

Commensal and parasitic Chironomidae

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Abstract: The following examples of symbiotic relationship between Chironomidae larvae and benthic animals found during sampling of benthic macrofauna will be described in detail:

- the larvae of *Xenochironomus xenolabis*, subfamily Chironominae, a miner of sponges
- *Demeijerea rufipes*, Chironominae, a parasite of sponges and bryozoa
- *Eukiefferiella ancyla*, subfamily Orthocladiinae, as commensal of the snail *Ancylus fluviatilis*
- *Dratmalia potamophylaxi*, Orthocladiinae, living in close connection with the caddisfly *Potamophylax*
- *Epoicocladius ephemerae*, Orthocladiinae, attached to *Ephemera danica*/Ephemeroptera, a digging mayfly
- *Symbiocladus rhithrogenae*, Orthocladiinae, a true and obligate parasite of Heptageniidae/Ephemeroptera larvae, feeding on the mayfly's hemolymph
- some facultative associations of Orthocladiinae, Tanytarsini and Chironomini with Spongillidae and Bryozoa colonies.

Mainly the morphological and functional aspects will be described.

Key words: Spongillidae, *Ancylus*, Mollusca, Ephemeroptera, Trichoptera, Chironomidae, Diptera, Insecta, Bryozoa, Northrhine-Westphalia, Germany, morphology, parasitism, commensalism.

Introduction

Symbiotic relationship between Chironomidae and several species of insects, molluscs, sponges and bryozoans and even fish is a known fact (fig. 1.1, 1.2). In this context some interesting examples have been found during benthic macrofauna sampling on duty of Landesamt für Natur, Umwelt und Verbraucherschutz North-Rhine-Westphalia within the scope of regular per-

formance of the EU-Water Framework Directive. The sampling region is drafted in figure 1.3. This article is focused on morphological and functional aspects of the Chironomidae larvae and their hosts. This paper is based on an article which has been published 2009 in the Lauterbornia-Journal. I added a brief description of the two species *Xenochironomus xenolabis* and *Demeijerea rufipes*, found in freshwater sponges.

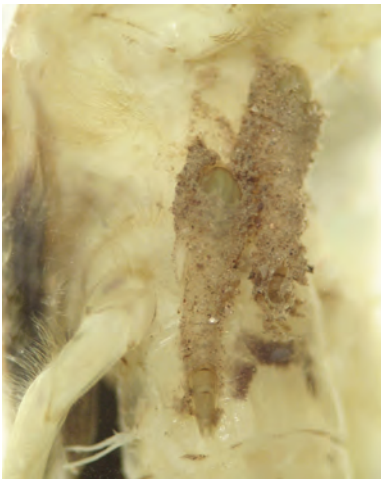


Fig. 1.1: Perfect timing show these puparia of *Epoicocladius ephemerae*, a commensal chironomid. Fixed on the sternum of *Ephemera danica* they used the resting state of their host immediately before hatching.



Fig. 1.2: The emergence of a *Parachironomus mauricii* female, a parasite of *Radix balthica*.



Fig. 1.3: Investigated area. Source: co. LANUV NRW.



Fig. 2.1: *Xenochironomus xenolabis*. Larva, in spongillid.



Fig. 2.2: *Xenochironomus xenolabis*. Larva, habitus.

Fig. 2.3:
Xenochironomus xenolabis. Larva, head ventrally.

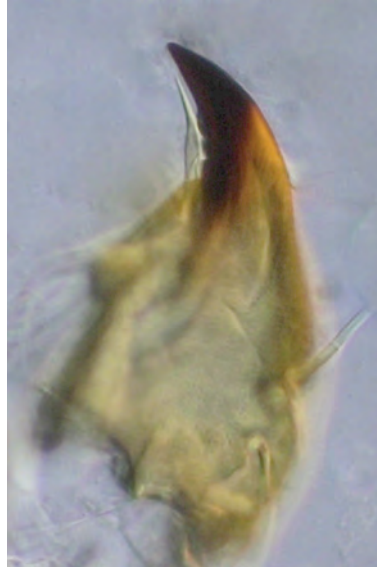


Fig. 2.5: *Xenochironomus xenolabis*. Larva, mandible.

Fig. 2.6: *Xenochironomus xenolabis* in *Ephydatia mülleri*.

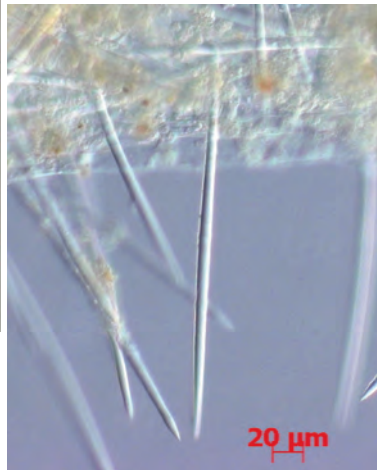


Fig. 2.7: *Ephydatia mülleri* spicules 200x.

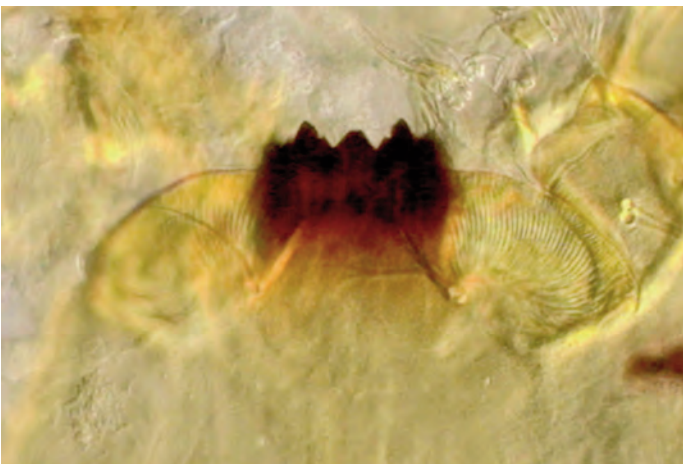


Fig. 2.4: *Xenochironomus xenolabis*. Larva, mentum.

