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New species of the genus *Megalothorax* Willem, 1900 (Collembola: Neelipleona) from a superficial subterranean habitat at Dobšinská Ice Cave, Slovakia

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Abstract

New species of *Megalothorax* Willem, 1900 from Dobšinská Ice Cave, Slovakia, *M. dobsinensis* **sp. n.**, is described and illustrated. New species inhabits a cold habitat along an inversed temperature gradient at the cave entrance. *M. dobsinensis* **sp. n.** differs from other species of the genus by the lack of chaeta *X* on Ant. IV and by T-shaped inner chaetae of thoracic and abdominal sensory fields. Only two other species, *M. tuberculatus* Deharveng & Beruete, 1993 and *M. sanctistephani* Christian, 1998 lack chaeta *X* on Ant. IV. *M. dobsinensis* **sp. n.** differs from both species by chaetotaxy of antennae and abdomen. Summary tables of antennae and legs chaetotaxy and dichotomous identification key for species with smooth mucro are provided.

Key words: Western Carpathians, MSS, taxonomy, troglophile, identification key

Introduction

The smallest order of Collembola, Neelipleona, contains altogether 6 genera. A comprehensive review of Neelipleona has been recently published involving redescriptions of genera *Acanthoneelidus*, *Neelides* and *Neelus* (Schneider 2017). This important study proposed unifying nomenclatural framework for the entire order, taking into consideration also juvenile morphology. New morphological characters, specified in that paper, substantially improved the identification of Neelipleona. *Megalothorax* Willem, 1900 is the most diverse Neelipleona genus with 29 species worldwide. Seven species have been found in Slovakia (Papáč & Kováč 2013), mostly as members of edaphic communities in various habitats occupying soil and litter. However, some species share troglomorphic adaptations, which are strictly limited to subterranean environment and have endemic distribution.

Several older studies carried out at the entrance habitats of Dobšinská Ice Cave, characteristic with microclimatic and vegetation inversion, revealed cold tolerant species of springtails *Hypogastrura crassaegranulata* (Stach, 1949) and *Appendisotoma absoloni* Rusek, 1966 and beetle *Choleva nivalis* (Kraatz, 1856) (Stach 1949; Nosek 1969; Růžička & Vávra 1993; Kováč *et al*. 1999). Complex study of cave invertebrates in this cave in 2004 (Kováč *et al*. 2006), covering entrance section and deeper glaciated and unglaciated parts, found communities with 54 terrestrial and aquatic invertebrates altogether. The entrance slope, characterized by pronounced microclimatic gradient, covers peculiar superficial subterranean habitats—milieu souterrain superficiel (MSS), occupied by several relicts among the soil fauna. During the recent study of invertebrates at entrance sites of Dobšinská Ice Cave, a new species of the genus *Megalothorax* was discovered. Inversed collapse doline at entrance of Dobšinská Ice Cave hosts also other congeners, *M. minimus* Willem, 1900 and *M. willemi* Schneider & D´Haese, 2013 that are restricted to upper, warmer part of the slope/gradient. The cave is occupied by another species, *M. carpaticus* Papáč & Kováč, 2013 found on water surface of the pools in its deeper, unglaciated parts (Papáč & Kováč 2013; Kováč 2018).

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Material and methods

Locality. Dobšinská Ice Cave is located in the Slovak Paradise National Park, Western Carpathians, in an area of temperate climate. The entrance of this static-dynamic ice cave is a collapse doline (Fig. 1) at an elevation of 969 m a.s.l. in a north-facing slope covered by a coniferous forest. It is the isolated terminal part of Stratenská Cave System, a 23.6 km long multilevel cave. The collapse separated the cave with 1483 m passages and vertical span of 112 m from the remainder of the system, probably in the Middle Quaternary. The main part of the cave consists of a large collapsed chamber containing perennial ice masses, descending to a depth of 70 m. Most of its volume is filled with a glacier with an ice volume of more than 110.132 m^3, glaciated surface 9772 m^2 and a maximum depth of 26.5 m, making it the largest known compact ice monolith in a cave in the world. The average air temperature in glaciated Great Hall is -2.7 to -3.9 °C in February and around + 0.2 °C in August (Bella & Zelinka, 2018).

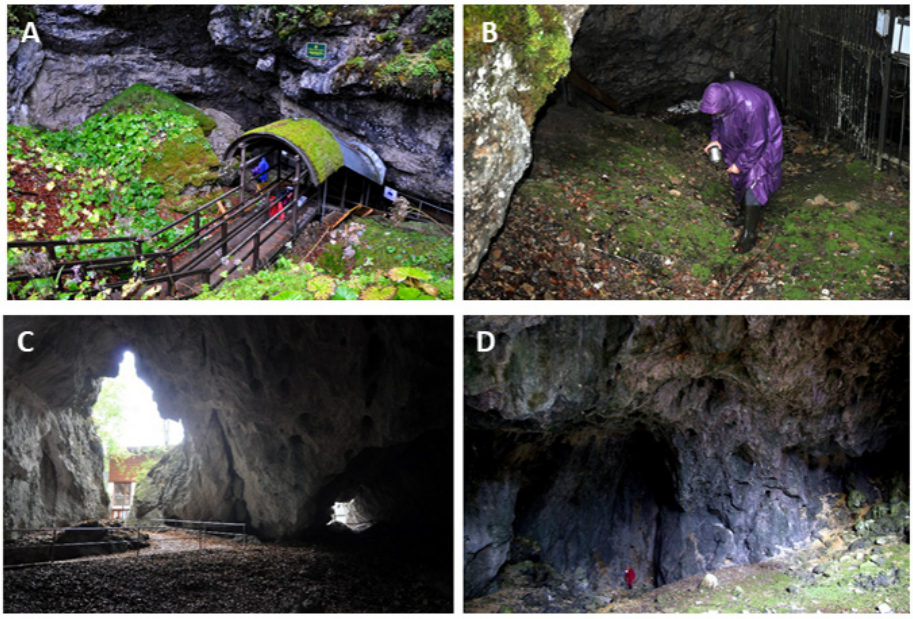


FIGURE 1. A, Dobšinská Ice Cave, entrance: collapse doline (Photo: Ľ. Kováč); B, Dobšinská Ice Cave, cold site at the cave entrance: limestone scree covered by soil, leaves and pioneer vegetation, mostly mosses and liverworts (Photo: Ľ. Kováč); C, Harmanecká Cave, entrance morphology (Photo: Ľ. Kováč); D, Harmanecká Cave, Izbica Hall, twilight zone, limestone scree on the bottom partly covered with sediment, algae, cyanobacteria and mosses (Photo: P. Fenďa).

Micro-climatic data of type habitat. At the cave entrance, the average annual temperature -0.5 °C was measured at a soil depth of 3 cm (October 2016–October 2017, data from iButton DS1921G data-loggers), temperature ranged from + 3.3 °C (September 2017) to -10.5 °C (January 2017). Gravimetric soil moisture at this site ranged between 34.59 % (October 2016) and 52.11 % (May 2017) (Raschmanová et al. 2018).

