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Ten new species in genera *Hypoaspis* (s.lat.) Canestrini, 1884, *Dendrolaelaps* (s.lat.) Halbert, 1915, and *Ameroseius* Berlese, 1903 (Acari: Gamasina) from Finland

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Abstract

This paper reports ten new species and one new status of Parasitiformes: Gamasina, found in Finland. The described species are: *Hypoaspis* (*Alloparasitus*) *pratensis* n. sp., *Hypoaspis* (*Cosmolaelaps*) *michaeli* n. sp., *Hypoaspis* (*Pneumolaelaps*) *saana* n. sp., *Hypoaspis* (*Pneumolaelaps*) *collina* n. sp., *Androlaelaps myrmecophila* (Evans & Till, 1966) new status, *Punctodendrolaelaps formicarius* n. sp., *Multidendrolaelaps putte* n. sp., *Multidendrolaelaps subcorticalis* n. sp., *Dendrolaelaps casualis* n. sp., *Ameroseius lehtineni* n. sp. and *Sinoseius pinnatus* n. sp. *Sinoseius* Bai et al., 1995, is accepted as a separate genus, including the species *S. pinnatus* n. sp. and *S. lobatus* Bai et al., 1995. Identification keys are presented to clarify the taxonomic position of the new species in relation to the previously known species.

Key words: Parasitiformes, Gamasina, systematics, Scandinavian soil mites

1. Introduction

Taxonomy, faunistics and ecology of soil-living Parasitiformes have been studied by few researchers in Finland. Virtually all published data originate from certain ecological experiments, mainly carried out in forest habitats (Huhta et al. 1979, 1986, 2005; Huhta, 1996). Lehtinen (1987) studied the mesostigmatid fauna of ant nests, but covering only Uropodina, Zerconidae and a few minor groups. The Finnish 'PUTTE-Project' (Research Program of Deficiently Known and Threatened Forest Species), supported by the Ministry of Environment in 2003–2007 (Juslén et al., 2008), rendered possible a comprehensive basic analysis of the soil fauna (Acarina, Collembola and Enchytraeidae) of Finland. In the possession of the Zoological Museum of Turku University there is a wide collection of Mesostigmata, mainly collected by Dr. Pekka T. Lehtinen in the early 1980's. Since then, the material has been waiting for identification, which became possible in the framework of the above mentioned program. Uropodina and Zerconidae from the same material were identified to species by P.T. Lehtinen and deposited at the museum, but, with the exception of the ant-nest communities, the data have not been published.

This paper reports the new species of Gamasina found in the Finnish material, except Zerconidae and Phytoseiidae. The new species belong to different subgroups: five species belong to Eviphidides: Dermanyssoidea, two species to Eviphidides: Phytoseioidea, and four species to Eugamasides: Rhodacaroidea. Identification keys are given to clarify the taxonomic position of the new species among the previously known species.

2. Material and methods

A systematic sampling was carried out in 15 different habitat and microhabitat types and 10 sampling areas with geographical coverage of Finland (Huhta et al., 2010). In addition, a separate sampling was carried out in four old-growth forests in southern Finland from dead wood (stumps or fallen trunks), under dead wood and soil apart from dead wood. All adult and easily identifiable deutonymphs were identified, in all comprising about 15000 specimens. The material deposited in the Zoological Museum of Turku was studied selectively, concentrating on habitats or microhabitats from which new species were expected.

Type localities and materials: The numbers after the locality names refer to the universal grid system used by natural history museums in Finland. The type specimens are stored at three museums in Finland and Germany: Zoological Museum, University of Helsinki, Finland (MusZHki); Zoological Museum, University of Turku, Finland (MusZTku); Senckenberg Museum für Naturkunde Görlitz, Germany (SMNG). If not otherwise mentioned, the material was collected by V. Huhta and his co-workers. PTL = Pekka T. Lehtinen.

The setal nomenclature is according to Christian & Karg (2008).

3. Dermanyssoidea Kolenati, 1859: family Hypoaspididae Vitzthum, 1941

Five new species belong to two families of Dermanyssoidea: Hypoaspididae Vitzthum, 1941, and Laelapidae Trägardh, 1908. Four new species belonging to Hypoaspididae are members of the large and widely distributed genus *Hypoaspis* (*s. lat.*) Canestrini, 1885, which was divided by Karg (1993a) into the subgenera *Hypoaspis s. str.*, *Alloparasitus*, *Cosmolaelaps*, *Pneumolaelaps*, *Geolaelaps*, *Holostaspis* and *Laelaspis*. The new species are placed into the subgenera *Alloparasitus*, *Cosmolaelaps* and *Pneumolaelaps*.

3.1. *Hypoaspis* (*Alloparasitus*) *pratensis* n. sp.

3.1.1. Differential diagnosis

Based on the shape of the tectum (deeply dentate), hypostomal denticulation (polydont), expanded genital shield, and simple dorsal setae, this new species should be placed in the subgenus *Alloparasitus* Berlese, 1920. Its position is between the species *Hypoaspis* (*Alloparasitus*) *oblonga* (Halbert, 1915) and *Hypoaspis* (*Alloparasitus*) *sardoa* (Berlese, 1911). The genital shield and inguinalia resemble those of *H. oblonga*, and the peritrematalia those of *H. sardoa*. *H. pratensis* has only simple setae on leg II (female), whereas *H. sardoa* bears conspicuous stout setae on femur, genu and tibia. Characteristic of the new species are the widely expanded genital shield, yet bearing only one pair of setae, broad anal shield with a relatively large anus, caudally pointed peritrematal shields (cf. *H. oblonga*) and thin, smooth dorsal setae (only i1 and Z5 are slightly stouter and shorter).

3.1.2. Description

Female: Length of dorsal shield 570 (550-600) µm, width 360 (350-390) µm. Structural pattern in the shoulder and postdorsal regions and central parts of prodorsum. All dorsal setae thin, smooth and roughly of the same length, only i1 and Z5 are slightly shorter and thicker (Fig. 1A). Length of setae i2 = 40 µm, almost reaching the bases of i3; setae i4 = 37 µm, half of the distance i4-i5; I1, I2, I3 and I4 = 42 to 43 µm, Z5 = 30 µm. Unpaired extra I-setae are present (arrows in Fig. 1A). The central dorsal setae, when viewed in proper angle, show a slight basal protuberance, as in several species in the subgenus *Cosmolaelaps* (Fig. 1C). Tectum strongly convex, with long and thin teeth (Fig 1D). Sternum broader than long (150 x 120 µm), with structural pattern in lateral and anterior areas. Genital shield strongly expanded behind coxae 4 (170 µm at the broadest point), but only the genital setae are located on the shield (Fig. 1B). Anal shield broader than long (100 x 75 µm), anus 30 µm. Peritrematal shields attenuated posteriorly. Ventral setae simple and about the same length (Vz4 = 35 µm). Distal ends of peritremes reach the midway between setae s1 and r1. Leg I bears two stout, pointed setae on trochanter and two on femur (Fig. 1E). All setae on leg II are simple. Chelicera: the movable digit has two strong teeth, the basal tooth twice the size of the distal one (Fig. 1F).

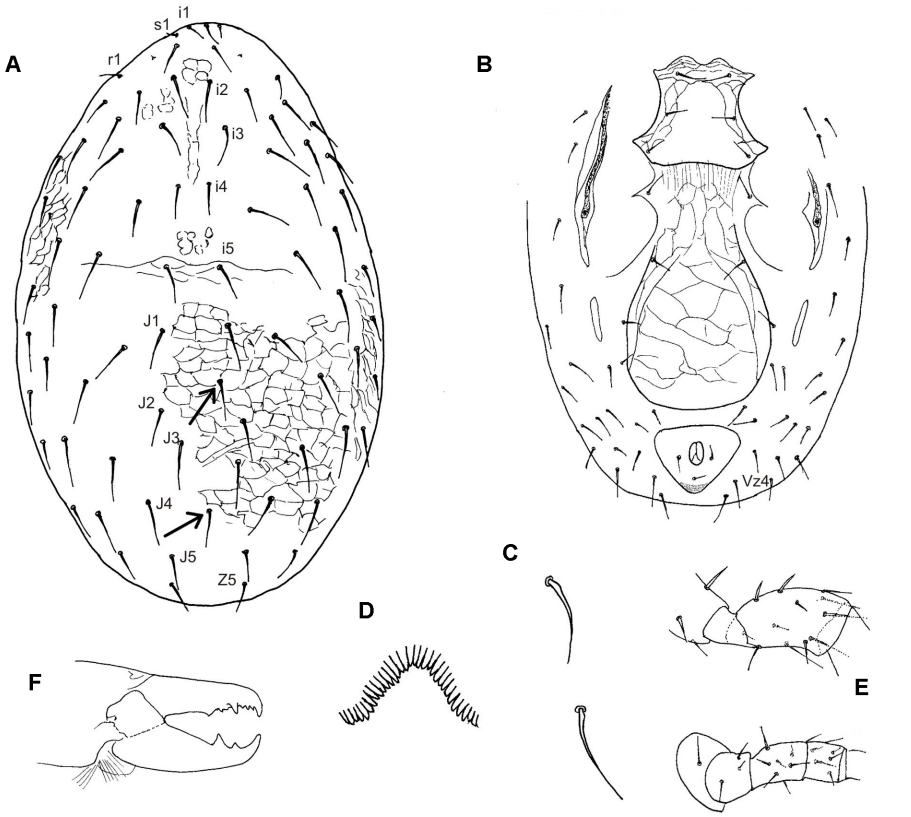

Fig. 1 *Hypoaspis (Alloparasitus) pratensis* n. sp., female. A: dorsal, B: ventral, C: dorsal seate i3 and i4, D: tectum, E: legs 1 (dorsal) and 2 (ventral), F: chelicere (D: Pyhtää, 20 June 2004, F: Valassaaret, 30 Aug. 2007 (D and F from paratypes, others from holotype).

3.1.3. Type locality and material

Holotype and paratypes, 4 females (on the same slide): Sipoo, 20 km east of Helsinki (6702:3403), dry, rocky meadow, 31 May 2004 (MusZHki). Paratype, 1 female, same date and locality (SMNG). 3 females, Pyhtää, Baltic coast 150 km east of Finland (6709:3488), dry meadow under grazing, 20 June 2004 (MusZTku). 1 female, Maalahti, 10 south of Vaasa (6702:3403), dry meadow, 11 Sept. 2004 (MusZHki). 3 females, Valassaaret (island outside Vaasa, 7050:3204), dry meadow, 30 Aug. 2007 (MusZHki).

