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Description of the larva and pupa of *Tapeinotus sellatus* (Fabricius), with comments on its biology (Coleoptera: Curculionidae)

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Abstract. Mature larva and pupa of *Tapeinotus sellatus* (Fabr.) are described. It presents the diagnostic characters of immature stages, and includes information about life-cycle and ecology of mentioned species. *T. sellatus* is an oligophagous, eurytopic, univoltine species with summer developmental stages and wintering imagines. The chaetotaxy of its pupa shows some features unseen in other known pupae of weevils.

Key words: entomology, morphology, *Coleoptera*, *Curculionidae*, *Tapeinotus sellatus*, larva, pupa, life-cycle.

INTRODUCTION

Genus *Tapeinotus* Schoenherr, 1825 is represented by one species only, *Tapeinotus sellatus* (Fabr.), that has been recorded from almost the whole Palearctic (Alonso-Zarazaga 2008). Except for a few countries it is known from almost the whole Europe. Also in Poland its occurrence is recorded from majority of the region (included some mountain areas) (Burakowski et al. 1997; Wanat & Mokrzycki 2005). *T. sellatus* is distinguishable by e.g.: tiny, medium sized (2.9-4.2 mm), yellowish color of the body with black transversal strip on elytra (Smreczyński 1974). Mentioned weevil belongs to hygrophilous species found in lake banks, ponds, old river-beds, wet meadows and undergrowth of melting floodplain forests or alder forests. According to Koch (1992) *T. sellatus* belongs to stenotopic species, that may be debatable (Gosik 2006). Yellow loosestrife (*Lysimachia vulgaris* L.) and tufted loosestrife (*L. thyrsiflora* L.) are given as host plants for *T. sellatus* (Burakowski et al. 1997). The biology of the mentioned

weevil is relatively well described. The adults of *T. sellatus* were collected from April to August. The oviposition takes place from the beginning of May to the middle of June. The eggs are laid separately inside basal parts of stems. The larvae feed inside the stem and the root, where also the metamorphosis takes place. New generation of adults appears in the second part of August. The overwintering takes place in the plant remains and detritus (Burakowski et al. 1997).

The fragmentary description of larval stage and pupa of *T. sellatus* is given by Scherf (1964). New, detailed description of developmental stages of this species seems to be necessary because the information provided by Scherf (1964) evidence that morphology of immature stages of *T. sellatus* is different in comparison with other known weevils species. This information may be important not only in the context of mentioned species but also in the aspect of bionomics of whole family *Curculionidae* as well.

MATERIAL AND METHODS

The examined material contained: 64 exemplars of different larval stages (included 27 specimens of L_3), pupae – 14 specimens.

The examined material was collected in: Dubienka ad Dorohusk (UTM nets: GB05), Orchówek ad Włodawa (FC81), Ciechanki (FB38), Zemborzyce (FB08) and Nasutów (FB09) near Lublin (CE Poland) on May 15th, June 7th, 9th, 20th, 27th, July 11th, 21st, 25th, August 11th, 18th, 25th, September 20th 2008. The observation of life-cycle of the mentioned species were conducted in vegetative seasons 2001 – 2008.

The specimens were collected on stems and roots of yellow loosestrife (*Lysimachia vulgaris* L.) growing on wet meadow. In order to correctly determine the immature stages of *T. sellatus*, some larvae were kept alive in laboratory conditions until pupation, and then until the emergence of adults. The preimaginal stages were preserved in a liquid of 75% alcohol. The punctured larvae and pupae were rinsed in distilled water and cleared in 10% liquid of potassium hydroxide (KOH) and finally placed in 10% glycerin to prepare microscopic slides. The drawings were made using camera lucida. The terminology given by Scherf (1964) and May (1977, 1994) was used in the morphological description of the larva and the pupa.

RESULTS

1. Morphological description

Larva (Figs 2 -16)

Body length: 2.25 – 8.55 mm; head width: 0.34 - 1.0 mm.

