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RESEARCH

First Descriptions of Immature Stages of the Weevils *Bagous elegans*, *B. aliciae*, and *B. lutulosus*

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ABSTRACT. Last-instar larvae of *Bagous elegans* (F.), *Bagous aliciae* Cmoluch, and *Bagous lutulosus* (Gyllenhal), and the pupa of *B. elegans*, are described and illustrated for the first time. Biology of these species is analyzed in association with larval morphology and feeding habits. Overall larval and pupal morphological diagnoses of the genus *Bagous* are updated.

Key Words: beetle, *Coleoptera*, *Curculionidae*, *Bagoini*, *Bagous*

Abbreviations: Morphology: AbI–IX, subsequent abdominal segments (Roman numerals); als_n, anterolateral setae; ams_n, anteromedial setae; as_n, apical setae; at, antenna; BH, body height; BL, body length; BW, body width; cl, clypeus; cls_n, clypeal setae; d_n, dorsal setae; des_n, dorsal epicranial setae; dms_n, dorsal setae of the mala; $dpls_n$, dorsopleurolateral setae; ds_n, discal setae (of pronotum); fes_n, femoral setae; fs_n, frontal setae; HW, head width; HL, head length; L2, L3, larval instars; les_n, lateral epicranial setae; $ligs_n$, ligular setae; lpa, labial palp; lr, labral rods; lrm, labrum; $lrms_n$, labral setae; ls_n, lateral setae; ma, mala; mds_n, dorsal setae of mandible; mes_n, median setae; mpa, maxillary palp; $msts_n$, mesosternal setae; os_n, orbital setae; pas_n, postantennal setae; pc, pseudocerci; pda_n, pedal setae; pds_n, postdorsal setae; pes_n, postepicranial setae; pfs_n, palpiferal setae; plb, praelabium; $plbs_n$, praelabial setae; pls_n, posterolateral setae; $prns_n$, pronotal setae; prs_n, prodorsal setae; pslb, postlabium; $pslbs_n$, postlabial setae; *rs*, rostral setae; sos_n, superorbital setae; st, stemmata; stp, stipes; *stps*, stipal setae; sts_n, sternal setae; ThI–III, subsequent thoracic segments; vms_n, ventral setae of the mala; $vpls_n$, ventropleural setae; vs_n, vertical setae (of the vertex). Collectors & depositories: MNHW, Museum of Natural History, University of Wrocław; MW, Marek Wanat; RG, Rafał Gosik.

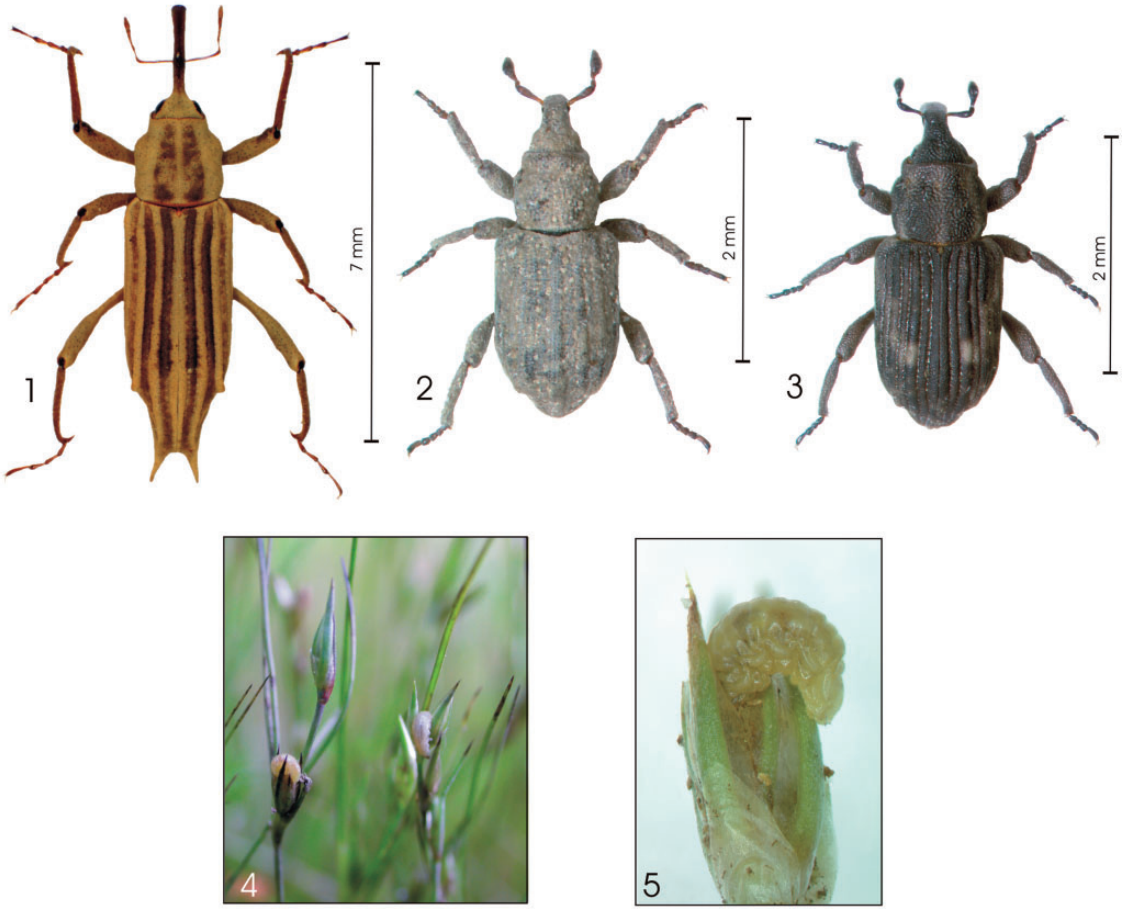
The almost worldwide distributed (except Central and South America) genus *Bagous* Germar, 1817 includes presently more than 250 valid species, thus being among the most speciose weevil genera. It has been subjectively enlarged after amalgamation of several long-recognized genera and subgenera of the tribe Bagoini into one genus in a series of recent taxonomic revisions, a tentative proposal to meet canons of modern phylogenetics in the classification of this morphologically uniform group until its thorough worldwide revision (O'Brien and Askevold 1992, 1995; O'Brien et al. 1994; Caldara and O'Brien 1998). Therefore, the previously distinct genera: *Hydronomus* Schoenherr, 1826 and *Dicranthus* Motschulsky, 1845, and a number of subgenera (e.g., *Cyprus* Schoenherr, 1825, *Ephimeropus* Hochhuth, 1847, *Parabagous* Schilsky, 1907, *Abagous* Sharp, 1917), are presently treated as synonymous with *Bagous*. Instead, a provisional division of this genus into a large number of apparent monophyletic species-groups has been proposed (Caldara and O'Brien 1998).

Over a half species of *Bagous* (130) occur in the Palaearctic region, majority of them (82) in the Western Palaearctic (Cuppen and Heijerman 1995, Caldara and O'Brien 1998, Alonso-Zarazaga 2011). In the Central Europe 31 species are known (Dieckmann 1983, Böhme 2005), classified in 18 species-groups by Caldara and O'Brien (1998). The adult weevils have small- to medium-sized body (1.2–8.9 mm) densely covered with granulate and mostly pitted scales and often with waterproof coating; slender, ventrally sinuate, or bisinuate tibiae with conspicuous uncus, and tarsi linear or at most having subcordate, not distinctly bilobed third segment (Smreczyński 1972, O'Brien et al. 1994, Caldara and O'Brien 1998).

Bionomics and hosts associations of Bagoini are better known only for the European fauna and they appear very diverse. Majority of species inhabit water-related habitats, primarily ponds, old river-beds, shallow lakes, slow-flowing waters, floodplain meadows, and forests, where many of them develop on submerged vegetation. Several species are more or less strictly associated with halophilous habitats, mainly in Mediterranean and South-West Asia. A minor number are purely terrestrial species, either mesophilous, like *B. tempestivus* (Herbst, 1795), *B. lutulosus* (Gyllenhal, 1827), or *B. diglyptus* Boheman, 1845, or even xerothermophilous (e.g., *B. aliciae* Cmoluch 1983) (Dieckmann 1983, Burakowski et al. 1995, Caldara and O'Brien 1998). A vast majority of *Bagous* weevils, regardless whether higro-, meso-, or xerophilic, are monophagous or very narrowly oligophagous, and their specified host plant species recruit from very different families and orders of angiosperms, or even of horsetails. The examples are *B. lutulentus* on *Equisetum fluviatile* L. (Equisetales), *B. rotundicollis* on *Nymphaea* and *Nuphar* (Nymphaeales), *B. binodulus* on *Stratiotes aloides* L. (Alismatales: Hydrocharitaceae), *B. nodulosus* on *Butomus umbellatus* L. (Alismatales: Butomaceae), *B. frivaldszkyi* on *Phalaris arundinacea* L. (Poales: Poaceae), *B. brevis* on *Ranunculus flammula* L. (Ranunculales), *B. frit* on *Menyanthes trifoliata* L. (Asterales: Menyanthaceae), and *B. petro* on *Utricularia* spp. (Lamiales) among water-loving species, and *B. lutulosus* on *Juncus bufonius* L. (Poales: Juncaceae), *B. diglyptus* on *Saxifraga granulata* L. (Saxifragales) or *B. aliciae* on *Anthemis tinctoria* L. and *Anthemis subtinctoria* Dobrocz. (Asterales: Asteraceae) among the terrestrial ones. Broadly oligophagous species are exceptions, like *B. glabrirostris* and *B. limosus* recorded from several plant species of different families (Scherf 1964, Dieckmann 1983, Burakowski et al. 1995, Caldara and O'Brien 1998, Gosik 2006b, Wanat 2011). Also the mode of larval feeding is highly diverse among Bagoini. The larvae use to live inside plant tissues, both in emerged and submerged parts, usually in stems and leaf petioles and nerves. However, the larvae of several species (e.g., *B. binodulus*,

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Figs. 1–5. Beetles in dorsal view: (1) *B. elegans*; (2) *B. aliciae*; (3) *B. lutulosus*. (4) *B. lutulosus* larvae on *Juncus bufonius* (in field); and (5) *B. lutulosus* larva feeding on its host plant (in labor).

