SILENT STORIES

-- Biotic Interactions of Insects with Plants and Other Associates in Two Mid Mesozoic Ecosystems of Northeastern China

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Two Formations in the Mesozoic of NE China

Jiulongshan Fm. Middle Jurassic, Yanliao Biota

Yixian Fm. Lower Cretaceous, Jehol Biota
Insect Fossil Treasures – CNU Collection
more than 250,000 insect fossils
Insect Associations with Plants

Pollination or “flower” visits

Photos by Jason Shih and CK Shih
Siphonate Mecopterans


Lichnomesopsyche gloriae
Ren, Labandeira et Shih, 2010.
Siphonate mouthparts, from 9-14 mm, associated with the ovular tube of gymnosperms
Fed on gymnosperm pollination drops
Engaged in pollination mutualisms with gymnosperms during the Mid-Jurassic
(Ren et al. 2009, Science)
Siphonate Mecopterans - Pseudopolycentropidae

*Pseudopolycentropus janeannae*
Ren, Shih et Labandeira, 2010
Siphonate Mecopterans - Aneuretopsychidae

*Jeholopsyche liaoningensis* Ren, Shih et Labandeira, 2011.
Lepidoptera – Beauty and Grace

(A) (B) *Spiniferlepidopterix elachiptera* Zhang, Shih Labandeira et Ren 2013, (C) a cluster of bristles on hind wing. (D) spines on hind wing.

Zhang et al. 2013. PLoS ONE
Mouthparts most likely for pollen feeding

*Sinolepidopterix dualis* Zhang, Shih Labandeira et Ren 2013. PLoS ONE
Mimesis and Camouflage

Photos by Jason Shih or CK Shih
Bellinympha filicifolia Wang, Ren, Liu et Engel, 2010. PNAS

Pre angiosperm origin for leaf mimesis
Bellinympba dancei Wang, Ren, Shih et Engel 2010. PNAS

Artwork by Zhihua Ma
Venation of *Bellinympha filicifolia* imitated leaves of gymnosperms

(Wang et al. 2010. PNAS)
Jurassic Mimicry

between a hangingfly (Cimbrophlebiidae) & a ginkgo leaf from China

Juracimbrophlebia ginkgofolia  Wang, Labandeira, Shih and Ren, 2012. PNAS
Named as one of the top 10 new species in 2012 by International Institute for Species Exploration (IISE)

Artwork by Chen Wang
Orthoptera – The Sound of Chirping

*Aboilus cornutus*  
Li, Ren et Wang, 2007

*Bacharaboilus jurassicus*  
Li, Ren et Wang, 2007

*Parahagla sibirica*  
Sharov, 1968 (female)

Head of *Allaboilus gigantus*  
Ren et Meng, 2006
Homoptera - 17 Years Underground

*Palaeontinodes reshuitangensis*  
Wang et Zhang 2007

*Anthoscytina aphthosa* Ren, Yin et Dou, 1998

*Daohugoucossus shii*  
Wang, Ren et Shih, 2007
Blood-Sucking Insects – the earliest fleas

- Long serrated stylets for piercing tough and thick skin or hides of hosts
- Primitive ectoparasites: lived on and sucked the blood of relatively large hosts, eg. feathered dinosaurs, pterosaurs, and medium-sized mammals

_Pseudopulex jurassicus_ Gao, Shih et Ren 2012.
Blood-Sucking Insects: Basal Fleas

*Pseudopulex magnus* Gao, Shih et Ren 2012. Current Biology
Saurophthirus exquisitus (female) Gao, Shih, Rasnitsyn, et Ren 2013. Current Biology
Saurophthirus exquisitus (male) Gao, Shih, Rasnitsyn, et Ren 2013. Current Biology
A Transitional Flea with Fully Distended Abdomen

*P. tanlan* might have consumed 0.02 milliliter (ml) of blood, which is about 15 times of the intake volume by extant fleas.
The Earliest Record of Blood-feeding True Bugs from the Early Cretaceous of China

Torirostratus pilosus (male) Yao, Shih, et Engel, 2014. Current Biology
*Flexicorpus acutirostratus* (female) Yao, Cai, et Engel, 2014. Current Biology
Ecological reconstruction of blood-feeding torirostratid true bugs feeding on blood from a sleeping feathered dinosaur.

Artwork by Chen Wang
Insect Associations with Other Insects

Parasitoid Wasps

Insect Associations with Vertebrates

Photos by Jason Shih
Parasitoid Ephialtitidae

Proephialtitia acantha
Li, Shih, Rasnitsyn & Ren, 2015

Acephialtitia colossa Li, Shih, Rasnitsyn & Ren, 2015

Proephialtitia tenuata Li, Shih, Rasnitsyn & Ren, 2015
Parasitoid Pelecinids


Pelecinus polyturator (Drury) Schletterer, 1890

Shoushida regilla Liu, Shih et Ren, 2009
Pelecinids

*Megapelecinus nashi* Shih et al. 2010

Pelecinidae and two outgroups with their respective characteristic forewings in geological context
Predation

Photos by Jason Shih or CK Shih
Odonata - Terminators with Wings

Falsisophoaeschna generalis
Zhang, Ren et Pang, 2008

Sinoeuthemis daohugouensis
Li, Nel, Shih, Ren et Pang 2013

Sophoaeschna frigida
Zhang, Ren et Pang, 2008

Sopholibellula eleganta
Zhang, Ren et Zhou, 2006
Neuroptera – Grace with Lace, but.....

Mantispidae with raptorial forelegs

Archaeodrepanicus nuddsi Jepson, Heads, Makarkin et Ren 2013
Dipteromantispidae with raptorial forelegs

*Dipteromantispida brevisubcosta* Makarkin, Yang et Ren 2013

- Well-developed forewings with reduced venation
- Hind wings extremely modified as small halteres
Mecoptera

Hangingflies: Bittacidae and Cimbrophlebiidae

_Telobittacus bellus_ Yang, Shih et Ren 2013

_Formosibittacus macularis_ Li, Ren et Shih, 2008
Extreme Sexual Display

The earliest case of exaggerated male organ in a scorpionfly

Fortiholcorpa paradoxa Wang, Shih et Ren 2013. PLoS ONE

Artwork by Chen Wang
Reproduction

Forever Love: The Hitherto Earliest Record of Copulating Insects

*Anthoscytina perpetua* Li, Shih et Ren, 2013. PLoS ONE
Artwork by Chen Wang

Photo by Jason Shih

Reported by the New York Times on page A-12, 11/7/2013, and by numerous on-line media.
Summary

1. The Mesozoic Era was biotically richer and more complex than previous realized.

2. Insects in both Yanliao and Jehol Biota were diverse systematically, biologically and ecologically.

3. In the ecosystems, insects played important roles in maintaining food chains and circulation of substances and energy by close biotic interactions with plants, vertebrates and other insects.

4. Our research provide a rare glimpse of lost worlds of these interactions, some of which were now extinct or less diverse.
Papers


Books

Future Action Plans

- To continue building on our strengths & upgrading research capabilities
- To enhance cooperation with collaborators in China and internationally
- To apply high-tech instruments and better methodologies
- To publish high-quality papers and books on our research
- To arrange for exhibitions in CNU or in museums outside China
Thank you for your attention!

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