Etymology: The species name '*pratensis*' refers to the habitat type: all records come from dry grasslands (*lat. pratum* = meadow).

3.1.4. Taxonomy of the subgenus *Alloparasitus* Berlese, 1920

Diagnosis: Margin of the tectum serrate, hypognathal rows with more than 6 teeth, female genital shield enlarged, mostly with more than one pair of setae, dorsal setae smooth and with no remarkable differences in length, leg I or leg II of ♀ mostly with some thorn-like setae. - So far 7 species are known (Karg 1979). The differential characteristics are arranged into a key as follows:

Key of the known and new species of *Hypoaspis* (*Alloparasitus*):

1 (2) Genital shield not broader than anal shield, leg II ♀ with thorn-like setae:..... ..... *H. subterranea* (Willmann, 1952) – Europe.

2 (1) Genital shield enlarged, broader than anal shield

3 (4) Peritrematal shield prolonged and broadened behind coxae IV:..... .....*H. oblonga* (Halbert, 1915) – Europe.

4 (3) Peritrematal shield not prolonged behind coxae IV

5(12) Femur of leg II ♀ with a thorn-like seta

6(11) Dorsal setae relatively long, for example setae I1 and I2 as long as or longer than the distance to the next seta in the line

7 (8) Genital shield extremely broad, broader than long and with 3 pairs of setae:..... .....*H. eugenitalis* Karg, 1978 – South America

8 (7) Genital shield distinctly longer than wide

9(10) Genital shield with 2 pairs of setae, femur II ♀ with a thumb-like thorn, genu II and tibia II with two thorn-like setae: ..... *H. sardoa* (Berlese, 1911) – Europe.

10 (9) Genital shield with 3 pairs of setae, only femur II ♀ with one thorn-like seta:..... ..... *H. femorata* Karg, 1978 – South America

11 (6) Dorsal setae short, I1 and I2 shorter than the distance to the next seta in the line, genital shield with 3 pairs of setae, femur II ♀ with a strong thorn:..... .....*H. tribina Karg*, 1979 – South America

12 (5) Femur of leg II ♀ without a thorn-like seta

13(14) Genital shield extremely broad, nearly as wide as long and with 3 pairs of setae, dorsal setae short, not reaching the next setae in the series, no unpaired extra I-setae: ..... *H. pygnosis* Karg, 1979 – South America.

14(13) Genital shield little broadened and only with one pair of setae, dorsal setae longer, several setae reaching the next seta in the series, unpaired extra I-setae present, leg I ♀ with two stout, pointed setae on trochanter and two on femur: .....***H. pratensis* n. sp.** – Europe.

3.2. *Hypoaspis* (*Cosmolaelaps*) *michaeli* n. sp.

3.2.1. Differential diagnosis

Characteristic to this new species are the leaf-like dorsal setae that place it in the *cuneifer*-group of the subgenus *Cosmolaelaps* Berlese, 1903. The leaf-like setae have clear basal protuberances, and their mid-ribs have small pointed tips extending outside the margin of seta. The ventral setae are simple, anal shield is shorter than the sternum, and legs I and IV shorter than the idiosoma. The genital shield is caudally drop-like, the anus is large. The shape of the setae places the species close to *Hypoaspis longicostalis* Karg, 1978. However, the latter species has no basal protuberances in the dorsal setae, legs I and IV are longer than idiosoma, the genital shield has lateral swellings caudally, and the anus is only 1/6 the length of anal shield.

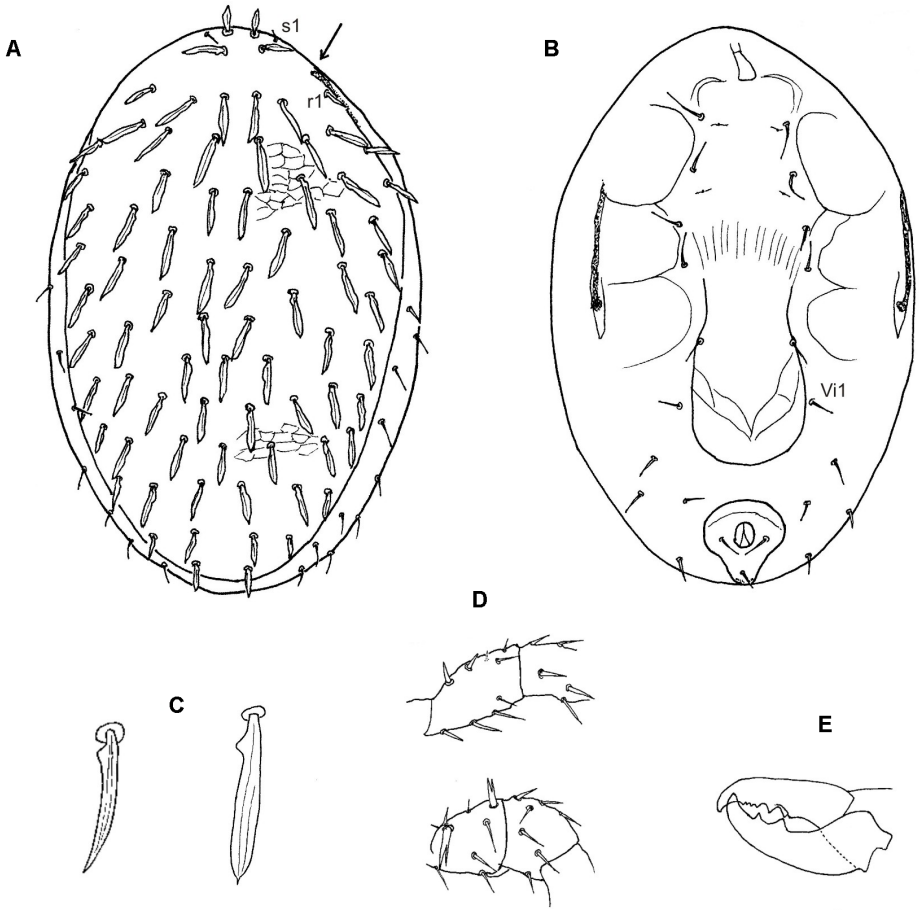

Fig. 2 *Hypoaspis* (*Cosmolaelaps*) *michaeli* n. sp., female. A: dorsal, B: ventral, C: dorsal setae z1 and z4, D: legs 1 and 2, E: chelicera (E: paratype, others from holotype).

3.2.2. Description

Female: Length of idiosoma 400 (370–410) µm, width 250 (230–260) µm. Weak structural pattern in the central parts of prodorsum and postdorsum (Fig. 2A). All dorsal setae except s1 are leaf-like and about the same length (32–35 µm), each pair extending to the base of the next pair. They have a clear basal protuberance and a mid-rib that ends in a tiny spine extending outside the setal margin (Fig. 2C). The ventral shields are weakly sclerotized. The genital shield has a drop-like shape, broadest (75 µm) between setae Vi1. Anal shield as long as broad (60 µm), with concave posterior margins (Fig. 2B). Peritrematal shields have pointed hind ends; anterior ends of peritremata in front of setae r1 (arrow in Fig. 2A). Leg I = 350 µm. Leg I has several thick setae in femur and genu, in particular the proximal dorsal seta of femur. Femur II bears two stout, bifid dorsal setae, other setae are normal (Fig. 2D). The chelicerae have two strong teeth on the movable digit, four small and two larger teeth on the fixed digit (Fig. 2E). Corniculi and chelicerae are of normal length (25 and 35 µm, respectively).

3.2.3. Type locality and material

All specimens come from one sample: Nauvo, Seili, southwestern archipelago of Finland, nest of Tetramorium sp., 19 Aug. 1984, leg. M. Saaristo. Holotype and paratype, 2 females, MusZTku; 3 females, SMNG; 2 females, MusZHki.

Etymology: The species is named in honour of the Finnish arachnologist Michael Saaristo (1938-2008), who collected the only specimens hitherto known.

3.2.4. Taxonomy of the subgenus *Cosmolaelaps* Berlese, 1903

Diagnosis: Dorsal setae of particular form: leaf-like, spatulate, clavate or lancet-like, tectum with a serrate margin, hypognathal rows with more than 6 teeth, digitus mobilis of chelicerae ♀ with two teeth, spermadactyl ♂ like a finger. Karg (1981) divided the subgenus into 3 species groups. The diagnostic features can be arranged in a key:

1 (2) Dorsal setae leaf-like, plumose, with a conspicuous middle rib or distally dentate: .....*Hypoaspis* (*Cosmolaelaps*) *cuneifer*-group
2 (1) Dorsal setae not very strongly expanded, more spatulate, clavate or lancet-like
3 (4) Dorsal setae spatulate or clavate: .....*Hypoaspis* (*Cosmolaelaps*) *claviger*-group
4 (3) Dorsal setae slender, lancet-like or scimitar-like, mostly with a small basal protuberance: .....*Hypoaspis* (*Cosmolaelaps*) *nasoseta*-group

Karg (1988) recorded 13 species of the *H. cuneifer*-group. One new species was detected from the Galapagos-Archipelago (Karg 1993b), and two new species were described from China (Bai & Gui, 1993; and Ma, 2007). Within the group we distinguish species having a dentate margin in the dorsal setae and species having a smooth margin but a conspicuous middle rib. The new species from Finland belongs to the latter group. The diagnostic features of the species in this group are:

- *H. fusca* Berlese, 1917; tectum with a longer middle tip
- *H. cardiophora* Berlese, 1917; tectum with an extremely long tip, 10 x as long as the other teeth
- *H. scimita* (Womersley, 1956); tectum with a very long middle tip, genital shield strongly broadened
- *H. bengalensis* Bhattachryya, 1968; setae with a middle rib and lateral ribs
- *H. ornatissima* Aswegen & Loots, 1970; pre-endopodal shields remarkably large

- *H. elsi* Aswegen & Loots, 1970; ventral setae leaf-like, similar to the dorsal setae
- *H. longicostalis* Karg, 1978; genital shield ♀ caudal with 3 corners, lateral and ventral interscutal setae leaf-like
- *H. wangae* Bai & Gu, 1993; genital shield ♀ rectangular, nearly 3 x as long as wide
- *H. antennata* Karg, 1993; tectum with a longer middle tip, lateral and ventral interscutal setae leaf-like
- ***H. michaeli* n. sp.**; leaf-like dorsal setae with a basal protuberance

3.3. *Hypoaspis* (*Pneumolaelaps*) *saana* n. sp.

