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A new species of the genus *Cheyletus* (Acari: Trombidiformes: Cheyletidae) from Kurdistan of Iran

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ABSTRACT

Cheyletus kurdistaniensis **sp. nov.** is described and illustrated based on females collected from soil under *Astragalus* sp. (Fabaceae), from Qorveh, Kurdistan Province, Iran. A key to all known species of the genus *Cheyletus* (females) is provided. The new species belongs to the *trouessarti* species group of *Cheyletus*. Within this group, it is classified in the *trouessarti* species subgroup which is defined by: Dorsomedian setae small and flag-like, dorsal shield with one pair of median setae, hysterosomal shield with 1–3 pairs of median setae, peritremes M-shaped or II-shaped.

KEYWORDS

Arthropods, mite, predators, Qorveh, soil

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INTRODUCTION

Members of the family Cheyletidae Leach (Acariformes: Trombidiformes: Cheyletoidea) have a wide distribution and habitats (Summers and Price 1970; Gerson *et al.* 1999, 2003; Fain and Bochkov 2001a, b). This family contains two groups of mites: 1. those with small, poorly developed, non-grasping palpi and parasitic mites (approximately 22%), and 2. those with large, highly developed, grasping palpi and primarily free-living predators (approximately 78%) (Baker 1949). Most cheyletids are free-living predators, though some are permanent ectoparasites (Bochkov 2004, 2009) and such are of importance to agriculture (Smiley 1978). Fain *et al.* (1997) compiled a key to the subfamilies of the family Cheyletidae. Gerson *et al.* (1999) provided a key to the genera of the Cheyletinae and a list of all known species in the family. Bochkov and Fain (2001) studied the phylogeny of the Cheyletidae with special reference to their host-parasite associations, and Fain and Bochkov (2001) also provided a key to the species of the genus *Cheyletus*. A key to the species known from Iran was provided by Bochkov *et al.* (2005) and Salarzehi et al. (2018).

The genus *Cheyletus* was established by Latreille (1796) and to date, nine species have been reported from Iran, namely: *C. eruditus* Schrank, 1781; *C. trouessarti* Oudemans, 1902; *C. malaccensis* Oudemans, 1903; *C. carnifex* Zachvatkin, 1935; *C. cacahuamilpensis* Baker, 1949; *C. malayensis* Cunliffe, 1962; *C. bidentatus* Fain & Nadchatram, 1980; *C. kuznetzovi* Bochkov & Khaustov, 1999; *C. rashtiensis* Salarzehi, Hajizadeh & Ueckermann, 2018. In this work, *Cheyletus kurdistaniensis* **sp. nov.** is described and illustrated from the vicinity of Qorveh city, Kurdistan Province, Iran.

MATERIAL AND METHODS

Mites were collected from soil under *Astragalus* sp. (Fabaceae), in Qorveh, Kurdistan Province, and

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mounted directly in Hoyer's medium (Walter and Krantz 2009). The specimens were measured, identified, and drawn by means of an Olympus BX51 differential interference contrast (DIC) microscope under 1000× magnification and equipped with a drawing tube. Setae were measured from their insertion to their tips; the distance between setae was measured as the distance between their insertions. Legs were measured from the base of the trochanter to the pretarsus (base of claws). In the description of the species, the idiosomal chaetotaxy follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The nomenclature for leg setae follows that of Grandjean (1944). All measurements are given in micrometers, and the measurements of the paratype are given in parentheses.

RESULTS

TAXONOMY

Family Cheyletidae Leach, 1815
Subfamily Cheyletinae Leach, 1815
Tribe Cheyletini Leach, 1815
Genus *Cheyletus* Latreille, 1796

Type species: *Acarus eruditus* Schrank, 1781

Cheyletus kurdistaniensis sp. nov. (Figs 1–10)

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Diagnosis

Eyes absent; palpal claw with two basal teeth; peritremes M-shaped, each with 10 pairs segments, tarsi with two comb-like eupathidia, dorsum with two large separate shields, propodosomal shield with one pair of flag-like dorsomedian setae and four pairs of long barbed lanceolate setae, hysterosomal shield with one pair of flag-like dorsomedian setae and four pairs of barbed lanceolate setae, all tarsi bear smooth claws and empodia.

