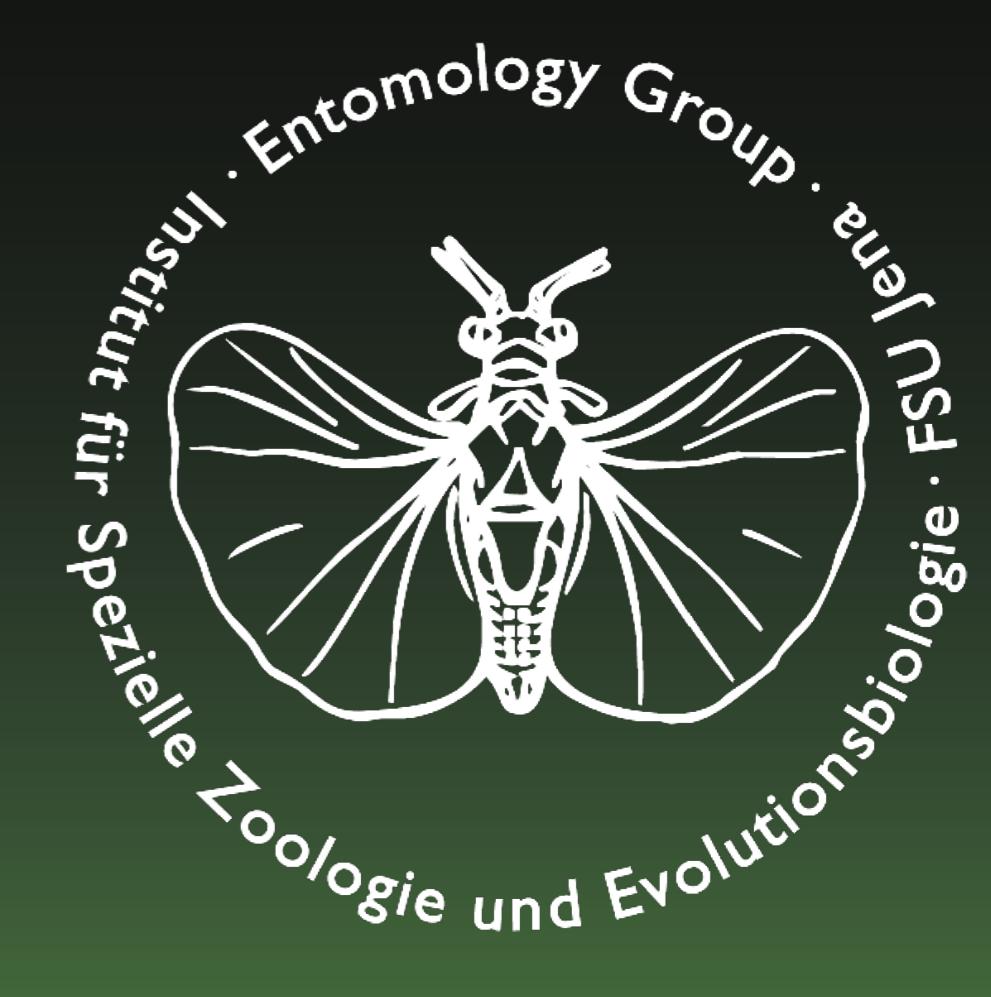




Catching prey with the antennae

The larval head morphology of *Corethrella appendiculata* and *Chaoborus crystallinus* (Culicomorpha, Diptera)

