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A new species of *Cheyletus* Latreille (Prostigmata: Cheyletidae) from Iran and a key to the Iranian species

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ABSTRACT

A new species, *Cheyletus rashtiensis* n. sp. (Acariformes: Prostigmata: Cheyletidae) is described on the basis of adult females from Rasht, Guilan Province, Northern Iran. The new species can be distinguished from other species by the following features: presence of hysterosomal shield with two pairs of dorsomedian setae d1 and e1, absence of setae d4, genua I without solenidion σ ; setae d1 situated on anterior margin of hysterosomal shield; dorsomedian setae of hysterosomal shield flag-like; and tibial claw with 3 – 4 basal teeth. Additionally, a key to the Iranian species (females) of the genus *Cheyletus* Latreille is provided.

Keywords *Cheyletus*, Cheyletidae, Iran, Guilan, key, new species, taxonomy

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Introduction

The family Cheyletidae (Acariformes: Cheyletoidea) presently includes over 440 species in 75 genera (Zhang *et al.*, 2011; Bochkov and Abramov 2016). About 78% of cheyletid species are predators, the remaining species are permanent parasites of mammals and birds. The predatory species occupy a wide variety of habitats including plants, soil-litter, stored products, colonies and galleries of insects, patchy or ephemeral substrates requiring dispersal by phoresy on insects or vertebrates (Hughes, 1976; Fain and Bochkov, 2001a; Bochkov and Oconnor 2004; Fuangarworn and Lekprayoon, 2010).

The genus *Cheyletus* established by Latreille (1796), is the most important genus in the family Cheyletidae. Predacious species of this genus are mostly associated with nests of vertebrates or stored grains. These mites play an important role in the control of agricultural pests and some species are common components of the house dust acarofauna (Fain and Bochkov, 2001b). Summers and Price (1970) listed 27 species from genus *Cheyletus* and provided an identification key for nine species in the United States of America. Volgin (1969, 1987) listed 29 species of genus *Cheyletus*. After Volgin's revision, studies dealing with the systematics of genus *Cheyletus* in different parts of world were published by some researchers like those of Fain and Nadchatram (1980) for the Oriental Region, Fain (1982) for the Afrotropical Region and Madagascar, and Corpuz-Raros (1988) for the Philippines. Gerson *et al.* (1999) provided a list containing 68 species of *Cheyletus*. Fain and Bochkov (2001b) revised the species of the genus *Cheyletus* and provided an identification key for females and males of 29 valid species. The last authors put members of the genus *Cheyletus* in three groups and six subgroups. Prior to this study 42 species from 21 genera of cheyletid mites were recorded from Iran, among them 8 species belonging to the genus *Cheyletus* (Fathipour *et al.*, 1999; Kamali *et al.*, 2001; Bochkov *et al.*, 2005; Doğan *et al.*, 2011; Hajizadeh *et al.* 2011; Ardeshir 2017; Paktinat-Saeij *et al.* 2017; Salarzahi *et al.*, 2017). During a taxonomic study of

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cheyletid mites in Guilan Province, Northern Iran, a new species of *Cheyletus* was discovered. Herein, we describe *C. rashtiensis* n. sp., and provide an identification key to *Cheyletus* species of Iran.

Materials and methods

This study was conducted in Rasht county, Guilan Province, Northern Iran, during the period 2016–2017. The mites were extracted from stored materials like rice flakes, barn and barley, by placing them in a Berlese/Tullgren funnel or directly collecting them under a stereomicroscope. Mites were cleared in Nesbitt's solution and mounted in Hoyer's medium on microscope slides. The mites were examined under 1000× magnification of an Olympus BX51 phase contrast and a differential interference contrast microscope (Olympus Optical Co; LTD; Japan). All drawings were prepared with the help of a 1.25X Olympus camera lucida (Olympus Optical Co; LTD; Japan). Body length measurements represent the distance between the anterior tip of the gnathosoma and the posterior end of idiosoma; width was measured at the broadest point of the idiosoma. Leg measurements are from trochanter to pretarsus. In the description below, the idiosomal setation follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The nomenclature for leg setae follows that of Grandjean (1944). Dorsal idiosomal setation followed that of Kethley (1990) in the description and left-hand side of figure 1A (right-hand side of figure 1A shows that of Fain *et al.*, 1997). All measurements are given in micrometers (µm). Voucher material were preserved as slide-mounted specimens and will be deposited in Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Iran. One female paratype will be deposited in the National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa.

