

A review of the family Linyphiidae (Araneae) in Bulgaria, faunistic and zoogeographical analyses

Обзор пауков семейства Linyphiidae (Araneae) Болгарии, фаунистический и зоогеографический обзоры

C. DELTSHEV
Х. ДЕЛЧЕВ

Institute of Zoology, Bulgarian Academy of Sciences, 1, Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria. email: cdeltshev@zoology.bas.bg

ABSTRACT. The Linyphiidae fauna of Bulgaria numbers 218 species in 92 genera, based on the current synopsis both of original data and all literature-derived records. Species of Linyphiidae are distributed in all districts of Bulgaria, occurring in lowlands, forests, mountains and caves. Reasoning from the known distribution of the Bulgarian linyphiids, the fauna can be considered in terms of 19 zoogeographical categories and five chorological complexes (Cosmopolitan, Holarctic, European, Endemics, Mediterranean). The widespread Holarctic species predominate, whereas the endemics (28 altogether) make up the most characteristic element of the fauna. The high level of endemism of the Bulgarian linyphiids can be attributed to the relative isolation of mountainous regions compared to the lowlands, in the context of palaeo-environmental changes since the Pliocene.

РЕЗЮМЕ. Согласно последней сводке оригинальных и всех литературных данных, фауна Linyphiidae Болгарии насчитывает 218 видов из 92 родов. Виды Linyphiidae распространены во всех районах Болгарии и обитают в низинах, лесах, горах и пещерах. Исходя из данных по известному распространению болгарских линифид, фауна может быть подразделена на 19 зоогеографических групп и пять хорологических комплексов (космополитический, голарктический, европейский, эндемичный и средиземноморский). Хотя широкораспространенные голаркты преобладают, эндемики (всего 28) составляют характерный элемент фауны. Высокий уровень эндемизма болгарских линифид объясняется за счет относительной изолированности гор (в сравнении с низинами) в контексте палео-климатических изменений начиная с Плиоцена.

KEY WORDS: spiders, Linyphiidae, faunistics, zoogeography, distribution, Bulgaria.

КЛЮЧЕВЫЕ СЛОВА: пауки, Linyphiidae, фаунистика, зоогеография, распространение, Болгария.

Introduction

The Bulgarian fauna of the family Linyphiidae is comparatively well studied, and the early work of Drensky [1936] in his “Katalog der echten Spinnen (Araneae) der Balkanhalbinsel” reported 114 species in 46 genera. More recent

publications [Blagoev & Deltshev, 2002; Deltshev, 1972, 1973a,b, 1974, 1975a,b, 1980, 1983a,b,c, 1984, 1985, 1987, 1988a,b, 1990, 1992, 1995, 1996, 1998, 1999, 2000; Deltshev & Blagoev, 1992, 1997, 2001; Deltshev & Ćurčić, 1997, 2002; Deltshev *et al.*, 2003; Helsing *et al.*, 1977, 2001; Lazarov *et al.*, 2001;



Fig. 1. The geographical regions and districts of Bulgaria. Abbreviations are given above in 'Study area and material' [after Hubenov, 1997].

Рис. 1. Географические регионы и дистрикты Болгарии. Сокращения даны выше в 'Study area and material' [по Hubenov, 1997].

Thaler *et al.*, 1994] resulted from intensive faunistic investigations post 1966. This accumulation of new data made possible the critical taxonomic and faunistic reviews, together with the zoogeographic analysis presented herein.

Study area and material

Bulgaria is situated in south-eastern Europe in the eastern part of Balkan Peninsula and covers an area of 110 993 km². The northern border follows the river Danube, excluding its delta. In the north-east it borders Romania, crosses Dobrudzha and reaches the Black Sea coast. The eastern border follows the Black Sea coast to the mouth of the Resovska river and is shared in the south-east with Turkey. In the south, Bulgaria borders Greece from the Maritsa river to peak Tumba of Belasitsa mountain. The western border is shared with Macedonia and Serbia from peak Tumba to the mouth of the river Timok (Fig. 1).

The material treated herein consists of two major parts: (1) the original collections obtained from 1965–1992 during a field survey covering most of the districts in Bulgaria (Fig. 1); and (2) a complete critical synopsis of all the available literature records regarding the distribution of linyphiids in Bulgaria.

The geographical regions of Bulgaria and their corresponding abbreviations are adopted from Hubenov [1997] (see Fig. 1): DW = western Danubian plain; DM = middle Danubian plain; DE = eastern Danubian plain; DEL = Ludogorie-Dobrudzha district; Dep = Popovo-Providia district; SPW = western Predbalkan; SPM = middle Predbalkan; SPE = eastern Predbalkan; SBW = western Stara planina Mt.; SBM = middle Stara planina Mt.; SBE = eastern Stara planina Mt.; PKR = Rouy Mt.; PKG = Golo Burdo Mt.; PKV = Verila Mt.; PKK = Kraishte; PKZ = Zemenska planina Mt.; PKQ = Konyavska planina Mt.; PVS = Sofia basin; PVL = Lyulin Mt.; PVV = Vitosha Mt.; PVP =

Table 1.

Comparison of land area and Linyphiidae species richness of some European countries.

Таблица 1.

Сравнение территории и видового богатства Linyphiidae некоторых европейских стран.

Country	Area (km ²)	Richness	Sources
Bulgaria	110 993	218	[present data]
Austria	83 858	364	[Blick <i>et al.</i> , 2002]
Czech Republic	77 280	300	[Buchar & Růžička, 2002]
Hungary	92 340	191	[Samu & Szinetár, 1999]
Greece	128 900	65	[Bosmans, pers. data]
Portugal	91 500	75	[Cardoso, 1999]
Serbia	102 000	154	[Deltshv <i>et al.</i> , 2003]

Plana Mt.; PSP = Podbalkan basin; PSI = Ihtimanska Sredna Gora Mt.; PSL = Lozenska planina Mt.; PSC = Sushtinska Sredna Gora Mt.; PSA = Surnena Sredna Gora Mt.; PT = Thracian lowland; PBT = Sakar-Toundzha district; PBC = Sakar Mt.; PBB = Bakadzhik-Burgas district; PBD = Strandzha-Derwent district; PBS = Strandzha Mt.; ROO = Osogovo Mt.; ROV = Vlahina planina Mt.; ROM = Maleshevska planina Mt.; ROG = Ograzhden Mt.; ROB = Belasitsa Mt.; ROT = Boboshevo-Simitly valley; ROP = Krupnik-Sandansky-Petrich valley; RPR = Rila Mt.; RPP = Pirin Mt.; RPS = Slavianka Mt.; RPT = Sturgach Mt.; RPM = Mesta valley; RRW = western Rhodope Mt.; RRE = eastern Rhodope Mt.; BN = northern Black Sea coast; BS = southern Black Sea coast.

