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Cave Invertebrates in Ponor Special Protection Area (Natura 2000), Western Bulgaria: Faunistic Diversity and Conservation Significance

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Abstract: Ponor Special Protection Area is one of the richest in caves areas in Bulgaria, with more than 70 horizontal and vertical caves hitherto known from its territory. Caves are scattered all over the mountain, but the regions of Tserovo, Zimevitsa, Iskrets-Breze-Dobravitsa and Gintsi are richest and form specific karst regions within the mountain. A total of 20 caves have up to now been explored from biospeleological point of view, in which 119 species of invertebrate animals are found. The places with the highest number of cave invertebrates with conservation value are: cave Dushinka near of Iskrets, cave Vodnata Peshtera near the Tserovo, as well as Dinevata, Svetata Voda and Krivata Pesht caves near the Gintsi. The Mesovoid Shallow Stratum (M.S.S.) is entirely unexplored. The paper summarizes also the agricultural practices that are harmful to the cave fauna, such as: dumping of garbage and carcasses of dead animals in precipices and caves; using the caves as storage places, dairy farms, mushroom cellars, or pens; pouring out of chemicals, as well as raw sewage or polluted water in precipices and whirlpools; excessive use of nitrogen fertilizers on the agricultural lands in the watersheds of karst springs. The endemic cave-dwellers *Typhloiulus bureschi*, *Paranemastoma bureschi*, *Pheggomisetes globiceps*, *Plusiocampa bureschi*, *Niphargus bureschi* and *Bureschia bulgarica* could be used as indicators for bio-monitoring and assessment of the effect of applied agro-ecological measures in the area.

Keywords: assessment, troglobites, bio-indicators, biospeleology

Introduction

The caves in Ponor Special Protection Area (Ponor SPA) are comparatively well studied in biospeleological aspect (Beron 1994, 2007; Guéorguiev, Beron 1962; Pandrurski 2000, 2007; Evtimova *et al*. 2009; Petrov *et al.* 2014). The abundance of karst forms (Tzonev *et al*. 2014) has for a long time provoked the interest of speleologists, while the proximity of the mountain to Sofia had facilitated its study. Cave Dushnika near the village of Iskrets, cave Vodnata near Tserovo and cave Tsarkveto near Breze are among the first caves in Bulgaria that have been studied by biologists Buresch (1926).

Ponor Mountain is situated some 60 km to the north of the Bulgarian capital Sofia, forming the central part of the Western Stara planina Mountain range, between Petrohan Pass and Iskar Gorge. Geologically, Ponor Mountain is formed mainly by Triassic and Jurassic limestones and dolomites. The mountain has the shape of a rectangle stretching from West to East 23-25 km and from North to

South about 15 km. Its ridge is broad and flat, located about 1400 meters above sea level. The highest point is Mount Sarbenitsa (1481.6 meters), located in its eastern part (Neykovski, Stoitsev, 1975, Haydutov *et al.* 1995, Petrov *et al*. 2014). There are more than 70 horizontal and vertical caves discovered till now in Ponor SPA. They are scattered all over the mountain and form the cave regions (from east to west) – Tserovo, Zimevitsa, Iskrets-Breze-Dobravitsa and Gintsi. Fewer in number, but sometimes richer in cave fauna, are the caves near the villages of Mecha Polyana, Zasele, Zanoge and the station of Lakatnik. Twenty caves have been studied in biospeleological aspect and there have been recorded 119 species of invertebrates, out of which 36 troglobites[1] (Beron 1994; Guéorguiev, Beron 1962; Pandrurski 2000, 2007; Evtimova *et al*. 2009). In spite of its small size, Ponor SPA is among the richest in cave animals areas in the country, comparable only with the neighbouring Vrachanska Mountain. However, still almost two-thirds of the caves in Ponor SPA have not been studied in biospeleological aspect. From a total of 21 caves around the village of Zimevitsa, only four have been prospected and that only marginally. The same is also true for the region of Tserovo where the data is available only for five caves. Regarding the degree of knowledge, it could be stated that only the water crustaceans (Copepoda) have been studied in detail (Pandrurski 2000, 2007, Evtimova *et al.* 2009). The cave isopods (Isopoda), spiders (Araneae), harvestmen (Opiliones), centipedes and millipedes (Chilopoda and Diplopoda), flies (Diptera) as well as ground beetles (Coleoptera: Carabidae) are studied to an average degree (Beron 1994; Deltshev 1988; Deltshev *et al*. 2003; Stoev 2001, 2004). The cave insects of the orders Collembola and Diplura, the family Leiodidae (Coleoptera), false scorpions (Pseudoscorpiones), mites (Acari), amphipods (Amphipoda), snails (Gastropoda) and leeches (Hirudinea) are as a whole very poorly known. Mesovoid Shallow Stratum (M.S.S.) is entirely unexplored (Deltshev *et al*. 2011). The knowledge on the biology and ecology of the cave animals is limited. The research done up to the moment covers primarily faunistic and taxonomic aspects of the cave biota.

