

The third instar larva of *Eunanus valmorbidai* Ferreira, Grossi & Seidel, 2024 with notes on Geniatini larvae (Coleoptera: Melolonthidae: Rutelinae)

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Abstract. The present study describes and illustrates the third instar larva of *Eunanus valmorbidai* Ferreira, Grossi & Seidel, 2024 (Coleoptera: Melolonthidae: Rutelinae) based on specimens collected on South Brazil. A key to third instar larvae of Geniatini is provided, and the taxonomy of Geniatini immatures is discussed.

Keywords. Geniatini; Neotropical; Pleurosticti; Scarabaeoidea; White grub.

INTRODUCTION

The New World Rutelinae of the tribe Geniatini (Coleoptera: Melolonthidae) is composed by 13 genera (Jameson & Hawkins, 2005): *Bolax* Fischer von Waldheim, 1829; *Eunanus* Ohaus, 1909; *Evanos* Castelnau, 1840; *Geniates* Kirby, 1818; *Geniatosoma* Costa Lima, 1940; *Heterogeniates* Ohaus, 1909; *Leucothyreus* MacLeay, 1819; *Lobogeniates* Ohaus, 1917; *Microchilus* Blanchard, 1851; *Mimogeniates* Martínez, 1964; *Rhizogeniates* Ohaus, 1909; *Trizogeniates* Ohaus, 1917; and *Xenogeniates* Villatoro & Jameson, 2001.

Also named “bearded scarabs”, geniatines are usually differentiated from other Rutelinae by (Jameson & Hawkins, 2005): labrum dorsoventrally large; labrum and prementum each with an apicomedial projection; protarsus large and flat, especially in males; outer elytral margin with and membranous border.

Adults feed on leaves, fruits, or flowers, whereas larvae are rhizophagous with one species recorded for termite nests (Puker *et al.*, 2015); some species were reported as potential pests since immatures damage roots of several crops and adults are defoliators or damage trunks. Bearded scarabs were reported damaging cultures of tea or chá

(*Camellia sinensis* (L.) Kuntze, Theaceae), coconut palm or coqueiro (*Cocos nucifera* L., Arecaceae), *Eucalyptus* spp. (Myrtaceae), Surinam cherry or pitangueira (*Eugenia pitanga* (O. Berg) Nied., Myrtaceae), apple tree or macieira (*Malus* sp, Rosaceae), mango tree or mangueira (*Mangifera indica* L., Anacardiaceae), guava tree or goiabeira (*Psidium guajava* L., Myrtaceae), *Rosa* spp. (Rosaceae), grapevine or videira (*Vitis* sp., Vitaceae) (see Anjos & Majer, 2003; Jameson & Hawkins, 2005; Pardo-Locarno *et al.*, 2005; Montoya *et al.*, 2015; Ferreira *et al.*, 2016).

Geniatini includes about 330 species (Grossi & Vaz-de-Mello, 2018), of which only four have their immatures morphologically described (Fig. 12): *Eunanus valmorbidai* Ferreira, Grossi & Seidel 2024 (described here), *Geniates barbatus* Kirby, 1819 (see Fuhrmann, 2013), *Geniates borelli* Camerano, 1894 (see Rodrigues *et al.*, 2017) and *Leucothyreus femoratus* Burmeister, 1844 (see Pardo-Locarno *et al.*, 2006).

Eunanus is a small genus that includes five species from Brazil (Mato Grosso do Sul, Rio Grande do Sul states), Paraguay and Argentina. The species of the genus are mainly distinguished from other geniatine genera by their body covered in white, recumbent, scale-like setae; mandibles

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with a rounded apical lobe; male antennal club longer than antennomeres I-V combined; and aedeagus with a ventral sclerite (Gutiérrez, 1951; Jameson & Hawkins, 2005; Ferreira *et al.*, 2024; Fig. 1C). The genus was taxonomically revised by Ferreira *et al.* (2024).

The purpose of the present study is to describe the third instar larva of *Eunanus valmorbidai*, update the key to third instar larvae and clarify the classification of the immature stages of Geniatini.

MATERIAL AND METHODS

White grubs were collected in cultivated and natural grassland areas of the Brazilian Pampa region in 2012 and 2013. The sampling area is placed in Itaqui and Uruguiana municipalities (Fig. 1A, B), State of Rio Grande do Sul (RS), Brazil. A total of 18 locations were sampled, in each location 25 randomized trenches were dug (50 length \times 25 width \times 20 cm depth), spaced about 50 m from each other. Larvae were collected and placed individually in 70 ml pots containing trench's soil. Larvae were reared in growth pots at $25 \pm 1^\circ\text{C}$ and 12:12 [L:D] h photoperiod (modified from Aragón-García *et al.*, 2005). Pots were verified weekly for adult emergence, and soil was moistened when necessary. Fifteen larvae of *E. valmorbidai* were col-

lected in natural grassland, and 26 were collected in cultivated areas, in Uruguiana municipality. Two male and two female adults were obtained from the reared larvae; these specimens were used as the type series of *Eunanus valmorbidai* (see Ferreira *et al.*, 2024). A third instar larva (MZSP 10377) was preserved in 70% ethanol and is housed at Immature Coleoptera Collection of Museu de Zoologia da Universidade de São Paulo (MZSP), Brazil. This larva was used here for morphological study.

The terminology used follows: Böving (1936), Lawrence (1991) and Sousa *et al.* (2018). The epipharynx of Scarabaeoidea larvae is quite important to taxonomy and this complex structure includes several diagnostic characters to almost all white grubs. Knowing the importance of the structure and that discordant terminology is often used (see Rodrigues *et al.*, 2017; Sousa *et al.*, 2018) a short, illustrated study of the scarabaeoid epipharynx is provided (Fig. 2) helping the correspondence between terms and termed structures. The setae are classified according to their length as long, short, or minute, and according to their shape as thin, thick, spine-like, or leaf-shaped. The family group classification follows Cherman & Morón (2014).

Illustrations were produced using a camera lucida attached to a Carl Zeiss Stemi SV6 stereomicroscope and to a Zeiss Axioskop microscope. The photographs were

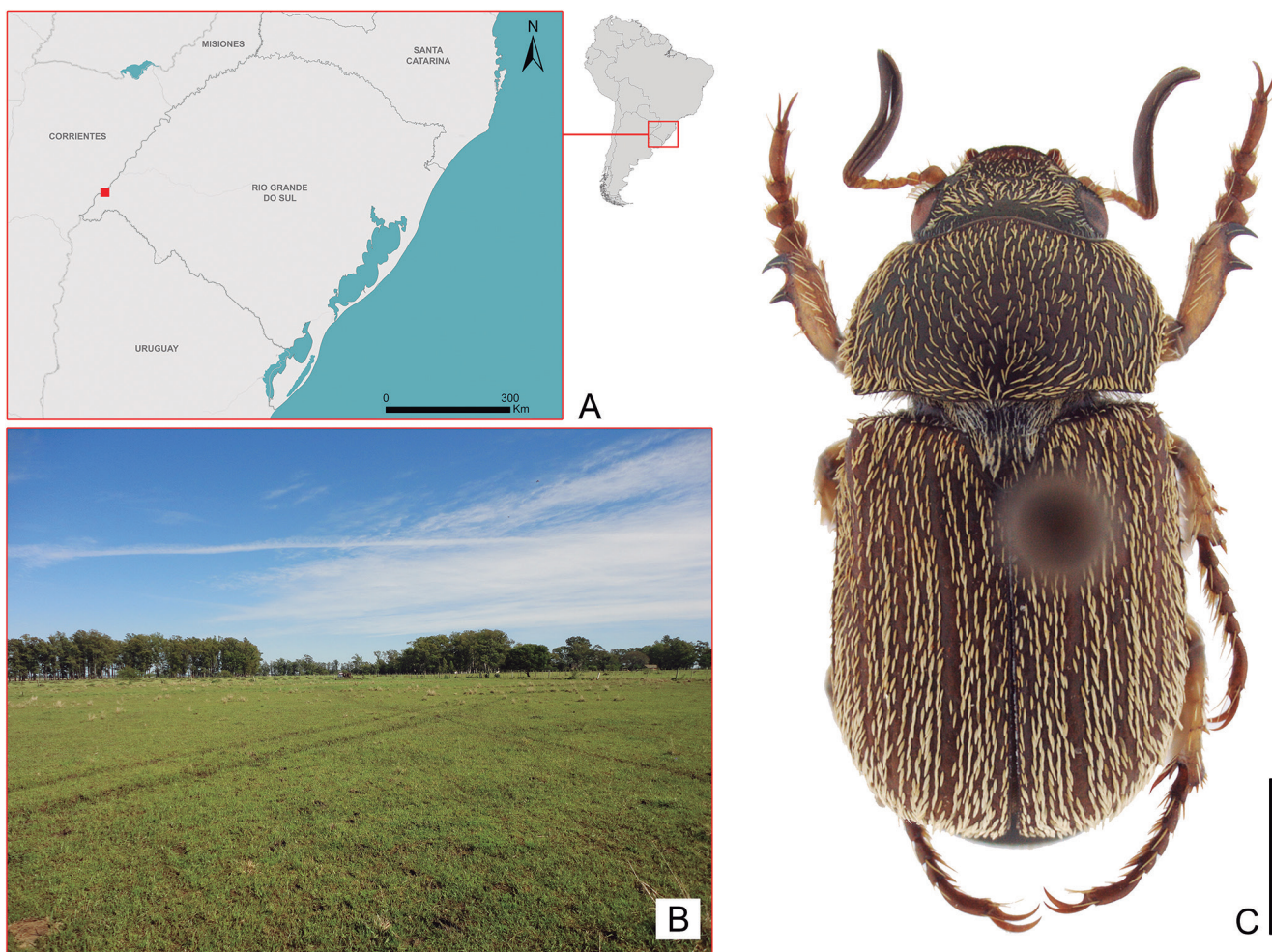


Figure 1. *Eunanus valmorbidai*, (A) Uruguiana municipality, Brazil. (B) sampling area, cultivated grassland (credits: Ivair Valmorbidai). (C) male adult, dorsal. Scale = 1 mm.

