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Metacryptoseius samanii n. sp., a new eviphidid mite (Acari: Mesostigmata) associated with *Scarabaeus carinatus* (Coleoptera: Scarabaeidae) from Tajikistan

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Original research

ABSTRACT

We present the first record of *Metacryptoseius* in Central Asia on the basis of a new phoretic species, *M. samanii* Joharchi & Tavakal **n. sp.**, collected on dung beetle, *Scarabaeus carinatus* (Coleoptera: Scarabaeidae), from Tajikistan. The new species is described and illustrated based on morphological characters of the adults and compared with known congeners. An updated key to all known species of the genus is presented.

Keywords Dermanyssina ; Eviphidoidea ; morphology ; Central Asia
Zoobank http://zoobank.org/86A56EFB-881C-4719-9CCD-A88EAFEBA73E

INTRODUCTION

A remarkable diversity of phoretic and parasitic mites is found on dung beetles, representing three main groups: the Mesostigmata, Prostigmata, and Astigmatina. The complex interactions among these mites are not clearly understood, and the role of any single species cannot be determined without considering the impact of other species in the community (Halliday 2019). The family Eviphididae (Acari: Mesostigmata) includes a range of insecticolous species tend to have more intimate associations with dung beetles and flies, even some species inhabit the subelytral cavity of their beetle hosts and breed in their subterranean nesting chambers (Mašán 1994; Mašán & Halliday 2009a, b, 2010; Makarova 1998). The family is cosmopolitan, and includes more than 120 described species placed in 20 genera (Mašán & Halliday 2009a, b, 2010; Joharchi *et al.* 2014). However, very few species of Eviphididae from Central Asia are included in the existing classification of this family. Bregetova (1977) reviewed the limited available information on this family in former Soviet Union which was included Central Asia. Makarova (1998) erected *Cryptoseius* Makarova based on adults and a deutonymph of a species collected on *Scarabaeus transcaspicus* Stolfa (Scarabaeidae) in Turkmenistan. Nevertheless, we do not have any information about the free-living or insect-associated species of Eviphididae from Tajikistan. The genus *Metacryptoseius* Kazemi & Moraza, 2008 comprises three nominal species, which have been recorded only from Iran and China, where they have been found on

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Scarabaeus transcaspicus Stolfa and *Copris hispanus* (L.) (Coleoptera: Scarabaeidae) (see Kazemi *et al.* 2008). Herein, we describe the fourth species of the genus on the basis of adults collected on *Scarabaeus carinatus* (Gebler) (Coleoptera: Scarabaeidae) from Tajikistan, thereby expanding its geographical range to include Central Asia. In addition, an identification key to all known species of the genus is updated.

Material and methods

Mites were removed from underneath the beetle elytra and cleared in lactic acid solution and mounted in Hoyer's medium (Walter & Krantz 2009). The line drawings and examinations of the specimens were performed with Zeiss Axio Imager A2 compound microscope equipped with differential interference contrast optical systems, attached to camera AxioCam ICc 5. Most images were captured in stacks (with focal depth manually controlled). Selected images were combined using Helicon Focus 7.6.4 Pro (Helicon Soft Ltd., 2000). Digital drawings were prepared using Adobe Photoshop CS2 software based on the original pencil line drawings. Images and morphological measurements were taken via ZEN 2012 software (version 8.0). Photomicrographs were taken with an AxioCam 506 camera (Carl Zeiss, Germany). Measurements of structures are expressed as ranges (minimum–maximum) in micrometers (μm). The length and width of the idiosoma and dorsal shield were taken from the anterior to the posterior margins along the midline, and at the level of *j6* respectively. Length and width of the sternal shield were measured at the maximum length and broadest points (at level between coxae II and III) respectively. The length of the epigynal shield was measured along the midline from the anterior margin of the hyaline extension to the posterior margin of the shield, and its width where maximal, posterior to epigynal setae *st5*. Length of the anal shield was measured along the midline from anterior to the posterior margins of cribrum, and the width at widest point. The length of the second cheliceral segment was taken from its base to the apex of the fixed digit. The lengths of the fixed cheliceral digit were measured from the dorsal poroid to the apex, and that of the movable digit from the base to apex. Leg length was measured from the base of the coxa to the apex of the tarsus (excluding the pre-tarsus). The nomenclature used for the dorsal idiosomal chaetotaxy follows that of Lindquist & Evans (1965) and Mašán & Halliday (2010). The notations for leg and palp setae follow those of Evans (1963a, b), and other anatomical structures mostly follow Evans & Till (1979) as applied to Eviphididae by Mašán & Halliday (2010). Notations for idiosomal pore-like structures (gland pores and poroids/lyrifissures) and peritrematal shield follow mostly Athias-Henriot (1971, 1975). The notations for pore-like structures on the sternal shield and for the peritrematal shield region also follow modifications and additions by Johnston & Moraza (1991). The holotype and paratypes are deposited at the Acarological Collection of the Tyumen State University Museum of Zoology, Tyumen, Russia (TUMZ).

Taxonomy

Family Eviphididae Berlese

Genus *Metacryptoseius* Kazemi & Moraza

Metacryptoseius Kazemi & Moraza, 2008: 2 (in Kazemi *et al.* 2008).

