

A PRELIMINARY LIST OF CRENOBIONTIC SPECIES IN THE BJESHKET E NEMUNA NATIONAL PARK (REPUBLIC OF KOSOVO)

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Abstract. The Bjeshket e Nemuna/Alpet Shqiptare National Park is located in the western and southwestern part of Kosovo and features unique freshwater fauna. The aquatic invertebrate communities here are nearly unrecognised and need extensive studies. Ecological and faunistic research on benthic communities of rheocrenes in the Bjeshket e Nemuna show that the most important component of invertebrate fauna of local springs and streams are Chironomidae (non-biting midges). We present the preliminary list of crenobiontic macroinvertebrates in the mountain springs of Bjeshket e Nemuna/Alpet Shqiptare. The list includes crenobionts from the following groups: Hirudinea (2), Gastropoda (2), Hydrachnidia (2) and Insecta (13).

Keywords: Alpet Shqiptare, springs, benthos, macroinvertebrates, Balkan Peninsula.

Rezumat. Lista preliminară a speciilor crenobionice din Parcul Național Bjeshket e Nemuna (Republica Kosovo).

Parcul Național Bjeshket e Nemuna/Alpet Shqiptare este situat în partea de vest și sud-vest a Kosovo și are o faună unică de apă dulce. Comunitățile de nevertebrate acvatice de aici sunt aproape nerecunoscute și au nevoie de studii ample. Cercetările ecologice și faunistice asupra comunităților bentonice de reocreni din Bjeshket e Nemuna arată că cea mai importantă componentă a faunei de nevertebrate din izvoarele și pâraiele locale sunt Chironomidae (insecte diptere asemănătoare cu țânțarii, care nu mușcă). Prezentăm lista preliminară a macronevertebratelor crenobionte din izvoarele montane din Bjeshket e Nemuna/Alpet Shqiptare. Lista include crenobionte din următoarele grupe: Hirudinea (2), Gastropoda (2), Hydrachnidia (2) și Insecta (13).

Cuvinte cheie: Alpet Shqiptare, izvoare, bentos, macronevertebrate, Peninsula Balcanică.

INTRODUCTION

The Bjeshket e Nemuna/Alpet Shqiptare mountains comprise the western and southwestern part of Kosovo, a region with unique biodiversity. The national park has an area of 63,028 ha at 42°40'0"N 20°10'0"E. There are numerous lakes, streams and springs in the park. Springs are habitats at the interface between surface water and groundwater (WILLIAMS, 1991; WEBB et al., 1998). They maintain high biodiversity (PEŠIĆ et al., 2016; von FUMETTI et al., 2017; PŁÓCIENNIK et al., 2023). Springs in Bjeshket e Nemuna mountains have previously been studied by BERLAJOLLI et al. (2019). Organisms living in springs have special adaptations to these habitats (e.g. WILLIAMS & DANKS, 1991; FERRINGTON, 1995). As springs usually have stable water temperature, they are settled by stenotherm species (ILLIES, 1952; ERMAN & ERMAN, 1995; FISCHER et al., 1998). Mountain springs have been investigated in Europe, e.g. in the Alps the Berchtesgaden (GERECKE & FRANZ, 2006) and Gesäuse National Parks (GERECKE et al., 2012), as well as (SAMBUGAR et al., 2006; CANTONATI et al., 2007; STOCH et al., 2011). Some studies are focused on certain taxa autecology, such as stoneflies (AUBERT, 1965) or water mites (BADER, 1975). In the Dinaric Karst, VON FUMETTI et al. (2017) studied 35 rheocene springs along the Cvrcka river and found that dispersion and colonisation of adult insect stages take place mainly within the watercourse landscape corridors (Fig. 1).

