

17 Terrestrial Cave Animals in Bulgaria

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Abstract: Karstic landscape cover about 22.7% of the Bulgarian territory, with more than 5000 caves and potholes. Regular exploration of the cave fauna of Bulgaria started in 1922, and by the end of 2005 more than 800 animal species have been reported from 780 caves. Troglomite and stygobite species are 167, most of them Bulgarian endemics. The most important groups are Diplopoda (54 spp, 17 troglomites), Coleoptera (123 spp, 41 troglomites), and others. Monograph on the cave fauna of Bulgaria is being prepared, containing all available data and bibliography of over 500 titles. Main centers of biospeleological studies are the National Museum of Natural History and the Institute of Zoology (Bulgarian Academy of Sciences)

1 Introduction

Bulgaria is situated in one of the richest regions housing cave animals, especially the terrestrial ones: the eastern part of the Balkan Peninsula. Bulgarian cave fauna has been explored very actively, mostly by the Bulgarian biospeleologists. This is due mainly to the solid tradition left by the school of Dr. Ivan Buresch but also to the well-developed speleology, traditionally centered on the scientific research and led by specialists from Bulgarian Academy of Sciences. Already for more than 80 years, Bulgarian biospeleologists explore the rich troglomite fauna of their country, its karst containing almost 5000 caves. The results have been put together by several authors and now form a very solid basis for zoogeographical analysis. Such analysis was undertaken by V. Guéorguiev (1977, 1992) and other specialists and continues further with the accumulation of new data.

2 Karst and Caves in Bulgaria

The following review is given according to the monograph “Caves and Speleology in Bulgaria” (Beron et al., 2006; based on the subdivision of Popov, 1970).

Karstic features are developed on 22.7% of Bulgarian territory (Popov, 1970), or 25, 171 km² (Fig. 1). According to Boyadjiev (1964), the karst areas occupy 15, 778 km²; however, as Popov (1970) stated, this figure did not include the buried karst. Together with this category, most of the karstified area belongs to Danubian Plain (66% of karst in Bulgaria). The least in karst representation is the Transitional

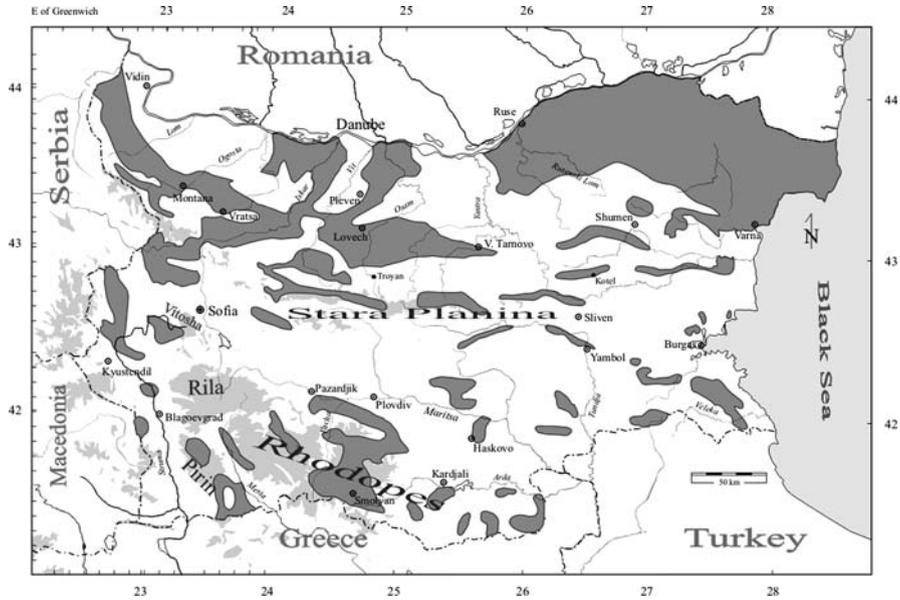


Fig. 1 Karstic areas in Bulgaria.

Geomorphological Region (6%). After many years of research, Vladimir Popov in 1968–1978 subdivided Bulgaria into four regions and 50 districts.

The Danubian Plain is subdivided into eight districts. Out of its extensive karst, 70% is buried karst (Sarmatian sediments). Several important caves are situated between the Serbian–Bulgarian border and Pleven area: Varkan near Druzhba Village (807 m), Bashovishki Pech near Oreshets Railway Station (over four km long), Sedlarkata near Rakita Village (1040 m), Gininata Peshtera near Sadovets Village (501 m), Kirov Vartop near Bohot Village (776 m), Aladjanskata Peshtera (1083 m), and Haidushkata Peshtera (438 m) near Gortalovo Village. The region of the valley of Rusenski Lom River is of particular interest. There, on the steep slopes of the river valleys near the villages Basarbovo, Ivanovo, Tabachka, Pepelina, and others many caves are formed, including Orlova Chuka (13,437 m), second in length in Bulgaria. Tamnata Dupka near Shirokovo is 878 m; Kulina Dupka near Krivnya, 326 m long.

In Ludogorie and Dobrudja there are many (over 350) relatively small caves. More important are Stoyanova Dupka near Ruino (357 m) and Dogulite near Topchii (305 m). From the abrasive caves between Kaliakra and Shabla the longest is Tyulenovata Peshtera (107 m).

The karst of Shumensko Plateau harbors several caves including Zandana (length 2220 m) and the pothole Tainite Ponori (–115 m deep and 1283 m long).

The Karstic Region of Stara Planina (the Predbalkan and the Stara Planina range) is subdivided into 19 districts. The karst of this region covers 4980 km², or 19.2% of its total area (Popov, 1970); this region is the richest in caves in Bulgaria. We find there 19 of the 53 Bulgarian potholes deeper than 100 m, and 46 of the 62 Bulgarian caves longer than 1000 m. In all parts of the region there are large caves and potholes.

In Belogradchik District, built of the Mesozoic limestone, are formed such caves as Magura (length 2500 m), Vodni Pech near Dolni Lom Village (1300 m), Mishin Kamik near Gorna Luka (695 m), as well as Pleshovska Dupka near Prevala Village (–102 m deep).

In Salash District, a noticeable cave is Rushkovitsa near Stakevtsi Village (450 m).

A classic karst area, and one among the richest in Bulgaria, is Vratsa District. More than 500 caves and potholes have been discovered in its thick Jurassic and Cretaceous limestone. In the higher parts of Vrachanska Planina have been explored potholes Barkite 14 (denivelation –356 m, length 2600 m), Belyar (–282 m, length 2560 m), Barkite 18 (–178 m), Pukoya near Pavolche Village (–178 m), Yavorets (–147 m) and Panchovi Gramadi (–104 m) near Zverino, and Haidushkata near Bistrets (–108 m). The water caves near Chiren (Ponora, length 3172 m; Mladenovata Propast, length 1732 m) are among the cavers' favorites. Other caves over 500 m in length are Toshova Dupka near Stoyanovo (1302 m), Mizhishnitsa (885 m), Sokolskata Dupka near Lyutadjik (815 m), and Gardyuva Dupka near Zgorigrad (510 m). The longest of the 130 little caves near Cherepish is Studenata Dupka (623 m).

The caves near Lakatnik also belong to Vratsa Region. Here we find Temnata Dupka (4500 m), Kozarskata Peshtera (709 m), Razhishkata Dupka (316 m), and Svinskata Dupka (300 m).

More than 140 caves and potholes have been recorded from the Ponor Karstic Region. Among them are the caves near Gintsi, Komshtitsa, Gubesh, Iskrets, Zimevitsa, and Tserovo. Some of these are well-known to the Sofia cavers: Dushnika (876 m), Katsite (–220 m, length 2560 m), Golemata Temnota near Drenovo (–106 m, length 2000 m), Golyamata Balabanova Dupka (4800 m), Malkata Balabanova Dupka (–125 m), Radolova Yama (–88 m), Krivata Pesht (1462 m), Tizoin (–320 m, length 3599 m), and Saguaroto (–135 m, length 2217 m). Some of the longest caves in West Bulgaria are the caves near Tserovo Railway Station (Vodnata Peshtera, 3264 m, and Mayanitsa, 1419 m).

At the border with Serbia the cave Temnata Dupka near Kalotina (Berende) marks the end of the present Bulgarian territory. Beyond the border, imposed by the Neuilly-sur-Seine Treaty of 1919, remain the former Bulgarian caves near Odorovtsi and Vetrena Dupka near Vlasi.

Another classical karstic area is Kameno Pole–Karlukovo. In this majestic karst has been built the National Caver's House "Petar Tranteev". In the valley of Iskar have been discovered more than 600 caves, including Bayov Komin (2169 m) and Drashanskata Peshtera (693 m) near Drashan; Starata Prodanka

(559 m) and Popovata Peshtera near Gabare; Golyamata Voda (−104 m, length 612 m), Zadanenka (1150 m), Bankovitsa (689 m), Stublenska Yama (−72 m, length 562 m); EC-20 (−94 m), and Tipchenitsa (−78 m), all near Karlukovo. A prominent cave in the majestic karstic landscape of Karlukovo also is Prohodna, the lower entrance of which is 42.5 m high.

In the thick (up to 450 m) limestone in the valleys of Vit, Panega, Batulska Reka, and Yablanishka Reka, are formed the caves of the Panega Region: Morovitsa near Glozhene (−105 m, length 3250 m), Vodnata Pesht near Lipnitsa (1010 m), the potholes Partizanskata (−107 m), Bezdanniyat Pchelin (−105 m), Yasenski Oblik (−104 m), Nanovitsa (−101 m), and others. The second largest karstic source in Bulgaria, Glava Panega (mean outflow 4.6 m³/sec), was explored by divers up to −52 m depth and 230 m length but it is reasonable to presume that amazing discoveries are yet to come in this huge underground system.

Large water caves are formed in Dragana–Bezhanovo Region of the Predbalkan: Parnitsite (2500 m), Gergitsovata (408 m), Sedlarkata (1070 m), and Skoka (723 m).

The caves of Teteven and Troyan regions are among the most interesting in Bulgaria. They belong to Vasilyov, Cherni Vit, and Cherni Osam areas. Some are particularly important, such as Raichova Dupka (−377 m, the deepest in Bulgaria, length 3333 m), Malkata Yama (−232 m, length 1101 m), Borova Dupka (−156 m), Ptichata Dupka (−108 m, length 652 m), Kumanitsa (−104 m, length 1656 m), Golyamata Garlovina (−100 m), and Varlata (1110 m), all in the area of Cherni Osam Village. The water cave Trona (Duhaloto) near Apriltsi is 1040 m long.

Many caves are known in Lovech area, including Golyamata Peshtera (1921 m) and Malkata Peshtera (1295 m) near Mikre, and Sopotskata Peshtera near Sopot (1225 m).

The subterranean karst in Devetaki Plateau is forming a special cave area. It includes the famous Devetashka Peshtera, 2442 m long and containing the largest cave chamber in Bulgaria, and also the caves near Krushuna: Popskata, or Boninskata Peshtera (4530 m), Vodopada (1995 m), Urushka Maara (1600 m), Gornik (1074 m); near Gorsko Slivovo (Chernata Pesht, 741 m), Karpachevo (Futyovskata Peshtera, 700 m), Alexandrovo (Brashlyanskata Peshtera, 608 m), and Chavdartsii (Mandrata, 450 m). In this area are also the potholes Kanchova Varpina (−100 m, length 425 m) and Blagova Yama near Etropole (−130 m).

Some of the remarkable Bulgarian caves are developed in the Aptian–Urgonian limestone of the plateau of Arbanasi and Belyakovets. The cavers are proud with the new discoveries near Emen: Ruse (−100 m, length 3306 m), Troana (2750 m), Bambalovata (2923 m), as well as with the extension of the “old” Emenska Peshtera up to 3113 m. Other important caves are Genchova Dupka (740 m) near Malak Chiflik and the water cave Musinskata Peshtera (382 m) near Musina.

Large caves have been found in Strazha–Debelets District such as Machanov Trap near Zdravkovets (1921 m) and Izvora near Yantra (1400 m). The longest cave in Debeli Dyal Subdistrict is Marina Dupka near Genchevtsi (2393 m). Favorite meeting point of cavers are the big caves near Dryanovski Monastery, Bacho Kiro (3500 m) and Andaka (over 4000 m). In the same area, in the small cave Polichki

have been conducted some of the first archeological explorations in Bulgarian caves, as early as the end of 19th century.

