

Chthonius (Chthonius) carinthiacus and *Chthonius (Ephippiochthonius) tuberculatus* new to the fauna of Slovakia (Pseudoscorpiones: Chthoniidae)

Jana Christophoryová, Andrej Mock & Peter Luptáčik

doi:10.5431/aramit4206

Abstract: The pseudoscorpions *Chthonius (Chthonius) carinthiacus* Beier, 1951 and *Chthonius (Ephippiochthonius) tuberculatus* Hadži, 1937, are recorded for the first time from Slovakia. An illustrated description of these species is provided based on their morphological and morphometric characters. The descriptions of the species offer an update on the variability of their morphological and morphometric characters.

Keywords: Central Europe, morphology, morphometric analysis, new records, taxonomy

Until recently, fifty two species of pseudoscorpions were known from Slovakia, including the first regional record of *Allochernes powelli* (Kew, 1916) (CHRISTOPHORYOVÁ et al. 2011a, 2011b). In the present paper two further pseudoscorpion species *Chthonius (Chthonius) carinthiacus* Beier, 1951 and *Chthonius (Ephippiochthonius) tuberculatus* Hadži, 1937 are reported as the first regional records. They are distributed across several European countries – *C. (C.) carinthiacus* in Austria, Czech Republic, Italy, and Slovenia; *C. (E.) tuberculatus* in Germany, Greece, Hungary, Macedonia, and Romania (HARVEY 2009). The genus *Chthonius* C. L. Koch, 1843 includes 14 species currently known in Slovakia (10 species from the subgenus *Chthonius (Chthonius)* C. L. Koch, 1843 and 4 from the subgenus *Chthonius (Ephippiochthonius)* Beier, 1930). The aim of the present study was to describe the new species records in detail and to update our knowledge of their variability in both morphological and morphometric characteristics.

Material and methods

Six females and ten males of *Chthonius (C.) carinthiacus* were examined from Slovakia (leg. P. Luptáčik, A. Mock, K. Tajovský). Faunistic data: Čierna Hora Mts., locality Koľvek on the Roháčka Hill (48°56'00" N, 20°59'13" E, 780–795 m a.s.l.), collected in pitfall

traps situated partly in quartzite scree crest and covered by deciduous wood, overgrown by blueberries and mosses, 13. Nov. 1997–5. May 1998, 1 ♀, 3 ♂♂; 23. Sep. 1998–13. Nov. 1998, 1 ♂; 18. Oct. 2001–13. Febr. 2002, 2 ♀♀, 4 ♂♂. Čierna Hora Mts., locality Sivec Hill (48°50'43" N, 21°06'11" E, 700 m a.s.l.), SE slope, collected in pitfall traps situated in beech forest (*Fagetum nudum*) on limestone, 9. May 2007–17. Oct. 2007, 2 ♀♀, 1 ♂ (vid. G. Gardini). Slovak Karst, Silická ľadnica Ice Cave (48°33'01" N, 20°30'14" E, 503 m a.s.l.), collected in soil samples taken from young hornbeam forest surrounded by maple and oak trees in the entrance part of the chasm, 18. May 2005, 1 ♀, 1 ♂. One female of *Chthonius (E.) tuberculatus* was examined (leg. A. Mock, vid. G. Gardini): Slovakia, Čierna Hora Mts., locality Hradová Hill (48°45'27" N, 21°14'22" E, 300–320 m a.s.l.), sifted from leaf litter under a group of trees and shrubs (*Acer campestre*, *Prunus spinosa*) on a xerotherm slope surrounded by hornbeam oak, 31. May 2002.

The specimens were determined by J. Christophoryová, studied as temporary slide mounts and photographed using a Leica DM1000 compound microscope with a ICC50 Camera Module (LAS EZ application, 1.8.0). Measurements were taken from the photographs using the AxioVision 40LE application (v. 4.5). The material is deposited in the collection of the first author in the Comenius University, Bratislava.