Description

Measurements – Measurements of holotype with measurements of the paratypes in parentheses: Length of body 403 (388–400), including rostrum 611 (593–610); width 375 (350–355).

Dorsal idiosoma (Fig. 1) – With two large separate shields. Eyes absent. Anterior shield covering most of propodosoma. Propodosomal shield wider than long, with one pair of flag-like dorsomedian setae *c1* 12 (10–12) and four pairs of long marginal lanceolate barbed setae (*vi*, *ve*, *sci*, *sce*). Setae *c2* lanceolate barbed (Fig. 1A), and situated off propodosomal shield. Hysterosomal shield with one pair of flag-like dorsomedian setae *d1* 10 (9–12) on anterior margin of shield, and four pairs of lanceolate barbed marginal setae *d2*, *e2*, *f2*, *h2*. Two pairs of setae *h1*, *h3* situated off hysterosomal shield. Lengths of setae: *vi* 45 (43–45), *ve* 47 (46–47), *sci* 47 (45–48), *sce* 45 (41–44), *c2* 59 (55–57), *d2* 45 (40–43), *e2* 42 (38–39), *f2* 45 (40–42), *h1* 43 (40–42), *h2* 43 (41–42), *h3* 45 (42–43). Distances between dorsal setae: *vi–vi* 98 (93-102), *ve–ve* 156 (164–170), *sci–sci* 190 (190–197), *sce–sce* 220 (210–228), *c1–c1* 95 (93–97), *d1–d1* 51 (50–57), *c2–c2* 330 (300–317), *d2–d2* 150 (145–163), *e2–e2* 150 (138–150), *f2–f2* 102 (102–104), *h1–h1* 55 (53–60), *h2–h2* 90 (90–117), *h3–h3* 80 (68–73).

Ventral idiosoma (Fig. 2) – Ventral surface of idiosoma finely striate, bearing three pairs of intercoxal setae (*1a*, *3a*, *4a*). Genitoanal area with two pairs of genital setae (*g1* and *g2*) and three pairs of pregenital setae (*ag1*, *ag2* and *ag3*) and three pairs of anal setae (*ps1, ps2* and *ps3*). All ventral setae smooth, excluding anal setae barbed. Lengths of setae: *1b* 40 (36–42), *1c* 80 (75–78), *2c* 43 (42–44), *3b* 42 (35–40), *3c* 46 (43–45), *4b* 32 (30–31), *4c* 53 (44–51), *1a* 32 (26–28), *3a* 32 (32–34), *4a* 25 (25–27), *ag1* 25 (26–30), *ag2* 30 (30–34), *ag3* 28 (27–30), *g1* 30 (30–35), *g2* 32 (30–35), *ps1* 30 (27–30), *ps2* 30 (26–30), *ps3* 31 (27–30). Distances between ventral setae: *1a–1a* 43 (30–44), *3a–3a* 65 (53–65), *4a–4a* 76 (52–77), *ag1–ag1* 52 (42–50), *ag2–ag2* 33 (35–38), *ag3–ag3* 67 (48–60), *g1–g1* 33 (27–32), *g2–g2* 40 (34–38), *ps1–ps1* 15 (14–15), *ps2–ps2* 23 (17–22), *ps3–ps3* 26 (23–28).