The aim of this study is to present a review of the invertebrate fauna from the caves of Ponor SPA and its conservation significance on the basis of the critical incorporation of available literature data and new faunistic records carried out by research in the last 5 years.

[1] Here as well as in many other places in this text the term is used in its wider meaning, i.e. it includes the terrestrial as well as the aquatic (stygobites) cave invertebrates.

Materials and methods

The material treated herein comes from two major sources. The first part comprises critical incorporation of all available literature records concerning the distribution of invertebrates found in the caves of Ponor SPA. We also incorporated data deriving from recent collecting conducted in the caves of the region (Fig. 1, Table 2). The invertebrates have been collected mainly by hand, from the walls, under stones or from the clayish layers and water areas in the caves. The material is deposited in the National Museum of Natural History, Bulgarian Academy of Sciences (Sofia).

Results and discussion

Assessment and conservation significance of invertebrates in the caves of Ponor SPA

From altogether 119 cave animals so far known from the area, 41 species and subspecies (Tables 1, 2, Fig. 1) could be considered as significant from conservational point of view. They fall into the following categories: local endemics (species which occur only in Ponor SPA and nowhere else), regional endemics (species inhabiting Ponor SPA and adjacent regions), Bulgarian endemics (more or less widespread in the country), Balkan species (usually relict species that are found sporadically in different regions of the Balkan Peninsula) and rare species.

The places with the highest concentration of conservation significant cave invertebrates in Ponor SPA are three: cave Dushnika near Iskrets, Vodnata Peshtera near Tserovo as well as the three horizontal caves near the village of Gintsi, i.e. Dinevata, Svetata Voda and Krivata Pesht. The biggest number of troglobites is established in Dushnika cave (17); 13 out of 27 species found in this cave are of conservation importance. These are: *Cavernisa zaschevi*, *Iglica acicularis, Diacyclops pelagonicus saetosus, Acanthocyclops propinquus, Speocyclops lindbergi, Maraenobiotus parainsignipes, Stygoelaphoidella elegans, Parastenocaris balcanica, Sphaeromides bureschi*, *Bureschia bulgarica, Niphargus bureschi, Paranemastoma bureschi, Balkanopetalum armatum, Nycteridopsylla trigona balcanica* and *Pheggomisetes globiceps globiceps.*

Forty-one invertebrate species live in Vodnata Peshtera cave near the village of Tserovo, ten being troglobites. In addition to the relicts *Sphaeromides bureschi* and *Bureschia bulgarica*, the cave is inhabited also by *Acanthocyclops radevi* and *Elaphoidella cavernicola*, which are endemics of the subterranean waters of Ponor SPA. The cave