Results

Chthonius (Chthonius) carinthiacus Beier, 1951
Description (6 ♀♀, 10 ♂♂): Carapace, chelicerae and chelal hands dark-brown, other body parts light-brown. Carapace (Fig. 1A): approximately as long as broad, smooth, with small, distinctly serrated epistome

Jana CHRISTOPHORYOVÁ, Department of Zoology, Faculty of Natural Sciences, Comenius University, Mlynská dolina B-1, SK-842 15 Bratislava, Slovak Republic
E-Mail: christophoryova@gmail.com

Andrej MOCK, Peter LŮPTÁČIK, Institute of Biology and Ecology, Faculty of Science, P.J. Šafárik University, Moyzesova 11, SK-041 67 Košice, Slovak Republic
E-Mail: andrej.mock@upjs.sk, peter.luptacik@upjs.sk

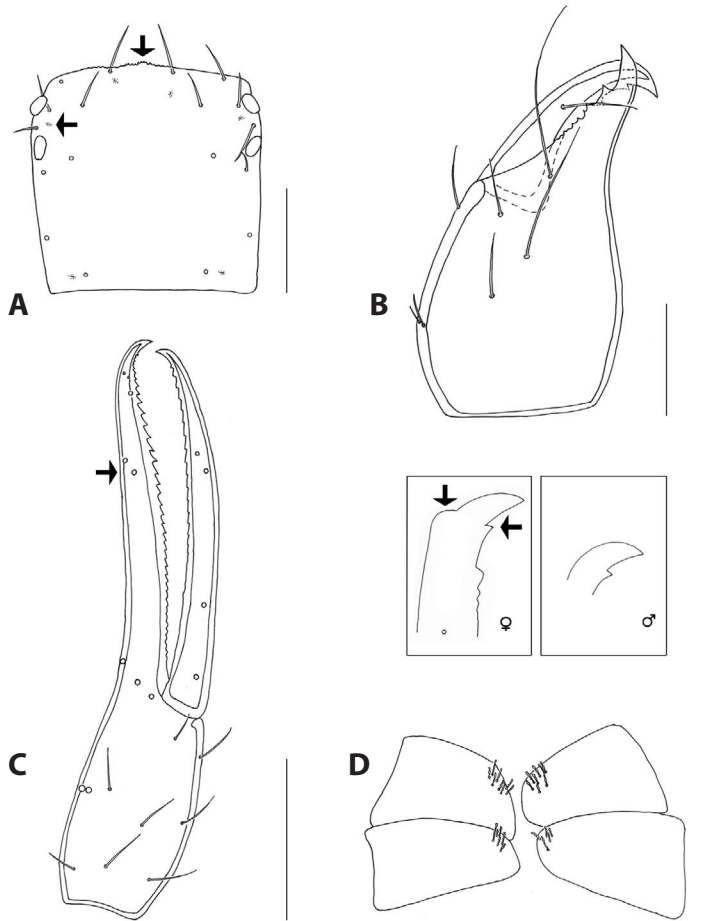


Fig. 1: Adult of *Chthonius (C.) carinthiacus*. **A.** Carapace (dorsal view). Arrows point to the epistome and one lyrifissure. **B.** Left chelicera (dorsal view) with details of the male and female movable cheliceral finger and spinneret. Arrows point to the spinneret and isolated subdistal tooth. **C.** Left palpal chela showing the trichobothrial pattern (lateral view). Arrow points to the exterior subterminal trichobothrium (*est*). **D.** Coxal spines on coxae II and III (ventral view). Scales: 0.1 (B, D), 0.2 (A, C) mm.

on its anterior margin; two pairs of eyes present, anterior eyes well-developed with lenses, posterior eyes flattened; chaetotaxy of carapace: 18 thick macrosetae, anterior margin with 4 and posterior margin with 2 setae, setae shorter and broader, no microchaetae present; 3 pairs of slitlike lyrifissures present on carapace – the first pair within anterior part of carapace behind the epistome, the second pair between the first and second pair of eyes and the third posteriorly near the two setae of the posterior carapace margin (Fig. 1A). Chelicerae (Fig. 1B): relatively large and strongly