Results and discussion

Species composition

The family Linyphiidae is represented in Bulgaria by 218 species in 92 genera (Table 1). The number of linyphiid species is high compared with those recorded from other European countries with comparable territories.

The species richness, however, not only depends on the size of the region, but also on the completeness of our knowledge of its fauna. In Bulgaria, the most species rich linyphiid genera are *Centromerus* (16 species or 7.3% of the entire linyphiid fauna), *Walckenaeria* (14; 6.4%), *Tenuiphantes* (11; 5%), *Diplocephalus* (9; 4.1%).

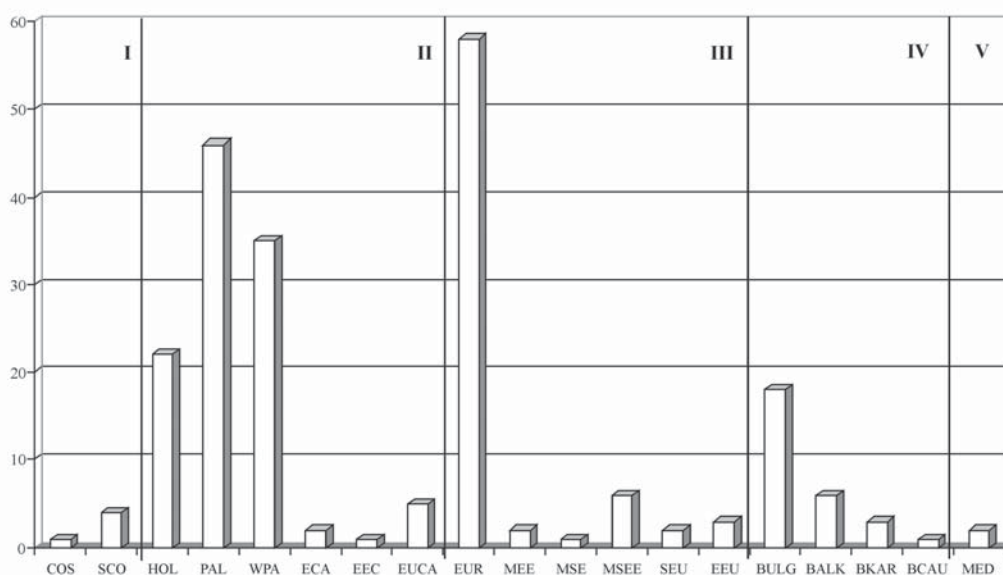


Fig. 2. Zoogeographical composition of the Bulgarian linyphiid spiders. Abbreviations, see Table 2.

Рис. 2. Зоогеографический состав болгарских линифид. Сокращения, см. таблицу 2.

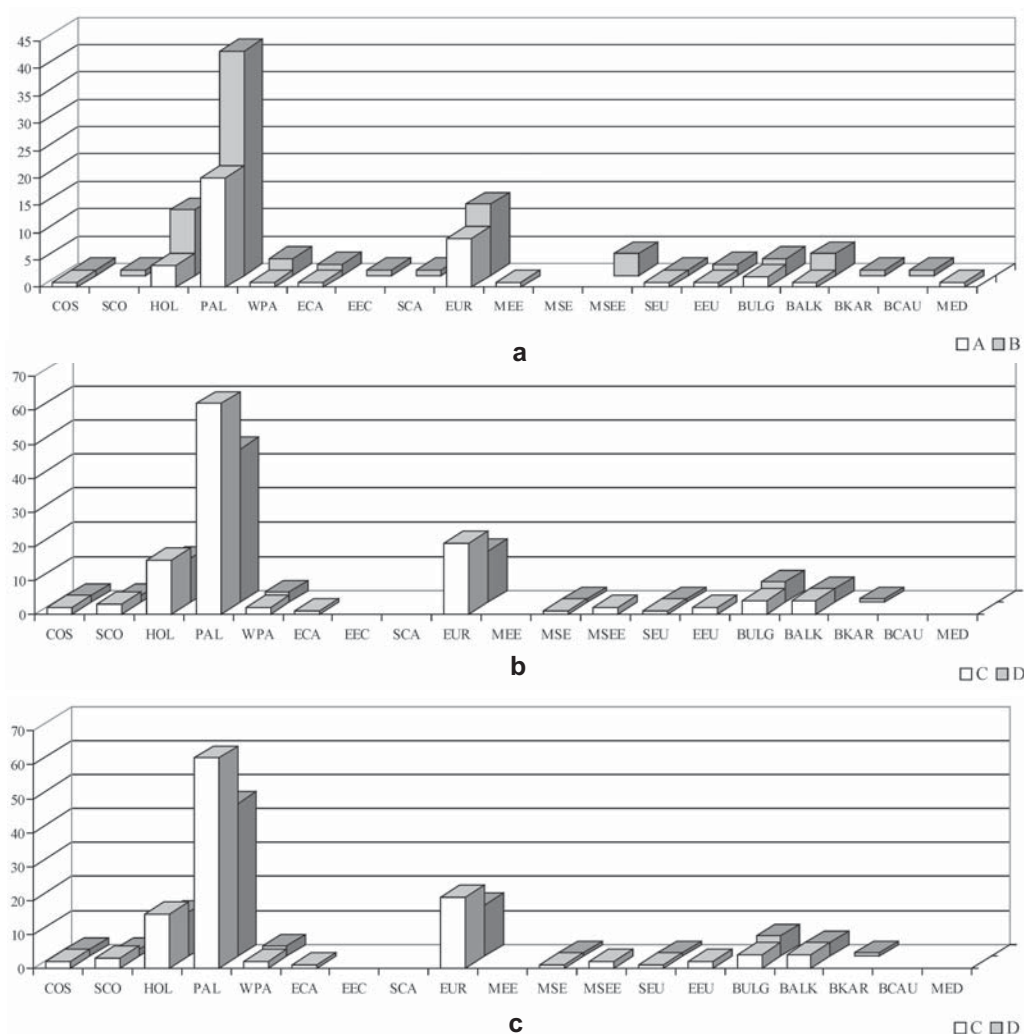


Fig. 3. Composition of chorotypes of the linyphiid spiders over the altitudinal belts of Bulgaria:
 a) A = Sub-Mediterranean: *Quercetum* (0–700 m); B = Submontane: *Quercetum*, *Carpinetum* (600–1 000 m);
 b) C = Montane-deciduous: *Fagetum* (900–1 500 m); D = Montane-coniferous: *Piceetum*, *Pinetum* (1 300–2 000 m);
 c) E = Subalpine: *Pinetum*, *Juniperetum* (2 000–2 500 m); F = Alpine: *Caricetum*, *Seslerietum* (2 500–2 925 m).