Sampling. The specimens were obtained from scree slope with north exposition (25–30°), a specific cold habitat with pioneer mosses near the ice cave entrance (Fig. 1B). The samples, represented by soil cores 10 cm in diameter to a maximum depth of 6 cm, were extracted in modified high-gradient apparatus (Crossley & Blair 1991). A total of 10 soil samples were taken from site in autumn and spring during the period 2016–2017.

Observation. Specimens were preserved in 96 % benzinalcohol then cleared in 10 % potassium hydroxide and chloralfenol and finally mounted on microscope slides using Swann mounting medium (Rusek 1975). Specimens were examined using a light microscope Leica DM 1000 equipped with phase contrast optics and drawings were made using a drawing tube. Fig. 15 was made using a light microscope Leica DM 2500 with differential interference contrast.

Measurements. Measurements were performed with a micrometric ocular. Values given in µm were measured on several relevant specimens (holotype and paratypes). Body length was measured on slides without antennae and furca; claw and empodium length were measured between the most basal proximal point and the tip (inner margin). Besides common measurements for *Megalothorax*, we also included here the ratio "claw I (inner margin): Ti I length".

TABLE 1. Lengths (µm, mean in parenthesis) of morphological structures in *M. dobsinensis* **sp. n.** (male and females separately)

Body part	*M. dobsinensis* **sp. n.**, females	*M. dobsinensis* **sp. n.,** male
Body total	450–550 (496)	500
a1 labrum	6–10 (7.75)	8
a2 labrum	10–15 (12.5)	12
Antenna	87–98 (90.1)	87
Ant. I	11–12 (11.8)	12
Ant. II	16–19 (17.8)	16
Ant. III–IV	57–67 (60.3)	59
Tibiotarsus I length	35–44 (40.1)	39
Tibiotarsus II length	30–39 (34.5)	32
Tibiotarsus III length	29–34 (31.8)	32
Unguis I	15–19 (16.8)	18
Unguis II	13–18 (15.1)	15
Unguis III	11–16 (12.2)	15
Unguiculus I	8–11 (9.3)	9
Unguiculus II	8–10 (8.5)	9
Unguiculus III	7–11 (8.6)	8
Manubrium	25–33 (29.1)	24
Dens (proximal part, dp)	20–28 (23.8)	23
Dens (distal part, dd)	31–40 (35.6)	36
Mucro	30–39 (35.1)	38
Mucro width (middle part)	4–6 (5.2)	6
a6/a5 setae on Th III	13–18/9–14 (15.8/11.2)	18/14
seta on Sc1 (Leg I)	6–8 (6.8)	8

Nomenclature. We used the Neelipleona morphological nomenclature after Schneider & D´Haese (2013) and Schneider (2017).

Abbreviations. l.v.—linea ventralis; Ant.—antennal segment; Th.—thoracic segment; Abd.—abdominal segment; sf—sensory field; wrc—free wax rod generating crypt; Or—Ant. IV organite; s1/s2—trunk swollen sensilla; a.v.—anal valve; la/lp—claw anterior/posterior basal lamellae; Bp—claw postero-median lamella; sc—subcoxa; cx—coxa; Tr—trochanter; Fe—femur; Ti—tibiotarsus; MNHN—Muséum national d´Histoire naturelle, Paris; SCA—Slovak Caves Administration, Rimavská Sobota.

Taxonomy

Genus *Megalothorax* Willem, 1900

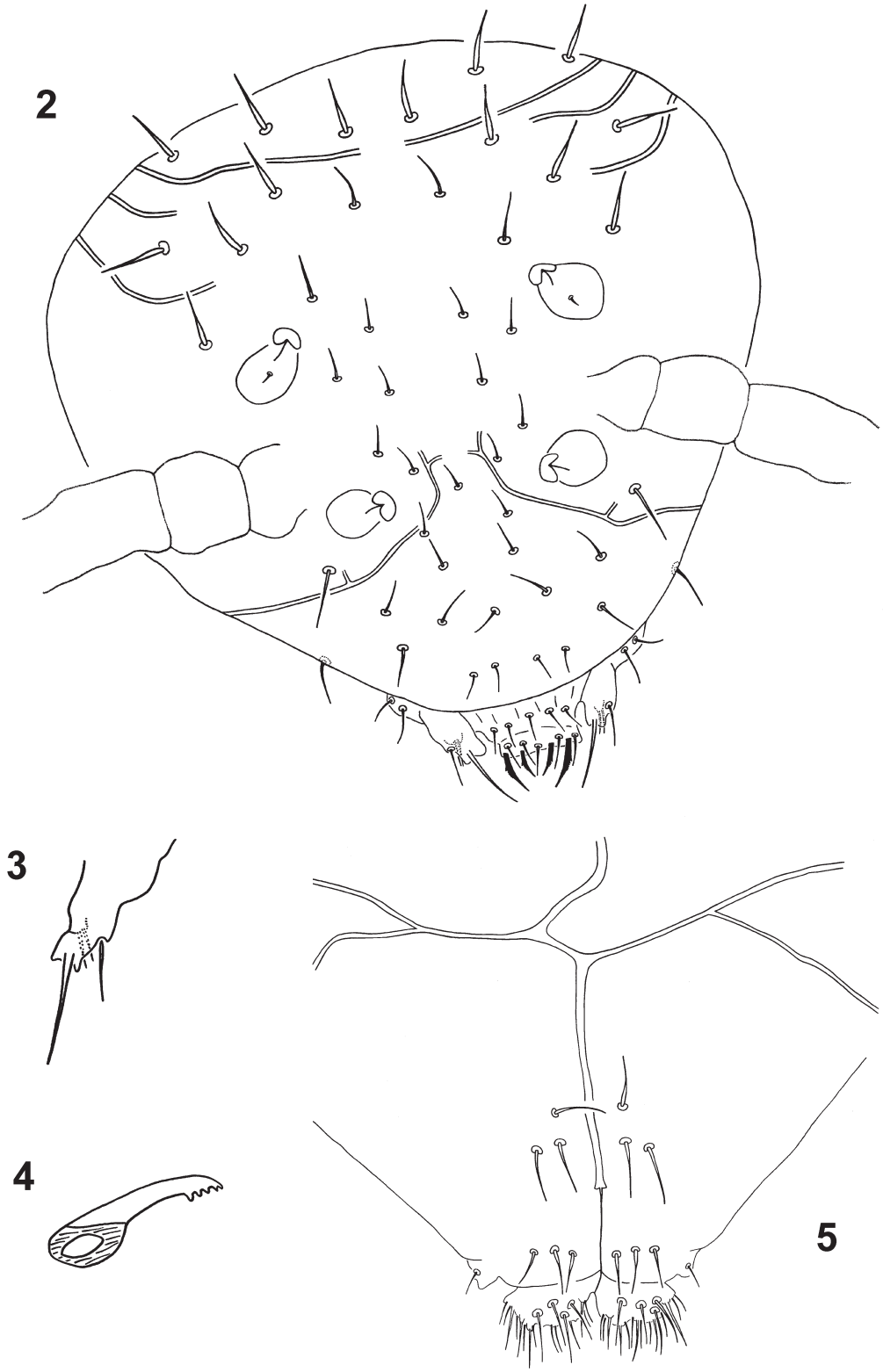
Megalothorax dobsinensis sp. n.