sclerotized, 7 setae on cheliceral hand, one on cheliceral movable finger; movable cheliceral finger with conspicuous spinneret: well-developed in females as tubercle, flat in males (Fig. 1B); 8–10 teeth situated on fixed cheliceral finger, 2 of them distinctly larger, 6–7 teeth on movable cheliceral finger, the first one larger, isolated subdistal tooth on movable cheliceral finger present (Fig. 1B); cheliceral rallum with 11 blades, serrula exterior with 14 blades. Palps (Fig. 1C): smooth, chelal hand without any depression dorsally, distinctly bulbous, in lateral view, the dorsum not level with the finger but clearly rounded; chelal hand brown and darker than other palpal segments; chelal fingers of approximately equal length, movable chelal finger slightly shorter than fixed finger, with normal number of trichobothria (8 on fixed chelal finger and 4 on movable chelal finger); fixed chelal finger with 33–38 contiguous teeth, 10–16 of them situated between fixed chelal finger tip and exterior subterminal trichobothrium (*est*); movable chelal finger with 17–20 teeth, basal teeth flattened (Fig. 1C). Coxae II with 5–10 coxal spines and coxae III with 4–6 coxal spines (Fig. 1D); long tactile seta on metatarsus and tarsus IV present and situated in basal third of the segments. Tergites I–IV bearing 4 setae, tergites V–IX 6 setae, tergite X 4 and tergite XI 6 setae; female genital operculum anterior and posterior both with 9–10 setae and 2 lyrifissures.

Both sexes of the species were measured; all data are summarised in Tables 1 and 2. Female legs were measured only in one case (measurements in mm). Leg I: femur I 0.26/0.07 (ratio x3.71); femur II 0.14/0.06 (x2.33); tibia 0.15/0.05 (x3.00); tarsus 0.29/0.04 (x7.25). Leg IV: femur 0.45/0.17 (x2.65); tibia 0.28/0.08 (x3.50); tarsus I 0.15/0.07 (x2.14); tarsus II 0.29/0.03 (x9.67).

Chthonius (Ephippiochthonius) tuberculatus
Hadži, 1937

Description (1 ♀): Carapace (Fig. 2A): as long as broad, smooth, with distinctly serrated anterior margin; two pairs of eyes present, posterior eyes strongly reduced; chaetotaxy of carapace: 20 macrosetae and two preocular microsetae on each side, anterior margin with 4 setae, posterior margin with 4 setae, from which medial setae are longer than lateral ones; 7 slitlike lyrifissures present on carapace – three of them within anterior part of carapace behind the epistome, two between the first and second pair of eyes; last two lyrifissures situated posteriorly between the lateral and medial macrosetae of the posterior carapace margin (Fig. 2A). Chelicerae (Fig. 2B): relatively large and strongly sclerotized, 8 setae on cheliceral hand, one

on cheliceral movable finger; movable cheliceral finger with conspicuous spinneret well-developed as tubercle; 10 teeth situated on fixed cheliceral finger, 2 of them distinctly larger, 5 teeth on movable cheliceral finger, the first one larger, isolated subdistal tooth on movable cheliceral finger present (Fig. 2B); cheliceral rallum with 9 blades, serrula exterior with 12 blades. Palps (Fig. 2C): smooth, dorsum of chelal hand with a small but distinct protuberance distal of interior basal (*ib*) and interior subbasal (*isb*) trichobothria, base of movable finger with enforced and internal apodeme (Fig. 2C); chelal fingers of approximately equal length, with normal number of trichobothria (8 on fixed chelal finger and 4 on movable chelal finger); fixed chelal finger with 16 distinct teeth and 2 small teeth, 9 of them situated between fixed chelal finger

tip and exterior subterminal trichobothrium (*est*); movable chelal finger with 12 basally gradually decreasing teeth, the last of them very small, teeth almost reaching subbasal trichobothrium (*sb*), proximally continued basal lamella (Fig. 2C). Coxae II with 6–8 coxal spines and coxae III with 3–4 coxal spines (Fig. 2D); long tactile seta on metatarsus and tarsus IV present and situated in basal third of the segments. Tergites I–IV bearing 4 setae, tergites V–IX 6 setae, tergite X 4 and tergite XI 6 setae; female genital operculum anterior with 10 setae and 2 lyrifissures, operculum posterior with 12 setae and 2 lyrifissures.

Morphometric data of a female of *Chthonius (E.) tuberculatus* (measurements in mm): Body: length 1.16. Carapace: 0.35/0.35 (ratio x1.00); anterior eyes 0.04 mm from anterior margin of carapace. Chelicerae: 0.24/0.14 (x1.71); movable cheliceral finger length 0.14. Pedipalps: femur 0.36/0.07 (x5.14); patella 0.16/0.09 (x1.78); chela 0.55/0.12 (x4.58); hand 0.22/0.12 (x1.83); finger length 0.33. Leg IV: femur 0.33/0.15 (x2.20); tibia 0.22/0.06 (x3.67); tarsus I 0.12/0.05 (x2.40); tarsus II 0.22/0.03 (x7.33).