Results

Subfamily: Cheyletinae Leach, 1815

Tribe: Cheyletini Leach, 1815

Genus: *Cheyletus* Latreille, 1796

Type species: *Acarus eruditus* Schrank, 1781

***Cheyletus rashtiensis* n. sp. (Figs 1-3)**

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Diagnosis (female) — Body (including gnathosoma) 540 (480–596) long; gnathosoma 174 (160–196) long, 163 (140–172) wide; idiosoma 366 (320–400) long, 292 (240–312) wide; propodosomal shield 152 (140–180) long, 239 (220–280) wide; hysterosomal shield 161 (132–200) long, 161 (132–200) wide; palp 133 (116–148) long; palp femur with equal length and width 81 (76–84). Length of legs I–IV: 285 (280–392); 211 (208–216); 238 (232–242); 287 (280–300)

Description. Female (n=5)

Dorsum (Fig. 1A) — Dorsum of idiosoma with two large separate shields. Eyes absent. Propodosomal shield wider than long, trapezoidal, with one pair of flag-like dorsomedian setae c1 15 (13–16) long, and four pairs rather large marginal lanceolate setae (vi, ve, sci, sce). Setae c2 lanceolate situated ventrally. Outer lumbar setae (d2) located between propodosomal and hysterosomal shields. Hysterosomal shield equal in length and width and bearing two pairs of flag-like dorsomedian setae d1 14 (12–14) long, e1 13 (11–15), and three pairs of lanceolate barbed setae (e2, f1, f2) laterally. Two pairs of setae (h1, h2) situated off hysterosomal shield.

