

**REDEFINITION OF THE GENUS *CERATTOMA*  
(ACARI: HETEROSTIGMATA: PYGMEPHORIDAE)  
WITH REDESCRIPTION OF *C. URSULAE* FROM EUROPEAN RUSSIA**

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ABSTRACT: The genus *Cerattoma* Mahunka, 1972 (Acari: Pygmephoridae) is redefined. *Cerattoma ursulae* (Krczal, 1959) is redescribed, based on phoretic females collected under the elytra of a *Crypticus* sp. (Coleoptera: Tenebrionidae) darkling beetle in European Russia. An updated key to the genera of the Pygmephoridae family is provided.

KEY WORDS: Heterostigmatina, Pygmephoridea, systematics, morphology, phoresy.

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## INTRODUCTION

The cosmopolitan family Pygmephoridae, the second largest in the Pygmephoridea superfamily, includes 31 genera and more than 300 species (Khaustov and Trach 2018). In all likelihood, all pygmephorid mites are fungivorous (Kaliszewski *et al.* 1995).

The genus name *Cerattoma* Mahunka was first mentioned in Mahunka (1970) as created in 1969. However, the description of the genus *Cerattoma* was not published and type species was not designated in 1969 (Mahunka 1972). The brief description and type designation (type species *Pygmephorus ursulae* Krczal, 1959) of *Cerattoma* were provided in Mahunka (1972). He placed five species in the genus *Cerattoma*: *C. ursulae* (Krczal, 1959), *P. ceratophyi* (Krczal, 1959), *C. endroedyoungai* (Mahunka, 1965), *C. szekessyi* Mahunka, 1970, and *C. graeca* Mahunka, 1972. Cross and Moser (1971) created the subgenus *Pygmephorellus* of the genus *Pygmephorus* Kramer, 1877 and placed five species in it: *P. ceratophyi* (Krczal, 1959) (type species), *P. ursulae* (Krczal, 1959), *P. karafiati* (Krczal, 1959), *P. brachycerus* Cross and Moser, 1971, and *P. bennetti* Cross and Moser, 1971. Cross (1974) considered *Cerattoma* *sensu* Mahunka (1970) (with type species *P. ceratophyi*) as an invalid generic name and replaced it by *Pygmephorellus* and moved *P. karafiati* and *P. bennetti* to *Elattoma* Mahunka, 1969. Apparently, Cross (1974) did not know about the publication of Mahunka (1972) where he designated *P. ursulae* as type species. Sevastianov (1978) also used the generic name *Cerattoma* Mahunka, 1969 with the type species *Pygmephorus ceratophyi* Krczal, 1959. It is not clear why Cross (1974) and Sevastianov (1978)

considered *P. ceratophyi* as the type species of *Cerattoma*.

During the study of insect-associated mites, a rare species *Cerattoma ursulae* was discovered in European Russia. This is the first record of this species from Russia. The study of the morphology of this species revealed several apomorphic characters, which are found neither in the type nor in most other *Pygmephorellus* species. Based on these characters, we redefine the genus *Cerattoma* Mahunka, 1972 and redescribe its type species, *C. ursulae*.

The latest key to the Pygmephoridae genera was provided by Khaustov (2015). Since that time, several genera were described or redefined (Rahiminejad *et al.* 2015, 2016; Khaustov *et al.* 2017a, b, 2018). Here, we provide an updated key to the Pygmephoridae genera.

## MATERIAL AND METHODS

The mites were collected under the elytra of a single beetle *Crypticus* sp. that was captured by V. Abramov in the Tula Region, Russia. The mites were mounted in Hoyer's medium. The terminology follows that of Lindquist (1986); the nomenclature of subcapitular setae and the designation of cheliceral setae follow those of Grandjean (1944, 1947), respectively. The systematics of Pygmephoridea follows that of Khaustov (2004, 2008). All measurements are given in micrometers (µm). For leg chaetotaxy, the number of solenidia is provided in parentheses. DIC micrographs were taken using the Carl Zeiss Axio Imager A2 compound microscope and the AxioCam 506 color digital camera. For SEM microscopy, alcohol-preserved mites were dried in freeze-drying device JFD 320 (JEOL, Japan), dusted with gold, and scanned with the aid