The relatively small caves high on Shipchenska Planina (Stoletovskata Peshtera and others) contain interesting cave fauna. In the mountains of Elena–Tvarditsa only some 30 caves and potholes have been recorded but they include the recently discovered pothole Magliviya Snyag (–146 m, length 2568 m) near Tvarditsa, and the cave Dolnata Maaza near Byala (280 m), known for a long time.

In the Cretaceous limestone of Kotlenska Planina there are many caves and potholes but the cave fauna is rather poor. The pothole Golyamata Yama near Kipilovo (–350 m, third deepest in Bulgaria) is an outstanding one. Important caves are known in the area of Zelenich (Prikazna, 4728 m, with the richest fauna in the area; Lutsifer, –130 m, length 3200 m; Karvavata Lokva, –140 m; Bilernika, –80 m; and Golyamata Humba, –94 m). Already from the time of Georgi Rakovski (1821–1867), the caves in the area of Zlosten were known: potholes Lednika (–242 m, length 1367 m), Maglivata (–220 m), Uzhasat na Imanyarite (–158 m), Akademik (–140 m), and the cave-sink Subatta (460 m). There are caves also near Medven Village (including the ice cave Lednitsata). The source cave in Kotel has an outflow up to 2.5 m³/sec.

In the Preslavka Mts. the most important is the cave Prolazkata (Derventskata) Peshtera (446 m).

The Transitional Karstic Region comprises a long strip stretching from the border with Serbia to the border with Turkey, between the regions of Stara Planina and the Rhodopes. In the mountains around Tran, Zemen, and Treklyano the caves are small but in the Triassic dolomite and limestone on the western slope of Vitosha near Bosnek Village have been formed some of the most important caves in Bulgaria: Duhlata (17,600 m, the longest cave in Bulgaria), Vreloto (5280 m), and PPD (1020 m). In this belt from Sofia to Sakar Mts. there are no caves of some importance but the source cave Chirpan Bunar near Belozem (220 m, 30–40 l/sec) has to be noticed.

In the districts of Sakar and Dervent Hills are known several dozens of caves in the Triassic marble-limestone. They include Bozkite (324 m) and Dranchi Dupka (145 m) near Mramor, and Kirechnitsata (225 m) and Dranchi Dupka (–25 m) near Melnitsa.

In the Strandja District 77 relatively small caves and potholes have been recorded, among which are Bratanovata (384 m), Kaleto (301 m), Bazat 1 (208 m), Bazat 2 (201 m), Kerechnitsata (224 m), and Stoyanovata Peshtera near Kosti (150 m). The deepest among the few potholes in Strandja are Golyamata Vapa near Stoilovo (–125 m, length 381 m) and Tangarachkata Dupka near Bogdanovo (–74 m).

Rila–Rhodopean Region contains 13 cave districts in the mountains Pirin and Rhodope, developed mainly in the Proterozoic marble and (less) in limestone.

In Pirin are known mostly potholes, especially in the Vihren Subdistrict. Right under the summit of Vihren the pothole Vihrenska Propast was descended down to –170 m; in the Bayuvi Dupki circus there is the pothole Chelyustnitsa (–104 m); in Banski Suhodol, “20 Godini Akademik” (–118 m), Propast

No. 9 (−230 m), and Propast No.14 (−103 m). Prominent among the caves in Sinanitsa Subregion are Aleko (−130 m, length 600 m), Sharaliiskata (470 m), Rimskata (293 m), and Ruikovata (120 m). Near Razlog is the source cave Spropadnaloto (605 m).

The caves in South Pirin, Slavyanka, and Stargach are few but interesting. The deepest pothole is Garvanitsa (−60 m) near Gotsev Vrah; some interesting cave animals have been found in Rupite near Paril and Starshelitsa near Goleshovo. In the marble of Dabrash part of the Rhodopes the cave Manailovata (Manoilovskata) Peshtera near Ribnovo is prominent (−115 m, length 2119 m).

In the Velingrad District between Velingrad and Rakitovo the cave Lepenitsa is situated; it was one of the first to be opened as “show cave” but was vandalized many times. Near the town of Peshtera are the caves Vodnata Peshtera (1000 m), Novata Peshtera (825 m), Yubileyna (814 m), and the show cave Snezhanka (276 m).

In Dobrostan District, the largest karst district in the Western Rhodopes, we know over 200 caves and potholes. Some important among them are Garvanitsa near Kosovo (925 m), Topchika (727 m), Hralupa (311 m), and Gargina Dupka near Mostovo (534 m). Particularly interesting are the potholes Lisek (−164 m) and Kutelska Yama (−88 m) near Dryanovo, Druzhba (−130 m) and Ivanova Voda (−112 m) near Dobrostan. The stone bridges Erkyupriya (Chudnite Mostove) near Zabardo and Mostovo are to be noted.

The majestic gorges of the Trigrad District, cut in the marble (up to 1600 m thick), have many caves. Among them are Yagodinskata Peshtera (or Imamova Dupka, 8501 m, third longest in Bulgaria) and Sanchova Dupka (8880 m) near Yagodina; Izvora (2480 m) and Eminova Dupka (592 m) near Borino; the potholes Drangaleshkata (−225 m, length 1142 m) and Kambankite (−158 m) near Mugla; and Ledenitsata near Gela (−108 m, length 1419 m). In Chepelare District, the longest cave is Samurskata Dupka (634 m).

Borikovskata Peshtera (440 m) and Goloboitsa (362 m) are caves in the marble south and southeast of Smolyan. The deepest pothole in the area is Kladeto near Polkovnik Serafimovo (−147 m).

In the Ardino District, 44 caves and potholes are known, including Vodnata Peshtera near Nedelino (203 m), Gyaurhambar near Stomantsi (112 m), and Karagug near Tyutyunche (105 m).

Among the small caves is Maazata near Madretsi (114 m). In the easternmost part of the Rhodopes, 35 caves have been explored, including Karangil near Shiroko Pole (490 m), Samara (327 m), Oglealnata Peshtera (157 m) near Ribino, and Belopolyanskata Peshtera near Belopolyane.

The volcanic caves (caves in non-carbonate rocks) in Bulgaria have been studied mainly by Boris Kolev. Only on the territory of Eastern Rhodopes, he has recorded 77 caves. They are short but spacious (Golyamata Peshtera near Byal Kladenets, 51 m; Ehtyashkata, 30 m; and Prilepnata, 18 m).

Among the caves in sandstone, conglomerate and gneiss, Lepenishki Pech near Prolaznitsa, Belogradchik area (35 m), Uske near Chetirtsi (88 m), and others are to be noticed.

3 History of Biospeleological Studies of Bulgarian Cave Animals

The first to find cave animals in Bulgaria was the Hungarian entomologist Eduard Merkl. In 1878 (the year of founding of the independent Bulgarian state), he visited some caves near the summits of Kurudja and Sveti Nikola (now Stoletov) in Central Stara Planina. There, Merkl discovered three blind beetle species, described in 1879 by Johan Frivaldzsky as *Trechus (Anophthalmus) balcanicus*, *Pholeuon merkli*, and *Ph. merkli* var. *simile*. This discovery remained largely unknown for a long time as it was not mentioned in the descriptions that the beetles were found in caves. The next “biospeleological” trip to Bulgaria took place more than 30 years after Merkl’s.

In 1909, the Austrian entomologist Fritz Netolitzky visited the cave Zmeyovi Dupki near Tryavna and found another blind beetle, described later by Josef Müller from Trieste as *Netolitzkya maneki*. The second discovery also did not attract the attention of biospeleologists, who concentrated on the fauna of the French and West Balkan caves.

The curiosity of Bulgarian zoologists for studying cave animals was aroused by a geologist, V. Arnaudov, who in 1922 indicated to Dr. Ivan Buresch the existence of strange yellowish insects in the cave Ledenika near Vratsa. The experienced Director of the Royal Museum of Natural History in Sofia immediately realized how important this observation was. Together with his fellow entomologists from the Museum, Dr. Buresch undertook a series of visits to the caves near Vratsa and in Iskar Gorge. In several years (1923–1926), dozens of troglobites from different groups have been discovered and described. Prominent foreign specialists visited Bulgaria or identified the material collected (we can mention K. Verhoeff, E. Knirsch, E. Handschin, V. Redikorzev, A. Wagner, L. Fage, C. F. Roewer). Their publications increased notably the knowledge on groups like Isopoda, Myriapoda, Pseudoscorpiones, Opiliones, Collembola, Coleoptera, and others in Bulgaria. Many visits of Dr. Buresch and his associates to the caves, by 1927 brought the number of known cave organisms to 44; among them were some remarkable troglobites. A general list of this fauna was presented by Dr. Buresch in September 1927 to the International Zoological Congress in Budapest (Buresch, 1929). Meanwhile, he published two important papers on the cave fauna of Bulgaria (Buresch, 1924, 1926). Nenko Radev started publishing Catalogue of Bulgarian caves, of which two parts were published (in 1926 and 1928). On 18 March 1929, the Bulgarian Speleological Society was founded. New visits to the caves followed, and a series of new publications contributed to the study of Araneae (Drensky), Diptera (Czerny), Thysanura (Silvestri), Coleoptera (Buresch, Jeannel, Mandl), Pseudoscorpiones (Hadži), Oligochaeta (Černosvitov), Nycteribiidae (Z. Karaman), Crustacea (Klie), Isopoda (Strouhal), Gastropoda (A. Wagner), Isopoda, Diplopoda, and Chilopoda (Verhoeff), and other groups. A third general paper on Bulgarian biospeleology was published by Buresch (1936).

After the World War II, again Dr. Buresch organized two "caving brigades" within Bulgarian Academy of Sciences. They studied some caves in Northeastern Bulgaria and collected many new cave animals, arranged in the collection "Fauna cavernicola bulgarica" in the Institute of Zoology in Sofia. Part of this material was identified by J. Kratochvil (Opiliones), A. Angelov (Gastropoda), C. Attems (Myriapoda), I. Buresch and V. Guéorguiev (*Stenasellus*), C. F. Roewer (Opiliones), Z. Karaman (Coleoptera), E. Pretner (Coleoptera), F. Miller (Araneae), J. Lang (Diplopoda), S. and G. Karaman (Amphipoda), and others.

These papers concern, together with the older material of Dr. Buresch and his associates, some new animals (like *Paralola buresi* and *Tranteeva paradoxa*) collected in the 1950s by Petar Tranteev and the group of young biospeleologists formed around him (V. Guéorguiev, P. Beron, V. Beshkov, T. Michev, M. Kwartirnikov, A. Popov, S. Andreev, Ch. Deltshv).

After the resurrection of the organized caving in Bulgaria in 1958 the Caving Commission at Bulgarian Tourist's Union formed many caving clubs and a much more intensive research in caves took place everywhere in the country, even abroad. Considerable new collections have been accumulated and studied by the new generation of Bulgarian and some foreign specialists: Protozoa (D. Tashev, V. Golemansky), Hirudinea (A. Angelov), Mollusca (A. Riedel, especially Zonitidae), Isopoda (A. Vandel, S. Andreev), Chilopoda (J.-M. Demange, J. Gulička, Z. Matic, V. Golemansky), Diplopoda (K. Strasser), Opiliones (V. Šilhavý, W. Staręga), Araneae (Ch. Deltshv), Orthoptera (A. Popov), Collembola (J. Rusek, M. M. da Gama), Diplura (J. Rusek), Homoptera Aphidodea (D. Tashev), Coleoptera (V. Guéorguiev, Z. Karaman, L. Genest, L. Zerche), Trichoptera (K. Kumanski), Diptera and Siphonaptera parasites of bats (K. Hürka), Diptera (V. Beschovski). More specialized studies on the nervous system and ecology of *Pheggomisetes* and other cave beetles have been started (M. Kwartirnikov). Specializations in cave biology in the Laboratoire Souterrain de Moulis (France) took place (P. Beron in 1967; V. Guéorguiev in 1968), and the first dissertation on cave animals was presented by P. Beron (1976).