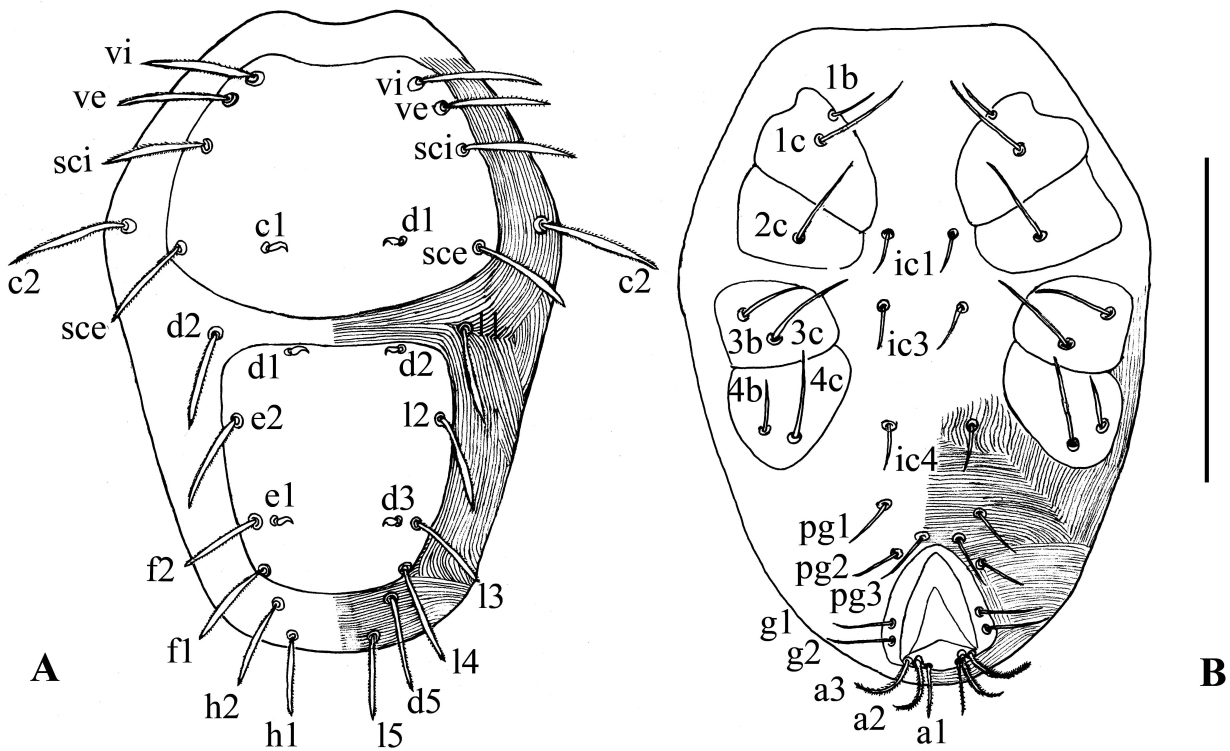


Figure 1 *Cheyletus rashtiensis* n. sp. (Adult female): A – Dorsal view of idiosoma with notation system of Kethley, 1990 right and Fain *et al.* 1997 left; B – ventral view of idiosoma. Scale bar: 160 μ m.

Lengths of setae: vi 49 (48 – 50), ve 43 (36 – 48), sci 46 (44 – 48), sce 39 (36 – 40), c2 69 (60 – 80), d2 36 (32 – 38), e2 41 (40 – 42), f2 40 (38 – 44), f1 41 (40 – 42), h1 41 (40 – 42), h2 40 (42 – 44). Distances between dorsal setae: vi – vi 95 (80 – 110), ve – ve 146 (135 – 155), sci – sci 167 (155 – 180), sce – sce 188 (170 – 200), vi – ve 31 (20 – 40), ve – sci 32 (28 – 36), sci – sce 64 (55 – 70), c2 – c2 265 (240 – 288), d2 – d2 166 (140 – 184), e2 – e2 134 (120 – 145), f1 – f1 102 (84 – 114), f2 – f2 115 (114 – 122), h1 – h1 82 (72 – 90), h2 – h2 70 (64 – 74), d2 – e2 64 (48 – 74), e2 – f2 60 (64 – 68), f1 – f2 32 (28 – 36), f1 – h1 38 (28 – 44), h1 – h2 22 (20 – 28).

Venter (Fig. 1B) — Ventral surface of idiosoma finely striate, bearing three pairs of setaceous intercoxal setae (ic1, ic3, ic4). Genitoanal area with two pairs of genital setae (g1 and g2), three pairs of pregenital setae (pg1, pg2 and pg3) and three pairs of anal setae (a1, a2 and a3). All ventral setae setaceous, excluding anal setae a1 – a3 barbed. Lengths of setae: ic1 25 (24 – 26), ic3 25 (24 – 28), ic4 23 (22 – 26), g1 34 (30 – 40), g2 35 (30 – 42), pg1 24 (22 – 26), pg2 26 (24 – 28), pg3 25 (23 – 26), a1 36 (32 – 38), a2 34 (30 – 38), a3 33 (28 – 36). Distances between ventral setae: ic1 – ic1 30 (26 – 32), ic3 – ic3 59 (52 – 64), ic4 – ic4 62 (56 – 64), g1 – g1 41 (38 – 44), g2 – g2 49 (46 – 52), pg1 – pg1 55 (52 – 58), pg2 – pg2 23 (20 – 26), pg3 – pg3 45 (40 – 48), a1 – a1 12 (10 – 14), a2 – a2 19 (16 – 22), a3 – a3 26 (24 – 28), ic1 – ic3 44 (38 – 48), ic3 – ic4 75 (70 – 78), ic4 – pg1 68 (64 – 72), pg1 – pg2 25 (22 – 28), pg2 – pg3 24 (22 – 26), g1 – g2 12 (10 – 14), g1 – pg3 15 (13 – 17), g2 – ag3 26 (24 – 28).

