The larva of *Ecclisopteryx malickyi* Moretti, 1991 (Trichoptera: Limnephilidae: Drusinae), with comments on the genus

WOLFRAM GRAF1 *, MLADEN KUČINIĆ2, ANA PREVIŠIĆ3, STEFFEN U. PAULS4 & JOHANN WARINGER5

1Department of Hydrobiology, University of Agriculture, Max Emanuelstraße 17, A-1180 Wien, Austria (wolfram.graf@boku.ac.at)
2Department of Biology, Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10000 Zagreb, Croatia (kucinic@zg.biol.pmf.hr, Group for Systematic Zoology & Entomology)
3Department of Biology, Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10000 Zagreb, Croatia (aprevis@zg.biol.pmf.hr, Group for Systematic Zoology & Entomology)
4Biodiversity and Climate Research Centre (BiK-F), Senckenberganlage 25, D-60325 Frankfurt am Main, Germany (steffen.pauls@senckenberg.de)
5Department of Freshwater Ecology, University of Vienna, Althanstraße 14, A-1090 Wien, Austria, (johann.waringer@univie.ac.at)
(*) corresponding author

Abstract

The paper presents a description of the hitherto unknown larva of *Ecclisopteryx malickyi* Moretti 1991. Information for the identification of this species is given, and the most important diagnostic features are illustrated. Some zoogeographical and ecological notes are added. Furthermore, larval morphology of the whole genus is discussed and differentiating characters are given.

Key words: genus Ecclisopteryx, *Ecclisopteryx malickyi*, 5th instar larva, description, identification

Introduction

According to Malicky (2005), the rare *Ecclisopteryx malickyi* Moretti is one of 5 *Ecclisopteryx* species worldwide. Three of them (*Ecclisopteryx dalecarlica* Kolenati, *E. guttulata* Pictet and *E. madida* McLachlan) are included in the larval keys of Pitsch (1993) and Waringer and Graf (1997, 2004), the larva of *E. asterix* Malicky was described by Urbanič et al. (2003) whereas *E. malickyi* has been unknown so far. Recently, larvae and pupae of an *Ecclisopteryx* species morphologically close to *E. asterix* were collected from Trentino Alto Adige, Italy. Adults and mature pupae clearly identified the unknown larvae as *E. malickyi*.

Description of the 5th instar larva of *Ecclisopteryx malickyi* (head width ≥ 1.5 mm)

Material examined: *Ecclisopteryx malickyi*: 5 fifth-instar larvae and 1 fourth-instar larva from Camposilvano, Trentino Alto Adige, Italy, were collected on 17.VII.2007 by W. Graf. In addition, 10 specimens of *E. asterix* from the Babniaikgrabten and Loiblbach, Carinthia, Austria, were checked for morphological characters in order to separate the species.

Body length of final-instar larva: 7.0–10.9 mm; head width: 1.5–1.6 mm. Length of larval case: 7.0–10.7 mm. Smooth case slightly curved and tapering posteriorly (width at anterior opening
2.6–3.2 mm and at posterior opening 1.5–2.3 mm) and consisting completely of mineral particles with grain sizes increasing distinctly in anterior direction.

Head capsule and all body sclerites dark brown to black brown. Head capsule (Fig. 1) lacking additional setae or spines and very closely resembling Drusus annulatus (Stephens). Mandibles lacking not only terminal teeth along edges, but also ridges in central concavity.

In profile, dorsal line of pronotum rounded in its posterior 3rd (Figs 1, 3), thereby creating small dorsal hump. This hump, however, not fitting seamlessly with curvature of anterior 2/3rds of pronotum as in D. biguttatus (F.J. Pictet), but sharply offset, thereby creating step-like interruption of dorsal silhouette, as is also true in D. annulatus or E. asterix (Figs 2, 4); no median incision in anterior view. Differences in dorsal hump curvature of D. annulatus, E. asterix and E. malickyi subtle (for separation of first 2 species see Urbanič et al. 2003). Dark brown pronotal surface densely covered by black setae. Prosternite brownish, densely covered by spinules, these spinules extending posteriorly and anteriorly to soft cuticle surrounding prosternal horn. Mesonotum completely covered by 2 blackish brown sclerites. Metanotum partially covered by 3 pairs of sclerites; anterior metanotal (sa1) sclerites large, ovoidal, their median separation being distinctly smaller than their maximum length along body axis. Abdominal sternum I with 110–130 black setae. Setal bases at central section of the abdominal sternum I large, with marked tendency of fusing, thereby creating multilobed sclerotized pattern (Fig. 5).

Dorsal gills present from abdominal segments II (presegmental position) to VII (postsegmental position). Ventral gills range from abdominal segments II (presegmental) to VII (presegmental) and lateral gills are present from segments II (presegmental) to III (postsegmental position). Lateral fringe present on last 1/3rd of segment III to first 1/4th of segment VIII. Abdominal sclerite IX with 2 central intermediate setae. Femora of anterior legs each with 3 to 4 ventral spines. Groups of setae present on anterior faces of all femora. Posterior faces of metathoracic femora without additional setae.

