Zootaxa 4200 (1): 047–082
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://doi.org/10.11646/zootaxa.4200.1.2
http://zoobank.org/urn:lsid:zoobank.org:pub:00D32877-F83A-4AE0-9139-894872F0EB72

Remarkable diversity of the genus *Endonura* Cassagnau, 1979 (Collembola: Neanuridae: Neanurinae) in the Caucasus

ADRIAN SMOLIS[1,3] & NATALIYA KUZNETSOVA[2]

[1]*Institute of Environmental Biology, University of Wrocław, Przybyszewskiego 63/77, 51-148 Wrocław, Poland*
[2]*Institute of Biology and Chemistry, Moscow Pedagogical State University, Moscow 129164, Russia*
[3]*Corresponding author. E-mail: adek@biol.uni.wroc.pl*

Abstract

Endonura alticola (Stach, 1951) **comb. nov.** is redescribed based on the type material and seven new species of the genus *Endonura* are described from the various parts of the Caucasus. *E. paracantabrica* **sp. nov.** can be recognized by the number of chaetae (L+So) on head and a fusion of tubercles Di and De on the first thoracic segment. Specific traits of *E. aibgai* **sp. nov.** include small body size, low number of chaetae (L+So) on head, nonogival labrum, dentate claws, and long tibiotarsal chaetae B4 and B5. *E. diminutichaeta* **sp. nov.** is characterized by an unusually short chaeta Di1on abdomen IV. *E. dobrolyubovae* **sp. nov.** can be distinguished from its congeners by notably long chaeta Ocp on head and the presence of male ventral organ. The absence of chaetae E and O on head, ogival labrum, cryptopygy and dentate claws are typical of *E. cryptopyga* **sp. nov**. *E. ossetica* **sp. nov.** is most easily recognized by an unusual shape of tubercle Af on head connected with chaetae D and E. Main characteristics of *E. kremenitsai* **sp. nov.** include the presence of chaeta E and five chaetae Dl on head. A key to all known species of the genus including the above outlined taxa is given. General remarks on distribution and possible historical biogeography of the genus are also provided.

Key words: Springtails, taxonomy, new species, redescription, comb. nov., Russia

Introduction

The Caucasus is commonly treated as the south-east border between Europe and Asia. The region is traditionally located between the Kuma-Manich depression to the north and the Turkey-Iran border to the south. On the west, the Caucasus is limited by the Black and Azov Seas, and on the east by the Caspian Sea. In terms of climate, the Caucasus is at the junction of sub-tropical and moderate zones. One of the major peculiarities of the Caucasus is its high landscape diversity. A broad spectrum of landscapes is found in the region, from humid to arid, from sub-tropical to alpine-nival-glacial, and from low- to highlands. The remarkable altitudinal gradient (from sea level to 5642 meters of the Mount Elbrus), the extension of the north-south (46° 51' N, 38° 24' N), the geological complexity and wide variety of climatic conditions determine rich natural environments. The level of biodiversity in the Caucasus is relatively well-known. With more than 6000 plant species and a high level of endemism the Caucasus is recognized as the richest floristic region among temperate climate zones (Zazanashvili & Mallon (Eds) 2009). Caucasus fauna is also very rich. For example, fauna of vertebrates consists of 152 species of mammals, of which 32 are endemic. Birds make up 389 species (3 endemic species), reptiles 76 species (21 endemic species) and amphibians 13 species (WWF 2001). As one of the most biologically rich regions on Earth, especially in the temperate context, the Caucasus is ranked among the planet's 25 most important biodiversity hotspots (Myers *et al.* 2000).

Unfortunately, many groups of invertebrates including springtails, primitive and wingless hexapods, are still insufficiently known in the region. Among springtails, the subfamily Neanurinae, with more than 800 described species, is one of the most diversified and speciose. Nevertheless, till now only five members of the subfamily were described from the region, namely *Endonura transcaucasica* (Stach, 1951); *Biloba alticola* Stach, 1951; *Biloba caucasica* Stach, 1951; *Caucasanura stebayevae* Kuznetzova & Potapov, 1988, and *Ghirkanura chernovae* Kuznetzova & Potapov, 1988 (Stach 1951, Deharveng 1982a, Kuznetsova & Potapov 1988, Smolis 2016).

Accepted by W.M. Weiner: 29 Sept. 2016; published: 28 Nov. 2016

In term of species richness and distribution *Endonura* Cassagnau, 1979 is one of the largest genera within Neanurini, one of the six tribes established by Cassagnau (1989) in the subfamily Neanurinae. *Endonura* is a Holarctic genus that currently encompasses 40 valid species (Dallai 1983, Deharveng 1979, 1982a, Fanciulli & Dallai 2008, Pomorski & Skarżyński 2000, Pozo & Simón 1982, Smolis & Kaprus' 2003, 2009, Smolis 2006, 2008a Smolis *et al.* 2007, 2011, 2016). Nevertheless, the genus is mostly Palaearctic in distribution with a sole species, *E. reticulata* (Axelson, 1905), known from North America (Alaska, Smolis *et al.* 2011). It should be noted additionally that this geographic pattern is characterised by the highest concentration of species in Europe where three fourth of known species of *Endonura* were recorded. However, this picture is not reliable as many areas of the Palaearctic, also in the closest vicinity of Europe, are still fragmentary investigated in the respect. According to Smolis (2008a), the diagnosis of *Endonura* is based on the following characters: 0–2 ocelli, reduced mouth parts with a thin mandible and a styliform maxilla, separate tubercles Di and De with the non-cross-type of chaetotaxy on the head and three or two tubercles on abdomen V. Within the tribe Neanurini, the genus seems to be closely related to two genera: *Cryptonura* Cassagnau, 1979 and *Deutonura* Cassagnau, 1979. It can be easily distinguished from the former one by having two or three tubercles on dorsal side of abdominal segment V (four in *Cryptonura*), and from the latter by separateness of tubercles Di and De on head (fused in *Deutonura*).

In this paper we present the descriptions of seven new species of *Endonura*. Our study is based on a rich material of Neanurinae collected during several expeditions in the region and nowadays preserved in the entomological collection of Moscow State Pedagogical University. Additionally, thanks to the kindness of Prof. Wanda M. Weiner from Institute of Systematics and Evolution of Animals PAS (Cracow, Poland), we have to possibility to examine and describe the type material of *B. alticola* Stach, 1951, classified so far into the genus *Neanura* MacGillivray, 1893 (Gisin 1960) or *Deutonura* Cassagnau, 1979 (Deharveng 1982a). The study showed that its original description is insufficient and inaccurate, and we assign here this form to the genus *Endonura*.

Terminology, materials and methods

Specimens were collected from soil, litter and decaying wood samples. Samples were extracted using a Berlese-Tullgren apparatus. Thus obtained specimens were cleared in 10% solution of KOH, subsequently mounted on slides in Phoera liquid and observed using a phase contrast microscope Nikon E600. All line drawings were made using a camera lucida on a phase contrast microscope Nikon E600 and prepared for publication using Adobe Photoshop CS3. Terminology and layout of the tables used in the paper follow Deharveng (1983), Deharveng & Weiner (1984), Smolis & Deharveng (2006) and Smolis (2008a). Nevertheless, authors of this paper would like also point out that in spite of the same names, some of chaetae must be not homologous.

Abbreviations used:

General morphology: abd.—abdomen, ant.—antenna, AOIII—sensory organ of antennal segment III, Cx—coxa, Fe—femur, Scx2—subcoxa 2, T—tibiotarsus, th.—thorax, Tr—trochanter, VT—ventral tube.

Groups of chaetae: Ag—antegenital, An—chaetae of anal lobes, ap—apical, ca—centroapical, cm—centromedial, cp—centroposterior, d—dorsal, Fu—furcal, vc—ventrocentral, Ve or ve—ventroexternal, Vea—ventroexternoanterior, Vem—ventroexternomedial, Vep—ventroexternoposterior, Vel—ventroexternolateral, Vec—ventroexternocentral, Vei—ventroexternointernal, Vi or vi—ventrointernal, Vl—ventrolateral.

Tubercles: Af—antenno–frontal, Cl—clypeal, De—dorsoexternal, Di—dorsointernal, Dl—dorsolateral, L—lateral, Oc—ocular, So—subocular.

Types of chaetae: Ml—long macrochaeta, Mc—short macrochaeta, Mcc—very short macrochaeta, me—mesochaeta, mi—microchaeta, ms—s-microchaeta or microsensillum, S or s—chaeta s, bs—border s-chaeta on ant. IV, miA—microchaetae on ant. IV, iv—ordinary chaetae on ventral ant. IV, or—organite of ant. IV, brs—border s-chaeta on ant. IV, i—ordinary chaeta on ant. IV, mou—cylindrical s–chaetae on ant. IV („soies mousses"), x—labial papilla x, L'—ordinary lateral chaeta on abd. V, B4, B5—ordinary chaetae on tibiotarsi.

Depositories:

DIBEC Department of Invertebrate Biology, Evolution and Conservation, Institute of Environmental Biology, University of Wrocław, Poland;

ISEA Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow, Poland;
MSPU Moscow State Pedagogical University, Moscow, Russia.

Systematic part

Endonura alticola (Stach, 1951) comb. nov.

Figs 1–6, Tab. 1

Biloba alticola: Stach 1951: 36.
Neanura alticola: Gisin 1960: 102.
Detonura alticola: Deharveng 1982a: 81.

Type material. Holotype: adult female on slide, Russia, Caucasus, Northern Ossetia, Karaugom-glacier, 20.VII.1935, leg. R. Wojtusiak, (ISEA: coll. J. Stach).

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 large pigmented eyes. Buccal cone long, labrum ogival. Head with chaetae A, B, O, C, D, E, F and G. Tubercles Cl and Af separate. Chaetae D free. Tubercles Dl and (L+So) on head with 6 and 10 chaetae respectively. Tubercles Di and De on th. I present and fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 6 chaetae respectively. Abd. IV and V with 7 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 short.

Redescription. Habitus typical of the genus. Body length of lectotype (without antennae): 1.25 mm. Colour of the body dark blue. 2+2 large pigmented eyes (Fig. 1).

Types of dorsal ordinary chaetae. Macrochaetae Ml relatively long and thin, almost cylindrical, straight or slightly arc-like, narrowly sheathed, feebly serrated, apically rounded or pointed (Figs 4–6); macrochaetae Mc and Mcc thickened, straight and rounded at apex or pointed; mesochaetae and microchaetae short, thin, feebly serrated and pointed.

Head. Labrum ogival, with ventral sclerifications as in Fig. 2. Labrum chaetotaxy 2/2, 4. Labium with four basal, three distal and four lateral chaetae, papillae x absent. Maxilla and mandible hardly to recognize. Antennal segments I and II with 7 and 11 chaetae respectively. Chaetotaxy of antennal segments III and IV impossible to recognize. Chaetotaxy of head as in Tab. 1a, b, and Figs 1, 3–4. Tubercle Dl with 6 chaetae, chaeta Dl3 present. Tubercle (L+So) with 10 chaetae, chaetae So2, L3 and L4 present (Figs 1, 2). Elementary tubercles BE absent. Chaeta E not connected with tubercle Af. Chaeta A shorter than B. Chaeta D free.

Thorax, abdomen, legs. Body s-chaeta thin and smooth, distinctly shorter than nearby macrochaetae (Figs 5, 6). Chaetotaxy of thorax and abdomen as in Tab. 1b and in Figs 5, 6. Tubercles Di on th.I well differentiated and fused with De. Chaetae De2 on th. II–III and De3 on th. III–abd. III free (Fig. 6). The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd. I–III. Tubercles Di on abd. IV and V fused (Fig. 5). No cryptopygy. Chaetotaxy of ventral abdomen and legs in most impossible to recognize. Claw without inner tooth.

Remarks. Stach (1951) described *Biloba alticola* based on one specimen found "in moss in pine-wood growing on the moraine of Karaugom-glacier (Caucasus, Russia)". Later the species was considered as member of *Neanura* (e.g. Gisin 1960, Salmon 1964, Massoud 1967) or *Deutonura* (Deharveng 1982a, Deharveng *et al.* 2015). The assignation of the species to the genus *Deutonura* was mainly based on original Stach's figures where tubercles Di and De on head are fused (Stach 1951: plate VII, figure 1). Nevertheless, a detailed analysis of existing type made it possible to ascertain that the type of *B. alticola* is characterized by separateness of the mentioned tubercles on head and as a consequence should be classified into another genus, *Endonura*. Furthermore, this allowed us to redescribe this species using most of the modern characters.

E. alticola is characterized by fusion of tubercles Di on abd. IV along midline, a character till now observed within the genus only in *E. dudichi* (Loksa, 1967), a species from the Carpathians in Central Europe (Hungary, Slovakia, Poland, Smolis 2008a). However these two species differ in many characters including: colour of body (blue in *alticola*, white in *dudichi*), presence/absence of chaetae O and E on head (present in *alticola*, absent in *dudichi*), presence/absence of non-reticulate area between chaetae A and B on head (absent in *alticola*, present in *dudichi*), fusion/separateness of tubercles Di and De on the first thoracic segment (fused in *alticola*, separate in *dudichi*) and fusion/separateness of tubercles De and Dl on abd. IV (separate in *alticola*, fused in *dudichi*).

