Published in final edited form as:

. 2009 ; 31(2): 111–117. doi:10.1080/01650420802627159.

The Larva of *Rhyacophila ferox* Graf, 2006 (Trichoptera: Rhyacophilidae) from the Eastern Alps (Carinthia, Austria)

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Abstract

The larva of *Rhyacophila ferox* Graf, 2006 is described and figured, ecological and zoogeographical notes are added.

Keywords

Rhyacophila ferox; larva; ice-age refugia; Eastern Alps; Austria

Introduction

In 1950 Döhler established six subgenera (*Hyperthyacophila*, *Parathyacophila*, *Hyporhyacophila*, *Metarhyacophila*, *Prosrhyacophila* and *Rhyacophila s.str.*) within genus *Rhyacophila* in Central Europe, based on on the number and shape of larval gills. Although his concept is not reflected in adult morphology (Schmid, 1970) Döhler's classification is commonly used to characterise larval morphology as this striking feature is, besides coloration which can show a high degree of variation, the most reliable one to distinguish different taxa.

Genus *Rhyacophila* is represented by 26 species and one subspecies in Austria (Malicky 1999, Malicky in print, Graf 2006). Generally, Döhler's system works well with only *R. intermedia* belonging to the *Parathyacophila* group. Recently, larvae and exuviae of a *Parathyacophila*-type species were collected in a springbrook in Carinthia (Austria) which could be clearly separated from *R. intermedia* and which was confirmed as *R. ferox*.

Description

Material—*R. ferox*: 3 exuviae and 12 last instar larvae collected on 15 May 2006, 5 July 2006, 11 September 2006, 19 May 2007, 22 May 2007, 24 June 2007; one fourth instar larvae collected on 27 April 2007 and one third instar larva collected on 19 May 2007; all from Saualpe, Carinthia, Austria, 46°50' N, 14°40' E, 1700 m a.s.l., leg. WG; 1 last instar larva collected on 6.7.2007 at Koralpe, Carinthia, 46° 51' N, 14° 59' E, leg. Stradner. *R. intermedia*: 5 fifth instar larvae from the Schreierbach, Lower Austria, 15°04'E, 47°50' N, 687 m a.s.l., collected by Waringer on 7 April 1989; 10 fifth instar larvae from the Oswaldbach, Carinthia, Austria, collected by Graf.

Larval length ranges up to 25.3 mm; soft body parts with purple markings, ventrally lightly coloured; sclerotised areas (head, pronotum, legs, 9th abdominal dorsum and anal prolegs) chestnut brown (Figs. 1, 2, 5, 8).

Head: Width of fifth instars 1.75-2.30 mm (n=15), fourth instar 1.55 mm (n=1), third instar 1.00 mm (n=1); Conspicuous muscle attachment spots at dorsal and ventral side of parientalia and at frontoclypeus. Insertion points of setae as well as frontoclypeal suture with pale surroundings. Frontoclypeus with dark marking at the anterior end, aboral part with characteristic six to eight whitish muscle attachment spots (Fig. 1). Anteclypeus with three longitudinal dark stripes. Mouthparts as in other *Rhyacophila* species.

Thorax: Pronotum faded-brown with conspicuous brown spots in anterior part. Posterior margin with continuous black margin (Fig. 2). Two setae of equal length present in anterolateral corners. Legs typical of the genus. One single lateral gill on meso- and metathorax inserting dorsally of each coxa (Fig. 5).

Abdomen: Abdominal segment I shorter than the others. Four lateral gill filaments present on each side of segments I to VIII arising from a common base in the last instar (Figs. 6, 7). Gills of fourth instars with three, third instars with two gill filaments. Anal appendages with a sword process, anal claw with two ventral teeth (Fig. 8).

