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## Description of the mature larva and pupa of *Bagous lutulentus* (GYLLENHAL), with comments on its biology (Coleoptera: Curculionidae)

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ABSTRACT. The larva and pupa of *Bagous lutulentus* (GYLL.) is described in detail. Diagnostic characters of *Bagous lutulentus* larva are also given. Some information on life-cycle and ecology of the species is also provided. *B. lutulentus* is a monophagous, eurytopic, univoltine species with summer developmental stages and wintering imagines.

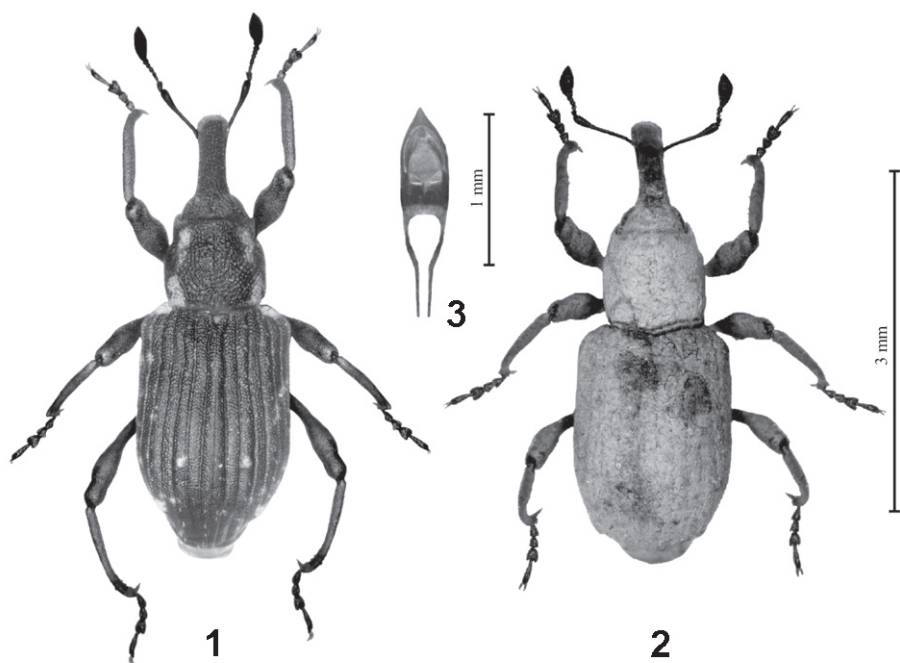
Key words: entomology, morphology, larva, pupa, life-cycle Coleoptera, Curculionidae, *Bagous lutulentus*.

### INTRODUCTION

Genus *Bagous* GERMAR is represented by more than 200 species, 72 of which have been recorded from the Palearctic, ca. 40 occur in Europe, 27 of them are present in polish fauna (O'BRIEN & ASKENVOLD 1992, CUPPEN & HEIJERMAN 1995, WANAT & MOKRZYCKI 2005). The insects under discussion are in the majority tiny, rarely medium sized beetles (2-6 mm in length). Except for a few species they are associated with plants growing in lakes, ponds, old river-beds, slow-flowing waters, wet meadows and undergrowth of alder forest or melting floodplain forest (BURAKOWSKI et al. 1995). Most of *Bagous* species are monophagous, trophic connected with several waterplants or helophytes (CUPPEN & HEIJERMAN 1995). These beetles are often considered as rare, stenotopic species, often endangered (SPRICK 2001). The information about their biology and (especially) morphology of preimaginal stages are still incomplete. Morphology of the *Bagous* larvae is known in detail for 7 species: *B. australasiae* BLACKBURN, *B. brevis* GYLL., *B. collignensis* HERBST, *B. frivaldszkyi* TOURN., *B. nodulosus* GYLL., *B. rufimanus*

HOFFMANN and *B. subcarinatus* GYLL. (SCHERF 1964, MANTOVANI et al. 1992, MAY 1994, CUPPEN & HEIJERMAN 1995, STANIEC & GOSIK 2003, GOSIK 2006a, 2006b) and partially known for: *B. lutulentus* (GYLL.), *B. binodulus* HERBST, *B. glabrirostris* HERBST and *B. alismatis* (MARSH.) (SCHERF 1964). Moreover, the pupae have been described so far only for: *B. collignensis*, *B. frivaldszkyi*, *B. nodulosus*, *B. rufimanus*, and *B. subcarinatus* (SCHERF 1964, MANTOVANI et al. 1992, STANIEC & GOSIK 2003, GOSIK 2006a, 2006b).

