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MITES OF THE FAMILY LAELAPIDAE (ACARI, MESOSTIGMATA) ASSOCIATED WITH SCARAB BEETLES IN UKRAINE

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Mites of the Family Laelapidae (Acari, Mesostigmata) Associated with Scarab Beetles in Ukraine. Trach, V. A., Joharchi, O. — One genus (*Coleolaelaps* Berlese, 1914) and five species (*Coleolaelaps agrestis* (Berlese, 1887), *C. inopinatus* Grandi, 1925, *H. integer* Berlese, 1911, *H. krameri* (G. et R. Canestrini, 1881) and *Gaeolaelaps rhizotrogi* (Mašán, 1998)) are recorded for the first time in Ukraine. Morphological characters of female and male of *Hypoaspis integer* to complement the description are provided.
Key words: Parasitiformes, *Coleolaelaps*, *Gaeolaelaps*, *Hypoaspis*, Coleoptera.

Introduction

The Laelapidae comprises about 146 genera and 1520 species of morphologically and behaviorally diverse mites that are free living or associated with arthropods, mammals, or birds (Lindquist et al., 2009; Joharchi, Shahedi, 2016; Keum et al., 2017). Members of the genera *Angosomaspis* Costa, 1971, *Cerambylaelaps* Costa, 1979, *Coleolaelaps* Berlese, 1914, *Dynastaspis* Costa, 1971, *Huntaracarus* Costa, 1975 *Hypoaspis* G. Canestrini, 1884, *Lucanaspis* Costa, 1971, *Promacrolaelaps* Costa, 1971 are strongly associated with beetles (Hyatt, 1964; Costa, 1971, 1975, 1979; Costa, Hunter, 1971).

The genera *Coleolaelaps* and *Hypoaspis* are superficially similar in morphology and have often been confused with each other. Species in both genera have some long and wavy setae on the dorsal shield, on soft cuticle and on some leg segments, mites are also similar in their biology, occurring in poorly understood symbiotic or parasitic relationships with soil-dwelling scarab beetles (Costa, 1971; Joharchi, Halliday, 2011). These genera together include about 60 species. Mites of the genus *Coleolaelaps* are strictly associated with scarab beetles of the genera *Anoxia* Laporte de Castelnau, 1832 and *Polyphylla* Harris, 1842 (Coleoptera, Scarabaeidae, Melolonthinae). Members of the genus *Hypoaspis* associated with different scarab and lucanid beetles (Coleoptera, Scarabaeidae, Lucanidae). Currently, only four species of the genus *Coleolaelaps* and four species of the genus *Hypoaspis* are known in Europe: *Coleolaelaps abnormalis* Costa et Hunter, 1971, *C. agrestis* (Berlese, 1887), *C. anoxiae* (Koyumdjieva, 1977), *C. inopinatus* Grandi, 1925, *Hypoaspis campestris* (Berlese, 1887), *H. integer* Berlese, 1911, *H. krameri* (G. et R. Canestrini, 1881), *H. terrestris* (Leonardi, 1899) (Canestrini, Canestrini, 1881; Berlese, 1887, 1911; Leonardi, 1899; Grandi, 1925; Samšiňák, 1960; Costa, 1971; Costa, Hunter, 1971; Bregetova, 1977; Koyumdjieva, 1977).

Also some species of the genera *Cosmolaelaps* Berlese, 1903 and *Gaeolaelaps* Evans et Till, 1966 (Pearse et al., 1936; Hunter, Mollin, 1964; Hyatt, 1964; Mollin, Hunter, 1964; Hunter, Yeh, 1969; Delfinado, Baker, 1975; Rosario, 1981; Arutunjan, 1993; Mašán, 1998; Sklyar, 2012; Trach, 2012, 2016; Jonarchi, Babaeian, 2014) are associated with beetles.

The fauna of arthropod-associated Mesostigmata in Ukraine is very poorly known. The purpose of this paper is to add new records of beetle-associated laelapid mites from Ukraine and to provide a number of morphological features of female and male of *Hypoaspis integer* to complement the description.

Material and methods

Beetles were sampled by hand, by using Barber traps with bait and at UV light (mercury tungsten blended lamp or mercury vapour lamp). Specimens were transferred into vials containing 70 % ethyl alcohol and later were examined with aid of a MBS-9 microscope (LOMO). Mites collected from beetles were cleared in lactic acid and slide-mounted in Hoyer's medium. The morphology of mites was studied using the Axio Imager A2 (Carl Zeiss) and Mikmed-1 microscope (LOMO) equipped with a binocular head AU-12 and ocular micrometer AM9-2. The morphological terminology generally follows Evans and Till (1979), dorsal and ventral setae were labelled according to the systems of Lindquist & Evans (1965) and Lindquist (1994), palpal and leg chaetotaxy follows Evans (1963 a, b, 1969). All pore-like structures, glandular openings (solenostomes) and poroids (lyrifissures) are named as pores. Lengths of shields were measured from the anterior to posterior shield margins along the midline. Measurements are given in micrometres (μm). Beetle classification follows Catalogue of Palaearctic Coleoptera (Bartolozzi, Sprecher-Uebersax, 2006; Bezdek, 2006; Krell, 2006; Löbl et al., 2006 a, b; Smetana, 2006; Smetana, Král, 2006). Slide-mounted voucher specimens are deposited in the collection of the Department of Zoology, Odesa I. I. Mechnikov National University.

Results and discussion

As the result, two species of the genus *Coleolaelaps*, one species of the genus *Gaeolaelaps* and three species of the genus *Hypoaspis* are recorded in Ukraine.

