

A parasitoid puzzle: phylogenetic relationships of Labeninae wasps (Ichneumonidae)

Introduction

Ichneumonidae is a large family of parasitoid wasps in the order Hymenoptera (ants, bees, and wasps). These wasps are incredibly diverse in their ecological roles, morphology, and biogeographical distribution. The Labeninae, a subfamily nested within ichneumon wasps, provides an excellent study system to explore and better understand evolutionary trends. Species of Labeninae are found almost exclusively in South America and Australia, with a few species in North America.



Fig. 1: The labenine wasp *Labena grallator*

It has been hypothesized that labenines are an “ancient” lineage that originated before the split of Gondwana during the Mesozoic Era. We used molecular data, ultraconserved genomic elements (UCEs), to construct a phylogenetic tree in an effort to better understand relationships within the subfamily in the context of previous biogeographic hypotheses.

Materials and Methods

- DNA extraction: 39 museum specimens from 7 genera (*Apechoneura*, *Certonotus*, *Grotea*, *Labena*, *Labium*, *Ozlabium*, *Poecilocryptus*)
- DNA sheared to ~ 300-600 base pairs using sonication
- Library prep: tagged individual specimens for pooled sequencing
- Hybridized DNA fragments with probes designed by Branstetter et al. (2017) for targeting Hymenoptera UCEs
- Sequencing using Illumina MiSeq (PE 300 bp)
- Used Phyluce pipeline to process the sequences: demultiplexing, assembly, alignment, & concatenation of loci into a matrix
- Integrated data for 13 Labeninae & outgroups from Santos *in prep.*
- Used maximum likelihood (RAxML) to infer the optimal tree and conduct bootstrap analysis
- Divergence dating analyses performed using the *chronus* function in R based on fossil evidence