B. brevis B. lutulosus) are exophagous at least in their older instars, and larva of *B. alismatis* is a leaf-miner. The pupation proceeds usually in the larval chamber, occasionally in the soil, and the overwintering stage is always imago (Scherf 1964; Cuppen and Heijerman 1995; Sprick 2001; Gosik 2008, 2010; Wanat 2004, 2011).

Most of European Bagoini are specialized and stenotopic species, associated with the clear water-dependent natural microhabitats, vanishing nowadays. Because of these biological constraints many of them are now seriously endangered, affected by devastation of their biotopes, overwhelming drainage and pollution, agriculture impact and expansion of anthropophytes into water, and littoral plant communities (Sprick 2001, Wanat 2004). A thorough study of their biology could help to select some species as relevant indicators of the condition and quality of several types of subnatural wet habitats.

Considering genus *Bagous* in its present shape, the morphology of larval instars has been studied in 12 species (*B. alismatis, B. australasiae, B. binodulus, B. brevis, B. collignensis, B. frit, B. frivaldszkyi, B. lutulentus, B. nodulosus, B. robustus, B. rufimanus*, and *B. subcarinatus*), whereas the pupae have been described in only seven of them (Scherf 1964; Leiler 1987; Mantovani et al. 1992; May 1994; Cuppen and Heijerman 1995; Staniec and Gosik 2003; Gosik 2006a, b, 2008, 2010). In this contribution, we provide first larval descriptions of further three European species from two very distinct and unrelated species groups. *Bagous elegans,* long time placed in a separate genus *Dicranthus* due to outstanding morphology of the elytra, is besides *B. majzlani* a member of the *elegans*-species group, probably the most-specialized water weevils now existing. *B. aliciae* and *B. lutulosus* represent the *subruber*-species group containing in all three purely terrestrial species, the nominotypic one being halophylic (Caldara and O'Brien 1998).

Materials and Methods

The larvae and pupae were picked up from their host plants and fixed in 80% ethanol. Detailed collecting data are given for respective species in the following chapter. Specimens were examined under Olympus SZ60 optical microscope and camera lucida. Measurements were taken using the calibrated oculars and Olympus SZ60 microscope. All adult weevils and their immature stages are deposited at collections of the senior author (RG) and the Museum of Natural History, University of Wrocław (MNHW).

Measurements

The following features of each specimen were measured using a calibrated microscopic eyepiece:

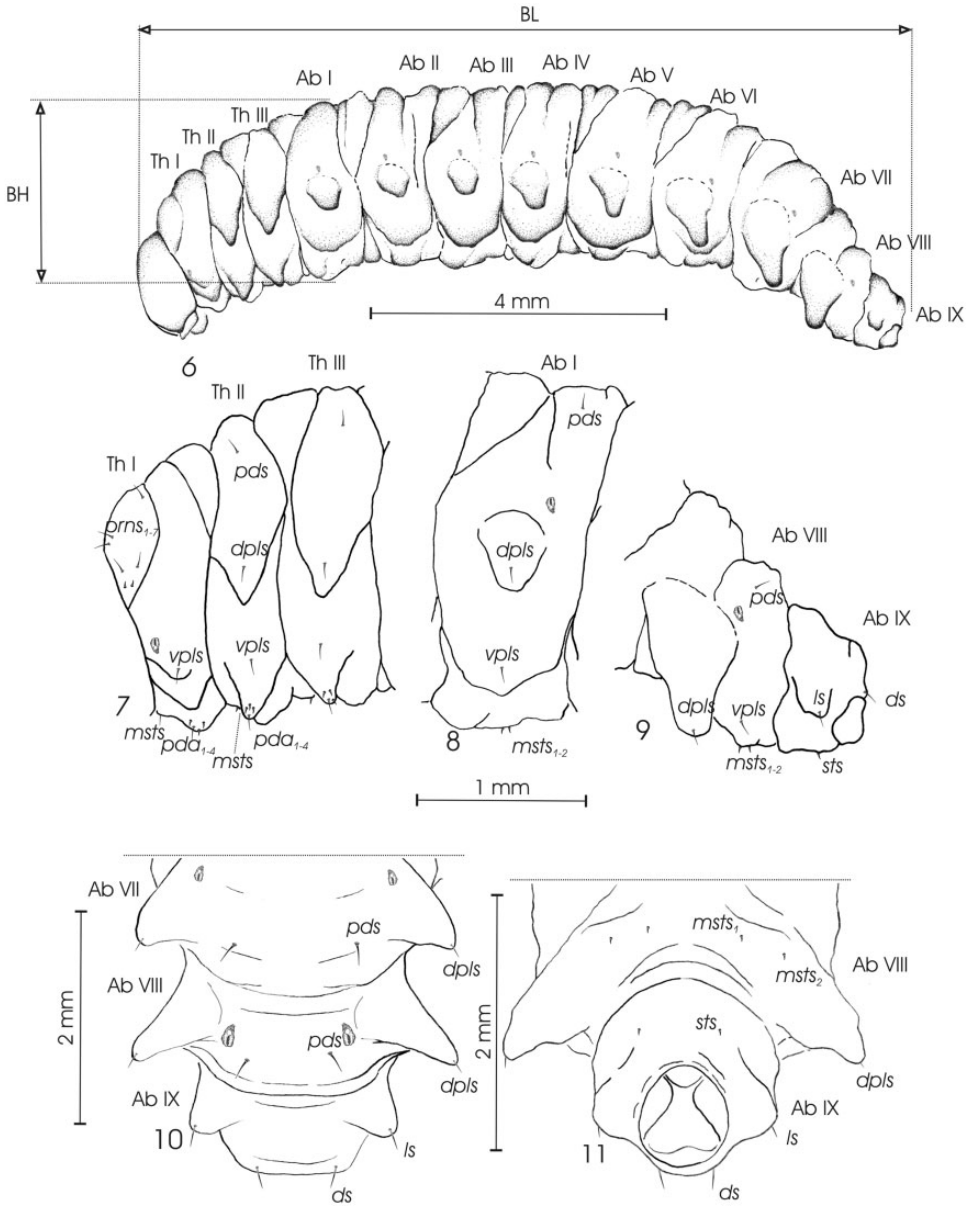
1. Larva: length (BL) (from front of the head to end of AbIX), height (BH) of the body (the latter on the thickest place in lateral view) (see Fig. 6), and maximum width (HW) and length (HL) of the head capsule (see Fig. 12).
2. Pupa: length (BL) (from apex of head, without protuberances of vertical setae to end of AbIX, without pseudocerci), and width (BW) (between apices of middle femora in the pupa).

Pronotum length in pupa was measured along its middle line.

Illustrations

Drawings were made using a drawing tube installed on an optical microscope and processed by computer programs (Adobe Photoshop, Corel Photo-Paint 11). Photos were made using Olympus SZX16 microscope and processed by the Olympus Stream Motion software.

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Figs. 6–11. *B. elegans*, larva, habitus and chaetotaxy: (6) habitus; (7) thoracic segments; (8) first abdominal segment; (9–11) abdominal segments VII–IX: (9) lateral view, (10) dorsal view, and (11) ventral view. Abbreviations: (Ab_n) abdominal segment, (BL) body length, (BH) body height, (Th_n) thoracic segment; setae: (*dpls*) dorsopleurolateral, (*ds*) dorsal, (*ls*) lateral, (*msts*) mesosternal, (*pda*) pedal, (*pds*) postdorsal, (*prns*) pronotal, (*sts*) sternal, and (*vpls*) ventropleural.

Terminology

Names and abbreviations of general body parts follow terminology proposed by Scherf (1964). Setae are named after May (1994) and setal codes are consistently given in italics. Terms used in descriptions of the mouth parts and antennae are adopted from Marvaldi (1997, 1998).

Results

Descriptions are arranged according to taxonomic placement of the species.

Bagous elegans (Fabricius 1801)

(Fig. 1)

Material Examined

POLAND: Biebrza National Park, Brzostowo, UTM: EE90, Pupae 1♂ 1♀ and several teneral adults (30 July 1999), and two mature larvae (8 June 2000) collected from the internodes of canarygrass reed (*P. arundinacea* L.) growing on old river bank, leg. MW (MNHW).