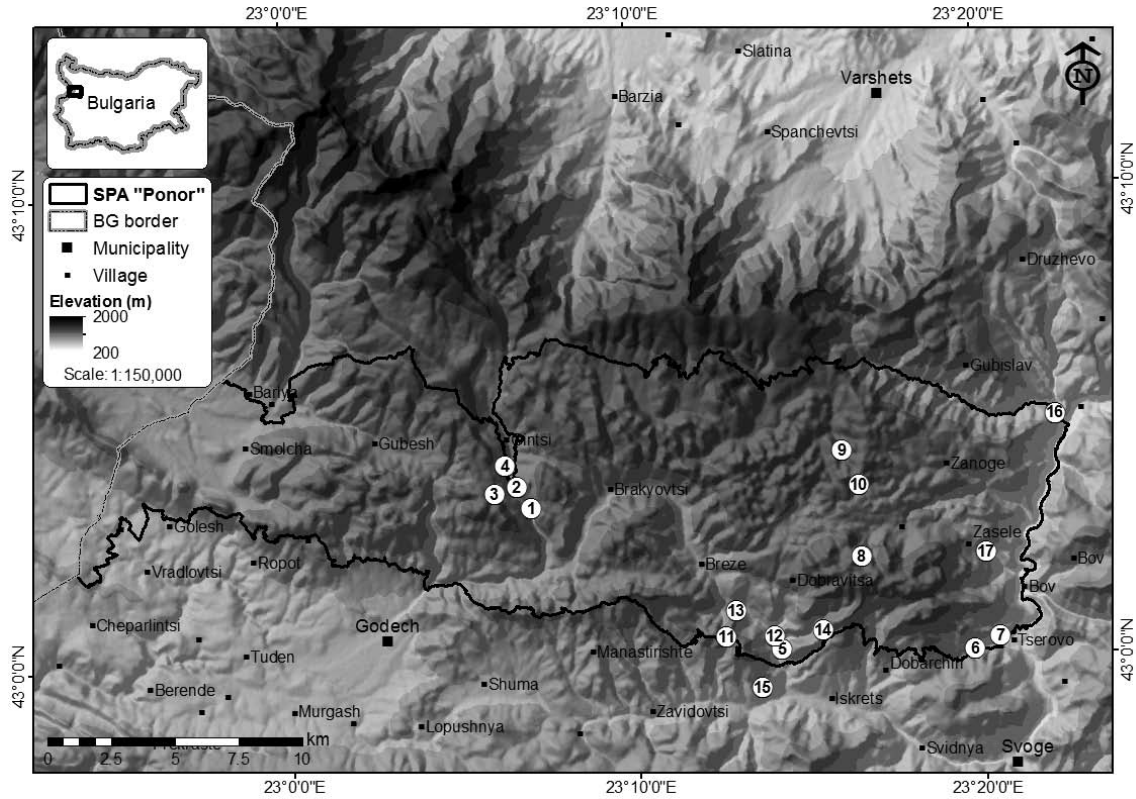

Fig. 1. Map of the conservation significant caves in Ponor Special Protection Area (the scale 1:150 000 refers to the map of Bulgaria in the upper left corner of figure; 1-17 – caves with conservation significant invertebrates as in Table 2)

is also the type locality of the biggest terrestrial troglobite in Bulgaria, the centipede *Eupolybothrus andreevi*. Special attention should be given to the three caves Dinevata, Svetata Voda and Krivata Pesht, which are situated close to each other in proximity to the village of Gintsi. They have been known to and actively studied by biospeleologists since 1939. Today there are 34 invertebrate species known to occur in these caves; among them, the Pleistocene relict cave leech *Dina absoloni* found also in caves in Bosnia and Herzegovina and Montenegro, as well as the local subspecies of the ground beetle *Pheggomisetes globiceps breiti*. Great attention should be given to the paleoendemic harvestman *Paralola buresi*, which up to this moment has been identified only in four caves in the region of the station of Lakatnik; one of the caves is within the borders of the Ponor SPA. Similar to *Paralola buresi*, the cave isopod *Sphaeromides bureschi* also has an ancient (probably Miocene) origin. The pot holes Elata, Kolkina Dupka and Katsite near the village of Zimevitsa are inhabited by 7 species of conservation value. Two such species are encountered in the cave Poroynata Dupka near the village of Zasele. A total of twelve conservation significant taxa live in the caves Padezh (Zli Vurtezh), Marina Dupka and Tsurkveto near Breze, 4 in Travninata near Dobravitsa, and 2 in Iskretskata Peshtera near Otechestvo (Table 2).

Evaluation and analysis of the agricultural activities, which affect the cave invertebrate fauna in the region

It is difficult to find a direct link between the agricultural activities and the caves and their fauna. Nevertheless, being often located in regions where active agricultural activity is carried out, one can fiund an indirect negative influence, and some of the main threats (bad practices) are listed below with concrete examples from the studied region:

1. Dumping of materials, consumer waste, dead or sick animals in caves and precipices. Very often the caves located in close proximity to settlements are used as dunghills. That is how they turn into centers of contagion, which could via the rain water seep be carried over a big area and thus cause contagious outbreaks. The pot hole Elata has been highly contaminated by tourists camping in it and by the waste dumped by locals there. Few years after it had been cleaned out by nature lovers, it was contaminated again (Dr. Vladimir Beshkov, personal observation).

2. Setting up shepherd's enclosures and lighting of fires in the entrance zones of the caves. Caves are often used by shepherds and tourists as shelters in

Table 1. Conservation significant cave invertebrates in Ponor Special Protection Area. Legend: BAE – species found is several cave regions in the Balkan Peninsula; BE – Bulgarian endemics; RE – Regional endemics; LOE – Local endemic; R – rare species; stygo- and troglobites are indicated in bold.