L_3: body length: 5.80 - 8.55 mm (mean 7.40 mm); head width: 0.80 – 1.0 mm (mean 0.90 mm).

Body moderately slender, C - shape curved, gray-yellow, head red-brown, pronotum grayish, setae short, light brown. Cuticle on the thoracic and abdominal segments minutely spiculate. Chaetotaxy of the body is strongly reduced (Figs 1–3). Long setae occur only on dorsal parts of prothorax, other segments with micro setae (visibly only

by great magnification – 200x). Prothorax (on each side) with 4 long setae (prns) on anterior margin, 2 short setae dorsopleurally (dpls) and next two short setae ventropleurally (vpls). Mesothorax (on each side) with two micro setae postdorsally (pds), one micro seta dorsolaterally (dls), next micro seta on alar area (as) and one micro seta dorsopleurally (dpls). Chaetotaxy of metathorax similar to chaetotaxy on mesothorax. Each pedal area of thoracic segments with 6 macro setae. Each thoracic segment with two micro setae placed ventrally between pedal lobes. Abdominal segments I-VII (on each side) with 4 micro setae postdorsally (pds), two spiracular setae (ss), one micro seta dorsopleurally (dpls), one micro seta ventropleurally (vpls) and one micro seta laterosternally (lsts). Abdominal segment VIII (on each side) posses three micro setae on postdorsal area dorsally, one micro seta ventropleurally (vpls) and next one micro seta laterosternally (lsts). Segment IX (on each side) with 6 very small micro setae (2 ls, 2 ds and 2 sts). Abdominal segment X reduced to four anal lobes about unequal size. Each anal lobes with group of three micro setae (Figs 1-3). Spiracles bicameral (Figs 4-6), located, except those of abdominal segment VIII – localized more dorsally.

Head subglobose, slightly oblate laterally, frontal suture distinct, Y- shaped, extended to antennae (Figs 7, 8). Macro setae of head: 10 dorsal epicranial setae (2 des_1, 2 des_2, 2 des_3, 2 des_4, 2 des_5). Des_1, placed near of suture coronalis, des_2 and des_3 located in vicinity of suture frontalis, des_2 twice shorter than other epicranial setae. Des_4 and des_5 localized in central part of epicranium. Frontal setae (fs_1 and fs_2) placed near of frontal suture short, sharp, distinctly shorter then fs_3 that localized on epistoma. Lateral epicranial setae (les_1 and les_2) twice shorter than les_3. Epicranial area with group of 9 pores on each side. Four pores placed on upper margin of epicranium, two pores in vicinity of des_4, next one between des_1 and des_2. Two pores laterally on each side of head. Single ocellus (oc) placed on each side latero-posteriorly. Antenna (Fig. 9) placed in the end of suture frontalis, stock, rounded, conical, not exceed outline of head; basal membranous area with 1 setal sensille and 3 pores. Clypeus (cl) and labrum (lrm) (Fig 10) trapeze form: clypeus 2.8 x as wide as long with 2 long setae and 4 setal sensillae; labrum about 3.0 x as wide as long with 4 long labral setae (lrms) placed laterally. All labral setae equal in length. Anterior margin of labrum straight. Epipharynx (Fig. 11) with: a pair of short, curved median setae (mes), 2 pairs of short, sharp, thorn-like anteromedian setae (ams); 6 antero-lateral setae (als), als_1 long, finger-like, next pairs diminish gradually. Tormae (t) distinctly, broad, slightly convergent in the anterior parts. Mandible (Fig. 12) broad, bifid, with 3 setal sensillae on the dorsal area; teeth unequal height, truncate. Maxilla (Fig. 13) consists of triangle cardo (cd), stipes (st), mala (ma) and maxillary palp (mp). Stipes and mala fused, stipes with 3 setae dorsally and 2 pores. Mala with 6 almost equal in length, straight, finger-like setae dorso-apically (dms) and 4 setae ventro-apically (vms); vms distinctly smaller than dms. Maxillary palp 2-segmented; segment I longer and wider than segment II, length ratio of segment I and II: 1 : 1.2 respectively. Segment II with two pores and 4 conical cuticular processes apically; segment I with 2 pores medially and one micro setae. Praelabium (plb) (Fig. 14) rounded, with one pair of long, sharp setae postero-medially, two pairs of short, blunt truncate micro setae antero-medial and one pair of pores, labial palp (lpa) two-segmented, localized antero-laterally. Both segments of labial palp almost

