Evolutionary transformation of female genitalia in a phytophagous insect taxon (Hemiptera: Cicadina)

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Scientific Background

With ca. 45,000 described species the Cicadina or Auchenorrhyncha are the largest hemimetabolous insect taxon. Exclusively phytophagous, Auchenorrhyncha are characterized by their highly specialized sucking mouthparts, and known to feed on xylem, phloem or suck the content of plant cells. Concerning their host range, Cicadina species display varying degrees of specialization, some being extremely polyphagous, while others are oligophagous to monophagous, with some species utilizing a single plant species. Consequently, Cicadina play an important role in virtually all ecosystems, with some species causing serious problems on crops such as rice, corn, cotton, sugarcane, potato, and grapevine. While the Cicadina are rather modest in regard to body size (less than 10 mm in most species), they are insect record-holders in regard to nymphal development (17 years), and sound-intensity (80-100 decibels at a distance of 18m).

Despite the fascinating biology of the few species studied and their economic importance, little is known about the mechanical interaction between these insects and their hostplants which occur e.g., during feeding and oviposition. The current research project examines the diversity of internal and external structures of the female genital tract in Cicadina using high-resolution holotomography. The study will be supplemented by SEM and histological sections within the framework of M. Zilch´s dissertation research.

First results

During the first series of experiments conducted during June 11 - 13 2011, the following species were investigated: Cixiidae: *Hyalesthes obsoletus* (adult male and female), *Cixius pallipes* (adult female), *Bennaria damisa* (V. instar nymph; adult female), Delphacidae: *Asiraca clavicornis* (adult female), Issidae: *Hysteropterum vasconicum* (male and female, in copula), and Cicadellidae/Macropsinae: *Oncopsis* sp. (adult female). All samples were subject to holotomographical procedures and all samples yielded high-resolution images with valuable information content.

The species selected display various types of ovipositor realized within the Hemiptera: the piercing-type, or orthoperoid, ovipositor (Delphacidae, Cicadellidae), the reduced orthopteroid ovipositor (Cixiidae) and the gathering-mixing ovipositor (Issidae). For the first time, information is available on structural details in situ allowing assessments of homology of structures, particularly at the ovipositor base, among taxa. Information is still being extracted from the images and will be integrated into the comparative morphological analysis which is being conducted by M. Zilch as part of his dissertation research [1].

Additional results.

One of the taxa examined here, *Bennaria damisa* [2], is a member of the enigmatic cixiid tribe Bennini [3]. This taxon is characterized by lateral abdominal appendages unique in insects. The movable appendages arise from the base of the abdomen and carry a highly specialized sensory unit of unknown function at their distal end [4]. Hitherto, material suited for ultrastructural studies has been scarce (predominantly dried museum specimens). The acquisition of fresh material in alcohol

offered an unanticipated research opportunity, and in the course of the studies on female genitalia, also the lateral abdominal appendages could be examined at DESY. Fig. 1 shows the first ever 3D-reconstruction of a Bennini lateral abdominal appendage, revealing insights into general morphology (identification of musculur, nerve and glandular tissue) and advancing our knowledge of its function (sensory, secretory). The results from the tomography experiments at DESY will be synthesized with other information; the pertaining manuscript is in preparation (Hoch, H., Asche, M., Bräunig, P., Mühlethaler, R., Stelbrink, B., Wessel, A., Wipfler, B., Wolff, C., Zilch, M.).

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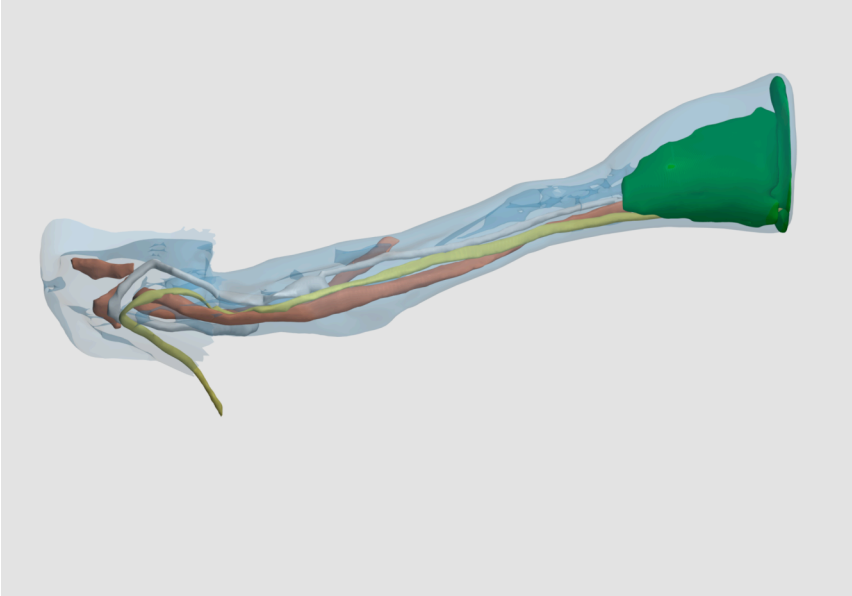

Figure 1: *Bennaria damisa* Hoch & Dem: Lateral abdominal appendage, adult female. Red- muscles, green – glandular tissue, white – trachea, yellow – nervous system.

References

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