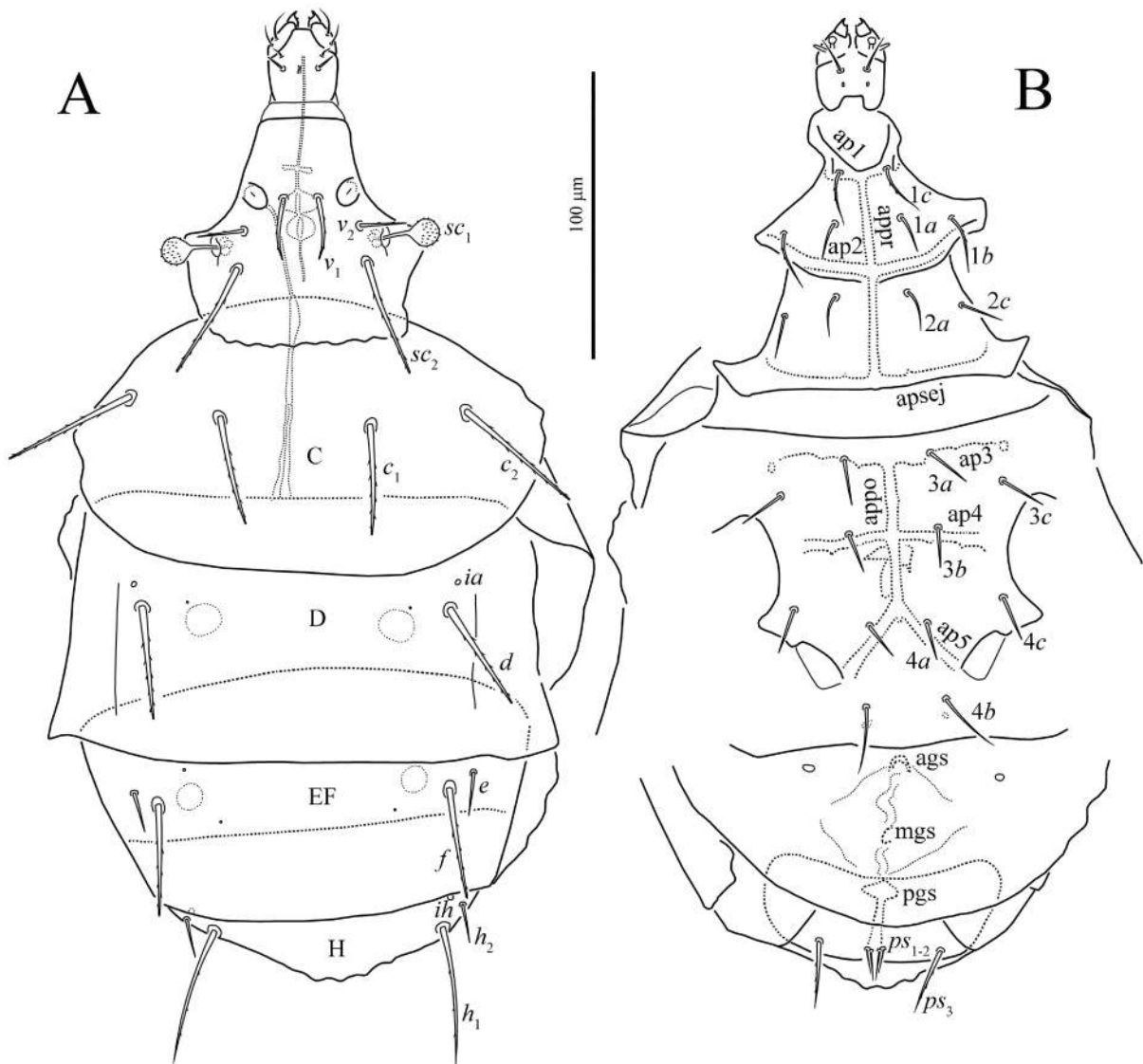


Fig. 1. *Cerattoma ursulae* (Krczal, 1959), female: A—dorsum of the body; B—venter of the body. Legs omitted.

of a JEOL–JSM-6510LV SEM microscope. All materials have been deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

### SYSTEMATICS

Family **Pygmephoridae** Cross, 1965

Genus ***Cerattoma*** Mahunka, 1972

Type species: *Pygmephorus ursulae* Krczal, 1959, by original designation.

**Diagnosis.** *Female.* Body well sclerotized, oval. Gnathosomal capsule of about equal length and width, dorsally with one pair of cheliceral setae (*cha*), setae *chb* absent; postpalpal setae (*pp*) present; palps prominent, with two pairs of setae (*dFe*, *dGe*); tibial claw large; palpal solenidion (*sol*)

well developed, accessory setigenous structure (*ass*) large, mushroom-like. Palp tibiotarsus with tiny distal eupathidium. Subcapitular setae (*m*) present. Subcapitulum with one pair of oval alveolar pits *n* in posterior half. Pharyngeal pumps tripartite, situated on long and thin oesophagus; pump 1 bow-shaped, smooth, far separated from pump 2, pumps 2 and 3 subuqual, oval, situated close to each other. Prodorsum with three pairs of setae ( $v_1$ ,  $v_2$ ,  $sc_2$ ), one pair of clavate trichobothria ( $sc_1$ ) and one pair of oval stigmata; prodorsal shield not divided. Tracheal trunks thin, long. Posterior part of prodorsal shield covering anterior part of tergite C. Tergite C with two pairs of setae ( $c_1$ ,  $c_2$ ); tergite D with one pair of setae (*d*) and one pair of round cupules *ia*; tergite EF with two pairs of setae (*e*, *f*), cupules *im* absent; tergite H with two pairs

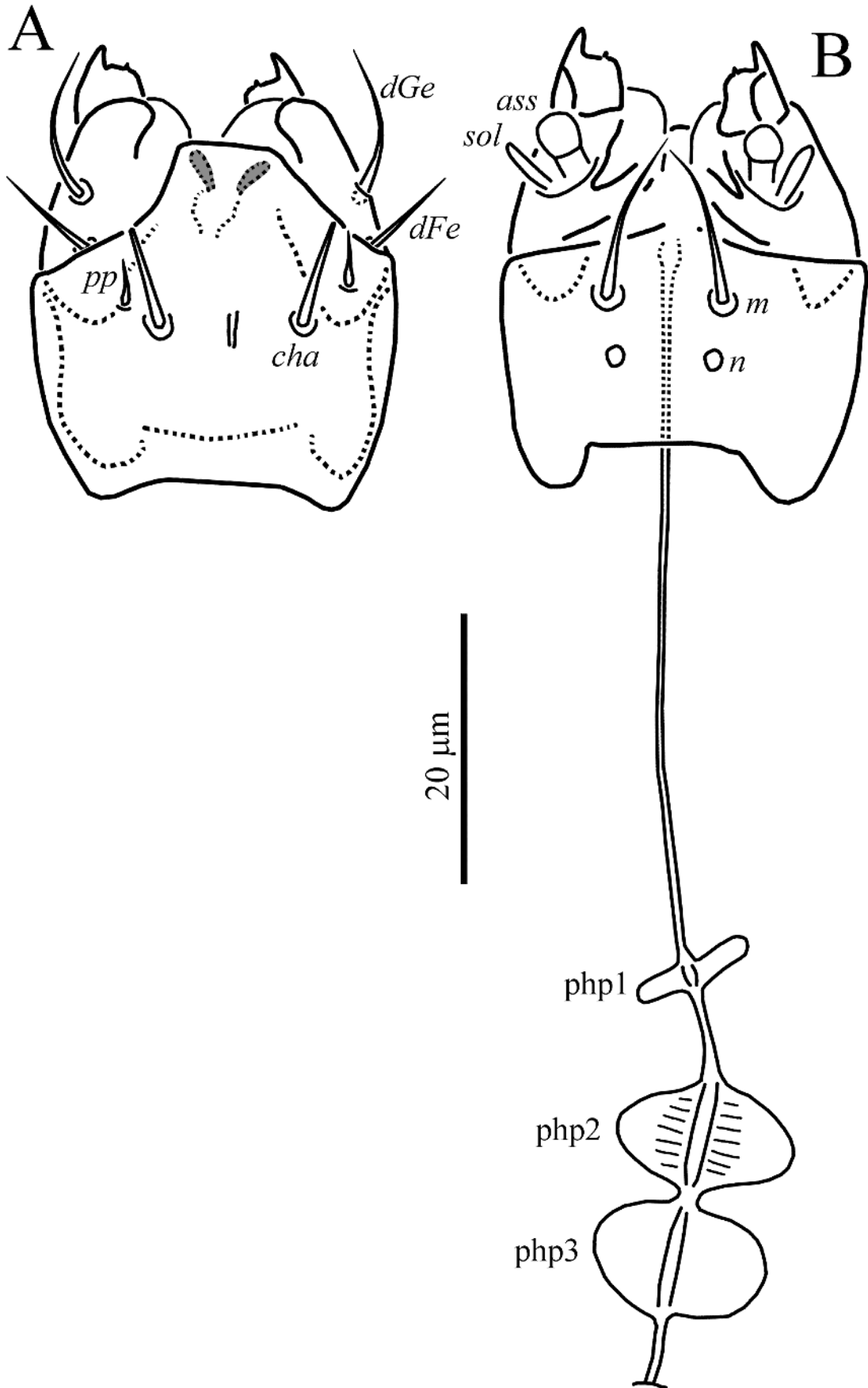


Fig. 2. *Cerattoma ursulae* (Krczal, 1959), female: A—gnathosoma in dorsal view; B—gnathosoma and pharyngeal pumps in ventral view.

