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Two new records of the genus *Dactylochelifer* (Pseudoscorpiones: Cheliferidae) from Iran

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Abstract. There are five species belonging to the genus *Dactylochelifer* Beier, 1932 previously reported from Iran, which are widely distributed and can be found in leaf litter, under the bark of trees and stones. Two species, *D. intermedius* Redikorzev, 1949 and *D. mrciaki* Krumpál, 1984 are recorded here for the first time from Iran and were collected from leaf litter. In addition, the morphological and morphometric characteristics of Iranian specimens are presented.

Key words. Distribution, faunistics, morphometry, leaf litter, Arachnida, Pseudoscorpiones, Cheliferidae, *Dactylochelifer*, Iran, Palaearctic region.

INTRODUCTION

The members of the family Cheliferidae can be identified by the presence of a venom apparatus in both chelal fingers and of coxal sacs and ram's horn organs in males (Harvey 1992). The genus, *Dactylochelifer* Beier, 1932 belongs to the tribe Dactylocheliferini, which can be separated from the tribe, Cheliferini by the presence of an atrium in males and an unpaired median cribriform plate in females (Beier 1932). The identification of species belonging to this genus depends mainly on the shape and the size of male tarsus I, the morphological characters of males and rarely the shape of the cribriform plates of females, e.g. *D. gracilis* Beier, 1951 is easily recognized as the ratios of the male tarsus I which are mostly robust and very different from those of *D. intermedius* Redikorzev, 1949.

The genus, *Dactylochelifer* consists of 44 species, which occur in diverse habitats in different climatic conditions. There are 28 species belonging to this genus that occur in the Middle East and Central Asia (Harvey 2013). The species that occur in Iran are: *Dactylochelifer gracilis* in Kerman and Elborz provinces, *D. kussariensis* (Dadday, 1889) in Tabriz city and *D. latreillei latreillei* (Leach, 1817) in Guilan province, *D. brachialis* Beier, 1952 and *D. spasskyi* Redikorzev, 1949 in Kerman province (Beier 1951, 1971; Mahnert 1974; Nassirkhani & Takalloo zade 2013). Two species, *D. intermedius* and *D. mrciaki* Krumpál, 1984, which were collected during recent faunistic investigations are reported here for the first time as occurring in Iran.

MATERIAL AND METHODS

The material examined during this study is deposited in the Collection of the Acarology Laboratory, Islamic Azad University of Arak (IAUA), Iran. The specimens were collected by sieving leaf litter and preserved in 70% ethanol for transporting to the laboratory. The pedipalps, chela, chelicera, first and fourth legs were removed, cleared in 60% lactic acid and mounted permanently in Hoyer's medium (a mixture of distilled water, chloral hydrate, Arabic gum and glycerin) on dished glass microscope slides and covered with a 18 mm coverslip. The terminology and measurements mostly follow Chamberlin

(1931), Harvey (1992), Judson (2007) and Harvey et al. (2012). The specimens were examined using an Olympus BH-2 compound microscope, measured using a scaled ocular lens and illustrated at a suitable magnification using a drawing tube attached to the microscope.

The following abbreviations for the trichobothria are used: *eb* = external basal; *esb* = external sub-basal; *ib* = internal basal; *isb* = internal sub-basal; *ist* = internal sub-terminal; *est* = external sub-terminal; *it* = internal terminal; *et* = external terminal; b = basal; *t* = terminal; *sb* = sub-basal; *st* = sub-terminal. In addition, the following abbreviations are used in the text: mm = millimeter; L = length; W = width; D = Depth; M = male; F = female.

Family Cheliferidae Risso, 1827
Tribe Dactylocheliferini Beier, 1932
Genus *Dactylochelifer* Beier, 1932

***Dactylochelifer intermedius* Redikorzev, 1949**
Figs 2–8, 12–13

Dactylochelifer intermedius Redikorzev, 1949: 664, figs 30–32, 36.

Material examined. **Iran**: **Lorestan**: 8 males, 2 females, Oshtoran-Kooh, Darr-e-Takht, leaf litter, littoral zone, June 2013, M. Nassirkhani lgt. (IAUA); 1 male, Azna, leaf litter, June 2013, M. Nassirkhani 1eg. (IAUA). **Markazi**: 5 males, 2 females, Varche, leaf litter, beside a stream, June 2013, M. Nassirkhani 1gt. (IAUA). **Fars**: 1 male, 3 females, Neyriiz, leaf litter, pomegranate garden, July 2014, M. Nassirkhani 1gt. (IAUA).

