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Description of the egg, larva and pupa of *Platystethus alutaceus* (THOMSON, 1861) (Coleoptera: Staphylinidae)

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ABSTRACT. The egg, larva and pupa of *Platystethus alutaceus* (THOMSON) are described for the first time, an illustrations of structural features are provided. Some differences between its larval instars are described. Diagnostic characters of the *Platystethus* egg, larva and pupa are listed. Some differences and similarities in morphological structure between the eggs, larvae and pupa of *P. alutaceus*, *P. cornutus*, *P. arenarius* and other closely related the *Oxytelinae* species are also mentioned and illustrated.

Key words: entomology, morphology, egg, larva, *Coleoptera*, *Staphylinidae*, *Platystethus alutaceus*.

INTRODUCTION

Platystethus alutaceus is distributed in Europe, Morocco, Egypt, Afghanistan and Mongolia (BURAKOWSKI at al. 1979, LUCHT 1987, HERMAN 2001). In Poland it is known from several localities, more recent data concerning Puszcza Białowieska (DERUNKOV & MELKE 2001). KOCH (1989) defined it as a stenotopic, hygrophilous and psammophilous species. *P. alutaceus* usually occurs in warm and sunny areas with tightly compact soil in river valleys. It was also found in floodwater and detritus (BURAKOWSKI at al. 1979, KOCH 1989). Like in the case of *Platystethus cornutus* (GRAVENHORST), all stages of the examined species live in soil, where larvae and adults bore galleries (STANIEC 1993 b). Their subterranean way of living manifests itself by oval entrance apertures and tiny heaps ("molehills") of the transformed soil, removed from the galleries.

The egg, larva and pupa of *P. alutaceus* have not been described previously. Besides *P. alutaceus*, the other Polish members of the genus *Platystethus* are: *P. arenarius* (FOURCROY), *P. capito* (HEER), *P. cornutus*, *P. nitens* (C. R. SAHLBERG) and *P. nodifrons* (C. R. SAHLBERG). In the case of *P. arenarius* the larva and pupa were described by HINTON (1944) and STANIEC (1993 a), respectively. PIERRE (1944) and STANIEC (1993 b) provide a description of the developmental stages of *P. cornutus*. The larval morphology of other species of the genus *Platystethus* and closely related genera was described by KASULE (1968), LEGNER & MOORE (1977), PAULIAN (1941), POTOCKAYA (1965, 1967), STANIEC (1992, 1997 a, 1997 b, 1999, 2001) and TOPP (1978).

MATERIAL AND METHODS

All preimaginal stages of *P. alutaceus* were obtained by rearing adults identified by the author. They were collected (15 specimens) in Łańcuchów (UTM-FB37) and Ciechanki Łańcuchowskie near Łęczna (central part of eastern Poland) on 15 April 1999. The adults were found on the field-paths with tightly compact, moist soil in the Wieprz River valley together with a few dozen mature individuals of *Platystethus nitens* (C. R. SAHLBERG, 1832). The adults of *P. alutaceus* were kept in Petri dishes (10 cm in diameter, 2 cm high), filled with highly compact and moist soil (about 4/5 of their height) from the collecting area and green algae (*Pleurococcus vulgaris* MENEGH.) scraped off the tree bark as food. The soil was wetted every couple of days with several drops of distilled water. The preimaginal stages were preserved in a 1:1 solution of glycerine and alcohol. For microscopic slides the punctured larvae and pupae were rinsed in distilled water and cleared in chloralphenol and finally placed in Berlese's liquid. The surface sculpture of the egg chorion was observed on slides with glycerine at 1000 x magnification. The drawings were made using camera lucida.

MATERIAL EXAMINED: 13 eggs, 9 first larval instar (L_1), 10 second larval instar (L_2), 11 last larval instars (L_3), 11 pupae and about 15 adults.

DESCRIPTION

Egg:

Length 0.62-0.71 mm ($\bar{x} = 0.65$, $SD = \pm 0.03$), width 0.34-0.45 mm ($\bar{x} = 0.40$, ± 0.04), shape oval, color lemon yellow, older eggs light yellow, chorion thin with characteristic microstructure, surface rough, micropyle absent. Eggs usually occur in regular clusters of four (exceptionally five) clinging to each other with their lateral surface (Figs 1, 2).

Mature larva (L_3):

Length: 3.58-4.63 mm ($\bar{x} = 4.15$, $SD = \pm 0.33$); body elongated, cylindrical, weakly sclerotized, head and antennae yellow-brown, mandibles brown, body dark

yellow, urogomphi light yellow, all sclerites almost colorless, with simple, light brown setae of different length (Fig. 3).