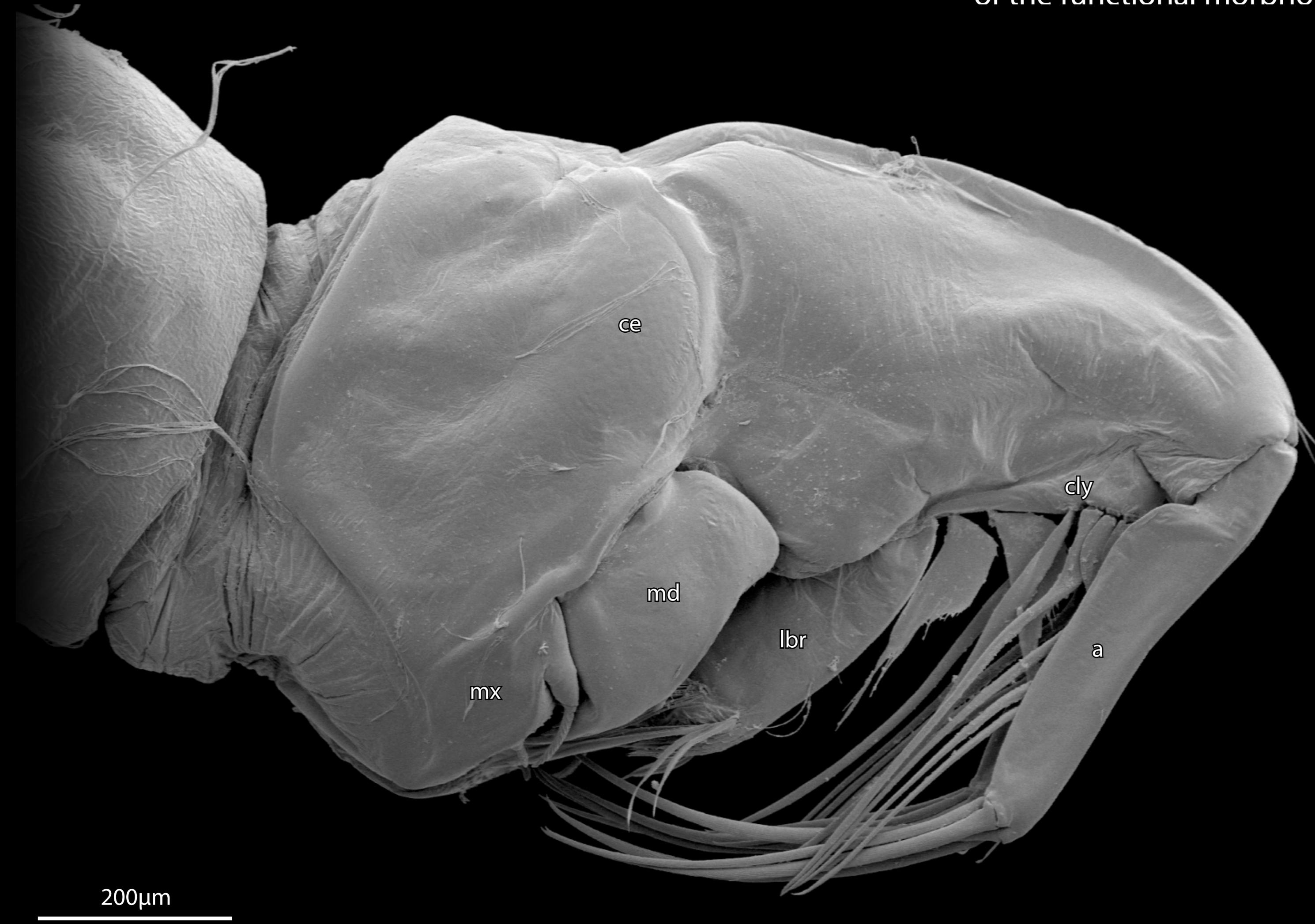


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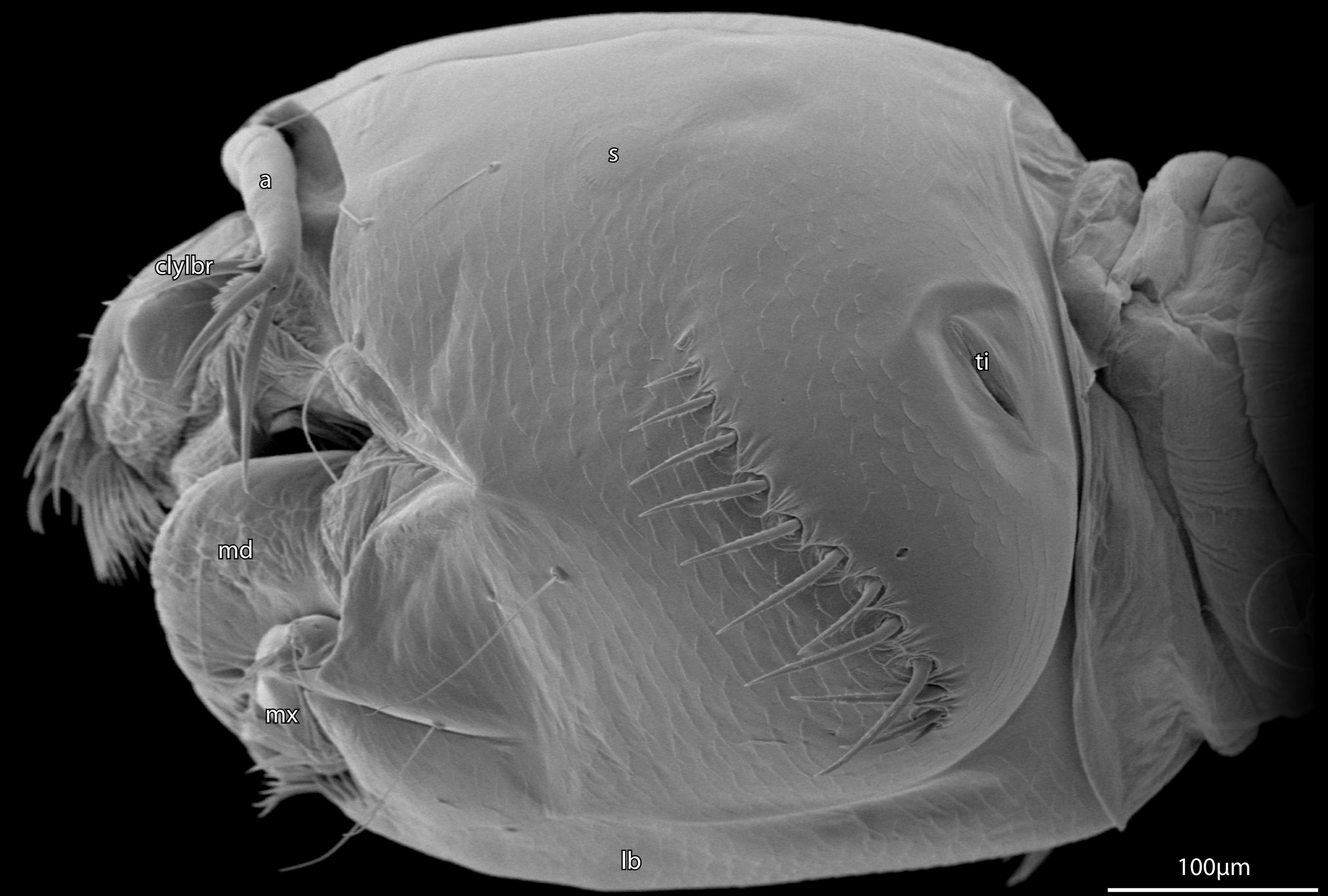
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Introduction

The frog-biting-midges or Corethrellidae are a small group among the lower Diptera. They can be found all over the world in subtropic and tropic regions living in standing waterbodies. Their