3.3.1. Differential diagnosis

Dorsal setae short (i4 = 1/3 of distance between i4-i5), unpaired dorsal setae present, fixed digit of chelicerae with three teeth. These characters place *Hypoaspis saana* close to *H. minutissima* Evans & Till, 1966, and *H. lubricoides* Karg, 1971. The main differential characters of the new species are its strongly expanded genital shield (140 µm) and very broad anal shield (broader than long). In *H. minutissima* the genital shield is less dilated, and the anal shield is longer than broad; in *H. lubricoides* the genital shield is narrow, and the anal

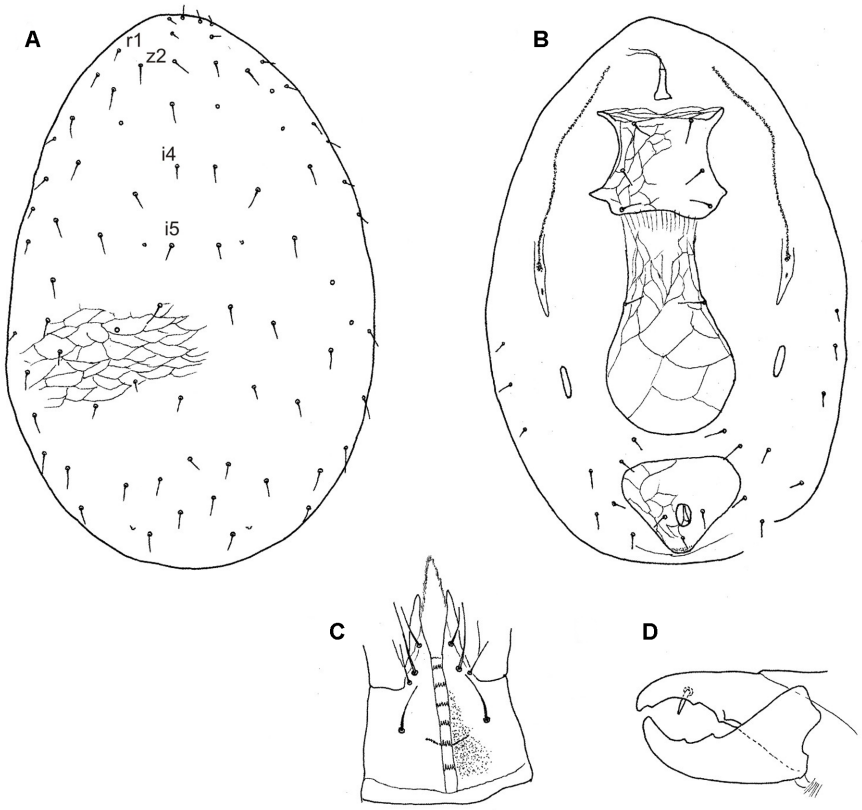

Fig. 3 *Hypoaspis (Pneumolaelaps) saana* n. sp., female. A: dorsal, B: ventral, C: hypostome, D: chelicera (A from holotype, others from paratypes).

shield is as long as broad. Moreover, the latter two species are smaller (490 and 480–510 µm, respectively) than *H. lubricoides*.

3.3.2. Description

Female: Length of idiosoma 520–555 µm, width 350–360 µm. Dorsal setae short: i4 = 28 µm, or ca. 1/3 of distance between i4-i5 (77 µm). 4 to 5 unpaired setae present on the postdorsum (Fig. 3A). Structural pattern on the anterior field of postdorsum, less distinct in the shoulder, frontal and posterior areas. Ventral shields with reticulate pattern, presternal area with indistinct transverse structure (Fig. 3B). Genital shield strongly expanded behind coxae IV, 140 µm at the broadest point. Anal shield wide, broader than long (120 x 90 µm). Peritremes extend to the level of r1-z2. Legs: all setae simple. Hypostome: basal-medial area faintly granular, corniculi slender (Fig. 3C). Cheliceral fixed digit with 3 small teeth, movable digit with two shallow teeth (Fig. 3D).

3.3.3. Type locality and material

All specimens were collected in Enontekiö, on the fell (mountain) Saana at the north-western corner of Lapland, 8 Oct. 2008. Holotype and paratypes, 3 females, subarctic mountain birch stand (7675:3253) (MusZHki); paratypes, 2 females, (SMNG); 2 females, 2 km SE from the former, mountain birch (7671:3255) (MusZTku);1 female, mountain grassland (7671:3255) (MusZHki).

Etymology: We name the species for the Saana fell, one of the most famous mountains in Finnish Lapland.

3.4. *Hypoaspis* (*Pneumolaelaps*) *collina* n. sp.

3.4.1. History and differential diagnosis

The species *Hypoaspis* (*Pneumolaelaps*) *montana* (Berlese, 1904) was redescribed by Evans & Till (1966), and their figures were copied in the keys of Bregetova et al. (1977) and Karg (1993a, Fig. 111). However, Karg (1979, 1993a, Fig. 113) also presented another variety of the species, with longer dorsal setae. The difference was regarded as a consequence of geographical variation. The material collected from Finland revealed that (1) both varieties occur, and (2) there are no intermediate forms, only those with short and those with long setae. Most of those with short setae were collected from ant hills, and those with long setae from organic residues, but both forms were also found in "each other's" habitats, even in the same sample. We therefore conclude that both varieties should be regarded as good species. We leave the name '*montana*' to be used for the short-haired variety living mainly in ant nests, and describe the long-haired one as a new species. The principal difference between them is the length of dorsal setae, which reach the bases of the next following pair of setae in *H. collina*, but are only half that long in *H. montana* (Fig. 4).

3.4.2. Description

Female: Lenth of diosoma 490 (460–500) µm, width 325 (290–320) µm (same size as *H. montana*). Dorsal setae 38–42 µm, each pair reaching the basis of the next following pair (17–20 µm in *H. montana*). Number of unpaired I-setae varies from 1 to 3 (zero to 2 in *H. montana*). Z5 are longer than the other setae (60 µm; same as in *H. montana*). Weak structural pattern in the lateral areas of prodorsum (Fig. 4B). (*H. montana* has weak rounded ornamentations in the dorsum; Fig. 4A). Sternum, genital shield and anal shield similar to those of *H. montana* (there is variation in both species; Fig. 4). The ventral setae are also

shorter in *H. collina* than in *H. montana*: setae Vz4 = 55–60 µm (45–50 µm or about half the length of anal shield in *H. montana*). Legs and chelicerae as in *H. montana*.

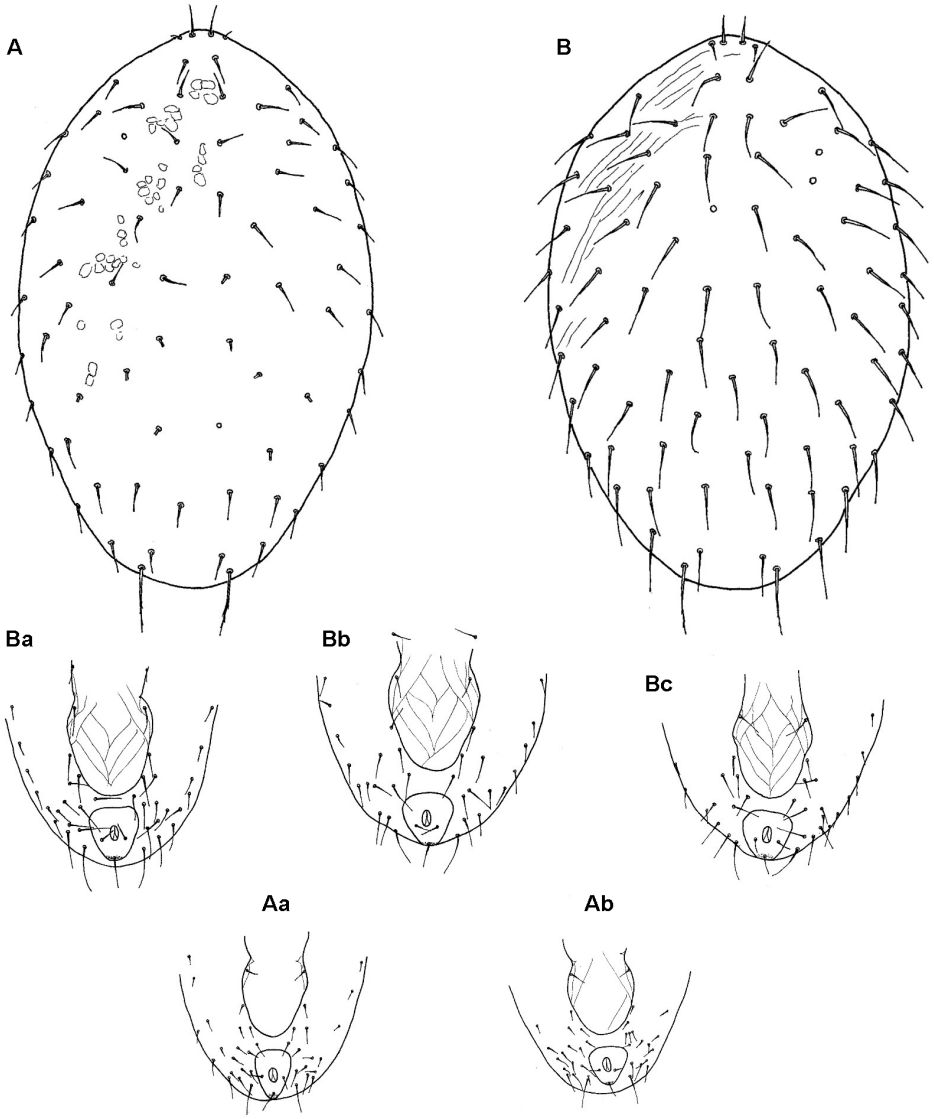

Fig. 4 A: *Hypoaspis* (*Pneumolaelaps*) *montana* (Berlese, 1904), B: *H. collina* n. sp., females dorsally; Aa-b: ventral sides of *H. montana*, Ba-c: ventral sides of *H. collina*.

