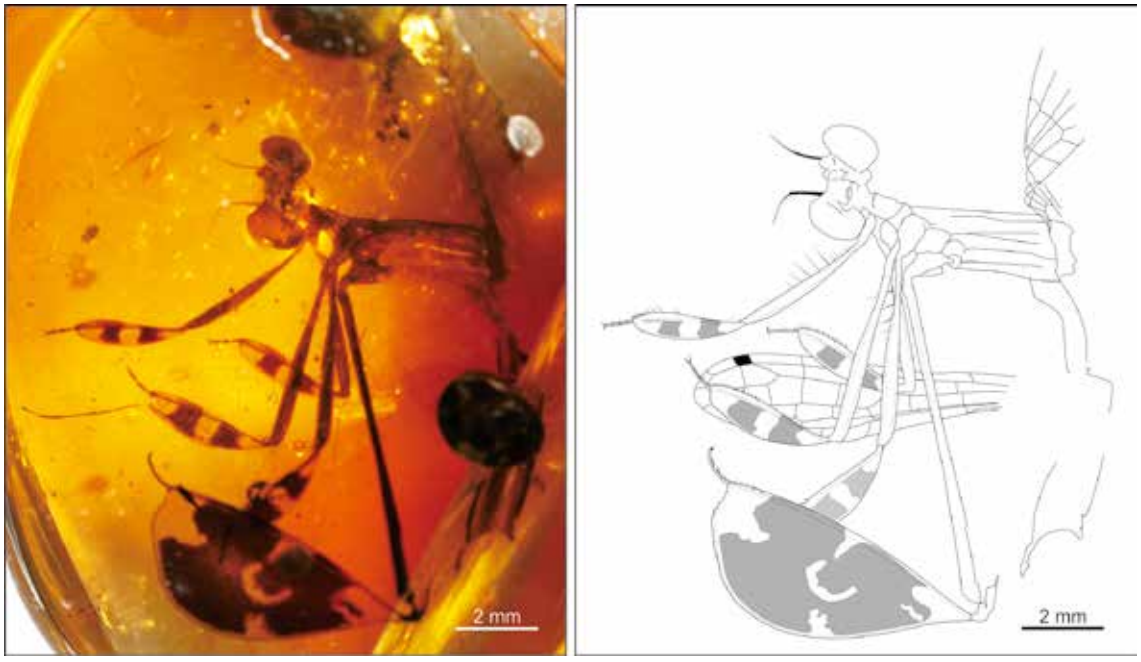
Courtship Behaviour Trapped in 100-Million-Year-Old Amber

Courtship behaviours, frequent among modern insects, have left extremely rare fossil traces. In odonates, the male must persuade the female to mate in tandem and the female should be willing to engage her genitalia with the male's. Many territorial odonatans display their courtship by high-frequency wing-beats towards an approaching female. Most courtship, mating and parenting (social-sexual) behaviour cannot be preserved and fossil reports are few and ambiguous. No courtship behaviour was previously recorded for fossil odonatans.

Recently, Dr. ZHENG Daran and Prof. WANG Bo from Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences described three male damselflies showing ancient courtship behaviour from mid-Cretaceous Burmese amber. These fossils were named *Yijenplatycnemis huangi* after Mr. Huang Yijen from Taiwan, for his generous donation of the type specimen.

Y. huangi has spectacular extremely expanded, pod-like tibiae, helping to fend off other suitors as well as attract mating females, increasing the chances of successful mating. The new findings provide suggestive evidence of damselfly courtship behaviour as far back as the dinosaur age.

Modern Platycnemidinae and Chlorocyphidae convergently acquired similar but less developed structures. During courtship, male *Platycypha caligata* waves the white anterior surface of all six laterally enlarged tibiae at the females, but uses the posterior surface of the tibiae for intra-sexual signaling during territorial defense.



Photograph and line drawing of specimen *Yijenplatycnemis huangi*. (Image by ZHENG Daran)

Similarly, male East Asian *Platycnemis* species with expanded, feather-like tibiae well differentiated from the females, exhibit a strong sexual dimorphism. The males display their white legs in a fluttering flight in front of females before mating. By morphological inference, the six extremely expanded tibiae of *Y. huangi* could also have a signaling function for courtship displays. *Platycypha* has all six tibiae expanded, but all less so than *Y. huangi* in size. *Platycnemis* has more expanded mid and hind tibiae, but is still smaller than *Y. huangi*. These more expanded fossil tibiae suggest an extreme adaptation for courtship behaviour.

More importantly, unlike *Platycypha* and *Platycnemis*, the tibiae of *Y. huangi* are asymmetric and pod-shaped, especially the hindleg tibia with a semi-circular outline. This pod-like shape would make waving slower due to air resistance. *Y. huangi* waving its giant pod-like tibiae would make males more easily noticed and attract female attention, increasing mating opportunities and implying sexual selection.

The tibial shape of *Y. huangi* also resembles the wings of some members of the extinct neuropteran families. The tibiae of *Y. huangi* are hyaline and partly covered with two narrow brown bands, making them even more like pigmented wings. In addition, there is an eye-shaped spot in the middle of the hindleg, quite like the wing spots in Kalligrammatidae and some recent butterfly eyespots. These well-developed eyespots were and are used to make a conspicuous and contrasting display to intimidate vertebrate predators or protect the body by deflecting an attack to the wings.

Deflective eyespots in butterflies and fossil lacewings are smaller than deimatic ones and both are never on the legs, but dragonflies are predators with good eyesight, and the tiny ones in *Y. huangi* may have less to do with paralleling fossil lacewings in deflecting nearby predators and more to do with raising the interest of females (*cf*. peacock eyespots). That none of the pigmented tibiae in *Y. huangi* are damaged, however, suggests they did not precipitate an aggressive response.

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Reference:

Daran Zheng, André Nel, Edmund A. Jarzembowski, Su-Chin Chang, Haichun Zhang, Fangyuan Xia, Haoying Liu, Bo Wang, 2017. Extreme adaptations for probable visual courtship behaviour in a Cretaceous dancing damselfly, *Scientific Reports*, 7:44932; doi: 10.1038/srep44932.

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Reconstruction showing the courtship behavior (Image by YANG Dinghua)