predaceous larvae feed mainly on other insect larvae but start a cannibal behavior when the rate of prey is too low. They capture the prey with their raptorial antennae, a snatching mechanism which also can be found in the closely related phantom midges (Chaoboridae). The homology of the larval head structures and the snatching mechanism has not been completely resolved up to now. A closer analysis of inner structures and mouthparts of *Corethrella appendiculata* Grabham 1906 and *Chaoborus crystallinus* De Geer 1776 contributes to answer questions of homology and the understanding of the functional morphology of the feeding mechanism.



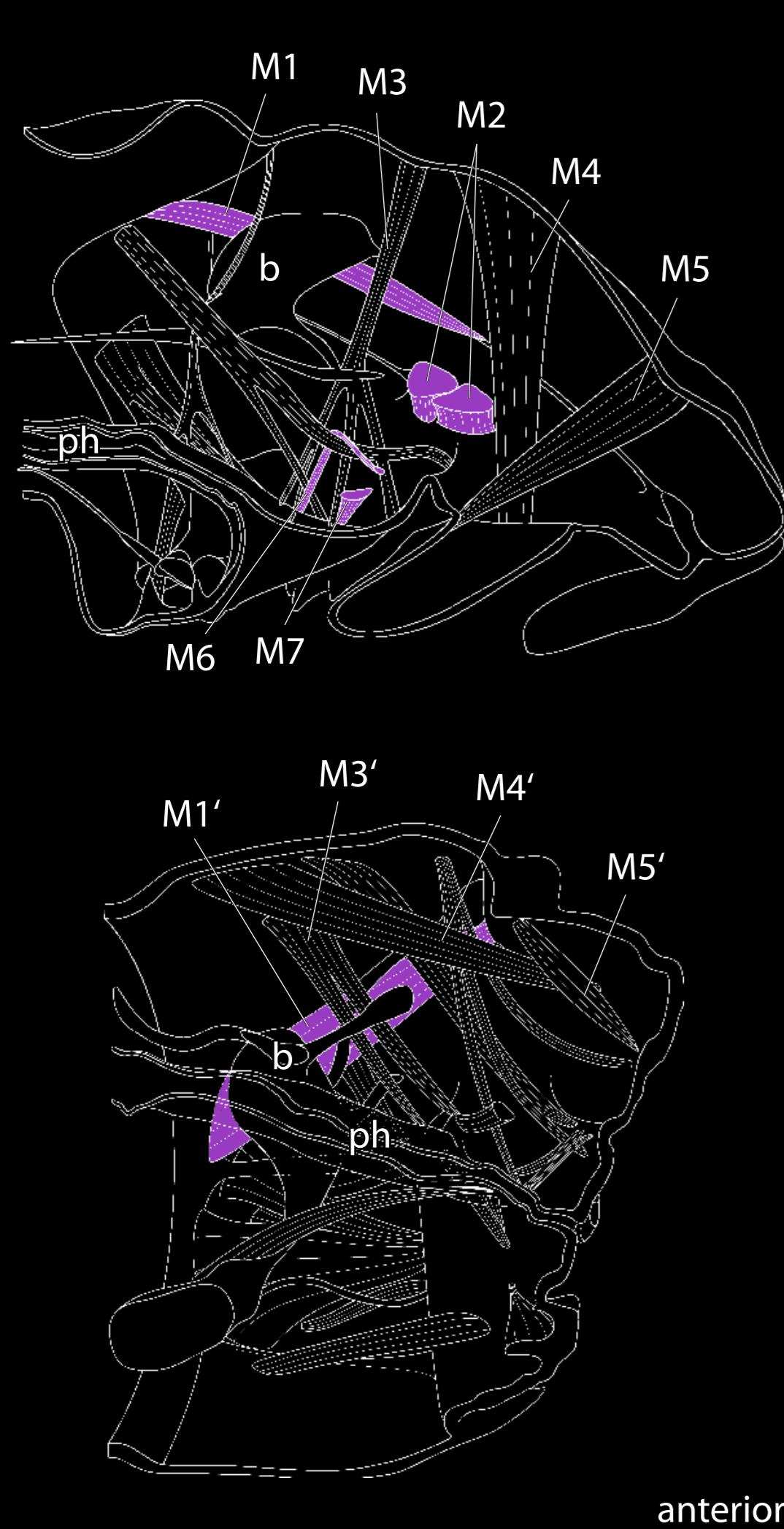
Lateral view of the head of *Chaoborus crystallinus*. Antennae in resting position.



