameters by localities and discuss results based on literature data. Sampling was conducted at seven sites, mussel farms (Ljuta, Orahovac 1, COGImar, Risan, Sveta Neđelja, Obala Đuraševića, Kalardovo), at the eighth site (IBM) mussels were sampled from the native population. The total number of analyzed individuals from all sites was 239. During processing, the following morphometric characters were taken: width, height and length of the shell. Characters of total mass, the mass of wet meat and shell weight were measured by beam scale. Geometric morphometrics were measured with two following programs,TpsDig and MorphoJ. Gender is determined visually on the basis of the colour of the gonads. The condition index is calculated based on the weight of wet meat and the total mass of the shellfish (Almeida *et al*., 1999). The largest condition index was recorded at the site COGImar, and the smallest at the site of IBM in natural populations. The highest values of total weight and dimensions of specimens were recorded at Obala Đuraševića, lowest at the site of Orahovac 1. By observation of the length-weight relationship of populations has been found that the most correct ratio of the length growth and the masses have a population of Risan and COGImar.

The results show that the process of growth and development of mussels caused by a large number of varying environmental factors including food composition, salinity, water temperature, and anthropogenic factors. COGImar has a much higher value because of multitrophic cultivation method so mussels have more food; ObalaĐuraševića in the winter has the best values of temperature and salinity in relation to other farms.

Keywords: mussel, condition index, morphometrics, environmental factors, growth, commercial cultivation


ENTOMOLOGIJA,
HERPETOLOGIJA,
ORNITOLOGIJA,
MAMOLOGIJA
ENTOMOLOGY,
HERPETOLOGY,
ORNITOHLOGY,
MAMMALOGY

KOLEMBOFAUNA AP VOJVODINE: RED SYMPHYPLEONA BÖRNER, 1901

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Prošlo je tri veka od opisa prve vrste skokuna (Collembola), a svake godine nauka upoznaje na desetine novih. Do kraja druge polovine dvadesetog veka smatrani su entognatnim beskrilnim insektima, no danas predstavljaju zasebnu klasu heksapodnih zglavkara. Pored razlike u lokalizaciji usnog aparata u odnosu na insekte, ne poseduju Malpigijeve sudove, očne oblasti su sa ocelama ili odsustvuju, nema prestanka mitarenja u adultnoj fazi. Za razliku od beskrilnih insekata, beskrilnost je za skokune primarna osobina. Oni su ametabolični organizmi sa osobenim organima furca (viljuška) i colophor (ventralna tuba) koji pored ostalih funkcija imaju ulogu u skokunima osobenom skakanju. Do danas je opisano preko 9000 vrsta svrstanih u 4 reda, a većina kolembologa smatra da realan broj vrsta ide i do 100 000 kojih tek treba opisati.

Red Symphypleona Börner, 1901 je monofiletska grupa sa blizu 1500 opisanih vrsta. Predstavnici ovog reda su globularne građe, pri čemu se jasno razlikuju region glave i region većeg abdomena (torakalni i abdominalni segmenti su srasli). Glavena kapsula je sa izrazito izdignutim verteksom, sa antenama postavljenim iza sredine glave i razvijenim očima. Dens je nepodeljen i sa brojnim čekinjama (chaetae), dok je mucro kanalisan i podseća na cev. Ovo su živo obojeni skokuni, sa raznobojnim tačkama, prugama i drugim šarama. Sama pigmentacija, koja se dugo koristila kao jedna od glavnih karaktera u identifikaciji vrsta se pokazala kao varijabilna karakteristika, stoga je danas detaljna hetotaksija primaran način identifikovanja vrsta ovog reda.

Na teritoriji Republike Srbije fauna skokuna je slabo istraživana, iako se zbog samog položaja unutar Balkanskog poluostrva može očekivati visok diverzitet. Od pionirskih istraživanja krajem 1960-ih godina svega se nekoliko istraživača bavilo ovom grupom. Do sada je na teritoriji Autonomne pokrajine Vojvodine sprovedeno svega 6 istraživanja ove grupe, i to većinom 1970-ih godina. Na osnovu literaturnih podataka napravljena je kontrolna lista skokuna AP Vojvodine. Taksonomija je revidirana prema savremenim odrednicama Zajednice kolembologa sveta. Ustanovljeno je da je na teritoriji AP Vojvodine registrovano ukupno 137 vrsta skokuna, od čega 27 predstavnika reda Symphypleona, dok predstavnici reda Neelipleona Massoud, 1971 izostaju. U okviru reda, najbrojnija porodica je Bourletiellidae Börner, 1913 sa ukupno 8 registrovanih vrsta, dok je najmanje brojna porodica Sminthurididae Börner, 1906 sa svega jednom registrovanom vrstom. Vrsta *Sminthurinus elegans* (Fitch, 1863) bila je prisutna na najvećem broju lokaliteta. U uzorku zemljišta iz Novog Sada (Futoški park) iz aprila 2022. godine ustanovljeno je prisustvo predstavnika sedam vrsta ovog reda, od kojih jedna nova za kontrolnu listu skokuna Vojvodine -*Sminthurinus niger* (Lubbock, 1862). Zaključno sa ovim saopštenjem na teritoriji AP Vojvodine registrovano je 28 vrsta skokuna reda Symphypleona. Među ovim vrstama nalaze se i dve koje se nalaze na listi strogo zaštićenih divljih vrsta ali pod starim imenima. U pitanju su *Bourletiella albanica angulipunctata* Loksa & Bogojevic, 1970 (zapravo *Fasciosminthurus angulipunctatus* (Loksa & Bogojevic, 1970)) i *Bourletiella quadrangulata* Loksa & Bogojevic 1970 (odnosno *Deuterosminthurus quadrangulatus* (Loksa & Bogojevic, 1970)) opisane po tipskim primercima sa Deliblatske peščare 1970. godine. Naše dalje istraživanje usmereno je ka istraživanju hetotaksije ove dve vrste savremenim pristupom na tipskim primercima, radi preciznijeg opisa vrste, kao i rešavanju problematičnih navoda iz prikupljene literature ponovljenim terenskim istraživanjima nakon pola veka.

Ključne reči: kolembofauna, skokuni, Collembola, Symphypleona,Vojvodina, Srbija

COLLEMBOFAUNA OF VOJVODINA PROVINCE: ORDO SYMPHYPLEONA BÖRNER, 1901

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It has been three centuries since the description of the first species of springtails (Collembola), and science meets dozens of new ones every year. Until the end of the second half of the twentieth century, they were considered entognathous wingless insects. Today, however, they represent a separate class of hexapod arthropods. Compared to insects, in addition to the difference in the localization of the oral apparatus, they do not have Malpighian vessels, the eye areas are with ocelli or are absent, there is no cessation of moulting in the adult phase. Unlike wingless insects, winglessness is a primary characteristic of springtails. They are ametabolic organisms with specific organs furca (furcula) and collophore (ventral tube) which, in addition to other functions, play a significant role in characteristical jumping. There have been more than 9,000 species classified into 4 orders described so far.

The order Simphipleona Borner, 1901 is a monophyletic group with almost 1500 described species. The representatives of this order have a globular structure, with a clearly defined head region and a larger abdominal region (the thoracal and abdominal segments are fused). The head capsule has a distinctly raised vertex, with antennae placed on the back of the head and evolved eyes. The dens is undivided and with numerous setae, while the mucro is channeled and resembles a tube. These are brightly colored springtails, with colorful dots, stripes and other patterns. Pigmentation, which has long been considered one of the main characteristics in species identification, has proven to be a variable characteristic. This is why detailed chaetotaxy is the primary way to identify species of this order today.