Coleolaelaps Berlese, 1914

Coleolaelaps Berlese, 1914: 141.

Coleolaelaps agrestis (Berlese, 1887)

Laelaps (*Iphis*) *agrestis* Berlese, 1887: fasc. XL, n. 7.

Material. Ukraine, Donetsk Region, Manhush District, vicinity of Bilosarayska Kosa (46.90 N, 37.33 E), Azov Sea Coast, on *Polyphylla alba* Pallas, 1773, 15.07.2010, 9 ♀ (G. V. Popov).

Distribution. Bulgary (Karg, Rössner, 1999); Germany (Karg, Rössner, 1999); Greece (Karg, Rössner, 1999); Italy (Berlese, 1887); Kazakhstan (Bregetova, 1977); Marocco (Niogret et al., 2007); Ukraine (**first record**).

Hosts. *Polyphylla alba* (**first record**); *P. boryi* Brullé, 1832 (Karg, Rössner, 1999); *P. fullo* Linnaeus, 1758 (Berlese, 1887; Bregetova, 1977; Karg, Rössner, 1999); *P. olivieri* Laporte, 1840 (Karg, Rössner, 1999); *Sphodroxia maroccana* Ley, 1923 (Niogret et al., 2007).

Coleolaelaps inopinatus Grandi, 1925

Coleolaelaps inopinatus Grandi, 1925: 11.

Material. Ukraine: Odesa Region, Tatarbunary District, vicinity of Primorske (45.63 N, 29.83 E), Black Sea Coast, on *Anoxia orientalis* (Krynicki, 1832), 10.07.2004, 4 ♀ (A. V. Gontarenko); Bilgorod-Dnistrovsky District, vicinity of Zatoka (46.02 N, 30.40 E), Black Sea Coast, on *A. orientalis*, 4.07.2010, 3 ♀ (V. A. Trach); Rozdilna District, vicinity of Kuchurhan (46.73 N, 29.98 E), on *A. pilosa*, 17.07.2017, 6 ♀ (A. A. Lapteva); Donetsk Region, Manhush District, vicinity of Bilosarayska Kosa (46.90 N, 37.33 E), Azov Sea coast, on *Anoxia pilosa* (Fabricius, 1792), 15.07.2010 26 ♀ (G. V. Popov).

Distribution. Austria (Costa, Hunter, 1971); Greece (Karg, Rössner, 1999); Hungary (Kontschán, 2015); Israel (Costa, Hunter, 1971); Italy (Grandi, 1925); Romania (Costa, Hunter, 1971); Spain (Costa, Hunter, 1971); Tajikistan (Bregetova, 1977); Turkey (Karg, Rössner, 1999); Ukraine (**first record**).

Hosts. *Anoxia asiatica* Desbrochers des Loges, 1872 (Karg, Rössner, 1999); *A. maculiventris* Reitter, 1890 (Costa, Hunter, 1971); *A. matutinalis* Laporte, 1832 (Grandi, 1925); *Anoxia orientalis* (Costa, Hunter, 1971; Kontschán, 2015; this study); *A. pilosa* (Costa, Hunter, 1971; this study); *A. villosa* (Fabricius, 1781) (Costa, Hunter, 1971; Karg, Rössner, 1999); *Polyphylla boryi* (Karg, Rössner, 1999).

Remarks. According to the figures, indications of *Coleolaelaps agrestis* by Costa & Hunter (1971) and Kontschán (2015) belong to *Coleolaelaps inopinatus*.

Coleolaelaps inopinatus differs from *C. agrestis* by the narrowed dorsal shield posteriorly of lateral incisions.

Gaeolaelaps Evans & Till, 1966

Hypoaspis (*Gaeolaelaps*) Evans & Till, 1966: 159.

Gaeolaelaps rhizotrogi (Mašán, 1998)

Hypoaspis rhizotrogi Mašán, 1998: 20.

Material. Ukraine, Odesa Region, Bolgrad District, vicinity of Gorodne (45.88 N, 28.85 E), wheat field, on *Amphimallon solstitiale* (Linnaeus, 1758) (Scarabaeidae, Melolonthinae), 24.06.2016, 26 ♀ (L. V. Nedelcheva).

Distribution. Slovakia (Mašán, 1998); Ukraine (**first record**).

Hosts. *Rhizotrogus aestivus* (A. G. Olivier, 1789) (Mašán, 1998); *Amphimallon solstitiale* (**first record**).

Remarks. By far, *Gaeolaelaps rhizotrogi* was known only from the type series.

Hypoaspis G. Canestrini, 1884

Hypoaspis Canestrini, 1884: 1569.

Hypoaspis eremitus (Sklyar, 2012)

Hypoaspis eremitus Sklyar, 2012: 82.

Distribution. Ukraine (Sklyar, 2012).

Hosts. *Osmoderma coriarius* (DeGeer, 1774) (Sklyar, 2012).

Remarks. This species was briefly described based on one female specimen from *Osmoderma coriarius* and known only from type locality (Donetsk Region). Depository of the type specimen is unknown, microslide with the mite has not been ever deposited (as was indicated in the original description) to the Schmalhausen Institute of Zoology, NAS of Ukraine, Kyiv, Ukraine (Leonid O. Kolodochka pers. comm.). This nominal species is similar to *Hypoaspis breiti* Arutunjan, 1990, also briefly described based on one female from *Osmoderma eremita* (Scopoli, 1763) from Austria and possibly is its junior synonym (Arutunjan, 1990). We have examined two specimens of *Osmoderma coriarius* from Odesa Region, but no mites were found.

