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Two new species and a new record of mites of the family Stigmaeidae (Acari: Prostigmata) collected from mosses in Russia

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ABSTRACT — Two new species of the family Stigmaeidae (Acari: Prostigmata), Eustigmaeus extremiorientalis n. sp. and Stigmaeus mollibus n. sp., are described from mosses in the Far East and Western Siberia, Russia. Stigmaeus minus is reported from Russia for the first time.

KEYWORDS — Acari; Prostigmata; Raphignathoidea; systematics; predatory mites; mosses

INTRODUCTION

The predatory mite family Stigmaeidae (Acari: Prostigmata) is the largest in the superfamily Raphignathoidea and includes more than 500 species in 30 valid genera (Zhang et al. 2011). Among them, the genera Eustigmaeus Berlese, 1910 and Stigmaeus Koch, 1836 are the largest in the family and include more than 100 and about 140 species, respectively, and distributed worldwide (Khaustov and Tolstikov 2014; Dogan et al. 2015; Khaustov 2015; Maake et al. 2015). The lists of mites of the genera Eustigmaeus and Stigmaeus from Russia were recently provided by Khaustov and Tolstikov (2014) and Khaustov (2015), respectively. During the study of mites associated with mosses in Russia two new species of stigmaeid mites were revealed. Stigmaeus minus Summers, 1962 is reported from Russia for the first time.

MATERIALS AND METHODS

Mites were collected from mosses using Berlese funnels and mounted in Hoyer’s medium. In the description below, the palpal, idiosomal and the leg setations follow those of Grandjean (1939, 1944, 1946). Prodorsal nomenclature follows that of Kethley (1990). All measurements are given in micrometres (µm) for holotype and 5 paratypes (in parentheses). In descriptions of leg setation the number of solenidia is given in parentheses. The type material is deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. SEM photos were made with the aid of JEOL –JSM-6510LV SEM microscope. Photographs were taken with a digital camera AxioCam ICC5 via compound microscope Carl Zeiss AxioImager. A2 with phase-contrast illumination.
RESULTS

Family Stigmaeidae Oudemans, 1931
Genus Eustigmaeus Berlese, 1910

Type species: Stigmaeus kermesinus Koch, 1841, by original designation.

Eustigmaeus extremiorientalis n. sp.
(Figures 1-6)

Description Female (Figures 1-6) — Idiosoma almost round in outline. Length of idiosoma 340 (320 – 340), width 270 (270 – 280).

Idiosomal dorsum (Figures 1A, 5A, B, 6A, B) — Idiosoma completely covered by 2 large and well sclerotized plates. Plates with large round dimples (Figures 1A, 5A, 6B) and weak cuticular reticulation. Dorsal setae situated on short protuberances, subequal, widened distally and strongly barbed (Figures 5A, B). Setae e2 absent. Setae h1 and h2 situated ventrally. Setae h2 only slightly thickened, not widened distally and weakly barbed. Lengths of dorsal setae: v1 42 (40 – 43), v2 50 (48 – 51), s1 38 (37 – 40), s2 51 (30 – 33), c1 40 (39 – 41), e2 28 (27 – 29), d1 41 (40 – 43), d2 35 (34 – 36), e1 43 (42 – 44), f1 46 (43 – 46), h1 33 (31 – 34), h2 19 (17 – 20).

Idiosomal venter (Figures 1B, 5C, 6C, D) — With 2 pairs of callosities between idiosomal plate and humeral plate. Anterior callosity slightly larger than posterior one (Figure 5C). Suranal plate situated ventrally, with distinct large dimples. Endopodal plates separated mediately distinctly reticulated. Humeral plate subtriangular, with distinct large dimples. Than posterior one (Figure 5C). Suranal plate situated ventrally. Setae h1 and h2 of tibia, l” of genu, and d of femur distinctly thickened distally and strongly barbed, situated on protuberances. Seta l2 8 (8 – 9). Solenidion ω short 15 (13 – 15), finger-shaped; solenidion φ ω 8 (8 – 9) and φp 11 (10 – 11) baculiform. Setae (ft), (pl) and ω of tarsus weakly barbed; (a), (u) smooth. Leg II (Figure 3B).