No	Species of conservation significance	Category
1.	Hirudinea: ***Dina absoloni* Johansson, 1913**	BAE
2.	Gastropoda: ***Cavernisa zaschevi* (Angelov, 1959)**	LOE
3.	Gastropoda: ***Iglica acicularis* Angelov, 1959**	LOE
4.	Gastropoda: *Deroceras bureschi* (H. Wagner, 1934)	BE
5.	Copepoda: ***Diacyclops pelagonicus saetosus* Pandourski, 1993**	LOE
6.	Copepoda: ***Acanthocyclops iskrecensis* Pandourski,1992**	RE
7.	Copepoda: ***Acanthocyclops radevi* Pandourski, 1993**	LOE
8.	Copepoda: ***Acanthocyclops reductus* (s.l.) (Chappuis, 1925)**	R
9.	Copepoda: ***Acanthocyclops propinquus* Plesa, 1957**	R
10.	Copepoda: ***Speocyclops lindbergi* Damian. 1957**	R
11.	Copepoda: ***Stygoelaphoidella elegans* Apostolov, 1991**	LOE
12.	Copepoda: ***Elaphoidella cavernicola* Apostolov, 1992**	RE
13.	Copepoda: ***Maraenobiotus bulbiseta* Bassamakov & Apostolov, 1989**	BE
14.	Copepoda: ***Maraenobiotus parainsignipes* Apostolov, 1991**	LOE
15.	Copepoda: ***Parastenocaris balcanica* Petkovski, 1959**	LOE
16.	Amphipoda: ***Niphargus bureschi* Fage, 1926**	BE
17.	Isopoda: ***Sphaeromides bureschi* Strouhal 1963**	LOE
18.	Isopoda: ***Balkanoniscus corniculatus* (Verhoeff, 1926)**	BE
19.	Isopoda: ***Bureschia bulgarica* Verhoeff, 1926**	BE
20.	Isopoda: ***Trichoniscus bureschi* Verhoeff, 1926**	BE
21.	Acari: ***Microtrombicula balcanica* Kolebinova 1982**	LOE
22.	Opiliones: ***Paralola buresi* Kratochvil, 1951**	RE
23.	Opiliones: ***Paranemastoma bureschi* (Roewer, 1926)**	RE
24.	Opiliones: *Paranemastoma radewi* (Roewer, 1926)	BE
25.	Araneae: *Antrohyphantes sofianus* (Drensky, 1931)	BE
26.	Araneae: *Cenromerus cavernarum* (L. Koch, 1872)	R – relict
27.	Chilopoda: ***Eupolybothrus cf. gloriastygis* (Absolon, 1916)**	BAE
28.	Chilopoda: ***Eupolybothrus andreevi* Matic, 1964**	LOE
29.	Diplopoda: ***Trachysphaera orghidani* (Tabacaru, 1958)**	R
30.	Diplopoda: *Balkanopetalum armatum* Verhoeff, 1926	RE
31.	Diplopoda: *Brachydesmus herzogowinensis* Verhoeff, 1897	LOE
32.	Diplopoda: ***Typhloiulus bureschi* Verhoeff, 1926**	BE
33.	Collembola: ***Pseudosinella duodecimocellata* Handschin, 1928**	BE
34.	Diplura: ***Plusiocampa bureschi* Silvestri, 1931**	BE
35.	Diplura: ***Plusiocampa* cf. *beroni* Bareth & Condé, 2002**	BE
36.	Siphonaptera: ***Nycteridopsylla trigona balcanica* Hurka, 1965**	RE
37.	Coleoptera: Carabidae: ***Pheggomisetes globiceps globiceps* Buresch, 1925**	LOE
38.	Coleoptera: Carabidae: ***Pheggomisetes globiceps breiti* Mandl, 1942**	LOE
39.	Coleoptera: Carabidae: ***Pheggomisetes globiceps stoicevi* V. Gueorguiev, 1964**	RE
40.	Coleoptera: Carabidae: ***Pheggomisetes globiceps lakatnicensis* Jeannel, 1928**	RE
41.	Coleoptera: Carabidae: ***Pheggomisetes globiceps cerovensis* V. Gueorguiev, 1964**	LOE

unfavorable weather conditions. Setting up fires in the entrance zones changes the microclimate in the caves and could cause serious damage to the fauna.