3.4.3. Localities and material

Holotype, female, Hailuoto (island outside Oulu; 7218:3383), compost of garbage and garden residues, 14 Oct. 2004 (MusZHki); 1 female, Kuusamo, Ruka (734:353), Lasius nest

under stones, 2 Aug. 1982 (PTL) (SMNG); 4 females, 1 male and 2 deutonymphs, Kuusamo, Kallunki, bottom of firewood pile, 2 Aug. 1982 (PTL) (MuzZTku).

Etymology: We have named the new species as *H. collina* (*lat. collinus* = living on hills), not referring to habitat, but to emphasize its similarity with the 'old' species *H. montana*.

4. Dermanyssoidea Kolenati, 1859: family Laelapidae Trägårdh, 1908

A new species of *Androlaelaps* was established from an earlier status of subspecies. The genus *Androlaelaps* belongs to the family Laelapidae, mainly comprising species which are found on rodents and other small mammals.

4.1. *Androlaelaps myrmecophila* (Evans & Till, 1966), new status

4.1.1. History and diagnosis.

Female: Evans & Till (1966) described the subspecies *myrmecophila* of *Androlaelaps casalis* (Berlese, 1887). They noted their different size (length of idiosoma 620–710 µm for *A. c. casalis* and 504 µm for *A. c. myrmecophila*), as well as dissimilarities in their habitat preferences: bird nests etc. for *A. c. casalis* and ant nests (*Formica rufa*) for *A. c. myrmecophila*.

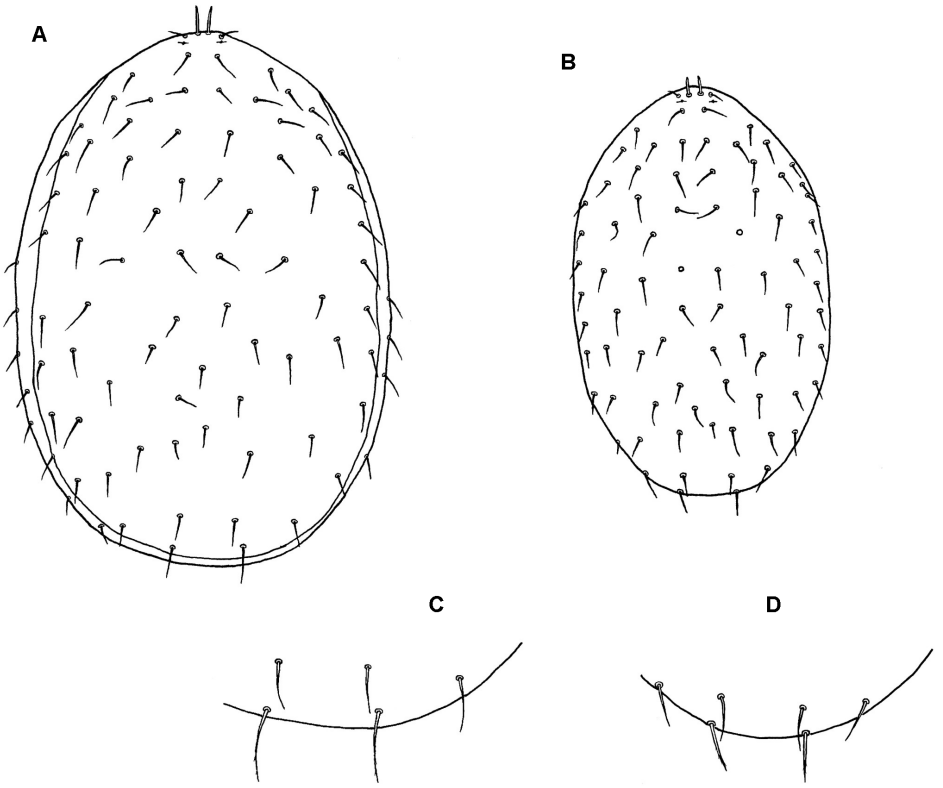

Fig. 5 Androlaelaps casalis (Berlese, 1887) (A) and A. myrmecophila (Evans & Till, 1966) (B) in the same scale. C and D: posterior dorsal setae l5, Z5 and S5, respectively.

The present material from Finland includes numerous samples of *A. c. casalis* from different habitats and microhabitats, bird nests in particular but also from ant nests, and a few samples of *A. c. myrmecophila*, most of them from ant nests. As the habitat records of these two forms are different, and there is no overlap between their body sizes, we conclude that *A. c. myrmecophila* should be described as a full species. The two species are very similar in most respects, the only obvious differential character being the body size (Fig. 5A,B) and lengths of posterior dorsal setae I5, Z5 and S5. The idiosoma of *A. casalis* varies between 650 and 750 µm, and that of *A. myrmecophila* between 500 and 550 µm. In *A. casalis* the setae Z5 are 60–70 µm = 1.3 x I5, and in *A. myrmecophila* 33–40 µm = 1.3 x I5. Setae Z5 are also normally stouter than I5 in *A. myrmecophila*, while in *A. casalis* they have almost equal thickness (Fig. 5C,D), but specimens with thin Z5 were found in northern Finland.

4.1.2. Material of *A. myrmecophila*

1 female, Muhos, east of Oulu (7203:3452), rotten wood; 5 females, Korsholm, near Vaasa (7022:3236), ant hill (*Formica* s. lat.); 42 females, Kolari, Kolarinsaari (western Lapland, 7475:3361), ant hill; Korppoo (SW archipelago), *Formica pratensis* nest.

5. Phytoseioidea Karg, 1965: family Ameroseiidae Evans, 1963

5.1. Taxonomy

We know 4 families of the Phytoseioidea: Phytoseiidae, Podocinidae, Ameroseiidae and Epicriidae. The Ameroseiidae were revised by Karg (2005). Ten genera are included to the family. The highest numbers of species are found in the genera *Ameroseius* Berlese, 1903 and *Proctolaelaps* Berlese, 1923.

Karg (2005) divided the Ameroseiidae to two groups: one group with females having two pairs of setae on the sternal shield, as in the genus *Ameroseius*, and another group with females having three pairs of sternal setae, as in the genus *Proctolaelaps*. The genus *Sinoseius* has an intermediate position, the sternal shield as in *Proctolaelaps*, but the dorsal setation as in *Ameroseius*. Within the species with three pairs of sternal setae, the genus *Mycolaelaps* Lindquist, 1995 shows the same reduced dorsal setation as in *Sinoseius*. However, the setae of *Mycolaelap* are short, simple needles.

The present investigation yields two new species of Ameroseiidae, belonging to the genera *Sinoseius* Bai et Gu, 1995 and *Ameroseius* Berlese, 1903. The leg chaetotaxy of the new species was investigated with particular reference to the setation of genu IV. It represents the IX-type in agreement with Evans (1963) and Karg (2005). Karg (2005) first regarded *Sinoseius* as a synonym of *Ameroseius* and the type species *Sinoseius lobatus* Bai et Gu, 1995 as an aberration within the genus *Ameroseius*. All previously known females of *Ameroseius* spp. exhibit only two pairs of setae on the sternal shield. However, *Sinoseius lobatus* and one of our new species show three pairs. Detailed inspection reveals further common characteristics to the two species from Finland and China, but different from those of all other species of *Ameroseius*. Therefore, *Sinoseius* should be accepted as a separate genus.

5.2. *Sinoseius pinnatus* n. sp.

5.2.1. Differential diagnosis

Characteristic to this new species and the genus *Sinoseius* are the feather-like, deeply dentate dorsal setae. Such dorsal setae are found in no other genus of Ameroseiidae, this hair

form representing a taxonomically relevant autapomorphy. The dorsum is covered with large depressions. Tectum is a smooth bow, corniculi with 3 warts, digitus fixus with 3 big teeth, legs I with claws and anal shield with 1 pair of setae. To distinguish the two species of the genus the following characters can be given:

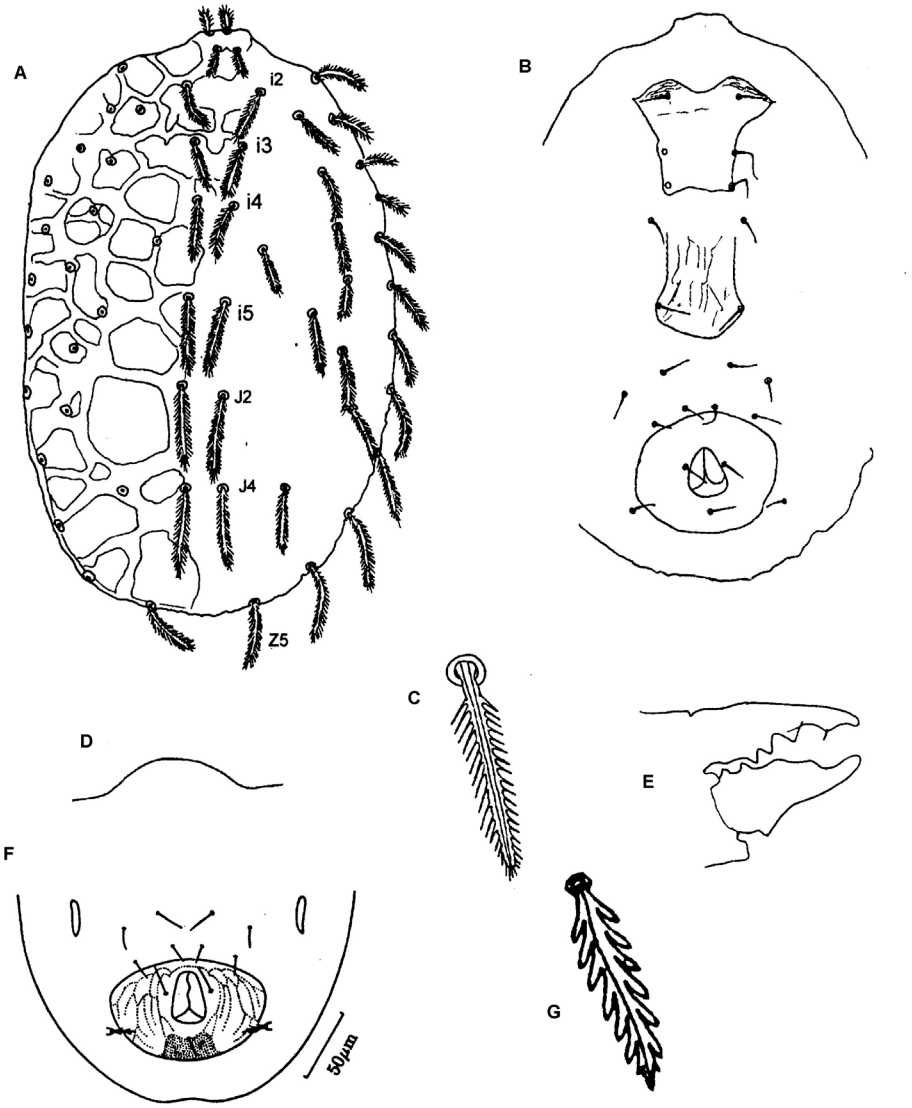

Fig. 6 *Sinoseius pinnatus* n. sp., female, A: dorsal, B: ventral, C: dorsal seta, D: tectum, E: chelicera (A–C: holotype, D–E: paratypes); *Sinoseius lobatus*, F: ventral, G: dorsal seta (after Bai & Gu, 1995).