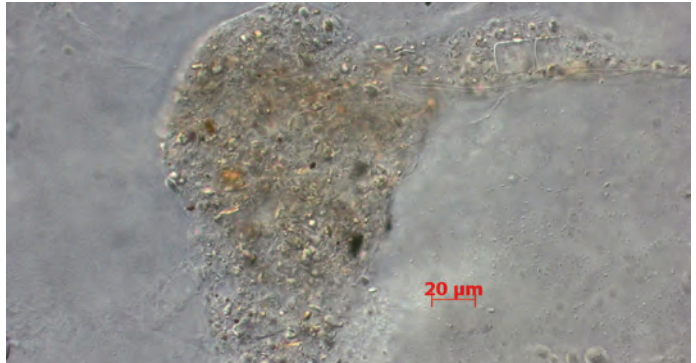


Fig. 2.8: *Xenochironomus xenolabis*, gut content 400x.

Xenochironomus xenolabis

The medium to large sized larvae of *Xenochironomus xenolabis*, Chironomini, are obligate miners in freshwater sponges (fig. 2.1, 2.2) They are red (living), up to 15mm long with a black trifold mentum (fig. 2.3, 2.4, 2.5) and 2 pairs of roundish eyes. The labrum possesses a noticeable lamellar brush, extending beyond the margin of the head. This genus is impossible to confuse with other Chironomini. This specimen (fig. 2.6) is collected in the river Ruhr in May 2014 within the freshwater sponge *Ephydatia mülleri*. The sponge body includes lots of long needle-like megascleres (spicules) (fig. 2.7). Although the mouthparts of *Xenochironomus* are very robust the spicules or their fragments cannot be found in the gut of the larva (fig. 2.8). The examination of *Xenochironomus*-larvae from some other waterbodies didn't perform other results. However, the much smaller gemmoscleres of other spongillids are found in one specimen (collection of B. Janecek).

Demeijerea rufipes

The larvae of *Demeijerea rufipes*, Chironomini, mine in freshwater sponges and bryozoan (fig. 3.1). They are dark red and up to 12mm long (fig. 3.2, 3.3) The ventraltubules, which are curved under the abdomen and the shape of the 3 pairs of eyes are conspicuous (fig. 3.4, 3.5). The robust mentum usually is badly worn (fig. 3.6, 3.7). Other than *Xenochironomus* the larvae of *Demeijerea* eat the spongemass including the spicules.

However, an interesting phenomenon can be seen investigating the gut of a specimen found with *Ephydatia mülleri* (fig. 3.8). The ingested megascleres look grinded off, the sharp needlepoints are missing. It seems that *Demeijerea* has found a strategy to make them harmless for digestion.

Eukiefferiella ancyla

The larvae of *Eukiefferiella ancyla*, subfamily Orthoclaadiinae, live in close community with the mollusc *Ancylus fluviatilis*. The blue abdomen, the yellowish thorax and the dark margins on the head are conspicuous (fig. 4.1, 4.2). *Ancylus fluviatilis* (fig. 4.3, 4.4) is a pulmonate snail. It is rather abundant and prefers stony rhithral habitats, even with strong currents. With its very long radula it scrapes phytobenthos from the surface of the stones, moving slowly, and with long phases of inactivity. The egg-cocoons are deposited on stones (fig. 4.5). The shape of the shell is well adapted to the habitat, modifying according to the specific local current. It serves as a perfect shelter to the chironomid against predation. The larvae live in the mantle cavity of the limpet, dwelling in a loosely woven tube which is

fixed at the inner rim of their hosts shell (fig 4.6). This phenomenon was discovered by GELDIAY (1956). The species was described for the first time by Svensson (1986). The shape and the structure of the mentum represent the character of *Eukiefferiella* (fig. 4.7). The specimens differ slightly but significantly in the shape of the median teeth of the mentum (fig. 4.8, 4.9). The young pupa in figure 11 was the first specimen of *Eukiefferiella ancyla*, found in the river Urft, (Rur/Maas, North-Eifel; fig. 1) at May 2006 and also the first found in Northrhine-Westphalia. The puparium requires much space and fits perfectly in the region between the head and the limpet's shell (ancyla= bent). We observed a living limpet, creeping upside down along a slide containing a pupa of *Eukiefferiella*, obviously without any restraint (fig. 4.10). This male pupa had nearly reached its emergence. The pulled out abdomen of the imago shows the nearly unfolded genitalia (fig. 4.11, 4.12).

The anal lobe of the pupa is conspicuous. Unlike all other limnic chironomids the pupa of *Eukiefferiella ancyla* has no bristles or setae at the anal lobe (fig 4.13, 4.14). This lack of bristles is discussed as an adaptation to the peculiar mode of life. Anchoring structures might be less important or even bothersome. Other than the larval tube, the woven puparium is a smooth velvet-like silk-web in front of the head region of the mollusc (fig. 4.15). It consists of fibres, less than 2 µm. For comparison: The diatoms *Cocconeis* attached to the web are 25-30 µm in diameter (fig. 4.16).

Figure 4.17 shows a curiosity. This specimen of *Ancylus fluviatilis* is inhabited by two *Eukiefferiella ancyla*, a pupa and, at the opposite side, a larva. *Ancylus fluviatilis* also serves as a frequent host for an oligochaete, the naidid *Chaetogaster lymnaei* (fig. 4.18, 4.19). The worms adhere to the mantle cavity of *Ancylus* in quantities up to 15 individuals. We observed that those *Ancylus* containing *Eukiefferiella* are never infested with *Chaetogaster*.

Dratnalia potamophylaxi

The species belongs to the same subfamily of Orthoclaadiinae as *Eukiefferiella ancyla* (fig. 5.1, 5.2). It also lives in close connection to aquatic animals, the larvae of Trichoptera. The small larvae of *Dratnalia potamophylaxi* live within the larval stone-case, fixed at the abdomen or thorax of their hosts. *Dratnalia potamophylaxi* was found on *Potamophylax rotundipennis* (fig. 5.3) and on *Potamophylax* of the *cingulatus* group (fig. 5.4), but also on *Halesus* sp. and other Trichoptera from the same family of Limnephilidae. *Lasiocephala basalis*, a representative of the family of Lepidostomatidae, is obviously a facultative host, too.