For a long time the studies on bats (Chiroptera) in Bulgarian caves have been carried out without nets, which resulted in very limited results (I. Buresch, G. Heinrich, P. Beron, V. Beshkov, M. Kwartirnikov). The visit of the first Czech theriologists with nets (Horaček et al., 1974) contributed new species to the Bulgarian fauna. Another visit by British cavers brought new data, published by M. Hazelton (1970) and F. Turk (1970). Some other visits or publications by foreign cave biologists also contributed to better understanding of the Bulgarian fauna (H. Coiffait, J.-M. Thibaud, D. Dancau, L. Botosaneanu, V. Decu, A. Riedel, L. Genest). Most data on the cave fauna of Bulgaria, however, were collected after 1960 by the Bulgarian scientists. The latest bibliography of Bulgarian cave fauna (Beron, 1994) contains 409 titles, of which 230 belong entirely or partly to the Bulgarians.

Numerous data obtained have been compiled by Guéorguiev and Beron (1962), then by Beron and Guéorguiev (1967), Beron (1972), and finally by Beron (1994) who published a complete list of 704 animal species from 646 Bulgarian caves.

Since the beginning of the 1990s, a considerable “new wave” of biospeleologists marked another leap forward in the knowledge of the cave and underground fauna of Bulgaria. Several young researchers (P. Stoev, B. Petrov, S. Beshkov, T. Ivanova, I. Pandourski) carried further the efforts of the older workers. Meanwhile, some of the explorers of Bulgarian cave animals died (P. Tranteev in 1979, I. Buresch in 1980, V. Guéorguiev in 1994) or retired (V. Beshkov, 1995). The young specialists work in the National Museum of Natural History (NMNH) and in the Institute of Zoology, Bulgarian Academy of Sciences; they study selected groups of cave fauna (Myriapoda, P. Stoev; Pseudoscorpiones, B. Petrov; Copepoda, I. Pandourski; Lepidoptera, S. Beshkov). Very active is also the group for study and protection of bats, based in the NMNH (T. Ivanova and others). Bulgarian biospeleologists work actively also in the Bulgarian Federation of Speleology (President, P. Beron) and in the international organizations.

The compilation of a new “Cave Fauna of Bulgaria” by P. Beron, B. Petrov, and P. Stoev is in progress. The updated bibliography in this book contains over 500 titles.

4 Survey of Terrestrial Cave Animals in Bulgaria

By the end of 2006, from Bulgarian caves have been recorded over 800 animal species. Among them more than 115 (including several under study) are considered to be troglobites. Table 1 lists the terrestrial troglobites in Bulgaria.

Protozoa. The free-living protozoans in Bulgarian caves are not well known. Some epibiont *Vorticella* and *Tokophrya* (Ciliata), living on the cave crustaceans, have been recorded. Four endoparasitic gregarines (Sporozoa) of the genera *Lepismatophila* (Stylocephalidae) and *Stenophora* (Stenophoridae) have been described. They live in *Plusiocampa bureschi* (Diplura) and in three species of millipeds.

Nemathelminthes. Almost nothing is known about the multitude of tiny nematods inhabiting cave substratum.

Annelida. Eight species of Lumbricidae have been recorded so far in Bulgarian caves but they are not of special interest as the same species live also outside the caves.

Mollusca. Snails (Gastropoda) are many and include troglobites as well as typical troglophiles. Thanks to the Polish malacologist A. Riedel, the family Zonitidae is well known in Bulgaria and in the Balkans. One probable troglobite belonging to this family has been described from the Ptichata Dupka pothole, the tiny white *Spinophallus* (*Lindbergia* auct.) *uminskii*. Many species of the closely related genus *Lindbergia* live in the caves of Greece but *S. uminskii* is so far the sole species from Bulgaria. Other interesting taxa of cave snails should be expected in Bulgaria, taking into account the rich fauna of the neighboring countries. So far, 16 terrestrial snail species have been recorded from Bulgarian caves. Besides *Spinophallus uminskii*, particularly interesting is the troglophile *Balcanodiscus frivaldskyanus* living in the caves of Eastern Rhodopes.

Crustacea. Terrestrial crustaceans are represented by the order Isopoda. One crab (Decapoda) has also been found in a Rhodopean cave outside water. Isopoda

Table 1 Troglobites in Bulgarian caves

Taxa	Cave(s)	Endemic Status
Phylum MOLLUSCA		
Class GASTROPODA		
Order BASOMMATOPHORA		
Family ZONITIDAE		
<i>Spinophallus uminski</i> (Riedel)	Ptichata Dupka (Cherni Osam); troglobite or troglophile?	Central Stara Planina
Phylum ARTHROPODA		
Class CRUSTACEA		
Order ISOPODA		
Suborder ONISCIDEA		
Family STYLONISCIDAE		
<i>Cordioniscus bulgaricus</i> Andreev	Boichovata Peshtera (Logodash)	Vlahina Mts.
<i>Cordioniscus schmalzfussi</i> Andreev	Zimin Burun (Mostovo), Shepran Dupka (Belitsa)	Western Rhodopes
Family TRICHONISCIDAE		
<i>Bureschia bulgarica</i> Verhoeff	Vodnata Peshtera (Tserovo Railway Station), Temnata Dupka (Lakatnik Railway Station), Belyar (Vratsa)	Western Stara Planina
<i>Balkanoniscus corniculatus</i> Verhoeff	Haidushkata Dupka (Karlukovo), Rushovata Peshtera and Djebin trap (Gradeshnitsa), Cave Yamata (Tserovo Railway Station), Razrushenata Peshtera (Kumino Railway Station)	Western Stara Planina and Central Predbalkan
<i>Balkanoniscus minimus</i> Vandel	Parnitsite (Bezhanovo)	Central Predbalkan
<i>Rhodoptonicus beroni</i> (Vandel)	Topchika and Yamata (Dobrostan)	Western Rhodopes
<i>Trichoniscus bulgaricus</i> Andreev	Yulen Ere (Hristo Danovo)	Central Stara Planina
<i>Trichoniscus rhodopiense</i> Vandel	12 caves in the Rhodopes, mostly Kardjali District	Rhodopes and Thassos Island, Greece
<i>Trichoniscus valkanovi</i> Andreev	Sarpitskata Peshtera and Kirechmitsata (Kosti)	Strandja
<i>Trichoniscus anophthalmus</i> Vandel	Studenata Dupka and Ezeroto (Cherepish Railway Station), Mishin Kamik, Vreloto, and Aiduchkata Dupka (Prevala), Tatarska Dupka (Replyana), Parasinskata Propast (Belimel), Toshova Dupka (Stoyanovo)	Western Stara Planina

<i>Trichoniscus tranteevi</i> Andreev (= <i>T. anophthalmus intermedius</i> Vandel, praecoecup.)	Tamnata Peshtera (Tabachka)	Ludogorie
<i>Trichoniscus petrovi</i> Andreev	Shepran Dupka (Belitsa)	Rhodopes
<i>Trichoniscus tenebrarum</i> Verhoeff	Andaka (Dryanovski Manastir), Golyama Podlitsa (Veliko Tarnovo), Devetashkata Peshtera (Devetaki)	Central Predbalkan
<i>Trichoniscus stoevi</i> Andreev	Stoletovskata Peshtera (Shipka)	Central Stara Planina
<i>Trichoniscus bononiensis</i> Vandel	Varkan (Tsar Petrovo), Suhl Pech, Propast, and Parnak (Oreshets), Redaka 1, Prelaz, and Mechata Dupka (Salash), Yame 2 and Yame 3 (Targovishite), Krachimirskoto Vrelo (Stakevtsi), Zmitskata Propast (Krachimir), Tsankinoto Vrelo (Granitovo), Neprivetlivata (= Gornata Propast) and Haidushkata Propast (Belogradchik), Tanni Pech and Golemi Pech (Varbovo), Pech (Gorna Luka), Yankulova Dupka (Prolaznitsa)	Western Danubian Plain, Western Predbalkan, and Western Stara Planina
<i>Trichoniscus garevi</i> Andreev	Sinyoto Ezero (Dragana), Alchashkata Peshtera (Bezhanovo), Popskata Peshtera (Krushuna), Tanyova Peshtera and Voditsata (Aglen)	Central Predbalkan
<i>Trichoniscus beroni</i> Andreev	Bratanovskata peshtera (Kosti)	Strandja
<i>Beroniscus capreolus</i> Vandel	Parnitsite (Bezhanovo)	Central Predbalkan
<i>Cyphoniscellus</i> (= <i>Bulgaroniscus</i>) <i>gueorguievi</i> (Vandel)	Desni Suhli Pech (Dolni Lom), Zhivkova Dupka (Gorna Luka), Vreloto, Aiduchkata Dupka, and Mitsina Dupka (Prevala), Neprivetlivata (Belogradchik), Yame 2 (Targovishite), Tatarska Dupka (Replyana), Parnak (Oreshets)	Western Predbalkan and Western Stara Planina
<i>Bulgaronethes haplophthalmoides</i> Vandel	Novata Peshtera (Peshtera)	Western Rhodopes
<i>Vandeloniscellus</i> (= <i>Cyphoniscellus</i>) <i>bulgaricus</i> (Vandel)	Toshova Dupka (Stoyanovo)	Western Stara Planina
<i>Tricyphoniscus bureschi</i> Verhoeff	Haidushka Dupka, Bezimenna 22, and Cherdjenitsa (Karlukovo), Vodnata Peshit, Kozarnika, and Bankovets (Lipnitsa)	Western and Central Predbalkan

continued

Table 1 continued

Taxa	Cave(s)	Endemic Status
<i>Hylomiscus flammula</i> Vandel	Magura, Magura 2, and Varmitsata (Rabisha)	Western Predbalkan
Class ARACHNIDA		
Order OPILIONES		
Suborder CYPHOPHTHALMI		
Family SIRONIDAE		
<i>Siro beschkovi</i> Mitov	Haidushkata peshtera (Deventsitsi)	Central Predbalkan
<i>Tranteeva paradoxo</i> Kratochvíl	Rushovata Peshtera (Gradeshnitsa), Topyla (Golyama Zhelyazna)	Central Predbalkan
Suborder LANIATORES		
Family PHALANGODIDAE		
<i>Paratola buresi</i> Kratochvíl	Kozarskata Peshtera, Svinskata Dupka, Zidanka, and Temnata Dupka (Lakatnik Railway Station)	Western Stara Planina
Suborder PALPATORES		
Family NEMASTOMATIDAE		
<i>Paranemastoma (Buresiolla) bureschi</i> (Roewer)	31 caves	Western Stara Planina
Order PSEUDOSCORPIONES		
Family CHTHONIIDAE		
<i>Chthonius troglodites</i> Redikorzev	Kasapnitsite and Haidushka Dupka (Karlukovo Railway Station), Haidushkata Peshtera (Deventsitsi)	Central Predbalkan
Family NEOBISIDAE		
<i>Neobisium (Heoblothrus) bulgaricum</i> (Redikorzev) (= <i>Obisium subterraneum</i> Redikorzev)	Yalovitsa (Golyama Zhelyazna)	Central Predbalkan
<i>Neobisium (Heoblothrus) beroni</i> Beier	Svinskata Dupka (Lakatnik Railway Station)	Western Stara Planina
<i>Neobisium (Blotrus) kvartirnikovi</i> Mahnert	Duhlata (Bosnek)	Vitoshka
<i>Balkanoronus bureschi</i> (Redikorzev) (= <i>Obisium bureschi</i> Redikorzev, = <i>B. praeceps</i> Čurčić)	Saeva Dupka (Brestmitsa), Djebin Trap (Gradeshnitsa)	Central Predbalkan
<i>Balkanoronus hadzii</i> Harvey (= <i>Roncus bureschi</i> Hadží)	Razhishka Peshtera (Lakatnik Railway Station)	Western Stara Planina
<i>Roncus mahneri</i> Čurčić et Beron	Vodnata Dupka (Botunya)	Western Stara Planina

