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## A REDESCRIPTION OF *ACANTHOCREAGRIS IRANICA* (PSEUDOSCORPIONES, NEOBISIIDAE) INHABITING SOIL UNDER OAK TREES IN ZAGROS FOREST, WESTERN IRAN

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**A Redescription of *Acanthocreagris iranica* (Pseudoscorpiones, Neobisiidae) Inhabiting Soil under Oak Trees in Zagros Forest, Western Iran.** Nassirkhani, M., Mirab-Balou, M., Bazgir, M., Zamani, M. — During study on soil mesofauna in Choqa Sabz Forest and Dalab Protected Area in Ilam Province (western Iran), the following pseudoscorpions belonging to four families were collected and identified: *Chthonius* (*Chthonius*) *shelkovnikovi* Redikorzev, 1930, *Chthonius* (*Ephippiochthonius*) *negarinae* Nassirkhani and Vafai, 2015, *Paramenthus nanus* Mahnert, 2007, *Cardioplum asiaticum* (Dashdamirov, 1990), and *Acanthocreagris iranica* Beier, in Mahnert 1976. All of these species are new to the fauna of western Iran. In this survey, the adults of *A. iranica* collected from Ilam and Lorestan Provinces are redescribed and figured. Additionally, its tritonymph and deutonymph are briefly described.

Key words: Arachnida, pseudoscorpion, intraspecific variation, developmental stages, Middle East.

### Introduction

The family Neobisiidae is poorly known in Iran and currently contains 10 species belonging to three genera. Of which, only three species, *Acanthocreagris roncifformis* (Redikorzev, 1949), *A. iranica* Beier, 1976 and *A. caspica* (Beier, 1971) are attributed to the subfamily Microcreagrinae (Harvey, 2013). The members of this subfamily are characterized by the presence of developed galea, the shape of rallar blades, and usually the subbasal position of trichobothrium *isb* (Mahnert, 1974; Harvey, 1992).

The records of five species, *Chthonius* (*Chthonius*) *shelkovnikovi* Redikorzev, 1930 (2 ♀, 3 ♂, 2 tritonymphs), *Chthonius* (*Ephippiochthonius*) *negarinae* Nassirkhani and Vafai, 2015 (1 ♂) and *Acanthocreagris iranica* (2 ♀, 5 ♂, 3 tritonymphs, 1 deutonymph) from Choqa Sabz Forest Park and *Paramenthus nanus* Mahnert, 2007 (1 ♀, 1 tritonymph) and *Cardioplum asiaticum* (Dashdamirov, 1990) (1 ♀) from Dalab Protected Area, are the first records of pseudoscorpions inhabiting soil under oak trees in Zagros forests from Ilam Province, westernmost part of Iran.

*Acanthocreagris iranica*, the neobisiids examined during this study bear a number of morphological variations which were not mentioned in the original description by Beier in Mahnert (1976). In addition, only the dorsal view of the pedipalp was illustrated in the original description so the newly collected specimens from western Iran are described here on the basis of the modern terminology and completely illustrated, also short descriptions of the deutonymph and tritonymphs are given.

### Material and methods

The examined specimens were collected from soil by Berlese funnel. All specimens were mounted on microscope slides in Swan's fluid and lodged in Collection of Acarology Laboratory, Islamic Azad University of Arak (IAUA), Iran. Unfortunately, fixing the materials in 96 % ethanol for a long time caused some minor damages to their opisthosoma. The specimens were studied with an Olympus BH-2 compound microscope, illustrated with a tube attachment, and also measurements were taken with an ocular micrometer. Morphological terminology and mensuration follow Chamberlin (1931), Harvey (1992), Harvey et al. (2012), Judson (2007) and Zaragoza (2008).

The following abbreviations are used: L = length; W = width; D = depth. Trichobothriotaxy: *eb* = external basal; *esb* = external sub-basal; *est* = external sub-terminal; *et* = external terminal; *ib* = internal basal; *isb* = internal sub-basal; *ist* = internal sub-terminal; *it* = internal terminal; *t* = terminal; *st* = sub-terminal; *sb* = sub-basal; *b* = basal. Chaetotaxy: *Em* = external microseta; *Im* = internal microseta; *Mm* = medial microseta; *TS* = tactile seta.

