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IMMATURE STAGES OF *ASTERIZA FLAVICORNIS* (OLIVIER) AND *PHYSONOTA ALUTACEA* BOHEMAN (COLEOPTERA: CHRYSOMELIDAE: CASSIDINAE)

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Abstract.— The first instar larva of *Physonota alutacea* Boheman, 1854, a member of the tribe Physonotini Spaeth, 1942, and the mature larva and pupa of *Asteriza flavicornis* (Olivier, 1790), a member of the tribe Asterizini Hincks, 1952, are described for the first time. The mature larva and the pupa of *Physonota alutacea* are redescribed. Immatures are figured and described using light microscopy, the first instar larva of *Physonota alutacea* using scanning electron microscopy. Similarities in the larval morphologies of *Cistudinella* Champion, 1894, a member of the tribe Ischyrosonychini, Chapuis, 1875, and *Physonota* suggest both genera are close phylogenetically and should be placed in a single tribe. The additional similarities between the mature larva of *Asteriza* and those of *Physonota* and *Cistudinella* suggest all three genera should be placed within a single tribe.

Key words.— Coleoptera, Chrysomelidae, Cassidinae, Physonotini, Asterizini, *Physonota alutacea*, *Asteriza flavicornis*, morphology of immatures, Neotropics.

INTRODUCTION

Spaeth in Hincks (1952) placed the genera *Physonota* and *Asteriza* in two different tribes – Physonotini Spaeth, 1942 and Asterizini Hincks, 1952; and he placed the genera *Cistudinella* Champion, 1894 and *Eurypedus* Gistel, 1834 in the tribe Ischyrosonychini Chapuis, 1875. Borowiec (1995) suggested in his tribal classification of tortoise beetles uniting these into a single tribe, Ischrosonychini, because synapomorphies based on adult characters are lacking in each of the existing tribes. Later, in his catalogue of world genera of Cassidinae Borowiec (1999) again placed all the genera in a single tribe but preferred the name Physonotini over Ischyrosonychini because the latter was based on a junior synonym (*Ischyrosonyx* Sturm, 1843 is a synonym of *Eurypedus* Gistel, 1834). Świętojańska and Medeiros (2007) redescribed first and last instar larvae of *Cistudinella obducta* (Boheman, 1854) and compared them with descriptions of mature larvae of several *Physonota* species. They suggested the mature larva of *Cistudinella* is not close to *Physonota* larvae and proposed to restore the tribe Ischrosonychini but with some reservations because first instar larvae of *Physonota* were hitherto unknown.

Until now the following immatures of the Physonotini *sensu lato* are described: *Physonota alutacea* Boheman, 1854, *Ph. arizonae* Schaeffer, 1925, *Ph. helianthi* Boheman, 1854, and *Ph. unipunctata* (Say, 1824) by Sanderson (1948), *Eurypepla calochroma* (Blake, 1965) by Woodruff (1976) and *Cistudinella obducta* (Boheman, 1854) by Fiebrig (1910) and Świętojańska and Medeiros (2007). While the descriptions

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of mature larvae by Fiebrig, Sanderson and Woodruff are incomplete, some features suggest that *Physonota* and *Eurypepla* are distinct from *Cistudinella*. The most distinctive characters are the number and structure of lateral scoli. Eleven or 14 pairs of lateral scoli are found in *Physonota*, 14 in *Eurypepla*, whereas 16 are found in *Cistudinella*. Lateral scoli are short and conical in *Physonota* and *Eurypepla* species, while in *Cistudinella* they are long and covered with numerous lateral branches and setae. A recent redescription of the mature larva of *Cistudinella obducta* by Świętojańska and Medeiros, (2007) also confirms this difference. Mature larvae were described for all species mentioned above but only the first instar was described for *Cistudinella obducta* (Fiebrig 1910, Świętojańska and Medeiros 2007). The mature larvae of Cassidinae often present characters of adaptative value (autapomorphies) while useful synapomorphies found in earlier instars tend to disappear. This shift in larval characters is especially noticeable with chaetotaxy, which changes strongly from first to last instar (Borowiec and Świętojańska 2003). Thus, first instar larval characters are often more useful in tribal level determinations in Cassidinae.

Below we redescribe in detail the mature larva and pupa of *Physonota alutacea* and we describe its first instar larva. We also describe the mature larva and pupa of *Asteriza flavicornis*. Moreover, we compare the first instar larva of *Physonota alutacea* with the first instar larva of *Cistudinella obducta* and the last instars of all three taxa and discuss their taxonomic position. Comparative characters of all known mature larvae and pupae of Physonotini *sensu lato* are also given.

Material and methods

Examined immatures of *Asteriza flavicornis* were collected in Haiti: Dept. L'Queste Pace National de la Visite (vicinity of park headquarters, 1800 m) in 23.05.1984 by M. C. Thomas on food plant *Cordia* sp. (Boraginaceae).

Immatures of *Physonota alutacea* were collected in Panama: Pmá Pr. E. Canal Area Pipeline Rd in 16.05.1993 by D. M. Windsor.

Larvae initially killed and preserved in 75 to 80% ethanol were removed and boiled in 10% NaOH solution, cleared in distilled water and then mounted on slides with Swan's liquid (distilled water 20 g., gum arabic 15 g., chlorhydrate 60 g., glucose 3 g., glacial acetic acid 2 g.) and glycerine for light microcopy. Heads of the larvae were separated from the rest of the body and then mouthparts were dissected.

Slides and measurements of larvae and pupae were made using a Nikon SMZ 1500 stereomicroscope. A Nikon ECLIPSE 80i microscope with phase contrast was used for specimen examination and drawing figures.

The photos of mature larvae and pupae were made using a Nikon COOLPIX MDC Lens camera and Nikon SMZ 1500 stereomicroscope.

Larvae for SEM examination were transferred from 75% to 100% ethanol and dried using HMDS (Hexamethyldisilazane). After fixing on stubs with carbon tabs they were sputter-coated with gold and examined with a LEO 435 VP scanning microscope at magnifications up to 20 000×.

All studied materials were deposited at Department of Biodiversity and Evolutionary Taxonomy, Zoological Institute, University of Wrocław, Poland. Voucher specimens of *Asteriza* and *Physonota* are deposited in the insect collection of the Smithsonian Tropical Research Institute in Panama.

Descriptions

Physonota alutacea Boheman, 1854

First instar larva. Measurements (n=6; [mm]). Length (without head) from anterior border of pronotum to base of supra-anal processes: 1.75, 2.00, 2.00, 1.75, 1.70, 1.80; width across mesonotum, without lateral scoli (respectively): 0.75, 1.00, 0.95, 0.90, 0.90, 0.95.

Body flattened dorso-ventrally, oval, moderately narrowed posteriorly, widest across meso- and metathorax (Figs 1, 2). Larvae preserved in alcohol are yellowish-brown with brown pronotum, head, legs, lateral scoli and supra-anal processes. Meso-, metanotum and abdominal tergites with small brown patches, each at base of seta. Posteriorly patches merge into one brown elongated patch thus abdominal tergites VI–VIII are with two elongated patches. Sternites of thorax and abdominal sternites I–V yellowish-brown. Abdominal sternites VI and VII yellowish-brown with brown patch in the middle. Abdominal sternite VIII brown.

Nine pairs of spiracles (one on thorax and 8 on abdomen), each distinctly elevated (Figs 25, 26). Spiracles of thorax visible from ventral view.

Body with 14 pairs of lateral scoli and a single pair of long and stout supra-anal processes (Figs 1, 21). All lateral scoli visible from dorsal as well as ventral view. Scoli of first pair the shortest (Figs 1, 2). Scoli 5th and 7th pairs the longest. Remainder scoli more or less of the same length. All lateral scoli without lateral branches, but covered with long setae. Lateral scoli armed apically with one long seta. Setae of lateral scoli (including long setae placed apically) at the top with small spines. Supra-anal processes stout, bent dorsally, covered with numerous setae. Apex of supra-anal processes acute without apical setae (Figs 1, 21, 27).

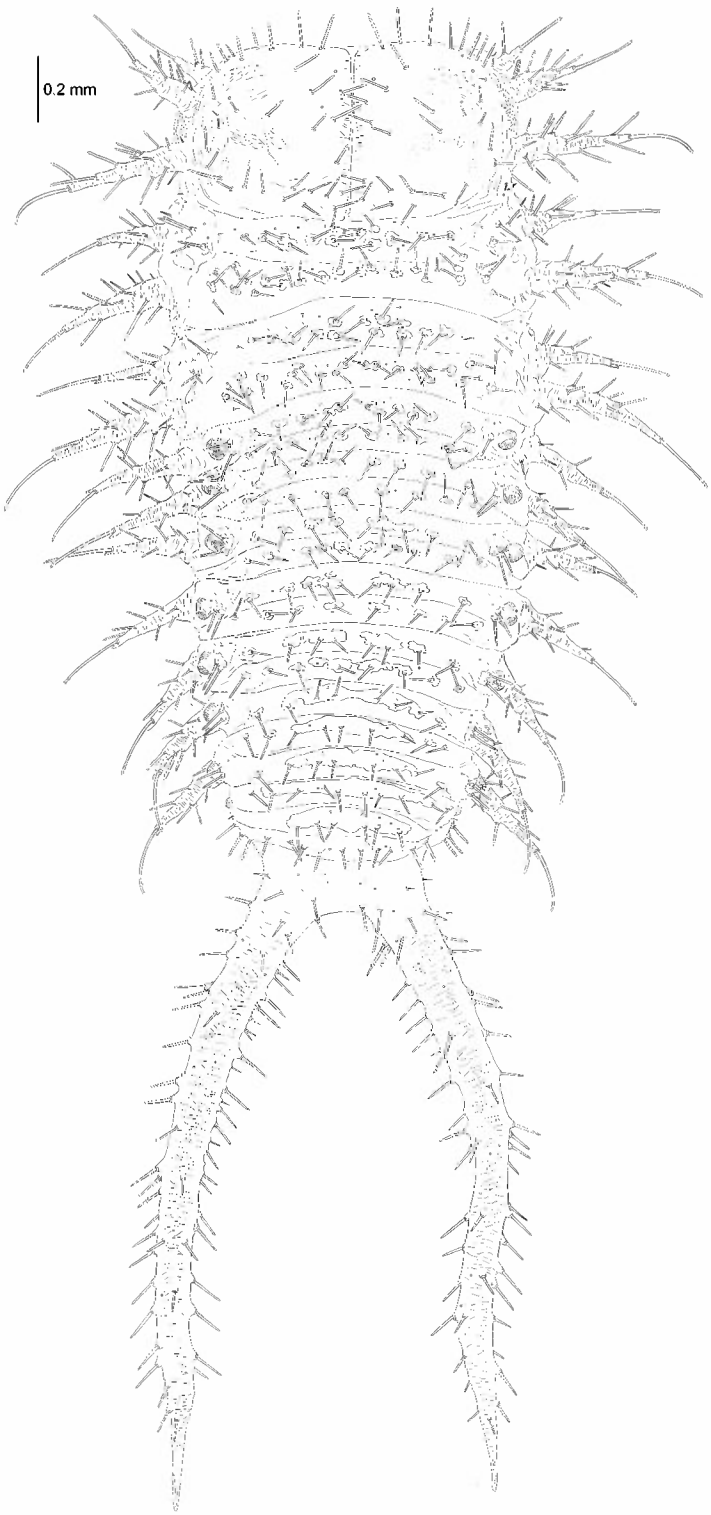


Figure 1. *Physonota alutacea*, dorsal side of first instar larva.

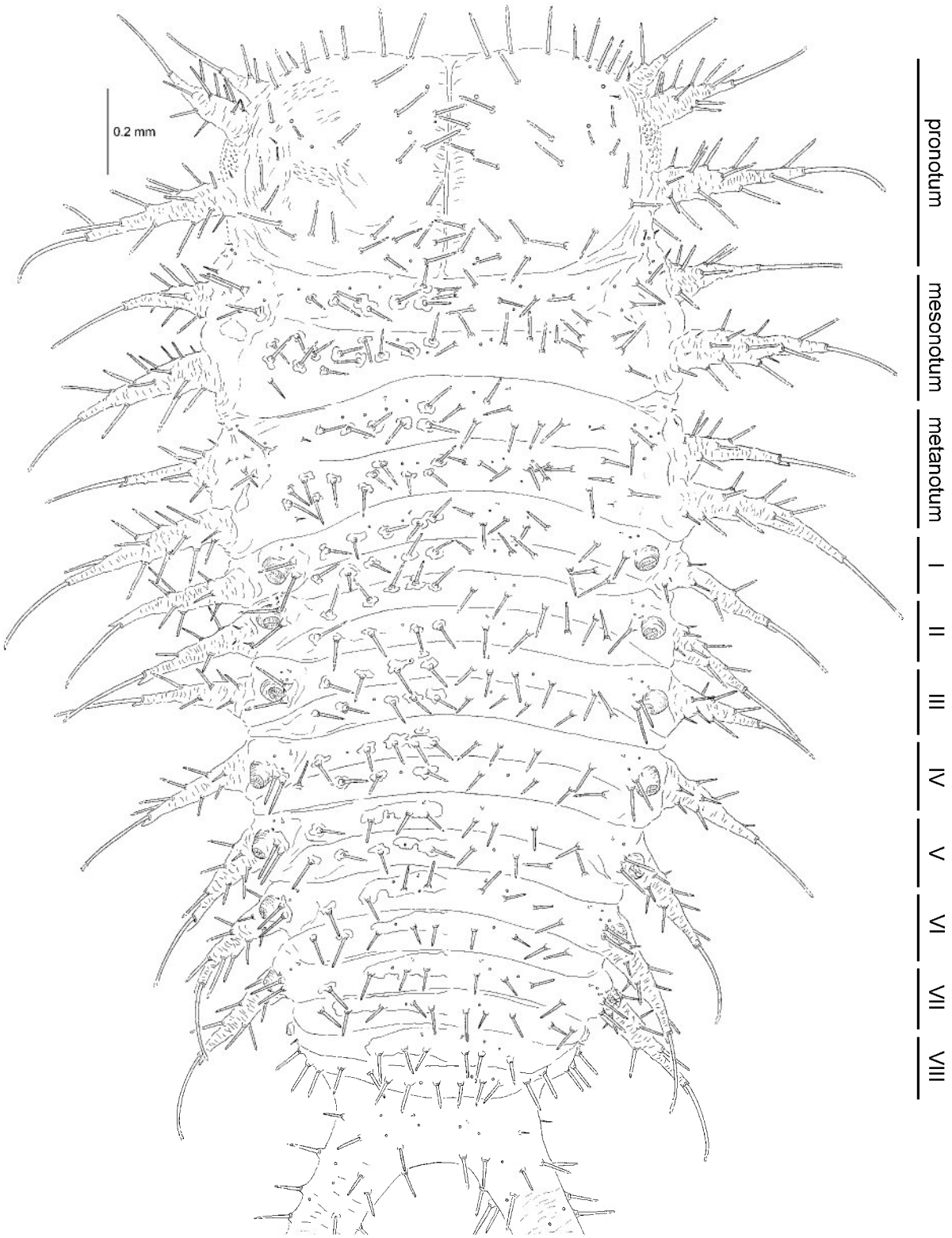


Figure 2. *Physonota alutacea*, chaetotaxy of dorsal side of first instar larva.