Diagnosis. *Dactylochelifer intermedius* can be easily identified by the shape of male and female genital organs, the ratio of male tarsus I (3.10–3.70×) and the shape of male tarsus I.

Description. Adults (Figs 2–8, 12–13). Females are generally darker in colour than males.

Body length: males 2.55–2.80 and females 2.95–3.77 mm.

Carapace: dark brown, darker than abdomen, slightly lighter than pedipalps; heavily granulate; equal in size or slightly longer than wide, L/W 1.00–1.14; 2 transverse furrows present; anterior furrow situated medially, narrower than posterior furrow in males and slightly wider than posterior furrow in females, anterior and posterior furrows straight and extending to lateral margin (Fig. 2), furrows with small granules; with 2 well-developed eyes; with slightly projecting setae with terminal denticulations; anterior margin with 8–14 in males and 8–12 in females and posterior margin with 6–11 in males and 9–15 setae in females; with 5 pairs of lyrifissures, first two pairs situated on anterior margin, third pair situated slightly posterior to eyes, fourth pair situated very close to posterior furrow and fifth pair on posterior margin.

Tergites: brown, lighter in colour than carapace and pedipalps; sclerotized and completely granulate; with median suture line, tergites XI incompletely divided; tergites I–IV and XI with one lateral seta, tergites V–X with two lateral setae; tergite XI with two long tactile setae situated laterally; circum anal setae acute, simple and longer than tergal setae; most setae short and stout with terminal denticulations; tergal setae arranged: in males 10–14: 12–18: 14–18: 14–18: 15–20: 16–20: 17–20: 15–19: 15–18: 12–16: 7–12: 2 and in females 12–16: 15–18: 15–18: 16–20: 18–21: 18–21: 16–21: 18–20: 15–19: 12–18: 7–12: 2.

Sternites: brown, lighter in colour than tergites; lightly sclerotized and less granulate than tergites; sternites IV–XI with median suture, sternite XI divided incompletely; sternites II and III deformed and form the anterior and posterior operculum, anterior operculum of males with 46–50 and anterior operculum of females with 10–22 simple setae; males with coxal sac and well-developed atrium (Fig. 6) [male genital organ is illustrated in fig. 8]; females with one hearth-like cribriform plate with caudal filaments and two oval cribriform plates situated laterally(Fig. 13); posterior spiracles with one and anterior spiracle without a seta; anterior trachea larger than posterior trachea; sternites IV–VII with more lyrifissures than sternites VIII–XI; sternites X and XI with two long tactile setae; most setae simple and longer than tergal setae; sternal setae arranged:

in males 46–50: 10–15: 7–15: 10–17: 11–18: 12–15: 10–17: 10–15: 10–13: 9–12: 2 and in females 20–22: 4–6: 7–9: 12–13: 12–13: 13–14: 12–15: 11–14: 11–12: 8–12: 2.

Pleural membrane: robust and irregularly striate.

Chelicera: light brown with hexagonal ornamentation, lighter in colour than legs, base of movable finger darker than hand; hand slightly sclerotized; hand with 5 simple setae (Fig. 5a); serrula exterior and serrula interior present; serrula exterior with 16–18 blades (Fig. 5c); serrula interior wing-shaped; rallum with three blades, distal blade longest and denticulate (Fig. 5d); galea with 5–6 distal rami in males [3 apical, 2–3 subapical and 1 basal rami] (Figs 5a, c) and 4–5 distal rami in females; fixed finger with 5–7 teeth, terminal teeth acute and basal teeth large and blunt; movable finger with galeal seta situated distally, with one curved apical lobe and one pointed sub-apical tooth (Fig. 5c).