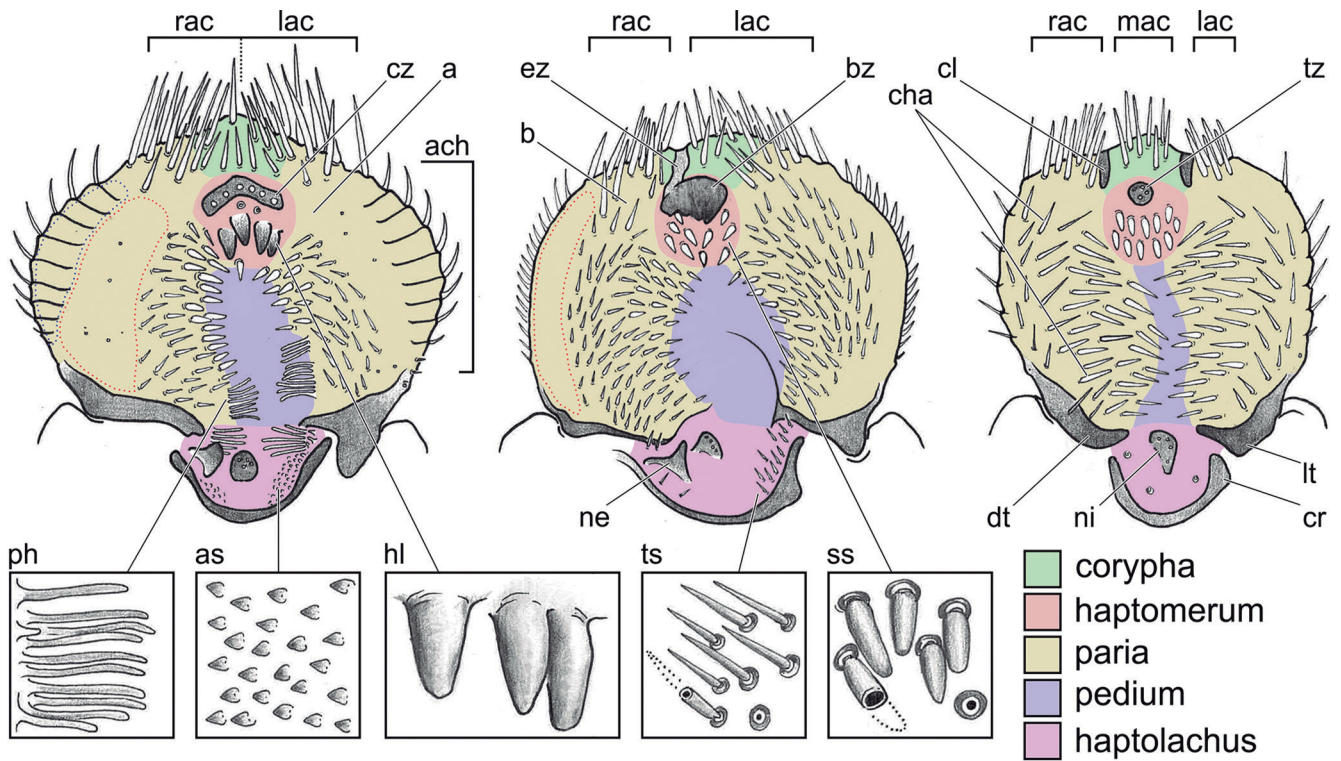


Figure 2. Epipharynx of three generalized Scarabaeoidea larvae, morphology and terminology. Areas of epipharynx colored. When present, gymnoparia and plegmatium noticed by red or blue dotted lines, respectively. a = acroparia separate from chaetoparia; b = acroparia in contact with chaetoparia. Processes and sclerites: as = asperites (minute cuticular sclerotized processes); bz = beak-like zygum; cz = bar-like zygum; cl = clithrum; cr = crepis; dt = dextortorma (or right tortorma); ez = epizygum; hl = heli (fix rigid cuticular processes); lt = laeotorma (or left tortorma); ne = nesium externum (or sclerotized plate); ni = nesium internum (or sensorial cone); ph = phoba (comb of minute fleshy cuticular processes); ss = spine-like setae; ts = thin setae; tz = tubercle-like zygum. Setal groups: ach = left acanthoparia; cha = left chaetoparia; lac = left acroparia; mac = medial acroparia; rac = right acroparia.

taken with a Canon EOS 80D DSLR camera using a Canon MP-E 65 mm f/2.8 macro-lens, and the LED illumination system (Kawada & Buffington, 2016). The multi-focal images were processed using the software Zerene stacker. Scanning electron microphotographs (SEM) of larval mouthparts were taken using a Microscope Zeiss LEO 440, with specimens covered with gold. The Adobe Photoshop CC 22.00.0 software was used for image processing. Measurements were taken in millimeters using a micrometer.

Here is highlighted the importance of different image procedures to find characters. For example, the pronotum of the larva has a pair of lateral sclerites, and these plates are almost indistinct in SEM images or multi-focal photographs (Fig. 3A), and are evident in microscopy, as illustrated (Fig. 11C).

RESULTS

Key to third instar larvae of Neotropical Rutelinae tribes and to Geniatiini species (modified from Rodrigues et al., 2017)

Larvae of *Leucothyreus alvarengai* Frey, 1979 was noted and figured in Pereira et al. (2013) with 2-3 dorsoepicranial setae; each palidia with 3 spine-like setae; septula quadrate; each tegillar area bearing about 6 spine-like setae, none of them are preseptular, these setae are equal in shape as pali; anal lobe with about 30 spine-like

setae and 14 long thin setae. This characterization is insufficient to separate *L. alvarengai* from *L. femoratus* (described by Pardo-Locarno et al., 2006).

1. Last antennomere with 2 or more dorsal sensory spots Rutelini
- 1': Last antennomere with 1 dorsal sensory spot..... 2
2. Epipharynx with weakly prominent haptomerum, zygum as a cross-bar, with 2-4 heli Anomalini
- 2': Epipharynx with prominent haptomerum, zygum beak-like or tubercle-like, prominent, without heli..... 3
3. Antennomere IV with 3 ventral sensorial spots; palidia absent..... Anoplognathini
- 3': Antennomere IV with 2 ventral sensorial spots; palidia usually evident... Geniatiini ... 4
4. Plegmatia present Geniates ... 5
- 4': Plegmatia absent..... 6
5. Palidia long, each with 12-16 pali..... *G. barbatus* Kirby
- 5': Palidia short, each with 6-8 pali *G. borelli* Camerano
6. Some body areas with leaf-shaped setae (Figs. 3C, 4E), stemmata absent, septula triangular (Figs. 3F, 11A) *Eunanus valmorbidai* Ferreira, Grossi & Seidel
- 6': Leaf-shaped setae absent, stemmata present, septula quadrate *Leucothyreus femoratus* Burmeister

***Eunanus valmorbidai* Ferreira, Grossi & Seidel, 2024**

Third instar larva: Body (Fig. 3A) length about 20 mm, yellowish white, head, and respiratory plates (Fig. 3D)



Figure 3. *Eunanus valmorbidai*, third instar larva, (A) habitus, lateral. (B) detail of spine-like setae of dorsal lobes. (C) detail of leaf-shaped setae of lateral areas of thorax. (D) detail of right abdominal spiracle VIII. (E) raster. (F) raster, detail of palidia. (G) detail of anal opening. Scale: A = 0.5 mm; E = 1 mm; details (boxes) without scale.