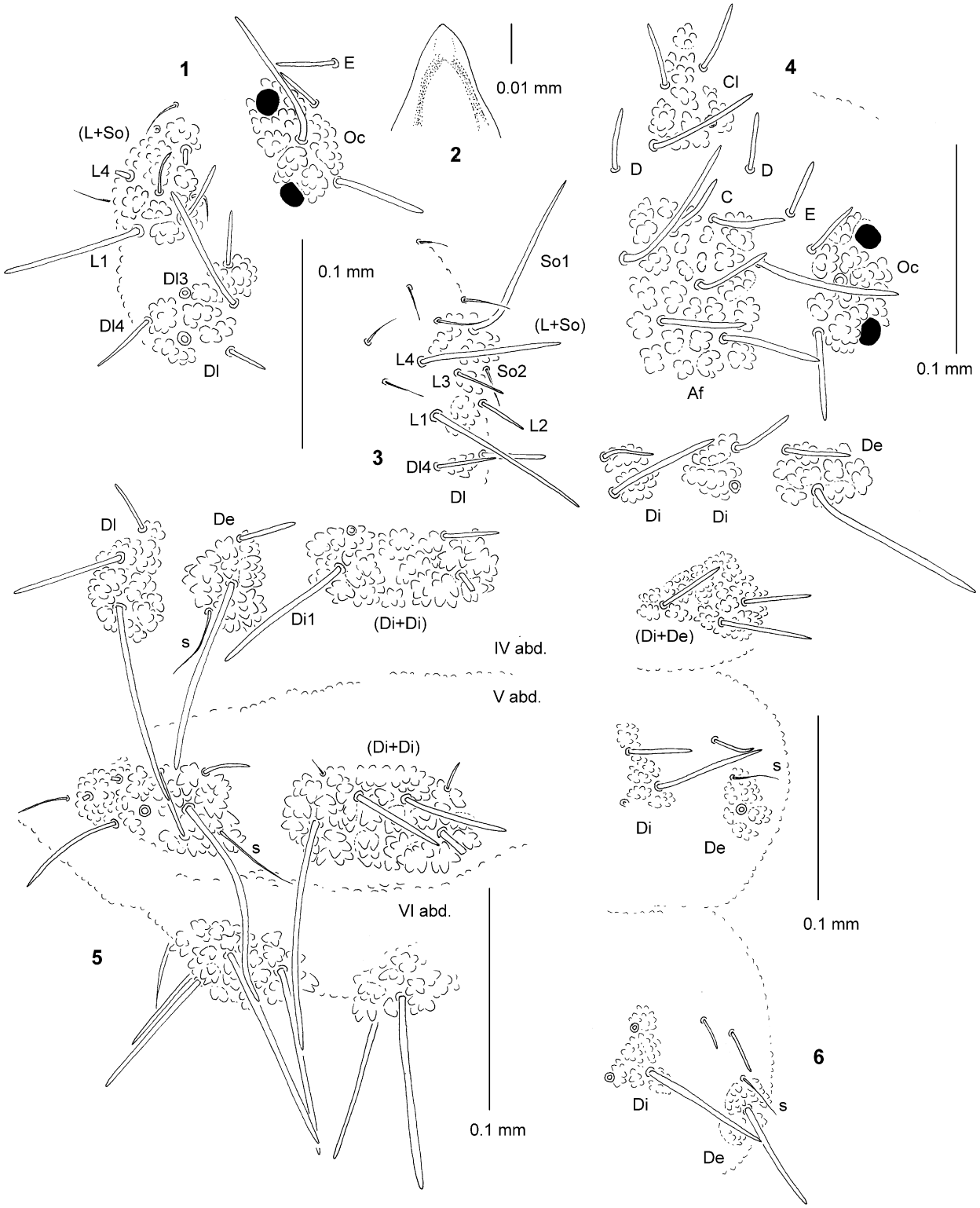
Morphologically, *E. alticola* seems to be most similar to two species, *E. quadriseta* Cassagnau & Péja, 1979 (known from Greece, Turkey and Crimea) and *E. reticulata* (Axelson, 1905) (Scandinavia, North Russia and United States). Besides the above mentioned character, fusion of tubercles Di on abd. IV, *E. alticola* differ from both in the presence of ogival labrum (non ogival in *quadriseta* and *reticulata*), two prelabral chaetae (four in *quadriseta* and *reticulata*) and fusion of tubercles Di and De on th. I (separated in *quadriseta* and *reticulata*). Among the Caucasian species, *E. alticola* resembles *E. diminutichaeta* **sp. nov**. However, they can be separated using the following features: number of chaetae Dl on head (6 in *alticola*, 4–5 in *diminutichaeta*), presence/absence of elementary tubercle BE on head (absent in *alticola*, present in *diminutichaeta*) and length of chaetae Di1 of abd. IV (relatively long in *alticola*, notably short in *diminutichaeta*).

TABLE 1. Chaetotaxy of *Endonura alticola*:
a) Cephalic chaetotaxy—dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	11	Ml	B
		Mc	A, C. O, D, E
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc	Oca
Di	2	Ml	Di1
		Mcc	Di2
De	2	Ml	De1
		Mc	De2
Dl	6	Ml	Dl1, Dl5
		Mc	Dl4, Dl3
		Mcc	Dl2, Dl6
(L+So)	10	Ml	L1, L4, So1
		Mc	L2
		Mcc	L3
		me	So2–6

b) Postcephalic chaetotaxy–dorsal side.

	Terga			
	Di	De	Dl	L
th. I		3	1	-
th. II	3	2+s	3+s+ms	3
th. III	3	3+s	3+s	3
abd. I	2	3+s	2	3
abd. II	2	3+s	2	3
abd. III	2	3+s	2	4
abd. IV	(2+2)	2+s	3	6
abd. V	(3+3)	8+s		
abd. VI		7		



FIGURES 1–6. *Endonura alticola*: 1, chaetotaxy of tubercles Oc, Dl and (L+So), dorsolateral view; 2, ventral sclerifications of labrum; 3, chaetotaxy of tubercles Dl and (L+So), ventrolateral view; 4, central area of head, dorsal view; 5, dorsal chaetotaxy of abd. IV–VI; 6 chaetotaxy of tubercles Di and De of th. I–III.

***Endonura paracantabrica* sp. nov.**
Figs 7–16, Tab. 2

Type material. Holotype: adult male on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Aibga Range (ropeway Gornaya Karusel), 960 m alt., litter from mountain mixed forest (*Picea orientalis*, *Abies nordmanniana*, *Fagus orientalis*), N43.66693˚, E40.25630˚, 29.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (housed in MSPU). Paratypes: 3 females and one male on slides, same data as holotype (preserved in DIBEC and MSPU).

Etymology. The species name refers to the similarity to the Iberian species *E. cantabrica* Deharveng, 1979.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 pigmented eyes. Buccal cone rather short, labrum nonogival. Head with chaetae A, B, O, C, D, F and G. Chaetae E absent. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 6 and 10 chaetae respectively. Tubercles Di and De on th. I fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 relatively long.

Description. Habitus typical of the genus. Body length (without antennae): 0.77–1.65 mm (holotype 1.23 mm). Colour of the body bluish grey. 2+2 medium pigmented eyes (Fig. 7).

Types of dorsal ordinary chaetae. Macrochaetae Ml relatively long, slightly thickened, almost cylindrical, straight or arc-like, narrowly sheathed, serrated, apically rounded (Figs 7, 14–15); macrochaetae Mc and Mcc thickened, straight or arc-like, serrated, pointed or rounded at apex; mesochaetae and microchaetae short, thin, feebly serrated and pointed.

Head. Labrum nonogival, with ventral sclerifications as in Fig. 9. Labrum chaetotaxy 4/2, 4 (Fig. 8). Labium with four basal, three distal and four lateral chaetae, papillae x absent. Maxilla styliform (Fig. 11), mandible thin with two basal and two subapical teeth (Fig. 10). Chaetotaxy of antennae as in Figs 12, 13 and Tab. 2c. Apical vesicle distinct, trilobed. S-chaetae of ant. IV relatively long and thin. Chaetotaxy of head as in Tab. 2a, b, and Fig. 7. Chaeta D not connected with tubercle Cl. Tubercle Af on head longer than tubercles Oc. Elementary tubercles CD present. Chaeta A shorter than B.

TABLE 2. Chaetotaxy of *Endonura paracantabrica* **sp. nov**.:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	9	Ml	B
		Mc	A, C, O
		Mc or Mcc	D
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc	Oca
Di	2	Ml	Di1
		Mcc	Di2
De	2	Ml	De1
		Mc or Mcc	De2
Dl	6	Ml	Dl1, Dl5
		Mc	Dl4
		Mcc	Dl2, Dl3, Dl6
(L+So)	10	Ml	L1, L4, So1
		Mcc	L2
		me	L3, So2–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	3
Vem	4
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae (adult)
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

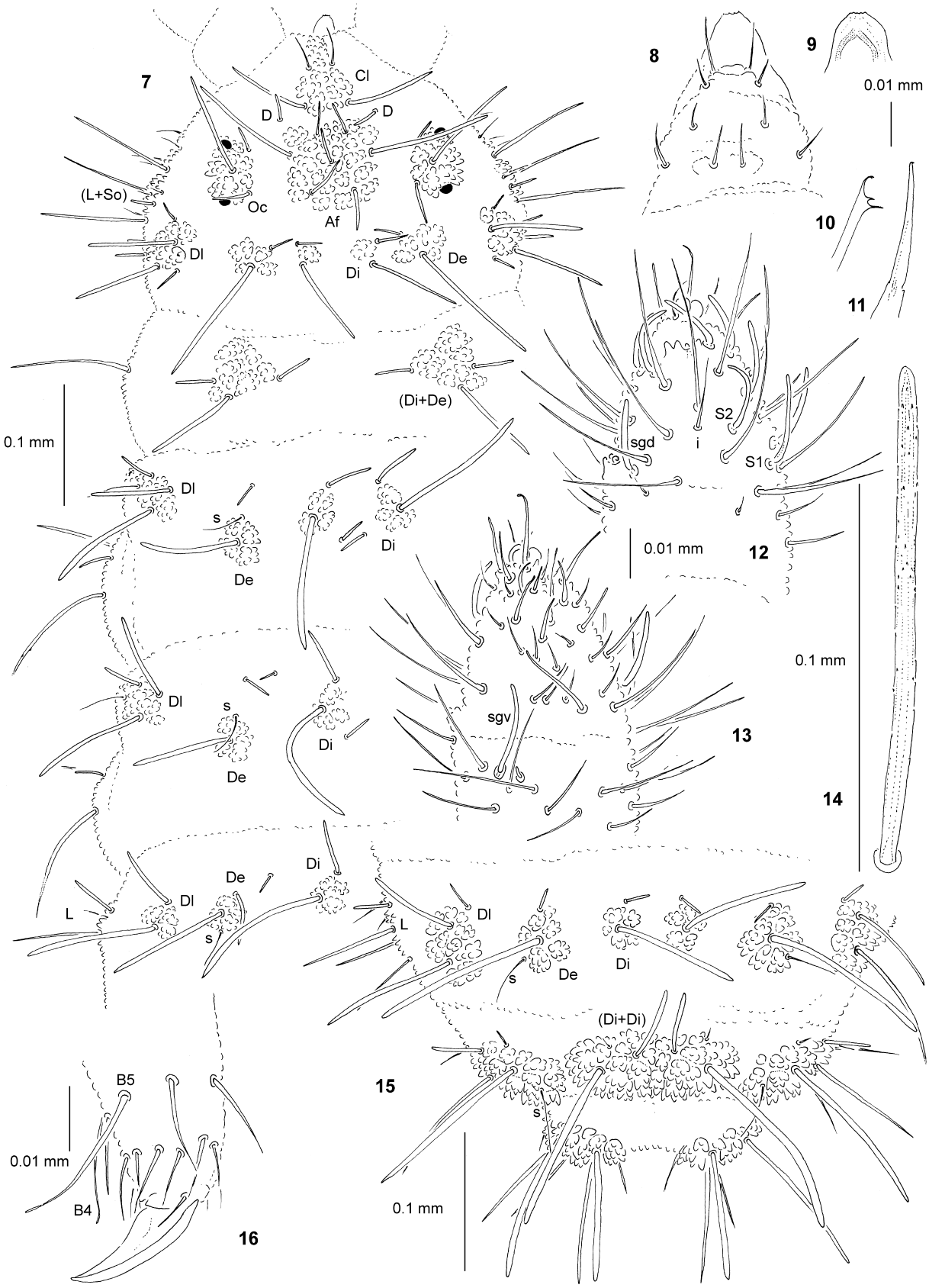
d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I		3	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel:5–6; Fu: 5–6 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7–8+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 14; An: 2mi				

Thorax, abdomen, legs. Body s-chaetae thin and smooth, distinctly shorter than nearby macrochaetae (Figs 7, 15). Chaetotaxy of thorax and abdomen as in Tab. 2d and in Figs 7, 15. Tubercles Di on th. I differentiated and fused with tubercles De (Fig. 7). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig. 7). The line of chaetae De1–chaeta s parallel to the dorsomedian line on abd I–III. Furca rudimentary without microchaetae. Tubercles Di on abd. V fused, with chaetae Di2 as Mc or Mcc, and chaetae Di3 as mi (Fig. 15). Male without modified chaetae ("male ventral organ"). Chaetae L' on abd. V present. Abd. IV 3+3 chaetae Ag. No cryptopygy. Chaetotaxy of legs as in Fig. 16 and Tab. 2d.

Remarks. In general appearance (size and colour of body, shape of dorsal chaetae, chaetotaxy of central area of head and dorsal side of thorax and abdomen, and absence of cryptopygy), *E. paracantabrica* **sp. nov.** is the most similar to Iberian species *E. cantabrica* Deharveng, 1979 known to date from north Spain and Portugal (Deharveng 1979, Jordana *et al*. 1997). Nevertheless, the two species differ in a few essential characters, important from taxonomic point of view: presence/absence of elementary tubercle BE on head (*paracantabrica* **sp. nov.** absent, *cantabrica* present), number of chaetae (L+So) on head (in *paracantabrica* **sp. nov.** 10, in *cantabrica* 8–9) and presence/absence of fusion of tubercles Di and De on the first thoracic segment (separated in *cantabrica*).

Ecological note. The species was collected in leaf litter of a mountain mixed forest.



FIGURES 7–16. *Endonura paracantabrica* **sp. nov.**: 7, dorsal chaetotaxy of head, th. I–III and abd. I (holotype); 8, chaetotaxy of labrum; 9, ventral sclerifications of labrum; 10, mandible; 11, maxilla; 12, dorsal chaetotaxy of ant. III–IV; 13, ventral chaetotaxy of ant. III–IV; 14, chaeta Di1 of abd. V; 15, dorsal chaetotaxy of abd. IV–VI; 16, tibiotarsus and claw III, dorsolateral view.

***Endonura aibgai* sp. nov.**
Figs 17–24, 48 Tab. 3

Type material. Holotype: adult male on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Aibga Range (ropeway Gornaya Karusel), nothern slope, 2300 m alt., alpine zone, under *Rhododendron caucasicum*, N43.64175˚, E 40.26222˚, 29.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (housed in MSPU). Paratypes: 4 females, 4 males and 3 juveniles on slides, same data as holotype (preserved in DIBEC and MSPU).

Etymology. The species name refers to the Aibgai ridge where the species was found.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 eyes darkly pigmented. Buccal cone relatively long, labrum nonogival. Head with chaetae A, B, O, C, D, F and G. Chaetae E absent. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 5 and 8 chaetae respectively. Tubercles Di and De on th. I not fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 8 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw with inner tooth. Tibiotarsi with chaetae B4 and B5 long.

Description. Habitus typical of the genus. Body length (without antennae): 0.7 (juvenile)–1.05 mm (holotype: 0.89 mm). Colour of the body bluish grey. 2+2 large dark-pigmented eyes (Fig. 17).

Types of dorsal ordinary chaetae. Macrochaetae Ml slightly thickened, relatively short, arc-like or straight, narrowly sheathed, feebly serrated, apically pointed or rounded (Figs 17, 21–22); macrochaetae Mc and Mcc thickened, straight, pointed or apically rounded; mesochaetae and microchaetae short, thin and pointed.

Head. Buccal cone short. Labrum nonogival, with ventral sclerifications as in Fig. 20. Labrum chaetotaxy 4/2, 4. Labium with four basal, three distal and four lateral chaetae, papillae x absent. Maxilla styliform, mandible thin with two basal and two apical teeth. Chaetotaxy of antennae as in Figs 18, 19 and Tab. 3c. Apical vesicle distinct, trilobed. S–chaetae of ant. IV of medium length and relatively thin. Chaetotaxy of head as in Tab. 3a, b, and Fig. 17. Tubercle Af on head longer than tubercles Oc. Chaeta D free. Elementary tubercles CD present. Chaeta A shorter than B.

Thorax, abdomen, legs. Body s-chaetae thin and smooth, shorter than nearby macrochaetae (Figs 17, 22). Chaetotaxy of th. and abd. as in Tab. 3d and in Figs 17, 22. Tubercles Di on th.I differentiated and not fused with De (Fig. 17). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig. 17). The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd I–III. Furca rudimentary without microchaetae. Tubercles Di on abd. V fused, with chaetae Di3 as Mcc or mi (Fig. 22). Male without modified chaetae ("male ventral organ"). Chaetae L' and Vl on abd. V present. No cryptopygy. Chaetotaxy of legs as in Fig. 23 and Tab. 2d. Claw with small but distinct inner tooth (Figs 23, 24).