Рис. 3. Состав хоротипов пауков-линифиид по высотным поясам Болгарии:

- a) A = Субсредиземноморский: *Quercetum* (0–700 м); B = предгорный: *Quercetum*, *Carpinetum* (600–1 000 м);
 b) C = Горно-широколиственный: *Fagetum* (900–1 500 м); D = горно-хвойный: *Piceetum*, *Pinetum* (1 300–2 000 м);
 c) E = Субальпийский: *Pinetum*, *Juniperetum* (2 000–2 500 м); F = Альпийский: *Caricetum*, *Seslerietum* (2 500–2 925 м).

Zoogeographical analysis

According to their current distribution, the Bulgarian linyphiid spiders can be considered representative of 19 chorotypes (= distributional patterns), and further grouped into five chorological complexes (I, Cosmopolitan; II, Holarctic; III, European; IV, Endemic; V, Med-

iterranean). Data concerning the general distribution of spiders are adopted from Mikhailov [1997], Marusik *et al.* [2000], Platnick [2003] and Vigna Taglianti *et al.* [1999] (see Figs 2, 3a,b,c). The abbreviations used here for describing the chorotypes are explained in the legend to Table 2 (see below).

Best represented is the complex of species widely distributed in the Holarctic region (HOL + PAL + WPA + ECA + EEC + SCA), comprising 111 (50.9%) species widespread in Bulgaria (Fig. 2). The Palaearctic species (*sensu lato*) predominate (46; 41.4%), followed by the west Palaearctic (35; 31.5%) and the Holarctic species (22; 19.8%). The remaining chorotypes are represented by single species. The complex includes rather widespread species associated with lowlands, woodlands and high altitude mountainous zones. Most of the species are well represented in the mountains. The characteristic mountain elements are *Bolyphantes alticeps*, *B. luteolus*, *Frontinella frutetorum*, *Gonatium rubens*, *Pityohyphantes phrygianus*, *Tenuiphantes alacris*, *T. tenebricola*. The high altitude elements are *Entelecara media* and *Mecynargus paetulus*, which have not been recorded in the forest belt. Some xenotopic species [*sensu* Thaler, 1988] are widespread in the mountains and reach the highest summits as aeronauts. The latter group includes *Dicymbium nigrum*, *Diplostyla concolor*, *Meioneta rurestris*, *Oedothorax agrestis*, *O. apicatus*, *O. fuscus*, which inhabit the mountain zone in dense populations [Deltshev, 1990, 1995].

The European chorological complex (EUR + MEE + MSE + MSEE + SEU + EEU) comprises 72 species (33%) widespread in Europe and Bulgaria (Fig. 2). The European species (*sensu lato*) predominate (58; 80.5%); followed by the middle–south-east European species (6; 8.3%) and the east European species (3; 4.2%). The remaining chorotypes are represented by single species. The complex comprises widespread species inhabiting both the lowland and the mountains. Interesting is a group of the European mountain species best represented in the forest, the subalpine and the alpine belts. The characteristic mountain elements are: *Araeoncus anguineus*, *Bolyphantes kolosvari*, *Cinetata gradata*, *Diplocephalus foraminifer*, *Improphantes imbrotulus*, *Maso gallicus*, *Mughiphantes pulcher*, *Oreonetides glacialis*, *Tiso vagans*. The following species: *Palliduphantes istrianus*, *Centromerus capucinus*, *C. cavernarum*, *Porrhomma lativelum* and *P. microps*, are characteristic cave dwellers.

The complex of endemics (BALK + BULG + BCAU + BKAR) includes 28 species (12.8%)

recorded to date in Bulgaria, the Balkan Peninsula and the neighbouring territories of Asia Minor, the Caucasus and the Carpathians (Fig. 2). The established number is high and reflects the originality of the local fauna. The status and distribution of the endemic spiders found in Bulgaria poses a complicated question, as some of them have been found only in restricted areas, whereas others show a wider distribution, sometimes inhabiting the entire peninsula. The largest fraction of endemics was recorded mainly from caves and from the high altitude zones.

According to origin, the endemics form two groups: the palaeoendemics, which can be regarded as apparent remnants of the ancient Mediterranean mountain fauna, and the neoendemics, which seem to have migrated from the northern parts of Europe during the glacials and which evolved on the isolated mountains during the interglacials. The curious distribution of *Antrohyphantes rhodopensis*, found only in the high altitude zone and in caves, suggests a relic of the ancient Mediterranean mountain fauna [see Deltshev, 1990, 1996]. With regard to the formation of the cave fauna, Deeleman-Reinhold [1976] wrote that “many European cave spiders are probably the relics of populations of the moist Tertiary forests”. Due to a lack of knowledge, it is difficult to state with certainty which of the cave spider endemics of Bulgaria are either Tertiary or Quaternary elements. Nevertheless, the other species of the endemic genus *Antrohyphantes* (*A. balcanicus*, *A. sofianus*), as well as the blind species *Centromerus bulgarianus*, *Troglohyphantes drenskii* and *T. bureschianus* (the species with the primitive, trifold paracymbium), can also be regarded as apparent palaeoendemics [Deltshev, 1996].

The species *Araeoncus clivifrons*, *Diplocephalus altimontanus*, *Drepanotylus pirinicus*, *Erigone l. pirini*, *Incestophantes annulatus*, *Mughiphantes lithoclasticolus*, *Metopobactrus orbrelicus*, known only from the high alpine parts of Pirin and Rila, are the high alpine elements. *Tenuiphantes drenskyii*, which occurs in the high altitude belts of Pirin, Rila, central Stara Planina and Vitosha mountains, can also be included in this group. These species are regarded here as derivatives (= neoendemics) of their respective north or middle European species

(*Diplocephalus picinus*, *Drepanotylus borealis*, *Erigone longipalpis*, *Lepthyphantes armatus*, *Metopobactrus prominulus*), due to the disjunction of ranges during the glacial and interglacial periods [Deltchev, 1995, 1996, 1997, 1998].

The Cosmopolitan species complex (COS + SCO; 5; 2.3%) comprises species widespread in Bulgaria (Fig. 2). *Prinerigone vagans* is well represented in the lowlands, woodlands and the high altitude mountainous zones. *Microctenonyx subitaneus* is widespread and considered here an introduced species.

The Mediterranean species complex (MED; 1; 0.45%) includes the only species *Diplocephalus graecus* known from southern Europe and northern Africa (Fig. 2). This species is one of the commonest Mediterranean erigonines, often occurring in man-made or man-influenced habitats [Bosmans, 1996].

Vertical distribution

Vertical zonation is clearly demonstrable in Bulgaria, due to the relief and climate, characterized by specific vegetation and faunas.