Ukrainian species of the genus *Hypoaspis* differs from species of the genus *Coleolaelaps* of Ukraine by the absence lateral incisions on the dorsal shield.

Hypoaspis integer Berlese, 1911

Hypoaspis integer Berlese, 1911: 186.

Material. Ukraine, Odesa Region, Kiliya District, vicinity of Primorske (45.53 N, 29.67 E), meadow, on *Polyphylla fullo*, 15.07.2002, 3 ♀ (M. O. Son); Bilgorod-Dnistrovsky District, vicinity of Zatoka (46.02 N, 30.40 E), Black Sea Coast, on *P. fullo*, 4.07.2010, 11 ♀, 2 ♂ (V. A. Trach).

Distribution. Czech Republic (Costa, 1971); France (Samšiňák, 1960); Germany (Costa, 1971); Kyrgyzstan (Karg, Rössner, 1999); Poland (Haitlinger, 2012); "Prussia" (Costa, 1971); "Southern Russia" (possibly Ukraine) (Costa, 1971); Spain (Karg, Rössner, 1999); Ukraine (**first record**).

Hosts. *Oryctes nasicornis* (Linnaeus, 1758) (Berlese, 1911; Samšiňák, 1960; Costa, 1971); *Polyphylla fullo* (Costa, 1971; Karg, Rössner, 1999; Haitlinger, 2012; this study); *P. tridentata* Reitter, 1890 (Karg, Rössner, 1999).

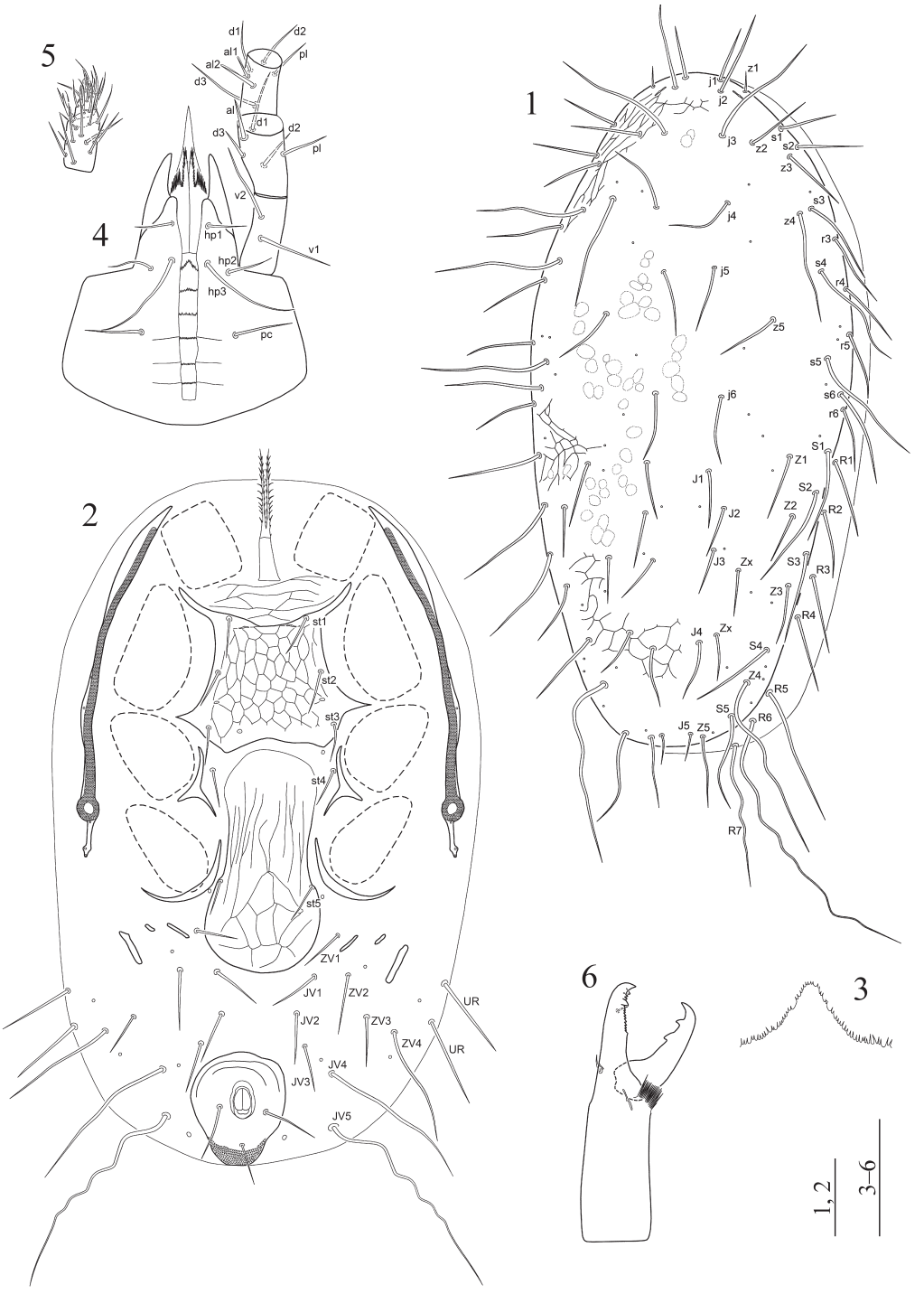
Redescription. Adult female (n = 5) (figs 1–9)

