Description of immature stages of Gymnetron species (Coleoptera, Curculionidae, Curculioninae), with particular emphasis on the diagnostic morphological characters at the generic and specific levels

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Abstract

The immature stages of the following five Palaearctic Gymnetron species are described for the first time: G. tibiellum Desbrochers des Loges, 1900, G. veronicae (Germar, 1821), G. rotundicolle Gyllenhal, 1838, G. melanarium (Germar, 1821), and G. villosulum Gyllenhal, 1838. These species belong to four different groups previously established according to a phylogenetic analysis: the first two belong to the G. veronicae group and the other three to groups respectively bearing their name (G. rotundicolle, G. melanarium, and G. villosulum groups). All these species exhibit several diagnostic characters distinguishing them from each other. Some characters that can be used to separate Gymnetron from other genera in the tribe are also suggested. Three highly significant characters for the larvae and three for the pupae were identified. For the larvae they are: (1) labial palpi with single palpomeres, (2) all...
spiracles unicameral, and (3) epipharynx with a single pair of mes or none at all. For the pupae they are: (1) the pronotum with prominent pronotal protuberances, (2) abdominal segment VIII with a conical abdominal protuberance dorsally, and (3) very short or even reduced urogomphi. The species studied here are compared with those Gymnetron species already known and with other genera in the tribe Mecinini. Keys to the larvae and pupae described here are provided. All the characters used for identification are illustrated by photographs or drawings.

**Keywords**
Biology, mature larva, Mecinini, morphology, pupa, taxonomy, weevils

### Introduction

The genus *Gymnetron* Schoenherr, 1825 belongs to the tribe Mecinini (Curculionidae, Curculioninae) and includes some 35 Palaearctic species (Caldara 2008a; Alonso-Zarazaga et al. 2017) and 70 Afrotropical species (Caldara 2003). The adults of this tribe were recently subjected to morphological revision and phylogenetic analysis (Caldara 2003, 2008a). Based on this analysis, nine Palaearctic species groups and 13 Afrotropical species groups were recognized. Within this tribe the genus *Gymnetron* seems more closely related to *Rhinusa* Stephens, 1829 than to other genera (Caldara 2001). Preliminary molecular studies appear to confirm this placement (Hernández-Vera et al. 2013; I. Toševski unpublished data).

The Palaearctic *Gymnetron* species live on *Veronica* (Caldara 2008a), currently included in Plantaginaceae (Olmstead et al. 2001; Albach et al. 2004), whereas those in the Afrotropical region (Caldara 2003; Caldara et al. 2010), where Plantaginaceae are poorly represented, appear to live on various genera of Scrophulariaceae distributed mainly in the southern hemisphere, i.e., *Diascia, Hemimeris* and *Nemesia* (Hemimerideae), *Hebenstreitia, Selago, Sutera* and *Tetraselago* (Selaginaceae), *Buddleja* (Buddlejeae), as well as on Stilbaceae, i.e., *Anastrebe*, a plant genus previously placed within Scrophulariaceae (Olmstead et al. 2001; APG 2016). The larvae develop inside the ovaries, stems or roots of the host plants and can sometimes induce the formation of galls (Hoffmann 1958; Caldara 2001).

To date, larvae and pupae of only three species of *Gymnetron* (*G. auliense* Reitter, 1907, *G. miyoshii* Miyoshi, 1922, and *G. vittipenne* Marseul, 1876) have been adequately described (Jiang and Zhang 2015). Immatures of some other *Gymnetron* species – *G. anagallis* Marshall, 1933 (Gardner 1934; van Emden 1938); *G. beccabungae* (Linnaeus, 1760) and *G. villosulum* Gyllenhal, 1838 (van Emden 1938; Scherf 1964) – have been previously studied, but no detailed descriptions are available.

Therefore, the aims of the present study are to describe larvae and pupae of five *Gymnetron* species in detail for the first time, to find characters that are diagnostic at the generic and specific levels, and finally, to compare the characters of the immature stages of this genus with other genera of the same tribe that might be phylogenetically informative.
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Materials and methods

The material for this study, i.e., L3 larvae and pupae from each of the species studied was collected from their host plants together with the adult, and subsequently preserved in 2 ml screw-cap micro tubes (Sarstedt, Germany) filled with 96% ethanol at 4–6 °C. The insect taxa were identified by Roberto Caldara, those of the plants by Ivo Toševski.

Part of the larval and pupal material was preserved in glycol or Pampel fixation liquid (see Skuhrovec and Bogusch 2016) and used for the morphological descriptions. These specimens are now deposited in the Group Function of Invertebrate and Plant Biodiversity in Agro-ecosystems of the Crop Research Institute (Prague, Czech Republic). Slide preparation basically followed May (1994). The larvae selected for study under the microscope were cleared in 10% potassium hydroxide (KOH), then rinsed in distilled water and dissected. After clearing, 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 of distilled water and 60 cm³ of glycerol) (Hille Ris Lambers 1950).

All the specimens described were fixed in 95% ethanol and examined under an optical stereomicroscope (Olympus SZ 60 and Nikon Eclipse 80i) with calibrated oculars. The following measurements of larval instars were made: body length (BL), body width (BW) (at the third abdominal segment) and width of the head capsule (HW) (see Gosik et al. 2016). The pupal measurements included body length (BL), 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). All the measurements are given in Table 1 (mature larva) and Table 2 (pupa).

Table 1. Measurements (in mm) of body parts (mature larva) in the Gymnetron species studied here; n = number of specimens.

| Species          | Body length | Body width | Head width |
|------------------|-------------|------------|------------|
| G. melanarium    | 2.33, 3.00, 2.66 | 0.76, 1.00 | 0.50, 0.53 |
| G. rotundicolle  | 2.20, 2.25, 2.33, 2.26 | 0.75, 0.86 | 0.40, 0.47, 0.50 |
| G. tibiellum     | 2.25, 2.37, 2.50 | 0.87, 0.95 | 0.42, 0.45 |
| G. veronicae     | 2.16, 2.56, 2.83, 3.00 | 0.76, 1.00 | 0.50, 0.53 |
| G. villosulum    | 2.25, 2.33, 2.46 | 0.83, 1.10 | 0.40, 0.51 |

Table 2. Measurements (in mm) of body parts (pupa) in the Gymnetron species studied here; n = number of specimens; BL = body length; BW = body width; THW = head width.

| Species          | Female | Male |
|------------------|--------|------|
|                  | BL     | BW   | THW  | BL     | BW   | THW  |
| G. melanarium    | 2.12, 2.32 | 1.25 | 0.75 | 2.25 | 1.32 | 0.82 |
| G. rotundicolle  | 2.37, 2.62 | 1.32, 1.42 | 0.75, 0.85 | 2.20, 2.22 | 1.12, 1.32 | 0.70 |
| G. tibiellum     | 1.87, 2.25, 2.50 | 0.62, 0.75 | 0.75, 1.12 | 1.92, 2.07 | 0.92, 1.12, 1.25 | 0.67, 1.00 |
| G. veronicae     | 2.12, 2.32 | 1.25 | 0.70, 0.75 | 2.25 | 1.32 | 0.80 |
| G. villosulum    | 2.24, 2.50, 2.73 | 1.30, 1.35, 1.50 | 0.82, 0.87, 0.88 | 2.24, 2.40, 2.60 | 1.32, 1.35, 1.55 | 0.82, 0.87 |
The drawings and outlines were made using a drawing tube (MNR–1) installed on a stereomicroscope (Amplival) and processed by computer software (Corel Photopaint X7, Corel Draw X7). The thoracic spiracle was located on the prothorax near the boundary of the prothorax and mesothorax, as shown in the drawing, but this spiracle is of mesothoracic origin (Marvaldi et al. 2002; Marvaldi 2003). The drawings show the thoracic and abdominal spiracles. The lengths of all setae are visible in the figures. The numbers of setae of the bilateral structures are given for one side.