equal in length, segment I distinctly wider than segment II, segment II with two pores and 4 conical cuticular processes apically; segment I with 1 pore. Postlabium (pslb) (Fig. 15) with a pair of macro setae localized postero-laterally.

Pupa (Figs 16-20)

Body length: 3.80-5.6 mm (mean 4.75 mm), width in widest place (between knees of first pair) 2.15-3.20 mm (mean 2.45 mm). Body relatively elongated, grayish-white or light yellow; setae short, yellow, placed on visibly protuberance. Head with 2 vertical setae (vs), 2 orbital setae (os), 2 super orbital setae (sos) and 4 post antennal setae (pas). The median pair (pas_1) distinctly shorter than pas_2. Rostrum rather long, about 3x as long as wide, exceed apexes of coxae of second pair, with 2 rostral setae (rs) placed below of the basis of antennae. Antennae of relatively medium length.

Table 1. Setal index of larval of *Tapeinotus sellatus* (Fabr.) given by Scherf (1964) (A), present work (B), together with modal numbers of *Curculionidae* (C) given by May (1977), (1 – macro setae; *1* – microsetae; v – variable; nd. - no data).

	A	B	C		A	B	C
Prothorax				Abdomen IX:			
pronotal	nd	4	v	dorsal	nd	*2*	v
dorsopleural	nd	*2*	1-3	pleural	nd	*2*	2
ventropleural	nd	*2*	2	sternal	nd	*2*	2
mediosternal	nd	*1*	1	Abdomen X:			
pedal area	nd	*6*	v	anal area	nd	*3*	1-3
Meso- Metathorax				Head			
prodorsal	nd	0	1	dorsal	nd	5	5
postdorsal	nd	*2*	4	posterior	nd	*0*	*4*
dorsolateral	nd	*1*	1-2	lateral	nd	2	2
alar area	nd	*1*	1-3	ventral	nd	0	2
dorsopleural	nd	*1*	1	frontal	nd	3	5
ventropleural	nd	0	1	clypeal	nd		2
mediosternal	nd	*1*	1	labral	4	2	3
pedal area	nd	*6*	v	madibular	nd	*3*	2
Abdomen I-VIII				Epipherygeal lining			
prodorsal I-VII	nd	0	1	anteriolateral	3	3	3
VIII	nd	0	0-1	anteriomedial	3	2	2
postdorsal I-VII	nd	*4*	5	medial	nd	1	3
VIII	nd	*3*	v	Maxilla			
spiracular I-VII	nd	*2*	2	lacinia (dorsal)	7-8	6	v
VIII	nd	0	1	lacinia (ventral)		4	v
dorsopleural I-VII	nd	*1*	2	palpal	nd	*1*	*1*
VIII	nd	0	2	stipital	4	1	1
ventropleural I-VII	nd	*1*	2	palpiferal		2	2
VIII	nd	*1*	2	Labium			
laterosternal	nd	*1*	1	postlabial	3	1	3
mediosternal I-VII	nd	*1*	2	prelabial	2		1
VIII	nd	0	2	ligular	1	0	2