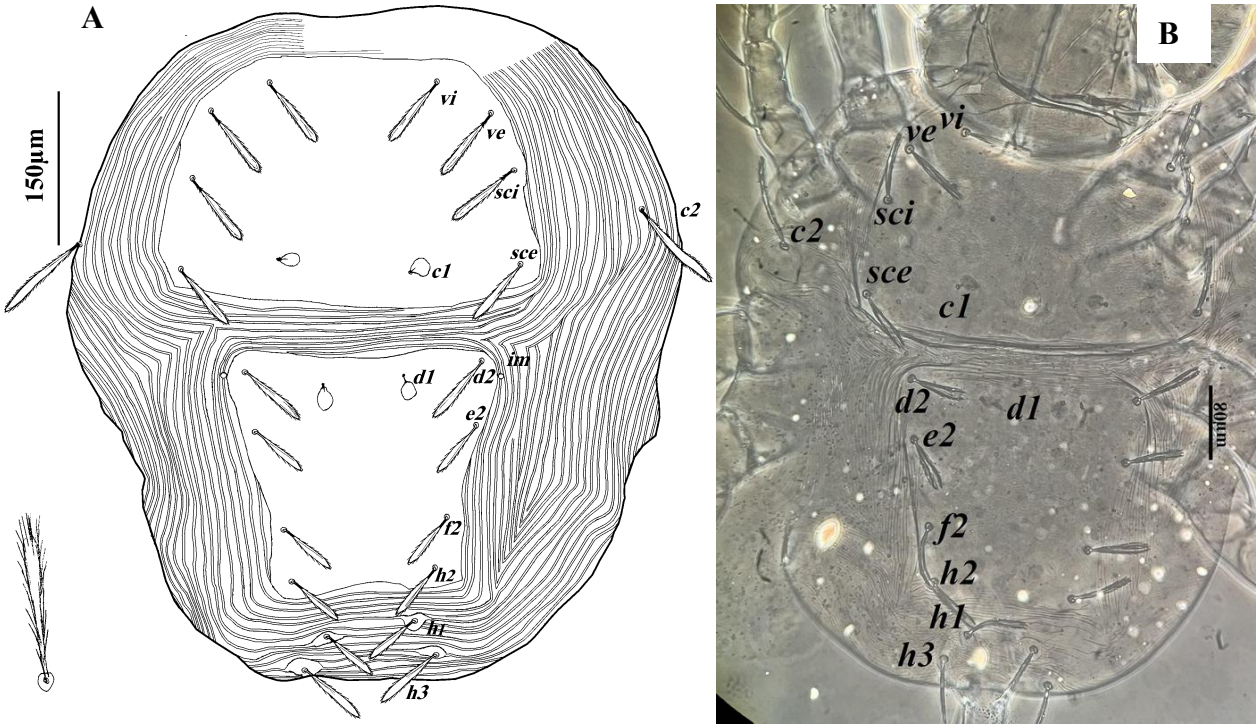


Figure 1. *Cheyletus kurdistaniensis* **sp. nov.** (female) – **A.** Dorsal idiosoma (holotype); **B.** Photograph of Dorsal idiosoma (paratype).

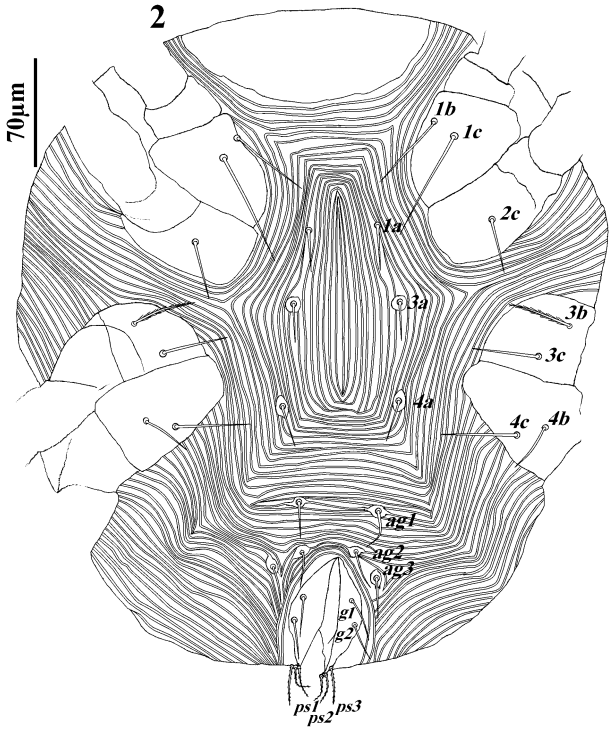
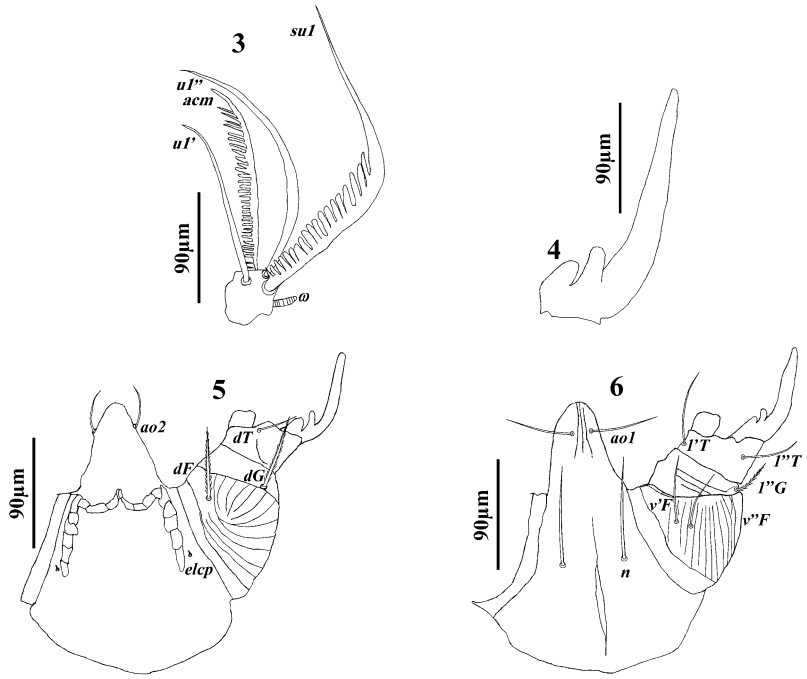