The linyphiid fauna is best represented in the montane-deciduous belt (121; 55.5%) (Fig. 3b), where the Palearctic species predominate (46.2%). The species *Bolyphantes alticeps*, *B. luteolus*, *Ceratinella brevis*, *Diplocephalus picinus*, *Gonatium rubellum* are the montane elements. The European complex is also well represented (17.3%) and the species *Araeoncus anguineus*, *Diplocephalus latifrons*, *Hilaira excisa*, *Palliduphantes alutacius*, *Oedothorax gibbifer*, *Tiso vagans* can be considered as montane elements. The species *Palliduphantes spelaeorum* and *Porrhomma microps* are the cavernicolous elements. The endemics, *Antrohyphantes sophianus*, *Centromerus acutidentatus*, *C. lakatnikensis*, *Troglohyphantes drenskii* and *T. bureschianus*, should also be regarded as montane elements.

The linyphiid spiders are also abundant in the montane-coniferous belt (93; 42.6%) (Fig. 3b). Best represented are again the Palearctic and European species, with the montane elements reaching 61%. The characteristic species are: *Bolyphantes alticeps*, *B. luteolus*, *Cinetata gradata*, *Frontinellina frutetorum*, *Mansuphantes mansuetus*, *Piniphantes pinicola*, *Mi-*

crargus herbigradus, *M. subaequalis*, *Tenuiphantes alacris*. The cavernicolous elements are: *Centromerus cavernarum*, *Porrhomma microphthalmum* and *P. convexum*. The endemics are: *Antrohyphantes rhodopensis*, *Centromerus s. paucidentatus*, *C. lakatnikensis*, *Gonatium orientale*, *Lepthyphantes centromeroides*, *Mansuphantes rectilamelus*, *Tenuiphantes drenskyi*, *Troglohyphantes drenskii* and *T. bureschianus*.

The linyphiid fauna of the submontane belt has been revealed as having virtually the same number of species (91; 41.7%) as the previous group (Fig. 3a). Characteristic for the belt are the cavernicolous elements, most of which are endemics: *Centromerus bulgarianus*, *C. lakatnikensis*, *C. milleri*, *Palliduphantes byzantinus*, *P. trnovensis*. The endemics *Centromerus valkanovi* and *Pelecopsis krausi* have restricted distributions in Bulgaria. They are characteristic for the oak forest of the south Black Sea coast (*C. valkanovi*) and the Strouma river valley in southwest Bulgaria (*P. krausi*). As *C. valkanovi* is recorded both from a forest by the sea shore and from the lower part of Strandzha Mt. at 800–900 m a.s.l. (the only two known localities for the species), it is included in the group of endemics of the sub-Mediterranean belt (see below).

A total of 43 species (19.7%) (Fig. 3a) have been recorded from the sub-Mediterranean belt, with the Palearctic (46.5%) and European species (20.9%) predominating. The endemics are represented by *Centromerus milleri*, *C. valkanovi* and *Palliduphantes byzantinus*.

The subalpine belt is inhabited by 48 species (22.0%), of which some occur also in the forest zone (Fig. 3c). The Palearctic species, which are abundant in this belt, include montane elements such as *Ceratinella brevis*, *Bolyphantes alticeps*, *B. luteolus*, *Meioneta gulosa*. A group of European species comprises mainly of those typical for the high mountains of middle Europe, viz., *Araeoncus anguineus*, *Cinetata gradata*, *Diplocephalus foraminifer*, *Evansia merens*, *Improphantes improbulus*, *Mughiphantes pulcher*. The endemics include the montane (*Centromerus s. paucidentatus*, *Gonatium orientale*, *Mansuphantes rectilamelus*, *Tenuiphantes drenskyi*) and the high montane (*Araeoncus clivifrons*, *Erigone l. pirini*)

elements. The distribution of *Antrohyphantes rhodopensis* is peculiar, as the species occurs at high altitudes and in caves [Deltshev, 1990, 1995, 1997, 1999, 2000].

The alpine belt is populated by 21 species (9.6%), including mainly high altitude elements (Fig. 3c). Most characteristic are the endemic high altitude elements, *Mughiphantes lihtoclasicola* and *Metopobactrus orbelicus*, known only in the high alpine belt of Rila and Pirin, *Incestophantes annulatus*, found only from the high altitude zone of Rila, and *Diplocephalus altimontanus* and *Drepanotylus pirinicus*, recorded only from the high alpine belt of Pirin. *Araeoncus clivifrons* and *Erigone l. pirini*, which occur in the subalpine and alpine belts of both mountains [Deltshev, 1995, 1997], also belong with this group. The Holarctic species *Entelecara media* and *Mecynargus paetulus*, the Palaearctic *Scotynotilus alpigena* and the European *Improphantes improbulus* and *Oreonetides glacialis* are the high altitude elements, which can be regarded as the ancient (arctic-alpine, boreo-alpine) species.

Conclusions

The faunistic richness of 218 linyphiid spider species shows that Bulgaria is a territory of considerable species diversity. This conclusion is further supported by the existence of 28 endemic species, which reflects the originality of the local fauna.

Zoogeographically, the widespread Holarctic species predominate, but the most characteristic faunal elements remain the endemics. They reflect quite well the geological/climatological history of the region and comprise the palaeo-endemics (mainly occurring in caves) and the neoendemics (mainly occurring in the high altitude and mountain zones). The endemics originate from two principal faunistic complexes: the Mediterranean and European faunas. This phenomenon can be explained by the relative isolation of the mountains compared to the lowlands, in the context of palaeo-environmental changes that have occurred since the Pliocene.

ACKNOWLEDGEMENTS. I am especially indebted to my colleagues G. Blagoev and S. Lazarov

for discussion and helpful assistance. Two anonymous referees helped much in improving an earlier draft.