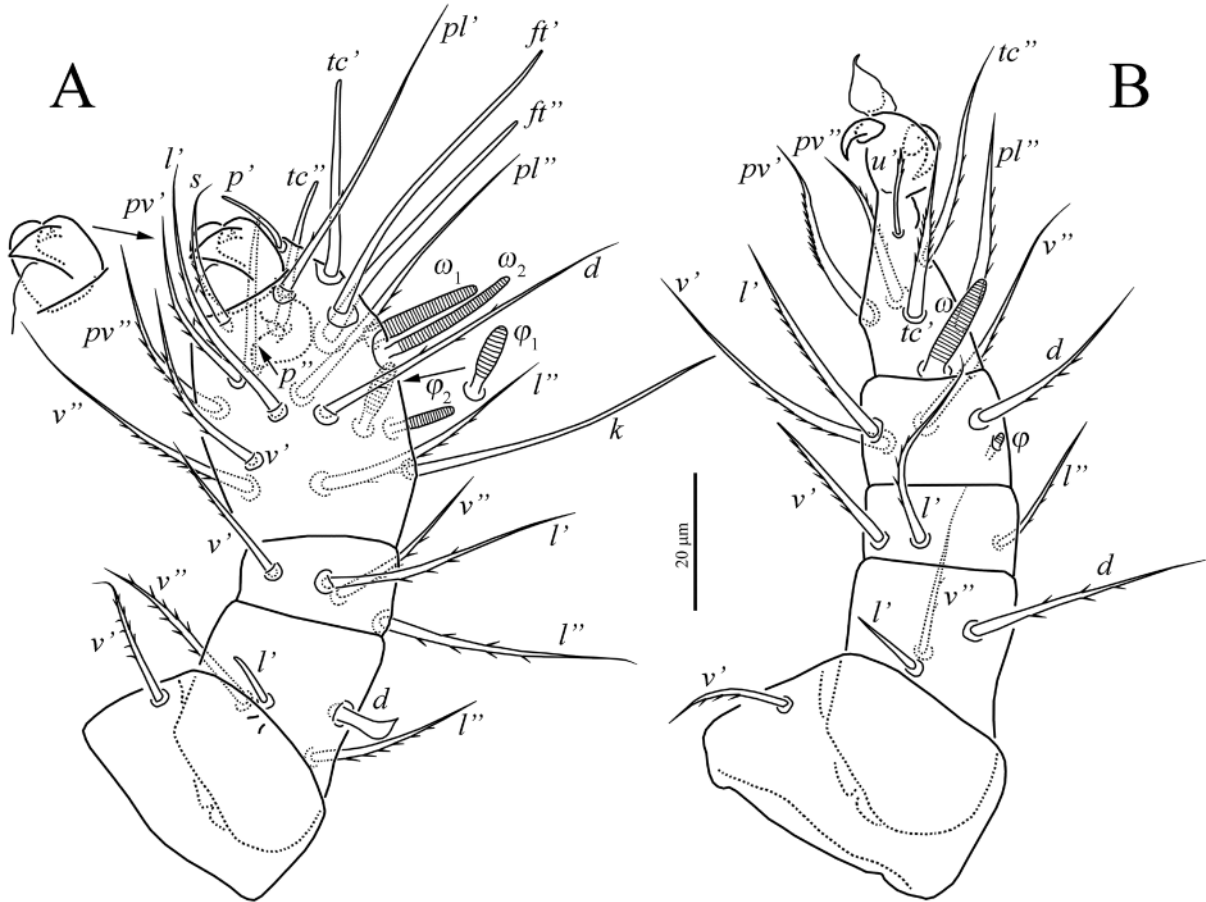


Fig. 3. *Cerattoma ursulae* (Krczal, 1959), female: A—right leg I in dorsal view; B—right leg II in dorsal view.

of setae ( $h_1, h_2$ ) and one pair of round cupules *ih*. Coxal fields I with three pairs of setae (1a, 1b, 1c), setae 1b not modified; coxal fields II with two pairs of setae (2a, 2c); coxal fields III with three pairs of setae (3a, 3b, 3c); coxal fields IV with three pairs of setae (4a, 4b, 4c). Pseudanal segment with three pairs of setae ( $ps_{1-3}$ ). Apodemes 1 (ap1) well developed, thick, apodemes 2 (ap2) well developed, joined with well-developed prosternal apodeme (appr); appr joined with sejugal apodeme (apsej); secondary transverse apodeme absent; apodemes 3 (ap3) weak, diffuse; poststernal apodeme (appo) well developed, fused with long apodemes 4 (ap4) and well developed apodemes 5 (ap5). Posterior margin of posterior sternal plate entire. Anterior genital sclerite (ags) small, bell-like, median genital sclerite (mgs) present, posterior genital sclerite (pgs) widened anteriorly and narrowed posteriorly (Fig. 5D). Leg I 4-segmented, with massive tibiotarsus. Tarsal claw large, twisted ventrally and arising from apicomedial portion of tibiotarsus. Unguinal setae fused to form bifurcate structure opposing the tarsal claw and twisted dorsally (Fig.