The terms and abbreviations for the setae of the mature larvae and pupae are as in Scherf (1964), May (1977, 1994) and Marvaldi (1997, 1999), but see also Skuhrovec (2007). The antennae terminology follows Zacharuk (1985).

The sequence of the species follows that proposed by Caldara and Fogato (2013) and Caldara et al. (2013).

The botanical taxonomy follows APG IV (APG 2016).

Results

Morphology of immature stages

Genus Gymnetron Schoenherr, 1825

Description of mature larva (L3). Measurements (in mm). Body length: 2.16–3.00. The widest point in the body (meso- and metathorax) measures up to 1.20. Head width: 0.36–0.53.

General. Body elongate or relatively elongate, slender, weakly curved, rounded in cross section.

Colouration. Pale yellow or dark brown head. All thoracic and abdominal segments white, cuticle smooth or with many reddish or brown asperities.

Vestiture. Setae on body thin, distinctly different in length (minute to very short or long).

Head capsule. Head almost oval or suboval, endocarinal line present. Frontal sutures on head distinct, extended to antennae. One stema, in the form of a pigmented spot with convex cornea, both located on each side anterolaterally, above frontal suture. Dorsum of epicranium with three or five setae; des1 located in central part of epicranium; des2 lateral, sometimes absent; des3 located anteriorly on epicranium close to frontal suture; des4 often medially, sometimes absent; des5 located anterolaterally. Frons with three to four fs1, fs2, fs3, fs4 and fs5 subequal. Head with two les, one or two ves, and two to six pes.

Antennae located at end of frontal suture on each side, membranous and distinctly convex basal article bearing one conical sensillum, relatively long.

Clypeus trapezium-shaped, ~ 3–4× as wide as long with two relatively long cls, located posterolaterally.

Mouth parts. Labrum ~ 3–4× as wide as long, with three piliform lms, relatively long; anterior margin doubly sinuate. Epipharynx with two or three long digitate
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als; with two or three ams, and one or without mes; labral rods indistinct. Mandibles distinctly broad, bifid, teeth of unequal height; slightly truncate; both mds relatively long, piliform, located in distinct holes. Maxilla: stipes with one stps, two pfs and sensillum, with or without mbs; mala with four or five elongated digitate dms; three or four vms, of various length; all vms distinctly shorter than dms. Maxillary palpi with two palpomeres; basal palpomere with one mxps and one sensillum; distal palpomere with one sensillum and a group of conical, cuticular apical processes. Praelabium oval, with one prns; ligula with two ligs. Labial palpi with one palpomere; palpomere with one sensillum and short, cuticular apical processes. Postlabium with two or three pms, all located laterally; membranous area finely or distinctly asperate.

Thorax. Prothorax distinctly smaller than meso- and metathorax. Spiracle unicameral, situated between pro- and mesothorax (see Material and methods). Prothorax with seven to eleven prns; two ps; and two eus. Mesothorax with or without two prs; two or three pds; one long as; two or three ss; one eps; one ps; and one or two eus. Each pedal area of thoracic segments well separated, with three or five pada.

Abdomen. Abdominal segments I–III of almost equal length, next abdominal segments shortening gradually to the terminal parts of the body. Abdominal segment X reduced to four anal lobes of unequal size, the lateral lobes being distinctly the largest, and the dorsal and ventral ones very small. Anus located terminally; ambulatory ampullae bilobate to circular. Spiracles unicameral, seven abdominal spiracles located laterally. Abdominal segments I–VI with one or two prs; one or two pds; two ss; one eps; one or two ps; one lsts and one or two eus. Abdominal segments VII–VIII without, one or two prs; one or two pds; one or two ss; one eps; one or two ps; without or one lsts; and one or two eus. Abdominal segment IX with one or two ds; one or two ps; and one or two sts. Abdominal segment X with one or two setae (ts).

Description of pupa. Measurements (in mm). Body length: 1.87–2.73. Body width: 0.62–1.55. Thorax width: 0.67–1.12.

Body. Moderately stout, yellowish or brownish. Pronotal protuberances (p-pr) sclerotized, prominent, body covered with fine, knobby asperities; fused at base or well separated. Rostrum rather or moderately slender, ~ 4× as long as wide, extending to mesocoxae. Antennae rather short, clava smooth. Pronotum 1.5–2.2× as wide as long. Mesonotum slightly or sometimes distinctly smaller than metanotum. Abdominal segments I–V of equal length; segments VI–VIII tapering gradually to the terminal part of the body, segment IX distinctly reduced. Spiracles on abdominal segments I–V functional. Urogomphi reduced or short. Abdominal segment VIII with well visible conical abdominal protuberance dorsally (a-pr), extending the outline of the body.

Chaetotaxy. Sparse, setae of different lengths, transparent. Head with one or two os. Rostrum with or without one rs. Pronotum with one or two as, one or two ds, with two or without sls, one or three ls and three or four pls. Dorsal parts of meso- and metathorax with two or three setae. Apex of femora with one or two fes. Abdominal segments I–VIII with two or five setae dorsally. Each lateral part of abdominal segments I–VIII with one or two setae. Ventral parts of abdominal segments I–VIII with two or three setae. Abdominal segment IX with two setae ventrally.
Descriptions of immature stages of the species

*Gymnetron tibiellum* Desbrochers des Loges, 1900

**Material examined.** Serbia, Bela Palanka, 43°13.150′N, 22°18.886′E, 288 m, ex *Veronica anagallis-aquatica*, 29.06.2020, leg. Toševski (9 larvae and 9 pupae).

**Description of mature larva** (Figs 1A, B, 2A–F, 3A–C). **Measurements** (in mm). Body length: 2.25–2.50. The widest point in the body (meso- and metathorax) measures up to 0.95. Head width: 0.42–0.45.

**General.** Body elongate, slender, weakly curved, rounded in cross section (Fig. 1A).

**Colouration.** Head pale brown (Fig. 1B). All thoracic and abdominal segments white, cuticle smooth (Fig. 1A).

**Vestiture.** Setae on body thin, yellowish, distinctly different in length (minute to very short or long).

**Head capsule** (Figs 1B, 2A). Head suboval, endocarinal line present, extending for 2/3 of length of frons. Frontal sutures on head very broad and distinct. Stemma, in the form of a very small pigmented spot with convex cornea. *Des*₁ long, located in middle of central part of epicranium; *des*₂ medium; *des*₃ long, located anteriorly on epicranium close to border with frontal suture; *des*₄ short; *des*₅ long, located anterolaterally above stemma (Fig. 2A). *Fs*₁ absent; *fs*₂ short, located medially; *fs*₃ short; *fs*₄ short, located anteriorly; and *fs*₅ long, located anterolaterally, close to antenna (Fig. 2A). *Les*₁ and *les*₂ as long as *des*₅; one short *ves*. Epicranial area with six postepicranial setae.

**Antennae** membranous and distinctly convex basal membranous article bearing one relatively long conical sensorium and three sensilla of different types: two basiconical and one ampullaceum (Fig. 2B).

**Clypeus** (Fig. 2C) ~ 3× as wide as long with two medium *cls*, located posterolaterally, without sensillum; fused to labrum.

