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Homothyrea inornatipennis (Coleoptera: Scarabaeidae: Cetoniinae: Leucocelina): immature stages and distribution

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Abstract. *Homothyrea inornatipennis* Gahan, 1903 is the only known Cetoniinae from the Socotra Island (Yemen). Recently collected adults were kept in laboratory conditions and reared. All immature stages (larval instars and pupa) are described in detail and compared with the known larvae of the subtribe Leucocelina. Available data on distribution of this rose chafer are presented.

Key words. Scarabaeoidea, Cetoniini, *Homothyrea*, immature stages, description, distribution, Yemen, Socotra

Introduction

Recently, the authors had the opportunity to study the Scarabaeoidea collected during several Czech expeditions to the Socotra Island. Among this material, a collection of the rose chafer *Homothyrea inornatipennis* Gahan, 1903, originating from several localities throughout the island was found. Part of the material was imported alive to Prague, reared, and it became the basis for the description of immature stages presented below.

Rose chafers of the genus *Homothyrea* Kolbe, 1895 are confined to the Afrotropical region. Seven species-group taxa have been described so far from the eastern and north-eastern part of Sub-Saharan Africa and from the Arabian Peninsula including the Socotra Island (Mikšić 1982; Antoine 1993, 2001; Krajčík 1998; Smetana 2006). According to Krikken 1984 the genus *Homothyrea* is included in the Cetoniini subtribe Leucocelina, which contains approximately 190 species in 26 genera. Including the herein described species, immature stages of only 11 Leucocelina species are known so far (Šípek & Král 2012).

Material and methods

The terminology for larval description follows Hayes (1929), Böving (1936) and Ritcher (1966). Antennomeres I–IV were labelled with the respective abbreviations (an I–an IV) in the

HÁJEK J. & BEZDĚK J. (eds.): Insect biodiversity of the Socotra Archipelago. *Acta Entomologica Musei Nationalis Pragae* **52 (supplementum 2)**: i–vi + 1–557.

descriptions. In order to give the most accurate information on chaetotaxy hair-like setae of the cranium and other structures were classified by their relative size into two groups: medium to long (80–300 μm) and minute or small (5–40 μm or less) setae. For a detailed schematic figure, refer to Šípek et al. (2008). Morphological analyses and measurements were carried out using Olympus SZX9 and Olympus BX 40 light microscopes, both equipped with an Olympus Camedia 5060 digital camera. Mouthparts were dissected and, whenever necessary, mounted on slides in Liquide de Swan (e.g., Švácha & Danilevsky 1986). Photographs were taken using a Canon 550D digital camera, equipped with a Canon MP-E 65/2.8 MACRO lens with 5:1 optical magnification. Partially focused images of each specimen were combined using Zerene photo stacker software (Zerene systems LLC, Richland, USA). Structures examined with the JEOL 6380 scanning electron microscope were cleaned in 10% lactic acid for 24 hours, dried with critical point drying and mounted on aluminium plates. All pictures were digitally enhanced using Adobe Photoshop CS4. Exact label data are cited for the material examined. The authors' remarks and additional comments are found in square brackets. Information in ('parentheses') indicates the original spelling in the original description.

Adults were kept in standard laboratory conditions in a 10 litre transparent bucket, filled with a 20 cm layer of rearing substrate, composed of decaying leaf litter (beech, oak), soft rotten wood and sand (2:1:2 ratio). Adults were provided with ripe banana *ad libitum* and the bucket was sprayed with water every 2–3 days.

The specimens included in this study are deposited in the following institutional and private collections:

BMNH The Natural History Museum, London, United Kingdon (Maxwell V. L. Barclay);
CNCI Canadian National Collection of Insects, Arachnids and Nematods, Ottawa, Canada (Owen Lonsdale);
CULS Faculty of Forestry, Czech University of Life Sciences, Prague, Czech Republic (Jan Farkač);
CUPC Department of Zoology, Charles University, Prague, Czech Republic (Petr Šípek);
JBCP Jan Batelka collection, Prague, Czech Republic;
NMPC National Museum, Prague, Czech Republic (Martin Fikáček, Jiří Hájek).

Results

Homothyrea inornatipennis Gahan, 1903

(Figs. 1–5)

Homothyrea inornatipennis Gahan, 1903: 269. Type locality: 'Sokotra: Hadibu plain'.