Gnathosoma (Fig. 2) — Peritremes M-shaped, composed of eight pairs of fairly strong chambers. Dorsum of gnathosoma with adoral setae ao2 32 (30 – 34) and a pair of very small supracoxal setae elcp (measurement impossible). Venter of gnathosoma bearing subcapitular setae n 73 (72 – 74) and adoral setae ao1 24 (22 – 30). Palp setal formula as follows: trochanter without seta; femora with one barbed setaceous dF 98 (92 – 102) and two smooth setaceous

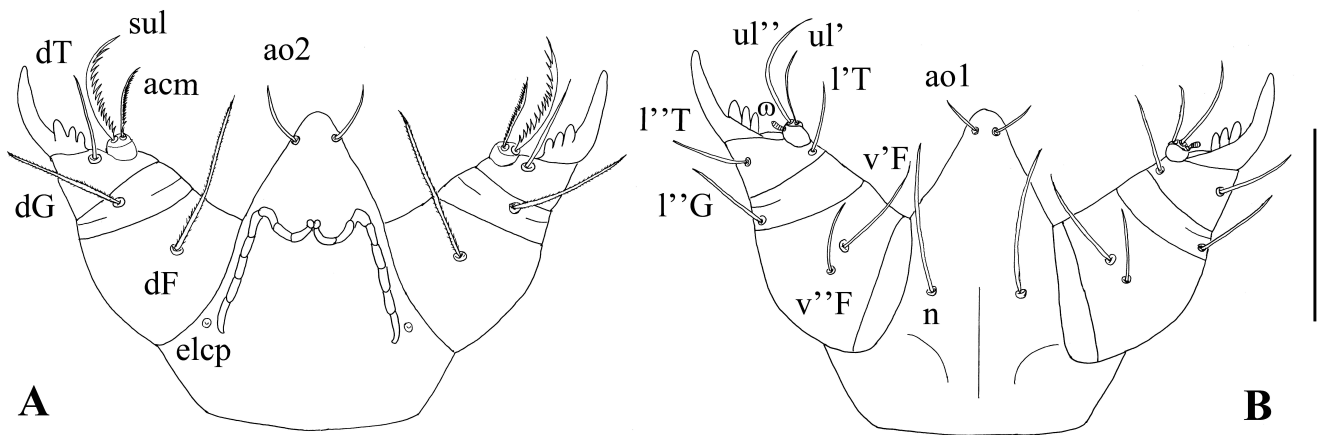


Figure 2 *Cheyletus rashtiensis* n. sp. (Adult female): A – Dorsal view of gnathosoma; B – ventral view of gnathosoma. Scale bar: 100 μ m.

setae v'F 56 (54 – 60), v''F 36 (34 – 38); genua with one barbed setaceous setae dG 56 (50 – 60) and one smooth setaceous setae l''G 40 (34 – 42); tibiae with three smooth setaceous setae dTi 46 (40 – 50), l'Ti 35 (32 – 38) l''Ti 37 (34 – 40); tibial claw 55 (50 – 60) long and 3 – 4 basal teeth; tarsi with two comb-like eupathidia (acm, sul), outer comb (sul) about as long as claw, with 14 tines distributed throughout inner surface; inner comb (acm) almost straight, with approximately 22 tines, two smooth setaceous setae (ul', ul'') and one solenidion (ω). Distance between ao1–ao1 12 (10 – 14), ao2–ao2 23 (20 – 28), ao1–ao2 7 (6 – 8), n–n 49 (46 – 52), dF–dF 146 (140 – 150), dG–dG 193 (190 – 196), dTi–dTi 184 (180 – 188), v'F–v'F 131 (128 – 136), v''F–v''F 152 (148 – 156), v'F–v''F 12 (10 – 14), l''G–l''G 201 (200 – 206), dG–l''G 16 (14 – 18), l'Ti–l'Ti 155 (152 – 158), l''Ti–l''Ti 218 (214 – 222), l'Ti–l''Ti 29 (26 – 32). Guard setae (ft) of solenidion (ω I) 31 (28 – 36) long and about 1.5 times longer than solenidion 20 (18 – 22) long.

Legs (Fig. 3) — All legs with barbed setaceous setae. Dorsal setae on femora I–IV and genua III thickened, of same structure as those on setae dorsal shield. Leg I–IV setal formulae: tarsus 9 + solenidion ω I (tc', tc'', a'', u', u'', p', p'', ft, vs) –7 + solenidion ω II (tc', tc'', u', u'', p', p'', vs) –7–7 (tc', tc'', u', u'', p', p'', vs); tibia 5+ solenidion ϕ I (l'T, l''T, v'T, v''T, dT) –4–4–4 (l''T, dT, v'T, v''T); genu –2–2–2–2 (dG, l'G); femur 2–2–2–1; trochanter 1–1–2–1; coxa 2–1–2–2 smooth setaceous.