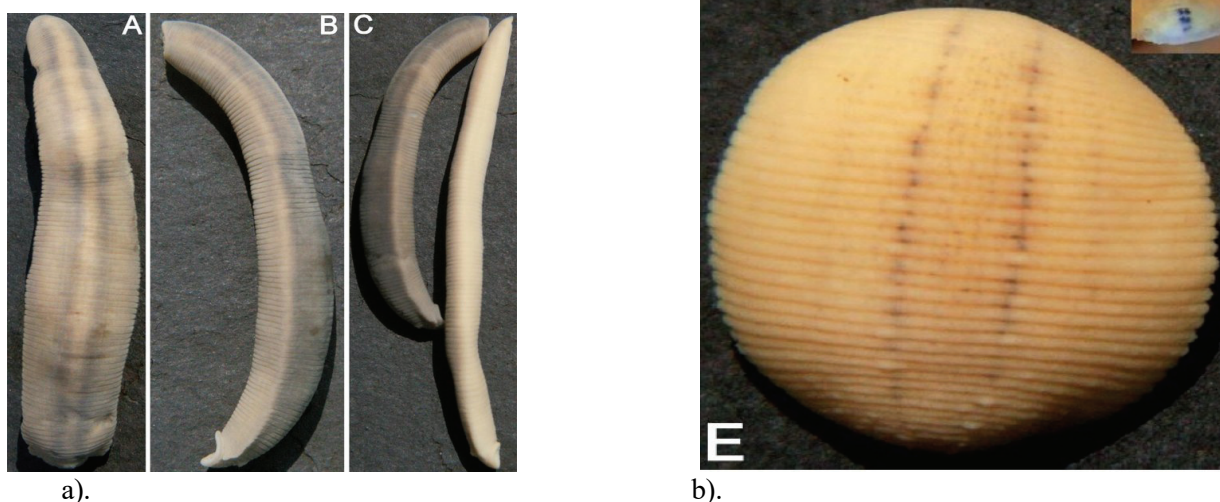


Figure 1. Endemic crenobionts in Bjeshket e Nemuna: a) *Dina prokletijaca* Grosser & Pešić, 2016 and b) *Glossiphonia balcanica* Grosser & Pešić, 2016. Photos after GROSSER et al., (2016).

Springs reveal characteristic spatial zonation into springhead (eucrenal) and springbrook (hypocrenal) zones (ILLIES & BOTOSANEANU, 1963). Crenobionts are found frequently or exclusively in spring habitats, whereas crenophiles inhabit springs, but also frequently other habitats. Crenoxenes only occasionally occur in springs.

Springs in the mountainous areas of Kosovo have been poorly investigated. Most papers deal with the faunistic or taxonomical research of some taxa living in stream habitats. There are several studies on Hirudinea (GROSSER et al., 2016) (Figure 1), Gastropoda (GLÖER et al., 2014), Plecoptera (DAUTI, 1980), Trichoptera (IBRAHIMI et al., 2014), Ephemeroptera (XËRXA et al., 2019), Odonata (GERECKE et al., 2012; VINKO et al., 2020), Culicidae (MUJA-BAJRAKTARI et al., 2019), and Chironomidae (BERLAJOLLI et al., 2019, 2020, 2022). Here we present a review of taxa that can be regarded as crenobiont/crenophile, recorded in previous and new studies in the park.

MATERIALS AND METHODS

In Bjeshket e Nemuna, macroinvertebrates were collected with a Surber sampler (0.15 m², mesh size 350 µm) from the eucrenal of each spring at different altitudes from 472 to 1700 m a.s.l. (BERLAJOLLI et al., 2019; 2020; 2022).

RESULTS AND DISCUSSION

The preliminary list of crenobiontic species found in springs in Bjeshket e Nemuna is presented in Table 1.

Springs in Bjeshket e Nemuna National Park are mostly pristine small rheocrenes with high benthos diversity. The Bjeshket e Nemuna bedrock consists mainly of limestone. Regular monthly sampling in two springs from autumn 2014 to autumn 2015 reported as much as 51 taxa. The fully aquatic invertebrates were represented by 13 taxa, whereas two-thirds (38 taxa) belonged to insects with flying dispersal adult stage (BERLAJOLLI et al., 2019). Among them, three crenobiontic species were found: two water mites *Lebertia glabra* and *Atractides fonticolus* and the leech *Dina prokletijaca* endemic to springs of the Bjeshket e Nemuna. Meanwhile from other 50 springs there were found crenobiontic leech species *Glossiphonia balcanica* and gastropod *Bythinella istoka*. Diptera from which Chironomidae (the non-biting midges) were the dominant group were represented by 43 taxa, including 13 crenobiontic/crenophile species: *Apsectrotanypus trifascipennis*, *Diamesa* spp., *Brillia bifida*, *Chaetocladius dentiforceps* agg., *Chaetocladius melaleucus*, *Chaetocladius piger* agg., *Heleniella ornatocollis*-type, *Metriocnemus hygropetricus* agg., *Parametriocnemus stylatus*-type, *Paraphaenocladus penerasus*, *Paraphaenocladus pseudirritus*, *Micropsectra* type A, and *Thaumalea veralli* from other midge family, the Thaumaleidae (BERLAJOLLI et al., 2020). *Bythinella drimica alba* Radoman (1976) were found in the spring of Decani.

