Rhacochelifer disjunctus (Pseudoscorpiones: Cheliferidae) new to the fauna of Slovakia

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doi: 10.5431/aramit5306

Abstract. An illustrated description of *Rhacochelifer disjunctus* (L. Koch, 1873) collected in Slovakia is presented. One female was found phoretic on Lepidoptera in a Malaise trap. Another 37 specimens, including both sexes, tritonymphs and a protonymph, collected in the 1950s were deposited in the Natural History Museum in Prague, Czech Republic and identified as well. The discoveries of *R. disjunctus* specimens at five localities within Slovakia represent the first records of the species for this country.

Keywords: Malaise trap, morphometric analysis, new record, phoresy, pseudoscorpion, taxonomy

Zusammenfassung. *Rhacochelifer disjunctus* (Pseudoscorpiones: Cheliferidae) neu für die Fauna der Slowakei. Eine illustrierte Beschreibung von in der Slowakei gesammelten *Rhacochelifer disjunctus* (L. Koch, 1873) wird präsentiert. Ein auf einem Schmetterling phoresierendes Weibchen wurde in einer Malaise-Falle gefunden. Weiterhin wurden 37 Individuen beider Geschlechter, Tritonymphen und eine Protonymphe identifiziert, die in den 1950er Jahren gesammelt und im Naturhistorischen Museum in Prag (Tschechische Republik) hinterlegt wurden. Der Nachweis von *R. disjunctus* an fünf Orten in der Slowakei stellt den Erstnachweis der Art für das Land dar.

A total of 35 species and five subspecies are recognized within the genus *Rhacochelifer* Beier, 1932, distributed in Africa, Asia and chiefly in southern Europe (Harvey 2013). The genus *Rhacochelifer* is characterized by the presence of a dentate subterminal seta on the tarsi and absence of lateral spurs on the posterior tergite's margin; by modified and stout tarsi of the anterior legs and the presence of coxal sacs on coxae IV in males; and the presence of one median cribriform plate in females (Beier 1932a, 1963).

Rhacochelifer disjunctus was described as *Chelifer disjunctus* (Koch, 1873) from the Pyrenees, southern France (Koch 1873). Heurtault (1980) indicated as its type locality "Mont Lubéron, Vaucluse", which was confirmed by Judson (1997) in comments to his designation of a lectotype female of the species. Beier (1963) indicated a distribution in the western Mediterranean region: Italy, southern France and Spain, but Simon (1898) already mentioned a record of the species from Portugal. Daday (1889) published the occurrence of the species from Azerbaijan, but no recent confirmation of this record is available. Beier (1932b) mentioned Morocco as well, which came from Ellingsen`s (1910) misidentification of *R. maculatus* (L. Koch, 1873). The incorrect presence of *R. disjunctus* in Morocco appeared later in other publications (Roewer 1937, Vachon 1940a, Marcuzzi et al. 1971, Callaini 1988), as well as in the world pseudoscorpion catalogue (Harvey 2013), despite of the fact that Harvey (2013) pointed out the misidentification by Ellingsen (1910).

Until now *R. disjunctus* was found under the bark of citrus, *Platanus* and pine trees (Koch 1873, Simon 1879, Navás 1918). Weygoldt (1969, 1971) collected specimens in sand dunes in southern France and described the mating dance and the embryonic development of this species.

The aim of this paper is not only to report new localities within the known distribution of *R. disjunctus*, but also to provide complete morphological data including illustrations of the specimens found in Slovakia.

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submitted 11.8.2016, accepted 8.2.2017, online 17.2.2017

