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Ostracoda in South-eastern Alps (Slovenia): assemblages in ground waters, springs and adjacent spring brooks

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Slovenian Alps (southeastern Alps) are composed of carbonate rocks, predominantly Triassic age limestone with some dolomite and dolomitize limestone. The area is well karstified with highly permeable karst-fissured aquifers. The biodiversity of alpine ground waters is poorly investigated in Slovenia, and little is known about meiofauna living in springs and spring brooks of Slovenian Alps. In this presentation we provide first data on occurrence of ostracodes inhabiting three connected habitats in Slovenian Alps: spring mouths (*eucrenon*), ground waters that fed those springs and spring brooks (*hypocrenon*) that are fed by springs. The aim of the study is to gain new knowledge about ecology and distribution of ostracods living in alpine surface and ground waters and to demonstrate if spring assemblages of ostracodes reflect the transitional nature of springs as border habitats between ground waters and streams.

Within the Alpine region of Slovenia, three mountain ranges (the Julian Alps, Karavanke and Kamniško-Savinjske Alps) are spreading from the northwest to the northeast of the country. 4 springs were selected within each mountain range and sampled three times over a year 2009 (Fig. 1).

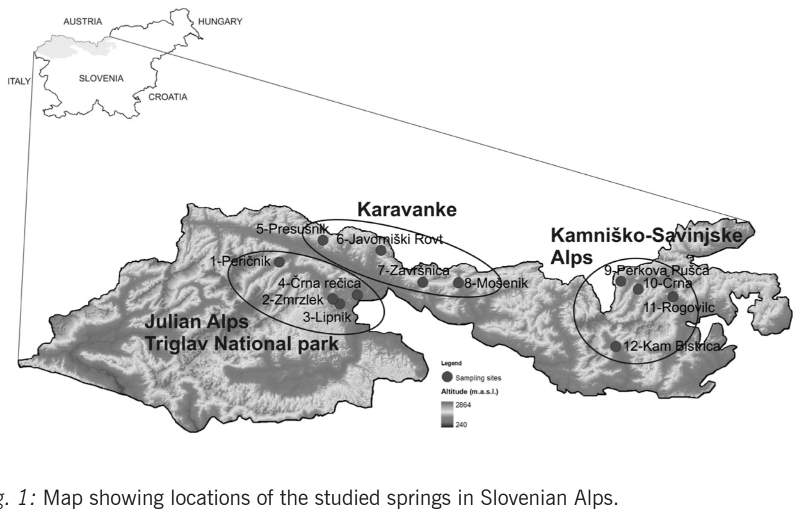

Fig. 1: Map showing locations of the studied springs in Slovenian Alps.

The majority of springs are situated along deep, narrow Alpine valleys at altitudes from 645 to 941 m. Three of them are emerging higher on the slopes with altitudes of 1107–1236 m. Temperature, conductivity, and oxygen were measured in the field and water samples were taken to the laboratory to be analysed for major ions. Flow velocity, discharge and substrate composition were also estimated in the field. Drift (24 hours), benthos in spring mouths (*eucrenon*) and spring brooks (*hypocrenon*) were sampled in June, August and November 2009 using 0.1 mm mesh net.

The all springs are surrounded by forests and are rheocrenes. Flow rates were between 0.1 and 1.2 ms^{-1}. The substrate of the spring mouth was similar, with the prevalence of gravel and cobbles. The temperature of spring water varied between 4.9 and 10.2°C. The spring water was well oxygenated (8.5–11.7 mg l^{-1}). The physical and chemical characteristics of the water in spring brook (up to 5 m away from the spring mouth) did not differ from the water flowing out of the spring mouth.

We collected altogether 17 ostracod species. 12 species were found in drift samples, 4 in spring mouths and 11 species in spring brooks (Tab. 1).