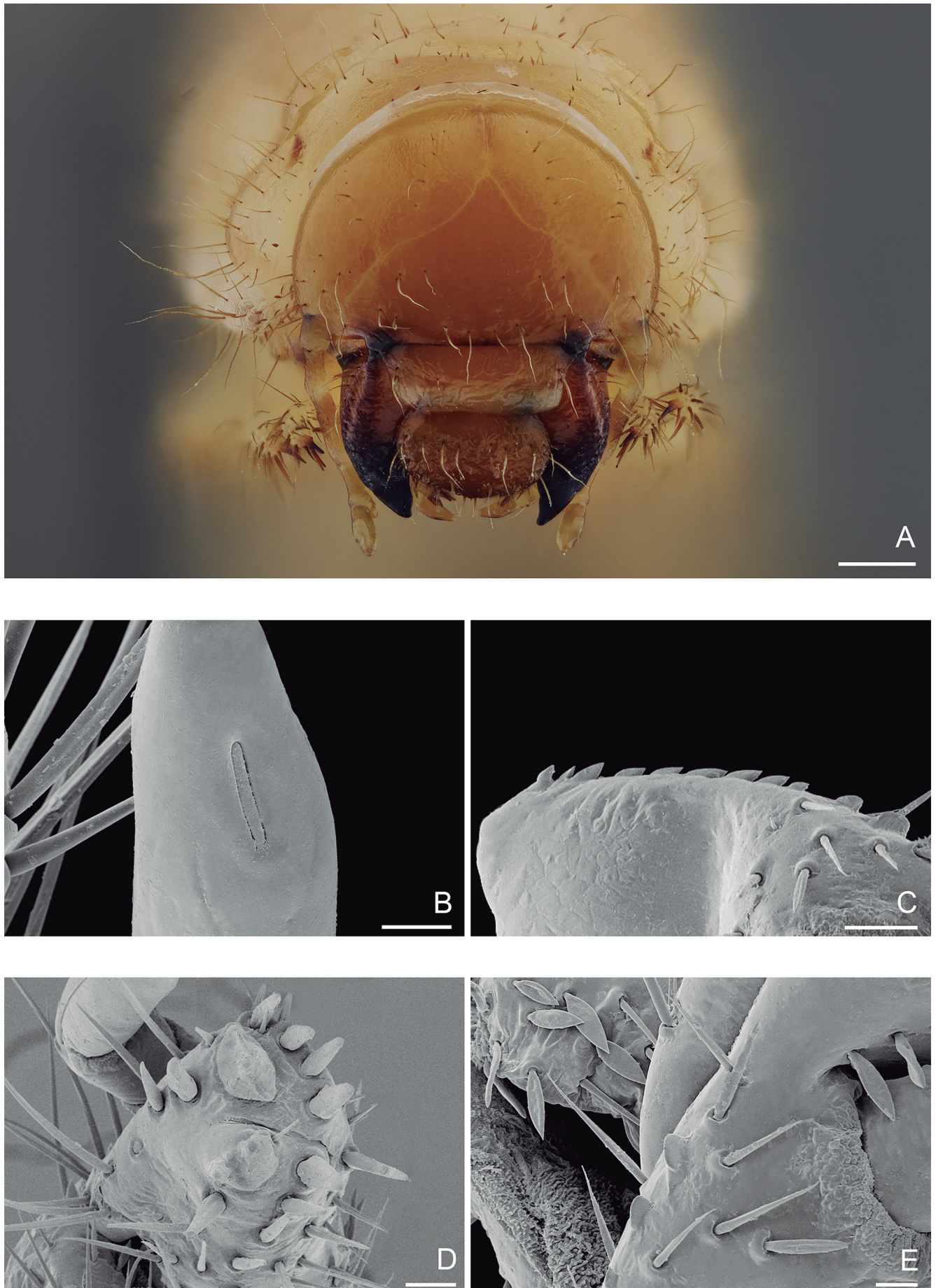


Figure 4. *Eunanus valmorbidai*, third instar larva, (A) head. (B) detail of outer sensillum of maxillary palpomere IV. (C) detail of dorsal maxillary stridulatory teeth. (D) detail of apex of maxillary mala. (E) detail of long and leaf-shaped setae of maxilla. Scale: A = 0.5 mm; B-E = 0.1 mm.

Table 1. Chaetotaxy of the known third instars of Geniatini.

	sp.	<i>E. valmorbidae</i>	<i>G. barbatus</i>	<i>G. borelli</i>	<i>L. alvarengai</i>	<i>L. femoratus</i>
parietals	des	4 long, 2 short	5	7-10	2-3	3
	pes	2 long, 5 short	1	3	?	2
	aes	2	2	2	?	2
	ees	15	1	8-10	?	5 dorsally visible
frons	pfs	2	2	2	?	1
	efs	2	1	1	?	1
	aas	1	1	1	?	1
	afs	2	0 or 2 minute	2	?	1
clypeus	acs	1	1	1	?	1
	ecs	2	2	4	?	2
	pls	4	2	3	?	0
labrum	lls	4 long, 2 short	3	4	?	6 as figured
	mls	1	1	1	?	1 as figured
	als	1	2	2	?	1 as figured
raster	tg	0	12-16	15-20	~6	40-44
	pr	0	0	0-2	0	?
	pa	5-6	12-16	5-8	3	3-4
	al	16 thin, 6 thick	87	92-124	~ 14 thin, 30 thick	?

The chaetotaxy is given for each parietal, for each side of frons, clypeus and labrum, and for the entire ventral anal lobe (al). ~, about; ?, setae not quantified or figured by studies.

Preseptular setae (pr): tegillar setae anterior to palidia-septula.

Setae: aas, anterofrontal angle setae; acs, antero-clypeal setae; aes, anteroepicranial setae; afs, anterofrontal setae; al, ventral anal lobe setae; als, anterolabral setae; des, dorsoepicranial setae; lls, laterolabral setae; mls, mediolabral setae; ecs, externoclypeal setae; ees, externoepicranial setae; efs, externofrontal setae; pa, palidium setae (pali); pes, posteroepicranial setae; pfs, posterofrontal setae; pls, posterolabral setae; pr, tegillar preseptular setae; tg, tegillar setae (including pr).

dark yellow, mandibles dark, and setae yellowish brown. **Head** (Fig. 4A; chaetotaxy in Table 1) width about 2.3 mm, epicranial and epistomal sutures distinct, stemmata absent, antennifer somewhat cylindrical and with 2 punctures, cranium with homogeneously distributed punctures, and each side of clypeus with 8-10 punctures. Each side of cranium and clypeus with (Figs. 5A, 9E): 6 dorsoepicranial setae (*des*), 7 posteroepicranial setae (2 long, 5 minute; *pes*), 2 anteroepicranial setae (*aes*), 15 externoepicranial setae (5 long, 10 small; *ees*), 2 posterofrontal setae (*pfs*), 2 externofrontal setae (*efs*), 1 anterofrontal angle seta (*aas*), 2 anterofrontal setae (*afs*), 2 externoclypeal setae (*ecs*), and 1 antero-clypeal seta (*acs*). Each side of **labrum** (Figs. 5G, 6B) with 19 sensilla (15 posterolateral small, 2 medial large, 2 lateral large), 4 posterolabral setae (*pls*), 1 mediolabral seta (*mls*), 6 laterolabral setae (4 posterior long, 2 anterior thick; *lls*), and 1 anterolabral seta (*als*). **Antenna** (Figs. 5B-F, 6A) with 4 antennomeres: I with 4 sensilla (1 dorsal, 2 inner, 1 ventral); II with 2 dorsal and 2 ventral setae, and 6 sensilla (2 dorsal, 1 inner, 2 outer, 1 ventral); III with 6 sensilla (2 dorsal, 2 inner, 2 outer, 2 ventral), ventrodiscal process bearing a dorsal sensorial spot and 4 sensilla (3 distal, 1 proximal); IV with 6 sensilla (1 dorsodistal, 1 ventrodiscal, 1 ventral, 2 placed in a small inner tubercle), 1 dorsal sensorial spot, and 2 ventral sensorial spots separated from each other by a constriction, and a distal sensorial area (Fig. 5B) bearing about 5 sensilla. **Epipharynx** (Figs. 5H, 6C). **Corypha** with epizygum distinct and clithra indistinct. **Haptomerum** prominent, sclerotized, zygum as a tubercle-like prominence bearing 7 sensilla. **Paria** with acroparia evidently separated from chaetoparia, right acroparia with 15 setae, left acroparia with 18 setae, right acanthoparia with 12 setae, left acanthoparia about 10 setae, right

gymnoparia with 24 sensilla, left gymnoparia with 16 sensilla, right chaetoparia with 80 setae (52 thick, 7 thin and small, 10 minute, 11 posterior leaf-shaped), left chaetoparia with 51 setae (32 thick, 9 thin and small, 5 minute, 5 posterior leaf-shaped). Dextiotorma about two times longer than laeotorma, left pterotorma rounded, apotorma indistinct, epitorma area with an impressed line contiguous to laeotorma. Plegmatia, proplegmatia, and phobae absent. **Pedium** small, longitudinal, and oblong. **Haptolachus** with right area bearing 6 small setae and 15 leaf-shaped setae, left area with 8 small setae and 15 leaf-shaped setae; nesium internum (sensorial cone) tubercle-like and with 4 sensilla; nesium externum (sclerotized plate) prominent and blade-like; crepis indistinct. **Mandible** (Figs. 7, 8). Incisivus with 1 apical tooth, dorso-proximal area with 2 punctures. Ventral surface with posterior asperites, about 17 striae in a stridulatory area; dorsal surface with medial asperites. Scrobe (outer proximal area) with about 4-5 long setae. Ventral processes with 4-6 ventroproximal sensilla. Mola with about 4 dorso-proximal setae in a row, ventroproximal tuft indistinct; right brustia with 4 setae, left brustia with 6 setae; right mola with 2 chisel-like teeth, a sinuous calx, and a shallow dorsodistal concavity; left mola with a distal chisel-like tooth, a dorsal and a ventral tubercle-like teeth, an acia bearing about 5 minute setae, and a semicircular calx. **Maxilla** (Figs. 6E, 6F, 9A, 9B, 9F) with galea and lacinia fused and forming mala. Galea with 24 setae (5 dorsal small, 3 dorsal leaf-shaped, 4 outer spine-like, 5 ventral long, 5 inner-ventral long, 2 inner-distal spine-like), about 3 ventral sensilla, and an uncus (Fig. 4D). Lacinia with 22 setae (5 in a dorsal row, 4 in each of three inner rows, 4 distal spine-like, 1 ventral small), 2 sensilla, 2 acute unci (one bearing a proximal small setae), and a blunt un-