Fig. 3.1: *Demeijerea rufipes*, larva in *Ephydatia mülleri*.



Fig. 3.5: Head lateral with eyes.



Fig. 3.2: *Demeijerea rufipes*, larva, habitus.



Fig. 3.6: Head ventrally

Fig. 3.3: *Demeijerea rufipes*, larva, head dorsally.

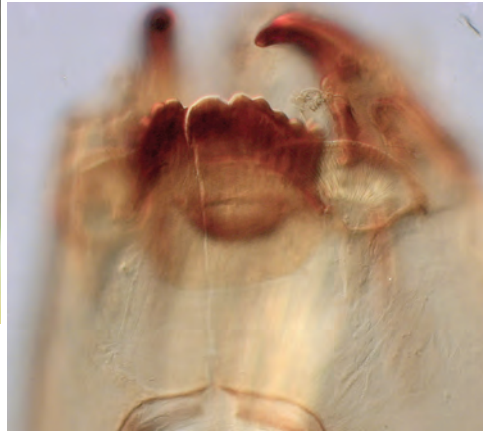
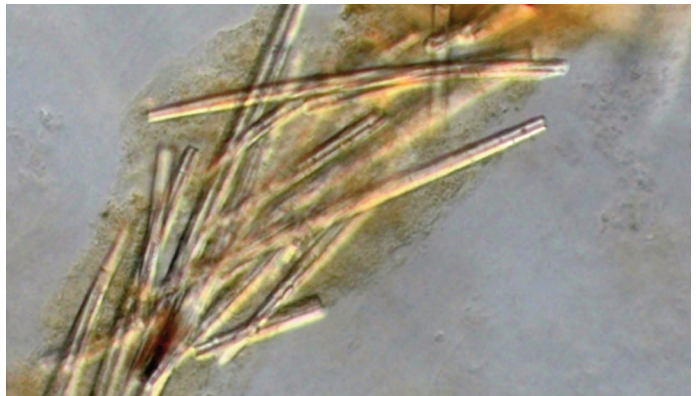


Fig. 3.7: Mentum.



Fig. 3.4: Abdomen with curved ventraltubuli.

Fig. 3.8: Gut content 400x.



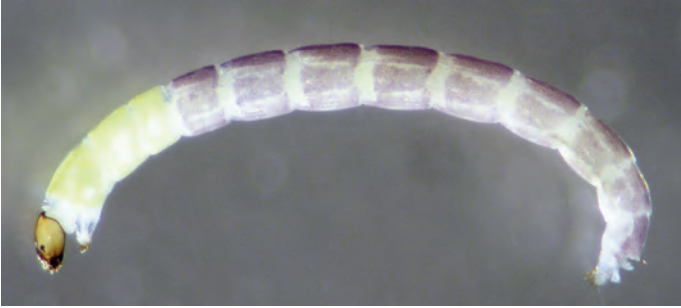


Fig. 4.1: *Eukiefferiella ancyla*. Larva, habitus, 5 mm.

Fig. 4.2: *Eukiefferiella ancyla*. Larva, head.



Fig. 4.3: *Ancylus fluviatilis*. Habitus.



Fig. 4.4: Ventral view.



Fig. 4.5: Three young individuals in egg cocoon (2 mm) on stone surface.



Fig. 4.6: *A. fluviatilis* inhabited by *Eukiefferiella ancyla*.

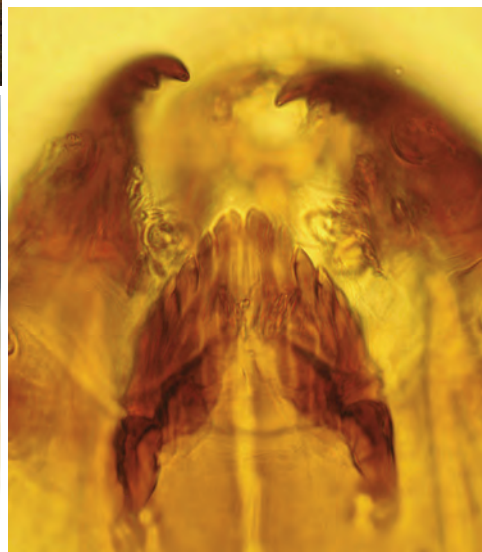


Fig. 4.7: Head, ventral view.



Fig. 4.8: Mentum form 1.

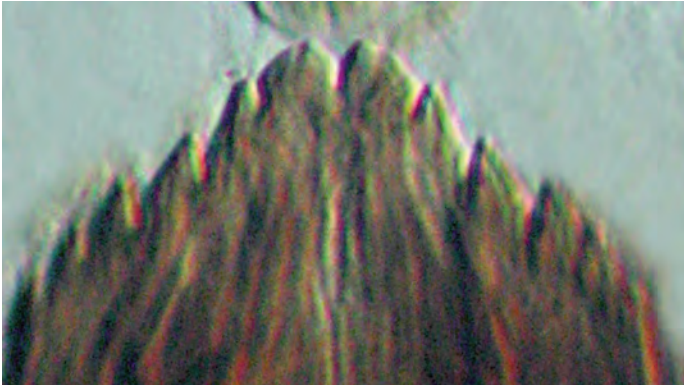


Fig. 4.9: Mentum form 2.

Fig. 4.10: *Ancylus fluviatilis* with Pupa of *Eukiefferiella ancyla*.



Fig. 4.11: *Eukiefferiella ancyla*. Older pupa.



Fig. 4.12: *Eukiefferiella ancyla*. Abdomen of the pupa.



Fig. 4.13: Male imago.



Fig. 4.14: *Eukiefferiella ancyla*. Pupa anal lobe.

Fig. 4.15: Pupal exuvia, anal lobe.

