

The larvae of *Brachypalpus chrysites* Egger, 1859 and *Chalcosyrphus valgus* (Gmelin, 1790) (Diptera, Syrphidae)

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The larvae (3. instar) of *Brachypalpus chrysites* Egger, 1859 and *Chalcosyrphus valgus* (Gmelin, 1790) are described. Larvae of both species were obtained from gravid females, which laid eggs in captivity. The larvae survived about 6 ½ and 7 months, respectively. They were reared in a moist mixture of decaying wood from *Picea abies*, *Alnus glutinosa* and *Acer pseudoplatanus*. The development of larvae is briefly described. Hibernation of larvae failed.

Key words: *Brachypalpus chrysites*, *Chalcosyrphus valgus*, xylophagous larvae, rearing, nature conservation, Syrphidae

Zusammenfassung

Die Larven (3. Stadium) von *Brachypalpus chrysites* Egger, 1859 und *Chalcosyrphus valgus* (Gmelin, 1790) werden beschrieben. In beiden Fällen wurden die Larven aus Eiern gezogen, die gefangene Weibchen im Labor abgelegt hatten und die in einem feuchten Gemisch aus sich zersetzendem Holz von *Picea abies*, *Alnus glutinosa* und *Acer pseudoplatanus* gehalten wurden. Die Entwicklung der Larven über 6 ½ (*B. chrysites*) bzw. 7 Monate (*C. valgus*) bis zum Herbst wird skizziert. Eine erfolgreiche Überwinterung der Larven gelang nicht.

Introduction

Syrphidae play an increasing role in the assessment of habitat parameters for nature conservation. Red lists are compiled for regional, national and supranational areas and Syrphidae are used more and more to point out the importance and quality of nature reserves or to anticipate consequences of landscape management.

Lists of species and faunistic records of Syrphidae are, as a rule, based on records of imagines. However, in most cases the larval stages depend on much more specific habitat resources (see Speight 2004, Speight & Castella 2004). So the knowledge of the early stages is of outstanding interest both for taxonomic and nature conservation purposes. In recent years the work of Graham Rotheray above all has enlarged our

knowledge of the larval stages of European Syrphidae. His "Colour Guide to Hoverfly Larvae", published in 1993, has stimulated many workers to focus not only on imagines but also on larvae of Syrphidae.

Syrphidae records give valuable information especially about the quality of woodland and wetland habitats. The species whose larvae are described here are associated with woodland. *Brachypalpus chrysites* is a montane insect. The preferred environment is "conifer forest; open *Abies/Picea* forest with overmature trees, from the upper limit of *Fagus*, up to the *Larix/Pinus mugo* zone" (Speight 2004). In the Red Lists of Germany (Ssymank & Doczkal 1998), of Bavaria (Dunk et al. 2003) and of Baden-Württemberg (Doczkal, Rennwald & Schmid 2001) *B. chrysites* is categorized as endangered (RL category 3). The preferred environment of *Chalcosyrphus valgus* is "coniferous forest; old *Fagus/Picea* forest with overmature trees, toward the upper altitudinal limit of the *Fagus* and in old *Pinus* forest, including western taiga" (Speight 2004). Speight stated further that the species is "very probably now threatened with extinction at European level – there are few published 20th century European records". In the Red Lists of Germany *Chalcosyrphus valgus* is categorized as endangered (RL 3) but in the regional lists for Bavaria and Baden-Württemberg it is considered extremely rare and endangered but because of a deficit of data it is not assigned to a definite category.