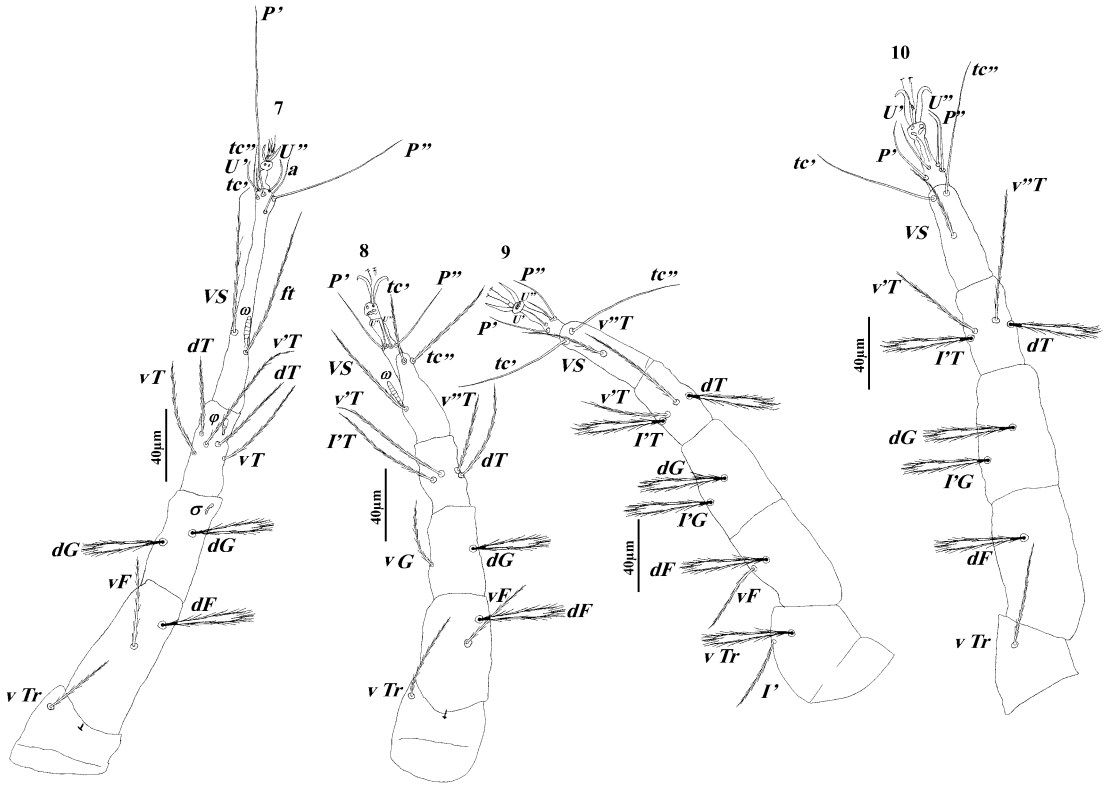
Figure 2. *Cheyletus kurdistaniensis* **sp. nov.** (female) – Ventral view of idiosoma.