**Separation of Ecclisopteryx malickyi from other Trichoptera**

A summary of morphological features for the identification of Limnephilidae and Drusinae larvae was given by Waringer (1985). Within the framework of the limnephilid key by Waringer and Graf (1997, 2004), E. malickyi is keyed together with Drusus annulatus, D. biguttatus and Ecclisopteryx asterix and separated from other Drusinae species by the following features:

- Head and pronotum without thick layer of woolly hairs.
- Head capsule without groups of additional spines, without central concavity and without rims surrounding the frontoclypeus.
- First abdominal sternum without large median sclerotized patch bearing numerous (30–40) black setae.
- Prominent ridge or sharp keel lacking on pronotum.
- Mandibles lacking not only terminal teeth along edges, but also ridges in central concavity.
- Additional setae present on faces of mid- and hindleg femora; dorsal setae on mid- and hindtibiae present at distal 1/3rd only.
- Metanotal sclerites large, ovoidal, their median separation being distinctly smaller than their maximum length along body axis.
- Lateral fringe present on last 1/3rd of abdominal segment III to first 1/4th of abdominal segment VIII.
- Median setae present at anterior border of pronotum.
Finally, the 5th instar larva (head width > 1.5 mm) of *E. malickyi* can be easily separated from those of *Drusus annulatus* and *D. biguttatus* by the beginning of the lateral fringe at the anterior border of the abdominal segment III in the latter 2 species; in *E. asterix* and *E. malickyi*, the lateral
fringe does not start before the last 1/3rd of this segment. Among other known larvae of Central European Drusinae, only Drusus monticola and D. chrysotus have a lateral fringe that begins so far posterior. D. monticola is readily separated from E. asterix by the high pronotal keel and its deep median incision in anterior view (Urbanič et al. 2003: Fig. 10), while D. chrysotus (Rambur) is easily distinguished by the deep central concavity of the head capsule (Waringer 1987). In the remaining Drusinae species, the lateral fringe starts between the middle of abdominal segment II and the first 1/3rd of abdominal segment III. In E. guttulata, E. dalecarlica and E. madida the fringe is present from the beginning of segment III. As with the bristles at the pronotum and head, the differences in lateral fringe delimit a 2nd lineage within the Ecclisopteryx-group.

Differentiation between E. malickyi and E. asterix larvae is subtle, indicating their close relationship, and is much more difficult than in adults. Postsegmental dorsal gills are present until segment VII in E. malickyi; in E. asterix they only reach segment VI. Lateral gills are present from segment II (presegmental) to segment III (postsegmental position) in E. malickyi but extend to the posterior edge of segment IV in E. asterix. At dorsum VIII, 6 setae are present in E. asterix whereas E. malickyi only has 4 setae at this position. The dorsal shape of the pronotum is slightly different but not easy to describe (see Figs 3, 4): in lateral view the part ascending caudally is more convex in E. asterix while it is straight in E. malickyi; the crest is rounded in E. asterix whereas it is more acutely angled in E. malickyi. Median setae behind the hump are significantly shorter in E. malickyi than in E. asterix: in E. malickyi they are about 1/3rd of the length of 2 median setae immediately anterior of the hump (Fig. 1, arrow: prl and pom respectively) whereas in E. asterix they are about half the length (Fig. 2 arrow: prl and pom respectively). The ventral side of each fore femur bears 5 yellowish spines in E. asterix while E. malickyi has 3–4 spines there. Abdominal sternum I has 2 median, quite narrowly situated, sclerotised patches bearing several setae in E. malickyi (Fig. 5). In E. asterix these patches are widely separated, smaller and bear only 1 seta each (Fig. 6).

The distribution area of the 2 species is well separated, and no overlap is documented. According to Malicky (2004), Cianficconi et al. (2005), and Cianficconi et al. (2007), E. malickyi is exclusively known from 2 regions in the central-eastern Alps, Trentino a Adige and Veneto in a small mountainous area eastwards of Lago di Garda (Camposilvano, Pian di Fugazze, Sega di Ala; Val di Tovo) whereas E. asterix lives near the borders of Austria, Slovenia and Italy in the south-eastern Alps (Urbanič et al. 2003, Malicky 2004) (Fig. 7).

**FIGURE 7.** Distribution of Ecclisopteryx malickyi and E. asterix.
Habitat and distribution


While *E. guttulata* and *E. dalecarlica* prefer larger streams and rivers with epi-metarhithral characteristics, *E. asterix* and *E. malickyi* are confined to springs and springfed brooks. *E. madida* has a wider ecological range and lives from crenal sections to small rivers (Graf *et al.* 2002).

*Ecclisopteryx malickyi* is on the wing from May to July (Malicky 2004, Cianficconi *et al.* 2005) but the single female from 15 October 2006 indicates a more prolonged flight period.