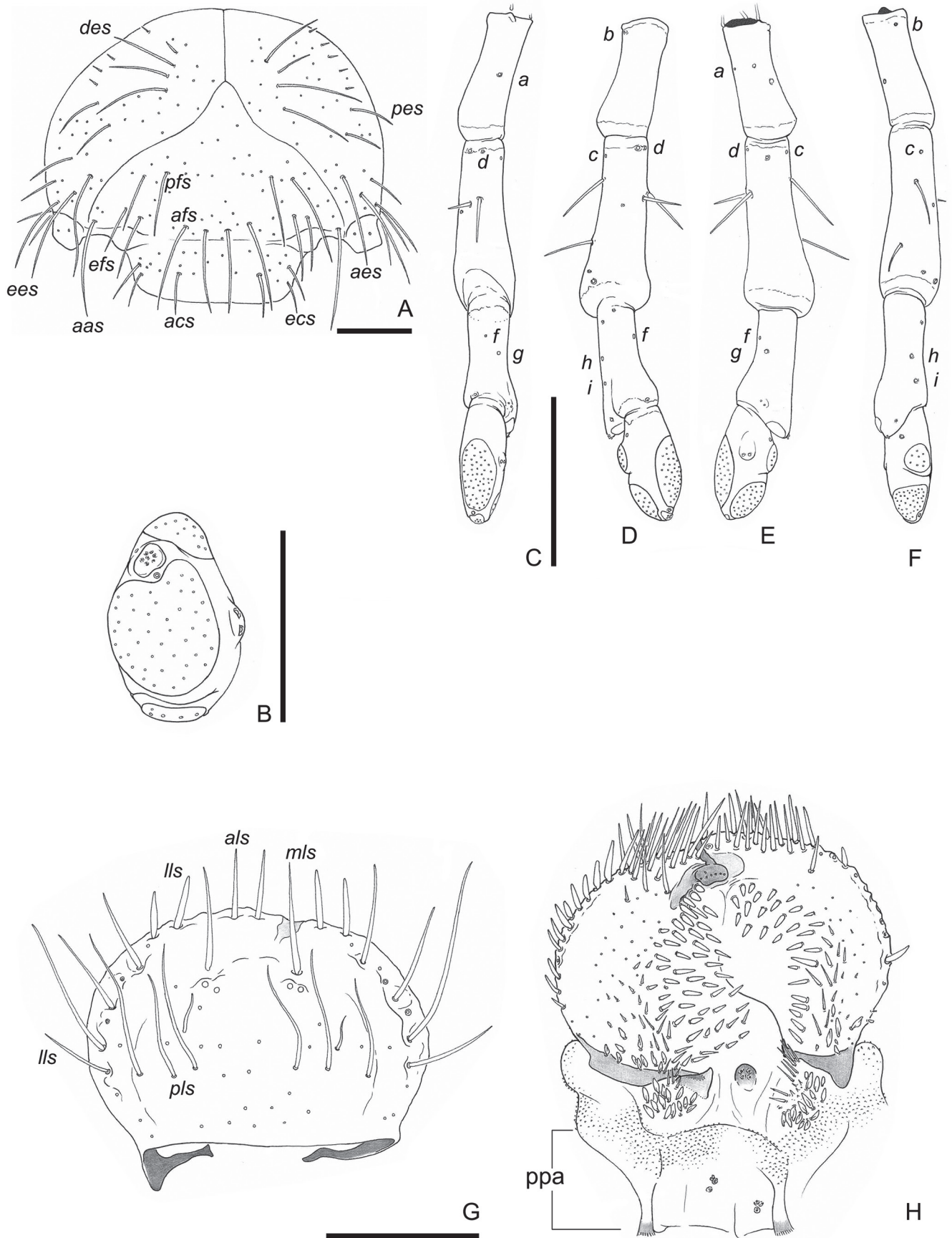


Figure 5. *Eunanus valmorbidai*, third instar larva, (A) cranium and clypeus. (B-F) right antenna (apex of antennomere IV; dorsal; outer; inner; ventral; some sensilla were appointed to easily the correspondence). (G) labrum. (H) epipharynx. aas = anterofrontal angle setae; acs = antero-clypeal setae; aes = anteroepicranial setae; afs = antero-frontal setae; als = anterolabral setae; des = dorsoepicranial setae; ecs = externoclypeal setae; ees = externoepicranial setae; efs = externofrontal setae; lls = laterolabral setae; mls = mediolabral setae; pes = posteroepicranial setae; pfs = postero-frontal setae; pls = posterolabral setae; ppa = posterior preoral area. Scale: A, C-H = 0.5 mm; B = 0.2 mm.

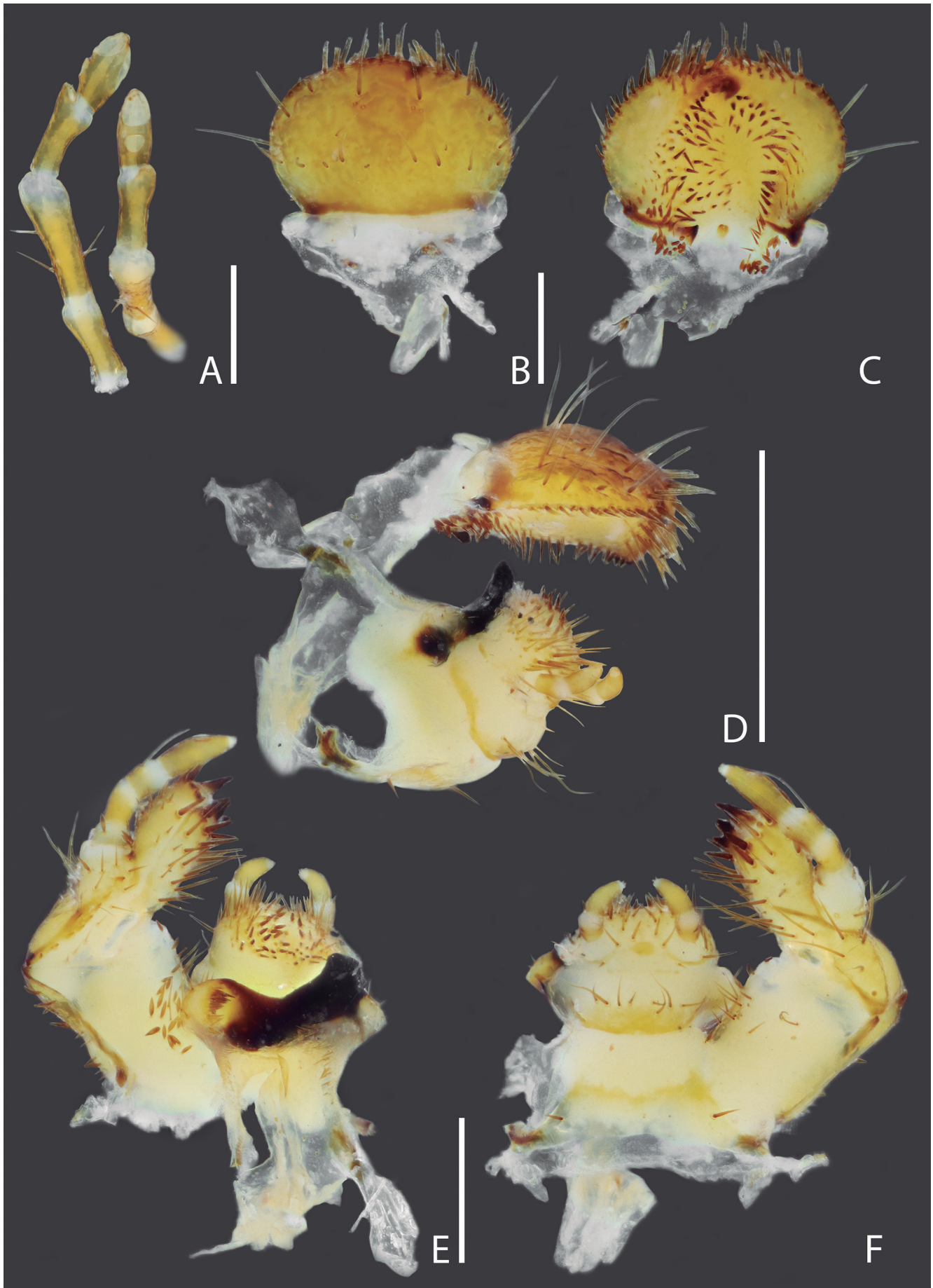


Figure 6. *Eunanus valmorbidai*, third instar larva, (A) antenna (inner, ventral). (B) labrum. (C) epipharynx. (D) cibarium, lateral. (E) maxilla, hypopharynx and labium. (F) maxilla and labium. Scale: 0.5 mm.