Remarks — The new species belongs to the tribe Cheyletini and *trouessarti* group because of the presence of modified dorsomedian setae that is very small and flag-like (Fain and Bochkov, 2001b). *Cheyletus rashtiensis* n. sp. can be distinguished from *C. trouessarti* Oudemans, 1903 by 1) the presence of two pairs of median setae, d1 and e1, on hysterosomal shield (vs. three pairs of median setae on hysterosomal shield); 2) genua I without solenidion σ (vs. genua I with solenidion σ); 3) Guard setae (ft) of solenidion (ω I) (31) μ m and about 1.5 times longer than solenidion (20 μ m) [vs. guard seta (ft) of solenidion (ω I) about twice as long as solenidion (ω I)]. *Cheyletus rashtiensis* n. sp. differs from *C. carnifex* Zachvatkin, 1935 by 1) hysterosomal shield with two pairs of dorsomedian setae d1 and e1 (vs. hysterosomal shield with one pair of dorsomedian setae); 2) dorsomedian setae d1 situated on anterior margin of hysterosomal shield (vs. dorsomedian setae d1 situated off hysterosomal shield); 3) peritreme M-shaped (vs. peritremes inverted U-shaped); 4) tibial claw with 3 – 4 basal teeth (vs. tibial claw have 2 basal teeth); 4) palp femur as wide as long (vs. palp femur longer than the width). *Cheyletus rashtiensis* n. sp. differs from *C. cacahuamilpensis* Baker, 1949 by having 1) hysterosomal shield with two pairs of median setae, d1 and e1 (vs. hysterosomal shield with