References

- Blagoev G. & Deltshev C. 2002. Check List of Bulgarian Spiders. Version 1.0. Institute of Zoology, Bulgarian Academy of Sciences, online at <http://cl.bas.bg/bulgarianspiders/>
- Blick T., Hänggi A. & Thaler K. 2002. Checklist of the arachnids of Germany, Switzerland, Austria, Belgium and the Netherlands (Arachnida: Araneae, Opiliones, Pseudoscorpiones, Scorpiones, Palpigradi). Version 2002 June 1, online at http://www.AraGes.de/checklist_e.html
- Bosmans R. 1996. The genera *Araeoncus* Simon, *Delorripis* Simon and *Diplocephalus* Bertkau in North Africa (Araneae: Linyphiidae: Erigoninae). Studies on North African Linyphiidae VII. // Belg. J. Zool. Vol.126. P.123–151.
- Buchar J. & Růžička V. 2002. Catalogue of Spiders of the Czech Republic. Edited by P. Merrett. Praha: Praha Press. 351 p.
- Cardoso P. 1999. Portuguese spiders checklist. <http://www.geocities.com/RainForest/Vines/15197/checklist.html>
- Deeleman-Reinhold C. 1976. Distribution patterns in European cave spiders // First Intern. Symp. Cave Biol. Cave Paleontol. (Cape Town). P.25–35.
- Deltshev C. 1972. A contribution to the study of spiders (Araneae) from the caves in Bulgaria. II. Genus *Lepthyphantes* in Bulgarian caves // Izv. Zool. Inst. Vol.36. P.137–147.
- Deltshev C. 1973a. A new *Troglohyphantes* from Bulgarian caves (Araneae, Linyphiidae) // Int. J. Speleol. Vol.5. P.103–109.
- Deltshev C. 1973b. Redescription of *Centromerus bulgarianus* (Drensky, 1931) and *Centromerus lakatnikensis* (Drensky, 1931) (Araneae, Linyphiidae) // Int. J. Speleol. Vol.5. P.117–126.
- Deltshev C. 1974. A new *Centromerus* from Bulgarian caves (Araneae, Linyphiidae) // Int. J. Speleol. Vol.6. P.81–86.
- Deltshev C. 1975a. A new species (*Troglohyphantes bureschianus* n.sp., Araneae, Linyphiidae) from Bulgarian caves // Acta Zool. Bulg. Vol.3. P.99–104.
- Deltshev C. 1975b. The genus *Lepthyphantes* in Bulgarian caves // Proc. 6th Int. Arachnol. Congr., Amsterdam. P.210–213.
- Deltshev C. 1980. A contribution to the taxonomical study of the *pallidus* group of the genus *Lepthyphantes* Menge (Araneae, Linyphiidae) in Bulgaria // Acta Zool. Bulg. Vol.16. P.44–56.
- Deltshev C. 1983a. A contribution to the study of the *sylvaticus* group of the genus *Centromerus* F. Dahl (Araneae, Linyphiidae) in Bulgaria // Acta Zool. Bulg. Vol.21. P.53–58.
- Deltshev C. 1983b. Notes on the spiders of the genus *Erigone* Audouin (Araneae, Erigonidae) in Bulgaria // Acta Zool. Bulg. Vol.22. P.71–75.

- Deltshev C. 1983c. A contribution to the taxonomical and faunistic study of the genus *Lepthyphantes* Menge (Araneae, Linyphiidae) from Pirin Mountain // Acta Zool. Bulg. Vol.23. P.25–32.
- Deltshev C. 1984. A new *Diplocephalus* species from Bulgarian mountains (Arachnida, Araneae, Erigonidae) // Reichenbachia. Bd.22. S.91–93.
- Deltshev C. 1985. A contribution to the study of the family Erigonidae (Araneae) from Pirin Mountain, Bulgaria, with a description of a new species (*Metopobactrus orbelicus* sp.n.) // Bull. Br. Arachnol. Soc. Vol.6. P.359–366.
- Deltshev C. 1987. A critical review of the genus *Araeoncus* Simon in Bulgaria, with description of a new species (*Araeoncus clivifrons* sp.n.) (Arachnida, Araneae, Erigonidae) // Reichenbachia. Bd.25. S.97–102.
- Deltshev C. 1988a. A contribution to the study of genus *Lepthyphantes* Menge (Araneae, Linyphiidae) from the Pirin Mountain with a description of a new species (*Lepthyphantes rectilamellus* sp.n.) // Acta Zool. Bulg. Vol.36. P.52–55.
- Deltshev C. 1988b. The genus *Fageiella* Kratochvil and the genus *Antrohyphantes* Dumitresco (Araneae, Linyphiidae, Lepthyphanteae) in the caves of Balkan peninsula // J. Haupt (ed.), TUB-Dokument. Kongr. Tagung. Berlin. Bd.38. S.293–299
- Deltshev C. 1990. The high-altitude spiders (Araneae) in the Pirin Mountains, Bulgaria // Acta Zool. Fenn. Vol.190. P.111–115.
- Deltshev C. 1992. *Drepanotylus pirinicus* n.sp. from Pirin Mountain (Bulgaria), with comparative remarks on the other species of the genus (Arachnida, Araneae, Linyphiidae) // Ber. Naturwiss. Med. Vereins Innsbruck. Bd.79. S.173–176.
- Deltshev C. 1995. Spiders (Araneae) from the high altitude zone of Rila Mountain (Bulgaria) // Ber. Naturwiss. Med. Vereins Innsbruck. Bd.82. S.217–225.
- Deltshev C. 1996. The origin, formation and zoogeography of endemic spiders of Bulgaria (Araneae) // Rev. Suisse Zool. (Vol. Hors Série). P.141–151.
- Deltshev C. 1998. Spiders from the high altitude zone of Central Stara Planina Mountain (Bulgaria) (Araneae) // Ber. Naturwiss. Med. Vereins Innsbruck. Bd.85. S.213–221.
- Deltshev C. 1999. A faunistic and Zoogeographical Review of Spiders (Araneae) of the Balkan Peninsula // J. Arachnol. Vol.27. P.255–261.
- Deltshev C. 2000. The Endemic Spiders (Araneae) of the Balkan Peninsula // Ekologia (Bratislava). Vol.19. P.59–65.
- Deltshev C. & Blagoev G. 1992. A faunistic and zoogeographic analysis of spiders (Araneae) in Zemen gorge (Southwestern Bulgaria) // Acta Zool. Bulg. Vol.45. P.26–35.
- Deltshev C. & Blagoev G. 1997. The spiders of Pirin Mountain (Bulgaria). Taxonomic, faunistic and zoogeographical analysis (Araneae) // Ber. Naturwiss. Med. Vereins Innsbruck. Bd.84. S.269–286.
- Deltshev C. & Blagoev G. 2001. A critical check list of Bulgarian spiders (Araneae) // Bull. Br. Arachnol. Soc. Vol.12. P.110–138.
- Deltshev C. & Čurčić B.P.M. 1997. Contribution to the knowledge of the group *europaeus* of *Centromerus* Dahl (Linyphiidae, Araneae) in the Balkan Peninsula // Rev. Suisse Zool. T.104. P.49–55.
- Deltshev C. & Čurčić B.P.M. 2002. A contribution to the study of the genus *Centromerus* Dahl (Araneae, Linyphiidae) in the caves of the Balkan Peninsula // Rev. Suisse Zool. T.109. P.167–176.
- Deltshev C., Čurčić B.P.M. & Blagoev G. 2003. The Spiders of Serbia. Belgrade: Inst. Zool. Fac. Biol. Univ. 833 p.
- Drensky P. 1936. Katalog der echten Spinnen (Araneae) der Balkanhalbinsel // Sb. Bulg. Akad. Nauk. Vol.32. P.1–223.
- Helsdingen P. van, Thaler K. & Deltshev C. 1977. The *tenuis* group of *Lepthyphantes* Menge (Araneae, Linyphiidae) // Tijdschr. Ent. Vol.120. P.1–54.
- Helsdingen P. van, Thaler K. & Deltshev C. 2001. The European species of *Bolyphantes* with an attempt of a phylogenetic analysis (Araneae, Linyphiidae) // Mem. Soc. Entomol. Ital. Vol.80. P.3–35.
- Hubenov Z. 1997. Possibilities for using of a system from the really defined natural territories for the faunistic researches in Bulgaria // Acta Zool. Bulg. Vol.49. P.5–9.
- Lazarov S., Deltshev C. & Blagoev G. 2001. Spiders (Araneae) of Sushtinska Sredna Gora Mountain, Bulgaria // Acta Zool. Bulg. Vol.53. P.3–28.
- Marusik Yu.M., Logunov D.V. & Koponen S. 2000. Spiders of Tuva, South Siberia. Magadan: IBPN FEB RAS. 252 p.
- Mikhailov K.G. 1997. Catalogue of the spiders of the territories of the former Soviet Union (Arachnida, Aranei) // Sbornik Trudov Zool. Muzeya MGU. Moscow: Zool. Museum, Moscow State Univ. Vol.37. 416 p.
- Platnick N. 2003. The world spider catalog, version 3.5 American Museum of Natural History, online at <http://research.amnh.org/entomology/spiders/catalog81-87/index.html>
- Samu F. & Szinetár C. 1999. Bibliographic check list of the Hungarian spider fauna // Bull. Br. Arachnol. Soc. Vol.11. P.161–184.
- Thaler K. 1988. Arealformen in der nivalen Spinnenfauna der Ostalpen (Arachnida: Araneae) // Zool. Anz. Bd.220. S.233–244.
- Thaler K., Helsdingen P. van & Deltshev C. 1994. Vikariante Verbreitung im Artenkomplex von *Lepthyphantes annulatus* in Europa und ihre Deutung (Araneae, Linyphiidae) // Zool. Anz. Bd.232. S.111–127.
- Vigna Taglianti A., Audisio P., Biondi M., Bologna M.A., Carpaneto G., De Biase A., Fattorini S., Piattella E., Sindaco R., Venchi A. & Zapparoli M. 1999. A proposal for a chorotype classification of the Near East fauna, in the framework of the Western Palaearctic Region // Biogeographia. Vol.20. P.31–59.