Pronotum 1.32 x as wide as long, at the base with 4 apical setae (as_1, as_2), 2 lateral setae (ls), 4 discal setae (ds_1, ds_2) and 4 posterolateral setae (pls_1, pls_2). The marginal pair of posterolateral setae (pls_2) distinctly shorter than median pair (pls_1). Metanotum 1.5 x longer than mesonotum, meso- and metanotum without setae. Each femora with thin, long, seta placed apically; femora of 3rd pair additionally with one micro seta. Abdominal segments I – IV gradually widened and then gradually narrowed to the end of body. Segments VI shorter than posterior ones. Segment VII almost semicircular. Pseudocerci (pc) on IX abdominal segment finger-like, straight, short. Spiracles on abdominal segments I-V well visible, placed dorsolaterally, functional; sixth pair of spiracles atrophied, located dorsally. All abdominal segments without setae. Sexual dimorphism in structure of VII and IX sternites well-marked. The gonotheca in female visibly divided, in male single (Figs 19, 20).

2. Remarks on the ecology and biology

T. sellatus generates numerous populations in adequate biotopes. The different developmental stages were observed on up to 70% to 95% of specimens of yellow loosestrife growing on the investigated sites. According to my observations, and contrary to the information given by Scherf (1964), the inhabited plants didn't exhibit the decrease of vitality. Because of relatively long period of oviposition (from the beginning of May to the end of June) different larval stages were observed concurrently in field conditions. The eggs were placed separately inside the stem, usually ca. 10 cm over the ground (rarely up to 30 cm). Probably one female laid only one egg in the same plant, because in 95% of cases I found only one specimen (larva or pupa) on the same plant specimen. Occasionally two larvae in different level of development were observed in a single plant. The younger larvae was found always in the stem. Most probably its presence was caused by the later oviposition of other female. Because I never found two pupae in the same plant, I supposed that younger larvae died because of the competition. Metamorphosis took place in the lower part of stem or in root. In

Table 2. Setal index of pupa of of *Tapeinotus sellatus* (Fabr.) (1 – macro setae; *1* – micro-setae).

Head		Mesothorax	0
vertical seta	1	Metathorax	0
super orbital setae	1	Abdomen I-VI	
orbital setae	1	dorsal	0
post antennal setae	2	ventral	0
Rostrum		Abdomenvii	0
rostral setae	1	Abdomen Ix	
Prothorax		dorsal	0
apical setae	2	pleural	0
lateral setae	1	ventral	0
discal setae	2	terminal	0
posterolateral setae	2	Legs-femoral	1

laboratory conditions the pupation lasted 5 days, then young adults left pupation places. Only three exemplar of larvae were infected by a parasitoid (indeterminate specimen of *Hymenoptera*).

CONCLUSIONS

The diagnostic characters of the mature larva of *Tapeinotus sellatus* are the following: (1) setae on the dorsal part of pronotum 5-6 x longer than other thoracical or abdominal setae; (2) des_2 distinctly shorter than other des; (3) fs_1 and fs_2 distinctly shorter than fs_3; (4) antenna short, basally membraneous with three pores and one sensiliar setae; (5) epipharynx with one pair of ams; (6) each mandible with three sensiliar setae; (6) maxilla with 6 dms and 4 vms; (8) labial palps two segmented, located apically; (9) pslb with 1 pair setae.

The diagnostic characters of the pupa of *Tapeinotus sellatus* are the following: (1) head with 5 pairs of setae; (2) pas_1 distinctly shorter than pas_2; (3) rostrum with one pair of setae; (4) prothorax with 7 pairs of setae; (5) pls_2 distinctly shorter than pls_1; (6) meso- and metathorax without setae; (6) all abdominal setae without setae; (8) spiracles of 6th abdominal seg. placed more dorsally than those on other segments; (9) pseudocerci short; (10) each femora with one setae, femora of 3rd pair with one micro seta additionally.

