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THE SPRINGTAILS (INSECTA: COLLEMBOLA) FAUNA AT DIFFERENT MICROHABITATS OF BEČIĆI BEACH, MONTENEGRO

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ABSTRACT

Collembola fauna has been investigated at different microhabitats near the beach in Bečići, Montenegro. Samples were collected from four locations: Hotel "Tara", "Sveti Toma" Church (St. Thomas), Hotel "Naftagas" and "Zelena Stena" (Green Rock). Each of the location presented different microhabitat: under the palm tree, cypresses tree, larch tree and white pine tree. Samples were taken in May and September 2015 and results presented as qualitative findings.

Total number of 30 Collembola species was identified, classified into six families and 17 genera. Representatives of the family Hypogastruridae and Isotomidae were recorded at all of the studied sites, while representatives of the families: Naenuridae, Onychiuridae, Entomobryidae and Sminthuridae were present on some of locations.

The biggest number of species and the highest Collembola population density was found at the Green Stone site, 24 species in total, microhabitat- white pine, and the smallest number of species, 6 on site "St. Thomas" Church, microhabitat- cypresses trees.

Keywords: Collembola, microhabitats, Bečići Beach, Montenegro.

INTRODUCTION

Springtails (Insecta: Collembola) communities have been shown to vary in abundance and species composition according to changes in vegetation and soil conditions (Hågvar, 1982; Ponge, 1993; Chagnon et al., 2000). Soil acidity, mainly through associated changes in food and habitat, but also through chemical composition or osmolarity of the soil solution may favor or disfavor some species (Hågvar & Abrahamsen, 1984; Vilkamaa & Huhta, 1986; Salmon & Ponge, 2002), and pH 5 has been noted as a landmark between two distinct types of communities (Ponge, 1993). The opposition between grassland and woodland can also be traced by the species composition of springtails population (Gisin, 1943; Rusek, 1989; Ponge, 1993). As a whole, Collembola are highly tolerant to a wide range of environmental conditions, including agricultural and industrial pollution, but species differ in their sensitivity to environmental stress (Lebrun, 1976; Prasse, 1985; Sterzyńska, 1990).

The springtails biodiversity in Montenegro is poorly investigated. Till now the Collembola fauna was studied in the surrounding area of fishing village Bigova, on the south coast of Trašte Bay. A total number of 16 Collembola species was noted classified in 5 families and 11 genera (Bogojević, 1978).

Collembolan fauna of Yugoslavia (Serbia and Montenegro) is a rich and diverse; total number of 233 species is known in Serbia. They are classified in 43 genera and 5 families. 89 species were recorded. In Montenegro classified in 10 genera and 7 families. 28 species and subspecies are endemic for Serbia (12,02%) and 11 for Montenegro (12,36%). Most of the endemic and relict forms live in caves, but some of them inhabits forests and cultivated steppe. Two centers of endemic Collembola differentiations are recognized in Yugoslavia: northern and eastern part (eastern Serbia) and the second one in the south and west (Montenegro, western and south-western Serbia) (Ćurčić & Lučić, 1997). According to Ćurčić et al., (2008), 8 springtails cave species have been recorded in Montenegro.

The aim of this study is to identify and evaluate collembolan fauna in selected microhabitat that are situated near the Bečići Beach and mostly under influence of human activities.

MATERIAL AND METHODS

The collembolan specimens concidered herein were collected in the region of Bečići Beach (Figure 1), Montenegro from four different microhabitats.

Samples were taken from four locations: Hotel "Tara", Church "Sveti Toma" (St. Thomas), Hotel "Naftagas" and "Zelena Stena" (Green Rock) and from four different microhabitats. On the first site, sampling was done under the palm tree (*Phoenix canariensis* Chabaud). This site is under the firm influence of human activities. These include regular grass cutting, watering and probably occasional fertilization. On the second site samples were taken under the cypresses tree (*Cupressus sempervirens* L.). This sampling spot if facing south and exposed to the direct sun influence. On the third site, samples were taken from two microhabitats: under the larch tree (*Larix decidua* Mill.) and white pine (*Pinus sylvestris* L.) and on

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the fourth site under the white pine tree pine (*Pinus sylvestris* L.). Samples were taken in May, during the rainy season and September 2015, after the drought season for each location, and results were presented as qualitative findings.