Table 2.

Species composition and distribution of linyphiid spiders in Bulgaria. Distribution (see Fig. 1). A–F, altitudinal belts (see Fig. 3). Chorotypes (= distributional patterns): COS = Cosmopolitan; SCO = Subcosmopolitan; HOL = Holarctic; PAL = Palaearctic; WPA = west Palaearctic; ECA = Euro-central Asiatic; EEC = east Euro-central Asiatic; SCA = south-east Euro-central Asiatic; EUCA = Euro-Caucasian; EUR = European; MEE = middle-east European; MSE = middle-southeast European; MSEE = middle-southeast European; SEU = south European; EEU = east European; BULG = Bulgarian endemic; BALK = Balkan endemic; VKAR = Balkan-Karpatian endemic; BCAU = Balkan-Caucasus endemic; MED = Mediterranean. Abbreviations for district names are given above in 'Study area and material'.

Таблица 2.

Видовой состав и распространение видов линифид в Болгарии. Распространение (см. Рис. 1). А–F, высотные пояса (см. Рис. 3). Хорологические типы: COS = космополитный; SCO = суб-космополитный; HOL = гопларктический; PAL = палеарктический; WPA = западно-палеарктический; ECA = евро-центральноазиатский; EEC = восточноевропейско-центральноазиатский; SCA = юго-восточноевропейско-центральноазиатский; EUCA = еврокавказский; EUR = европейский; MEE = переднеазиатско-европейский; MSE = средне-южноевропейский; MSEE = средне-юго-восточноевропейский; SEU = южноевропейский; EEU = восточноевропейский; BULG = болгарский эндемик; BALK = балканский эндемик; VKAR = балканско-карпатский эндемичный; BCAU = балкано-кавказский эндемичный; MED = средиземноморский. Сокращения для названий дистриктов даны выше в 'Study area and material'.

Taxa	Districts	A	B	C	D	E	F	Chorotype
<i>Abacoroecus saltuum</i> (L. Koch, 1872)	DEL, PSC, ROO, ROP, RPP	+		+				PAL
<i>Acartauchenius scurrilis</i> (O. Pickard-Cambridge, 1872)	ROO, RPP, PVS		+		+			WPA
<i>Agyreta cauta</i> (O. Pickard-Cambridge, 1902)	SPM, ROO			+				PAL
<i>Anguliphantes angulipalpis</i> (Westring, 1851)	SBW							WPA
<i>Anguliphantes balcanicus</i> (Drensky, 1931)	SPM			+				BULG
<i>Anthrohyphantes rhodopensis</i> (Drensky, 1931)	RPR, RPP, RRW				+			BULG
<i>Anthrohyphantes sophianus</i> (Drensky, 1931)	SBW			+				BULG
<i>Araeoncus anguineus</i> (L. Koch, 1869)	SPM, PVV, ROO, RPR, RPP, PBS			+		+		EUR
<i>Araeoncus clivifrons</i> Deltchev, 1987	RPR, RPP							BULG
<i>Araeoncus crassiceps</i> (Westring, 1861)	SBM			+				PAL
<i>Araeoncus humilis</i> (Blackwall, 1841)	SBW, PVV, RPP, ROP			+		+		WPA
<i>Archaeoncus prospiciens</i> (Thorell, 1875)	PBS		+					EEC
<i>Bathyphantes gracilis</i> (Blackwall, 1841)	SBM, RPR, RPP			+				HOL
<i>Bathyphantes nigrinus</i> (Westring, 1851)	SBM, PKZ, RPP		+	+				WPA
<i>Bolyphantes alticeps</i> (Sundevall, 1833)	SBM, PBS, PVV, ROO, RPR, RPP			+				PAL
<i>Bolyphantes kolosvaryi</i> (Caporiacco, 1936)	RPR, RPP			+				SEU
<i>Bolyphantes luteolus</i> (Blackwall, 1833)	SBM, PVV, PSC, RPR, RPP			+		+		WPA
<i>Caviphantes dobrogicus</i> (Dumitrescu et Miller, 1962)	RRE		+					EUR
<i>Centromerita bicolor</i> (Blackwall, 1833)	RPP							EUR
<i>Centromeris acutidentatus</i> Deltchev, 2002	ROV, RPS			+		+		BALK
<i>Centromeris brevivulvatus</i> Dahl, 1912	PSC		+					EUR
<i>Centromeris bulgarianus</i> (Drensky, 1931)	SBW			+				BULG
<i>Centromeris capucinus</i> (Simon, 1884)	PSC	+						EUR
<i>Centromeris cavernarum</i> (L. Koch, 1872)	SBW, SBM, PSC, PBS		+	+				EUR
<i>Centromeris incilium</i> (L. Koch, 1881)	SBM, PKZ		+	+				EUR
<i>Centromeris lakatnikensis</i> (Drensky, 1931)	SBW, PSC, RPP, RRW		+	+				BALK

Table 2 (continued).
Таблица 2 (продолжение).