The chaetotaxy of developmental stages of *Tapeinotus sellatus* is highly different from setal index proposed by May (1977) as typical for *Curculionidae*. The description given by Scherf (1964) and presented work points presence of some features different from other described larvae and pupae of weevils. e.g.:

1. general reduction of number of setae (most segments of pupa without of setae);
2. in larval stages, well visible long setae occur only on head and pronotum;
3. reduction of number of micro setae.

Similar reduced chaetotaxy is observed also in developmental stages of some other hygrophilous weevils whose larvae develop inside of plants.

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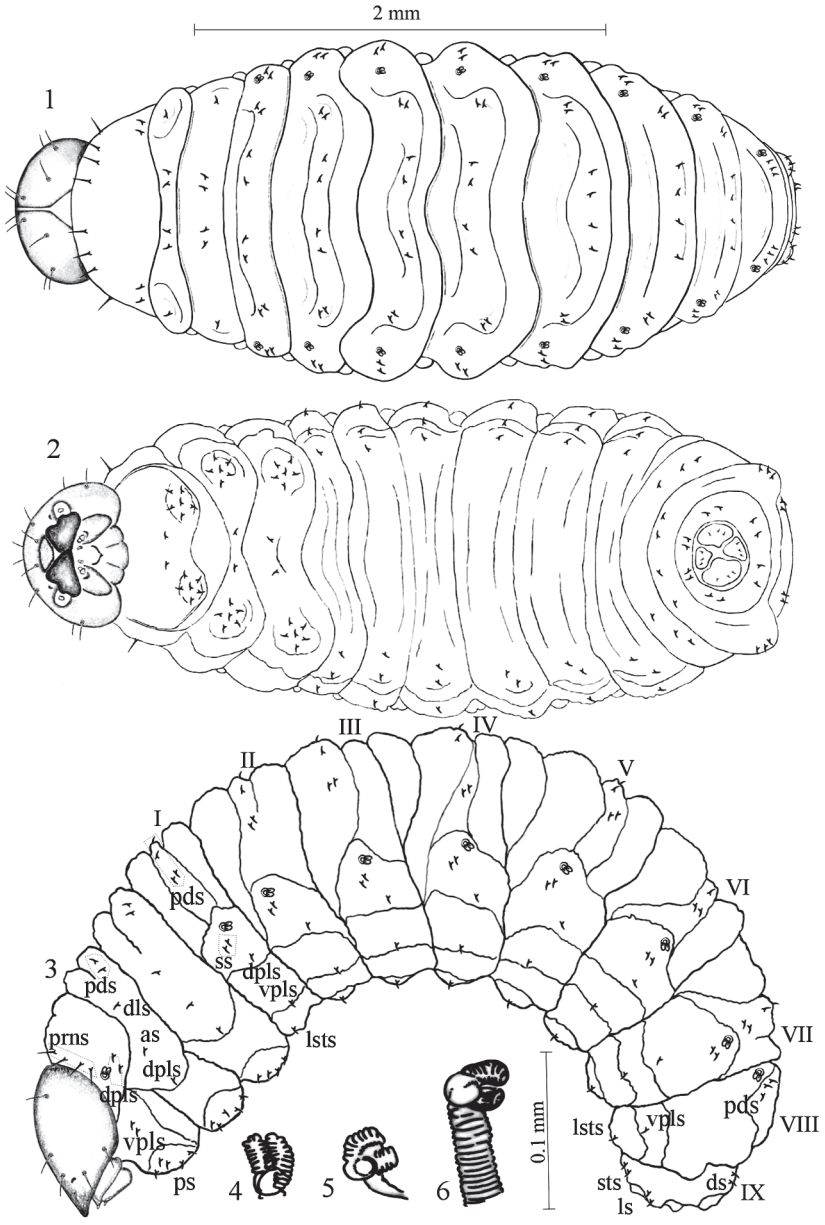
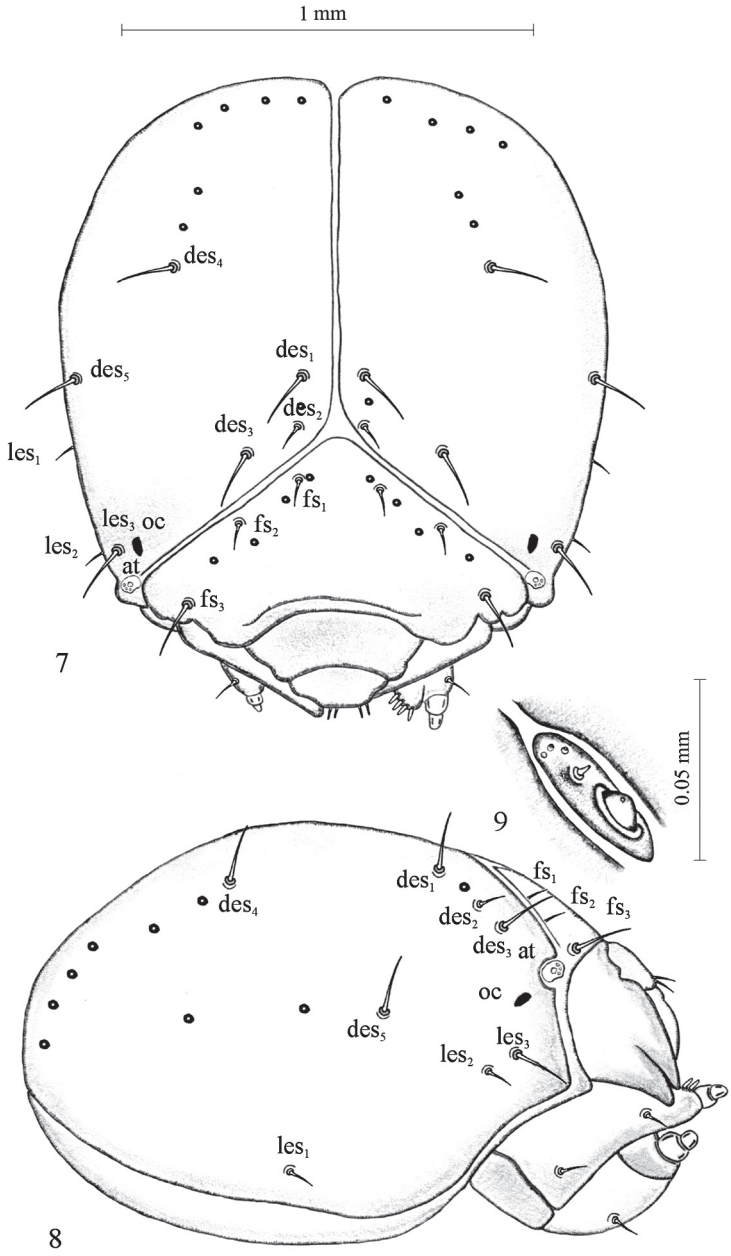
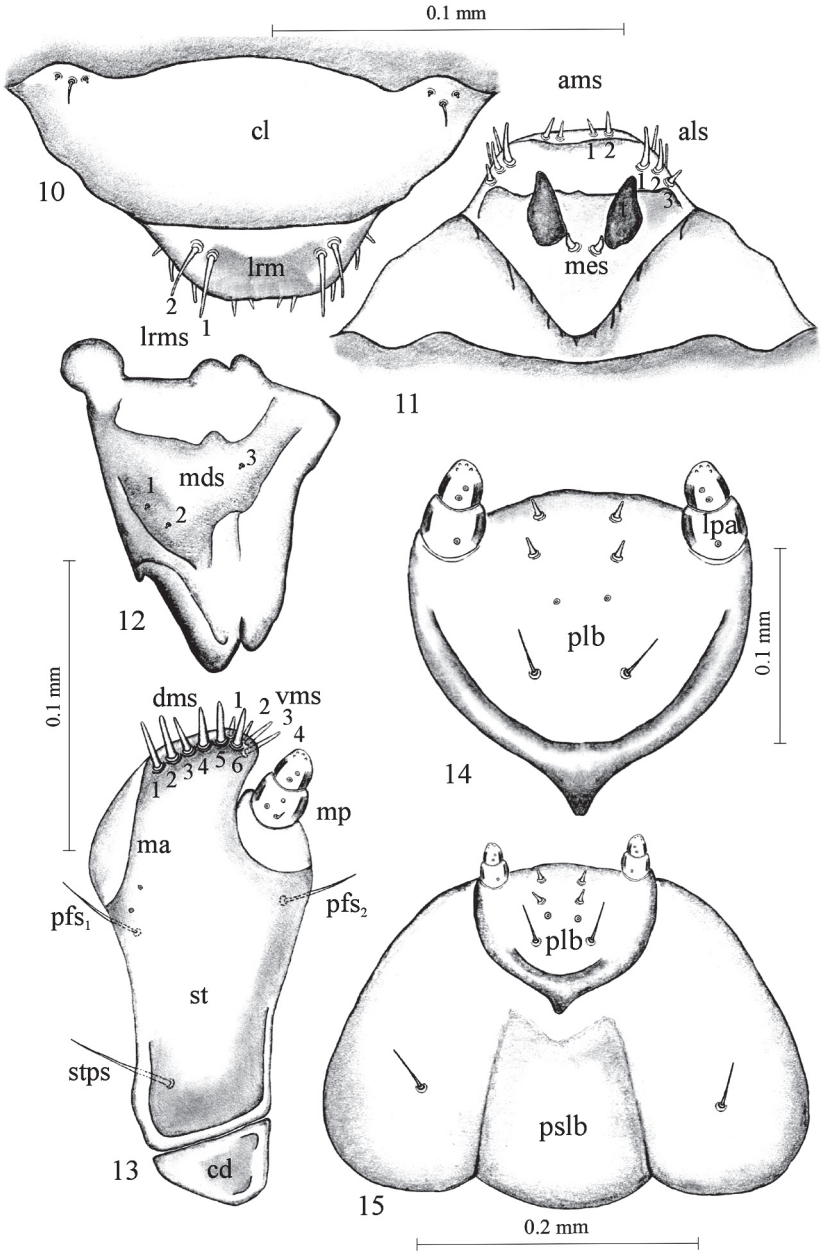