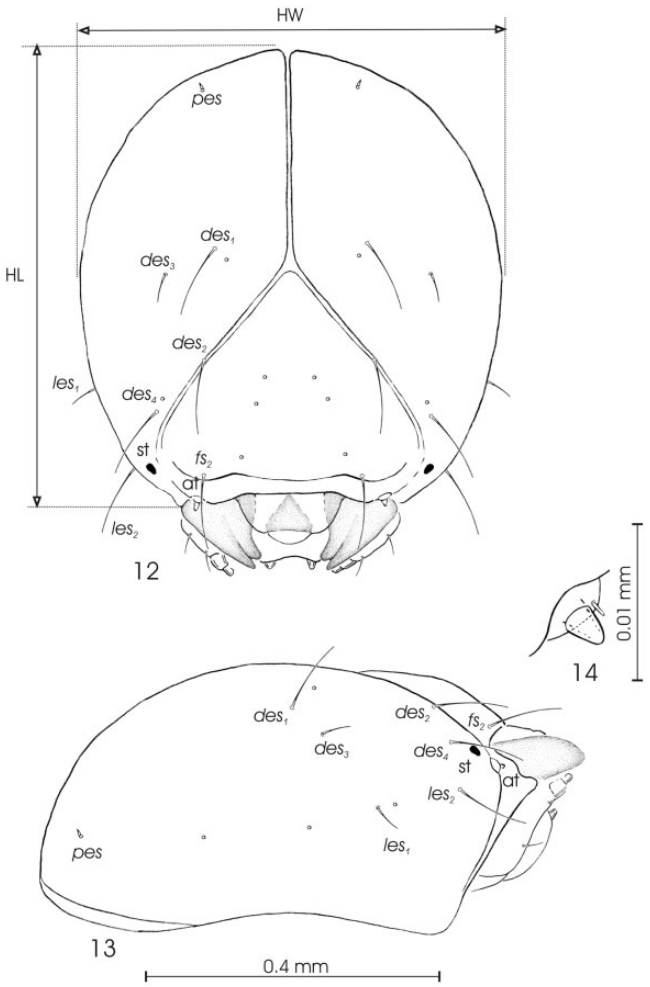
Description of Larva (L_3)

(Figs. 6–19)

General Morphology

All thoracic and abdominal segments white–yellow. Cuticle smooth. Pronotal area of first thoracic segment feebly sclerotized, light yellow. Body slender, elongate, slightly curved (Fig. 6), and rounded in cross section, at widest place (AbI) measuring up to 1.40 mm; total body length: 7.5–7.8 mm. Prothorax slightly smaller than similar to each other meso- and metathorax. AbI–III of almost equal length, slightly bigger than metathorax. AbIV shorter than AbV–VI, AbVII–VIII decreasing gradually to the terminal parts of the body, AbIX again distinctly smaller than previous ones, and AbX reduced to three anal lobes of unequal size. Dorsal parts of AbI–VII divided into three lobes, AbVIII with two dorsal

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Figs. 12–14. *B. elegans*, larval head: (12) dorsal view; (13) lateral view; and (14) antenna, magnified. Abbreviations: (at) antenna; (HL) head length, (HW) head width, (st) stemma; setae: (*des*) dorsal epicranial, (*fs*) frontal, (*les*) lateral epicranial, and (*pes*) postepicranial.

lobes. Lateral folds of AbI–IX well isolated, on segments VII–IX developed into conical protuberances. Spiracles nine pairs, bicameral, first pair placed on anterior margin of pronotum, next seven pairs laterome-dial, and the last pair placed dorsolaterally on AbVIII.

Chaetotaxy

Feebly developed, setae light yellow, hairform, varying in size, and poorly distinguished. Prothorax on each side (Fig. 7) with seven *prns* of unequal length (four long and three short, all located on sclerotized shield), one *vpls* and one short *msts*. Meso- and metathorax both on each side with one *pds*, one *dpls*, one *vpls,* and one *msts*. Each pedal area of thoracic segments with one long and three short *pda*. AbI–VIII with paired one short *pds*, one short *dpls*, one *vpls,* and two short *msts*. (Fig. 8). AbIX with paired one *ds*, one *ls,* and one *sts* (Figs. 9–11).

Head and Mouth Parts

Head light yellow; width: 0.84–0.86 mm, length: 0.80–0.82 mm, oval shaped, slightly oblate bilaterally, frontal-suture distinct, and Y-shaped. Setae on head hairform, different in length. Des_1 three times longer than des_3, both located in central part of epicranium, des_2 as long as des_1, placed on frontal suture, des_4 as long as des_1 located anterolaterally (Figs. 12 and 13). Fs_2 as long as des_1, placed laterally, close to epistome. Les_1 as long as des_3 and les_2 slightly shorter than des_1. Postepicranial area with one very short *pes* (Fig. 13). Frons with three pairs of pores placed medially; one pore placed laterally on each side of head, one pare near to des_1, one near to des_4, and last one close to les_2. Antenna located on end of frontal suture; antennal segment with sensorium conical, slightly elongated, and located medially; basal membranous article with one elongated sensillum (Fig. 14).

Labrum (lrm) (Fig. 15) ~2.7 times as wide as long, with three pairs of $lrms_{1-3}$ of different length; $lrms_2$ almost twice as long as $lrms_1$ and $lrms_3$, all *lrms* placed on distinct protuberances; anterior margin slightly roundly emarginate. Clypeus (cl) (Fig. 15) 3.6 times as wide as long, with three triangular and equally long cls_{1-3} based on protuberances, localized posteromedially; anterior margin of clypeus gently arcuated inwards. Epipharynx (Fig. 16) with three pairs of finger-like als_{1-3} of different length; two pairs of short ams_{1-2}; and two pairs of conical mes_{1-2}. Labral rods (lr) kidney shaped, slightly converging posteriorly. Mandibles (Fig. 17) slightly truncate, bifid, teeth of unequal length, and the cutting edge almost straight. *Mds* short, hairform. Maxillary stipes (stp) (Fig. 18) with one *stps* and two short, equally long *pfs*; mala (ma) with six bacilliform or finger-like dms_{1-6} of different length; vms_{1-3} short, of almost equal length; *vms* shorter than *dms*. Maxillary palps (mpa) with two segments; each of them with a pore, basal palpomere 1.3 times longer than distal one. Apical part of distal palpomere with a group of 5–6 long, conical, and cuticular processes. Praelabium (plb) (Fig. 19) rounded, with three pairs of variously long $plbs_{1-3}$ ($plbs_1$ located posteriorly on premental sclerite, $plbs_{2-3}$ near to each of palpomera). Ligula with four pairs of hairform, micro $ligs_{1-4}$ of equal length. Premental sclerite well visible, in a form of complete ring, with elongated proximal part. Labial palps (lpa) one-segmented, located on conical protuberances; each palp with some short, cuticular apical processes, and a pore. Postlabium (pslb) (Fig. 19) densely covered with small, triangular cuticular processes, and with three pairs of short, almost equal $pslbs_{1-3}$, the first pair localized medially, remaining two pairs laterally.

Description of Pupa

(Figs. 20–24)

General Morphology

Body length: 9.0 mm (♀), 8.0 mm (♂), maximum width at the level of mesocoxae: 4.8 mm (♀), 3.8 mm (♂), head width: 0.88 mm (♀), 0.84 (♂). Body elongated, slender, white, or yellowish. Cuticle smooth. Rostrum long, ~5.5 times as long as wide, surpassing mesocoxae in repose range. Antennae moderately long and slender. Pronotum almost as wide as long. AbI–IV of almost equal length, segments V–VIII gradually diminished, VIII semicircular, and IX distinctly smaller than preceding ones. Pseudocerci very short and triangular. Sexual dimorphism visible in the structure of AbIX: gonotheca of ♀ divided and ♂ undivided. Five pairs of functional spiracles placed laterally on AbI–V.

