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Morphology of immature stages and life cycle of *Dorytomus longimanus* (Forster, 1771) (Curculionidae, Ellescini)

by

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Abstract. The mature larva and pupa of *Dorytomus* (*Dorytomus*) *longimanus* (Forster, 1771) are re-described and illustrated by colour photos and SEM techniques. The development of this species is presented, life cycle data are summarized, and host plant data are discussed. Attention is drawn to the considerable colour variation and the visual similarity of the larvae with different developmental stages of the catkins of black poplars and black poplar hybrids, which may be a special form of camouflage or mimesis.

Zusammenfassung. Das letzte Larvenstadium und die Puppe von *Dorytomus longimanus* werden mit Hilfe von Farbfotos und rasterelektronischenmikroskopischen Aufnahmen beschrieben. Die Entwicklung der Art wird vorgestellt, Wirtspflanzenangaben werden diskutiert, und es wird auf die erhebliche Farbvariation und die visuelle Übereinstimmung der Larven mit verschiedenen Entwicklungsstadien der Kätzchen von Schwarzpappeln und Schwarzpappelhybriden zum Zweck der Tarnung (Mimese) hingewiesen.

Streszczenie. Ostatnie stadium larwalne i poczwarka *Dorytomus longimanus* zostały opisane i zilustrowane za pomocą fotografii świetlnej oraz zdjęć skaningowych. Szczegółowo przedstawiono rozwój osobniczy gatunku oraz omówiono dane dotyczące roślin żywicielskich. Wskazano również na znaczną zmienność ubarwienia larw i poczwarek *D. longimanus* koresponduj ąca ze zmiennością barw kotków topoli czarnej i jej mieszańców, co stanowi przykład kamuflażu (mimesis).

Keywords. Salicaceae, *Populus*, biology, morphology, colour variation, camouflage, mimesis, larva, pupa.

Introduction

One time in spring 2007, many *Dorytomus longimanus* weevils were recorded mating and boring holes in flower buds of the leafless *Populus nigra* L. trees already on 12.03.2007 in the Leine river valley close to Hannover-Herrenhausen (Fig. 1 and 11A). On 09.04.2007, a yellowish-white larva had been observed moving on a piece of bare and moist ground. In the following year, but now a month earlier, on 13.03.2008, a nearly completely red-coloured larva was again seen moving on the ground, and a third one with red and whitish longitudinal stripes was picked up from a catkin lying on the ground, both at the same site as in 2007. These observations directed my attention to the inflorescences of this tree species.

I picked some young, just developed catkins from the trees to rear these larvae. I remember well that I was astonished that at the next inspection after a few days there were more larvae than collected previously and placed inside the box. I repeated the breeding until the conditions where favorable, received the first pupa on 05.04.2008 and documented on 18.04.2008 the first adults of *Dorytomus longimanus* that appeared in the box demonstrating one of my first successful breeding attempts (Fig. 1G, H). A short documentation had already been published on the Snudebiller DWD work for *Dorytomus* and related genera (CURCULIO Team 2008).

After several years and the start of a long-lasting cooperation with the co-author, which was intensified during the “Bodenrüssler-Projekt” ('Soil-dwelling weevils project'), and which had been proposed by Martin Hommes from the Julius-Kühn-Institut in Braunschweig (see Sprick & Stüben 2012, and Gosik et al. 2016), I remembered the relatively easy breeding of these *Dorytomus* larvae and tried to expand it to other species.

Aim of our study was a re-description of the fully-grown larva and of the pupa, at first described by Scherf (1964), using newly developed techniques, to fill some gaps in chaetotaxy, to summarize life-cycle data and to review and discuss host plant data of this species.

Material

All specimens were reared from larvae that inhabited male catkins. Each larva was collected on the first given date, usually hiding in the catkins (instar not known), and larvae and pupae were taken out at the second date.

Mature larvae: 19 ex.
5 ex., 21.03.-07.05.2013, Koldingen (Hannover), *Populus nigra*.
3 ex., 17.04.-20.04.2021, Hannover-Herrenhausen, Leine river, *Populus nigra*.
2 ex., 21.03.-31.03.2020, Hannover-Linden, Leine river, *Populus x canadensis* Moench (= *Populus nigra* x *P. deltoides* Bartram ex Marshall).
5 ex., 21.03.-28.03.2020, Hannover-Linden, Leine river, *Populus x canadensis*.
1 ex., 17.04.-28.04.2021, Hannover-Herrenhausen, Leine river, *Populus nigra*.
3 ex., 21.03.-04.04.2020, Hannover-Herrenhausen, Leine river, *Populus x canadensis*.
Additional specimens:
7 ex., 01.04.-03.04.2025: Hannover-Linden, Leine river, *Populus x canadensis.*
3 ex., 04.04.-11.04.2025: Hannover-Herrenhausen, Leine river, *Populus nigra*.
2 ex., 04.04.-15.04.2025: Hannover-Herrenhausen, Leine river, *Populus nigra*.

Pupae: 9 ex. (5♀, 4♂).
1 ex., 21.03.-02.04.2020, Hannover-Linden, Leine river, *Populus x canadensis*.
3 ex., 17.04.-20.04.2021, Hannover-Herrenhausen, Leine river, *Populus nigra.*
3 ex., 17.04.-25.04.2021, Hannover-Herrenhausen, Leine river, *Populus nigra*.
2 ex., 04.04.-07.04.2021, Hannover-Linden, Leine river, *Populus x canadensis*.
Additional specimens:
2 ex., 04.04.-11.04.2025: Hannover-Herrenhausen, Leine river, *Populus nigra*.
1 ex., 04.04.-15.04.2025: Hannover-Herrenhausen, Leine river, *Populus nigra*.

To ensure species identification, some of the larvae and pupae were reared to the adult stadium in the laboratory (Fig. 1 G, H).