The fauna of the springtails is poorly researched on the territory of the Republic of Serbia, although a high diversity can be expected due to its position within the Balkan Peninsula. Only a few researchers have been interested in this group since the pioneering research in the late 1960s. In addition to this, only 6 studies of this group have been conducted on the territory of the Autonomous Province of Vojvodina so far - mostly in the 1970s. A checklist of springtails of AP Vojvodina was created based on the literature data. The taxonomy has been revised according to the modern guidelines of the Community of Collembola of the World. It was established that a total of 137 species of springtails were registered on this territory, with 27 representatives of the order Simphipleona, while representatives of the order Neelipleona Massoud, 1971 are absent. The most numerous family within the order is Bourletiellidae Borner, 1913 with a total of 8 registered species, while the least numerous family is Sminthurididae Borner, 1906 with only one registered species. The species *Sminthurinus elegans* (Fitch, 1863) was present in the largest number of localities. In the soil sample from Novi Sad (Futoški Park) from April 2022, the presence of representatives of seven species of the order was found - one of which is new for the checklist-*Sminthurinus niger* (Lubbock, 1862). In conclusion with this announcement, 28 species of springtails of the order Simphipleona have been registered on the territory of AP Vojvodina. Among these species, there are also two that are on the list of strictly protected wild species, but under old names. Those are *Bourletiella albanica angulipunctata* Loksa&Bogojević, 1970 (actually *Fasciosminthurus angulipunctatus* (Loksa&Bogojević, 1970)) and *Bourletiella kuadrangulata* Loksa&Bogojević 1970 (or *Deuterosminthurus quadrangulatus* (Loksa&Bogojevic, 1970)). Our further research is focused on the chaetotaxy of these two species with a modern approach on type specimens, as well as solving problematic collected sources by repeated field research after half a century.

Keywords: Collembofauna, springtails, Collembola, Symphypleona,Vojvodina, Srbija.

СУКЦЕСИЈА НА НЕКРОФАГНАТА ФАУНА НА ТРУПОВИ ОД СТАОРЦИ ВО ПРИГРАДСКАТА ОБЛАСТ ВО СКОПЈЕ (Р. МАКЕДОНИЈА)

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Предмет на проучување во оваа студија беа некрофилните инсекти, сукцесивните модели и нивниот потенцијал како форензички индикатори. Експериментот беше спроведен во приградска средина во близина на паркот Гази Баба (Скопје, Р. Македонија) од есента 2021. до пролетта 2022. За овој експеримент беа користени три лабораториски глувци (*Rattus norvegicus,* Berkenhout, 1769). Рачно и со помош на стапици кои беа поставени под и околу труповите беа собирани адултни и ларви на Coleoptera и Diptera. Температурата и дождовите беа следени како фактори што влијаат на степенот на распаѓање на трупот, активноста на инсектите и нивното изобилство. Степенот на распаднатост на труповите забележан во оваа студија ја следи Ридсовата класификација: свежа, подуена, распадната и сува фаза. Податоците за времето на појавување како и должината на периодот на присуство во одредената сезона беа евидентирани за форензички корисни таксони. Резултатите покажуваат дека пронајдената заедница на некрофилните инсекти е под значително влијание на сезонските промени. Во периодот есен-зима на труповите доминираа претставници од Diptera и Staphylinidae. Поголем диверзитет на тврдокрилци од кои најмногу Silphidae, Histeridae, Nitidulidae, Dermestidae (Coleoptera) беа забележани во пролет. За прв пат во државата беше пријавен и форензички значајниот *Dinothenarus flavocephalus* (Goeze, 1777), проширувајќи ја веќе познатата дистрибуција на овој таксон во Европа и Средниот Исток. Оваа студија потврди дека живеалиштата и сезонските преференци на некрофилните инсекти се извор на вредни информации за тоа кога настанала смртта.

Клучни зборови: Форензичка ентомологија, Diptera, Coleoptera, распаѓање, сукцесија на инсекти, Р. Македонија

SUCCESSION OF NECROPHAGOUS FAUNA ON RAT CARRION IN SUBURBAN AREA IN SKOPJE (R. N. MACEDONIA)

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In this study, diversity of necrophagous insects, successional patterns and their potential as forensic indicators were examined. The experiment was conducted in a suburban area near the park Gazi Baba (Skopje, R. N. Macedonia) from autumn 2021 to spring 2022. Three laboratory rats (*Rattus norvegicus,* Berkenhout, 1769*)* were used in the experiment. Coleoptera and Diptera adults and larvae were collected both by hand and with pitfall traps placed under and around the carcass. Temperature and rainfall were measured as factors influencing the stages of carcass decay, insect activity and abundance. The stages of decomposition recognised in this study follow Reed's classification: fresh, bloated, decay and dry stage. Data on appearance time and length of the presence period in the particular season were recorded for forensically useful taxa. The results show that the community of necrophagous insects was found to be significantly affected by seasonal change. Diptera and rove beetles (Staphylinidae) were the dominant representatives on carcasses during the autumn - winter period. Higher diversity of beetles, mostly Silphidae, Histeridae, Nitidulidae, Dermestidae (Coleoptera) was recorded in spring season. Forensically important rove beetle *Dinothenarus flavocephalus* (Goeze, 1777) was reported for the first time for the country, extending the known distribution of this taxon in Europe and the Middle East. This study confirmed that habitat and seasonal preferences of necrophilous insects are a source of valuable information about the season of death.

Key words: Forensic entomology, Diptera, Coleoptera, decomposition, insect succession, R. N. Macedonia

РАЗНОВИДНОСТ, СТРУКТУРА НА ЗАЕДНИЦАТА И СЕЗОНСКА ДИНАМИКА НА САПРОКСИЛНИ ТВРДОКРИЛЦИ ВО РИПАРИСКИ ШУМИ, Р. С. МАКЕДОНИЈА - ПРЕЛИМИНАРНИ ПОДАТОЦИ

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Целта на ова истражување беше да се утврди структурата на заедницата и распространувањето на сапроксилните тврдокрилци во добро сочувани старорастечки крајречни шуми. Користени беа четири методи за колекционирање на тврдокрилци зависни од мртва дрвесина: почвени замки, висечки замки, метод на прекинат лет и метод на рачно пребарување, во периодот мај - септември 2020 година во две рипариски шуми покрај реките Црн Дрим и Радика, во западните делови на Северна Македонија. Идентификувани беа вкупно 102 сапроксилни тврдокрилци кои припаѓаат во 39 видови и 16 фамилии. Видовото богатство (37 видови, 16 фамилии) и абундантноста (92 единки) на сапроксилни тврдокрилци населени на бреговите на реката Радика беа повисоки во споредба со оние населени на бреговите на реката Црн Дрим (5 видови, 5 фамилии, 10 единки), веројатно како резултат на антропогениот притисок од блискиот град Струга. Видово најразнообразната фамилија беше фамилијата Cerambycidae (18 видови). Претставниците од фамилијата Staphylinidae беа најзастапени во двете крајречни области (80 и 58 единки, соодветно), во споредба со фамилиите Biphyllidae и Lymexylidae, кои беа регистрирани со најниска абундантност (1 единка по фамилија). Во однос на сезонската динамика, сапроксилните тврдокрилци покажаа поголема активност во пролетно-летниот период, при што највисоки вредности за видовото богатство и абундантност беа регистрирани во јуни, а помала активност беше покажана во есенскиот период, регистрирана во септември. Овие прелиминарни податоци ја истакнуваат важноста на крајречните шуми како природни резервоари на сапроксилна разновидност. Понатамошното истражување за видовата разнообразност, составот и однесувањето на сапроксилните тврдокрилци ќе го надополни и зголеми нашето разбирање за биолошката разновидност, екологијата, фенологијата и распространувањето на тврдокрилната фауна во различните хабитати.

Клучни зборови: Coleoptera, Cerambycidae, Staphylinidae, тврдокрилци зависни од мртва дрвесина

DIVERSITY, COMMUNITY STRUCTURE AND SEASONAL DYNAMICS OF SAPROXYLIC BEETLES IN RIPARIAN FORESTS, R. N. MACEDONIA - PRELIMINARY DATA

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The aim of this research was to determine the community structure and distribution of saproxylic beetles in well-preserved old-growth riparian forests. Four methods were used to collect deadwood-dependent beetles: pitfall traps, air traps, interception traps, and hand searching, in the periods of May - September 2020 in two riparian forests by the rivers Crn Drim and Radika, in the western parts of North Macedonia.A total of 102 saproxylic beetles belonging to 39 species and 16 families were identified. Species richness (37 species, 16 families) and abundance (92 individuals) of saproxylic beetles inhabiting the river banks of Radika were higher in comparison to the ones inhabiting the river banks of Crn Drim (5 species, 5 families, 10 individuals), probably as a result of anthropogenic pressure from the nearby city of Struga. The species' richest family was Cerambycidae (18 species). Staphylinids were the most abundant beetles in both riparian areas (80 and 58 individuals, respectively), in comparison to Biphyllidae and Lymexylidae, which were registered with the lowest abundance (1 individual per family). Regarding the seasonal dynamics, saproxylic beetles showed higher activity during the spring-summer period, with the highest values for species richness and abundance registered in June, and lower activity during the autumn period, registered in September. These preliminary data highlight the importance of riparian forests as natural reservoirs of saproxylic diversity. Further research on species richness, composition, and behaviour of saproxylic beetles will complement and increase our understanding of the biodiversity, ecology, phenology, and distribution of beetle fauna in different habitats.