Figs 2–18

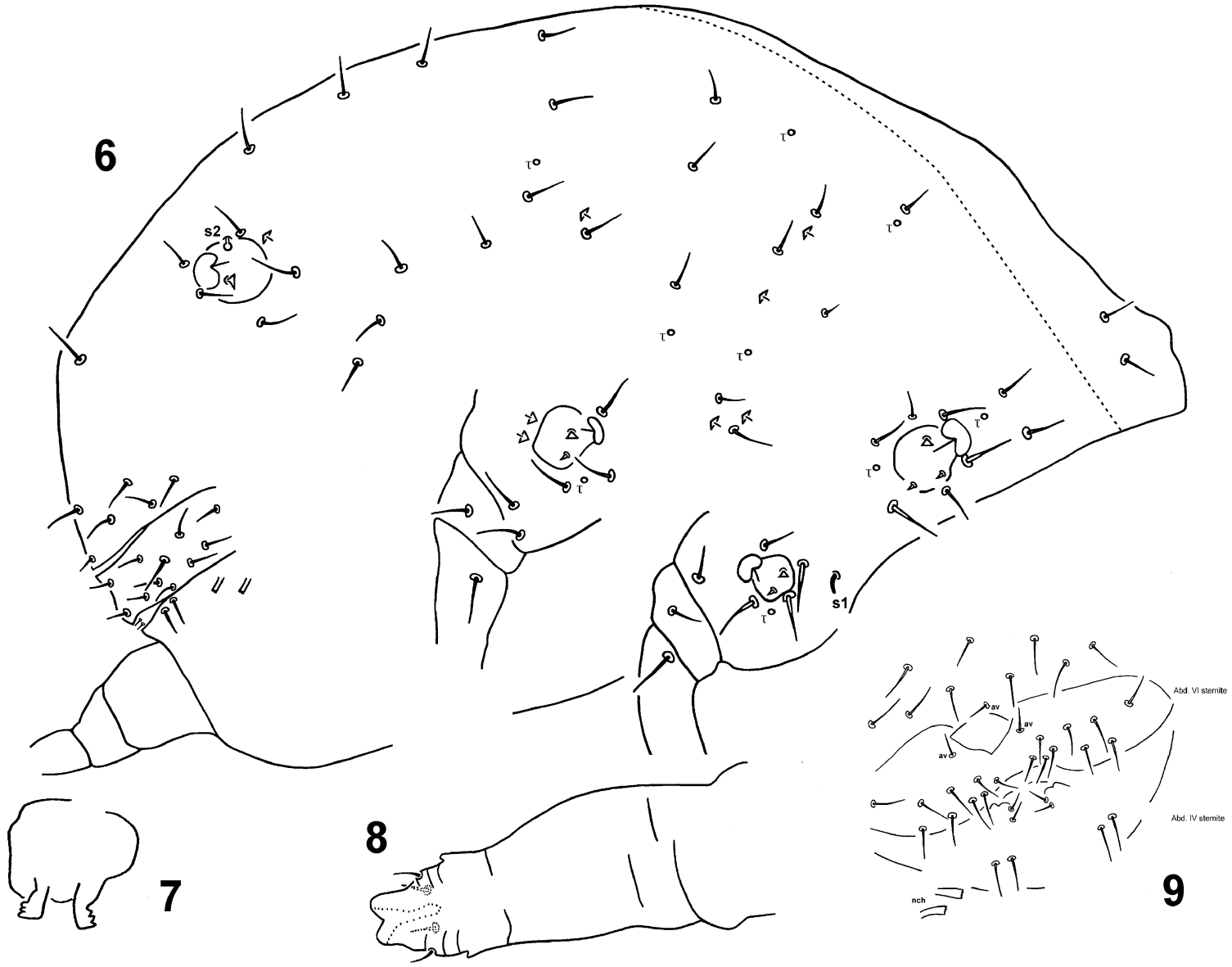
Material examined. Holotype: female on slide (350–16), Slovakia, Slovak Paradise; cold section of scree slope at entrance of Dobšinská Ice Cave; 48.8680°N, 20.3041°E; alt= 969 m; 4.x.2016; extraction of soil; N. Raschmanová and Ľ. Kováč leg. Paratypes: male and 7 females on slides (350–16), same data as the holotype. Type material (holotype and 3 paratypes) saved in the Apterygota collection of MNHN, Paris. Other paratypes saved in collection of SCA, Rimavská Sobota, Slovakia.

Other material. Slovakia: Slovak Paradise; cold section of scree slope at entrance of Dobšinská Ice Cave: 2 females and male on slides, 10.v.2017 (43–17), 5 juveniles and male on slides (44–17), 3 females on slides (46–17), 2 females and male on slides (47–17); 13 females, 2 males, 3 juveniles on slides and 4 individuals in alcohol, 4.x.2016, (352–16). All specimens collected by N. Raschmanová and Ľ. Kováč.

Slovakia: Veľká Fatra Mts., Harmanecká Cave, 48.8139°N, 19.0401°E; alt= 821 m; 3 males and 8 females (30–14), 30 m from entrance, Izbica Hall; direct collection on surface of water pool; 18.ix. 2014; V. Papáč leg.