Idiosomal dorsum (fig. 1). Dorsal shield oval; 828–911 long and 409–493 maximum width at *r5*; shield smooth in central part and reticulate along antero-lateral and post-lateral margins. Dorsal shield with 38 (or 39) pairs of setae; 21 (or 22) pairs of setae on podonotal shield (*j1–j6*, *z1–z5*, *s1–s6*, *r3–r6*), seta *z6* bilaterally present in 1 specimens, unilaterally present in 3 and completely absent in 7 from investigated 11 mites; 17 pairs of setae on opisthonotal shield (*J1–J5*, *Z1–Z5*, *S1–S5* and 2 pairs of *Zx* setae) and 21 pairs of distinguishable pores. Soft cuticle with setae *R1–R7*. All dorsal setae smooth and pointed; setae *Z4*, *R6* and *R7* wavy; seta *Z4* longest; measurements of some setae: *j1* 63–92, *j6* 71–84, *J5* 38–59, *z1* 25–34, *z4* 151–197, *Z1* 63–76, *Z5* 101–113, *s5* 143–176, *R5* 105–160, *R6* 210–252, *R7* 147–189.

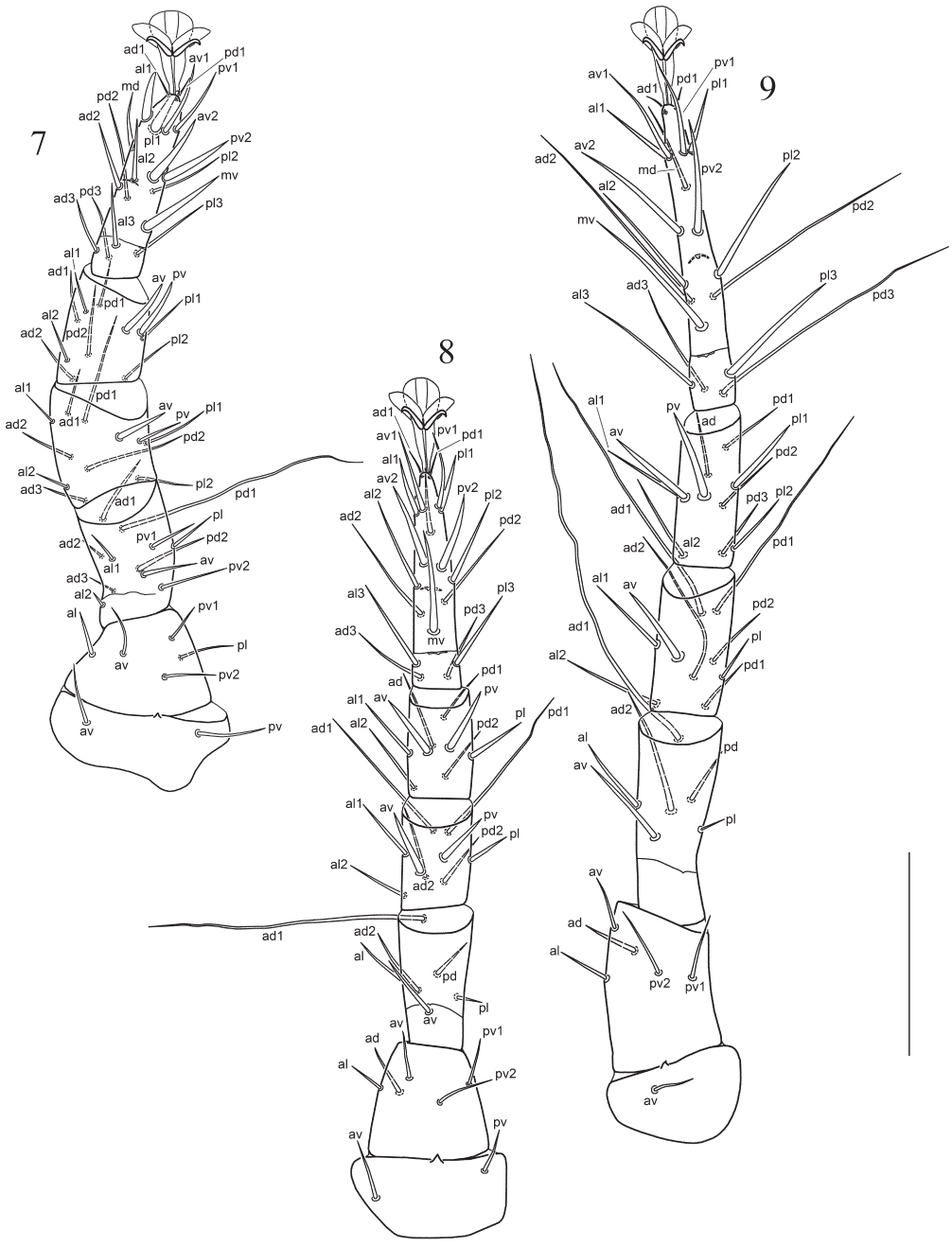
Idiosomal venter (fig. 2). Tritosternum with paired pilose laciniae, base elongated, 50–59 long, 25–29 wide at base, laciniae free for most of total length (134–151), and fused for 13–21 long. Pre-sternal area weakly sclerotised. Sternal shield fused with endopodal platelets of coxae I/II and coxae II/III; 126–139 long midline, 185–218 wide at level of endopodal platelets of coxae I/II, 210–239 wide at level of endopodal platelets of coxae II/III, 118–130 wide at narrowest level between coxae II; with slightly concave anterior margin and concave irregular posterior margin; with 3 pairs of setae (*st1* 46–55, *st2* 46–59, *st3* 42–55), setae *st1* and *st2* not reach base of next posterior setae; sternal shield bearing 2 or 3 pairs of pores (*iv1*, *iv2* located on shield, *iv3* located on shield or on soft cuticle); surface of shield with reticulation. Metasternal platelets absent; setae *st4* (42–50) located on soft cuticle. Endopodal platelets formed between coxae III and IV. Genital shield tongue-shaped; length 269–319, maximum width 126–151, posterior margin rounded, surface with reticulate ornamentation, genital setae *st5* (38–46) on edge of the shield; genital pores placed off shield. Parapodal platelets free. Anal shield rounded triangular; 126–134 long and 92–109 maximum wide; smooth; bearing pair of para-anal setae (46–59) and unpaired post-anal seta (43–42); cribrum well developed. Soft cuticle around of anal shield with 2–3 pairs of elongate metapodal platelets, 13 pairs of setae (*JV1–JV5*, *ZV1–ZV4*, 2 pairs setae of *UR*-series) and 5 pairs of distinguishable pores. All ventral setae smooth and pointed; setae *JV4* and *JV5* wavy; measurements of some setae: *JV1-JV3*, *ZV1-ZV3* 50–92, *JV4* 105–139, *JV5* 210–286, *ZV4* 147–210, *UR* 84–147. Peritrematal shields free from exopodal plate; with 5 pairs of distinguishable pores; peritreme extending from anterior margin of coxa IV to mid-level of coxa I. Spermathecal apparatus not seen.

