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ON THE PHORETIC PHASE OF *ARRENURUS* LARVAE (ACARI, HYDRACHNELLAE) ASSOCIATED WITH ZYGOPTERAN Nymphs

BY Arnold ÅBRO *

**ABSTRACT** : Larval water mites of the genus *Arrenurus*, ectoparasitic on zygopteran imagine of *Enallagma cyathigerum*, contact the aquatic zygopteran nymph and cling to it, awaiting the emergence of the zygopteran imago. Thus the phoretic association of the water mite with the nymph is established prior to the parasitic phase. Ultrastructural evidence indicated that the phoretic larva sticks to its potential host by means of an adhesive substance deposited between the larval pedipalps and cuticle of the zygopteran nymph. The adhesive substance appears to be secreted by the arrenurid larva.

**RÉSUMÉ** : Les larves d'Hydrachnelles du genre *Arrenurus* ectoparasites des imagos du Zygoptère *Enallagma cyathigerum*, établissent le contact avec la nympe aquatique de ce Zygoptère en grimpant sur elle pour attendre qu'émerge l'imago. Ainsi une association phorétique s'établit-elle entre l'Hydrachnelle et la nympe de son hôte avant la phase parasitaire. Un examen de l'ultrastructure a montré que la larve phorétique s'attache à son hôte potentiel au moyen d'une substance adhésive déposée entre les pédipalpes de la larve et la cuticule de la nympe du Zygoptère. Cette substance adhésive paraît être sécrétée par la larve d'Arrenuride.

**INTRODUCTION**

Water mite larvae of the genus *Arrenurus*, ectoparasitic on zygopteran imaginates, anchor themselves to the host’s cuticle by means of their powerful mouthparts which pierce the cuticle to gain access to the host’s tissue fluids (ÅBRO 1979, 1984). In several species of *Arrenurus* the parasitic phase is preceded by a transitory waiting stage or transport phase (phoresis), when the tiny larval mites rest, but do not feed, on the preimaginal developmental stage or terminal instar of their chosen host (ÅBRO 1982). During the phoretic phase, the larval mites usually conceal themselves beneath the wing sheaths of the zygopteran nymph; subsequently they transfer from the nymphal skin to the emerging imago (ÅBRO 1984). The present article reports on a mode of attachment utilized by arrenurid larvae associated with their potential hosts, as observed under an electron microscope.

**MATERIALS AND METHODS**

Terminal instars of the zygopteran species *Enallagma cyathigerum*, carrying arrenurid larvae, were collected during the spring in a pond near

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Bergen in western Norway. Several nymphs carrying arrenurid larvae were taken back to the laboratory and kept in an aquarium for observation under a surgical operating microscope. A sample nymph specimens were injected with fixing fluid using a fine hypodermic needle and then immersed in the same fluid in the field. In the laboratory, samples of the nymphal body wall with larval mites attached were processed for electron microscopy along the lines of previous studies (ÅBRO 1979, 1982 and 1984). Ultrathin sections were taken using diamond knives. For scanning electron microscopy, specimens were critical point dried and sputter coated with thin layers of carbon and gold-palladium.

RESULTS

Direct observations.

The phoretic larval mite appears to become firmly attached to the zygopteran nymph. Its mouth parts are appressed to the nymph's cuticle and it remains largely quiescent. Under aquarium conditions at least, larvae were seldom seen
FIG. 3: A further vertical section through the same specimen as depicted in Fig. 2. Here the larval mite is sectioned through the buccal aperture and one of the palps. Adhesive substance may be observed between larval palp and nymphal cuticle (asterisk). Note the absence of adhesive on the buccal aperture and surrounding velum (ve). Scale line: 10 μm.

to relocate to another part of the potential host or to move away. Upon relocating, the larva makes a ventrad folding of the gnathosoma, thus once again appressing its mouthparts to the nymphal skin, the idiosoma swaying gently for a while but soon becoming quiescent. Most phoretic larval mites remained attached to the nymphal skin during histological fixation and embedding.