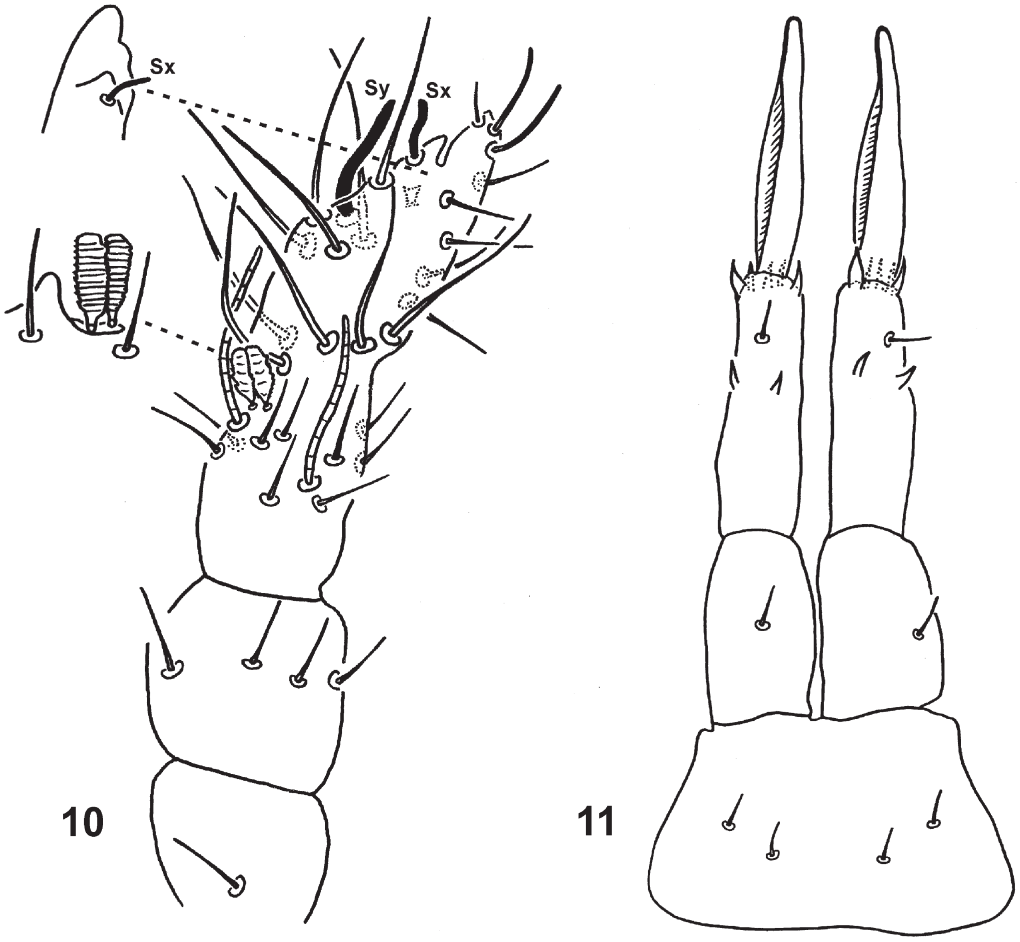


FIGURES 2–5. *Megalothorax dobsinensis* **sp. n.**: 2, head, dorsal side; 3, outer lobe of maxilla; 4, left mandibula; 5, ventral side of head with labium and connection of epicuticular channels with linea ventralis.



FIGURES 6–9. *Megalothorax dobsinensis* **sp. n.**: 6, body chaetotaxy; 7, retinaculum; 8, tubus ventralis; 9, female genital plate, nch—neosminthuroid chaetae.

Diagnosis. White, with few dots of black pigments scattered on dorsal part of head, thorax, abdomen and subcoxae. Presence of integumentary triangle instead of chaeta *X* on Ant. IV. Labium: basomedian fields with 3+3 chaetae, basolateral fields with 1+1 chaetae. Integumentary channels branched on posterior part of head, present also on anterior part, connection of channels with *l.v.* circular. Some chaetae enlarged and thickened, of which 7+7 dorsal, posterior on head and 3+3 on Th. II tergum. Inner chaeta of *sf2* slender with pointed apex, other inner chaetae of *sf3–6* T- and candlelight-shaped. Dorsal s-chaetae *s2* globular, absence of dorsal s-chaetae *s3*. Abd. I to V terga with 19+19 ordinary chaetae. Each claw of ordinary morphology, subequal. Tenaculum with 3+3 teeth. Abd. IV sternum with 2+2 chaetae. Mucronal lamellae smooth, thin.



FIGURES 10–11. *Megalothorax dobsinensis* **sp. n.**: 10, antenna, dorsal view (S-chaetae S2, S3 on Ant. III enlarged); 11, furca, posterior view.

Description. General aspect. Habitus and segmentation typical of the genus. Length from labrum to anus: ~550 μm. Body chaetotaxy sparse including ordinary chaetae, s-chaetae, τ-chaetae as trichobothria (hardly visible), neosminthuroid chaetae, wax rod secretory elements and special swollen chaetae within *sf2–6*. Length of chaetae ranging from microchaetae [inferior to 6 μm] to mesochaetae [6–15μm] and macrochaetae [superior to 15 μm]. Shape of chaetae ranging from simple to thickened.

Integument. Integumentary channels branched laterally and dorsally in posterior and anterior part of head (Figs 2, 16). Cephalic channels connection with *l.v.* circular (Figs 5, 17).

Sensory fields and wax rods. A total of 14+14 wax rod secretory crypts (2+2 on head, 12+12 on body), including the ones inserted in each of 6+6 sensory fields (Figs 2, 6, 15, 16, 18). *sf1* without inner chaeta (Fig. 1). *sf2* with one slender inner chaeta with pointed apex (Fig. 2). *sf3* with three inner chaetae, bigger one is more T-shaped. *sf4* and 5 each with two inner chaetae, bigger one is more T-shaped. *sf6* with one inner T-shaped chaeta (Fig. 6, 15, 18).

Mouth parts. Labrum with mesochaetae in *a*- and *m*-row (Fig. 2), *a1*, *2* with one small external tooth and with slightly serrate outward tip; *m0* almost on the same level as *m1*. Oral fold with 2+2 mesochaetae. Maxillary outer

lobe: palp with sub-apical mesochaeta and apical papillate macrochaeta, edge of apical papilla with integumentary lobes (Figs 2, 3); sublobal plate with two mesochaetae (6 μm). Basomedian fields of labium with 3+3 mesochaetae (Fig. 5), basolateral fields with 1+1 mesochaetae on tubercle. Labial palp chaetal equipment typical of the genus, guard hairs strong in regard of papillate chaetae. Maxillae typical of the genus. Both mandibulae with five apical teeth and well-developed molar plate (Fig. 4), right mandibula with simple tooth between apex and molar plate. Ridge of the labrum with two pikes.

Head chaetotaxy. 7+7 thickened posterior macrochaetae distinctly longer and stronger than anterior chaetae (16 μm, Fig. 2). Dorsal anterior area with 10 pairs of chaetae (9+9 mesochaetae, 1+1 macrochaetae) and two axial mesochaetae. Lateral anterior area with 1+1 mesochaetae. Dorsal posterior area with 12 pairs of chaetae (7+7 thickened macrochaetae, 2+2 thickened mesochaetae and 3+3 ordinary mesochaetae (Figs 2, 16). Ventral side with three pairs of post-labial mesochaetae (Figs 5, 17).

TABLE 2. Summary of antennal chaetotaxy.