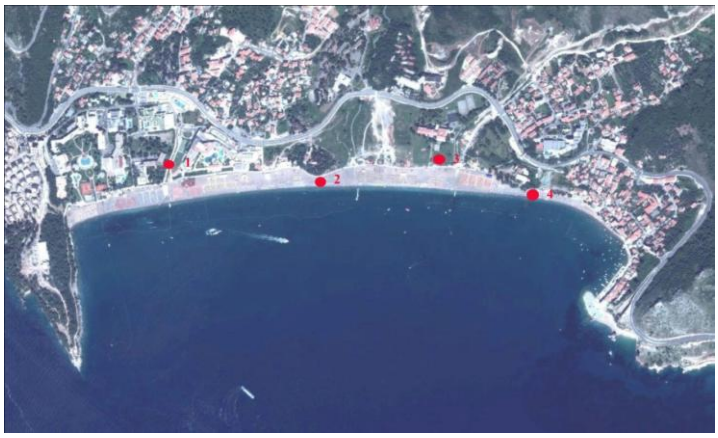

Figure 1. Bečići Beach with studied sites: 1. Hotel "Tara", 2. "St. Thomas" Church, 3. Hotel "Naftagas", 4. Green Stone.

Total number of 8 samples was collected. The soil samples, all together with leaf-litter was dimension 10X10X 10cm. Soil animals were separated using modified Berlese-Tullgren funnel. Collembola specimens were separated and preserved in 75% ethyl-alcohol with few drops of glycerin. The slides were mounted in DPX. It was studied using KRŰSS MML 1204 (400X magnification) and TENSION EUMC 1600 (1000X magnification) microscopes. Identification was done using following dichotomous keys: Gisin (1960), Stach (1956), Stach (1960), Stach (1963) and Bellinger et al., (2015) Checklist of the Collembola of the world. Available from http:/www.collembola.org.

Specimens at the present are deposited in the collection of the Faculty of Sciences and Mathematics, University of Priština with settlement in Kosovska Mitrovica.

RESULTS AND DISCUSSION

Total number of 30 species of Collembola were identified, classified into six families and 17 genera at all of four investigated sites. (Table 1).

Site 1- „Tara" Hotel

Site is situated nearby, Tara" Hotel in Boreti, coordinates N: 42.282628, E: 18.863026. The microhabitat investigated here was the area surrounding the palm tree *Phoenix canariensis*. This site is under the firm influence of human activities with shallow and hard soil with little litter. These include regular grass cutting, watering and probably occasional fertilization. Beside several species of mites and spiders, we have identified 11 Collembola species: *Neanura muscorum* MacGillivray, 1893, *Bilobella mahunkai* Danyi, 2010, *Anurida maritima* Guérin-Méneville, 1836, *Hypogastrura viatica* Tullberg, 1872, *H. distincta* Axelson, 1902, *Onychiurus sp.*, *Isotomurus alticolus* Handschin, 1919, *Isotomurus italicus* Carapelli, A., Frati, F., Fanciulli, P.P. et Dallai, R., 1995, *I. stuxbergi* Tullberg, 1877, *Isotoma riparia* Nicolet, 1842, and *Entomobrya multifasciata* Tullberg, 1821. The abundance of the collembolan community was very low. A total of 38 collembolan individuals were counted in both samples with the dominance of *Isotomurus* genera.

Mites and spiders were abundant in the sample, and few insects' larvae were present.

Site 2- "St. Thomas" Church

Site 2 was chosen as specific place with cypresses trees community, coordinates: N: 42.281302, E: 18.870366. There is no significant human activities in the sense of grass cutting, watering, fertilization, etc.. The sampling spot is facing south and thus exposed to the direct sun influence and very close to the beach itself. The halophyte-psammophyte vegetation was present and tipical foredune zone. Total number of 6 springtails species was identified: *Hypogastrura viatica* Tullberg, 1872, *H. distincta* Axelson, 1902, *H. purpurescens* Lubbock, 1870, *Onychiurus sp.*, *Isotomurus alticolus* Handschin, 1919 and *Sminthurus hispanicus* Nayrolles, 1995. Collembolan community was abundant, with the highest diversity, richness and equitability of species from Hypogastrura family that is in compliance with Fernandes et al., (2009) for foredune zone.