Material and methods

Larvae of both species were reared and collected by TM. Imagines were caught in mixed woodland dominated by *Picea abies* in the vicinity of Salzburg, Austria. To study larval development of both species an artificial habitat was offered for egg laying; the hypothetical larval requirements were derived from those of related species. Adults of both species were kept in 250 ml transparent polycarbon boxes supplied with moist paper tissue. Larvae were transferred to a substrate of rotten wood and decaying material from rotten stumps in a layer of about 3-4 cm. Due to the lack of any information or presumption on larval preference a mixture of material from *Picea abies*, *Alnus glutinosa* and *Acer pseudoplatanus* was used. *Picea* is the species predominant in the habitat, while *Alnus* and *Acer* are present in smaller numbers. The substrate was kept moist; sometimes the material was partly replaced.

For documentation and description at least one specimen of each size (most probably larval instars) was preserved.

Larvae were killed in nearly boiling water and preserved in 70% alcohol. They were studied in alcohol using a binocular microscope (Zeiss Stemi SV 11); drawings were made using a drawing tube.

Measurements were made using a measuring eyepiece. Photographs of larvae were made by using a Leica DFC320 digital camera on a Leica Z16 APO macroscope. The digital photographs were subsequently processed by using Auto-Montage (SynchroscoPy) software. Morphological terms follow Rotheray (1993, 2004) and Rotheray & Gilbert (1999).

Results and discussion

Brachypalpus chrysites Egger, 1859 – description of third stage larva

Material: Hacklwald/Großmain/S, Austria, 47°44'N, 12°57'E, 580m ASL, larva reared from eggs oviposited by imago collected 17.V.1999, leg. Th. Moertelmaier.

Overall appearance: Short-tailed larva (anal segment moderately elongated); anal segment with three pairs of lappets of different sizes; abdominal segments 1-6 with prolegs bearing crochets; mesothoracic prolegs and crochets present; mouthparts of the saprophagous type (Rotheray & Gilbert 1999); anterior fold of prothorax with four rows of spicules; thorax with two pairs of lateral, heavily sclerotized hooks.

Shape: short-tailed larva, truncate anteriorly and tapering posteriorly; subcylindrical in cross-section with maximum width anteriorly; length 18 mm, width of thorax 3.2 mm, width of abdomen 2.4-2.9 mm, height 2.5-3 mm.

Colour: body whitish, lateral hooks of thorax dark brown, posterior respiratory process pale brown.

Head: antennomaxillary complex on a bifurcated fleshy projection; mandibles and mandibular lobes internal; lateral lips densely coated with fine setae (up to 0.07 mm).

Thorax: clearly broader than abdomen and separated by a distinct groove; anterior fold of prothorax with a spicule band with four (somewhat irregularly arranged) rows of strongly curved, weakly sclerotized, opaque spicules with the longest spicules anteriorly (0.13 mm); meso- and metathorax covered by vestiture of very short (0.02 mm), backwardly directed setae, without spicules; two pairs of heavily sclerotized, laterally and backwardly directed hooks, the greater hook (length 0.21 mm) anterior to sensilla 4 on mesothorax, the smaller hook (0.13 mm) anterior to sensilla 5 of mesothorax (fig. 1); prothoracic spiracle sclerotized, anterior to sensilla 3 of mesothorax, small (length 0.15 mm), cylindrical with oblique tip and eight slits; mesothoracic prolegs with about 20 crochets.