3. Blocking up the entrances of potholes with stones and branches. This malicious practice affects primarily cave bats but it is possible that it could affect in a negative way the invertebrate cave fauna, too. Various organic and non-organic substances penetrate the area through the cave entrances and serve as a food source for the cave dwellers. Obstructing the entrances disrupts the water and air flow in the caves which undoubtedly affects the fauna in a negative way.

4. Using the caves for commercial purposes (storehouses, dairy farms, restaurants, mushroom cellars, pens, etc.). This practice is especially harmful for the cave organisms as it often involves the introduction of various chemicals, organic and non-organic products, as well as an increase in the levels of disturbance of cave organisms. Using the caves for pens significantly changes the structure of the soil surface. Cave Travninata has often been used in the past as a temporary pen for sheep taken out to pasture.

5. Pouring out chemicals (paint, petrol, etc.), as well as raw sewage or highly polluted water

Table 2. A list of caves known to harbor the largest number of conservation significant invertebrates in Ponor Special Protection Area

No	Cave	Location	Species of conservation significance
1	Yamata	village of Gintsi	Diplopoda: *Typhloiulus bureschi*
2	Dineva Pesht	village of Gintsi	Hirudinea: *Dina absoloni* Copepoda: *Acanthocyclops iskrecensis* Amphipoda: *Niphargus bureschi* Opiliones: *Paranemastoma bureschi*, *P. radewi* Araneae: *Cenromerus cavernarum* Acari: *Microtrombicula balcanica* Coleoptera: Carabidae: *Pheggomisetes globiceps breiti*
3	Svetata Voda	village of Gintsi	Opiliones: *Paranemastoma radewi, P. bureschi* Coleoptera: Carabidae: *Pheggomisetes globiceps breiti*
4	Krivata Pesht	village of Gintsi	Opiliones: *Paranemastoma radewi, P. bureschi* Coleoptera: Carabidae: *Pheggomisetes globiceps breiti*
5	Dushnika	village of Iskrets	Gastropoda: *Cavernisa zaschevi*, *Iglica acicularis* Copepoda: *Diacyclops pelagonicus saetosus, Acanthocyclops propinquus, Speocyclops lindbergi, Maraenobiotus parainsignipes, Stygoelaphoidella elegans, Parastenocaris balcanica* Isopoda: *Sphaeromides bureschi*, *Bureschia bulgarica* Amphipoda: *Niphargus bureschi* Opiliones: *Paranemastoma bureschi* Diplopoda: *Balkanopetalum armatum* Siphonaptera: *Nycteridopsylla trigona balcanica* Coleoptera: Carabidae: *Pheggomisetes globiceps globiceps*
6	Yamata	village of Tserovo	Gastropoda: *Cavernisa zaschevi* Copepoda: *Acanthocyclops radevi, Elaphoidella cavernicola* Isopoda: *Balkanoniscus corniculatus* Coleoptera: Carabidae: *Pheggomisetes globiceps cerovensis*
7	Vodnata Peshtera	village of Tserovo	Gastropoda: *Cavernisa zaschevi* Copepoda: *Acanthocyclops radevi, Elaphoidella cavernicola* Isopoda: *Sphaeromides bureschi, Bureschia bulgarica, Trichoniscus bureschi* Aphipoda: *Niphargus bureschi* Opiliones: *Paranemastoma radewi, P. bureschi* Chilopoda: *Eupolybothrus andreevi* Diplopoda: *Balkanopetalum armatum, Typhloiulus bureschi* Diplura: *Plusiocampa bureschi*