- *Sinoseius lobatus*: Dorsal setae remarkably long: i4 = distance i4 – i5, i5 longer than i5 – I2, teeth of setae strong (Fig. 6G), anal shield distinctly wider than long, length: width = 2:3 (Fig. 6F), corniculi distally with 2 processes.
- *Sinoseius pinnatus*: Dorsal setae moderate: i4 = 2/3 distance i4 – i5, i5 shorter than i5 – I2 (Fig. 6A), teeth of setae very thin (Fig. 6C), anal shield only a little wider than long (Fig. 6B), corniculi distally with 3 elongations.

5.2.2. Description

Female: Length of idiosoma 390 (365–410) µm, width 255 (235–280) µm. Dorsum covered with depressions, of which the largest occur in the medial and posterior areas (Fig. 6A). The dorsal setae are all roughly of the same length, i2 and i3 ca. 40 µm, i5 and I5 ca. 55 µm, each of these pairs nearly reaching the bases of the next posterior pair. The setae are feather-like, densely equipped with long teeth on both sides (Fig. 6C).

Tectum is a simple, smooth bow (Fig. 6D). Sternal shield wide anteriorly, faint transverse striation in front of setae st1 (Fig. 6B). Anal shield rounded, broader (100 µm) than long. Cheliceral fixed digit with 3 large teeth, movable digit with two small teeth basally (Fig. 6E).

5.2.3. Type locality and material

All but one specimens are from one sample: Parainen, Sunnaberg (southwest Finland), bottom of straw shed, 10 Oct. 1982 (PTL). Holotype, female, and paratypes, 8 females, MusZTku; paratype, 1 female, SMNG; paratypes, 4 females, MusZHki. 1 female: Pöytyä, Himainen (southwest Finland), grass in garden of old farm, 10 Apr. 1983 (PTL), SMNG.

Etymology: The species is named *S. pinnatus* because of its feather-like dorsal setae (*lat. pinna* = feather).

5.3. *Ameroseius lehtineni* n. sp.

5.3.1. Differential diagnosis

Dorsal shield with a network of depressions, the ridges between them with small warts. Dorsal setae leaf-like, serrate. The anterior margin of dorsum with tooth-like protuberances. Tectum prolonged into one apex, anal shield with one pair of setae, leg I with claws, cheliceral digitus fixus with 3 big teeth. With these characters, the new species resembles *A. macrochelae* Westerboer, 1963, but the latter has depressions only in the anterior part of dorsum, no warts on the ridges, and no protuberances on the anterior margin.

5.3.2. Description

Female: Idiosoma 340 x 240 µm. Dorsal shield covered with depressions; rows of small rounded warts along the ridges between the depressions (Fig. 7A); warts also around the shield margins. Anterior margin of dorsum provided with tooth-like protuberances, the largest of them on both sides of i1. All dorsal setae long, leaflike, with longitudinal rows of small teeth (Fig. 7B). Length of setae i2 and i3 = 35 µm, i5 and I2 = 55 µm, each of these extending to the bases of the next following pair. Anal shield 110 µm broad, broader than long, with only one pair of setae (Fig. 7C). Two transverse rows of 4 setae in front of the anal shield, and one pair outside the hind margin.

5.3.3. Type locality and material

Only one female, Kuusisto, Ylitalo, old pile of sawdust under barn, 6 May 1983 (PTL) (MusZTku).

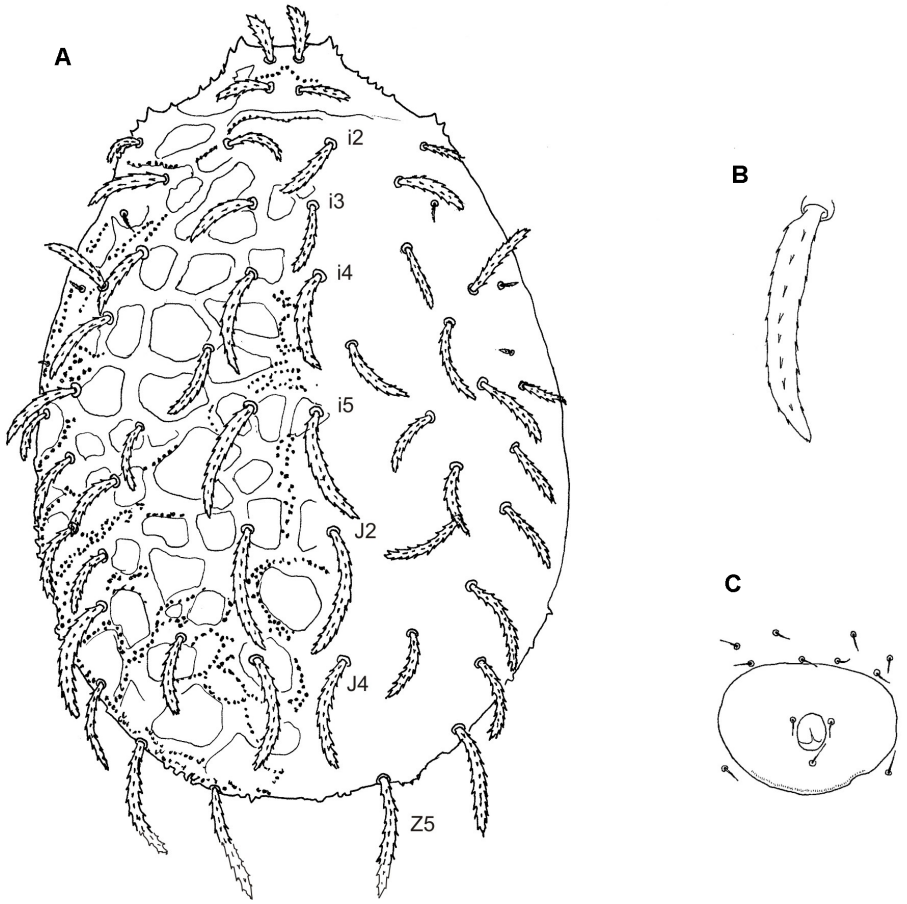

Fig. 7 *Ameroseius lehtineni* n. sp., female, holotype. A: dorsum, B: dorsal seta, C: ventrianal shield.

Etymology: The species is named after the well known Finnish arachnologist and acarologist Dr. Pekka T. Lehtinen, who collected the type specimen.

5.3.4. Taxonomy of *Ameroseius*

Karg (1993a) distinguished two groups in the genus *Ameroseius*, one having a special shape of tectum with a prolonged apex, and another having a tectum with an undifferentiated margin. The new species belongs to the first group, which we name *Ameroseius delicatus* species group. It includes the following European species:

- *A. delicatus* Berlese, 1918: Dorsal setae long, i5, I2, I4 extending to the bases of the next following pair, dentate, ventrianal shield with 3 pairs of setae
- *A. plumosus* (Oudemans, 1903): Sternal shield anteriorly with a strong chitinous bow, dorsal setae slender, leaf-like
- *A. plumigerus* (Oudemans, 1930): Dorsal shield only with a net-like pattern, setae

long, dentate, I5, I2 and I4 longer than their distances to the next following pair
- *A. gracilis* Halbert, 1923: Dorsum only with a net-like pattern, dorsal setae long, i5, I2, I4 as long as their distances to the next pair, dentate
- *A. macrochelae* Westerboer, 1963: Anterior part of the dorsum with depressions, setae shorter than their distances in the series
- *A. insignis* Bernhard, 1963: Dorsum laterally with some depressions, ventrianal shield with 2 pairs of setae
- *A. apodius* Karg, 1971: Leg I without claws
- *A. fimetorum* Karg, 1971: Dorsum with several depressions, setae i5, I2 I4 longer than their distances to the next pair, dentate, ventrianal shield with 3 pairs of setae
- *A. submagnisetosus* Ma & Lin, 2005: Dorsum with a net-like pattern only, with extremely long setae, mostly 250 to 300 µm, ventrianal shield ♀ with 2 pairs of setae
- ***A. lehtineni* n. sp.**: All the dorsal area with depressions, dorsal setae i5, I2, I4 as long as their distances to the next pair, dentate, ventrianal shield ♀ with 2 pairs of setae

6. Rhodacaroidea: family Rhodacaridae Oudemans s. Karg, 2006

The family includes 23 genera (Karg 1993a, 2000, 2003). The present investigation yielded one new species in the genus *Punctodendrolaelaps* Hirschmann & Wiśniewski, 1982 s. Karg (1993a), 2 new species in the genus *Multidendrolaelaps* Hirschmann, 1974 and one new species in the genus *Dendrolaelaps* Halbert, 1915 s. Karg (1993a).

6.1. *Punctodendrolaelaps formicarius* n. sp.

6.1.1. Differential diagnosis

The broad dental line Q6 of hypostome, two pairs of scleronoduli, and gonoporus between basi- and telofemur place this new species to the genus *Punctodendrolaelaps* (Hirschmann & Wisniewski 1982). The ventrianal shield carries the setae Vi1-3, Vi5, Vz2 and Vz3. The dorsal setae are smooth and roughly of the same length. Based on these characters, the species is close to *P. strenzkei* (Hirschmann, 1960). However, in the latter species the peritremes are shortened, only reaching the level of sternal setae st3, and postdorsal setae Z2, Z3 and Z5 are longer than the other setae. In *P. formicarius* the peritremata reach coxae II, and only Z5 are slightly longer than the other setae.