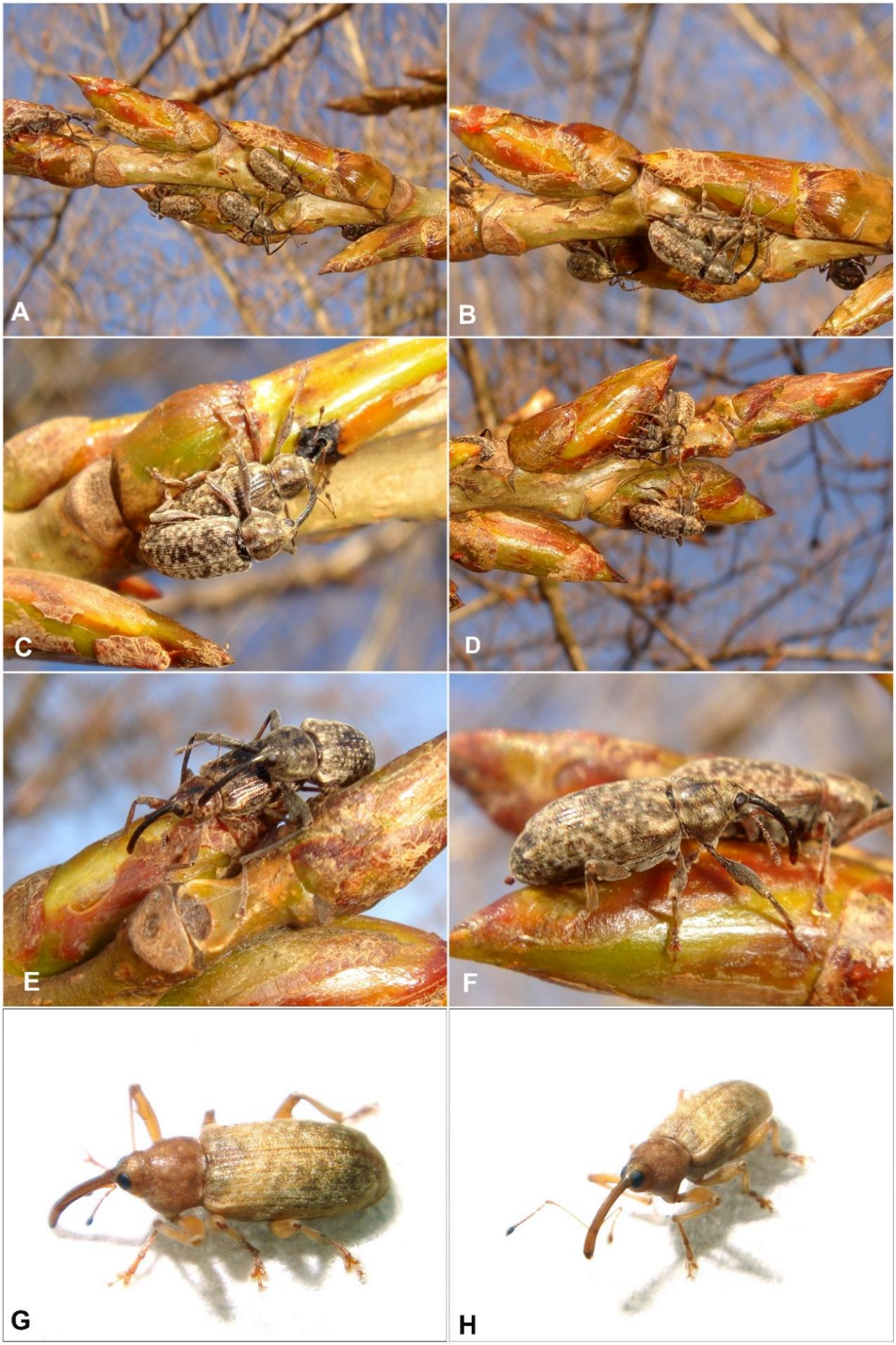

Figure 1. *Dorytomus longimanus,* adults, 12.03.2007; **A–F**– specimens on the host plant, mating and (C) preparing the oviposition site; **G, H**– specimens from laboratory breeding, 18.04.2008 (photos P. Sprick).

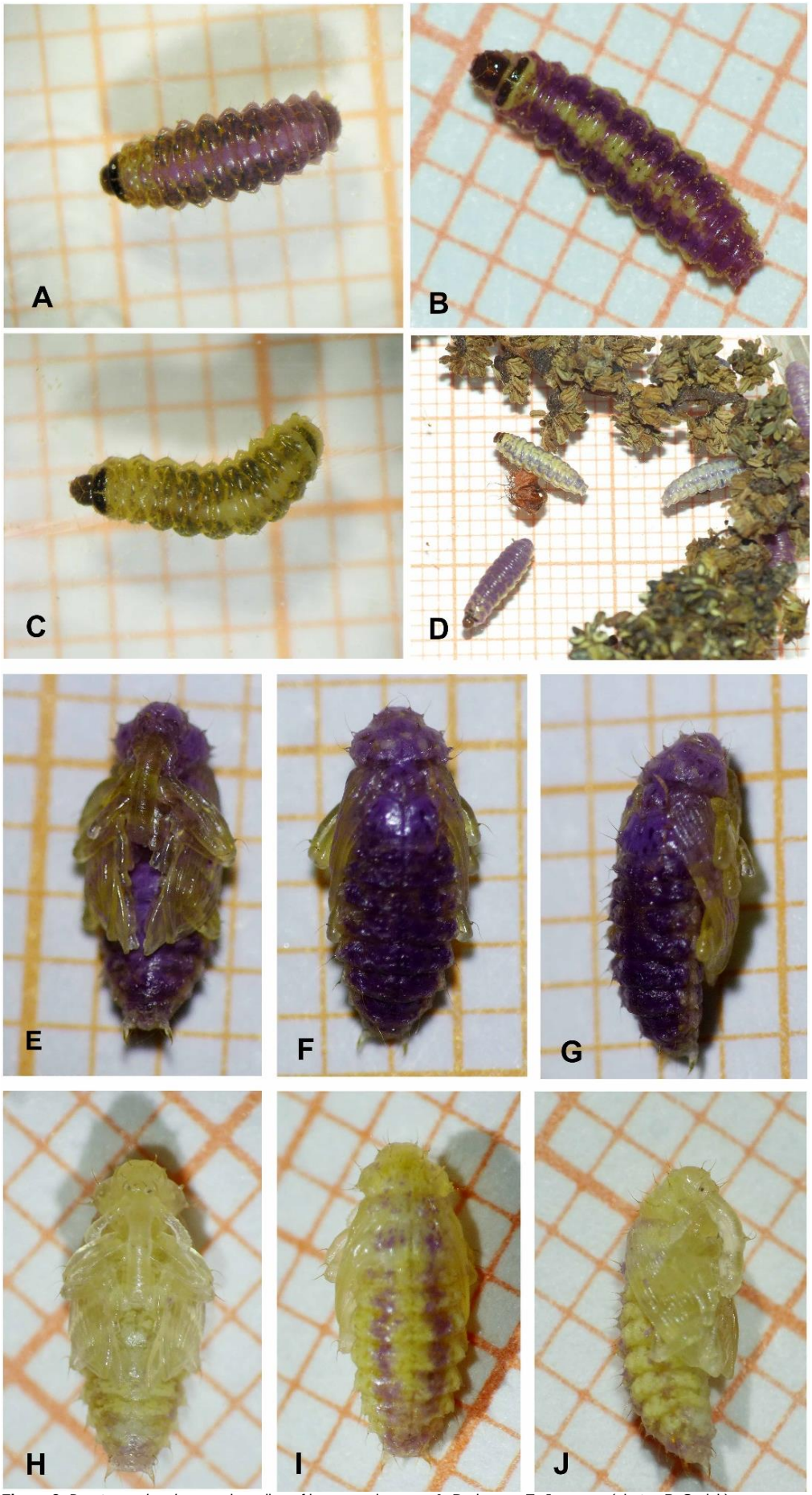

Figure 2. *Dorytomus longimanus*, breeding of larvae and pupae: **A–D**– larvae; **E–J**– pupae (photos P. Sprick).