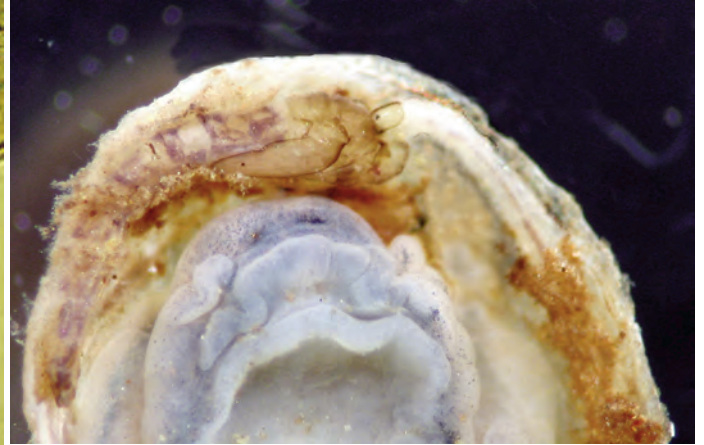


Fig. 4.18: *Eukiefferiella ancyla*. Pupa and larva in one host.

Fig. 4.16: *Ancylus fluviatilis* with silk web of the pupa of *Eukiefferiella ancyla*.

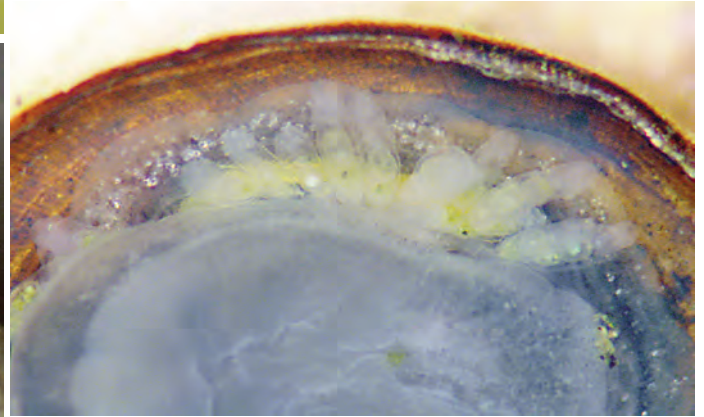
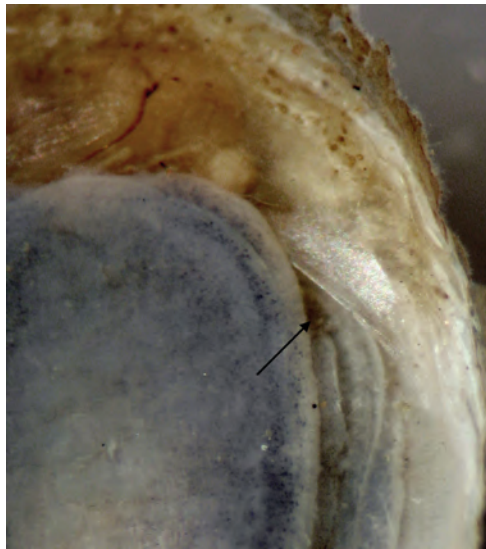


Fig. 4.19: *Ancylus fluviatilis* infested with *Naididae*.

Fig. 4.17: *Eukiefferiella ancyla*. Silk web of the pupa with *Cocconeis* sp. (Bacillariophyceae), 400x.

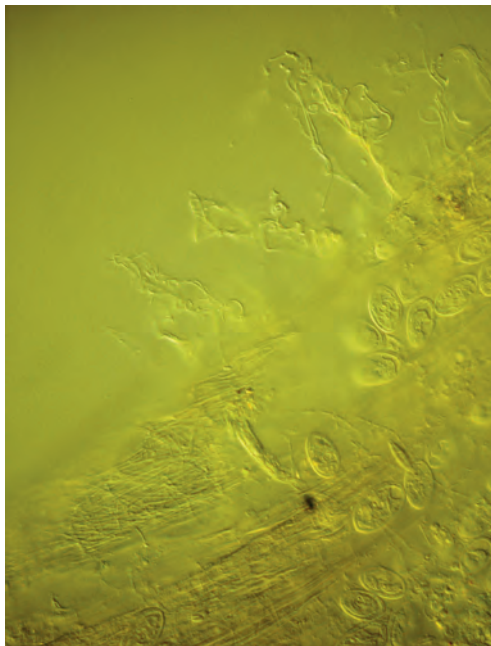


Fig. 4.20: *Chaetogaster limnaei*, commensal of *Ancylus fluviatilis*.



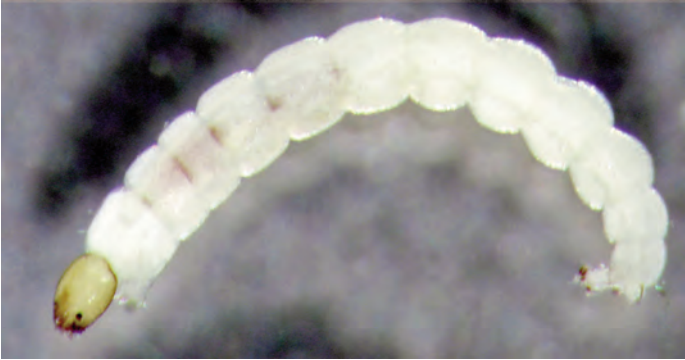


Fig. 5.1: *Dratnalia potamophylaxi*. Larva. Habitus, 5 mm.

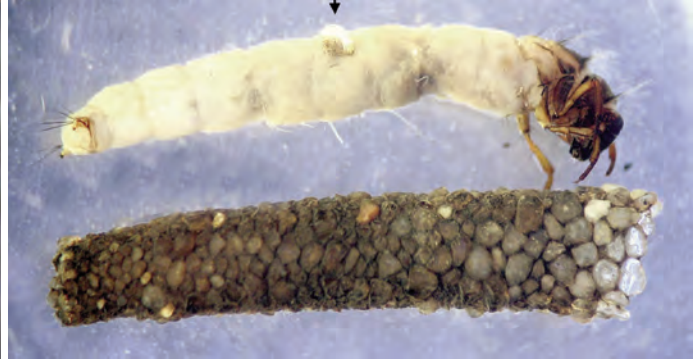


Fig. 5.5: *Lasiocephala basalis*. Larva and case, with *Dratnalia potamophylaxi* larva.