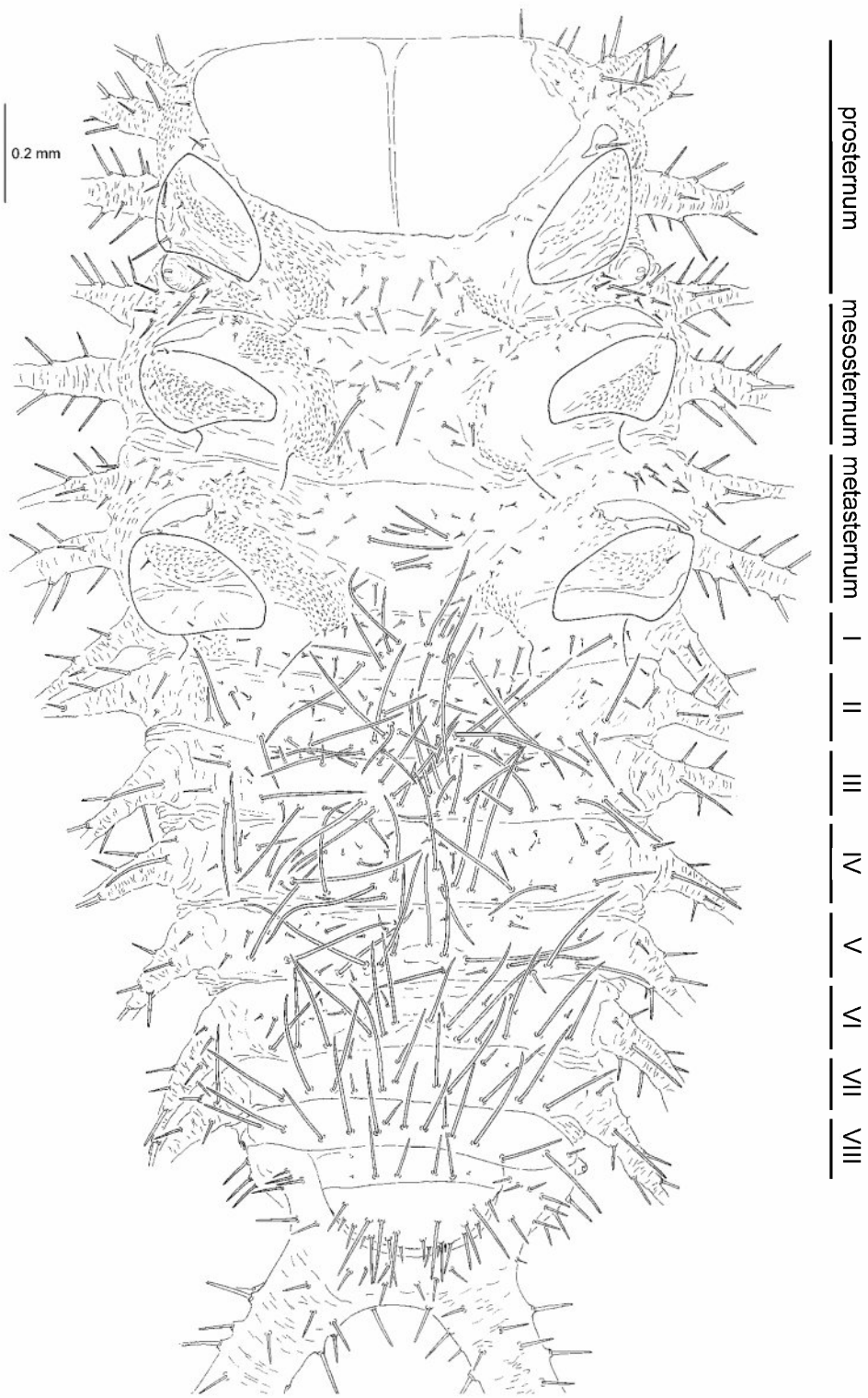
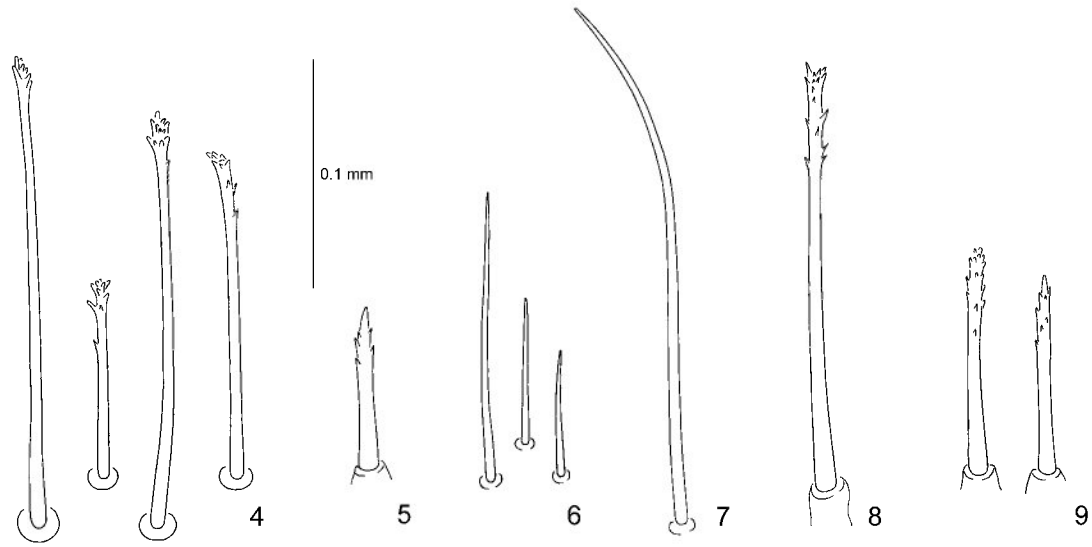


Figure 3. *Physonota alutacea*, chaetotaxy of ventral side of first instar larva.



Figures 4–9. *Physonota alutacea*, setae of first instar larva. (4) Setae of head; (5) seta of I abdominal tergite; (6) setae of metasternum placed medially; (7) seta of II abdominal sternite; (8) seta of the top of lateral scoli; (9) setae which covered lateral scoli.

Setae of supra-anal processes look like setae on lateral scoli and on tergites.

Tergites and sternites with long setae, and at anterior border of each segment with minute setae (Figs 1–3, 21, 22). Setae of tergites more or less in similar length slightly shorter than setae of sternites (Figs 5–7). Setae of tergites at the top with small spines (Figs 5, 28). Setae of sternites slightly shorter or distinctly longer than setae of tergites. Most setae of sternites pointed at the tops only some setae with small spines at the tops (Figs 6, 7). The longest setae of body are on abdominal sternites and at the top of lateral scoli (Figs 1–9, 21, 22).

Pronotum on each side with long setae distributed along border and in the middle of each tergite (Fig. 2). Meso- and metanotum with three (seldom two or four) long setae on each antero-lateral side and with two rows of long setae: one placed anteriorly with around 14 setae and second placed posteriorly with about 25 setae. Four small setae and a few campaniform sensilla at base of each lateral scolus of 4^{th} and 6^{th} pair. Meso-, metanotum and each abdominal tergite medially close to anterior border with a pair of very minute setae. Each abdominal tergite with two rows of long setae. Rows of individual segments with the same number of setae. Number of setae in rows decrease posteriorly from 11 on abdominal tergite I to 6 on tergite VIII. Two minute setae, two campaniform sensilla and two (seldom one) long setae laterally on each abdominal tergite close to spiracle.

A few minute setae close to anterior border of all sternites, few small setae also at base (on episternum) of legs and one small seta on each epimeron (Fig. 3). Close to each thoracic spiracle 6–9 setae. Prosternum in the middle with numerous shorter setae. Meso- and metasternum in the middle with numerous shorter setae and one pair of long pointed setae. Abdominal sternites covered with numerous setae of different length but very long setae predominate.

Six stemmata on each side of head: five of the same size and one slightly smaller (Figs 10, 30).

Frontal side of head with five (sometimes four or six) small vertical setae, around 26–30 long and a few shorter setae, and few campaniform sensilla (Figs 10, 29). Setae placed temporally slightly shorter than setae on frontal side (Figs 11, 30). Tops of most setae with small spines (Figs 4, 31).

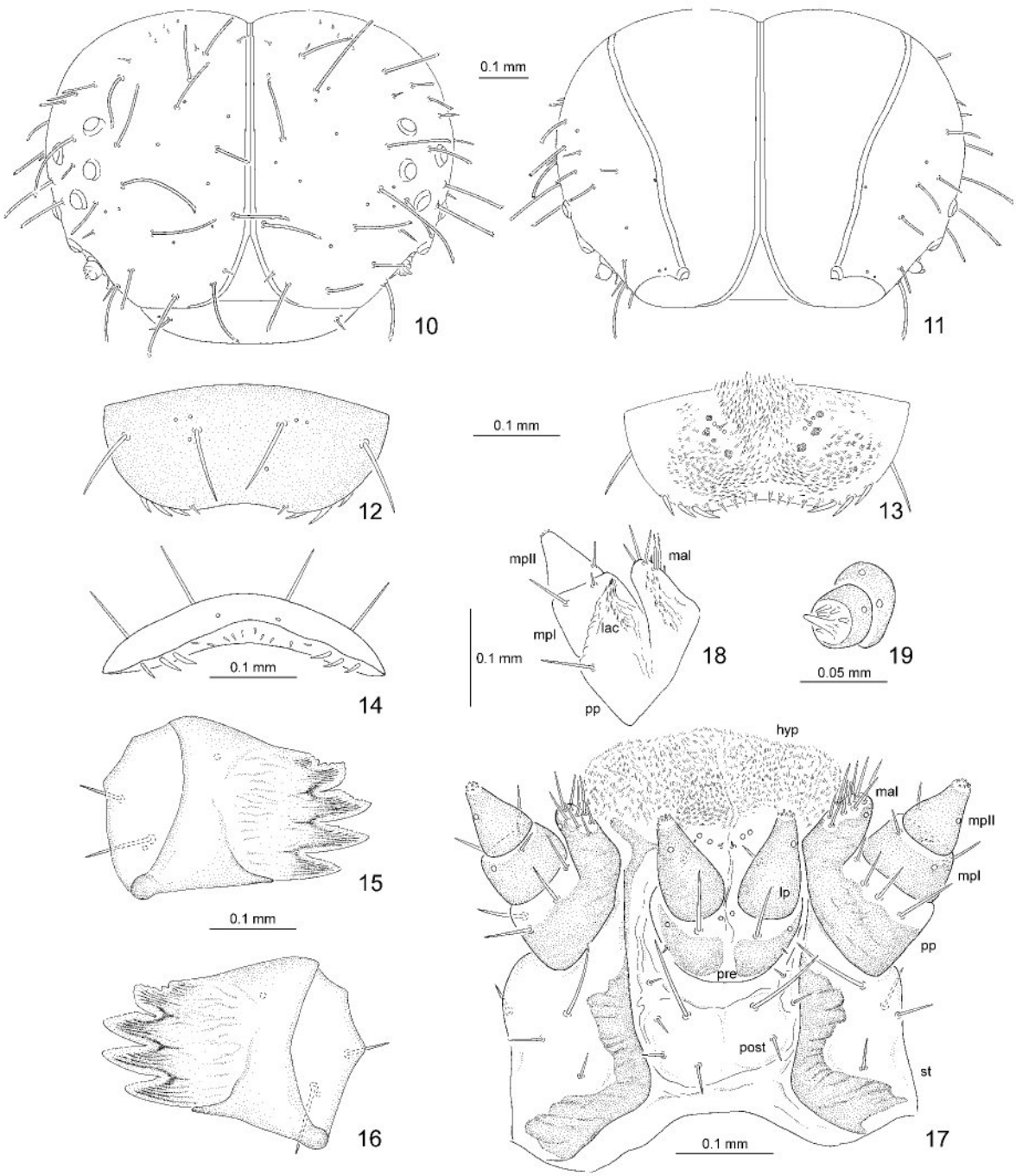
Antennae 2-segmented, set in membranous ring (Figs 19, 32). First segment transverse, wider than second one, with two campaniform sensilla. Second segment stout more or less as wide as long, at the apex with a group of six peg-like sensilla: one prominent (sensory appendix) and five small. At base of second segment one peg like sensillum (or campaniform sensillum).