Pedipalps: dark brown; sclerotized and completely granulate; trochanter swollen, dorsal margin with two small projections, L/W 1.80–2.00 for males and 1.85–2.00 for females; femur elongate, with distinct short pedicel, lateral margins more granulate, retrolateral margin curved basally (Fig. 3), L/W 3.91–4.30 for males and 3.45–4.11 for females; patella with distinct curved pedicel, retrolateral margin curved distally; patella with three lyrifissures, two lyrifissures situated basally and one located distally; patella L/W 2.85–3.33 for males and 3.03–3.57 for females; chela with distinct pedicel, fingers not granulate and slightly curved basally, hand with straight margins; setae on trochanter, femur, patella, hand and retrolateral margins of fingers short with lateral and terminal denticulation; chela (with pedicel) L/W 4.00–4.24 for males and 3.78–4.43 for females; chela (without pedicel) L/W 3.50–3.94 for males and 3.43–4.00 for females; hand (with pedicel) L/W 2.24–2.42 for males and 2.16–2.47 for females; movable finger shorter than hand with pedicel; hand 1.09–1.23 for males and 1.13–1.34 for females longer than movable finger; fixed finger with 8 and movable finger with 4 trichobothria (Figs 4, 12); fixed finger with trichobothrium *it* situated closer to *et* than *est*, *ist* situated slightly posterior to *est* and *eb*-*esb*-*ib*-*isb* aggregated

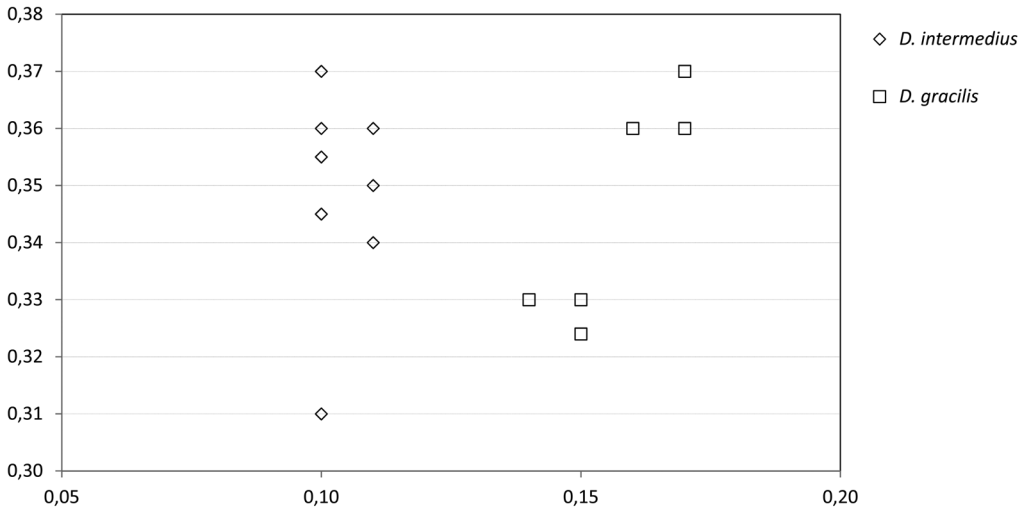

Fig. 1. Comparison of the L/D (in mm) ratios of the male tarsus I in *Dactylochelifer intermedius* Redikorzev [n=8] and *D. gracilis* Beier [based on Nassirkhani & Harvey (2013)].

basally; movable finger with trichobothrium *t* situated approximately medially, *st* situated slightly closer to *sb* than *t* and *sb* situated close to *b;* fixed finger of males with 42–48 and movable finger with 41–50 and fixed finger of females with 48–51 and movable finger with 48–54 similar-shaped teeth; fixed finger with 2–3 terminal teeth located on external margin of main teeth; nodus ramosus present on both fingers, apparently longer on movable finger than fixed finger, situated slightly posterior to *st* on movable finger, and posterior to *est* on fixed finger.

Legs: brown, slightly lighter in colour than carapace; granulate; coxae are shown in Fig. 6; prolateral margin of tibia I curved basally, with short and denticulate setae, L/D 3.16–5.80 for males and 4.00–4.45 for females; tarsus of leg I elongate with slightly straight margins (Fig. 7), first half of prolateral and basal two thirds of retrolateral margins with denticulate setae, two tactile setae situated distally, sub-terminal setae simple, L/D 3.27–3.70 for males and 5.00–5.75 for females; claws asymmetrical in males, internal claw apically curved with 5–7 acute teeth and external claw simple (Fig. 7); claws symmetrical in females; tibia of leg IV distinctly longer than tarsus, with denticulate setae, prolateral margin curved basally, L/D 4.92–5.30 for males and 5.33–5.92 for females; tarsus elongate, first half of prolateral and basal two thirds of retrolateral margins with denticulate setae, two tactile setae situated distally, sub-terminal setae simple, L/D 5.37–5.86 for males and 5.22–6.00 for females; claws symmetrical, without teeth.