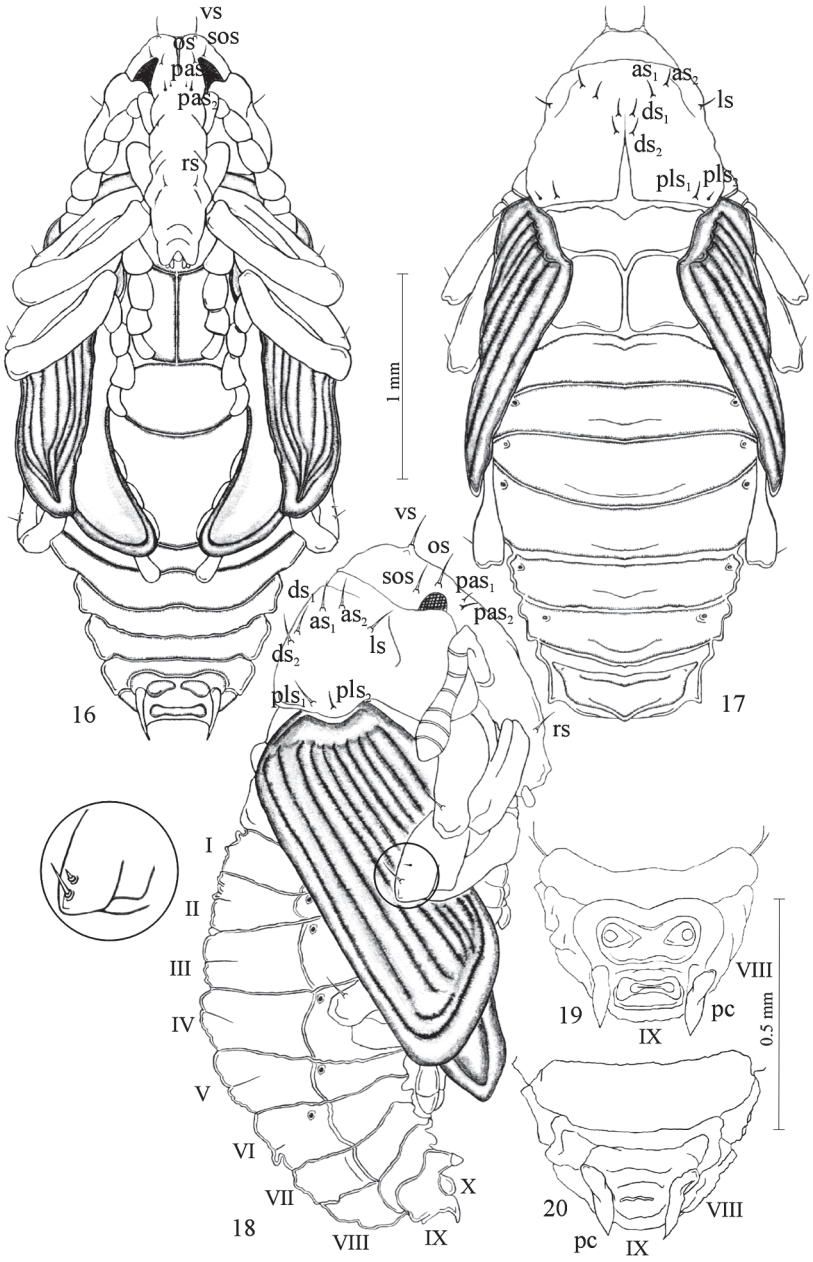
1-6. *Tapeinotus sellatus* (Fabr.), mature larva, habitus: 1 – dorsal view, 2 - ventral view, 3 – lateral view (prns - pronotal setae, dpls - dorsopleural s., vpls - ventropleural s., ps - pedal s., pds - postdorsal s., dls - dorsolateral s., as - alar s., ss - spiracular s., lsts - laterosternal s., sts - sternal s., ls - lateral s., ds - dorsal s., I - number of segment), spiracles of: 4 - first thoracic seg., 5 - first abdominal seg., 6-8th abdominal seg.)