Labrum wider than long, anterior margin emarginate. Dorsal side of labrum with four long setae and three pairs of campaniform sensilla placed centrally and two setae at anterior margin (Figs 12, 33, 34). Mid part of ventral surface (epipharyngeal area) with a pair of small setae, six campaniform sensilla, and four groups of four small sensilla (Fig. 13). Central and lateral parts of ventral side of labrum armed with numerous small spines. Anterior margin with 8 small setae placed medially and three stout longer setae on each side (Fig. 14). Eight small setae placed medially not visible from dorsal view remainder setae visible.

Mandibulae heavily sclerotized, palmate, with four distinct, triangular, apical teeth and small tubercle or

hardly developed teeth in one row, and fifth smaller distinctly retracted tooth (Figs 15, 16). Dorsal side of mandibles at base with two setae and two campaniform sensilla.

Maxillae and labium connate (Figs 17, 35). Each stipes (st) with one long pointed seta and three (seldom four) shorter pointed setae. Mala (mal) not distinctly bordered from palpiger (pp). Broad, truncate at the apex mala bear: eight long pointed setae, one blunt seta, one peg like sensillum (very short blunt seta?) and one campaniform sensillum. Dorsally palpiger with short protuberance (lacinia? – lac) covered with spines



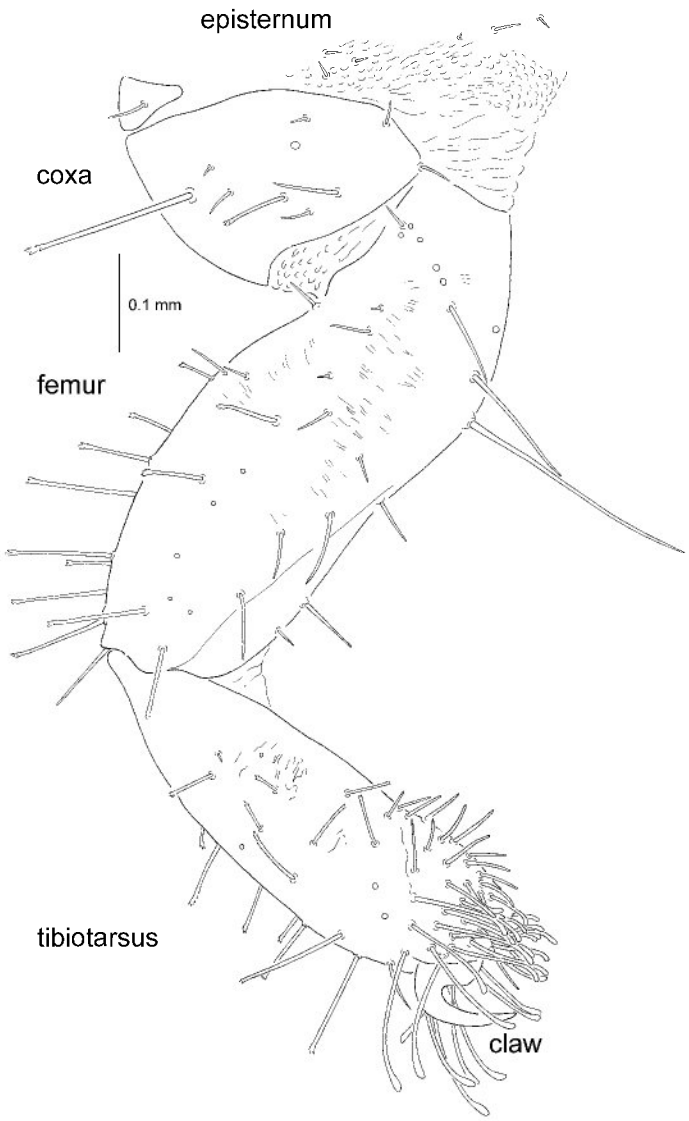
Figures 10–19. *Physonota alutacea*, first instar larva. (10) Frontal side of head; (11) temporal side of head; (12) dorsal side of labrum; (13) ventral side of labrum; (14) anterior margin of labrum; (15, 16) mandibles; (17) maxillae and labium ventrally: st – stipes, pp – palpiger, mal – mala, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp, lp – labial palp, lig – ligula, pre – prementum, post – postmentum; (18) dorsum of palpiger and maxillary palpi: pp – palpiger, mal – mala, lac – lacinia, mpII – second segment of maxillary palp; (19) antenna.

(Figs 18, 36). Ventrally palpiger with four long setae. Maxillary palp two-segmented: first segment (mpl) with three setae (two long and one short) and one campaniform sensillum, second segment (mpll) with a group of sensilla at apex, and with one campaniform sensillum and one seta below the apex. Labial palp (lp) one-segmented with a group of sensilla at the apex and one campaniform sensillum and one short seta below the apex. Hypopharynx (hyp) covered with numerous spines, and with four campaniform sensilla and two short setae at base. Prementum (pre) with two long and two short setae, and four campaniform sensilla. Postmentum (post) with two long and 6 (sometimes 7) shorter setae.

Legs elongate, three segmented consist of: coxa, femur and tibiotarsus (Fig 20). Tibiotarsus apically with heavily sclerotized, short and curved, single and simple claw armed basally with a pointed seta. Claw surrounded by a complex of numerous long setae (Figs 23, 24). The longest setae slightly curved apically. Tibiotarsus above claw and femur with numerous setae. At base of femur: internally a group of five campaniform sensilla and one short pointed seta, ventrally one campaniform sensillum and externally two campaniform sensilla. Coxa with two long and around 16 shorter setae.

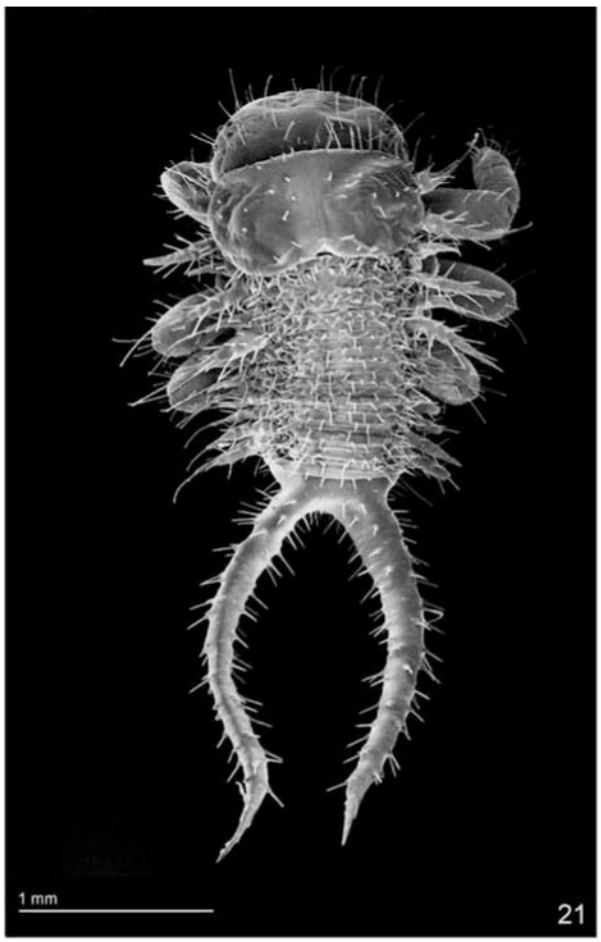
Last instar larva. Measurements (n=3 [mm]). Length without head, from anterior border of pronotum to base of supra-anal processes: 10.50, 12.00, 12.00; width across metanotum, without lateral scoli (respectively): 5.70, 5.60, 5.80.

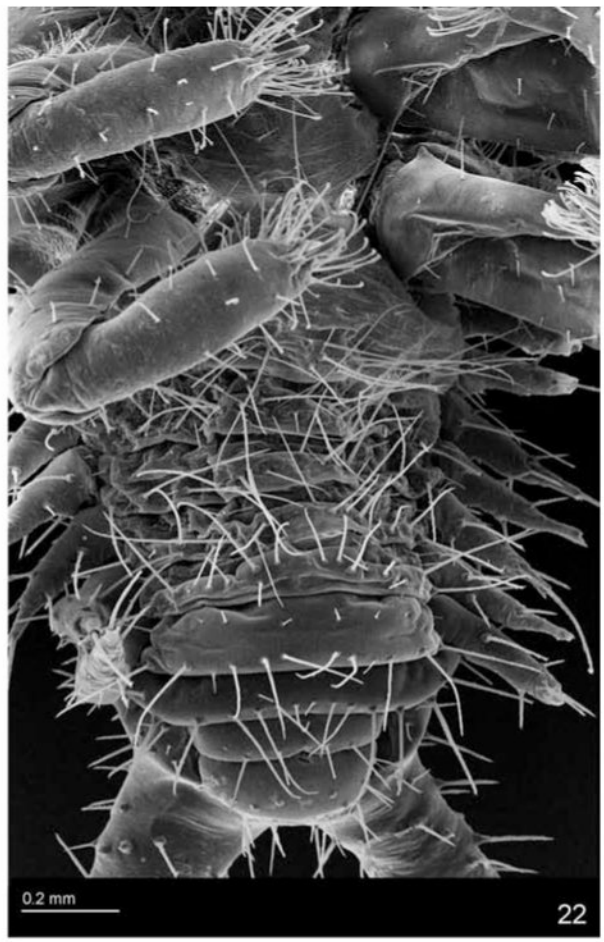
Body the widest across meso- and metathorax, abdominal segments strongly narrowed posteriorly

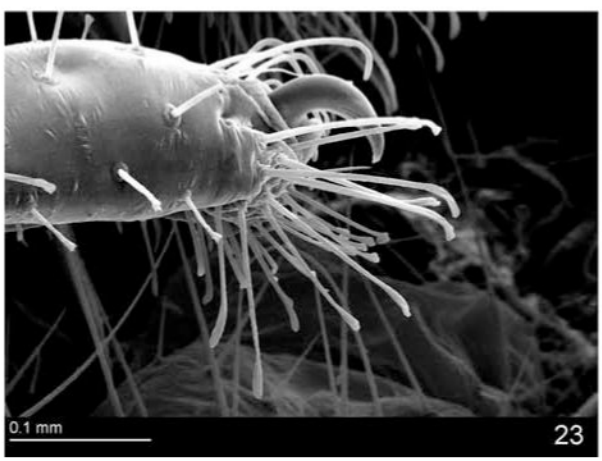


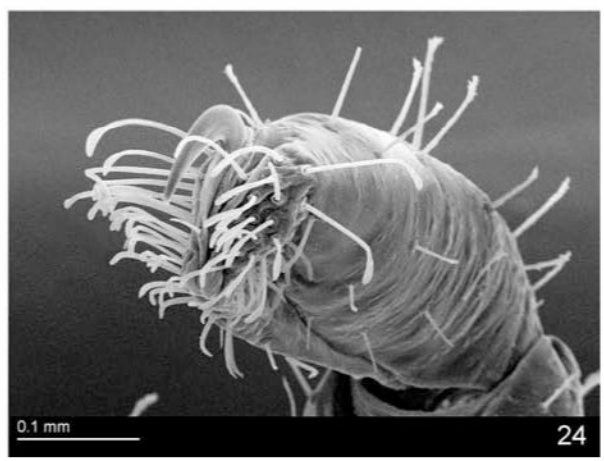
Figures 20. *Physonota alutacea*, leg of first instar larva.