Published record. Sokotra, 10.16 Dec. [18]98, Hadibu plain, W.R.O.Grant, Lectotype, BMNH (Antoine 1993).
Material examined (112 adult specimens). Yemen, Soqotra Is., 22.xi.2003, ca 20–170m, Suq, E env. – sand dune, N12°40′02″E54°03′45″ (GPS), David Král lgt., Yemen – Soqotra 2003 Expedition; Jan Farkač, Petr Kabátek & David Král, 2 spec. in NMPC; Yemen, Soqotra Is., 5.–6.xii. 2003, Noged plain, Qaareh (waterfall), 57 m, N12°20′10″E 53°37′56″ (GPS), David Král lgt., Yemen – Soqotra 2003 Expedition; Jan Farkač, Petr Kabátek & David Král, 3 spec. in NMPC; same data but Jan Farkač lgt., 1 spec. in NMPC; Yemen, Soqotra Is., 5.–6.xii. 2003, Noged plain (sand dunes), 11 m, N12°21′09″E54°01′47″ (GPS), David Král lgt., Yemen – Soqotra 2003 Expedition; Jan Farkač, Petr Kabátek & David Král, 18 spec. in NMPC; same data but Jan Farkač lgt., 26 spec. in CULS, 23 spec. in NMPC; same data but Petr Kabátek lgt., 18 spec. in NMPC; Yemen, Soqotra Is., 6.–7.xii.2003, Noged plain, Wadi Ireeh, 95 m, N12°23′11″ E53°59′47″ (GPS), David Král lgt., Yemen – Soqotra 2003 Expedition; Jan Farkač, Petr Kabátek & David Král, 9 spec. in NMPC; Yemen, Soqotra Is., 9.xii.2003, Qalansiyah env., Ditwah (lagoon), 23m, N12°41′42″ E 53°30′08″ (GPS), David Král lgt., Yemen – Soqotra 2003 Expedition; Jan Farkač, Petr Kabátek &

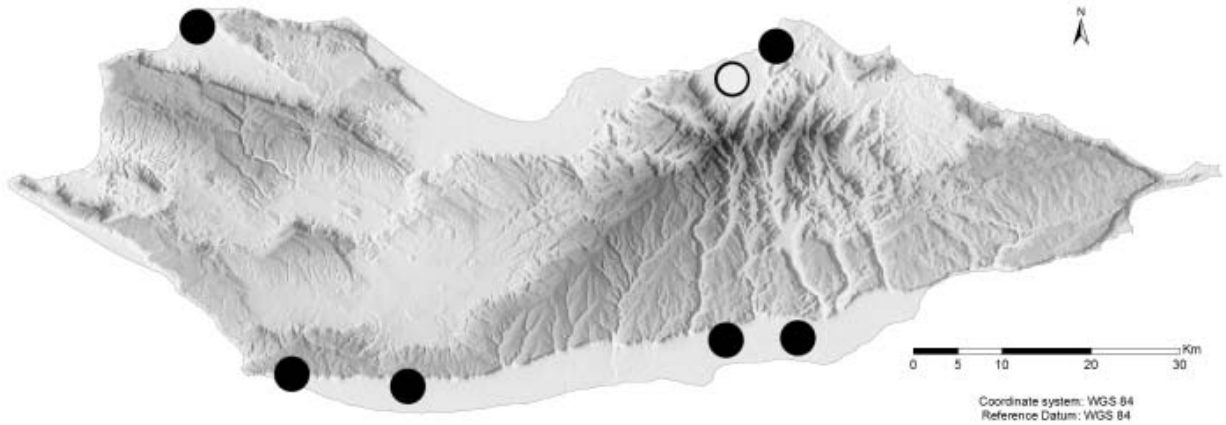

Fig. 1. Sketch map of the Socotra Island with known distribution of *Homothyrea inornatipennis* Gahan, 1903, empty dot represents the type locality.

David Král, 5 spec. in NMPC; Yemen, Socotra Island, 10.–11.xi.2010, Noged plain (sand dunes), Sharet Halma vill. env., 12°21.9′N, 54°05.3′E, 20 m, Jan Batelka leg., 26 spec. in JBCP; same data but Jan Bezděk leg., 2 spec. in NMPC; same data but Jiří Hájek leg., 7 spec. in NMPC.

Natural history. This species is probably associated with sandy habitats, including sand dunes. The above material was taken predominantly from flowers of Asteraceae, trees and shrubs of *Adenium* Roemer & Schultes, *Tamarix* Linnaeus and Mimosoideae (formerly referred to as genus *Acacia* Miller).

Distribution. Endemic to the Socotra Island, see map on Fig. 1.

Remark. Old records of *Homothyrea helenae* from the Socotra Island (Waterhouse 1881, Taschenberg 1883) are most likely related to *H. inornatipennis*. These records come from the time when *H. inornatipennis* had not yet been described and more recent records (Mikšić 1982, Smetana 2006) only seem to repeat the older sources.

Immature stages of *Homothyrea inornatipennis* Gahan, 1903

(Figs. 2B–K, 3–5)

Material examined. Eight first-instar larvae; 13 second-instar larvae, 60 third-instar larvae, and one pupa. All material was reared from adults collected by David Král in Yemen, Soqotra Island 5.–6. xii. 2003, Noged plain Qaareh (waterfall), 57 m, N12°20′10″ E53°37′56″. The material is deposited at CNCI, CUPC, and NMPC.