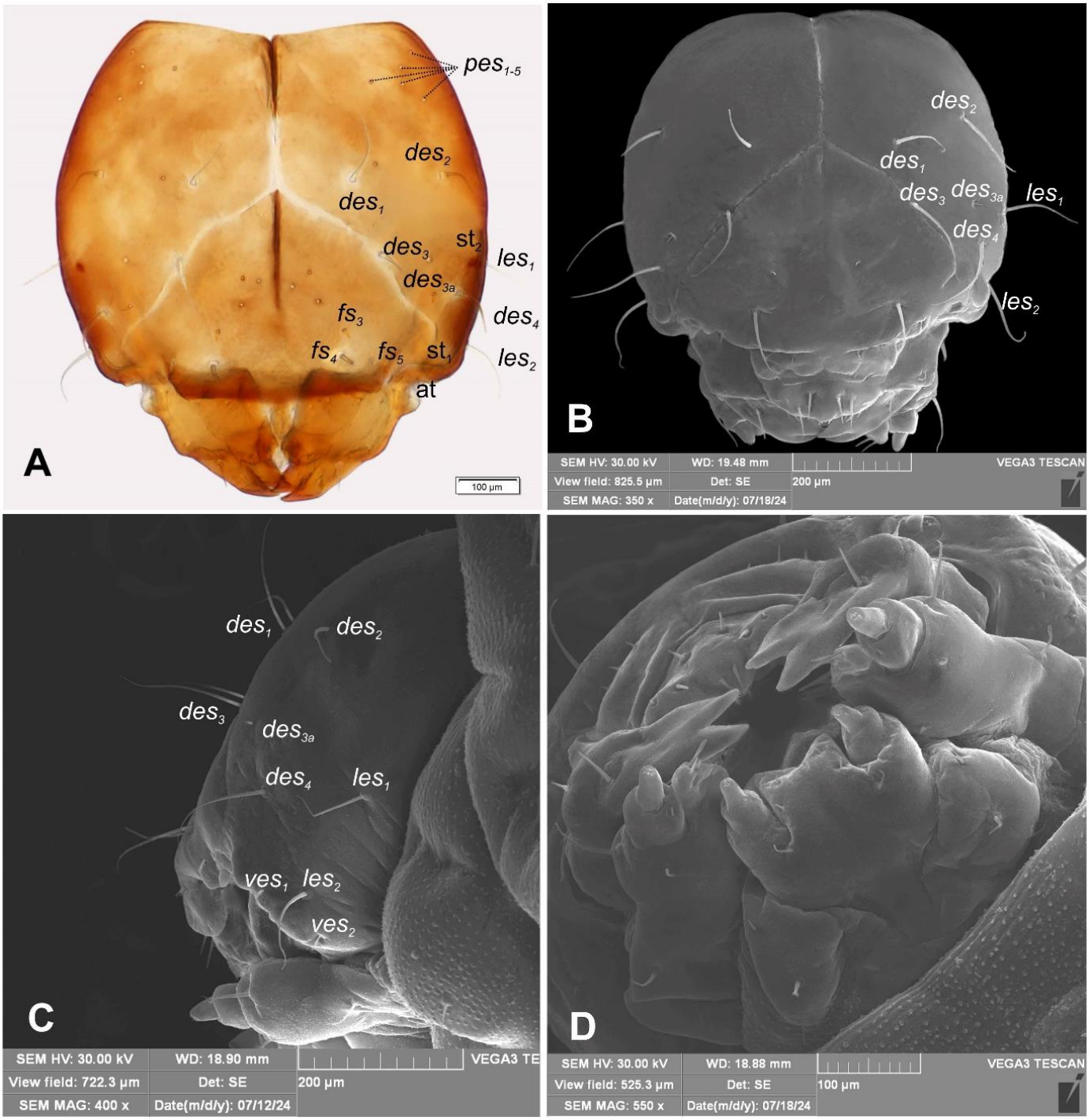

Figure 3. *Dorytomus longimanus,* mature larva, head: **A**– dorsal view (photo); **B**– dorsal view (SEM); **C**– lateral view (SEM); **D**– ventral view (SEM) (abbreviations: at–antenna, st–stemmata, setae: *des*–dorsal epicranial, *fs*–frontal epicranial, *les*–lateral epicranial, *pes*–postepicranial, *ves*–ventral epicranial) (photos R. Gosik).

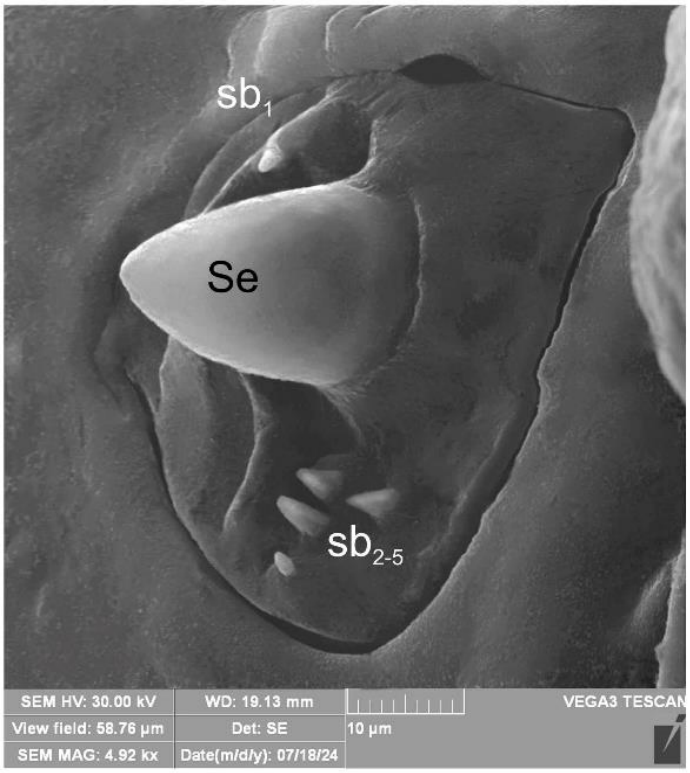

Figure 4. *Dorytomus longimanus*, mature larva, antenna, lateral view (SEM): sb–sensilla basiconica, Se–sensorium (photos R. Gosik).