(Figs 37–39). Meso- and metathorax distinctly convex, abdomen slightly flattened dorso-ventrally. Dorsal side of larval body yellow with black borders of each tergite including anterior border of pronotum, two black elongated spots in the middle of pronotum, black transverse band across meso-, metanotum and each abdominal tergite. Ventral side of body yellow with two black spots in the middle of meso- and metasternum, black spots at base of lateral scoli of meso-and metasternum, black lateral side of abdominal sternite I–III and VII, and almost completely black abdominal sernites IV–VI. Lateral scoli yellow, supra-anal processes black. Head yellow with black spot on each lateral side and two dark brown triangular spots on





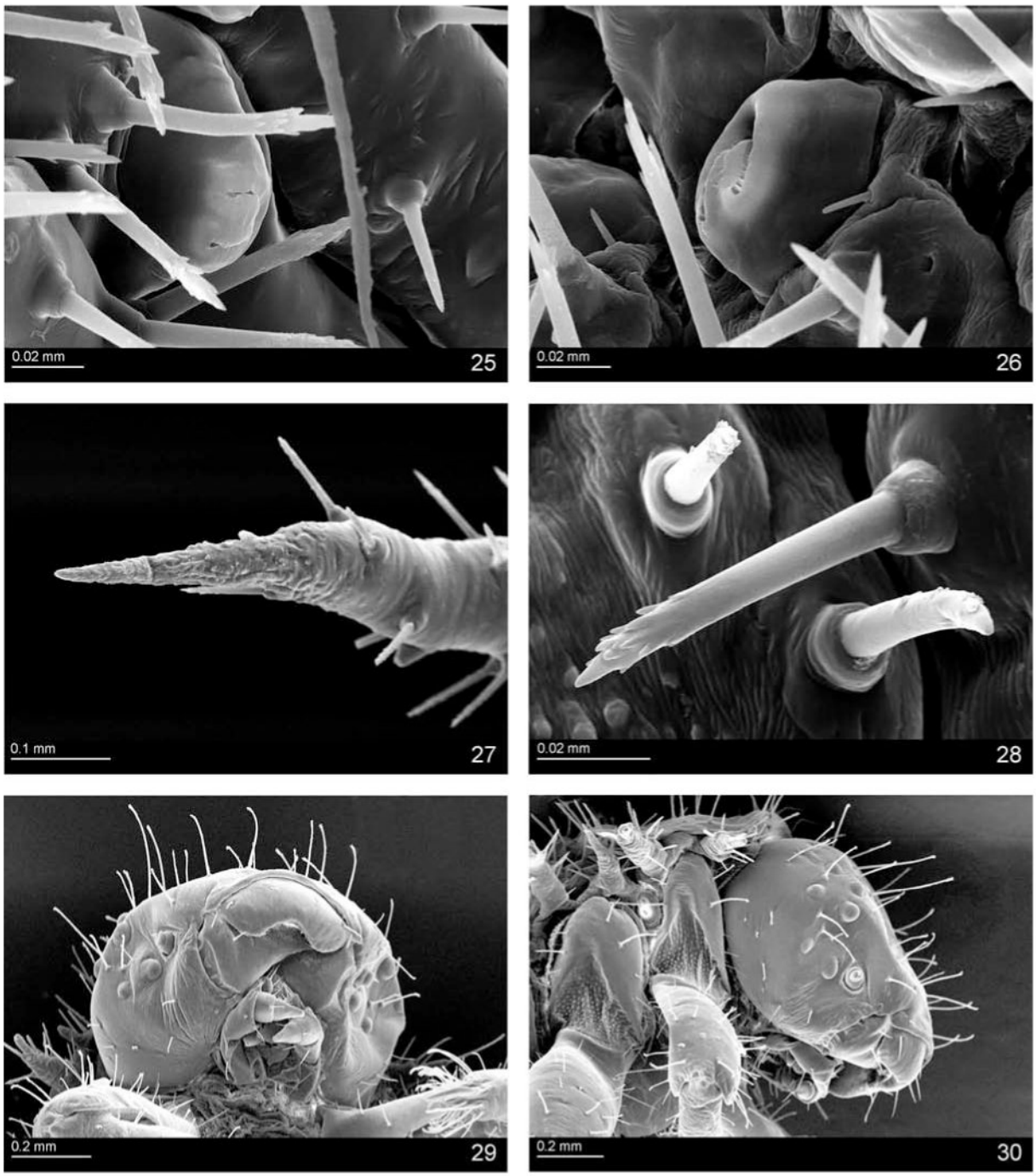




Figures 21–24. *Physonota alutacea*, first instar larva. (21) Dorsal aspect; (22) ventral aspect; (23, 24) tops of legs.

frontal side, clypeus yellow with dark brown to black patch along fronto-clypeal suture, labrum and mandibles dark brown to black (Fig. 43). Legs yellow with black patch along base of each coxa and femur, and black streak along dorsal side of femur and tibio-tarsus (Fig. 45).

Body with 14 pairs of lateral scoli and a pair of supra-anal processes (Figs 37–39). Prothorax with three pairs of lateral scoli, meso- and metathorax with two pairs, abdominal segments I–VII with one pair, abdominal segment VIII without lateral scoli. First two lateral scoli placed very close to

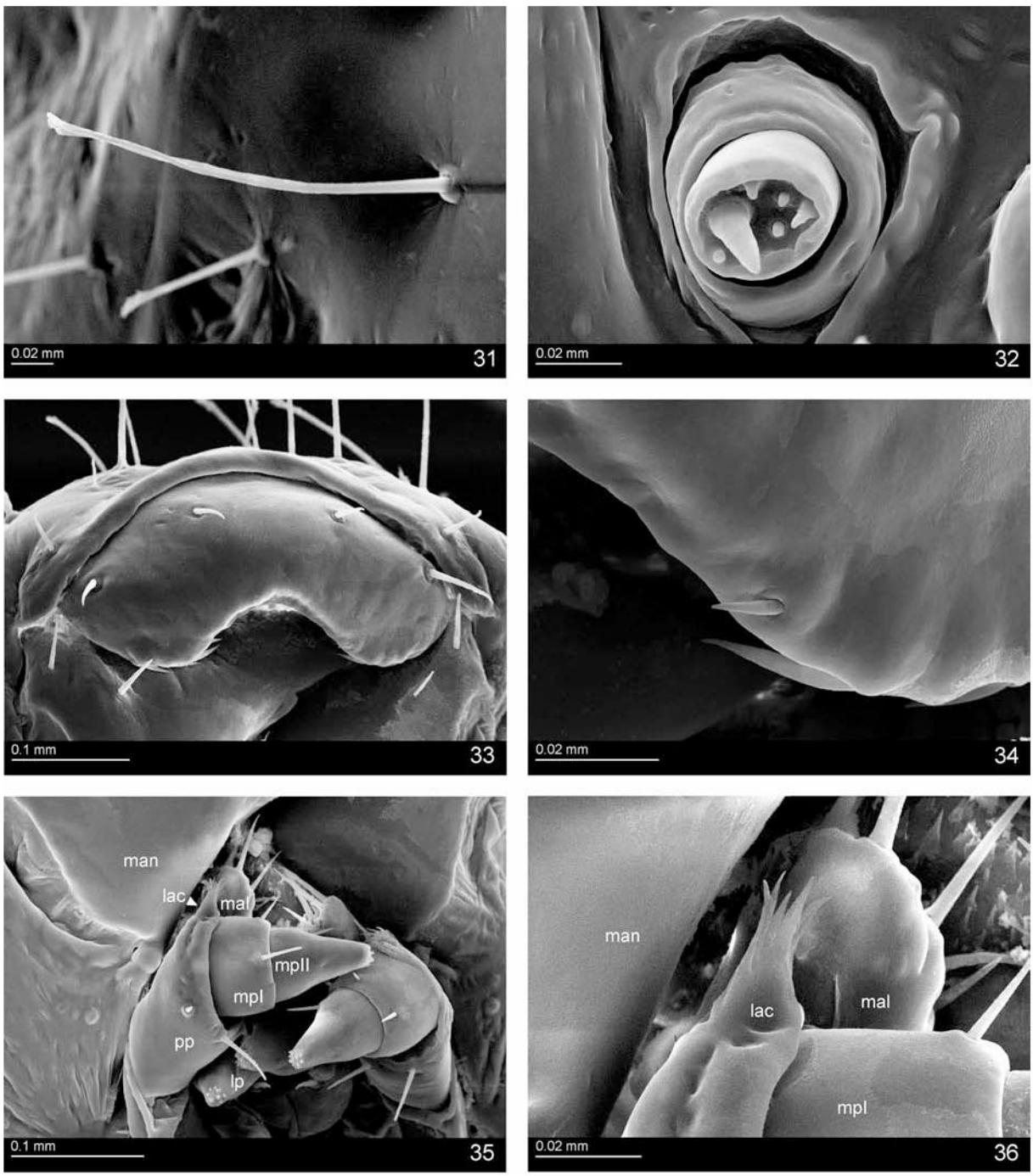


Figures 25–30. *Physonota alutacea*, first instar larva. (25, 26) Spiracles; (27) top of supra-anal process; (28) seta of dorsal side of body; (29) head frontally; (30) head lateral aspect.

each other (Fig. 49). Lateral scoli short conical, each slightly bended posteriorly. All scoli without lateral branches but covered with short setae. Apex of scoli armed with pointed seta. Supra-anal processes long strongly sclerotised covered with short setae (Fig. 50).

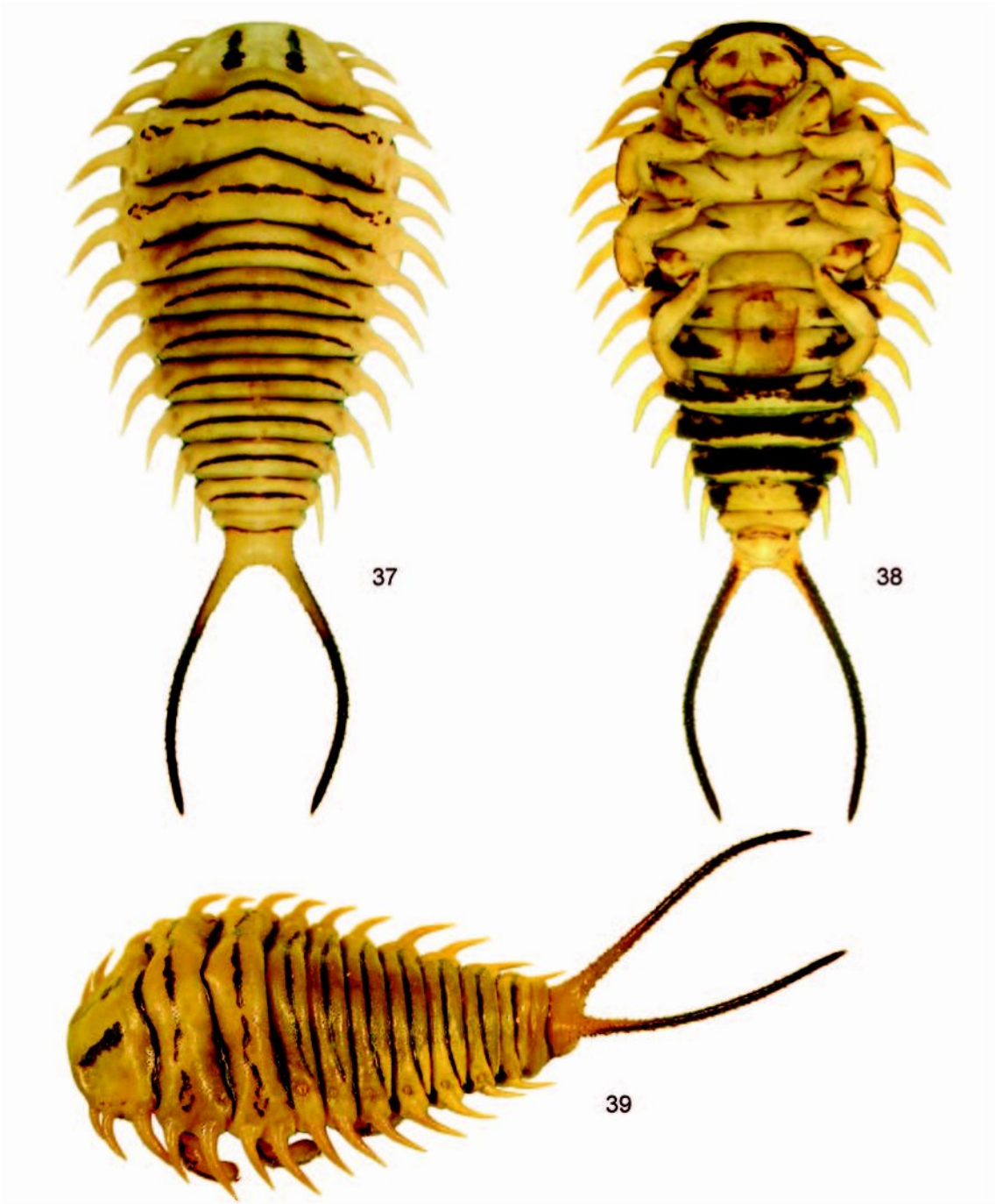
Nine pairs of spiracles (one pair on thorax and eight on abdomen). Spiracles of thorax visible from ventral side. Diameter of spiracles slightly decreasing posterad.

Whole body including head, legs, lateral scoli and supra-anal processes covered with numerous setae



Figures 31–36. *Physonota alutacea*, first instar larva. (31) seta of head; (32) antenna; (33) labrum; (34) anterior border of labrum; (35) maxillae and labium: man – mandibula, pp – palpiger, lac – lacinia, mal – mala, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp, lp – labial palp ; (36) lacinia: man – mandibula, lac – lacinia, mal – mala, mpI – first segment of maxillary palp.

(Figs 51–56, 65, 66, 83). Pro-, meso-, metanotum and abdominal tergites with numerous, distributed regularly on whole surface short setae (Fig. 51). Short dorsal setae placed on small tubercles. Setae of ventral side also placed on protuberances like setae of dorsum (Figs 52–56). Pro-, meso-, metasternum and abdominal sternite with numerous setae of different length. Ventral setae usually longer than dorsal setae but their length are more diverse. In the middle of sternite predominate long setae. Setae on lateral sides of sternites are shorter than in the middle but longer than on tergites. The longest setae are placed in the middle of sternites especially on segments I–III. Setae in the middle of abdominal sternites the most numerous but number of setae on sternite decrease posterad (Figs 54, 56).



Figures 37–39. *Physonota alutacea*, mature larva. (37) Dorsal aspect; (38) ventral aspect; (39) laterally.

Head well sclerotized, hypognathous, retracted into pronotum. Median suture complete, connected with fronto-clypeal suture (Figs 43, 65, 66). Clypeus distinct, wider than long, with a pair of long setae and a few short setae along fronto-clypeal suture.

Six stemmata on each side of head (Fig. 65).