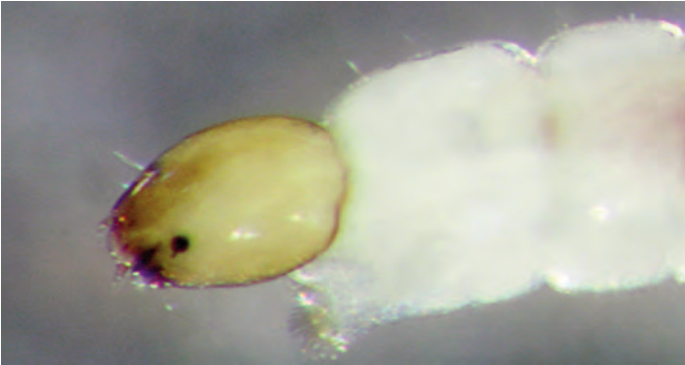


Fig. 5.2: Head.

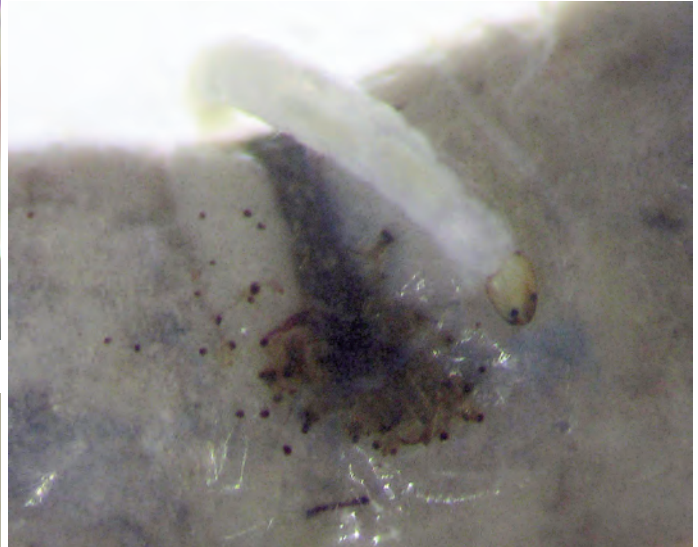


Fig. 5.6: *Lasiocephala basalis*. Larva, abdomen with *Dratnalia potamophylaxi* larva.



Fig. 5.3: *Potamophylax rotundipennis*. Larva in its case.



Fig. 5.4: *Potamophylax cingulatus*-Gr. Larva and case, with *Dratnalia potamophylaxi* larva behind the fifth abdominal



Fig. 5.7: *Dratnalia potamophylaxi*. Larva, attached on *Lasiocephala basalis* on the felted. Web with own exuvia of previous instar.

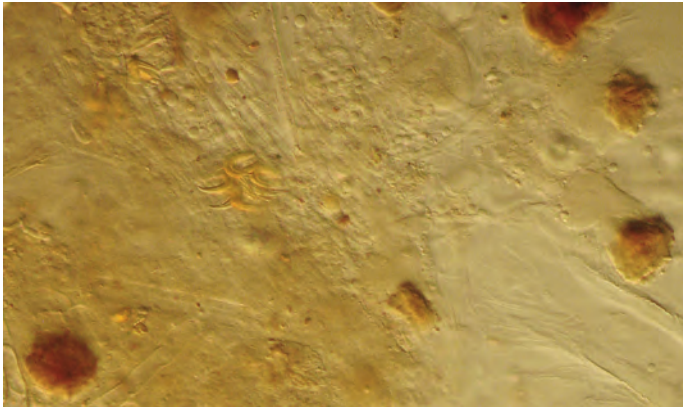


Fig. 5.8: *Lasiocephala basalis*. Cuticula with scars and left back parapod claws of *D. potamophylaxi*, 400 x.

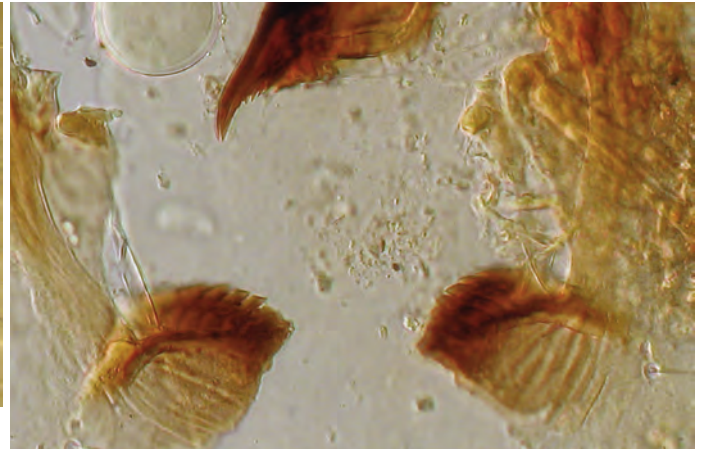


Fig. 5.10: *Dratnalia potamophylaxi*. Larva, mouthparts flattened by slide.



Fig. 5.9: *Dratnalia potamophylaxi*. Larva, head ventral.

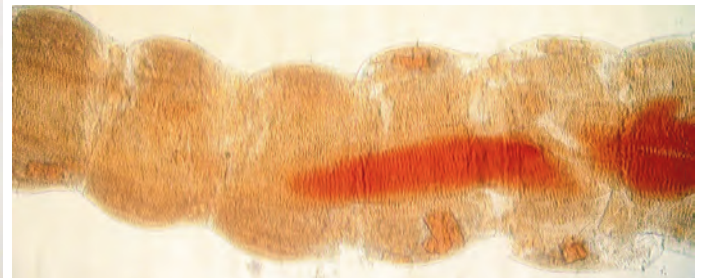


Fig. 5.11: *Dratnalia potamophylaxi*. Larva, abdomen, 200 x.