Gnathosoma (figs 3–6). Epistome triangular, irregularly denticulate (fig. 3). Subcapitulum 185–227 wide at widest level. Hypostomal groove with 6 rows of 12–20 denticles, and smooth anterior and posterior transverse lines (fig. 4). Hypostome with 4 pairs of smooth and pointed setae; seta *hp3* longest (97–105), *pc* 38–55, *hp1* 34–50, *hp2* 38–50. Corniculi entire, symmetrical, robust and horn-like, reaching mid-level of palp femur. Internal malae with two pairs of lobes; inner lobes longer, pointed, with serrated edges, projecting beyond tips of corniculi; outer lobes shorter than corniculi, with serrated edges. Labrum strongly projecting beyond tips of internal malae. Palp length from trochanter to tarsus 252–277; setal formula: 2–5–6–14–15; palpfemoral seta *al*, palpgenual setae *al1* and *al2* weakly spatulate, palptarsal apotele 2-tined, other setae simple (figs 4, 5). Fixed cheliceral digit with large median and preapical teeth, small 10–15 teeth, pilus dentilis, curved dorsal seta, dorsal and lateral pores; movable digit with 2 large teeth and fringed arthrodial corona; second

cheliceral segment length 218–231 (from base to apex of fixed digit), movable digit length 92–105 (fig. 6).



Figs 1–6. *Hypoaspis integer*, ♀: 1 — idiosoma, dorsal view; 2 — idiosoma, ventral view; 3 — epistome; 4 — subcapitulum and palp (from trochanter to genu), ventral view; 5 — palptibia and palptarsus, dorsal view; 6 — chelicera. Scale bars 100 μm.



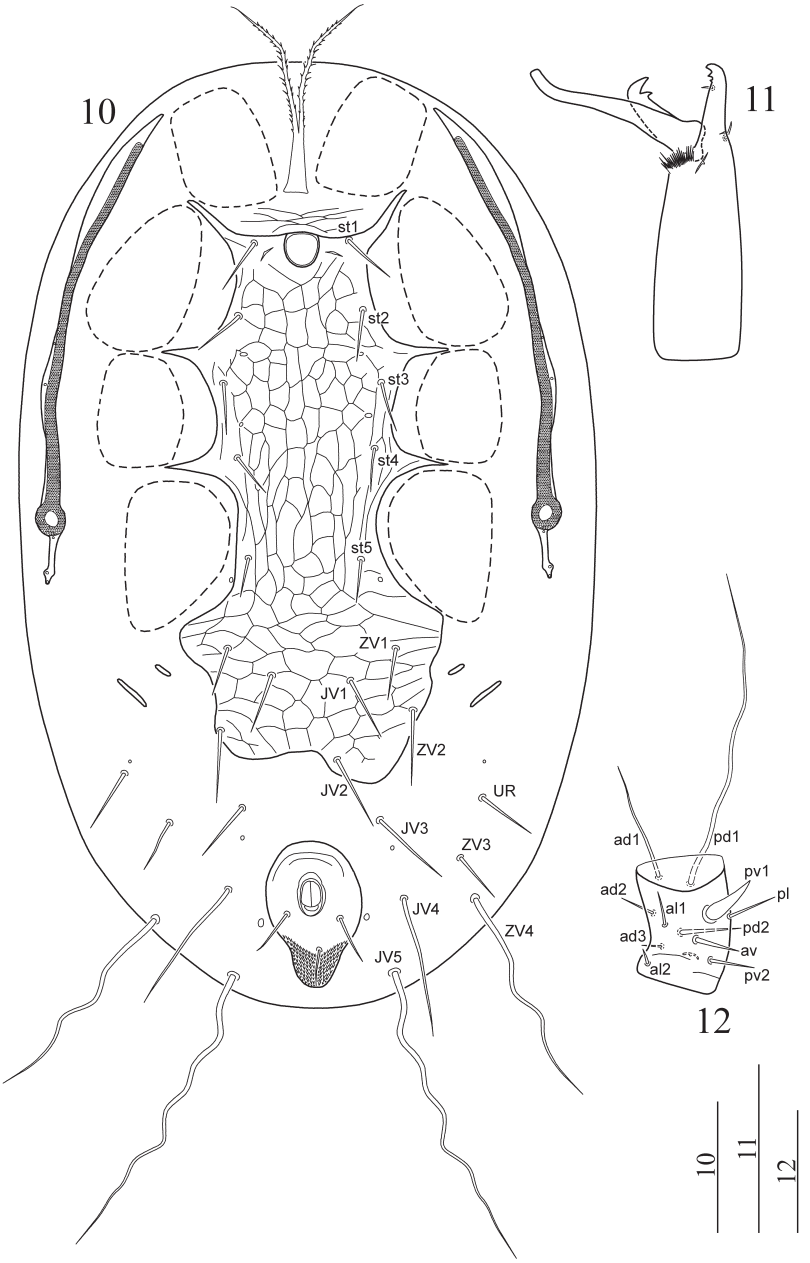
Figs 7–9. *Hypoaspis integer*, ♀: 7–9 — legs II–IV, respectively, ventral view. Scale bar 200 μm.