6.1.2. Description

Female: Length of idiosoma 350–360 µm, width 220–230 µm. Dorsal setae relatively long, i2 to i4 = 35 µm, I1 to I3 = 30 µm, each pair extending over the midway to the next following pair. Setae in the Z row are longer, reaching the bases of the next pair (Fig. 8A). Of the posterior dorsal setae, Z5 is slightly longer (38 µm) than the others. The postdorsum has a slight punctate pattern, and near the hind margin there is a row of small pits. The sternal shield is longer than broad, and in the presternal area there is a weak transverse line structure. The ventrianal shield is slightly longer than broad (280 x 260 µm), and has sinuous lateral margins. It carries setae Vi1, Vi2, Vi3, Vi5, Vz2 and Vz3, is slightly punctate in the posterior area, and has a reticulate pattern in the anterior area (Fig. 8B). The setae are relatively long, e.g. Vi2 reach the bases of Vi3, and Vi3 almost the bases of Vi5. The peritremes end distally at the middle of coxae II, the level of sternal setae st1. The insemination apparatus in leg III is slightly sinuous, narrower towards the distal end (Fig. 8C). Chelicerae are normal to the genus (Fig. 8D).

Male: Idiosoma 310 x 200 µm, dorsal pattern and relative lengths of setae as in the female (Fig. 8E). Leg II with protuberances normal to the genus (Fig. 8F). Chelicera with a curved embolus (Fig. 8G).

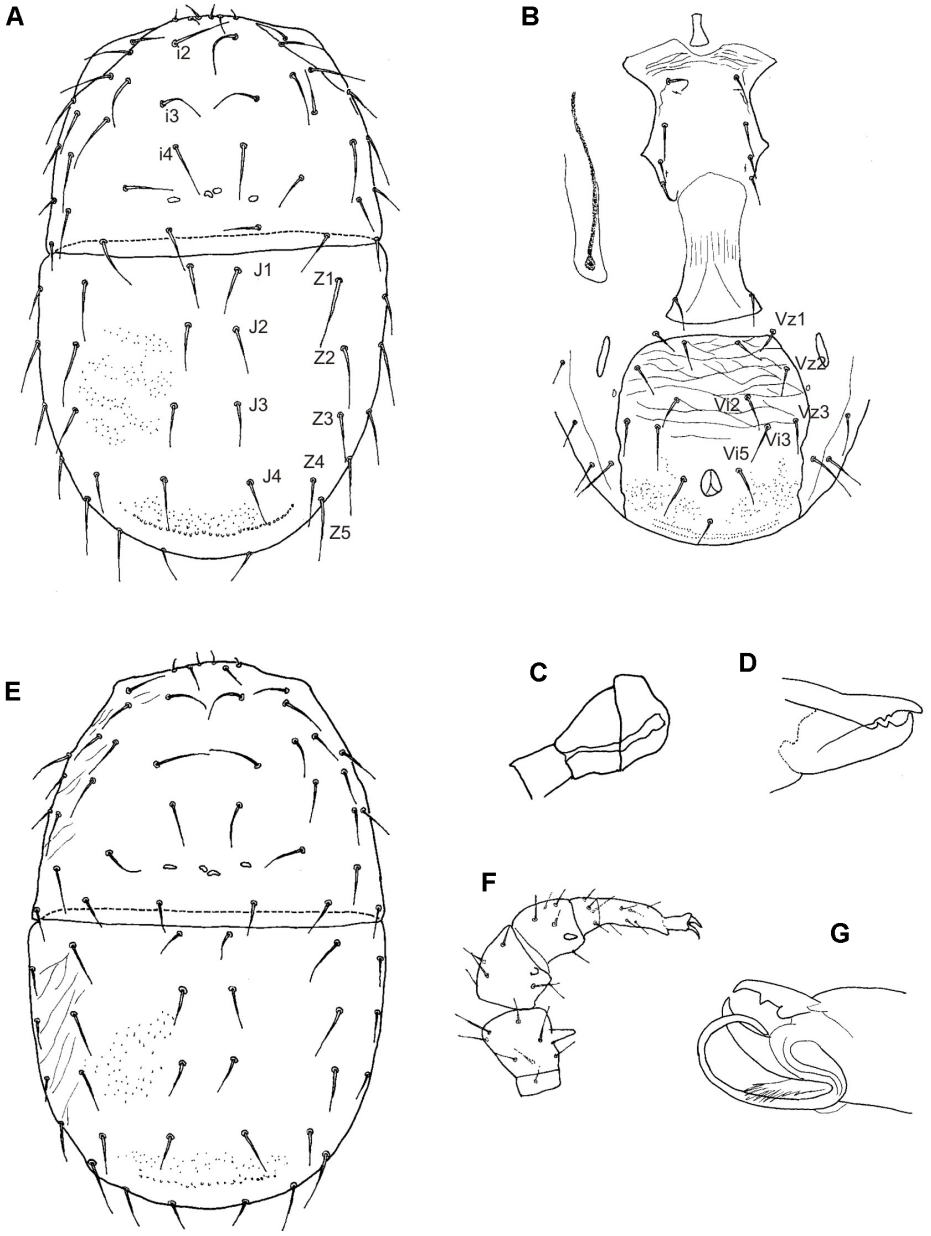

Fig. 8 *Punctodendolaelaps formicarius* n. sp., A: female, dorsal, B: ventral, C: insemination apparatus in leg III, D: chelicera, E: male, dorsal, F: leg II, G: chelicere (A and B: holotype, E–G: paratype, C: Kisko, 3 May 2005, D: Viitasaari 5 May 2005).

6.1.3. Type locality and material

Holotype, female, and paratypes 1 female and 1 male, Kisko, southwestern Finland (6679:3309), ant hill (Formica s. lat.), 3 May 2005 (MusZHki). Paratypes, 1 male and 3 females from the same sample (SMNG). 3 females, Isokyrö, east of Vaasa (6991:3259), and hill, 11 Sept. 2004 (MusZTku). 1 female, Viitasaari, central Finland (6973:3422), ant hill, 4 May 2004 (MusZHki).

Etymology: The species is named *P. formicarius*, since all specimens were collected from ant hills (*Formica rufa s. lat.*).

6.1.4. Taxonomy.

The new species belongs to a species-group related with *Punctodendrolaelaps strenzkei* (Hirschmann, 1960), having the ventrianal shield with 6 to 7 pairs of setae, and shortened peritremes.

Key for the species of the P. strenzkei-group:

1 (8) Ventrianal shield with 6 pairs of setae.....
2 (5) Ventrianal shield as long as wide .....
3 (4) Setae Z4 and I4 pilose, ventrianal shield strongly broadened anteriorly:.....
.....*P. latior* (Leitner, 1949)
4 (3) Setae Z4 and I4 smooth:.....*P. strenzkei* (Hirschmann, 1960)
5 (2) Ventrianal shield longer than wide.....
6 (7) Several caudal setae on the dorsum remarkably long, I4 = 3 x length of I3, Z4 = 3 x I3, Z5 = 4 x I3: ..... *P. strenzkeiformis* Hirschmann et Wiśniewski, 1982
7 (6) Caudal setae not remarkably longer than setae I3:..... ***P. formicarius* n. sp.**
8 (1) Ventrianal shield with 7 pairs of setae: .....*P. rotundus* (Hirschmann, 1960)

6.2. *Multidendrolaelaps putte* n. sp.

6.2.1. Differential diagnosis

The fork in palptarsal apotele with two teeth, two pairs of mediodorsal scleronoduli, gonopores in coxae III and more than 5 teeth in the movable digit of the female chelicerae place the new species in the genus *Multidendrolaelaps* Hirschmann 1974. The tectum is triramous, with the middle ramus distally split. Caudal setae Z5 and S5 are thick and greatly elongated. Considering these characters, the species is close to *M. bispinosus* (Karg, 1971). However, in the latter, setae Z4 are thorn-like, and the ventrianal shield has 4 pairs of setae, whereas in the new species setae Z4 are normal and the ventrianal shield carries 5 setal pairs.

6.2.2. Description

Female: Length of dorsal shield 520 (500–560) µm, width 280 (270–290) µm. Dorsal setae i3 to I3 = 25–30 µm, i2 and I4 = 37 µm, setae in the row z-Z somewhat longer than the i-I setae; Z3 = 60 µm (Fig. 9A). Posterior setae Z5 and S5 conspicuosly stout and long (Z5 = 160 µm, S5 = 140 µm). Scleronoduli behind the level of z4. In the anterior margin of the postdorsal shield there is an obscure U-shaped figure, not seen in all specimens. The postdorsal shield is slightly punctate behind I4, and with faint structural pattern in the area of Z3-I4. The medial end of tectum is shorter than the lateral ones, and distally split (Fig. 9C). The sternum has a central longitudinal cleavage, varying in breadth between specimens, and a transverse line behind setae st1 (Fig. 9B). The ventrianal shield carries setae Vi1, Vi2, Vi3,

Vi5 and Vz2. It has a transverse structural pattern in the anterior part, and a pitted structure posteriorly. The shield is enlarged posteriorly, and has a clearly separated lobe in the posterior-lateral margin (Fig. 9B). The peritremes are very short, only reaching the level of sternal setae st3. Legs with normal setae except for the basal dorsal seta in femur IV, which is stouter than the others. Hypostome typical for the genus (Fig. 9D). Cheliceral fixed digit with 4 large and 5 small teeth; the movable digit has a stronger basal teeth and a row of 8 smaller, equal teeth (Fig. 9D).

Male: Idiosoma 480 x 300 µm. Lengths of setae relatively the same as in the female.