*Bagous lutulentus* (GYLLENHAL) (= *B. nigratarsis* THOMSON) (Figs 1, 2) is recorded almost in whole Europe, West Siberian and also from some localities in the Near East (ALONSO-ZARAZAGA 2007). Distribution of *B. lutulentus* in Poland is well known. It was recorded from majority of region, reaching altitude of 700 m (KNUTELSKI 1993, WANAT & SZYPULA 1998). Compared to other similar species belonging to this genus (especially: *B. puncticollis* BOH., *B. glabrirostris* (HERBST) and *B. robustus* H. BRIS.) *B. lutulentus* is distinguishable by e.g.: black color of tarsus and the characteristic shape of prothorax and aedeagus (Fig. 3) (DIECKMANN 1964). According to KOCH (1992), it belongs to the stenotopic species groups, but on the basis of other observations it should be regarded as a eurytopic (BURAKOWSKI et al. 1995). The biology of the mentioned weevil is partly described. The specimens of *B. lutulentus* were collected from May to August, in lakes, ponds, swamp, wet meadow, moor and ditch. The adults were found on some species of horsetails (*Equisetum* L.), however immature stages only on stems of water horsetail (*Equisetum fluviatile* L.). New generation of adults appear in July



1-3. *Bagous lutulentus* GYLL., 1 – teneral adult, 2 – adult after overwintering, 3 – aedeagus

(KNUTELSKI 1993, BURAKOWSKI et al. 1995). A fragmentary, not illustrated, description of larval instars of the mentioned species is given by SCHERF (1964).

#### MATERIAL AND METHODS

The examined material contained:  $L_1$  – twelve specimens, probably  $L_2$  – three specimens,  $L_3$  – eleven specimens, pupae – six specimens.

The examined material was collected in: Dubienka near Dorohusk (UTM nets: GB05) (CE Poland) on May 9<sup>th</sup>, 15<sup>th</sup>, June 6<sup>th</sup>, 18<sup>th</sup>, July 12<sup>th</sup> 2007. The observations of life-cycle of the mentioned species were conducted in vegetation seasons 2001 – 2007.

The specimens were collected on stems of water horsetail (*Equisetum fluviatile* L.) growing on wet meadow, with domination of plant association *Equisetetum fluviatilis* STEFFEN 1931. The preimaginal stages were preserved in a 1:2 solution of glycerine and alcohol. The punctured larvae and pupae were rinsed in distilled water and cleared in chloralphenol and finally placed in Berlesy's liquid to prepare microscopic slides. The drawings were made using camera lucida. The terminologies given by SCHERF (1964) and MAY (1994) were used in the morphological description of the larva and the pupa.