*Acanthocreagris iranica* Beier, 1976, (figs 1–18)

Beier in: Mahnert, 1976: 199–200, fig. 15.

Material. Iran: Ilam Province, Choqa Sabz Forest Park, soil under oak trees, 17 May 2014, 2 ♀, 4 ♂, 3 tritonymphs, 1 deutonymph, coll. M. Mirab-balou (IAUA). Lorestan Province, Kooh Dasht, soil under oak trees, 21 June 2016, 1 ♀, 2 ♂, 2 tritonymphs, coll. M. Zamani (IAUA). Lorestan Province, Ashtar, litter containing leaf and woods of evergreen trees, 6 August 2016, 2 ♀, 2 ♂, coll. M. Zamani (IAUA).

Description. Males (females in parentheses) Carapace: brown, beside eyes darker, posterior margin desclerotized and pale; entirely smooth; 1.02–1.16x longer than broad (♀ 1.00–1.02); with 2 pairs of very small eyes (figs 1–2), anterior eyes with distinct lens, posterior eyes smaller and with weak lens; with 24–28 setae, anterior margin with 4 setae, each side with 1–2 preocular setae (fig. 2), 1–2 setae situated each side between eyes, posterior margin with 6 setae, chaetotaxy: mm4mm(m4m):mm6mm(m6m): 3–4: 2: 6; setae long, acute and thorn like; transverse furrows absent; epistome very small, reduced and apically rounded (1 ♀ with reduced epistome; fig. 3); with 6 microlyrifissures, two pairs situated in ocular zone and one pair located on posterior margin.

Tergites: yellowish brown, lighter in color than carapace; undivided; smooth; tergites without lyrifissures; all setae simple and acute; tergites X–XI with four long tactile setae (X without tactile setae in 1 ♀); tergal setae arranged: 6–8: 8–11: 9–11: 8–12: 9–12: 11–12: 10–12: 10–12: 10–12: T1T2T1T–1T1T2T1T1: T1T1T1T–1T1TT1T1: 2 (♀ 7–8: 8–11: 10: 10: 10: 10–11: 11–13: 10–11: 9–11: T1T1T1T–T1T1T2T: T1T1T1T: 2).

Sternites: yellow, slightly lighter in color than tergites; smooth; undivided; male genital area with 13–15 setae on anterior operculum, posterior operculum with 14 setae, 4 of them along posterior margin of genital aperture; genital organ with 2 stout basal arms, relatively long lateral genital sacs, 8–10 glandular setae (right + left = 5+5/5+4/5+3); female genital area with 12–13 microsetae on anterior operculum, 11–14 setae on posterior operculum, with large and curved cribriform plate; anterior spiracles with 3 (1♂ with 2), and posterior spiracles with 2–3 short and acute setae; V–IX with 2 discal setae (♀ III and VI–X with 2 discal setae); all setae acute and simple; chaetotaxy: 13–15: (3)14(3): (2–3)8–11(2–3): 14–16: 16: 15–17: 14–17: 14–15: 1T1T2T1T1–T3T2T3T: T2T: 2 (♀12–13: (2)11–14(2): (2–3)7–10(2–3): 11: 14–16: 16–17: 16: 16: 14–15: T3T1T2T–T2T: 2).

Pleural membrane: coarsely granulate.

Chelicera: brown; hand with 6 acuminate setae (fig. 6) [1 ♂ with 7 setae]; galea with 4–6 short terminal rami; galeal setae situated subdistally; fixed finger with 12–16, short and large teeth situated alternately (fig. 7); movable finger with 8–10 (1 ♂ with 14) teeth, one large tooth situated sub-distally, the others medium or small, dental row ending proximal to galeal seta (fig. 7); serrula interior with 9–15 and serrula exterior with 22–24 blades (fig. 7); rallum with 8 blades, 5 anterior blades simple, 3 posterior blades long and intensity denticulate (fig. 8) [1 ♀ with four dentate and four simple blades; 2 ♂ with 7 blades, 3 anterior blades dentate].