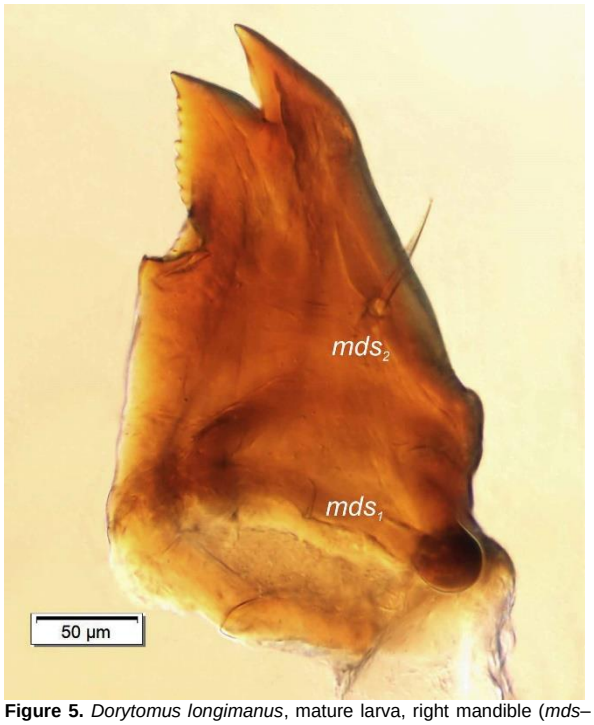

Figure 5. *Dorytomus longimanus*, mature larva, right mandible (*mds*–mandibular setae) (photos R. Gosik).

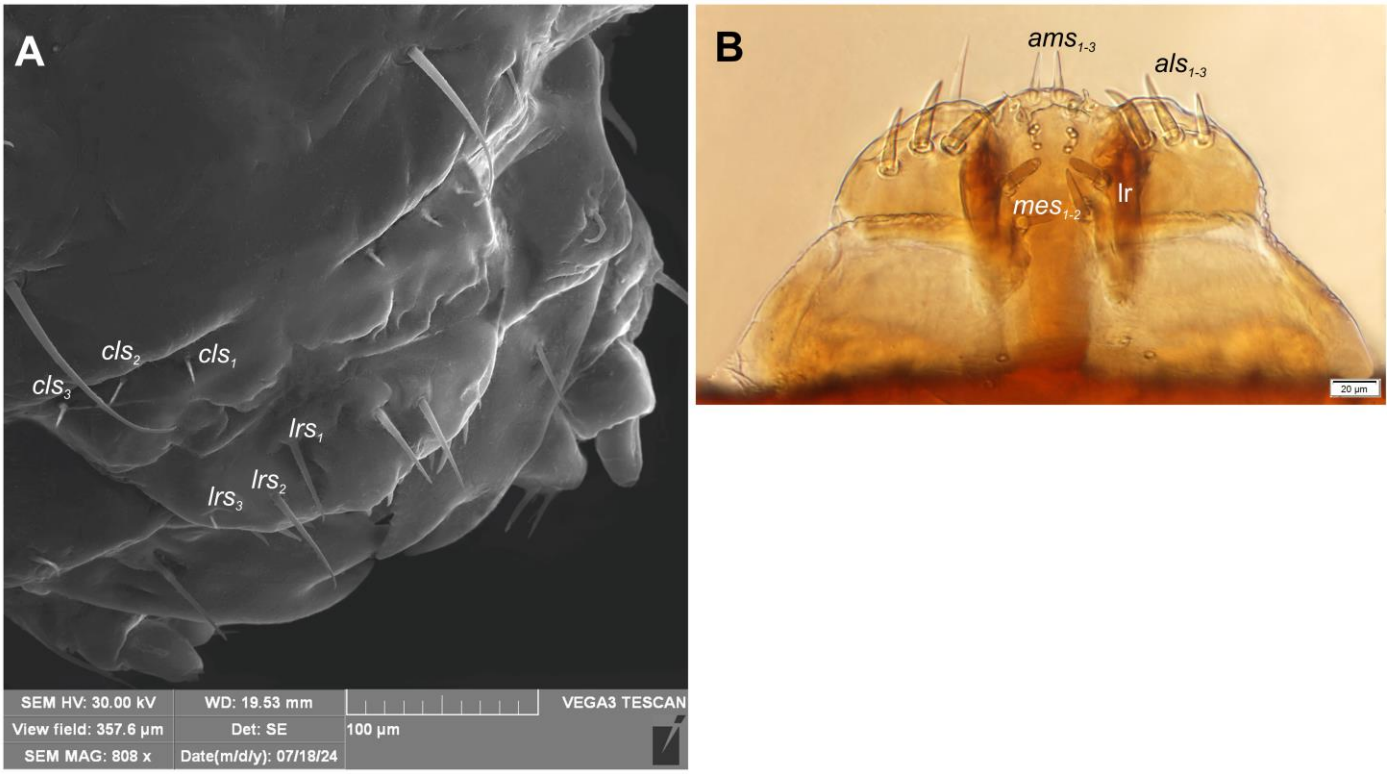

Figure 6. *Dorytomus longimanus*, mature larva, mouthparts: **A**– general view (SEM); **B**–epipharynx (photo) (lr–labral rods, setae: *als*–anterolateral, *ams*–anteromedial, *cls*–clypeal, *lrs*–labral, *mes*– median) (photos R. Gosik).