Type species *Metacryptoseius persicus* Kazemi & Moraza, 2008: 2; by original designation.

Diagnosis — The concept of *Metacryptoseius* used here is based on that of Kazemi *et al.* (2008).

Metacryptoseius samanii Joharchi & Tavakal n. sp.

Zoobank: CA476194-75A8-45EC-9446-3734B9890F40

(Figures 1–5)

Type material

Holotype, female, Tajikistan, Khatlon Region, Danghara, Kavralin village, 38°05′ N, 69°21′ E, alt. 690 m, 27 May 2022, M.K. Tawakal & S.F. Khushdil coll., under elytra of *Scarabaeus carinatus* (Coleoptera: Scarabaeidae). Paratypes, 11 females and six males, same data as holotype.

Diagnosis (adult female)

Dorsal shield polygonal in shape, posterior margin truncated, slightly narrowed posteriorly, with 26 pairs of simple and variable in length setae; setae *j2*, *z2*, *z4*, *s4*, *s5*, *S3*, *S4*, *S5* conspicuously longer than other setae on shield, ventral seta *JV5* longest, about ten times longer than *J5* in female; opisthonotal setae shorter; setae *z2* and *j2* about two times longer than *s2* and three times longer than *j3* and *z1*. Sternal setae *st2* reaching base of *st3* and *st3* well past base of *st4*. Peritreme extends to anterior margin of coxa II. Anal shield subrectangular, with anterior margin slightly convex.

Description adult female

(Figures 1–3)

Six specimens measured.

Dorsal idiosoma — (Figures 1A & 2A) — Length 829–855, width 545–560.

Dorsal shield polygonal in shape, with posterior margin truncated, not covering whole dorsal idiosoma, 639–650 long, 357–378 wide; lightly punctate throughout; shield without distinct reticulate ornamentation except some striations laterally, slightly narrowed posteriorly and anterolateral incisions reaching level of setae *z2* to *j3*; dorsum with 30 pairs of setae: setae *j1-j6*, *J1*, *J3-J5*, *z1*, *z2*, *z4*, *z5*, *Z2-Z5*, *s2*, *s4*, *s5*, *S3-S5*, *r2* and *r3* on dorsal shield (*s2*, *r2* and *r3* on laterodosal elements); setae *s6*, *r5*, *R3*, *R5* on soft cuticle, *R1* and *R4* absent. Dorsal setae *j2*, *z2*, *s5*, *S3*, *S4*, *S5* (85–100), *z4*, *s4* (65–70) conspicuously longer, other dorsal setae on podonotal (30–40), *j1* (19–21) and opisthonotal (16–24), *J5* (13–15) shorter. Dorsal shield with 22 pairs of discernible pore-like structures (eight podonotal, 14 opisthonotal), including 15 poroids (five podonotal, ten opisthonotal) and seven gland openings (three podonotal, four opisthonotal); three pairs poroides on soft cuticle, marginal poroid *Rp* (=*idR3*) located between setae *R3-R5*.

Ventral idiosoma — (Figures 1B & 2B) — Tritosternum with paired sparsely pilose laciniae (97–108), trapezoidal base 36–39 × 30–33 wide (Figures 1B & 2B); presternal area lightly sclerotized, with a few transverse curved lines, sternal shield length 163–179, maximum width 180–191, narrowest between coxae II (128–235), whole surface micropunctated (Figures 1B & 2B), shield with irregular anterior and posterior margins; bearing three pairs of smooth setae (*st1* 57–59, *st2* 61–65, *st3* 76–78) and two pairs oval poroids, *st2* reaching base of *st3* and *st3* well past base of *st4*. Metasternal setae *st4* (65–67) and metasternal poroids located on small metasternal platelets (Figures 1B & 2B). Endopodal plates between coxae I/II and II/III completely fused to sternal shield, endopodal plates III/IV elongate, narrow and curved (Figures 1B & 2B). Epigynal shield oblong, hyaline in anteriormost part, slightly expanded posteriorly behind setae *st5*, surface micropunctate, anterior margin convex, posterior margin broadly rounded; length 159–165, maximum width 80–87, setae *st5* (71–74) on lateral borders of shield, paragenital poroids *iv5* located on soft cuticle lateral to shield near seta *st5*. Anal shield subrectangular, with anterior margin slightly convex, surface lightly micropunctate, length 114–118, width 109–120, anus small in size, located on anterior half of shield, para-anal setae (32–34) shorter than post-anal seta (40–50), cribrum small, consisting of a terminal tuft with 4–5 irregular rows of spicules, limited to region posterior to post-anal seta, gland pores *gv3* absent (Figures 1B & 2B). Soft opisthogastric cuticle with a pair of nearly oval metapodal platelets (26–34 long × 12–14 wide), five pairs of smooth setae: *JV1* (65–70), *JV2* (68–75), *JV5* (136–144), *ZV2* (60–62) and *ZV3* (46–48) and six pairs of poroids (*iv5*, three pairs of *ivo*; *ivp*). Parapodal platelets narrow, strip-like, extending narrowly behind coxae IV, bearing gland pore