Legs (figs 7–9). Lengths: I 725–809, II 586–688, III 623–763, IV 846–1042. Leg chaetotactic formulae normal for genus: leg I: coxa 2 (0 0/1 0/1 0), trochanter 6 (1 0/1 1/2 1), femur 13 (2 3/1 2/3 2), genu 13 (2 3/2 3/1 2), tibia 13 (2 3/2 3/1 2); leg II: coxa 2 (0 0/1 0/1 0), trochanter 5 (1 0/1 0/2 1), femur 11 (2 3/1 2/2 1), genu 11 (2 3/1 2/1 2), tibia 10 (2 2/1 2/1 2); leg III: coxa 2 (0 0/1 0/1 0), trochanter 5 (1 1/1 0/2 0), femur 6 (1 2/1 1/0 1), genu 9 (2 2/1 2/1 1), tibia 8 (2 1/1 2/1 1); leg IV: coxa 1 (0 0/1 0/0 0), trochanter 5 (1 1/1 0/2 0), femur 6 (1 2/1 1/0 1), genu 9 (2 2/1 3/0 1), tibia 10 (2 1/1 3/1 2). Tarsi II–IV with 18 setae (3 3/2 1/1 3/2 3). Macrosetae present on femur II (*pd1* 202–294), femur III (*ad1* 218–302), genu III

(*ad1* 92–176, *pd1* 105–164), femur IV (*ad1* 302–416), genu IV (*ad1* 239–290, *ad2* 88–122, *pd1* 139–193), tarsus IV (*ad2* 172–185, *pd2* 147–218, *pd3* 202–244). All setae smooth. Setae *av* on genu II, *av*, *pv* on tibia II, *av2*, *mv*, *pv2* on tarsus II, *av*, *pv* on genu III, *av*, *pv*, *pl* on tibia III, *av2*, *mv*, *pv2* on tarsus III, *av* on genu IV, *av*, *pv*, *pl1* on tibia IV, *av1*, *av2*, *mv*, *pv1*, *pv2*, *pl1*, *pl2*, *pl3* on tarsus IV thickened. Setae *al1* and *pl1* on tarsus II blunt and thickened. All pre-tarsi with pair of claws and thin membranous ambulacrum.

Adult male (n = 2) (figs 10–12).

Idiosomal dorsum. As in female. Dorsal shield 725–809 long and 400–419 maximum width at *r5*.



Figs 10–12. *Hypoaspis integer*, ♂: 10 — idiosoma, ventral view; 11 — chelicera; 12 — femur II, lateral view. Scale bars 100 μm.

Idiosomal venter (fig. 10). Tritosternum as in female, 151–160 long. Pre-sternal area weakly sclerotised. Sternal shield, genital shield, endopodal and parapodal platelets fused into a single reticulate plate, posterior margin of this shield concave and irregular; 399–407 long midline; bearing 8–9 pairs of setae (*st1–st5*, *JV1*, *ZV1*, *ZV2*; seta *JV2* may be absent or placed off shield) and 4 pairs of distinguishable pores. Anal shield free, rounded triangular; 113–118 long and 80–97 maximum wide; smooth; bearing one pair of para-anal setae, and unpaired post-anal seta; cribrum well developed. Soft cuticle around of anal shield with 2 pairs of elongate metapodal platelets, 6 pairs of setae (*JV3–JV5*, *ZV3*, *ZV4*, *UR*) and 3 pairs of distinguishable pores. All ventral setae smooth and pointed; setae *JV5* and *ZV5* wavy; measurements of ventral setae: *st1–st5* 34–46, *JV1-JV3*, *ZV1-ZV3* 38–71, *JV4* 118–151, *JV5* 244–273, *ZV4* 172–181, *UR* 59–71. Peritrematal shields as in female.

Gnathosoma. Fixed cheliceral digit with one large median tooth; movable digit with one large preapical tooth, 0–2 small teeth and long slender spermatodactyl; second cheliceral segment length 172–181, movable digit length 63–67 excluding spermatodactyl and 126–134 including spermatodactyl (fig. 11). Other details as in female.

Legs. Lengths (from base of coxa to apex of tarsus, excluding ambulacrum): I 651–707, II 549–605, III 623–651, IV 828–902. Legs chaetotaxy and macrosetae as in female. Ventral setae on femur–tarsus II more thickened than in female, especially seta *pv1* on femur II (fig. 12). Setae *av*, *pv* on genu III, *av*, *pv*, *pl* on tibia III, *av2*, *mv*, *pv2*, *al1* on tarsus III, *av* on genu IV, *av*, *pv*, *pl1* on tibia IV, *av2*, *mv*, *pv2*, *pl2*, *pl3* on tarsus IV thickened. Setae *al1*, *pl1* on tarsus II and seta *pl1* on tarsus III blunt and thickened.