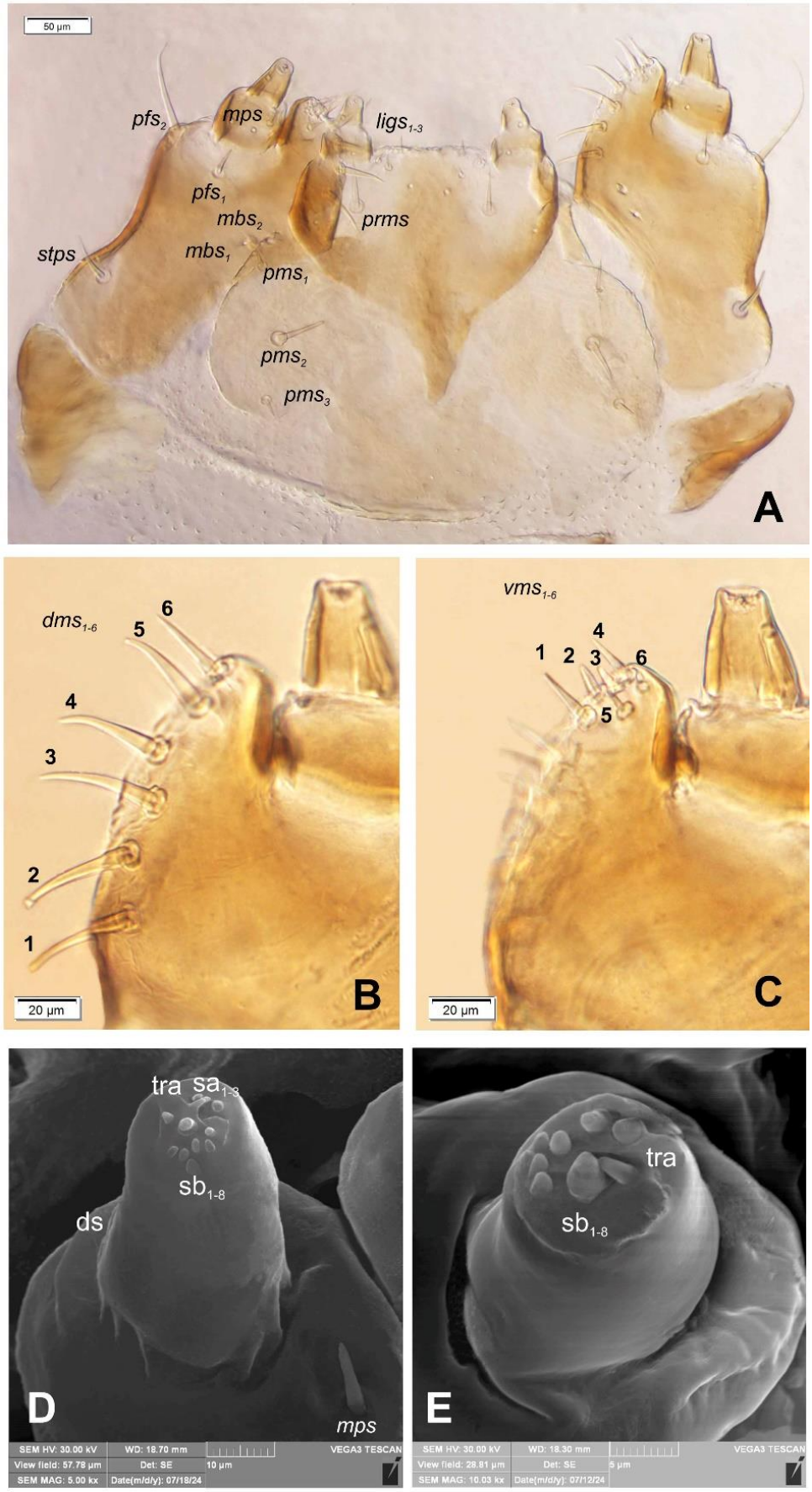

Figure 7. *Dorytomus longimanus,* mature larva, maxillo-labial complex: **A**– general view; **B**– maxilla, apical part (dorsal aspect); **C**– maxilla, apical part (ventral aspect); **D**– maxillary palp (SEM); **E**– labial palp (SEM) (sa–sensillum ampullaceum, sb–sensillum basiconicum, ds– digitiform sensillum, tra–terminal receptive area; setae: *dms*–dorsal malar, *ligs*–ligular, *mbs*–basiventral, *mps*–maxillary palps, *pfs*–palpiferal, *pms*–postmental, *prms*–premental, *stps*–stipital, *vms*–ventral malar setae) (photos R. Gosik).

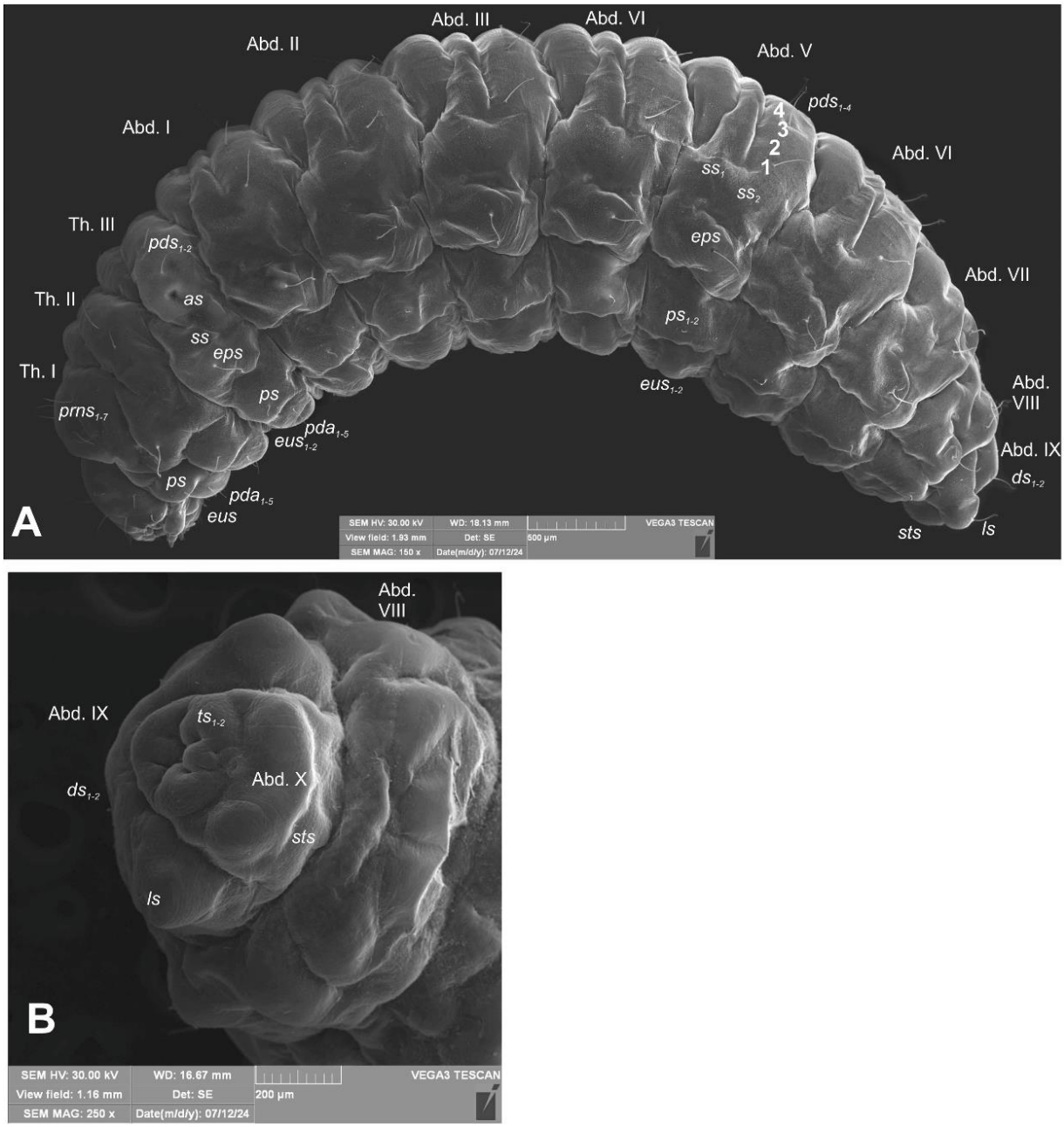

Figure 8. *Dorytomus longimanus*, mature larva, habitus (SEM): **A**– habitus, lateral view; **B**– ventral view of abdominal segments VIII–X (Th. I–III–number of thoracic segment, Abd. I–IX–number of abdominal segment, setae: *as*–alar, *ds*–dorsal, *eps*–epipleural, *eus*–eusternal, *ls*–lateral; *pda*–pedal, *pds*–postdorsal, *prns*–pronotal, *prs*–prodorsal, *ss*–spiracular, *ps*–pleural, *sts*–sternal, *ts*–two minute) (photos R. Gosik)