Table 1. Preliminary list of crenobiontic species from Bjeshket e Nemuna National Park.

Crenophile/crenobiont taxa	Habitat	Reference
Gastropoda		
<i>Bythinella istoka</i> (Glöer and Pešić, 2014)	Large perennial rheocrene with stony bottom	GLÖER & PEŠIĆ, 2014
<i>Bythinella drimica alba</i> Radoman (1976)	Large perennial rheocrene with stony bottom	MOLLUSCABASE, 2021
Hirudinea		
<i>Dina prokletijaca</i> (Grosser and Pešić, 2016)	Perennial rheocrenes with fine mineral bottom and stones	GROSSER & PEŠIĆ, 2016 BERLAJOLLI et al., 2019
<i>Glossiphonia balcanica</i> (Grosser and Pešić, 2016)	Perennial rheocrenes with fine mineral bottom and stones	GROSSER & PEŠIĆ, 2016 BERLAJOLLI et al., 2019
Hydrachnidia		
<i>Atractides fonticolus</i> (Viets, 1920)	Perennial rheocrenes with fine mineral bottom and stones	BERLAJOLLI et al., 2019
<i>Lebertia glabra</i> (Thor, 1897)	Perennial rheocrenes with fine mineral bottom and stones	BERLAJOLLI et al., 2019
Chironomidae		
<i>Diamesa</i> spp.	Perennial rheocrenes with stones and gravel	BERLAJOLLI et al., 2020
<i>Apsectrotanypus trifascipennis</i> (Zetterstedt, 1838)	Perennial rheocrenes with plant litter and sand	BERLAJOLLI et al., 2020
<i>Brillia bifida</i> (Kieffer, 1909)	Perennial rheocrenes with plant litter and gravel	BERLAJOLLI et al., 2020
<i>Chaetocladius dentiforceps</i> (Edwards, 1929) agg.	Perennial and intermittent rheocrenes with gravel, stones and plant litter	BERLAJOLLI et al., 2020
<i>Chaetocladius melaleucus</i> (Meigen, 1818)	Perennial rheocrenes with plant litter, gravel and stones	BERLAJOLLI et al., 2020
<i>Chaetocladius piger</i> (Goetghebuer, 1913) agg.	Intermittent seepage with anoxic mud and perennial rheocrene	BERLAJOLLI et al., 2020
<i>Heleniella ornatocollis</i> (Edwards, 1929) agg.	Perennial rheocrenes with gravel and stones	BERLAJOLLI et al., 2020
<i>Metriocnemus hygropetricus</i> Kieffer, 1912 agg.	Perennial rheocrenes with plant litter, sand and gravel	BERLAJOLLI et al., 2020
<i>Parametriocnemus stylatus</i> (Kieffer, 1924) agg.	Perennial rheocrenes with plant litter	BERLAJOLLI et al., 2020
<i>Paraphaenocladus penerasus</i> (Edwards, 1929)	Intermittent seepages and perennial rheocrene with gravel and stones	BERLAJOLLI et al., 2020
<i>Paraphaenocladus pseudirritus</i> Strenzke, 1950	Perennial rheocrenes with plant litter, gravel and sand	BERLAJOLLI et al., 2020
<i>Micropsectra</i> type A sensu Brooks et al. (2007)	Perennial rheocrenes and intermittent seepages with plant litter, sand and gravel	BERLAJOLLI et al., 2020
Thaumaleidae		
<i>Thaumalea veralli</i> Edwards, 1929	Intermittent seepages and perennial rheocrenes with plant litter and gravel	BERLAJOLLI et al., 2020

Springs in Bjeshket e Nemuna National Park are mainly perceived as water suppliers – for hikers, cattle and urban communities (SUTER et al., 2007). The awareness of the ecological significance of springs is still scarce in the society. Human impact on conditions is evident in many springs. Most endemic species in Bjeshket e Nemuna occur in different types of springs. Further efforts to protect these endangered ecosystems are recommended.

CONCLUSIONS

Due to the complex geological history of the Alpet Shqiptare during the Tertiary and Quaternary periods, the phylogeography of many freshwater species exhibits a complex pattern. Many less mobile species of leeches, mollusks, and water mites display strong endemism. Within these groups, there are endemics limited to specific springs and their immediate outflows. These species are strict crenobionts and narrow endemics.