Dimensions (L/W, in mm). **Males**: Carapace: 0.79–0.95/0.75–0.88. Pedipalp: trochanter 0.39–0.46/0.22–0.25; femur 0.82–0.95/0.20–0.24; patella 0.75–0.90/0.23–0.27; chela (with pedicel) 1.20–1.40/0.30–0.33; chela (without pedicel) 1.10–1.30; hand (with pedicel) L.0.67–0.80; movable finger L. 0.60–0.66. (L/D, in mm) Leg I: tibia 0.34–0.38/0.11–0.15; tarsus 0.34–0.37/0.10–0.11. Leg IV: Femur + patella 0.69–0.76/0.17–0.19; tibia 0.55–0.59/0.10–0.12; tarsus 0.40–0.44/0.07–0.08. **Females**: Carapace: 0.90–1.07/0.85–0.10. Pedipalp: trochanter 0.44–0.50/0.22–0.28; femur 0.90–1.15/0.23–0.28; patella 0.79–1.05/0.26–0.32; chela (with pedicel) 1.30–1.70/0.37–0.40; chela (without pedicel) 1.20–1.55; hand (with pedicel) L.0.77–0.99; movable finger L. 0.65–0.74. (L/D, in mm) Leg I: tibia 0.37–0.49/0.09–0.11; tarsus 0.38–0.46/0.07–0.08. Leg IV: femur + patella 0.87–0.96/0.21; tibia 0.59–0.71/0.10–0.12; tarsus 0.43–0.51/0.08–0.09.

Remarks. It is easy to distinguish between *D. intermedius* and *D. gracilis* using the ratios of male tarsus I, which are not so robust and highly modified (Fig. 1). On the other hand, the specimens collected from Iran, are very similar to *D. intermedius*, which is reported from Kirghizstan, Tajikistan, Turkmenistan, Turkey and Pakistan (summarized by Harvey 2013), and *D. kussariensis*, reported from Afghanistan, Iran, Caucasus and Kazakhstan (summarized by Harvey 2013) in terms of the shape and ratio of male tarsus I.

The pedipalp of the newly collected specimens from Iran is distinctly larger than that of *D. intermedius* and *D. kussariensis*, e.g. the pedipalpal femur L/W of *D. intermedius* is 0.82/0.22 mm for males and 0.86/0.23 mm for females and 0.75/0.21 mm for males and 0.69–0.75/0.19–0.21 mm for females of *D. kussariensis* (Beier 1951, Dashdamirove & Schawaller 1995). The pedipalpal femur L/W of the newly collected specimens from Iran is 0.82–0.95/0.20–0.24 mm for males and 0.90–1.15/0.23–0.28 mm for females. Also, the chela (with pedicel) L/W of *D. intermedius* is 1.28/0.34 mm for males and 1.37/0.36 mm for females, and that of *D. kussariensis* is 1.23/0.31 mm for females (Dashdamirov & Schawaller 1995). The chelal (with pedicel) size of the recently collected material is L/W 1.20–1.40/0.30–0.33 for males and 1.30–1.70/0.37–0.40 mm for females,