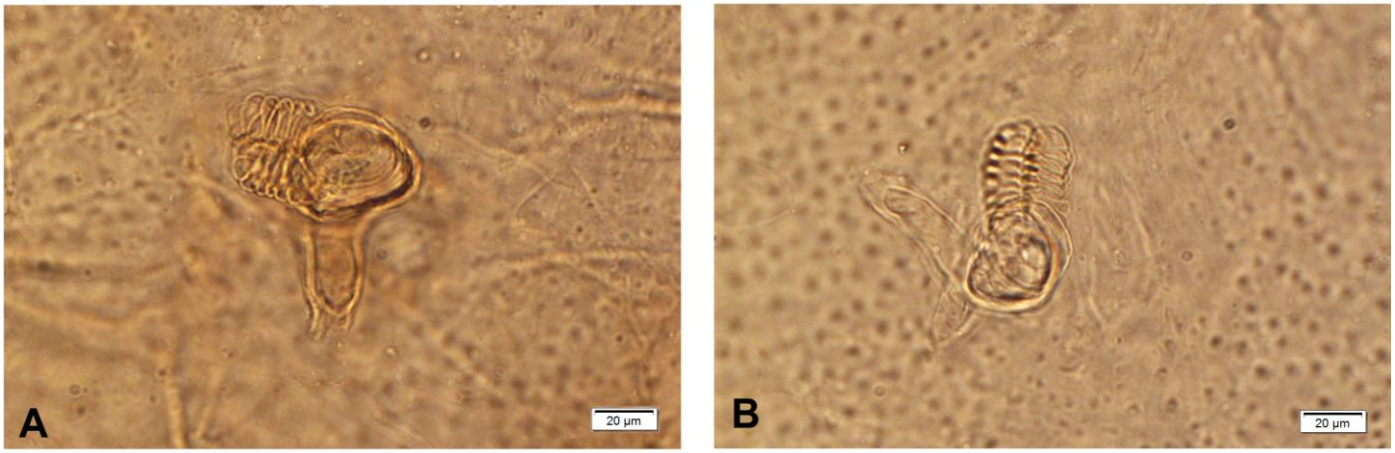

Figure 9. *Dorytomus longimanus*, mature larva, spiracles (photos): **A**– thoracic; **B**–abdominal (photos R. Gosik).

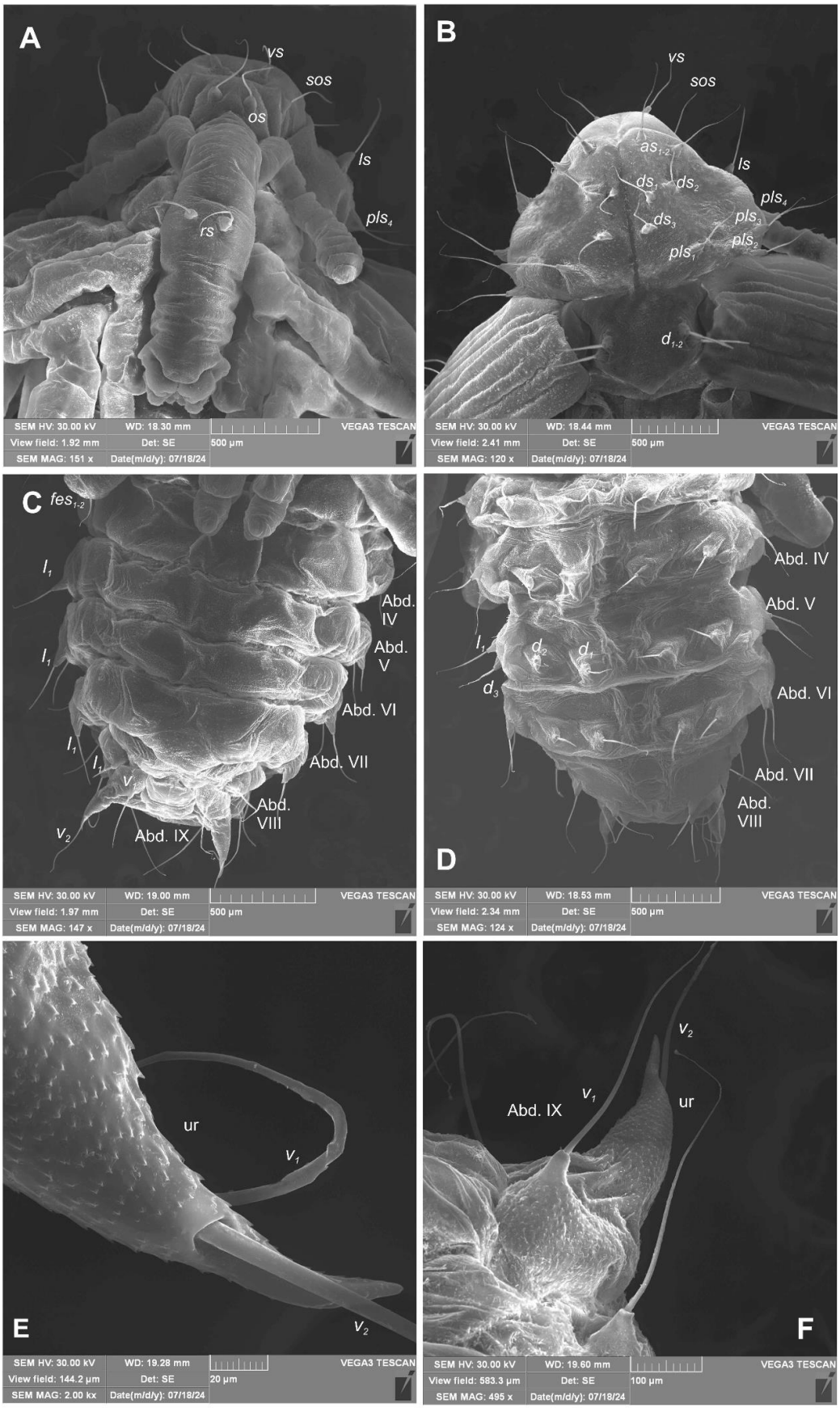

Figure 10. *Dorytomus longimanus,* pupa, habitus, urogomphus (ur) (SEM): **A**– head and rostrum (frontal view); **B**– thorax (lateral view); **C**– abdomen (ventral view); **D**– abdomen (dorsal view); **E, F**– setae: *as*–apical, *d*–dorsal, *ds*–discal, *fes*–femoral, *l*–lateral, *ls*–lateral, *os*–orbital, *pls*–posterolateral, *rs*–rostral, *sos*–superorbital, *v*–ventral, *vs*-vertical (photos R. Gosik).