Gnathosoma (Figs 3–6) – Peritremes M-shaped, each with 10 (10) pairs of segments. Dorsum of gnathosoma with adoral setae *ao2* 34 (30–32) and a pair of very small supracoxal setae *elcp*. Venter of gnathosoma bearing subcapitular setae *n* 85 (85–90) and adoral setae *ao1* 55 (55–58). Palp strong; rostrum of normal size. Palp setal formula as follows: trochanter without seta; femur about as long as wide, femur with one barbed seta (*dF*) and two nude setae (*v'F*, *v''F*); femoral setae subequall in size, genua with two barbed setae (*dG*, *l''G*), that dorsal setae longer than lateral setae; tibiae with three nude setae; tibial claw strong and with two basal teeth; tarsi with two comb-like eupathidia (*acm*, *sul*), outer comb (*sul*) longer

than claw, with 19 (19) teeth distributed throughout inner surface; inner comb (*acm*) almost straight, with approximately 31 (31) teeth, two nude sickle like setae (*ul'*, *ul''*) and one solenidion (*ω*), outer comb is longer than inner comb. Distance between *ao1–ao1* 14 (14–15), *ao2–ao2* 30 (29–30), *n–n* 49 (42–48).



Figures 3–6. *Cheyletus kurdistaniensis* **sp. nov.** (female) – **3.** Palp-tarsus; **4.** Palpal tibial claw; **5.** Dorsal surface of gnathosoma; **6.** Ventral surface of gnathosoma.



Figures 7–10. *Cheyletus kurdistaniensis* **sp. nov.** (female) – **7.** Leg I; **8.** Leg II; **9.** Leg III; **10.** Leg IV.

Legs (Figs 7–10) – setal formulae of Leg segments (solenidia in parentheses and not included in setal counts) as follows: coxa 2–1–2–2; trochanter 1–1–2–1; femur 2–2–2–1; genua 2(1)–2–2–2; tibiae

5(1)–4–4–4; tarsi 9(1)–7(1)–7–7. Leg I 269 (275–277); leg II 185 (190–195); leg III 218 (225–227), leg IV 260 (238–248). Length of tarsus I 93 (94–95); tibia I 40 (40–42), solenidia *ωI* 12 (11–12) and *ft* 64 (64–65). Coxa III (*3b*) with a lanceolate barbed seta, sensory seta on tarsus I short, rod–like; guard seta pilose, more than five times as long as sensory seta.

Remarks

Cheyletus kurdistaniensis **sp. nov.** belongs to the *trouessarti* species group of *Cheyletus*. Within this group, it is classified in the *trouessarti* species subgroup (Table 1), which is defined by: Dorsomedian setae small and flag-like, dorsal shield with one pair of median setae, hysterosomal shield with 1–3 pairs of median setae, peritremes M-shaped or II-shaped.