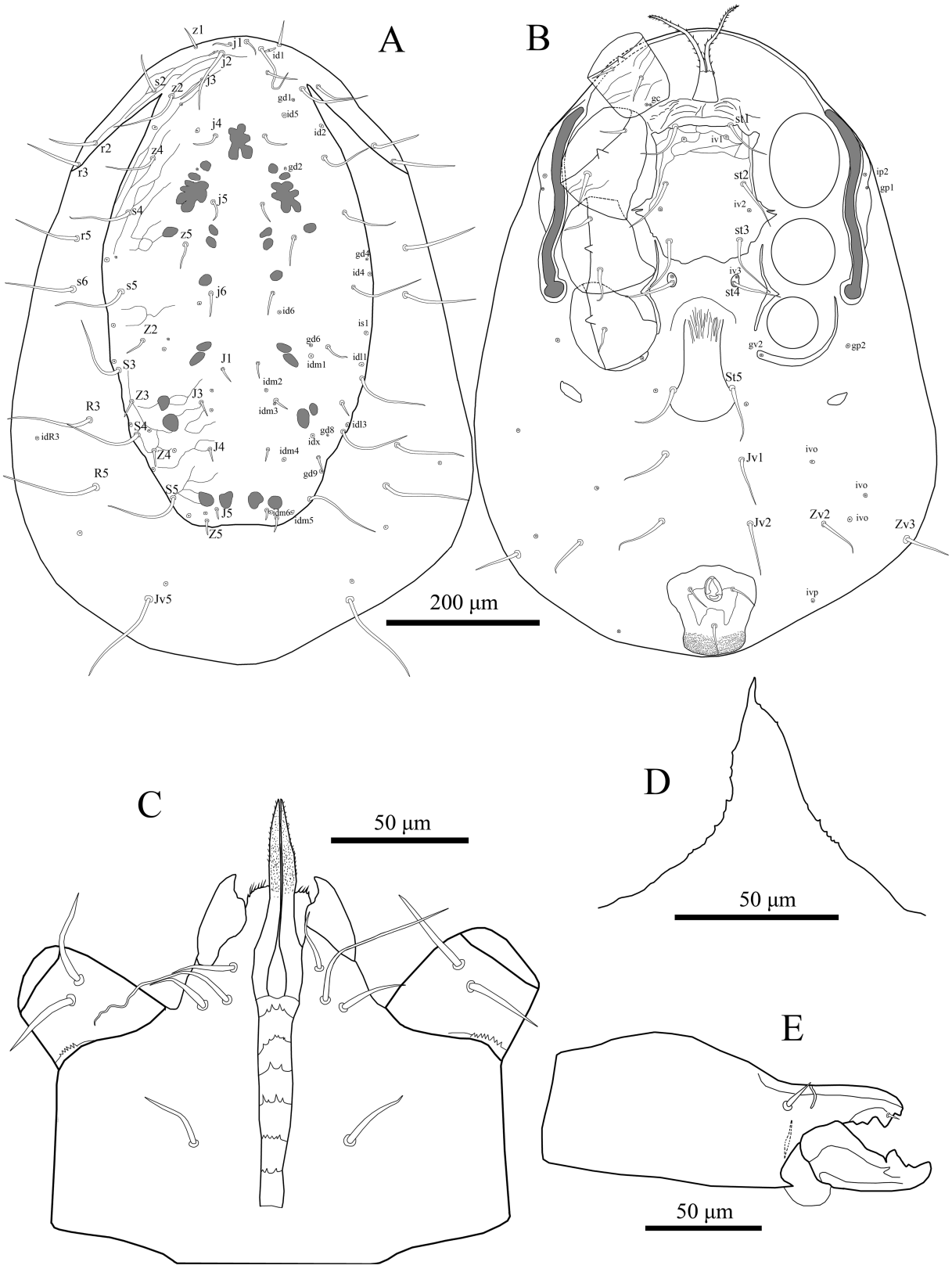

Figure 1 *Metacryptoseius samanii* Joharchi & Tavakal **n. sp.**, adult female: A – Dorsal idiosoma; B – Ventral idiosoma; C – Subcapitulum; D – Epistome; E – Chelicera.