![Figure 1. Gymnetron tibiellum Desbrochers des Loges mature larva](image)

*A* habitus *B* head, dorsal view. Scale bars: 0.5 mm (*A*); 0.25 mm (*B*).
Morphological characters of immatures of Gymnetron species

Figure 2. Gymnetron tibiellum Desbrochers des Loges mature larva, head and mouth parts A head B antenna C clypeus and labrum D epipharynx E left mandible F maxillolabial complex. Abbreviations: at – antenna, lr – labral rods, sa – sensillum ampullaceum, sb – sensillum basiconicum, Se – sensorium, st – stemma; setae: als – anteriolateral, am – anteromedial, cls – clypeal, des – dorsal epicranial, dms – dorsal malar, fi – frontal epicranial, les – lateral epicranial, ligs – ligular, lms – labral, mbs – basioventral, mds – mandibular dorsal, mpix – maxillary palps, pes – postepicranial, pfs – palpiferal, pms – postmental, prms – premental, stps – stipital, ves – ventral, vms – ventral malar.
Mouth parts. Labrum (Fig. 2C) ~ 2× as wide as long, with three piliform lms, relatively long, of almost equal length; lms1 located anteromedially, lms2 located partly close to clypeus, and lms3 located anterolaterally. Epipharynx (Fig. 2D) with three very long digitate als, almost identical in length; with two piliform, medium ams; without mes; labral rods indistinct, irregular in shape. Mandibles (Fig. 2E) with two relatively long, piliform mds, located in distinct holes. Maxilla (Fig. 2F) with one stps, two pfs and with one mbs and one sensillum, stps and both pfs1–2 relatively long; mala with four elongate, digitate dms; four vms, almost equal in length. Maxillary palpi with two palpomeres; length ratio of basal and distal palpomeres: 1:0.6. Praelabium (Fig. 2F) ovate, with one long prms; ligula with sinuate margin and two short ligs; premental sclerite broad, well visible. Postlabium (Fig. 2F) with three pms, medium pms1 located medially, elongated pms2 located laterally, and medium pms3 located anterolaterally; membranous area sparsely and finely asperate.

Thorax. Prothorax (Fig. 3A) with 11 long and one short to minute prns, small pigmented dorsal sclerite present with five long and one short prns, this sclerite subdivided into two triangular plates medially; two long ps; and two short to very short eus. Mesothorax (Fig. 3A) without prs, two long and one short pds; one long as; two long and one very short to minute ss; one long eps; one long ps; and two short eus. Chaetotaxy of metathorax (Fig. 3A) almost identical to that of mesothorax. Each pedal area of thoracic segments well separated, with three long and two short pda.

Abdomen. Spiracles on abdominal segments I–VI close to anterior margin, functional, spiracles on abdominal segment VII not functional. Abdominal segments I–VII (Fig. 3B, C) with two minute prs; two long pds; one long and one very short to minute ss; one short eps; one short ps; one short lsts; and two very short and sometimes one additional minute eus. Abdominal segment VIII (Fig. 3C) with two minute prs; two long pds; one very short to minute ss; one short eps; one short ps; one short lsts; and two very short and sometimes one additional minute eus. Abdominal segment IX (Fig. 3C) with two short ds; two short ps; and two very short sts. Abdominal segment X (Fig. 3C) with two minute setae (ts).

Description of pupa (Figs 4A–C, 5A–C). Measurements (in mm). Body length: 1.87–2.50. Body width: 0.62–1.25. Thorax width: 0.67–1.12.

Body. Brownish, pronotal protuberances (p-pr) sclerotized, covered with conical asperities; apical parts of femora, head, rostrum and pronotum darker than rest of body. Rostrum moderately slender. Pronotal protuberances fused at base. Pronotum 1.5× as wide as long. Mesonotum slightly smaller than metanotum. Urogomphi in form of minute sclerotized protuberances, almost invisible. Abdominal segment VIII dorsally with rounded, prominent abdominal protuberance (a-pr) (Fig. 5A–C).

Chaetotaxy. Sparse, setae short to medium, transparent. Head with one medium os. Rostrum without setae (Fig. 5B). Pronotum with one as, one ds, two sls, one ls and three pbs almost equal in length. Dorsal parts of meso- and metathorax with two setae of various length, placed medially. Apex of pro- and mesofemora with two mediumsized fes, metafemora with one seta (Fig. 5A–C). Abdominal segments I–VIII with three short setae of equal length dorsally: first placed medially, the next two more laterally. Each lateral part of abdominal segments I–VIII with single, medium-sized seta. Ventral parts of abdominal segments I–VIII with three medium-sized setae. Abdominal segment IX with two minute setae ventrally (Fig. 5A–C).
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**Figure 3.** Gymnetron tibiellum Desbrochers des Loges mature larva, habitus A lateral view of thoracic segments B lateral view of abdominal segment I C lateral view of abdominal segments VI–X. Abbreviations: Th1–3 – numbers of thoracic segments, Ab1–10 – numbers of abdominal segments, setae: as – alar, ds – dorsal, eps – epipleural, eus – eusternal, lsts – laterosternal, pda – pedal, pds – postdorsal, prns – pronotal, prs – prodorsal, ss – spiracular, ps – pleural, sts – sternal, ts – terminal.
Biological notes. The immature stages of *G. tibiellum* were collected from capsules of *Veronica anagallis-aquatica* L. Previously, nothing was known about the biology of this species. The adults are active from mid-April following the appearance of the host plants. Oviposition takes place from early June until mid-August. The presence of larvae inside the seed capsules is readily detected from the dark colour of the deposited frass. The biologies of *G. tibiellum* and *G. veronicae* are very similar but no competition between these two weevil species has been observed in over 500 dissected seeds capsules where they occur in syntopy.

Remarks and comparative notes. *Gymnetron tibiellum* is widely distributed in the south-eastern part of central Europe, Italy, the Balkans, Caucasus, Anatolia and the Middle East (Alonso-Zarazaga et al. 2017). The adults of this species are very closely related to *G. veronicae*, from which they differ by the shape of the rostra and the penis (Caldara 2008a). This close relationship was confirmed here by several characters which the immature stages have in common, although differences in several other characters of both larvae and pupae readily discriminate these two species.

**Gymnetron veronicae** (Germar, 1821)

Material examined. Serbia, Gornji Milanovac, Donja Vrbava, GPS 44°1.663’N, 20°34.496’E, 370 m, ex *Veronica anagallis-aquatica*, 20.06.2020, leg. Toševski (4 larvae and 4 pupae).

Description of mature larva (Figs 6A, B, 7A–F, 8A–C). **Measurements** (in mm). Body length: 2.16–3.00. The widest point in the body (meso- and metathorax) measures up to 1.00. Head width: 0.50–0.53.

**General.** Body elongate, slender, weakly curved, rounded in cross section (Fig. 6A).

**Colouration.** Head dark brown (Fig. 6B). All thoracic and abdominal segments white with numerous reddish or brown asperities (Fig. 6A).
Morphological characters of immatures of Gymnetron species

Figure 5. Gymnetron tibiellum Desbrochers des Loges pupa habitus A ventral view B dorsal view C lateral view. Abbreviations: a–pr – abdominal protuberances, p–pr – pronotal protuberances, ur – urogomphi; setae: as – apical, d – dorsal, ds – discal, fes – femoral, l, ls – lateral, os – orbital, pls – posterolateral, sls – superlateral, v – ventral.
Vestiture. Setae on body thin, orange, distinctly different in length (minute to very short or long).

Head capsule (Figs 6B, 7A). Head suboval, flattened laterally, endocarinal line present, clearly extending to half the length of frons. Frontal sutures on head very broad and distinct. Stemma, in the form of a very small pigmented spot with convex cornea. Des₁ long, located in middle of the central part of epicranium; des₂ short, placed medially; des₃ relatively long, located anteriorly on epicranium close to border with frontal suture; des₄ short, placed above frontal suture; des₅ long, located anterolaterally (Fig. 7A). Fs₁ short; Fs₂ absent; Fs₃ located medially; Fs₄ short, located anteriorly; and Fs₅ long, located anterolaterally, close to antenna (Fig. 7A). Les₁ and Les₂ as long as des₅; one ves minute. Epicranial area with four postepicranial setae.

Antennae membranous and distinctly convex basal membranous article bearing one relatively long conical sensorium and six sensilla different in length (four basiconica and two ampullacea) (Fig. 7B).

Clypeus (Fig. 7C) ~ 3× as wide as long with two medium cls, located posterolaterally, without sensillum; fused to labrum.