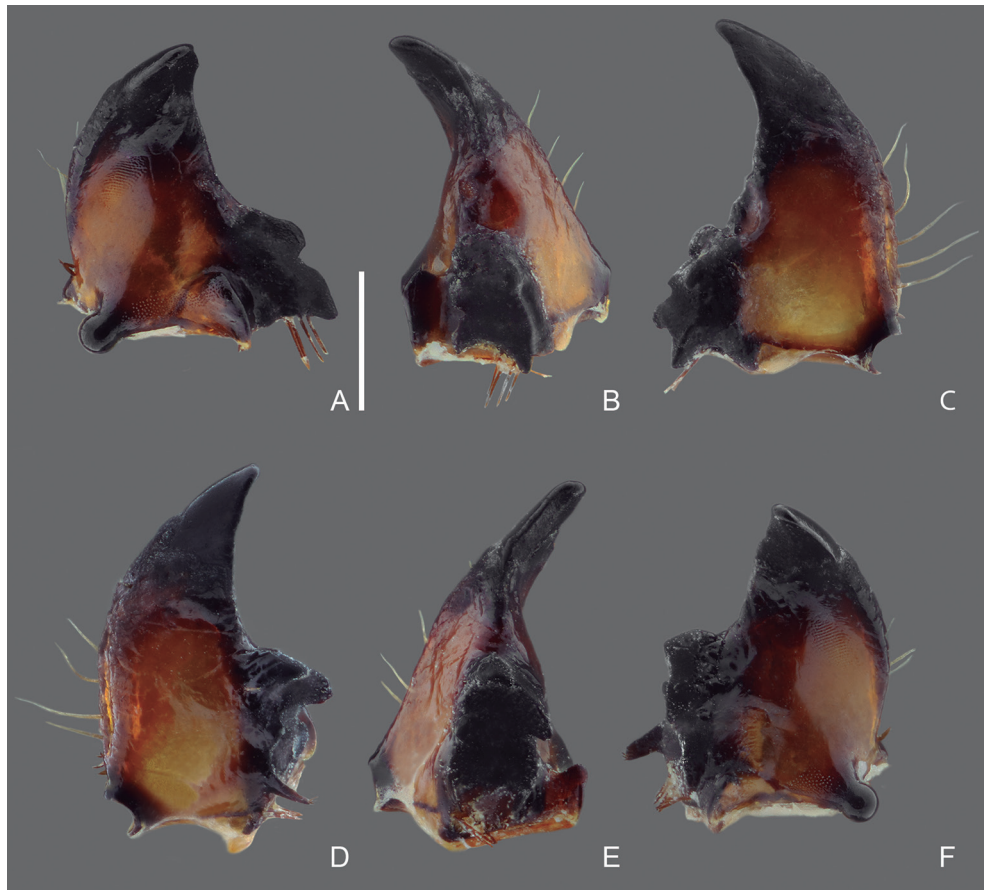


Figure 7. *Eunanus valmorbidai*, third instar larva, (A-C) right mandible (ventral, inner, dorsal); (D-F) left mandible (dorsal, inner, ventral). Scale = 0.5 mm.

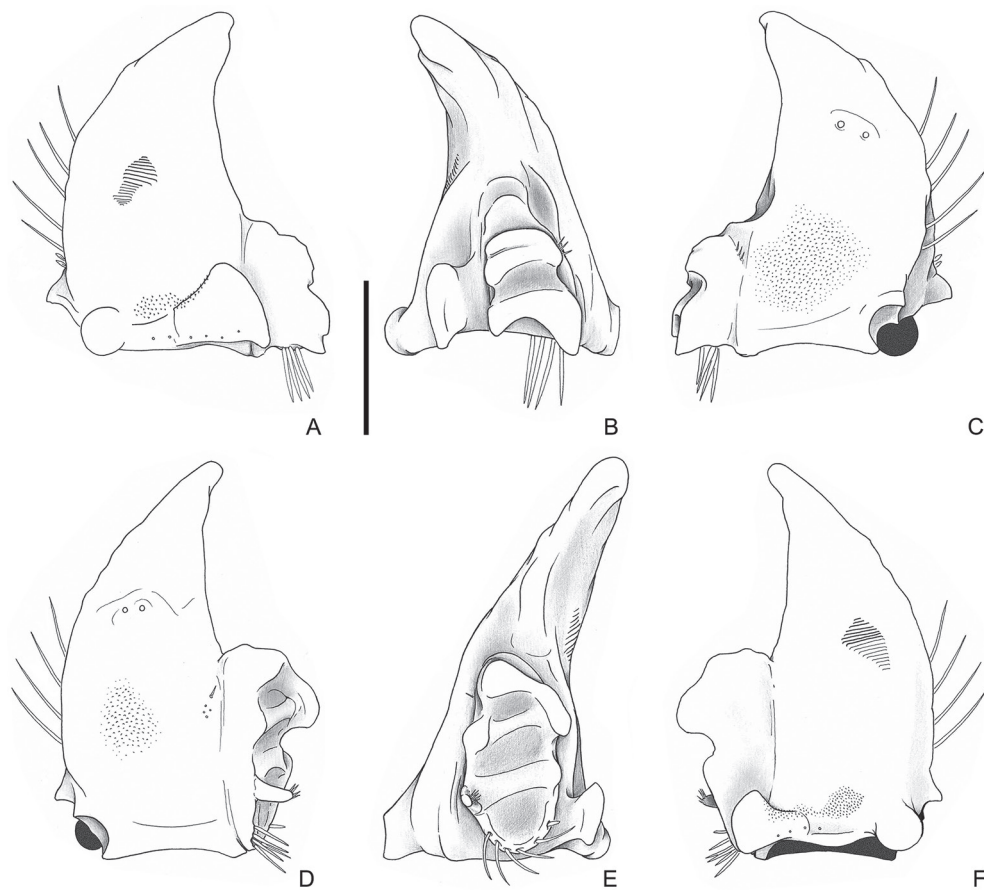


Figure 8. *Eunanus valmorbidai*, third instar larva. (A-C) right mandible (ventral, inner, dorsal); (D-F) left mandible (dorsal, inner, ventral). Scale = 0.5 mm.

