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

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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 Babniakgraben 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

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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.

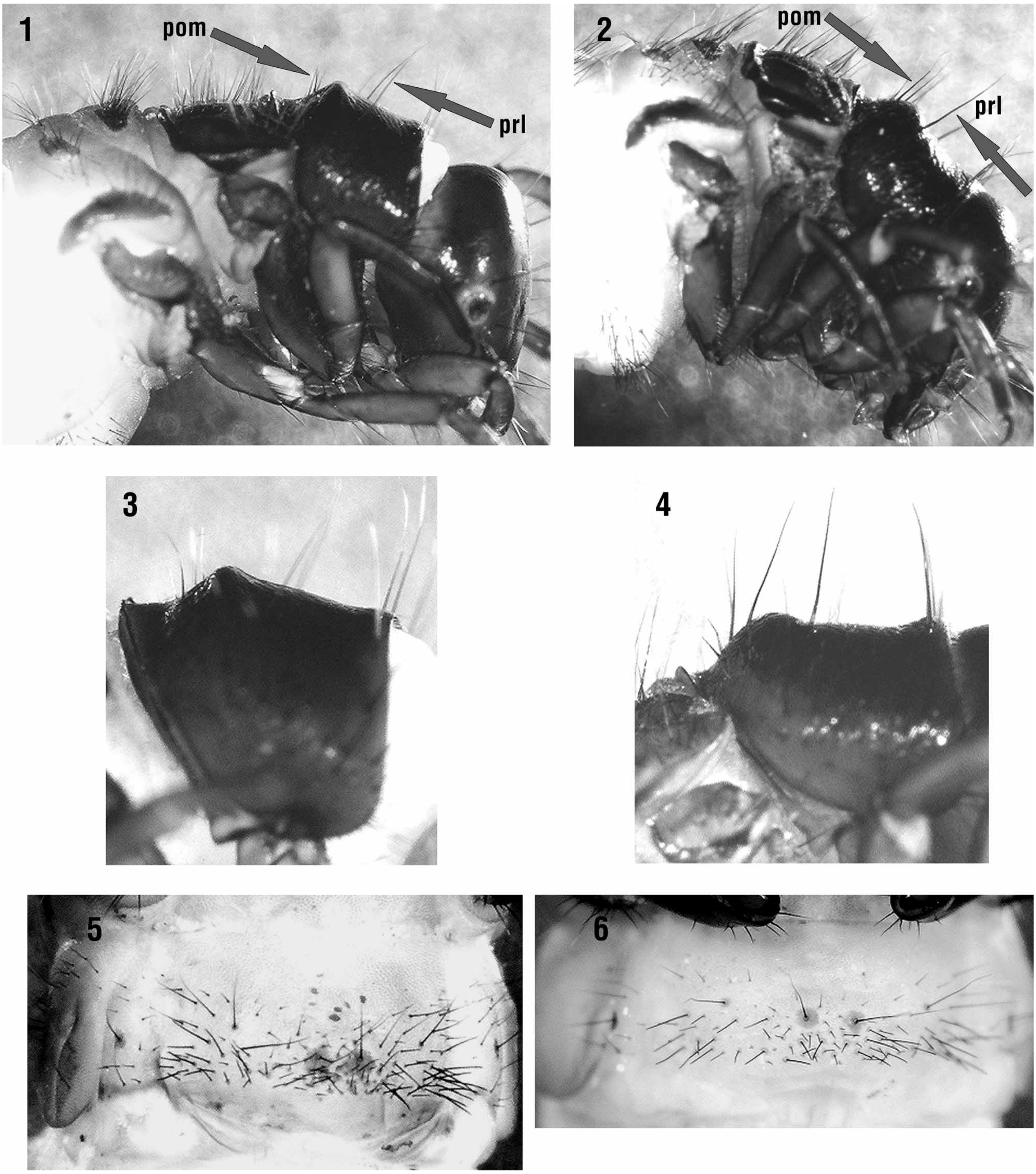
In profile, dorsal line of pronotum rounded in its posterior 3rd (Figs 1, 3), thereby creating small dorsal hump. This hump, however, not fitting seamlessly with curvature of anterior 2/3rds of pronotum as in *D. biguttatus* (F.J. Pictet), but sharply offset, thereby creating step-like interruption of 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.