Cheyletus kurdistaniensis **sp. nov.** resembles *C. cacahuamilpensis* Baker, 1949 in having: coxae III with a lanceolate barbed seta, anterior shield covering most of propodosoma, setae *d2* situated on hysterosomal shield, propodosomal shield with one pair dorsomedian setae and four pairs marginal lanceolate serrate setae, hysterosomal shield with four pairs of marginal lanceolate serrate setae and one pair of dorsosubmedian setae, setae *c2* lanceolate serrate, dorsomedian setae shorter than marginal, tibial claw with two basal teeth, peritremes M-shaped, palp strong, rostrum of normal size, femur about as long as wide. Both species belongs to the tribe Cheyletini and *C. trouessarti* group and *C. trouessarti* subgroup, however the new species differs from *C. cacahuamilpensis* by: 1. guard seta more than five times as long as *ω*I in *C. kurdistaniensis* though guard seta four times as long as *ω*I in *C. cacahuamilpensis*; 2. tarsus I 93–95; tibiae I 40–42 in *C. kurdistaniensis* while 80, 34 respectively in *C. cacahuamilpensis*; 3. tibia I with five pairs of setae almost the same size in *C. kurdistaniensis* whereas with small clavate and pilose setae in *C. cacahuamilpensis*; 4. genito-anal area with three pairs of pre-genital, and three pairs of pseudoanal setae instead of two pairs in *C. cacahuamilpensis*; 5. dorsomedian setae are flag-like in *C. kurdistaniensis* opposed to staghorn-like in *C. cacahuamilpensis*; 6. inner and outer comb-like setae of palp tarsus with 31 and 19 teeth in *C. kurdistaniensis* while 20 and 18 *C. cacahuamilpensis*; 7. peritreme each with 10 pairs of segments in *C. kurdistaniensis*, instead of eight in the latter; 8. Palp femur setae are equal in length in the new species, but short pilose seta in *C. cacahuamilpensis*. Comparison with all known species of the *Cheyletus trouessarti* group is provided in Table 1.

Etymology

The new species is named after the type locality in Kurdistan Province, where types specimens were collected.

Table 1. Important characters of *Cheyletus* species of *Cheyletus trouessarti* group.

Species	P.Sh	P.Se (pair)	T.P.C	O.C.T	I.C.T	Me.P.S (pair)	Ma.S.P.S (pair)	Me.H.S (pair)	Ma.S.H.S (pair)	M.S.Sh	L ft to *ω*I
C. trouessarti **Oudemans, 1903**	M	-	-	-	-	1	4	3	3	flag-like	-
C. cacahuamilpensis **Baker, 1949**	M	8	2	18	20	1	4	1	4	staghorn-like	4 times longer
C. kurdistaniensis **sp. nov.**	M	10	2	19	31	1	4	1	4	flag-like	5 times longer
C. *morinus* Barilo, 1986	-	-	-	-	-	1	-	-	-	flag-like	-
C. *carnifex* Zachvatkin, 1935	∩	-	-	-	-	1	-	1	-	flag-like	-
C. *trux* Rohdendorf, 1940	M	-	-	-	-	1	-	3	-	flag-like	-
C. *schneideri* Oudemans, 1902	M	-	-	-	-	1	4	3	3	flag-like	-
C. rashtiensis **Salarzehiet *et al.*, 2018**	M	8	3-4	14	22	1	4	2	3	flag-like	1.5 time longer
C. volgini **Fain & Bochkov, 2001**	M	-	-	-	-	3	4	5	3	cloud-like	1.5 time shorter
C. linsdalei **Baker, 1949**	-	-	-	-	-	3	-	5	-	cloud-like	1.3 time longer

Note 1: This table has been completed according to the descriptions of the female C*heyletus trouessarti* group (Fain and Bochkov 2001).
Note 2: P.Sh = Peritreme's shapes, P.Se = Peritremes segments, T.P.C = Teeth palpal claw, O.C.T = Outer comb teeth, I.C.T = Inner comb teeth, Me. P.S = Median propodosomal setae, Ma.S.P.S = Marginal setae of propodosomal shield,, Me. H.S = Median hysterosomal setae, Ma.S.H.S = Marginal setae of hysterosomal shield, M.S.Sh = Median setae shape, L ft to *ω*I = Length of ft compared to *ω*I.

Type materials

Holotype and four paratype females, collected from soil under *Astragalus* sp. (Fabaceae) bush, Qorveh, Kurdistan Province, Iran, 5 January 2024, coll. Fatemeh Amini. Holotype and paratype females are deposited as slide-mounted specimens in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamadan, Iran.