Lateral view of the head of *Corethrella appendiculata*. Antennae in resting position.

Methods

Raster electron microscop images of the larvae were taken with a FEI (Philips) XL 30 ESEM on a specimen holder after Pohl 2010. For three-dimensional models cross sections were aligned and reconstructed with the programm Amira 5.3 (Visage Imaging GmbH). The final smoothing of the model was done in Maya 2012 (Autodesk).



A) *Chaoborus crystallinus* head sagittal view. B) *Corethrella appendiculata* head sagittal view. Focused muscles are colored in purple.

Results

The antennae of the frog-biting midge *Corethrella appendiculata* are close-set, and monadic. When relaxed they lay in a horizontal position in a pocket formed by the head capsule. The labrum is fused with the clypeus and therefore is called here "clypeolabrum". At its tip there is a row of macro-setae (white arrow), probably used for the help of fixing the prey.

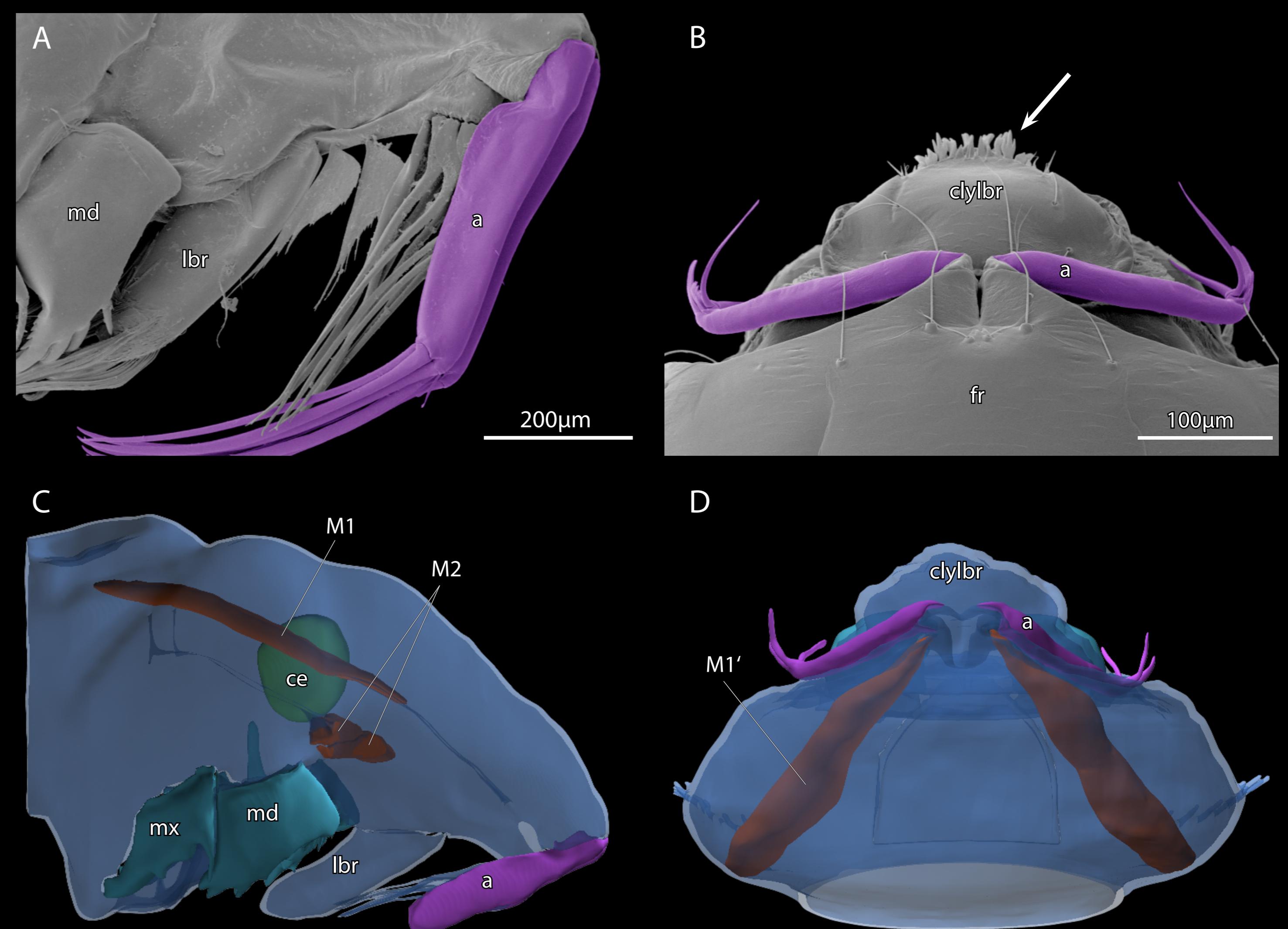
When prey is detected the abduction of the antennae is caused by the contraction of M1'. The prey will be enclosed by the antennae and fixed with 3 long setae at the tip of them and the clypeolabrum. It will then be shredded and consumed with the mouthparts. Since there are no muscles for antennal adduction, it is most likely that this is managed just by the relaxing of M1'.

In contrast to *Corethrella appendiculata* the antennae of *Chaoborus crystallinus* can be regarded analogous to the mantid raptorial forelegs. They are also monadic and elongated but lay in a vertical position referring to the head. Located in front of the compound eyes, they provide improved catching coordination.

Their abduction is caused indirectly by the contraction of M2 increasing the haemolymph pressure in the head capsule. M6 and M7 contribute to this function by stabilizing the membranous region of the mouth. The labrum is narrow, highly elongated and largely sclerotized. Its non-sclerotized

parts are equipped with brushes. During the snatching process, M1 accomplishes the adduction of the antennae. The labrum and the lacinia mobilis, a rake like structure of the mandibles, help to fix the prey while the mandibles are used for shredding and consuming. Nevertheless, the homologization

of some head structures is very problematic and further studies are necessary. It may give a better understanding of phylogenetic relationships of the Chaoboridae and Corethrellidae and the evolution of this unique snatching apparatus.



Left column: Head of *Chaoborus crystallinus* lateral view, A) Closeup of the antennal region; C) 3D-Model. Right column: Head of *Corethrella appendiculata* dorsal view, B) Closeup of the antennal region; D) 3D-Model.

Abbreviations

a, antenna; b, brain; ce, compound eye; cly, clypeus; cylbr, clypeo-labrum; fr, frons; lbr, labrum; md, mandible; mx, maxille; ph, pharynx; s, stema; ti, tentorial invagination; M1/M1', M. tentoriocapalis posterior; M2, not homologized yet; M3/M3', M. frontobuccalis anterior/posterior; M4/M4', M. frontolabralis; M5/M5', M. frontoepipharyngalis; M6, not homologized yet; M7, not homologized yet.

References

- Borkent, A. 2004. Insecta: Diptera, Corethrellidae. pp. 638–641. Freshwater Invertebrates of the Malaysian Region.
Schremmer F. (1950). Zur Morphologie und funktionellen Anatomie des Larvenkopfes von *Chaoborus* (*Corethra* auct.) *obscuripes* v. d. Wulp (Dipt. Chaoboridae). – Österreichische Zeitschrift für 471–516.