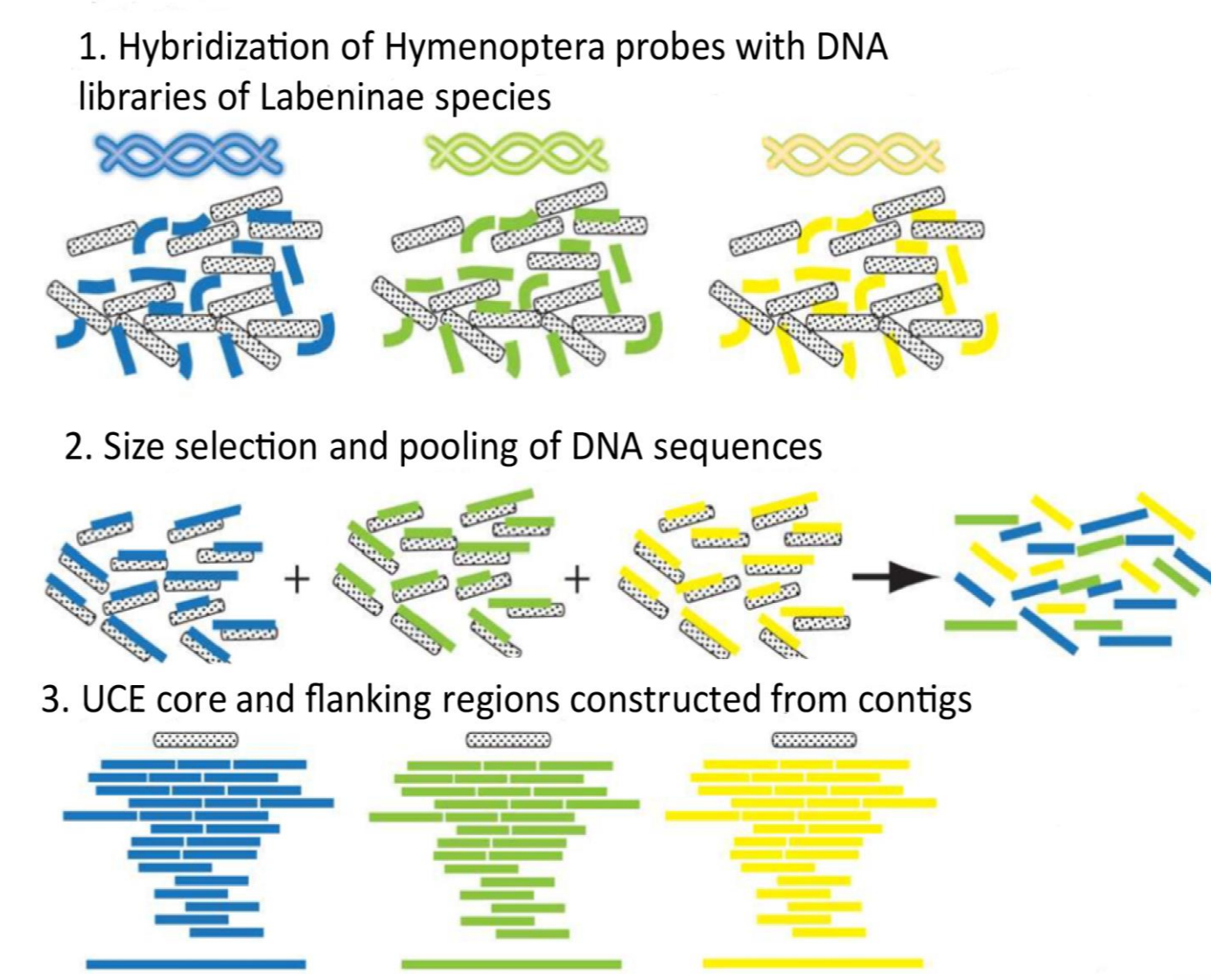


Fig.2: The steps for preparing UCE data (Faircloth et al 2015)

Results

We generated a data matrix consisting of 196,925 aligned base pairs from 1,140 UCE loci. Phylogenetic analyses from the UCE data show the monophyly of Labeninae. From our dating analysis, the origin of Labeninae occurred ~ 115 million years ago. Each genus exhibits monophyly except for *Ozlabium* which is nested within *Labium*. Species within each genera occur in similar geographical locations (i.e. Neotropics or Australia) with the exception of *Labena* whose clades contain species from both regions.

