

Relatedness defies biogeography: the tale of two island endemics

(Acacia heterophylla and A. koa)

Brief overview

- Author of correspondence: Johannes J. Le Roux (*et al*)
- biogeographic anomalies despite usual strong link between distance and relatedness

What are acacia trees?

- Large trees under the family Leguminosae (Fabaceae)
- Widespread
- Typically bisexual flowers, multiple stamens; calyx and corolla 4-5 lobed; glands on upper side of rachis and petiole
- Shown: *Acacia karroo* inflorescence



A little more specific

- Examples of interest: *A. heterophylla* of Réunion Island and *A. koa* of Hawaii
- Differ by petal connotation, size of seeds and seed pods, and structure of compound pinnae
- *A. melanoxylon* – Australian species, invasive
- Similarities suggest secondary colonization, not convergent evolution



Fig. 1 *Acacia koa* from the Hawaiian Islands (a, b) and *A. heterophylla* from Réunion Island (c, d), showing the strong morphological similarities between these two island endemics. Photographs courtesy of Johannes Le Roux.

So what's the problem?

- Issue of long-distance dispersal: goes against normal logic of proximity-to-relatedness



Protocol / Study Methods

- Sampling and DNA extraction
- DNA sequencing from both nucleus and chloroplast
- Construction of sequences using BioEdit, deposit of sequences to GenBank
- flow cytometry to determine relative genome sizes
- ecological niche overlap comparisons

Example: Acacia koa clone 196 microsatellite sequence 1...360

1 agagagagag agagagagag aaggaggggg gtttattgtc gattagatag caggttcact

61 tctgtatcat atgggtttgg tttcttcat catcattttc tcattatccc tcataatctc

121 taaaccacat ccatccaatt aacacagtac tacttttact tttcttcat tttctcaatc

181 agtgaccaag atgtagccaa tgagaaaaaa gataagaaga gtatctcctt ccgttacaag

241 ttaccagatc tcgtatttgc tgacacattt cacattttcc accactctca tttcagttta

301 tgctctttaa cctcctcaat ttctgtgtgc tagtcacttt cccaaacctc acgcctctgt

Results

- Network analysis, phylogeny and molecular dating: a haplotype between *A. heterophylla* samples were shared
- This haplotype was closely related to *A. koa* than to *A. melanoxyton*
- *A. koa* had more than one haplotype (9 found); *A. heterophylla*'s haplotype fell within this group
- *A. koa*'s haplotypes were more divergent than *A. melanoxyton*
- niche overlap: niches between *A. koa* and *A. heterophylla* were more similar than between *A. koa* and *A. melanoxyton*

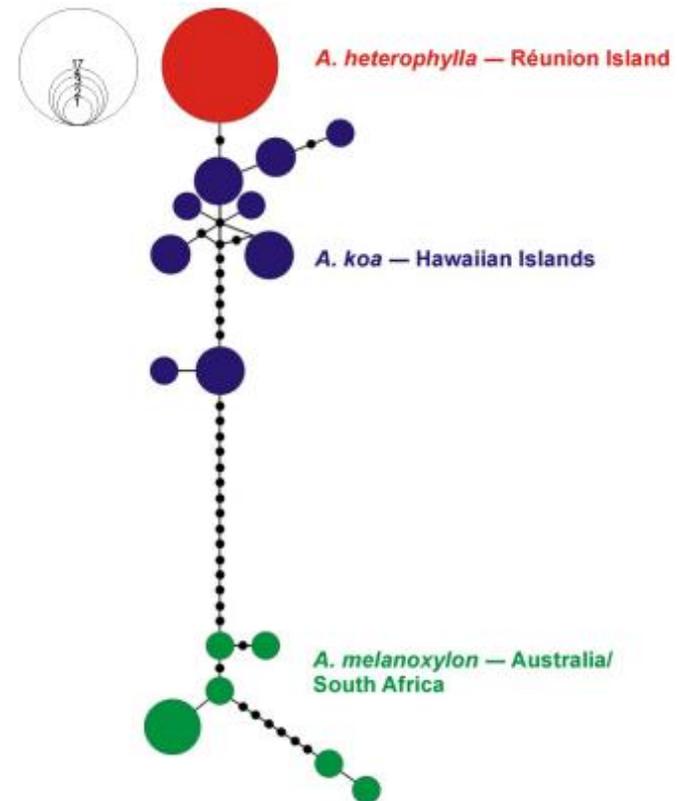


Fig. 2 Parsimony haplotype network based on the chloroplast *rpl32-trnL* and *trnL-F* intergenic spacer (IGS) regions. Each circle represents a single haplotype and each haplotype's frequency is related to the surface area of each circle (see inset for guide). Black dots represent mutation steps separating connected haplotypes.

Discussion

- *A. heterophylla* is a direct descendent of *A. koa*, very closely related and possibly considered the same species
- dispersal likely occurred about 1.4 MYA
- Human-aided dispersal is impossible, suggests natural historical dispersal instead, *A. koa* existed in Hawaii long before humans arrived
- Split between *A. koa* and *A. melanoxylo*n is even greater at about 6 MYA
- Suggests dispersal by petrels which exist in an overlapping range between *A. koa* and *A. heterophylla*
- Seeds of acacias may have survived in the gut during migrations



Citations

Roux, J. J., Strasberg, D., Rouget, M., Morden, C. W., Koordom, M., & Richardson, D. M. (2014). Relatedness defies biogeography: The tale of two island endemics (*Acacia heterophylla* and *A. koa*). *New Phytologist New Phytol*, 204(1), 230-242.

<http://www.gardeningknowhow.com/wp-content/uploads/2014/07/sweet-thorn.jpg>

http://www.birdlife.org/sites/default/files/styles/1600/public/blackpetrel_hg_karenbaird_3.jpg?itok=9sRYF7Nw