FIGURES 1, 3, 5. *Ecclisopteryx malickyi*, 5th instar larva. 1, head, thorax and abdominal segment I, right lateral view; arrows: prl = praemedian setae; pom = postmedian setae; 3, profile of right side of pronotum; 5, abdominal sternum I, ventral view;

FIGURES 2, 4, 6. *Ecclisopteryx asterix*, 5th instar larva. 2, head, thorax and abdominal segment I, right lateral view; arrows: prl = praemedian setae; pom = postmedian setae; 4, profile of right side of pronotum; 6, abdominal sternum I, ventral view.

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. malicky*; 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* while 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) .

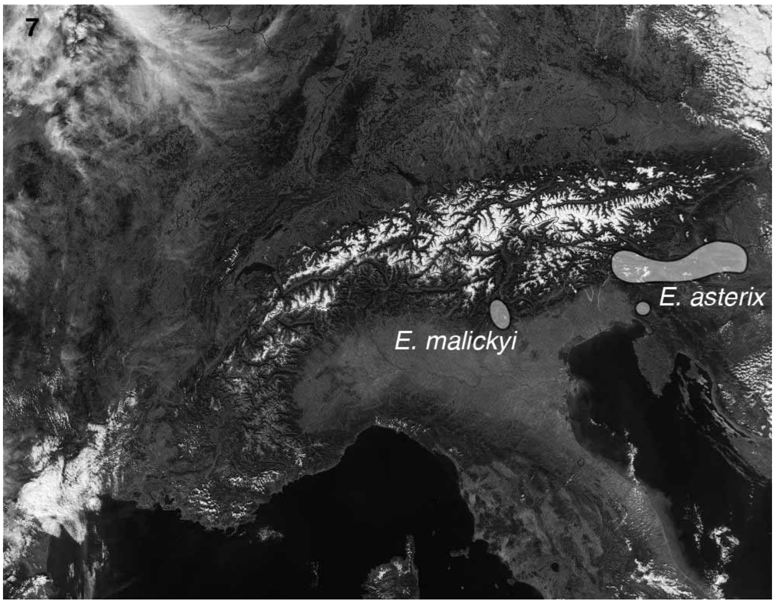


FIGURE 7. Distribution of *Ecclisopteryx malickyi* and *E. asterix*.

Habitat and distribution

Larvae and adults of *Ecclisopteryx malickyi* were collected on 15 October 2006 and 17 July 2007 by W. Graf in a springbrook near Camposilvano southeast of Rovereto, Monti Lessini, Trentino, 45°45,391' N, 11°09,445' E; 1171 m a.s.l. At this location, *E. malickyi* was sympatric with the caddisflies *Rhyacophila producta* McLachlan, *Rhyacophila aquitanica* McLachlan, *Rhyacophila vulgaris* Pictet, *Synagapetus padanus* Bertuetti, Lodovici & Valle, *Philopotamus ludificatus* McLachlan, *Plectrocnemia geniculata* McLachlan, *Plectrocnemia brevis* McLachlan, *Plectrocnemia kisbelai* Botosaneanu, *Tinodes dives* (Pictet), *Lithax niger* (Hagen), *Diplectrona atra* McLachlan, *Rhyacophila* cf. *schmidinarica* Urbanič, Krusnik & Malicky, *Odontocerum albicorne* (Scopoli), *Sericostoma personatum* Kirby & Spence and the stonefly species *Dictyogenus fontium* (Ris), *Leuctra dylani* Graf, *Leuctra braueri* Kempny and *Leuctra autumnalis* Aubert.

While *E. guttulata* and *E. dalecarlica* prefer larger streams and rivers with epi-metarhithral characteristics, *E. asterx* 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* (Table1).

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*.

Species/ character	Additional short bristles present on parietalia	Lateral fringe starting at	Colour of sclerites	pronotum with sharp ridge
E. guttulata	yes	the beginning of abd. segment III	brownish-red	yes
E. dalecarlica	yes	the beginning of abd. segment III	yellow	no
E. madida	yes	the beginning of abd. segment III	black	yes
E. asterix	no	the last third of abd. segment III	brownish-black	no
E. malickyi	no	the last third of abd. segment III	brownish-black	no
D. biguttatus	no	the beginning of abd. segment III	brownish-black	no
D. annulatus	no	the beginning of abd. segment III	brownish-black	no

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. franzi* 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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