Key words: Coleoptera, Cerambycidae, Staphylinidae, deadwood-dependent beetles

PRVI PODACI O *XANTHIUM STRUMARIUM* I *HELIANTHUS DECAPETALUS* KAO BILJKAMA HRANITELJKAMA AMBROZIJINE ZLATICE (*OPHRAELLA COMMUNA* L.) U SRBIJI

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Do sada je u Srbiji bilo poznato da se ambrozijina listara (*Ophraella communa*) hrani samo biljkama iz roda Ambrosia (*Ambrosia artemisifolia*, A. *trifida*). Na lokalitetu Tošin bunar (Beograd) registrovan je prvi slučaj ishrane imaga *O. communa* na listu *Xanthium strumarium* i *Helianthus decapetalus* što predstavlja ujedno i prvi slučaj ishrane imaga ambrozijine listare listom ovih biljaka u Srbiji. Na biljci *H. decapetalus* broj jedinki imaga vrste *O. communa* se kretao od 1 do 18 jedinki po biljci, dok je kod vrste *X. strumarium* bilo do 10 jedinki imaga. Stabla ambrozije imala su i do 100 % oštećenosti lisne mase, dok kod vrsta *X. strumarium* i *H. decapetalus* oštećenost biljaka nije prelazila 10-15% lisne mase po biljci. S obzirom na podatak da se insekt hranio na samonikloj alohtonoj vrsti *H. decapetalus* potrebno je izvršiti dodatni nadzor na prisustvo ove vrste u poljima gde se gaji industrijski suncokret (*Helianthus annus*), a takođe je poželjno raditi kontinuirani nadzor na svim biljkama iz familije *Asteracae*, naročito na alohtonim vrstama koje vode poreklo iz Severne Amerike, prirodnog staništa vrste *Ophraella communa*.

Ključne reči: *Ophraella communa*, *Xanthium strumarium*, *Helianthus decapetalus*, *Ambrosia artemisifolia*.

FIRST RECORD ON *XANTHIUM STRUMARIUM* AND *HELIANTHUS DECAPETALUS* AS HOST PLANTS OF RAGWEED LEAF BEETLE (*OPHRAELLA COMMUNA* L.) IN SERBIA

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So far, the confirmed host plants of the ragweed leaf beetle in Serbia belonged to the genus Ambrosia (Ambrosia artemisifolia, A. trifida). At one locality Tošin bunar (Bežanija, Belgrade, Serbia) the first case of Ophraella communa adults feeding on leaves of Xanthium strumarium and Helianthus decapetalus was recorded in Serbia. The number of specimens of O. communa on H. decapetalus ranged between 1 and 18 specimens per plant, while on X. strumarium it was up to 10 adult specimens. While the ragweed plants had up to 100% damaged leaves, the leaves of X. strumarium and H. decapetalus had 10-15% less leaf damage per plant. Considering our findings of the insect feeding on spontaneous allochthonous plant species H. decapetalus, seasonal monitoring of O. communa is recommended especially in fields where sunflowers (Helianthus annus) are widely cultivated. Monitoring of O. communa on other plant species of Asteraceae, especially on allochthonous species originating from North America which share the same natural habitats with the ragweed leaf beetle is also recommended.

Keywords: *Ophraella communa*, *Xanthium strumarium*, *Helianthus decapetalus*, *Ambrosia artemisifolia*.

PRIMJENA STANDARDNIH I MODIFICIRANIH OVIPOZICIJSKIH KLOPKI U MONITORINGU INVAZIVNIH VRSTA KOMARACA NA PODRUČJU SLAVONSKOG BRODA

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Azijski tigrasti komarac (*Aedes albopictus* Skuse, 1894) prirodno nastanjuje tropske šume jugoistočne Azije, međutim transportom ljudi i roba proširio se i u Europu te je od 2004. godine prisutan u hrvatskoj fauni. Sa zdravstvenog stajališta ova je vrsta važna zbog sposobnosti prenošenja različitih arbovirusa koji kod ljudi mogu uzrokovati bolesna stanja. Na tragu nacionalnog sustava praćenja invazivnih vrsta komaraca, u Slavonskom Brodu je od svibnja do srpnja 2022. godine provedeno istraživanje prisutnosti i rasprostranjenosti invazivnih vrsta komaraca. S ciljem provjere učinkovitosti standardene ovipozicijske klopke u istraživanje su uključene i modificirane ovipozicijske klopke (ljepljive klopke). Na svakoj od 10 lokacija postavljene su 3 klopke (1 standardna i 2 modificirane) tijekom 10 tjedana uzorkovanja. Laboratorijskom obradom utvrđeno je da je u standardnim ovipozicijskim klopkama zabilježeno ukupno 2840 jaja komaraca od čega je čak 30% vezano za lokaciju smještenu neposredno uz granični prijelaz sa Bosnom i Hercegovinom. Determinacijom komaraca razvijenih iz jaja utvrđeno je 98,8 % jedinki vrste *Ae. albopictus*, i 1,2 % vrste *Aedes japonicus,* Theobald 1901.

Ovipozicijska klopka modificirana premazivanjem deratizacijskog ljepila uhvatila je 32 odrasle gravidne ženke vrste *Ae. albopictus*. Druga vrsta modificirane klopke koja je uključivala ljepilo za muhe prikupila je 73 odrasle ženke a sve su pripadale vrsti *Ae. albopictus*. Od modificiranih ovipozicijskih klopki najveću brojnost jedinki komaraca pokazale su one postavljene na gradskom groblju. Preventivnim aktivnostima kroz edukaciju i senzibilizaciju javnosti o invazivnim vrstama komaraca i provođenjem tretmana suzbijanja istih, kvalitet života i zdravlje ljudi mogu biti očuvani.

Ključne riječi: komarci, ovipozicijska klopka, *Ae. albopictus*

APPLICATION OF STANDARD AND MODIFIED OVIPOSITION TRAPS IN THE MONITORING OF INVASIVE MOSQUITO SPECIES IN SLAVONSKI BROD, CROATIA

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The Asian tiger mosquito (*Aedes albopictus* Skuse, 1894) naturally inhabits tropical forests of Southeast Asia. Due to the transportation of goods, it spread to Europe. Since 2004, the species has been observed in Croatia. From a health point of view, this species is important because of its ability to transmit various arboviruses that can cause diseases in humans. On the trail of the national monitoring system for invasive mosquito species, from May to July 2022, a survey of the presence and distribution of invasive mosquitoes was conducted in Slavonski Brod. In the research, with the aim of determining the efficiency of standard oviposition traps, we included modified oviposition traps (sticky traps) as well. At each of the 10 locations, 3 traps (1 standardised, 2 modified) were placed during the 10 weeks of sampling. Laboratory analysis determined that with standard oviposition traps, a total of 2,840 mosquito eggs were recorded, of which even 30% were related to the location directly next to the border crossing with Bosnia and Herzegovina. By determining mosquito species developed from eggs, it was determined that 98.8% of individuals were the species *Ae. albopictus*, and 1.2% of the species were *Aedes japonicus* Theobald, 1901.

One type of sticky oviposition trap caught 32 adult gravid females of the species *Ae. albopictus*. Another type of modified trap collected 73 adult females, all of which belonged to the species *Ae. albopictus*. Of the modified oviposition traps, the highest number of mosquito individuals was shown by those placed in a city cemetery. Preventive activities through education and public awareness of invasive mosquito species and the implementation of treatments to control them can be maintained.

Keywords: mosquitoes, oviposition traps, *Ae. albopictus*

PRELIMINARNI REZULTATI HERPETOLOŠKIH (VERTEBRATA: CHORDATA: AMPHIBIA, REPTILIA) ISTRAŽIVANJA MATINSKOG VISA 2021./2022.

