A tree of leaves
Molecular phylogeny and biogeography of leaf insects

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1. The true leaf insects (Phyllinae) are dorso-ventrally flattened, feature lobe-like expansions at body and legs and therefore uniquely masquerade leaves. Their phylogenetic position among Phasmatoidea has been recovered to be subordinate among the otherwise twig or bark resembling stick insect lineages\textsuperscript{1}. In the past, leaf insects were considered as species poor, yet with a wide Oriental distribution stretching from the Seychelles (Indian Ocean) to Fiji (South Pacific)\textsuperscript{2}. Despite the relatively small number of morphological diagnostic characters, 80+ species are currently recognised which mostly pertain to the same genus (Phyllium). Here we present the first phylogeny inferred from a comprehensive taxon sample of leaf insect corrobating molecular and geographical data.

2. 59 Phylliidae specimens
45 phasmatoidean outgroup species

- Set of five nuclear and mitochondrial genes (28S, H3, 16S, COI, COII)
- Tree reconstruction (IQ-TREE\textsuperscript{3}+ UBoot\textsuperscript{4})
- Dating analysis (treePL\textsuperscript{5})
- Historical biogeography (BioGeoBEARS\textsuperscript{6})

3. Our molecular phylogenetic analysis reveals the presence of cryptic species, often in combination with a species’ occupation of different geographical areas. Phyllium is found to be paraphyletic. Pronounced sexual dimorphism (Nanophyllium) led at least in one case to the different sexes being described as two separate species. Nanophyllium females (Phyllium frondosum) askierense) were recovered as sister taxon to the remaining Phyllinae.

The origin of Phyllinae was reconstructed as Australia/Papua New Guinea/Southwest Pacific, an area still being connected at that time (\textasciitilde 50 mya). We observe one single dispersal event to the Philippines, and one to continental Asia, probably via Borneo. Low sea levels connecting the different landmasses allowed early leaf insects to spread throughout Southeast Asia.

The fossil species Eophyllium\textsuperscript{\textsuperscript{7}} from Germany and the European stick insects (Bacillinae) as sister taxon to the extant Phyllinae\textsuperscript{8} indicate an ancestral range as far as Europe.

4. Our results highlight the need for a thorough revision of this Phasmatoidea subgroup.

References
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