Head. Width 0.69-0.73 mm ($x = 0.70$ mm, ± 0.01), length to width ratio 1 : 1, rounded sides; surface with delicate, indistinct microsculpture, 1 black stemma (Oc) on each side (Fig. 4). Chaetotaxy: frontal dorsal setae (Fd_1 - Fd_3), frontal lateral setae (Fl_1 , Fl_2), epicranial dorsal setae (Ed_1 - Ed_4), epicranial lateral setae (El_1 - El_4), frontal campaniform sensilla (Fc) and epicranial campaniform sensillae (Ec_1 , Ec_2) on dorsal side (Fig. 4); epicranial marginal setae (Em_1 , Em_2), lateral (L_1), ventral lateral setae (Vl_1 , Vl_2), ventral setae (V_1), lateral campaniform sensillae (Lc_1 - Lc_3) and ventral campaniform sensilla (Vc) on lateral and ventral side (Figs 6, 7). Antenna (Figs 8, 9); segments I-III length ratio 2.4 : 3 : 1; segment I with 4 pores, 1.7 longer than wide; segment II with 3 setae, 1 pore and 3 various size and shape sensory appendages (Sa) latero-apically, 2.6 x longer than wide; segment III with 3 setae and 4 solenidia (So) apically, 1.9 x longer than wide. Labrum approximately trapeziform (Fig. 14), its base about 1.3-1.4 x broader than anterior margin; with 10 setae and 2 pores dorsally, a pair of long setae, 4 of short, thick and blunt setae and two pairs of pores ventro-anteriorly. Adoral surface of labrum (epipharynx) as in Fig. 16. Mandible (Figs 17, 18) relatively short and stout, with 3 apical teeth wide and obtuse, 2 pores and 2 short setae. Maxilla (Fig. 20) consists of triangular cardo (Cdo), stipes (Stp) fused with wide mala (Ma), palpifer (Pf) and 3-segmented maxillary palp (Pm). Cardo with 1 seta; stipes with 2 setae, palpifer with 1 seta; mala darkened apically, with 3 setae, 2 pores and a few cuticular processes laterally. Adoral margin of mala with several spines and ctenidium of 13 denticles divided into two groups by denticle-free edge (Fig. 21). Apical group consists of moderately long and bent denticles, the lower group is formed of short and wide denticles. Maxillary palp 3-segmented (Fig. 24), length ratio 3 : 1 : 1.5 respectively. Segment I with 1 short seta basally, 1 pore laterally and several triangular cuticular processes apically; segment II with 2 setae and 1 pore; segment III with 1 digital sensory appendage, 1 pore, 1 micro setae near apex and several sensillae apically. Hypopharynx as in Fig. 27. Labium (Fig. 28) consists of ligula (Lg) fused with prementum (Pmnt), mentum (Mnt) fused with submentum (Smt) and labial palps (Lp). Submentum with 2 long setae; mentum with 4 long setae and reticulate basal area; prementum with 2 micro setae posteriorly, 2 pores, 2 macro setae and a few triangular cuticular processes in the anterior part, ligula distinctly narrowed towards anterior margin with slightly triangular cut anteriorly (Figs 28, 29). Labial palps 2-segmented, segments I-II length ratio 2.1 : 1, each about twice as long as wide, with 1 pore.

Thorax. Leg (Fig. 32); coxa (Cx) with 10 setae; triangular trochanter (Tr) with 5 setae and a few campaniform sensillae, femur (Fm) with 8 setae and 1 pore; tibia (Tb) with 9 setae. Fore tibia with 8 spine-shaped and 1 thin and long seta; mid and hind tibia with 7 spine-shaped and 2 thin and long setae each. Trochanter, femur, tibia and tarsungulus length ratio 3.5 : 4.1 : 4.6 : 1. Tarsungulus (Tu) relatively short, slightly curved with 2 micro setae (Fig. 33). Pro-, meso-, and metanotum

with mid-longitudinal ecdysial line, micro and macro setae (discal setae, rows Da-De) and pores (campaniform sensillae C_1 - C_5); chaetotaxy of meso- and metanotum very similar (Fig. 34). Sternites with short setae (Fig. 35). Each thoracic pleurite with 1 seta (Fig. 37); each epimeres (Em) with 1 seta and a few perforate cuticular structures - Cf (placoid sensilla probably), nearly round and recessed in cuticle (Fig. 37a).

Abdomen. Abdominal segments I-VIII of almost equal width, each with tergite (Tg), sternite (Sn) and binate pleurite (Pl). Besides, segment I with binate laterosternite (Ls) situated on sides (Figs 38, 39, 41). Pleurites with 2 setae (segment I) or with 1 seta (segments II-VIII). Tergites and sternites with micro setae, macro setae and pores (tergites). Tergites and sternites II-VIII (chaetotaxy: anterior seta - A_1 , discal setae - D_1 , D_2 , posterior setae - P_1 - P_3) similar in distribution of setae (Figs 38, 39). Structure of segments IX and X different from that of other segments (Figs 42-44); their dorsal and ventral sclerites grow into uniform rings, surrounding segments. Urogomphus (Ug) 3.5-3.6 x longer than wide at the base, with 8 setae (6 macro setae, 2 micro setae) and 2 pores (Fig. 45). Urogomphus with 1 long seta apically.

The larva of *P. alutaceus* belongs to peripneustic type. Of 9 pairs of spiracles (Sp), the first occurs on forepleurites of thorax (Fig. 37), the second located on the lateral parts of the first abdominal tergite, remaining ones are on the sides of the abdominal segments II-VIII, between their tergites and pleurites (Fig. 41).

The first eight abdominal tergites, laterosternites and abdominal sternites II-VIII bear each small, round cuticular structures (Cf) posterolaterally (placoid sensilla probably) (Figs 38, 39).

Some diagnostic morphological features for the second and first larval instars of *Platystethus alutaceus* are listed below.

Second instar (L_2). Body length: 1.54-2.77 mm ($x = 2.13$, $SD = \pm 0.34$), head width: 0.48-0.52 mm ($x = 0.50$ mm, ± 0.01). Antenna (Fig. 10); segments I-III length ratio 2.8 : 2.9 : 1, segment I-III 1.4, 1.9 and 1.7 x longer than wide respectively. Urogomphus 2.7 x longer than wide at the base (Fig. 46).

First instar (L_1). Body length: 1.26-1.75 mm ($x = 1.64$, $SD = \pm 0.15$), head width: 0.34-0.36 mm ($x = 0.35$, ± 0.01). Chaetotaxy of head without epicranial dorsal setae Ed_1 , Ed_2 and epicranial campaniform sensilla Ec_1 (Fig. 5). Antenna (Fig. 11); segments I-III length ratio 1.7 : 2.5 : 1, segment I-III 0.8, 1.8 and 1.7 x longer than wide respectively. Mandible relatively short, with the exterior edge of the lower tooth serrate (Fig. 19). Chaetotaxy of pronotum without discal setae Da_2 , Db_2 , De_1 (Fig. 36); metanotum with 2 tiny, triangular egg-bursters (Eb). Abdominal sternite II without discal setae D_2 (Fig. 40). Urogomphus suddenly narrowed in the apical part, 2.4 x longer than wide at the base (Fig. 47).