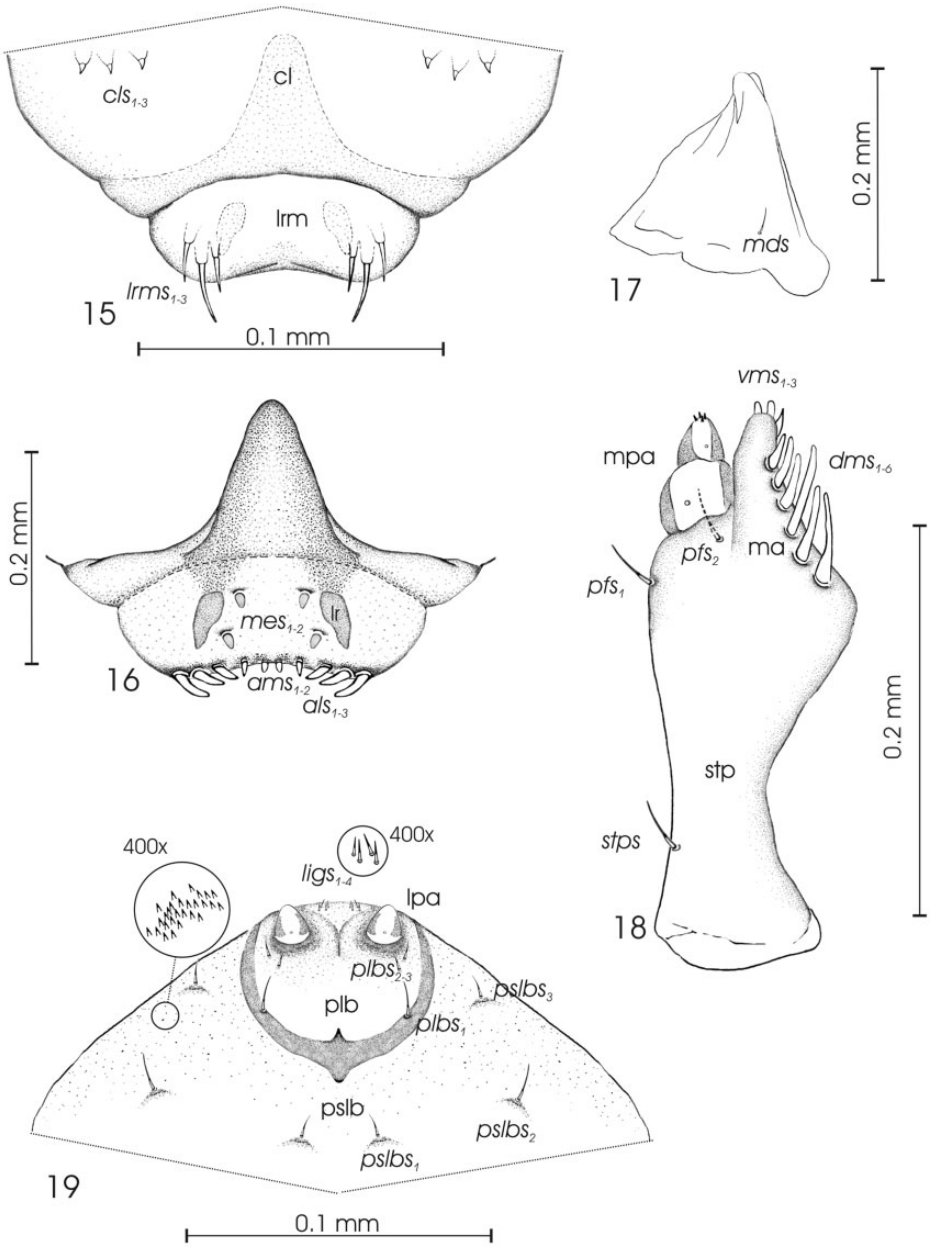
Chaetotaxy

Setae short, straight, of unequal length, light brown or brown, on rostrum, head, and pronotum based on small protuberances. Rostrum with a pair of *rs*; head capsule bearing paired *vs*, *sos*, *pas,* and two pairs of os_{1-2} (Fig. 21). Setae *rs*, *vs,* and sos_1 darker and two times longer than remaining ones. Pronotum on each side with paired as_{1-2}, ls_{1-2}, ds_{1-2}, and pls_{1-2} (Fig. 23). Chaetotaxy of metathorax as on mesothorax, consisting of paired triplets d_{1-3} (Fig. 22). Each femoral apex with a pair of *fes* of almost equal length (Fig. 20). Tergal parts of AbI–VIII each with two triplets of d_{1-3} located laterally, respective sternal parts of AbI–VIII with a short seta (l_1) close to the border with tergum. AbIX with paired ventral (v_1) and dorsal setae (d_1) (Figs. 22, 24).

Ecology

The Lower Biebrza Valley is the only area in Poland where *B. elegans*, extremely rare and endangered European weevil, was found in the past 70 years (Wanat 2004, 2005). The population there is associated exclusively with the canarygrass reed (*P. arundinacea* L.), which

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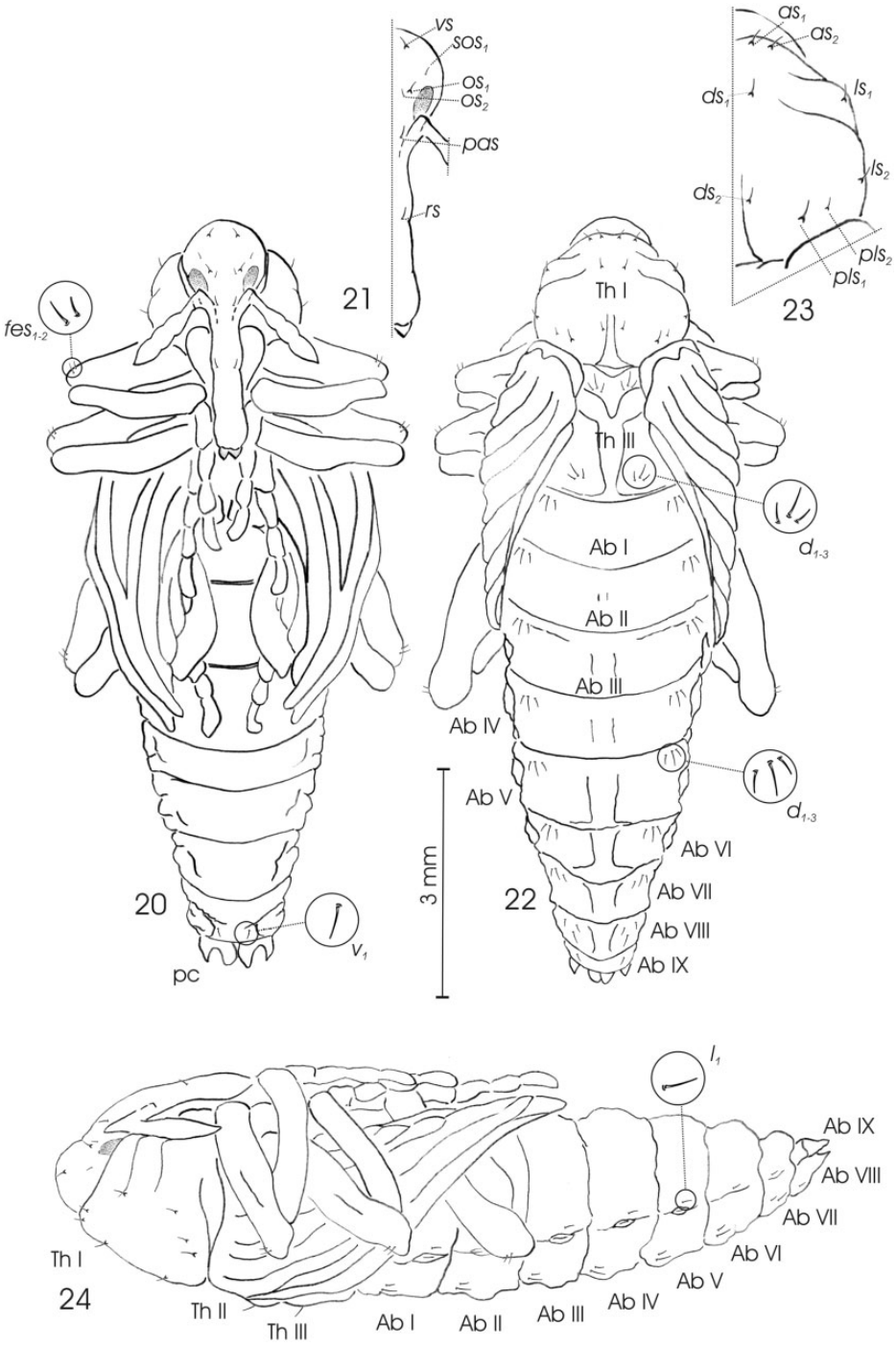


Figs. 15–19. *B. elegans*, larval mouth parts: (15) labrum and clypeus; (16) epipharynx; (17) mandible; (18) maxilla; (19) praelabium and postlabium, ventral aspect. Abbreviations: (cl) clypeus, (lpa) labial palp, (lr) labral rods, (lrm) labrum, (mpa) maxillary palps, (ma) mala, (plb) praelabium, (plsb) postlabium, (stp) stipes; setae: (*als*) anterolateral, (*ams*) anteromedial, (*cls*) clypeal, (*dms*) dorsal malar, (*ligs*) ligular, (*lrms*) labral, (*mds*) dorsal mandibular, (*mes*) median, (*pfs*) palpiferal, (*plbs*) praelabial, (*pslbs*) postlabial, (*stps*) stipal, and (*vms*) ventral malar.

is exceptional in this species. It inhabits old-rivers and channels near their mouth to the Biebrza river, connected with the main river bed, and thus with a partly refreshed water till at least June after the spring melt. Larval development takes place in the submerged stolons of the grass and is always restricted to the most basal second or third internode. The larvae feed and pupate inside the stem, always one per internode, and fresh beetles were found there since end of July, when the inhabited basal internodes are often emerged after the summer fall down of water level. However, phenology of this species is highly dependent on the seasonally variable water level in the river and its drainage, and its reproductive success is apparently largely limited in years with dry springs. It is likely that in extremely dry years and low water supply in winter/spring a part of the specimens do not attempt to breed and remain in diapause until the next season, as it was confirmed for the closely related *B. majzlani* (Kodada et al. 1992). Adults of *B. elegans* are poorly active, flightless, and nonswimming beetles, and they rarely appear on emerged parts of stems during a day, spending long time under water, and breathing thanks to the plastron or the oxygen produced by plants. They are surprisingly resistant to standard procedures of killing in preservation liquids or ethyl acetate mist, and it takes an unusually long time to get them quiet compared with all other beetles we ever experienced.

The biology of *B. elegans* in the Biebrza Valley is very similar to that studied in *B. frivaldszkyi* (Gosik 2006b). The latter species is common and abundant throughout the Southern Biebrza Basin, including all places occupied by *B. elegans* (Wanat 2005). Although both these weevils develop in the stems of *P. arundinacea*, the larvae of *B. frivaldszkyi* have never been found beside those of *B. elegans* in basal internodes of the grass. They apparently develop in more distant

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Figs. 20–24. *B. elegans*, pupa, habitus and chaetotaxy: (20) total, ventral view; (21) chaetotaxy of head; (22) total, dorsal view; (23) chaetotaxy of pronotum; and (24) total, lateral view. Abbreviations: (Ab_n) abdominal segment, (pc) pseudocerci, (Th_n) thoracic segment; setae: (*as*) apical, (*d*) dorsal, (*ds*) discal, (*fes*) femoral, (*l*, *ls*) lateral, (*os*) orbital, (*pas*) postantennal, (*pls*) posterolateral, (*sos*) super-orbital, (*v*) ventral, and (*vs*) vertical.

internodes closer to water surface, thus the larvae of these two weevil species do not meet on the same plant.

The host plant of the Biebrza population of *B. elegans* is not that well known for this weevil in Europe, i.e., the common reed *Phragmites australis* (Cav.) Trin. ex Steud. (Brauns 1891, Poot 1972, Dieckmann 1983, Messner and Dieckmann 1987, Balalaikins and Bukejs 2010). Moreover, Kodada et al. (1992) indicated and illustrated slight morphological differences between various populations of *B. elegans* in Western Palaearctic. Therefore, taxonomic status of the Biebrza population of *B. elegans* remains still not well established, despite lack of convincing morphological differences of adult beetles from those reared from *Ph. australis* in Germany (Mark Brandenburg: Templin).