Material and methods

All specimens recorded in this paper were found in Slovakia (Fig. 1). One female was found phoretic on *Eupithecia* sp. (Lepidoptera, Geometridae) (det. M. Kulfan), which was caught immediately after flying into a Malaise trap in Harmónia on 21 May 2014 (48°22'58.69"N, 17°17'02.32"E; leg. E. Stloukal) (Fig. 2). The following specimens are stored in the F. Miller Collection housed in the Natural History Museum (NHM) in Prague, Czech Republic: 3♀♀, Kľak Village, Žarnovica, May 1957 (48°35'00.60"N, 18°38'36.83"E, leg. F. Miller; inventory number P6A 6386); 12♂♂, 8♀♀, 3 tritonymphs, 1 protonymph, Kľak, Muránska planina Mountains, 25 March 1958 (48°46'45.69"N, 19°58'03.43"E, leg. F. Miller; P6A 6387); 5♂♂, 2♀♀ Richnava, 30 July 1959 (48°55'33.78"N, 20°55'28.54"E, leg. F. Miller; P6A 6388); 2♂♂, 1♀, Banská Štiavnica, 13 May of an unknown year (48°27'10.76"N, 18°54'40.63"E, leg. F. Miller; P6A 6389). The coordinates of F. Miller's sampling localities are approximate and indicate a location within the territory of Slovakia. Dr. Miller did not mention the habitat or sampling method of his collected specimens but he noted "pines" on locality labels from the years 1957 and 1959.

The specimen found in Harmonia was mounted as a permanent slide mount in Swann's fluid. For identification, the palp, legs I and leg IV were removed from the specimen from the left side of the body. The specimens from the NHM in Prague are deposited in ethanol. Described individuals were mounted as temporary slide mounts without preparation, using lactic acid for clearing. Specimens were photographed

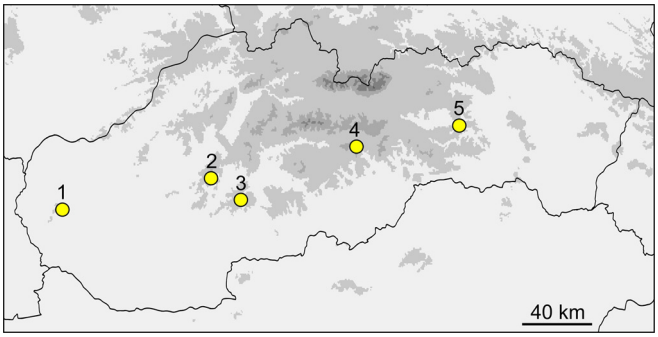

Fig. 1: Records of *Rhacochelifer disjunctus* in Slovakia: **1** Harmónia; **2** Kľak Village, Žarnovica; **3** Banská Štiavnica; **4** Kľak, Muránska planina Mountains; **5** Richnava

Fig. 2: Female of *Rhacochelifer disjunctus* phoretic on *Eupithecia* sp., Lepidoptera. Scale: 1 mm

Fig. 3: Male of *Rhacochelifer disjunctus*. Scale: 1 mm

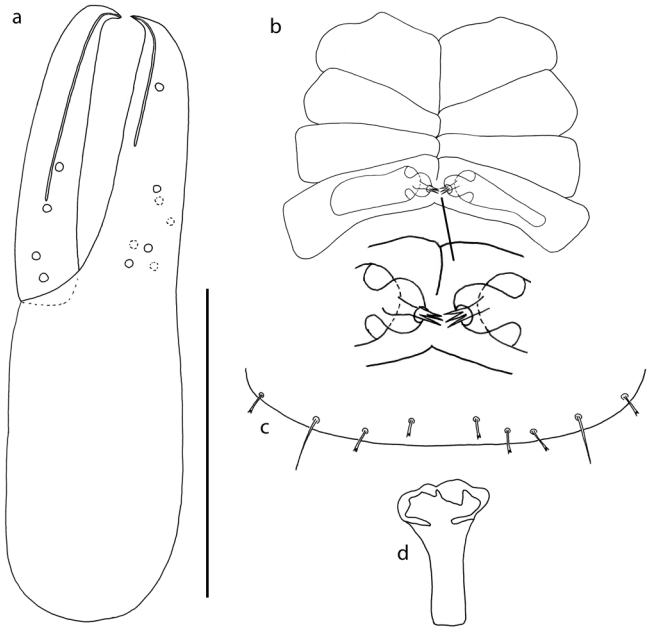

Fig. 4: *Rhacochelifer disjunctus*; **a.** palpal chela with trichobothrial pattern, female; **b.** coxae with developed coxal sacks (inset amplified), male; **c.** tergite XI with short tactile setae, female; **d.** spermatheca, female. Scale for **a**: 0.5 mm