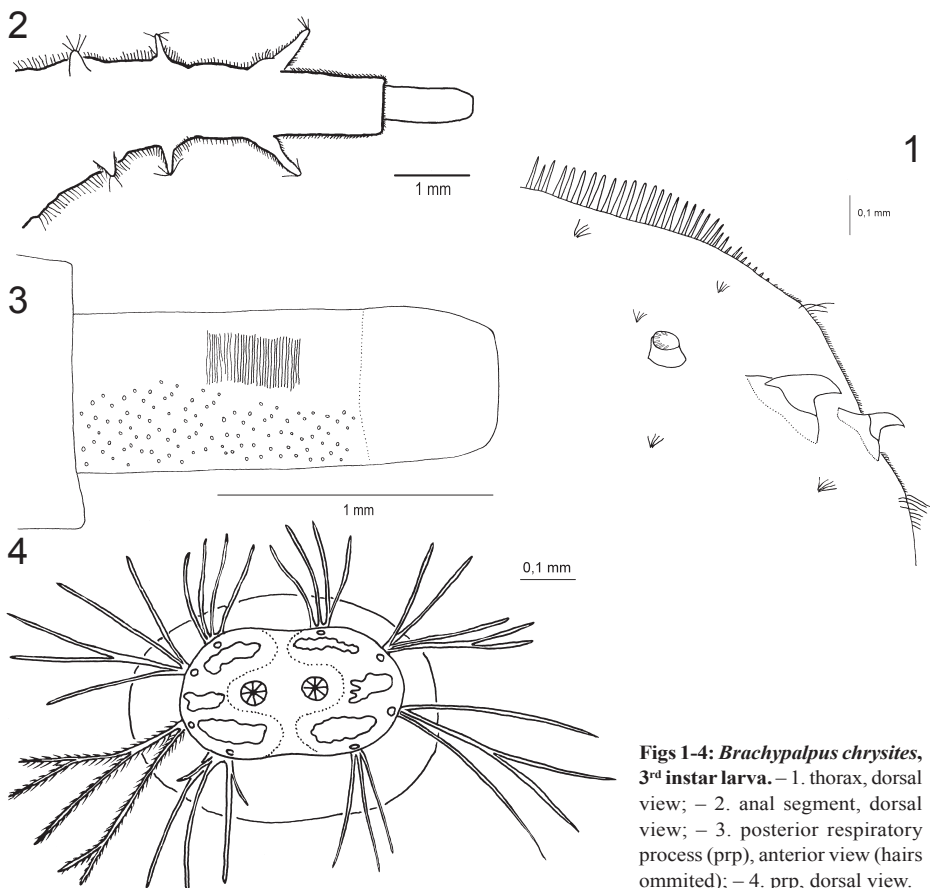
Abdomen: coated in dense vestiture of slightly backwardly directed, white setae up to 0.05 mm, vestiture on anal segment upright, sparser and longer, up to 0.24 mm near the base of the lateral lappets; prolegs present on segments 1-6; crochets arranged biserially, with both rows transverse on segment 1 and more and more parallel to the body axis posteriorly; each row with about 6-9 primary crochets and some slightly smaller crochets; anal segment (fig. 2) with three pairs of lappets, with the distance between the anterior pairs shorter; length of lappets increasing: first pair 0.17mm, second pair 0.30 mm, third pair 0.85 mm; posterior respiratory process (prp) nearly cylindrical: length 1.2 mm, width at base 0.46 mm, width subapically 0.44 mm, basal part translucent yellowish, apical third opaque yellowish brown, prp with very fine, transverse grooves inside and fine punctures over the entire surface, the distance between punctures much wider than their diameter, tip of prp with three pairs of spiracular slits and 2x4 groups of branched interspiracular setae (figs 3, 4).

Identification: The short-tailed larvae of *Brachypalpus* are characterized by the combination broad dorsal lips, an anterior fold bearing a band of 3-4 rows of spicules

(those in the first row the largest), two pairs of large, backwardly directed thoracic hooks (one separated and below the other), prolegs with 7 or 8 primary crochets and an anal segment with three pairs of lappets, first two about the same size, third pair longest (Rotheray 1993, Rotheray & Gilbert 1999). According to Speight (2004) there are three species of *Brachypalpus* in Europe: *B. chrysites* Egger, *B. laphriformis* (Fallén, 1816) and *B. valgus* (Panzer, 1798).

The larva of *B. chrysites* differs from the larva of *B. laphriformis*, described by Rotheray (1991), in several features:

- first row of spicules of the anterior fold completely sclerotized and dark coloured in *B. laphriformis*, only weakly sclerotized in *B. chrysites*.
- thoracic hooks: lower hook only a little smaller than the upper in *B. laphriformis* (upper hook 0.24 mm, lower hook 0.20), much smaller in *B. chrysites* (upper hook 0.21 mm, lower hook 0.13 mm).
- anal lappets equidistant in *B. laphriformis*, not so in *B. chrysites*.