Mouth parts. Labrum (Fig. 7C) ~ 4× as wide as long, three piliform lms, relatively long but of different lengths; lms₁ located anteromedially, lms₂ located partly close to clypeus, and lms₃ located anterolaterally, lms₁ and lms₂ relatively elongate, lms₃ short. Epipharynx (Fig. 7D) with two very long digitate als, almost identical in length; with three ams of different length, ams₁ and ams₂ piliform and short, ams₃ digitate and enlarged in middle; without mes; labral rods indistinct, irregular in shape. Mandibles (Fig. 7E) with two relatively long, piliform mds, located in distinct holes. Maxilla (Fig. 7F): stipes with one stps, two pfs and one minute mbs and one sensillum, stps and both pfs relatively long; mala with five medium, digitate dms; four vms, of different lengths, two setae very short, and two setae minute. Maxillary palpi with two palpomeres; length ratio of basal and distal palpomeres: 1:0.5. Praelabium (Fig. 7F) suboval-shaped, with one medium prms; ligula with sinuate margin and two very
Morphological characters of immatures of *Gymnetron* species

![Figure 7. *Gymnetron veronicae* (Germar) mature larva, head and mouth parts. A head B antenna C clypeus and labrum D epipharynx E left mandible F maxillolabial complex. Abbreviations: at – antenna, lr – labral rods, sa – sensillum ampullaceum, sb – sensillum basiconicum, Se – sensorium, st – stemma; setae: als – anteriolateral, ams – anteromedial, cls – clypeal, des – dorsal epicranial, dms – dorsal malar, fs – frontal epicranial, les – lateral epicranial, ligs – ligular, lms – labral, mbs – basioventral, mds – mandibular dorsal, mpxs – maxillary palps, pes – postepicranial, pfs – palpiferal, pms – postmental, prms – premental, stps – stipital, ves – ventral, vms – ventral malar.](image-url)
short ligs; premental sclerite broad, well visible. Postlabium (Fig. 7F) with three pms: 
$pms_1$ very long; $pms_2$ short, located medially; $pms_3$ located laterally; membranous area 
densely and finely asperate.

**Thorax.** Prothorax (Fig. 8A) with seven long and one short prns, small pigmented 
dorsal sclerite present with three long prns, this sclerite subdivided into two triangular 
plates medially; two long ps; and two short to very short eus. Mesothorax (Fig. 8A) with 
two very short to minute prs; one short and two long pds; one long as; one long and 
two very short to minute ss; one long eps; one long ps; and two short eus. Chaetotaxy 
of metathorax (Fig. 8A) almost identical to that of mesothorax. Each pedal area of 
thoracic segments well separated, with three long and two very short to minute pda.

**Abdomen.** Spiracles on abdominal segments I–VI close to the anterior margin and 
functional, spiracles on abdominal segment VII not functional, and abdominal segment 
VIII with atrophied spiracles. Abdominal segments I–VII (Fig. 8B, C) with two minute 
prs (segment VII with one prs); one long and one minute pds; one long and one very 
short to minute ss; one long eps; one relatively long ps; one short lsts; and two very short 
and sometimes one additional minute eus. Abdominal segment VIII (Fig. 8C) with one 
minute prs; one long pds; one very short to minute ss; one long eps; one relatively long ps; 
one short lsts; and two very short and sometimes one additional minute eus. Abdominal 
segment IX (Fig. 8C) with one relatively long ds; one relatively long ps; and one short to 
very short sts. Abdominal segment X (Fig. 8C) with one very short seta (ts).

**Description of pupa** (Figs 9A–C, 10A–C). **Measurements** (in mm). Body length: 
2.12–2.32. Body width: 1.25–1.23, Thorax width: 0.70–0.80. 

**Body.** Brownish, pronotal protuberances (p-pr) sclerotized, covered with conical 
asperities; apical parts of femora, head, rostrum and pronotum darker than rest of 
body. Rostrum moderately slender. Pronotal protuberances almost completely fused. 
Pronotum twice as wide as long. Mesonotum slightly smaller than metanotum. 
Urogomphi short, conical, with sclerotized apices. Abdominal segment VIII with 
rounded, prominent abdominal protuberance dorsally (a-pr) (Fig. 10A–C).

**Chaetotaxy.** Sparse, setae short to medium, transparent. Head with one medium 
$os$. Rostrum without setae (Fig. 10B). Pronotum with two elongate as, one $ds$, one $sls$, 
and three $pls$, all of almost equal length. Dorsal parts of meso- and metathorax with 
three setae of various length, situated medially. Apex of femora with two medium-sized 
$fe$ (Fig. 10A–C). Abdominal segments I–VIII with four medium to short setae placed 
in horizontal line medially. Each lateral part of abdominal segments I–VIII with two 
setae of various size. Ventral parts of abdominal segments I–VIII with three medium 
setae. Abdominal segment IX with two minute setae ventrally (Fig. 10A–C).

**Biological notes.** The larva was already known to feed on the ovary of *Veronica 
beccabunga* L, where it pupates and develops to the adult stage, and the adult was 
also collected on *V. anagallis-aquatica* L. and *V. scutellata* L. (Hoffmann 1958; Koch 
1992; Sprick 1997). We can now confirm that at least *V. anagallis-aquatica* L. must be 
another host plant. The biology of this weevil species is the same as that of *G. tibiellum*.

**Remarks and comparative notes.** The adult of this species, widely distributed 
throughout Europe (Alonso-Zarazaga et al. 2017), is closely related to *G. tibiellum*, but 
with which it is sympatric only in south-eastern Europe. The two species differ mainly
Figure 8. Gymnetron veronicae (Germar) mature larva, habitus A lateral view of thoracic segments B lateral view of abdominal segment I C lateral view of abdominal segments VI–X. Abbreviations: Th1–3 – numbers of thoracic segments, Ab1–10 – numbers of abdominal segments; setae: as – alar, ds – dorsal, eps – epipleural, eus – eusternal, lsts – laterosternal, pda – pedal, pds – postdorsal, prns – pronotal, prs – prodorsal, ss – spiracular, ps – pleural, sts – sternal, ts – terminal.
in the shapes of the rostra and the penis. Examination of the larvae confirms the relationship between them: they share the praedorsal segment on the abdominal segments with two pds, the epicranium with f_3, and the labral setae in one line. However, the larva of *G. veronicae* differs from that of *G. tibiellum* by the cuticle of the body covered with numerous reddish or brown asperities and setae emerging from black spots, the dark brown not pale yellow head, and the epipharynx with two (not three) als and three (not two) ams. The pupae also have many characters in common (see the key), but clearly differ by the number of setae as, ls and sls on the pronotum, those on the meso- and metathorax, and on the dorsal parts of abdominal segments I–VII.

**Gymnetron rotundicolle** Gyllenhal, 1838

**Material examined.** Serbia, Kalna, GPS 43°24.673’N, 22°25.737’E, 365 m, ex *Veronica hederophylla*, 20.06.2020, leg. Toševski (20 larvae); Serbia, Zemun, GPS 44°51.313’N, 20°22.625’E, 105 m, ex *V. opaca*, 19.06.2020, leg. Toševski (4 larvae and 2 pupae).

**Description of mature larva** (Figs 11A, B, 12A–F, 13A, B). **Measurements** (in mm). Body length: 2.20–2.33. The widest point in the body (meso- and metathorax) measures up to 0.86. Head width: 0.36–0.50.