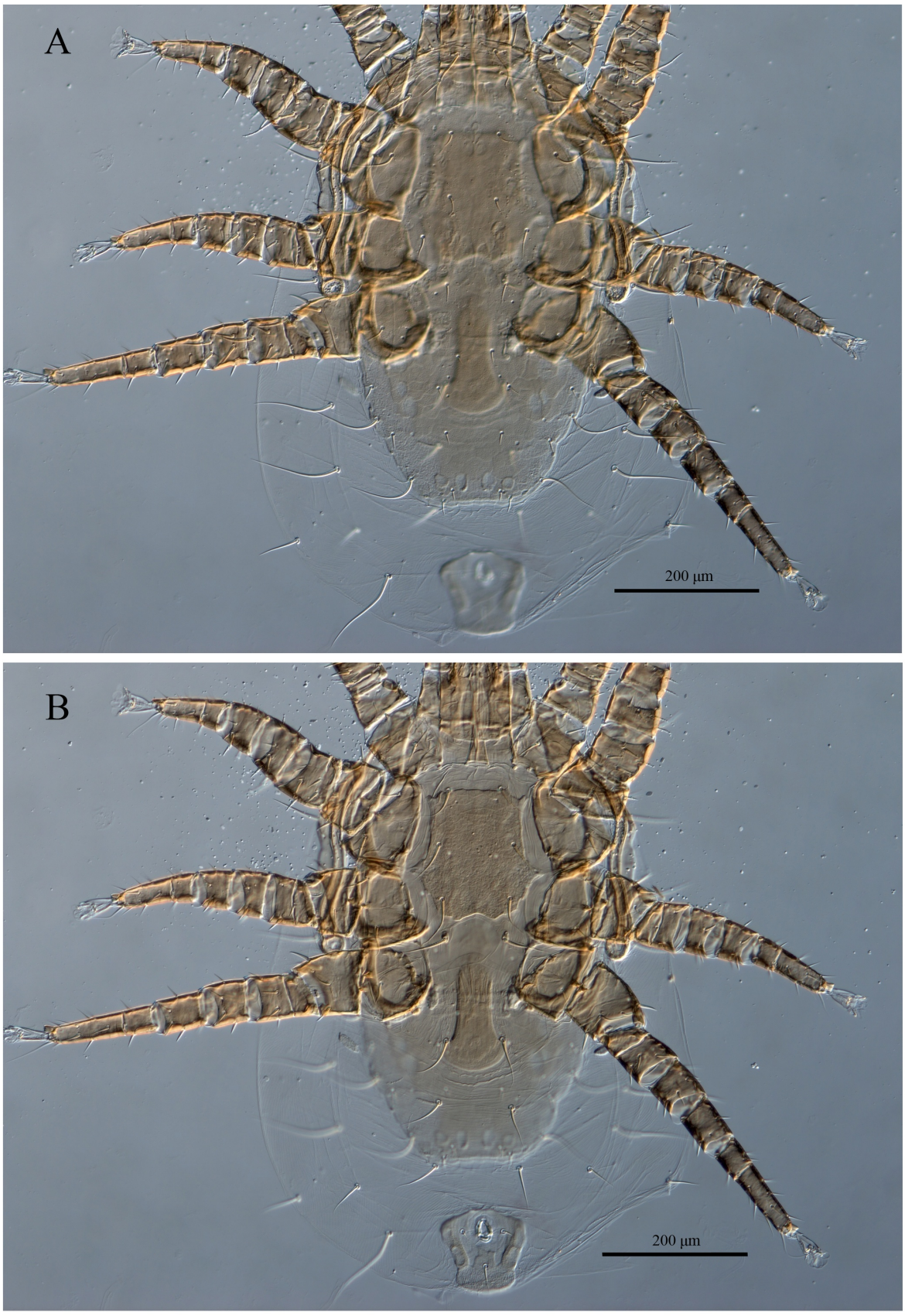

Figure 2 DIC micrographs of *Metacryptoseius samanii* Joharchi & Tavakal **n. sp.**, adult female: A – Idiosoma in dorsal view; B – Idiosoma in ventral view.