Figs 1-4: *Brachypalpus chrysites*, 3rd instar larva. – 1. thorax, dorsal view; – 2. anal segment, dorsal view; – 3. posterior respiratory process (prp), anterior view (hairs omitted); – 4. prp, dorsal view.

- third pair of lappets much shorter in *B. laphriformis* (0.42 mm; *B. chrysites* 0.85 mm).

In the larva of *B. valgus*, as illustrated by Dušek & Láska (1988, fig. 7), the anal segment is much less elongated, the distance between the lappets shorter, the lappets are broader and the distal pairs of lappets not much longer than the preceeding pair.

Biological notes

Egg laying was observed on 17. V. 1999, one day after the female specimen had been caught. Oviposition behaviour was similar to *C. valgus* (see below). Larvae of *B. chrysites* hatched after 4-5 days (about 30 specimens). After transfer to the breeding box they immediately dug themselves into the substrate. From the very beginning larvae seemed to prefer the area between the substrate and the surface of the box; so they were easy to observe. As described for *C. valgus* the larvae of *B. chrysites* ingested large quantities of organic matter, perhaps as a consequence of lack of food in the substrate. Freshly hatched larvae were about 2 mm long. Within four weeks they grew about 30 percent, within four months they had doubled in size and two months later they have reached a length of about 12-15 mm. Until this stage no mortality had been observed but now larvae began to die. The remaining larvae continue to feed and to grow, reaching a final length of about 17-20 mm, but no specimen survived more than six and a half months.

Larvae of *Brachypalpus laphriformis* were found in April in a rot hole/exudate in *Taxus* and in the end of March (28.III.) in a water and sap filled cavity under fractured bark of *Quercus* (Rotheray 1991). Dušek & Láska (1988) had collected larvae of *Brachypalpus valgus* in the mid of March (15.III.) from a wet fissure in the bark of the trunk of *Alnus glutinosa*. Pupation took place in the end of March, the imagines appear in 7.-18.IV. Sarthou (in Speight 2004) reared *B. valgus* from a trunk cavity of *Quercus suber*. As with *B. valgus*, *B. chrysites* very probably hibernates in the larval stage, too. Poor diet in a suboptimal substrate as well as the absence of a decrease in temperature as a stimulus for larval diapause may be reasons for the failure in rearing.

Although we have not observed cannibalism in larvae we can't exclude the possibility that this may be an explanation for decrease in numbers of larvae followed by growth in the remaining specimens. Speight (pers. comm.) pointed out, that some saproxylic larvae of Elateridae (Coleoptera) cannot complete development without some animal protein, usually the larvae of other saproxylic species. Perhaps it is no accident that, as Krivosheina (2001) observed, larvae of some species of *Chalcosyrphus* are found in the burrows of other arthropods. If larvae of some saproxylic Syrphidae really will depend on the presence of other saproxylics and not only on the presence of larval microhabitats this will be help to understand why some of these species are so scarce (Speight pers. comm.).

Brachypalpus chrysites was observed in the Hacklwald area from mid May to the beginning of June. Three specimens were collected: 1 male (10.V.1999), 2 females (17.V.1999). The Hacklwald is situated about 10 km SW of Salzburg, Austria. The area is a

part of large coniferous woodland on the northern slopes of the Untersberg mountains, dominated by spruce *Picea abies*. Most parts of these woodlands are characterized by intensive forestry. Only a few areas with older trees and a higher amount of decaying wood remain. One of these areas is the Hacklwald. Unfortunately most of the sites in which *B. chrysites* and *C. valgus* were recorded have been destroyed during the last few years.