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Područje Matinski vis se nalazi u centralnoj Bosni i Hercegovini i pripada općini Žepče. Ovo područje koje se prostire od 445 m do 945 m nadmorske visine, odlikuju mnoge blagodati, a jedno od njih i jeste bogata raznolikost flore i faune. Prilikom istraživanja ovog planinskog vrha, koji je dio specifične ofiolitske zone, konstantovan je znatan broj jedinki iz skupine vodozemaca i gmizavaca što predstavlja veliki značaj kako za ovo područje tako i za sveukupnu faunu Bosne i Hercegovine.

Istraživanje prisutne herpetofaune (vodozemaca i gmizavaca) na području Matinskog visa vršeno je u dva navrata i to u periodu između 28. 7. i 1. 8. 2021. godine, te između 11. 5. i 15. 5. 2022. godine. Metodologija rada obuhvatala je aktivno pretraživanje različitih staništa, vizuelnu opservaciju vrsta te hvatanje jedinki ručno i uz pomoć opreme. Određenom broju jedinki je uzet tkivni uzorak za buduće DNK analize i pohranjen trajno u 96% etanolu, tkivna baza BHHU - ATRA. Pretraživana staništa su podrazumijevala termofilne šume crnog bora na serpetinu (zajednica *P. nigra* sa *Quercus sp.*), kamenite i planinske livade, kamenjare uz makadam, te vodena staništa kao što su manja planinska jezera, bare, lokve i potočni ekosistemi. Prilikom istraživanja ovih staništa zabilježeno je prisustvo četrnaest vrsta, od kojih su osam pripadnici klase Amphibia (*Ichthyosaura alpestris, Salamandra salamandra, Bombina variegata, Hyla arborea, Bufo bufo, Rana graeca, Rana dalmatina* i *Pelophylax sp.*), a šest pripadnici klase Reptilia (*Podarcis muralis, Lacerta viridis, Anguis fragilis, Coronella austriaca, Natrix natrix,* i *Vipera ammodytes*). Pretraživanjem šuma i livada obzervirane su i uhvaćene jedinke skupine gmizavaca poput *Lacerta viridis, Coronella austriaca, Podarcis muralis*, kao i ostale navedene vrste, dok je pretraživanjem Matinskog potoka zabilježena značajna populacija potočne žabe *Rana graeca*. Od specifičnih aktivnosti izvršen je cenzus (apsolutno prebrojavanje jedinki) na odabranoj lokalnoj populaciji vrste *Bombina variegata* koja predstavlja NATURA2000 vrstu. Cenzus je bio izvršen u dva navrata, na lokacijama Donje jezero i Jezero Plane, prilikom čega su jedinke hvatane tokom noći uz pomoć Meredov mreže. Dodatno je izvršeno i relativno prebrojavanje jedinki vrste *Ichthyosaura alpestris* uz pomoć vrša za ribe na lokaciji Gornje jezero.

Detaljnim pretraživanjem ovog područja ustanovljeni su iznimno dobri rezultati koji uključuju veliki broj jedinki i raznolikost vrsta na užem lokalitetu.

Ključne riječi: Amphibia, Reptilia, Matinski vis, biodiverzitet, Bosna i Hercegovina

PRELIMINARY RESULTS OF THE HERPETOLOGICAL (VERTEBRATA: CHORDATA: AMPHIBIA, REPTILIA) RESEARCH OF MATINSKI VIS 2021/2022

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The Matinski vis area is located in central Bosnia and Herzegovina and belongs to the municipality of Žepče. This area, which extends from 445 m to 945 m above the sea level, is characterized by many benefits, one of which is the rich diversity of flora and fauna. During the research of this mountain peak, which is part of a specific ophiolitic zone, a considerable number of individuals from the group of amphibians and reptiles was found, which is of great importance both for this area and for the overall fauna of Bosnia and Herzegovina.

The research of the present herpetofauna (amphibians and reptiles) in the area of Matinski vis was carried out on two occasions, between 28th of July and 1st of August 2021, and between 11th of May and 15th of May 2022. The work methodology included an active search of different habitats, visual observation of species and catching individuals manually and with the help of equipment. A tissue sample was taken from a certain number of individuals for future DNA analysis and stored permanently in 96% ethanol, tissue base BHHU - ATRA. Searched habitats included thermophilic black pine forests on the serpentine (community of *P. nigra* with *Quercus sp.*), stony and mountain meadows, stone fields next to macadam, and water habitats such as small mountain lakes, ponds, puddles and stream ecosystems. During the investigation of these habitats, the presence of fourteen species was recorded, of which eight are members of the class Amphibia (*Ichthyosaura alpestris, Salamandra salamandra, Bombina variegata, Hyla arborea, Bufo bufo, Rana graeca, Rana dalmatina* and *Pelophylax sp.*), and six are members of the class Reptilia (*Podarcis muralis, Lacerta viridis, Anguis fragilis, Coronella austriaca, Natrix natrix,* and *Vipera ammodytes*). By searching the forests and meadows, reptiles such as *Lacerta viridis, Coronella austriaca, Podarcis muralis*, as well as the other mentioned species were observed and caught, while a significant population of the *Rana graeca* stream frog was recorded by searching the Matinski potok. Among the specific activities, a census (absolute count of individuals) was performed on a selected local population of the species *Bombina variegata*, which represents a NATURA2000 species. The census was carried out on two occasions, at the locations of Donje jezero and Jezero Plane, during which individuals were caught during the night with the help of a fishing net. In addition, a relative count of individuals of the species *Ichthyosaura alpestris* was carried out with the help of fish traps at the location of Gornje jezero.

A detailed search of this area revealed extremely good results, which include a large number of individuals and a variety of species in a narrow locality.

Keywords: Amphibia, Reptilia, Matinski vis, biodiversity, Bosnia and Herzegovina

MEĐUPOPULACIONA VARIJABILNOST ODABRANIH MORFOLOŠKIH KARAKTERISTIKA BARSKE KORNJAČE

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Barska kornjača (*Emys orbicularis*) je strogo zaštićena i jedina domaća vrsta vodenih kornjača koja nastanjuje Srbiju. U ovom radu istraživano je prisustvo i karakter međupopulacionih razlika barske kornjače na osnovu odabranih morfoloških karakteristika. Prilikom odlaska na terene uzimane su određene mere koje su neophodne za poređenje jedinki, a to su pravolinijska dužina karapaksa (SCL) i masa. Istraživani uzorak predstavljaju populacije lokaliteta Malo Crniće, Rudinje i Ludaško jezero. Podaci za SCL i masu su analizirani odvojeno za mužjake i ženke, nakon što je potvrđeno prisustvo polnog dimorfizma u veličini. Rezultati testa analize varijanse (ANOVA) pokazali su statistički značajne razlike u veličini (SCL) između tri populacije kada su poređeni mužjaci i ženke. Takođe, statistički značajne razlike između populacija dobijene su i za masu mužjaka i ženki. Statistički značajna razlika u veličini prisutna je samo između populacija Malo Crniće i Rudinje, pri čemu su mužjaci i ženke populacije Malo Crniće najveće i najteže. Imajući u vidu značajne razlike u veličini odraslih jedinki između populacija barske kornjače, može se zaključiti da na istraživanim lokalitetima vladaju sredinski uslovi koji na različite načine pogoduju njihovom rastu, ili ga ograničavaju.

Ključne reči: ANOVA, polni dimorfizam, rast, sredinski uslovi

INTERPOPULATION VARIABILITY OF SELECTED MORPHOLOGICAL CHARACTERISTICS OF THE EUROPEAN POND TURTLE

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The European pond turtle (*Emys orbicularis*) is strictly protected and is the only native species of freshwater turtle that inhabits Serbia. In this study, the presence and character of interpopulation differences of the European pond turtle were investigated based on selected morphological characteristics. During the field studies, certain measures were taken that are necessary for comparing individuals, and those are the straight carapace length (SCL) and mass. Sampled populations are located in the Malo Crniće oxbow near Mlava river, Rudinje pond on the slopes of Stara planina Mt. and Ludaš lake in the far north of Vojvodina province. Data for SCL and mass were analyzed separately for males and females, after confirming the presence of sexual size dimorphism. Results of the ANOVA test showed statistically significant differences in size (SCL) between the three populations when males and females were compared. Also, statistically significant differences between populations were obtained for the mass of males and females. A significant difference in size is present only between Malo Crniće and Rudinje populations, with males and females of the Malo Crniće population being the largest and heaviest. Bearing in mind the differences in the size of adult individuals between populations, we can conclude that different environmental conditions in the studied localities govern and shape the growth of European pond turtles in different ways.