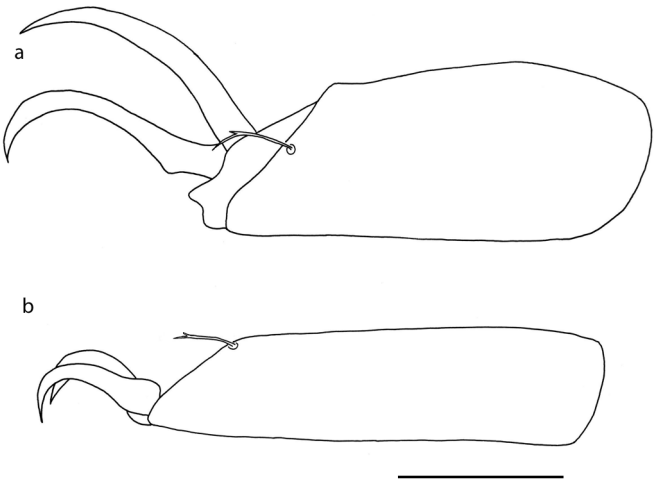

Fig. 5: *Rhacochelifer disjunctus* – tarsi of leg I with a position of subterminal seta; **a.** male, **b.** female. Scale: 0.1 mm

using a Leica DM1000 compound microscope with a ICC50 Camera Module (LAS EZ application, 1.8.0). Measurements were taken from photographs using the AxioVision 40LE application (v. 4.5). Figs 4 and 5 were drawn using a Leica drawing tube. The material is deposited in the zoological collections of the Comenius University in Bratislava and the NHM in Prague.

Results and discussion

***Rhacochelifer disjunctus* (L. Koch, 1873)**

Material. 3♀♀ – SLOVAKIA, Kľak Village, Žarnovica; 1♀, 1♂ – Kľak, Muránska planina Mountains; 2♀♀, 2♂♂ – Richnava; 1♀, 2♂♂ – Banská Štiavnica; 1♀ – Harmónia.

Description of males and females

Abdominal tergites and sternites divided. Short clavate setae present on carapace and tergites; acuminate setae present on sternites. Two narrow transverse furrows and one pair of eyes present on carapace; carapace densely granulated and without epistome. Chelicerae small, slightly sclerotized (Fig. 3); cheliceral hand with five setae, one seta present on cheliceral movable finger; galea well-developed with six–seven terminal rami; rallum with three setae; serrula exterior with 19 blades. Palps slender, femur extends abruptly from pedicel (Fig. 3); chelal fingers clearly shorter than hand; venom apparatus developed in both chelal fingers (Fig. 4a); 12 trichobothria (eight on fixed and four on movable chelal finger) present on chelal fingers (Fig. 4a).

Males (Tab. 1, Figs 3, 4b, 5a)

Carapace. Setae number on carapace highly variable, total setae number of 58–67, 28–36 of them situated in front of anterior transverse furrow, 17–24 setae on medial disk, 10–12 setae on posterior carapace margin; two lyrifissures present in

front of anterior transverse furrow, 4–7 lyrifissures situated on posterior carapace margin.
Palps. 32–34 teeth situated on fixed chelal finger, 34–38 teeth situated on movable chelal finger.
Legs. Coxae IV with developed coxal sacks extending to 2/3 of coxal length, atrium present in each coxal sac (Fig. 4b). Male tarsi of legs I slender, anterior end obtuse-angled, and slightly concave (Fig. 5a); claws on tarsi of legs I asymmetric, the longer one without accessory tooth (Fig. 5a); subterminal seta on tarsi dentate (Fig. 5a). Tarsi of legs IV without tactile seta, short pseudotactile seta present.
Tergites. I: left hemitergite 6–7 + right hemitergite 6–8 setae; II: 7 + 6–8; III: 6–7 + 5–7; IV: 5–8 + 7; IV: 7–8 + 7–9; V: 7–10 + 7–9; VI: 7–10 + 8–9; VII: 6–8 + 7–10; VIII: 7–9 + 7–9; IX: 7–8 + 7–8; XI: 2–4 + 3–4 with one pair of short acuminate tactile setae.
Sternites. IV: left hemisternite 4–5 + right hemisternite 4–7; V: 6–7 + 5–8; VI: 5–7 + 6–7; VII: 6–8 + 6–7; VIII: 5–6 + 5–7; IX: 4–6 + 5–6; X: 4–6 + 5–6; XI: 2–4 + 2–4 with one pair of short acuminate tactile setae. Anterior genital operculum with 36–44 acuminate setae and without lyrifissures. Posterior genital operculum with 13–18 acuminate setae and 4–11 lyrifissures.