In general the habitat of *B. chrysites* in the Hacklwald corresponds to the characterization given by Speight (2004): an open *Picea abies* forest with mature and overmature trees (in average about 75 [-100] years old) mixed with some *Pinus sylvestris*, *Acer pseudoplatanus*, and *Alnus glutinosa*. Adults fly along the edges of the forest. Flight behaviour seems to mimic that of *Bombus* sp. (Hymenoptera, Apidae), although this syrphid has a close resemblance to *Laphria flava* (Diptera, Asilidae). The flies like to rest on low growing vegetation (especially *Rubus idaeus*) at the edges of clearings. Territorial behaviour or flower visits have not been observed. In the same area some further rare species occur, amongst them *Chalcosyrphus femoratus*, *Chalcosyrphus piger*, *Caliprobola speciosa* and *Psilota anthracina*.

Chalcosyrphus valgus (Gmelin, 1790) – description of third stage larva

Material: Hacklwald/Großgmain/S, Austria, 47°44'N, 12°57'E, 580m ASL, larva reared from eggs oviposited by imago collected 09.VI.1998, leg. Th. Moertelmaier

Overall appearance (figs 9-10): Short-tailed larva (anal segment moderately elongated); anal segment with three pairs of lappets of different size; abdominal segment 1-6 with prolegs bearing crochets; mesothoracic prolegs and crochets present; mouthparts of the saprophagous type (Rotheray & Gilbert 1999); anterior fold of prothorax with five rows of spicules; thorax lateral to the anterior spiracles with pairs of heavily sclerotized hooks of different sizes, rising from a single socket.

Shape: short-tailed larva, truncate anteriorly and tapering posteriorly; subcylindrical in cross-section with maximum width anteriorly (thorax region); length 15 mm, width of thorax 2.4 mm, width of abdomen 2.1-2.3 mm, height 1.9-2.3 mm.

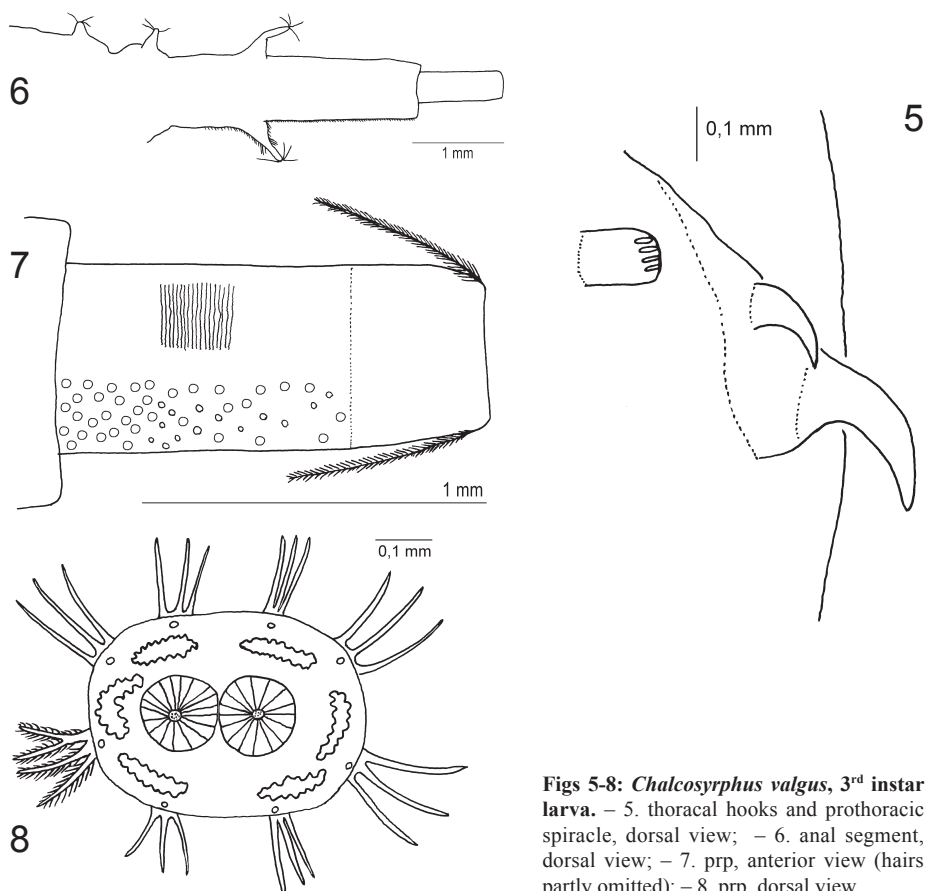
Colour: body withish, lateral hooks of thorax brown, tip of posterior respiratory process pale brown.

