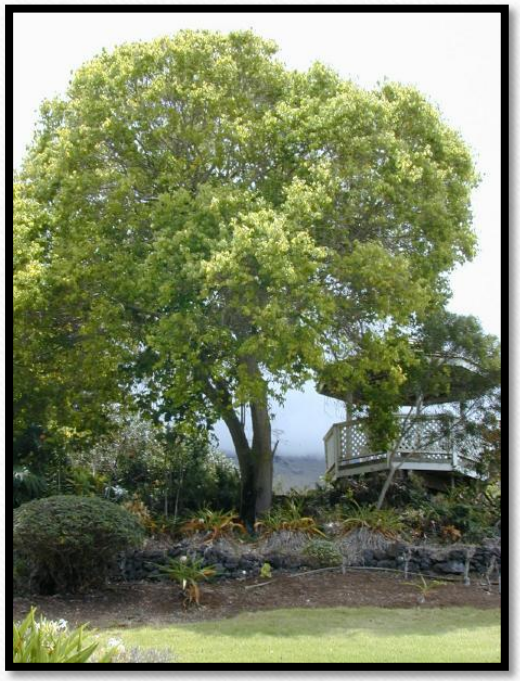
Origins and Evolution of Cinnamon and Camphor

A phylogenetic and historical biogeographical analysis of the Cinnamomum group

Introduction

- *Cinnamomum* is a genus of evergreen aromatic trees and shrubs belonging to the laurel family (Lauraceae).
- It is a primarily tropical and sub tropical Asian lineage with some species distributed in Neotropics, Australasia and Africa.



The Hypotheses

- There was a continuous boreotropical paleoflora during the climatically warm periods of the Paleogene in the Northern Hemisphere.
  - The Bering and North Atlantic land bridges have been used to explain the migration of subtropical and tropical lineage.
  - Various transoceanic land bridges to account for the amphi-Pacific disjunctions of many plant genera
- Long-distance dispersal may also play a role in disjunct tropical genera with fruits that can float and remain viable for a longer time in salt water.

Main Objectives of the Study

- Reconstruct phylogenetic relationships within the *Cinnamomum* group and elucidate if the group ismonophyletic
- Explore the biogeographic history of the *Cinnamomum* group and elucidate the origin and nature of its amphi-Pacific and other disjunctions.

The Process

- DNA extraction, PCR and sequencing
- Sequence alignment and phylogenetic analysis
- Molecular dating and estimation of divergence times
- Ancestral area reconstructions

Results

- Phylogenetic analyses
  - Clade 1 = almost all the sampled Asian sect. *Camphora* samples
  - Clade 2 = Three sect. *Camphora* samples, all the Asian sect. *Cinnamomum* species, six Australian samples and African *O. ikonyokpe*
  - Clade 3 = the American *Cinnamomum* species, *M. cinnamomoidea* and the three *Aiouea* samples.

Results cont.

- Divergence time estimates
  - *Cinnamomum* group split from core Laureae at ca. 55.97 Ma and began to diversify at ca. 46.51 Ma
  - Split between Clade 2 and Clade 3 was ca. 48.37 Ma
- Ancestral area reconstructions
  - Results shows Asia and South America as the most likely ancestral areas followed by Asia and North America.

Conclusions

- Phylogenetic analysis recovered supported monophyletic *Cinnamomum* group containing three subclades.
- As currently defined, neither the genus *Cinnamomum* nor sections *Camphora* and *Cinnamomum* were supported as monophyletic.
- Morphological characters were found not to be very reliable for this purpose.
- *O. ikonyopke* and *Mocinnodaphne* were switched to *Cinnamomum*.

Conclusions

- *Cinnamomum* arose in the early Eocene of Laurasia and moved from North to South during the cooling periods of later Eocene
- First cooling period resulted in the split between North American and Eurasian taxa and shaped the subtropical and tropical amphi-Pacific disjunction npatterns.
- The second cooling interval contributed to the breakup of boreotropical continuity within Eurasia, creating the Asian-African disjunction.
- Birds feeding on the fruits could have played into North to South dispersal.

Conclusions

- Cooling periods resulted in the extinction of diverse *Cinnamomum* group lineages from the high latitude forests of the Northern Hemisphere.
- Current distribution of the group in Asia and America represents a relic of Northern Hemisphere distribution.
- The formation and eventual breakup of extinct boreotropical paleoflora helped shape the biogeographic history of the *Cinnamomum* group.