Pupa:

Body length: 2.88-3.53 mm (3.24 mm, ± 0.17), head width: 0.62-0.91 mm (0.73 mm, ± 0.07), pronotum width: 0.70-0.90 mm (0.81 mm, ± 0.06). Pupa of

exarata type, body relatively stocky, moderately elongate, lightly sclerotized, colour dark yellow (Figs 48, 49). Head directed downwards with 2 preocular setae (Po), two pairs of frontal setae (F_1 , F_2) and a pair of epicranial setae (E). Labrum trapeziform with deep triangular incision on its anterior margin. Pronotum clypeate, posterior angles not marked, side margins distinctly rounded, usually with 18 setae (anterior setae A_1 - A_4 , posterior setae P_1 - P_5). Meso- and metanotum each with 2 micro and 2 macro setae. Both elytra and wings clearly separate, hind margin of shortened elytra well visible. Wings distinctly protrude beyond anterior margin of abdominal sternite II. Tibiae and tarsi (except fore tarsi) directed obliquely to the middle of the body. Hind tarsi at least distinctly protrude beyond posterior margin of abdominal sternite II. Abdomen with 9 tergites and 8 visible sternites. Abdomen gradually widened to segment V, and then narrowed below these segments to the terminal parts of the body. Last segments extended laterally into two, relatively short abdominal projections. Chaetotaxy of abdomen (Figs 48, 49): ventral side - segments II-VI each with 8 ventral setae ($2Vs_1$ - Vs_4) and 2 latero-ventral setae ($2Lv$).; dorsal side - segment I usually with 6 dorsal setae ($2Ds_1$ - Ds_3), exceptionally 5, segments II-VII each usually with 8 dorsal setae ($2Ds_1$ - Ds_4) and 2 latero-dorsal setae ($2Ld$). Spiracles (Figs 50-52): 3 pairs functional (Fs) on abdominal segment I-III and 5 pairs atrophied (As) on abdominal segments IV-VIII. Atrophied spiracles on segment IV differ in structure from atrophied spiracles on segments V-VIII (Figs 51, 52). Sexual dimorphism well-marked; male pupa with two blunt processes (Pr) in clypeal area, which in adult develop into a pair of long tapered horns (Figs 53, 56); gonotheca in female double, in male single (Figs 54, 55).

Adult: habitus and genitalia as in Figs 56-59.

CONCLUSION

With respect to sizes, number of eggs deposited in each egg-chamber and chorion microstructure the eggs of *P. alutaceus* are very similar to those of *P. cornutus*, *Aploderus caelatus* (GRAV.) and *A. caesus* (ER.) (STANIEC 1993 b, 1997 b, 1999). The combination of characters that distinguish the larva of *Platysthetus* MANNERHEIM from known larvae of the other related genera of *Oxytelinae* (HERMAN 1970, KASULE 1968, KROGERUS 1925, MOORE 1964, PAULIAN 1941, POTOTSKAYA 1967, STANIEC 1992, 1993 b, 1997 a, 1997 b, 1999, 2001, TOPP 1978) is as follows: (1) one stemma each side of head; (2) antenna with segment II about twice as long as wide; (3) mandible stout, with 3 apical teeth, without cuticular processes dorso-basally; (4) mala at least partly fused with stipes, without bunch of hairs apically; (5) maxillary palp with segment II distinctly shorter (usually about 3 x) than segment I and distinctly shorter (1.5-1.7 x) than segment III; (6) prementum and ligula fused, prementum slightly longer than ligula; (7) mentum and submentum fused; (8) urogomphi straight, relatively short, 2-3.6 times as long as wide at the base, narrowed before apex, at most as long as terminal segment (pygopod); (9)

tarsungulus relatively short, with 1 or 2 micro setae; (10) body with relatively short setae, lightly sclerotized, all sclerites and urogomphi light coloured; (11) larvae feebly active and moving relatively slowly. In the light of the present study, the opinion that in mature larva of *Platystethus* the tarsungulus bears 1 micro seta (POTOTSKAYA 1967) and the urogomphi are 2-3 x as long as wide (TOPP 1978) should be modified. Actually there are 2 or 1 seta (2 setae in *P. alutaceus*) on each tarsungulus and urogomphi 2-3.6 x as long as wide (3.6 in *P. alutaceus*).

Some differences in morphological structure between the mature larva *Platystethus alutaceus*, *P. cornutus* and *P. arenarius* are illustrated (Figs 9, 12-15, 21-26, 29-31). They involve the following features: (1) length ratio of segments I-III of antenna - 2.4 : 3 : 1 in *P. alutaceus*, 1.6 : 2.3 : 1 in *P. arenarius*, 2.1 : 2.4 : 1 in *P. cornutus* respectively (Figs 9, 12, 13); (2) shape of labrum (Figs 14, 15); (3) detailed structure of adoral margin of mala (Figs 21-23); (4) detailed structure and length ratio of segments I-III of maxillary palp - 3 : 1 : 1.5 in *P. alutaceus*, 3.4 : 1 : 1.8 in *P. cornutus*, 3.1 : 1 : 1.9 in *P. arenarius* respectively (Figs 24-26); (5) detailed structure of ligula and prementum (Figs 29-31).