Order ARANEAE		
Family LINYPHIDAE		
<i>Troglohyphantes drenskii</i> Deltshv		Western Rhodopes
<i>Centromerus bulgarianus</i> (Drensky)		Western Stara Planina
<i>Porrhomma microps</i> (Roewer)		Ludogorie and Eastern Stara Planina
Family LEPTONEIIDAE		
<i>Protoleptoneta beroni</i> Deltshv		Western Stara Planina
<i>Protoleptoneta bulgarica</i> Deltshv		Western Predbalkan
Family NESTICIDAE		
<i>Nesticus beroni</i> Deltshv		Western Rhodopes
MYRIAPODA		
Class CHILOPODA		
Family LITHOBIDAE		
<i>Lithobius tiasnatensis</i> Matic (= <i>L. popovi</i> Matic)		Central Predbalkan and Sakar
<i>Lithobius stygius</i> Latzel		Western Rhodopes and western part of the Balkan Peninsula
<i>Lithobius rusevovensis</i> Matic (= <i>L. beschkovi</i> Matic et Golemansky)		Central Predbalkan
<i>Lithobius lakatnicensis</i> Verhoeff		Western Stara Planina and Western Rhodopes
<i>Lithobius bifidus</i> (Matic)		Strandja
<i>Eupolybohrus andreevi</i> Matic		Western Stara Planina
	Suhata Dupka (Velingrad)	
	Zidanka and Razhishka Peshtera (Lakatnik Railway Station), Sokolskata Dupka (Lyutadjik), Belyar (Vratsa)	
	Kulina Dupka (Krivnya), Samar Daala (Voden), Prikazna (Kotel)	
	Belimelskata Peshtera (Belimel)	
	Mecha Dupka (Lepitsa), Djurdjina Dupka (Erden)	
	Dupkata (Mostovo)	
	Devetashkata Peshtera (Devetaki), Tyasnata Propast (Mramor)	
	Lepenitsa and Suhata Peshtera (Velingrad), Yubileina (Peshtera Town), Modarskata Peshtera (Modar), Lednitsata (Gela)	
	Rushovata Peshtera (Gradeshnitsa)	
	many caves	
	Izvornata Peshtera (Mladezhko)	
	Vodnata Peshtera (Tserovo Railway Station)	

continued

Table 1 continued

Taxa	Cave(s)	Endemic Status
Class DIPLOPODA		
Order GLOMERIDA		
Family DODERIDAE		
<i>Trachysphaera orghidani</i>	Kozarskata Peshtera and Sedmovratitsa (Lakatnik Railway Station), Tamma Dupka (Targovishte)	Western Stara Planina
<i>lakamicensis</i> Tabacaru		
Order POLYDESMIDA		
Family POLYDESMIDAE		
<i>Brachydesmus radewi</i> Verhoeff	Promakinyalo (Dolna Beshovitsa)	Western Predbalkan
Family TRICHOPOLYDESMIDAE		
(= BACILLESIMIDAE)		
<i>Bacillidesmus bulgaricus bulgaricus</i>	Mishin Kamik (Gorna Luka), Mladenovata Peshtera (Chiren)	Western Predbalkan and Western Stara Planina
Strasser		
<i>Bacillidesmus bulgaricus dentatus</i>	Drashanskata Peshtera (Drashan)	Western Predbalkan
Strasser		
Order CHORDEUMATIDA		
Family		
ANTHROLEUCOSOMATIDAE		
<i>Bulgarosoma bureschi</i> Verhoeff	Ledenika, Belyar, Malkata Mecha Dupka, and Reznovete (Vratsa), Kitova Kukla (Druzhevo)	Western Stara Planina
<i>Troglodicus meridionale</i> (Tabacaru)	Imamova Dupka (Yagodina)	Western Rhodopes
<i>Troglodicus tridentifer</i> Gulička	Chelechkata (Choveshkata) Peshtera (Orehovo)	Western Rhodopes
<i>Stygotoma beroni</i> Gulička	Manaliovata Peshtera (Ribново)	Western Rhodopes
<i>Anamastigona falcatius</i> Gulička	Kipilovskata Peshtera (Kipilovo); troglobite or troglophile?	Eastern Stara Planina
<i>Anamastigona lepenicae</i> (Strasser)	Lepenitsa (Velinograd)	Western Rhodopes
<i>Anamastigona delzevi</i> (Strasser)	Artificial galleries and caves near Paril; troglobite or troglophile?	Slavyanka
<i>Anamastigona (Balkandicus) alba</i> (Strasser)	Puchata Dupka and Kumanitsa (Cherni Ossam)	Central Stara Planina
<i>Bulgaridicus tranteevi</i> Strasser	Bankovitsa (Karlukovo)	Central Predbalkan

Order JULIDA			
Family JULIDAE			
<i>Typhlotulus bureschi</i> Verhoeff	31 caves	Popskata Peshtera (Krushuna); troglobite or troglophile?	Western and Central Predbalkan, Western Stara Planina Central Predbalkan
<i>Typhlotulus georgievi</i> Verhoeff	13 caves		Western Stara Planina
<i>Serboitulus spelaeophilus</i> Gulička		Belyar (Vratsa)	Western Stara Planina
<i>Typhlotulus (Inversoryphilus) longipes</i> Strasser		Prelaz (Salash)	Western Stara Planina
<i>Typhlotulus staregati</i> Strasser			
Class INSECTA			
Order COLLEMBOLA			
Family ENTOMOBRYIDAE			
<i>Pseudosinella bulgarica</i> Gama	Stoletovskata Peshtera (Shipka), Prikazna (Kotel)		Central and Eastern Stara Planina
<i>Pseudosinella duodecimocellata</i> Handschin	13 caves		Western Stara Planina, Pirin, and Western Rhodopes
<i>Pseudosinella kwartirnikovi</i> Gama		Gurlyova Dupka and Tavancheto (Krushuna), Stoletovskata Peshtera (Shipka), Ovnarkata (Kartukovo), Kozarnika (Lipnitsa)	Western and Central Predbalkan, Central Stara Planina
Family ONYCHIURIDAE			
<i>Onychiurus sensitivus</i> Handschin		Ledenika (Vratsa)	Western Stara Planina
<i>Onychiurus vornatscheri</i> Stach		Tsankinoto Vrelo (Granitovo)	Western Predbalkan
<i>Protaphorura beroni</i> (Gruia)		Venetsa, Propast (Oreshets)	Western Predbalkan
Order DIPLURA			
Family CAMPODEIDAE			
<i>Platycampa bulgarica</i> Silvestri		Magura (Rabisha), Yavoratskata Peshtera (Lakatnik), Lepenitsa (Velingrad), Hvoinskata Peshtera (Hvoina), Sbirkovata Peshtera (Progled), Haramiiskata Dupka (Trigrad), Dupkite (Chepelare), Imamova Dupka (Yagodina)	Western Predbalkan, Western Stara Planina, and Western Rhodopes

continued

Table 1 continued

Taxa	Cave(s)	Endemic Status
<i>Plustiocampa bureschi</i> Silvestri (= <i>P. rauseri</i> Rusek)	Temnata Dupka and Razhishkata Peshtera (Lakatnik Railway Station), Vodnata Peshtera (Tserovo Railway Station)	Western Stara Planina
<i>Plustiocampa beroni</i> Bareth et Condé	Magura (Rabisha), Varkan (Tsar Petrovo)	Western Danubian Plain and Western Predbalkan
<i>Plustiocampa</i> cf. <i>beroni</i> 1	Novata Peshtera (Peshtera Town)	Western Rhodopes
<i>Plustiocampa</i> cf. <i>beroni</i> 2	Padezh (Breze)	Western Stara Planina
<i>Plustiocampa gueorguievi</i> Bareth et Condé	Toplya (Golyama Zhelyazna)	Central Predbalkan
<i>Plustiocampa arbanasiensis</i> Bareth et Condé	Lyaskovkata Peshtera (Arbanasi)	Central Predbalkan
<i>Plustiocampa vodnensis</i> Bareth et Condé	Vodni Pech (Dolni Lom)	Western Stara Planina
Order COLEOPTERA		
Family CARABIDAE		
<i>Duvalius (Paraduvallius) balcanicus</i> (Frivaldszky)	Cave (?) in Shipchenska Planina	Central Stara Planina
<i>Duvalius (Paraduvallius) beroni</i> Guéorguiev	Toshova Dupka (Stoyanovo)	Western Stara Planina
<i>Duvalius (Paraduvallius) bulgaricus</i> Knirsch	Zmeyovi Dupki (Hitrevtsi), Kumincheto (Genchevtsi)	Central Predbalkan
<i>Duvalius (Paraduvallius) bureschi</i> Jeannel	Lepenitsa (Velingrad)	Western Rhodopes
<i>Duvalius (Paraduvallius) garevi</i> Casale et Genest	Sinyoto Ezero (Dragana)	Central Predbalkan
<i>Duvalius (Paraduvallius) joakimovi</i> B. Guéorguiev	Stoikova Dupka 1 (<i>ex errore</i> Golyama Stoikovitsa)	Slavyanka
<i>Duvalius (Paraduvallius) kotlensis</i> Genest	Prikazna (Kotel)	Eastern Stara Planina
<i>Duvalius (Paraduvallius) papasoffi</i> Mandl	Temnata Dupka, Zidanka, and Pyasachnata Dupka (Lakatnik Railway Station)	Western Stara Planina
<i>Duvalius (Paraduvallius) petrovi</i> B. Guéorguiev	Zandana (Dolno Cherkovishite), ? Hasarskata Peshtera (Gorna Shezhinka)	Eastern Rhodopes
<i>Duvalius (Paraduvallius) pirinensis</i> B. Guéorguiev	Sharaliskata Peshtera (Pirin)	Pirin
<i>Duvalius (Paraduvallius) premeri</i> Guéorguiev	Mechata Dupka (Bov)	Western Stara Planina
<i>Duvalius (Paraduvallius) regisborisi</i> Buresch	Yalovitsa (Golyama Zhelyazna)	Central Predbalkan
<i>Duvalius (Paraduvallius) zivkovi</i> Knirsch (= <i>D. zivkovi deltshevi</i> Guéorguiev)	Ledemika, Malkata Mecha Dupka, 25 Godini Akademik, and Malkata Nevestina Propast (Vratsa)	Western Stara Planina
<i>Duvalius (Paraduvallius) legrandi</i> Genest	Kalgerova Dupka (Arbanasi)	Central Predbalkan

<i>Duvalius (Paraduvallius) karalliurkai</i> Farkac	Erkypriya (Mostovo)	Western Rhodopes
<i>Duvalius (Biharotrechus) beshkovi</i> Coiffait	Mecha (Lisicha) Dupka (Stradalovo)	Osogovo
<i>Pheggomisetes burei burei</i> Knirsch	Ledenika and 25 Godini Akademik (Vratsa)	Western Stara Planina
<i>Pheggomisetes burei medenikensis</i> Knirsch	Medenik (Eliseina Railway Station)	Western Stara Planina
<i>Pheggomisetes globiceps globiceps</i> Buresch	Dushmika (Iskrets)	Western Stara Planina
<i>Pheggomisetes globiceps breiti</i> Mandl	Dinevata Pesht, Svetata Voda, and Krivata Pesht (Gimtsi)	Western Stara Planina
<i>Pheggomisetes globiceps georgievi</i> Z. Karaman	Propast 30 (Karlukovo)	Central Predbalkan
<i>Pheggomisetes globiceps lakatnicensis</i> Jeannel	Temnata Dupka and Zidanka (Lakatik Railway Station), Radyova Propast (Milanovo), Kolkina Dupka (Zimevitsa), Golenata Mecha Dupka (Vratsa), Govedarskata Dupka (Chiren)	Western Predbalkan and Western Stara Planina
<i>Pheggomisetes globiceps stoitcevi</i> Guéorguiev	Eliata (Zimevitsa), Nevestina Propast (Vratsa)	Western Stara Planina
<i>Pheggomisetes globiceps karlukovensis</i> Genest	Bezimmna 84 (Karlukovo)	Central Predbalkan
<i>Pheggomisetes globiceps ilandjievi</i> Guéorguiev	Balabanova Dupka, Malata Balabanova Dupka, and Granicharskata Propast (Komshtitsa)	Western Stara Planina
<i>Pheggomisetes globiceps mladenovi</i> Guéorguiev	Malkata Mecha Dupka and 25 Godini Akademik (Vratsa)	Western Stara Planina
<i>Pheggomisetes globiceps cerovenensis</i> Guéorguiev	Yamata, Peshterata, and Propastta (Tserovo Railway Station)	Western Stara Planina
<i>Pheggomisetes radevi radevi</i> Knirsch	Ledenika (Vratsa)	Western Stara Planina
<i>Pheggomisetes radevi ilcevi</i> Knirsch	Medenik (Eliseina Railway Station)	Western Stara Planina
<i>Pheggomisetes radevi trantzevi</i> Guéorguiev	Shubata Yama (Druzhevo)	Western Stara Planina
<i>Pterostichus ledenikensis</i> Knirsch	Ledenika (Vratsa), Grebenyo (Gorno Ozirovo)	Western Stara Planina
Family CHOLEVIDAE (= CATOPIDAE)		
<i>Beronia micevi</i> Guéorguiev	Neprivetlivata (Gornata Propast) and Haidushkata Propast (Belogradchik)	Western Predbalkan
<i>Beskovia bulgarica</i> Guéorguiev	Studenata Dupka and Serapionovata Peshtera (Cherepish Railway Station)	Western Stara Planina
<i>Hexaurus merkli</i> (Fritvaldszky)	Cave under Kurudja Summit	Central Stara Planina