However, the situation is different for insects that have aquatic larvae and adult stages capable of flight. Chironomidae found in the Alpet Shqiptare, classified as crenobionts or crenophiles, usually have broad ranges in the western Palearctic. Midges, being more adaptable, can colonize new springs more easily than, for example, snails. As aerial plankton, they can be transported even over considerable distances. This is why the mentioned Chironomidae typically inhabit various types of springs, seepages as well as streams and even smaller rivers. On the other hand, there is a lack of genetic research on populations inhabiting the Alpet Shqiptare. Such studies could reveal high cryptic endemism among small aquatic insects and demonstrate the existence of numerous cryptic species that are truly crenobiotic, not found outside the Bjeshket e Nemuna National Park's springs.

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REFERENCES

- AUBERT J. 1965. *Les Plécoptères du Parc National Suisse*. Ergebnisse der wissenschaftlichen Untersuchungen im Schweizerischen Nationalpark. Aarau. 10 pp.
- BADER C. 1975. *Die Wassermilben des Schweizerischen Nationalparks*. Ergebnisse der wissenschaftlichen Untersuchungen im Schweizerischen Nationalpark. Aarau. 14 pp.
- BERLAJOLLI V., PŁÓCIENNIK M., ANTCZAK-ORLEWSKA O., PEŠIĆ V. 2019. The optimal time for sampling macroinvertebrates and its implications for diversity indexing in rheocrenes case study from the Prokletije Mountains. *Knowledge and Management of Aquatic Ecosystems*. The French Biodiversity Agency, Lumière. **420**: 1-6.
- BERLAJOLLI V., PŁÓCIENNIK M., PEŠIĆ V., BERLAJOLLI XH. 2020. Chironomidae of the Cursed Mountains (Bjeshkët e Nemuna National Park). *Conference: BIODIVEST 2020*. Abstract Book. Muzeul Olteniei Craiova: 93.
- BERLAJOLLI V., PŁÓCIENNIK M., PEŠIĆ V., BERLAJOLLI XH. 2022. Chironomidae diversity of the Cursed Mountains (Kosovo Republic). *Conference: MarFresh 2021*. Şanlıurfa: 1-2.
- CANTONATI M., BERTUZZI E., SPITALE D. 2007. *The spring habitat: biota and sampling methods*. Museo Tridentino di Scienze Naturali, Trento. Monografie del Museo Tridentino di Scienze Naturali, Trento. 350 pp.
- DAUTI E. 1980. Faunisticko Ekolosko istrazivanje Plecoptera na podrucju Kosova. *Doktorska disertacija, Prirodoslovno Matematički Fakultet Sveučilišta u Zagrebu*, University of Zagreb: 1-60.
- ERMAN N. A. & ERMAN D. C. 1995. Spring permanence, Trichoptera species richness and the role of drought. *Journal of the Kansas Entomological Society Supplement*. New York. **68**(2): 50–64.
- FERRINGTON Jr. L. C. 1995. Biodiversity of aquatic insects and other invertebrates in springs: Introduction. *Journal of the Kansas Entomological Society*. Special Publication. New York. **68**: 1-225.
- FISCHER J., FISCHER F., SCHNABEL S., BOHLE H. W. 1998. Spring fauna of the Hessian Mittelgebirge: Population structure, adaptative strategies, and relations to habitats of the macroinvertebrates, as exemplified by springs in the Rhenisch metamorphic shield and in the East-Hessian sandstone plate. In Botoşăneanu, L. (ed), *Studies in crenobiology. The Biology of Springs and Springbrooks*. Backhuys Publishers. Leiden: 182-199.
- GERECKE R. & FRANZ H. 2006. Quellen im Nationalpark Berchtesgaden. Lebensgemeinschaften als Indikatoren des Klimawandels. *Nationalparkverwaltung Berchtesgaden*. Forschungsbericht: 51.
- GERECKE R., HASEKE H., KLAUBER J., MARINGER A. 2012. Quellen. *Schriften des Nationalparks Gesäuse*. Band 7. Weng im Gesäuse: 7.
- GLÖER P. & PEŠIĆ V. 2014. Two new species of the genus *Bythi-nella* Moquin-Tandon, 1856 (Mollusca: Gastropoda: Hydrobiidae) from the Western Balkan Peninsula. *Ecologica Montenegrina*. University of Montenegro. **1**: 249–255.
- GROSSER K., PEŠIĆ V., BERLAJOLLI V., GLIGOROVIĆ B. 2016. *Glossiphonia balcanica* n. sp. and *Dina prokletijaca* n. sp. (Hirudinida: Glossiphoniidae, Erpobdellidae) - two new leeches from Montenegro and Kosovo. *Ecologica Montenegrina*. University of Montenegro. **8**: 17-26.