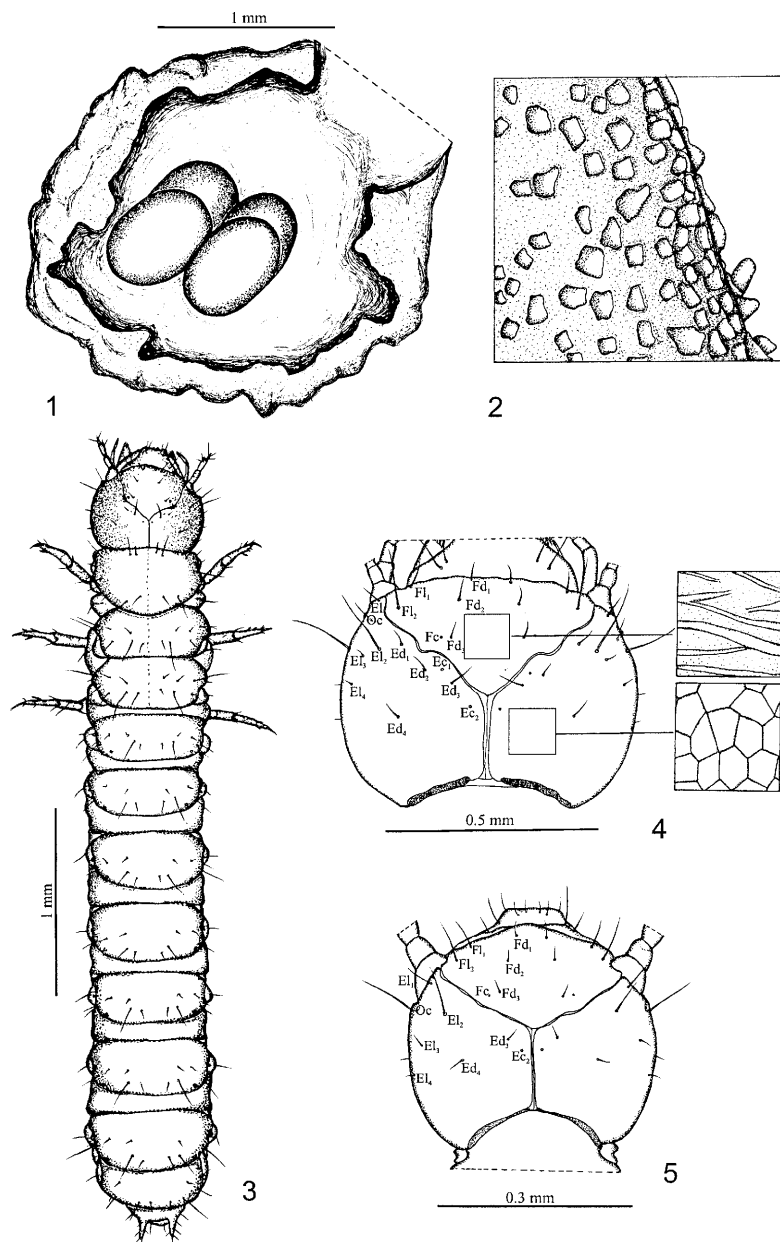
Differences in the morphology between particular larval instars (L_1 - L_3) of *P. alutaceus* are illustrated (Figs 4, 5, 9-11, 18, 19, 34, 36, 39, 40, 45-47). They involve the following characters: (1) chaetotaxy of head (Figs 4, 5); (2) structure and length ratio of antennal segments I-III (Figs 9-11); (3) detailed structure of mandible (Figs 18, 19); (4) chaetotaxy of pronotum and the presence a pair of egg-bursters on metanotum in L_1 (Figs 34, 36); (5) chaetotaxy of abdominal sternites (Figs 39, 40); (6) structure of urogomphus (Figs 45-47).

The combination of characters that distinguish the pupa of *Platystethus* from pupae of the other related genera of *Oxytelinae* (STANIEC 1993 a, 1993 b, 1997 b, 2001) is as follows: (1) head, pro-, meso-, metanotum and abdominal tergites and sternites (except sternite I and terminal sternite and tergite) with straight and relatively short setae; (2) all setae on head, pronotum (except a pair of long anterior setae in *Platystethus arenarius*) and on abdominal segments several times shorter than width of the listed parts of body; (3) three pairs of functional spiracles present; (4) posterior angles of pronotum not marked, body relatively stocky; (5) male pupa often with two blunt processes in clypeal area.