Pedipalps: reddish brown, darker in color than carapace; trochanter slightly granulate, basal third and toward the midline of femur distinctly granulate, patella entirely smooth, distal half of chelal hand and base of fixed finger granulate, movable finger smooth (fig. 11) (1 ♂ with a few small granules on the base of the movable finger); coxal manducatory process with 3 setae; retrolateral face of trochanter with 4 (1 ♂ with 3) stout and short setae situated on 1 row (fig. 11); trochanter L/W 2.13–2.43 (♀ 2.28–2.64); femur with short pedicel, 1–2 microprotuberances at basal third of retrolateral margin, setae on prolateral margin longer than setae on retrolateral margin, with 2–3 long setae without enlarged alveoli, L/W 3.27–3.47 (♀ 3.17–3.53); patella with curved and relatively long pedicel (L = 0.15–0.16 mm); patella distinctly shorter and wider than femur, with 5 lyrifissures (3 situated basally, median one larger than others, and 2 situated distally), L/W 2.34–2.55 (♀ 2.35–2.58); chela (with pedicel) L/W 3.54–3.95 (♀ 3.33–3.80); chela (without pedicel) L/W 3.16–3.67

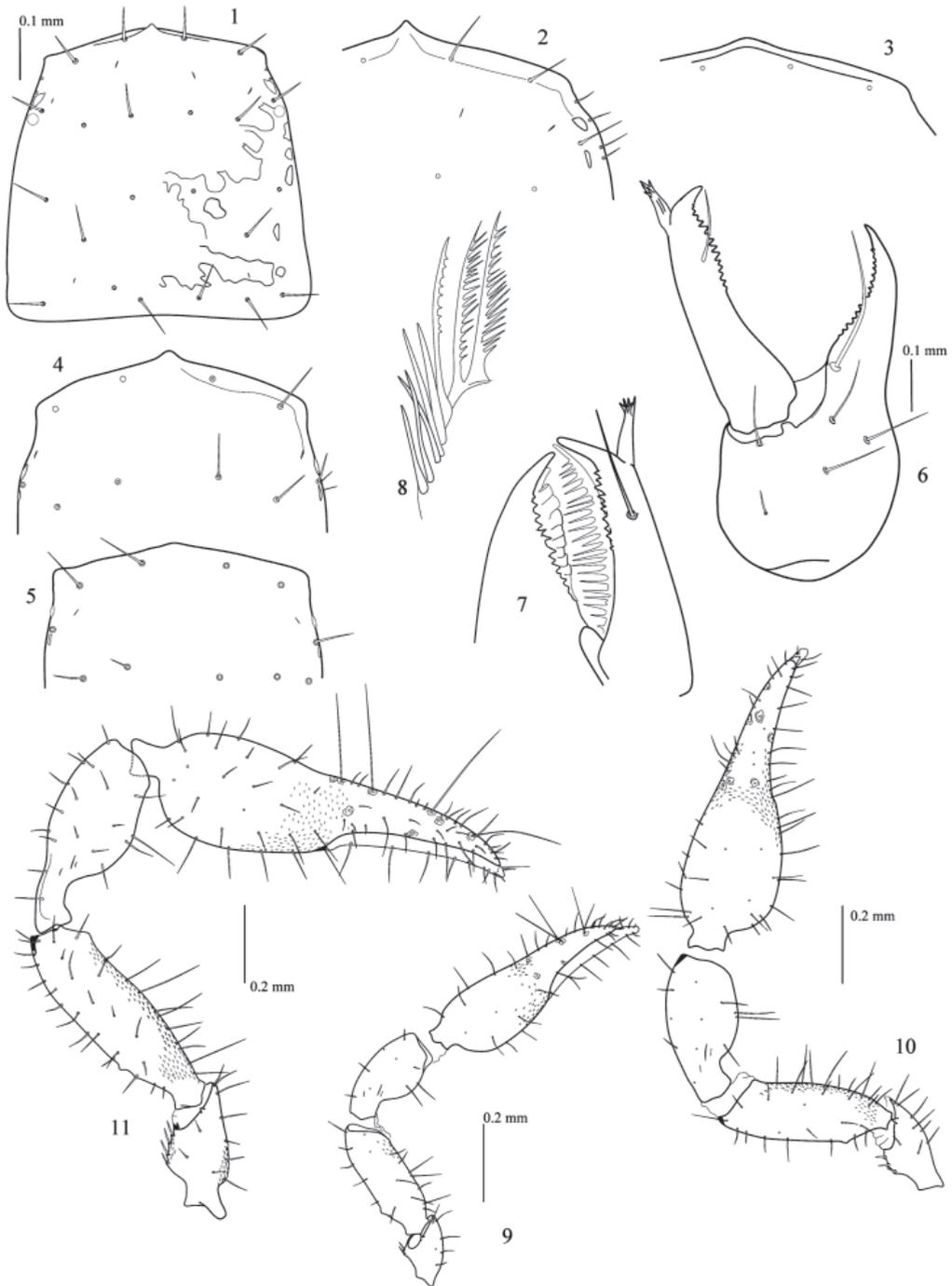


Fig. 1–11. *Acanthocreagris iranica*: 1 — male, carapace (showing chaetotaxy, eyes position, lyrifissures and epistome structure), dorsal view; 2 — male, anterior margin of carapace (showing setal arrangement close eyes), dorsal view; 3 — female, anterior margin of carapace (showing loss of epistome), dorsal view; 4 — tritonymph, distal part of carapace, dorsal view; 5 — deutonymph, distal part of carapace, dorsal