#### RESULTS

##### 1. MORPHOLOGICAL DESCRIPTION

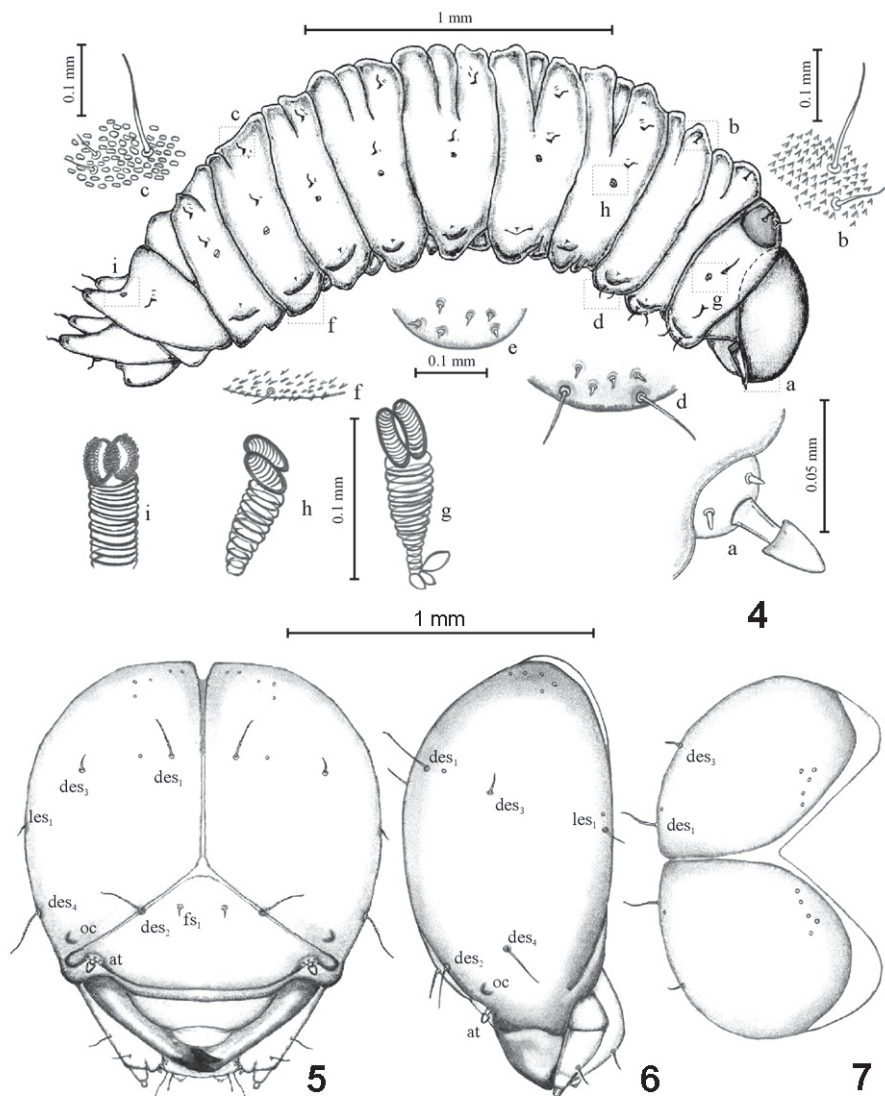
###### Larva (Figs 4-17)

$L_1$ : body length: 1.65 – 1.80 mm (mean - 1.67 mm); head width: 0.24 mm.

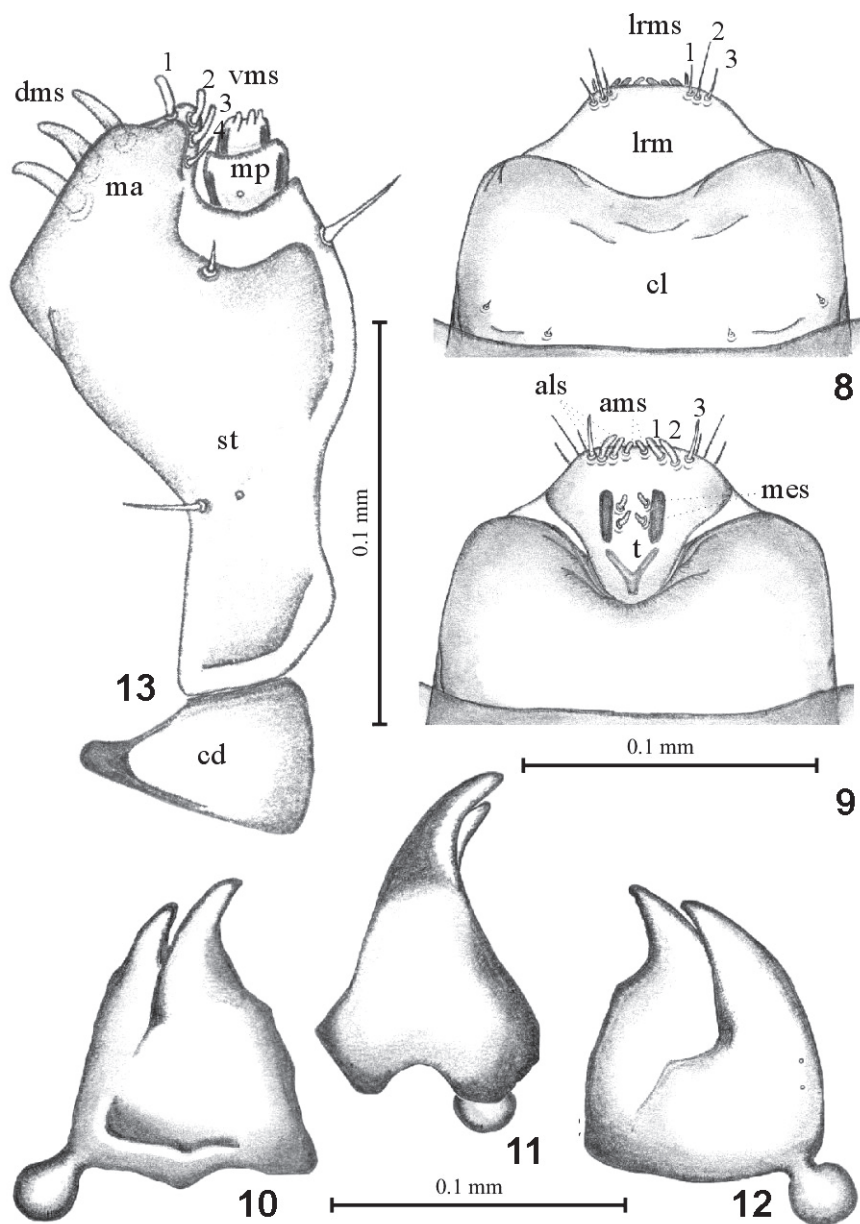
$L_3$ : body length: 4.26 - 4.64 mm (mean 4.40 mm); head width: 0.57 mm.