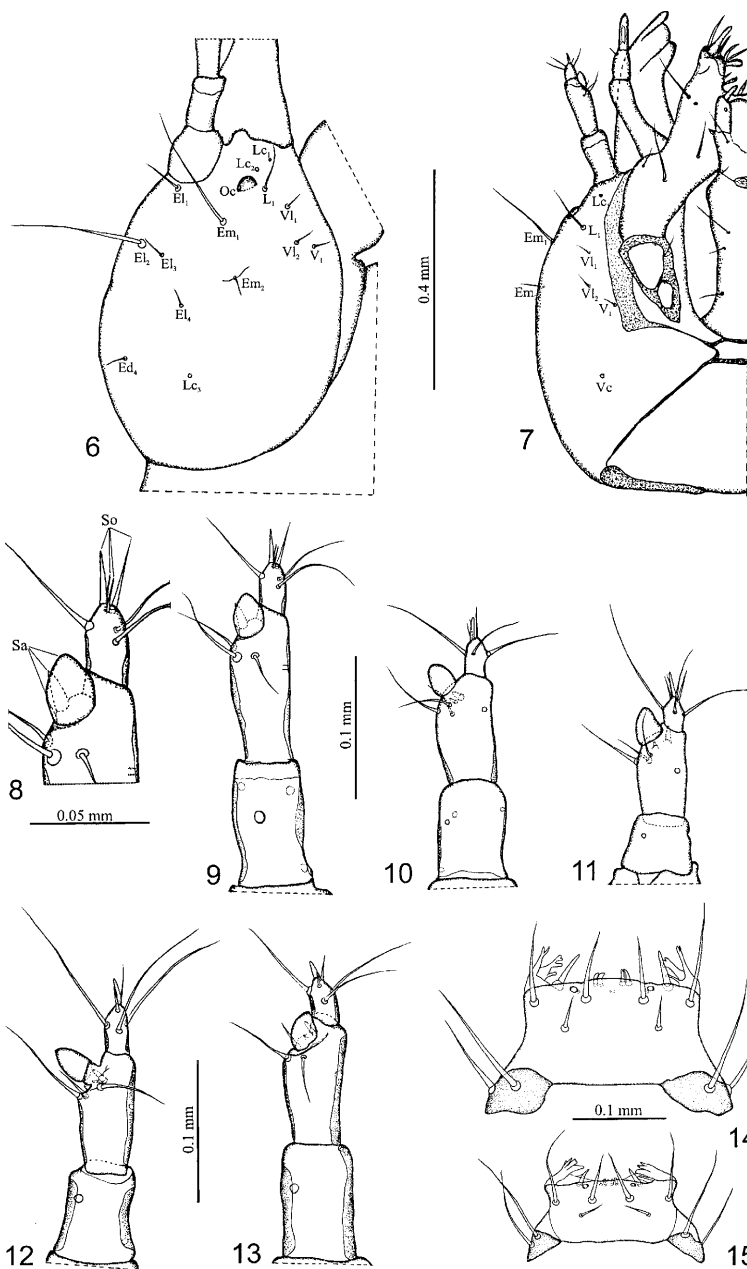
The morphology of the pupa of *P. alutaceus* is very similar (chaetotaxy, measurements, general view) to the earlier described pupa of *P. cornutus* (STANIEC 1993 b). Some differences between the pupae of the listed species may concern detailed structure of spiracles. However, that feature in the case of pupa of *P. cornutus* has not been illustrated or described. On the other hand, differences in the structure of pupae between the above-named species and *P. arenarius* (STANIEC 1993 a) are more distinct. The presence of a pair of long and thick setae on the anterior part of pronotum and two well visible mid-longitudinal strips of micro-structure on ventral side of abdomen, pro-, meso- and partly metanotum appear to be the diagnostic characters of pupa of *P. arenarius*.

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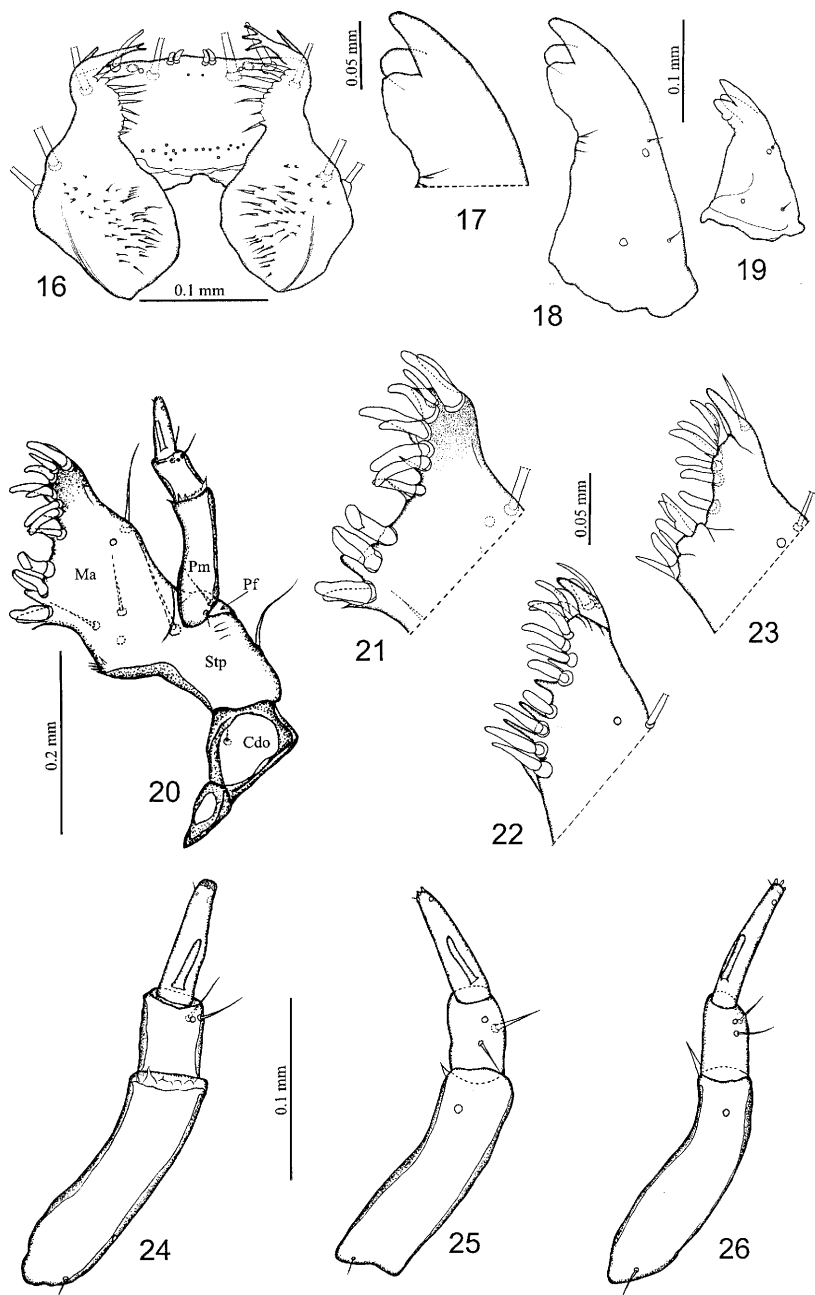
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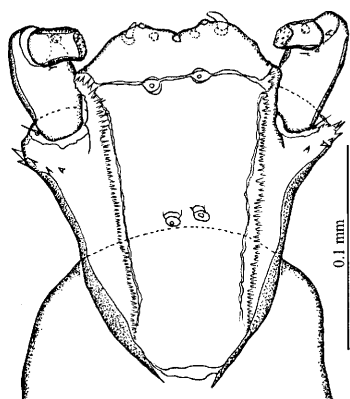
1-5. *Platystethus alutaceus*: 1.- egg chamber with cluster of four eggs; 2. microstructure of egg; 3 - mature larva (L_3), general view; 4 - head of L_3 with microstructure, dorsal view; 5 - head of L_1 , dorsal view