Leg setation: Tr 1 (v’), Fe 6 (d, l', l”, v', v", bu”), Ge 4 (d, l', l", k), Ti 5(2) (d, l', l”, v’, v”, φ, φp), Ta 13(1) (p’, p”， tc’, tc”, ft’, ft”, u’, u”, a”, pl’, ω, ω), Setae (p) and (tc) of tarsus are eupathidia. Setae d, l”, l” of tibia, l”, d of genu, l” and d of femur distinctly thickened distally and strongly barbed, situated on protuberances. Seta k 8 (8 – 9). Solenidion ω short 15 (13 – 15), finger-shaped; solenidion φ ω 8 (8 – 9) and φp 11 (10 – 11) baculiform. Setae (ft), (pl) and ω of tarsus weakly barbed; (a), (u) smooth. Leg II (Figure 3B).

Leg setation: Tr 1 (v’), Fe 5 (d, l', l”, v’, v", bu”), Ge 4 (d, l’, l”, k), Ti 5(1) (d, l’, l”, v’, v”, φ), Ta 9(1) (p’, tc’, tc” , u”, u” , a”, pl”, ω , ω). Setae p’ and tc’ of tarsus represented by eupathidia. Setae d, l” of tibia, d, l” of genu, and d and l” of femur distinctly thickened distally and strongly barbed, situated on protuberances. Solenidion ω 9 (9 – 10) finger-shaped; solenidion φp 7 (7 – 8) baculiform. Seta k 6 (5 – 6). Setae tc” and ω of tarsus weakly barbed; (a), (u) and pl’ of tarsus smooth. Leg III (Figure 4A). Leg setation: Tr 1 (v’), Fe 3 (d, l’, εv’), Ge 1 (d), Ti 5(1) (d, l’, l”, v’, v”, φ), Ta 7(1) (tc’, tc”, u”, a”, a”, pl”, ω, ω). Solenidion ω 5 (4 – 5) baculiform; solenidion φp 6 (5 – 6) baculiform. Setae d, l” of tibia, d of genu, and d and l” of femur distinctly thickened distally and strongly barbed, situated on protuberances. Setae (u) of tarsus smooth, other tarsal setae weakly barbed. Leg

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FIGURE 1: Eustigmaeus extremiorientalis n. sp., female: A – idiosomal dorsum, B – idiosomal venter.
**Figure 2:** *Eustigmaeus extremiorientalis* n. sp., female: A – gnathosoma dorsally, B – distal part of tibia and tarsus of palp, C – subcapitulum.
Figure 3: Eustigmaeus extremiorientalis n. sp., female: A – leg I, B – leg II.
FIGURE 4: Eustigmaeus extremiorientalis n. sp., female., female: A – leg III, B – leg IV.
FIGURE 5: Phase-contrast micrographs of *Eustigmacaeus extremiorientalis* n. sp., female: A – central part of prodorsum, B – anterior part of prodorsum and chelicerae, C – humeral plate and callosities, D – subcapitulum.
IV (Figure 4B). Leg setation: Tr 1 (v’), Fe 2 (d, ev’), Ge 1 (d), Ti 5 (1) (d, l’, l”, v’, v”, φ), Ta 7 (1) (tc”, tc”, u’, u”, a’, a”, vs, ω). Solenidion ω 4 (4 – 5) baculiform; solenidion φ 6 (5 – 6) baculiform. Setae d, l’, l” of tibia, d of genu and femur distinctly thickened distally and strongly barbed, situated on protuberances. Setae (u) of tarsus smooth, other tarsal setae weakly barbed.

Male and immatures: unknown.

Type material — Female holotype, slide N° ST181215, Russia: Primorsky kray, Vladivostok, Botanical Garden-Institute, Far Eastern Branch of the Russian Academy of Sciences, 43°13’26.3”N, 131°59’34.6”E, from mosses on log, 18 December 2015, coll. S. Tupitsyn. Paratypes: 17 females, same data as holotype.

Etymology — The new species name refers to its distribution in the Far East of Russia.

Differential diagnosis — The new species is most similar to E. absens Doğan, 2005, described from Turkey (Doğan 2005), by the absence of setae c2, presence of two callosities, only one seta on trochanter III and two pairs of aggenital setae. The new species differs from E. absens by distinctly thickened distally and strongly barbed dorsal idiosomal setae (vs. baculiform and weakly barbed in E. absens) and by setae sci longer than sce (vs. sci about two times shorter than sce in E. absens).

Genus Stigmaeus Koch, 1836

Type species: Stigmaeus cruentus Koch, 1836, by subsequent designation by Berlese (1910).

Stigmaeus mollibus n. sp. (Figures 7-15)

Description Female (Figures 7-10, 15) — Length of idiosoma 350 (350 – 390), width 175 (175 – 230).