TABLE 3. Chaetotaxy of *Endonura aibgai* **sp. nov.**:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	9	Ml	B
		Mc	A, C, O, D
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc	Oca
Di	2	Ml	Di1
		Mcc	Di2
De	2	Ml	De1
		Mcc	De2
Dl	5	Ml	Dl1, Dl5
		Mcc	Dl2, Dl4, Dl6
(L+So)	8	Ml	L1, L4, So1
		Mcc	L2
		me	So3–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

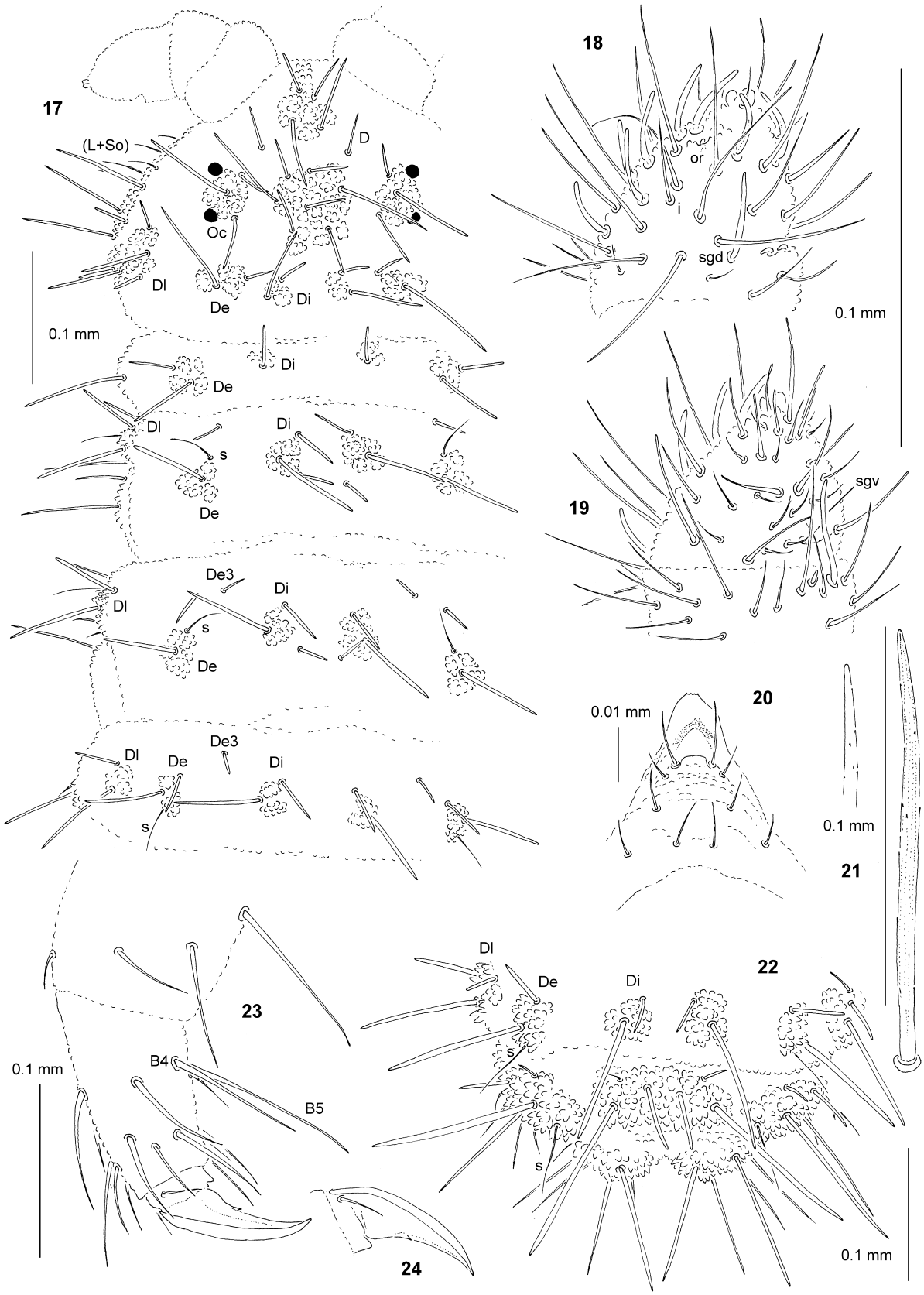
Segment, Group	Number of chaetae	Segment, Group	Number of chaetae adult
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I	1	2	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 4-5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel:5–6; Fu: 5–6 me, 0 mi				
abd. IV	2	2+s	3	8	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 14; An: 2mi				

Remarks. Because of several characters: large eyes, number of chaetae Dl on head, dorsal chaetotaxy of thorax and abdomen, dentate claws, and long tibiotarsal chaetae B4 and B5, *E. aibgai* **sp. nov.** strongly resembles *E. lusatica* (Dunger, 1966), species described from Germany and known to date also from Poland and Ukraine (Dunger 1966, Smolis 2008a). Nevertheless, the new species can be distinguished from *E. lusatica* by the following characters: maximum length of the body without antennae (in *aibgai* 1.05 mm, in *lusatica* 3.1 mm), presence/absence of chaetae E on head (in *aibgai* absent, in *lusatica* present), number of chaetae (L+So) on head (in *aibgai* 8, in *lusatica* 9), presence/absence of tubercle Di on first thoracic segment (in *aibgai* present, in *lusatica* absent), shape of ventral sclerifications of labrum (in *aibgai* nonogival, in *lusatica* ogival) and presence/absence of male ventral organ (in *aibgai* absent, in *lusatica* present).

Ecological note. The species was found in litter under shrubs of *Rhododendron caucasicum* (Fig. 48).



FIGURES 17–24. *Endonura aibgai* **sp. nov.**: 17, dorsal chaetotaxy of head, th. I–III and abd. I (holotype); 18, dorsal chaetotaxy of ant. III–IV; 19, ventral chaetotaxy of ant. III–IV; 20, chaetotaxy of labrum; 21, chaeta Di1 of abd. V; 22, dorsal chaetotaxy of abd. IV–VI; 23, femur, tibiotarsus and claw III, ventrolateral view; 24, claw III, lateral view.

***Endonura dobrolyubovae* sp. nov.**
Figs 25–40, Tab. 4

Type material. Holotype: adult female on slide, Russia, Caucasus, Krasnodarsky Krai, Adygeya, Lagonaki Plateau ('Kamennoye More"), 1748 m alt., litter mountain coniferous forest (*Abies nordmanniana*), N44.08259˚, E40.00691˚, 5.VII.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (MSPU). Paratypes: 2 males on slides, same data as holotype (DIBEC and MSPU).

Other material. Male on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Aibga Range (ropeway Gornaya Karusel), northern slope, 2300 m alt., alpine zone, under *Rhododendron caucasicum*, N43.64175˚, E40.26222˚, 29.VI.2014, leg. M.Potapov, N. Kuznetsova, A. Kremenitsa; female and juvenile on slides, Russia, Caucasus, Krasnodarsky Krai, road between Tuapse and Khadyzhensk, surroundings of Gothski pass, about 300 m alt., litter from beech forest (*Fagus orientalis*) on a slope, N44.26951˚, E39.27032˚, 7.VI.2013, leg. M. Potapov, A. Kremenitsa; female on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Achishkho Range, road to Khmelevskiye Lakes, beech forest, decaying bark on lying tree, N43.70180˚, E 40.23352˚, 30.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa; female on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, eastern spurs of Achishkho Range, Khmelevskiye Lakes, observation deck “Far”, under *Rhododendron caucasicum*, 1913 m alt., N43.72683˚, E40.17008˚, 30.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa; (slides housed in MSPU and DIBEC).

Etymology. The new species is dedicated to our colleague Tatiana Dobrolyubova who has made a contribution to the study of Collembola of Caucasus.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 eyes darkly pigmented. Buccal cone notably short, labrum nonogival. Head with chaetae A, B, O, C, D, F and G. Chaetae E absent. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 5 and 8 chaetae respectively. Tubercles Di and De on th. I not fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. “Male ventral organ” present. Claw with inner tooth. Tibiotarsi with chaetae B4 and B5 relatively short.

Description. Habitus typical of the genus. Body length (without antennae): 1.25 (juvenile)–2.48 mm (holotype: 1.65 mm). Colour of the body bluish grey. 2+2 medium dark pigmented eyes (Fig. 27).

TABLE 4. Chaetotaxy of *Endonura dobrolyubovae* **sp. nov.**:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	8	Ml	B
		Mc	A
		Mcc	C, D
Oc	3	Ml	Ocm, Ocp
		mi	Oca
Di	2	Ml	Di1
		Mcc	Di2
De	2	Ml	De1
		Mcc	De2
Dl	5	Ml	Dl1, Dl5
		Mcc	Dl4
		mi	Dl2, Dl6
(L+So)	8	Ml	L1, L4, So1
		Mcc	L2
		me	So3–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae adult
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

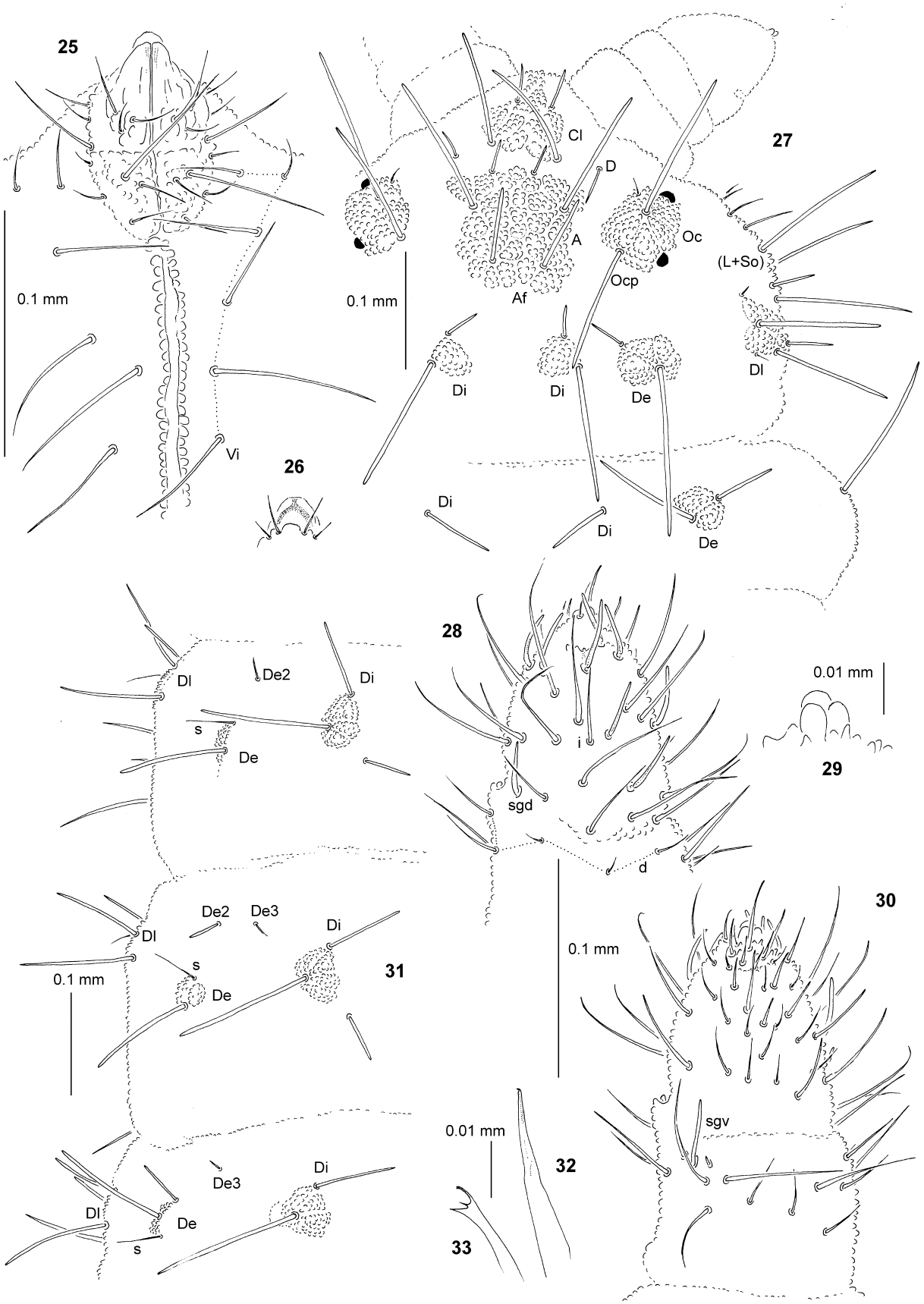
d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I	1	2	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 4–5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel:5; Fu: 6–7 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 14; An: 2mi				

Types of dorsal ordinary chaetae. Macrochaetae Ml relatively thin, long, straight or slightly arc–like, narrowly sheathed, feebly serrated, apically rounded or rarely pointed (Figs 27, 31, 38, 39); macrochaetae Mc and Mcc thin, straight, apically rounded or pointed; mesochaetae and microchaetae short, thin and pointed.

Head. Buccal cone notably short (Fig. 25). Labrum rounded, with ventral sclerifications nonogival as in Fig. 26. Labrum chaetotaxy 4/2, 4. Labium as Fig. 25. Maxilla styliform (Fig. 32), mandible thin with two basal and two apical teeth (Fig. 33). Chaetotaxy of antennae as in Figs 28–30 and Tab. 4c. Apical vesicle distinct trilobed (Fig. 29). S-chaetae of ant. IV of medium length and thickness. Chaetotaxy of head as in Tab. 4a, b, and Figs 25, 27. Chaetae D free. Tubercle Af on head longer than tubercles Oc. Chaeta Ocp longer than A (Fig. 27). Tubercle Dl with 5 chaetae, chaeta Dl3 absent. Tubercle (L+So) with 8 chaetae, chaetae So3 and L3 absent (Fig. 27). Elementary tubercle BE present. Chaeta A shorter than B.

Thorax, abdomen, legs. Body s-chaetae fine and smooth, distinctly shorter than nearby macrochaetae (Figs 31, 39). Chaetotaxy of thorax and abdomen as in Tab. 4d and in Figs 27, 31, 34, 39. Tubercles Di on th. I not differentiated (Fig. 31). Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig.31).



FIGURES 25–33. *Endonura dobrolyubovae* **sp. nov.**: 25, chaetotaxy of labium and group Vi; 26, ventral sclerifications of labrum; 27, dorsal chaetotaxy of head and th. I; 28, dorsal chaetotaxy of ant. III–IV; 29, apical bulb; 30, ventral chaetotaxy of ant. III–IV; 31, dorsal chaetotaxy of th. II–III and abd. I; 32, maxilla; 33, mandible.

The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd. I–III. Furca rudimentary without microchaetae. Male with thick and forked chaetae ("male ventral organ") on anal plates (abd. VI) and in groups: Ag (abd. V), Ve and Vl (abd. IV), Fu and Ve (abd. III, Figs 34, 37). Tubercles Di on abd. V fused, with chaetae Di2 as Mc and Di3 as mi (Fig. 39). Chaetae Vl on abd. V present. Cryptopygy slightly developed. Chaetotaxy of legs as in Fig. 35 and Tab. 4d. Claw with distinct inner tooth (Figs 35, 36).