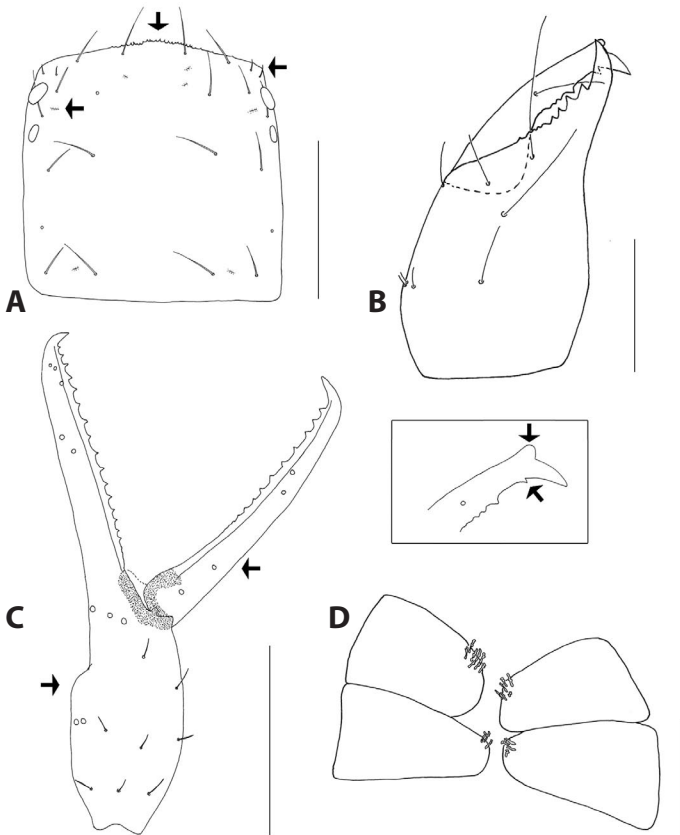


Fig. 2: Female of *Chthonius (E.) tuberculatus*. **A.** Carapace (dorsal view). Arrows point to the serrated anterior margin, preocular microsetae and one lyrifissure. **B.** Left chelicera (dorsal view) with details of the movable cheliceral finger and spinneret. Arrows point to the spinneret and isolated subdistal tooth. **C.** Left palpal chela showing the trichobothrial pattern (lateral view). Arrows point to the subbasal trichobothrium (*sb*) and protuberance on the dorsum of the chelal hand. **D.** Coxal spines on coxae II and III (ventral view). Scales: 0.1 (B, D), 0.2 (A, C) mm.

Tab. 1: Morphometric data for females of *Chthonius* (*C.*) *carinthiacus* (measurements in mm, n=6)

Characteristics	x	M	SD	Min	Max
Body, length	1.39	1.40	0.15	1.18	1.59
Carapace, length	0.44	0.44	0.01	0.44	0.45
Carapace, width	0.43	0.44	0.03	0.39	0.45
Carapace, length/width ratio	1.04	1.02	0.07	0.98	1.13
Distance of anterior eyes of anterior carapace margin	0.04	0.04	0.00	0.04	0.04
Chelicera, length	0.37	0.37	0.02	0.35	0.41
Chelicera, width	0.19	0.19	0.01	0.18	0.21
Chelicera, length/width ratio	1.92	1.95	0.07	1.84	2.00
Cheliceral movable finger, length	0.19	0.19	0.01	0.18	0.20
Palpal femur, length	0.49	0.49	0.02	0.46	0.53
Palpal femur, width	0.11	0.11	0.01	0.09	0.12
Palpal femur, length/width ratio	4.60	4.44	0.32	4.36	5.11
Palpal patella, length	0.22	0.22	0.01	0.21	0.24
Palpal patella, width	0.12	0.12	0.01	0.11	0.13
Palpal patella, length/width ratio	1.83	1.83	0.06	1.75	1.91
Palpal hand, length	0.27	0.28	0.02	0.25	0.29
Palpal hand, width	0.16	0.16	0.01	0.15	0.17
Palpal hand, length/width ratio	1.71	1.71	0.04	1.67	1.75
Palpal finger, length	0.47	0.47	0.02	0.45	0.50
Palpal chela, length	0.75	0.75	0.03	0.72	0.79
Palpal chela, length/palpal hand width	4.68	4.69	0.11	4.50	4.80

