Evolutionary and morphological adaptations in the roach-termite transition zone

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Background

One of the most spectacular recent achievements in systematic entomology was the identification of termites as social cockroaches. While their systematic position as closest relatives of the wood-feeding roach *Cryptocercus* is widely accepted, it is completely unknown which morphological adaptations took place in the transition zone between omnivorous solitary roaches, wood-feeding and gregarious Cryptocercidae, and highly organized, eusocial, multi-caste termites. The aim of our study was to investigate structural changes in the head and thorax and their possible correlation with the modified life style.

Material and specimen preparation

We examined *Cryptocercus punctatus*, the American roach *Periplaneta americana*, and all three castes of *Mastotermes darwiniensis* – the presumingly most basal termite. Adult female specimens of these species were fixed in 70% ethanol, dried at the critical point and mounted on metal carriers.

Results

The high quality and high density resolution of the scans obtained at beamline BW2 with 8KeV ensured a very efficient in-depth evaluation of the produced data. Detailed descriptions and illustrations were generated using 3D-reconstruction programs (Amira and Maya). The time frame of the investigations was minimized compared to a study using traditional techniques such as serial sectioning. Based on the well documented detailed morphological data we were able to identify several characters unique to the wood-feeding and subsocial roach *Cryptocercus* and the termites, thus further supporting their close relationship. The morphological adaptations in the cephalic region are mostly linked to xylophagous habits and include among others rasping fields of lamellae on the mouthparts. Our results strengthen the hypothesis that the social behaviour observed in both groups might have evolved along with the change of diet: wood did not only serve as nutrient but also provided a shelter from predators, thus allowing the insects to invest the gained energy in parental care.

Outlook

Our investigations were carried out in the framework of an extensive project on the phylogeny and evolution of the “lower neopteran insects” (Polyneoptera). This extensive lineage includes roaches, termites, mantids, grasshoppers, earwigs, stick insects, stoneflies and some more obscure groups of insects. In addition to the head and thorax, other morphological character systems like the pregenital abdomen, the female genitalia, the wings and the wing articulation will be studied. The morphological characters will be combined with molecular data and analysed phylogenetically. The compilation of the required very extensive morphological data set would not be possible in a reasonable time frame without the use of SRμCT facilities.

Acknowledgements

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References

Dressler, C. and Wipfler, B. Systematics 2009, 1st meeting of Biosyst EU Leiden. p. 46, (2009)

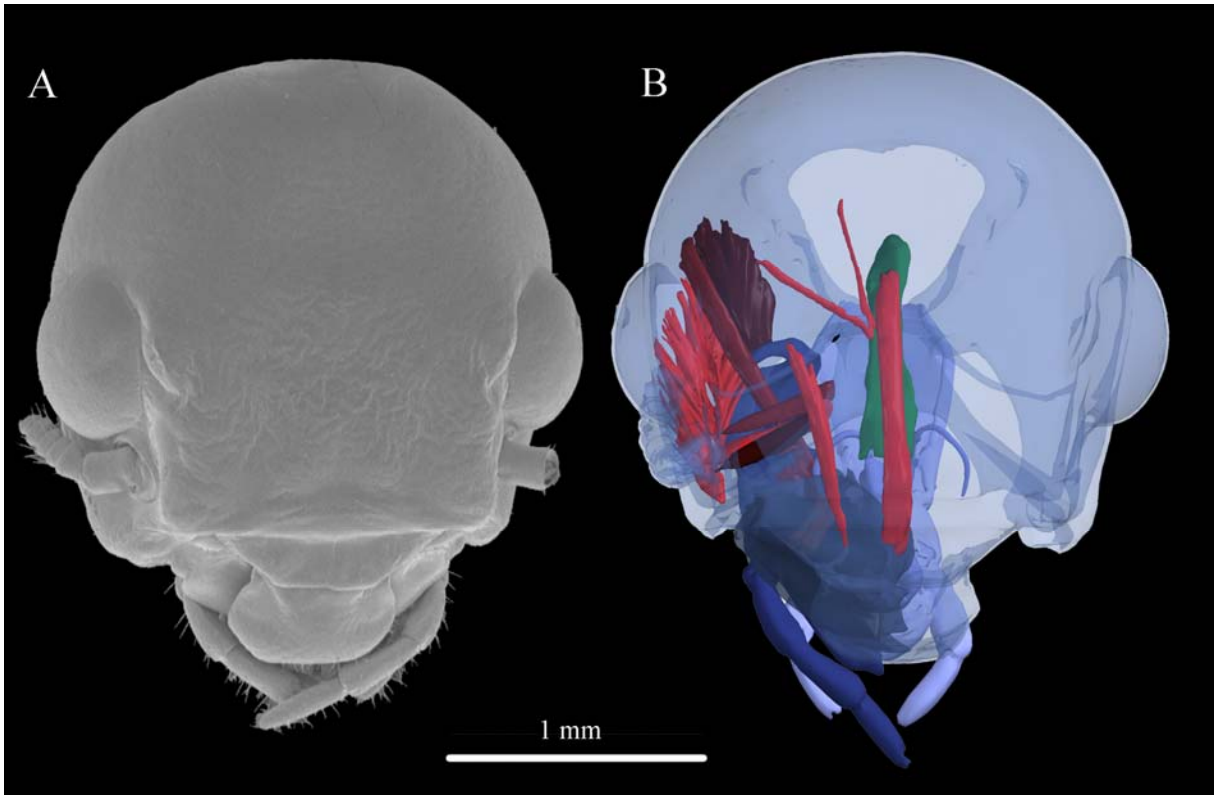

Figure 1: Head of the alate caste of the termite species *Mastotermes darwiniensis* seen from above. A: SEM image; B: Reconstruction based on image stacks acquired at DESY beamline BW2: Cuticle rendered transparent; red: musculature; green: gut; blue: mouthparts and skeletal elements.