Remarks. *E. dobrolyubovae* **sp. nov.** is similar to *E. persica* Smolis *et al*., 2016, by its short buccal cone and non ogival labrum, the same number of lateral chaetae Dl and (L+So) on head, the absence of chaeta O on head, the presence of the same free chaetae on dorsal side of th. and abd., and presence of toothed claws (Smolis *et al*. 2016). However, they are different in the length of chaeta Ocp (in *dobrolyubovae* distinctly longer than chaeta A, in *persica* slightly shorter than A), the presence/absence of elementary tubercles BE on head (in *dobrolyubovae* present, in *persica* absent), the presence/absence of chaetae E on head (in *dobrolyubovae* absent, in *persica* present) and the presence/absence of "male ventral organ" (in *dobrolyubovae* present, in *persica* absent).

Ecological note. The species was collected both in litter of different type of mountain forests (Fig. 40), and in alpine zone under rhododendron's shrubs.

***Endonura diminutichaeta* sp. nov.**
Figs 41–48, Tab. 5

Type material. Holotype: adult male on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Aibga Range (ropeway Gornaya Karusel), nothern slope, 2300 m alt., alpine zone, under *Rhododendron caucasicum*, N43.64175˚, E40.26222˚, 29.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (MSPU). Paratypes: female and male on slides, same data as holotype (DIBEC and MSPU).

Other material. 2 females, male and 2 juveniles on slides, Russia, Caucasus, Krasnodarsky Krai, between Anapa and Novorossiysk, village Semigorsky, litter from broadleaved forest on canyon floor, N44.89285˚, E37.61940˚, 5.VI.2013, leg. M. Potapov, A. Kremenitsa, M. Furgoł, T. Maulana; male on slide, same data as holotype; 2 juveniles on slides, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Achishkho Range (road to Khmelevskiye Lakes), litter from beech forest, 1800 m alt., 30.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa; (DIBEC and MSPU).

Etymology. The species name refers to notable morphological feature – unusual short chaeta Di1 on abd. IV.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. Eyes 2+2, large and dark pigmented. Buccal cone long, labrum ogival. Head with chaetae A, B, O, C, D, E, F and G. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 4–5 and 10 chaetae respectively. Tubercles Di and De on th. I fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 relatively long.

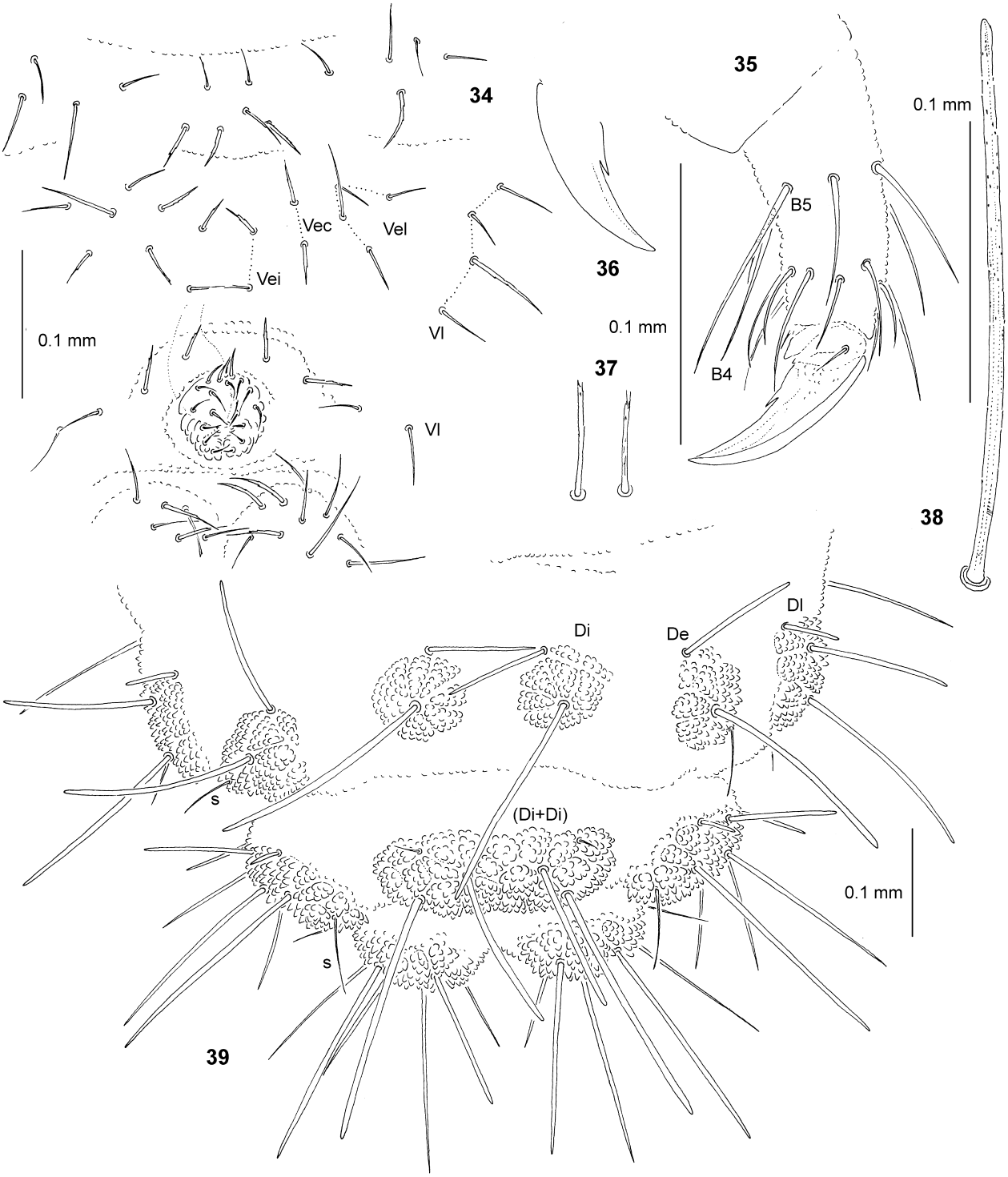
Description. Habitus typical of the genus. Body length (without antennae): 0.57 (juvenile)–1.9 mm (holotype: 1.4 mm). Colour of the body bluish grey. 2+2 large dark-pigmented eyes (Fig. 43).

Types of dorsal ordinary chaetae. Macrochaetae Ml slightly thickened, relatively long, straight or rarely arc-like, narrowly sheathed, feebly serrated, apically rounded or pointed (Figs 43, 46); macrochaetae Mc and Mcc thickened, straight, pointed or apically rounded; mesochaetae and microchaetae short, thin and pointed.

Head. Buccal cone long. Labrum ogival, with ventral sclerifications as in Fig. 42. Labrum chaetotaxy 4/2, 4. Labium as Fig. 41. Maxilla styliform, mandible thin with two basal and two apical teeth. Chaetotaxy of antennae as in Figs 44, 45 and Tab. 5c. Apical vesicle distinct, trilobed. S-chaetae of ant. IV of medium length and relatively thin (Fig. 44). Chaetotaxy of head as in Tab. 5 a, b, and Fig. 43. Tubercle Af on head longer than tubercles Oc. Chaeta D free. Elementary tubercles CD and BE present (Fig. 40). Chaeta A shorter than B.

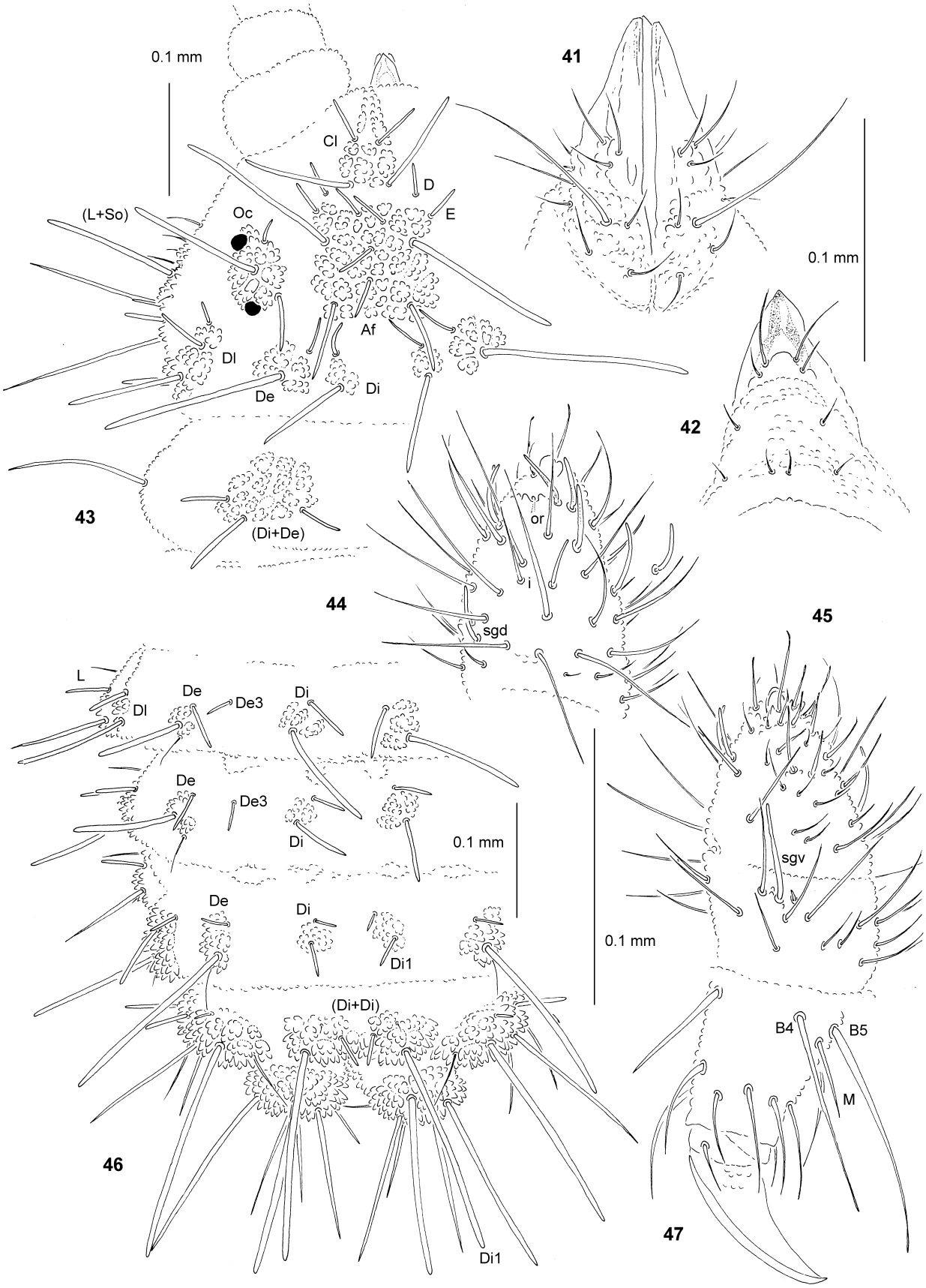
Thorax, abdomen, legs. Body s-chaetae thin and smooth, shorter than nearby macrochaetae (Fig. 46). Chaetotaxy of thorax and abdomen as in Tab. 5 d and in Figs 40, 45. Tubercles Di on th. I differentiated and fused with De (Fig. 43). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig. 46). The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd. I–III. Chaetae Di 1 on abd. III and IV notably short, at least four times shorter than Di1 of abd. V (Fig. 46). Tubercles Di on abd. V fused, with chaetae Di3 as mi. Furca rudimentary without microchaetae. Chaetae Vl on

abd. V present. Male without modified chaetae ("male ventral organ"). Cryptopygy slightly developed. Chaetotaxy of legs as in Fig. 47 and Tab. 5 d. Tibiotarsi with chaetae B4 and B5 relatively long. Claw without inner tooth (Fig. 47).



FIGURES 34–39. *Endonura dobrolyubovae* **sp. nov.**: 34, ventral chaetotaxy of abd. III–V (adult male); 35, tibiotarsus and claw III, dorsolateral view; 36, claw III, lateral view; 37. chaetae of male ventral organ; 38, chaeta Di1 of abd. V; 39, dorsal chaetotaxy of abd. IV–VI (holotype).

FIGURE 40. Mountain coniferous forest (dominated by Caucasian fir *Abies nordmanniana*) at Lagonaki Plateau, type locality of *Endonura dobrolyubovae* **sp. nov**.



FIGURES 41–47. *Endonura diminutichaeta* **sp. nov.**: 41, chaetotaxy of labium; 42, chaetotaxy of labrum; 43, dorsal chaetotaxy of head and th. I (holotype); 44, dorsal chaetotaxy of ant. III–IV; 45, ventral chaetotaxy of ant. III–IV; 46, dorsal chaetotaxy of abd. II–VI(holotype); 47, tibiotarsus and claw III, ventrolateral view.

Remarks. See remarks of *E. alticola* and *E. kremenitsai* **sp. nov**.

Variability. We observed two specimens, including holotype, with additional chaeta O (Fig. 43).

Ecological note. The type material of *Endonura diminutichaeta* **sp. nov.** and *Endonura aibgai* **sp. nov.** was collected within alpine zone, under *Rhododendron caucasicum* (Fig. 48). The species was also collected in lower elevations, in broadleaved forests.