Abbreviations: x – arithmetic mean, M – median, SD – standard deviation, Min – minimum, Max – maximum, n – number of individuals measured

Discussion

Chthonius (*C.*) *carinthiacus* was originally described by BEIER (1951) as *Chthonius* (*Neochthonius*) *pygmaeus carinthiacus* from Austria. *Chthonius* (*Neochthonius*) *pygmaeus* was transferred to the subgenus *Chthonius* by MAHNERT (1979); the status of *Neochthonius* and *Kewochthonius* had been clarified by JUDSON (1988, 1990). CALLAINI (1980) designated the species *Chthonius* (*Chthonius*) *baccettii* in Italy. Later GARDINI (2004) considered *C.* (*C.*) *carinthiacus* as a full species and synonymized *C. baccettii* Callaini, 1980 from Italy with it. The description of BEIER (1951) contains only a few morphological and morphometric characteristics, particularly the ones which separate the subspecies *C. pygmaeus pygmaeus* Beier, 1934 and *C. pygmaeus carinthiacus*. The main taxonomic characters of the Slovak specimens correspond with those given by BEIER (1951), despite registering greater variability in the number of coxal spines and a lower number of teeth on the movable chelal finger. Compared to the description by CALLAINI (1980), we recorded smaller specimens with lower numbers of teeth on the movable chelal finger. Based on the

variable number of teeth on the movable finger (Slovak specimens 17–20/other specimens 20–33) three specimens (both sexes) were confirmed by G. Gardini.

C. (*C.*) *carinthiacus* is an epigeal species widely distributed in central and southern Europe (GARDINI 2000, 2004). The type locality of *Chthonius* (*Neochthonius*) *pygmaeus carinthiacus* is Bürgerboden, near Warmbad Villach, Carinthia, Austria (BEIER 1951); that of *Chthonius* (*Chthonius*) *baccettii* is Andriano, Bolzano, Trentino-Alto Adige, Italy (CALLAINI 1980). Later it was recorded in the Czech Republic (RŮŽIČKA et al. 1995) and in Slovenia (ČURČIĆ 1974). Published records are from specimens collected mainly in leaf litter or under the leaves of deciduous or coniferous trees and in mixed forest and on stony debris (BEIER 1951, RŮŽIČKA et al. 1995, GARDINI 2000, 2004, ŠTÁHLAVSKÝ & TUF 2009). Some specimens were recorded in caves or in tree hollows

of *Fraxinus excelsior* (GARDINI 2004, ŠTÁHLAVSKÝ & TUF 2009). In Slovakia, the specimens were found in beech forest and hornbeam forest surrounded by maple and oak trees in the entrance part of the chasm. The species was confirmed from flatlands (90 m a.s.l.) to mountains (1550 m a.s.l.) (BEIER 1951, 1963, RŮŽIČKA et al. 1995, GARDINI 2000, 2004, ŠTÁHLAVSKÝ & TUF 2009) – the altitude of the Slovak localities ranges from 503 to 795 m a.s.l.

C. (*E.*) *tuberculatus* was originally described from sieved leaf litter and caves in Rašče, Skopje (as Skoplje), Macedonia (HADŽI 1937). Later the species was recorded from a cave in the Ossa Mts., Greece (600 m a.s.l.) (MAHNERT 1979), from Hungary (MAHNERT 1983), Romania and Germany (HELVENSEN 1966, PLATEN et al. 1995, HARVEY 2009). The female from Slovakia corresponds morphologically with the characters figured in the original description (HADŽI 1937). Later BEIER (1963) and MAHNERT (1983) gave more data on the variability of the morphometric characteristics. The main taxonomic characters of the studied female correspond to the published descriptions from other countries and we did not register any

Tab. 2: Morphometric data for males of *Chthonius* (*C.*) *carinthiacus* (measurements in mm)