7D). Tibiotarsus without pinnaculum. Seta *d* of femur I hook-like. Seta *k* smooth, blunt-ended. Legs II–IV each with one pair of claws and empodium with characteristic pointed tip (Fig. 7E). Claws on tarsi II and III thickened basally, on tarsus IV simple. Femora III and IV divided into basi- and telofemur. Leg setation: leg I; Tr 1 ( $v'$ ), Fe 4 ( $d, l', l'', v''$ ), Ge 4 ( $l', l'', v', v''$ ), TiTa 17(4) ( $d, l', l'', v', v'', k, tc', tc'', p', p'', ft', ft'', pv', pv'', pl', pl'', s, \omega_1, \omega_2, \phi_1, \phi_2$ ); leg II: Tr 1 ( $v'$ ), Fe 3 ( $d, l', v''$ ), Ge 3 ( $l', v', l''$ ), Ti 4(1) ( $d, l', v', v'', \phi$ ), Ta 6(1) ( $tc'', tc'', pl'', pv', pv'', u', \omega$ ); leg III: Tr 1 ( $v'$ ), Fe 2 ( $d, v'$ ), Ge 2 ( $l', v'$ ), Ti 4(1) ( $d, l', v', v'', \phi$ ), Ta 6 ( $tc'', tc'', pl'', pv', pv'', u'$ ); leg IV: Tr 1 ( $v'$ ), Fe 2 ( $d, v'$ ), Ge 1 ( $v'$ ), Ti 4(1) ( $d, l', v', v'', \phi$ ), Ta 6 ( $pl'', tc', tc'', u', pv', pv''$ ).

*Male and larva unknown.*

**Species included.** The genus *Cerattoma* includes two species: *C. ursulae* (Krczal, 1959) and *C. graeca* Mahunka, 1972.

**Distribution and habitat.** *C. ursulae* was described from the soil obtained from a potato field in Germany (Krczal 1959). It was also recorded

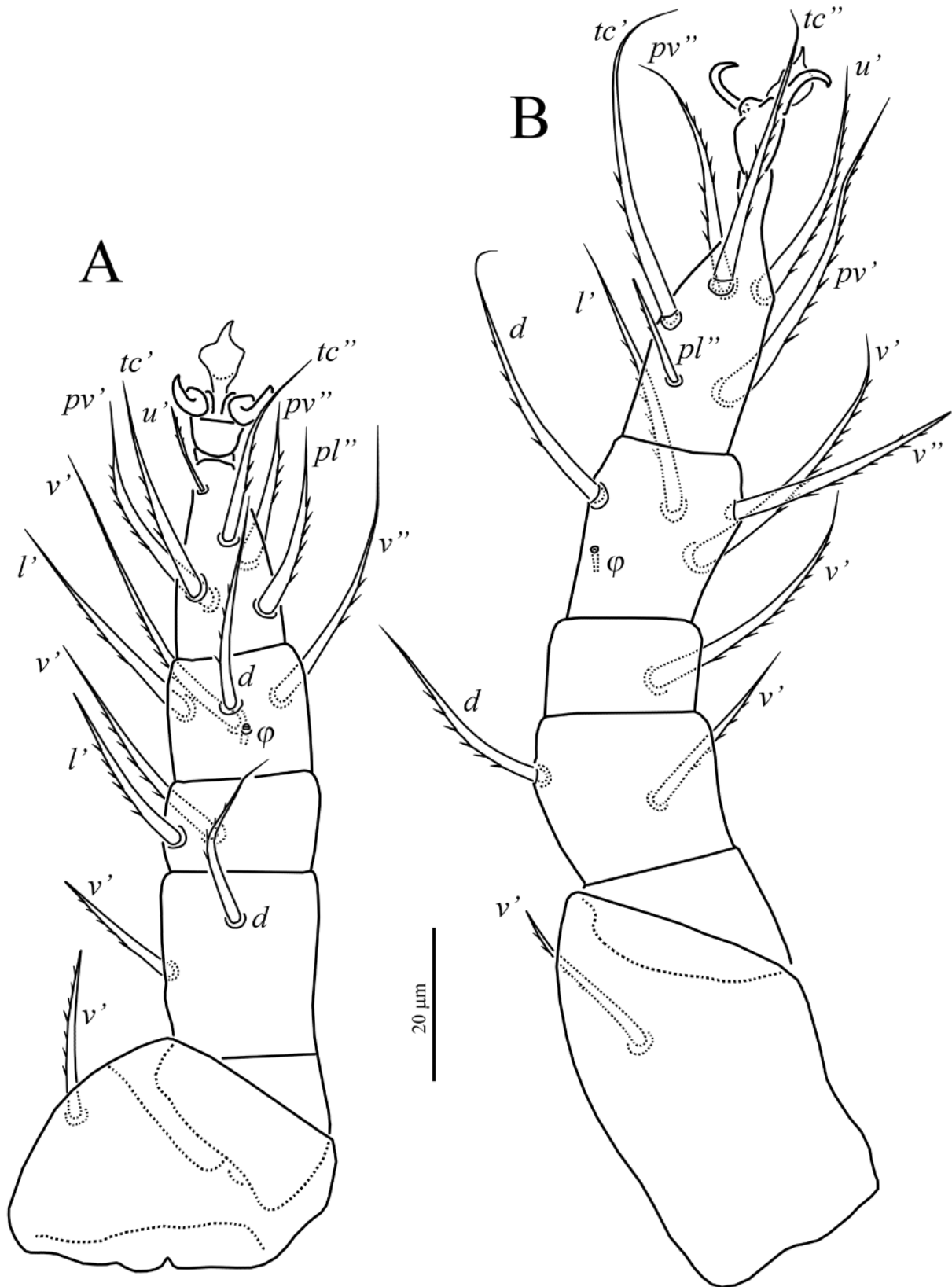


Fig. 4. *Cerattoma ursulae* (Krczal, 1959), female: A—right leg III in dorsal view; B—right leg IV in dorsal view.

from soils in Hungary (Mahunka 1981) and Ukraine (Sevastianov 1978). This species is phoretic under

the elytra of the *Crypticus* sp. darkling beetle in European Russia (present data). *Cerattoma graeca*