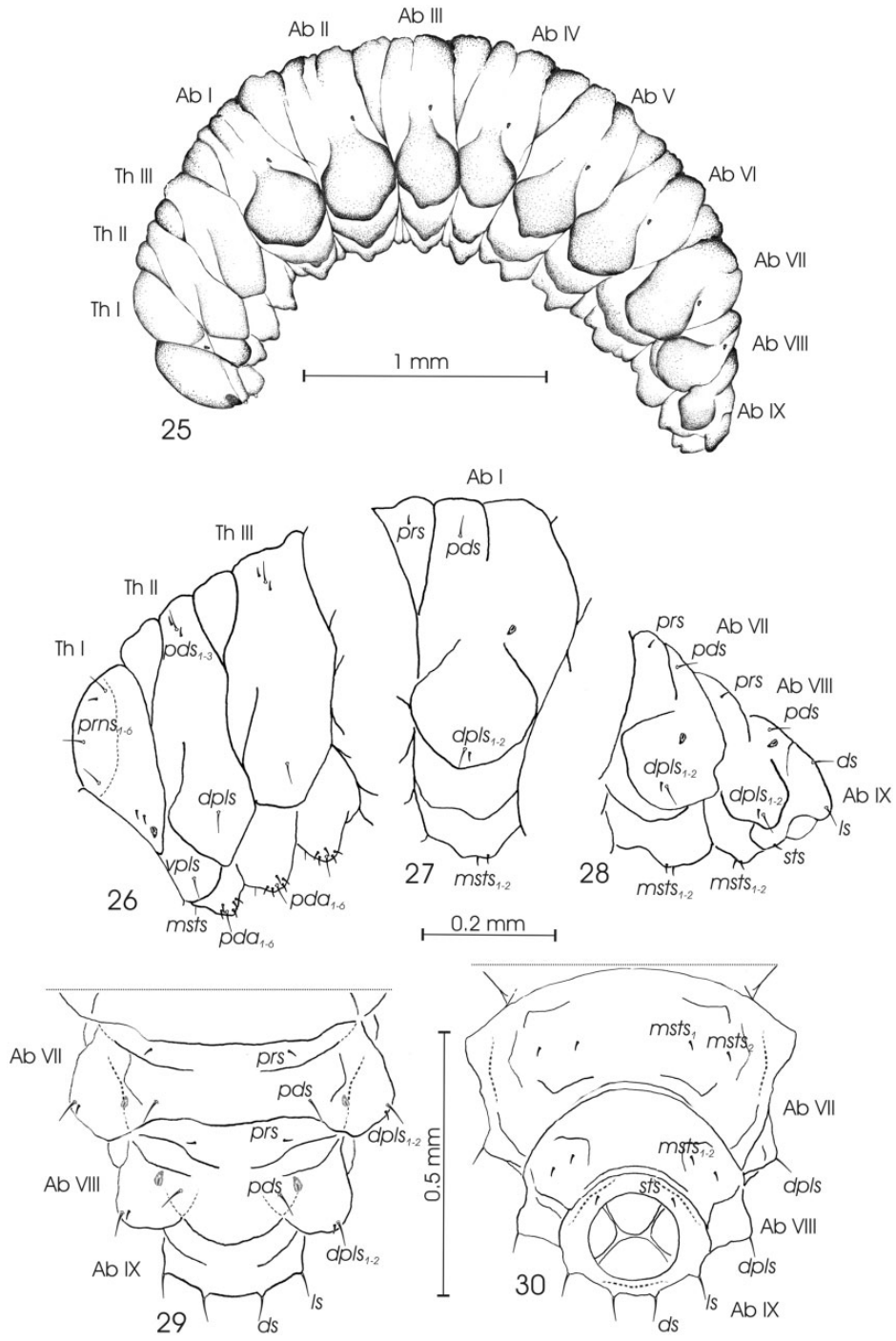
Bagous aliciae Cmoluch, 1983

(Fig. 2)

Material Examined

POLAND: Wieprzecka Góra near Zamość, UTM: FB51, 21 June 1994, nine larvae of different instars, leg. J. Szypuła & MW (MNHW, RG). All collected from top parts of rachitic golden chamomile

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Figs. 25–30. *B. aliciae*, larva, habitus and chaetotaxy: (25) habitus; (26) thoracic segments; (27) first abdominal segment; (28–30) abdominal segments VII–IX: (28) lateral view, (29) dorsal view, and (30) ventral view. Abbreviations: (Ab_n) abdominal segment, (TH_n) thoracic segment; setae: (*dpls*) dorsopleurolateral, (*ds*) dorsal, (*ls*) lateral, (*msts*) mesosternal, (*pda*) pedal, (*pds*) postdorsal, (*prns*) pronotal, (*prs*) prodorsal, and (*sts*) sternal.

(*A. tinctoria* L.) growing mostly on the border between natural xerothermophilous swards (*Thalictro-Salvietum* type communities) and agrocoenose (wheat field).

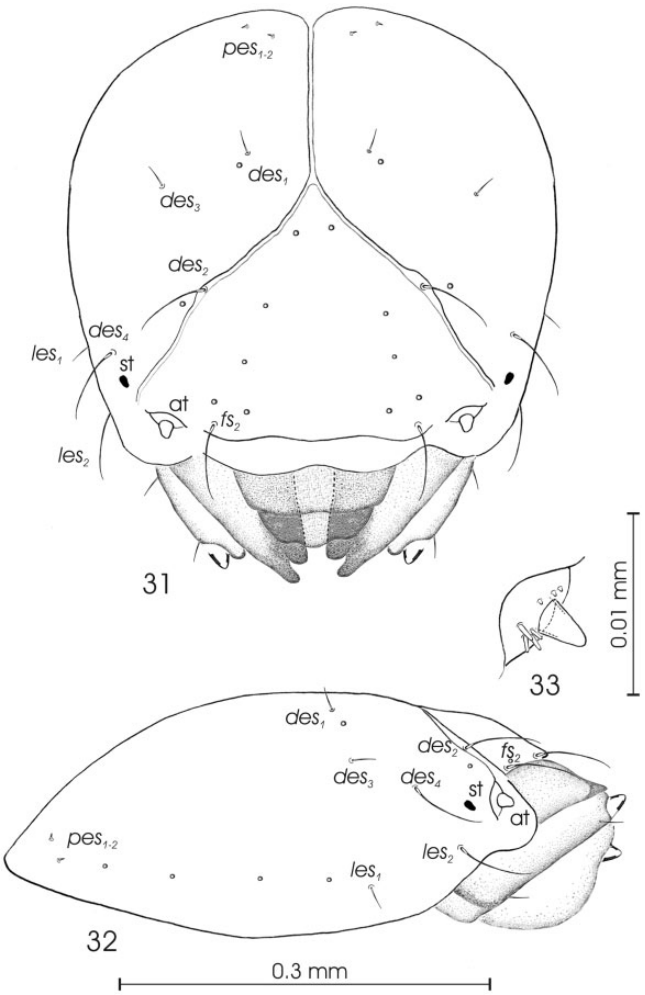
Description of larva (L_2, L_3)

(Figs. 25–38)

General Morphology

All thoracic and abdominal segments yellow. Cuticle minutely spiculated. Pronotal area of first thoracic segment sclerotized, light brown. Body (L_3) 1.8–3.2 mm long, slender, curved, and rounded in cross section (Fig. 25). The thickest place of body (AbI) up to 0.75 mm of height. Prothorax narrow, smaller than mesothorax. Metathorax similar to mesothorax, both slightly smaller than AbI. AbI–V almost of equal length, subsequent segments gradually decreasing, AbIX semicircular in dorsal view. AbX reduced to four anal lobes of equal size. Dorsal parts of AbI–VIII divided into three lobes. Lateral lobes on abdominal segments well isolated, on AbVII–VIII each forming a small protuberance on the posterior segmental margin. Spiracles in all nine pairs, bicameral, first pair placed in anterior margin of pronotum, next

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Figs. 31–33. *B. aliciae*, larval head: (31) dorsal view; (32) lateral view; and (33) antenna, magnified. Abbreviations: (at) antenna; (st) stemma; setae: (*des*) dorsal epicranial, (*fs*) frontal, (*les*) lateral epicranial, and (*pes*) postepicranial.

seven pairs lateromedial, and the last one placed dorsolaterally on AbVIII.

Chaetotaxy

Setae minute, light yellow, hairform, differing in size, and poorly distinguishable. Each side of prothorax (Fig. 26) with six *prns* unequally long (three long and one short located on the sclerotized part, two short placed close to the spiracle), one *vpls* and one short *msts*. Both meso- and metathorax on sides with three *pds* of different length, one *dpls* and one *msts*. Pedal areas of thoracic segments each with one long and five short *pda*. AbI–VIII on each side with one short *prs*, one medium long *pds*, two *dpls* of different length, and 2 short *msts* (Fig. 27). AbIX with paired relatively long *ds*, *ls,* and *sts* (Figs. 28–30).

Head and Mouth Parts

Head (L_3) brown or light brown; width: 0.30–0.36 mm, length: 0.27–0.32 mm, oval shaped, frontal suture distinct, and Y-shaped. Setae, on head hairform, are of different length. Setae des_1 and des_3 moderately long, located in central part of epicranium; des_2 very long, placed on frontal suture; des_4 as long as des_2, located anterolaterally, and close to the stemma (Figs. 31 and 32). Setae fs_2 as long as des_2, placed laterally close to epistome. Setae les_1 short, les_2 slightly shorter than des_2. Postepicranial area with a pair of very short *pes*. Frons with five pairs of pores distributed along frontal suture; four pores placed laterally on each side of head, one pore near des_1, and the last one close to des_2. Antenna located on end of frontal suture; antennal segment with sensorium conical, slightly elongated, and located centrally; basal membranous article with seven sensillae of different shape and size (Fig. 33).