Fig. 5.12: *Epoicocladius ephemeræ*. Larva, abdomen, 200 x; in comparison with *Dratnalia potamophylaxi*.

Specimens from a lowland river in Niedersachsen, Germany, show a high rate of infested individuals (fig. 5.5). The cuticle of the Trichoptera-abdomen is smooth and not sclerotized. Some of the hosts of the chironomid do not show any noticeable changes. But many of the infested Limnephilidae and all *Lasiocephala basalis* specimens bear traces of the adhering *Dratnalia*. The region where the chironomid is fixed, is covered with brown dots of scarred wounds, bacteria and, particularly on *Lasiocephala*, with a kind of felted web, obviously produced by *Dratnalia* (fig. 5.6). It seems to serve as a better foothold for the chironomid. The figure shows a *Dratnalia* fixed at the web round its own last peeled exuvia (fig. 5.7). The figure shows the cuticula of *Lasiocephala* in high magnification with scarred wounds. Interesting: The parapod claws left back by a *Dratnalia*

are still fixed at the brown layer of bacteria (fig. 5.8). The shape of the mentum is noticeable. It is strongly bent over (fig. 5.9, 5.10). With these mouthparts, working like a parrot bill, the chironomid might be able to cause lesions like punctures into the cuticle of its host. Other than the commensal living Chironomids *Eukiefferiella ancyla* and *Epoicocladius flavens*, the guts of *Dratnalia*-larvae do not content any mineral particles (fig. 5.11, 5.12). Trichoptera larvae are often covered with Peritricha (ciliated protozoa) and also with organic particles, but it seems reasonable to assume that the Chironomid in some cases feeds on their host's hemolymph.



Fig. 6.1: *Epoicocladius ephemerae*. Larva, habitus, 6 mm.



Fig. 6.4: *Epoicocladius ephemerae*. Larva, abdomen with bristles.



Fig. 6.2: *Epoicocladius ephemerae*. Larva, head and thorax.

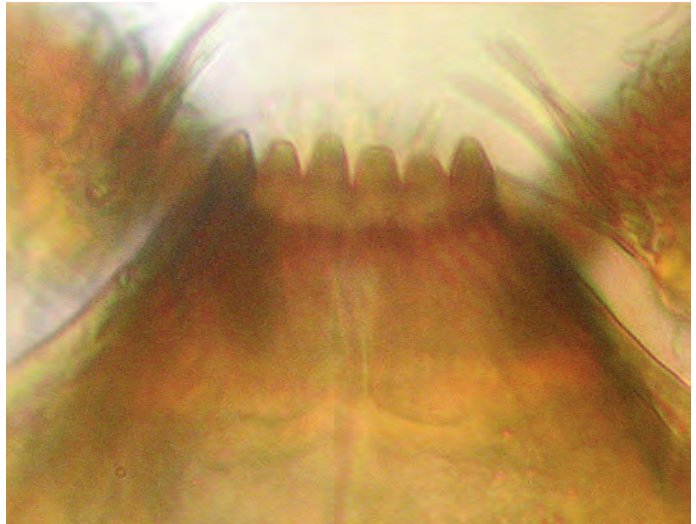


Fig. 6.5: *Epoicocladius ephemerae*. Larva, mentum, 400 x.



Fig. 6.3: *Ephemera danica* Larva with adhering *Epoicocladius ephemerae* Photo: Brigitta Eiseler.



Fig. 6.6: *Epoicocladius ephemerae*. Pupae fixed at sternum of a mature *Ephemera danica* larva.

Epoicocladius ephemerae

This chironomid, also a representative of the subfamily of Orthoclaadiinae, is attached to *Ephemera danica*/Ephemeroptera in a phoretic relation. It lives between the gills, at the thorax and at the cerci of the nymph. Both, host and the adhering commensal, are wide spread (fig. 6.1, 6.2). *Ephemera danica* is a digging mayfly living rhithral in sediments. Fig. 6.3 shows a living *Ephemera danica* with an adhering *Epoicocladius*.

The bristles covering the larval body are obviously an adaptation to the special mode of life on the mayfly and might have the function of a brush (fig. 6.4). The tiny mentum is characteristic to the species (fig. 6.5).

Symbiocladius rhithrogenae

The species, another member of Orthoclaadiinae (fig. 7.1), is a true and obligate parasite of Heptageniidae-nymphs (Ephemeroptera). It prefers *Rhithrogena* of the *semicolorata*-Group. The figure shows a *Rhithrogena* with its parasite (fig. 7.2, 7.3). The young larva creeps towards the wing bud of the host and drills itself under it. When the Heptageniid nymph loses its exuvia, the parasite has to fix at the new cuticle (fig. 7.4, 7.5). *Symbiocladius* feeds on the mayfly's hemolymph, but there are reports of normal development to adults in some cases after being parasitized. The mouthparts are strongly modified, especially the tweezers-like mandibles and the mentum (fig. 7.6, 7.7, 7.8, 7.9) and also the reduced parapods (fig. 7.10, 7.11) and the anal setae. Fig. 50 shows a free living *Nanocladius rectinervis*, near related to *Symbiocladius* and a *Symbiocladius rhithrogenae* (fig. 7.12) for comparison and to demonstrate the morphological change of the parasite.



Fig. 7.1: *Symbiocladius rhithrogenae*. Larva with gelatinous membrane.



Fig. 7.3: *Rhithrogena semicolorata*-Gr. Larva with *Symbiocladius rhithrogenae* larva.



Fig. 7.2: *Rhithrogena* sp. Larva.
Photo: Brigitta Eiseler.



Fig. 7.4: *Rhithrogena semicolorata*-Gr. Larva with *Symbiocladius rhithrogenae* larva, higher magnification.