TABLE 5. Chaetotaxy of *Endonura diminutichaeta* **sp. nov**.:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	11–12	Ml	B
		Mc	A
		Mc or Mcc	C, O, D, E
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc	Oca
Di	2	Ml	Di1
		Mc or Mcc	Di2
De	2	Ml	De1
		Mc or Mcc	De2
Dl	4–5	Ml	Dl5
		Mc	Dl1, Dl4
		Mcc	Dl2, Dl6
(L+So)	10	Ml	L1, L4, So1
		Mcc	L2, L3
		me	So2–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	4
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae adult
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I		3	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel: 3–5; Fu: 5–6 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 13-14; An: 2mi				

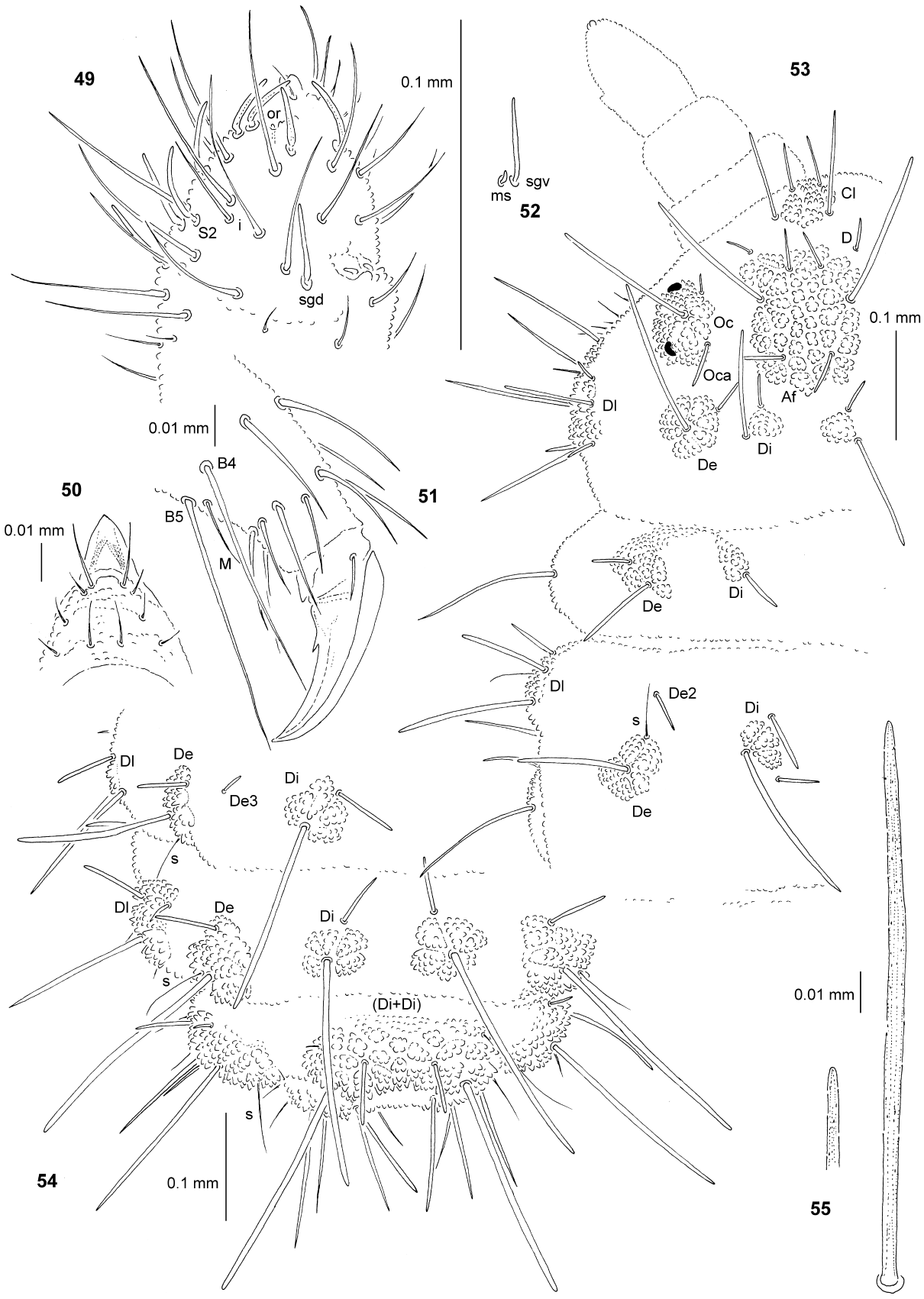
FIGURE 48. Alpine shrubs of *Rhododendron caucasicum* in Aibga Range, type locality of *Endonura diminutichaeta* **sp. nov.** and *Endonura aibgai* **sp. nov**.

***Endonura cryptopyga* sp. nov.**
Figs 49–56, Tab. 6

Type material. Holotype: adult female on slide, Russia, Caucasus, Krasnodarsky Krai, up from Krasnaya Polyana, Achishkho Range (Khmelevskiye Lakes), 1913 m alt., southern slope, subalpine zone, mosses and silt on rocks, N43.72683˚, E40.17008˚, 30.VI.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (MSPU).

Other material. 3 juveniles on slide, Russia, Caucasus, Krasnodarsky Krai, road between Belorechensk and Krasnodar, surroundings of settlement Ryazanskoe, forest shelter belt, N 44.97402˚, E 39.60708˚, 9.VI.2013, leg. M. Potapov, A. Kremenitsa, M. Furgoł, T. Maulana.

Etymology. The species name refers to characteristic feature—cryptopygy.



FIGURES 49–55. *Endonura cryptopyga* **sp. nov.**: 49, dorsal chaetotaxy of ant. III–IV; 50, chaetotaxy of labrum; 51, tibiotarsus and claw III, ventrolateral view; 52, sensillum sgv and ms of ant. III; 53, dorsal chaetotaxy of head and th. I–II (holotype); 54, dorsal chaetotaxy of abd. III–VI (holotype); 55, chaeta Di1 of abd. V.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 eyes darkly pigmented. Buccal cone long, labrum ogival. Head with chaetae A, B, C, D, F and G. Chaetae E and O absent. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 5 and 8 chaetae respectively. Tubercles Di and De on th. I not fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw with inner tooth. Tibiotarsi with long chaetae B4 and B5.

Description. Habitus typical of the genus. Body length (without antennae): 0.49 (juvenile)–1.61 mm (holotype: 1.61 mm). Colour of the body bluish grey. 2+2 large dark-pigmented eyes (Fig. 53).

TABLE 6. Chaetotaxy of *Endonura cryptopyga* **sp. nov.**:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	8	Ml	B
		Mc	A, C
		Mcc	D
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc or mi	Oca
Di	2	Ml	Di1
		Mcc	Di2
De	2	Ml	De1
		Mc	De2
Dl	5	Ml	Dl1, Dl5
		Mc	Dl4
		Mcc	Dl2, Dl6
(L+So)	8	Ml	L1, L4, So1
		Mcc	L2
		me	So3–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	3
Vem	3
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae adult
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I	1	2	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5-6; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel:5–6; Fu: 5–6 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7-8+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 13-14; An: 2mi				

FIGURE 56. Mosses on rocks in subalpine zone of Achishkho Range, type locality of *Endonura cryptopyga* **sp. nov**.

Types of dorsal ordinary chaetae. Macrochaetae Ml slightly thickened, relatively long, straight or arc-like, narrowly sheathed, feebly serrated, apically rounded or pointed (Figs 53–55); macrochaetae Mc and Mcc thickened, straight, pointed or apically rounded; mesochaetae and microchaetae short, thin and pointed.

Head. Buccal cone long. Labrum ogival, with ventral sclerifications as in Fig. 50. Labrum chaetotaxy 4/2, 4. Labium with four basal, three distal and four lateral chaetae, papillae x absent. Maxilla styliform, mandible thin with two basal and two apical teeth. Chaetotaxy of antennae as in Figs. 49, 52 and Tab. 6c. Apical vesicle trilobed.

S–chaetae of ant. IV of medium length and relatively thin. Chaetotaxy of head as in Tab. 6a, b, and Fig. 53. Tubercle Af on head longer than tubercles Oc. Chaeta D free. Elementary tubercles CD and BE present (Fig. 53). Chaeta A shorter than B.

Thorax, abdomen, legs. Body s-chaetae thin and smooth, shorter than nearby macrochaetae (Figs 53–54). Chaetotaxy of thorax and abdomen as in Tab. 6d and in Figs 53–54. Tubercles Di on th. I differentiated but not fused with De (Fig. 53). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig. 54). The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd. I–III. Tubercles Di on abd. V fused, with chaetae Di3 as mi (Fig. 54). Furca rudimentary without microchaetae. Chaetae Vl on abd. V present. Cryptopygy well developed, abd. VI only partially visible in dorsal view (Fig. 54). Chaetotaxy of legs as in Fig. 51 and Tab. 6d. Claw with distinct inner tooth (Fig. 51).

Remarks. The following set of characters: body grayish-blue, absence of chaeta O on head, same number of chaetae De on th. II– abd. III, chaetae De 3 on th. II–abd. III free, presence of distinct inner tooth on claw and elongated chaetae B4 and B5 on tibiotarsi, place the new species closely to *E. dentifera* Smolis *et al.*, 2007, described from Crimea (Smolis *et al*. 2007). Nevertheless, the two species differ in several essential features: presence/absence of chaetae E on head (in *cryptopyga* absent, in *dentifera* present), number of chaetae Dl on head (in *cryptopyga* 5, in *dentifera* 6), number of chaetae (L+So) on head (in *cryptopyga* 8, in *dentifera* 10), shape of ventral sclerifications of labrum (in *cryptopyga* ogival, in *dentifera* nonogival) and presence/absence of cryptopygy (in *cryptopyga* present, in *dentifera* absent).

Ecological note. Holotype of the new species was collected within subalpine zone, in mosses and silt on rocks (Fig. 56), other specimens were found in forest belt.

***Endonura ossetica* sp. nov.**
Figs 57–66, Tab. 7

Type material. Holotype: adult female on slide, Russia, Caucasus, Northern Ossetia, Tseyskoye Canyon, Verkhniy Tsey, near turistic base, maple forest, litter, 16.IX.1990, leg. M. Potapov (MSPU). Paratype: juvenile on slide, same data as holotype (DIBEC).

Etymology. The species name refers to geographic area where it was found – the Republic of Northern Ossetia.

Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 eyes darkly pigmented. Buccal cone long, labrum ogival. Head with chaetae A, B, C, D, E, F and G. Chaeta O absent. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 6 and 8 chaetae respectively. Tubercles Di and De on th. I fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with relatively long chaetae B4 and B5.

Description. Habitus typical of the genus. Body length (without antennae): 0.75 (juvenile)–2.47 mm (holotype: 2.47 mm). Colour of the body white. 2+2 large dark-pigmented eyes (Figs 57, 58).

Types of dorsal ordinary chaetae. Macrochaetae Ml slightly thickened, relatively long, straight or arc-like, narrowly sheathed, feebly serrated, apically rounded or pointed (Figs 57, 58, 63, 65, 66); macrochaetae Mc and Mcc thickened, straight, pointed or apically rounded; mesochaetae and microchaetae short, thin and pointed.

Head. Buccal cone long. Labrum ogival, with ventral sclerifications as in Fig. 61. Labrum chaetotaxy 4/2, 4. Labium as in Fig. 62. Maxilla and mandible as in Figs 59, 60. Antennal segments I and II with 7 and 11 chaetae respectively. Chaetotaxy of antennal segments III and IV impossible to recognize. Apical vesicle poorly visible, probably trilobed. Chaetotaxy of head as in Tab. 7a, b, and Figs 57, 58. Tubercle Af on head longer than tubercles Oc. Tubercle Af with chaetae D and E (Fig. 58). Elementary tubercles CD and BE present. Chaeta A shorter than B.

Thorax, abdomen, legs. Body s-chaetae thin and smooth, notably shorter than nearby macrochaetae (Figs 57, 63, 65, 66). Chaetotaxy of thorax and abdomen as in Tab. 7 c and in Figs 57, 63, 65, 66. Tubercles Di on th. I differentiated and fused with De (Fig. 57). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De3 on th. III (Fig. 63) and abd. I free. The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd. I–III. Tubercles Di on abd. V fused, with chaetae Di3 as MCC or mi (Fig. 65). Furca rudimentary without microchaetae. Chaetae L'

and Vl on abd. V present. Cryptopygy slightly developed, abd. VI visible in dorsal view (Fig. 65). Chaetotaxy of legs as in Fig. 61 and Tab. 7c. Claw without inner tooth (Fig. 64).

TABLE 7. Chaetotaxy of *Endonura ossetica* **sp. nov.**:
a) Cephalic chaetotaxy–dorsal side.

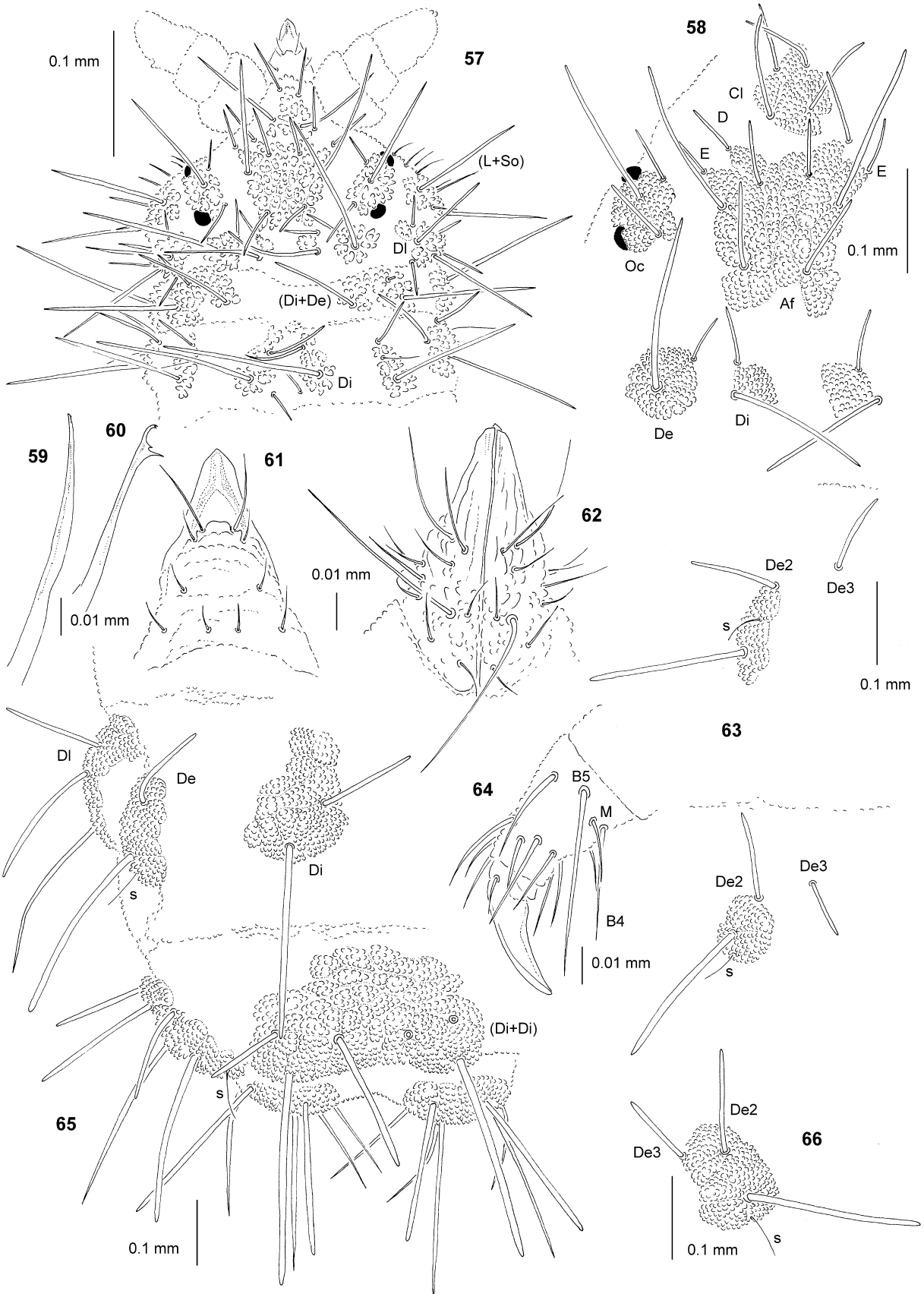
Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	10	Ml	B
		Mc	A, C, D
		Mc or Mcc	E
Oc	3	Ml	Ocm
		Mc	Ocp
		Mc or Mcc	Oca
Di	2	Ml	Di1
		Mc	Di2
De	2	Ml	De1
		Mc or Mcc	De2
Dl	6	Ml	Dl1, Dl5
		Mc	Dl3, Dl4
		Mcc	Dl2, Dl6
(L+So)	8	Ml	L1, L4, So1
		Mcc	L2
		me	So3–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	3
Vem	3
Vep	3–4
labium	11, 0x

c) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I		3	1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel: 4–5; Fu: 5 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 13; An: 2mi				



FIGURES 57–66. *Endonura ossetica* **sp. nov.**: 57, dorsal chaetotaxy of head and th. I–II; 58, chaetotaxy of central area of head (holotype); 59, maxilla; 60, mandible; 61, chaetotaxy of labrum; 62, chaetotaxy of labium; 63, chaetotaxy of tubercles De of th. III and abd. I; 64, tibiotarsus and claw III, dorsolateral view; 65, dorsal chaetotaxy of abd. IV–VI; 66, chaetotaxy of tubercle De of abd. III.