view; 6 — male, chelicera, ventral view (rallum, serrula exterior and serrula interior omitted); 7 — male, cheliceral finger (showing teeth, serrula exterior and serrula interior); 8 — male, rallum; 9 — deutonymph, left pedipalp, dorsal view; 10 — tritonymph, left pedipalp, dorsal view; 11 — male, left pedipalp, dorsal view.

(♀ 3.07–3.54); chelal hand (with pedicel) L/W 1.87–2.12 (♀ 1.85–2.15); chelal setae simple and acute; movable finger as long as or slightly shorter than hand (with pedicel); hand (with pedicel) 1.00–1.10 times longer than movable finger; chelal hand with parallel sides in lateral view; fixed finger with 8 and movable finger with 4 trichobothria (fig. 12); fixed finger with trichobothrium *et* situated closer to *it* than to tip of finger, *est* between *ist* and *it* (1 ♀, 2 ♂ *est* distinctly closer to *ist* than to *it*, 4 ♀, 6 ♂ *est* approximately in the middle between *ist* and *it*), *isb* on retrolateral face, *ib* and *isb* situated basally, *eb* and *esb* situated subbasally; movable finger with trichobothrium *st* situated closer to *t* than *sb*; fixed chelal finger with a row of sensory setae and 4–5 short sensory setae situated basally, between trichobothria *eb* and *isb* ( $Em = 0$ ,  $Mm = 1-2$ ,  $Im = 3-4$ ); fixed finger with 41–48 (♀ 41–47) teeth, 4–6 basal teeth blunt; movable finger with 40–41 uniform teeth (♀ 36–43; 1 ♂ with 47 teeth); venedens present in both fingers (figs 13–14); nodus ramosus present in fixed chelal finger and situated distinctly distal to *et* (fig. 13).