Keywords: ANOVA, environmental conditions, growth, sexual dimorphism

PREVALENCA ZARAŽENOSTI BARSKE KORNJAČE (*EMYS ORBICULARIS*) HEMOPARAZITIMA NA CENTRALNOM DELU BALKANSKOG POLUOSTRVA

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Slatkovodne kornjače su prelazni domaćini za različite vrste hemoparazita, najčešće predstavnika roda *Haemogregarina*, čiji su konačni domaćini pijavice. Hemoparaziti su relativno niske patogenosti po prelazne domaćine, nijedna od ispitivanih kornjača nije pokazivala vidljive znake infekcije. Za ovo istraživenje, uzeti su uzorci krvi 115 jedinki barske kornjače (*Emys orbicularis*), sa pet lokaliteta na teritoriji Republike Srbije (Ludaško jezero, Kraljevac, Galovica, Malo Crniće, Rudinje) i još dva lokaliteta na teritoriji Republike Severne Makedonije (Mariovo, Crničani). Deo uzete krvi se koristio za pravljenje razmaza krvi na mikroskopskim pločicama, a deo se čuvao za molekularne analize. Prisustvo hemoparazita registrovano je na nekoliko načina, posmatranjem krvnih razmaza pod mikroskopom, umnožavanjem određenih sekvenci 18S rRNK pomoću tehnika PCR i gel elektroforeze. Zaraženost hemoparazitima primećena je kod 47,8% uzorkovanih kornjača. Od ukupnog broja zaraženih kornjača 53% čine mužjaci, 45% ženke i 2% juvenilne jedinke. Na terenu je sakupljeno ukupno sedam pijavica koje su bile zakačene za kornjače, od kojih je četiri bilo zaraženo. Najveći broj zaraženih jedinki u odnosu na broj testiranih sa jednog lokaliteta, primećen je na Staroj planini, na lokalitetu Rudinje gde živi jedna zatvorena i izolovana populacija. Nije primećena značajna razlika u zaraženosti između mužjaka i ženki (p=0,34), kao ni između adlutnih i juvenilnih jedinki (p=0,61). Granična statistička značajnost razlika je primećena između zaraženosti kornjača na različitim lokalitetima u Srbiji (p=0,05), dok u Severnoj Makedoniji to nije bio slučaj (p=0,57). Izučavanje krvnih parazita je od velikog značaja za očuvanje barskih kornjača, i njihovih staništa, ali i potencijalne detekcije bolesti koje se mogu javiti kao posledica degradacije staništa.

Ključne reči: *Haemogregarina,* krvni paraziti, PCR, Severna Makedonija, Srbija

PREVALENCE OF HAEMOPARASITES IN EUROPEAN POND TURTLE (*EMYS ORBICULARIS*) IN THE CENTRAL BALKANS

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Freshwater turtles are intermediate hosts for different types of blood parasites, genus *Haemogregarina* is the most widespread, whose final hosts are leeches. Haemoparasites are characterized by a relatively low degree of pathogenicity for intermediate hosts, none of the examined turtles showed visible signs of infection. For this research, blood samples were taken from 115 individuals of *Emys orbicularis,* from five localities on the territory of the Republic of Serbia (Ludaš lake, Kraljevac, Galovica, Malo Crniće, Rudinje) and two localities on the territory of the Republic of North Macedonia (Mariovo, Crničani). Part of the blood taken was used to make blood smears on microscope slides, and part was kept for molecular analyses. The presence of haemoparasites was registered in several ways, by observing blood smears under a microscope, and amplifying partial 18S rRNA gene sequences using PCR techniques and gel electrophoresis. Prevalence of haemoparasites was observed in 47.8% of the sampled turtles. Of the total number of infected turtles, 53% were males, 45% were females, and 2% were juveniles. Seven leeches were collected on the field that were attached to turtles, four of which were infected. The largest number of infected individuals compared to the number tested from one locality was observed on Stara planina, in the locality of Rudinje, which is inhabited by a closed and isolated population. No significant difference in prevalence was observed between males and females (p=0.34), nor between adult and juvenile individuals (p=0.61). There is a border value statistically significant difference between the prevalence of turtles in different localities in Serbia (p=0.05), while this was not the case in North Macedonia (p=0.57). The study of blood parasites is of great importance for preserving European pond turtle populations and their habitats, but also for potentially detecting diseases that may occur as a result of habitat degradation.

Keywords: blood parasites, *Haemogregarina*, North Macedonia, PCR, Serbia.

ANALIZA INFEKTIVNOSTI KRVNIH PARAZITA (APICOMPLEXA, HAEMOGREGARINIDAE) U PRIRODNIM POPULACIJAMA BARSKE KORNJAČE (*EMYS ORBICULARIS*) IZ SRBIJE

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Predstavnici roda *Haemogregarina (Apicomplexa,* Haemogregarinidae) su krvni paraziti koji u toku životnog ciklusa inficiraju ribe i gmizavce, kao i pijavice koje predstavljaju njihovog definitivnog domaćina. Cilj ovog rada bio je utvrđivanje razlika u infektivnosti krvnih parazita između mužjaka i ženki barske kornjače (*Emys orbicularis*), kao i između pet različitih populacija iz Srbije (Ludaš, Kraljevac, Galovica, Malo Crniće i Rudinje). Krvni razmazi 33 jedinke su analizirani pod mikroskopom prebrojavanjem parazita prisutnih u 2000 eritrocita, na dva krvna razmaza za svaku jedinku, pri čemu je srednja vrednost prebrojanih parazita korišćena u daljim analizama. Za utvrđivanje značajne statističke razlike između polova korišćen je „Two-sample T-test", dok je ANOVA test korišćen radi utvrđivanja razlike u infektivnosti krvnih parazita među populacijama. Rezutati oba testa su pokazali da nema statistički značajne razlike u infektivnosti kod različitih polova, kao ni kod različitih populacija (p>0,05). Imajući u vidu ove rezultate, moguće je pretpostaviti da su uslovi na staništima slični u pogledu pogodovanja razvoju infekcije *Haemogregarina*, kao i izvesti zaključak da je napredovanje infekcije krvnih parazita jednako kod oba pola i u svim analiziranim populacijama barske kornjače.

Ključne reči: ANOVA, *Haemogregarina*, krvni razmaz, polni dimorfizam

ANALYSIS OF INFECTIVITY OF BLOOD PARASITES (APICOMPLEXA, HAEMOGREGARINIDAE) IN NATURAL POPULATIONS OF EUROPEAN POND TURTLE (*EMYS ORBICULARIS*) FROM SERBIA

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Blood parasites from the genus *Haemogregarina* are infecting fish and reptiles during their life cycle, as well as leeches which represent their definitive host. This work aimed to determine the existence of differences in infection rates of blood parasites between males and females of European pond turtle (*Emys orbicularis*), as well as between five different populations from Serbia (Ludaš, Kraljevac, Galovica, Malo Crniće, and Rudinje). Blood smears of 33 individuals were analyzed under a microscope by counting the number of parasites present in 2000 erythrocytes, on two separate blood smears for each individual, whereby the mean value of the counted parasites was used in further analyses. To determine a significant statistical difference between the sexes, the Two-sample T-test was used, while the ANOVA test was used to determine the difference in infection rates between populations. The results of both tests showed that there is no statistically significant difference in infection rate of blood parasites between sexes, neither between populations (p>0.05). Considering these results, it is possible to assume that the habitat conditions are similar in terms of favoring the development of *Haemogregarina* infection, and that the progress of the parasite infection is the same for both sexes of European pond turtle, as well as in all of the analyzed populations.