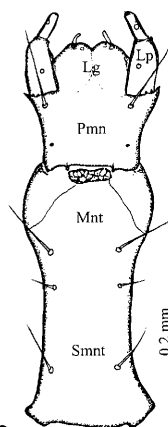
6-11. *Platystethus alutaceus*, larva: 6 - head of L₃, lateral view; 7 - head of L₃, ventral view; 8 - L₃, apex of right antenna; 9 - right antenna of L₃; 10 - right antenna of L₂; 11 - right antenna of L₁, dorsal view; 12 - *P. arenarius*, right antenna, dorsal view of L₃; 13 - *P. cornutus*, right antenna of L₃, dorsal view; 14 - *P. alutaceus*, labrum of L₃; 15 - *P. arenarius*, labrum of L₃, dorsal view



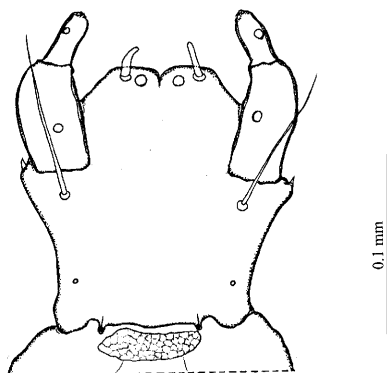
16-21. *Platystethus alutaceus*, L₃ (except of 19): 16 - epipharynx; 17 - apex of right mandible; 18 - right mandible; 19 - right mandible of L₁, dorsal view; 20 - right maxilla; 21 - apex of right maxilla; 22 - *P. arenarius*, L₃, apex of right maxilla; 23 - *P. cornutus*, L₃, apex of right maxilla, dorsal view. 24-26. Right maxillary palp of L₃, dorsal view: 24 - *P. alutaceus*; 25 - *P. cornutus*; 26 - *P. arenarius*



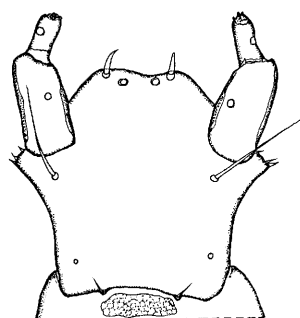
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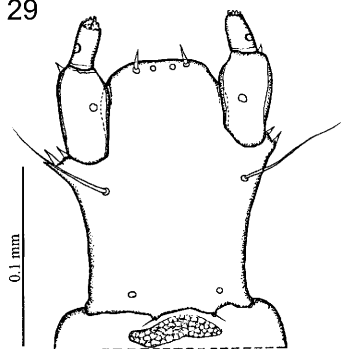
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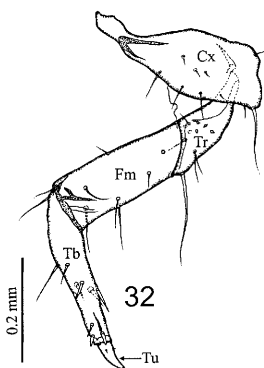
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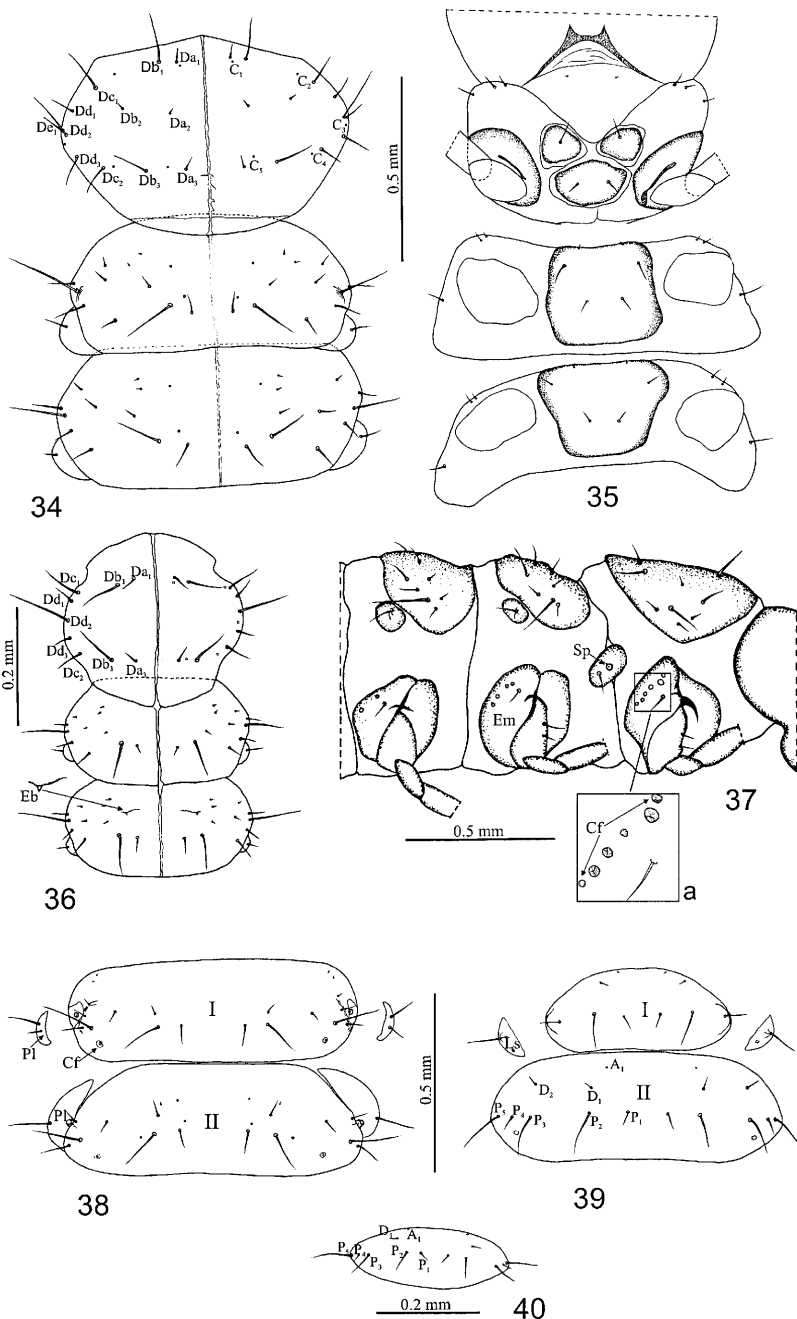