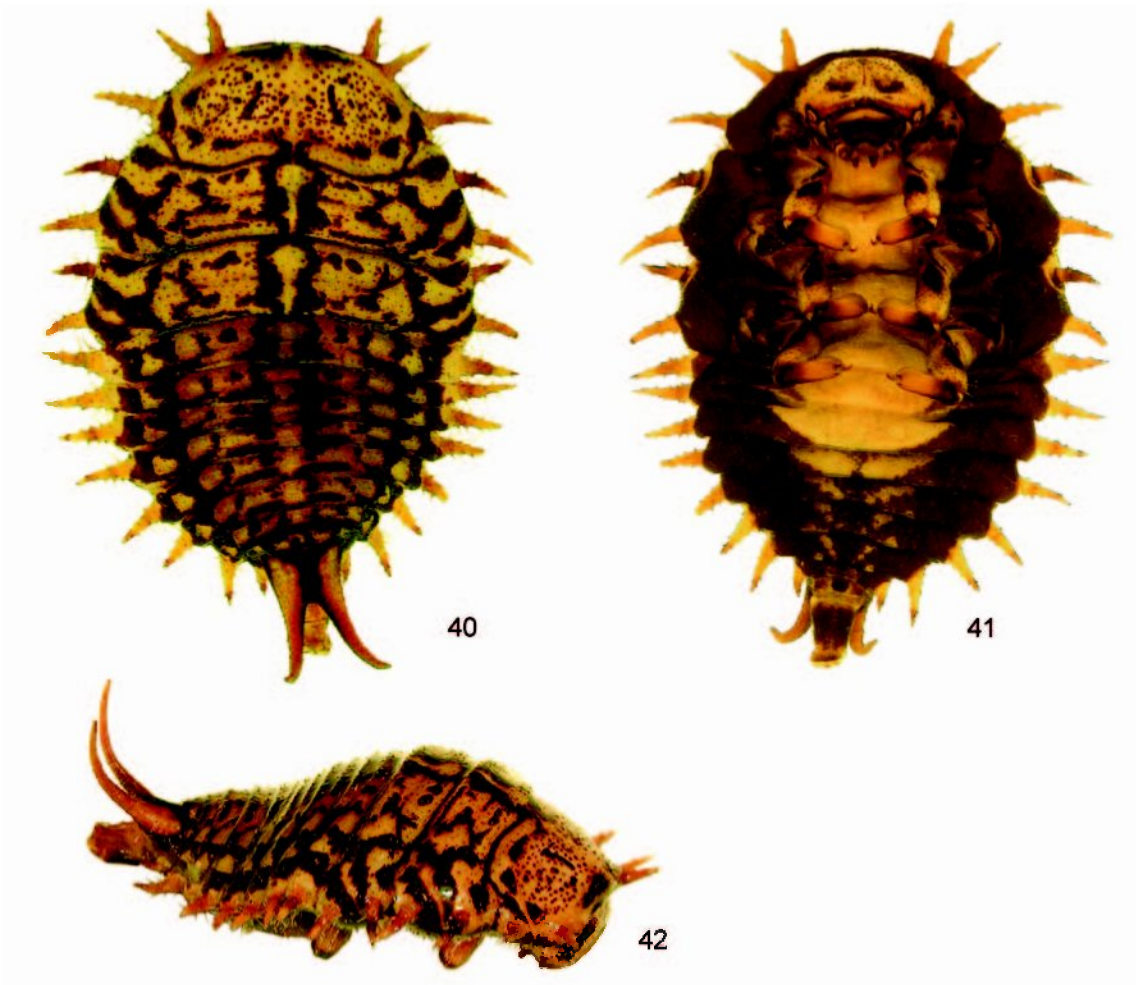
Head with extremely numerous setae distributed on whole surface. Setae of different size: on vertex shorter than setae placed close to stemmata, along fronto-clypeal suture and on temporal side (Figs 65, 66).

Antennae 2-segmented, set in membranous ring. First segment transverse, wider than second one, with two campaniform sensilla. Second segment stout more or less as wide as long, with one peg-like sensillum (or campaniform sensillum) at base, and a group of six peg-like sensilla at the apex: one prominent (sensory appendix) and five smaller.

Labrum wider than long, anterior margin emarginate (Figs 67, 68). Dorsal side of labrum with four long setae and numerous short setae (short setae easily break during dissection of mouth part thus it is impossible to distinguish between socket of broken seta and campaniform sensillum). Two short setae at anterior margin dorsally. Mid part of ventral surface (epipharyngeal area) on each side with small seta, three campaniform sensilla, and two groups of four small sensilla. Central and lateral parts of ventral side of labrum armed with numerous small spines. Anterior margin with 8 small setae placed medially and three stout and slightly longer setae on each lateral side.

Mandibulae heavily sclerotized, palmate, with five distinct, triangular, apical teeth in one row and sixth teeth heavily marked and distinctly retracted (Figs 69–72). Dorsal side of mandibles at base with two longer setae, a few (6–8) small setae and two campaniform sensilla (Figs 70, 72).

Maxillae and labium connate (Fig. 73). Each stipes (st) with 5–6 long pointed setae and few (13–16) short setae. Mala (mal) not distinctly bordered from palpiger (pp). Broad, truncate at the apex mala bear: eight



Figures 40–42. *Asteriza flavicornis*, mature larva. (40) Dorsal aspect; (41) ventral aspect; (42) laterally.

long pointed setae, one blunt seta, one peg like sensillum (very short blunt seta?) and one campaniform sensillum. Dorsally palpiger with short protuberance (lacinia? – lac) covered with spines (Fig. 74). Ventrally palpiger with 4–6 long setae, few (8–11) short setae and one or two campaniform sensilla. Maxillary palp two-segmented: first segment (mpl) with 6–9 setae and one campaniform sensillum, second segment (mpll) with a group of sensilla at apex, and below the apex with campaniform sensillum and one seta. Labial palp (lp) one-segmented with a group of sensilla at the apex and one campaniform sensillum and 5–8 setae below the apex. Hypopharynx (hyp) covered with numerous spines with 2–4 setae and 4–6 campaniform sensilla at base. Prementum (pre) with 2 long, 2–6 short setae and 4 campaniform sensilla. Postmentum (post) with around 13 long setae and few very short setae.

Legs three segmented consist of: coxa, femur and tibiotarsus (Figs 45, 83). All segments covered with numerous setae. Tibiotarsus apically with heavily sclerotized, curved, single and simple claw which is surrounded by blunt and clubate setae. Extremely numerous blunt and clubate setae are below claw. Femur with slightly longer than of tibiotarsus setae and two extremely long setae.

Larvae carry no shields on their supra-anal processes.

Pupa. Measurements (n=1). Length: 10.50 mm; width across first abdominal segment, without lateral scoli: 7.10 mm.

Body short-oval, almost rounded, tergites distinctly convex (Figs 85, 86).

Pronotum dorsally yellow with four dark brown to black spots in the middle and one elongated on each lateral side. Mesonotum black to dark brown on lateral sides, with yellow anterior and posterior border. Metanotum yellow with three black spots in the middle and one dark brown on each lateral side. Abdominal

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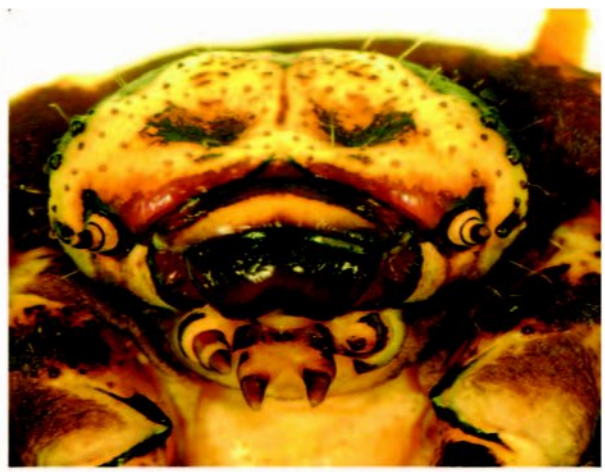

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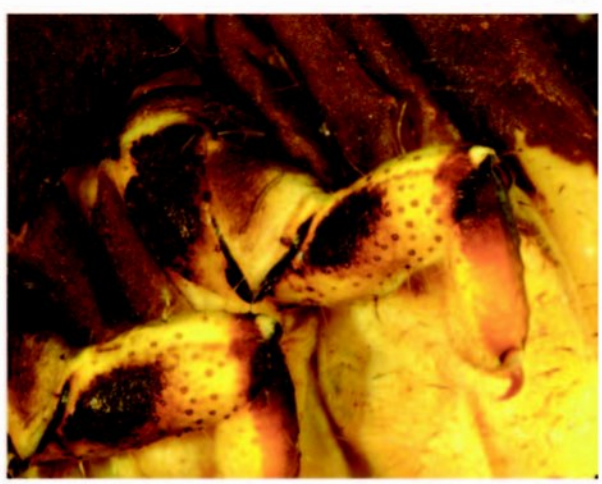

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Figures 43–46. Mature larvae: 43, 45. *Physonota alutacea*; 44, 46. *Asteriza flavicorni*. (43, 44) Heads; (45, 46) legs.

tergites I–III yellow with black spot on each lateral side. Spots on segment III strongly elaborated covering most of the segment. Abdominal tergites IV and V yellow with three black spots: one in the middle and on one each lateral side. Abdominal tergites VI and VII yellow with black strip across segments. Spiracles of abdominal tergites I–V light brown. Lateral scoli of abdominal segment I dark brown with yellow strip. Lateral scoli of segments II–VII yellow. Tops of lateral scoli of segments II and III dark brown. Prosternum yellow with two dark brown spots on each lateral side and two spots at anterior border. Elytral portion with yellow and dark brown stripes. Abdomen ventrally yellow except to sternites IV–VI. Head yellow, antennae and mouth part dark brown. Legs yellow with dark brown stripe along their length.

Pro-, meso-and metanotum without lateral scoli.

Abdominal segments I–V with conical lateral scoli which are gradually shortened towards posterior part of body. Lateral scoli without lateral branches and setae. Abdominal segments VI and VII with a short spine-like process on each side (Fig. 89). Segments VIII and IX without lateral processes.

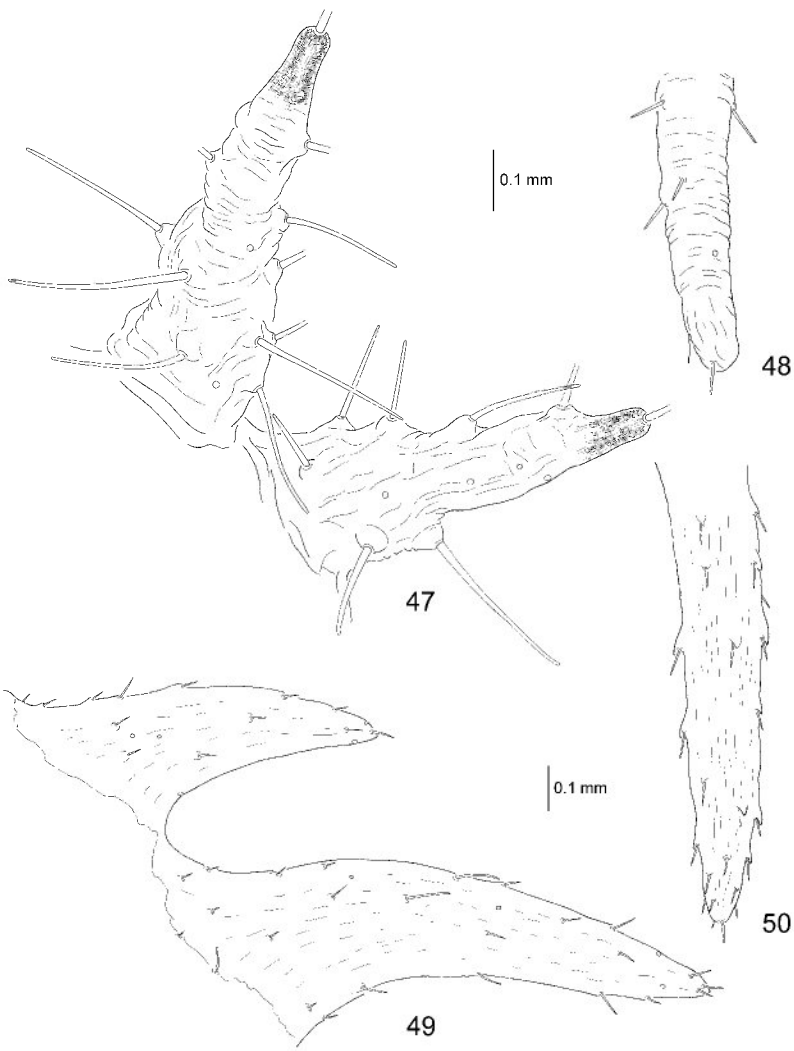
Setae on body not observed.

Abdomen with 7 pairs of spiracles; diameter of spiracles of each pair decrease posteriorly.

Larval skins of last instar is retained by the pupa.

