Investigating Plant–Insect Interactions from the Early Permian of Texas: Analysis of Insect Herbivory in the Sanzenbacher Flora

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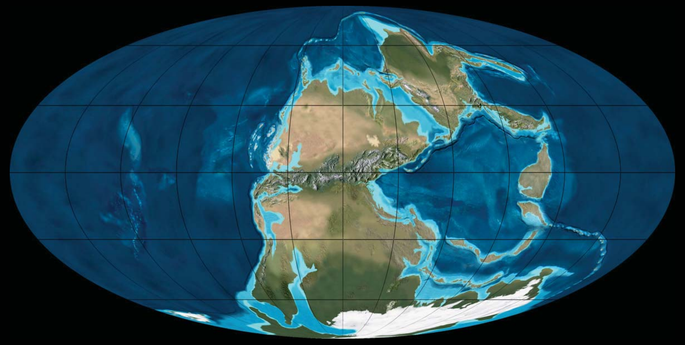
Introduction

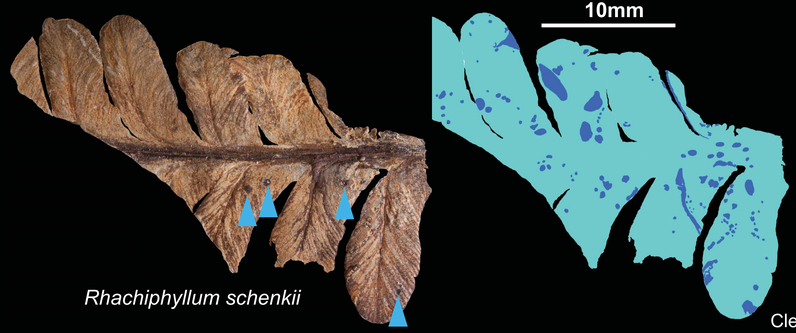
The cataloging of paleontological insect and plant diversity is necessary for understanding ancient ecosystems, for the construction of phylogenies, and for establishing evolutionary lineages to test ecological hypotheses involving inter-organismic antagonisms and mutualisms. We examined plant–insect interactions to understand how insect herbivore feeding niches were occupied during the late Paleozoic. We documented patterns of insect herbivory at the Sanzenbacher Locality in north-central Texas, which dates to the early Wolfcampian stage of the Permian. The Sanzenbacher deposit consists of ca. 300 specimens of vascular plants embedded in a mudstone matrix that is associated with a fluvial depositional environment. By (i) recording the frequency of insect-mediated damage, (ii) establishing the particular spectrum of damage types (DTs) present, and (iii) documenting the percent herbivorized foliage by area for each taxon, the DT frequency and richness for each host species and for the entire bulk flora were calculated. These modes of estimating fossil herbivory allow determination of the proportion of specialized vs. generalized herbivory and which host was the most consumed.



Earth during the early Permian

Methods

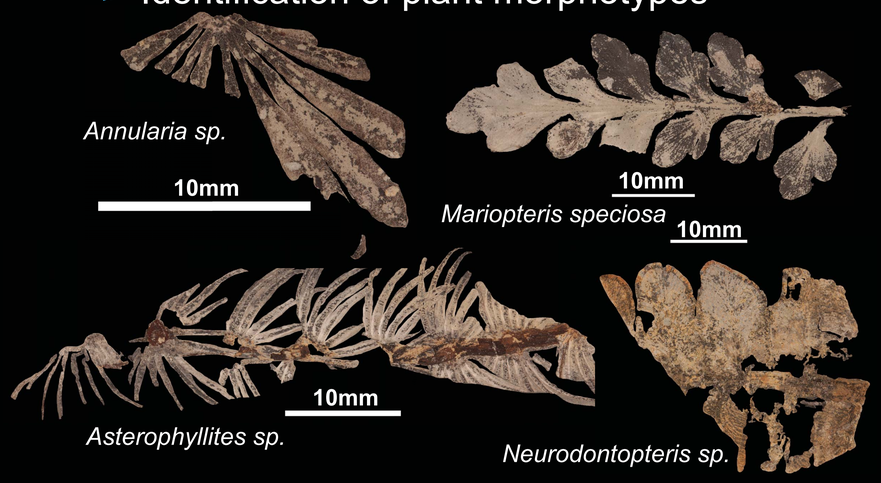
- Annotation of insect herbivory in Photoshop
- Calculation of percent of foliage herbivorized in ImageJ
- Calculation of morphotype-specific damage