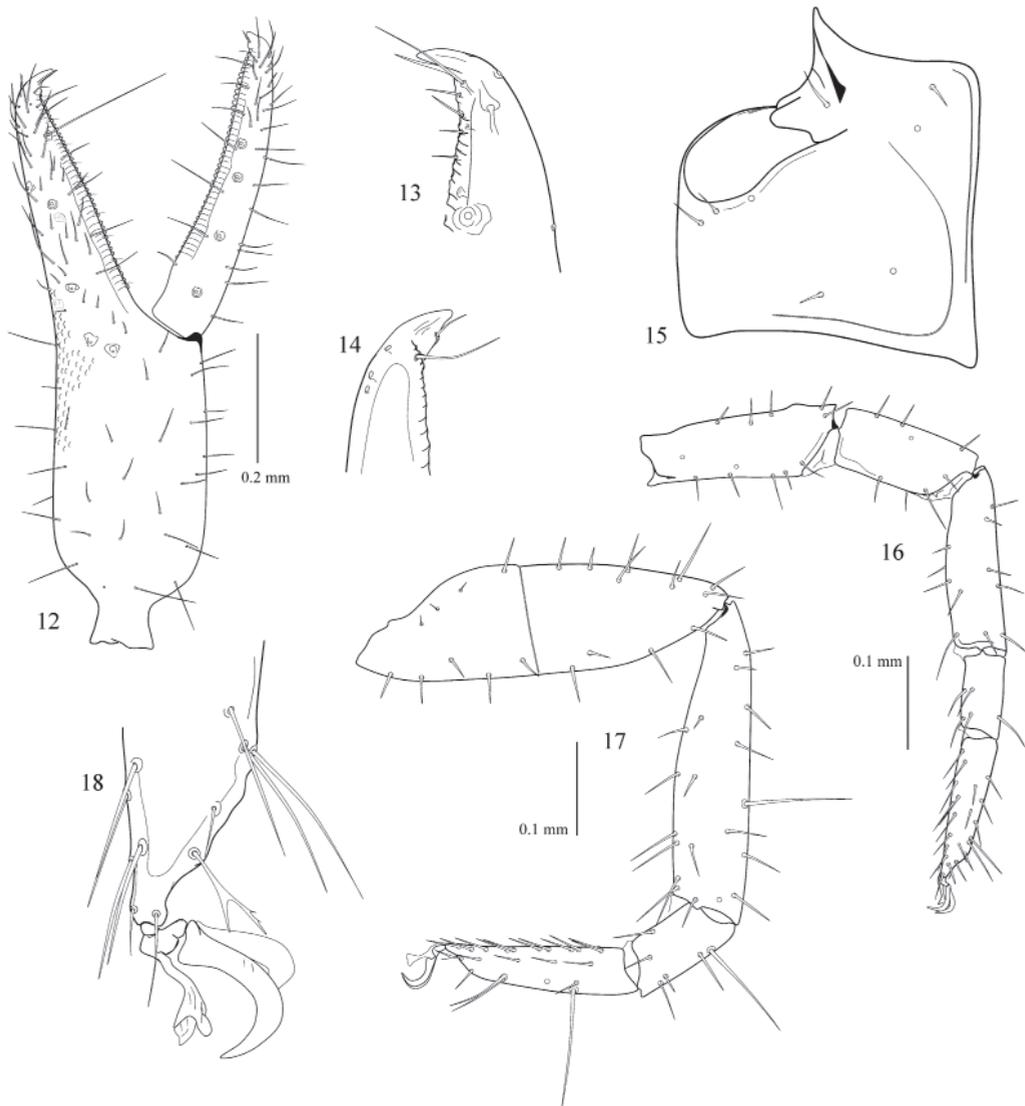


Fig. 12–18. *Acanthocreagris iranica*: 12 — female, right chela, lateral view; 13 — female, tip of fixed chelal finger (showing nodus ramosus); 14 — female, tip of movable chelal finger; 15 — male, right pedal coxa I (showing anterolateral process), ventral view; 16 — male, leg I (trochanter omitted); 17 — male, leg IV (trochanter omitted); 18 — male, tip of tarsus IV (showing claws, arolium and sub-terminal seta).

Legs: light brown; smooth; coxa I with long, triangular and apically pointed anterolateral process (fig. 15); coxal chaetotaxy: 7–8: 4–6: 4–5: 9–11 (♀ 6–7: 6–7: 3–4: 10–11); sub-terminal setae bifid, longer branch denticulate (Fig. 18); claws simple; arolia simple and shorter than claws or as long as claws. Leg I (fig. 16): femur L/D 2.85–3.12 (♀ 3.00–3.14); patella L/D 2.12–2.57 (♀ 2.28); femur 1.33–1.41x longer than patella; tibia L/D 2.57–3.93 (♀ 3.14–3.43); metatarsus L/D 2.00–2.20 (♀ 2.00); tarsus L/D 4.25–4.50 (♀ 4.00–4.25). Leg IV (fig. 17): femur L/D 1.50–1.69 (♀ 1.66); patella L/D 1.75–1.92 (♀ 1.83); femur + patella L/D 3.15–3.54 (♀ 3.50); tibia with one tactile seta situated distal to middle (TS = 0.62–0.65), L/D 4.44–4.62 (♀ 3.08–4.11); metatarsus with one tactile seta situated basally (TS = 0.28), L/D 2.00–2.33 (2.16–2.34); tarsus with a tactile seta situated proximal to middle (TS = 0.33–0.36), L/D 3.67–4.00 (♀ 4.16–4.60).