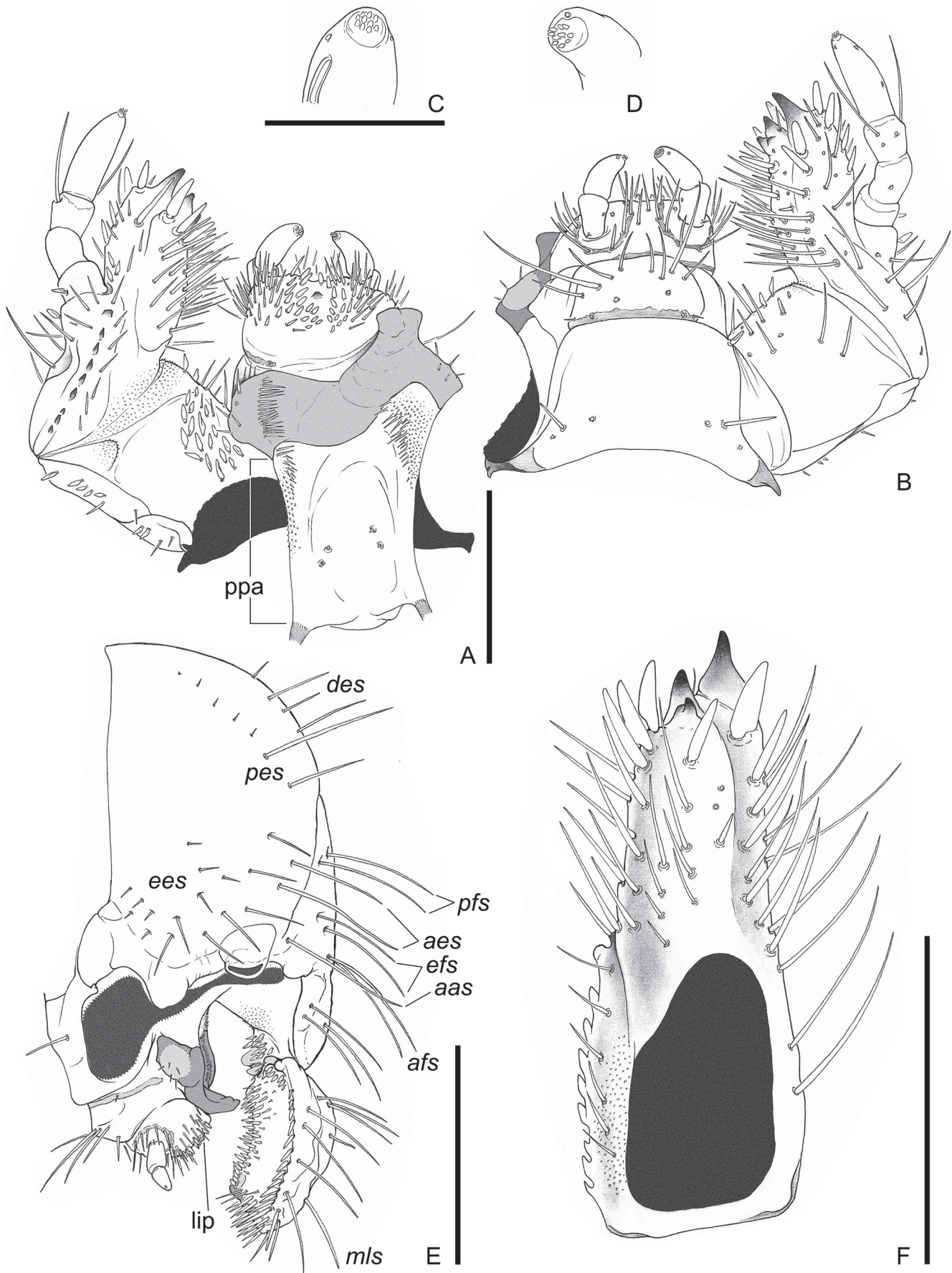


Figure 9. *Eunanus valmorbidai*, third instar larva. (A) maxilla, hypopharynx and labium. (B) maxilla and labium. (C) detail of apex of maxillary palpomere IV. (D) detail of apex of labial palpomere II. (E) cranium and cibarium, lateral. (F) maxillary stipes, inner. aas = anterofrontal angle setae; aes = anteroepicranial setae; afs = anterofrontal setae; des = dorsoepicranial setae; ees = externoepicranial setae; efs = externofrontal setae; lip, tubercle-like process of ligula; mls = mediolabral setae; pes = posteroepicranial setae; ppa = posterior preoral area; pfs = posterofrontal setae. Scale: A-D, F = 0.5 mm; E = 1 mm.

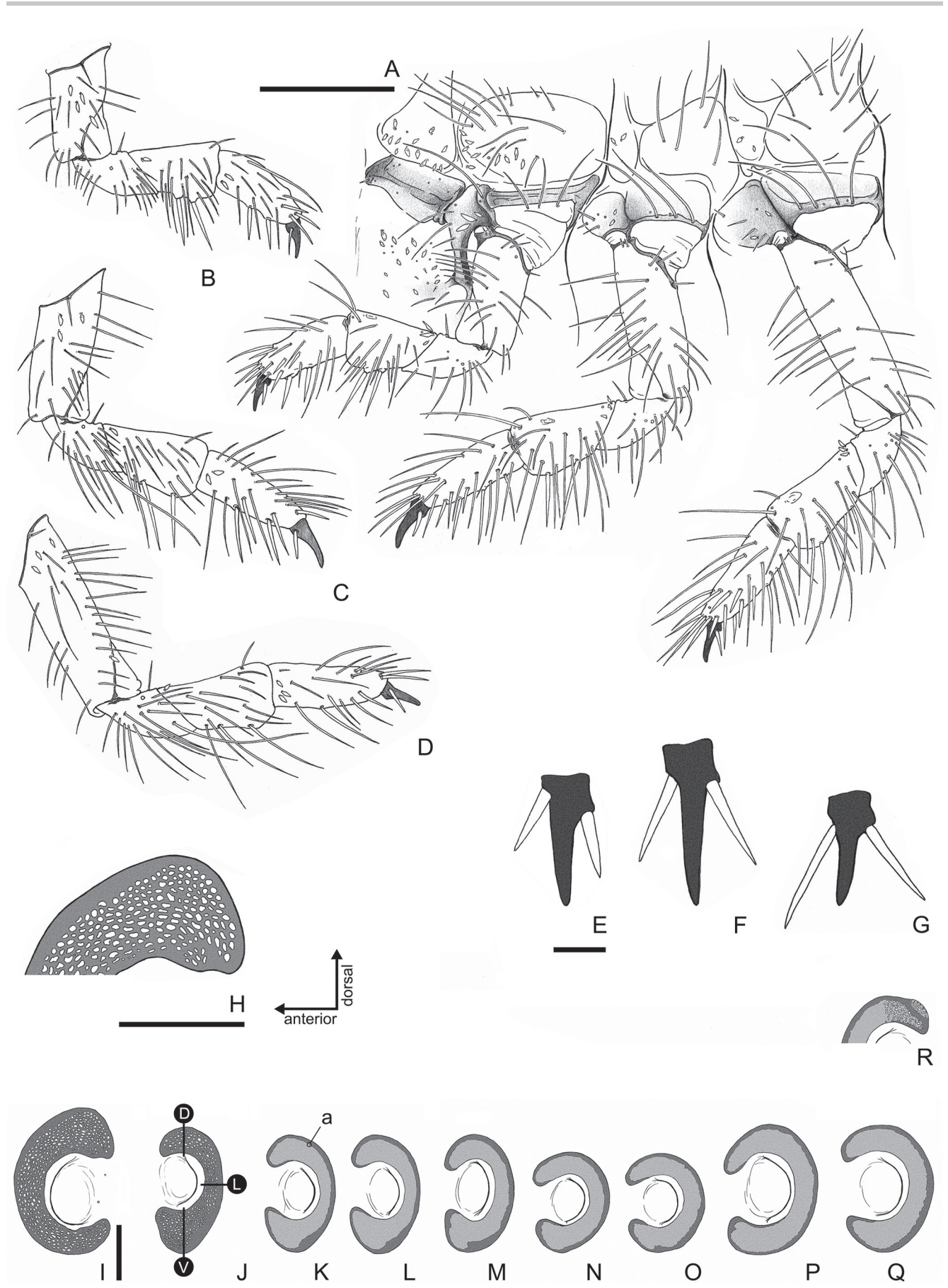


Figure 10. *Eunanus valmorbidai*, third instar larva. (A) pleurites and posterior side of left legs. (B-D) anterior side of left legs (anterior, medial, posterior). (E-G) left pretarsus (anterior, medial, posterior). (H-Q) left spiracles. (H) detail of dorsal arm of mesothoracic spiracle. (I) mesothoracic spiracle. (J-Q) abdominal spiracle I-VIII. R, detail of dorsal arm of right abdominal spiracle VIII. Spiracle radius (white letter in black circle) = D, dorsal; L, longitudinal; V, ventral. a, limit of perforated area (light grey) and smooth area (dark grey) of spiracular plate. Scale: A-D = 0.5 mm, E-R = 0.1 mm.