Table 2. Continued

No	Cave	Location	Species of conservation significance
8	Elata	village of Zimevitsa	Copepoda: *Acanthocyclops iskrecensis* Amphipoda: *Niphargus bureschi* Opiliones: *Paranemastoma radewi, P. bureschi* Coleoptera: Carabidae: *Pheggomisetes globiceps stoicevi*
9	Katsite	village of Zimevitsa	Copepoda: *Acanthocyclops iskrecensis* Amphipoda: *Niphargus* sp. Opiliones: *Paranemastoma bureschi*
10	Kolkina Dupka	village of Zimevitsa	Coleoptera: Carabidae: *Pheggomisetes globiceps lakatnicensis*
11	Padezh (Zli Vyrtezh)	village of Breze	Gastropoda: *Deroceras bureschi* Araneae: *Antrohyphantes sofianus* Diplopoda: *Typhloiulus bureschi* Collembola: *Pseudosinella duodecimocellata* Diplura: *Plusiocampa* cf. *beroni*
12	Tsarkveto	village of Breze	Copepoda: *Stygoelaphoidella elegans, Speocyclops lindbergi* Araneae: *Antrohyphantes sofianus* Diplopoda: *Typhloiulus bureschi* Chilopoda: *Eupolybothrus* cf. *gloriastygis*
13	Marina Dupka	village of Breze	Copepoda: *Stygoelaphoidella elegans*, *Speocyclops lindbergi*, *Acanthocyclops reductus* (s.l.) Opiliones: *Paranemastoma radewi* Diplopoda: *Brachydesmus herzogowinensis reflexus, Typhloiulus burschi*
14	Travninata	village of Dobravitsa	Copepoda: *Speocyclops lindbergi* Amphipoda: *Niphargus bureschi* Opiliones: *Paranemastoma radewi* Diplura: *Plusiocampa bureschi*
15	Otechestvo	village of Iskrets	Opiliones: *Paranemastoma bureschi* Coleoptera: Carabidae: *Pheggomisetes globiceps globiceps*
16	Kozarskata Peshtera	station of Lakatnik	Copepoda: *Maraenobiotus bulbiseta* Opiliones: *Paralola buresi* Diplopoda: *Trachysphaera orghidani* Diplura: *Plusiocampa bureschi*
17	Poroynata Dupka	village of Zasele	Opiliones: *Paranemastoma radewi, P. bureschi*