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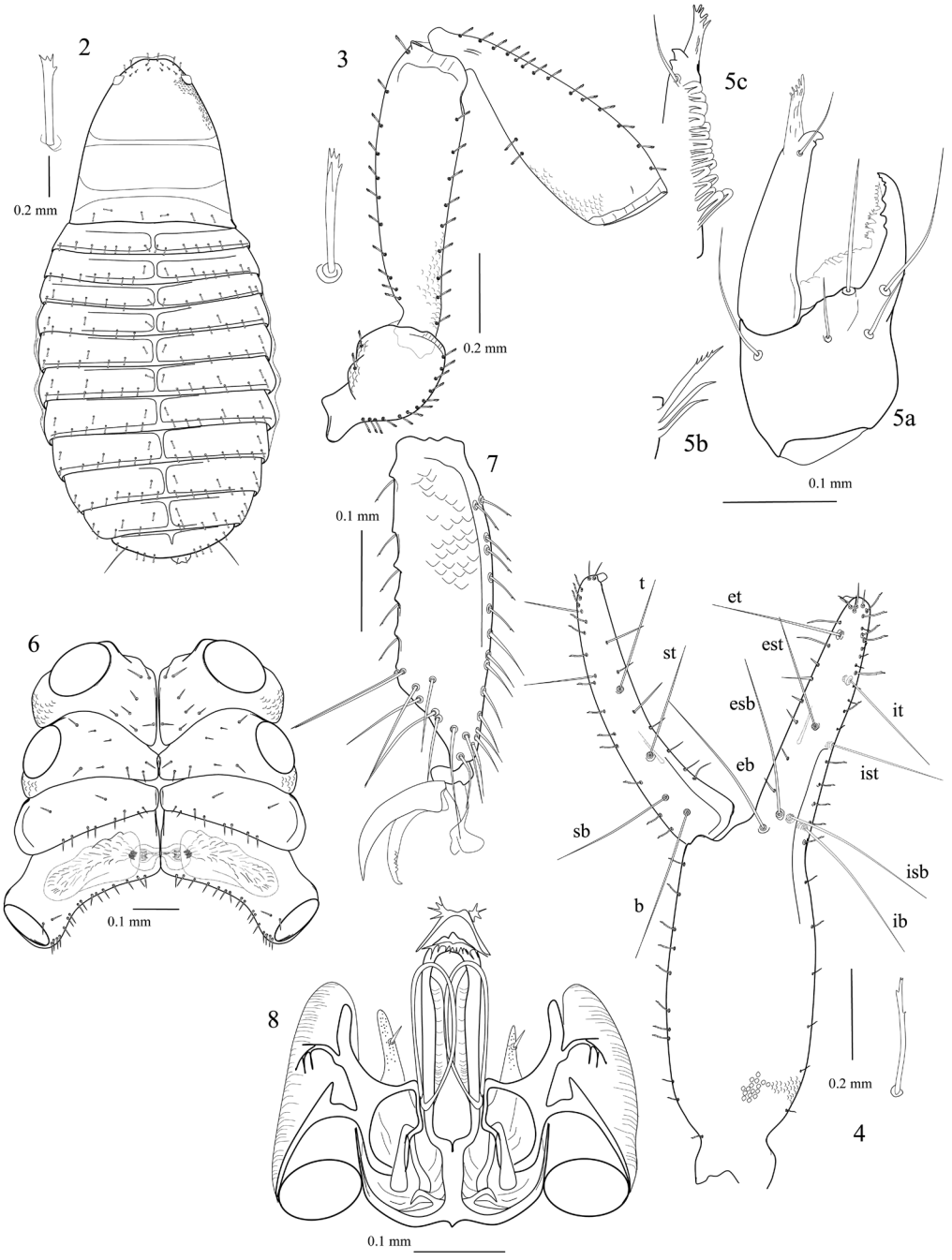
Figs 2–8. *Dactylochelifer intermedius* Redikorzev, male: 2 – dorsal view of body; 3 – pedipalp; 4 – left chela (showing trichobothrial pattern and position of nodus ramosus); 5a – chelicera; 5b – cheliceral rallum; 5c – movable cheliceral finger (showing serrula exterior, apical lobe and pointed sub-apical tooth); 6 – coxae (showing coxal sacs and well developed atrium); 7 – tarsus I; 8 – genital organ.


2
0.2 mm
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0.2 mm
4
8
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which clearly overlaps the measurements reported in this study. These two species are considered to be synonymous, but the type specimens need to be checked.

These species can be separated on basis of the structure of the cribriform plates of females. The female genitalia of *D. intermedius* consist of an oblong median cribriform plate and 2 indented lateral cribriform plates, whereas those of *D. kussariensis* consist of lentil-like median and oval lateral cribriform plates and two large membranous sacs (Dashdamirov & Schawaller 1995). Therefore, based on the morphometric characters there is insufficient evidence for reporting a new species, and based on the shape of the females' genitalia, we attribute these specimens to *D. intermedius*, which is reported and illustrated for the first time from Iran.