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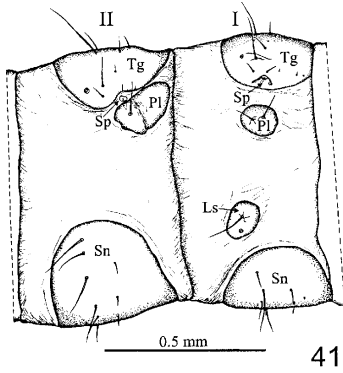


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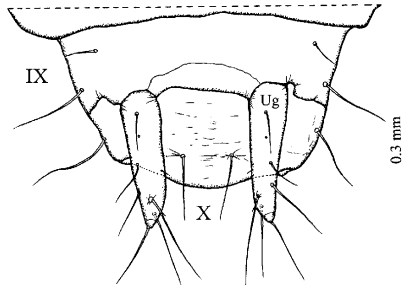
27-29. *Platystethus alutaceus*, L3: 27 - hypopharynx, dorsal view; 28 - labium, ventral view; 29 - ligula and prementum; 30 - *P. cornutus*, L₃, ligula and prementum; 31 - *P. arenarius*, L₃, ligula and prementum, ventral view. 32, 33. *P. alutaceus*, right foreleg of L₃: 32 - total aspect; 33 - apical part of tibia with tarsungulus, anterior view



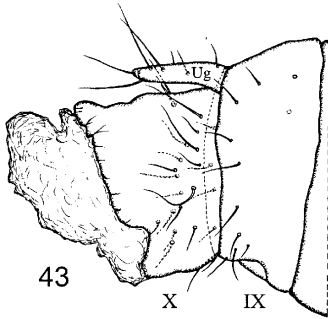
34-40. *Platystethus alutaceus*, L₃ (except of 36, 40): 34 - thorax, dorsal view; 35 - thorax, ventral view; 36 - thorax of L₁, dorsal view; 37 - thorax, lateral view; 38 - abdominal segments I and II, dorsal view; 39 - abdominal segments I and II, ventral view; 40 - abdominal sternite II of L₁