Labrum (Fig. 34) approximately two times as wide as long, with three pairs of *lrms* of different length; $lrms_2$ almost two times longer than $lrms_1$ and $lrms_3$, all *lrms* placed on protuberances. Clypeus three times as wide as long, with paired equally long short-conical cls_{1-2} localized posteromedially; anterior margin almost straight. Epipharynx (Fig. 35) with three pairs of blunt, finger-like *als* of different length; 2 pairs of short, triangular *ams*, and 2 pairs of finger-like *mes*; labral rods elongated, converging posteriorly. Mandibles (Fig. 36) slightly truncate, bifid with teeth of unequal length, and the cutting edge with a small triangular tooth. *Mds* short, hair-like. Maxilla (Fig. 37) having stipes with one *stps* and two *pfs*, (pfs_1 longer than pfs_2); mala with seven bacilliform or spatulate *dms* of different length; three *vms* short, almost equal in length; *vms* shorter than *dms*; maxillary palps with two palpomeres, distal one 2.4 times longer than basal one, with a single pore sub basally and a group of 5–6 distinct, conical cuticular processes apically. Praelabium (Fig. 38) almost rounded, with two pairs of unequally long *plbs* ($plbs_1$ located posterolaterally, $plbs_2$ laterally on the premental sclerite). Ligula with four pairs of hairform micro *ligs* of equal length. Premental sclerite well visible, forming incomplete ring. Labial palps one-segmented, located on conical protuberances; each palpomere with several short, apical cuticular processes, and a pore. Postlabium (Fig. 38) with three pairs of variously long *pslbs*; $pslbs_2$ distinctly longer than the other ones and directed outward, the first pair localized medially, the remaining one laterally.

Ecology

The host species discovered at Wieprzecka Góra hill in Poland by J. Szypuła is *A. tinctoria*, and dwarf plant specimens, growing in suboptimal conditions, and usually on bare ground, were evidently preferred for oviposition there. The larvae are in fact exophagous, although they were found hidden deeply in tight apical leaf buds of golden chamomile, so at least by sunny day they are not exposed on the plant. No traces of pupal chambers were observed in the plants occupied by mature larvae and, considering external larval feeding, pupation is almost certainly in the soil near the host plant, like it was confirmed for the close relative *B. lutulosus*.

Three localities of this little known and very rare species in Poland, though all open and sunny, are very different regarding environmental conditions. Its *locus typicus* in Opoka Wielka and the rich site on Wieprzecka Góra (well over 100 adults collected in all) are warm and floristically rich steppe grasslands growing on calcareous soils, while the last discovered site in Piątnica (Wanat 2005) is an initial ruderal plant community covering sandy and clay ground of abandoned gravel-pit.

Interestingly, the intensely yellow coloration of larval body is contrasting with the plant substrate, which is silver-white due to dense clothing of hairs on early developing leaves. However, it fits well the deeply yellow color of golden chamomile flowers, being still in buds with a small yellow "eye" when the larvae end their development. Thus it may be considered a mimics, especially for mature larvae being too large to hide inside the leaf bud. On the contrary, the adults are concolorous with a young leaf surface due to white hydrofuge coating of the body, but they are also practically invisible on the ground near the plant.

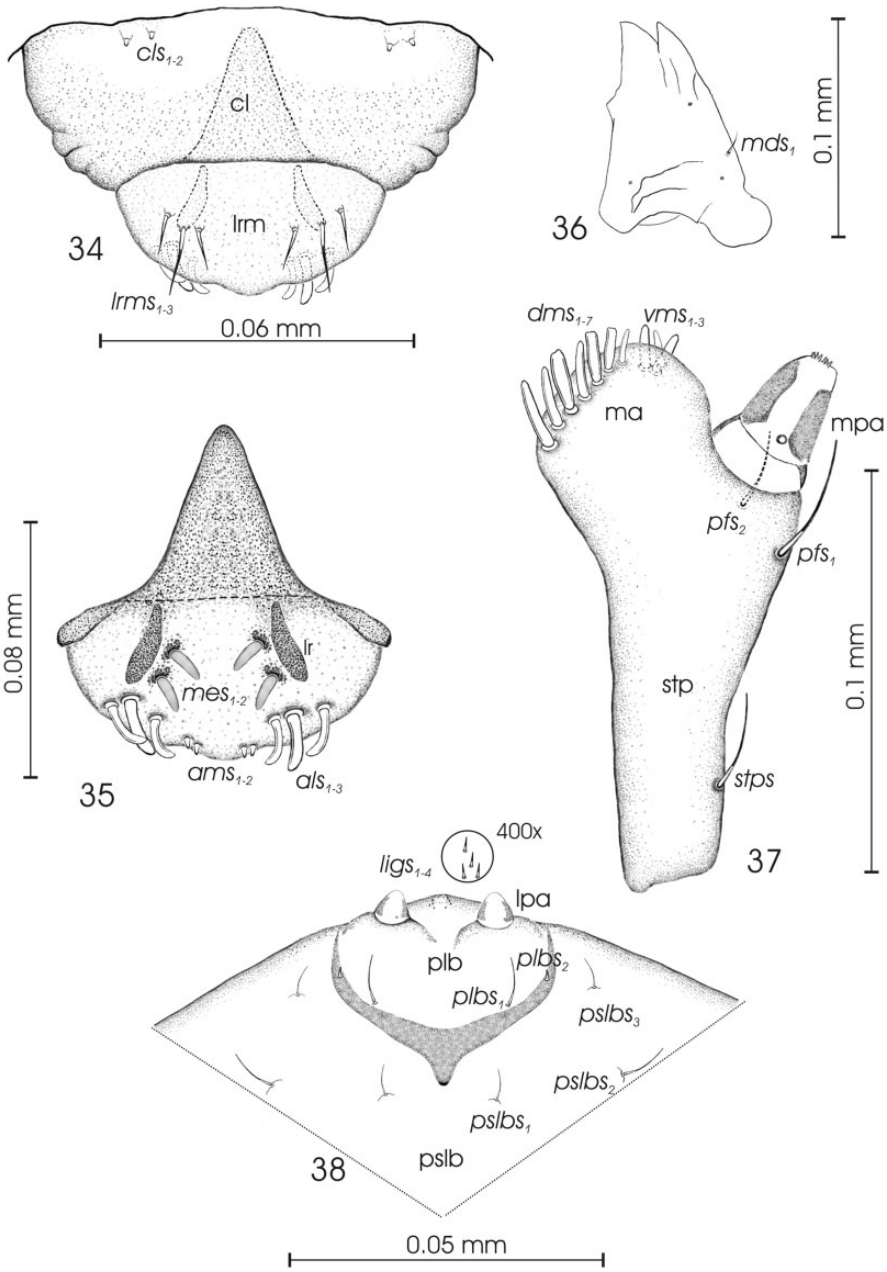
Bagous lutulosus (Gyllenhal, 1827)

(Fig. 3)

Material Examined

POLAND: Biebrza National Park, Szostaki, UTM: EE90, 16 June 2010, four larvae of different instars collected from florets of toad rush

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Figs. 34–38. *B. aliciae*, larval mouth parts: (34) labrum and clypeus; (35) epipharynx; (36) mandible; (37) maxilla; (38) praelabium and postlabium, and ventral aspect. Abbreviations: (cl) clypeus, (lpa) labial palp, (lr) labral rods, (lrm) labrum, (mpa) maxillary palps, (ma) mala, (plb) praelabium, (plsb) postlabium, (stp) stipes; setae: (*als*) anterolateral, (*ams*) anteromedial, (*cls*) clypeal, (*dms*) dorsal malar, (*ligs*) ligular, (*lrms*) labral, (*mds*) dorsal mandibular, (*mes*) median, (*pfs*) palpiferal, (*plbs*) praelabial, (*pslbs*) postlabial, (*stps*) stipal, and (*vms*) ventral malar.

(*J. bufonius* L.) (further six larvae taken with plants to laboratory and reared to adults on 7 July 2010); leg. MW (MNHW, RG).

Description of larva (L_2, L_3)

(Figs. 4, 5, 39–52)