Idiosomal dorsum (Figures 7A, 15A, C, D) — Idiosoma fusiform, soft, mostly striated. Eyes absent. Propodosomal plate with setae vi and ve, weakly defined by more narrow striae than outside ones; with distinct median propodosomal apode. Area anteriorly and anterolaterally to propodosomal plate with numerous microtubercles. Setae ve, c2, and h3 pointed, sparsely barbed. Other dorsal setae distinctly blunt-ended and barbed. Setae c2 situated ventrally. Ratio ve/sci = 3.3. Suranal plate divided, with three pairs of setae. Setae e1 and f1 situated on platelets (Figure 15D), remaining surface of hysterosoma without plates. Lengths of dorsal setae: vi 11 (11 – 14), ve 43 (43 – 45), sci 13 (13 – 15), sce 16 (15 – 16), c1 12 (12 – 15), c2 45 (45 – 53), d1 11 (11 – 12), d2 10 (10 – 11), e1 12 (11 – 13), e2 10 (10 – 12), f1 16 (16 – 17), h1 16 (16 – 18), h2 31 (27 – 31), h3 18 (18 – 23).

Idiosomal venter (Figures 7B, 15B) — Ventral setae weakly barbed and pointed, except for ps1–ps3 which are barbed and blunt-ended. Four pairs of aggenital setae; a1 situated on separate small platelets; a2–a4 on weakly defined platelet. Two pairs of genital setae. Cuticle posteriadal to gnathosomal base and posterolateral to coxae IV with microtubercles. Lengths of ventral setae: la 22 (22 – 24), lb 20 (20 – 22), lc 29 (26 – 30), lb 50 (47 – 54), 2c 27 (27 – 34), 3a 25 (25 – 29), 3b 20 (17 – 20), 3c 17 (17 – 19), 4a 20 (20 – 24), 4b 14 (14 – 15), 4c 12 (12 – 14), a1 18 (18 – 20), a2 18 (18 – 19), a2 20 (20 – 23), a4 22 (22 – 24), g1 19 (19 – 20), g2 22 (22 – 24), ps1 20 (19 – 21), ps2 23 (19 – 23), ps3 15 (15 – 17).

Gnathosoma (Figure 8) — Tibial claw large. Setae l’ of palpal tibia thin, seta-like (Figure 8A). All palpal setae of subcapitulum without reticulation. Lengths of subcapitulum (Fig. 8B) relatively long, with lateral lobes. Subcapitular setae pointed; n weakly barbed in basal part, other setae smooth. Basal part of subcapitulum without reticulation. Lengths of subcapitular setae: m 20 (20 – 22), n 63 (60 – 65), or1 10 (10 – 11), or2 11 (11 – 12).

Legs (Figures 9-10) — Empodial raylets capitate. Leg segments without reticulation. Leg I (Figure 9A). Coxae I postero-dorsally with small, thick, with distinctly rounded tip leg supracoxal setae (el). Leg setation: Tr 1 (v’), Fe 4 (d, l’, l”, bo”), Ge 6 (d, l’, l”, v’, v”, k), Ti 5 (1) (d, l’, l”, v’, v”, φ), Ta 13 (1) (p’, p”), tc”, tc”, ft”, ft”, u’, u”, a”, a”, pl”, pl”, vs, ω). Setae d of tibia and (p), (tc) and ft’ of tarsus are eupathidia. Seta

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Figure 7: *Stigmaeus mollibus* n. sp., female: A – idiosomal dorsum, B – idiosomal venter.
FIGURE 8: Stignaeus mollibus n. sp., female: A – gnathosoma dorsally, B – subcapitulum.
FIGURE 9: *Stignacaeus mollibus* n. sp., female: A – leg I, B – leg II.
Figure 10: Stigmaeus mollibus n. sp., female: A – leg III, B – leg IV.
Figure 11: *Stigmaeus mollibus* n. sp., female, male: A – opisthosoma dorsally, B – opisthosoma ventrally.

$k 6 (6 – 7)$. Solenidion ω short 12 (11 – 12), finger-shaped; solenidion φp 15 (14 – 15) uniformly thin. Solenidion φ absent. Setae ft", (pl) and vs of tarsus weakly barbed; (u) and (a) smooth. Leg II (Figure 9B). Leg setation: Tr 1 (v'), Fe 4 (d, l', l", bv"), Ge 2 (l', l"), Ti 5(1) (d, l', l", v', v", φp), Ta 8(1) (tc", tc", u', u", a', a", pl', vs, ω). Setae p' of tarsus absent. Solenidion ω 9 (8 – 9) finger-shaped; solenidion φp 10 (10 – 11) uniformly thin. All tarsal setae smooth. Setae d of tibia and tc' of tarsus very long and smooth.