continued

Table 1 continued

Taxa	Cave(s)	Endemic Status
<i>Hexaurus schipkaensis</i> Zerche	Stoletovskata Peshtera (Shipka)	Central Stara Planina
<i>Hexaurus similis</i> (Fridvaldszky)	a cave in Shipchenska Planina	Central Stara Planina
<i>Hexaurus paradisi</i> Zerche	Han Maara (Rai Hut)	Central Stara Planina
<i>Netolitzkya jeanneli jeanneli</i> Buresch	Bacho Kiro (Dryanovski Manastir)	Central Predbalkan
<i>Netolitzkya jeanneli matroffi</i> Jeannel	Lyaskovska Peshtera and Kalugerova Dupka (Arbanasi)	Central Predbalkan
<i>Netolitzkya maneki maneki</i> J. Müller	Zmeyovi Dupki (Hitrevtsi), Kumincheto (Genchevtsi)	Central Predbalkan
<i>Netolitzkya maneki ilschewi</i> Jeannel	Golyama Podlitsa (Belyakovets)	Central Predbalkan
<i>Radevia hamusi</i> Knirsch	Ledenika, Bezimenna, Zmeyova Dupka I, Zmeyova Dupka III, Propast 13, Bulina Dupka, Golemata Mecha Dupka, and Radyova Propast (Vratsa)	Western Stara Planina
<i>Rhodopiola cavicola</i> Guéorguiev	Sipeya (Bachkovski Manastir)	Western Rhodopes
<i>Vratzamiola pandurskii</i> Dupré	25 Godini Akademik and Barkite 9 (Vratsa)	Western Stara Planina
<i>Tranteviella bulgarica</i> Pretner	Rushovata Peshtera (Gradeshnitsa), Varovit (Malka Zhelyazna)	Central Predbalkan
<i>Bureschiana drenska</i> Guéorguiev	Tilkimi (Ostrovitsa), Hasarskata Peshtera (Gorna Snezhinka)	Eastern Rhodopes
<i>Balcanobius etropolensis</i> Guéorguiev	Bezimenmata Peshtera I, Zahlupena Dupka, and Neikova Dupka (Etropole)	Central Stara Planina
<i>Genestellina gueorguievi</i> (Giachino)	Yalovitsa and Toplya (Golyama Zhelyazna)	Central Predbalkan
<i>Beroniella tetevensis</i> Giachino et Guéorguiev	Dyado Draganovata Peshtera (Teteven)	Central Predbalkan
<i>Bathyscia raitchevi</i> Casale, Giachino et Etonti	Imamova Dupka (Yagodina)	Western Rhodopes
Family CURCULIONIDAE		
<i>Trogloorrhynchus beroni</i> Angelov	Inkaya (Tsyvatovo)	Eastern Rhodopes
<i>Trogloorrhynchus gueorguievi</i> Angelov	Yalovitsa (Golyama Zhelyazna)	Central Predbalkan
<i>Trogloorrhynchus angelovi</i> Guéorguiev et Petrov	Zandana (Dolno Cherkovishhte)	Eastern Rhodopes

are represented in Bulgarian caves by three suborders, Asellota, Flabellifera, and Oniscidea; only the latter is terrestrial. Terrestrial isopods include some of the most numerous and interesting troglobites in Bulgarian caves. They live on rotten wood, on clay, and on stalagmite surface. One of the most remarkable species (*Bureschia bulgarica*) is amphibious and occurs in large numbers around and in the lakes in the cave Temnata Dupka near Lakatnik. In total, 50 species of terrestrial isopods have been recorded from Bulgarian caves; at least 23 of them could be considered troglobites (Table 1). Almost all of them are endemic. They live in a number of caves (ca. 90 Bulgarian caves are known to contain troglobitic isopods), mostly in Stara Planina and the Rhodopes, but also in isolated localities in Ruse and Blagoevgrad areas, and in Strandja. The troglobitic Isopoda belong mostly to the family Trichoniscidae (*Hyloniscus*, *Trichoniscus*, *Balkanoniscus*, *Rhodopioniscus*, *Bureschia*, *Bulgaronethes*, *Cyphoniscellus* = *Bulgaroniscus*, *Tricyphoniscus*, *Beroniscus*, *Vandeloniscellus*, *Alpioniscus* = *Illyrionethes*; in total not less than 21 troglobites). Only one of the remaining seven families of terrestrial isopods, found in Bulgarian caves, contains troglobites: Styloniscidae, with two species, the northernmost record for this family.

Arachnida. The arachnids are represented in Bulgarian caves by seven orders: Palpigradi, Scorpiones, Pseudoscorpiones, Opiliones, Araneae, and two orders of Acari. The Palpigradi are tiny, white, archaic animals. In Bulgaria they have been so far recorded from three caves in Western Stara Planina: Samuilitsa near Kunino, Mecha Dupka near Salash, and the pothole Randjolova Tarsha near Prevala (Montana District). They are unknown in Bulgaria outside the caves. Scorpions (*Euscorpius* spp., Euscorpiidae) are rarely found in the Balkan caves, mainly near the entrances; they are troglloxenes. Among the pseudoscorpions, on the contrary, there are many troglobites; 15 species have been recorded from Bulgarian caves, including seven troglobites of the genera *Chthonius*, *Neobisium*, *Balkanoroncus*, and *Roncus* (Table 1). Pseudoscorpions found in many Bulgarian caves are deposited in NMNH; this abundant material collected is still under study.

One of the most numerous and important groups of animals in Bulgarian caves are spiders (Araneae). They are well known in Bulgaria, thanks to Pencho Drensky (before the World War II) and now to Christo Deltshev and his team. About 80 species of spiders have been recorded from the Bulgarian caves but only six are troglobites (*Porrhomma microps*, *Centromerus bulgarianus*, and *Troglohyphantes drenskii*, Linyphiidae; *Protoleoneta bulgarica* and *P. beroni*, Leptonetidae; and *Nesticus beroni*, Nesticidae). Of the 17 families of spiders in Bulgarian caves the most numerous is Linyphiidae, containing ca. 30 species, including three troglobites and many common troglphilic from the genera *Centromerus*, *Troglohyphantes*, *Lepthyphantes*, *Porrhomma*, and others. They are small spiders, often found among stones on the cave floor and on rotten wood. The larger troglphilic spiders are found most often near the entrances. They belong to genera *Tegenaria* (Agelenidae), *Meta* (Metidae), and *Nesticus* (Nesticidae). Spiders play an important role in the food chain of cave communities.

Out of 61 species of harvestmen (Opiliones) known in Bulgaria, 22 have been recorded from Bulgarian caves; four of them are troglobites. *Paralola buresi*

from the caves near Lakatnik is the only representative of the family Phalangodidae and of the entire suborder Laniatores in Bulgarian caves. *Paranemastoma (Buresiolla) bureschi* is known from caves in Western Stara Planina. There are two members of the short-legged suborder Cyphophthalmi: *Tranteeva paradoxa* from the caves Rushovata near Gradeshnitsa and Toplya near Golyama Zhelyazna, and *Siro beschkovi* from Haidushkata Peshtera near Deventsi. The most common troglophile is *Paranemastoma radewi* (Palpatores: Nemastomatidae). The remaining species are occasional visitors to the caves.

The large group of mites and ticks (Acari) is not well represented in caves. Many mites (Acariformes and Parasitiformes) live in the guano but there are no troglobites among them. The only mites which to some extent meet the requirements for the "troglobite" category are some Trombidiidae from the Dinaric Karst and some species of Rhagidiidae (white mites, running fast on the cave clay). Often on the cave walls are seen flat, long-legged ticks. They are the males of a specific parasite on bats (host-specific, not infesting humans), *Ixodes vespertilionis* (Ixodidae). The bats are hosts also of other parasitic mites but they are not true cave dwellers.

Myriapoda. The four classes forming the large group of Myriapoda are unevenly represented in caves. The small Symphyla and Pauropoda are almost unknown there but the centipeds (Chilopoda) and even more the millipeds (Diplopoda) are among the most important cave animals. Chilopoda are represented by 28 species from Bulgarian caves (two of the order Geophilomorpha, two of Scolopendromorpha, one of Scutigermorpha, and 23 of Lithobiomorpha, all from the family Lithobiidae). Five *Lithobius* are troglobites (Table 1); particularly widespread is *L. lakatnicensis*, known from 16 caves in Stara Planina and the Rhodopes. In Vodnata Peshtera near Tserovo lives the large troglobite *Eupolybothrus andreevi*.

The millipeds (Diplopoda) are among the most interesting cave animals (along with the beetles, the isopods, and the pseudoscorpions). So far, 54 species have been recorded from Bulgarian caves (about half of the species of this class living in Bulgaria), 17 of them being troglobites. Of the small, white, rolling in a ball, representatives of Glomerida only *Trachysphaera orghidani lakatnicensis* from the caves near Lakatnik and from Tamnata Dupka near Targovishte (Vidin District) is considered a troglobite; however *T. dobrogica*, described from Northern Dobrudja in Romania, could be expected in Southern Dobrudja in Bulgaria as well. Species of the order Polydesmida are often found in Bulgarian caves (13 species and four subspecies). Of those, troglobites are *Brachydesmus radewi* of Polydesmidae and two endemic subspecies of the family Trichopolydesmidae, *Bacillidesmus bulgaricus bulgaricus* from the caves near Tsar Petrovo and Dolni Lom and *B. b. dentatus* from Drashanskata Peshtera. Several interesting troglobites are known among the Anthroleucosomatidae (order Chordeumatida, or Ascospermophora). Such are the inhabitants of the caves of Stara Planina (*Bulgarosoma bureschi* in Ledenika Cave and other species) and of Rhodopean caves (*Troglodicus meridionale*, *T. tridentifer*), the species of *Anamastigona* (= *Prodicus*) in the caves in Troyan area, Stoletovskata Peshtera in Central Stara Planina, Lepenitsa in the Western Rhodopes, caves near Paril and others. The monotypic

endemic genera *Stygiosoma* (*S. beroni* from Manailovata Peshtera) and *Bulgardicus* (*B. tranteevi* from Bankovitsa near Karlukovo) are also troglobites. The order Callipodida does not contain troglobites in Bulgarian caves but here belong four very large and typical troglaphiles: *Balkanopetalum armatum* in the caves of Western Stara Planina, and three species in the Rhodopes. *Typhloiulus* species, particularly abundant in Temnata Dupka near Lakatnik and in Vodnata Pesht near Lipnitsa, belong to order Julida (family Julidae). Of six species from genus *Typhloiulus* in Bulgarian caves, four are considered troglobites. Similar to *Typhloiulus* is the genus *Serboiulus* with one species *S. spelaeophilus* living in the caves of Northwestern Bulgaria. Often troglaphiles of *Apfelbeckiella*, *Troglocicus*, as well as *Nopoiulus kochii* (= *N. venustus*, *N. pulchellus*), are found, sometimes abundant, in bat guano. Other interesting troglobitic diplopods are currently under study.

Insecta. Many families and orders of insects avoid the cave environment. Among 15 orders of insects inhabiting Bulgarian caves, troglobites are found only among the beetles (Coleoptera: Carabidae, Cholevidae, and Curculionidae), Collembola, and Diplura (Campodeidae). The remaining 12 orders (Thysanura, Ephemeroptera, Plecoptera, Orthoptera, Psocoptera, Homoptera, Heteroptera, Hymenoptera, Siphonaptera, Diptera, Trichoptera, and Lepidoptera) contain only troglaphiles, troglaxenes, and parasites. Of more than 200 species of Collembola in Bulgaria, 41 are known from caves, and seven species are considered troglobites (Table 1). We should proceed with collecting Collembola in the Bulgarian caves, as in the neighboring Romania their number is twice as large. More spectacular are the Diplura, frail white insects with long antennae and two cerci. Only seven species of this order have been recorded (including six troglobites of genus *Plusiocampa*) but others are under study by the French zoologists Bareth and Condé. Of the other dipluran family (Japygidae) troglobites in Bulgaria so far have not been found but in the show cave Kutuki near Athens has been found the most extreme troglobite of this group.