Discussion

The genus *Ecclisopteryx* was established by Kolenati in 1848, based mainly on the structure of male genitalia. However, larvae of the genus can only be separated from other known larvae of the subfamily Drusinae by a combination of a multitude of features like: additional, stout bristles on head capsule (situated mainly around the eyes; *E. madida*, *E. guttulata* and *E. dalecarlica*) and at the pronotum (*E. madida* and *E. dalecarlica*), a sharp pronotal ridge (*E. madida* and *E. guttulata*) and the lateral fringe starting point on the beginning of abdominal segment III (*E. madida*, *E. guttulata* and *E. dalecarlica*) or by the unusual late start of the lateral fringe at the last 1/3rd of abdominal segment III in *E. asterix* and *E. malickyi* (Table 1).

**TABLE 1.** Synoptic key for the diagnosis of the larvae of genus *Ecclisopteryx* [for separating *E. asterix* from *E. malickyi* see text above; the other 3 species can be identified by using the keys of Pitsch (1993) and Waringer & Graf (1997; 2004)] and morphologically close species of *Drusus*.

<table>
<thead>
<tr>
<th>Species/character</th>
<th>Additional short bristles present on parietalia</th>
<th>Lateral fringe starting at</th>
<th>Colour of sclerites</th>
<th>pronotum with sharp ridge</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. guttulata</em></td>
<td>yes</td>
<td>the beginning of abd. segment III</td>
<td>brownish-red</td>
<td>yes</td>
</tr>
<tr>
<td><em>E. dalecarlica</em></td>
<td>yes</td>
<td>the beginning of abd. segment III</td>
<td>yellow</td>
<td>no</td>
</tr>
<tr>
<td><em>E. madida</em></td>
<td>yes</td>
<td>the beginning of abd. segment III</td>
<td>black</td>
<td>yes</td>
</tr>
<tr>
<td><em>E. asterix</em></td>
<td>no</td>
<td>the last third of abd. segment III</td>
<td>brownish-black</td>
<td>no</td>
</tr>
<tr>
<td><em>E. malickyi</em></td>
<td>no</td>
<td>the last third of abd. segment III</td>
<td>brownish-black</td>
<td>no</td>
</tr>
<tr>
<td><em>D. biguttatus</em></td>
<td>no</td>
<td>the beginning of abd. segment III</td>
<td>brownish-black</td>
<td>no</td>
</tr>
<tr>
<td><em>D. annulatus</em></td>
<td>no</td>
<td>the beginning of abd. segment III</td>
<td>brownish-black</td>
<td>no</td>
</tr>
</tbody>
</table>
Based on phylogenetical analyses of Pauls et al. (2008), genus Ecclisopteryx is nested within species of genus Drusus, rejecting monophyly of the genus which is underlined by the present study. Results of the molecular phylogeny group E. madida, E. guttulata and E. dalecarlica with Drusus botosaneanui while E. malickyi forms a distantly related clade with E. asterix (Pauls et al. 2008). This separation of Ecclisopteryx into 2 lineages is supported by larval morphology, which clearly allows delimiting 2 groups: E. madida, E. guttulata and E. dalecarlica; and E. malickyi and E. asterix, respectively. Both E. asterix and E. malickyi lack spines at the head capsule, which are characteristic for the other species (E. guttulata, E. dalecarlica and E. madida) of this small genus. Furthermore E. asterix and E. malickyi lack a sharp rim at the pronotum and the lateral fringe starts at only abdominal segment III.

Pauls et al. (2008) proposed that larval feeding guilds reflect the main evolutionary groups in the Drusinae and used the grouping revealed by the molecular phylogeny to predict the feeding ecology of several species whose larval stages were unknown at the time. For example, based on its position in the phylogeny among grazers, they hypothesised that E. malickyi must be a grazer, without teeth on the edge of the mandibles and without filtering bristles on abdominal sternum I and legs. The identification of the larvae of E. malickyi brought forth in this paper, shows that E. malickyi is in fact a grazer without teeth on the mandible edges and without any filtering bristles. The results thus support the observation that the main groups observed in the molecular phylogeny correspond to larval feeding ecology.

From a zoogeographical point of view both E. asterix and E. malickyi are microendemic species which live at the southern slopes of the Alps in disjunct ranges. The remaining species of Ecclisopteryx are much more widespread.

There are many examples of species pairs within Drusinae with eastern and western areas greatly extending towards the central Alps, thereby making the group an ideal model for examining speciation processes within southern glacial refugia and postglacial range expansion within the alpine chain. Such disjunctions are known, e.g., for Metanoea rhaetica Schmid (east) and M. flavipennis (F.J. Pictet) (west), Drusus monticola McLachlan and D. nigrescens Meyer-Dür, D. adustus McLachlan and D. melanchaetes McLachlan, D. chrysotus (Rambur) and D. muelleri McLachlan, D. franz Schmid and D. alpinus Meyer-Dür, and among divergent lineages within Drusus discolor (Rambur) (Graf et al. 2005, Graf et al. 2009, Pauls et al. 2006, Waringer et al. 2007, Waringer et al. 2008). These patterns implicate comparable mechanisms of regression, divergence and expansion. Concentrations of endemic species in the south and southeastern Alps are well known among Trichoptera species (Malicky 1983, 2000) but disjunction of species which, based on genetics and larval morphology, turn out to be sister species reveals a new aspect of survival during glaciation and recolonisation of formerly glacial areas within freshwater insects.

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