**Leg III (Figure 10A).** Leg setation: Tr 2 (v', l'), Fe 3 (d, l', ev'), Ge 0, Ti 5(1) (d, l', l", v', v", φp), Ta 7(1) (tc", tc", u', u", a', a", vs, ω). Solenidion ω 5 (5 – 6) baculiform; solenidion φp 9 (9 – 10) uniformly thin. Setae d of tibia and (tc) of tarsus very long and smooth.

**Leg IV (Figure 10B).** Leg setation: Tr 1 (v'), Fe 2 (d, ev'), Ge 1 (d), Ti 5(1) (d, l', l", v', v", φp), Ta 7(1) (tc', tc", u", a', a", vs, ω). Solenidion ω 5 (4 – 5) baculiform; solenidion φp 9 (9 – 11) uniformly thin. Setae d of tibia and (ts) of tarsus extra-long and smooth.

Male (Figure 11) — Similar with female, but smaller and with more narrow posterior end of the body. Length of idiosoma 290, width 155. **Idiosomal dorsum** (Figure 11A) — As in female, except absence of setae h₃ and undivided suranal plate. Lengths of dorsal setae: vi 12, ve 45, sci 11, sce 13, c₁ 11, c₂ 37, d₁ 10, d₂ 10, e₁ 11, e₂ 10, f₁ 16, h₁ 17, h₂ 23.

Idiosomal venter (Figure 11B) — Podosoma as in female. Opisthosomal venter with three pairs of aggenital setae situated on longitudinal platelets. Pseudanal setae ps₁₂ spine-like, smooth, ps₃ blunt-ended and weakly barbed. Penis short, thin, weakly sclerotized. **Legs** (Figures 12-13) — Leg setation as in female, except presence of large male solenidia ω♂ on tarsi I-IV.

Deutonymph (Figure 14) — In general similar with female, but little smaller. Length of idiosoma 335, width 175.

Idiosomal dorsum (Figure 14A) — As in female, except absence of setae h₃ and undivided suranal plate. Lengths of dorsal setae: vi 12, ve 45, sci 11, sce 18, c₁ 15, c₂ 45, d₁ 19, d₂ 11, e₁ 10, e₂ 9, f₁ 17, h₁ 18, h₂ 24.

Idiosomal venter (Figure 14B) — Podosoma as in female. Opisthosomal venter with three pairs of aggenital setae; setae ag₃ situated on small platelets.

Legs (Figure 12-13) — Leg setation as in female, except absence of setae on trochanter and genu IV.
FIGURE 12: Stigmaeus mollibus n. sp., female, male: A – leg I, B – leg II.
Figure 13: *Stigmaeus mollibus* n. sp., female, male: A – leg III, B – leg IV.
Type material — Female holotype, slide N° AK040415, Russia, Tyumen Province, Tyumen Province, vicinities of lake Kuchak, 57°20’05.3”N 66°03’08.9”E, 4 April 2015, moss on soil, coll. A.A. Khaustov. Paratypes: 9 females, 1 male, 1 deutonymph, same data.

Etymology — The name of the new species is derived from Latin word *mollibus* meaning soft and refers to soft and weakly sclerotized body.

Differential diagnosis — The new species is most similar to *S. shendabadiensis* Haddad, Akbari and Lotfollahi, 2010, described from Iran (Haddad et al. 2010), by soft and finely striated body, divided suranal plate with three pairs of setae and similar leg setation. However, it differs from the latter by absence of seta *l”* of palpgenu (vs. present in *S. shendabadiensis*), absence of solenidion *φ* of tibia I (vs. present in *S. shendabadiensis*), setae *d2* and *e2* situated on striated cuticle (vs. *d2* and *e2* situated on platelets in *S. shendabadiensis*).


Material examined — Seven females, Russia, Leningrad Province, vicinity of Sestroretsk station, Sestroretsk swamp, in wet moss *Sphagnum magellanicum* Brid. (Bryophyta: Sphagnaceae), 28 June 2015, 60°07’22,8”N, 30°02’36,9”E, coll. D.A. Filippov.

Remarks — This species was described in the U.S.A. (Arizona) from litter under *juglans rupestris* (Summers 1962). It was also recorded from litter in Latvia (Kuznetsov and Petrov 1984). This is a new record for the fauna of Russia.

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Figure 15: SEM photos of *Stigmaeus mollibus* n. sp., female: A – dorsal view of body, B – ventral view of body, C – prodorsum, D – opisthosoma dorsally, E – palptarsus.
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