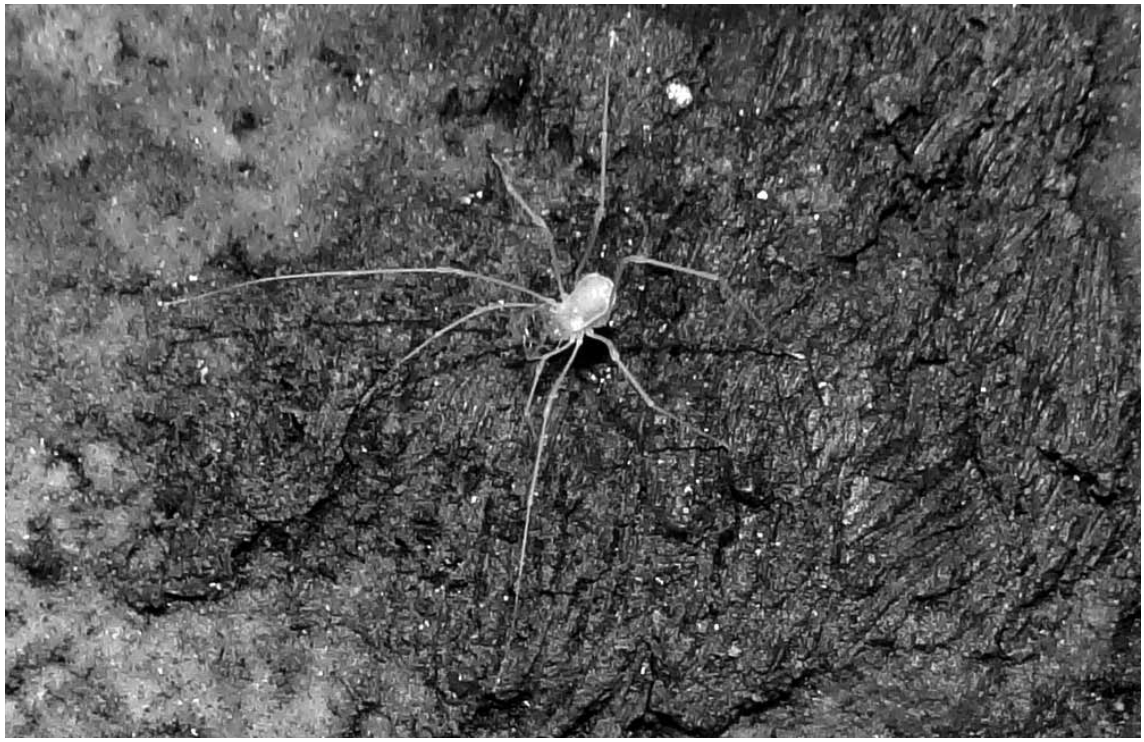

Fig. 2. *Paralola buresi*, photography by B. Petrov

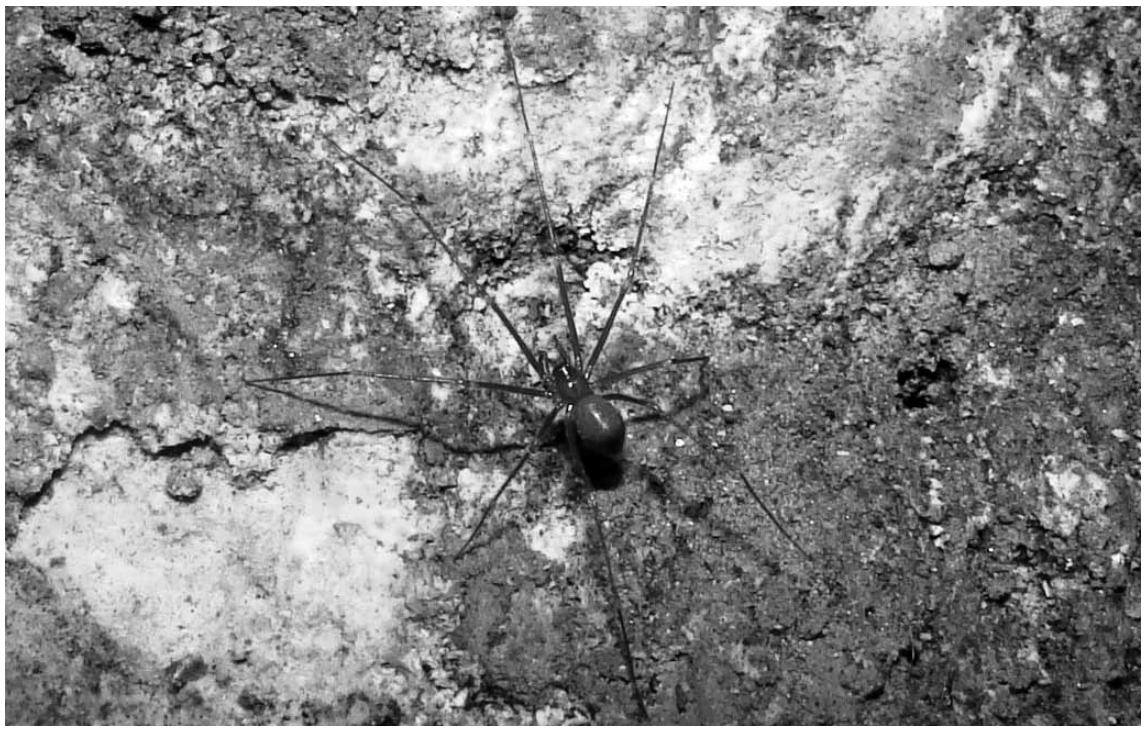

Fig. 3. *Antrohyphantes sofianus*, photography by B. Petrov

in precipices or whirlpools. The practice of pouring out chemicals is not only harmful to the cave fauna but to all organisms in the region as a whole. Such toxic materials are easily dispersed through underground waterways at big distances and sometimes contaminate drinking water, which could affect large areas and a big number of people and animals. Such case of pollution has already been registered in Ponor SPA. At the occasion of washing up and changing the oil of a tractor in the region of Magareshnitsite the contaminated water has flown out from the spring at the waterfall of Skaklya near

Fig. 4. *Pheggomisetes buresi*, photography by B. Petrov

the village of Zasele. The contaminated water has run for 6-7 km underground (Dr. Vladimir Beshkov, personal observation). Another case of pouring out raw sewage from a cow farms in the region of Studena Reka directly into a sinkhole situated nearby was registered in the 1980s. The cowsheds do not exist anymore and the contamination of underground water has reduced (Dr. Ivan Pandourski, personal observation).

6. Execution of uncontrolled logging and deforestation of big territories. It has been proven that forests retain rain water and contribute to its transposition to the lower soil layers and from there the water reaches the subterranean cavities. In cases of erosion on hills, rain water cannot be retained sufficiently. It flows down the surface and thus lowers the flow rate of karst springs in the region. The altered water balance significantly affects the cave fauna.

7. Excessive treatment with nitrogen fertilizers of agricultural areas situated in the watersheds of karst springs. This leads to an increase in the nitrate content of the water and has a significant impact on the aquatic cave fauna. Although to a smaller extent, the terrestrial cave animals could also be affected by contaminated water.