Key to species of the genus *Cheyletus* (females)

(adapted from Fain and Bochkov 2001)

1. Dorsal shields without median setae ..... *eruditus* group 23
– Dorsal shields with median setae 2
2. Median setae modified, very small, transparent, flag-like or cloud-like, propodosomal shield with 1–3 pairs of median setae, hysterosomal shield with 1–5 pairs of median setae ..... *trouessarti* group 14
– Median setae not modified, setiform, sometimes very short, rod-like, propodosomal shield with one pair of median setae, hysterosomal shield with 1–3 pairs of median setae ..... *nidicolus* group 3
3. Setae *c2* fan-like or lanceolate 8
– Setae *c2* hair-like 4
4. Peritremes M-shaped, guard seta (*ft'*) smooth, shorter or not more than 1.3 times longer than solenidion *ωl*, dorsal setae of idiosoma hair-like, setae *f2* not less than 2 times longer than *h2* 5
– Peritremes Π–shaped, guard seta (*ft'*) senate, not less than 3 times longer than solenidion ω*l*, dorsal setae of idiosoma spatulate, setae *f2* and *h2* subequal ..... *C. vivatus*
5. Setae *d1* present, setae *d2* and *vi*, *ve* subequal 6
– Setae *d1* absent, setae *d2* more than two times longer than *vi, ve* ..... *C. legendrei*
6. Guard seta (*d2*) shorter than solenidion *ωl*, setae *h2* situated on the hysterosomal shield, setae *sce* 1.7 times longer than *d2*, setae *c2* 1.6 times longer than *sce* 7
– Guard seta (*ft'*) longer than solenidion *ωl*, setae *h2* situated off the hysterosomal shield, setae *sce* 2.5 times longer than *d2*, setae *c2* and *sce* subequal ..... *C. nidicolus*
7. Peritremes with 9–10 links, setae *e2* situated on the hysterosomal shield ..... *C. pseudomalaccensis*
– Peritremes with 5–6 links, setae *e2* situated off the hysterosomal shield ..... *C. mafekingensis*
8. Dorsal shields covered by strong ornamentation 10
– Dorsal shields without ornamentation 9
9. Setae *d1* absent ..... *C. attiahi*
– Setae *d1* present ..... *C. kuznetzovi*
10. Dorsal setae fan-like, setae *d1* present ..... *misonnei* subgroup 11
– Dorsal setae spatulate, setae *d1* absent ..... *C. punctulatus*
11. Dorsomedian setae much shorter than lateral setae 13
– Dorsomedian setae not shorter than lateral setae 12
12. Dorsomedian setae fan-like, similar in shape to the fan-like lateral setae, setae *e1* absent, guard seta longer than solenidion *ωl*, femur IV with one seta, dorsal seta of palpal femur thickened ..... *C. kivuensis*
– Dorsomedian setae narrowly lanceolate, with a different shape than the fan-like lateral setae, setae *e1* present, guard seta (*ft'*) shorter than solenidion *ωl*, femur IV with two setae, dorsal seta of palpal femur fan-like ..... *C. funisciuri*
13. Peritremes M-shaped, dorsomedian setae setiform ..... *C. tanzaniensis*
– Peritremes ∩-shaped, dorsomedian setae rod-like ..... *C. misonnei*
14. Median setae flag-like, propodosomal shield with 1 pair of median setae, hysterosomal shield with 1–3 pairs of median setae ..... *trouessarti* subgroup 16