There were very few mites and spiders present in the sample. One representative of Scorpiones order and one of Pseudoscorpiones order were present. *Polyxenus lagurus* L., 1758 (Diplopoda) has also been identified in this sample.

Site 3- "Naftagas" Hotel

Site 3 is located nearby "Naftagas" Hotel in Bečići, coordinates: N: 42.282234, E: 18.874273. Two different microhabitats were investigated at this site: under the larch tree and white pine tree. The larch tree microhabitat was similar to the site 1 and 7 collembolan species were common for these two sites (Table 1). The soil was hard with little litter. 9 collembolan species have been identified at this spot: *Hypogastrura viatica* Tullberg, 1872, *H. purpurescens* Lubbock, 1870,, *Isotomurus alticolus* Handschin, 1919, *I. fucicolus* Axelson, 1906, *I. italicus* Carapelli, A., Frati, F., Fanciulli, P.P. et Dallai, R., 1995, *I. stuxbergi* Tullberg, 1877, *Folsomia quadrioculata* Tullberg, 1871, *Entomobrya multifasciata* Tullberg, 1821 and *Cyphoderus bidenticulatus* Börner, 1903 with the dominance of species from *Isotomurus* genera. From the same site, but second microhabitat-under the white pine tree, similar to the "Green Stone" site, but not so close to the beach, 12 collembolan species have been identified: *Neanura muscorum* MacGillivray, 1893, *Pseudachorutes parvulus* Börner, 1901, *Hypogastrura viatica* Tullberg, 1872,, *H. distincta* Axelson, 1902,, *H. purpurescens* Lubbock, 1870 , *Onychiurus sp.*, *Isotomurus alticolus* Handschin, 1919, *I. fucicolus* Axelson, 1906, *I. italicus* Carapelli, A., Frati, F., Fanciulli, P.P. et Dallai, R., 1995, *I. stuxbergi* Tullberg, 1877, *Entomobrya muscorum* Nicolet, 1842 and *E. nicoleti* Lubbock, 1870. 10 species were common with site 4 with the same

microhabitat. Total number of (Table 1) the species identified was 15 for both microhabitats, out of which six were common.

Table 1. Collembola species on studied sites at Bečići beach

Collembola / Sites		"Tara" Hotel Palm tree	"St. Thomas" Cypresses tree	"Naftagas" Hotel White pine tree	"Naftagas" Hotel Larch tree	Green Rock White pine tree
Familia	Species					
Neanuridae Börner, 1901	*Neanura muscorum* MacGillivray, 1893	+		+		+
	Bilobella mahunkai Danyi, 2010	+				
	Anurida maritima Guérin-Méneville, 1836	+				+
	Anurida granaria, Tullberg, 1869					+
	Pseudachorutes palmiensis Börner, 1903					+
	Pseudachorutes parvulus Börner, 1901			+		
	Xenylla grisea Axelson, 1900					+
	Xenylla maritima Tullberg, 1896					+
Hypogastruridae Börner, 1901	*Ceratophysella bengtssoni* Ågren, 1904					+
	Ceratophysella succinea Gisin, 1949					+
	Hypogastrura viatica Tullberg, 1872	+	+	+	+	+
	Hypogastrura distincta Axelson, 1902	+	+	+		+
	Hypogastrura purpurescens Lubbock, 1870		+	+	+	+
Onychiuridae Lubbock, 1876	*Onychiurus sp.*	+	+	+		
Isotomidae Schäffer, 1896	*Isotomurus alticolus* Handschin, 1919	+	+	+	+	+
	Isotomurus fucicolus Axelson, 1906			+	+	+
	Isotomurus italicus Carapelli, A., Frati, F., Fanciulli, P.P. et Dallai, R., 1995	+		+	+	+
	Isotomurus stuxbergi Tullberg, 1877	+		+	+	+
	Isotoma riparia Nicolet, 1842	+				+
	Isotoma viridis Bourlet, 1839					+
	Folsomia quadrioculata Tullberg, 1871				+	
Entomobryidae Schäffer, 1896	*Orchesella flavescens* Bourlet, 1839					+
	Entomobrya muscorum Nicolet, 1842			+		+
	Entomobrya albanica Stach, 1922					+
	Entomobrya multifasciata Tullberg, 1821	+			+	
	Entomobrya nicoleti Lubbock, 1870			+		+
	Lepydocyrtus lusitanicus da Gama, 1964					+
	Cyphoderus bidenticulatus Börner, 1903				+	
Sminthuriade Lubbock, 1862	*Sminthurus hispanicus* Nayrolles, 1995		+			+
	Arropalithes caecus Tullberg, 1871					+