The cave beetles (Coleoptera) have an honor to be the first terrestrial troglobites to be ever described (from Slovenia); following the growth of biospeleology, they also were the first troglobites to be described from Greece, Bulgaria, and other countries. In Bulgarian caves, the family Carabidae is represented by 16 species of genus *Duvalius*, three species and many subspecies of *Pheggomisetes* and one species of *Pterostichus* (*P. ledenikensis*), altogether 16 troglobite species (Table 1), as well as many other troglaphiles and troglaxenes. Another remarkable family is Cholevidae (formerly Catopidae), represented so far by 17 troglobite species of 13 genera of subfamily Leptodirinae (formerly Bathysciinae) (Table 1), as well as by eight "subtroglaphile" species of the genera *Choleva*, *Catops*, *Nargus*, and *Sciodrepoides*. Certain cholevids (*Beskovia* in caves near Cherepish, *Netolitzkya* in caves near Arbanasi, *Hexaurus* in Stoletovskata Peshtera) are sometimes very numerous. Others are more rare and scarce in number. Typical cases are within the Carabidae. *Pheggomisetes*, *Duvalius*, *Rambousekiella*, and other cave beetles

should not be collected excessively, as their number could decline very fast and their populations recover slowly. Most species are represented by few specimens, scattered and difficult to find without traps or bait. Cave beetles are important for zoogeography; their biology is completely unknown in Bulgaria, and is a vast field for further studies.

In the guano and litter in caves are found also other Coleoptera, of which best known are Staphylinidae. The larger black staphylinids belong usually to the genus *Quedius*, the tiny ones, to *Atheta*. In total, 27 species of Staphylinidae are recorded from Bulgarian caves but none of these are troglobites. Other families of Coleoptera found in Bulgarian caves are Dytiscidae, Hydrophilidae, Histeridae, Pselaphidae, Colydiidae, Endomychidae, Cryptophagidae, Curculionidae, and Ptinidae. Of particular biospeleological interest are Pselaphidae and Curculionidae. We could expect troglobites among pselaphids as such are known from Greece and former Yugoslavia. On plant roots in caves a careful observer may notice tiny weevils *Troglorrhynchus* (Curculionidae), three species of which are considered troglobites (Table 1).

The flying insects in caves are of limited interest; they are not troglobitic and the collected material rarely contains new species. Among the stalactites, sometime hide the large, wasplike Hymenoptera of genus *Diphyus* (= *Amblyteles*) (Ichneumonidae). Often, on the ceiling or the walls, our attention is attracted by the mothlike caddisflies (Trichoptera), 16 species of which live in Bulgarian caves. Particular attention deserve three genera of Limnephilidae: *Micropterna* (six species), *Stenophylax* (three species) and *Mesophylax* (one species), which are regular troglonexes. The remaining six species are occasional troglonexes. Some moths (Lepidoptera) also regularly occur in caves; of 17 lepidopteran species such are *Triphosa dubitata* and *T. sabaudiata* (Geometridae); some Noctuidae such as *Apopestes*, *Scoliopteryx* and others; representatives of Alucitidae (Orneodidae); and Tineidae. The latter often live in cave guano and are poorly known in Bulgaria.

Among flies (Diptera), of which 56 species are known from Bulgarian caves, typical cave dwellers belong to Muscidae, Helomyzidae, Mycetophilidae, as well as the long-legged Limnobiidae, often seen on cave walls. Wingless parasitic flies of the family Nycteribiidae can be easily seen on bat fur. Recently, *Brachytarsina flavipennis*, a species from another family of bat parasites (Streblidae), was added to the fauna of Bulgaria, thanks to the efforts of Bulgarian cave biologists.

Vertebrates are not very numerous in Bulgarian caves; rarely, frogs, toads or salamander larvae are found there. At the entrances one finds nests of pigeons, swallows, in some deep potholes nests the alpine chough (*Pyrrhocorax graculus*). This interesting bird is protected by law and its colonies are to be preserved, especially during the breeding season. Deep in caves enter mice, dormice, foxes, and other mammals.

The most interesting cave mammals are the bats (Chiroptera), of which 16 species have been recorded in Bulgarian caves (five belonging to Rhinolophidae and 11, to Vespertilionidae). Large colonies are formed by Schreibers' long-fingered bat (*Miniopterus schreibersi*) and by both large species of genus *Myotis* (*M. myotis*

and *M. blythi*). Several protected winter and summer roosts have been observed, with colonies of *Myotis capaccinii* and horseshoe bats (Rhinolophidae) of European importance. Bulgaria enjoys almost the full list of European bats and some very numerous colonies are worth protection. Visits, especially of larger groups, in bat caves like Parnitsite near Bezhanovo, are very improper. Disturbing of breeding bat colonies or winter roosts could deprive Bulgaria of this component of its biodiversity, and some Central European countries already face such a threat.

5 Zoogeographical Analysis of the Terrestrial Cave Fauna in Bulgaria

The intensive research on the cave and underground living animals in Bulgaria since 1922 accumulated a rather complete information on the composition and distribution of most of the groups of underground living animals. Time has come to formulate hypotheses about the origin and zoogeography of this fauna. Such hypotheses are due mainly to V. Guéorguiev, who analyzed the terrestrial troglobites known from Bulgarian caves. His series of papers (Guéorguiev, 1966, 1973a, 1973b) was crowned by his monograph on the origin, the formation and the zoogeography of the terrestrial troglobites of Balkan Peninsula (Guéorguiev, 1977). This remarkable book was followed by his speleozoogeographical subdivision of Bulgaria (Guéorguiev, 1992). Other attempts to analyze the distribution of the terrestrial cave fauna in Bulgaria find place in the papers of Beron (1976, 1978) and in some articles on different groups of cave animals (e.g. Deltshv, 1978).

All these papers do not deal with the stygobites. Some of the stygobites have been found in caves but most are living in the stygal hyporheic water or other parts of the underground ecosystems. The distribution and origin of the stygobites have been analyzed by several qualified Bulgarian stygobiologists (the late L. Tzvetkov, A. Petrova, and the very active explorer of cave Copepoda I. Pandourski).

In his monograph, Guéorguiev (1977) subdivided the Balkan Peninsula into four provinces (Dinaric, Aegean, Stara Planina, and Rhodopean). This subdivision remains valid but needs to be refined, especially concerning Bulgaria, and the list of the species-indicators are now much longer. According to Guéorguiev (1977), Bulgarian territory falls into two of these provinces: the Stara Planina Province (with two zones, Western and Eastern) and Rhodopean Province (also with two zones, Western and Eastern). The Stara Planina Province included also Serbia east of Morava River, and the Rhodopean Province included also Northern Greece. Beron (1976) subdivided the Stara Planina Province into seven regions, some of them provisional: Eastern Serbia, Ogosta, Iskar, Osam, Ruse, Kamchiya, and Dobrudja. Guéorguiev (1977) also delineated some special regions within his zones. In Bulgaria, these regions (indicated on Fig. 1) are:

In the Western zone of Stara Planina:

- Vrachanska Planina (the richest region in troglobites in the eastern part of Balkan Peninsula): by 1977, there were 29 terrestrial troglobites in this region, including

17 indicators: “*Cyphoniscellus*” (now *Vandeloniscellus*) *bulgaricus*, *Bulgarosoma bureschi*, *Typhloiulus longipes*, *Centromerus bulgarianus*, *Neobisium beroni*, “*Microcreagris bureschi*” (now *Balkanoronus hadzii*), *Onychiurus sensitivus*, *Plusiocampa bureschi*, *Pheggomisetes radevi*, *Ph. r. ilcevi*, *Ph. r. tranteevi*, *Ph. globiceps mladenovi*, *Duvalius beroni*, “*D. deltschevi*” (now synonym of *D. zivkovi*), *D. papasoffi*, *D. zivkovi*, *Radevia hanusi*;

- Ponor Planina: 12 troglobites, including three indicators: *Eupolybothrus andreevi*, *Pheggomisetes globiceps globiceps*, *Ph. g. cerovensisi*;
- Golyama Planina: seven troglobites, including one indicator (*Duvalius pretneri*);
- Karlukovo Region: five troglobites, one indicator (*Tricyphoniscus bureschi*);
- Vasilyovska Planina: eight troglobites, six indicators: *Tranteeva paradoxa*, *Neobisium bulgaricum*, *N. subterraneum* (now synonym of *N. bulgaricum*), *Plusiocampa gueorguievi*, *Duvalius regisborisi*, *Tranteeviella bulgarica*;
- Troyanska Planina: three troglobites, all considered indicators: “*Lindbergia*” (now *Spinophallus uminskii*, *Trichoniscus bulgaricus*, “*Prodicus*” *albus* (now *Anamastigona alba*); “*Lindbergia*” *uminskii* now is no more considered troglobite.

In the Eastern zone of Stara Planina:

- Shipchenska Planina: three troglobites, all indicators: *Duvalius balcanicus*, *Hexaurus merkli*, *H. similis*; new: *Hexaurus paradisi*, *H. shipkaensis*;
- Trevnenska Planina: three troglobites, all indicators: *Duvalius bulgaricus*, *Netolitzkya jeanneli*, *N. maneki*;
- as a new region, we can add now Kotlenska Planina, with the troglobite indicators *Duvalius kotelensis* and *Porrhomma microps*.

In Western Rhodopes:

- Batashki Rid: four troglobites, indicators: *Troglohyphantes drenskii*, *Duvalius bureschi*;
- Ravnogor: two troglobites, one indicator (*Bulgaronethes haplophthalmoides*).

In Eastern Rhodopes:

- Chernatitsa (geographically speaking, part of Western Rhodopes): two troglobites, one indicator (*Troglodicus tridentifer*);
- Dobrostan Massif (also geographically part of Western Rhodopes): three troglobites, indicators: “*Balkanoniscus*” (now *Rhodopioniscus*) *beroni*, *Rhodopiola cavicola*; new: *Nesticus beroni*;
- Trigrad Plateau (also geographically part of Western Rhodopes): indicator: “*Bulgarosoma*” (now *Troglodicus*) *meridionale*.

Several species have been added to the list 30 years since the publishing of the book of Guéorguiev (1977).

Almost no genera and species in common exist between the Eastern and the Dinaric parts of the Balkan Peninsula delineated by Guéorguiev. The two provinces in the Eastern part of the Peninsula (Stara Planina and Rhodopes) have very few indicator genera and species in common. Such is *Lithobius lakatnicensis* (Chilopoda; Rhodopes and Stara Planina). Some genera, previously believed to inhabit both

Stara Planina and the Rhodopes, proved to be separate, and the Rhodopean species have been placed in new genera (*Rhodopioniscus*, *Rhodoposoma*).

