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Previous volumes (2010-2017): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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

Alexander A. KHAUSTOV

(Received 15 February 2016; accepted 23 March 2016; published online 22 July 2016)

Tyumen State University, Tyumen, Semakova 10, 625003 Russia. alex1973khaustov@gmail.com

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 Stigmaidae Oudemans, 1931**

**Genus Eustigmaeus Berlese, 1910**

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

*Eustigmaeus extreminiortalis 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, B) and weak subcuticular reticulation. Dorsal setae situated on short protuberances, subequal, widened distally and strongly barred (Figures 5A, B). Setae e2 absent. Setae h1 and h2 situated ventrally. Setae h2 only slightly thickened, not widened distally and weakly barred. Lengths of dorsal setae: v = 42 (40 – 43), v' = 50 (48 – 51), s' = 38 (37 – 40), s'c = 31 (30 – 33), c1 = 40 (39 – 41), c2 = 28 (27 – 29), d1 = 41 (40 – 43), d2 = 35 (34 – 36), c1 = 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 callוסities between idiosomal plate and humeral plate. Anterior callosity slightly larger than posterior one (Figure 5C). Suranal plate situated ventrally, with distinct large dimples. Endodermal plates separated medially distinctly reticulated. Humeral plate subtriangular, with distinct large dimples. Most of ventral setae weakly barred; with 2 pairs of simple subequal aggenital, and 3 pairs of simple pseudanal setae; setae ps2 clearly shorter than subequal ps1 and ps3. Lengths of ventral setae: l'a = 23 (21 – 24), l'b = 22 (20 – 23), l'c = 16 (15 – 19), l'bc = 16 (15 – 18), l'ce = 17 (14 – 17), s'a = 20 (18 – 22), s'b = 16 (13 – 17), s'bc = 19 (17 – 20), s'bc = 17 (16 – 18), s'c = 15 (13 – 16), a'g1 = 16 (15 – 17), a'g2 = 18 (16 – 19), ps1 = 14 (14 – 16), ps2 = 11 (10 – 11), ps3 = 16 (15 – 17).

**Gnathosoma** (Figures 2, 5B, D, 6E, F) — Tibial claw well-developed. Seta l' on palpal tibia very short, spine-like (Figure 2B). Setae d' and l' of palpal femur widened distally and strongly barred; other palpal setae of femur, genu and tibia (except l'Ti) pointed and barred; seta v of palp-tarsus weakly barred; other setae of palp-tarsus smooth. Number of setae on palpal segments: Tr 0, Fe 3 (d', l', v'), Ge 2 (d', l'), Ti 3 (d', l', l'Ti), Ta 8 (1 fused eupathidia ul', ul", sul, eupathidion acm, ba, bp, lp, 1 solenidion v). Palpal supracoxal setae (ep) needle-like. Rostrum of subcapitulum (Figure 2C) short and wide. Subcapitular setae or1 smooth, distinctly thickened, curved and blunt-ended; other subcapitular setae simple, pointed. Basal part of subcapitulum with numerous small dimples and weak subcuticular reticulation (Figure 5D). Length of subcapitular setae: m' = 19 (18 – 22), n' = 18 (17 – 21), or1 = 12 (11 – 12), or2 = 12 (11 – 12). Chelicerae dorsally with numerous small dimples (Figure 5B).