Methods

Prior to compiling the description, all the specimens were fixed in 75% ethanol and examined under an optical stereomicroscope (Olympus SZ 60 and SZ11) with calibrated oculars. The following measurements of the larva were taken: body length (BL), body width (BW) (at the third thoracic segment), head capsule width (HW) and head capsule height (HH, measured from apex to epistoma). The pupal measurements included body length (BL, measured from fore-margin of the head to end of abdomen without gonothecae), body width (BW) (at the level of the mid–legs), head width (HW) (at the level of the eyes), length of rostrum (RL) and width of pronotum (PW). Slide preparation method basically follow May (1994). The head of the larva selected for microscopic study was cut off and cleared, after which the mouthparts were separated. The remaining part of the body was cleared in 10% potassium hydroxide (KOH), then rinsed in distilled water and dissected. Thereafter, the head, mouthparts and body (thoracic and abdominal segments) were separated and mounted on permanent microscope slides in Faure–Berlese fluid (50 g gum arabic and 45 g chloral hydrate dissolved in 80 g distilled water and 60 cm^3 glycerol) (Hille Ris Lambers 1950).

The photographs were taken using an Olympus BX63 microscope and processed with Olympus cellSens Dimension software. The larvae selected for SEM (scanning electron microscope) imaging were first dried in absolute ethanol (99.8%), then rinsed in acetone, treated by CPD (Critical Point Drying) and finally gold–plated. TESCAN Vega 3 SEM was used to examine selected structures.

The general terminology and chaetotaxy follow Anderson (1947), May (1994) and Marvaldi (1999, 2003), the terminology for the antennae Chaika & Tomkovich (1997). For the status of epipharynx median setae (*mes*) I followed Trnka et al. (2015) and Skuhrovec et al. (2015). For all symmetrical, bilateral structures the number of setae is given only for one side.

Results

Description of the mature larva of *Dorytomus longimanus*

Measurements (in mm). Body length: 6.86–5.50 (average [= $\bar{X}$]: 5.75). The widest place in the body (meso– and metathorax) measures up to 1.5. Head width: 0.76–0.73 ($\bar{X}$: 0.75), head height: 0.60–0.50 ($\bar{X}$: 0.53).

Head and antenna. Head capsule (Fig. 3A–D) almost rounded; endocarina reaches 2/3 of the frons; frontal sutures distinct along entire length up to antennae; two pairs of stemmata (st), well visible, the first placed close to antenna, the second medio-laterally. Hypopharyngeal bracon absent. Setae of head hair–like, various in length: from elongate and medium to minute. Cranial setae: des_1 elongate, placed medially, des_2 elongated, placed posterolaterally, elongate des_3 on frontal suture, minute additional seta (des_{3a}) placed lateral to des_3, des_4 elongate, placed anterolaterally. Frontal setae fs_1 and fs_2 absent, fs_3 minute placed medially, elongate fs_4 placed anteromedially, short fs_5 placed anterolaterally, close to antenna, les_1 and les_2 both elongate, postepicranial area with 5 minute *pes*.

Antennae (Fig. 4) placed on each side on anterior margin of head; membranous basal segment flat, almost rounded, bearing conical, moderately elongate sensorium and 5 sensilla basiconica (sb).

Mouthparts. Clypeus (Fig. 6A) approximately 4.7x wider than long, with three short *cls*, placed posteriorly. Anterior margin of clypeus almost straight. Labrum (Fig. 6A) approximately 4x wider than long, anterior margin slightly sinuate; both lrs_1 and lrs_2 elongate, placed anteromedially, lrs_3 short, placed laterally. Epipharynx (Fig. 6B) with 3 digitate *als* and 3 *ams* (first elongate, second and third short, digitate), a pair of *mes* prominent, digitate. Labral rods (lr) elongate, partially sclerotized, parallel. Mandible (Fig. 5) symmetric, relatively narrow: with 2 apical teeth of various height, molar area with small, sharp, additional tooth. Setae: mds_1 short, and mds_2 elongate, both placed anterolaterally. Maxillo-labial complex: (Fig. 7A-E) stipes with 1 medium *stps*, pfs_1 elongate, pfs_2 short, and a pair of minute *mbs*; mala with a row of 6 digitate, almost equally sized *dms*, 6 *vms*: first elongate, second to sixth short, digitate; maxillary palpi 2–segmented; basal palpomere much wider than distal one; length ratio of basal and distal palpomeres almost 1:0.5; basal palpomere with minute *mps*, 1 pore and 1 small digitiform sensillum (ds), distal palpomere (Fig. 7D) with a group of 11 apical sensilla (3 ampullacea and 8 basiconica) on terminal receptive area (tra); labium with cup–shaped prementum, with 1 medium-sized *prms*, placed medially; ligula concave, with 3 *ligs* short, equal in length; premental sclerite Y–shaped; postmentum oval-shaped, with 3 *pms* of various length: short pms_1, placed posterolaterally, elongate pms_2, placed mediolaterally, and short pms_3, placed anterolaterally. Labial palpi (Fig. 7E) 1–segmented; each palpus with a single pore, and a group of 8 apical sensilla basiconica on terminal receptive area; surface of labium smooth, only lateral parts covered with fine, uneven asperities.

General habitus. Live larva distinctly various in colour (from nearly completely red to monochrome yellowish or whitish) with dark brown to almost black head capsule (Figs 1D–F, 2A–D, SEM photo 8A). Prothorax (Fig. 8A) smaller than mesothorax, pronotal shield well separated, smooth, black; mesothorax and metathorax of equal size; each divided dorsally into two lobes (prodorsal and postdorsal lobes almost equal in size). Pedal lobes of thoracic segments weakly isolated, smooth (Fig. 8A). Abdominal segments I–VI of similar size, slightly bigger than metathorax; segments VII–IX tapering towards posterior body end. Abdominal segments I–VII divided into three lobes. Abdominal segment VIII divided into two lobes, segment IX dorsally undivided. Epipleural, laterosternal and eusternal lobes of segments I–VIII conical, well isolated. Abdominal segment X divided into six lobes of unequal size (Fig. 8B). Anus situated terminally. Cuticle densely covered with thorn-like processes except for the smooth pronotal shield. All spiracles bicameral (Fig. 9A, B), placed on thorax laterally, at the border between pro- and mesothorax; abdominal spiracles placed antero–laterally on segments I–VIII. Body very elongate, slightly curved, rounded in cross section.

Chaetotaxy. Setae various in length, minute to elongate, hair–like.

Thorax (Fig. 8A): prothorax with 7 elongate *prns,* all placed on premental shield or on its border, one medium and one short *ps* and 1 short *eus*. Meso– and metathorax each without *prs*, 2 elongate *pds*, 1 minute *as*, 1 minute *ss*, 1 short *eps*, 1 short *ps* and 2 short *eus*. Pedal areas of thoracic segments each with 5 *pda*, various in length. Abdomen (Fig. 8A, B): segments I–VII without *prs*, 4 *pds* (first and third elongate, second and fourth minute, sometimes absent), 2 minute *ss* (on segments VI and VIII absent), 1 elongate *eps*, 1 medium and 1 minute *ps* and 2 minute *eus*; segment IX with 3 medium *ds*, 1 medium *ps* and 1 minute *sts*; two lateral lobes of segment X with two minute setae (*ts*).