8. Reduction in the discharge of underground drainage caused by the use of a collective channel to lead underground water in a different direction. It is proven by experiments that the water from the sinkholes of the rivers Studena Reka, Perachka Bara and Ponor SPA supply the karst spring Iskretski, which is the biggest in maximum flow rate karst spring in Bulgaria (35 900 l/sec). After a collector drain was built in 1950s to convey north part of the water going down south from Koznitsa, its flow rate has reduced considerably. Although there is no specific research done, this change in the water balance has most probably affected negatively the populations of various cave organisms inhabiting the caves in the region.

9. Using bat guano for fertilization of agricultural areas. This practice exists in some regions in the country but it has not been registered till now on the territory of Ponor SPA.

Evaluation and analysis of the trends for a future change in the state of the populations of the cave invertebrates in the Ponor SPA due to agricultural activities

The aquatic cave organisms are those, which are mostly threatened by the existing agricultural practices as they could easily be exterminated by chemical pollution or by a change in underground rivers' natural paths. Dumping of chemicals in illegal dunghills around the villages or directly in the precipices and sinkholes is a common practice among the population of the country and could cause serious damage to the cave fauna. The fact that part of the water supplying the Iskretski karst spring has been conveyed in a different direction, causing a reduction in its flow rate, is especially disturbing. Although there is a lack of research, this has probably had negative effect on the populations of the cave aquatic organisms. Another serious threat to aquatic and terrestrial cave fauna is posed by the tree logging in the watersheds of the rivers passing through a specific cave region or through adjacent areas. Forests, especially those in karst mountains such as Ponor SPA serve to retain the water running off their surface and to maintain the

corresponding level of humidity in the caves under them, or they convey the water to the underground channels passing through them. Deforestation could have a significant influence on the whole cave fauna in a specific region and lead to its total destruction.

There is no research done in the country that could show the way agricultural activities influence cave animals. Our present knowledge is enough only to outline the potential threats of such practices and make a prediction on how they could affect the cave fauna. As far as the region of Ponor SPA is concerned, it should be noted that the diversion of underground water through a collective drain to the north has definitely had a negative effect. At the same time, the decrease of stock-breeding, thereby the practices of using caves as temporary shelters, as well as the reduced intensity in the cultivation of agricultural land, have probably had a positive impact. There are unpublished data that the population of *Pheggomisetes globiceps breiti* in the cave Dinevata peshtera has reduced in the last 40 years. Nowadays, the species is considerably rarer in the places where it has been frequently found in the 1960s and 1970s.

Biological monitoring by using cave invertebrates as indicators in long-term evaluation of the effect of agricultural activities

The stygobites *Niphargus bureschi* and *Bureschia bulgarica* are proper indicators for the evaluation of the results from the applied agro-ecological measures. These species are included in the National Biodiversity Monitoring System (NBMS). **The troglobite species *Typhloiulus bureschi, Paranemastoma bureschi, Pheggomisetes globiceps* and *Plusiocampa bureschi* can also be considered as suitable bioindicators**. The stygobites proposed for monitoring could be studied long-term following the scheme: two times a year – in March and September – water samples should be collected from caves Dushnika and Vodnata Peshtera, in order to assess any change in the number of *Bureschia bulgarica*. There are two ways of sampling – visual, i.e. number of species per linear metre of river (less precise) or the number of species caught with Tsvetkov's phreatic dipnet per specific volume of water which has passed through the net. It is advisable for the second stygobite species, *Niphargus bureschi*, samples to be taken from three sites in the mountain, so that the changes in the region could be completely covered. Samples with Tsvetkov's phreatic dipnet should be taken twice a year as well, in June and November, from caves Dinevata Peshtera, Travninata (or Elata) and Vodnata Peshtera near Tserovo.

Terrestrial species could be monitored through visual observations on the number of species in a specific stretch of explored caves. Another option is setting up baits (the most proper for the respective species) at specific places in the cave and their constant check-up. Different smelly food products could be used as lures. Most of the troglobites have highly developed olfactory organs and could easily allocate organic residues left in the cave. This is a reliable method to determine any changes in the number of the specific species. *Typhloiulus bureschi* could be monitored in the caves Tsarkveto and Vodnata Peshtera, *Paranemastoma bureschi* in Dinevata Pesht, Elata, Dushnika and Vodnata. The caves that are suitable for biomonitoring of *Pheggomisetes globiceps* are Dinevata Pesht, Elata, Dushnika and Yamata while for *Plusiocampa bureschi* these are Travninata, Vodnata and Kozarskata Peshtera.

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