Electron microscopy.

Ultrathin sections through fragments of the body wall of zygopteran nymphs with attached arrenurid larvae revealed the larval gnathosoma to be glued to the nymphal skin. A cake of adhesive made up of a rather fine granular substance was found between the larval palps and the nymphal skin. The substance surrounded and covered section profiles of the palpal setae and large claws (Figs. 2 and 3). However, the presence of adhesive substance could not be demonstrated between the buccal aperture of the mite and the nymphal skin (Fig. 3). Bacteria were often identified in the adhesive substance itself or on its surface. The pedipalp claws were never found to be inserted into the cuticle of zygopteran nymphs such as may be observed during the parasitic phase. Fig. 1 shows the gnathosoma of a phoretic Arrenurus larva which has been dislodged from the zygopteran nymph and then immersed in fixing fluid; here it is viewed in the scanning electron microscope after washing and cleaning by means of ultrasound treatment.

Although this study is based mainly on nymphs of the zygopteran species Enallagma cyathigerum and its associated larval mites, similar observations of arrenurid larvae fixed by an adhesive substance to nymphs belonging to other zygopteran species have occasionally been recorded from western Norway.
DISCUSSION

BINNS (1975) has studied the distribution of arrenurid larvae associated with dragonflies and reviewed (BINNS 1982) the mite-insect phoresy in general. Electron microscopy of collected specimens has revealed evidence as to the mode of attachment that could hardly be obtained by other known methods.

The adhesive substance depicted exhibits a texture very much like the gelatinous coat sealing the functional juncture between the larval pharynx and the host tissues during the parasitic phase (ÅBRO 1979, 1984). This suggests that the adhesive is extruded by the larva itself, and on the basis of morphological features alone, appears similar to the secretion that may be observed as a liquid droplet on the gnathosomal apex prior to larval attachment in the feeding position (ÅBRO 1979). The adhesive therefore probably issues from the buccal aperture of the larva. This secretion may have the ability to adhere to the nymph's cuticle as well as to solidify under water. The swaying movements of the larval idiosoma seen when larvae are about to attach themselves to the nymph possibly reflect a pushing forward and immersion of the pedipalps with their claws and setae in the sticky substance before it coagulates and the larvae attain a motionless position of waiting. When the zygopteran nymph with its attached larval mites leaves the water for hatching, the sunshine and dry air apparently promote desiccation of the nymphal skin, thereby causing the tough coating of adhesive to sever. Also, STECHMANN (1978) has noted that phoretic arrenurid larvae remain quiescent and motionless on their potential host until after the zygopteran nymph has left the water for metamorphosis. The mite larvae become active when the nymph has dried in the air and its skin has split along the mid-dorsal line of the thorax (ÅBRO 1984). STECHMANN (1978) has observed the larval mite pressing its mouthparts against the cuticle of the aquatic zygopteran nymph, its potential host, apparently in order to examine it.

The deposition of a patch of adhesive substance by the larval mite might be considered an adaptation to secure phoretic association; it prevents dislodgement of the arrenurids by the zygopteran nymphs. This mode of attachment is thus entirely different from the attachment in feeding position when the pedipalp claws hook on to the host cuticle (ÅBRO 1984). It should be emphasized that the solidified adhesive is apparently not permitted to adhere to the buccal aperture and the surrounding velum, which might be important when the larval mouth becomes tightly appressed to the zygopteran imaginal skin so that the arrenurid chelicerae prepare themselves to perforate it. Immediately before this anchoring in feeding position, a tiny droplet of fresh liquid secretion appears at the larval mouth (ÅBRO 1979).

Abbreviations in the figures.
ch cheliceral sabre, distal part
ep zygopteran epidermis
ex exuvial space
is imaginal cuticle
ns nymphal cuticle, thickened
P pedipalp
pc palpal claw
Pt palpal tibia
ve velum

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