Body moderately slender, slightly curved, light yellow, head light brown, pronotum grayish-brown, setal numbers greatly reduced, setae light brown. Antenna relatively long, slender, arrow-like, visibly exceeding outline of head; basal membranous area with 2 setal sensillae (Fig 4a). Cuticle minutely spiculate (on the thoracic segments), minutely knobbly (on the abdominal segments) (Figs 4b, c). Each pedal area of thoracic segments with 2 macro setae and 4-5 micro setae; in  $L_1$  with 6-7 micro setae (Figs 4d, e). Ventral parts of abdominal segments I-VII with thorn-like cuticular processes and several, slender micro setae (Fig. 4f). Spiracles bicameral, placed medially, except those of abdominal segment VIII – localized more dorsally (Figs 4g, h, i). Head subglobose with macro setae, pores, antenna and single ocellus (oc) on each side latero-posteriorly, frontal suture distinct, Y- shaped. Macro setae of head: 8 dorsal epicranial setae (2  $des_1$ , 2  $des_2$ , 2  $des_3$ , 2  $des_4$ ),  $des_2$  located on sutura frontalis,  $des_3$  much shorter than other  $des$ . 2 frontal setae ( $fs_1$ ) short, sharp; 2 lateral epicranial setae ( $les_1$ ) twice shorter than  $des$ . Epicranial area with group of 5 pores on each side and single pores placed in the vicinity of  $des_1$  and  $les_1$  (Figs 5-7). Clypeus (cl) and labrum (lrm): clypeus 2.0 x as wide as long with 4 setal sensillae; labrum about 2.0 x as wide as long with 6 labral setae (lrms). The  $lrms_1$  and  $lrms_3$  short, equal length,  $lrms_2$  2 x longer than other lrms (Fig. 8). Epipharynx: anteromedian setae (ams), 1 pair, short, blunt, finger-like; 6 antero-lateral setae (als),  $als_1$  and  $als_2$  short, curved finger-like,  $als_3$

long, sharp; median setae (mes), 2 pairs, short, curved, blunt; torma (t) in the anterior parts parallel, in posterior parts Y-shaped (Fig. 9). Mandible broad, bifid, with 2 pores on the ventral area; teeth almost of equal height, slightly truncate (Figs 10-12). Maxilla consists of triangle cardo (cd), stipes (st), mala (ma) and maxillary palp (mp). Stipes and mala fused, stipes with 3 setae dorsally and 1 pore. Mala with 3 equal length,



4-7. *Bagous lutulentus* GYLL., mature larva: 4 – habitus (lateral view). a – right antenna (lateral view), b, c – structure of cuticle, d, e, f – chetotaxy of pedal area (d, f –  $L_3$ , e –  $L_1$ ), g, h, i – spiracles; 5-7. head: 5 – dorsal view, 6 – lateral view, 7 – posterior view (des – dorsal epicranial setae, fs – frontal seta, les – lateral epicranial seta, oc – ocellus, at – antenna)