- IBRAHIMI H., KUČINIĆ M., GASHI A., GRAPCI-KOTORI L. 2014. Trichoptera Biodiversity of the Aegean and Adriatic Sea Basins in the Republic of Kosovo. *Journal of Insect Science*, Oxford University Press, University of Oxford. **14**: 1-8.
- ILLIES J. 1952. Die Mölle. Faunistisch-ökologische Untersuchungen an einem Forellenbach im Lipper Bergland. *Archiv für Hydrobiologie*. Berlin. **46**: 424-612.
- ILLIES J. & BOTOȘĂNEANU L. 1963. Problèmes et méthodes de la classification et de la zonation écologique des eaux courantes, considérées surtout du point de vue faunistique. *Mitteilungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie*, International Society of Limnology, Berlin. **12**: 1-57.
- MOLLUSCABASE 2021. MolluscaBase. *Bythinella drimica alba* Radoman, 1976. Accessed at: <http://www.molluscabase.org/aphia.php?p=taxdetails&id=827888> on (Accessed: December 12, 2022).
- MUJA-BAJRAKTARI N., ZHUSHI-ETEMI F., DIKOLLI-VELO E., KADRIAJ P., GUNAY F. 2019. The composition, diversity, and distribution of mosquito fauna (Diptera: Culicidae) in Kosovo. *Journal of Vector Ecology*. Wiley Press. Hoboken. **44**: 94-104.
- PEŠIĆ V., DMITROVIĆ D., SAVIĆ A., VON FUMETTI S. 2016. Studies on eucrenal-hypocrenal zonation of springs along the river mainstream: a case study of a karst canyon in Bosnia and Herzegovina. *Biologia*. De Gruyter, Berlin. **71**: 809-817.
- PŁÓCIENNIK M., BERLAJOLLI V., DMITROVIĆ D., GLIGOROVIĆ B., PESIĆ V., GADAWSKI P. 2023. The Chironomidae (Diptera) diversity in the Balkan Peninsula spring systems and other small water bodies. *International Journal of Limnology*, EDP Sciences, France. **59**: 6.
- SAMBUGAR B., DESSI G., SAPELZA A., STENICO A., THALER B., VENERI A. 2006. *Südtiroler Quellfauna*. (In German). Autonome Provinz Bozen. 365 pp.
- STOCH F., GERECKE R., PIERI V., ROSSETTI G., SAMBUGAR B. 2011. Exploring species distribution of spring meiofauna (Annelida, Acari, Crustacea) in the south-eastern Alps. *Journal of Limnology* **70**(SUPPL.): 65-76.
- SUTER D., KÜRY D., BALTES B., NAGEL P., LEIMGRUBER W. 2007. Kulturelle und soziale Hintergründe zu den Wahrnehmungsweisen on Wasserquellen. *Mitteilungen der Naturforschenden Gesellschaft beider Basel*. Binningen, **10**: 81-100.
- VINKO D., KULIJER D., ZHUSHI F., HOSTNIK M., ŠALAMUN A. 2020. *The first systematic survey of the dragonfly fauna of Kosovo*. The International Dragonfly Fund Report. Rheinfelden/Baden. 147 pp.
- VON FUMETTI S., DMITROVIĆ D., PEŠIĆ V. 2017. The influence of flooding and river connectivity on macroinvertebrate assemblages in rheocene springs along a third-order river. *Fundamental and Applied Limnology*. Schweizerbart Science Publishers. Nova Hedvigia. **190**: 251-263.
- WEBB D. W., WETZEL M. J., REED P. C., PHILIPPE L. R., YOUNG T. C. 1998. The macroinvertebrate biodiversity, water quality, and hydrogeology of ten karst springs in the Salem Plateau of Illinois. In: Botoșăneanu, L. (ed.), *Studies in crenobiology: the biology of springs and springbrooks*. Backhuys Publishers. Leiden: 39-48.
- WILLIAMS D. D. 1991. *The spring as an interface between groundwater and lotic faunas and as a tool in assessing groundwater quality*. Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie. Berlin. **24**: 1621 pp.
- WILLIAMS D. D. & DANKS H. V. 1991. *Arthropods of springs: introduction*. In: Arthropods of springs, with particular reference to Canada. (Eds. D. D. Williams & H. V. Danks): 3-5. Memoirs of the Entomological Society of Canada. Toronto. 155 pp.
- XËRXA B. L., SARTORI M., GASHI A., GATTOLLIAT J-L. 2019. First checklist of mayflies (Insecta, Ephemeroptera) from Kosovo. *ZooKeys*. Pensoft Publishers. Sofia. **874**: 69-82.

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