Keywords: ANOVA, blood smear, *Haemogregarina*, sexual dimorphism

GUSTINA GNEZDA I IZBOR MESTA ZA GNEŽĐENJE SVRAKE (PICA PICA) NA LIMANU I I II TOKOM 2019. GODINE

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Više od polovine svetskog stanovništva živi u gradovima, a sa porastom ljudske populacije povećava se površina urbanih ekosistema na račun prirodnih. Neke vrste su se uspešno prilagodile procesu urbanizacije i suživotu sa čovekom. Ptice iz porodice vrana (Corvidae) su dobar i često proučavan primer. Svraka, kao generalista u izboru mesta za gnežđenje i omnivor u pogledu ishrane, u urbanim sredinama može biti brojnija nego u poluprirodnim i prirodnim predelima. Cilj istraživanja je utvrditi prostorni raspored, gustinu parova i izbor mesta za gnežđenje svrake tokom 2019. godine u naseljima Liman I i II u Novom Sadu.

Naselja Liman I i II obuhvataju komplekse stambenih zgrada, Univerzitetski park, vrtiće, škole i druge javne ustanove okružene drvoredima, parkovima i drugim zelenim površinama sa brojnim drvenastim i žbunastim biljkama različite starosti. Istraživanje je sprovedeno u periodu od februara do maja 2019. godine. Tom prilikom popisana su stara gnezda od prethodnih godina i nova gnezda u izgradnji. Gnezdo je praćeno sve do potvrde aktivnosti istog. Osim aktivnosti, beležena je visina na kojoj se gnezdo nalazi, vrsta drveta i da li se gnezdo nalazi pri vrhu ili u sredini krošnje stabla.

Zabeleženo je 19 aktivnih gnezda svrake na površini 85 hektara, čime je relativna gustina iznosila 0,2 gnezda po hektaru. Najveći broj gnezda (devet) je bio na visini 10-14 m, četiri gnezda se nalazilo na 15-20 m, a po tri gnezda su bila na visini manjoj od 10 m i većoj od 20 m. Svrake su gnezda pravile na 11 različitih drvenastih taksona od kojih je na kopriviću (Celtis sp.) bila jedna četvrtina gnezda. Pri vrhu krošnje se nalazio najveći broj gnezda (16; 84%), a samo tri gnezda (16%) su bila u sredini krošnje stabla. Između dva gnezda, najmanja udaljenost je bila 45 metara.

Svraka je redovna gnezdarica zelenih površina Novog Sada čime je pokazatelj urbanistički dobro organizovanih naselja. Obično se gnezdi na srednje visokim stablima pri vrhu krošnje. Međutim, kako bi se utvrdilo da li svraka bira određenu vrstu drveta ili je to stablo jedino dostupno u blizini, potrebno je popisati sva stabla u istraživanom području.

Ključne reči: svraka, Novi Sad, urbana ekologija

BREEDING DENSITY AND NEST-SITE SELECTION OF BLACK-BILLED MAGPIE (PICA PICA) ON LIMAN 1 AND LIMAN 2 DURING THE YEAR OF 2019

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More than half of the world’s human population lives in cities, and with the increase in human population, the area of urban ecosystems increases at the expense of natural ones. Some species have successfully adapted to the process of urbanization and coexistence with humans. Crows (Corvidae) are a good and often studied example. The Black-billed Magpie (hereafter: Magpie), as a generalist in choosing nesting sites and an omnivore, can be more numerous in urban areas than in semi-natural and natural areas. The aim of the research is to determine the spatial distribution, the density of breeding pairs, and the choice of nesting sites for magpies during 2019. in the Liman I and II quarters in Novi Sad.

Liman I and II quarters include complexes of buildings, University Park, kindergartens, schools, and other public institutions surrounded by tree avenues, parks, and other green areas with numerous trees and shrubs of different ages. The research was conducted in the period from February to May 2019. On that occasion, old nests from previous years and new nests were recorded. The nest was monitored until confirmation of its activity. In addition to the activity, the height at which the nest is located, the type of tree, and whether the nest is located near the top or in the middle of the tree canopy were recorded.

19 active magpie nests were recorded on an area of 85 hectares, which resulted in a relative density of 0.2 nests per hectare. The largest number of nests (nine) was at a height of 10-14 meters, four nests were located at 15-20 meters, and three nests each were at a height of less than 10 and more than 20 meters. Magpies built their nests on 11 different tree taxa, of which a quarter of the nests were on Hackberry (*Celtis* sp.). The highest number of nests (16; 84%) was located at the top of the tree canopy, and only three nests (16%) were in the middle of the tree canopy. The shortest distance between the two nests was 45 meters.

The Magpie is a common breeder of the green areas of Novi Sad, which is an indicator of urbanistically well-organized quarters. It usually nests on medium-tall trees near the top of the canopy. However, to determine whether the Magpie chooses a certain type of tree or if that tree is the only one available in the vicinity, it is necessary to list all the trees in the study area.

Keywords: Black-billed Magpie, Novi Sad, urban ecology

REZULTATI ISTRAŽIVANJA FAUNE ŠIŠMIŠA (CHIROPTERA) SA XII INTERNACIONALNOG KAMPA „NACIONALNI PARK UNA 2022.“

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Nacionalni park Una od 2008. godine zakonski je zaštićeno područje, ukupne veličine 19.800 ha koji je administrativno pod teritorijom Grada Bihaća, a jedan manji dio se prostire na području općine Drvar. Pripada Unsko-koranskoj zaravni i obuhvata dijelove rijeka Une i Unca, padine planina Grmeč, Osječenica i Plješevica. Tokom kampa organizovanog od strane Udruženja studenata biologije u Bosni i Hercegovini istraživana je hiropterofauna ovog područja.

Nacionalni park Una sa svojim rijekama, očuvanim šumama, prirodnim pećinama, tunelima i ostalim građevinama u svom okruženju predstavlja vrlo zanimljivo područje za šišmiše. U periodu od 25. 7. do 31. 7. 2022. godine sprovođene su standardne metode za istraživanje šišmiša: inspekcija potencijalnih skloništa, postavljanje mreže iznad potencijalnih putanja leta i snimanje eholokacijskih signala šišmiša pomoću detektora. Automatski snimači eholokacionih signala (Song Meter SM4 i AudioMoth) šišmiša postavljeni su na odabranim lokacijama u blizini rijeke Une i vrela rijeke Bastašice, dok su na nekim lokacijama korišteni ručni detektori (Petterson D240x i Echo Meter Touch 2) radi snimanja transekata. Dnevnim inspekcijama potencijalnih skloništa šišmiša pregledana su četiri tunela, tri pećine, osam kuća i jedan mlin, te je također izvršena inspekcija i pukotina u stijenama kanjona rijeka Une i Unca. Postavljanje vertikalnih mreža vršeno je na tri lokaliteta: Kulen Vakuf, Martin Brod i Bastaško vrelo. Dnevnim inspekcijama zabilježeno je prisustvo 63 jedinke od ukupno 5 vrsta šišmiša. Najznačajniji nalaz jeste pronalazak porodiljske kolonije malog potkovastog šišmiša (*Rhinolophus hipposideros*). Pomoću vertikalnih mreža uhvaćeno je 46 jedinki od ukupno 9 vrsta. U okviru istraživanja također je vršeno prstenovanje 37 jedinki šišmiša.

Tokom ovog istraživanja zabilježeno je prisustvo idućih vrsta: *Myotis daubentonii, M. mystacinus, M. alcatoae, M. capaccinii, M. blythii, M. myotis, M. emarginatus, Pipistrellus pipistrellus, P. pygmaeus, Rhinolophus ferrumequinum i R. hipposideros*. Očekuje se povećanje broja vrsta nakon analize svih eholokacionih signala.

Ključne riječi: Chiroptera, fauna, Nacionalni park Una, Bosna i Hercegovina

RESEARCH RESULTS ON BAT FAUNA (CHIROPTERA) AT THE XII INTERNATIONAL CAMP “NATIONAL PARK UNA 2022.”

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The Una National Park has been a legally protected area since 2008, with a total size of 19800 ha, which is administratively under the territory of the City of Bihać, and a smaller part is spread over the territory of the municipality of Drvar. It belongs to the Una-Koran plain and includes parts of the Una and Unac rivers, the slopes of the Grmeč, Osječenica and Plješevica mountains. During the camp organized by the Association of Biology Students in Bosnia and Herzegovina, the chiropterofauna of this area was investigated.