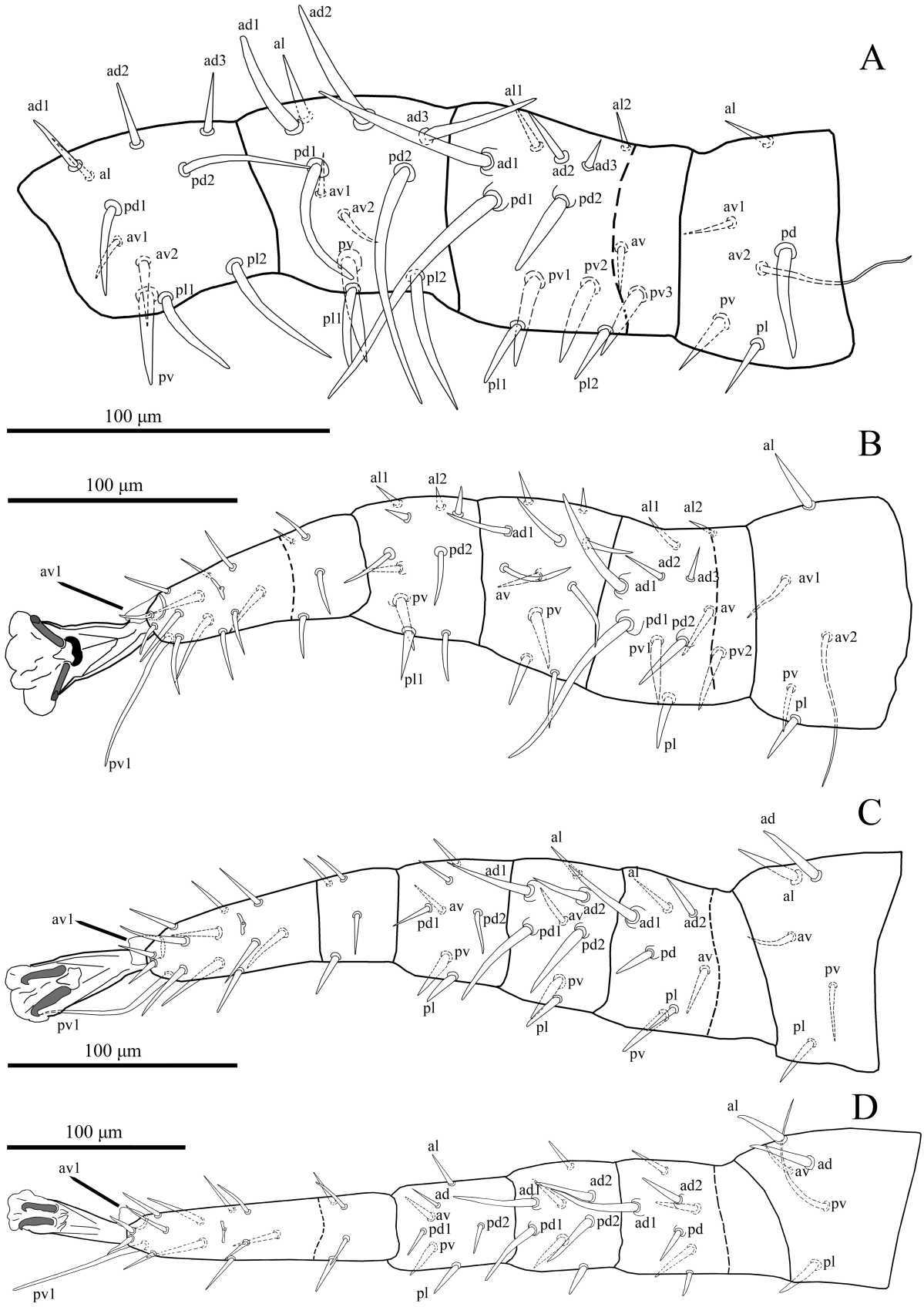

Figure 3 *Metacryptoseius samanii* Joharchi & Tavakal **n. sp.**, adult female: A – Leg I (trochanter-tibia); B – Leg II (trochanter-tarsus); C – Leg III (trochanter-tarsus); D – Leg IV (trochanter-tarsus).

gv2 (Figures 1B & 2B). Peritrematal shield well developed outside peritremes, bearing one pair of gland pore and one poroid; poroid *ip2* and adjacent gland pore *gp1* inserted on its dorsal edge at level between coxae II and III; post-stigmatic extension of shield absent, poststigmatic gland pore (*gp2*) on soft cuticle. Peritremes long, extending anteriorly to anterior level of coxae II (Figures 1B & 2B).

Gnathosoma — (Figure 1C-E) — Epistome triangular, with slightly serrate margin, anterior margin almost smooth with apical point (Figure 1D). Corniculi stout, horn-like, acute at tip, internal malae slender, pointed, finely fringed, extending beyond anterior border of palp femur; salivary stylets thin and rounded apically; labrum prominent, blade-like, reaching to palp tibia, with pilose surface; hypostomal and capitular setae smooth, *h3* (60–63) > *pc* (27–30) > *h1* = *h2* (21–25); hypostomal groove with six rows of denticles, all rows connected by lateral margins of groove, each row bearing 2–6 denticles, groove progressively narrowing from anterior to posterior ends (Figure 1C). Supralabral process not distinguishable. Palps with normal setation, chaetotaxy of palps: 2–5–6–14–15, all setae smooth and needle-like; palp tarsus without a pair of long closely-spaced terminal setae, palp tarsal claw two-tined. Chelicerae heavily sclerotized, second cheliceral segment length (153–156), movable digit (59–62) slightly longer than fixed digit (42–45). Cheliceral digits well developed, fixed cheliceral digit with a large median tooth and 2 small proximal teeth, pilus dentilis minute and setiform; dorsal seta short, smooth and near dorso-proximal lyrifissure; movable digit with large subdistal tooth and one small apical tooth, arthrodial brush absent (Figure 1E).

Insemination structures — Not seen, apparently unsclerotised.

Legs — (Figures 3) — Legs II and III short (396–419, 415–428), I and IV longer (460–472, 520–550) (excluding pre-tarsus). Leg I (Figure 3A): coxa 0-0/1, 0/1-0, trochanter 1-0/2, 1/1-1 (*av2* elongated, whip-like, *pd* thickened), femur 2-3/1, 2/3-2 (dorsal and ventral setae thickened; *ad1*, *pd1*, *pd2* inserted on small tubercles; *ad1* (58–61), *pd2* (82–85) longest), genu 1-3/2, 2/1-2 (*pd2* (75–78) longest), tibia 1-3/2, 2/1-2 (*pv* thickened). Leg II (Figure 3B): coxa 0-0/1, 0/1-0, trochanter 1-0/2, 0/1-1 (*av2* elongated, whip-like), femur 2-3/1, 2/2-1 (*ad1*, *pd1* and *pd2* inserted on small tubercles; *ad1* (56–59), *pd2* (80–83) longest), genu 2-3/1, 2/1-2 (*pv* thickened), tibia 2-2/1, 2/1-2 (*pv* thickened). Leg III (Figure 3C): coxa 0-0/1, 0/1-0, trochanter 1-1/1, 0/1-1 (*ad* and *al* slightly thickened), femur 1-2/1, 1/1-1 (*ad1*and *pd* inserted on small tubercles), genu 1-2/1, 2/1-1 (dorsal setae inserted on small tubercles), tibia: 1-1/1, 2/1-1. Leg IV (Figure 3D): coxa 0-0/1, 0/0-0, trochanter 1-1/1, 0/1-1 (*ad* and *al* slightly thickened, *pv* elongated), femur 1-2/1, 1/1-1 (*ad1*, *pd1* and *pd* inserted on small tubercles; *ad1* (50–53) longest), genu 1-2/1, 2/1-1 (dorsal setae inserted on small tubercles), tibia 1-1/1, 2/1-1. Tarsi II-IV with 18 setae (3- 3/2, 3/2-3 + *mv*, *md*); seta *av1* enlarged and thick, with dentated tip, *pv1* (62–80) longer than others. All pretarsi with well-developed paired stout claws, rounded pulvilli and normal ambulacral stalk.