Characteristics	x	M	SD	Min	Max	n
Body, length	1.27	1.26	0.07	1.17	1.40	10
Carapace, length	0.42	0.43	0.01	0.40	0.44	10
Carapace, width	1.06	1.05	0.03	1.02	1.10	10
Carapace, length/width ratio	0.04	0.04	0.00	0.03	0.04	10
Distance of anterior eyes of anterior carapace margin	1.06	1.05	0.03	1.02	1.10	10
Chelicera, length	0.33	0.34	0.01	0.30	0.35	10
Chelicera, width	0.17	0.17	0.01	0.15	0.18	10
Chelicera, length/width ratio	1.96	1.97	0.07	1.78	2.06	10
Cheliceral movable finger, length	0.17	0.17	0.01	0.16	0.18	10
Palpal femur, length	0.47	0.46	0.02	0.43	0.49	10
Palpal femur, width	0.10	0.10	0.01	0.09	0.11	10
Palpal femur, length/width ratio	4.72	4.60	0.36	4.18	5.44	10
Palpal patella, length	0.20	0.20	0.01	0.19	0.21	10
Palpal patella, width	0.11	0.11	0.00	0.10	0.11	10
Palpal patella, length/width ratio	1.84	1.82	0.08	1.73	2.00	10
Palpal hand, length	0.25	0.25	0.01	0.24	0.27	10
Palpal hand, width	0.14	0.14	0.01	0.13	0.15	10
Palpal hand, length/width ratio	1.74	1.71	0.10	1.60	1.92	10
Palpal finger, length	0.44	0.44	0.01	0.42	0.47	10
Palpal chela, length	0.69	0.69	0.02	0.67	0.72	10
Palpal chela, length/palpal hand width	4.83	4.86	0.25	4.47	5.15	10
Leg I femur I, length	0.26	0.27	0.01	0.25	0.28	6
Leg I femur I, width	0.06	0.06	0.01	0.06	0.07	6
Leg I femur I, length/width ratio	4.13	4.17	0.35	3.71	4.67	6
Leg I femur II, length	0.12	0.12	0.01	0.12	0.13	6
Leg I femur II, width	0.06	0.06	0.01	0.05	0.06	6
Leg I femur II, length/width ratio	2.23	2.17	0.17	2.00	2.40	6
Leg I tibia, length	0.15	0.15	0.01	0.14	0.16	6
Leg I tibia, width	0.05	0.05	0.01	0.04	0.05	6
Leg I tibia, length/width ratio	3.34	3.35	0.50	2.80	4.00	6
Leg I tarsus, length	0.29	0.30	0.01	0.28	0.30	6
Leg I tarsus, width	0.04	0.04	0.00	0.04	0.04	6
Leg I tarsus, length/width ratio	7.31	7.38	0.24	7.00	7.50	6
Leg IV femur, length	0.43	0.44	0.02	0.40	0.45	6
Leg IV femur, width	0.18	0.19	0.02	0.16	0.21	6
Leg IV femur, length/width ratio	2.36	2.37	0.14	2.10	2.50	6
Leg IV tibia, length	0.27	0.27	0.01	0.26	0.29	6
Leg IV tibia, width	0.07	0.07	0.01	0.06	0.08	6
Leg IV tibia, length/width ratio	3.82	3.71	0.38	3.38	4.33	6
Leg IV tarsus I, length	0.15	0.15	0.01	0.14	0.16	6
Leg IV tarsus I, width	0.06	0.06	0.00	0.05	0.06	6
Leg IV tarsus I, length/width ratio	2.58	2.50	0.13	2.50	2.80	6
Leg IV tarsus II, length	0.29	0.30	0.01	0.28	0.30	6
Leg IV tarsus II, width	0.03	0.03	0.00	0.03	0.03	6
Leg IV tarsus II, length/width ratio	9.78	9.83	0.27	9.33	10.00	6

Abbreviations: see Tab. 1

more variability in the morphological and morphometric data.

Acknowledgements

The first author would like to thank Dr. Giulio Gardini for checking and confirming the identification of pseudoscorpion species, Alica Christophoryová for technical assistance with the figures, Dr. Karel Tajovský for collecting pseudoscorpion material and Prof. Volker Mahner and one anonymous reviewer for their valuable comments. The project was financially supported by VEGA 1/0176/09 and VEGA 1/0139/09.

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