Ant.	**I**	**II**	**III**		**IV**			
	chaetae	chaetae	chaetae	S-chaetae	chaetae	S-chaetae	Organit	Sensory rods
M. dobsinensis **sp. n.**	1	4	9	*S1–S4*	6 (*X* absent)	12 (10 *S*, *Sx*, *Sy*)	*Or*	2 (*a*, *sa*)

Antennal chaetotaxy. Illustrated in Fig. 10 and summarized in Table 2. Ant. I with one mesochaeta. Ant. II with four chaetae: thickened mesochaetae (10 μm) and 3 ordinary mesochaetae (6 μm). Ant. III with 9 ordinary mesochaetae, 2 long S-chaetae (*S1*, *S4,* more than *20* μm) and 2 short S-chaetae (*S2*, *S3, 8–10* μm). *S2* and *S3* protruding from shallow cupule but partially covered by strong integumentary lobe. *S2*, *S3* ornamentation feebly visible. *S4* in apical position to *S1*, on the same level as *S2*, *S3*. Ant. IV with 12 S-chaetae (*10 S*, *Sy* and *Sx*), 6 micro- and mesochaetae (without chaeta *X*) a small organite *Or*, 2 apical and subapical rods (*a*, *sa*). S-chaetae *S* with blunt apex, chaeta *X* missing, integumentary triangle lobe placed immediately above chaeta *Sx*.

Thoracic terga chaetotaxy. Th. II with 12+12 chaetae of different length, 1+1 s-chaetae *s1* tubular (5 μm) and 3+3 τ-chaetae (Figs 6, 18). Chaetae including 5+5 macrochaetae (same length of *a2, a4*, *a7*, *a8*, *a9*,) and 7 + 7 mesochaetae. Th. III with 10+10 chaetae, 6+6 free wax-rod generating crypts (*wrc1–6*) and 5+5 τ-chaetae (Figs 6, 18). Chaetae including 4+4 macrochaetae (*a6, a7, a8, a9*), 6+6 mesochaetae (stouter *a1*, *a5*, *p2*, *p3*, *p4 and slender a3*). Chaeta *p4* moved posteriorly from *wrc2*. Chaeta *a6* stronger than *a5* (Fig. 6). Pattern of folds on Th I. is similar to *M. minimus* (sensu Schneider, 2017).

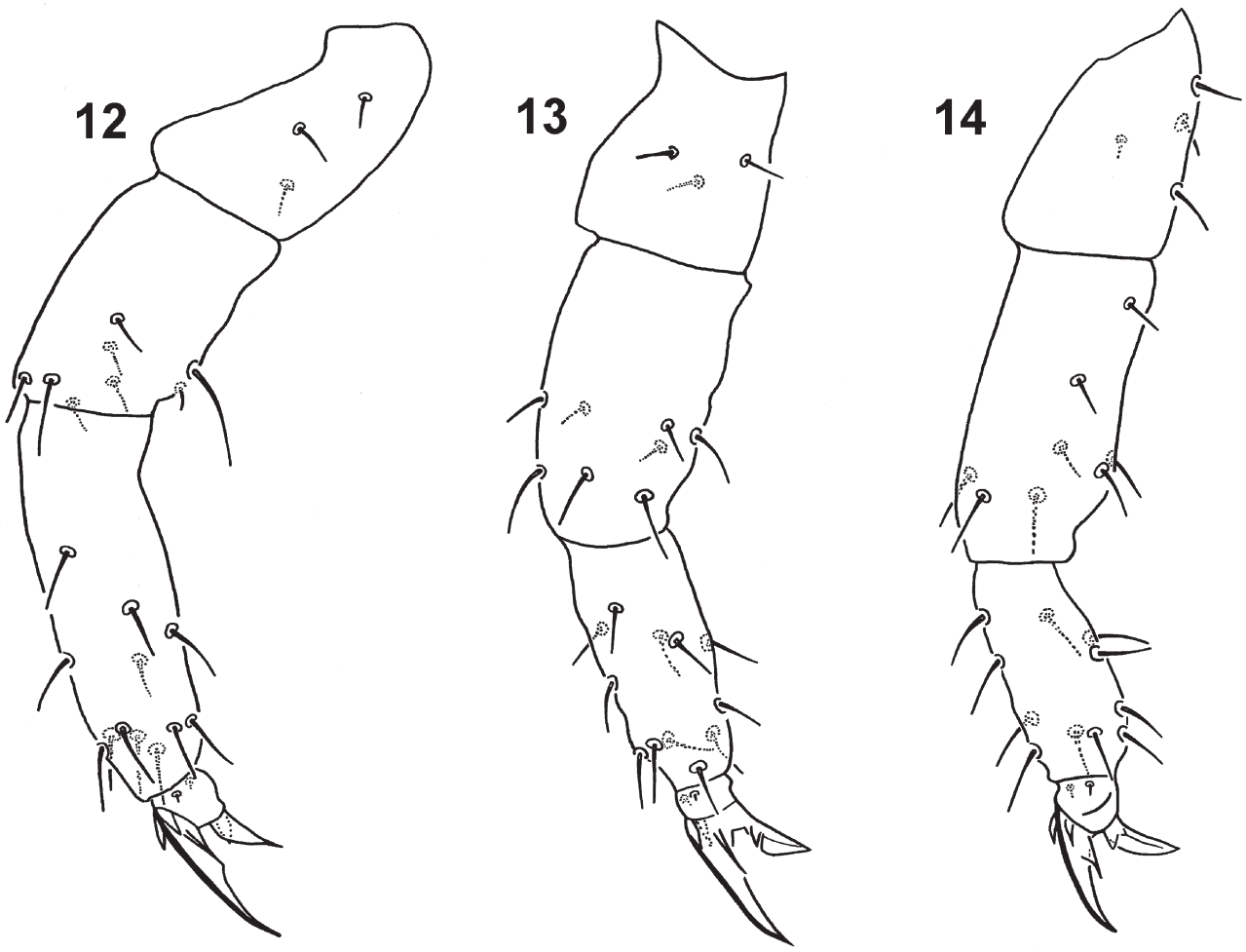
Legs chaetotaxy. Legs with ordinary chaetae of variable size as in Figs 6, 12–14 and summarized in Table 3. Subcoxa 1 I with a mesochaeta, coxa I with a microchaeta. Subcoxa 1, 2 II with a mesochaeta, coxa II with a macrochaeta. Subcoxa 1, 2 III and coxa III with respectively 2, 1, 1 macrochaetae. Anterior and posterior microchaetae present on each pretarsus.

TABLE 3. Summary of legs chaetotaxy.

Leg	**I**						**II**						**III**					
Segment	Sc1	Sc2	Cx	Tr	Fe	Ti	Sc1	Sc2	Cx	Tr	Fe	Ti	Sc1	Sc2	Cx	Tr	Fe	Ti
M. dobsinensis **sp. n.**	1	0	1	3	8	12	1	1	1	3	8	12	2	1	1	4	8	11

Foot complex. Each claw with ordinary morphology (Figs 12–14), subequal in unguis length and subtly in the proportion of unguiculus. Unguis basal and posterior auxiliary lamellae (*la*, *lp* and *Bp*) well developed, *Bp* more protrude only on claw II and III. Each unguiculus with a well developed lobe not or feebly protruding. Ratio unguis length vs tibiotarsus length on leg I–III respectively as 0.54, 0.60, 0.58.