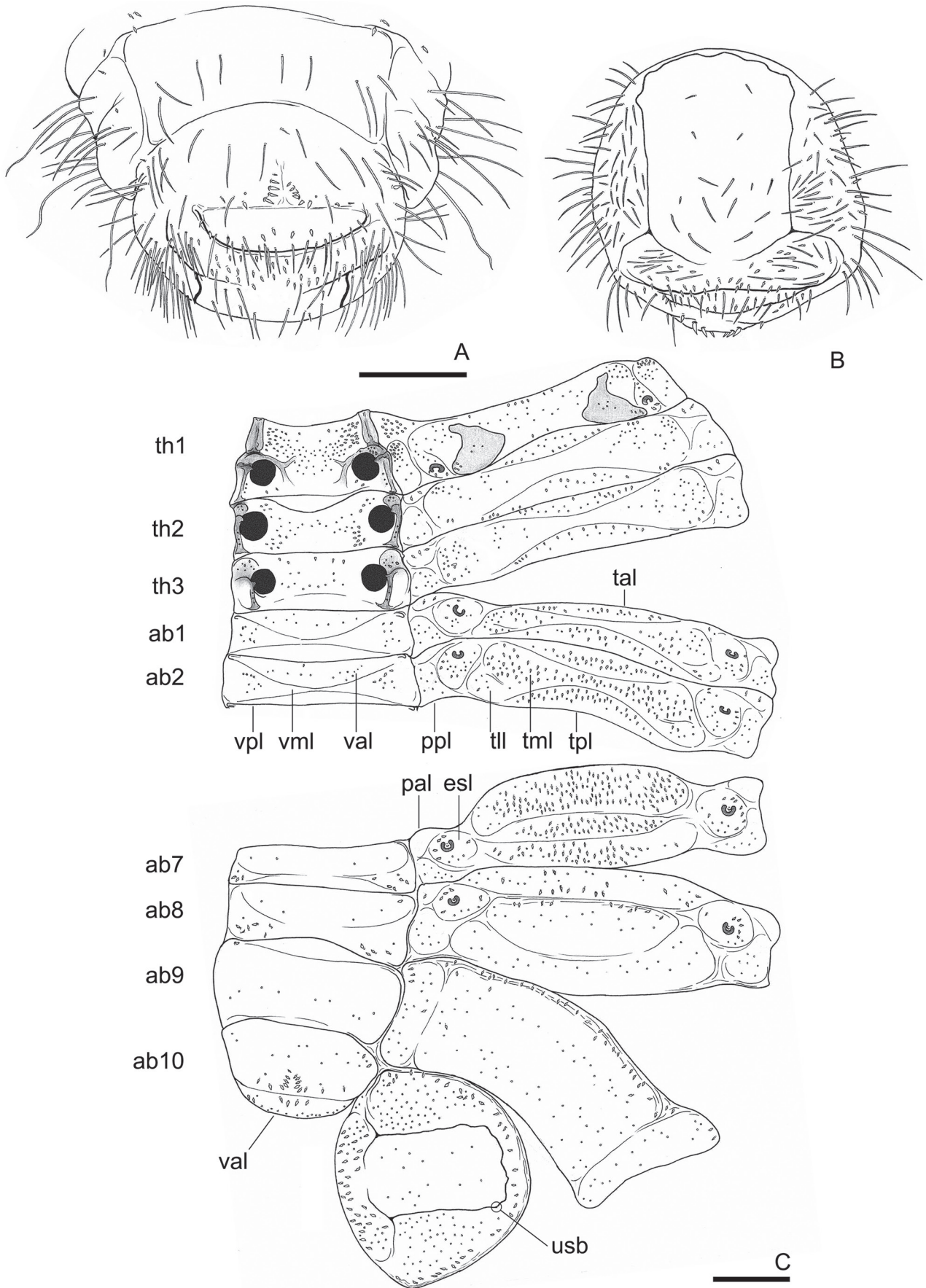


Figure 11. *Eunanus valmorbidai*, third instar larva. (A) raster and associated areas. (B) abdominal tergite X, posterior view. (C) distended body tegument (hair-like setae represented by their puncture, abdominal segments III-VII omitted). ab1-10, abdominal segment I-X; esl, spiracle lobe; pal, pleural anterior lobe; ppl, pleural posterior lobe; tal, tergal anterior lobe; th1-3, pro-, meso- and metathorax; tll, tergal lateral lobe; tml, tergal medial lobe; tpl, tergal posterior lobe; usb, U-shaped sclerotized bar; val, ventral anterior lobe; vml, ventral medial lobe; vpl, ventral posterior lobe. Scale = 1 mm.

Table 2. Chaetotaxy of thorax and abdomen of *Eunanus valmorbidai*.

	sgs	t1	t2	t3	a1	a2	a3	a4-6	a7	a8	a9
Dorsal Lobes	tl*	21 ^a 4-5 ^c	u	u	u	u	u	u	u	u	26-31 ^a 13-16 ^c
	tal	u	4 ^a 5-8 ^c	4-7 ^a 6-8 ^c	3 ^a 6-7 ^b	3-5 ^a 9-11 ^b	=	3-5 ^a 15-20 ^b	12-19 ^a 49-53 ^b	9-12 ^a 6-8 ^b	u
	tml	u	17-28 ^a 2-3 ^c	26-30 ^a 3-4 ^c	10-16 ^a 6-7 ^b	9-11 ^a 29-34 ^b	14-19 ^a 32-38 ^b	=	4-5 ^a 18-19 ^b	7-8 ^a 4-6 ^b	u
	tpl	u	3-4 ^a 5-8 ^c	=	3-5 ^a 6-10 ^b	3-5 ^a 12-18 ^b	=	=	=	10-12 ^a	u
	ts	3-5 ^a 4 ^b	u	u	u	u	u	u	u	u	u
Dorsolateral Lobes	pl*	13 ^a 9-10 ^c	u	u	u	u	u	u	u	u	12-17 ^a 2-4 ^c
	pal	u	2-3 ^c	=	0	=	=	=	=	=	u
	ppl	u	6-9 ^a	=	=	=	=	=	=	=	u
	esl	5 ^a 2-3 ^c	u	u	5-6 ^a 3 ^c	8-11 ^a 4-5 ^c	=	=	4-6 ^a 5-7 ^c	=	u
	tll	u	u	u	1-4 ^a 1-2 ^b	4-5 ^a 1-2 ^b	u	u	u	u	u
Ventral Lobes	vl*	u	u	u	u	u	u	u	u	u	4-5 ^a
	val	24-30 ^a 21-23 ^c	10-12 ^a 12 ^c	6 ^a 2-4 ^c	4-6	=	=	=	2	=	u
	vml	u	u	u	4-7 ^a 2-4 ^c	=	=	=	1 ^a 3-5 ^c	=	u
	vpl	0	=	=	=	=	=	=	=	=	u

* When segment lobes (sgs) are undivided, the general lobe (tl, pl, vl) chaetotaxy is given.

=, similar to immediately anterior segment; a, thin setae; b, spiny setae; c, leaf-shaped setae; u, unapplied (when the lobe is indistinct).

Segments: t1-3, pro-, meso- and metathorax; a1-9, abdominal segment I-IX. **Dorsal lobes:** tal, tergal anterior lobe; tl, tergal lobe; tml, tergal medial lobe; tpl, tergal posterior lobe; ts, tergal sclerite of prothorax. **Dorsolateral lobes:** esl, spiracular lobe; pla, pleural anterior lobe; ppl, pleural posterior lobe; tll, tergal lateral lobe. **Ventral lobes:** val, ventral anterior lobe; vl, ventral lobe; vml, ventral medial lobe; vpl, ventral posterior lobe.

cus (almost indistinct). Stipes with a medial outer constriction, 18 setae (5 dorsal, 7 in a dorsal-inner row, 1 outer, 5 ventral), 1 ventral sensillum, 9 dorsal stridulatory teeth (Figs. 4C, 9F, 8 proximal acute, 1 distal truncate). Palpifer with 3 setae (2 long, 1 leaf-shaped) and a sensillum. Palpus with 4 palpomeres: I small, with a leaf-shaped seta; II with 1 ventral sensillum; III with 2 setae (1 outer, 1 ventral) and 2 ventral sensilla; IV with 3 small circular sensilla (1 inner-distal, 1 outer-distal, 1 outer-proximal), a long outer sensillum in a shallow depression (Fig. 4B), and a distal sensorial area bearing about 10 sensilla (Fig. 9C). **Hypopharynx** (Figs. 6E, 9A) with asymmetrical sclerite, each lateral lobe with 5-7 setae; left lateral lobe with 15 setae. **Posterior preoral area**, each side of dorsal area (posterior to epipharynx, Fig. 5H) with 3 sensilla; each side of ventral area (posterior to hypopharynx, Fig. 9A) with 2 sensilla; right ventral area with 2 distal setae, a phoba bearing about 8 spiny processes, and asperites; left ventral area with a phoba bearing about 17 spiny processes, and asperites. **Labium** (Figs. 6D, 6F, 9B, 9E). Submentum with a barely distinct sclerite, mentum and submentum with a transverse proximal sclerite, submentum with a semicircular sclerite that surround palpi. Each side of submentum with 1 seta and 2 sensilla; each side of mentum with 5 setae (4 distal long, 1 proximal minute) and 2 sensilla (distal and proximal); each side of prementum with 1-2 medial setae, about 8 setae surrounding the palpus. Palpiger with an inner dorsal sensillum. Ligula (Figs. 6D, 6E, 9A, 9E) rectangular, right area with 33 setae (13 thin, 20 thick), left area

with 38 setae (20 thin, 18 thick), medial area with a tubercle-like process. Palp with 2 palpomeres: I with a minute ventroproximal seta and an inner sensillum; II with a ventrodistal sensillum and a distal sensorial area with about 10 sensilla (Fig. 9D). **Thorax** (Figs. 10A, 11C, for chaetotaxy see Table 2) with tergal sclerite large, of the same color as surrounding area, and bearing 3-5 thin setae and 4 leaf-shaped setae; cervical sclerite with about 12 sensilla and an anterior minute seta; episternum with 1-2 sensilla, 3-4 thin setae, 2-3 leaf-shaped setae; epimeron with 1-2 sensilla, 3-4 setae. **Prothorax** with medial area of tergal lobe (between tergal sclerites) bearing 18 thin setae and 9 leaf-shaped setae, each lateral area of tergal lobe with 12 thin setae; spiracular lobe with 5 thin setae and 2-3 leaf-shaped setae; pleural lobe with 13 thin setae and 9-10 leaf-shaped setae; each side of ventral anterior lobe with 24-30 thin setae and 21-23 leaf-shaped setae (2 posterior to coxa), ventral posterior lobe glabrous. **Mesothorax**, each side of tergal anterior lobe bearing 4 thin setae and 5-8 leaf-shaped setae, each side of tergal medial lobe with 17-28 thin setae and 2-3 leaf-shaped setae, each side of tergal posterior lobe with 3-4 thin setae and 5-8 leaf-shaped setae, pleural anterior lobe with 2-3 leaf-shaped setae, pleural posterior lobe with 6-9 thin setae, each side of ventral anterior lobe with 10-12 thin setae and 12 leaf-shaped setae, and ventral posterior lobe bare and almost indistinct. **Metathorax**, each side of tergal anterior lobe bearing 4-7 thin setae and 6-8 leaf-shaped setae, each side of tergal medial lobe with 26-30 thin setae and 3-4 leaf-shaped setae, tergal posterior lobe as