Dactylochelifer mrciaki Krumpál, 1984
Figs 9–11

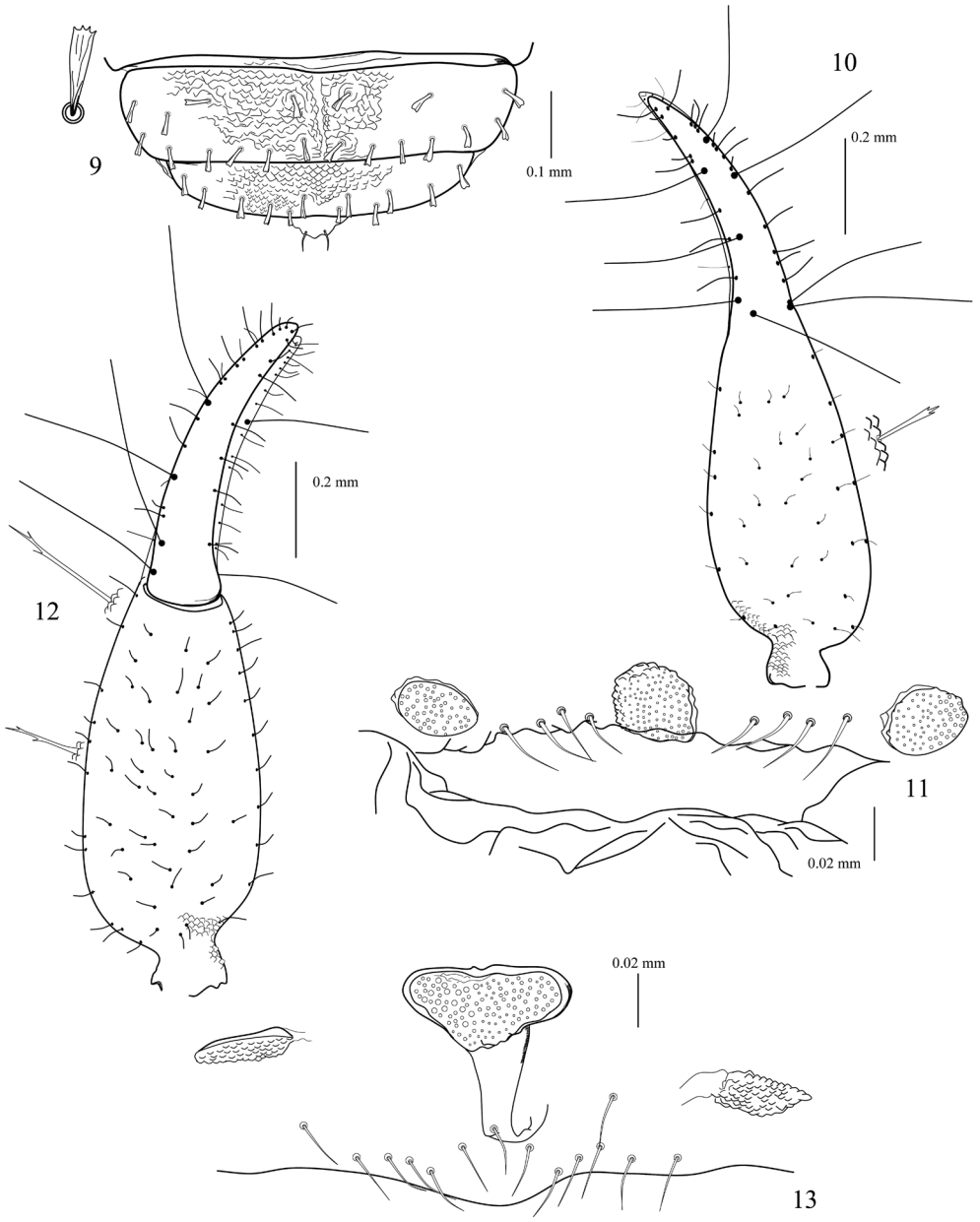
Dactylochelifer mrciaki Krumpál, 1984: 64, figs 1–4.

Material examined. **Iran**: **Fars**: 3 females, Ghatruiie, leaf litter, July 2014, M. Nassirkhani 1eg. (IAUA).

Diagnosis. *Dactylochelifer mrciaki* can be readily identified by the ratio of the male tarsus I (mostly 3.56×); the shape of the male tarsus I; the shape of male and female genital organ; the absence of tactile setae on tergite XI.

Description. Females (Figs 9–11). Body length: 2.72–2.87 mm.