Description adult male

(Figures 4 & 5)

Six specimens measured.

Dorsal idiosoma — (Figure 5A) — Length 648–677, width 441–451.

Dorsal shield 585–620 long, 373–377 wide, with ornamentation, adenotaxy and poroidotaxy similar to those of female, except length of dorsal shield setae shorter than those of female (Figure 5A): podonotal setae 29–40 long (except *z2* (41–43) and *s5* (45–48), opisthonotal setae 27–43 (*J5*=25–27) long.

Ventral idiosoma — (Figures 4A & 5B) — Tritosternum with paired sparsely pilose laciniae (87–93), trapezoidal base 23–27 × 26–29 wide. Sternal, genital, endopodal shields fused into holoventral shield, 272–287 long from anterior to posterior margins of shield, wide at levels of setae *st2* and *st5,* (114–117) and (57–60) respectively; shield surface micropunctated, weakly reticulate, more distinct anteriorly, margins heavily sclerotized and frame-like, especially between coxae III–IV (Figures 4A & 5B), shield with five pairs thickened sternal setae *st1* (34–38), *st2* (32–34), *st3* (36–39), *st4, st5* (38–41), and three pairs of oval poroids. Soft

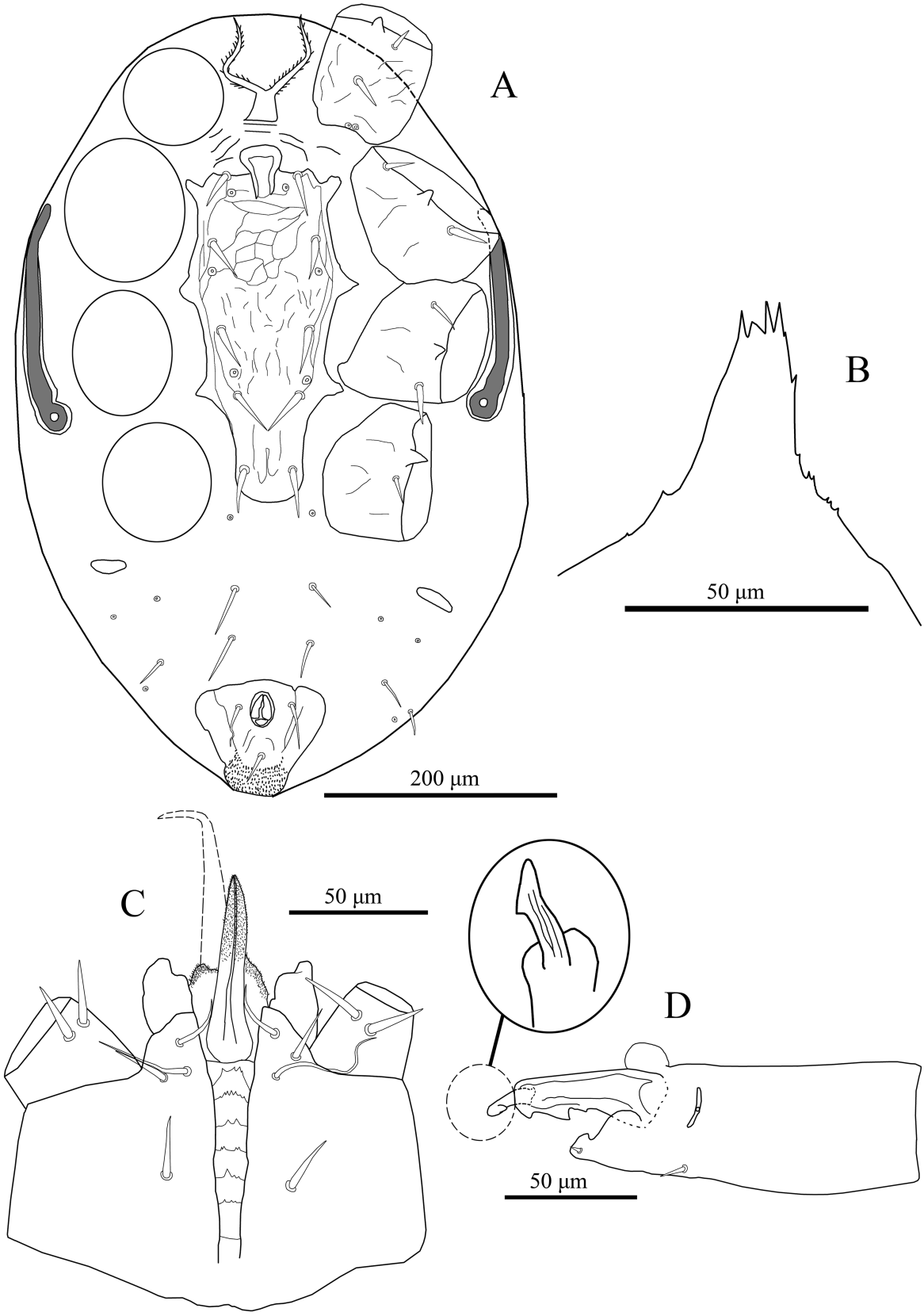

Figure 4 *Metacryptoseius samanii* Joharchi & Tavakal **n. sp.,** adult male: A – Ventral idiosoma; B – Epistome; C – Subcapitulum; D – Chelicera, spermatodactyl enlarged (not to scale).

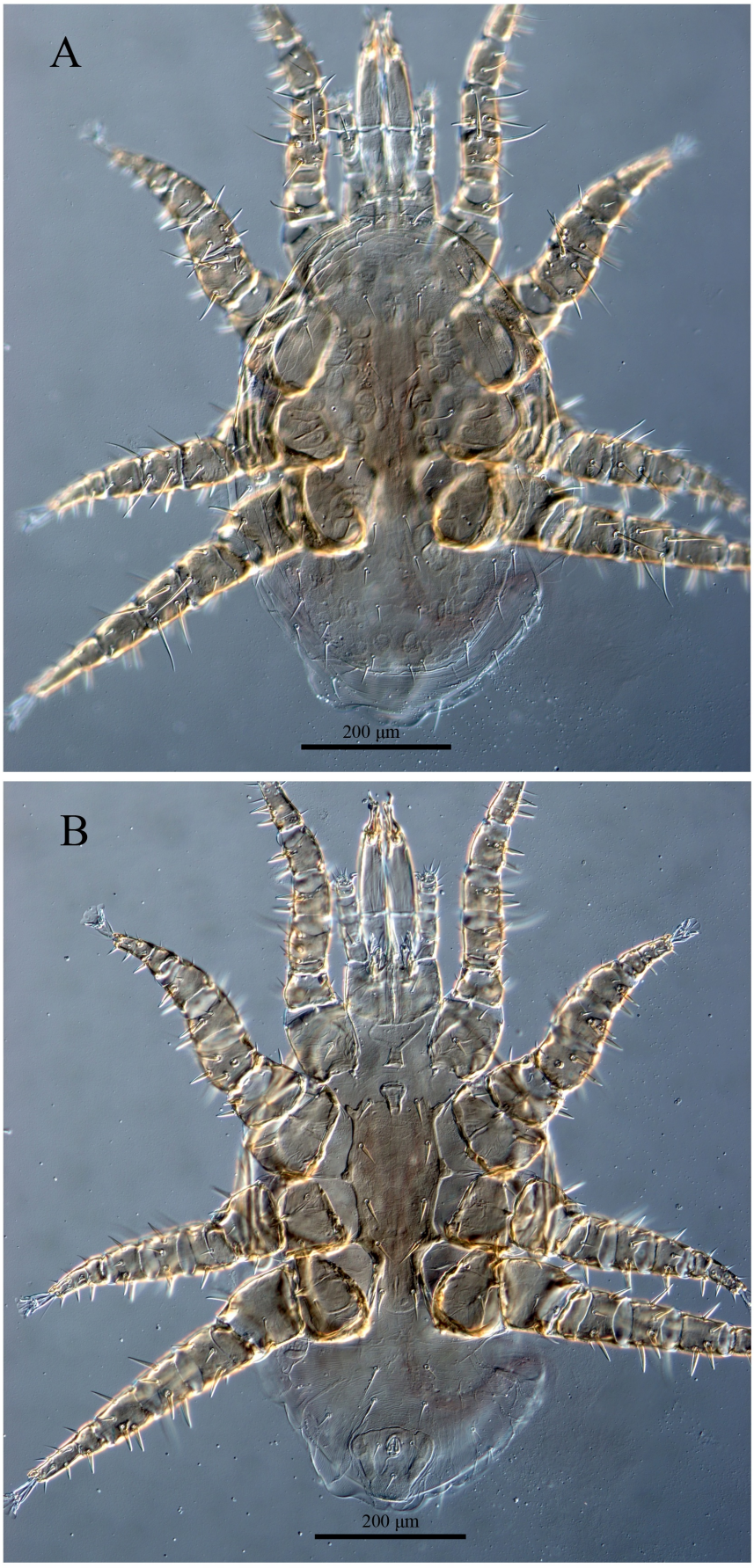

Figure 5 DIC micrographs of *Metacryptoseius samanii* Joharchi & Tavakal **n. sp.**, adult male: A – Idiosoma in dorsal view; B – Idiosoma in ventral view.

opisthogastric cuticle with five pairs of smooth setae: *JV1* (31–42), *JV2* (39–45), *JV5* (54–61), *ZV2* (23–26) and *ZV3* (17–21) and four pairs of poroids (*iv5*, two pairs of *ivo* and *ivp*). Peritremes slightly shorter than those of female, extending anteriorly to mid-level of coxa II (Figures 4A & 5B). Parapodal and metapodal shields similar to those in female (Figures 4A & 5B). Anal shield as for female (100–104 long, 98–114 wide); para-anal setae (27–30) slightly longer than post-anal seta (24–27) (Figures 4A & 5B).