Guéorguiev (1992) considered how his general zoogeographical subdivision of Bulgaria of 1982 fits with the biospeleological subdivision. In addition to two zoogeographical zones, Bulgaria was subdivided into seven regions, and their troglobitic fauna has been tested by the index of Czekanowski–Sørensen. Since the paper of Guéorguiev (1992) is in Bulgarian, it is worth to summarize its main conclusions. Moreover, this paper was submitted in 1989, and meanwhile several new troglobites and interesting troglaphiles were added to the Bulgarian cave fauna. The zoogeographical regions are characterized as follows:

1. *Danubian Region*. The cave fauna consists of 26 troglaphiles (troglaxenes not included) and only two troglobites: *Trichoniscus tranteevi* (Isopoda) and *Plusiocampa beroni* (Diplura) (Table 1). No similarity with the troglobites of any other region.
2. *Stara Planina Region*. The richest cave fauna in Bulgaria (total 191 species, including 103 troglaphiles and 88 troglobites). Also the richest region in endemics. Closest similarity with Rila–Rhodopean Region. The troglobitic fauna exhibits an insignificant similarity with the Rila–Rhodopean Region, the troglobites in common being only *Lithobius lakatnicensis* (Chilopoda), *Plusiocampa bulgarica* (Diplura), and *Pseudosinella duodecimocellata* (Collembola).
3. *Rila–Rhodopean Region*. The second richest region in Bulgaria for cave fauna. According to Guéorguiev (1992), 46 troglaphiles and 19 troglobites were recorded here. Since 1989, some other species have been added but now (end of 2006) the number of troglobite taxa in the Rila–Rhodopean Region is still only 20: *Cordioniscus bulgaricus*, *C. schmalfussi*, *Trichoniscus rhodopiense*, *Rhodopioniscus beroni*, *Bulgaronethes haplophthalmoides*, *Alpioniscus* (= *Illyri-onethes*) sp., *Nesticus beroni*, *Troglohyphantes drenskii*, *Lithobius lakatnicensis*, *Troglocidus meridionale*, *T. tridentifer*, *Stygiosoma beroni*, *Anamastigona lepenicae*, *A. delcevi*, *Plusiocampa bulgarica*, *Pseudosinella duodecimocellata*, *Duvalius bureschi*, *D. petrovi*, *D. karelhurkai*, *Rhodopiola cavicola*. Among the troglobites the most numerous are the Isopoda (six species), the Diplopoda (five species), and the Coleoptera (four species). The endemism of this fauna also places the Rila–Rhodopean Region at second place as it has 19 endemic troglobites (Balkan, Bulgarian, and local). The only troglobite in common with the Thracian Region is *Trichoniscus rhodopiense* (Isopoda), and in common with the Stara Planina are *Lithobius lakatnicensis*, *Pseudosinella duodecimocellata*, and *Plusiocampa bulgarica*.
4. *Struma–Mesta Region*. Very few caves, mostly in Slavyanka Mts. Three cave animals are quoted by Guéorguiev: the troglobites “*Tranteevonethes gueorguievi*” (Isopoda) (*nomen nudum*, now *Alpioniscus* sp. n.) and *Anamastigona delcevi* (Diplopoda) and the troglaphile “*Lepthyphantes gueorguievi*” (Araneae, now *L. spelaeorum*). We can add to them now some remarkable troglobites from the cave Stoikova Dupka 1 in Slavyanka (still

under study), including *Duvalius joakimovi* and a new species of *Troglohyphantes* (Araneae), also *Duvalius pirinensis* from Pirin.

5. *Thracian Region*. Guéorguiev (1982) included here also the Eastern Rhodopes. The intensive recent research in this area (Beron et al., 2004) added new species to the list of the troglaphiles and troglobites of Eastern Rhodopes, the area little studied previously. The actual list of troglobites in the Eastern Rhodopes is as follows: *Trichoniscus rhodopiense* (Isopoda), *Lithobius tiasnatensis* (Chilopoda), *Duvalius petrovi*, *Bureschiana drenskii*, *Troglorrhynchus angelovi*, *T. beroni* (Coleoptera). To this list we should add troglobites found in the caves of the Greek part of Eastern Rhodopes: *Alpioniscus thracicus* (Isopoda), *Maroniella beroni* (Coleoptera). Some interesting troglaphiles in the region are *Balkanopetalum petrovi*, *Apfelbeckiella trnowensis rhodopina*, *Rhodopiella beroni* (Diplopoda), *Balkanodiscus frivaldskyanus*, *B. cerberus* (Mollusca).
6. *Pontian Region* (in Guéorguiev, Black Sea Coast Region). Very few caves, only one troglaphile: the spider *Meta bourneti*, common with Strandja and Thrace.
7. *Strandja Region*. According to Guéorguiev (1992), the cave fauna consists of 21 troglaphiles (6 of them endemics) and four troglobites: *Trichoniscus valkanovi*, *T. beroni* and “*T. tashevi*” (nomen nudum) (Isopoda) and *Lithobius (Monotarsobius) bifidus* (Chilopoda). All troglobites are Bulgarian endemics.

6 Endemics in the Cave Fauna of Bulgaria

Mollusca. The most important group of terrestrial Gastropoda in Bulgarian caves are Zonitidae; of ca. 33 species found in Bulgaria, one-third (11 species) live in caves. Four of them can be considered endemic (Table 1). Two slugs also seem to be endemic: *Derocheras bureschi* (H. Wagner) and *Tandonia kusceri* (H. Wagner), but they are not troglobites.

Isopoda: Oniscidea. Zoogeographically, and from the point of view of cave evolution, the terrestrial Isopoda are among the most important and interesting groups in Bulgarian cave fauna. Of 24 genera and 50 species (including 26 troglobites) of cave isopods in Bulgaria, seven genera (*Balkanoniscus*, *Rhodopioniscus*, *Bureschia*, *Bulgaronethes*, *Bulgaroniscus*, *Vandeloniscellus*, *Tricyphoniscus*, all belonging to Trichoniscidae) and 31 species are endemic for Bulgaria. With 32 species in caves (including 24 out of 26 isopod troglobites), Trichoniscidae is the family by far the most important among Bulgarian cave isopods. Of these 32 species, 26 are Bulgarian endemics (see Table 1 for endemic troglobites). The only two other troglobites (*Cordioniscus bulgaricus* Andreev and *C. schmalfussi* Andreev) belongs to Styloniscidae. Both are Bulgarian endemics (Table 1), respectively for Boichovata Peshtera on the border with Republic of Macedonia and for the Rhodopes. Of the 32 species of Trichoniscidae, 26 are endemic for Bulgaria (four species of *Hyloniscus*, 14 *Trichoniscus*, *Alpioniscus* sp., *Balkanoniscus corniculatus* Verhoeff, *B. minimus* Vandel, *Rhodopioniscus beroni* (Vandel), *Bureschia bulgarica* Verhoeff, *Bulgaronethes haplophthalmoides* Vandel,

Cyphoniscellus gueorguievi (Vandel), *Vandeloniscellus bulgaricus* (Vandel), *Tricyphoniscus bureschi* Verhoeff, *Beroniscus capreolus* Vandel, and *Monocyphoniscus bulgaricus* Strouhal), and three are Balkan endemics (*Trichoniscus stankovici* Pljakic, *T. semigranulatus* Buturovic, *T. rhodopiense* Vandel).

Some other families of Oniscidea also contain endemics (troglonexes): the Balkan endemic *Ligidium herzegowinense* Verhoeff (Ligidiidae), Bulgarian endemics *Trachelipus bulgaricus bulgaricus* Verhoeff and *T. b. bureschi* Verhoeff (Trachelipidae), *Chaetophiloscia hastata* Verhoeff (Philosciidae), *Porcellium balkanicum* Verhoeff (Porcellionidae), and *Armadillidium elysii* Verhoeff (Armadillidiidae).

Pseudoscorpiones. The Bulgarian endemics include seven troglobite species (Table 1), with a subgenus *Heoblothrus* endemic to Stara Planina, and also *Neobisium* (*N.*) *intermedium* Mahnert from Eastern Predbalkan (Prolazkata Peshtera). A Balkan endemic is *Roncus parablothroides* Hadži.

Opiliones. Of 22 species of harvestmen known from Bulgarian caves, six are Bulgarian endemics, including all four troglobites (Table 1), and also *Dicranolasma thracium* Starega and *Histicostoma drenskii* Kratochvil. The species *Leiobunum rumelicum* Šilhavý, *Pyza bosnica* (Roewer), and *Rafalskia olympica* (Kulczyński) are Balkan endemics. The troglophile *Paranemastoma radewi* (Roewer) is a Balkan endemic widespread in Bulgaria but also known from Bosnia and Northern Greece.

The four troglobites (Table 1) are confined to Stara Planina and the Predbalkan west of Troyan and are among the most remarkable cave animals in Bulgaria. The monotypic troglobite genera *Paralola* and *Tranteeva* are endemic for Bulgaria. *Paranemastoma* (*Buresiolla*) *bureschi* (Roewer) lives in many caves in Western Stara Planina and, most certainly, in Western Confines (now Serbia), as we found it at the very border. *Siro beschkovi* is a member of a cyphophthalmid genus with many species in the Balkans, and is known so far only from one cave in the Eastern Predbalkan.

Araneae. Of 80 species of cave spiders in Bulgaria, 20 are considered here to be local, Bulgarian, or Balkan endemics. According to Deltšev (1996), the linyphiid genus *Antrohyphantes* is related to *Fageiella* from the western part of the Balkan Peninsula and is therefore an ancient (paleoendemic) element. Also, according to the same author, “the group of cave endemic spiders has similar presence, 17 (39.4%) as the group of high altitude spiders”. Six troglobite species belong to Leptonetidae, Linyphiidae, and Nesticidae, and their endemic status are listed in Table 1. In addition to the troglobites, we list below other endemic spiders found in Bulgarian caves. The most diverse are Linyphiidae, which include: *Centromerus lakatnikensis* (Drensky), a Balkan endemic (Western Stara Planina, Republic of Macedonia); *C. milleri* Deltšev, a Balkan endemic (Eastern Rhodopes); *C. acutidentatus* Deltšev, a Bulgarian endemic (South Pirin); *Palliduphantes byzantinus* (Fage), a Balkan endemic; *P. istrianus* (Kulczyński) (= *slivnensis* Drensky), a Balkan endemic; *P. trnovensis* (Drensky), a Balkan endemic (Stara Planina, Republic of Macedonia); *Tenuiphantes jacksonoides* (van Helsdingen), a Bulgarian endemic (Western Rhodopes); *Antrohyphantes sophianus* (Drensky) (= *Lepthyphantes*

tranteevi Miller), a Bulgarian endemic (Western Stara Planina); *A. balcanicus* (Drensky), a Balkan endemic (Central Stara Planina, Republic of Macedonia); *A. rhodopensis* (Drensky) (= *A. rodopicus* Dumitrescu), a Bulgarian endemic (Western Rhodopes); and *Troglohyphantes bureschianus* Deltshv, a Bulgarian endemic (Western Rhodopes). Also recorded are three Bulgarian endemic species of Agelenidae: *Histopona tranteevi* Deltchev, Western Rhodopes; *Coelotes drenskii* Deltshv, Eastern Stara Planina; *C. jurinitschi* (Drensky), Western Stara Planina; one Balkan endemic species of Amaurobiidae, *Calobius balcanicus* (Drensky); and one Balkan endemic subspecies of Liocranidae, *Mesiotelus cyprius scopensis* Drensky.

Diplopoda. Four genera (*Rhodoposoma*, *Troglocidicus*, and *Stygiosoma* from Western Rhodopes and *Bulgardicus* from the caves near Karlukovo in the Predbalkan) and all 16 species of troglobitic Diplopoda in Bulgaria (Table 1) are (so far) Bulgarian endemics; this list includes also two endemic diplopod subgenera, *Balkandicus* (genus *Anamastigona*) and *Inversotyphlus* (genus *Typhloiulus*). The following non-troglobitic diplopod taxa seem also to be endemics: order Glomerida, Glomeridae: *Glomeris balcanica* Verhoeff (= *G. bureschi* Verhoeff, = *G. latemarginata* Attems), a Balkan endemic; order Polydesmida, Polydesmidae: *Polydesmus herzogowinensis* Verhoeff, Balkan endemic; *P. renschi* Schubart, *P. zonkovi* Verhoeff, *P. bureschi* Verhoeff, and *Brachydesmus cristofer* Strasser, Bulgarian endemics; *B. herzogowinensis reflexus* Strasser, *B. h. trifidus* Strasser, *B. h. confinis* Strasser, and *B. dadayi brusenicus* Gulička, Bulgarian endemic subspecies; Paradoxosomatidae, *Metonomastus pomak* Golovatch et Stoev, a Bulgarian endemic (Eastern Rhodopes); order Chordeumatida, Mastigophorophillidae: *Mastigona bosniensis* (Verhoeff), a Balkan endemic; Haaseidae: *Haasea (Histrosoma) vidinensis* (Strasser), Bulgarian endemic species and subgenus; Anthroleucosomatidae: *Rhodoposoma rhodopinum* (Strasser), Bulgarian endemic genus and species (Rhodopes); order Julida, Julidae: *Leptoiulus borisi* Verhoeff, a Bulgarian endemic; *Typhloiulus kotelensis* Jawlowski, Eastern Stara Planina; *Megaphyllum rhodopinum* (Verhoeff) and *M. beroni* (Strasser), Rhodopes; *Balkanophoenix borisi* Verhoeff, Western Stara Planina; *Pachyiulus hungaricus gracilis* Verhoeff, Rhodopes, endemic subspecies; *P. cattarensis* (Latzel), a Balkan endemic; *Apfelbeckiella trnowensis* (Verhoeff) and its subspecies *A. t. rhodopina* Strasser and *A. t. deliormana* Strasser, Bulgarian endemics; *A. byzantina* Verhoeff, a Balkan endemic; *Rhodopiella beroni* Strasser, a Bulgarian endemic genus and species; order Callipodida, Schizopetalidae, five troglophile species of *Balkanopetalum* (Table 1).