Females (Tab. 1, Figs 2; 4a, c, d; 5b)
Carapace. Setae number on carapace highly variable, total setae number of 59–73, 30–37 of them situated in front of anterior transverse furrow, 19–28 setae on medial disk, 9–12 setae on posterior carapace margin; two lyrifissures present in front of anterior transverse furrow, 4–6 lyrifissures situated on posterior margin.
Palps. 32–36 teeth situated on fixed chelal finger, 34–40 teeth situated on movable chelal finger.
Legs. Tarsi of legs I without modifications (Fig. 5b); subterminal seta on tarsi dentate (Fig. 5b). Tarsi of legs IV without tactile seta, short pseudotactile seta present.
Tergites. I: left hemitergite 6–7 + right hemitergite 6–8 setae; II: 6–8 + 6–8; III: 6–8 + 5–8; IV: 6–8 + 6–8; V: 7–8 + 7–8; VI: 8 + 7–8; VII: 7–9 + 7–11; VIII: 8–9 + 8–10; IX: 7–9 + 7–9; X: 6–9 + 6–8; XI 3–4 + 3–4 with one pair of short acuminate tactile setae (Fig. 4c).
Sternites. IV: left hemisternite 4–7 + right hemisternite 4–7 setae; V: 5–6 + 5–7; VI, VII, VIII: 5–7 + 5–7; IX: 5–8 + 4–7; X: 4–7 + 4–6; XI 2–3 + 2–3 with one pair of short acuminate tactile setae. Spermatheca foliate, resembling those of *R. corcyrensis* (Beier, 1930) or *R. maculatus* (L. Koch, 1973) (Mahnert 1977), but it seems different from the more elongate spermatheca of the lectotype of *R. disjunctus* (M. Judson, pers. comm.), but no data are available on shape variation of this organ depending on clearing methods (Fig. 4d). Anterior genital operculum with 13–18 setae and two lyrifissures; posterior genital operculum with 7–10 setae and 2–5 lyrifissures.

Measurements (♂♂/♀♀): see Tab. 1.

Remarks
Two *Rhacochelifer* species, *R. peculiaris* (L. Koch, 1873) and *R. quadrimaculatus* (Tömösváry, 1882), were previously reported from Slovakia (Tömösváry 1882, Verner 1960). Tömösváry (1882) found both species under tree bark at the locality of Humenné, whereby it should be mentioned that for *R. quadrimaculatus* Humenné represents the type locality (Tömösváry 1882). Later Verner (1960) recorded one specimen of *R. quadrimaculatus* under oak bark in the Kováčovské kopce hills. Unfortunately, no *Rhacochelifer* specimens recorded from Slovakia are found in older collections. The building of the Hungarian Natural History Museum, together with the zoological collections, burned down in 1956 and many type specimens were destroyed. The curator of the arachnid collection suspects that part of Tömösváry`s collection was among this lost material (L. Dányi, pers. comm.). Moreover, no *Rhacochelifer* specimens were found in the collections of Dr. Verner in Charles University in Prague, Czech Republic (F. Šťáhlavský, pers. comm.). These facts lead us to conclude that the occurrence of both species cannot be verified in Slovakia, or even the existence of *R. quadrimaculatus* at all. According to the published data we suggest a synonymy between *R. quadrimaculatus* and *R. corcyrensis* (Beier, 1930), which have similar foretarsi quite different from that of *R. disjunctus*/*pecularis*. The original description clearly indicates the shape of the male foretarsus, and also Beier (1963) placed *R. quadrimaculatus* very close to *R. corcyrensis*. On the other hand, confusion between *R. peculiaris* and *R. disjunctus* cannot be excluded, since the two species are morphologically close and sometimes not easy to distinguish. Beier (1963: 295) separated the two species by the proportions and morphology of the male tarsus I: 2.7 times longer than deep and slightly concave anteriorly in *R. disjunctus* and 2.3 times and straight (not concave) anteriorly in *R. peculiaris.* Furthermore, figures 296 and 297 were interchanged during printing, i.e. Fig. 297 (Beier 1963: 294) represents *R. disjunctus* and vice versa (M. Beier, pers. comm. to VM). The proportions of the male tarsus I measured in our collections lie between the values indicated for the two species, the slightly concave anterior margin of male tarsus I led us to place the specimens as *R. disjunctus*. But the affinities/differences between the two species still need to be defined properly, since differences seem to exist in the shape of spermatheca (Mahnert 1977). Problems concerning taxonomy of Mediterranean species of the genus *Rhacochelifer* are complicated and it would be benefitial if they were subject to revision by taxonomists in the future.