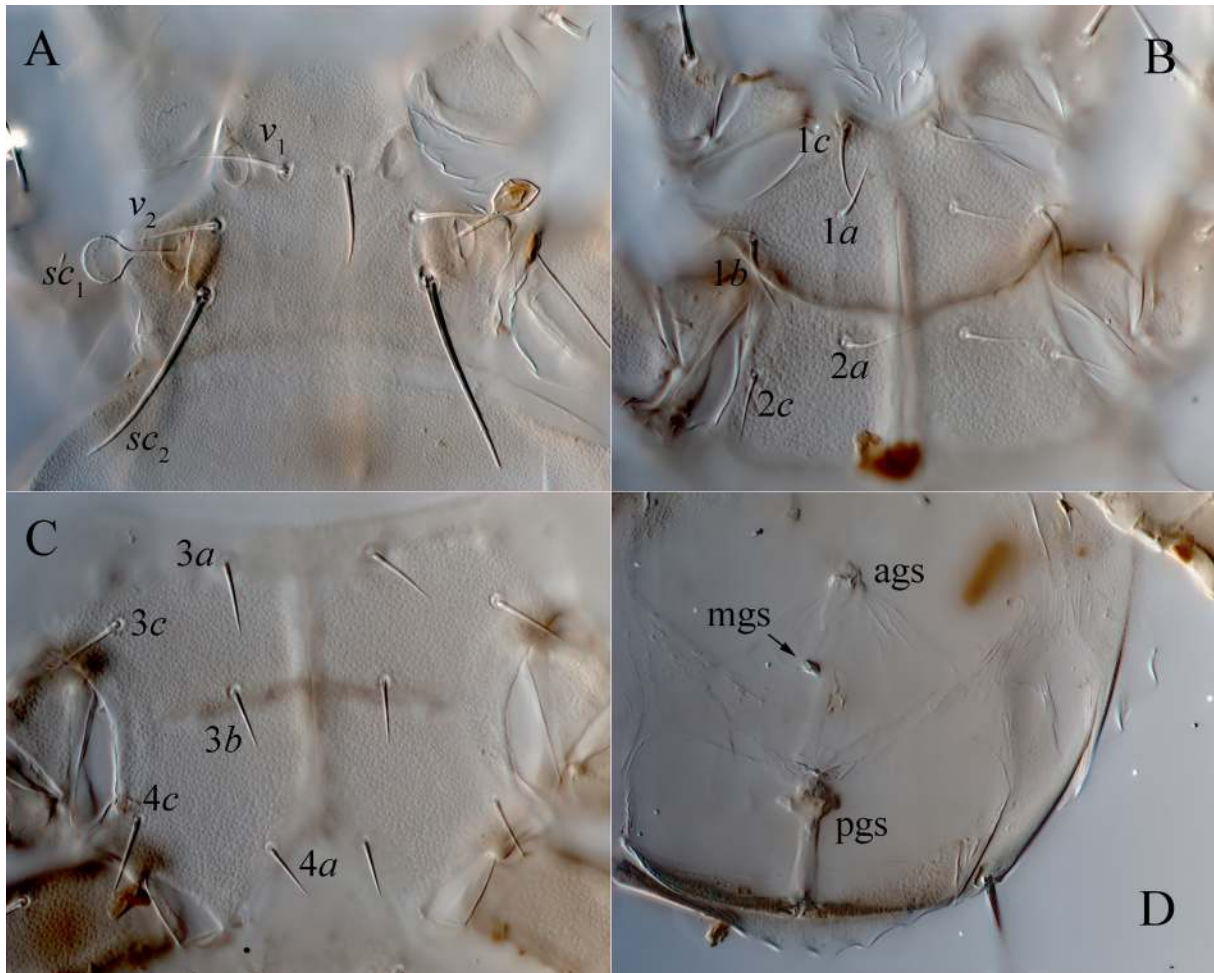


Fig. 5. DIC micrographs of *Cerattoma ursulae* (Krczal, 1959), female: A—prodorsum; B—anterior sternal plate; C—posterior sternal plate; D—genital sclerites.

was described from the leaf litter associated with *Quercus pubescens*, in Greece (Mahunka 1972).

**Remarks.** We retain the incompletely described species *Cerattoma graeca* in the genus *Cerattoma*, based on its unusual, twisted ventrally tarsal claw on tibiotarsus I, which was not illustrated in the original description, but was well-described in the text (Mahunka 1972). Other characters are also very similar to the type species of the genus *Cerattoma*.

**Differential diagnosis.** The genus *Cerattoma* is very similar to *Pygmephorellus* Cross and Moser, 1971 in the same idiosomal and leg chaetotaxy, as well as in the shape of seta *d* of femur I. It can be distinguished from *Pygmephorellus*, however, by an unusual tarsal claw on tibiotarsus I, which is twisted ventrally and arises from the apicomedial portion of tibiotarsus (in the normal dorsal position in *Pygmephorellus*). *Cerattoma* can also be distinguished from *Pygmephorellus* by the absence of cupules *im* on tergite EF (present in *Pygmephorellus*) and by an unusual shape of empodia, with

narrow pointed tips on tarsi II–IV (tips of empodia rounded in *Pygmephorellus*).

#### ***Cerattoma ursulae* (Krczal, 1959)**

*Pygmephorus ursulae* Krczal, 1959, p. 495, figs. 44–45

*Cerattoma ursulae*: Mahunka 1970, p. 159

*Pygmephorus* (*Pygmephorellus*) *ursulae*; Cross and Moser 1971, p. 55.

*Cerattoma ursulae*: Mahunka 1972, p. 73

(Figs. 1–7)

**Redescription.** *Female.* Length of idiosoma 285–325, width 150–180.

*Gnathosoma* (Figs 2, 6F). Length of gnathosomal capsule 23–27, width 23–28. Dorsal median apodeme present. All gnathosomal setae smooth. Setae *cha* blunt-ended, other gnathosomal setae pointed. Cheliceral levers very small, elongate-oval; cheliceral stylets indistinct. Pharyngeal pump 2 weakly transversely striated, other pumps smooth