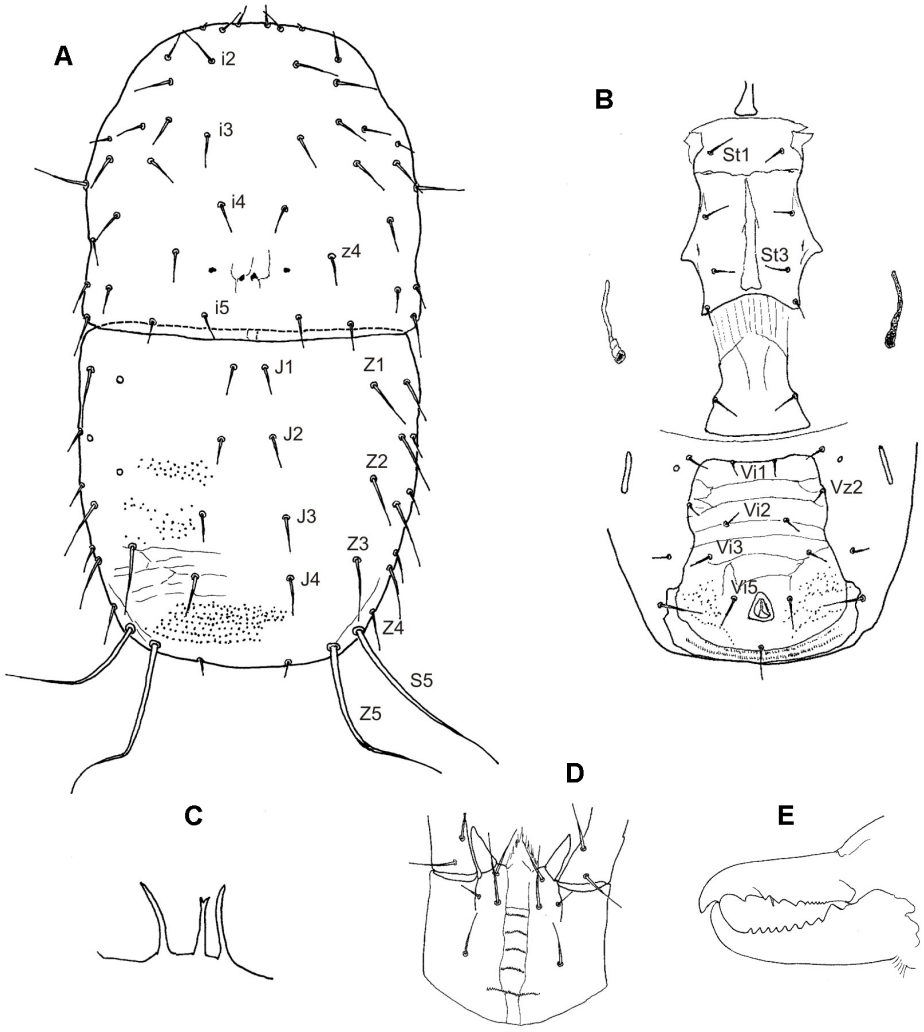

Fig. 9 *Multidendrolaelaps putte* n. sp., female. A: dorsal, B: ventral, C: tectum, D: hypostome, E: chelicere (D and E from paratype, others from holotype).

Transverse reticular pattern in the area of I4-Z4, slightly punctate behind this area (Fig. 10A). Setae Z5 and S5 stout and long, 5 µm thick near the bases. Leg II typical to the genus (Fig. 10B), setae of other legs as in the female. Cheliceral fixed digit with one large tooth, movable digit without teeth, embolus straight at the base, with the tip curved upwards (Fig. 10D).

Deutonymph: 400–440 x 220–260 µm. Similarly to the adults, the deutonymph is characterized by the strong posterior dorsal setae Z5 and S5 (Fig. 10C). The ventrianal shield is punctate laterally, and has a similar posterolateral lobe as the female (Fig. 10E).

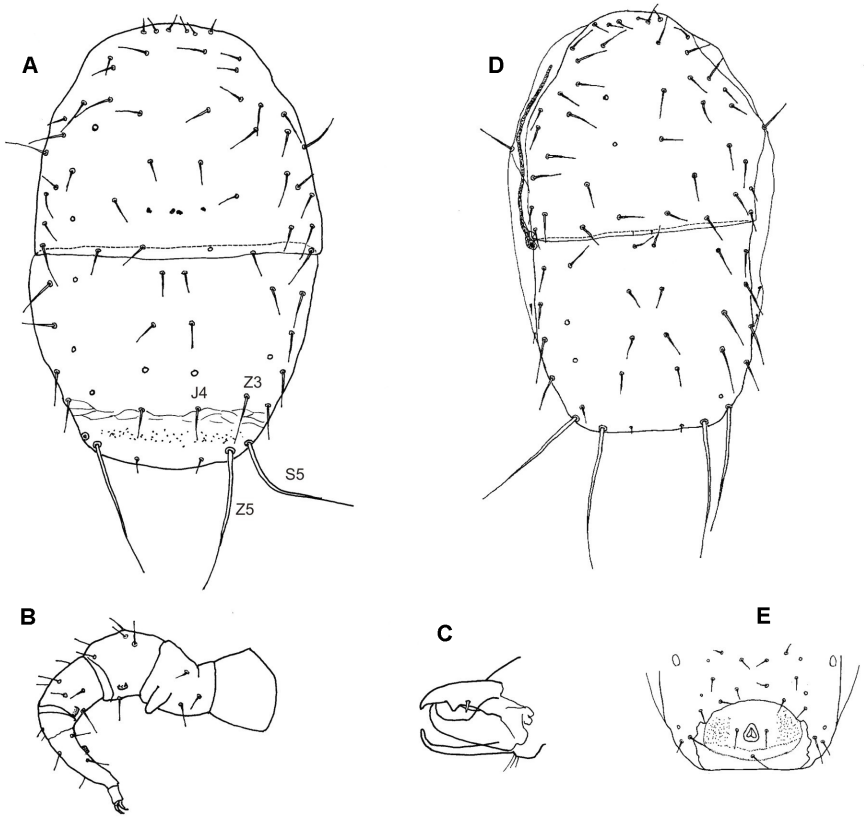

Fig. 10 *Multidendrolaelaps putte* n. sp., A: male, dorsum, B: leg II, C: chelicera, D: deutonymph, dorsum, E: posterior ventral area (all from paratypes).

6.2.3. Type locality and material

All specimens are from the same sample, Lammi, Evo (southern Finland, 6795:3395), decaying trunk of aspen, 7 Sept. 2007 (Anne Siira-Pietikäinen & M. Boucelham). Holotype and paratypes, 6 females, MusZHki; paratypes, 2 males, 5 females and 4 deutonymphs, MusZTku; paratype, 1 deutonymph, SMNG.

Etymology: We name this species as ‘M. putte’ in reference to the Finnish abbreviation of the project title ‘PUTTE’ (see Introduction), which made possible the present study.

6.3. *Multidendrolaelaps subcorticalis* n. sp.

6.3.1. Differential diagnosis

All dorsal are setae are simple, peritremes are very short, and the medial ramus of the tectum is shorter than the lateral ones. Based on its dorsal setation and short peritremes, the species can be placed close to *M. euepistomus* (Hirschmann, 1960). However, the tectum of the latter species has a long and strong medial end, and the peritremes reach to the level of st2. Dorsal setae Z3 of the new species are about 3 x i4, in *M. euepistomus* only 1.5 x i4. The new species is also much smaller than *M. euepistomus*, and its ventrianal shield is broader. Considering these characters, *M. subcorticalis* n. sp. is even more closely related to *M. putte* n.sp., described above. However, it can be distinguished by its smaller size (ca. 400 µm), the female by its weak sclerotization of the ventral shields, and the male particularly by the prominent apophyses on the coxa and femur of leg IV.

6.3.2. Description.

Female: Length of idiosoma 410 (380–410) µm, width 200 (190–200) µm. Dorsal spines relatively of the same length as in *M. putte* n.sp., i3 to I3 20 µm, i2, I4 and setae in the z-Z-row somewhat longer. Z3 = 50 µm, Z5 and S5 are strong and more than 100 µm in length (Fig. 11A). Scleronoduli posterior to the line connecting z4-z4. Hardly any structure can be seen on the front margin of postdorsal shield. Ventral shields are weakly sclerotized. The anterior and posterior margins of sternum hardly visible, faint structural lines present laterally. Ventrianal shield much longer (140 µm) than broad, broadest behind setae Vz4 (Fig. 11B), carrying setae Vi1, Vi2, Vi3, Vi5 and Vz2. Transversal lines separate a lobe in the posterior margin of the shield, which is narrower than in *M. putte* (Fig. 9B), and another, less distinct lobe in front of it. Peritremes are very short, distal ends between the level of sternal setae st3 and st4. Legs with normal setae, except the basal dorsal seta in femur IV, which is stouter than the others. Chelicerae as in *M. putte*, the fixed digit with 4 large and 5 small teeth, the movable digit has a stronger basal teeth and a row of 8 smaller, equal teeth (Fig. 11c). Tectum triramous, the medial ramus shorter and distally split.

Male: Idiosoma 380 x 200 µm. Setae relatively of the same length as in the female. Z5 and S4 5 stout and long, as in *M. putte* (Fig. 11D). Leg II: femoral apophysis with a nodule distally, and tarsus with a ventral protuberance distally (Fig. 11E). Leg IV with a conical apophysis on coxa and a thumb-like apophysis on femur (Fig. 11F). Fixed digit of chelicerae with one tooth, movable digit without teeth, embolus straight at the base, with the tip curved upwards (Fig. 11G).

6.3.3. Type locality and material

All specimens are from one sample: Parainen, Strandby (southwestern Finland), old scolytid galleries under bark of pine, 28 March 1983 (PTL). Holotype, 1 female, MusZTku; paratypes, 1 female and 1 male, SMNG, 2 females, MusZHki.

Etymology: The name *M. subcorticalis* is based on the microhabitat where the specimens were collected (*lat. cortex* = bark).