Gnathosoma — (Figure 4B-D) — Epistome and subcapitulum similar to female, except corniculi thumb-like, with rounded tip (Figure 4C) and epistome with more serration on its anterior margin (Figure 4B). Chelicera 154–157 long; movable digit (57–60) longer than fixed digit (33–36) (Figure 4D); spermatodactyl 18–22 long and truncate distally (Figure 4D). Fixed digit of chelicera with only one tooth and a short setiform pilus dentilis; movable digit with two teeth; hyaline process apparently absent.

Legs — (Figures 5A & 5B) — Chaetotaxy as in female, except seta *av-1* on tarsi II-IV conical shape and bifid and *pv-1* with basal third broad and rest whip-like. Length of legs I-IV, (400–432), (392–397), (390–395) and (491–511) respectively.

Immature stages

Unknown.

Etymology

The species is named in memory of Ismail Samani, the leader of the first nation of the Tajiks.

Remarks

Kazemi and Moraza (in Kazemi *et al.* 2008) erected the genus *Metacryptoseius* to accommodate two new species *M. persicus* and *M. khorasanicus*, which were described associated with scarab beetles (Coleoptera: Scarabaeidae) in northeast Iran. Meanwhile, they transferred *Scamaphis guyimingi* Ma, 1997 to the genus *Metacryptoseius* because the species was completely agree with their concept of the genus. Afterwards, Bahrami *et al.* (2011) collected *Metacryptoseius persicus* Kazemi & Moraza in association with three different beetle hosts— *Scarabaeus transcaspicus* Stolfa (Scarabaeidae), *Herpalus* sp. (Carabidae) and *Osphranteria coerulescens* Redtenbacher (Cerambycidae). Since that time, there has been no other formal occurrence or recording of *Metacryptoseius* in the world, and is now recorded in Central Asia for the first time. The genus *Metacryptoseius* is superficially similar in its morphology to *Cryptoseius* Makarova 1998 but this problem was comprehensively discussed by Kazemi *et al.* (2008).

A simple analysis of setae measures reveals both similarities and dissimilarities when comparing *Metacryptoseius samanii* to the other three described congeners. *Metacryptoseius samanii* Joharchi & Tavakal most closely resembles *M. khorasanicus* Kazemi & Moraza, 2008 (first couplet in the identification key to *Metacryptoseius* species provided by Kazemi *et al.* 2008), due to the dorsal setae on shield conspicuously variable in length, *z2* longer than *s2,* setae *Jv5* ten times longer than *J5* and males with setae *z2* twice longer than *s2*. *Metacryptoseius samanii* can easily be distinguished from *M. khorasanicus* and two other described congeners by having dorsal setae *s4*, *s5*, *S3*, *S4*, *S5* conspicuously longer than most of other setae on shield (versus *s/S*-series setae short in all three described congeners), dorsal shield polygonal in shape, with posterior margin truncated (versus dorsal shield ovoid in shape, with rounded posterior margin in *M. khorasanicus*), males with oval shaped most anterior poroids and peritremes slightly shorter than those of female (versus the anterior poroids slit-like and the length of peritremes similar to those of female in three described congeners). Kazemi *et al.* (2008) created a key to distinguish *Metacryptoseius* species. However, the key does not work very well to distinguish *M. khorasanicus* and *M. guyimingi* (Ma) based on the length of setae *JV5* [couplet 1: " setae *JV5* eight to ten times longer than *J5* "], because both species have very long setae *JV5* (about eight to ten times longer than *J5*), whereas they mentioned *M. guyimingi* (Ma) with setae *JV5* about four times longer than *J5* [couplet 2, the identification key of the genus

in Kazemi *et al.* (2008)] but in the dorsal idiosoma of *Scamaphis guyimingi* illustrated by Ma (1997, page 38, Fig. 1), setae *JV5* considerably longer than *J5* (about eight to ten times).

Key to species of genus *Metacryptoseius* (adult female)

Partly from Kazemi *et al.* (2008).

1. Sternal setae *st2* long (reaching at least base of *st3*) 2
— Sternal setae *st2* short (barely reaching more than half the *st2–st3* distance) 3

2. Dorsal shield polygonal in shape, with posterior margin truncated, shield setae in *s/S*-series conspicuously longer than most of other setae on shield . . . . . *M. samanii* Joharchi & Tavakal **n. sp.**
— Dorsal shield ovoid in shape, with rounded posterior margin, shield setae in *s/S*-series short (not longer than other setae on shield), except *s2* . . . . . *M. khorasanicus* Kazemi & Moraza

3. Setae *JV5* eight to ten times longer than *J5*; dorsal setae *j2*, *z2*, *r2*, *r3*, *r5* and *s6* conspicuously longer than other dorsal setae . . . . . *M. guyimingi* (Ma)
— Setae *JV5* about four times longer than *J5*; dorsal setae on shield not conspicuously variable in length, mostly subequal . . . . . *M. persicus* Kazemi & Moraza

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