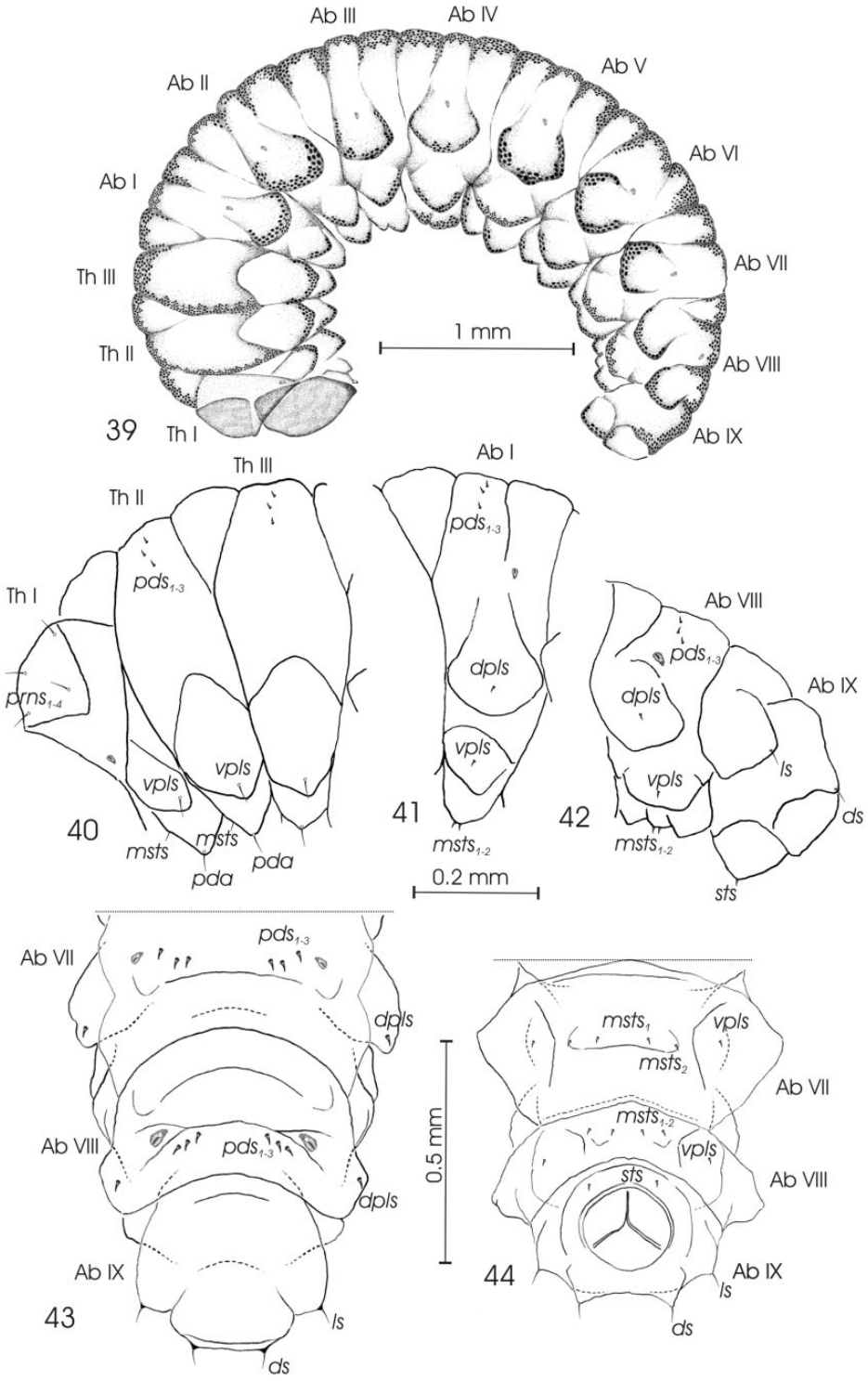
General Morphology

All thoracic and abdominal segments grayish, covered (especially on dorsal parts) by different in size spots, created by hardened, dark-pigmented cuticle. Pronotal area of first thoracic segment well sclerotized, black. Body (L_3) 3.4–3.7 mm long, slender, elongated, visibly curved, and slightly oblate dorsoventrally (Fig. 39); the thickest place (first abdominal segment) measuring up to 0.80 mm in height. Prothorax narrow, meso- and metathorax similar to each other and almost equal in size with the first segment of abdomen. AbI–V of almost equal length, subsequent ones gradually decreasing, AbIX almost semicircular in dorsal view. AbX reduced to three anal lobes of equal size. Dorsal parts of AbI–VII divided into three lobes, on AbVIII into two lobes. Lateral lobes on abdominal segments well isolated, on segments VIII and IX forming a small protuberances on posterior margin of each ones. Spiracles nine pairs, bicameral, first pair placed on anterior margin of pronotum, next seven pairs lateromedial, and last pair placed dorsolaterally on AbVIII.

Chaetotaxy

Feebly developed, setae light brown, hairform, variably sized, and poorly visible. Prothorax (Fig. 40) on each side with four long, equally sized *prns* placed on a sclerotized part, one *vpls* and one short *msts*.

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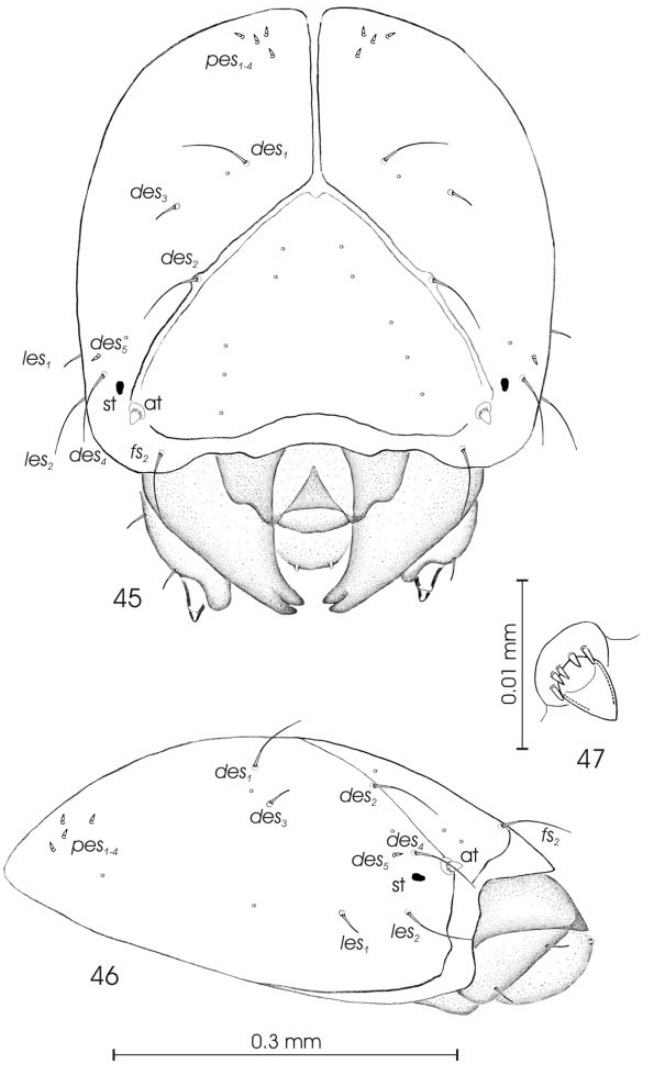
Figs. 39–44. *B. lutulosus*, larva, habitus, and chaetotaxy: (39) habitus; (40) thoracic segments; (41) first abdominal segment; (42–44) abdominal segments VII–IX: (42) lateral view, (43) dorsal view, and (44) ventral view. Abbreviations: (Ab_n) abdominal segment, (TH_n) thoracic segment; setae: (*dpls*) dorsopleurolateral, (*ds*) dorsal, (*ls*) lateral, (*msts*) mesosternal, (*pda*) pedal, (*pds*) postdorsal, (*prns*) pronotal, (*sts*) sternal, and (*vpls*) ventropleural.

Sides of meso- and metathoracic segments each with three short, equally long *pds*, one *vpls,* and one *msts*. Pedal area of each thoracic segment with one long *pda*. Each side of AbI–VIII with three short *pds*, one short *dpls*, 1 *vpls,* and two short *msts* (Fig. 41). AbIX with paired *ds*, *ls,* and *sts* (Figs. 42–44).

Head and Mouth Parts

Head black; width (L_3): 0.36–0.38 mm, length: 0.32–0.30 mm; slightly oblate bilaterally, frontal suture distinct, and Y-shaped. Setae of the head hairform, different in length (Figs. 45 and 46). Des_1 three times longer than des_3, both located in the central part of epicranium, des_2 as

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Figs. 45–47. *B. lutulosus*, larval head: (45) dorsal view; (46) lateral view; and (47) antenna, magnified. Abbreviations: (at) antenna; (st) stemma; setae: (*des*) dorsal epicranial, (*fs*) frontal, (*les*) lateral epicranial, and (*pes*) postepicranial.

long as des_1, placed on frontal suture, des_4 as long as des_1 located near to stemmata. A single micro-seta (des_5) present close to des_4 (Figs. 45 and 46). Seta fs_2 as long as des_1, placed anterolaterally. Seta les_1 as long as des_3, les_2 almost as long as des_1. Postepicranial area with group of four short pes_{1-4}. Frons with five pairs of pores distributed more or less along frontal sutures; further pairs of pores placed outside frontal area, one pair near des_1, other near des_4 and two pairs close to head margin (Fig. 46). Antenna located at end of frontal suture; antennal segment with sensorium conical, elongated, and located medially; basal membranous article with five sensillae of different shape and length (Fig. 47).

Labrum (Fig. 48) approximately three times as wide as long, with three pairs of $lrms_{1-3}$ of different length; $lrms_2$ very long, $lrms_1$ shorter than other ones; all *lrms* placed on protuberances; and anterior margin of labrum slightly bisinuate. Clypeus (Fig. 48) 3.5 times as wide as long with three triangular, short cls_{1-3}, of equal length, localized posteromedially; and anterior margin of clypeus broadly emarginate. Epipharynx (Fig. 49) with three pairs of blunt, finger-like als_{1-3} of almost equal length; three pairs of short, triangular ams_{1-3}, and two pairs of conical *mes*. Labral rods wedge-shaped with bisinuate inner margins, almost parallel. Mandibles (Fig. 50) truncate, bifid, teeth of slightly unequal length, and the cutting edge with a blunt prominence; mds_{1-2} short, hairform. Maxillary stipes with 1 *stps* and 2 *pfs* of equal length; mala with seven finger-like dms_{1-7} of different length; vms_{1-3} of almost equal length; and *vms* shorter than *dms* (Fig. 51). Maxillary palps with two palpomeres; basal palpomere 2.5 times longer than distal one, the latter apically with a group of five conical, cuticular processes. Praelabium (Fig. 52) heart shaped, with three pairs of variously long $plbs_{1-3}$ ($plbs_1$ located posteromedially, $plbs_{2-3}$ placed on premental sclerite). Ligula with three pairs of hairform, micro $ligs_{1-3}$ of equal length. Premental sclerite well visible, forming incomplete ring. Labial palps one-segmented, each palpomere with some short, cuticular apical processes and a pore. Postlabium (Fig. 52) with three pairs of $pslbs_{1-3}$, the first pair situated medially, the remaining two pairs laterally; $pslbs_2$ longer than two other ones.