Third-instar larva (Figs. 2B, 2E–K, 3A–G, 5A–E). Larva scarabaeiform, maximum length 23.0–32.5 mm, cranium pale brown to reddish-brown, body whitish. Abdominal segments IX and X fused dorsally, ventrally separated by an incomplete groove.

Head capsule (Fig. 2G). Maximum width 2.4–2.6 mm. Surface of cranium with weak microsculpture, pale brown to red-brown; antennifer, postclypeus and labrum brown; area around frontoclypeal suture and apices of mandibles black. Cranial chaetotaxy summarized in Table 1. Frontal sutures bisinuate. Epicranial insertions of antennal muscles feebly developed (visible as only small depressions near the middle of frontal sutures).

Table 1. Cranial chaetotaxy of the larva of *Homothyrea inornatipennis* Gahan, 1903.
Abbreviations. AAS = setae on anterior frontal angle; ACS = anterior clypeal setae; AES = anterior epicranial setae; AFS = anterior frontal setae; DES = dorsoepicranial setae; ECS = exterior clypeal setae; EES = exterior epicranial setae; EFS = exterior frontal setae; ELS = exterior labral setae; LLS = setae on lateral labral lobe; PES = posterior epicranial setae; PFS = posterior frontal setae; PLS = posterior labral setae; PMS = paramedial labral setae. SMLL = setae on the median labral lobe. Numbers in brackets indicate a rarely occurring state. For explanation of length categories of setae see Materials and methods.

	Epicranium				**Frons**				**Clypeus**		**Labrum**				
Group of setae	DES	PES	AES	EES	PFS	EFS	AFS	AAS	ACS	ECS	PLS	PMS	ELS	LLS	SMLL
L3															
Long and medium setae	1(2)	0(1)	1	2 (1–3)	1	–	–	1	1	1(2)	1–6	1	2	5–6	6–8
Minute setae	3–4 (2–7)	2–4 (1)	–	2–6	–	1	1	–	0(1)	1(0)	0(1)	0	–	–	–
L2															
Long and medium setae	1	–	1	2	1	–	–	1	1	1	3	1	2	4–6	8
Minute setae	1–3	0–3	–	1–4(6)	–	0–1	0–1	–	–	(0)1	–	–	–	–	–
L1															
Long and medium setae	1	–	1	2	1	–	–	1	1	1	3	1	2	5–6	6–8
Minute setae	2–6	1(4)	–	0–2	–	0–1	0–1	–	–	1	–	–	–	–	–

Anterior and exterior frontal setae minute. Clypeus subrectangular, anteclypeal part membranous represents about 1/3 of entire clypeal area. Postclypeus strongly sclerotized with one anterior and a pair of exterior clypeal setae (of which one might be heavily reduced). Frontoclypeal suture distinct. Stemmata absent.

Antennae (Figs. 2E–G). Tetramerous (an I–IV), relative length of antennomeres: an I > an IV > an II > an III); first antennomere (an I) about the length of an II and an III combined. Antennomere III with ventral, apical projection exhibiting single sensory spot. Ultimate antennomere (an IV) with two dorsal and three ventral sensory spots and a single round apical sensoric field.

Labrum. Symmetrical, anterior margin trilobed with numerous setae. Clithra present. Dorsal surface with two transverse rows of setae. Posterior row with about two to six setae on each side, anterior row with one prominent paramedian and one lateral seta on each side.

Epipharynx (Fig. 2I). Haptomerum: Zygum convex, with arcuate row of 10–14 stout setae and medial transverse row of another four to six stout slightly prolonged setae. Typically eight sensilla of zygum organized in arched row distal to row of stout setae. Haptomeral process and proplegmata absent. Acroparia: External margin of medial labral lobe with three to four long setae on ventral side and three to four setae on dorsal side. Lateral labral lobes with five to six long setae. Acanthoparia with four to seven small conical setae. Plegmata absent.

Chaetoparia asymmetric, right half exhibiting five to six, left four to five irregular rows of setae. Medial rows with stout, spine-like setae. Right side of chaetoparia with approximately 50, left with approximately 40 setae. Dexiotorma, robust, straight, right pternotorma present. Laeotorma reduced, left pternotorma triangular, large. Haptolachus: Sense cone (left nesium)