7-9. *Tapeinotus sellatus* (Fabr.), mature larva, head. 7 – dorsal view, 8 – lateral view (des - dorsal epicranial setae, fs - frontal s., les - lateral epicranial s., oc - ocellus, at - antenna), 9 – antenna



10-15. *Tapeinotus sellatus* (Fabr.), mature larva. 10 – labrum (lrm) and clypeus (cl) (lrms – labral setae), 11 – epipharynx (ams - anteromedial setae, als - anteriolateral s., mes - median s., t - tormae), 12 – right mandible (mds - mandible dorsal setae), 13 – right maxilla (dorsal view, dms - dorsally malae setae, vms - ventrally malae s., m - mala, cd - cardo, st - stipes, mp - maxillary palp, pfs - palpiferal s., stps - stipal s.), 14 – praelabium, ventral aspect (plb - praelabium, lpa - labial palp), 15 – labium (pslb - postlabium)



16-20. *Tapeinotus sellatus* (Fabr.), pupa, habitus. 16 – ventral view (vs - vertical seta, sos - super orbital setae, os - orbital setae, pas - post antennal setae, rs - rostral setae), 17 – dorsal view (as - apical setae, ls - lateral setae, ds - discal setae, pls - posterolateral setae), 18 – lateral view, 19 – terminal segment of female, 20 – terminal segment of female (pc - pseudocerci, I - number of segment)