**General.** Body relatively elongate, distinctly curved, rounded in cross section (Fig. 11A).

**Colouration.** Head pale yellow (Fig. 11B). All thoracic and abdominal segments white, cuticle smooth (Fig. 11A).

**Vestiture.** Setae on body thin, transparent, distinctly different in length (minute to very short or medium).

**Head capsule** (Figs 11B, 12A). Head suboval, endocarinal line present, shorter than half the length of frons. Frontal sutures on head of medium width, distinct. Stemma, in
Morphological characters of immatures of Gymnetron species

Figure 10. Gymnetron veronicae (Germar) pupa habitus A ventral view B dorsal view C lateral view. Abbreviations: a–pr – abdominal protuberances, p–pr – pronotal protuberances, ur – urogomphi; setae: as – apical, d – dorsal, ds – discal, fes – femoral, l – lateral, os – orbital, pls – posterolateral, sls – superlateral, v – ventral.
form of distinct, black pigmented spot with convex cornea. Des₁ short, located in middle of central part of epicranium; des₂ short, located in middle of central part of epicranium; medium size des₃ located anteriorly on epicranium close to border with frontal suture; des₄ short, located between des₂ and des₃; des₅ of medium size, located anterolaterally (Fig. 12A). Fs₁ absent; Fs₂ very short to minute, located medially; Fs₃ absent; Fs₄ medium, located anteriorly; and Fs₅ relatively long, located anterolaterally, close to antenna (Fig. 12A). Les₁ and les₂ as long as des₅; two ves short. Epicranial area with four postepicranial setae (pes).

**Antennae** membranous and distinctly convex basal membranous article bearing one relatively long conical sensorium and three sensilla basiconica (Fig. 12B).

** Clypeus** (Fig. 12C) ~ 3× as wide as long with two relatively long cls: cls₁ located posterolaterally, cls₂ located posteromedially, and one sensillum between setae; not fused with labrum.

**Mouth parts.** Labrum (Fig. 12C) ~ 3× as wide as long, with three piliform lms, relatively long, of almost equal length; lms₁ located posteromedially, close to clypeus, lms₂ located anteromedially, and lms₃ located anterolaterally. Epipharynx (Fig. 12D) with three very long digitate als, almost identical in length, two piliform als almost equal in length and one mes; labral rods indistinct, enlarged anteriorly. Mandibles (Fig. 12E) with two relatively long, piliform mds, located in distinct holes. Maxilla (Fig. 12F): stipes with one stps, two pfs, one mbs and sensillum, stps and pfs₁,₂ long, mbs very short; mala with five relatively long, digitate dms; four vms, different in length, one setae very short, and three setae minute. Maxillary palpi with two palpomeres; length ratio of basal and distal palpomeres: 1:0.5. Praelabium (Fig. 12F) oval, with one relatively long prns; ligula with sinuate margin and two very short ligs and one sensillum; premental sclerite broad, readily visible at sides but almost invisible in middle. Postlabium (Fig. 12F) with three pms, very long pms₂, and very short to short pms₁ and pms₃, all located laterally; membranous area sparsely and finely asperate.

**Thorax.** Prothorax (Fig. 13A) with six relatively long and one short to very short prns, pigmented dorsal sclerite present with four relatively long prns, this sclerite subdivided
Figure 12. *Gymnetron rotundicolle* Gyllenhal mature larva, head and mouth parts A head B antenna C clypeus and labrum D epipharynx E left mandible F maxillolabial complex. Abbreviations: at – antenna, clyss – clypeal sensillium, lr – labral rods, sb – sensillum basiconicum, Se – sensorium, st – stemma; setae: als – anteriolateral, ams – anteromedial, cls – clypeal, des – dorsal epicranial, dms – dorsal malar, fi – frontal epicranial, les – lateral epicranial, ligs – ligular, lms – labral, mbs – basioventral, mds – mandibular dorsal, mes – median, mpxs – maxillary palps, pes – postepicranial, pfs – palpiferal, pms – postmental, prms – premental, stps – stipital, ves – ventral, vms – ventral malar.
Figure 13. *Gymnetron rotundicolle* Gyllenhal mature larva, habitus A lateral view of thoracic segments B lateral view of abdominal segment I C lateral view of abdominal segments VI–X. Abbreviations: Th1–3 – numbers of thoracic segments, Ab1–10 – numbers of abdominal segments; setae: *as* – alar, *ds* – dorsal, *eps* – epipleural, *eus* – eusternal, *lsts* – laterosternal, *pda* – pedal, *pds* – postdorsal, *prns* – pronotal, *prs* – prodorsal, *ss* – spiracular, *ps* – pleural, *sts* – sternal, *ts* – terminal.
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into two triangular plates medially; two relatively long ps; and one short eus. Mesothorax (Fig. 13A) with two very short to minute prs; one relatively long and two short to very short pd; one relatively long as; two relatively long ss; one relatively long eps; one relatively long ps; and one short eus. Chaetotaxy of metathorax (Fig. 13A) almost identical to that of mesothorax. Each pedal area of thoracic segments well separated, with three long pda.

**Abdomen.** Spiracles on abdominal segments I–VI close to the anterior margin and functional, spiracles on abdominal segment VII not functional, and abdominal segment VIII with atrophied spiracles. Abdominal segments I–VI (Fig. 13B, C) with one very short to minute prs; one relatively long and one very short pd; one relatively long and one very short to minute ss; one relatively long eps; two very short ps; one very short lst; and one very short to minute eus. Abdominal segments VII–VIII (Fig. 13C) without prs; with one relatively long pd; one very short to minute ss; one relatively long eps; two very short ps; one very short lst; and one very short to minute eus. Abdominal segment IX (Fig. 13C) with one very short ds; one very short ps; and two very short sts. Abdominal segment X (Fig. 13C) with one very short to minute seta (ts).

**Description of pupa** (Figs 14A–C, 15A–C). **Measurements** (in mm). Body length: 2.20–2.37. Body width: 1.12–1.42, Thorax width: 0.70–0.85.

**Body.** Yellowish, pronotal protuberances (p-pr) weakly sclerotized, with serrated margins; apical parts of femora brownish. Rostrum slender. Pronotum twice as wide as long. Pronotal protuberances fused at basis. Mesonotum slightly smaller than metanotum. Urogomphi reduced, conical, with sclerotized apex. Abdominal segment VIII with rounded, prominent abdominal protuberance dorsally (a-pr) (Fig. 15A–C).

**Chaetotaxy.** Sparse, setae short to medium, transparent. Head with one short os. Rostrum without setae (Fig. 14B). Pronotum with two as, one ds, and three pls equal in length. Dorsal parts of meso- and metathorax with three setae of different length, situated medially. Apex of femora with one medium fes (Fig. 15A–C). Abdominal segments I–VIII with two short, equally long setae dorsally: one situated medially, the
other mediolaterally. All dorsal abdominal setae almost equal in length, short. Each lateral part of abdominal segments I–VIII with two setae of various length (one short, one minute). Ventral parts of abdominal segments I–VIII with three medium setae. Abdominal segment IX with two very short setae ventrally (Fig. 15A–C).
Biological notes. The adults of *G. rotundicolle* were previously recorded as collected on two species of *Veronica*: *V. persica* Poiret in Italy and Switzerland (Caldara 2008b; Germann et al. 2013), and *V. chamaedrys* L. in the Czech Republic and Slovakia (Krátký and Trnka 2012; Krátký 2013). The reports of *Veronica hederifolia* L. and *V. opaca* Fr. as host plants of this weevil are new data. The adults appear in early spring (mid-March), feeding on the upper leaves of newly growing shoots of the host. Oviposition takes place in the seed capsules, in which the larvae complete their development. The presence of larvae inside seed capsules can be detected from the dark colour of their frass.

Remarks and comparative notes. The first findings of this originally central Asian species in many countries of central and southern Europe (Italy, Switzerland, France, Germany, Czech Republic, Slovakia, Hungary, Poland) have been reported in many faunistic papers during the last 15 years (Strejček 2007; Caldara 2008b; Krátký and Trnka 2012; Krátký 2013; Germann et al. 2013; Reibnitz 2013; Podlussány et al. 2017; Wanat and Ruta 2018; Nolte and Haag 2019). These papers indicate with a high degree of certainty that this species only recently colonized areas where a few years ago it was absent, in contrast to its host plants (Caldara 2008b; Germann et al. 2013).

*Gymnetron melanarium* (Germar, 1821)

Material examined. Serbia, Pirot, Ponor, GPS 43°11.013’N, 22°25.067’E, 686 m, ex *Veronica austriaca* subsp. *jacquinii*, 20.06.2020, leg. Tóševski (35 larvae and 11 pupae).