8-13. *Bagous lutulentus* GYLL., mature larva: 8 – labrum (lrm) and clypeus (cl) (lrms - labral setae), 9 – epipharynx (ams - anteromedial setae, als - anteriolateral setae, mes - median setae), 10-12 – right mandible (10 – dorsal view, 11 – lateral view, 12 – ventral view), 13 – left maxilla (dorsal view, dms - dorsally malae setae, vms - ventrally malae setae, m - mala, cd - cardo, st - stipes, mp - maxillary palp)

curved, thick, finger-like setae dorso-apically and 4 curved, truncate setae ventro-apically,  $vms_4$  distinctly shorter than other  $vms$ . Maxillary palp 2-segmented; segment I is almost twice longer and distinctly wider than segment II, length ratio of segment I and II: 1 : 2. Segment II with 3 conical cuticular processes apically. Segment I with 1 pore dorsally (Fig. 13). Praelabium (plb) with 3 pairs of short, truncate micro setae antero-medially and 1 pair of pores; 1 pair of long seta postero-medially. Postlabium (pslb) with 3 pairs macro setae. The setae on pslb sharp; anterior pair distinctly shorter than posterior pair. Labial palp (lpa) one-segmented, localized on protuberances; each lpa with group of 4 conical cuticular processes apically (Figs 14, 15). Chaetotaxy of the body is strongly reduced. Dorsal parts of prothorax with complex of 3 macro setae and 2 micro setae on each side (Fig. 16). Other segments of thorax with 2 macro setae and 1 micro setae on each side of the body. Each abdominal segments (except segment VIII and IX) with 2 macro setae and 4-5 micro setae laterally, on each side. Segment VIII of abdomen with 2 long setae localized on marked protuberances. Segment IX with 2 pairs of long, marginal macro setae placed also on protuberances. Anus placed ventrally with 4 anal lobes (Fig. 17).

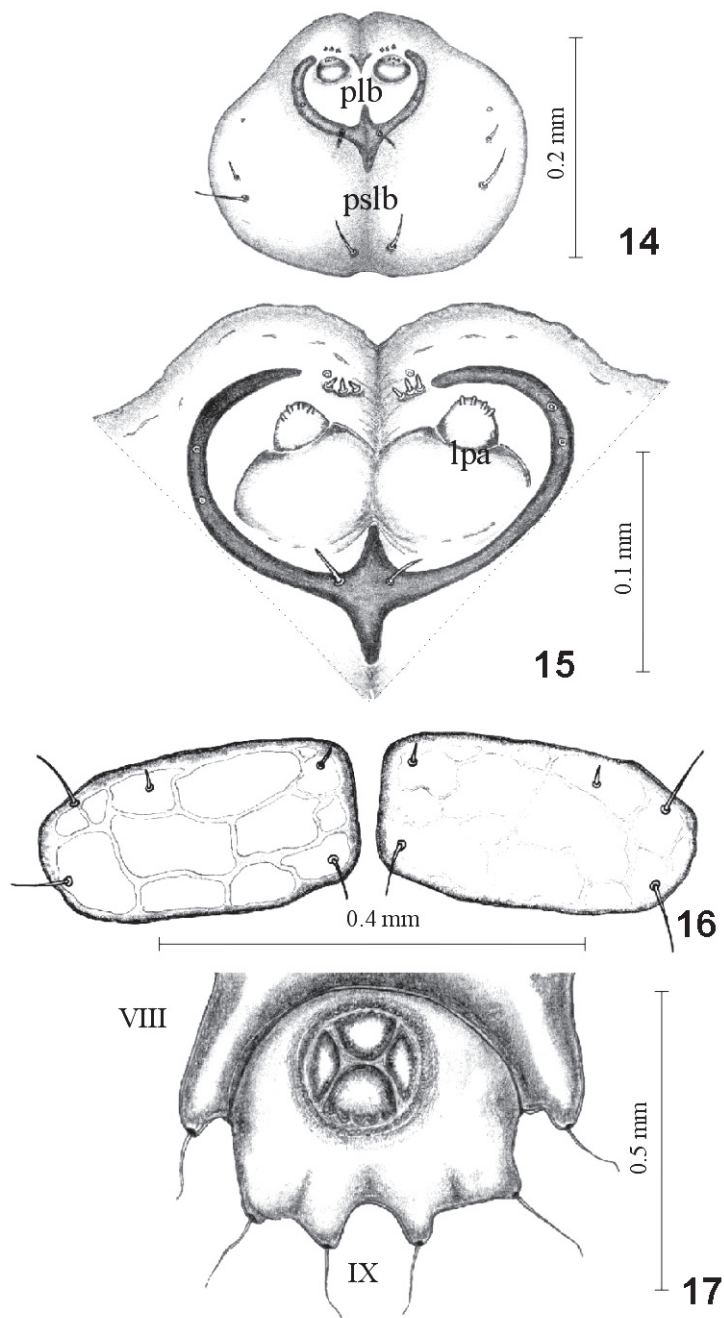
#### Pupa (Figs 18-22)