– Median setae cloud-like, propodosomal shield with 3 pairs of median setae, hysterosomal shield with 5 pairs of median setae ..... *linsdalei* subgroup 15
15. Solenidion *ωl* 1.5 time longer than guard seta (*ft'*), setae *c2* 1.9 time longer than the other lateral setae, about 130 long ..... *C. volgini*
– Solenidion 1.3 time shorter than guard seta (*ft'*), setae *c2* 1.3 time longer than other lateral setae, about 85 long ..... *C. linsdalei*
16. Setae *c2* lanceolate, hysterosomal shield with 1–4 pairs of median setae 18
– Setae *c2* hair-like, hysterosomal shield with 3 pairs of median setae 17
17. Dorsolateral setae spatulate, setae *ve* and *sci* subequal ..... *C. schneideri*
– Dorsolateral setae hair-like, setae *sci* 1.5 times longer than *ve* ..... *C. trux*
18. Setae *d2* situated off the hysterosomal shield 20
– Setae *d2* situated on the hysterosomal shield 19
19. Inner comb with 20 teeth, guard seta four times as long as ωI ..... *C. cacahuamilpensis*
– Inner comb with 31 teeth, guard seta more than five times as long as ωI .... *C. kurdistaniensis* **sp. nov.**
20. Hysterosoma dorsally with one pair of median setae, peritremes ∩-shaped 22
– Hysterosoma dorsally with 1–3 pairs of median setae, peritremes M-shaped 21
21. Hysterosoma dorsally with three pairs of median setae, genua I with solenidion σ ..... *C. trouessarti*
– Hysterosoma dorsally with two pairs of median setae, genua I without solenidion σ ..... *C. rashtiensis*
22. Hysterosomal shield represented by two small lateral shields ..... *C. morinus*
– Hysterosomal shield well developed ..... *C. carnifex*
23. Guard seta (*ft'*) longer than solenidion *ωl* of at least ¾ length of *ωl* 28
– Guard seta (*ft'*) 2 times or more shorter than solenidion *ωl* 24
24. Femur IV with 1 seta 25
– Femur IV with 2 setae ..... *C. eruditus*
25. Propodosomal and hysterosomal shields subequal in length, distance between these shields less than ½ of *d2* length, setae *e2* situated far behind the anterior margin of hysterosomal shield 26
– Propodosomal shield 1.5 or more longer than hysterosomal shield, distance between these shields and length of setae *d2* almost subequal, setae *e2* situated almost on anterior margin of hysterosomal shield ..... *C. malaccensis*
26. Setae *vi* and *sci* subequal; setae *d2, e2* and *f2* subequal 27
– Setae *sci* more than two times longer than *vi*; setae *e2* and *f2* more than two times longer than *d2* ..... *C. pluridens*
27. Rostrum with a pair of lateral tooth ..... *C. bidentatus*
– Rostrum without lateral tooth ..... *C. malayensis*
28. Hysterosomal shield rectangular, well developed, setae *f2* situated on shield, setae *e2* and *f2* about two times shorter than *vi* 31
– Hysterosomal shield reduced or absent, setae *f2* situated far behind shield, setae *vi*, *e2* and *f2* subequal 29
29. Hysterosomal shield absent, palpal tibial claw well developed ..... *C. ascutatus*
– Hysterosomal shield present but reduced and ovate, palpal tibial claw short 30
30. Hysterosomal shield with two pairs of setae ..... *C. batomysi*
– Hysterosomal shield with one pair of seta ..... *C. rwandae*
31. Setae *vi*, *ve* and *sci* subequal, dorsal shields with weak longitudinal striations, dorsal hysterosomal setae spatulate 32
– Setae *sci* two times longer than *vi* and *ve*, dorsal shields without ornamentation, dorsal hysterosomal setae hair-like ..... *C. philippinensis*
32. Dorsal propodosomal setae spahilate, distance between these shields less than half the length of setae *d2* ..... *C. gerbillicola*
– Dorsal propodosomal setae hair-like, distance between these shields subequal to the length of setae *d2* ..... *C. zumpti*

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Generative AI statement: The authors declare that no generative AI tools were used in the creation of this manuscript.

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گونه‌ای جدید از جنس *Cheyletus* (Acari: Trombidiformes: Cheyletidae) از استان کردستان ایران

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چکیده

گونهٔ جدید ***Cheyletus kurdistaniensis* sp. nov.** بر اساس نمونه‌های مادهٔ جمع‌آوری‌شده از خاک زیر گیاه *Astragalus* sp. (Fabaceae) در شهرستان قروه، استان کردستان، ایران توصیف و تصویرسازی شده است. همچنین کلیدی برای شناسایی تمام گونه‌های شناخته‌شده جنس *Cheyletus* (بر اساس افراد ماده) ارایه شده است. گونهٔ جدید به گروه گونه‌ای *trouessarti* تعلق دارد. در این گروه، این گونه در زیرگروه گونه‌ای *trouessarti* قرار می‌گیرد که این زیرگروه با مشخصات زیر تعریف می‌شود: موهای پشتی میانی کوچک و پرچم‌مانند، صفحهٔ پشتی دارای یک جفت موهای میانی، پس‌پاتنه دارای ۱–۳ جفت موهای میانی، لولهٔ تنفسی M یا II شکل.

واژگان کلیدی: بندپایان، هرنا، شکارگرها، قروه، خاک

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