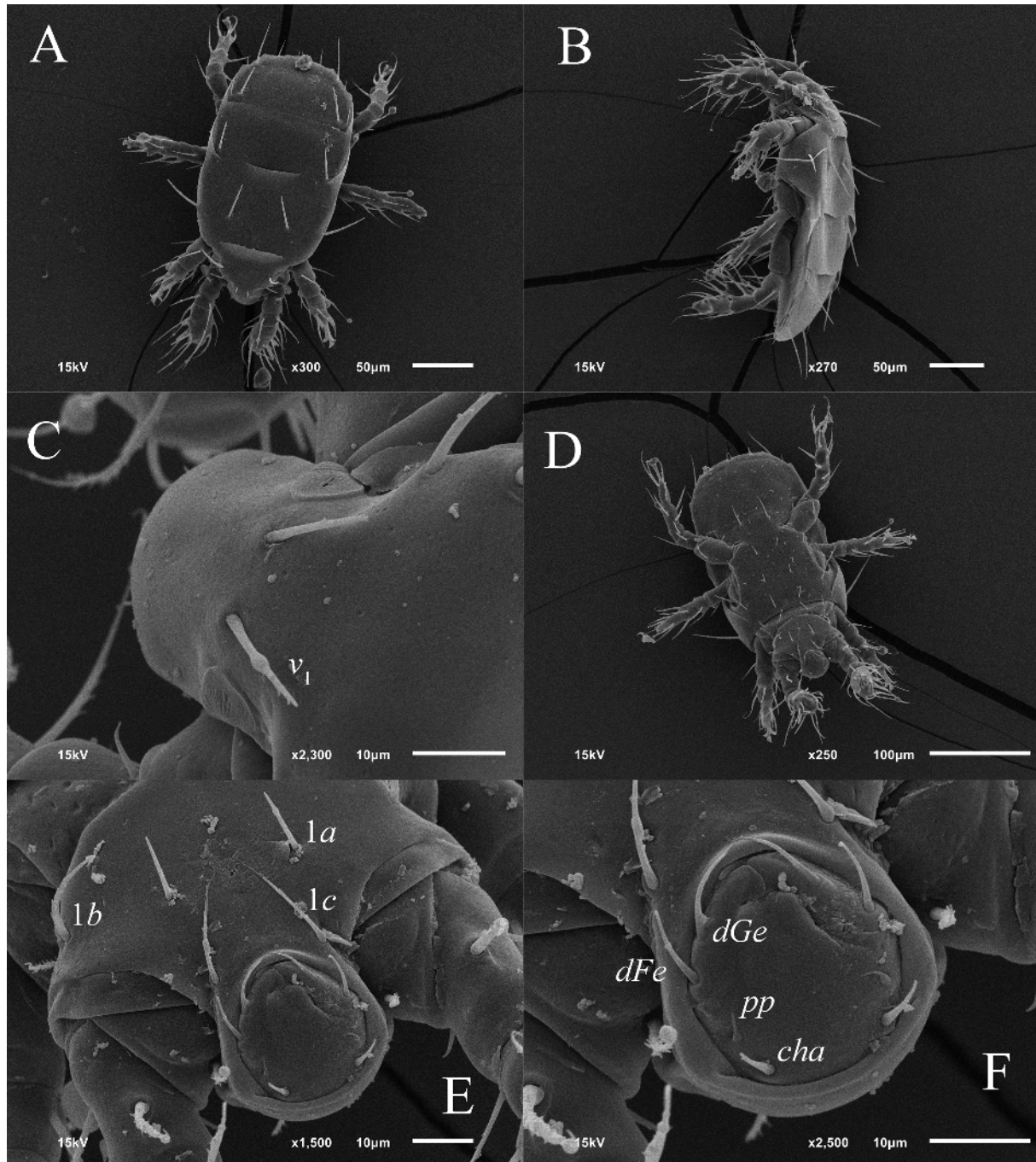


Fig. 6. SEM micrographs of *Cerattoma ursulae* (Krczal, 1959), female: A—general view dorsally; B—general view laterally; C—anterior half of prodorsum; D—general view ventrally; E—prosoma in ventral view; F—hypognathous gnathosoma.

(Fig. 2B). Lengths of gnathosomal setae: *cha* 7–9, *pp* 4–5, *dFe* 7–8, *dGe* 12–14, *m* 11–13.

*Idiosomal dorsum* (Figs. 1A, 5A, 6A, C). All dorsal shields with numerous and rather large dimples (Fig. 6A). Trichobothria distinctly barbed (Fig. 7A). All dorsal setae blunt-ended. Setae *e* and *h*<sub>2</sub> smooth, other dorsal setae weakly barbed. Cupules *ia* on tergite D, and *ih* on tergite H small, round. Setae *e* and *h*<sub>2</sub> situated

distinctly anteriorly bases of setae *f* and *h*<sub>1</sub>, respectively. Posterior margin of prodorsal shield weakly sclerotized and usually undulate. Tergites D and EF each with a pair of round porous areas located medially setae *d* and *f*, respectively. Lengths of dorsal setae: *v*<sub>1</sub> 18–21, *v*<sub>2</sub> 17–18, *sc*<sub>2</sub> 39–47, *c*<sub>1</sub> 35–44, *c*<sub>2</sub> 44–52, *d* 36–44, *e* 14–16, *f* 37–41, *h*<sub>1</sub> 45–50, *h*<sub>2</sub> 10–13. Distances between setae: *v*<sub>1</sub>–*v*<sub>1</sub> 8–11, *v*<sub>2</sub>–*v*<sub>2</sub> 32–38, *sc*<sub>2</sub>–*sc*<sub>2</sub> 39–43,