Head: antennomaxillary complex on a bifurcated fleshy projection; mouth hooks internal; mandibular lobes partly visible (perhaps an artefact), lateral lips long haired (setae up to 0.13 mm).

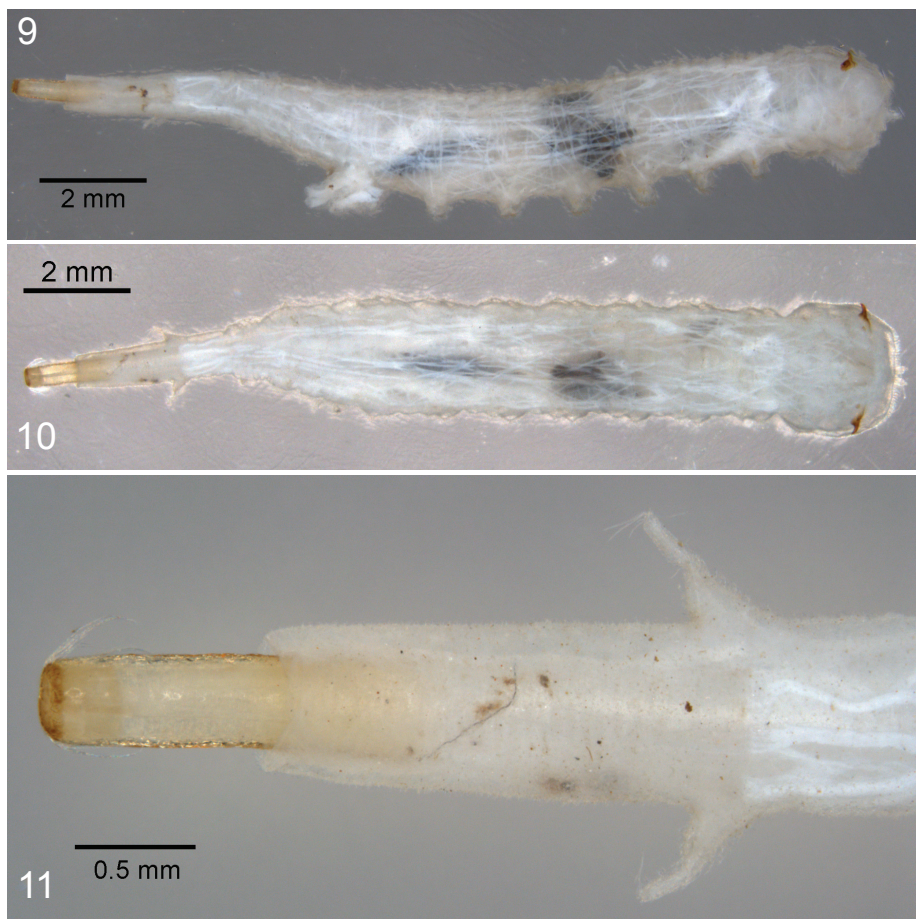
Thorax (figs 5, 12-13): broader than abdomen and separated by a distinct groove; anterior fold of prothorax with a spicule band of five rows of moderately curved, weak spicules, with the longest spicules anteriorly (0.17 mm); meso- and metathorax coated in vestiture of short (up to 0.035 mm) backwardly directed setae, without spicules; on each side, immediately beside the prothoracic spiracle, a pair of heavily sclerotized, brown hooks based on a fleshy, weakly sclerotized projection anterior to sensilla 3 and 4 of the mesothorax; dorsal hook smaller, straight and directed dorsolaterally (length