Remarks. Females and males *Hypoaspis integer* display morphological variability (Costa, 1971). Thus, the seta *z6* is often absent on the dorsal shield. Our data agree with the data of the previous study (table 1). Costa (1971) noted that only one of the 14 studied male specimens had a free anal shield. Both our specimens do not have a free anal shield.

From other Ukrainian species of the genus *Hypoaspis*, *H. integer* differs by the presence on genu IV three long macrosetae (*ad1*, *ad2*, *pd1*), other species have one relatively short macroseta *ad1*.

Hypoaspis krameri (G. Canestrini & R. Canestrini, 1881)

Gamasus krameri Canestrini, Canestrini, 1881: 1083.

Material. Ukraine, Chernihiv Region, Bakhmach District, Bakhmach town (51.18 N, 32.82 E), on *Carabus hortensis* Linnaeus, 1758 (Carabidae), 2005, 8 ♀ (N. M. Lysenko); Odesa Region, Odesa, Suvorovsky District (46.57 N, 30.77 E), street, on *Oryctes nasicornis*, 1.06.2005, 12 ♀ (V. A. Trach); Berezivka District, vicinity of Marynove (47.05 N, 35.75 E), dacha, on *O. nasicornis*, 07.2009, 12 ♀ (A. I. Korziukov); Balta District, vicinity of Gerbine (48.18 N, 29.82 E), forest, on *Lucanus cervus* (Linnaeus, 1758) (Lucanidae), 25.06.2009, 2 ♀ (L. V. Sokolov); Podilsk District, vicinity of Podilsk (47.75 N, 29.52 E), forest, on *L. cervus*, 16.05.2010, 6 ♀ (V. A. Trach); Mykolaiv Region, Pervomaisk District, vicinity of Grushevka (48.00 N, 30.97 E), forest, on *Dorcus parallelipipedus* (Linnaeus, 1758) (Lucanidae), 29.06.2014, 1 ♀ (V. A. Trach); Kherson Region, Oleshky District, vicinity of Radensk (46.55 N, 32.95 E), under the trunk of a pine, on *O. nasicornis*, 5.06.2010, 12 ♀ (V. A. Trach).

Distribution. Austria (Kofler, Schmölzer, 2000); Belgium (Fain, Meissen, 1997); Finland (Huhta, 2016); Germany (Hirschmann et al., 1969); Great Britain (Evans, Till, 1966); Hungary (Kontschán, 2015); Italy (Canestrini, Canestrini, 1881); Latvia (Salmane,

Table 1. Variation in the presence of seta *z6* in females of *Hypoaspis integer*

Characters	Number of specimens , %	
	This study	Costa, 1971 data
z6 completely absent	1 (9.1)	2 (6.9)
z6 unilaterally present	3 (27.3)	8 (27.6)
z6 bilaterally present	7 (63.6)	19 (65.5)

Telnov, 2009); Netherlands (Evans, Till, 1966); Norway (Gwiazdowicz, Gulvik, 2005); Turkey (Çobanoğlu et al., 2003); Ukraine (**first record**); "USSR" (Bregetova, 1977).

Hosts. *Anoplotrupes stercorarius* (Scriba, 1791) (Hirschmann et al., 1969); *Anoxia orientalis* (Çobanoğlu et al., 2003); *Carabus hortensis* (**first record**); *Dorcus parallelipipedus* (**first record**); *Lucanus cervus* (Evans, Till, 1966; Fain, Meissen, 1997; this study); *Oryctes*

Table 2. Scarabaeid beetles of the Ukrainian fauna, which are associated with mites of the family Laelapidae