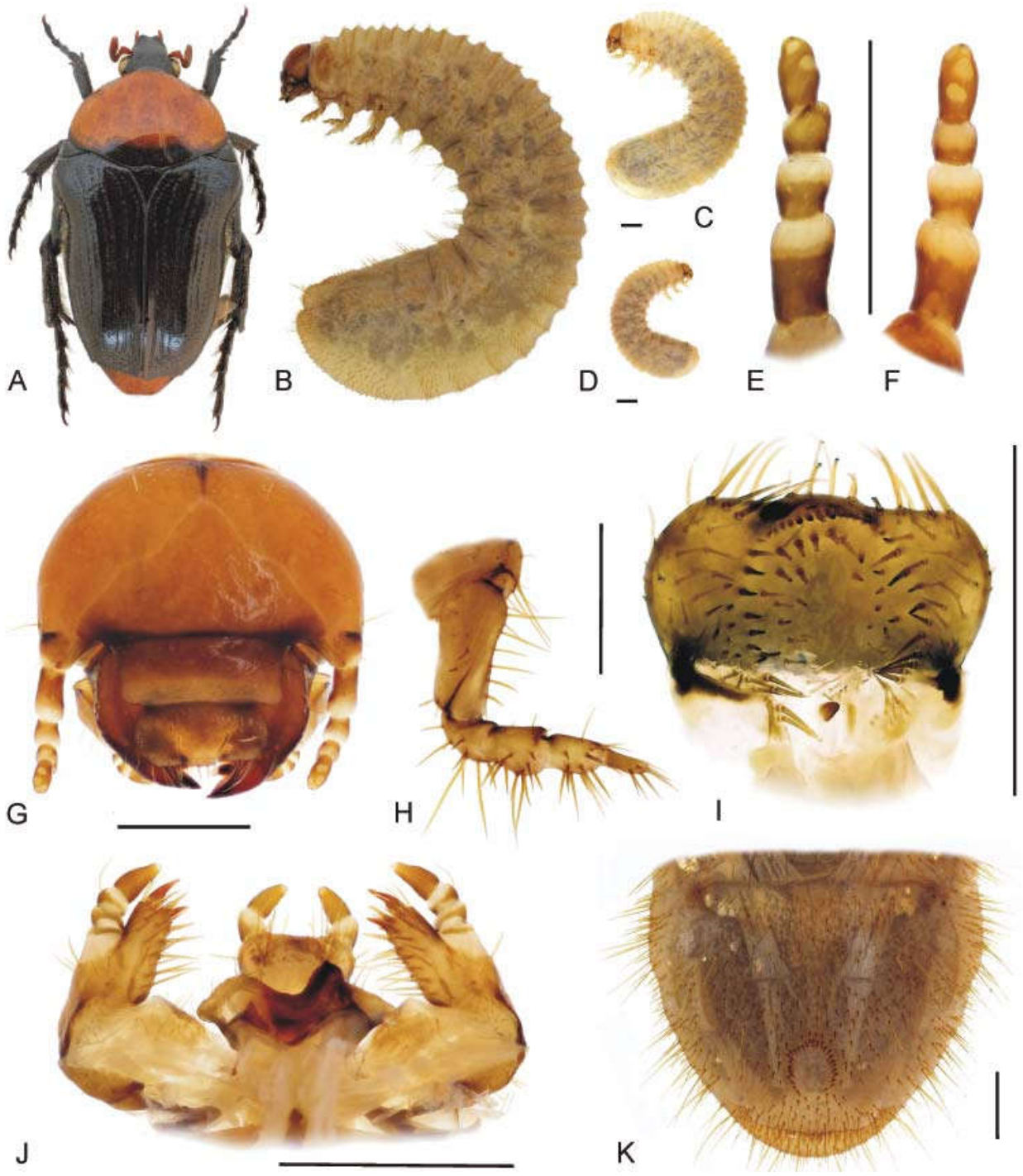

Fig. 2. *Homothyrea inornatipennis* Gahan, 1903. A – adult male. B–D – habitus of larva. B – third-instar, length 32 mm; C – second-instar; D – first-instar. E–K – third-instar larva. E – antenna, ventral view; F – antenna, dorsal view; G – cranium; H – metathoracic leg; I – epipharynx; J – maxillo-labial complex; K – last abdominal segment, raster. Scale bars: C–K = 1 mm.