Abd. I–V terga chaetotaxy. With a total of 19 + 19 chaetae, 1+1 τ-chaetae, 2+2 free wax-rod generating crypts (*wrc7*, *8*), 1+1 globular s-chaetae *s2* (Fig. 6, 15). Chaetae including 13+13 mesochaetae (the longest *α1*, *α2, β2*, *β3*, *δ4*, *η1* reaching 14 μm) and 6+6 macrochaetae (*α3*, *ε2*, *ε3, ζ2, η2, η3*, 17 μm). Chaeta *α3* close to *wrc7*, both clearly anterior to *β3*. Chaetae *β4* missing.



FIGURES 12–14. *Megalothorax dobsinensis* **sp. n.**: 12, part of the leg I; 13, part of the leg II; 14, part of the leg III.

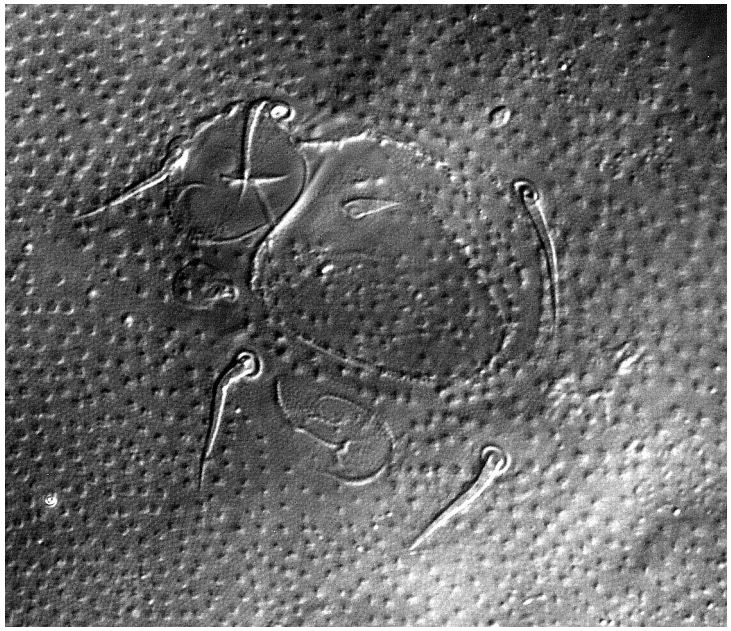


FIGURE 15. *Megalothorax dobsinensis* **sp. n.**: 15, abdominal sensory field with T-shaped inner chaeta.

Abd. VI and genital chaetotaxy. Abd. VI with 9 dorsal mesochaetae, axial unpair *a0* shorter than lateral a- and m-row chaetae (12–13 μm) (Fig. 9); each anal valve with mesochaeta *av*; with 9+9 ventral mesochaetae, in male

were not observed additional ventral cylindrical swollen chaetae *sm*. Genital plate: female with 2+2 microchaetae; male with 10+10 mesochaetae arranged in circle.

Other sterna. Abd. IV sternum with 2+2 neosminthuroid chaetae and 2+2 posterior mesochaetae (Fig. 9). Manubrium with 2+2 posterior mesochaetae (Fig. 10). Proximal subsegment of dens with one posterior mesochaeta; distal subsegment posteriorly with two basal spines, one median mesochaeta and two apical spines, anteriorly with three apical spines, posterior spines with slightly elongated apex. Mucro with a narrowing in the apical 2/5, lamellae edges smooth. Tenaculum with 3+3 hook-like teeth (Fig. 7). Ventral tube with two apical pairs of mesochaetae (Fig. 8).

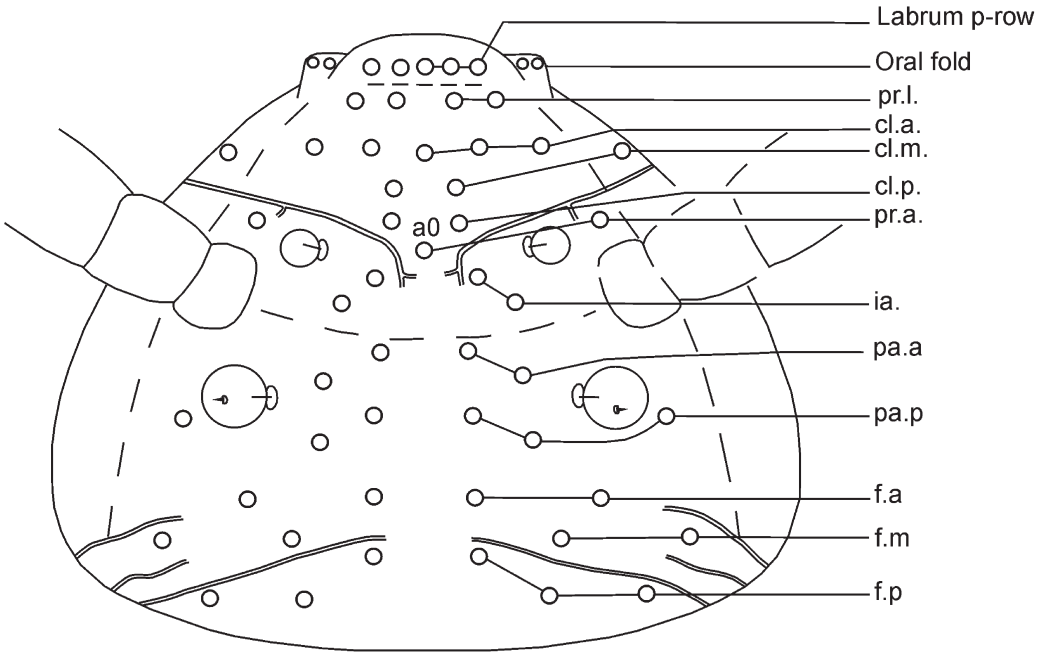


FIGURE 16. *Megalothorax dobsinensis* **sp. n.**: 16, diagram of dorsal chaetotaxy of head.