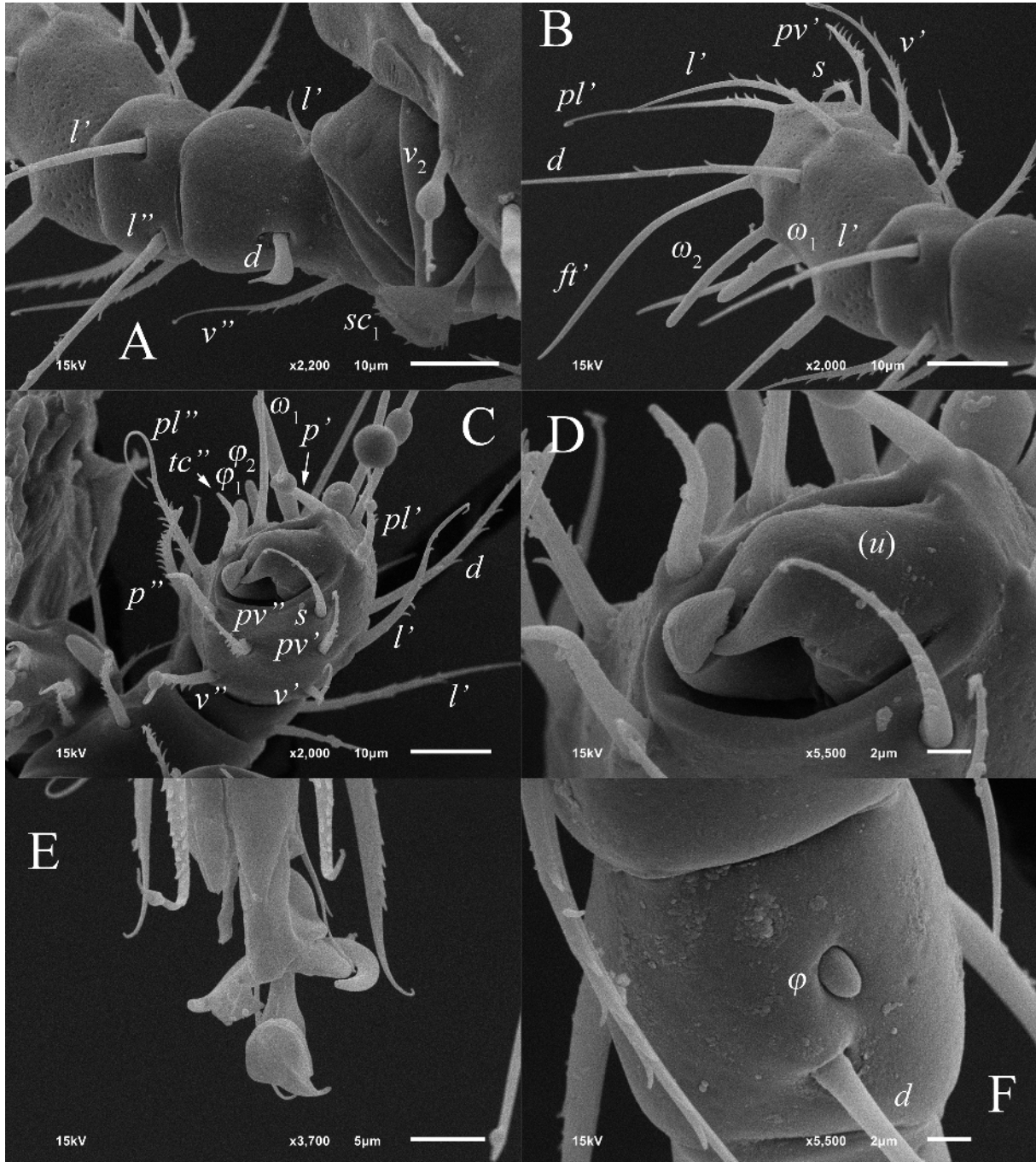


Fig. 7. SEM micrographs of *Cerattoma ursulae* (Krczal, 1959), female: A—lateral part of prodorsum and leg I; B—leg I in dorsal view; C—leg I in ventral view; D—claw and opposing structure (fused unguinal setae) on tibia I; E—tip of tarsus II in ventral view; F—tibia II in dorsal view.

$c_1-c_1$  46–54,  $c_1-c_2$  27–32,  $d-d$  88–100,  $e-f$  9–11,  $f-f$  84–99,  $h_1-h_1$  69–82,  $h_1-h_2$  9–11.

*Idiosomal venter* (Figs 1B, 5B–D, 6D, E). Ventral plates with numerous rather large dimples (Figs 5B, C). Setae  $1b$ ,  $1c$  and  $ps_3$  weakly barbed, other ventral setae smooth. Setae  $1b$ ,  $1c$ ,  $4b$  and  $ps_{1-3}$  pointed, other ventral setae weakly blunt-ended. Aggenital plate with a pair of well developed alveolar pits located posterolaterad setae  $4b$ . Lengths

of ventral setae:  $1a$  15–16,  $1b$  22–24,  $1c$  19–21,  $2a$  16–17,  $2c$  15–17,  $3a$  17–18,  $3b$  13–16,  $3c$  17–19,  $4a$  12–13,  $4b$  23–27,  $4c$  16–17,  $ps_1$  10–12,  $ps_2$  9–10,  $ps_3$  21–24.

*Legs* (Figs. 3, 7). Leg I (Figs. 3A, 7A–D). Tibiotarsus slightly thickened. Lengths of solenidia  $\omega_1$  17–18,  $\omega_2$  21–24,  $\phi_1$  10–11,  $\phi_2$  10–11; solenidion  $\phi_1$  clavate, other solenidia baculiform. Seta  $l'$  of femur and  $k$  of tibia I blunt-ended and



smooth, other leg setae (except eupathidia) pointed and barbed. Leg II (Figs. 3B, 7E, F). Solenidion  $\omega$  17–18 finger-shaped, solenidion  $\phi$  4–5 weakly clavate, situated in depression (Fig. 7F). Setae  $l'$  of femur,  $v'$  of genu and  $u'$  of tarsus weakly blunt-ended, other setae pointed. Seta  $l'$  of femur smooth, other setae weakly barbed. Leg III (Fig. 4A). Solenidion  $\phi$  3 weakly clavate, situated in depression. Setae  $v'$  of trochanter,  $v'$  of femur,  $l'$  of genu, and  $u'$  of tarsus weakly blunt-ended, other setae pointed. All leg setae barbed. Leg IV (Fig. 4B). Solenidion  $\phi$  very small 2–3, located in deep depression and only its tip visible in pore-like opening. All setae barbed. Setae  $v'$  of trochanter,  $v''$  of tibia, and  $pl''$  of tarsus blunt-ended, other leg setae pointed.

**Material examined.** 16 females, Tula Region, vicinity of Suvorov town, under elytra of a single specimen of darkling beetle *Crypticus* sp., collected in pitfall trap, 54°07'N, 36°30'E, September 28, 2018, coll. V.V. Abramov.

**Remarks.** *Cerattoma ursulae* is very similar to the incompletely described *C. graeca* Mahunka, 1972, but can be distinguished from the latter by the ~1.2 ratio of setae  $f$  to  $h_1$  ( $h_1$  is almost two times longer than  $f$  in *C. graeca*).

### Key to genera of Pygmephoridae

(based on females, after Khaustov 2015, with modifications)