Ecology

The host plant of this species is *Juncus bufonius* L. Late larval instars are permanently exophagous and feed partly or fully exposed on the sepals and petals (Figs. 4 and 5), occasionally also on the leaves wrapped around the bract supporting the floret. Pupation takes place in the permeable, sandy soil near the host plant. Pupal stage takes no longer than a week (Wanat 2011).

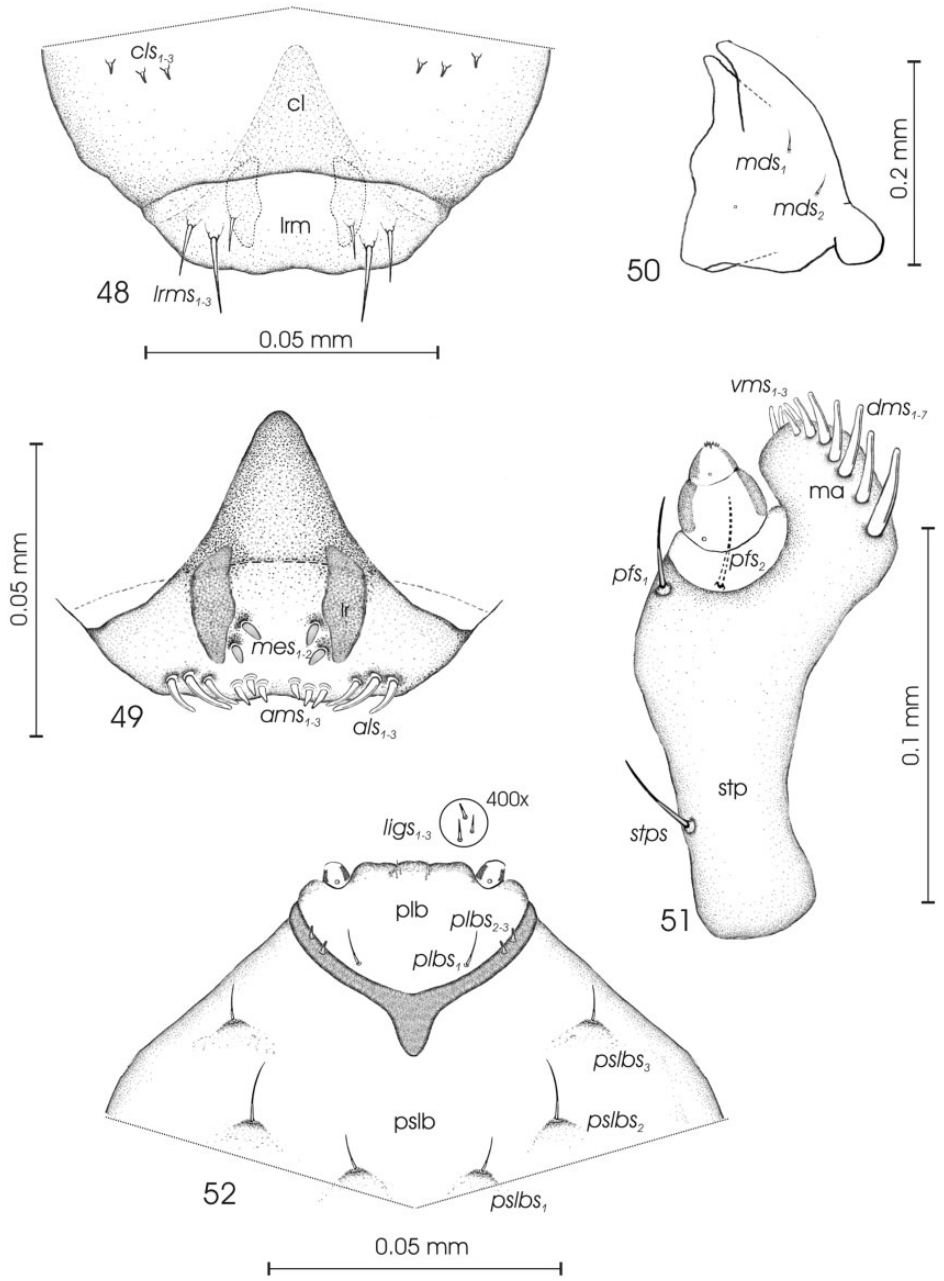
Discussion

The larvae described above represent species placed in two disparate species groups based on adult morphology (Caldara and O'Brien 1998) and expressing two very distinct modes of life. The larval and pupal characters of *B. elegans* confirm close relationship of the former genus *Dicranthus* with the *tubulus* group, as supposed from adult morphology and biological affinities. The larva of *B. elegans* shares with that of *B. frivaldszkyi*, a member of the *tubulus* group, described by Gosik (2006b), the following characters: slender and elongated body; almost identical chaetotaxy (especially on thorax and abdomen); setae relatively short, and praelabium with cuticular processes. Pupae of these two species have very slender body and reduced number of setae on dorsal parts of all abdominal segments and on pseudocerci. The most significant differences between larvae of these two species concern: shape of head (rounded in *B. frivaldszkyi* versus oblate bilaterally in *B. elegans*); labial palps in *B. frivaldszkyi* inserted on distinct protuberances, which are absent in *B. elegans*); shape of protuberances on AbVI–VIII (weakly developed in *B. frivaldszkyi* versus distinct and elongated in *B. elegans*).

The larvae of two other species studied herein are both terrestrial and exophagous, at least as L_3, although they are associated with very different plant groups (monocotyledonous Poales versus dicotyledonous Asterales) and biotopes (mesophilous to humid meadows versus xeric swards). Adults of *B. lutulosus* and *B. aliciae* are very close to each other in almost every respect of external morphology, so it was interesting to compare their larvae and estimate their distinctive characters. Although larvae of these weevil species have very different coloration (intensely yellow in *B. aliciae*; grayish with dark spots in *B. lutulosus*), the characters of head, mouthparts, postabdomen, and chaetotaxy appear very uniform. Surprisingly the most outstanding difference is in the structure of cuticle: densely covered with small spike-like cuticular processes in *B. aliciae* versus visibly coriaceous and covered with rounded, hardened spots in *B. lutulosus*. A similar form of cuticle was observed also in the larvae of *B. binodulus*, another exophytic species of *Bagous*, though living on a strictly water plant (Gosik 2010), but the spots never get dark in this species. Exophagous mode of feeding has not been reflected in different chaetotaxy, and the number, size, and shape of setae is similar to those observed in larvae of other *Bagous* species with endophytic development.

The structural diversity of immature stages of the genus *Bagous* is greater than it was previously supposed (Leiler 1987). The newly described larvae posses some features (e.g., reduction of des_1 in *B. aliciae*, spotting of the body and rough cuticular surface in *B. lutulosus*) not seen in the previously studied species. At the same time

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Figs. 48–52. *B. lutulosus*, larval mouth parts: (48) labrum and clypeus; (49) epipharynx; (50) mandible; (51) maxilla; and (52) praelabium and postlabium, ventral aspect. Abbreviations: (cl) clypeus, (lpa) labial palp, (lr) labral rods, (lrm) labrum, (mpa) maxillary palps, (ma) mala, (plb) praelabium, (plsb) postlabium, (stp) stipes; setae: (*als*) anterolateral, (*ams*) anteromedial, (*cls*) clypeal, (*dms*) dorsal malar, (*ligs*) ligular, (*lrms*) labral, (*mds*) mandibular dorsal, (*mes*) median, (*pfs*) palpiferal, (*plbs*) praelabial, (*pslbs*) postlabial, (*stps*) stipal, and (*vms*) ventral malar.

features previously attributed to a single species, proved to be more widespread. There is a black color of the head and pronotal area in *B. lutulosus*, considered as typical for the larvae of *B. alismatis* (Gosik 2008). Cuticular processes covering the surface of larval postlabium, regarded as typical only for *B. frivaldszkyi* by Gosik (2006b), were found also in the larva of *B. elegans*. Therefore, the set of diagnostic characters for the larva of *Bagous* developed by Gosik (2006a, 2008, 2009, 2010) can be extended with the following items: 1) chaetotaxy of the body poorly developed; 2) des_1 occasionally absent (*B. aliciae*), des_2 located on frontal suture, des_3 reduced to absent, des_4 present; 3) antenna with conical, more or less elongated sensorium; 4) epipharnyx with 1–2 pairs of *ams*, 2 pairs of *mes*, and 3 pairs of *als*; 5) maxilla with 1 *stps*, 2 *pfs*, and 3–7 *dms*, 1–4 *vms*; and 6) lateral folds of AbVIII, IX forming more or less visible protuberances.

The following diagnostic combination of characters can be compiled for the pupa of genus *Bagous* based on *B. elegans* and previously described species (Mantovani et al. 1992; Gosik 2006a, b, 2008, 2009): 1) body slender, white, or light yellow; 3) antennae rather short; 4) setae hairform, of different length; 5) setae on head, rostrum, and pronotum placed on more or less visibly protuberances; 7) pronotum with 1–2 pairs of *as*, 1–3 pairs of *ls*, 1–2 pairs of *ds*, and 1–2 pairs of *pls*; 10) each femoral apex of with a pair of setae and; 11) pseudocerci triangular, moderately long.

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for a long time permission and help in field studies on the weevils in the Park. A good company and field experience of Jurek Szypuła in looking for *Bagous* escapades are greatly acknowledged.

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