Separation from other Central European larvae of the *Pararhyacophila*-group

The following species are hitherto assigned to the *Pararhyacophila*-group: Apennine peninsula: *R. rougemonti* McLachlan 1880, *R. italica* Moretti 1981 (Moretti 1983), *R. vallei* Moretti 1997 (Moretti, 1997); Iberian peninsula: *R. laufferi* Navas 1918, *R. munda* McLachlan 1862, *R. pulchra* Schmid 1952, *R. melpomene* Malicky 1976, *R. lusitanica* McLachlan 1884, *R. terpsichore* Malicky 1976 (Viedma & Jalón, 1980; Viera-Lanero, 2000), *R. fonticola* Giudicelli & Dakki 1984 (Maghreb and Iberian peninsula, Viera-Lanero et al. 2008), *R. rupta* McLachlan 1879 (Décamps, 1966); Pyrenees: *R. angelieri* Décamps 1965 (Décamps, 1966); Caucasus: *R. forcipulata* Martynov 1926 and *R. bacurianica* Lepneva 1957 (the latter occurs also in Asia Minor: Lepneva 1970, Malicky 2004). In Central Europe, however, only two species belong to the *Pararhyacophila*-group: *R. rectispina* McLachlan 1884, with a restricted area in the Southern Alps (Switzerland and Italy; Buholzer 1978, Malicky 2004) and *R. intermedia* McLachlan 1868 which lives in the Alps (Slovenia, Austria, Germany, Switzerland, France) and in Spain, Portugal and the Pyrenees. *R. rectispina* lacks a sword process and can be easily separated from *R. intermedia* and *R. ferox* which both have a prominent process at the anal appendages.

While head width of last instar larvae of *R. intermedia* ranges from 1.15 to 1.30 mm (n= 15), *R. ferox* exceeds this distinctly (1.75 – 2.30 mm) and is, therefore, the largest larva of that type known so far (Décamps, 1966, Viedma & Jalón, 1980; Viera-Lanero et al. 2001, Viera-Lanero et al. 2008, Waringer & Graf 1997). Further differences can be found in colouration of the frontoclypeus: in *R. ferox*, the 6 to 8 muscle attachment spots of the caudal part of the

frontoclypeus are pale and embedded in a dark patch (Fig. 1) in all larval stages observed; in *R. intermedia* the 4 spots are always dark coloured (Fig. 3).

Döhler (1950) observed an increasing number of abdominal gill filaments during ontogenesis in the Pararyhacophila-group; the same is true for *R. ferox*. The number of abdominal gill filaments correlates with larval instar (Fig. 10), although larvae younger than the third instar are not known yet.

Key to the species

2- 4 gill filaments arising from one common base on each side of the abdominal segments; on meso- and metathorax one single gill filament on each side

	<i>Pararyhacophila sensu Döhler</i>
Anal claw without sword process	<i>Rhyacophila rectispina</i>
Anal claw with sword process	2
2- head width <1.40 mm, four abdominal gill filaments on each side, frontoclypeal muscle attachment spots dark (Fig. 3)	<i>Rhyacophila intermedia</i>
- head width >1.40 mm, three or four abdominal gill filaments on each side, frontoclypeal muscle attachment spots pale (Fig. 1)	<i>Rhyacophila ferox</i>
(larvae of <i>R. ferox</i> with head widths <1.40 mm have two abdominal gill filaments on each side only).	

Ecological notes

Larvae and the holotype of *R. ferox* were collected at two stony, fast flowing and nameless springbrooks at the Saualpe and Koralpe, Southern Carinthia. At various occasions between 2006 and 2007 the following Trichoptera and Plecoptera species were caught using sweeping nets and light traps: *Rhyacophila bonaparti* SCHMID, 1947, *Rhyacophila glareosa* McLACHLAN, 1867, *Rhyacophila stigmatica* (KOLENATI, 1859), *Rhyacophila tristis* PICTET, 1834, *Rhyacophila vulgaris* PICTET, 1834, *Philopotamus ludificatus* McLACHLAN, 1878, *Plectrocnemia conspersa* (CURTIS, 1834), *Acrophylax zerberus* BRAUER, 1867, *Anisogamus difformis* (McLACHLAN, 1867), *Conosophylax montivagus* (McLACHLAN, 1867), *Drusus discolour* (RAMBUR, 1842), *Drusus biguttatus* (PICTET, 1834), *Drusus chrysotus* (RAMBUR, 1842), *Drusus franzi* SCHMID, 1955, *Drusus monticola* McLACHLAN, 1876, *Metanoea rhaetica* SCHMID, 1955, *Leptotaulius gracilis* SCHMID, 1955, *Mesophylax impunctatus* McLACHLAN, 1884, *Parachiona picicornis* (PICTET, 1834), *Potamophylax cingulatus alpinus* TOBIAS, 1994, *Stenophylax permistus* McLACHLAN, 1895, *Lithax niger* (HAGEN, 1859), *Rhabdiopteryx alpina* KÜHTREIBER, 1934, *Brachyptera seticornis* (KLAPALEK, 1902), *Nemoura marginata* PICTET, 1835, *Nemoura mortoni* RIS, 1902, *Nemoura undulate* RIS, 1902, *Protonemura auberti* ILLIES, 1954, *Protonemura austriaca* THEISCHINGER, 1976, *Leuctra alpina* KÜHTREIBER, 1934, *Leuctra armata* KEMPNY, 1899, *Leuctra inermis*-group, *Leuctra nigra* (OLIVIER, 1811), *Capnia vidua vidua* KLAPALEK, 1904, *Arcynopteryx compacta* (McLACHLAN, 1872), *Dictyogenus fontium* (RIS, 1896), *Isoperla rivulorum* (PICTET, 1841), *Chloroperla susemicheli* ZWICK, 1967 and *Siphonoperla montana* (PICTET, 1841).