Species of beetles	Mites species	Distribution, references and results of this study
Anoplotrupes stercorosus (Scriba, 1791)	*Hypoaspis krameri* (G. et R. Canestrini, 1881)	Germany: Hirschmann et al., 1969; Ukraine: mites not registered
Copris hispanus /(Linnaeus, 1764)	*Hypoaspis terrestris* (Leonardi, 1899)	Italy: Leonardi, 1899; Ukraine: Bregetova, 1977; in this study mites not registered
Anoxia pilosa (Fabricius, 1792)	*Coleolaelaps inopinatus* Grandi, 1925	Austria: Costa, Hunter, 1971 Ukraine: this study
Anoxia villosa (Fabricius, 1781)	*Coleolaelaps inopinatus* Grandi, 1925	Spain, Romania: Costa, Hunter, 1971; Greece: Karg, Rössner, 1999; иUkraine: beetles not investigated
	Coleolaelaps variosetatus Karg, 1999	Turkey: Karg, 1999 Ukraine: beetles not investigated
	Coleolaelaps abnormalis Costa et Hunter, 1971	"Europa": Costa, Hunter, 1971 Ukraine: beetles not investigated
Anoxia orientalis (Krynicki, 1832)	*Coleolaelaps inopinatus* Grandi, 1925	Israel: Costa, Hunter, 19714 Hungary: Kontschán, 2015; Ukraine: this study
	Coleolaelaps abnormalis Costa et Hunter, 1971	Israel: Costa, Hunter, 1971 Ukraine: mites not registered
	Coleolaelaps anoxiae (Koyumdjieva, 1977)	Bulgaria: Koyumdjieva, 1977 Ukraine: mites not registered
	Hypoaspis krameri (Canestrini, 1881)	Turkey: Çobanoğlu et al., 2003 Ukraine: mites not registered
Melolontha melolontha (Linnaeus, 1758)	*Hypoaspis melolonthae* Joharchi et Halliday, 2011	Iran: Joharchi, Halliday, 2011 Ukraine: mites not registered
Polyphylla fullo (Linnaeus, 1758)	*Coleolaelaps agrestis* (Berlese, 1887)	Italy: Berlese, 1887; Kazakhstan: Bregetova, 1977; Germany, Bulgaria: Karg, Rössner, 1999; Ukraine: mites not registered
	Hypoaspis campestris (Berlese, 1887)	Italy: Berlese, 1887 Ukraine: not registered
	Hypoaspis integer Berlese, 1911	"South Russia", "former Prussia", Germany: Costa, 1971; Spain: Karg, Rössner, 1999; Poland: Haitlinger, 2012; Ukraine: this study
	Hypoaspis krameri (G. et R. Canestrini, 1881)	Hungary: Kontschán, 2015; Ukraine: mites not registered
Polyphylla alba (Pallas, 1773)	*Coleolaelaps agrestis* (Berlese, 1887)	Ukraine: this study
Amphimallon solstitiale (Linnaeus, 1758)	*Gaeolaelaps rhizotrogi* (Mašán, 1998)	Ukraine: this study
Rhizotrogus aestivus (A. G. Olivier, 1789)	*Gaeolaelaps rhizotrogi* (Mašán, 1998)	Slovakia: Mašán, 1998; Ukraine: beetles not investigated
Oryctes nasicornis (Linnaeus, 1758)	*Hypoaspis integer* Berlese, 1911	Italy: Berlese, 1911; France: Samšiňák, 1960; Czech: Costa, 1971; Ukraine: mites not registered
	Hypoaspis krameri (G. et R. Canestrini, 1881)	Britain, Netherlands: Evans, Till, 1966; "former USSR": Bregetova, 1977; Belgium: Fain, Meissen, 1997; Latvia: Salmane, Telnov, 2009; Ukraine: this study
	Hypoaspis neokrameri Costa, 1971	Israel: Costa, 1971 Ukraine: mites not registered
Pentodon idiota (Herbst, 1789)	*Hypoaspis terrestris* (Leonardi, 1899)	Iran: Joharchi, Halliday, 2011 Ukraine: this study
Phyllognathus excavatus (Forster, 1771)	*Hypoaspis phyllognathi* Costa, 1971	Egypt, Israel: Costa, 1971 Ukraine: mites not registered
Osmoderma coriarius (DeGeer, 1774)	*Gaeolaelaps eremitus* (Sklyar, 2012)	Ukraine: Sklyar, 2012; in this study mites not registered
	Gaeolaelaps breiti (Arutunjan, 1990)	Austria: Arutunjan, 1990 Ukraine: mites not registered

nasicornis (Evans, Till, 1966; Fain, Meissen, 1997; Salmane, Telnov, 2009; this study); *Pterostichus niger* (Schaller, 1783) (Kofler, Schmölzer, 2000).

Remarks. Bregetova (1977) noted that it is "widespread in the USSR", but without exact locations. We consider *Oryctes nasicornis* and *Lucanus cervus* (possibly and other large scarab and lucanid beetles) to be the main hosts of *H. krameri*. Other beetles are accidental hosts, which can permanently or temporarily inhabit the places where the larvae of the main hosts of the mites develop.

Hypoaspis terrestris (Leonardi, 1899)

Laelaps terrestris Leonardi, 1899: 508.

Material. Ukraine, Odesa Region, Odesa, Luzanivka microdistrict (46.55 N, 30.75 E), park, on *Pentodon idiota* Herbst, 1789 (Scarabaeidae: Dynastinae), 24.09.2006, 18 ♀ (V. A. Trach); Kodyma District, vicinity of Olexandrivka (48.00 N, 29.23 E), meadow, on *P. idiota*, 23.05.2009, 3 ♀ (V. A. Trach).

Distribution. Armenia (Ohanjanian, 1978); Italy (Leonardi, 1899); Iran (Joharchi, Halliday, 2011); Ukraine (Bregetova, 1977).

Hosts. Cetoniinae g. sp. (Leonardi, 1899); *Copris hispanus* (Linnaeus, 1764) (Bregetova, 1977); *Oryctes nasicornis* (Ohanjanian, 1978); *Pentodon idiota* (Joharchi, Halliday, 2011; this study); *Polyphylla olivieri* (Joharchi, Halliday, 2011).

Remarks. We examined 10 specimens of *Copris hispanus* from Kherson Region and Crimea, but no mites were found. *Hypoaspis terrestris* differs from *H. krameri* by the longer dorsal (*j3*, *z4*, *Z4*) and ventral (*st1–st3*) setae.

Fourteen species of scarabaeid beetles of the Ukrainian fauna are known to be hosts for mites of the family Laelapidae (table 2). In our study, mites were found on seven beetle species (*Anoxia orientalis*, *A. pilosa*, *Polyphylla alba*, *P. fullo*, *Amphimallon solstitiale*, *Oryctes nasicornis*, *Pentodon idiota*). On five beetle species (*Anoplotrupes stercorosus*, *Copris hispanus*, *Melolontha melolontha*, *Phyllognathus excavatus*, *Osmoderma coriarius*), mites were not found; two species of Scarabaeidae (*Anoxia villosa*, *Rhizotrogus aestivus*) were not studied.

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