Dimensions in mm: ♂ Carapace: 0.50–0.58/0.48–0.54. Pedipalp: trochanter 0.29–0.34/0.13–0.15; femur 0.49–0.59/0.15–0.17; patella 0.45–0.51/0.18–0.21; chela (with pedicel) 0.82–0.96/0.22–0.25; chela (without pedicel) 0.75–0.88; hand (with pedicel) L.0.45–0.53; movable finger L. 0.44–0.51. Leg I: femur 0.20–0.26/0.07–0.08; patella 0.15–0.18/0.07–0.08; tibia 0.18–0.24/0.06–0.07; metatarsus 0.10–0.11/0.05; tarsus 0.17–0.18/0.04. Leg IV: femur 0.20–0.22/0.13–0.14; patella 0.21–0.25/0.12–0.13; femur + patella 0.41–0.46; tibia 0.35–0.40/0.08–0.10; metatarsus 0.12–0.14/0.06–0.07; tarsus 0.22–0.24/0.06–0.07. ♀ Carapace: 0.50–0.63/0.50–0.70. Pedipalp: trochanter 0.32–0.41/0.14–0.17; femur 0.54–0.67/0.16–0.19; patella 0.47–0.55/0.19–0.24; chela (with pedicel) 0.90–1.12/0.27–0.33; chela (without pedicel) 0.83–1.02; hand (with pedicel) L.0.50–0.64; movable finger L. 0.47–0.58. Leg I: femur 0.22–0.24/0.07–0.08; patella 0.16/0.07; tibia 0.22–0.28/0.07–0.08; metatarsus 0.10–0.12/0.05–0.06; tarsus 0.17–0.21/0.04–0.05. Leg IV: femur 0.20/0.12; patella 0.22/0.12; femur + patella 0.42; tibia 0.37–0.40/0.09–0.13; metatarsus 0.13–0.17/0.06–0.08; tarsus 0.22–0.30/0.06–0.08.

Tritonymphs. Short description: weakly sclerotized; opisthosoma and legs yellowish brown; carapace and chelicerae pale brown; pedipalps brown. Carapace: distinctly longer than broad, L/W 1.37–1.42, blunt and small epistome present (fig. 4), with two pairs of small eyes, with four microlyrifissures (one pair situated in ocular zone, close to anterior eyes and one situated on posterior margin), without preocular setae, chaetotaxy: 4: 5–6 (+2): 4: 2: 6. Chelicera: hand with 6 setae, rallum with 7 blades (3 blades dentate, two anterior one with long, third one with short denticulations), galea with 3–5 terminal rami. pedipalp: trochanter and patella entirely smooth, prolateral face of femur distinctly granulate, chelal hand finely granulate mediolaterally (fig. 10); dorsal ridge of trochanter with 3 stout setae; trochanter L/W 2.07–2.30; retrolateral margin of femur with a microprotuberance situated sub-basally; femur L/W 2.91–3.06; patella with 5 lyrifissures (3 situated basally and 2 located distally), L/W 2.06–2.22; chela (with pedicel) L/W 3.30–3.39; chela (without pedicel) L/W 3.00–3.11; hand (with pedicel) L/W 1.83; movable finger slightly shorter than hand (with pedicel); fixed finger with 7 and movable finger with 3 trichobothrial setae; fixed finger with trichobothrium *it* situated closer to *est* than to *et*, *ist* distinctly proximal to *est*, and *isb* absent; movable finger with trichobothrium *st* closer to *t* than to *b*, and *sb* absent; nodus ramosus situated distal to *et* in fixed chelal finger only; fixed chelal finger with 33–36 and movable chelal finger with 28–30 teeth. Legs: sub-terminal setae bifid; claws simple; arolia simple and shorter than claws; tibia, metatarsus and tarsus IV with a long tactile seta (tibia IV of a specimen without tactile seta!).

Dimensions in mm: Body length: 1.87–2.25. Carapace: 0.41–0.50/0.30–0.35. Pedipalp: trochanter 0.23–0.27/1.10–0.13; femur 0.35–0.46/0.12–0.15; patella 0.31–0.40/0.15–0.18; chela (with pedicel) 0.61–0.76/0.18–0.23; chela (without pedicel) 0.56–0.69; hand (with pedicel) L.0.33–0.42; movable finger L. 0.31–0.38.