mesothorax, pleural anterior and posterior lobes as mesothorax, each side of ventral anterior lobe with 6 thin setae and 2-3 leaf-shaped setae, and ventral posterior lobe bare and almost indistinct. **Legs** (Fig. 10A-G), **anterior leg** with coxa with posterior area bearing 1 proximal sensillum, 2 minute proximal articular setae, 3 proximal thin setae, 15 medio-distal thin setae; anterior area bearing 1 proximal thin seta, 14 medio-distal thin setae, 4 leaf-shaped setae. Trochanter with 1 outer seta; posterior area bearing 3 sensilla and 8 thin setae; anterior area bearing 1 sensillum and 14 thin setae. Femur with posterior area bearing 1 proximal sensillum, 1 distal sensillum, 14 thin setae, 2 thick inner setae, 3 leaf-shaped setae; anterior area bearing 13 thin setae, 2 thick inner setae, 1 leaf-shaped seta. Tibiotarsus with posterior area bearing 13 thin setae, 6 thick setae, 2 thick inner setae; anterior area bearing 13 thin setae, 2 thick inner setae, 2 leaf-shaped setae. Pretarsus with 2 proximal thick setae. **Medial leg**, coxa with posterior area bearing 18 medio-distal thin setae, other elements as anterior leg. Trochanter as anterior leg. Femur with posterior area bearing 17 thin setae, anterior area bearing 15 thin setae, other elements as anterior leg. Tibiotarsus with posterior area bearing 14 thin setae, anterior area bearing 15 thin setae, 5 thick setae, other elements as anterior leg. Pretarsus as anterior leg. **Posterior leg**, coxa with anterior area bearing 22 medio-distal thin setae, other elements as anterior leg. Trochanter as anterior leg. Femur with posterior area bearing 17 thin setae, thick setae indistinct, other elements as anterior leg. Tibiotarsus with posterior area bearing 11 thin setae, 11 thick setae, thick inner setae indistinct; anterior area bearing 14 thin setae, thick inner setae indistinct, 3 leaf-shaped setae. Pretarsus as anterior leg. **Thoracic spiracle** (Figs. 10H, 10I) with respiratory plate bearing oblong perforations, with 11 perforations in dorsal radius, 7 perforations in longitudinal radius, and 5 perforations in ventral radius. **Abdomen** (Fig. 11C, for chaetotaxy see Table 2) with 10 well delimited segments. **Spiracles** (Figs. 3D, 10J-10R) I-IV larger than V-VI and smaller than VII-VIII; respiratory plate I-IV with 8 perforations in dorsal radius (DR), 5 perforations in longitudinal radius (LR), and 16 perforations in ventral radius (VR); re-

spiratory plates V-VI with 8 perforations in DR, 5 perforations in LR, and 10 perforations in VR; respiratory plates VII-VIII with 8 perforations in DR, 8-11 perforations in all radius; bulla of spiracles wider than the distances between respiratory plate arms. **Segment I**, each side of tergal anterior lobe bearing 3 thin setae and 5-7 spine-like setae (Fig. 3B); each side of tergal medial lobe with 10-16 thin setae and 6-7 thick setae; each side of tergal posterior lobe with 3-5 thin setae and 6-10 thick setae; tergal lateral lobe almost indistinct and with 1-4 thin setae and 1-2 spine-like setae; spiracular lobe with 5-6 thin setae and 3 leaf-shaped setae; pleural anterior lobe bare; pleural posterior lobe with 6-9 thin setae; each side of ventral anterior lobe with 4-6 thin (3 long, 1-2 short) setae; each side of medial of ventral medial lobe with 4-7 thin setae and 2-4 leaf-shaped setae; posterior ventral lobe bare. **Segment II**, each side of tergal anterior lobe bearing 3-5 thin setae and 9-11 spine-like setae; each side of tergal medial lobe with 9-11 thin setae and 29-34 thick setae; each side of tergal posterior lobe with 3-5 thin setae and 12-18 thick setae; tergal lateral lobe almost indistinct and with 4-5 thin setae and 1-2 spine-like setae; spiracular lobe with 8-11 thin setae and 4-5 leaf-shaped setae; other lobes as segment I. **Segment III** with tergal anterior and posterior lobes as segment II; each side of tergal medial lobe with 15-19 thin setae and 32-38 thick setae; tergal lateral lobe indistinct and fused with tergal medial lobe; tergal posterior lobe and spiracular as segment II; other lobes as segment I. **Segments IV, V, and VI**, each side of tergal anterior lobe bearing 3-5 thin setae and 15-20 spine-like setae; other lobes as III. **Segment VII**, each side of tergal anterior lobe bearing 12-19 thin setae and 49-53 spine-like setae; each side of tergal medial lobe with 4-5 thin setae and 18-19 thick setae; tergal posterior lobe as segment II; tergal lateral lobe indistinct; spiracular lobe with 4-6 thin setae and 5-7 leaf-shaped setae; pleural anterior and posterior lobes as segment I; each side of ventral anterior lobe with 2 thin long setae; each side of ventral medial lobe with 1 thin long seta and 3-5 leaf-shaped setae; posterior ventral lobe bare. **Segment VIII**, each side of tergal anterior lobe bearing 9-12 thin setae and 6-8 spine-like



Figure 12. Geniatiini third instar larvae, head. (A) *Eunanus valmorbidae* Ferreira, Grossi & Seidel, 2024. (B) *Geniates barbatus* Kirby, 1819. (C) *Geniates borelli* Cameron, 1894.

setae; each side of tergal medial lobe with 7-8 thin setae and 4-6 anterior leaf-shaped setae; each side of tergal posterior lobe with 10-12 thin setae; pleural anterior and posterior lobes as segment I; spiracular lobe and ventral lobes as segment VII. **Segment IX**, each side of tergal lobe bearing 13-16 anterior leaf-shaped setae, 12-14 medial thin setae, and 14-17 posterior thin setae; pleural lobe with 12-17 thin setae and 2-4 leaf-shaped setae; each side of ventral lobe with 4-5 thin setae. **Segment X** (Figs. 11A, 11B) with a curved anal opening (Fig. 3G), tergite with a U-shaped sclerotized thin bar (Figs. 11B, 11C), each side of anterior margin with 17-18 leaf-shaped setae, each side of medial area with 7-8 thin setae, each lateral area with 47-54 thin setae, each side of posterior area with 10 thin setae and 14 spine-like setae; each side of campus (anterior to raster) with 3-6 thin setae. **Raster** (Figs. 3E, 11A) with barbula indistinct, tegillar area almost glabrous; each palidium with 5-6 spine-like setae (Figs. 3E, 11A); septula triangular and posteriorly divergent (Fig. 3F). **Ventral anal lobe** (Figs. 3E, 11A) with 16 thin setae and 6 spine-like setae.

DISCUSSION

The Geniatiini larvae can be separated from other ruteline larvae by: antennomere IV bearing a dorsal sensorial spot and two ventral sensorial spots; haptomerum sclerotized, prominent, with a beak-like zygum, and without heli. The known larvae have a distinct septula, but an undetermined species was figured with septula indistinct (Pereira et al., 2013).

Third instar larvae of *Eunanus valmorbidai* are easily separated from other Rutelinae larvae by the presence of leaf-shaped setae (Fig. 3C; absent in the other ruteline larvae). Furthermore, larvae of *Eunanus* can be distinguished from other genera of Geniatiini (Fig. 12) by (characters of 1 = *Geniates* and 2 = *Leucothyreus* given in parentheses): stemmata absent (1 = and 2 = present); each side of frons with 2 posterofrontal setae (1 = as *Eunanus*, 2 = with 1 seta); epipharynx without plegmatia (1 = with plegmatia, 2 = as *Eunanus*); acia of left mandible with apex rounded and bearing minute setae (1 = as *Eunanus*, 2 = acuminate and glabrous); stipes of maxilla with a medial outer constriction (1 = and 2 = no constricted); abdominal spiracle VIII bigger than abdominal spiracle I (1 = as *Eunanus*, 2 = VIII much smaller than I).

The chaetotaxy is useful to separate the known species of Geniatiini (see Fig. 12 and Table 1). Other conspicuous characteristic is the presence of a thin U-shaped sclerotized bar in the abdominal tergite X (Fig. 11B, 11C); this characteristic is not found in other Geniatiini larvae.

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