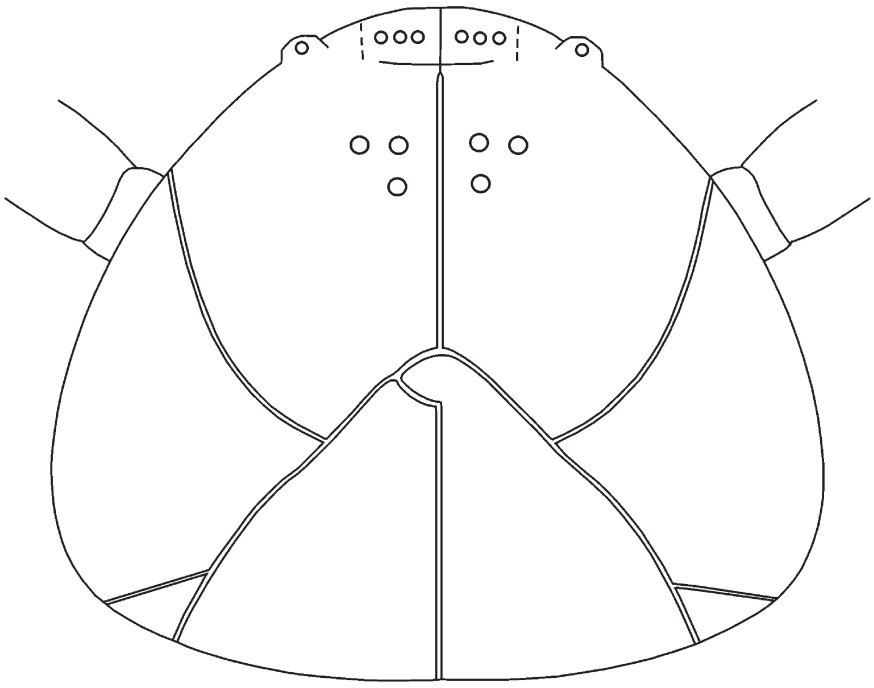


FIGURE 17. *Megalothorax dobsinensis* **sp. n.**: 17, diagram of ventral chaetotaxy of head and cuticular channels.

Etymology. The new species is named after the type locality, Dobšinská Ice Cave situated in Central Europe,Western Carpathians.

Affinities. *M. dobsinensis* **sp. n.** belongs to the *minimus* species group (Schneider & D'Haese 2013; Papáč & Kováč 2013). Within this group, it shares the absence of chaeta *X* on Ant. IV and branched integumentary structure on forehead with *M. sanctistephani* Christian, 1998 and *M. tuberculatus*. But it differs from both species by the presence of T-shaped inner chaetae in sensory fields (vs. candlelight-shaped), abdominal chaetotaxy (*M. dobsinensis* **sp. n.** has 19+19 chaetae with missing *β4* vs. 20+20 chaetae in *M. tuberculatus* and *M. sanctistephani*) and various number of ordinary chaetae on Ant. III (*M. sanctistephani* with 6 chaetae, *M. tuberculatus* 8 chaetae and *M. dobsinensis* **sp. n.** 9 chaetae) and Ant. IV (*M. sanctistephani* with 5 chaetae, *M. tuberculatus* 4 chaetae and *M. dobsinensis* **sp. n.** 6 chaetae). Moreover, *M. sanctistephani* lacks integumentary triangle lobe and chaeta *X* on Ant. IV, and chaeta *a0* on head is replaced by an oval depression.

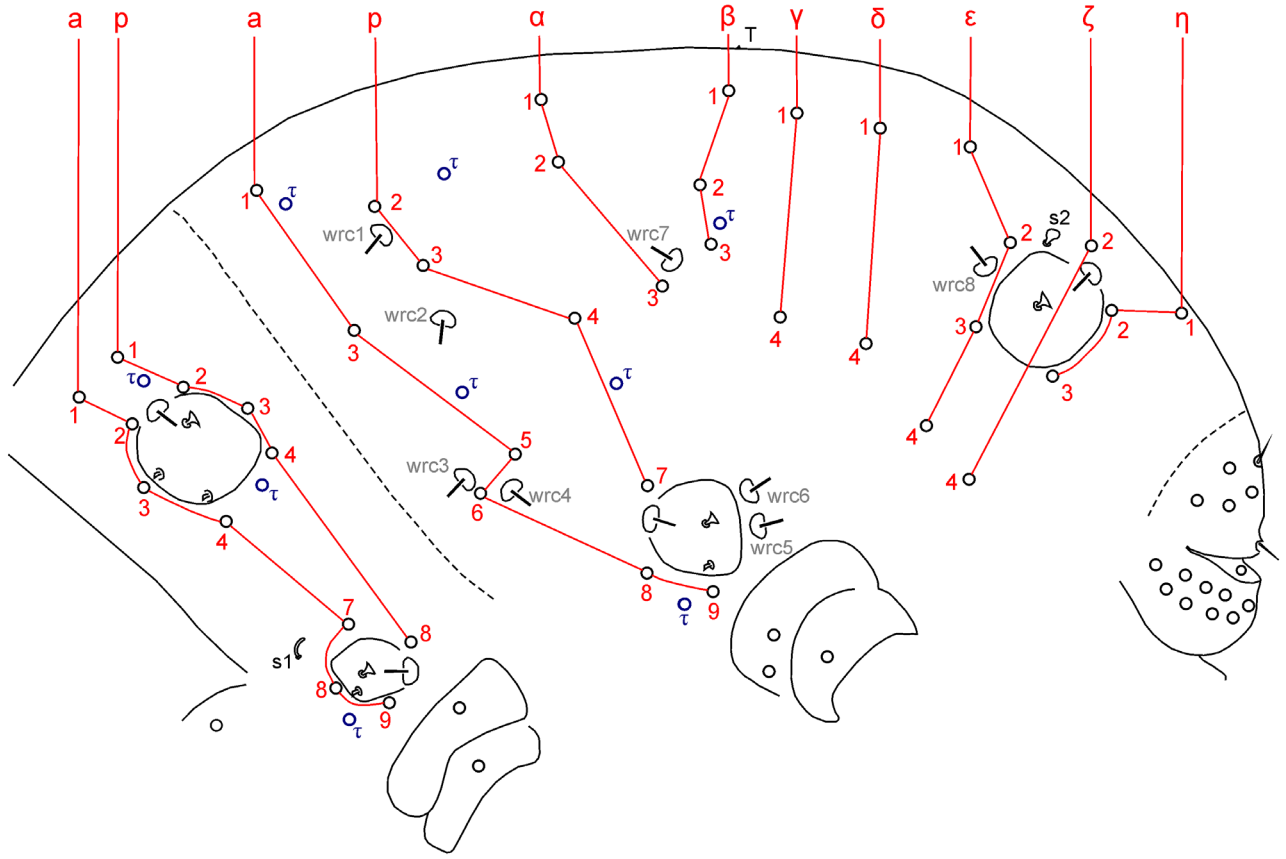


FIGURE 18. *Megalothorax dobsinensis* **sp. n.**: 18, diagram of chaetotaxy of thorax and abdomen.

Recently described *M. hipmani* Papáč & Kováč, 2013 belongs to *incertus* group of species and therefore is easily distinguished from the new species (serrate vs. smooth mucro and globular vs. T-shaped inner chaetae in sf). The thickened macrochaetae on hind margin of head clearly separate *M. dobsinensis* **sp. n.** from *M. tatrensis* Papáč & Kováč, 2013. *M. dobsinensis* **sp. n.** is the most similar to *M. carpaticus*. The main differences between both species are chaetotaxy of Ant. IV (absence or presence of chaeta *X* on Ant. IV and different number of ordinary chaetae: 6 in *M. dobsinensis* **sp. n.** vs. 8 in *M. carpaticus*) and shape of inner sensillae in sf (T- vs. candlelight-shaped).