The Una National Park with its rivers, preserved forests, natural caves, tunnels and other structures in its surroundings is a very interesting area for bats. In the period from July 25 to July 31, 2022, standard methods for bat research were carried out: inspection of potential roosts, placing a net over potential flight paths and recording echolocation signals of bats using detectors. Automatic recorders of bat echolocation signals (Song Meter SM4 and AudioMoth) were placed at select locations near the Una River and the source of the Bastašica river, while at some locations manual detectors (Petterson D240x and Echo Meter Touch 2) were used to record transects. During daily inspections of potential bat shelters, four tunnels, three caves, eight houses and one mill were inspected, and a crack in the rocks of the Una and Unca river canyons were also inspected. Vertical nets were installed in three localities: Kulen Vakuf, Martin Brod and Bastaško vrelo. Daily inspections recorded the presence of 63 individuals from a total of 5 species of bats. The most significant finding was the discovery of a maternity colony of the small horseshoe bat (*Rhinolophus hipposideros*). Using vertical nets, 46 individuals of a total of 9 species were caught. As part of the research, 37 bat individuals were also ringed.

During this research, the presence of the following species was recorded: *Myotis daubentonii, M. mystacinus, M. alcatoae, M. capaccinii, M. blythii, M. myotis, M. emarginatus, Pipistrellus pipistrellus, P. pygmaeus, Rhinolophus ferrumequinum* and *R. hipposideros*. An increase in the number of species is expected after the analysis of all echolocation signals.

Key words: Chiroptera, fauna, Una National Park, Bosnia and Herzegovina

MARKIRANJE JEŽEVA NA TERITORIJI GRADA NOVOG SADA, SRBIJA

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Usled povećane urbanizacije mnoge vrste suočene su sa većim stepenom ekološkog i antropogenog pritiska, takve promene životne sredine dovele su do gubitka određenih vrsta sa staništa koja su pretrpela takav uticaj. Nasuprot tome, neke vrste su se vrlo uspešno adaptirale novoj sredini, jedna od tih vrsta je severni belogrudi jež (*Erinaceus roumanicus)*. Ova vrsta je rasprostranjena širom istočne Evrope i u delovima Rusije do Sibira. Nažalost, tokom proteklih decenija, vrsta iz istog roda - evropski jež (*Erinaceus europaeus*), doživela je nagli pad brojnosti usled prekomerne urbanizacije i nedostatka zelenih površina u gradovima. Cilj našeg istraživanja je utvrđivanje brojnosti populacije ježeva u odabranim delovima Novog Sada i utvrđivanje da li je isti fenomen prisutan u ovom gradu.

U svrhu istraživanja životinje su markirane plastičnim rukavcima postavljenim na bodlje. Terenska istraživanja sprovedena su tokom 6 noći od aprila do avgusta 2022. Ukupno je markirano 40 jedinki (16 mužjaka, 22 ženke i 2 neodređena). Kao što je i očekivano, većina jednki je pronađena na više od 20 m udaljenosti od javnih puteva. Od 40 jedinki 21 je pronađena na 1) velikim zelenim površinama kao što su parkovi i šetališta, dok je ostalih 19 pronađeno oko 2) područja okruženim zgradama i putevima.

Rezultati pokazuju da se veći deo populacije ježeva na istraživanom području nalazi na većim zelenih površinama, bez obzira na činjenicu da ukupna površina ovih staništa čini mali udeo ukupne površine pokrivene tokom istraživanja. Ovo pokazuje da ježevi preferiraju delove grada poput parkova i šetališta, kao i da bi gubitak ovih staništa mogao dovesti do pada brojnosti u urbanim populacijama ježeva, nažalost usled manjka ponovnih nalaza nemamo dovoljno dokaza da učvrstimo ovu tvrdnju.

Ključne reči: *Erinaceus roumanicus*, urbanizacija, monitoring, sisari, smanjenje populacije

HEDGEHOG MARKING ON THE TERRITORY OF THE CITY OF NOVI SAD, SERBIA

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With the rise in urbanization many species had to face a high degree of ecological and anthropogenic pressure, due to that environmental shift some species were forced out of those regions, while on the other hand some have found a way to adapt to these altered conditions. One of those species is the northern white-breasted hedgehog (*Erinaceus romanicus*). This species inhabits Eastern Europe and parts of Russia up to Siberia. Unfortunately, in the last few decades species from the same genus, the european hedgehog (*Erinaceus europaeus*), have experienced a decline in population numbers due to excessive urbanization and a lack of green areas in cities. The aim of our research is to determine whether or not this phenomenon is present in the population of the northern white-breasted hedgehog on the territory of the city of Novi Sad.

For the purpose of monitoring the population size, animals were marked with plastic gloves attached to quills. Field research was carried out during six nights from April to August of 2022. A total of 40 individuals were marked (16 males, 22 females and 2 undetermined). As suspected, most of the individuals were found more than 20m from public roads. Out of 40 individuals, twenty-one were found in 1) large green areas such as parks and promenades while the rest were scattered around 2) areas sorrounded by buildings and roads.

Results show that the majority of the hedgehog population is concentrated in large green areas, regardless that it accounts for a minor percentage of the total land area, indicating the species' preference of this type of habitat. This indicates that the loss of green areas tied to excessive urbanization might be the cause of the drop in urban hedgehog populations, however due to the lack of recaptured individuals we cannot back this hypothesis.

Keywords: *Erinaceus romanicus*, urbanization, monitoring, mammals, population decrease

ISTRAŽIVANJE FAUNE SISARA (MAMMALIA) PREDELA IZUZETNIH ODLIKA „VLASINA"

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Predeo izuzetnih odlika „Vlasina" predstavlja zaštićeno područje na jugoistoku Srbije koje obuhvata planinski plato prosečne nadmorske visine od 1000 m do 1300 m i veštačko jezero po kojem predeo nosi ime, a koje je poznato po mnogobrojnim tresetnim ostrvima. Područje uprkos snažnim ugrožavajućim faktorima (urbanizacija, velika oscilacija nivoa vode u jezeru, zarastanje livada) odlikuje se visokim stepenom raznovrsnosti kako biljnih tako i životinjskih vrsta. Istraživanja sprovedena na kampovima u organizaciji Naučno-istraživačkog društva studenata biologije i ekologije „Josif Pančić" tokom prethodne dve godine primarno su bila fokusirana na popis vrsta sisara koje su prisutne na području.

Podaci o prisustvu vrsta dobijeni su analizom tragova i izmeta životinja, analizom gvalica, analizom snimaka ultrazvučnih signala slepih miševa snimljenih stacionarnim detektorom i fotografisanjem pomoću fotoklopki. Određen broj vrsta je direktno posmatran i zabeležen (*Sciurus vulgaris, Spalax leucodon, Lepus europaeus, Neomys fodiens, Mustela nivalis*). Tokom istraživanja u prethodne dve godine zabeleženo je ukupno 15 vrsta terestričnih sisara od kojih je prema Pravilniku o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva 2 strogo zaštićeno, a 10 zaštićeno. Pored toga, zabeleženo je i 7 vrsta slepih miševa uz 4 akustične grupe uključujući i rod *Myotis* čije identifikacije do nivoa vrste nisu bile moguće na osnovu dobijenih snimaka, sve vrste reda Chiroptera su prema Pravilniku o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva strogo zaštićene.

Treba napomenuti da je očekivani broj vrsta znatno veći, ovo je potrebno utvrditi budućim istraživanjima tokom više sezonskih aspekata u više tipova staništa. Posebno se očekuje veći broj vrsta slepih miševa koje je potrebno potražiti i u skrovištima.

Ključne reči: sisari, slepi miševi, fauna, Vlasina, diverzitet

RESEARCH OF MAMMALIAN FAUNA OF THE LANDSCAPE OF OUTSTANDING FEATURES "VLASINA"

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The Landscape of outstanding features "Vlasina" is a protected area in southeast Serbia. It encompasses a plateau with an average elevation between 1000 and 1300 m and a semi-artificial lake of the same name which is famous for its turf islands. Despite many threatening factors (urbanization, great shifts in water levels in the lake, overgrowth of shrubs and weeds on meadows), this area is characterized by a high degree of biodiversity. Research carried out during two summer camps organized in the past two years by the Scientific and research society of biology and ecology students "Josif Pancic" was primarily focused on surveying mammalian species present in the area.