Asteriza flavicornis (Olivier, 1790)

Last instar larva. Measurements (n=2, [mm]). Length without head, from anterior border of pronotum to base of supra-anal processes: 8.00, 8.30; width

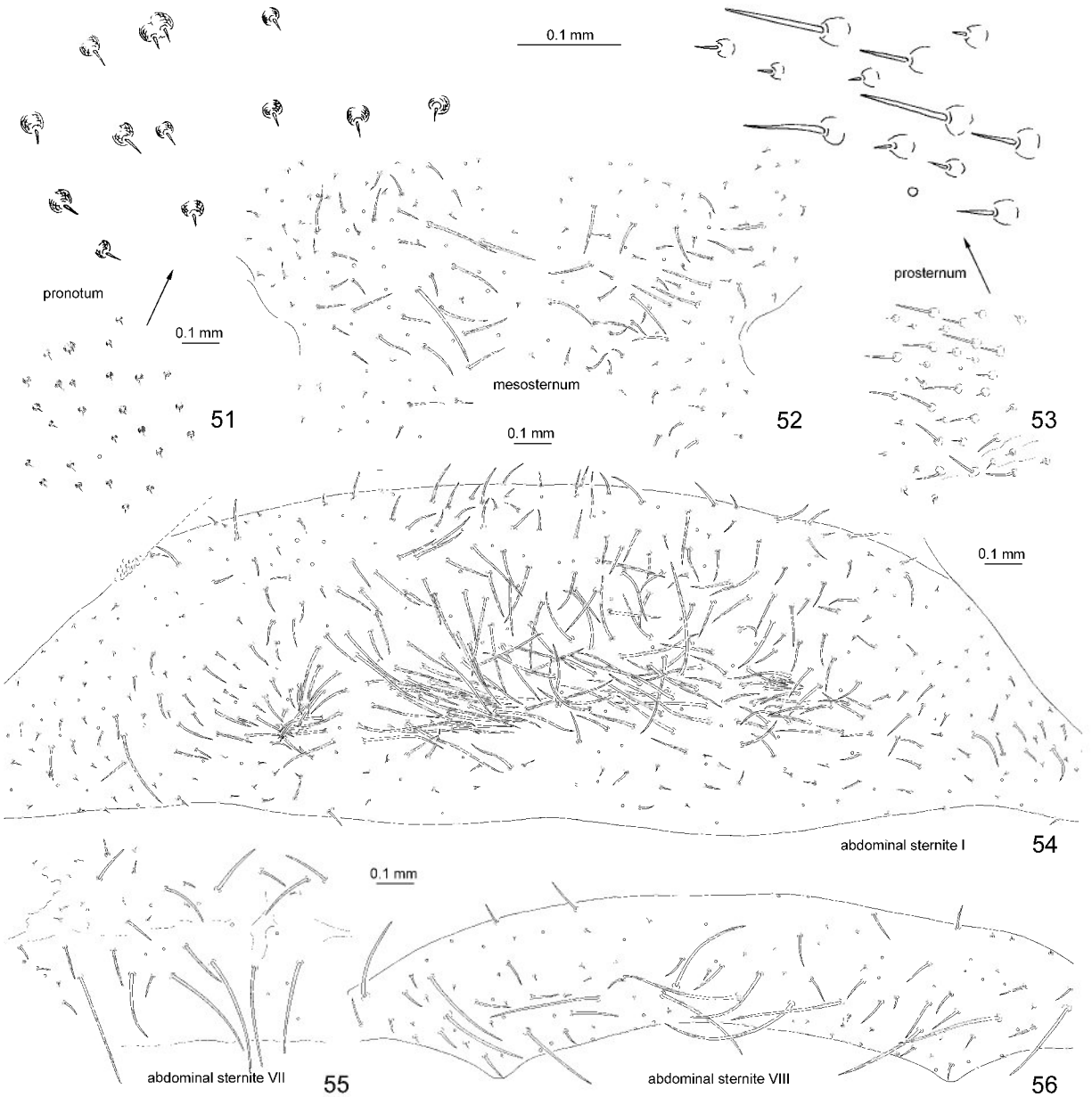


Figures 47–50 Mature larvae: 47, 48. *Asteriza flavicornis*; 49, 50. *Physonota alutacea*. (47, 49) First two lateral scoli; (48, 50) tops of supra-anal processes.

across metanotum, without lateral scoli (respectively): 4.80, 6.00.

Body short-oval, almost rounded, the widest across metathorax, flattened dorso-ventrally but thorax distinctly convex (Figs 40–42). Dorsal side of larval body yellow with numerous dark brown spots as in figure 40. Sternites of thorax and abdominal segments I–III in the middle yellow and laterally dark brown, abdominal sternites IV–VIII dark brown with yellow spots in the middle. Lateral scoli yellow with brown tops. Supra-anal processes yellowish-brown, at base black. Head yellow with black spot on each lateral side and two dark brown spots on frontal side, clypeus yellow with dark brown to black patch along fronto-clypeal suture, labrum and mandibles dark brown to black (Fig. 44). Each coxa dark brown to black (Fig. 46). Femur yellow, with dark brown to black basal and distal edge and with two black spots: one on internal and one on external side. Tibiotarsus ventrally yellow, dorsally dark brown to black at base.

Body with 15 pairs of lateral scoli and a pair of supra-anal processes (Figs 40, 41). Prothorax with

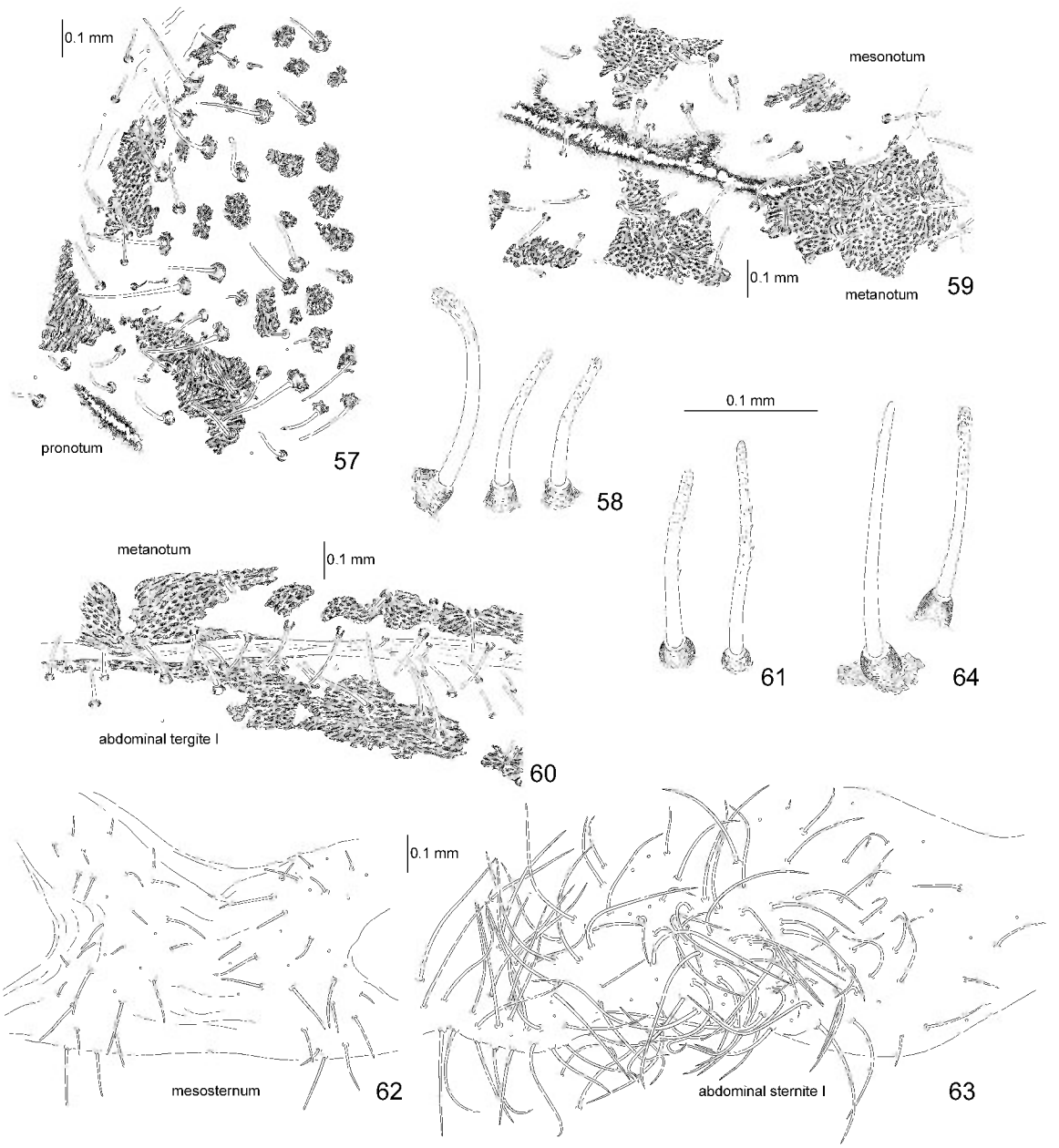


Figures 51–56. *Physonota alutacea*, setae of body, mature larva. (51) pronotum laterally; (52) mesosternum in the middle; (53) prosternum laterally; (54) I abdominal sternite; (55) VII abdominal sternite; (56) VIII abdominal sternite.

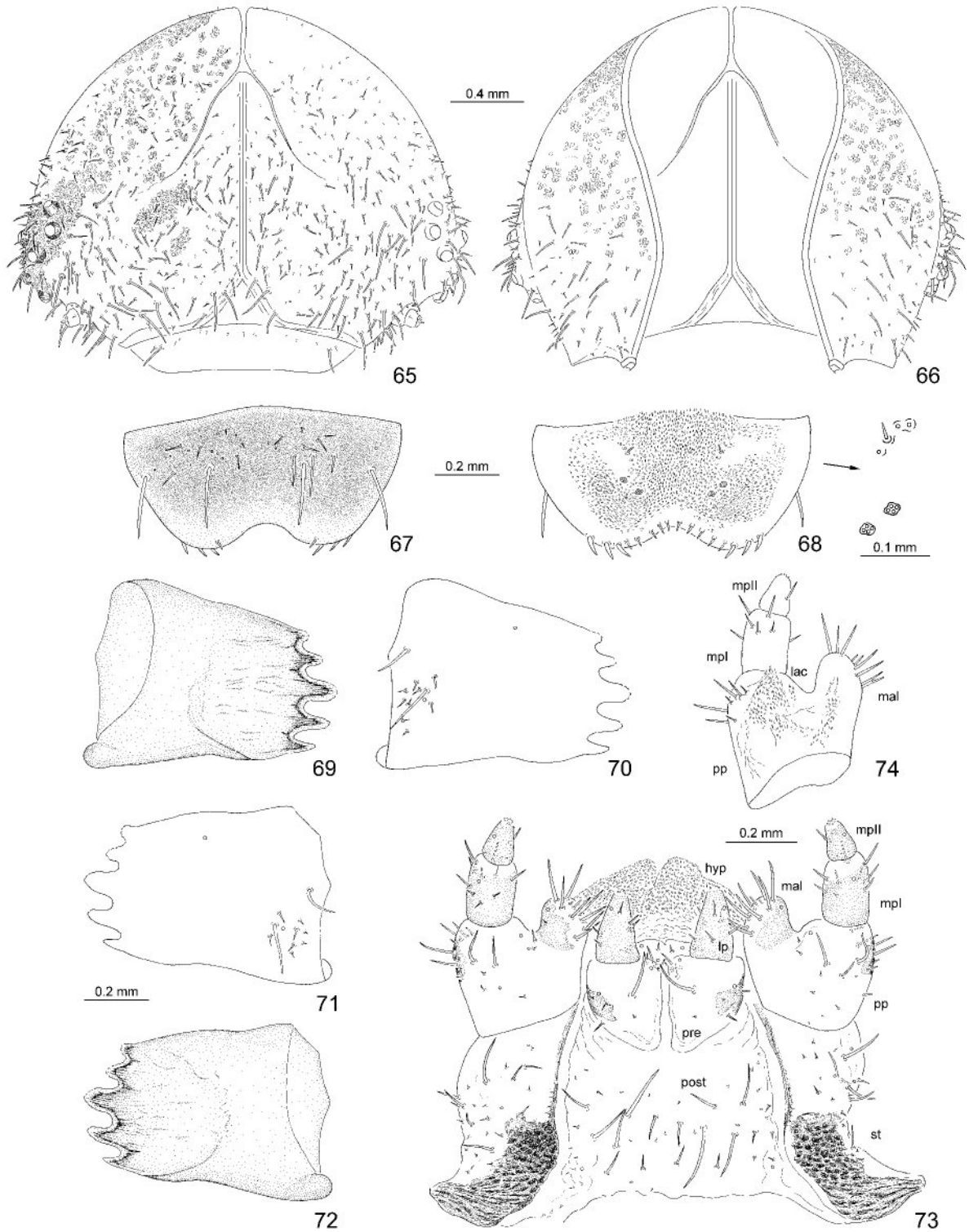
three pairs of lateral scoli, meso- and metathorax with two pairs, abdominal segments I–VIII with one pair. First two lateral scoli placed very close to each other (Fig. 47). Lateral scoli short. All scoli without lateral branches but covered with long setae. Apex of scoli armed with seta (in examined specimens setae at the tops of all lateral scoli were broken thus we do not know how long they are). Supra-anal processes short covered with setae. Apex of each supra-anal process armed with pointed seta (Fig. 48).

Nine pairs of spiracles (one pair on thorax and eight on abdomen). Spiracles of thorax visible from ventral side. Diameter of spiracles slightly decreasing posterad.

Whole body including head, legs, lateral scoli and supra-anal processes covered with numerous setae (Figs 57, 59, 60, 62, 63, 75, 76, 84). Most setae of tergites and head at the top covered with more or less numerous scales (Figs 58, 61, 64), setae on sternites and legs usually pointed at the top without scales. Setae of



Figures 57–64. *Asteriza flavicornis*, setae of body, mature larva. (57) pronotum laterally; (58) setae of thorax; (59) meso-and metanotum laterally; (60) metanotum and I abdominal segment medially; (61) setae of abdomen; (62) mesosternum medially; (63) I abdominal sternite medially; (64) setae of head.