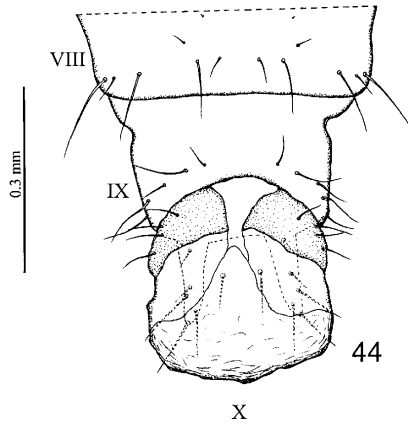
41



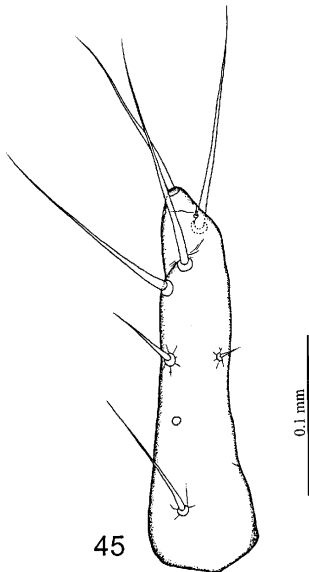
42



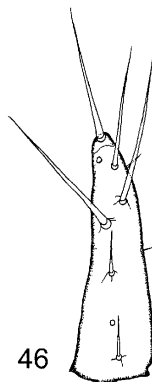
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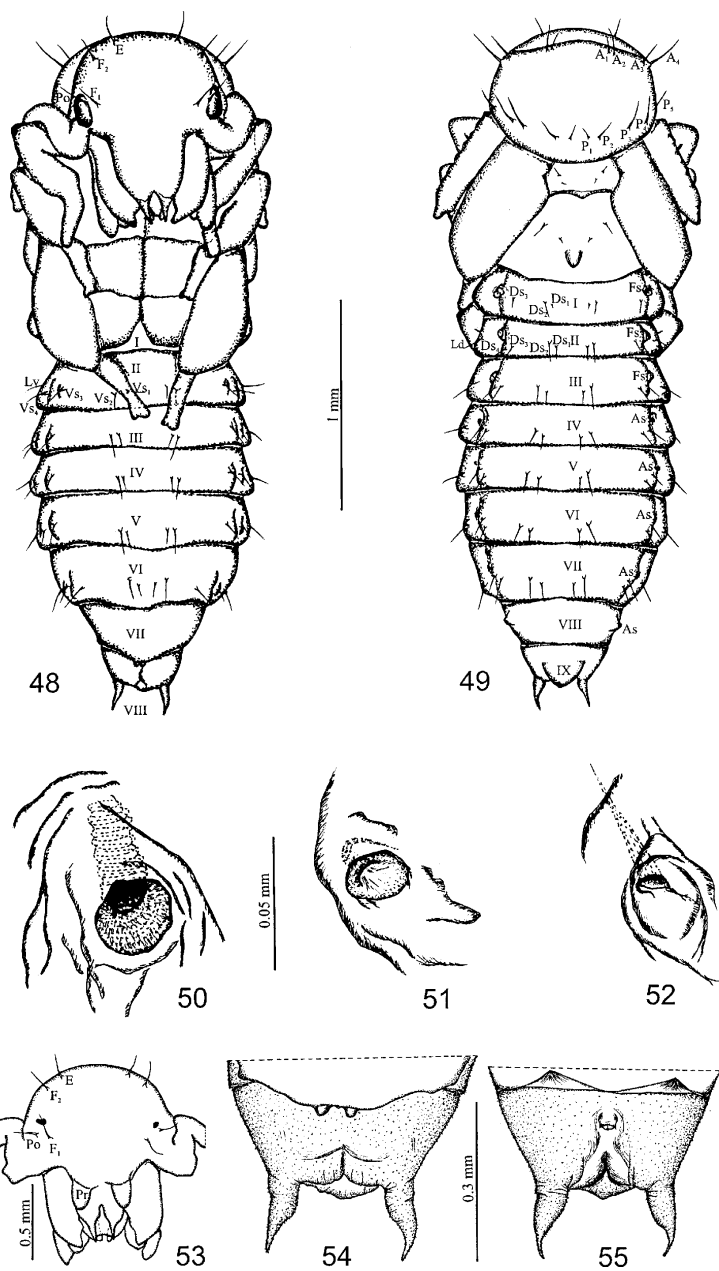


46

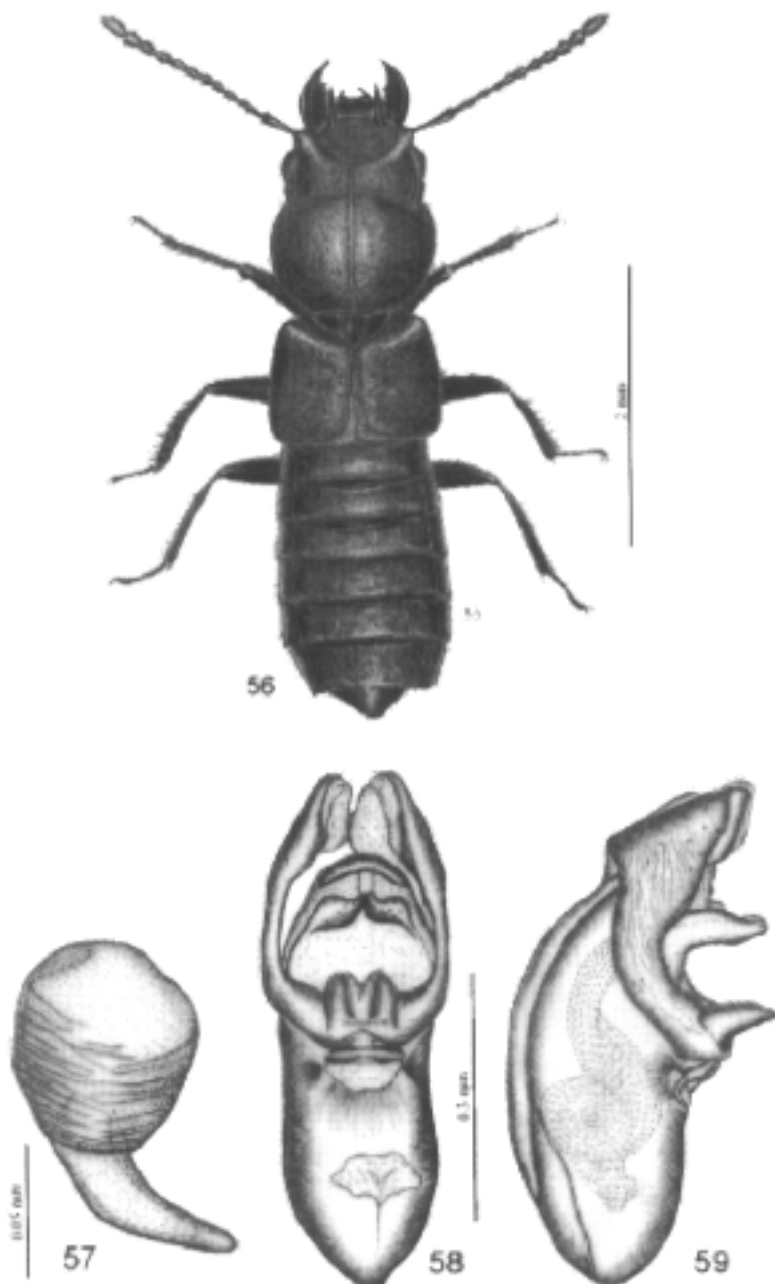


47

41-47. *Platystethus alutaceus*, L_3 (except of 46, 47): 41 - abdominal segments I and II, lateral view; 42 - abdominal segments IX and X, dorsal view; 43 - abdominal segments IX and X, lateral view; 44 - abdominal segments VIII-X, ventral view; 45-47 - right urogomphus in L_3 (45), L_2 (46) and L_1 (47), dorsal view



48-55. *Platystethus alutaceus*, pupa: 48 - ventral view; 49 - dorsal view; 50 - functional spiracles (first pair); 51 - atrophied spiracles (fourth pair); 52 - atrophied spiracles (fifth pair); 53 - head of male pupa, ventral view; 54 - terminal segment of female; 55 - terminal segment of male, ventral view



56-59. *Platystethus alutaceus*, adult: 56 - habitus of male; 57 - spermatheca; 58 - penis, ventral view; 59 - penis, lateral view