Body length: 3.20-3.5 mm (mean 3.30 mm), width in widest place (between knees of first pair) 1.85-2.00 mm (mean 1.91 mm). Body relatively stocky, white; setae median length, dark-brown, on marked protuberances. Head with 2 vertical setae ( $vs$ ), 4 orbital setae ( $os_1$ ,  $os_2$ ), 4 super orbital setae ( $sos_1$ ,  $sos_2$ ) and 2 post antennal setae ( $pas$ ). Rostrum rather long, about 4x as long as wide, exceed apexes of coxae of second pair, with 2 rostral setae ( $rs_1$ ). Antennae rather short and relatively stocky. Pronotum 1.4x as wide as long, at base with 4 apical setae (2  $as_1$ , 2  $as_2$ ), 6 lateral setae (2  $ls_1$ , 2  $ls_2$ , 2  $ls_3$ ), 4 discal setae (2  $ds_1$ , 2  $ds_2$ ) and 4 posterolateral setae (2  $psl_1$ , 2  $psl_2$ ). Metanotum 1.33x longer than mesonotum, meso- and metanotum each with 6 setae. Each knee with a pair of setae ( $ks$ ). Abdominal segments gradually decreasing in size towards the posterior end of body. Tergites I-VI each with 8 setae, segment VII almost semicircle with 4 pairs of setae, the lateral pair of setae placed on protuberances, distinctly longer than median pairs. Tergite of segment VIII with 2 long setae localized on protuberances; segment IX with pseudocerci and complex of long macro setae and several micro setae. Pseudocerci ( $pc$ ) thorn-like, straight, short, slightly curved to inside. Spiracles on abdominal segments placed dorsolaterally; on segments I-V functional, on segments VI-VIII atrophied (Figs 21, 22). Chaetotaxy of abdomen as in Figs 18-24. Sexual dimorphism in structure of VII and IX sternites is well-marked (Figs 23, 24).

## 2. REMARKS ON THE ECOLOGY AND BIOLOGY

*Bagous lutulentus* was collected only on water horsetail. The infected plant presented well visible deformation. The stems were curved or twisted in upper parts, where the development of the weevil took place. I always found only one specimens in the same plant. The first active specimens (adults) appeared in the second decade of April (April 20<sup>th</sup> 2007), in previous years the beginning of its activity was observed usually in the first decade of May. The adults were observed on plants until the end of June. After this time I collected the adults only by sieving of the plant remains, probably a





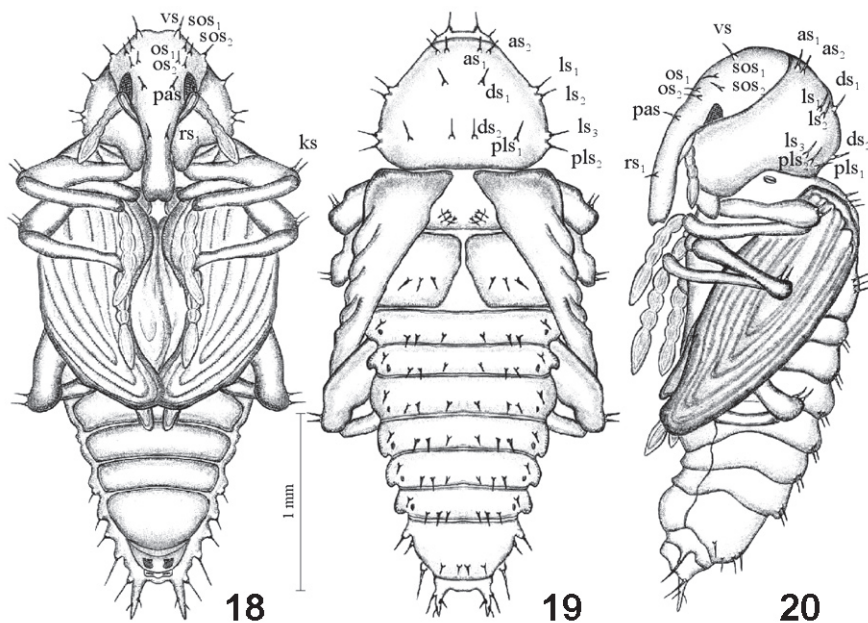
14-17. *Bagous lutulentus* GYLL., mature larva. 14 – labium, ventral aspect (plb - praelabium, psb - postlabium), 15 – apex of labium (lpa - labial palp), 16 – chetotaxy of pronotum, 17 – terminal segment of abdomen, ventral view (segments VIII and IX)