Remarks. An unusual shape of tubercle Af which is connected with chaetae D and E places the new species in an isolated position within the genus. Viewing the key below, *E. ossetica* **sp. nov.** seems to be most similar to *E. urotuberculata* Pomorski & Skarżyński, 2000, a taxon described from Bulgaria (Pomorski & Skarżyński 2000). Nevertheless, besides the character mentioned above, these forms differ in a number of features: presence/absence of eyes (present in *ossetica*, absent in *urotuberculata*), shape of labrum (ogival in *ossetica*, nonogival in *urotuberculata*), presence/absence of tubercle Di on head (present in *ossetica*, absent in *urotuberculata*), number of chaetae (L+So) on head (8 in *ossetica*, 9 in *urotuberculata*), presence of fusion of tubercles Di and De on th. I (present in *ossetica*, absent in *urotuberculata*), presence/absence of free chaeta De2 on th. II–III (absent in *ossetica*, present in *urotuberculata*), presence/absence of cauliflower-like tubercles on abd. V–VI (absent in *ossetica*, present in *urotuberculata*) and presence/absence of microchaetae on furcal remnant (absent in *ossetica*, present in *urotuberculata*).

Ecological note. The species was collected in litter of maple forest.

***Endonura kremenitsai* sp. nov.**
Figs 67–73, Tab. 8

Type material. Holotype: adult female on slide, Russia, Caucasus, Krasnodarsky Krai, between Adler and Sochi, Khostinsky Department Reserve, 250 m alt., subtropical deciduous forest (*Taxus baccata*, *Buxus colchica*), litter under *Taxus*, N43.31729˚, E39.52353˚, 1.VII.2014, leg. M. Potapov, N. Kuznetsova, A. Kremenitsa (MSPU). Paratypes: 4 females, male and 2 juveniles on slides, same data as holotype (MSPU and DIBEC).

Other material. Male and 2 juveniles on slides, Russia, Caucasus, Krasnodarsky Krai, road between Tuapse and Khadyzhensk, surroundings of Gothski pass, about 300 m alt., litter from beech forest (*Fagus orientalis*) on a slope, N44.26951˚, E39.27032˚, 7.VI.2013, leg. M. Potapov, A. Kremenitsa (MSPU).

Etymology. The new species is dedicated to our colleague Alexander Kremenitsa who is studying Collembola of Caucasus.

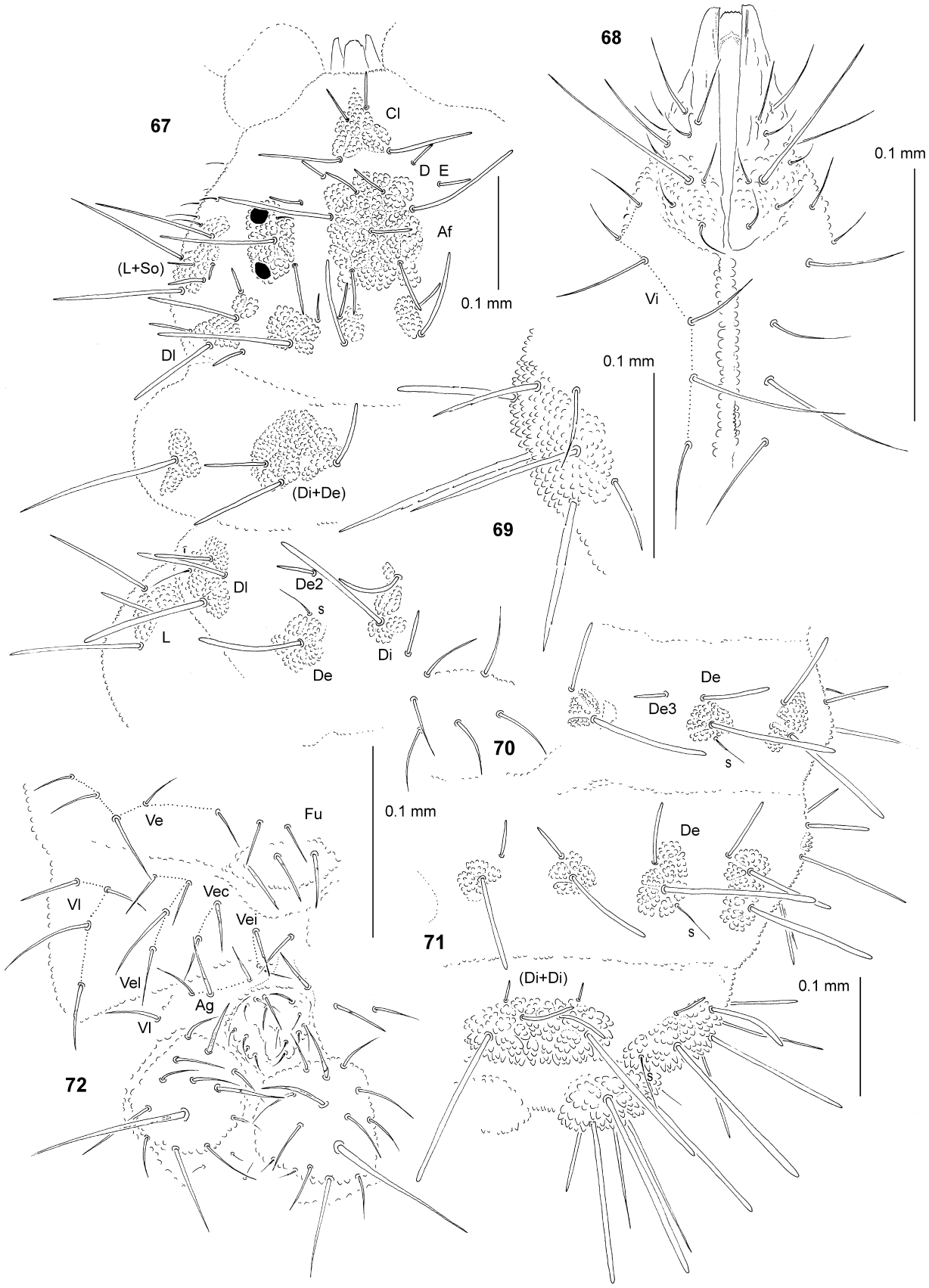
Diagnosis. Habitus typical of the genus *Endonura*. Dorsal tubercles present and well developed. 2+2 pigmented eyes. Buccal cone long, labrum nonogival. Head with chaetae A, B, O, C, D, E, F and G. Tubercles Cl and Af separate. Tubercles Dl and (L+So) on head with 5 and 10 chaetae respectively. Tubercles Di and De on th. I fused. Tubercles De on th. II and III with 3 and 4 chaetae respectively. Tubercles L on abd. III and IV with 4 and 7 chaetae respectively. Abd. IV and V with 8 and 3 tubercles respectively. Claw without inner tooth. Tibiotarsi with chaetae B4 and B5 relatively long.

Description. Habitus typical of the genus. Body length (without antennae): 0.77 (juvenile)–1.65 mm (holotype 1.23 mm). Colour of the body bluish grey. 2+2 large pigmented eyes (Fig. 67).

Types of dorsal ordinary chaetae. Macrochaetae Ml relatively long, slightly thickened, almost cylindrical, straight or arc-like, narrowly sheathed, serrated, apically rounded (Figs 67, 69, 71); macrochaetae Mc and Mcc thickened, straight or arc-like, serrated (Fig. 67, 71), pointed or rounded at apex; mesochaetae and microchaetae short, thin, feebly serrated and pointed.

Head. Labrum nonogival, with ventral sclerifications as in Fig. 68. Labrum chaetotaxy 4/2, 4. Labium as Fig. 68. Maxilla styliform, mandible thin with two basal and two subapical teeth. Chaetotaxy of antennae as in Tab. 8c. Apical vesicle distinct, trilobed. S-chaetae of ant. IV relatively long and thin. Chaetotaxy of head as in Tab. 8a, b, and Fig. 67. Chaeta D not connected with tubercle Cl. Tubercle Af on head longer than tubercles Oc. Elementary tubercles CD present. Chaeta A shorter than B.

Thorax, abdomen, legs. Body s-chaeta thin and smooth, distinctly shorter than nearby macrochaetae (Figs 67, 71). Chaetotaxy of thorax and abdomen as in Tab. 8d and in Figs 67, 69–72. Tubercles Di on th. I differentiated and fused with tubercles De (Fig. 67). Chaetae De3 on th. III and abd. I–III as Mcc. Chaetae De2 on th. II–III and De3 on th. III free. Chaetae De3 on abd. I–III free (Fig. 71). The line of chaetae De1-chaeta s parallel to the dorsomedian line on abd I–III. Furca rudimentary without microchaetae (Figs 70, 72). Tubercles Di on abd. V fused, with chaetae Di2 as Mc or Mcc, and chaetae Di3 as mi (Fig. 71). Male with thick and forked chaetae ("male ventral organ") on anal plates (abd. VI) and in groups: Ag (abd. V), Ve and Vl (abd. IV), and Fu (abd. III, Fig. 72). Chaetae Vl on abd. V present. No cryptopygy. Chaetotaxy of legs as in Tab. 8d. Tibiotarsi with chaetae B4 and B5 relatively long. Claw without inner tooth.



FIGURES 67–72. *Endonura kremenitsai* **sp. nov.**: 67, dorsal chaetotaxy of head and th. I–II (holotype); 68, chaetotaxy of labium and group Vi; 69, chaetotaxy of tubercle L of abd. IV; 70, furca rudimentary (adult female); 71, ventral chaetotaxy of abd. III–VI (adult male); 72, dorsal chaetotaxy of abd. III–VI.

FIGURE 73. Subtropical deciduous forest in Khostinsky Department Reserve, type locality of *Endonura kremenitsai* **sp. nov**.

Remarks. Morphologically, *E. kremenitsai* **sp. nov.** resembles two other new species described herein, *E. paracantabrica* **sp. nov.** and *E. diminutichaeta* **sp. nov**. However, it can be easily distinguished from them by the following combination of characters: presence/absence of chaeta E on head (in *paracantabrica* absent, in others present), presence/absence of elementary tubercles BE on head (in *diminutichaeta* present, in others absent), number of chaetae Dl on head (in *kremenitsai* 5, in *paracantabrica* 6, in *diminutichaeta* 4-5), shape of labrum (ogival in *diminutichaeta***,** nonogival in others), length of chaetae Di1 of abd. IV (in *diminutichaeta* notably short and several times shorter than chaetae Di1 of abd. V, in others short but only ca. twice shorter than chaetae Di1 of abd. V), and presence/absence of male ventral organ (in *kremenitsai* present, in others absent).

TABLE 8. Chaetotaxy of *Endonura kremenitsai* **sp. nov.**:
a) Cephalic chaetotaxy–dorsal side.

Tubercle	Number of chaetae	Types of chaetae	Names of chaetae
Cl	4	Ml	F
		Mc	G
Af	11	Ml	B
		Mc	A, C, O
		Mc or Mcc	D, E
Oc	3	Ml	Ocm
		Mc	Ocp
		Mcc or mi	Oca
Di	2	Ml	Di1
		Mc	Di2
De	2	Ml	De1
		Mc or Mcc	De2
Dl	6	Ml	Dl1, Dl5
		Mc	Dl4
		Mcc	Dl2, Dl3, Dl6
(L+So)	10	Ml	L1, L4, So1
		Mc	L2
		Mcc	L3,So2
		me	So3–6

b) Cephalic chaetotaxy–ventral side.

Group	Number of chaetae
Vi	6
Vea	3
Vem	4
Vep	4
labium	11, 0x

c) Chaetotaxy of antennae.

Segment, Group	Number of chaetae	Segment, Group	Number of chaetae adult
I	7	IV	or, 8 S, i, 12 mou, 6 brs, 2 iv
II	12		
III	5 sensilla AO III		
ve	5	ap	8 bs, 5 miA
vc	4	ca	2 bs, 3 miA
vi	4	cm	3 bs, 1 miA
d	5	cp	8 miA, 1 brs

d) Postcephalic chaetotaxy.

	Terga				Legs				
	Di	De	Dl	L	Scx2	Cx	Tr	Fe	T
th. I	3		1	-	0	3	6	13	19
th. II	3	2+s	3+s+ms	3	2	7	6	12	19
th. III	3	3+s	3+s	3	2	8	6	11	18
					Sterna				
abd. I	2	3+s	2	3	VT: 4				
abd. II	2	3+s	2	3	Ve: 5; chaeta Ve 1 present				
abd. III	2	3+s	2	4	Vel: 5–6; Fu: 5–6 me, 0 mi				
abd. IV	2	2+s	3	7	Vel: 4; Vec: 2; Vei: 2; Vl: 4				
abd. V	(3+3)	7–8+s			Ag: 3; Vl: 1				
abd. VI		7			Ve: 13-14; An: 2mi				

Ecological note. The species was collected in litter of different type of forests, subtropical deciduous forest (Fig. 73) and beech forest.

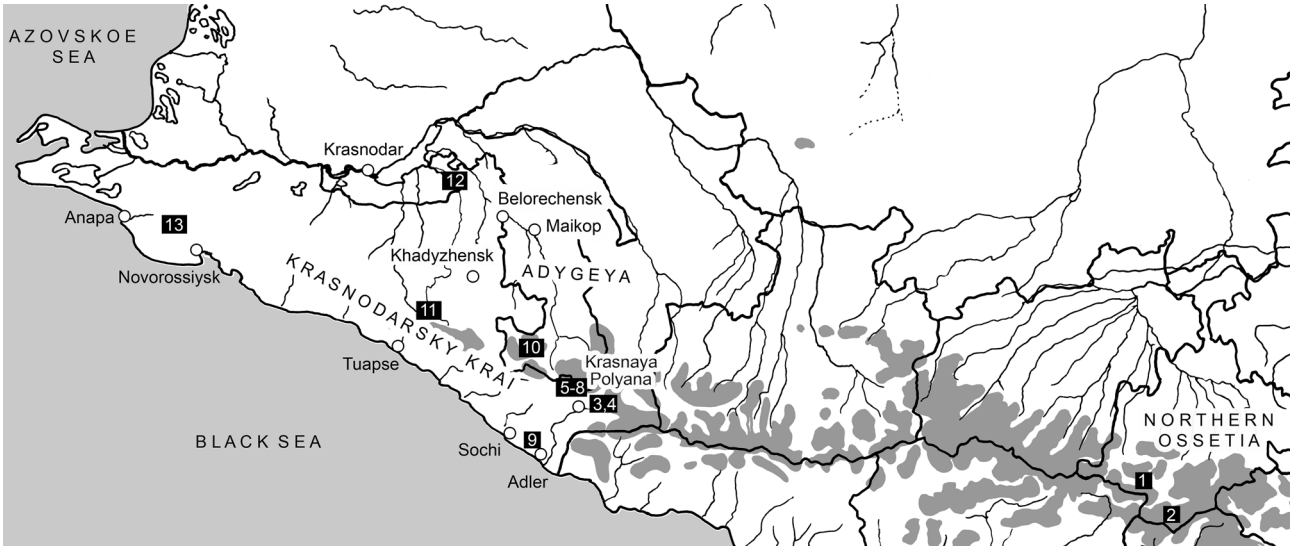


FIGURE 74. The localities of *Endonura* spp collecting in the Caucasus:
1, Northern Ossetia, Karaugom—***alticola***;
2, Northern Ossetia, Tseyskoye Canyon—***ossetica***;
3–4, Krasnodarsky Krai, up from Krasnaya Polyana, Aibga Range—***paracantabrica*** (960 m alt.)**,** ***aibgai*** (2300 m alt.), ***dobrolyubovae*** (2300 m alt.)**,** ***diminutichaeta*** (2300 m alt.);
5–8, Krasnodarsky Krai, up from Krasnaya Polyana, Achishkho Range, 1913 m alt.—***dobrolyubovae, diminutichaeta, cryptopyga***;
9, Krasnodarsky Krai, between Adler and Sochi, Khostinsky Department Reserve—***kremenitsai***;
10, Krasnodarsky Krai, Adygeya, Lagonaki Plateau—***dobrolyubovae***;
11, Krasnodarsky Krai, surroundings of Gothski pass—***dobrolyubovae, kremenitsai***;
12, Krasnodarsky Krai, surroundings of settlement Ryazanskoe—***cryptopyga***;
13, Krasnodarsky Krai, village Semigorsky,—***diminutichaeta.***

Key to the genus *Endonura*

Quite recently, in 2016, Smolis *et al*. published a key to all species of the genus (Smolis *et al*. 2016). Nevertheless, the seven new taxa described herein led us to provide an updated key to the genus.