Under the white pine tree, two specimen of *Polyxenus lagurus* L., 1758 (Diplopoda) were registered, and abundant communities of ants, mites and insects' larvae.

Site 4- Green Stone

This site is situated close to popular place on Bečići Beach, so called „Green Stone", coordinates: N: 42.280915, E: 18.878272. The microhabitat chosen for this site was under the white pine tree with humusly soil covered with litter in deep shadow. In the time of sampling, the site was fenced in order to protect construction works that haven't started at the time of sampling. Following springatils have been indentifid at this site: *Neanura muscorum* MacGillivray, 1893, *Anurida maritima* Guérin-Méneville, 1836, *A. granaria* Tullberg, 1869 *Pseudachorutes palmiensis* Börner, 1903, *Xenylla grisea* Axelson, 1900 *Xenylla maritima* Tullberg, 1896, *Ceratophysella bengtssoni* Ågren, 1904, *C. succinea* Gisin, 1949, *Hypogastrura viatica* Tullberg, 1872, *H. distincta* Axelson, 1902, *H. purpurescens* Lubbock, 1870, *Isotomurus alticolus* Handschin, 1919, *I. fucicolus* Axelson, 1906, *I. italicus* Carapelli, A., Frati, F., Fanciulli, P.P. et Dallai, R., 1995, *I. stuxbergi* Tullberg, 1877, *Isotoma riparia* Nicolet, 1842, *Isotoma viridis* Bourlet, 1839, *Orchesella flavescens* Bourlet, 1839, *Entomobrya muscorum* Nicolet, 1842, *E. albanica* Stach, 1922, *E. nicoleti* Lubbock, 1870 , *Lepydocyrtus lusitanicus* da Gama, 1964, *Sminthurus hispanicus* Nayrolles, 1995 and *Arropalithes caecus* Tullberg, 1871, 24 species in total. Species from *Hypogastrura* genera were numerous, but there were also many individuals from *Isotomurus* genera at the site, with no domination of certain groups.

There were poor communities of other expected biological groups, as recorded on the previously sites; mites were present, but with small abundance.

CONCLUSION

The springtails (Insecta: Collembola) fauna has been investigated during May and September 2015 in at specific microhabitats near by Bečići Beach, Montenegro. Total number of 30 species out from 17 genera and 6 families have been recorded at four investigated sites.

The „Green Stone" site had the reachest springtail diversity, with 24 species recorded. The poorest community was recorded at "St. Thomas" Church site, 6 species in total.. At the same time, population density was high, predominated by representatives of the Hypogastruridae family. 11 species were recorded at „Tara" Hotel site. The soil at the sampling site was shallow and hard, with occasional watering of the palm trees during the drought. Diverse community was recorded at the „Naftagas" Hotel site with 15 recorded species, out of which six were common at both investigated microhabitats.

Hypogastruridae family had the biggest share in the Collembola community at the all of studied sites.. At the "Green Stone" site, although the richest with the number of the species, no group was dominant, but the community was unified.

Representatives of the family Hypogastruridae and Isotomidae were recorded at all of the studied sites, while representatives of the families: Naenuridae, Onychiuridae, Entomobryidae and Sminthuridae were present on some of locations.

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