Description of mature larva (Figs 16A, B, 17A–F, 18A, B). Measurements (in mm). Body length: 2.33–2.66. The widest point in the body (meso- and metathorax) measures up to 1.00. Head width: 0.50–0.53.

General. Body elongate, slender, weakly curved, rounded in cross section (Fig. 16A).

Colouration. Head pale yellow (Fig. 16B). All thoracic and abdominal segments smooth (Fig. 16A).

![Gymnetron melanarium mature larva](image)

Figure 16. *Gymnetron melanarium* (Germar) mature larva **A** habitus **B** head, dorsal view. Scale bars: 0.5 mm (**A**); 0.25 mm (**B**).
Vestiture. Setae on body thin, yellow, distinctly different in length (minute to very short or long).

Head capsule (Figs 16B, 17A). Head almost oval, endocarinal line present, extending distinctly to 3/4 of the length of frons. Frontal sutures on head distinct. Stemma, in form of pigmented spot with convex cornea. Des1 medium, located in middle of central part of epicranium; medium des2; medium des3; medium des4; medium des5 placed laterally (Fig. 17A). Fs1 absent; fs2 medium, located medially; fs3 absent; fs4 medium, located anteriorly; and fs5 long, located anterolaterally, close to antenna (Fig. 17A). Les medium and les2 as long as des5; single ves medium. Epicranial area with six postepicranial setae.

Antennae membranous and distinctly convex basal membranous article bearing one relatively long conical sensorium and four sensilla: three basiconica and single ampullaceum (Fig. 17B).

Clypeus (Fig. 17C) ~ 3× as wide as long with two relatively long cls, located postero-laterally, with single sensillum; fused to labrum.

Mouth parts. Labrum (Fig. 17C) ~ 3× as wide as long, with three piliform lms, relatively long, lms3 slightly shorter than others; lms1 located anteromedially, lms2 located partly close to clypeus, and lms3 located anterolaterally. Epipharynx (Fig. 17D) with three very long digitate als, almost identical in length; with two piliform amss, equal in length, and one short, digitate mes; labral rods indistinct, narrow. Mandibles (Fig. 17E) with two relatively long, piliform mds, located in distinct holes. Maxilla (Fig. 17F): stipes with one stps, two pfs and one sensillum, without mbs; stps and both pfs long; mala with five moderately elongate digitate dms; four vms, different in length, two setae short, and two setae very short. Maxillary palpi with two palpomeres; length ratio of basal and distal palpomeres: 1:1.2. Praelabium (Fig. 17F) oval, with one medium prms; ligula with rounded margin and two very short ligs; premental sclerite broad, well visible. Postlabium (Fig. 17F) with three pms, short pms1, very long pms2, and short pms3, all located laterally; membranous area densely and distinctly asperate.

Thorax. Prothorax (Fig. 18A) with nine long and one minute prns; two long ps; and two very short eus. Mesothorax (Fig. 18A) with two minute prs; one medium and two long pds; one long as; two long and one minute ss; one long eps; one long ps; and one short eus. Chaetotaxy of metathorax (Fig. 18A) almost identical to that of mesothorax. Each pedal area of thoracic segments well separated, with one long, two medium and two very short to minute pda.

Abdomen. Spiracles on abdominal segments I–VI placed medially and functional, spiracles on abdominal segment VII not functional, and abdominal segment VIII with atrophied spiracles. Abdominal segments I–VI (Fig. 18B, C) with one minute prs; one long and one medium pds; one long and one very short to minute ss; one long eps; one relatively long ps; without lsts and two very short eus. Abdominal segments VII–VIII (Fig. 18C) without prs; one long and one medium pds; one very short to minute ss; one long eps; one long ps; and two very short eus. Abdominal segment IX (Fig. 18C) with one relatively long ds; one relatively long ps; and one medium sts. Abdominal segment X (Fig. 18C) with one very short seta (ts).
Morphological characters of immatures of Gymnetron species

Figure 17. Gymnetron melanarium (Germar) mature larva, head and mouth parts A head B antenna C clypeus and labrum D epipharynx E left mandible F maxillolabial complex. Abbreviations: at – antenna, clss – clypeal sensillium, lr – labral rods, sa – sensillum ampullaceum, sb – sensillum basiconicum, Se – sensorium, st – stemma; setae: als – anteriolateral, ams – anteromedial, cls – clypeal, des – dorsal epicranial, dms – dorsal malar, fs – frontal epicranial, les – lateral epicranial, lgs – ligular, lms – labral, mds – mandibular dorsal, mes – median, mpxs – maxillary palps, pes – postepicranial, pfs – palpiferal, pms – postmental, prms – premental, stps – stipital, ves – ventral, vms – ventral malar.
Description of pupa (Figs 19A–C, 20A–C). Measurements (in mm). Body length: 2.12–2.32. Body width: 1.25–1.32. Thorax width: 0.75–0.82.

Body. Yellowish, pronotal protuberances (p-pr) sclerotized, smooth; head, rostrum, antennae, dorsal parts of meso- and metanotum, and apical parts of femora brownish. Rostrum rather slender. Pronotal protuberances well separated. Pronotum 1.8× as wide as long. Mesonotum slightly smaller than metanotum. Urogomphi reduced, conical, with sclerotized apex. Abdominal segment VIII with conical abdominal protuberance dorsally (a-pr) having acute, sclerotized apex (Fig. 19A–C).
Morphological characters of immatures of Gymnetron species

Chaetotaxy. Sparse, setae rather short to moderately elongate, transparent. Head with two os, different in length. Rostrum with one rs. Setae on head and rostrum straight, as long as those on prothorax (Fig. 20B). Pronotum with two as, two ls, two ds and four pls; ds, and ls slightly shorter than other pronotal setae. Dorsal parts of meso- and metathorax with two setae placed medially. Apex of femora with two fes equal in length (Fig. 20A–C). Abdominal segments I–VIII with five short, equally long setae dorsally: first placed antero-medially, the others distributed in regular line along posterior margin of segment. All dorsal abdominal setae short, almost equal in length. Each lateral part of abdominal segments I–VIII with one elongated seta. Ventral parts of abdominal segments I–VIII with three medium setae. Abdominal segment IX with two very short setae ventrally (Fig. 20A–C).

Biological notes. Previously the larva of this species was observed on Veronica serpyllifolia L., on the stems where it produces a small uni- or bilocular gall in which metamorphosis takes place. The adult emerges from the gall at the end of summer and hibernates in the soil (Hustache 1931; Hoffmann 1958). The adult has also been collected on other Veronica species such as V. agrestis L., V. austriaca subsp. austriaca L., V. chamaedrys L., V. officinalis L, and V. teucrium (L.) D.A. Webb (Hoffmann 1958; Koch 1992; Sprick 1997). In Serbia, the development of G. melanarium is restricted to the seed capsules of Veronica austriaca subsp. jacquinii (Baumg.) Watzl, which is new information. Nearly 90% of the seed capsules are infested with one or two larvae. The larvae are seed feeders and development occurs in the basal part of the strongly flattened, glossy and glabrous seed capsules with no visible sign of larval presence. Oviposition takes place from mid-May onwards and the new generation of adults emerges during July.

Remarks and comparative notes. This species belongs to a group of very similar species characterized by slender subrectangular elytra, rostrum in lateral view tapered from the antennal insertion to the apex, and short protibiae in the female. There are no particular phylogenetic affinities with the adult (see Caldara 2008a) and pupal stages (abdominal protuberance short, triangular, head with 2 os) of the other species.