Legs (Figures 3, 4) — Empodial raylets capitate. Leg I (Figure 3A). Coxae I posterodorsally with needle-like leg supracoxal setae (el). Leg setation: Tr 1 (v'), Fe 6 (d', l', l", v', v", b'), Ge 4 (d', l', l"), Ti 5 (d', l', l", v', v", v"), Ta 13 (p", p", tc", tc", ft', ft", ut", u", a', a", pl', pl", vs, v). Setae (p) and (tc) of tarsus are eupathidia. Setae d', l', l" of tibia, l'" of genu, l'" and d of femur distinctly thickened distally and strongly barred, situated on protuberances. Seta k 8 (8 – 9). Solenidion ω short 15 (13 – 15), finger-shaped; solenidia φ 8 (8 – 9) and φp 11 (10 – 11) baculiform. Setae (ft), (pl) and vs of tarsus weakly barred; (a), (u) smooth. Leg II (Figure 3B). Leg setation: Tr 1 (v'), Fe 5 (d', l', l", v', b"), Ge 4 (d', l', l"), Ti 5 (d', l', l", v', v", v"), Ta 9 (p", tc", tc", ft', ft", ut", a", a", pl", pl", vs, v). Setae p' and tc' of tarsus represented by eupathidia. Setae d', l' and l" of tibia, d', l' and l" of genu, d and l" of femur distinctly thickened distally and strongly barred, situated on protuberances. Solenidion ω 9 (9 – 10) finger-shaped; solenidia φp 7 (7 – 8) baculiform. Seta k 6 (5 – 6). Setae tc" and vs of tarsus weakly barred; (a), (u) and pl' of tarsus smooth. Leg III (Figure 4A). Leg setation: Tr 1 (v'), Fe 3 (d', l', e'), Ge 1 (d), Ti 5 (d', l', l", v', v", v"), Ta 7 (tc", tc", ut", a", a", pl", vs, v). Solenidion ω 5 (4 – 5) baculiform; solenidion φp 6 (5 – 6) baculiform. Setae d', l' of tibia, d of genu, d and l' of femur distinctly thickened distally and strongly barred, situated on protuberances. Setae (u) of tarsus smooth, other tarsal setae weakly barred. Leg
Figure 1: Eustigmaeus extremiorientalis n. sp., female: A – idiosomal dorsum, B – idiosomal venter.
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 *Eustigmnaeus 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", vs, ω), 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. Tupsyn. 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 e2, 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 apodeme. 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 re/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; ag1 situated on separate small platelets; ag2–ag4 on weakly defined platelet. Two pairs of genital setae. Cuticle posteriord to gnathosomal base and posterolateral to coxae IV with microtubercles. Lengths of ventral setae: 1a 22 (22 – 24), 1b 20 (20 – 22), 1c 29 (26 – 30), 1d 50 (47 – 54), 2a 27 (27 – 34), 2b 25 (25 – 29), 3b 20 (17 – 20), 3c 17 (17 – 19), 4a 20 (20 – 24), 4b 14 (14 – 15), 4c 12 (12 – 14), ag1 18 (18 – 20), ag2 18 (18 – 19), ag3 20 (20 – 23), ag4 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 pointed; setae of femur and genu weakly barbed. Number of setae on palpal segments: Tr 0, Fe 3 (d, l', v'), Ge 1 (d), Ti 3 (d, l', l") , Ta 8(1) (fused eupathidia ul', ul", sul, eupathidion acm, ba, bp, lp,1 solenidion ω). Palpal supracoxal setae (ep) small, thick, with distinctly rounded tip. Rostrum 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 posterodorsally with small, thick, with distinctly rounded tip leg supracoxal setae (el). Leg setation: Tr 1 (v'), Fe 4 (d, l', l", v'), Ge 6 (d, l', l", v', v", k), Ti 5(1) (d, l', l", v', v", ω), Ta 13(1) (p', p", tc', tc", ft', ft", φ), Ta 13(1) (p', p", tc', tc", ft', ft", ω, u", a", a", pl', pl", 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: *Stignaeus mollibus* n. sp., female: A – leg I, B – leg II.
Figure 10: *Stigmaeus mollibus* n. sp., female: A – leg III, B – leg IV.
Stigmaeus mollibus n. sp., female, male: A – opisthosoma dorsally, B – opisthosoma ventrally.

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. Lengths of dorsal setae: vi 9, ve 38, sci 10, 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 ps1-2 spine-like, smooth, ps3 blunt-ended and weakly barbed. Penis short, thin, weakly sclerotized.

Legs (Figures 12-13) — Leg setation as in female, except absence of setae on trochanter and genu 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 9, 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.
**Stigmaeus mollibus** n. sp., female, deutonymph: A – opisthosoma dorsally, B – opisthosoma ventrally.

**Type material** — Female holotype, slide № AK040415, Russia, 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 palpigen (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.

**ACKNOWLEDGEMENTS**

The author thanks PhD student Sergey Tupitsyn (Tyumen State University, Russia) for his help in collecting mites. I also thank Dr. Dmitriy Filippov (Papanin Institute for Biology of Inland Waters RAS, Borok, Russia) for the identification of *Sphagnum* mosses and samples of mosses from swamps. The author appreciates valuable comments on the manuscript of Dr. Andrei V. Tolstikov (Tyumen State University, Tyumen, Russia). The present re-
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.
search was supported by the grant from the Russian Science Foundation, project No. 14-14-01134 to Dr. Alexander A. Prokin.

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