Pseudoscorpions have the ability to attach themselves to a variety of generally more mobile animals, in most cases arthropods (Poinar 1998). In the genus *Rhacochelifer* only a few records of phoresy were known until now. Vachon (1940b) recorded phoresy of *R. similis* Beier, 1932 on *Lonchaea laticornis* Meigen, 1826 (Diptera). Another record was published by Vachon (1953), who observed *R. maculatus* (L. Koch, 1873) on *Sterrha aversata* (Linnaeus, 1758) (Lepidoptera). The current finding of phoretic *R. disjunctus* could explain the species distribution in Slovakia. The localities listed in the present paper represent the northernmost known occurrence of *R. disjunctus*.

Acknowledgements
We are grateful to Eduard Stloukal for collecting the pseudoscorpion used in the paper and Miroslav Kulfan for identification of Lepidoptera. We would like to express our thanks to our colleagues František Šťáhlavský and Petr Dolejš for calling attention to material deposited in the Natural History Museum in Prague, as well as to Christoph Hörweg for his help with literature. Sincere thanks to Mark L.I. Judson for his information on the lectotype of *Rhacochelifer disjunctus*.

Tab. 1: Morphometric data for both sexes of *Rhacochelifer disjunctus*; Abbreviations: n – number of measured specimens, Min–Max (Mean±SD) – mean values of the measured characters ± standard deviation, all measurements in mm