Carapace: distinctly longer than wide, L/W 1.12–1.26; 2 transverse furrows present, posterior furrow with a median vertical column; with two well-developed eyes; setae distinctly stout with terminal denticulations (leaf like); anterior margin with 8–10 and posterior margin with 12–14 setae; with four pairs of lyrifissures, first pair situated on anterior margin, second pair situated posterior to and close to the eyes, third pair situated very close to posterior furrow and fourth pair on posterior margin. *Tergites*: sclerotized and completely granulate; with median suture line, tergite XI not divided; with leaf like shaped setae with four terminal denticulations, tergite XI without long tactile setae (Fig. 9); tergal setae arranged: 12–15: 15–16: 16–17: 18–20: 19–23: 22–23: 22–19: 20–22: 18–20: 19–20: 12–13: 2. *Sternites*: lightly sclerotized and less granulate than tergites; sternites IV–XI with median suture line, sternite XI divided incompletely; with three cribriform plates, spherical plate large and situated medially, lateral plates with semispherical shapes (Fig. 11); sternites IX, X and XI with leaf like shaped setae; most sternal setae thinner than tergal setae; sternite XI with two long tactile setae; sternal setae arranged: 13–16: (0)8–9(0): (1)4–5(1): 10–11: 10–11: 11: 11–12: 13–14: 11–14: 11: 2. *Pleural membrane*: striate. *Chelicera*: hand with 5 setae, sub-basal setae with terminal denticulations; serrula exterior with 17 blades; serrula interior with several membranous branches; rallum with three blades, distal blade longest and denticulate; galea with 6 distal rami, 4 apical, 1 subapical and 1 basal rami; galeal seta situated distally; fixed finger with 5 teeth, terminal teeth acute and basal teeth large and blunt; movable finger with a terminal lobe and one apical tooth. *Pedipalps*: sclerotized and completely granulate; most setae with three terminal denticulations; trochanter L/W 1.87–1.91; femur L/W 3.86–4.04; patella with 4 lyrifissures, 3 lyrifissures situated basally and one located distally; patella L/W 3.21–3.25; chela (with pedicel) L/W 4.14–4.33; chela (without pedicel) L/W 3.83–4.00; hand (with pedicel) L/W 2.43–2.50; movable finger shorter than hand with pedicel; hand (with pedicel) 1.23–1.25× longer than movable chelal finger; fixed finger with 8 and movable finger with 4 trichobothria (Fig. 10); movable finger with trichobothrium *t* just on the beginning of distal half of the finger, *st* situated slightly closer to *t* than *sb*; chelal fingers with 37–38 similar-shaped teeth; nodus ramosus and venom duct present in both fingers. *Legs*: most setae short, stout and denticulate; sub-terminal setae simple; claws symmetrical; leg I: tibia L/W 4.00; tarsus with two tactile setae situated distally,



Figs 9–13. *Dactylochelifer mrciaki* Krumpál, female: 9 – chaetotaxy of tergites X and XI; 10 – right chela, dorsal aspect; 11 – cribriform plates. *Dactylochelifer intermedius* Redikorzev, female: 12 – left chela, dorsal aspect; 13 – cribriform plates.

L/W 5.14–5.83; leg IV: femur + patella L/W 3.65–3.73; tibia distinctly longer than tarsus, L/W 5.54–5.72; tarsus with two tactile setae situated distally, L/W 5.12–5.71.
Dimensions (L/W, in mm). **Females**: Carapace: 0.87–0.88/0.69–0.78. Pedipalp: trochanter 0.42–0.43/0.22–0.23; femur 0.85/0.21–0.22; patella 0.76–0.77/0.24; chela (with pedicel) 1.25–1.30/0.30; chela (without pedicel) 1.15–1.20; hand (with pedicel) L.0.73–0.75; movable finger L. 0.58–0.61. Leg I: tibia 0.36/0.09; tarsus 0.35–0.36/0.06–0.07. Leg IV: femur + patella 0.71–0.73/0.19–0.20; tibia 0.61–0.63/0.11; tarsus 0.40–0.41/0.07–0.08.

Remarks. Generally, the females of this genus cannot be identified because the shape of male tarsus I is the basic character for identifying these species. In this case, based on the absence of long tactile setae on the tergite XI (Fig. 9) and the shape of the female cribriform plates (Fig. 11), we attribute these specimens to *Dactylochelifer mrciaki*, which is recorded for the first time from Iran. This species is reported from Uzbekistan, Kazakhstan, Turkmenistan, and Tajikistan (Krumpál 1984; Dashdamirov & Schawaller 1995). The absence of tactile setae on the tergite and sternite XI of *D. mrciaki* is reported by Dashdamirov & Schawaller (1995), whereas two long tactile setae are present on the sternite XI of the newly collected specimens from Iran, which is a chaetotaxial characteristic of *D. popovi* Redikorzev, which was synonymized with *D. mrciaki* by Schawaller (1989) and retrieved as a real species by Dashdamirov & Schawaller (1995). This difference is insufficient for recognizing a new species.

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