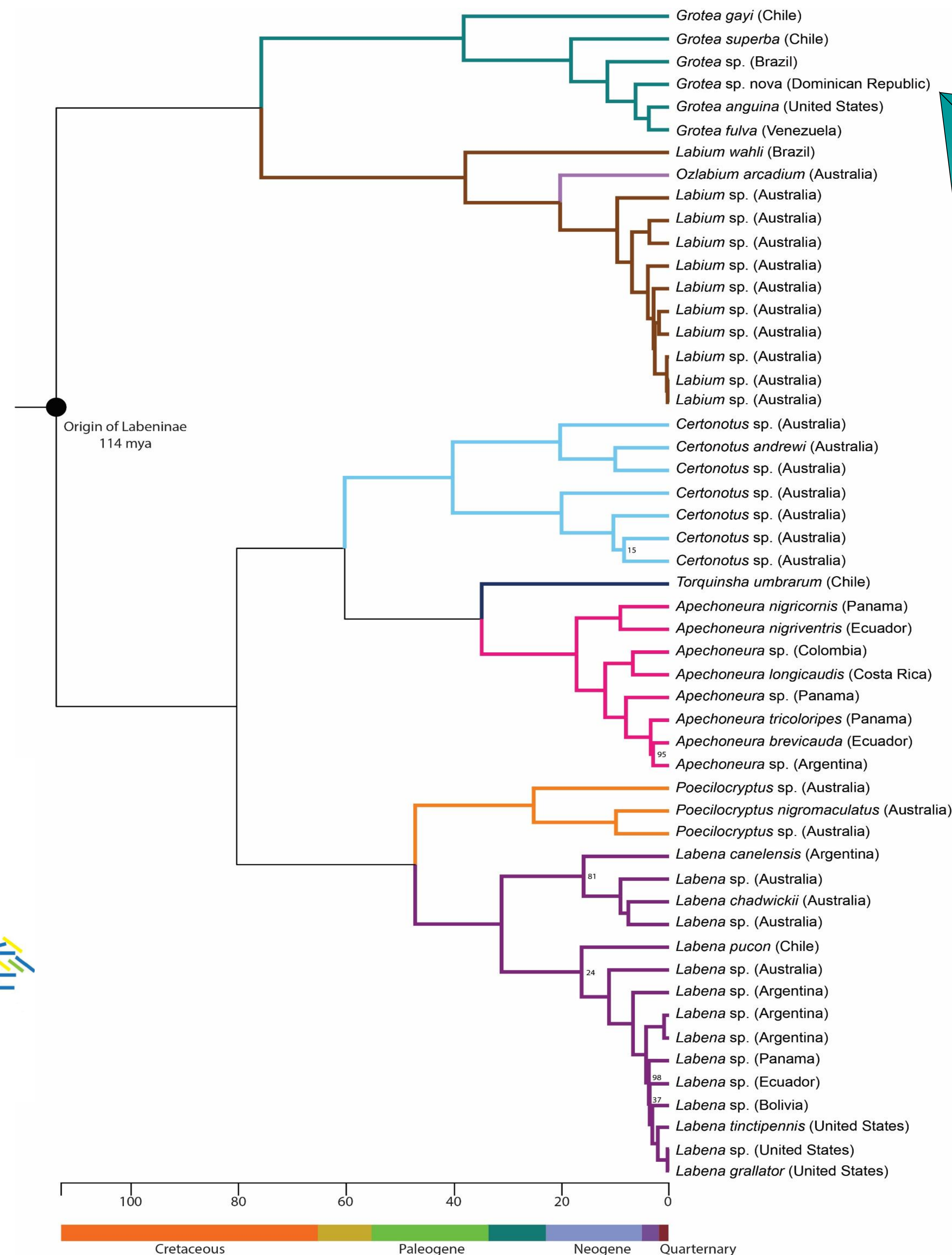


Fig.3: Maximum likelihood tree of Labeninae from UCE data. Colored branches correspond to the genera. The collection locality follows each taxon name at the tips of the tree. Outgroups are not shown for spatial convenience, and nodes that are not supported by 100% bootstrap values are listed.

Discussion

Our results show that divergence among the Labeninae genera had occurred by the early Eocene. This agrees with the hypothesis that during this time, South America and Australia were beginning to separate. Such history could help explain the clades in which Australian genera are sister to Neotropical ones. Our findings suggest that Australian species of *Labium* are more closely related to *Ozlabium* than to the Neotropical *Labium*. In the case of *Labena*, whose clades contain species from both regions, two separate dispersal events could help explain its history. The presence of *Labena* in North America, since it is most speciose in South America, could be an indicator of the group’s dispersal abilities.

Description of a New Species

While observing specimens for the phylogenetic analysis, we came across two specimens of the genus *Grotea* from the Dominican Republic, the first record of the genus for the Greater Antilles. Upon closer morphological examination, we confirmed that the species had yet to be described as its features did not fit those of previously known taxa. Unique characteristics seen in the *Grotea sp. nova*, include the following: uniform amber color of the mesosoma, antenna with 40 flagellomeres, triangular area basalis, posterior white triangles on tergites, and undifferentiated area superomedia of the propodeum.



Fig. 4 Top: First segment of metasoma



Fig. 5 Bottom: Lateral view of whole body of *Grotea sp. nova*

Acknowledgements

We would like to thank the National Science Foundation (OCE-1560088) for funding the NHRE program and to the following institutions whose specimens were included in this study: AMNH, ANIC, and USUC. Special thanks to Virginia Power and Gene Hunt for coordinating the program and providing constant support. Additionally, we appreciate the help from Matthew Buffington for his assistance with imaging the specimens.

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