Most of them are known to be crenal, hypocrenal or epirhithral species (Graf et al. 2002). *M. impunctatus* and *S. permistus* are species restricted to low altitudes which overwinter in higher altitudes in the adult stage.

Gut analysis of last instar larvae revealed, besides a high proportion of plant material, sclerites of unidentified Limnephilidae larvae. Therefore, *R. ferox* may be assigned to the functional feeding type of omnivores, as some of the plant fragments certainly do not originate from prey's guts. Anyhow, the total number of analysed larvae (n=10) seems to be too small to provide insights into the overall feeding habits, and more detailed investigations should be done in future.

Discussion

R. ferox is remarkable both in the larval and adult stage due to its size and brachyptery and cannot be easily mixed up with other species of the genus. Although only two records are known so far it can be assumed that *R. ferox* is restricted to small springbrooks in higher altitudes at the south-eastern slopes of the Alps, only 50 km southeast of the edge of the Alpine ice sheet during the last glacial maximum. This area of endemism for freshwater organisms is in concordance with the Dinodal-theory of Malicky (1983, 2000), which is primarily supported by endemic hotspots for caddisflies (Malicky, 2000) within alpine regions.

Brachypterous species of genus *Rhyacophila* are rare. So far, only three species (*R. vallisclausae* Guidicelli & Botosaneanu 1999, *Rhyacophila ferox* Graf 2006 and *Rhyacophila kumanskii turcica* Sipahiler 2007) are known in Europe. While *R. vallisclausae* and *R. kumanskii turcica* belong to the *vulgaris*-group sensu Schmid (1970), *R. ferox* has somehow modified genitalia (Fig. 9) and may be near to the *R. fasciata*-subgroup within the *vulgaris* group (Graf, 2006). The larva of *R. vallisclausae* resembles that of *R. obliterated* and can be classified as *Rhyacophila s.str.*-group sensu Döhler, while the larva remains unknown in *R. kumanskii turcica*. However, the larva of *R. ferox* belongs clearly to the *Pararhyacophila*-group. Brachyptery is, therefore, more likely to have evolved in response to environmental factors than within closely related species.

Acknowledgements

This paper is part of the outcomes of a project funded by the Austrian Science Fund (Project number P18073-B03; PI: J. Waringer).

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Figs. 1--9.

Figs. 1--2. *Rhyacophila ferox*, last instar larva: 1: head and pronotum, dorsal view; 2: posterior part of head and pronotum, dorsal view; Figs. 3--4. *Rhyacophila intermedia*, last instar larva: 3: head capsule, dorsal view; 4: pronotum, dorsal view; Figs. 5--9. *Rhyacophila ferox*, last instar larva: 5: Head and thorax, lateral view; 6: third to sixth abdominal segment, dorsal view; 7: third to fifth abdominal segment, left lateral view; 8: anal proleg, left lateral view; Fig. 9: male genitalia, left lateral view. Scale bars: 1 mm.

Fig. 10.

Frequency distribution histogram of measurements of maximum head widths of 17 larvae of *Rhyacophila ferox*. Instar numbers are indicated at top, and the abdominal gill filament number is indicated in parenthesis.