1. Head with fusion of tubercles Af and Cl 2
- Head with separation of tubercles Af and Cl 7
2. Chaeta O on head present 3
- Chaeta O on head absent 4
3. Tubercles Di on th. I present and fused with De, tubercle (Di+Dl+L) on abd. V with 9 chaetae . . . . . *E. poinsotae* Deharveng, 1980 (France, Corsica)
- Tubercles Di on th. I absent, tubercle (Di+Dl+L) on abd. V with 7 chaetae . . . . . *E. ichnusae* Dallai, 1983 (Italy, Sardinia)
4. Tubercles De on abd. I–III with 4 chaetae 5
- Tubercles De on abd. I–III with 3 chaetae . . . . . *E. granulata* (Cassagnau & Delamare Deboutteville, 1955) (Lebanon)
5. Tubercles Di and De on th. I fused, cryptopygy strongly developed . . . . . *E. gladiirostra* Smolis & Kaprus', 2003 (Israel)
- Tubercles Di and De on th. I separate, cryptopygy absent or weakly developed 6
6. Chaeta E on head present, Tubercle Dl on head with 4 chaetae . . . . . *E. tyrrhenica* Dallai, 1983 (Italy, Sardinia)
- Chaeta E on head absent, Tubercle Dl on head with 6 chaetae . . . . . *E. pejai* Deharveng, 1980 (France, Corsica)
7. Tubercle Af on head equal or shorter than tubercles Oc 8
- Tubercle Af on head longer than tubercles Oc 9
8. Labrum with ventral sclerifications ogival and without prelabral chaetae . . . . . *E. gracilirostris* Smolis, Skarżyński, Pomorski & Kaprus', 2007 (Crimea, Moldova)
- Labrum with ventral sclerifications nonogival and with prelabral chaetae . . . . . *E. taurica* (Stach, 1951) (Crimea)
9. Chaeta O on head present 10
- Chaeta O on head absent 31
10. Eyes completely absent 11
- Eyes present 12
11. Tubercles Di on th. I present . . . . . *E. arbasensis* Deharveng, 1979 (France, Spain)
- Tubercles Di on th. I absent . . . . . *E. caeca* (Gisin, 1963) (Bosnia and Herzegovina)
12. Anterior eye present and located outside tubercle Oc . . . . . *E. asiatica* Smolis, Deharveng & Kaprus', 2011 (Kyrgyzstan)
- Anterior eye present or absent, if present located within tubercle Oc 13
13. Anterior eye present 14
- anterior eye absent . . . . . *E. immaculata* Deharveng, 1980 (France, Corsica)
14. Claw with inner tooth, tibiotarsi with long chaetae B4 and B5 15
- Claw without tooth, tibiotarsi with short chaetae B4 and B5 17
15. Tubercle Dl on head with 3 chaetae, tubercles Di on th. II–III with 2 chaetae . . . . . *E. tetrophtalma* (Stach, 1929) (Hungary)
- Tubercle Dl on head with 5 chaetae, tubercles Di on th. II–III with 3 chaetae 16
16. Chaeta E on head present, tubercles Di on th. I absent . . . . . *E. lusatica* (Dunger, 1966) (Germany, Poland, Ukraine)
- Chaeta E on head absent, tubercles Di on th. I present . . . . . *E. aibgai* **sp. nov.**
17. Chaeta E on head absent 18
- Chaeta E on head present 20
18. Tubercle Cl on head with chaetae D, elementary tubercle DF present . . . . . *E. colorata* (Gama, 1964) (Portugal)
- Tubercle Cl on head without chaetae D, elementary tubercle DF absent 19
19. Tubercle (L+So) on head with 8-9 chaetae, tubercles Di and De on th. I separate . . . *E. cantabrica* (Deharveng, 1979) (Spain)
- Tubercle (L+So) on head with 10 chaetae, tubercles Di and De on th. I fused . . . . . *E. paracantabrica* **sp. nov.**
20. Tubercle Dl on head with at least 6 chaetae 21
- Tubercle Dl on head with less number of chaetae 28
21. Tubercles Di on head present 22
- Tubercles Di on head absent . . . . . *E. dalensi* Deharveng, 1979 (Andorra, France, Spain, Italy, Albania)
22. Body white 23
- Body blue or bluish–grey 24
23. Tubercle (L+So) on head with 9 chaetae, macrochaetae thin and pointed . . . . *E. deharvengi* Cassagnau & Péja, 1979 (Greece)
- Tubercle (L+So) on head with 8 chaetae, macrochaetae thickened and blunt . . . . . *E. levantica* Smolis, Deharveng & Kaprus', 2011 (Israel)
24. Tubercle De on th. III with 2 ordinary chaetae . . . . . *E. gladiolifer* (Cassagnau, 1954) (Algeria, Spain)
- Tubercle De on th. III with 3 ordinary chaetae 25
25. Tubercle Cl on head with chaetae D, furca rudimentary with microchaetae . . . . . *E. alavensis* Pozo & Simon, 1982 (Spain)
- Tubercle Cl on head without chaetae D, furca rudimentary without microchaetae 26
26. Labrum with ventral sclerifications ogival, tubercles Di and De on th. I fused . . . . . *Endonura alticola* (Stach, 1951) (Russia)
- Labrum with ventral sclerifications nonogival, tubercles Di and De on th. I separate 27
27. Tubercle (L+So) on head with 9 chaetae, free chaeta L on abd. IV present . . . . . *E. quadriseta* Cassagnau & Péja, 1979 (Greece, Turkey, Crimea)
- Tubercle (L+So) on head with 10 chaetae, free chaeta L on abd. IV absent . . . . . *E. reticulata* (Axelson, 1905) (Finland; Russia; Sweden; United States, Alaska)
28. Tubercles Di and De on th. I separate . . . . . *E. occidentalis* (Deharveng, 1979) (Spain)
- Tubercles Di and De on th. I fused 29
29. Tubercle De on th. III with 2 ordinary chaetae, tubercle (Di+Di) on abd. V with 1-2+1-2 chaetae . . . . . *E. cretensis* (Ellis, 1976) (Greece, Israel)
- Tubercle De on th. III with 3 ordinary chaetae, tubercle (Di+Di) on abd. V with 3+3 chaetae 30

30. Labrum with ventral sclerifications nonogival, chaeta E on head free ..... *E. kremenitsai* **sp. nov.**
- Labrum with ventral sclerifications ogival, chaeta E on head connected with tubercle Af ..... *E. diminutichaeta* **sp. nov.**
31. Cryptopygy strong and complete, tubercles of abd. VI invisible in dorsal view . *E. ludovicae* (Denis, 1948) (France, Corsica)
- Cryptopygy absent or weak, tubercles of abd. VI well or partially visible in dorsal view 32
32. Body bluish–grey 33
- Body white 37
33. Claw with inner tooth, labrum chaetotaxy 4/2, 4 34
- claw without inner tooth, labrum chaetotaxy 0/2, 2 ... *E. ceratolabralis* Smolis, Kahrarian, Piwnik & Skarżyński, 2016 (Iran)
34. Tubercle Dl on head with 6 chaetae ..... *E. dentifera* Smolis, Skarżyński, Pomorski & Kaprus', 2007 (Crimea)
- Tubercle Dl on head with 5 chaetae 35
35. Labrum elongated with ventral sclerifications ogival ..... *E. cryptopyga* **sp. nov.**
- Labrum short with ventral sclerifications nonogival 36
36. Chaeta E on head present, chaeta Ocp on head slightly shorter than chaeta A ..... *E. persica* Smolis, Kahrarian, Piwnik & Skarżyński, 2016 (Iran)
- Chaeta E on head absent, chaeta Ocp on head distinctly longer than chaeta A ..... *E. dobrolyubovae* **sp. nov.**
37. Chaeta C on head absent 38
- Chaeta C on head present 40
38. Macrochaetae Di1 on abd. V distinctly thickened and club–like ..... *E. baculifer* Deharveng, 1979 (Portugal)
- Macrochaetae Di1 on abd. V slightly thickened and cylindrical 39
39. Eyes present, tubercles Di on th. I present ..... *E. transcaucasica* (Stach, 1951) (Georgia)
- Eyes absent, tubercles Di on th. I absent ..... *E. carpatica* Smolis, 2006 (Poland)
40. Tubercle Cl on head with chaetae D, elementary tubercle DF present 41
- Tubercle Cl on head without chaetae D, elementary tubercle DF absent 42
41. Chaeta E on head present, tubercle Dl on head with 6 chaetae. ..... *E. tartaginenis* Deharveng, 1980 (France, Corsica)
- Chaeta E on head absent, tubercle Dl on head with 5 chaetae *E. dichaeta* Smolis, Kahrarian, Piwnik & Skarżyński, 2016 (Iran)
42. Chaeta E on head present 43
- Chaeta E on head absent 44
43. Eyes present, cauliflower-like tubercles on abd. V–VI absent ..... *E. ossetica* **sp. nov.**
- Eyes absent, cauliflower-like tubercles on abd. V–VI present .... *E. urotuberculata* Pomorski & Skarżyński, 2000 (Bulgaria)
44. Chaeta L4 on head free, eyes absent or present unpigmented 45
- Chaeta L4 within tubercle (L+So), eyes present pigmented or unpigmented 47
45. Abd. V with 2 tubercles. ..... *E. incolorata* (Stach, 1951) (Poland, Ukraine, Romania)
- Abd. V with 3 tubercles. 46
46. Abd. IV with 8 tubercles, macrochaetae Ml relatively short ..... *E. tatricola* (Stach, 1951) (Poland, Slovakia)
- Abd. IV with 5 tubercles, macrochaetae Ml long ..... *E. dudichi* (Loksa, 1967) (Hungary, Poland, Slovakia)
47. Tubercle Dl on head with 6 chaetae, tubercle L on abd. III with 3 chaetae .... *E. centaurea* Cassagnau & Péja, 1979 (Greece)
- Tubercle Dl on head with 5 chaetae, tubercle L on abd. III with 4 chaetae ..... *E. saleri* Fanciulli & Dallai, 2008 (Italy)

General remarks

Many papers indicate that Neanurinae have a strong tendency to speciation, which is likely related to the high stenotopy and low agility of their species. The mentioned stenotopy is illustrated by very strong association of this group with forests, which may in turn be linked with specific diet (e.g. slime moulds, fungi) or a limited resistance to drying. Both association with forest environments and low mobility result in easy formation of barriers between different populations, and in consequence, a high degree of endemism. Hence from many regions of the world local concentrations of species belonging to a sole genus are described. Interestingly, examples of such species diversity hot spots are known from both the tropical and temperate zones. For example, regional diversity hot spots, consisting of several to a dozen species, were detected in many genera e.g. *Australonura* Cassagnau, 1980; *Ectonura* Cassagnau, 1980; *Himalmeria* Cassagnau, 1984; *Monobella* Cassagnau, 1979; *Nepalimeria* Cassagnau, 1984; *Palmanura* Cassagnau & Palacios-Vargas, 1983; *Paranura* Axelson, 1902; *Phradmon* Greenslade & Deharveng, 1991; *Siamanura* Deharveng, 1987 (Cassagnau 1984, 1993, Deharveng 1987, 1989, Deharveng & Greenslade 1990a, 1990b, Greenslade & Deharveng 1991, Deharveng *et al*. 1997, Bedos & Deharveng 1998, Deharveng & Bedos 2002, Palacios-Vargas *et al*. 2009, Smolis & Deharveng 2015).

Analysis of the literature showed that a similar phenomenon has been also described within genus *Endonura* (Dallai 1983, Deharveng 1982a, Smolis *et al*. 2007, Smolis 2008a). As mentioned in the introduction, three-quarters of the species are known from Europe. The following concentrations of species have been described so far from the continent (in brackets given the number of species): Carpathian Mountains (4), Crimea (4), Sardinia (3), Corsica (5) and Spain (6). In comparison to these areas, the fauna of *Endonura* in the Caucasus seems to be a very

rich as it consists presently of nine species. An open question remains whether stenotopy and poor dispersal ability, together with the existence of geographical barriers in a form of high mountain ridges or large rivers are the only combination of factors responsible for the observed species richness in the area. It seems that one of the factors which may affect the speciation is the lack of competition, which is universally known especially with respect to the island ecosystems and many groups of organisms. In other words, thanks to the absence or low diversity of other Neanurinae, there was a large supply of unoccupied niches available for *Endonura* species. This assumption is in a sense confirmed by analysis of the collected material and literature data that point to the relatively low diversity of other members of the subfamily in the region. In the Caucasus Neanurinae includes, besides nine *Endonura* species, four species of the genus *Neanura* (Smolis & Kuznetsova in prep.), *Biloba caucasica*, *Caucasanura stebayevae*, *Ghirkanura chernovae*, and species of an unnamed genus (Kuznetsova & Smolis in prep.). For comparison, in the Carpathians, well known with respect to the richness and diversity of the subfamily, four *Endonura*, four *Neanura*, six *Deutonura*, three *Bilobella*, two *Cryptonura* and *Thaumanura*, and one species of *Adbiloba* and *Pumilinura*, were recorded (Dunger 1973, Deharveng 1982b, Weiner 1981, Smolis 2002, 2008b, Fiera 2007, Smolis & Kaprus' 2008, Smolis *et al.* in prep.). Additionally, *Endonura* species from the Caucasus are highly diverse in terms of body size and shape of a buccal cone, characters that probably allow to avoid interspecific competition.