	PVV	+	+	WPA
<i>Erigonella hiemalis</i> (Blackwall, 1841)	SBM, RPR, RPP		+	EUR
<i>Evansia merens</i> O. Pickard-Cambridge, 1900	DEL, SBW, SBM, PKZ, RPR, RPP, RRW, RRE		+	WPA
<i>Frontinella frutetorum</i> (C.L. Koch, 1834)	PVV		+	EUR
<i>Gnathonarium dentatum</i> (Wider, 1834)	PVC, RPS		+	PAL
<i>Gonatum hilare</i> (Thorell, 1875)	PKZ	+	+	SEU
<i>Gonatum nemorivagum</i> (O. Pickard-Cambridge, 1875)	SBM, RPR, RPP		+	BKAR
<i>Gonatum orientale</i> Fage, 1931	PKZ, PSC		+	PAL
<i>Gonatum paradoxum</i> (L. Koch, 1869)	RPP		+	PAL
<i>Gonatum rubellum</i> (Blackwall, 1841)	PSC, RPR, RPP		+	PAL
<i>Gonatum rubens</i> (Blackwall, 1833)	PSC, RPP		+	WPA
<i>Gongylidellum latebricola</i> (O. Pickard-Cambridge, 1871)	BS	+	+	WPA
<i>Gongylidellum murcidum</i> Simon, 1884	DEL, PVV, BN		+	PAL
<i>Gongylidum rufipes</i> (Linnaeus, 1758)	SBW		+	EUR
<i>Halorates reprobis</i> (O. Pickard-Cambridge, 1879)	SBM		+	EUR
<i>Hilaira excisa</i> (O. Pickard-Cambridge, 1871)	PVV		+	PAL
<i>Hilaira montigena</i> (L. Koch, 1872)	BN	+		PAL
<i>Hyllyphantes graminicola</i> (Sundevall, 1830)	PKZ	+		PAL
<i>Hypomma cornutum</i> (Blackwall, 1833)	PSC, RPR		+	WPA
<i>Improphantes decolor</i> (Westring, 1861)	SBM, RPR, RPP		+	EUR
<i>Improphantes improbulus</i> (Simon, 1929)	RPR		+	BKAR
<i>Incestophantes annulatus</i> (Kulczyński, 1882)	PSC, BN		+	WPA
<i>Incestophantes crucifer</i> (Menge, 1866)	SBW, SBM, RPP, RRW		+	BALK
<i>Lepthyphantes centromeroides</i> Kulczyński, 1914	PKK		+	WPA
<i>Lepthyphantes keyserlingi</i> (Ausserer, 1867)	DEL, SBW, SBM, SBE, PKZ, PVV, PSC, PBS, ROO, RPR, RPP, RRW, RPP		+	HOL
<i>Lepthyphantes leprosus</i> (Ohlert, 1865)	PKK		+	BULG
<i>Lepthyphantes melanotus</i> Drensky, 1921	RPP		+	MSEE
<i>Lepthyphantes notabilis</i> Kulczyński, 1887	RPR		+	EUR
<i>Lepthyphantes quadrimaculatus</i> Kulczyński, 1898	RPP		+	WPA
<i>Leptothrix hardyi</i> (Blackwall, 1850)	SPM		+	SCO
<i>Lessertia dentichelis</i> (Simon, 1884)	PVV, PSC, RPR, RPP		+	PAL
<i>Linyphia hortensis</i> Sundevall, 1830	SBW, SBM, PSC, RPR, BN		+	PAL
<i>Linyphia triangularis</i> (Clerck, 1757)	SBM, RPR, PSC		+	WPA
<i>Macrargus carpenteri</i> (O. Pickard-Cambridge, 1894)	SBM, PSC, RPP		+	WPA
<i>Macrargus rufus</i> (Wider, 1834)	PKZ, PVV, SBM, PSC, RPR, RPP		+	WPA
<i>Mansuphantes mansuetus</i> (Thorell, 1875)	PSC, RPR, RPP		+	BULG
<i>Mansuphantes rectiflamellus</i> (Deltšev, 1988)	RPR, RPP, BN		+	EUR
<i>Maso gallicus</i> Simon, 1894	PKZ, PVV, SBM, PSC, RPR, RPP, RRW, RPP		+	HOL
<i>Maso sundevalli</i> (Westring, 1851)	PKZ, PVV, SBM, PSC, RPR, RPP, RRW, RPP		+	HOL

Table 2 (continued).
Таблица 2 (продолжение).