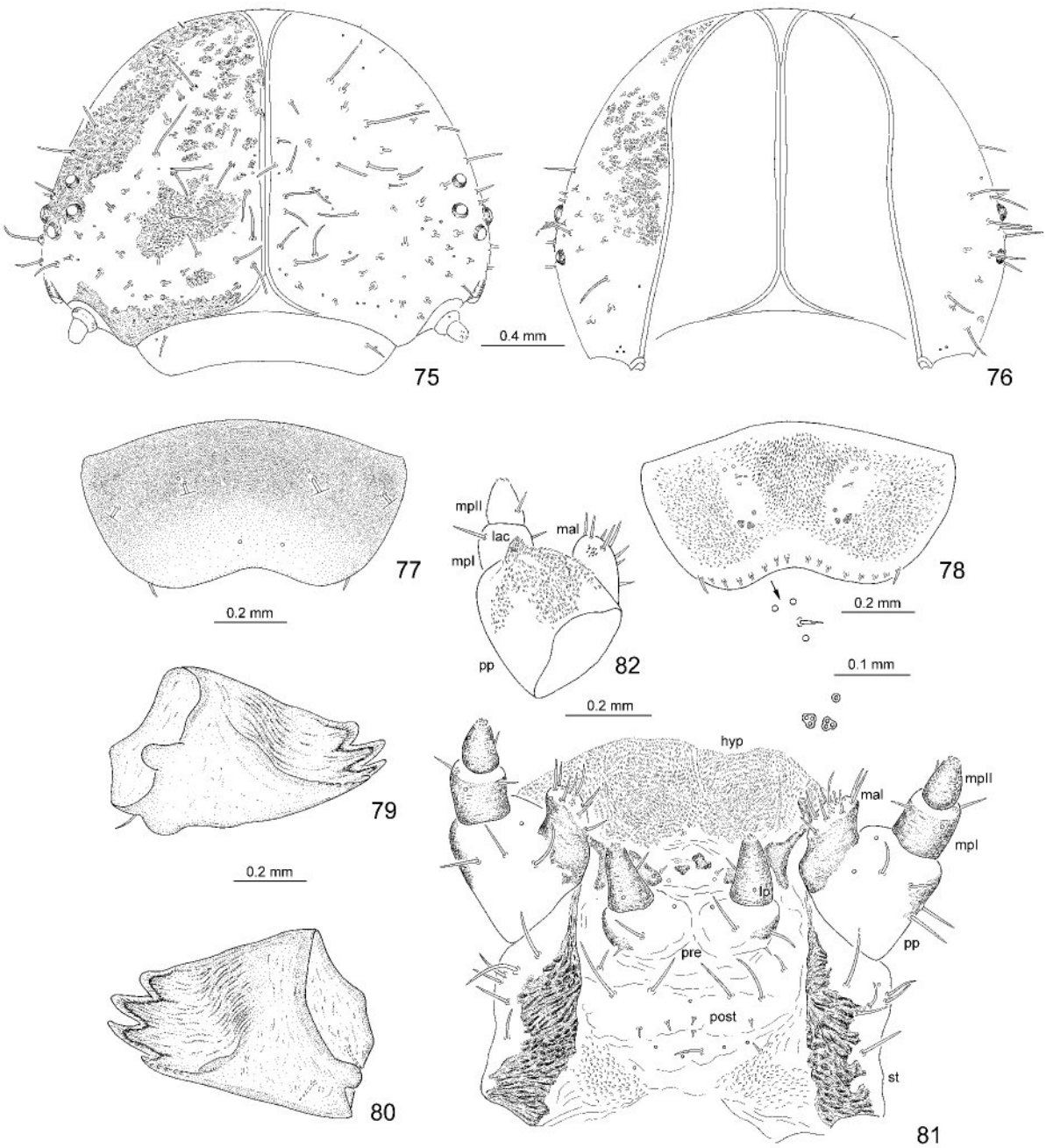
Figures 65–74. *Physonota alutacea*, mature larva. (65) Frontal side of head; (66) temporal side of head; (67) dorsal side of labrum; (68) ventral side of labrum; (69, 72) ventral side of mandibles; (70, 71) dorsal side of mandibles; (73) maxillae and labium ventrally: st – stipes, pp – palpiger, mal – mala, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp, lp – labial palp, lig – ligula, pre – prementum, post – postmentum; (74) dorsum of palpiger and maxillary palpi: pp – palpiger, mal – mala, lac – lacinia, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp.

tergites placed on stout tubercles. Setae of ventral side with tubercles slightly less prominent than setae of dorsum. Tergites with numerous setae but their number decreasing posterad. Setae on thoracic tergites distributed regularly on whole surface. Setae on abdominal tergites seem to form two irregular rows. Setae on sternites distributed regularly except setae in the middle of abdominal sternite I–III which are the most numerous and the longest setae of body.

Head well sclerotized, hypognathous, retracted into pronotum. Median suture complete, connected with fronto-clypeal suture (Figs 44, 75, 76). Clypeus distinct, wider than long, with a pair of long setae and a pair of campaniform sensilla.

Six stemmata on each side of head.

Head with numerous setae distributed on whole sur-



Figures 75–82. *Asteriza flavicornis*, mature larva. (75) Frontal side of head; (76) temporal side of head; (77) dorsal side of labrum; (78) ventral side of labrum; (79, 80) mandibles; (81) maxillae and labium ventrally: st – stipes, pp – palpiger, mal – mala, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp, lp – labial palp, lig – ligula, pre – prementum, post – postmentum; (82) dorsum of palpiger and maxillary palpi: pp – palpiger, mal – mala, lac – lacinia, mpI – first segment of maxillary palp, mpII – second segment of maxillary palp.

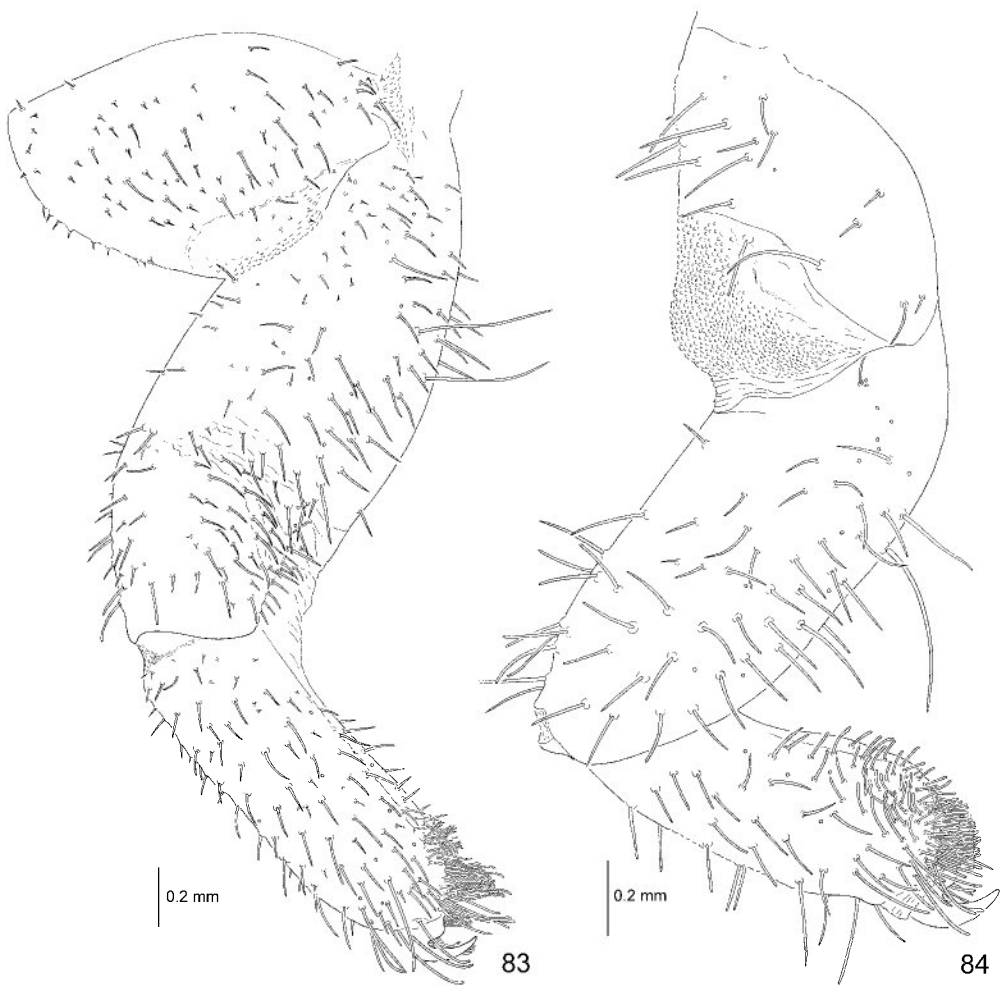
face. Setae of different size. In examined specimens setae on fronto-lateral side of head were broken (Figs 75, 76).

Antennae 2-segmented, set in membranous ring. First segment transverse, wider than second one, with one campaniform sensillum. Second segment stout more or less as wide as long, with one peg-like sensillum (or campaniform sensillum) below the top, and a group of five small peg-like sensilla at the apex. Antennae of examined specimens were in bad condition thus it is possible that some sensilla (especially sensory appendix) were broken.

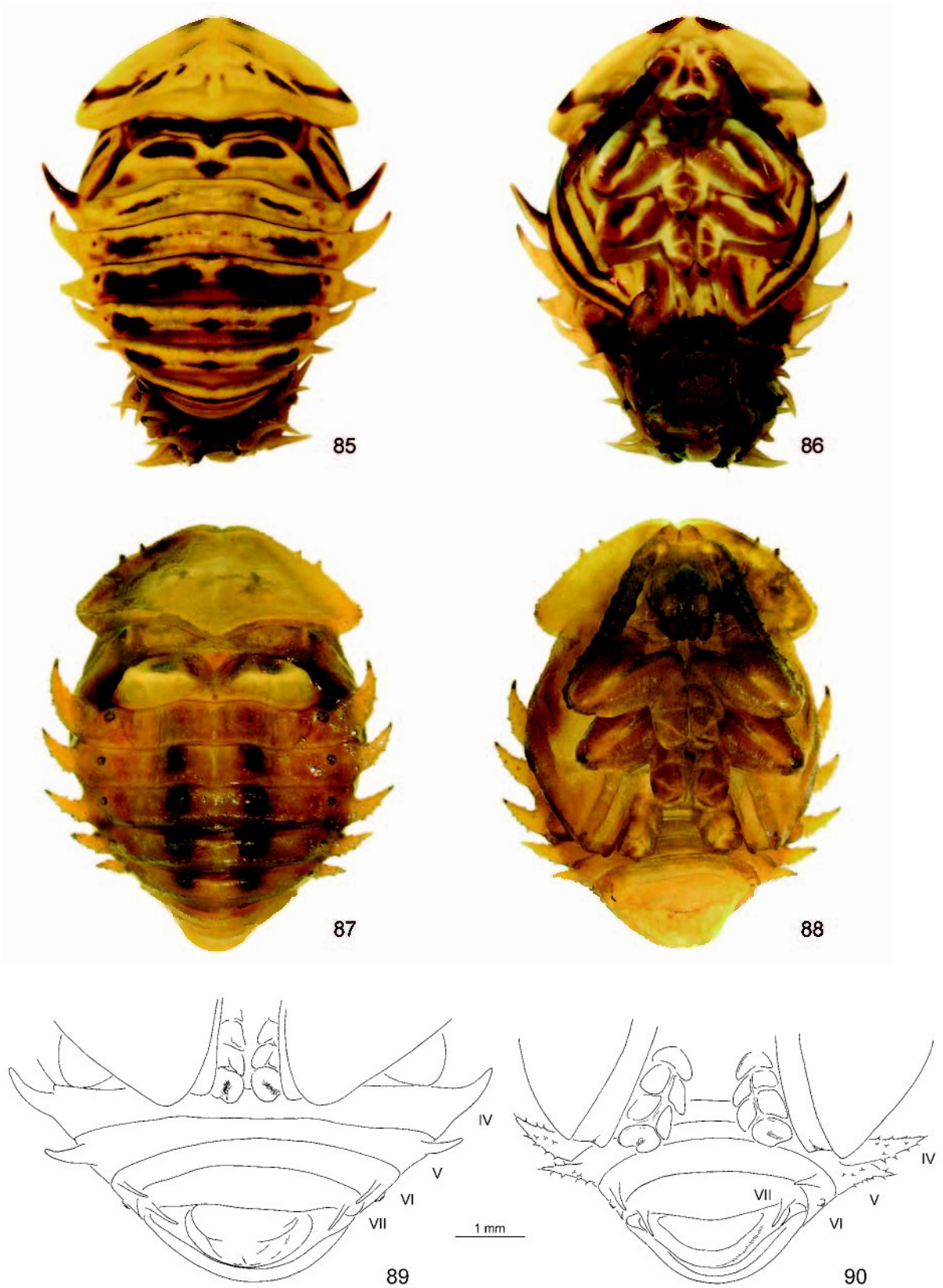
Labrum wider than long, anterior margin slightly emarginate (Figs 77, 78). Dorsal side of labrum with four long setae (all broken in examined specimens) and four campaniform sensilla. Mid part of ventral surface (epipharyngeal area) on each side with small seta, three campaniform sensilla, and two groups of 7–8 small sensilla. Central and lateral parts of ventral side of labrum armed with numerous small spines. Anterior margin with 16 setae. Setae of anterior margin in examined specimens were broken except for two setae placed laterally.

Mandibulae heavily sclerotized, palmate, with four distinct, triangular, apical teeth in one row, five small retracted teeth (or serrated posterior edge of fourth tooth) and with tubercle at molar part (Figs 79, 80). Dorsal side of mandibles at base with two setae and two campaniform sensilla.

Maxillae and labium connate (Fig. 81). Each stipes (st) with 6 long pointed setae. Mala (mal) not distinctly bordered from palpiger. Broad, truncate at the apex mala bear: eight long pointed setae, one blunt seta, one peg like sensillum (very short blunt seta?) and one campaniform sensillum. Dorsally palpiger (pp) with short protuberance (lacinia? – lac) covered with spines (Fig. 82). Palpiger with 3–4 long setae and one campaniform sensillum. Maxillary palp two-segmented: first segment (mpl) with two setae and one campaniform sensillum, second segment (mpll) with a group of sensilla at apex, and one seta and one campaniform sensillum below the apex. Labial palp (lp) one-segmented



Figures 83, 84. Leg of mature larva. (83) *Physonota alutacea*; (84) *Asteriza flavicornis*.