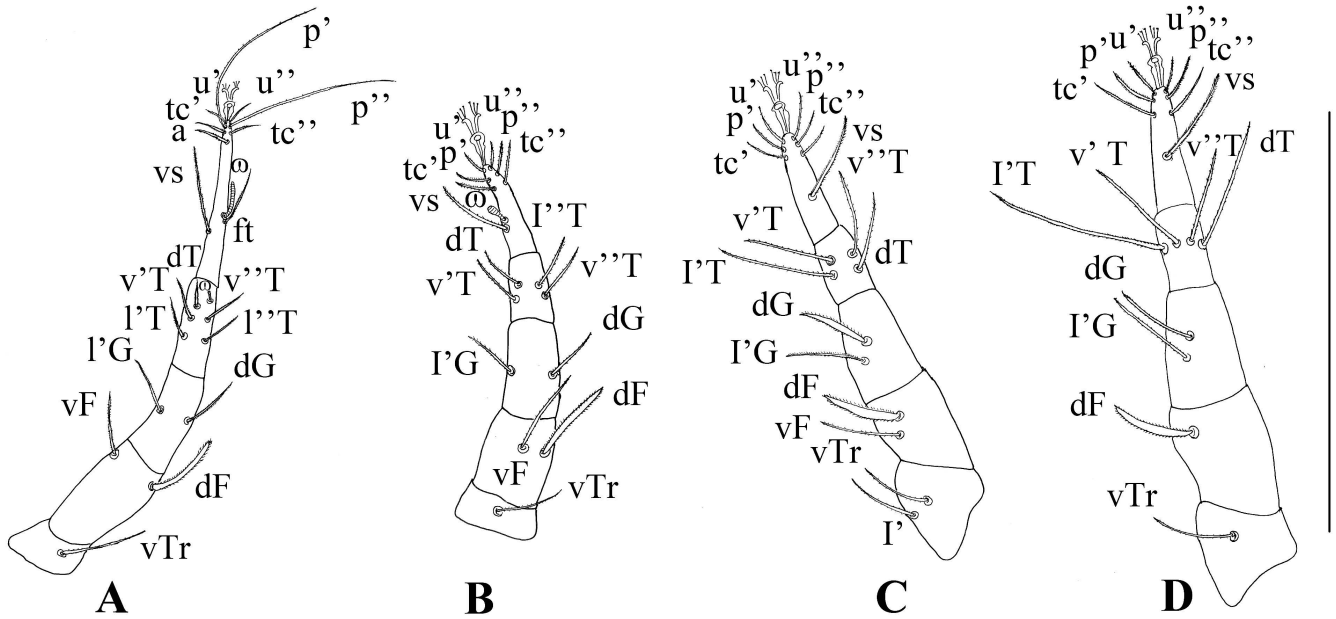


Figure 3 *Cheyletus rashtiensis* n. sp. (Adult female): A – Leg I; B – Leg II; C – Leg III; D – Leg IV. Scale bar: 225 µm for A; 202 µm for B; 207 µm for C; 219 µm for D.

one pair of dorsomedian setae); 2) hysterosomal shield with three pairs of marginal barbed setae (vs. hysterosomal shield with four pairs of marginal barbed setae); 3) setae d2 located off hysterosomal shield, between propodosomal and hysterosomal shields (vs. setae d2 situated on hysterosomal shield); 4) dorsal marginal setae of idiosoma lanceolate (vs. dorsal marginal setae of idiosoma spatulate); 5) tibial claw of the palp with 3 – 4 basal teeth (vs. tibial claw of the palp with 2 basal teeth); 6) the dorsal setae of the palp femur 98 µm long (vs. dorsal seta of palp femur relatively short, 55 µm long); 7) outer comb of tarsi with 14 tines and inner comb with approximately 22 tines (vs. outer comb of tarsi with 18 tines and inner comb with approximately 32 tines).

Etymology — The specific epithet is derived from the city of origin, Rasht, Guilan Province, Northern Iran.

Type materials — Holotype and 11 paratype females were collected from samples of stored rice and decayed rice bran; 1 paratype female, decayed plant material; 3 paratype females, pine rotten wood; Rasht (37°17'0"N, 49°35'0"E, alt. - 7 m), 27 May 2016, 2 August 2016, 29 February 2017; 3 paratype females, were collected from stored rice and decayed rice bran; Sangar (37°10'42"N, 49°41'38"E, alt. 31 m), 29 February 2017 by Safour Salarzehi. The holotype and paratype females are deposited in Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Iran. One female paratype will be deposited in the National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa.

Key to species of *Cheyletus* occurring in Iran (females)

- 1. Dorsal shields without median setae *eruditus* group 2
- Dorsal shields with median setae 5

2. Femur IV with two setae *Cheyletus eruditus* (Schrank, 1781)
 — Femur IV with one setae 3
3. Propodosomal shield 1.5 times or more, longer than hysterosomal shield. Distance between these shields and length of setae 11 almost subequal. Setae 12 situated almost on anterior margin of hysterosomal shield *Cheyletus malaccensis* Oudemans, 1903
 — Propodosomal and hysterosomal shields subequal in length. Distance between these shields less than 1.2 times length of setae 11. Setae 12 situated far behind the anterior margin of hysterosomal shield 4
4. Rostrum with a pair of lateral teeth *Cheyletus bidentatus* Fain and Nadchatram, 1980
 — Rostrum without lateral teeth *Cheyletus malayensis* Cunliffe, 1962
5. 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 6
 — 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 Setae *c2* fan-like, setae *d2* present *Cheyletus kuznetzovi*
 Bochkov and Khaustov, 1999
6. Setae *d2* situated on hysterosomal shield, peritremes M-shaped 7
 — Setae *d2* situated off hysterosomal shield, peritremes Π-shaped
 *Cheyletus carnifex* Zachvatkin, 1935
7. Setae 11 situated on hysterosomal shield, that shield with one pair of median setae
 *Cheyletus cacahuamilpensis* Baker, 1949
 — Setae 11 situated off hysterosomal shield, that shield with 2 or 3 pairs of median setae 8
8. Hysterosomal shield with two pairs of median setae, genua I without solenidion σ
 *Cheyletus rashtiensis* n. sp.
 — Hysterosomal shield with three pairs of median setae, genua I with solenidion σ
 *Cheyletus trouessarti* Oudemans, 1902

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