0.145 mm), the ventral hook thick, strongly curved and directed laterally (length 0.21 mm); prothoracic spiracle anterior to sensilla 3 of mesothorax, small (length 0.11 mm) with 4 slits, cylindrical with oblique tip; mesothoracic prolegs with about 8 primary crochets and numerous smaller crochets.

Abdomen: coated in dense vestiture of slightly backwardly directed, white setae of up to 0.035 mm, vestiture on anal segment upright and sparser, hairs laterally on anal segment longer (up to 0.13 mm); prolegs present on segments 1–6, each with about 8 primary and numerous smaller crochets; anal segment (fig. 6) with three pairs of lappets laterally, with the distance between the anterior pairs smaller; length of lappets increasing: anterior 0.14 mm, middle 0.19 mm, posterior 0.55 mm; posterior respiratory process (prp) nearly cylindrical (figs 7, 11): length 0.94 mm, width at base 0.40 mm, width subapically 0.37 mm, basal part translucent yellowish, apical third opaque yellowish brown, translucent parts of the prp with very fine transverse grooves inside and



Figs 5–8: *Chalcosyrphus valgus*, 3rd instar larva. – 5. thoracic hooks and prothoracic spiracle, dorsal view; – 6. anal segment, dorsal view; – 7. prp, anterior view (hairs partly omitted); – 8. prp, dorsal view.



Figs 9-13: *Chalcosyrphus valgus*, 3rd instar larva. – 9. lateral view; – 10. dorsal view; – 11. tip of anal segment and posterior respiratory process; dorsal view; – 12. thorax and anterior abdominal segments; lateral view; – 13. thorax and anterior abdominal segments; dorsal view. Photo: A. Staniczek & U. Schmid.

punctures over the entire surface, with the distance between punctures somewhat greater than their diameter, tip of prp (fig. 8) with three pairs of spiracular slits and 2x4 groups of interspiracular setae (up to 0.47 mm); most of the setae simple and unbranched.

Identification: The short-tailed larvae of *Chalcosyrphus* are characterized by the combination of broad dorsal lips, an anterior fold bearing a narrow band of 3-4 rows of spicules, with the spicules of the second row the largest, thorax with two groups of 1-2 black hooks lateral to the anterior spiracles (a separate, single hook may exist below these hooks), prolegs cylindrical with 6-8 primary crochets and an anal segment with three pairs of evenly sized lappets (Rotheray 1993; Rotheray & Gilbert 1999). In general the



larva of *C. valgus* fits this characterization of the genus but some minor features differ, e.g. there is an additional row of spicules on the anterior fold of the prothorax, thoracal hooks are brown and the lappets of the anal segment differ in size.

In Europe there are ten species of *Chalcosyrphus* (Speight 2004), but our knowledge of the larvae is insufficient. Hartley (1961) described the larva of the most numerous species, *C. nemorum* (Fabricius, 1805). Larva and puparium of *C. piger* (Fabricius, 1794) are described by Heiss (1938). The puparium of *C. eunotus* (Loew) is described by Maibach & Goeldlin (1992). Krivosheina (2001) gives a key to larvae of the genera *Xylota* and *Chalcosyrphus*, including *C. nitidus* (Portschinsky, 1879), *C. rufipes* (Loew, 1873), *C. piger* and *C. nemorum*, but without further larval description. Beyond this she also gives biological data on the microhabitats of these species and *C. femoratus* (Linnaeus, 1758).