Data on the presence of species was acquired by analyzing tracks and excrement, owl pellets, recordings of ultrasonic echolocation signals produced by bats and photographing animals via camera traps. A certain number of species were also observed in the wild (*Sciurus vulgaris, Spalax leucodon, Lepus europaeus, Neomys fodiens, Mustela nivalis*). During the research 15 species of terrestrial mammals were recorded, 2 of which are strictly protected and 10 are protected according to the Rulebook on declaration and protection of protected and strictly protected species of plants, animals and fungi. Additionally, 7 species of bats, along with 4 acoustic groups including the *Myotis* group were also recorded; all species in the order *Chiroptera* are strictly protected according to The Rulebook.

It should be noted that the number of species found was far lower than expected. This should be confirmed in future research which would take into account seasonality and cover more habitats. This is especially true for bats whose roosts and colonies should be searched for and documented.

Key words: mammals, bats, fauna, Vlasina, biodiversity

OBRAZAC POLNOG DIMORFIZMA INVAZIVNOG MALOG INDIJSKOG MUNGOSA (*HERPESTES AUROPUNCTATUS*), ZASNOVANO NA VELIČINI I OBLIKU DONJE VILICE

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Mali indijski mungos predstavlja malu karnivoru, koja pripada porodici Herpestidae i prirodno naseljava oblast južne Azije. Vrsta je introdukovana u mnoge delove sveta u svrhu kontrole određenih životinja, međutim vrsta je nažalost svrstana u 100 najgorih invazivnih vrsta. Što se tiče Evrope, mungos je prvo introdukovan u Hrvatsku 1910. i trenutno se širi duž mediteranske obale, stižući do Albanije. Sa obzirom da je introdukovan na mesta bez ili sa manje karnivora i/ili sa novim resursima hrane, mungos je verovatno oslobođen kompeticije što mu je omogućilo da okupira slobodne niše. Prethodna istraživanja ukazuju na oslobađanje karaktera (veće jedinke) i rapidnu evoluciju invazivnog mungosa, potencijalno kao posledica smanjenog selekcionog pritiska i promene životne sredine. Štaviše, viši stepen polnog dimorfizma u veličini (SSD = sexual size dimorphism) nađen je kod introdukovanih populacija u poređenju sa nativnim.

Cilj ove studije je da opiše obrazac SSD-a kao i polnog dimorfizma u obliku (SShD = sexual shape dimrphism) introdukovane populacije mungosa iz Crne Gore. Koliko znamo, ovo je prva studija koja analizira varijaciju donje vilice u kontekstu polnog dimorfizma kod bilo koje vrste mungosa koristeći geometrijsku morfometriju (GM). Prethodna morfometrijska istraživanja rađena na malom indijskom mungosu koristila su linearnu morfometriju, koja u poređenju sa GM ne obezbeđuje vizuelizaciju promena oblika, ne može da odvoji varijaciju veličine od varijacije oblika i ima slabiju statističku moć.

Ukupno je analizirana 21 adultna životinja (12 mužijaka, 9 ženki), sveukupno 42 donje vilice, svaka fotografisana po dva puta radi utvrđivanja efekta greške pri slikanju. Geometrijsko morfometrijske i statističke analize poput Procrustove ANOVE, analize glavnih komponenti (PCA), analiza diskriminantne funkcije i regresione analize rađene su u MorphoJ programu i Geomorph paketu za R statistički jezik.

Efekat greške pri slikanju se pokazao zanemarljivim, što ukazuje na validnost daljih analiza. Detektovano je prisustvo SSD-a kao i SShD-a, pokazujući da su mužjaci veći od ženki, kao i veći stepen SSD-a nego SShD-a. Oko 10% ukupne varijacije dimorfizma u obliku opisano je alometrijom (varijacija oblika u zavisnosti od veličine), i nakon alometrijske korekcije (bez alometrije) SShD nije identifikovan. Promene oblika povezane sa polnim dimorfizmom su najistaknutije u delovima koji vrše funkciju ishrane i žvakanja. Koronoidni nastavak je viši i malo uži kod mužjaka nego kod ženki. Maseteri i temporalni mišići se nalaze na koronoidnom nastavku i njihova površina je jedna od ključnih osobina koje određuju silu ugriza životinje, ukazujući na čvrstu vezu između forme i funkcije. Osim toga, kondiloidni nastavak, koji formira vilični zglob kod sisara širi je kod mužjaka, takođe deo donje vilice na kojem se nalaze sekutići i očnjaci je istaknutiji kod mužjaka u poređenju sa ženkama.

Obrazac SSD-a i SShD-a u ovoj studiji je diskutovana u svetlu dva biološka procesa: 1) seksualne selekcija, gde mužjaci povećavaju svoju reproduktivnu uspešnost direktno kroz intraseksualnu kompeticiju (npr. borba mužjaka), favorizujući veće mužjake i 2) divergencija niša, gde prirodna selekcija favorizuje različite forme donje vilice među polovima kako bi se izbegla kompeticija za hranidbene resurse. Ovaj rad prikazuje model funkcionalno povezanog SShD-a i značajnost alometrije kao mogućeg evolucionog pokretača polnog dimorfizma u obliku.

Ključne reči: geometrijska morfometrija, alometrija, invazivna vrsta, sisari, prirodna selekcija, divergencija niša

PATTERN OF THE SEXUAL DIMORPHISM IN INVASIVE SMALL INDIAN MONGOOSE (*HERPESTES AUROPUNCTATUS*), BASED ON MANDIBLE SIZE AND SHAPE

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The small Indian mongoose represents a small carnivore, belonging to the Herpestidae family, native to South Asia. The species was introduced in many regions of the world for the purpose of animal control, but unfortunately it became categorized as one of the top 100 worst invasive species. In terms of Europe, the mongoose was firstly introduced to Croatia in 1910 and currently it is spreading along the Mediterranean coast towards the south, reaching Albania. Introduced to areas with less or no carnivores and/or new food resources, the mongoose might have experienced a release from competition which may have allowed species to occupy free niches. Previous work offers evidence for character release (bigger size) and rapid evolution of invasive mongoose, possibly as a consequence of reduced selective pressure and environmental shift. Furthermore, introduced mongooses have exhibited greater sexual size dimorphism (SSD) compared to native.

The aim of this study is to describe patterns of both SSD and sexual shape dimrphism (SShD) in introduced mongoose population from Montenegro. As far as we know, this is the first study analyzing mandible variation in the context of sexual dimorphism in any mongoose species using geometric morphometrics (GM). Previous morphometric analysis performed on small Indian mongoose used linear morphometrics, which compared to GM does not provide visualization of shape changes, cannot separate size from shape variation and has a lower statistical power.

A total of 21 adult animals were analyzed (12 males, 9 females), 42 manidbles altogether, each photographed twice in order to estimate the effect of imaging error. Geometric morphometric and statistical analyses such as Procrustes ANOVA, Principal component analysis (PCA), Discriminant function analysis and Regression analysis were performed in the MorphoJ program and Geomorph package for R statistical language.

The effects of imaging error were negligible, which indicaties the validity of further analysis. Both SSD and SShD were observed, where males appear bigger than females and a higher degree of SSD has been estimated than SShD. Around 10% of total shape dimorpism variation was due to allometry (size-related shape variation), and after size correction (allometry-free) SShD appears insignificant. Shape changes associated with sexual dimorphism are the most prominent in parts that serve the mastication and feeding function. The coronoid process is higher and slightly narrower in males relative to females. The temporal and masseter muscles insert on the coronoid process and their surface area is one of the key features which determines the bite force of an animal, suggesting tight relationship between form and function. Furthermore, the condyloid process, which forms the jaw joint in mammals, is wider in males, and also the part of the mandible bearing incisors and canines is more prominent in males compared to females.

The observed pattern of SSD and SShD in this study have been discussed in the light of two biological processes: 1) sexual selection, where males increase their reproductive success directly through intrasexual competition (e.g. male-male combat), favoring bigger males and 2) niche divergence, where natural selection favors different mandible forms between the sexes to avoid intersexual competition for food resources. This work shows the model of functionally related SShD and the importance of allometry as a possible evolutionary driver of sexual shape dimorphism.

Keywords: geometric morphometrics, allometry, invasive species, mammals, sexual selection, niche divergence

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