Figures 85–90. Pupae. (85, 86) *Physonota alutacea*; (87, 88) *Asteriza flavicornis*; (85, 87) Dorsal aspect of body; (86, 88) ventral aspect of body. (89, 90) Abdominal sternites of pupae, (89) *Physonota alutacea*; (90) *Asteriza flavicornis*.

with a group of sensilla at the apex and two campaniform sensilla and one setae below the apex. Hypopharynx (hyg) covered with numerous spines with 2 setae and 4 campaniform sensilla (or 6 setae because it is possible that some setae were lost) at base. Prementum (pre) with 4 long, 2 short setae and 2 campaniform sensilla. Postmentum (post) with around 6 long setae and few short setae.

Legs three segmented consist of: coxa, femur and tibiotarsus (Figs 46, 84). All segments covered with numerous setae. Tibiotarsus apically with heavily sclerotized, curved, single and simple claw which is surrounded by blunt setae. Extremely numerous blunt setae are below claw. Femur with setae of similar length as on tibiotarsus and one or two extremely long setae.

None of the larvae had a shield attached to their supra-anal process and there were no shields loose among the specimens, strongly indicating that shields are not constructed or retained.

Pupa. Measurements (n=1). Length: 8.20 mm; width across first abdominal segment, without lateral scoli: 5.80 mm.

Body short-oval, almost rounded, tergites distinctly convex (Figs 87, 88).

Pronotum dorsally yellow to yellowish-brown on each antero-lateral side. Mesonotum yellowish-brown in the middle to dark brown on lateral sides. Metanotum yellow with two black spots in the middle close to anterior border. Abdominal tergites yellowish-brown. Abdominal tergites II–V with two black spots in the middle. Lateral scoli of abdominal segments I–V yellowish-brown with dark brown tops. Spiracles of abdominal tergites I–V black. Ventral side of body yellowish-brown with brown head, antennae and legs.

Pronotum with two short processes on each anterior border. Meso- and metanotum without lateral scoli. Abdominal segments I–V with conical lateral scoli which are gradually shortened towards posterior part of body. Abdominal segments VI and VII with a short spine-like process on each side (Fig. 90). Segments VIII and IX without lateral processes. Lateral scoli and processes without lateral branches. Lateral scoli of segments I–V covered with setae which are placed on distinct tubercles.

All tergites, prosternum and abdominal sternites covered with setae. Setae of tergites placed on distinct tubercles.

Abdomen with 7 pairs of spiracles; diameter of spiracles of each pair decrease posteriorly.

The cast skin of the last instar is retained by the pupa.

Diagnosis for first instar larvae. Until now the only described first instar larva for any Physonotini was that of *Cistudinella obducta* (Fiebrig 1910; Świętojańska and Medeiros 2007).

In general, the body structure of *Ph. alutacea* and *C. obducta* first instar larvae are very similar. In both species tergites and sternites are covered with long setae; setae on the ventral side, especially on abdominal sternites, are longer than setae of tergites; setae of tergites, head and legs are at their tips covered with small spines; lateral scoli are without lateral branches but are covered with long setae and armed apically with one long seta.

Both species possess characters of diagnostic value. *Ph. alutacea* differ from *C. obducta* in measurements: *Ph. alutacea* (length: 1.70–2.00 mm; width: 0.75–1.00 mm) is bigger than *C. obducta* (length: 0.85–1.40 mm; width: 0.50–0.57 mm). Moreover *Ph. aluacea* possesses 14 pairs of lateral scoli, *C. obducta* 16, although scoli of pair 4, 5, 7 and 9 are very short in *Cistudinella* such that the larva superficially appears to have only 12 pairs of scoli. Scoli pairs 4 and 16 of the *Physonota* larva are completely absent and are not marked by any tubercle or large seta. The lateral scoli of *Ph. alutacea* proportional to body width are shorter than in *C. obducta*. The supra-anal process of *Ph. alutacea* is covered along its entire length with long setae while in *C. obducta* only the basal half of each process is covered with long setae. The tips of the supra-anal processes of *Ph. alutacea* are acute while in *C. obducta* obtuse. Supra-anal processes of *Ph. alutacea* are distinctly stouter in ratio to lateral scoli than in *C. obducta*. Setae of body including head and legs of *Ph. alutacea* are more numerous than of *C. obducta*. In *Ph. alutacea* setae of head and legs in ratio to the size of head and legs are shorter than in *C. obducta*. Anterior border of labrum in *Ph. alutacea* is emarginated and with 16 setae while of *C. obducta* is not emarginated and with 14 setae. Mandibles of *Ph. alutacea* are with four triangular apical teeth and one small tubercle in continuous row and one small teeth distinctly moved back whereas in *C. obducta* mandibles are with three triangular apical teeth in one row and four small teeth moved back.

Discussion

Mature larvae of *Physonota alutacea* and *Asteriza flavicornis* possess features which are characteristic for primitive (generalized) tribes of Cassidinae sensu stricto. In both species the body including legs and head is covered with numerous setae (polytrichy), legs are long with a large number of setae around the claw, head with 6 distinct pairs of stemmata, and the number of lateral scoli is smaller than in species of more derived tribes (ie Cassidini and Aspidimorphini.). *Ph. alutacea* possesses 14 pairs of short conical, slightly posteriorly curved lateral scoli; *A. flavicornis* 15 pairs of straight, moderately long scoli whereas

Table 1.

species characters of mature larvae	*Cistudinella obducta* (after Świętojańska and Medeiros 2007)	*Physonota alutacea* (new data)	*Asteriza flavicornis* (new data)
length of body [mm]; from anterior border of prothorax to the base of supra-anal processes	5.00–7.40	10.50–12.00	8.00–8.30
width of body [mm]; without lateral scoli	2.40–3.10	5.60–5.80	4.80–6.00
shape of body	oval; the widest across meso- and metathorax; slightly narrowed posteriorly; slightly dorso-ventrally flattened	oval; the widest across meso- and metathorax; abdomen strongly narrowed posteriorly; meso-and metathorax distinctly convex,; abdomen slightly flattened dorso-ventrally	short-oval, almost rounded; the widest across meso- and metathorax; dorso-ventrally flattened; thorax distinctly convex, especially metathorax
number of pairs of scoli	16	14	15
scoli	long; straight; covered with numerous lateral branches and less numerous long setae	short; conical; slightly bended posteriorly; covered with numerous short setae	short; straight; covered with long setae
supra-anal processes	long; with apical half less sclerotised than basal	long; strongly sclerotised on whole length; covered with numerous short setae	short; strongly sclerotised; covered with short setae
setae of tergites	numerous; long; placed on elongated tubercles	numerous; short; placed on small tubercles	numerous; long; placed on stout tubercles
setae of sternites	numerous; mostly without tubercles; usually longer than of tergites; especially long setae are in the middle of abdominal sternite II to V	numerous; distinctly longer than of tergal setae; the most numerous setae are in the middle of abdominal sternitae but their number decrease posteriorly	numerous; as long as setae of tergites or distinctly longer; the most numerous and the longest setae are in the middle on abdominal sternite I-III
head	sclerotised; hypognathous; retracted into pronotum; median suture complete, connected with fronto-clypeal suture; setae numerous but not as in *Ph. alutacea*	sclerotised; hypognathous; retracted into pronotum; median suture complete, connected with fronto-clypeal suture; setae extremely numerous; of different length: setae of vertex shorter than setae placed along fronto-clypeal suture and close to stemmata	sclerotised; hypognathous; retracted into pronotum; median suture complete, connected with fronto-clypeal suture; setae numerous but less numerous than setae of *Ph. alutacea* and *C. obducta*
stemmata	6 pairs	6 pairs	6 pairs
dorsal side of labrum	with four long setae and four campaniform sensilla	with four long and numerous short setae	with four setae and four campaniform sensilla
anterior margin of labrum	not emarginated; with 14 setae	emarginated; with 16 setae: two dorsally, 8 in the middle and three slightly longer on each lateral side	slightly emarginated; with 16 setae
mandibulae	palmate; with three distinct triangular apical teeth in one row and four small retracted teeth; and with two setae and two campaniform sensilla dorsally	palmate; with five distinct triangular apical teeth in one row and one hardly marked and retracted teeth; and with two campaniform sensilla, two long and few (6-8) small setae dorsally	palmate; with four distinct apical teeth in one row and 5 small retracted teeth and distinct tubercle at molar part; and with two setae and two campaniform sensilla dorsally
legs	covered with numerous setae but not as numerous as in *Ph. alutacea*; distinct pulvilli at base of claw	covered with extremely numerous setae; pulvilli not observed	covered with numerous setae similar to *C. obducta*; pulvilli not observed
shield of supra-anal processes composed of	exuvia	shield absent	shield absent

Table 2.

species / characters of pupae	*Physonota alutacea* (new data)	*Physonota helianthi* (after Sanderson 1948)	*Physonota unipunctata* (after Sanderson 1948)	*Asteriza flavicornis* (new data)	*Eurypepla calochroma* (after Woodruff 1976)
length of body [mm]	10.50; or 11.00 (according to Sanderson 1948)	8.00	8.00	8.20	no information
width of body [mm]; without scoli	7.10	no information	no information	5.80	no information
shape of body	short-oval, almost rounded; tergites distinctly convex	oval	oval	short-oval, almost rounded; tergites distinctly convex	oval
anterior border of prothorax	without processes	without processes	without processes	with two short processes on each lateral side	with two short processes on each lateral side
scoli of abdominal segment I–V	distinct, conical, curved anteriorly their length gradually shortened towards posterior part of body	scoli of segment I–III very short, of segment IV, V hardly visible	distinct, their tops slightly curved posteriorly; scoli slightly shorter than in *Ph. alutacea*, *A. flavicornis* and *E. calochroma*	distinct, conical lateral scoli which are gradually shortened towards posterior part of body	distinct, conical, curved anteriorly their length gradually shortened towards posterior part of body
abdominal segments VI–VII	with a short spine-like process on each side	no information	no information	with a short spine-like process on each side	no information
abdominal segments VIII–IX	without lateral processes	no information	no information	without lateral processes	no information
surface/setae of body	setae not observed	no information	scoli of first four abdominal segments minutely tuberculate	all tergites, prosternum and abdominal sternites covered with setae; setae of tergites placed on distinct tubercles	dorsal surface is tuberculate, nearly granular on some of pronotum

derived Cassidinae tribes such as Cassidini and Aspidimorphini posses 16 pairs of long lateral scoli covered with numerous lateral branches, a smaller number of dorsal setae, 5 distinct pairs of stemmata (and usually one pair of very small, rudimentary stemmata in the shape of a pigmented spot), and claws surrounded by a small number of setae. According to Woodruff (1976) the mature larva of *Eurypepla* has 14 pairs of scoli and at first glance looks intermediate between the larvae of *Physonota* and *Asteriza*. The previously described mature larva of *Cistudinella obducta* (Świętojańska and Medeiros 2007) possesses some features characteristic for a generalized species (polytrichy of both dorsal and ventral side of body, long legs with distinct pulvilli and large numbers of setae around the claw, 6 pairs of stemmata, mandibles with 3 large apical teeth, anterior margin of labrum not medially emarginate, well developed lacinia) and some for derived (16 pairs of lateral scoli and long supra-anal processes), although 4 pairs on the anterior half of body (4, 5, 7 and 9) are distinctly shorter than neighbouring ones. These examples suggest that the mature larva in all tribes of Cassidinae close to Physonotini do not have a constant number of pairs of scoli and scoli in some species are rudimentary in shape or completely absent although in some genera various pairs of species tend toward reduction (*Physonota* and *Eurypepla* – pairs 4 and 16, *Asteriza* – 4, *Cistudinella* – 4, 5, 7 and 9). Generalized characters of all genera suggested their close relationship and in our opinion separating them into three different tribes based only on one variable character (numbers of scoli) is not justified.

The structure of the first instar larvae of *Physonota* and *Cistudinella* are very similar and generalized. In both species tergites and sternites are covered with long setae whereas in species of derived tribes the body is covered with cauliflower-shaped sensilla with long setae occurring only on the first three abdominal sternites. Lateral scoli of *Ph. alutacea* and *C. obducta* are

without lateral branches but are covered with long setae armed apically with one long seta. Lateral scoli of derived species are also without lateral branches but are covered with cauliflower-shaped sensilla armed apically with more or less elongate cauliflower-shaped or clubate sensilla. The similarity between first instars of *Physonota* and *Cistudinella* is more distinct than between mature larvae and it suggests close relationships between both taxa. Thus, suggestions in Świętojańska and Medeiros (2007), based on the study of mature larvae that both taxa should be placed in different tribes is not confirmed by our study of first instar larvae. Although the first instar larva of *Asteriza* is still unknown, the structure of the mature larva is very similar to larva of *Physonota* indicating the likely proximity of this genus to both *Physonota* and *Cistudinella*. Its close relationships to *Physonota* and *Cistudinella* is also confirmed by host plant *Cordia serrata* Roxb. (Boraginaceae) according to observations by Walcott (1927). The family Botraginaceae is principal host for most species of the tribe Physonotini, except two species of *Physonota* feeding on Asteraceae and Lamiaceae (Borowiec and Świętojańska 2008). Thus, the suggestion by Borowiec (1995) that the Asterizini, Ischyrosonychini and Physonotini should be merged into a single tribe is corroborated by our study of larvae, especially first instars. However, we do not propose a formal synonymization until the the first instar of *Asteriza* has been carefully studied.

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