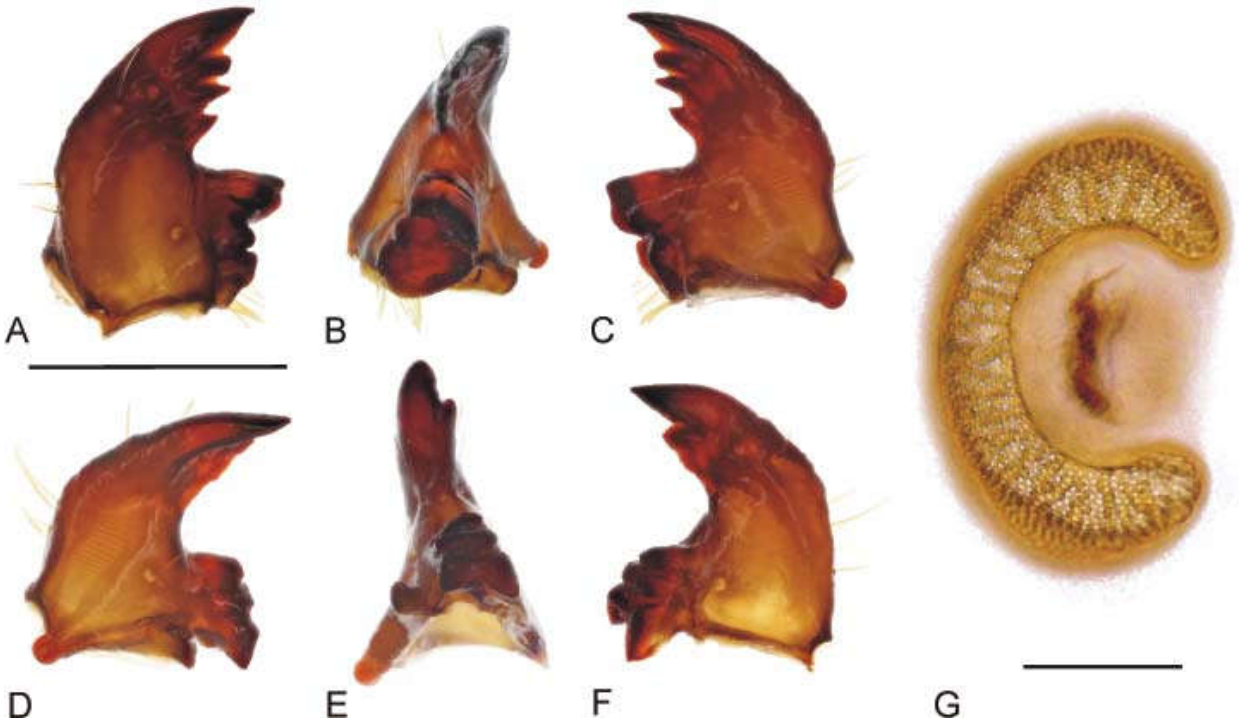

Fig. 3. *Homothyrea inornatipennis* Gahan, 1903, third-instar larva. A–C – right mandible. A – dorsal, B – medial, C – ventral view; D–F – left mandible. D – ventral, E – medial, F – dorsal view; G – thoracic spiracle. Scale bars: A–E = 1mm, G = 100 μm.

with four pores, sclerotized plate (right nesium) absent. Plate-shaped sclerite present medially to sense cone. Anterior part of haptolachus with several slender hair-like setae, posterolateral part with group of two pore-like setae on each side. Phoba and crepis absent.

Mandibles (Figs. 3A–F, 5A). Asymmetrical, scrobis with four to five setae, longitudinal furrow absent. Anterolateral portion of dorsal mandibular surface with row of two prominent setae and medial pore, another pore found near centre of dorsal mandibular face. Patches of two to four dorsomolar setae concealed in single rim present on both mandibles. Ventral surface with five to eight ventromolar setae in single rim and additional single seta. Stridulatory area present, with about 16–19 transversal ridges (Fig. 5A). Left mandible with four scissorial teeth. Right mandible with two prominent scissorial teeth and a third scissorial tooth indicated only as slight convexity on scissorial margin. Molar lobes of both mandibles with sharp projections. Posterior margin of right mandibular calyx bilobed (in medial aspect) with dorsal lobe about twice larger than ventral. Calyx of left mandible flattened with convex posterior margin. Brustia with three to five or 10–12 setae on right and left mandible, respectively.

Maxilla (Figs. 2J, 5B–D). Dorsal surface of cardo and labacoparia with two to four or 14–20 setae respectively. Dorsomedial surface of stipes with around 15 slender hair-like setae and oblique row of four to five well sclerotized spine-like stimulatory teeth and anterior truncate process (blunt tubercle, Fig. 5C). Another four to five prominent setae located in distal part of stipes. Ventral face of stipes with few setae. Galea and lacina entirely fused forming mala, galeo-lacinial suture indistinct, entirely absent on ventral face. Galear portion of mala with