Deutonymph. Short description: weakly sclerotized; opisthosoma, legs, carapace and chelicerae pale brown; pedipalps yellowish brown, chela slightly darker. Carapace: distinctly longer than broad, L/W 1.44, epistome absent (fig. 5), with two eyespots, four

microlyrifiatures (one pair situated in ocular zone, close to eyes and one situated on distal third), without preocular setae, chaetotaxy: 4 : 2: 5: 4: 2: 6. Chelicera: hand with 5 setae, rallum with 6 blades (2 anterior blades distinctly dentate with large denticulations), galea with 3 terminal rami. pedipalp: trochanter and patella entirely smooth, distal fourth of femur with fine granules on prolateral face, chelal hand finely granulate mediolaterally (fig. 9); dorsal ridge of trochanter with 2 stout setae; trochanter L/W 2.11; retrolateral margin of femur with a microprotuberance situated sub-basally; femur L/W 3.00; patella with 5 lyrifiatures, L/W 2.08; chela (with pedicel) L/W 3.33; chela (without pedicel) L/W 3.07; hand (with pedicel) 1.87; movable finger slightly shorter than hand (with pedicel); fixed finger with 6 and movable finger with 2 trichobothrial setae; fixed finger with trichobothria *it*, *ist* and *est* situated in the middle zone, *isb* and *esb* absent; movable finger with trichobothrium *t* situated at the same level as *et*, *st* and *sb* absent; nodus ramosus situated distal to *et* in fixed chelal finger only; fixed chelal finger with 24 and movable chelal finger with 25 teeth. Legs: sub-terminal setae bifid; claws simple; arolia simple and shorter than claws; tibia, metatarsus and tarsus IV with a long tactile seta.

Dimensions in mm: body length: 1.75. Carapace: 0.36/0.25. Pedipalp: trochanter 0.19/0.09; femur 0.30/0.10; patella 0.25/0.12; chela (with pedicel) 0.50/0.15; chela (without pedicel) 0.46; hand (with pedicel) L.0.28; movable finger L. 0.26.

**Remarks.** The genus *Acanthocreagris* currently contains 40 species, of which only eight species have been previously recorded from the Middle East and central Asia (Harvey, 2013): *A. anatolica* (Beier, 1963) from Turkey and also Greece; *A. caspica* and *A. iranica* from Iran; *A. obtusa* Mahnert, 1976, *A. osellai* (Beier, 1973) and *A. resslai* (Beier, 1965) from Turkey; *A. redikorzevi* Dashdamirov, 1988 from Azerbaijan, and *A. roncifformis* (Redikorzev, 1949) from Iran and Turkmenistan.

There are a few differences between the newly collected specimens from western Iran and the original description of *A. iranica* based on the types from northern Iran. The types were described with having four corneate eyes (Mahnert, 1976), while in the recently examined specimens, anterior eyes have the well-developed lens but the posterior eyes have somewhat weak lens.

The other slight difference is the number of setae on the cheliceral hand which are 5 in the types (Mahnert, 1976) and 6–7 in the specimens collected from Ilam and Lorestan provinces. The presence of four (three in one specimen) stout setae on the retrolateral face of the pedipalpal trochanter in most of the newly studied specimens is the other small difference (fig. 10). This number is three for the types (see Mahnert, 1976: fig. 15). It is worthy to mention that variability of these setal numbers has been recorded in several species. The median discal setae are situated on sternites V–VII of the types (Mahnert, 1976), whereas on the basis of the newly examined specimens, sternites V–IX in males, and sternites III and VI–X in females bear median discal setae. Unexpectedly, these setae are located sub-medially on the sternites VI–VII, and medially on the sternites VII–X in one female.

Unfortunately, the form of anterior margin of carapace was not mentioned in the first description of the species by Mahnert (1976). Epistome is small and generally blunt in most of the specimens examined here (figs 1, 3), and interestingly, is reduced to a weak prominence in only one female (fig. 2). In addition, the position of trichobothrium *est* may be varied; rarely, it is located distinctly close to trichobothrium *it* and commonly situated far of *it*, in the middle between *ist* and *it*.

According to the shape of the pedipalpal segments, the granulation pattern of the pedipalp, the trichobothriotaxy, and the morphometric character, the newly collected specimens from western Iran are attributed to *A. iranica*. Therefore, the mentioned small differences are considered here as normal variability within the species. Discussing about the level of intraspecific variations needs to examine more specimens collected from different localities.