Biological notes

A gravid female was caught which started to lay eggs two days later. Egg laying continued for two days; about 20-30 eggs were laid. The ovipositor was used to place single eggs into smallest crevices of the tissue. Larvae hatched after three days. They were transferred to the organic matter of decaying wood and dug themselves in immediately. First instar larvae could be found only after sifting out samples of the substrate layer. About two and a half weeks after transfer to the rearing box larvae were visible through the transparent sides of the boxes. They had increased in size by about 30 percent (2. instar larvae). The larvae were ingesting large quantities of substrate. To increase the nutritional value of the substrate small pieces of banana were added, following a suggestion by Martin Speight (pers. comm.). There was no effect on larval behaviour and growth but an uncontrolled spread of fungi, so adding banana was discontinued. About five weeks after transferring the larvae they had almost doubled in size. They reached a length of about 10 mm after four and a half months. Subsequently larval growth and larval numbers decreased. Only few of the larvae reached an age of seven months, and a length of about 17-20 mm, before they died.

All known larvae of species of *Chalcosyrphus* live in decaying wood (Rotheray & Gilbert 1999). For some species details about the habitat and the development of larvae are known:

C. femoratus (Linnaeus, 1758): Krivosheina (2001) found larvae in "wood of birch" and a puparium in "wood dust of birch" (*Betula*).

C. nemorum (Fabricius, 1805): The larvae is described by Hartley (1961) and "occurs beneath bark of water-sodden deciduous timber, stumps and in damp tree rot-holes in deciduous trees, such as *Betula*, *Fagus*, *Populus*, *Quercus*, *Salix* and *Ulmus*. Also recorded in stumps of *Pinus*." (Speight 2004)

C. nitidus (Portschinsky, 1879): "Larvae breed in light and brown wood in rotten fallen trunks of deciduous trees without bark, often covered with moss; always in old galleries of other insects, for example, *Temnostoma*..." (Krivosheina [2001], who mentioned *Alnus*, *Tilia* and *Ulmus*).



Fig. 14: Habitat of *Chalcosyrphus valgus* and *Brachypalpus chrysites*, Hacklwald, 09.VI.1998; Photo: T. Moertelmaier.

Fig. 15: *Chalcosyrphus valgus*, Imago, female, Hacklwald, 10.VI.1998; Photo: T. Moertelmaier.

C. piger (Fabricius, 1794): "Larvae breed under the bark of coniferous trees" (Krivosheina [2001], who mentioned "Siberian cedar" and *Larix*). Also known from other coniferous tree species (see Speight 2004).

C. rufipes (Loew, 1873): "Larvae inhabitant rotten old trunks with easily separating bark and dark bast. Larvae breed inside wood in galleries of other insects or in dust inside moist bark" (Krivosheina 2001). Krivosheina found larvae in *Tilia* and *Populus*. The larva hibernates.

In addition larvae of *C. eunotus* (Loew, 1873) were reared by Goeldlin & Maibach (1992) from wet sawdust.

At Hacklwald, flight period of *C. valgus* ranged from mid May to end of June. There are nine records: 3 males (20.V.1998), 1 male (03.VI.1998), 1 female (09.VI.1998), 1 female (20.VI.1998), 3 males (18.V.1999). Habitat (fig. 14) as described for *Brachypalpus chrysites*. Adults (fig. 15) fly along the edges of forests. They rest on stumps or freshly cut logs of coniferous trees (see also Speight 2004) and on the leaves of low-growing vegetation (especially *Rubus idaeus*) on the edges of clearings. Our observations (TM) confirm the statement of Speight (l.c.) that *C. valgus* in flight looks very much like a hymenopteran insect (eg an Ichneumonid). The specimens, especially the males, seems to be quite territorial. Insects flying past are investigated before returning to the resting site. Flower visits have not been observed.

Acknowledgements

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