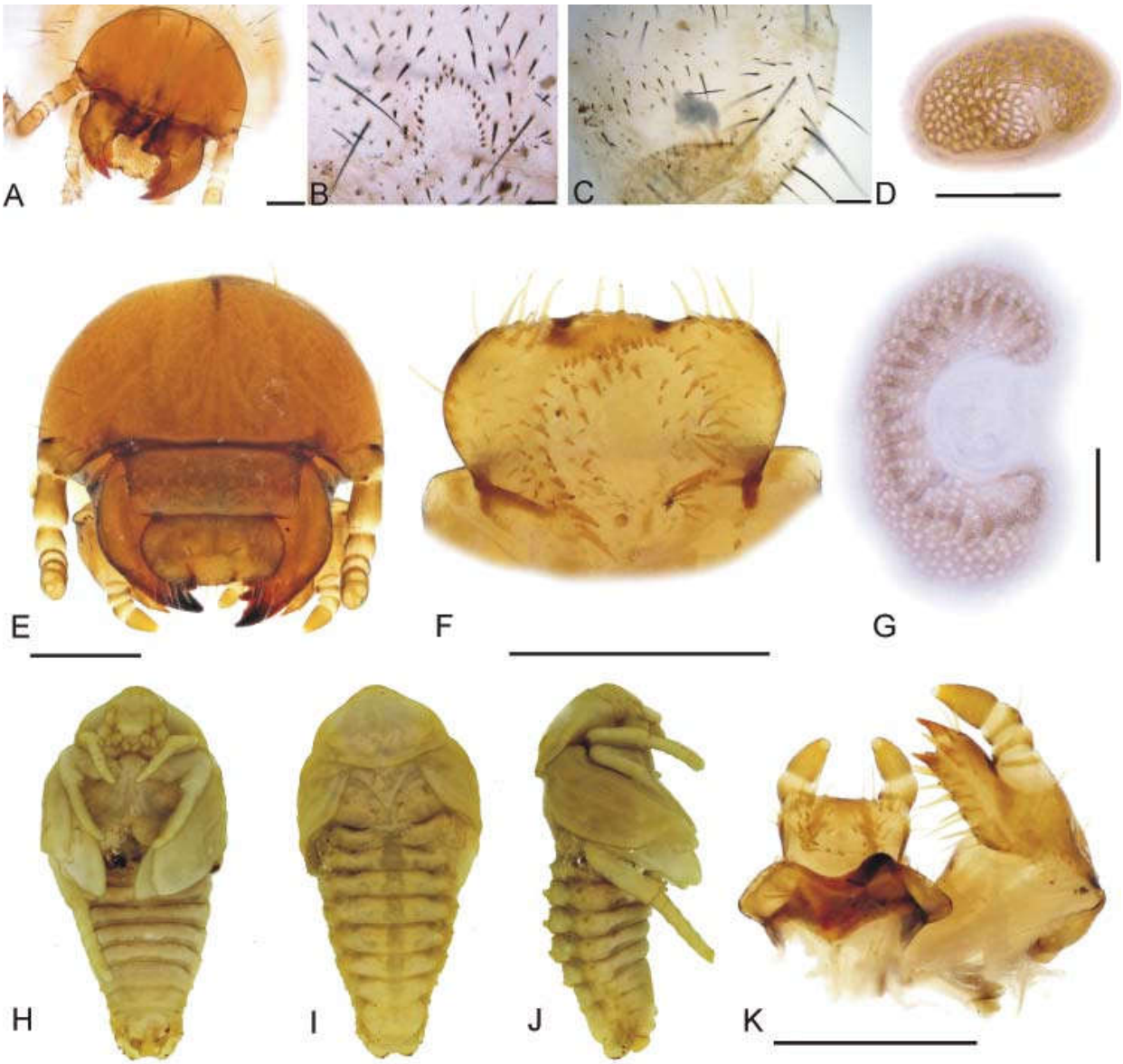

Fig. 4. *Homothyrea inornatipennis* Gahan, 1903, immature stages. A – first-instar larva, cranium; B – second-instar larva, raster; C – first-instar larva, raster; D – first-instar larva, thoracic spiracle; E – second-instar larva, cranium; F – second-instar larva, epipharynx; G – second-instar larva; spiraculum; H – pupa, ventral view (total length 13 mm); I – pupa, dorsal view; J – pupa, lateral view; K – second-instar larva, maxillo-labial complex (left maxilla removed). Scale bars: A–C = 200 μm; D, G = 50 μm; E, F, K = 0.5 mm.

single falcate uncus and several long and stout hair-like setae in longitudinal rows; lacinia with one large and one small uncus fused at their base (Fig. 5D); dorsomedial side with numerous very long hair-like setae. Ventral surface of mala with row of three to five stout setae and few long setae. Maxillary palpi tetramerous, penultimate palpomere usually with two setae.

Hypopharyngeal sclerome (Figs. 2J, 5E). Asymmetrical with strong protruding and pointed truncate process. Tufts of tegumentary expansions (= phoba, sensu Böving 1936) present on left lateral lobe and on mesolateral margin of hypopharyngeal sclerome below truncate process. Both lateral lobes only feebly sclerotized.