6.4. Taxonomy of *Multidendrolelaps*

Species or the genus *Multidendrolelaps* are similar to those in *Dendrolaelaps* Halbert, 1915. However, as a distinctive autapomorphy, in *Multidendrolaelaps* the digitus mobilis of the female chelicerae is equipped with a saw-like row of teeth, whereas in *Dendrolaelaps* it has the

'normal' armature of 4 teeth. Further, in most *Multidendrolaelaps*-species one to six pairs of posterior dorsal setae have been transformed into thorns. Fore example, *M. ulmi* (Hirschmann, 1960), *M. spinosus* (Hirschmann, 1960) and *M. bispinosus* (Karg, 1971) have one pair of thorn-like setae; *M. querci* (Hirschmann, 1960) two pairs, *M. tetraspinosus* (Hirschmann, 1960) 4 pairs, and *M. hexaspinosus* (Hirschmann 1960) 6 pairs. In one group of species the strengthened setae are lacking. Scherbak (1980) named this group *Multidendrolaelaps euepistomus*-group. The two new species from Finland belong to this group. We have arranged a key for this species group as follows:

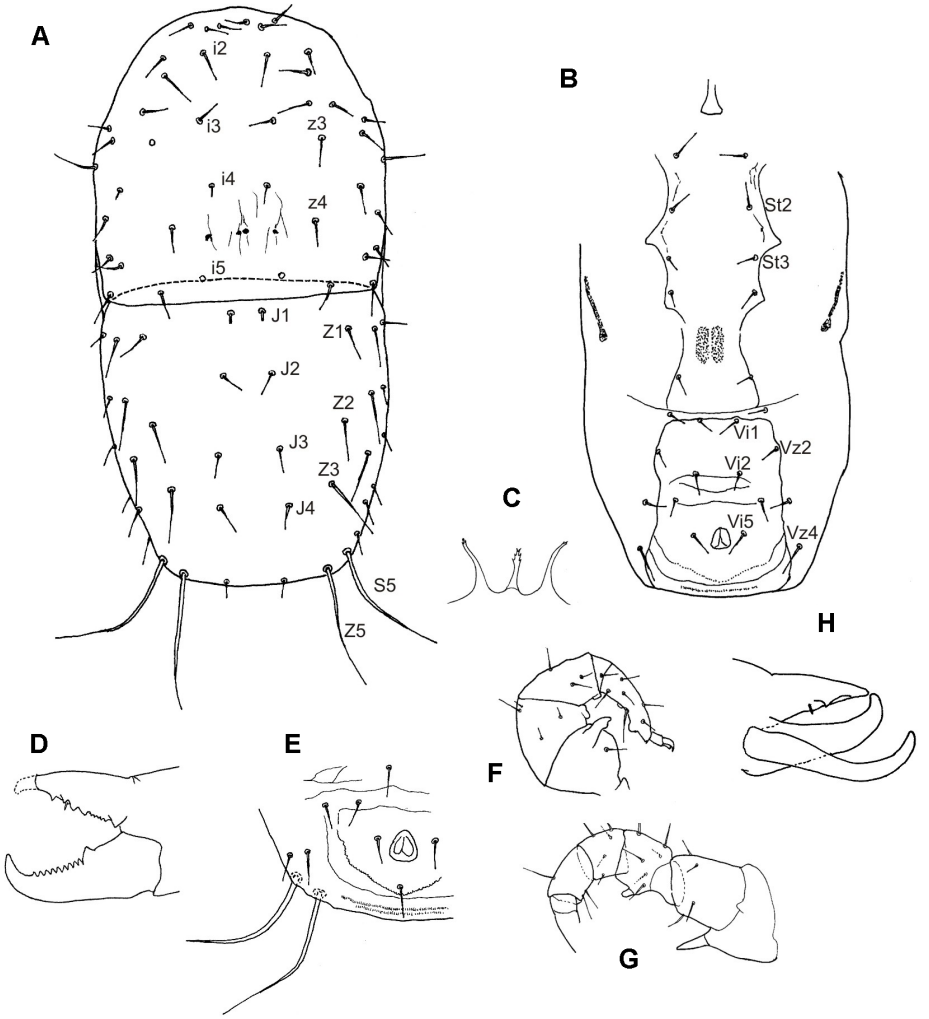

Fig. 11 *Multidendrolaelaps subcorticalis* n. sp.; Female, A: dorsal, B: ventral, C: tectum, D: chelicere. Male, E: posterior ventral area, F: leg II, G: leg IV, H: chelicerae (A and B from holotype, others from paratypes).

Key for the *Multidendrolaelaps euepistomus* species-group

1 (2) Peritremes long, reaching the anterior margin of the dorsum: .... *M. multidentatus* (Leitner, 1949)
2 (1) Peritremes reduced, reaching only the level of sternal setae st2 or between st3/st4
3 (4) Middle end of tectum longer than the lateral ends: .... *M. euepistomus* (Hirschmann, 1960)
4 (3) Middle end of tectum shorter than the lateral ends
5 (6) Ventrianal shield ♀ caudally remarkably broadened, as broad as long, idiosoma ♀ 500–560 µm long:..... ***M. putte* n. sp.**
6 (5) Ventrianal shield ♀ caudally only a little broader than anteriorly, idiosoma ♀ 380–410 µm: ..... ***M. subcorticalis* n. sp.**

6.5. *Dendrolaelaps casualis* n. sp.

6.5.1. Differential diagnosis

The specific characters integrate the new species into the genus *Dendrolaelaps* Halbert, 1915 s. Karg (1993a). The new species is related to *Dendrolaelaps brevipilis* (Leitner, 1949). In both species the peritremes are reduced and the digitus mobilis of the female chelicerae is equipped with 4 teeth. However, the setation of the dorsum and the configuration of the ventrianal shield differ.

6.5.2. Description

Female: Length if idiosoma 330–350 µm, width 190 µm. Dorsal setae i2 to i5, I1 to I4 and z2 to z5 = 200 µm, extending to the midway to the next following pair (Fig. 12A). Z1 to Z3 are slightly longer, Z5 and S5 = 45 µm. The anterior part of the postdorsum with weak structural pattern. Two weak incisions in the front margin of postdorsum. Sternal area weakly sclerotized. The three ends of tectum nearly equal, distally split (Fig. 12C). The ventrianal shield is 125 µm long, 75 µm broad anteriorly and posteriorly, narrower in the middle (50 µm at the level of Vi3). It carries the setae Vi1, Vi2, Vi3, Vi5 and Vz2 (Fig. 12B). Setae Vi5 and Vz4 = 25 µm, other V-setae 15 µm. The peritremes are reduced, reaching distally the level of St2-St3. Chelicerae normal, digitus mobilis with 4 teeth (Fig. 12D). All setae of the legs are simple, smooth. Gonoporus opening at the proximal lyrifissure of the femur III (Fig. 12E).

6.5.3. Type locality and material

All specimens are from the same sample. Holotype, female; paratypes, 2 females (on the same slide): Kittilä, Ylläs, western Lapland (7519:3386), 5 Aug. 2005 (MusZHki).

Etymology: We name the species *D. casualis* because of the casual nature of the type locality: a dry toilet compost on the roadside by a popular tourist route through Lapland.

6.5.4. Taxonomy

The new species belongs to a group of species with reduced peritremes together with *Dendrolaelaps brevipilis* (Leitner, 1949). We have arranged a key for these species:

Key of the *Dendrolaelaps brevipilis* species-group

1 (2) Ventrianal shield ♀ as long as broad, digitus mobilis of chelicerae ♀ only with one tooth, idiosoma ♀ 270–290 µm:..... *D. monodentatus* Wiśniewski & Hirschmann, 1989
2 (1) Ventrianal shield ♀ distinctly longer than broad, digitus mobilis ♀ with 4 teeth
3 (4) Caudal setae of the postdorsum a little longer than setae i4 on the prodorsum:

Z5 = 1 1/2 x i4, S5 = 2 x i4, postdorsum with a caudal area of little pores, ventrianal shield with wavy lateral margins, idiosoma ♀ 310-420 µm: ....*D. brevipilis* (Leitner, 1949)

4 (3) Caudal setae of the postdorsum distinctly longer than setae i4 on the prodorsum: Z5 = 2 1/2 x i4, S5 = 2 x i4 and further setae Z3 = 2 x i4, no caudal area with pores on the postdorsum, ventrianal shield with concave lateral margins, idiosoma ♀ 330–350 µm: .....***D. casualis* n. sp.**

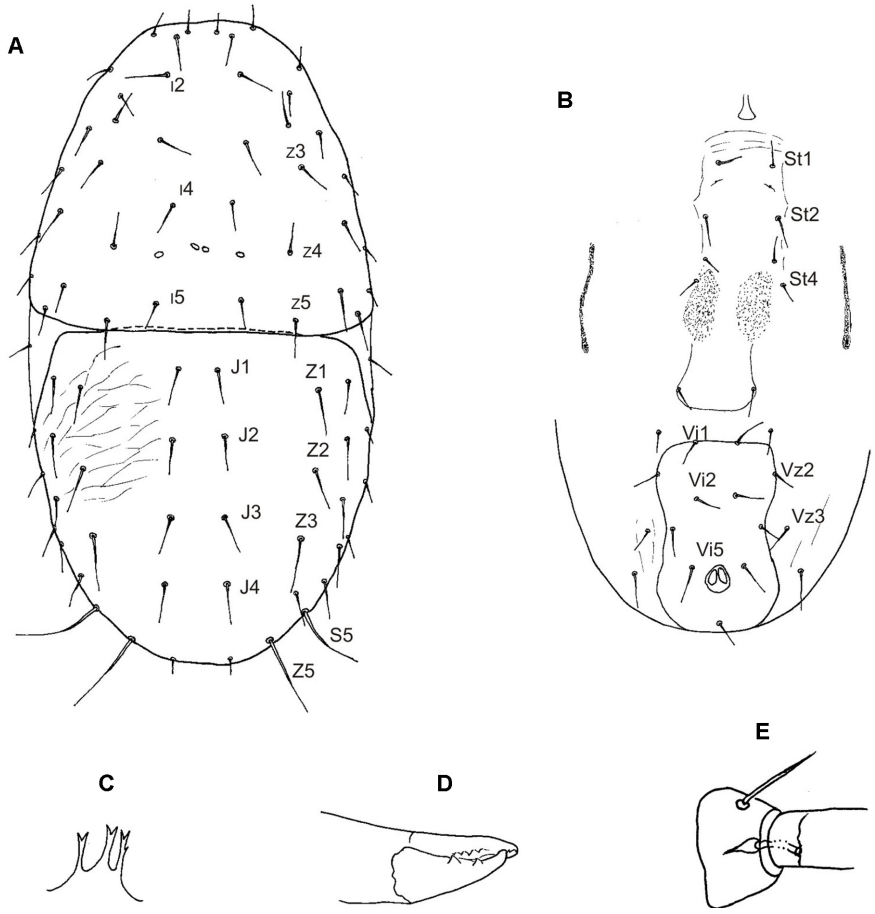

Fig. 12 *Dendrolaelaps casualis n.sp.* Female, A: dorsal (holotype), B: ventral (paratype), C: tectum, D: chelicere, E: coxa/femur III.

7. Acknowledgements

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