1. Legs I 5-segmented (tibia and tarsus separated)... 2
  - Legs I 4-segmented (tibia and tarsus fused).....10
2. Setae  $e$  absent..... 3
  - Setae  $e$  present.....6
3. Prodorsum with one or three pairs of simple setae (excluding trichobothria) ..... 4
  - Prodorsum with two pairs of simple setae (excluding trichobothria).....*Parasiteroptes* Livshits, Mitrofanov and Sharonov, 1986
4. Prodorsum with three pairs of simple setae (excluding trichobothria)..... 5
  - Prodorsum with one pair of simple setae (excluding trichobothria).....*Pediculitopsis* Mahunka, 1970 (non-phoretic female)
5. Setae  $4a$  present,  $4c$  absent, body oval .....*Krczaldania* Sasa, 1961
  - Setae  $4a$  absent,  $4c$  present, body fusiform.....*Siteroptes* Amerling, 1861
6. Setae  $h_2$  present, body oval ..... 7
  - Setae  $h_2$  absent, body very long, fusiform.....*Metasiteroptes* Cross, 1965
7. Prodorsum with three pairs of simple setae (excluding trichobothria)..... 8
  - Prodorsum with two pairs of simple setae (excluding trichobothria)..... *Ultrasiteroptes* Livshits, Mitrofanov and Sharonov, 1986
8. Cupules *im* present, postpalpal setae present, setae  $1b$  usually bifurcate, coxal fields II with 2 pairs of setae ..... 9
  - Cupules *im* absent, postpalpal setae absent, setae  $1b$  not bifurcate, coxal fields II usually with 3 pairs of setae .....*Pediculaster* Vitzthum, 1931 (non-phoretic female)
9. Coxal fields I with two pairs of setae.....*Sevastianoviella* Livshits, Mitrofanov and Sharonov, 1986
  - Coxal fields I with three pairs of setae.....*Neositeroptes* Livshits, Mitrofanov and Sharonov, 1986
10. Coxal fields II with three pairs of setae ..... 11
  - Coxal fields II with two pairs of setae ..... 16
11. Setae  $v'$  of femur and  $pl''$  of tarsus of leg IV not sword-like, claw of tibiotarsus I usually not very large, not striated..... 12
  - Setae  $v'$  of femur and  $pl''$  of tarsus of leg IV sword-like, claw of tibiotarsus I very large, striated, associated with small mammals.....*Pygmephorus* Kramer, 1877
12. Stigmata usually oval or round, sometimes with chambers, not long and narrow ..... 13
  - Stigmata long and narrow .....*Luciaphorus* Mahunka, 1981
13. Tibiotarsus I with claw ..... 14
  - Tibiotarsus I without claw.....*Microdispodides* Vitzthum, 1914.
14. Setae  $l''$  of femur I not modified and not similar in shape with  $d$  of femur I..... 15
  - Setae  $l''$  of femur I spine-like, similar in shape with  $d$  of femur I ..... *Mahunkania* Rack, 1972.
15. Setae  $d$  of femur I spatulate, longer than width of femur I .....*Pediculaster* Vitzthum, 1931 (phoretic female)(part)
  - Setae  $d$  of femur I blade-like, shorter than width of femur I ..... *Propygmephorus* Cross, 1974
16. Coxal fields I with two pairs of setae..... 17
  - Coxal fields I with one or three pairs of setae.... 21
17. Prodorsum with three pairs of simple setae (excluding trichobothria) ..... 18
  - Prodorsum with two pairs of simple setae (excluding trichobothria).....*Sasadania* Kurosa, 1989
18. Setae  $d$  of femur I not modified ..... 19
  - Setae  $d$  of femur I spatulate ..... 20
19. Trichobothria present .....*Dudichiana* Mahunka, 1970
  - Trichobothria absent ....*Asensilla* Rack, 1974

20. Tarsus II with four modified, spine-like setae.  
..... *Pygmephoroides* Mahunka and Fain, 1989.  
— Tarsus II without spine-like setae.....  
..... *Pediculaster* Vitzthum, 1931  
(phoretic female) (part)
21. Coxal fields I with three pairs of setae..... 22  
— Coxal fields I with one pair of setae.....  
..... *Geotrupophorus* Mahunka, 1970
22. Tarsi II and III with six setae each, trichobothria present..... 23  
— Tarsi II and III with only four setae each (*tc*' and *pl*' absent), trichobothria absent.....  
..... *Micropygmephorus* Khaustov, Hugo-Coetzee and Ermilov, 2017
23. Setae *d* of femur I longer than width of femur I, spatulate..... 24  
— Setae *d* of femur I shorter than width of femur I, spatulate or hook-like..... 28
24. Prodorsum with three pairs of simple setae (excluding trichobothria)..... 26  
— Prodorsum with two pairs of simple setae (excluding trichobothria)..... 25
25. Pseudanal segment distinctly narrowed and elongate posteriorly..... *Pediculitopsis* Mahunka, 1970 (phoretic form)  
— Pseudanal segment of normal shape, evenly rounded posteriorly.....  
..... *Apediculaster* Rahiminejad and Hajiqanbar, 2016
26. Setae *h*<sub>2</sub> present, body oval..... 27  
— Setae *h*<sub>2</sub> absent, body fusiform.....  
..... *Brasilopsis* Mahunka, 1975 (probably phoretic female of *Metasiteroptes*)
27. Leg IV distinctly shorter than leg III, tarsus IV short, with 3 very long, whip-like setae.....  
..... *Acarothorectes* Cross, 1965  
— Leg IV not shorter than leg III, tarsus IV not short, sometimes with only one whip-like setae *tc*'.....  
..... *Pediculaster* Vitzthum, 1931 (phoretic female)(part)
28. Empodia on tarsi II–IV present..... 29  
— Empodia on tarsi II–IV absent..... *Mesopotamiophorus* Sevastianov and Zahida Al Douri, 1991
29. Genu I with one or two setae, genu IV without setae..... 30  
— Genu I with three or four setae, genu IV with one setae..... 31
30. Tibiotarsus I with two solenidia, setae *d* of femur I hook-like, two pairs of pseudanal setae, setae *4a* and *4c* absent..... *Elattoma* Mahunka, 1969  
— Tibiotarsus I with four solenidia, setae *d* of femur I spatulate, three pairs of pseudanal setae, setae *4a* and *4c* present..... *Spatulaphorus* Rack, 1993
31. Lateral surfaces of tibiotarsus I without slit-like structures, most setae of anterior and posterior sternal plates not modified..... 32  
— Lateral surfaces of tibiotarsus I with slit-like structures, most setae of anterior and posterior sternal plates spine-like..... *Strephocheir* Mahunka, 1983
32. Stigmata oval, unguinal setae (*u*) of tibiotarsus I present as modified structure opposing to tarsal claw..... 33  
— Stigmata long and narrow, unguinal setae (*u*) of tibiotarsus I absent.....  
..... *Parapediculaster* Khaustov, 2015
33. Subcapitular setae *m* present, setae *2b* not bifurcate..... 34  
— Subcapitular setae *m* absent, setae *2b* bifurcate.....  
..... *Metapygmephorus* Rahiminejad, Hajiqanbar and Khaustov, 2015
34. Genu I with four setae, genu II with three setae..... 35  
— Genu I with three setae, genu II with two setae..... *Pseudopygmephorus* Khaustov, 2008
35. Cupules *im* present, empodia on tarsi II–III rounded distally, claw on tibiotarsus I situated dorsally..... *Pygmephorus* Cross and Moser, 1971  
— Cupules *im* absent, empodia on tarsi II–III pointed distally, claw on tibiotarsus I twisted ventrally..... *Cerattoma* Mahunka, 1972

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