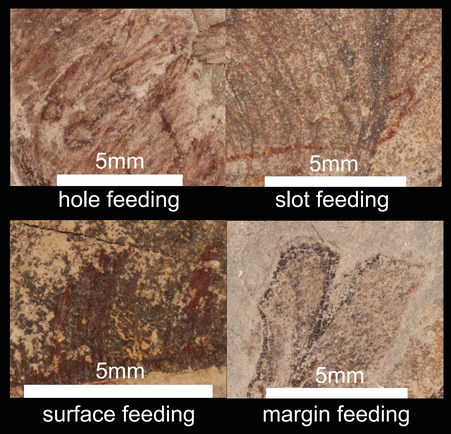
Rhachiphyllum schenkii

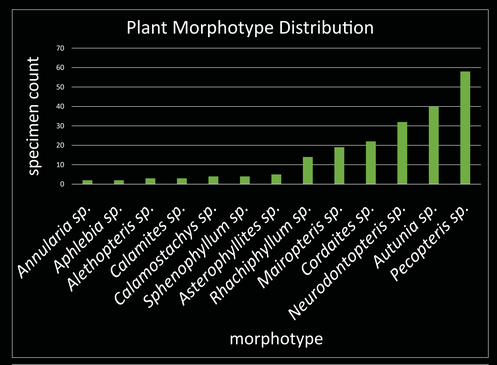
Results

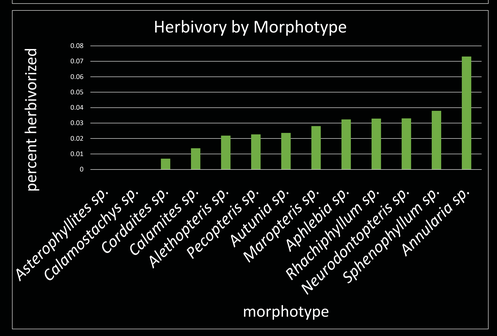
- Identification of plant morphotypes



Hole feeding represents most common damage type, followed by margin feeding, scale impressions or piercing and sucking damage, and surface feeding.



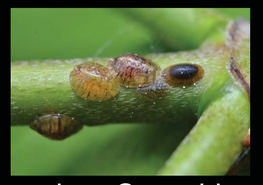




Conclusions

- Possible culprits include ancestors of grasshoppers, stick insects, and scale insects

modern Phasmatodea



modern Coccoidea

modern Orthoptera

- Sphenopsids and Medullosans most heavily herbivorized
- Over all 2.65% of flora herbivorized, relatively high, but less than a third of modern values

Future Directions

- Determine identity of amber-like substance
- Compare floral damage to that of similar collections

translucent globules (possibly resin or thick iron compounds) covering surface of *Autunia conferta*

References and Acknowledgements

Wittry, Jack. Mazon Creek fossil flora. Esconi, 2006.

Cleal, Christopher J., and Barry A. Thomas. Plant fossils of the British coal measures. Palaeontological Association, 1994.

Taylor, Edith L., Thomas N. Taylor, and Michael Krings. Paleobotany: the biology and evolution of fossil plants. Academic Press, 2009.

Labandeira, Conrad C., et al. "Guide to insect (and other) damage types on compressed plant fossils." Smithsonian Institution, National Museum of Natural History, Department of Paleobiology, Washington, DC (2007).

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