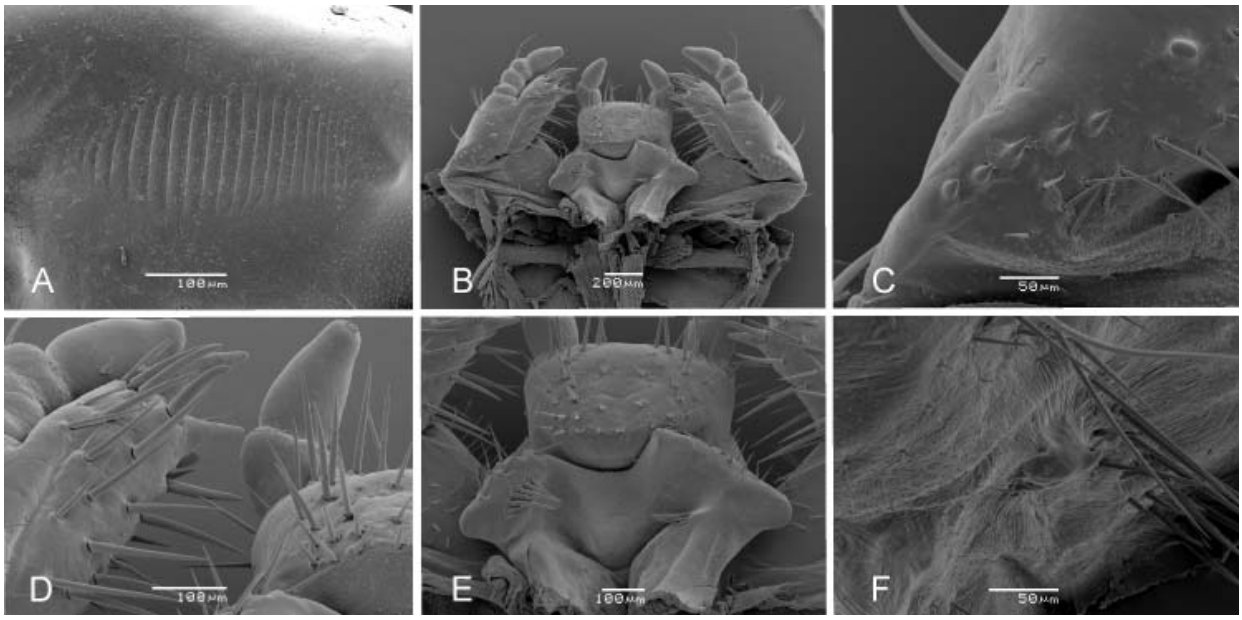

Fig. 5. *Homothyrea inornatipennis* Gahan, 1903, immature stages. A–E – third-instar larva. A – left mandible, stridulatory area; B – maxillo-labial complex; C – maxillary stridulatory teeth; D – left maxilla, detail with unci; E – hypopharyngeal sclerome; F – first-instar larva, egg-burster.

Ligula (Figs. 2J, 5E). Dorsal surface with a group of approximately 15 long hair-like setae on each side; paramedial longitudinal row of three stout setae; proximal transverse row of nine to 12 campaniform sensilla interrupted by paramedial pair of conical setae. Labial palpi bimerous.

Thorax (Figs. 2B, 2H, 3G). Prothorax with single dorsal lobe, meso- and metathorax with three well developed lobes. Each dorsal sublobe of thoracic segments with two or three rows of setae, anterior row(s) short (approx. 50 μm), setae of posterior row about two to three times as long as previous and interspersed with very long setae (400 μm). Prothoracic sclerite covering almost whole lateral portion of prothorax. Mesothoracic spiracle (Fig. 3G) with C-shaped respiratory plate; distance between lobes of respiratory plate about two times of maximum diameter of respiratory plate. Respiratory plate with eight to ten holes across diameter. All pairs of legs (Figs. 2B, 2H) subequal. Pretarsi cylindrical with eight setae, claws absent (Fig. 2H).

Abdomen (Figs. 2B, 2K). Nine-segmented. Dorsa of abdominal segments I–VI with three sublobes, segments VII and VIII with only two. Each sublobe bearing four to six rows of setae. Similarly to thorax, setae in anterior rows short, posterior row distinctly longer setae.

Abdominal spiracles similar to mesothoracic spiracle, all spiracles subequal in size. Abdominal spiracle VI–VIII more or less circular. Dorsum of ultimate abdominal segment (fused segments IX and X) with numerous (semi) hamate setae interspersed with several long hair-like setae.

Raster (Fig. 2K). Palidium monostichous (however, a few irregular pali may be scattered around main row), composed of approximately 25–30 pali arranged in single semi-elliptical or horseshoe-shaped row. Septula opened posteriorly, almost as wide as long. Tegilla fused

composed of numerous short to medium long setae, covering almost whole ventral surface of abdominal segment X. Ventral anal lip with numerous setae, medial portion with approximately 20 medium long to long setae. Chaetotaxy of dorsal anal lobe similar to ventral lobe; however, long setae more numerous.