Figure 19. Gymnetron melanarium (Germar) pupa habitus A ventral view B lateral view C dorsal view. Scale bars: 0.5 mm.
Figure 20. *Gymnetron melanarium* (Germar) pupa habitus A ventral view B dorsal view C lateral view. Abbreviations: a–pr – abdominal protuberances, p–pr – pronotal protuberances, ur – urogomphi; setae: as – apical, d – dorsal, ds – discal, fes – femoral, l, ls – lateral, os – orbital, pls – posterolateral, rs – rostral, v – ventral.
described here. By contrast, the larvae share several characters with *G. rotundicolle*, e.g., the praedorsal segment on abdominal segments with one *pds*, the epicranium lacking *f₃*, and the conical layout of the labral setae.

*Gymnetron villosulum* Gyllenhal, 1838

**Material examined.** Serbia, Boljetin, GPS 44°30.973’N, 22°0.921’E, 139 m, ex gall *Veronica anagallis-aquatica*, 16.07.2012, leg. Toševski (3 larvae and 1 pupa).

**Description of mature larva** (Figs 21A, B, 22A–F, 23A–C). **Measurements** (in mm). Body length: 2.25–2.46. The widest point in the body (meso- and metathorax) measures up to 1.20. Head width: 0.40–0.51.

**General.** Body elongate, slender, weakly curved, rounded in cross section (Fig. 21A).

**Colouration.** Head dark brown (Fig. 21B). All thoracic and abdominal segments white with many reddish or brown asperities (Fig. 21A).

**Vestiture.** Setae on body thin, orange, distinctly different in length (minute to very short or long).

**Head capsule** (Figs 21B, 22A). Head suboval, flattened laterally, endocarinal line present, clearly extending to 1/3 of the length of frons. Frontal sutures on head very broad and distinct. Stemma, in the form of a very small pigmented spot with convex cornea. *Des₁* short, located in middle of central part of epicranium; *des₂* absent; relatively long *des₃* located anteriorly on epicranium close to border with frontal suture; *des₄* absent; *des₅* long, located anterolaterally (Fig. 22A). *Fs₁* absent; *fs₂* relatively long, located medially; *fs₃* absent; *fs₄* relatively long, located anteriorly; and *fs₅* long, located anterolaterally, close to antenna (Fig. 22A). *Les₁* and *les₂* as long as *des₅*; *ves* short. Epicranial area with two postepicranial setae.

**Antennae** membranous and distinctly convex basal membranous article bearing one relatively long conical sensorium and four sensilla basiconica (Fig. 22B).

**Clypeus** (Fig. 22C) ~ 3–4x as wide as long with two relatively long *cls*, located posterolaterally, without sensillum; fused to labrum.

![Figure 21. Gymnetron villosulum Gyllenhal mature larva A habitus B head, dorsal view. Scale bar: 1 mm.](image-url)
Figure 22. Gymnetron villosulum Gyllenhal mature larva, head and mouth parts. A head, B antenna, C clypeus and labrum, D epipharynx, E left mandible, F maxillolabial complex. Abbreviations: at – antenna, lr – labral rods, sb – sensillum basiconicum, Se – sensorium, st – stemma; setae: als – anteriolateral, ams – anteromedial, cls – clypeal, des – dorsal epicranial, dms – dorsal malar, fs – frontal epicranial, les – lateral epicranial, ligs – ligular, lms – labral, mds – mandibular dorsal, mpxs – maxillary palps, pes – postepicranial, pfs – palpiferal, pms – postmental, prms – premental, stps – stipital, ves – ventral, vms – ventral malar.
**Mouth parts.** Labrum (Fig. 22C) ~ 4× as wide as long, with three piliform lms, relatively long, almost of equal length; lms, located anteromedially, lms₂ partly located close to clypeus, and lms₃ located anterolaterally. Epipharynx (Fig. 22D) with two very long digitate als, almost identical in length; with three als of different length, als₁ and als₂ piliform and short, digitate als₃ and enlarged in middle; without mes; labral rods indistinct, irregular in shape. Mandibles (Fig. 22E) with two relatively long, piliform mds, located

**Figure 23.** Gymnetron villosulum Gyllenhal mature larva, habitus A lateral view of thoracic segments B lateral view of abdominal segment I C lateral view of abdominal segments VI–X. Abbreviations: Th₁–Th₃ – numbers of thoracic segments, Ab₁–Ab₁₀ – numbers of abdominal segments; setae: as – alar, ds – dorsal, eps – epipleural, eus – eusternal, lsts – laterosternal, pda – pedal, pds – postdorsal, prns – pronotal, prs – prodorsal, ss – spiracular, ps – pleural, sts – sternal, ts – terminal.
in distinct holes. Maxilla (Fig. 22F): stipes with one stps, two pfs and without mbs and sensillum, stps and pfs1 long, pfs2 relatively long; mala with four short digitate dms; three vms, different lengths, one seta very short, and two setae minute. Maxillary palpi with two palpomeres; length ratio of basal and distal palpomeres: 1:0.5. Praelabium (Fig. 22F) oval, with one long prms; ligula with sinuate margin and two very short ligs; premental sclerite broad, well visible. Postlabium (Fig. 22F) with two pms, pms3 absent, short pms2 located laterally and very long pms3, located medially; membranous area sparsely and finely asperate.

**Thorax.** Prothorax (Fig. 23A) with six long and two very short to minute prns, small pigmented dorsal sclerite present with two long prns, this sclerite subdivided into two triangular plates medially; two long ps; and two short to very short eus. Mesothorax (Fig. 23A) with two very short to minute prs, two long pds; one long as; one long and two very short to minute ss; one long eps; one long ps; and two short eus. Chaetotaxy of metathorax (Fig. 23A) almost identical to that of mesothorax. Each pedal area of thoracic segments well separated, with three long and one very short to minute pda.

**Abdomen.** Spiracles on abdominal segments I–VI close to the anterior margin and functional, spiracles on abdominal segment VII not functional, and abdominal segment VIII with atrophied spiracles. Abdominal segments I–VI (Fig. 23B, C) with one short and one minute prs; one long pds; one long and one very short to minute ss; one long eps; one relatively long ps; one short lsts; and two very short and sometimes one additional minute eus. Abdominal segments VII–VIII (Fig. 23C) with one very short prs; one long pds; one long and one very short to minute ss; one long eps; one relatively long ps; one short lsts; and two very short and sometimes one additional minute eus. Abdominal segment IX (Fig. 23C) with one relatively long ds; two relatively long ps; and one short to very short sts. Abdominal segment X (Fig. 23C) with one very short seta (ts).

**Description of pupa** (Figs 24A–C, 25A–C). **Measurements** (in mm). Body length: 2.24–2.73. Body width: 1.30–1.55. Thorax width: 0.82–0.88.

**Body.** Brownish, pronotal protuberances (p-pr) sclerotized, smooth; head, rostrum and pronotum darker than rest of body. Rostrum moderately slender. Pronotal protu-
Figure 25. *Gymnetron villosulum* Gyllenhal pupa habitus **A** ventral view **B** dorsal view **C** lateral view. Abbreviations: a–pr – abdominal protuberances, p–pr – pronotal protuberances, ur – urogomphi; setae: as – apical, d – dorsal, ds – discal, fes – femoral, l, ls – lateral, os – orbital, pls – posterolateral, rs – rostral, v – ventral.
berances fused at basis. Pronotum 2.2× as wide as long. Mesonotum distinctly smaller than metanotum. Urogomphi short, conical, with sclerotized apices. Abdominal segment VIII with rounded, prominent abdominal protuberance dorsally (Fig. 25A, B).

**Chaetotaxy.** Sparse, setae short to medium, transparent. Head with one medium os. Rostrum with one rs (Fig. 25A). Pronotum with one elongate as, one ls, and four pls all almost equal in length. Dorsal parts of meso- and metathorax with two setae of various length, placed medially. Apices of femora with one medium-sized fes (Fig. 25A–C). Abdominal segments I–VIII with two medium-sized setae (one placed medially, the other laterally). Each lateral part of abdominal segments I–VIII with one medium-sized seta. Ventral parts of abdominal segments I–VIII with two medium-sized setae. Abdominal segment IX with two minute setae ventrally (Fig. 25A–C).