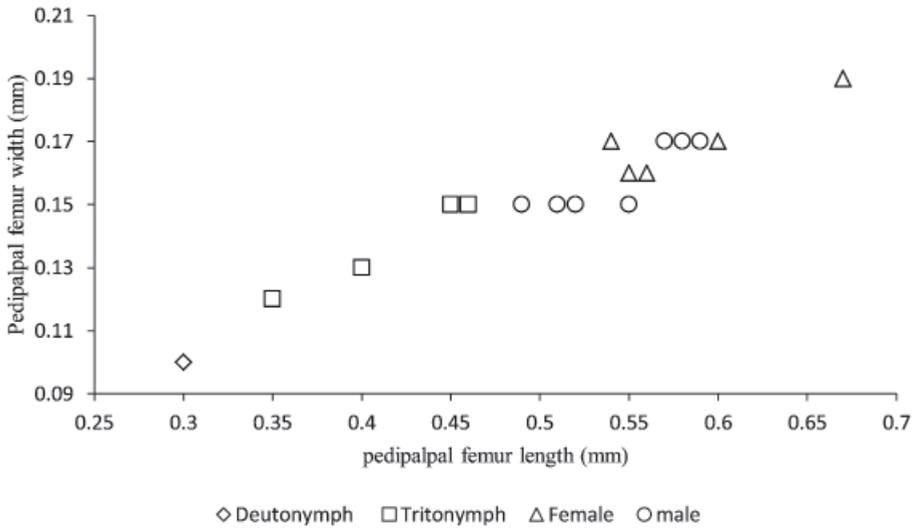


Fig. 19. *Acanthocreagris iranica* Beier, 1976: graph depicting pedipalpal femur ratio of deutonymph, tritonymphs and adults collected from Ilam and Lorestan Provinces, western Iran (mm = millimeter).

In addition, the original description of *A. iranica* did not contain any point about the presence/absence of preocular setae (see fig. 3). In fact, those setae may be disregarded by the author or were truly absent, so the types should be reexamined for clarifying.

*A. iranica* can be easily separated from most species of the region, *A. anatolica*, *A. obtusa*, *A. osellai*, *A. redikorzevi*, and *A. roncifformis*, by the pedipalpal granulation pattern, e. g. the pedipalpal patella is entirely smooth in *A. iranica* (Mahnert, 1976), slightly granulate in *A. anatolica*, *A. obtusa*, and *A. osellai* (Beier 1963, 1973; Mahnert 1976), and completely granulate in *A. redikorzevi* and *A. roncifformis* (Dashdamirov & Schawaller, 1992; Nassirkhani, 2016). *A. iranica* and *A. resslie* can be differentiated by the galeal structure which is reduced and bulge shape in *A. resslie* (Mahnert, 1976). On the basis of the granulation pattern, the pedipalpal shape and the trichobothriotaxy, *A. iranica* resembles *A. caspica* but those can be recognized by the length of the movable chelal finger, e. g. it is 1.30x longer than chelal hand (with pedicel) in *A. caspica* (see Beier, 1971), whereas it is as long as or slightly shorter than chelal hand (with pedicel) in *A. iranica*.

Many differences are apparent between each examined stages of *A. iranica*, including the morphometric character (fig. 19), density of the pedipalpal granulation, the number of rallar blades, and the trichobothriotaxy. Tritonymphs have the same pedipalpal granulation pattern with that of the adults, but the degree of granulation is stronger in the adults. Deutonymph has small granules only in distal fourth of the pedipalpal femur, and also, the chelal hand is finely granulated (see figs 10–12). Expectedly, there is no difference in the sequence of the trichobothrial appearance on the chelal fingers during development with that of the other studied pseudoscorpions (e. g. Gabbut & Vachon, 1968; Harvey, 1992; Mahnert, 1974). Retrolateral face of the pedipalpal trochanter bears a number of stout setae which are 2 in deutonymph, 3 in tritonymphs, and 4 (3) in the adults. The number of rallar blades increases during development, e.g. rallum consists of 5 blades in deutonymph, 6 blades in tritonymph and 7–8 blades in the adults. In the deutonymph, two anterior rallar blades are distinctly denticulate, while in the tritonymphs and the adults, three anterior blades are denticulate, of which two most anterior blades have large and third one has short denticulations. The other morphological differences are the form of epistome and the carapacial chaetotaxy. For example, the carapace of deutonymph is loss of the epistome and preocular setae (fig. 5), while tritonymphs have small defined epistome in the anterior margin of their carapace (fig. 4).

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