Site	drift	spring	spring brook
Mixtacandona sp. B (trapezoid shape)	341	4	9
Cavernocypris subterranea (Wolf, 1920)	168	98	11
Psychrodromus fontinalis (Wolf, 1920)	8	10	189
Mixtacandona n.sp. (beak shape)	147	4	1
Fabaeformiscandona cf. *brisiaca* (Klie, 1938)	73		
Mixtacandona cf. *laisi* (Klie, 1938)	43		
Potamocypris zschokkei (Kaufmann, 1900)	20		
Mixtacandona sp. C (oval shape)	9		
Mixtacandona cf. *stammeri* (Klie 1938)	3		
Cryptocandona vavrai Kaufmann, 1900	1		
Fabaeformiscandona breuili (Paris, 1920)	21		2
Fabaeformiscandona sp. A (with hump)	1		2
Potamocypris fulva (Brady, 1868)			3
Fabaeformiscandona cf. *latens* (Klie, 1940)			3
Potamocypris pallida Alm, 1914			2
Eucypris pigra (Fischer, 1851)			1
Fabaeformiscandona sp. B (G2 long)			1

Tab. 1: List of Ostracoda species collected in drift, spring mouths and spring brooks of Slovenian Alps.

Out of these, one species (*Potamocypris pallida* Alm, 1914) is new record for Slovenia. Further, in one spring (in the Julian Alps) we collected species of *Mixtacandona*, which is most probably a new species (Fig. 2). In drift samples, genus *Mixtacandona* and *Fabaeformiscandona* were prevailing, while in spring brooks genus *Fabaeformiscandona* Krstic, 1972 and *Potamocypris* Brady 1870 were predominating.

In springs (*eucrenon*) we collected only four species, two of them with wide distributional patterns (*Cavernocypris subterranea* (Wolf, 1920) and *Psychrodromus fontinalis* (Wolf, 1920)), while the other two were species of the genus *Mixtacandona*. We collected *C. subterranea* from all 12 springs. The species was more abundant in ground waters, but occurred with high abundances also in *eucrenon*. On the contrary, *P. fontinalis* was found only in 6 springs and was more abundant in spring brooks but occurred also in drift and springs. *C. subterranea* was reported to be widely distributed throughout Europe and was frequently collected in surface and underground waters (Meisch 2000). *P. fontinalis* was reported to be less common than the former across Europe, but often co-occuring with *C. subterranea* in spring brooks (Meisch 2000). The two *Mixtacandona* species were collected only in one spring from Julian Alps (Lipnik).

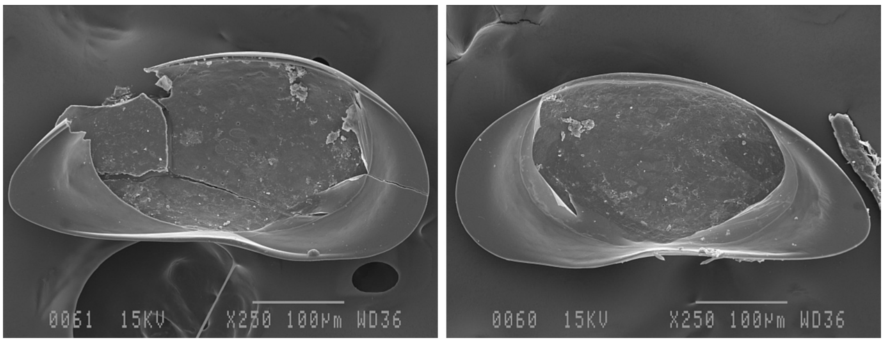

Fig. 2: LV int. (left photo) and RV int. (right photo) of *Mixtacandona* n. sp. collected from the spring Lipnik in the Julian Alps.

The groundwaters and headwater streams in Slovenian Alps seems rich in ostracodes while *eucrenon* (spring mouths) exhibited low ostracod diversity. One of the reasons could be that competition between species and special environmental conditions allows survival only of the most tolerant species, such as *C. subterranea* and *P. fontinalis*. However, this hypothesis needs to be tested on larger set of data. The majority of the species found in spring brooks in this study were recorded also in a study from Northern Italy, where they sampled meiofauna in 110 springs and they collected 18 species (Stoch et al. 2011). This indicates similar ostracod assemblages between those two regions.

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