Chilopoda. Of 44 species of this class found in Bulgarian caves, 14 are endemics (nine Bulgarian and five Balkan). Six troglobite endemic taxa are listed in Table 1. Other species are: order Lithobiomorpha, Lithobiidae: three Balkan endemics, *Lithobius beroni* Negrea (Bulgaria and Greece), *L. stygius* Latzel, and *L. wardaranus* (Verhoeff); *Harpolithobius folkmanovae* Kaczmarek, a Bulgarian endemic (South-eastern Bulgaria); *H. banaticus rhodopensis* Kaczmarek, an endemic subspecies (Rhodopes); and *Eupolybothrus gloriastygis* (Absolon), a Balkan endemic (Bulgaria

and Bosnia; known from two caves in Western Stara Planina); order Geophilomorpha, Himantariidae: *Thracophilus beroni* Matic et Darabanþu, Western Rhodopes; *Th. bulgaricus* Verhoeff (Western Rhodopes and Sredna Gora); and order Scolopendromorpha, Cryptopidae: *Cryptops croaticus* Verhoeff, a Balkan endemic.

Insecta. Among springtails (Collembola), there are eight Bulgarian endemics in the caves of Bulgaria, of which six are troglobites: three species of Entomobryidae (genus *Pseudosinella*), and three species of Onychiuridae (Table 1). In addition to troglobites, the list of endemic springtails found in caves includes *Onychiurus bureschi* Handschin and *O. subgranulosus* Gama (Onychiuridae) from Western Stara Planina, and *Bilobella digitata* Cassagnau (Neanuridae) from Eastern Stara Planina.

The order Diplura includes so far six Bulgarian endemic troglobites, all belonging to the genus *Plusiocampa* (Campodeidae) (Table 1).

The order Orthoptera is represented by some troglloxenes and a single troglophile species, the Balkan subendemic *Troglophilus neglectus* Krauss (Rhaphidophoridae).

Among beetles (order Coleoptera), the family Carabidae has 44 species of ground beetles recorded from the Bulgarian caves. Two genera are Bulgarian endemics, both in Western Stara Planina: *Rambousekiella* and *Pheggomisetes*. *Pheggomisetes* is practically a Bulgarian endemic since it was found also in one cave in Eastern Serbia. It is represented by several endemic troglobite species (Table 1). Another important genus is *Duvalius*, with 16 troglobite species endemic for Bulgaria (Table 1). Three other species of *Duvalius* (*Paraduvalius*) have been described from the MSS (Milieu souterrain superficiel) and other localities outside the caves: *D. hanae* Húrka from Central Balkan, *D. marani* (Knirsch) from Slavyanka, and *D. rajtchevi* (Genest et Juberthie) from Western Rhodopes.

Among Staphylinidae, only two species (*Quedius troglophilus* and *Qu. gueorguievi*), described by H. Coiffait from Bulgaria, are so far endemic for this country. They are not typical cave animals. Pselaphidae include only one (troglloxenic) species, *Bryaxis beroni* Z. Karaman, which seems to be a Bulgarian endemic (Western Bulgaria). Among weevils (Curculionidae), all three species of hypogeous weevils reported from Bulgaria are so far Bulgarian endemics (Table 1).

The highest endemism at the generic level in Bulgarian cave fauna is represented in the beetle family Cholevidae (= Leiodidae). Far from being completely known in Bulgarian caves, this family is represented there by 29 species belonging to 19 genera. Of these, 12 genera and 19 species are Bulgarian endemics (Table 1), including monotypic *Beronia*, *Radevia*, *Vratzaniola*, *Balcanobius*, *Beroniella*, *Tranteeviella* (= *Bulgariella*), and *Genestiellina*; *Hexaurus* is represented by four species, and *Netolitzkya*, by two species and four subspecies. All 12 genera are very narrow endemics, found in certain areas within Bulgaria (Table 1). All these genera belong to the subfamily Leptodirinae (= Bathysciinae).

Of the order Siphonaptera, only subspecies (so far endemic for Bulgaria) of two species of fleas have been described from Bulgarian cave bats: *Nycteridopsylla ancylyris johanae* Húrka and *N. trigona balcanica* Húrka.

7 Relicts in the Cave Fauna of Bulgaria

7.1 The issue of relicts

The issues of the relicts and the ancient age of troglobites are still open. According to Jeannel (1944, 1960), followed by Vandel (1964) and Guéorguiev (1977), there was no doubt that the paleotroglobites are very ancient and have no relatives among the recent animals living outside the caves. On the contrary, the neotroglobites still have relatives outside the caves and their evolutionary connection can be traced via intermediary forms. According to Leleup (1965), the main lineages of South European troglobites have their origin in the orophilic pre-Pleistocene fauna, very ancient and very rich, living in land habitats which formed in remote geological periods. Vandel (1964) stated that “terrestrial troglobites are mostly descendents of a tropical fauna populating Europe and North America in the first half of the Tertiary”; we have to keep in mind that the Paleogene (the first part of the Tertiary) occupied the time between 67 and 25 Mya!

Brignoli (1979) opposed this assertion, taken for a long time as axiomatic. This early deceased, prominent Italian specialist wrote: “. . . It is not true at all (or, at least, it is not for sure) that the troglobites are ancient”. And, further: “. . . The term of “relict” (or even of “living fossil”), so often applied to the troglobites, is for me completely meaningless”. However, other prominent specialists did support the opinion about the ancient nature of the troglobites. According to Beier (1969), “. . . the troglobite species show a high degree of specialization, and are without doubt to be considered relicts from the Tertiary”.

Guéorguiev (1977) was a firm supporter of the theories of Jeannel and Vandel and his classification of the troglobites according to their origin will be resumed here, completed with some new data. The present author also thinks that the assertions of Brignoli are exaggerated, and that relicts do exist. Which troglobite is ancient and which is more recent is of course matter of analysis.

7.2 Descendents of Gondwanan phyletic lineages

Among the most ancient Balkan relicts are members of the genus *Cordioniscus* (Isopoda: Styloniscidae). Two troglobite species found in Bulgaria (*Cordioniscus bulgaricus* Andreev and *C. schmalzfussi* Andreev), mark the northernmost localities of this family in Europe. The endemic troglobite genus and species *Tranteeva paradoxa* Kratochvil (Opiliones: Cyphophthalmi: Sironidae) from the caves of the Predbalkan is also considered a Gondwanan relict.

7.3 Descendents of Laurasian phyletic lineages

Guéorguiev (1977) considered as Laurasian relicts some spiders of the genus *Nesticus* and some Collembola (*Acherontides spelaeus* Ionesco, considered now a

troglophile). Bulgarian *Nesticus* species are also troglaphiles. A typical Laurasian element, according to Guéorguiev (1977), would be also the endemic genus and species *Bulgaronethes haplophthalmoides* Vandel (Isopoda: Trichoniscidae) from Western Rhodopes.

7.4 Descendents of Mesogeidean (Paleomediterranean) phyletic lineages

Isopods of the endemic genera *Balkanoniscus*, *Beroniscus*, and *Bureschia* (all in Stara Planina and the Predbalkan) are considered to be the descendents of a phyletic lineage, which inhabited in the Paleocene and early Eocene the land stretching from Cantabric Mountains to Caucasus and called Mesogeide (Guéorguiev, 1977). We should add here the genus *Rhodopioniscus*, described by Tabacaru in 1993 for the Rhodopean "*Balkanoniscus*" *beroni* Vandel. Among Diplopoda, such Mesogeidean relicts would be the glomerids *Trachysphaera orghidani* Tabacaru and *T. dobrogica* Tabacaru (not yet recorded but certainly living in Bulgarian Dobrudja). Among spiders (Araneae), such descendents are species of *Troglohyphantes* (in Bulgaria, the troglobite *T. drenskii* Deltshev and the troglaphile *T. bureschianus* Deltshev, both in Western Rhodopes).

Mesogeidean origin is presumed also for the troglobitic Opiliones *Paralola buresi* Kratochvil and *Paranemastoma (Buresiolla) bureschi* Roewer. The endemic genus *Paralola* (Phalangodidae) and its only species *P. buresi* from the caves near Lakatnik in Western Stara Planina represent in Bulgaria the (mostly tropical) suborder Laniatores. Among terrestrial troglobites, this strange creature gives impression of something really very ancient and alien to the present European fauna. However, Martens (1972) wrote that the Laniatores "should not be considered any more as Tertiary relicts in the European fauna as they are widespread in the areas remaining outside the Pleistocene glaciation". Nevertheless, *Paralola* is beyond doubt a relict; its age is to be considered further. As for *Buresiolla*, it is no more considered a separate genus but a subgenus of *Paranemastoma*. The only known species in Bulgaria is also an endemic of Western Stara Planina.

Pseudoscorpions of the subgenera *Blothrus* (genus *Neobisium*) and *Parablothrus* (genus *Roncus*) also belong to the category of Mesogeidean relicts. In Bulgaria, we know *Neobisium (Blothrus) kwartirnikovi* Mahnert from the cave Duhlata near Bosnek (Vitosha).

According to Guéorguiev (1977), about one-third of all endemic troglobite genera of Cholevidae (Coleoptera) on the Balkan Peninsula are of Mesogeidean origin. In Bulgaria, these are the genera *Netolitzkya*, *Hexaurus*, *Radevia*, *Rhodopiola*, *Beronia*, and *Bureschiana*.

7.5 Paleoaegeidean (Protoaegeidean) relicts

This group includes: isopod genera *Cyphoniscellus* (species *C. gueorguievi* Vandel) and *Tricyphoniscus* (species *T. bureschi* Verhoeff), both genera from

Trichoniscidae: Haplophthalminae; here also might belong the troglobitic species of the subgenus *Stygiocampa* (Diplura: Campodeidae: *Plusiocampa*), found in Bulgaria in Stara Planina and the Rhodopes.

7.6 North Aegeidean relicts

Most terrestrial troglobites of Balkan Peninsula belong to this category, due to the fact that major parts of former Yugoslavia, of Bulgaria and of Greece were located for long periods during the Tertiary within the landmass of Northern Aegeide (Guéorguiev, 1977).

Many genera of different groups which are listed by Guéorguiev (1977) in the categories of the descendents of Gondwanan phyletic lineages (*Tranteeva*), Laurasian phyletic lineages (*Bulgaronethes*) or of the descendents of Mesogeidean (Paleomediterranean) phyletic lineages (*Balkanoniscus*, *Bureschia*, *Buresiolla*, *Paralola*) or the Paleoaegeidean (Protoaegeidean) relicts (*Tricyphoniscus*) are considered by Guéorguiev (1977) also the North Aegeidean relicts. This assertion needs clarification. Further, as North Aegeidean relicts are considered also the following genera: Isopoda (*Hyloniscus*), Diplopoda (the anthroleucosomatids *Bulgarosoma*, *Stygiosoma* and the subgenus *Balkandicus*, and the julids *Typhloiulus*, *Serboiulus*, and *Apfelbeckiella*), and Opiliones (*Siro*). The endemic pseudoscorpion subgenus *Heoblothrus* (genus *Neobisium*) from Stara Planina can be also placed in this group, as well as the species of genus *Balkanoroncus*, not known to Guéorguiev by 1977. These are two species living in the caves of Stara Planina and the Predbalkan, *B. bureschi* and *B. hadzii*. Among beetles, here belong the species of genus *Pheggomisetes* (Carabidae) and the genera *Beskovia*, *Tranteeviella*, *Balcanobius* (Cholevidae). We may add the newly described cholevid genera *Beroniella* and *Vratzaniola*; the remarkable genus *Genestiellina* is also a North Aegeidean relict.

7.7 South Aegeidean relicts

The only Bulgarian "*Lindbergia*" ("*L.* *uminskii* Riedel, a gastropod from Central Stara Planina) is now considered to represent a separate genus *Spinophallus* but still of South Aegeidean origin.

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