Almost all new species of *Endonura* (excluding *E. ossetica*) were found in Krasnodarsky Krai, which occupies approximately one fourth of the Caucasus mountains. Thus, further new species of the genus can be expected from the rest parts of the regions where *Endonura* has been poorly studied yet. The Caucasus is located between the Mediterranean region and Central Asia where a notable number of the new *Endonura* species was described these last years (e. g. Smolis *et al*. 2011, 2016). Part of new species described here are more similar to Mediterranean (*cantabrica*, *dentifera*) and Central-European (*lusatica*) species, while other Caucasian species strongly resemble Iranian members of the genus (*ceratolabralis*, *persica*). The interesting question is the origin of Caucasian *Endonura* and the genus at all. It suggests their close affinity and the historical connection between these faunas. Combination of such features as high concentration of species on limited territory and complex character of the fauna (similarity with European and Asian groups of species), allow to assume that the Caucasus mountains may be territory of the origin of the genus *Endonura*. Our studies showed that members of the genus living here can be crucial for understanding history and phylogeny of one of the largest taxon of Neanurinae.

Acknowledgments

We are grateful to our colleagues who helped us to collect the material in the Caucasus expedition trips: A. Kremenitsa, M. Furgoł, L. Vanyavina, and especially to M. Potapov, who organized these trips. We thanks Prof. Wanda M. Weiner from Institute of Systematics and Evolution of Animals PAS (Cracow, Poland). To her kindness we have an opportunity to examine the type material of *Biloba alticola.* We are also very grateful Louis Deharveng and László Dányi for their remarkable suggestions and corrections to the manuscript. We would like to thank Anatoly Babenko for helpful comments on the manuscript.

The work was financially supported by the Russian Foundation for Basic Research (grant N16-04-01228).

References

Axelson, W.M. (1902) Diagnosen neuer Collembolen aus Finland und angrenzenden Teilen des nordwestlichen Russlands. *Meddelanden Societatis pro Fauna et Flora Fennica,* 28, 101–111.

Axelson, W.M. (1905) Einige neue Collembolen aus Finland. *Zoologisher Anzeiger*, 28, 788–794.

Bedos, A. & Deharveng, L. (1998) A taxonomic and cladistic analysis of the west European genus *Monobella* (Collembola, Neanuridae). *Zoologica Scripta*, 27 (4), 291–309.
http://dx.doi.org/10.1111/j.1463-6409.1998.tb00462.x

Cassagnau, P. (1954) Sur un rudiment de furca chez les Neanurinae et sur quelques espèces de ce groupe. *Extrait Du Bulletin de la Société D'Histoire Naturelle de Toulouse*, 89, 27–34.

Cassagnau, P. (1979) Les Collemboles Neanuridae des Pays Dinaro-Balkaniques: leur interêt phylogénétique et biogéographique. *Biologia Gallo–Hellenica*, 8, 185–203.

Cassagnau, P. (1980) Nouveaux critères pour un redécoupage phylogénétique des Collemboles Neanurinae (s. Massoud 1967).

In: Dallai, R. (Ed.), *Proceedings of the first International Seminar on Apterygota, University of Siena* 1978, 115–132.
Cassagnau, P. (1984) Introduction a l'étude des Phylliomeriens (Collembole Neanuridae): diagnoses preliminaires des espèces. *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 4 (3), 1–30.
Cassagnau, P. (1989) Les Collemboles Neanurinae; elements pour une synthèse phylogénétique et biogéographique. *In*: Dallai, R. (Ed.), *3rd International Seminar on Apterygota*, *Siena*, 171–182.
Cassagnau, P. (1993) Les Collemboles Neanurinae de l'Himalaya; III – Genre *Nepalimeria*. *Revue suisse de Zoologie*, 100 (1), 91–112.
http://dx.doi.org/10.5962/bhl.part.82502
Cassagnau, P. & Delamare Deboutteville, C. (1955) Mission Henri Coiffait (1951). 3. Collemboles. *Archivesde Zoologie Expérimentale et Génerale*, 91, 365–395.
Cassagnau, P. & Palacios-Vargas, J.G. (1983) Contribution a l'étude des Collemboles Neanurinae d'Amerique Latine. *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 4 (1), 1–16.
Cassagnau, P. & Péja, N. (1979) Diagnoses préliminaries de quelques Neanuridae de Grèce et d'Albanie. *Biologia Gallo–Hellenica*, 8, 205–222.
Dallai, R. (1983) Interesse biogeografico dei Neanuridi (Collembola) della Sardegna e delle isole dell'Arcipelago Toscano. Lavori della Societa Italiana di Biogeografia, (N.S.) 8, 417–465.
Deharveng, L. (1979) Contribution à la connaissance des Collemboles Neanurinae de France et de la Peninsule Iberique. *Travaux du Laboratoire d'Écobiologie des Arthropodes Edaphiques*, *Toulouse*, 1, 1–61.
Deharveng, L. (1980) Contribution à la connaissance systématique, écologique et biogéographique des collemboles Neanurinae de Corse. *Revue d'écologie et de biologie du sol*, 17 (3), 419–435.
Deharveng, L. (1982a) *Contribution à l'étude des Collemboles Neanurinae: évolution, spéciation, polymorphisme somatique et chromosomique des formes européennes.* PhD thesis, Toulouse, France, University of Paul Sabatier, 284 pp.
Deharveng, L. (1982b) Contribution à l'étude des *Deutonura* du groupe *phlegrea* (Collembola: Neanuridae). *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 3 (2), 1–20.
Deharveng, L. (1983) Morphologie évolutive des Collemboles Neanurinae en particulier de la lignée Neanurinae. *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 4, 1–63.
Deharveng, L. (1987) *Siamanura* n.g., nouveau genre Thailandais de Collembole Neanurinae. *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 5 (2), 1–41.
Deharveng, L. (1989) The genus *Paranura* Axelson 1902 in Thailand (Collembola: Neanurinae). *Tropical Zoology*, 2, 103–21.
http://dx.doi.org/10.1080/03946975.1989.10539432
Deharveng, L. & Bedos, A. (2002) Nouveaux *Ectonura* de Nouvelle-Calédonie (Collembola: Neanuridae). *In*: Najt, J. & Grandcolas, P. (eds.), *Zoologia Neocaledonica 5*, *Mémoires du Muséum national d'Histoire naturelle*, 187, 91–102.
Deharveng, L. & Greenslade, P. (1990a) Australian Species of the Genus *Australonura* (Collembola: Neanuridae). *Invertebrate Taxonomy*, 3, 565–93.
Deharveng, L. & Greenslade, P. (1990b) Species of *Australonura* (Collembola: Neanuridae) from the Solomon Islands. *Invertebrate Taxonomy*, 3, 595–603.
Deharveng, L. & Weiner, W.M. (1984) Collemboles de Corée du Nord III–Morulinae et Neanurinae. *Travaux de Laboratoire d'Écobiologie des Arthropodes Édaphiques*, *Toulouse*, 4, 1–61.
Deharveng, L., Mouloud, S.A. & Bedos, A. (2015) A new species of *Deutonura* (Collembola: Neanuridae: Neanurinae) from Algeria, with revised diagnosis of the genus and key to western Palaearctic species. *Zootaxa*, 4000 (4), 464–472.
Deharveng, L., Weiner, W.M. & Najt, J. (1997) Le genre *Ectonura* en Nouvelle-Calédonie (Collembola, Neanuridae, Neanurinae). *In*: Najt, J. & Matile, L. (eds.), *Zoologia Neocaledonica 4*, *Mémoires du Muséum national d'Histoire naturelle*, 171, 45–61.
Denis, J.R. (1948) Sur la faune Française des Aptérygotes (XXIV^{e} note). Étude du matériel récolté en Corse par P. et L. Rémy en 1942. *Annales des Sciences Naturelles Zoologie 11^{e} série*, 9, 1–12.
Dunger, W. (1966) Zur Kenntnis von Neanura tetrophtalma (Stach) (Collembola: Apterygota). *Abhandlungen und Berichte des Naturkundemuseums Görlitz*, 41 (4), 1–11.
Dunger, W. (1973) Neue und bemerkenswerte Collembolenarten der Familie Neanuridae. *Abhandlungen und Berichte des Naturkundemuseums Görlitz*, 48 (5), 1–20.
Ellis, W.N. (1976) Autumn fauna of *Collembola* from Central Crete. *Tijdschrift voor Entomologie*, 119, 221–236.
Fanciulli, P.P. & Dallai, R. (2008) Three new species of Collembola from north-east Italy. *Zootaxa*, 1701, 15–28.
Fiera, F. (2007) Checklist of Romanian springtails (Collembola). *Folia Entomologica Hungarica*, 68, 5–40.
Gama, M.M. da (1964) Colêmbolos de Portugal Continental. *Mémorias e Estudos do Museu Zoológico da Universidade de Coimbra*, 292, 1–252.
Gisin, H. (1960) *Collembolenfauna Europas. Muséum d'histoire naturelle*, Genève, 312 pp.
Gisin, H. (1963) Sieben neue Arten von Collembolen aus Bosnien und Wiederbeschreibung von *Onychiurus serratuberculatus* Stach. *Extrait du Godišnjak Biološkog Instituta Univerziteta u Sarajevu*, 14, 3–13.
Greenslade, P. & Deharveng, L. (1991) *Phradmon*, a New genus of Paleonurini (Collembola: Neanuridae) from Australia with a Key to the Genera from Southern Regions and Notes on *Pronura*. *Invertebrate Taxonomy*, 5, 837–54.
http://dx.doi.org/10.1071/IT9910837
Jordana, R., Arbea, J.I., Simón, C. & Luciáñez, M.J. (1997) Collembola, Poduromorpha. *In*: Ramos M. A. *et al.* (Eds), Fauna

Ibérica, vol. 8, Museo Nacional de Ciencias Naturales. CSIC, Madrid, 807 pp.
Loksa, I. (1967) Vier neue Höhlencollembolen aus Ungarn (Biospeologica Hungarica, XIII). *Opuscula Zoologica Budapest*, 6 (2), 289–296.
MacGillivray, A.D. (1893) North American Thysanura. *Canadian Entomologist*, 25. 313–318. http://dx.doi.org/10.4039/Ent25127-5
Massoud, Z. (1967) Monographie des Neanuridae, Collemboles Poduromorphes à pièces buccales modifiées. *In*: Delamare Deboutteville, C. & Rapoport, E.H. (eds.), *Biologie de l'Amérique Australe*, *Paris*, CNRS, pp. 7–399.
Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858. http://dx.doi.org/10.1038/35002501
Kuznetsova, N.A. & Potapov, M.B. (1988) New data on the taxonomy of springtails of the family Neanuridae and Hypogastruridae (Collembola). *Zoologichesky Zhurnal*, 67 (12), 1833–1844.
Palacios-Vargas, J.G., García-Barros, E. & Simón Benito, J.C. (2009) Phylogeny of the genus Palmanura (Collembola: Neanuridae). *Cladistics*, 25, 1–15.
Pomorski, R.J. & Skarżyński, D. (2000) A new species of *Endonura* Cassagnau, 1979 from Bulgaria with remarks on *Endonura centaurea* (Cassagnau & Peja, 1979) (Collembola, Neanuridae). *Zoosystema*, 22, 117–120.
Pozo, J. & Simón, J.C. (1982) Colémbolos del Pais Vasco I. *Neanura* (*Endonura*) *occidentalis alawensis* nov. ssp. y *Neanura* (*Deutonura*) *plena* ssp. *plena* Stach, 1951. *Eos*, 57, 221–229.
Salmon, J.T. (1964) *An index to the Collembola*. Vol. 1–2, Society Victoria University of Wellington, Wellington, 144 pp.
Smolis, A. (2002) A new species of the genus *Cryptonura* Cassagnau, 1979 from Poland (Collembola: Neanuridae). *Genus*, 13 (3), 325–330.
Smolis, A. (2006) *Endonura carpatica*, a new species from Poland (Collembola, Neanuridae, Neanurinae). *Genus*, 17 (4), 471–476.
Smolis, A. (2008a) Redescription of four Polish *Endonura* Cassagnau, 1979 (Collembola, Neanuridae, Neanurinae), with a nomenclature of the ventral chaetae of antennae. *Zootaxa*, 1858, 9–36.
Smolis, A. (2008b) Review of the Polish *Deutonura* Cassagnau, 1979 (Collembola: Neanuridae: Neanurinae) with redescription of *D. conjuncta* (Stach, 1926). *Acta zoologica cracoviensis*, 51B (1–2), 43–82.
Smolis, A. (2016) On the identity of some poorly known species of the genus *Endonura* Cassagnau, 1979 (Collembola, Neanuridae, Neanurinae). *Zootaxa*, 4173 (3), 237–250. http://doi.org/10.11646/zootaxa.4173.3.3
Smolis, A. & Deharveng, L. (2006) *Vitronura mascula*, a new species of Neanurinae (Collembola: Neanuridae) from northern Vietnam, with a key to the species of the genus. *Revue suisse de Zoologie*, 113 (2), 263–268. http://dx.doi.org/10.5962/bhl.part.80349
Smolis, A. & Deharveng, L. (2015) Diversity of *Paranura* Axelson, 1902 (Collembola: Neanuridae: Neanurinae) in Pacific region of Russia and United States. *Zootaxa*, 4033 (2), 203–236. http://dx.doi.org/10.11646/zootaxa.4033.2.2
Smolis, A. & Kaprus', I.J. (2003) A new species of the genus *Endonura* Cassagnau, 1979 from Israel (Collembola: Neanuridae). *Genus*, 14, 325–329.
Smolis, A. & Kaprus', I.J. (2008) *Bilobella carpatica*, a new species of Neanurinae (Collembola: Neanuridae) from the Carpathians. *Revue suisse de Zoologie*, 115 (3), 509–514. http://dx.doi.org/10.5962/bhl.part.80440
Smolis, A. & Kaprus', I.J. (2009) Redescription of *Endonura cretensis* (Ellis, 1976) (Collembola: Neanuridae: Neanurinae) with a new record from Israel. *Annales Zoologici*, 59, 1–6. http://dx.doi.org/10.3161/000345409X432538
Smolis, A., Deharveng, L. & Kaprus', I.J. (2011) Studies on the non-European *Endonura* Cassagnau, 1979 (Collembola, Neanuridae, Neanurinae). *Zootaxa*, 3004, 45–56.
Smolis, A., Kahrarian, M., Piwnik, A. & Skarżyński, D. (2016) *Endonura* Cassagnau in Iran, with a key of the genus (Collembola, Neanuridae, Neanurinae). *Zookeys*, 553, 53–71. http://dx.doi.org/10.3897/zookeys.553.6009
Smolis, A., Skarżyński, D., Pomorski, R.J. & Kaprus', I.J. (2007) Redescription of *Endonura taurica* (Stach, 1951) and *E. quadriseta* Cassagnau & Péja, 1979, and description of two new species of the genus *Endonura* Cassagnau, 1979 (Collembola: Neanuridae: Neanurinae) from the Crimea (Ukraine). *Zootaxa*, 1442, 19–35.
Stach, J. (1929) Verzeichnis der Apterygogenea Ungarns. *Annales Musei Nationalis Hungarici*, *Budapest*, 26, 282–283.
Stach, J. (1951) The Apterygotan fauna of Poland in relation to the world-fauna of this group of insects. Family: Bilobidae. Polska Akademia Umiejętności, Acta monographica Musei Historiae Naturalis, Kraków, 97 pp.
Weiner, W.M. (1981) Collembola of the Pieniny National Park in Poland. Acta zoologica cracoviensis, 25, 417–500.
Zazanashvili, N. & Mallon, D. (Eds.) (2009) Status and Protection of Globally Threatened Species in the Caucasus. Tbilisi: CEPF, WWF. Contour Ltd., 232 pp.