Characters	♀ n = 8 Min–Max (Mean±SD)	♂ n = 5 Min–Max (Mean±SD)
Body		
Length	1.84 – 2.60 (2.28±0.25)	1.77–2.10 (1.95±0.13)
Carapace		
Length	0.65–0.74 (0.69±0.03)	0.63–0.69 (0.65±0.02)
Anterior margin width	0.38–0.45 (0.42±0.03)	0.39–0.45 (0.42±0.03)
Posterior margin width	0.75–0.85 (0.80±0.03)	0.78–0.83 (0.81±0.03)
Length/posterior margin width ratio	0.83–0.89 (0.87±0.02)	0.76–0.85 (0.81±0.04)
Chelicera		
Length	0.20–0.23 (0.22±0.01)	0.21–0.22 (0.21±0.01)
Width	0.10–0.12 (0.11±0.01)	0.10–0.11 (0.11±0.00)
Length/width ratio	1.92–2.00 (1.96±0.04)	1.91–2.10 (1.98±0.08)
Movable finger length	0.15–0.17 (0.16±0.01)	0.16–0.16 (0.16±0.00)
Palp		
Trochanter length	0.32–0.35 (0.33±0.01)	0.30–0.33 (0.32±0.01)
Trochanter width	0.17–0.20 (0.18±0.01)	0.17–0.19 (0.18±0.01)
Trochanter length/width ratio	1.68–1.89 (1.81±0.08)	1.68–1.83 (1.77±0.05)
Femur length	0.61–0.67 (0.63±0.02)	0.58–0.63 (0.62±0.02)
Femur width	0.16–0.19 (0.18±0.01)	0.17–0.18 (0.17±0.01)
Femur length/width ratio	3.26–3.81 (3.51±0.21)	3.41–3.71 (3.54±0.13)
Patella length	0.53–0.57 (0.55±0.01)	0.52–0.56 (0.54±0.02)
Patella width	0.21–0.23 (0.22±0.01)	0.20–0.22 (0.21±0.01)
Patella length/width ratio	2.41–2.71 (2.53±0.10)	2.45–2.67 (2.56±0.10)
Hand with pedicel length	0.55–0.60 (0.58±0.02)	0.47–0.60 (0.54±0.05)
Hand width	0.29–0.32 (0.30±0.01)	0.28–0.31 (0.29±0.01)
Hand length/width ratio	1.81–2.00 (1.93±0.06)	1.68–1.97 (1.85±0.13)
Movable finger length	0.43–0.49 (0.47±0.02)	0.40–0.49 (0.45±0.03)
Chela length	0.97–1.05 (0.99±0.03)	0.95–1.01 (0.97±0.02)
Chela length/hand width ratio	3.16–3.39 (3.30±0.08)	3.13–3.46 (3.33±0.13)
Leg I		
Trochanter length	0.14–0.18 (0.15±0.01)	0.13–0.15 (0.14±0.01)
Trochanter width	0.11–0.12 (0.11±0.00)	0.11–0.12 (0.12±0.01)
Trochanter length/width ratio	1.25–1.64 (1.37±0.13)	1.17–1.27 (1.22±0.55)
Femur length	0.20–0.22 (0.21±0.01)	0.19–0.23 (0.22±0.02)
Femur width	0.12–0.12 (0.12±0.00)	0.11–0.13 (0.12±0.01)
Femur length/width ratio	1.67–1.83 (1.73±0.06)	1.73–1.92 (1.79±0.07)
Patella length	0.25–0.29 (0.27±0.01)	0.23–0.28 (0.25±0.02)
Patella width	0.10–0.11 (0.10±0.01)	0.09–0.11 (0.10±0.01)
Patella length/width ratio	2.50–2.80 (2.60±0.09)	2.50–2.89 (2.65±0.17)
Tibia length	0.25–0.27 (0.26±0.01)	0.23–0.27 (0.25±0.02)
Tibia width	0.09–0.10 (0.10±0.01)	0.11–0.12 (0.11±0.01)
Tibia length/width ratio	2.60–2.89 (2.74±0.09)	2.09–2.36 (2.23±0.10)
Tarsus length	0.23–0.29 (0.25±0.02)	0.21–0.28 (0.24±0.03)
Tarsus width	0.07–0.08 (0.07±0.01)	0.09–0.12 (0.10±0.01)
Tarsus length/width ratio	3.13–3.86 (3.45±0.26)	2.10–2.56 (2.35±0.18)
Leg IV		
Trochanter length	0.18–0.27 (0.24±0.03)	0.21–0.24 (0.22±0.01)
Trochanter width	0.12–0.15 (0.13±0.01)	0.12–0.13 (0.13±0.00)
Trochanter length/width ratio	1.50–1.93 (1.77±0.15)	1.62–1.85 (1.75±0.08)
Femoropatella length	0.40–0.54 (0.50±0.05)	0.48–0.51 (0.49±0.01)
Femoropatella width	0.14–0.18 (0.17±0.01)	0.14–0.16 (0.15±0.01)
Femoropatella length/width ratio	2.67–3.50 (3.04±0.27)	3.00–3.64 (3.22±0.25)
Tibia length	0.33–0.43 (0.39±0.03)	0.33–0.38 (0.36±0.02)
Tibia width	0.10–0.12 (0.11±0.01)	0.10–0.11 (0.10±0.00)
Tibia length/width ratio	3.18–3.90 (3.57±0.24)	3.00–3.80 (3.58±0.33)
Tarsus length	0.26–0.32 (0.29±0.02)	0.27–0.30 (0.28±0.01)
Tarsus width	0.08–0.09 (0.08±0.00)	0.07–0.08 (0.07±0.01)
Tarsus length/width ratio	3.25–3.75 (3.50±0.15)	3.63–3.86 (3.79±0.10)

Technical assistance with figures by our colleagues Daniel Jablonski and Daniel Gruľa is also appreciated. We would like to thank reviewers Giulio Gardini and František Šťáhlavský for all their corrections and comments that improved the manuscript. The study was financially supported by the project VEGA 1/0191/15.

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