Ecology and distribution. The new species was discovered at the entrance parts of Dobšinská Ice Cave (DIC) and Harmanecká Cave (HC) located in central karst regions of the Western Carpathians. Both caves are seasonally open to public, with electric lighting and a guided path. The specimens were found in a typical MSS habitat, i.e. stony debris covered with soil and litter at the cave entrance (DIC), and also on the surface of water pool inside the cave 30 m from the entrance (HC). The caves are situated at relatively high elevations, 969 m (DIC) and 821 m a.s.l. (HC).

Other Carpathian *Megalothorax* congeners were also found in moist soils and litter, and in cave environment. The combination of morphological features of the new species seems to be related to troglophilous mode of life. Regarding this, *M. dobsinensis* **sp. n.** has less morphologically specialized claws to cave environment than *M. car-*

paticus, M. tatrensis and M. hipmani, but more than *M. minimus* and *M. willemi*. Overall geographic distribution of *M. dobsinensis* **sp. n.** remains uknown, the species is probably distributed across the whole Western Carpathians Mts at cold sites associated with superficial subterranean habitats of MSS type.

Identification key

The identification key is updated from Schneider *et al*. (2018) and restricted to the species with a smooth mucro lamellae.

Key to the species of *Megalothorax* with smooth mucronal lamellae

1. Mucro elliptical with wide and wavy lamellae. . . . **2**
- Mucro not elliptical, with thin lamellae (no part of the mucro being clearly wider than basis) . . . **4**
2. Head and trunk with coarse granules and a complex and dense network of integumentary channels; basomedian fields of labium with 1+1 chaetae; tenaculum with 4+4 teeth . . . *M. granulosus* Schneider & D'Haese, 2013 (Chile)
- Integument with thin granules; tenaculum with 3+3 teeth . . . **3**
3. Basomedian fields of labium with 1+1 chaetae; ventral, post-labial region of head with 3+3 chaetae, the 1+1 external chaetae being clearly longer and thicker than the 2+2 median, short chaetae; sternum Abd. IV with 2+2 chaetae clearly stronger than chaetae on sternum Abd. VI . . . *M. rubidus* Salmon, 1946 (New Zealand)
- Basomedian fields of labium with 3+3 chaetae; ventral, post-labial region of head with 3+3 thin and long chaetae, subequal; sternum Abd. IV with 2+2 chaetae only slightly longer than chaetae on sternum Abd. VI and subequal in length . . . *M. aquaticus* Stach, 1951 (Poland)
4. S-chaetae *S1* and *S4* missing on Ant. III. . . . *M. poki* Christiansen & Bellinger, 1992 (Hawaii)
- S-chaetae *S1* and *S4* present on Ant. III . . . **5**
5. Inner chaetae of *sf2–6* with globular shape . . . **6**
- Inner chaetae of *sf2–6* either flam-shaped or T-shaped . . . **8**
6. Labrum with forked chaetae *a1*; posterior lamellae of mucro usually smooth, potentially with irregularities or very thin teeth . . . *M. piloli* Christiansen & Bellinger, 1992 (Hawaii)
- Chaetae *a1* of the labrum not forked; posterior lamellae of the mucro smooth with distal notch . . . **7**
7. Globular organ between antennae present, tenaculum with 3+3 teeth; labral chaetae *a2* with 2 clear teeth . . . *M. interruptus* Hüther, 1967 (Sudan)
- Globular organ between antennae absent, tenaculum with 4+4 teeth; labral chaetae *a2* with very faint teeth (almost smooth). . *M. laevis* Denis, 1948 (Intertropical zone)
8. Chaeta X on Ant. IV absent, anterior integumentary channels on head covering the clypeal area with multiple forks . . . **9**
- Chaeta X on Ant. IV present, anterior integumentary channels on head simple and not reaching the clypeal area . . . **11**
9. Integumentary process in position of chaeta X on Ant. IV absent, Ant. III with 6 ordinary chaetae; dorso-anterior chaeta *a0* missing, replaced with integumentary, oval protuberance . . . *M. sanctistephani* Christian, 1998 (Austria, France)
- Integumentary process in position of chaeta X on Ant. IV present, dorsal, dorso-anterior chaeta *a0* present, oval protuberance missing . . . 10
10. Ant. III with 8 ordinary chaetae; Ant. IV with 4 ordinary chaetae; chaeta *β4* on abdomen present; inner chaetae of *sf6* candle-light-shaped . . . *M. tuberculatus* Deharveng & Beruete, 1993 (France, Spain)
- Ant. III with 9 ordinary chaetae; Ant. IV with 6 ordinary chaetae; chaeta *β4* on abdomen absent; inner chaetae of *sf6* T-shaped . . . *M. dobsinensis* **sp. n.** (Slovakia, MSS, caves)
11. Dorso-posterior chaetae on head thin or ordinary, subequal to anterior chaetae . . . **12**
- Dorso-posterior chaetae on head thickened, stronger than anterior chaetae . . . **14**
12. Dorso-posterior chaetae on head thin and short; abdomen with peculiar pattern of granulation; unguis of ordinary shape . . . *M. svalbardensis* Schneider & D'Haese, 2013 (Svalbard)
- Dorso-posterior chaetae on head ordinary; no specific pattern of granulation on abdomen . . . **13**
13. Whitish, with black and brownish dots of pigmentation; channels on head without circles; unguis elongated . . . *M. tatrensis* Papáč & Kováč, 2013 (Slovakia)
- Adult with deep red pigmentation; channels on head forming a network; unguis ordinary . . . *M. sanguineus* Schneider, Porco & Deharveng, 2016 (France)
14. *sf3–6* each with at least 1 T-shaped inner chaeta, other inner chaetae candlelight-shaped; Abd. I–V terga with 20+20 chaetae (α–η rows) . . . *M. minimus* Willem, 1900 *sensu* Schneider & D'Haese (2013) (Cosmopolitan)
- Inner chaetae of *sf2–6* flam-shaped . . . **15**
15. Dorsal, posterior region of head with lanceolate macrochaetae, thorax with enlarged macrochaetae; clypeal area with chaetae on integumentary protuberance in front of chaeta *a0*. . . . *M. potapovi* Schneider, Porco & Deharveng, 2016 (Russia)
- Dorsal, posterior region of head and terga of thorax with ordinary or thickened chaetae; clypeal area without chaetae on integumentary protuberance in front of chaeta *a0* . . . **16**

16. Inner chaetae of *sf6* long; maxilla outer lobe with 1 sublobal hair; unguis ordinary . . . . . *M. willemi* Schneider & D'Haese, 2013 (Cosmopolitan)

- Inner chaetae of *sf6* short; maxilla outer lobe with 2 sublobal hairs; unguis elongated. . . . . *M. carpaticus* Papáč & Kováč, 2013 (Slovakia)

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