place where imagines overwinter. The different larval instars were collected on stems of water horsetail from the first half of May to the second decade of June. The first pupae were found in the beginning of June. In the last decade of June only several pupae and numerous teneral adults were found on stems. In the beginning of July only empty stems with feeding traces could be found. On several occasions I observed dead larvae on the stems. I have not found specimens of *B. lutulentus* on other *Equisetum* species: woodland horsetail (*E. sylvaticum* L.), great horsetail (*E. telmateia* EHRH.) or field horsetail (*E. arvense* L.). Its occurrence is strictly limited to biotopes with full insolation and static water. During my work in the Bug river valley and Nadwieprzański Landscape Park I observed specimens of the mentioned species on wet meadows, moors and on banks of drainage ditches. Usually I found samples (by using of entomological scoop) of 7 – 12 specimens of *B. lutulentus*.

#### CONCLUSIONS

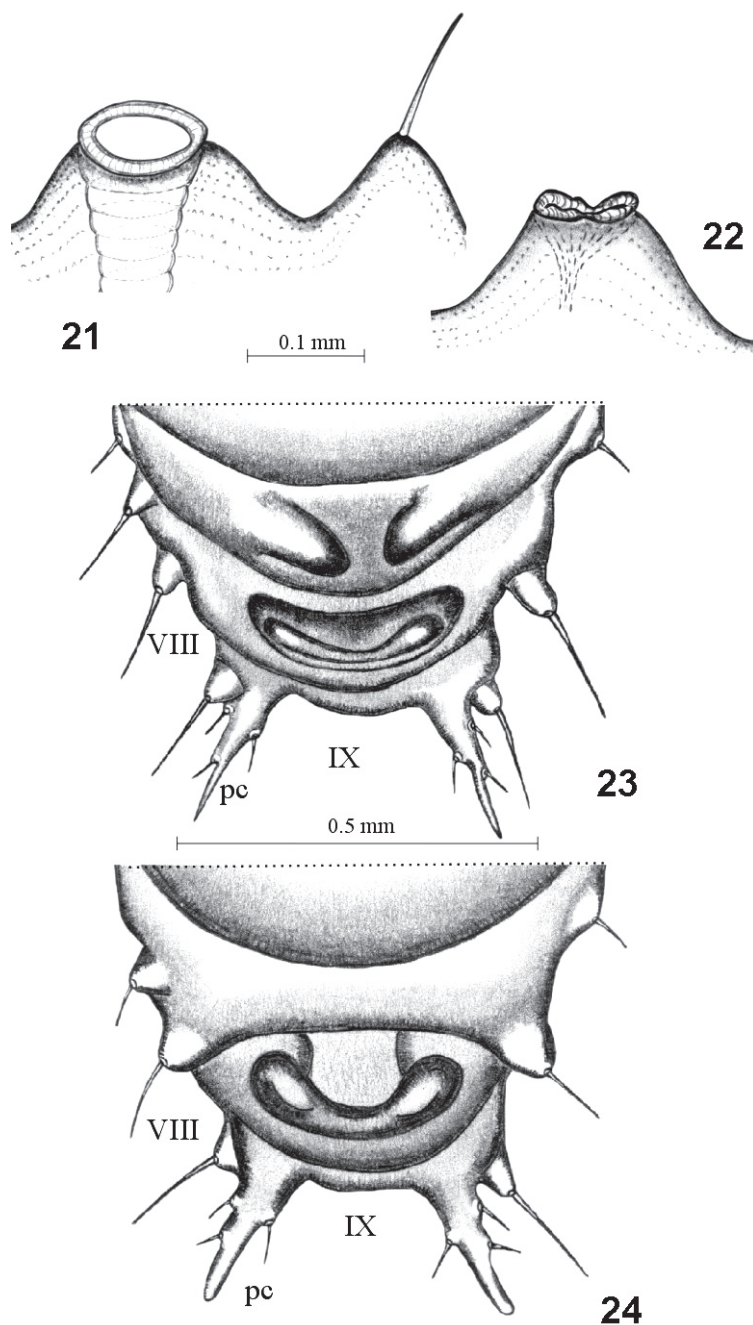
The diagnostic characters of the larva of the genus *Bagous* (based on description of: *B. australasiae*, *B. brevis*, *B. collignensis*, *B. nodulosus*, *B. frivaldszkyi*, *B. rufimanus* and *B. subcarinatus*) are following:

(1) body length 3.50-10.11 mm, head width: 0.48-0.88 mm; (2) head light brown, ocelli present (in *B. collignensis* absent); (3)  $des_1$ ,  $des_4$  constant,  $des_2$  (in *B. brevis* designated as  $des_3$  - CUPPEN & HEIJERMAN 1995) located on sutura frontalis,  $des_3$  absent



18-20. *Bagous lutulentus* GYLL., pupa, habitus: 18 – ventral aspect (vs - vertical seta, sos - super orbital setae, os - orbital setae, pas - post antennal setae, rs - rostral setae, ks - knee setae), 19 – dorsal aspect (as - apical setae, ls - lateral setae, ds - discal setae, pls - posterolateral setae), 20 – lateral aspect





21-24. *Bagous lutulentus* Gyll., pupa: 21 – spiracle of abdominal segment V, 22 – spiracle of abdominal segment VII, 23 – terminal segment of female, ventral aspect, (pc - pseudocerci, segments VIII and IX), 24 – terminal segment of female, ventral aspect

or reduced (in *B. collignensis* present); (4) antenna conical or arrow-like, basal membranous with some setal sensillae; (5) labrum with 6 setae lrms (in *B. australasiae* 4 lrms); (6) epipharynx with 2 ams, 4 mes, 6 als, (in *B. collignensis* 8 als); (7) tormae short thick; (8) mandibles teeth slightly truncate with 0-2 setae; (9) maxilla with 3 setae dorsally; 3-7 dms, 1-4 vms; (10) maxillary palp two segmented; segment II with some conical cuticular processes apically; (11) ligula concave; (12) labial palp one segmented (often localized on distinctly, conical, protuberances); (13) abdominal segments VIII, IX with long setae placed dorsally on protuberances; (14) spiracles bicameral; (15) anus ventral.

The diagnostic characters of the mature larva of *Bagous lutulentus* are following:

(1)  $des_3$  distinctly shorter than other  $des$ ; (2) fs very short, placed central, vicinity of suture frontalis; (3) antenna long, arrow-like; (4) mandibles without setae; (5) maxilla with 3 dms; (6) labial palps localized on conical protuberances.

According to SCHERF (1964) the larvae of *B. collignensis* and *B. lutulentus* are indistinguishable. The description of *B. collignensis* given by SCHERF is fragmentary, but even on its basis the distinguishing between both species is possible. The general shape of the body of both species are quite similar, also absence of the setae on mandible is visible, but shape and chaetotaxy of head are very different.

- *B. collignensis*: the spiracles of abdominal segments I-VII placed ventro-laterally; ocellus absent; head narrow, (1.39 as long as wide);  $des_1$  and  $des_3$  equal in length, antenna conical; frontal suture with 8 pairs of pores; frontal setae placed lateral, vicinity of antennae.

- *B. lutulentus*: the spiracles of abdominal segments I-VII placed laterally; ocellus present; head semicircular (1.18 as long as wide);  $des_1$  distinctly longer than  $des_3$ ; antenna arrow-like; frontal suture without pores; frontal setae placed central, vicinity of suture frontalis.

Pupae of only six species (*B. collignensis*, *B. nodulosus*, *B. subcarinatus*, *B. friwaldszkyi*, *B. rufimanus* and *B. lutulentus*) have been described. Because the number of descriptions of the pupa of different species belonging to this genus is very small, the separation of the features characteristic at the species level is unfortunately impossible. Moreover, the features of pupae of the species mentioned above are not convergent.

I suppose that occurrence of *B. lutulentus* on *Equisetum* species (other than *E. fluviatile*) observed by KNUTELSKI (1993) was accidental. In the area of Poland, *B. lutulentus* can be regarded as relatively common species. In comparison with other *Bagous* species its known localities are numerous. Also the populations I observed were usually moderately large. This species often settles in the anthropogenic biotopes (drainage ditch, some types of meadows). Therefore I suppose *B. lutulentus* is not endangered and does not require specially protection (nie wiem czy w takiej pracy tego typu wnioski sa potrzebne).

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