Novel Method for Estimating Carbon Assimilation Rates from Fossil Leaves

Melanie Cham (Wesleyan University, Middletown), Sophia Ronan (University of North Carolina, Greensboro), Alexander Lowe (University of Washington, Seattle), Dana Royer (Wesleyan University, Middletown), William Rember (University of Utah, Salt Lake City), Caroline Stromberg (University of Washington, Seattle; Burke Museum, Seattle)

The diversity and prevalence of ecological strategies is important for characterizing plant community ecology. Most previous paleoecological studies rely on a nearest living relative (NLR) approach to infer components of ecological strategy (e.g., plant functional types) from fossil plant assemblages. Here we present a novel method for reconstructing carbon assimilation rates (A) using gas-exchange modeling that requires both measured (stomatal size and density, leaf δ13C) and inferred (e.g., atmospheric CO2 concentration) inputs. Application to nine extant taxa produces estimates of A that are similar to measured values on the same leaves. We also applied the method to ten fossil taxa representing the most abundant angiosperms at the exquisitely preserved leaf fossil locality in Clarkia locality in northern Idaho (~15.9 Ma). Median reconstructed A estimates for the species range from 9.7 - 23.2 μmol m-2 s-1. However, we find that our estimates compare poorly to reconstructions based on two other methods: light-saturated mass-based photosynthetic rates in NLRs and fossil vein density measured on the same leaves. Sensitivity tests show that our model show is most reliable when CO2 is well constrained. Our method shows promise, but further testing on both living and fossil leaves is needed.

Insect damage reveals leaf bud folding patterns in a fossil leaf from the Eocene Geiseltal fossil site

Rebecca N. DeKoster (University of Wisconsin-Milwaukee) and Victoria E. McCoy (University of Wisconsin-Milwaukee, University of Leicester)

Certain plant families including Carpinus (hornbeam), Fagus (beech), and Alnus (alder) employ corrugated folding of immature leaves into buds before developing into mature leaves. Bud folding in leaves is impacted by taxonomy and ecology, and fossil evidence provides insight into its evolution. Direct evidence of leaf-bud folding patterns is rare in the fossil record. Here we describe a leaf compression from the middle Eocene (~50-41.2 Ma) Geiseltal lignite deposits in Germany which exhibits symmetrical patterns of damage consisting of lines of multiple holes across the leaf. The leaf is not yet identified, although taxonomic identification through cuticle analysis is ongoing. Origami models based on the fossil leaf, made using the digital origami editor ORIPA and digitally folded using an online origami simulator ((https://origamisimulator.org/), indicate that these patterns of damage are consistent with an insect feeding on a leaf bud that was folded in a semi-corrugated pattern resembling a variation of the collapsible Miura-Ori fold when the leaf was damaged, creating the observed pattern of damage after the leaf expanded at deployment. The patterns observed in these fossil leaves may confirm ecologies and life histories that may not be otherwise directly recorded in the rock record.

Occurrence of *Umaltolepis* seed-bearing structures and associated *Pseudotorellia* leaves from the Middle Jurassic to Early Cretaceous of North China

Chong Dong and Gongle Shi. Nanjing Institute of Geology and Palaeontology, Chinese Academy of Science

Umaltolepis is an extinct genus of seed-bearing structure which is considered to be produced by the same plants of *Pseudotorellia* leaves based on their close association in the same fossil bearing horizon and similarities in their cuticles, especially in stomatal structures. Recently, well-preserved *Umaltolepis* seed-bearing structures and associated *Pseudotorellia* leaves have been found from the Middle Jurassic Yima Flora in Henan Province, central China, and the Middle-Late Jurassic Daohugou Biota and the Early Cretaceous Huolinhe Flora in eastern Inner Mongolia, northeastern China. These further confirm a close affiliation of *Umaltolepis* and *Pseudotorellia*. *Umaltolepis* from the Daohugou Biota is studied based on a small number of whole seed-bearing