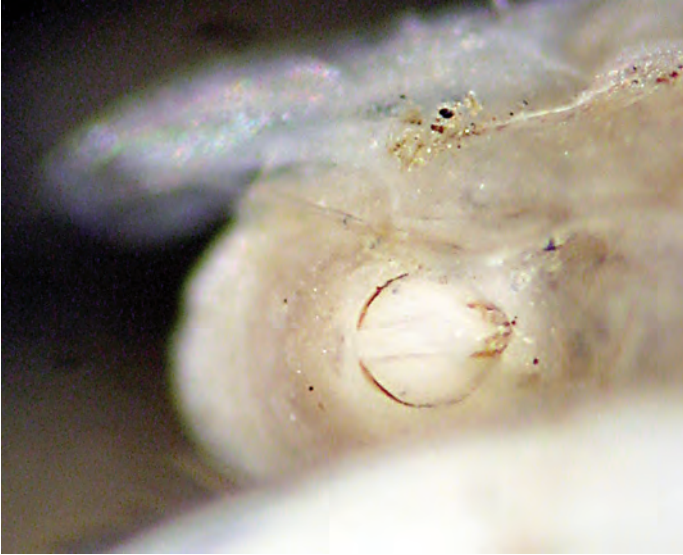


Fig. 7.5: *Symbiocladius rhithrogenae*. Larva, head under the wing bud of *Rhithrogena semicolorata*-Gr.

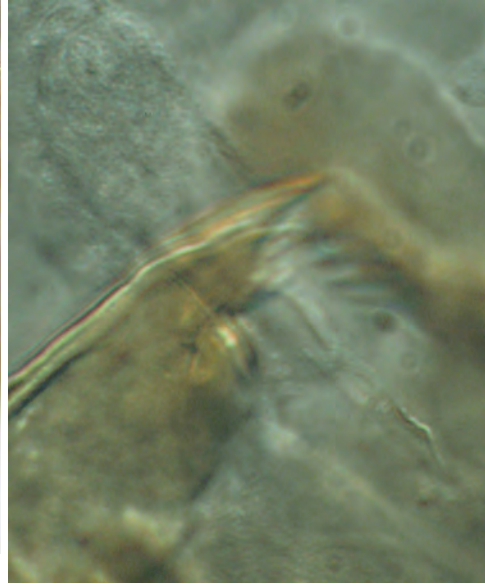


Fig. 7.8: Interconnected mandible, 1000 x.



Fig. 7.6: *Symbiocladius rhithrogenae*. Larva. Head, ventral view.

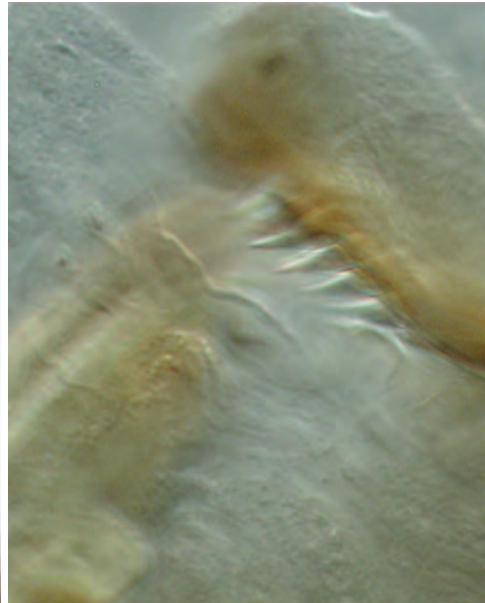


Fig. 7.9: Lateral teeth of mentum as counterpart of the mandible, 1000 x.

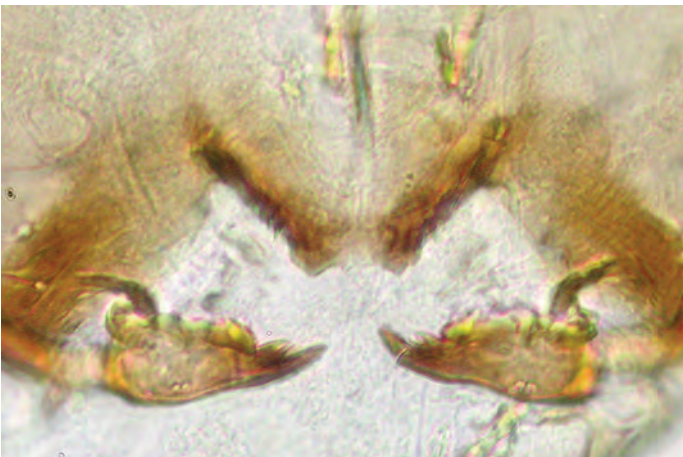


Fig. 7.7: mouthparts, 400 x.

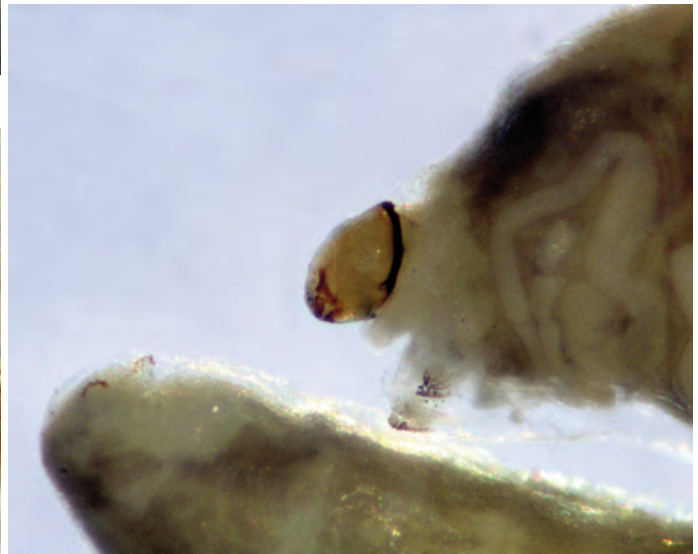


Fig. 7.10: *Symbiocladius rhithrogenae*. Larva with reduced parapods.

Fig. 7.11: *Symbiocladius rhithrogenae*. Larva, anterior parapod claws, 1000 x.