Second-instar larva (Figs. 2C, 4B, 4E–G, 4K). Larva similar to third-instar larva with the exception of the following: maximum body length 12–20 mm, maximum width of the head capsule 1.55–1.66 mm. Cranial chaetotaxy summarized in Table 1. Laeotorma more developed (Fig. 4F). Spiracles (Fig. 4G): bula without spiracular slit (ecdysial scar), distance between lobes of respiratory plate nearly same as maximum diameter of respiratory plate. Raster (Fig. 4B): Pali feebly developed, much shorter than setae of tegilla.

First-instar larva (Figs. 2D, 4A, 4C, D, 5F). Larva similar to third-instar larva with the exception of the following: maximum body length 11.0–12.5 mm, maximum width of the head capsule between 0.9 and 1.0 mm. Cranial chaetotaxy summarized in Table 1. Metathorax with peg-like egg-burster (Fig. 5F). Spiracles (Fig. 4D): respiratory plate elliptical, bula very small, ecdysial scar absent. Raster without pali, tegilla feebly developed.

Pupa (Figs. 4H–J)**.** Length 13 mm, maximum width 6 mm. Exarate, testaceous, surface glabrous. Head bent ventrally. Mouthparts and antenna well-separated. Labrum tumid, clypeus slightly concave. Maxilla elongated and conical. Compound eyes distinct. Thorax: pronotal disc convex. Lateral margins of pronotal disc distinct. Meso- and metanota differentiated. Mesonotum with triangular posterior projection. Pterothecae free, closely compressed around body and almost equal in length. Spines and spurs on tibiae poorly developed, tarsomeres well defined. Abdomen: Dorsal surface with nine visible, progressively narrowing segments, penultimate segment semicircular, large; last segment narrow (about 1/4 of the previous segment). Gin traps (dioneiform organs *sensu* Costa et al. 1988) absent. Terga of abdominal segments II–V with coarse medial tubercle (Figs. 4I, J). Spiracles of abdominal segments I–IV functional, feebly sclerotized, first spiracular pair almost covered by pterothecae. Spiracles of abdominal segments V–VIII non-functional and rudimentary. Urogomphi absent. Genital ampulla of male pupa spherical and prominent.

Discussion

Besides the above described larvae of *Homothyrea inornatipennis*, larvae of another ten Leucocelina species are known (Šípek & Král 2012). Donaldson (1987) described the larvae of *Leucocelis amethystina* (MacLeay, 1838), *L. haemorrhoidalis* (Fabricius, 1775), *L. rubra* (Gory & Percheron, 1833), *Leptothyrea perroudi* (Schaum, 1844), *Mausolepis amabilis* (Schaum, 1844), and *Phoxomela umbrosa* (Gory & Percheron, 1833). The larvae of *Grammopyga cincticollis* (Hope, 1842) have been described by Jerath & Unny (1965). The larvae of three *Oxythyrea* Mulsant, 1842 species are known so far: *O. cinctella* (Schaum, 1841) – Medvedev (1952); *O. funesta* (Poda, 1761) – Micó & Galante (2003), and *O. pantherina* (Gory & Percheron, 1833) – Šípek (2005). According to Donaldson (1987) and Micó & Galante (2003), third-instar larvae of the subtribe Leucocelina are characterized by a horseshoe-shaped palidium, which also applies to the larvae of *Homothyrea inornatipennis*.

However, this character does not correspond to the description of *Grammopyga cincticollis* by Jerath & Unny (1965) and *Phoxomela umbrosa* by Donaldson (1987). Unfortunately, a more detailed comparison of the *H. inornatipennis* larval morphology with the species described by Donaldson (1987) is impossible due to the descriptions which are too concise. The descriptions of *Oxythyrea funesta* and *O. pantherina* are far more complete and allow to conclude that larvae of both genera are very similar in their morphology, differing only in minute details. Species in the genus *Oxythyrea* have a higher number of pretarsal setae (nine to ten or 12–14 in *O. funesta* and *O. pantherina* respectively versus eight in *H. inornatipennis*) and a higher number of respiratory holes in the respiratory plates (10–14 and 13–16 respectively versus 8–10). Third-instar larvae of *O. funesta* also differ from those of *H. inornatipennis* in the mandibular stridulatory area being composed of approximately ten and 15–20 ridges respectively. Additionally, the distance between the ridges is almost the same in the entire stridulatory area of *H. inornatipennis*, while the distance between the distal ridges is approximately double the distance between the proximal stridulatory ridges in *O. funesta*. Besides an overall morphological similarity, larvae of both genera also have similar rearing requirements under laboratory conditions (for more details on captive breeding of *O. funesta* refer to Micó & Galante 2003). The only, but quite significant, difference is that larvae of the genus *Oxythyrea* exhibit a more seasonal pattern of reproduction, which is not present in *Homothyrea*, suggesting that the species may occur throughout the year. The developmental period took from 3–5 months.

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