<i>Mesopisthes peusi</i> Wunderlich, 1972	PSC, PBS	+	+	+	+	+	EUR
<i>Mesunargus paetulus</i> (O. Pickard-Cambridge, 1875)	SBM, RPP						HOL
<i>Megalephyphantes collinus</i> (L. Koch, 1872)	PKZ, SBM, PSC, RPP	+	+	+	+	+	WPA
<i>Megalephyphantes nebulosus</i> (Sundevall, 1830)	PVV						HOL
<i>Meioneta equestris</i> (L. Koch, 1881)	PSC	+					MEE
<i>Meioneta fuscipalpa</i> (C.L. Koch, 1836)	RPP						PAL
<i>Meioneta gulosa</i> (L. Koch, 1869)	RPP						PAL
<i>Meioneta rurestris</i> (C.L. Koch, 1836)	PVV, SBW, SBM, RPR, RPP	+					PAL
<i>Meioneta simplicitarsis</i> (Simon, 1884)	PKZ						EUR
<i>Metopobactrus orbelicus</i> Deltishev, 1985	RPP						BULG
<i>Micraragus herbigradus</i> (Blackwall, 1854)	SBM, RPP						PAL
<i>Micraragus subaequalis</i> (Westring, 1851)	SBW, SBM, PSC, RPP						PAL
<i>Microctenonyx subitaneus</i> (O. Pickard-Cambridge, 1875)	PSC, RPR, RPP	+					SCO
<i>Microlinyphia pusilla</i> (Sundevall, 1830)	PKZ, SBW, PSC, PBS, RPR, RPP						HOL
<i>Microneta viaria</i> (Blackwall, 1841)	PSC	+					HOL
<i>Minyriolus pusillus</i> (Wider, 1834)	PSC						PAL
<i>Moebelia penicillata</i> (Westring, 1851)	RPR, RPP	+					WPA
<i>Mughiphantes lithoclasticola</i> (Deltishev, 1983)	RPR, RPP						BULG
<i>Mughiphantes pulcher</i> (Kulczyński, 1881)	RPR, RPP						MSEE
<i>Nematogmus sanguinolentus</i> (Waickenaer, 1842)	SBM						PAL
<i>Neriere clathrata</i> (Sundevall, 1830)	PKZ, SBM, PSC, PBS	+					HOL
<i>Neriere emphana</i> (Waickenaer, 1842)	PSC, RPR						PAL
<i>Neriere furtiva</i> (O. Pickard-Cambridge, 1871)	SBM, PSC						EUR
<i>Neriere montana</i> (Clerck, 1757)	PKZ, PSC, PBS, RPR	+					HOL
<i>Neriere peltata</i> (Wider, 1834)	PKZ, PSC, PBS	+					WPA
<i>Neriere radiata</i> (Waickenaer, 1842)	PKZ, SBM, PSC, PBS, RPR, RPP	+					HOL
<i>Obscuriphantes obscurus</i> (Blackwall, 1841)	SBM, RPP						EUR
<i>Oedothorax agrestis</i> (Blackwall, 1853)	SBM, PSC, RPR, RPP	+					PAL
<i>Oedothorax apicatus</i> (Blackwall, 1850)	PKZ, PVV, SBM, PSC, RPR, RPP						PAL
<i>Oedothorax gibbifer</i> (Kulczyński, 1882)	PVV, SBW, RPP						WPA
<i>Oedothorax gibbosus</i> (Blackwall, 1841)	RPP						EUR
<i>Oedothorax retusus</i> (Westring, 1851)	DW, PVV						PAL
<i>Oreonetides glacialis</i> (L. Koch, 1872)	PKZ, PSC, BN	+					PAL
<i>Ostearius melanopygius</i> (O. Pickard-Cambridge, 1879)	RPR						EUR
<i>Pallidiphantes alutactus</i> (Simon, 1884)	PSC, RPP	+					COS
<i>Pallidiphantes byzantinus</i> (Fage, 1931)	SBW, SBM, PSC, RPR						EUR
<i>Pallidiphantes insignis</i> (O. Pickard-Cambridge, 1913)	DEP, SBE, PBB,	+					BALK
<i>Pallidiphantes istrianus</i> (Kulczyński, 1914)	PKZ,	+					EUR
	RRW						EEU

Table 2 (continued).
Таблица 2 (продолжение).

<i>Palliduphantes pallidus</i> (O. Pickard-Cambridge, 1871)	SBE, RPP					+				+			PAL
<i>Palliduphantes pillichi</i> (Kulczyński, 1915)	SBW					+				+			MSEE
<i>Palliduphantes spelaeorum</i> (Kulczyński, 1914)	RPS, RRW					+				+			BALK
<i>Palliduphantes tnovensis</i> (Drensky, 1931)	SBW, SBM					+				+			BALK
<i>Panamomops inconspicuus</i> (Miller et Valesova, 1964)	PSC					+				+			EUR
<i>Panamomops sulcifrons</i> (Wider, 1834)	PSC					+				+			EUR
<i>Peleceopsis elongata</i> (Wider, 1834)	PKZ					+				+			EUR
<i>Peleceopsis krausi</i> Wunderlich, 1980	PKZ					+				+			BCAU
<i>Peleceopsis parallela</i> (Wider, 1834)	PVV					+				+			PAL
<i>Piniophantes pinicola</i> (Simon, 1884)	RPP					+				+			EUR
<i>Pityophantes phrygianus</i> (C.L. Koch, 1836)	RPR, RPP					+				+			PAL
<i>Pocadicnemis juncea</i> Locket et Millidge, 1953	SBM, PSC,					+				+			EUR
<i>Pocadicnemis pumila</i> (Blackwall, 1841)	PVV					+				+			HOL
<i>Pociloneta variegata</i> (Blackwall, 1841)	PKZ, PSC, RPP					+				+		+	HOL
<i>Porrhomma convexum</i> (Westring, 1851)	DW, DM, DEP, SBW, SBM, SBE,					+				+			
	PBS, RPR, RRW					+				+			
	PBS					+				+			PAL
<i>Porrhomma lativellum</i> Tretzel, 1956	SBM					+				+			EUCA
<i>Porrhomma microphthalmum</i> (O. Pickard-Cambridge, 1871)	SBM, PSC					+				+			PAL
<i>Porrhomma microps</i> (Roewer, 1931)	SBE					+				+			EUR
<i>Porrhomma pygmaeum</i> (Blackwall, 1834)	PVV					+				+			PAL
<i>Prinerigone vagans</i> (Audouin, 1826)	SBM, PBS, RPR, RRW					+				+			SCO
<i>Sauron rayi</i> (Simon, 1881)	PSC					+				+			EUR
<i>Scotinotylus alpigena</i> (L. Koch, 1869)	DEL, PSC, RPR					+				+			WPA
<i>Silometopus bonessi</i> Casemir, 1970	RPR					+				+			PAL
<i>Silometopus reussi</i> (Thorell, 1871)	PSC					+				+			MSE
<i>Sintula spiniger</i> (Balogh, 1935)	SBM, PSC					+				+			PAL
<i>Stemonyphantes lineatus</i> (Linnaeus, 1758)	PKZ, SBM, PSC, RRW					+				+			EUCA
<i>Styloctetor romanus</i> (O. Pickard-Cambridge, 1872)	PKZ, SBM, PSC, RRW					+				+			EEU
<i>Tallusia experta</i> (O. Pickard-Cambridge, 1871)	PKZ, SBM, PSC, RRW					+				+			WPA
<i>Tallusia vindobonensis</i> (Kulczyński, 1898)	SBW, SBM, PSC					+				+			PAL
<i>Tapinocyba bisceisa</i> (L. Koch, 1869)	DW, PKZ, SBM					+				+			PAL
<i>Tapinocyba insecta</i> (L. Koch, 1869)	PKZ					+				+			MEE
<i>Tapinocyba mitis</i> (O. Pickard-Cambridge, 1882)	PSC					+				+			EUR
<i>Tapinocyba pallens</i> (O. Pickard-Cambridge, 1872)	PVV					+				+			EUR
<i>Tapinopa longidens</i> (Wider, 1834)	PBS					+				+			MSEE
<i>Tenuiphantes alacris</i> (Blackwall, 1853)	SBM, PSC					+				+			EUCA
<i>Tenuiphantes cristatus</i> (Menge, 1866)	SBM, PSC					+				+			PAL
<i>Tenuiphantes drenskyi</i> (van Heislingen, 1977)	SBM, RPR, RPP					+				+			EUR
	PVV, SBW, SBM					+				+			PAL
	PVV, RPR					+				+			BULG