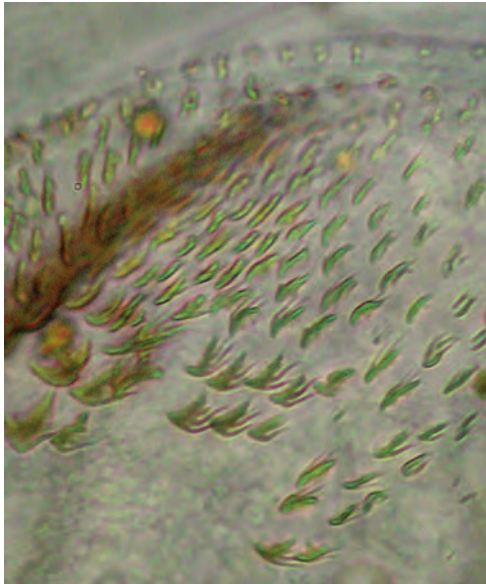


Fig. 7.14: *Heptagenia sulphurea*. Larva with embryos of unknown origin.



Fig. 7.12: *Nanocladius rectinervis*. Larva, habitus.

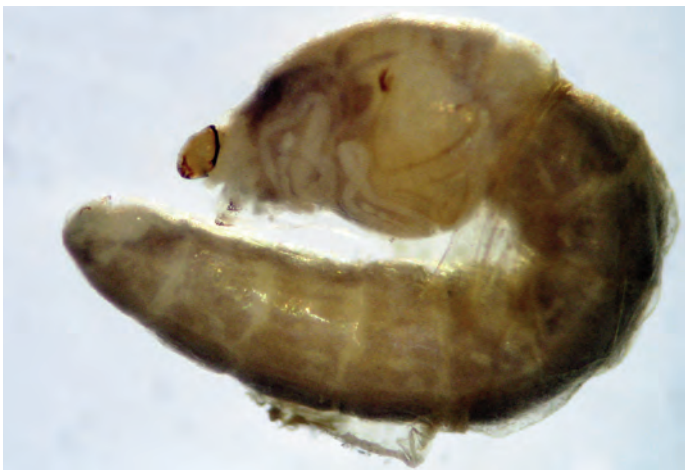


Fig. 7.13: *Symbiocladius rhithrogenae*. Larva, habitus.



Fig. 7.15: Idem embryos, higher magnification.

The eggs of *Symbiocladius rhithrogenae* are usually deposited on stones, but the figure shows a bunch of eggs with unknown origin, adhering at the wing-bud of the Heptageniidae-larva *Heptagenia sulphurea* (fig. 7.13, 7.14). It does not seem to be fixed by mistake. Developed embryos in the jelly are already distinguishable.

Facultative Associations

Some facultative commensally living chironomids have been found at Spongillidae and Bryozoa colonies. These *Glyptotendipes* sp. (Chironomini), have built a stabile tube deep into the body of a sponge, associated with Oligochaeta (fig. 8.1, 8.2, 8.3). An Orthoclaudiinae species, dwelling in the same colony, uses a channel of the sponge body for its tube (fig. 8.4). The Bryozoa colony (*Plumatella*) examined is inhabited by *Polypedilum* sp. and a *Glyptotendipes* species (fig. 8.5, 8.6, 8.7).



Fig. 8.1: Spongillidae colony with young larva of *Glyptotendipes pallens-agg.*



Fig. 8.2: *Glyptotendipes* sp. Larva in a Spongillidae colony with Oligochaeta.

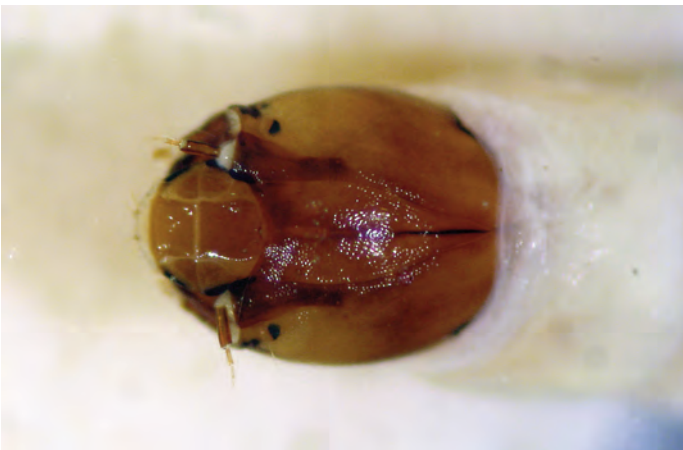


Fig. 8.3: *Glyptotendipes* sp. Larva, head.



Fig. 8.4: Orthocladiinae gen sp. Larva, framed by spicules of the sponge, 50x.



Fig. 8.5: *Polypedilum* sp. Larva between *Plumatella*-zooids and their statoblasts.



Fig. 8.6: *Glyptotendipes* sp. Larva associated with *Plumatella*.

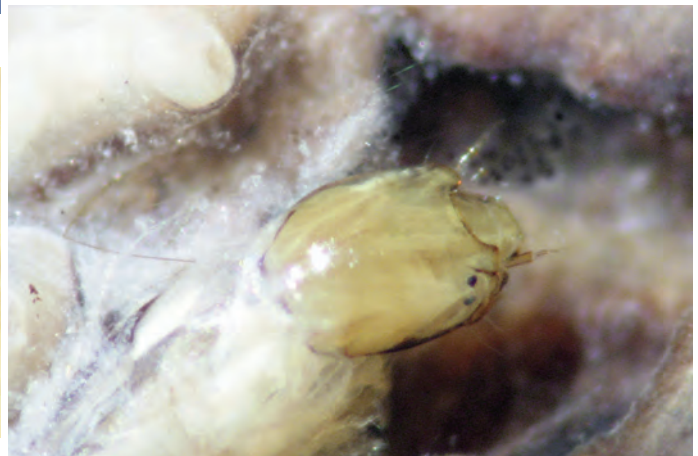


Fig. 8.7: *Glyptotendipes* sp. Larva, head.

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