**Biological notes.** The host plants of this species are several Veronica species: *V. anagallis-aquatica* L., *V. anagalloides* Guss., *V. beccabunga* L., *V. catenata* Pennell, *V. scutellata* L. (Kleine 1910; Urban 1930; Hustache 1931; Hoffmann 1958; Sprick 1997). The adults appear on the host plants in May. The females oviposit during June in the ovarial tissue, inducing a bulbous gall in which the larva develops.

**Remarks and comparative notes.** This species is common in the whole of Europe and Anatolia. The adult is closely related to *G. miyoshii*, a vicariant species living in eastern Asia (Caldara 2008a; Alonso-Zarazaga et al. 2017). The immature stages confirm this relationship, as they share the postdorsal segment on the abdominal segments with one pds and the dorsal epicranium without des4.

**Key to the known mature larvae of Gymnetron species**

The following key is based on the larvae of the five Gymnetron species described in this paper and one described by Jiang and Zhang (2015).

1. Postdorsal segment on abdominal segments with one pds. Dorsal epicranium without des4. Postlabium with two pms .............................................................. 2
2. Postdorsal segment on abdominal segments with two pds. Dorsal epicranium with des4. Postlabium with three pms .............................................................. 3
2. Pronotum with six prns (as prns and dpls). Des1 short; des2 short; des3 long, fs2 and fs4 short. Head with three pes .................................................... *G. miyoshii*
3. Pronotum with ten prns. Des1 medium; des2 absent; des3 medium, fs2 and fs4 medium. Head with two pes .................................................... *G. villosulum*
3. Praedorsal segment on abdominal segments with two pds. Epicranium with fs2. Labral setae in one line .............................................................. 4
4. Praedorsal segment on abdominal segments with one pds. Epicranium without fs5. Labral setae in a triangle .............................................................. 5
4. Body cuticle covered with numerous reddish or brown asperities, black spots at base of setae. Head dark brown. Epipharynx with two als and three ams .............................................................. *G. veronicae*
5. Body cuticle smooth, setae without black spots at base. Head pale yellow. Epipharynx with three als and two ams .............................................................. *G. tibiellum*
Morphological characters of immatures of Gymnetron species

5 Pronotum with seven setae. Meso- and metathorax with two as and one ss. Pedal area with three pda. Mbs present.......................... G. rotundicolle

– Pronotum with ten setae. Meso- and metathorax with one as and three ss. Pedal area with five pda. Mbs absent.......................... G. melanarium

Key to pupae of known Gymnetron species

The following key is based on the pupae of the five Gymnetron species described in this paper.

1 Abdominal protuberance prominent, disc-shaped. Head with one os........2

– Abdominal protuberance short, conical. Head with two os.... G. melanarium

2 Pronotal protuberances with serrated margin. Rostrum without setae. Pronotum with one ds and two or three pls. Ventral parts of abdominal segment I–VII with three setae .................................................................3

– Pronotal protuberances with smooth margin. Rostrum with one rs. Pronotum without ds and four pls. Ventral parts of abdominal segment I–VII with two setae................................................................. G. villosulum

3 Pronotum with three pls. Femora with two fes. Dorsal parts of abdominal segments I–VII with three or four setae .................................................................4

– Pronotum with two pls. Femora with one fes. Dorsal parts of abdominal segments I–VII with two setae................................................................. G. rotundicolle

4 Pronotum with one as, and one ls. Meso- and metathorax with two setae. Dorsal parts of abdominal segments I–VII with three setae...... G. tibiellum

– Pronotum with two as, and without ls. Meso- and metathorax with three setae. Dorsal parts of abdominal segments I–VII with four setae........ G. veronicae

Discussion

Comparison with immature stages of known Mecinini

It has been suggested that the number of palpomeres of the labial palpi is one of the most important morphological characters of larvae in the Mecinini (Skuhrovec et al. 2018). Phylogenetically, the basal state in weevils is the presence of two palpomeres on the labial palpi (Marvaldi 1997). In Mecinus there are species in the plesiomorphic state (e.g., Mecinus collaris Germar, 1821; Mecinus janthinus group), but also such with one palpomere (Gosik et al. 2020). All the Gymnetron species examined here have one labial palpomere, as do the few species of Rhinusa described to date. In contrast, Cleopomiarus and Miarus generally have two palpomeres, although in some Cleopomiarus species the basal palpomere is not distinctly separated from the labium and can appear to be just a single palpomere (Skuhrovec et al. 2018).

Another crucial generic-specific character in Mecinini larvae is the number of air tubes of the thoracic and abdominal spiracles. In Gymnetron all the spiracles are
unicameral (Jiang and Zhang 2015). In the larvae of Mecinus species this character has two states: (1) all spiracles unicameral, as in Gymnetron and (2) the thoracic spiracle bicameral and the abdominal ones unicameral, as in some Rhinusa (Anderson 1973; May 1993; Ścibior and Łętowski 2018; Gosik et al. 2020). In contrast, all known larvae of Cleopomiarus and Miarius species have bicameral spiracles on the thorax and abdomen (Skuhrovec et al. 2018).

Another debatable state in the larvae is the number of epipharyngeal setae (especially ams and mes), which has not yet been completely resolved in Curculionidae (Gosik and Skuhrovec 2011; Stejskal et al. 2014; Trnka et al. 2015). In the Mecinini there are three als, two or three ams, and none or one mes. In our view, the final decision regarding the number of each seta is important, but not crucial, and the comparison between groups/genera should be made together for all three kinds of these epipharyngeal setae in order to make fewer errors when creating a differential diagnosis for the genera in the tribe.

The last important characteristic observed within the Mecinini tribe is the integument of the body covered with distinct asperities, both in the larval and pupal stages (Skuhrovec et al. 2018). This feature is very variable within each genus, probably owing to the distinctive environmental conditions within plant tissues.

With regard to the pupae, an uncommon character is the presence of two more or less sclerotized pronotal prominences, which can be smooth or serrated. Moreover, these pronotal protuberances (p-pr) are divisible into two parts with or without a stem from the pronotum and may have conical asperities or serrated margins. These prominences are present in all the Gymnetron species studied here, but also in some Rhinusa and a few Mecinus (Gosik 2010). The evolutionary significance of this character, which disappears altogether in the adult, is unclear.

**Differences between immatures at the species level**

All the larvae and pupae of every species studied here, and also the three described by Jiang and Zhang (2015), have several characters distinguishing them from one another. These differences confirm that most of them belong to different groups, as suggested by the study of the adults (Caldara 2008a). Three species, very closely related on the basis of the adult morphology (G. veronicae, G. tibiellum and G. auliense), also have several characters in common in the larva (presence of fs3; pro- and postdorsal folds of abdominal segments I–VI (VIII) with two prs and two pds; labral setae in one line) and in the pupae (sclerotized pronotal protuberances covered with conical asperities). The other two related species, G. villosulum and G. miyoshii, resemble each other more than the other species (in the larvae des4 and mbs absent, postdorsal segment on abdominal segments with one pds; in the pupae pronotal protuberances smooth). The other species do not show clear relationships with each other or with the group of G. veronicae and G. villosulum. Only G. vittipenne could be related to the G. villosulum group, as also shown by the phylogenetic tree of the adults reported by Caldara (2008a).
Biological and evolutionary considerations

This study confirms that all the Palaearctic species of the genus *Gymnetron* with known biologies live only on *Veronica*. No other species belonging to the Mecinini live on this genus of Plantaginaceae. All the species usually seem to feed on various species of this genus, partly unrelated to each other and belonging to different subgenera as currently considered (Albach et al. 2004). They feed on the ovary or the stem of the plant, sometimes forming more or less voluminous galls. A recent study of *Gymnetron* and *Rhinusa* indicated a strong phylogenetic signal with respect to host plants but a weaker one with respect to the particular plant structures occupied by the insects in question on different plant structures (Hernández-Vera et al. 2013).

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