Description of the pupa of *Dorytomus longimanus*

Measurements (in mm). Body length: 5.20–5.95 ($\bar{X}$: 5.50); body width: 2.20–2.70 ($\bar{X}$: 2.60); thorax width: 1.50–1.70 ($\bar{X}$: 1.60); rostrum length ♂ and ♀ up to 1.70.

General habitus. Live pupa distinctly various in colour (Fig. 2E–J; SEM photos: Fig. 10A–F). Cuticle on head, rostrum and thorax smooth, on abdomen densely covered with thorn–like asperities. Rostrum robust, more than 3.5× as long as wide, metacoxae reaching. Pronotum trapezoidal, 1.5 as wide as long. Mesonotum much wider than metanotum. Abdominal segments I–VI of equal length, segment VII semicircular, segment VIII narrow, segment IX terminal. Gonotheca in male undivided, in female divided. Urogomphi (posterior processes) elongate, covered with robust protuberances, ending in sharp structure. Spiracles placed laterally on abdominal segments I–VI, functional on segments I–V, vestigial on segment VI.

Chaetotaxy. Well visible, setae various in length, hair-like, smooth. Head with one elongate *sos*, one elongate *vs* and one elongate *os*. Rostrum with single, elongate *rs*. Pronotum with two *as*, three *ds*, single *ls*, and four *pls*, all of them elongate. Dorsal parts of meso- and metathorax with two elongate setae; placed medially. Apex of femora with two elongate *fes*. Abdominal segments I–VII dorsally with three elongate setae placed posteromedially, segment VIII with two elongate setae. Each lateral part of abdominal segments I–VIII with single elongate seta. Ventral parts of abdominal segments I–VIII without setae; segment IX with three elongate setae: first and second close to gonotheca, third placed on urogomphi.

Figure 11. *Dorytomus longimanus*, habitats and larvae: **A, B**– habitats at Leine river near Herrenhausen and Garbsen; **C, E, G**– male catkins of *Populus nigra*, the microhabitat of the larvae; **D, F, H**– showing the wide colour variation of the larvae and camouflage in different situations of catkin development (with a lack of visual concealment on the bare ground) (photos P. Sprick).

Discussion

Larval biology

During their development *Dorytmus longimanus* larvae do not enter the catkin axis, as several smaller species do (e.g., *D. taeniatus*, see CURCULIO Team 2008). Therefore *D. longimanus* larvae depend on perfect hiding at their place of development, mainly the room between the flowers and anthers and the catkin axis, and sometimes on the surface of the catkins – what is likely to be an ectophagous behavior (Fig. 11). Curculio Team (2008) and Rheinheimer & Hassler (2010) already reported about camouflage and good colour matching of this species with the catkins of black and hybrid poplars.

But obviously little or nothing was known about the colour variation of *Dorytomus longimanus* larvae that may show an adaptation to the different levels of catkin development and is therefore considered an interesting case of camouflage or mimesis. Completely reddish or violet larvae may imitate the young, dense catkins with a prevailing red colour of the anthers (Fig. 11C, D), which turn gradually to violet during the rather short flowering period. The common larvae with two reddish or violet longitudinal stripes and some transitional forms (Fig. 11F; 2A–D) may imitate a bit older, elongated catkins that show a greater distance between the single flowers and make the yellowish light colour of the catkin axis and the flower stems stand out better (Fig. 11E). The rarer, completely yellowish larvae may imitate the oldest catkins with desiccated anthers (Fig. 11 G, H), but apparently they are worst protected by camouflage when moving about the bare ground, probably searching a place for pupation (Fig. 11H).

Life cycle

Dieckmann (1986) summarized all observations on the development of *Dorytomus longimanus*, which referred to Urban (1929), Hoffmann (1958), Köller (card index), Liebmann (no source given), and Nilsson (pers. comm. to Dieckmann): oviposition was in March, when flower buds are usually still closed (see Fig. 11). Larvae were found in March and April, either in flower buds or collected from catkins on the trees or from the ground, and young, light coloured adults were found at the end of April or in May. The larvae hide between the flowers, feed on it, mainly of blossoms and anthers, and nibble at the axis of the catkins. Usually they fall down with old catkins to the ground and pupate in soil.

Dieckmann (1986) and Hoffmann (1958) did not observe any weevils in late summer or autumn and winter on the trees. *D. longimanus* leaves the trees between May and June for aestivation and hibernation and spends this period in the vicinity of its host trees, and it occurs at the latest on March of the following year on the trees. A smaller peak of adults' beetle recording is shown in November by the "Verein für Naturwissenschaftliche Heimatforschung zu Hamburg e.V." (Tolasch & Gürlich 2024). This peak may depend by far on sifting or hand collecting of adult weevils, which hide under the loose bark of *Populus* trees. On the other hand, D. Masur observed a few specimens in December, which may be explained by exceptional early egg-laying activity during warm winter periods (pers. comm.). - Dorn (1921) reported about stridulation of the adult weevils, but without further explanation.

Host plant use

Scherf (1964) listed *Populus tremula* L. and *P. monilifera* Aiton as host plants of *Dorytomus longimanus*. According to Burakowski et al. (1995) females of *D. longimanus* lay eggs to male catkins of *Populus alba* L., *P. nigra*, *P. serotina* Hartig, and *P. italica* Muenchh., whereas Smreczyński (1972) recorded only *P. nigra* and *P. italica*. *Populus monilifera* is regarded as a subspecies of the American *P. deltoides. P. serotina* is only a cultivar of *P. x canadensis* (= *Populus x canadensis* cv. 'Serotina'), and *P. italica* is a form or variety of *Populus nigra* (= *P. nigra* 'Italica') with characteristic columnar appearance.

Dieckmann (1986) published the following host plants: *Populus x canadensis* (= *P. deltoides x P. nigra*), *P. nigra* and *P. alba*. He reported that *D. longimanus* was reared from these *Populus* species, and he rejected *P. tremula*. This is not fully plausible, as *P. alba* and *P. tremula* are closely related and tend to hybridize resulting in the rather widespread *P. x canescens* (Aiton) Sm. This means, in our opinion, that *P. nigra* and *P. x canadensis* are the main host plants and that *P. alba* and perhaps *P. tremula* should be regarded as exceptionally used host plants of *D. longimanus*, only, especially since *P. alba* and *P. tremula* usually host other groups of *Dorytomus* species.

Outlook

The larva and the pupa of *Dorytomus longimanus* were previously studied by Scherf (1964). Despite of the current paper with an improved illustration of chaetotaxy, the low number of species with known morphology of immatures does still not allow a synthesis of features, which means that a higher level taxonomy of *Dorytomus* is impossible at this moment. Further extensive studies on the biology and particularly the morphology of developmental stages may provide more information that will shed new light on the phylogenetic relationships and taxonomy, based on larval morphology, within the genus *Dorytomus*. The present work is aimed to be the first step in a series of papers to expand the knowledge of morphology and bionomy of this genus.

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