



Applications: An Overview

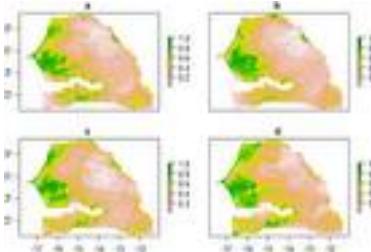


Doug Soltis
University of Florida



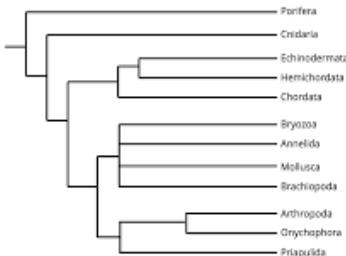
Connecting Specimens, Trees, Niche Models, Tools: Examples

RESOURCES:



Niche Models

- ecological niche modeling
- biodiversity and range analysis
- visualization



Trees

- phylogenies
- taxonomy / names
- visualization



Analytical Tools

- evolutionary models
- comparative methods
- visualization



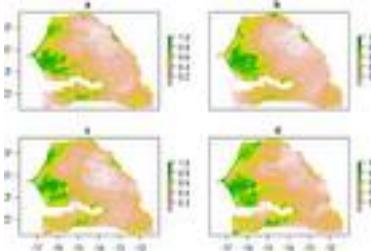
iDigBio

- trait data
- specimen data / images
- fossil data / images



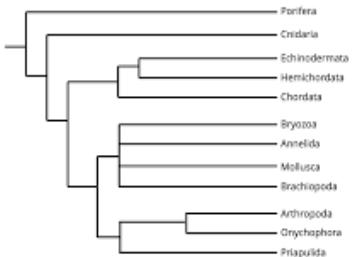
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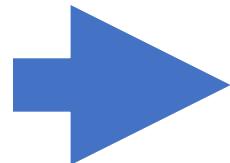
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Label Data (Occurrences)

- Scientific name
- Date
- Collector
- Location – state, county, specific site, GPS coordinates
- Associated species



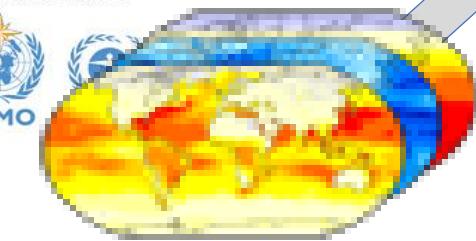
Niche Models



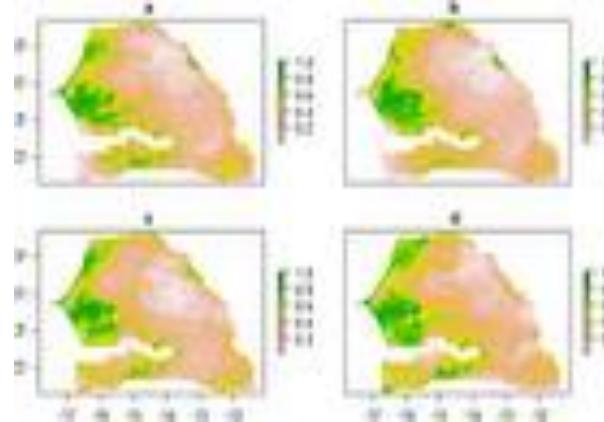
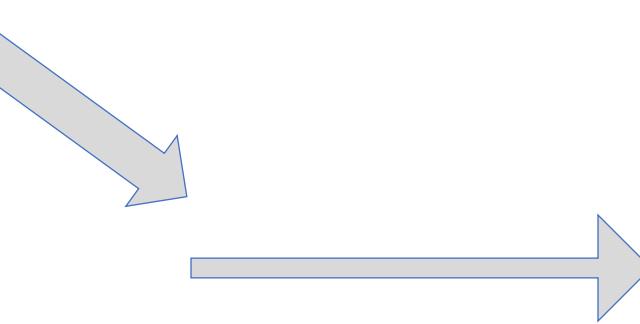
Species Occurrence Data

IPCC

INTERGOVERNMENTAL
PANEL ON
CLIMATE CHANGE

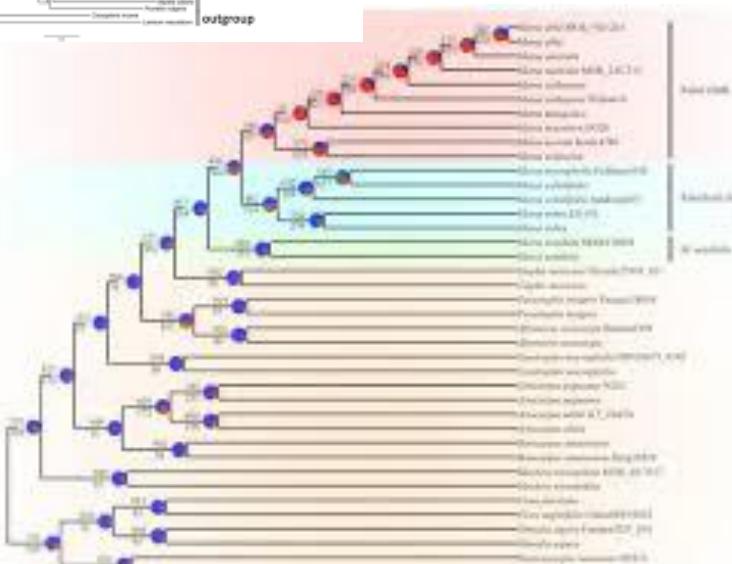
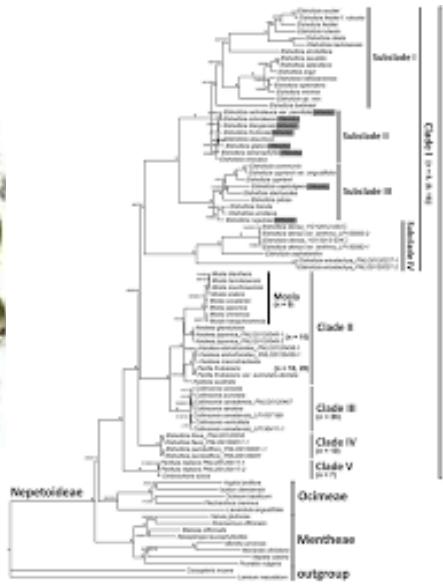
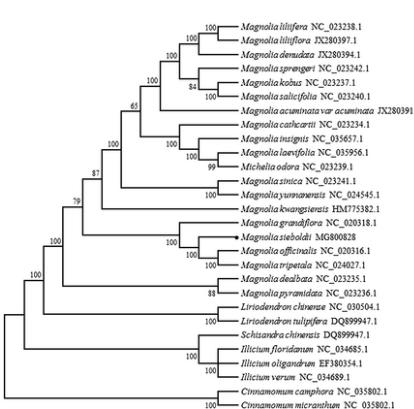
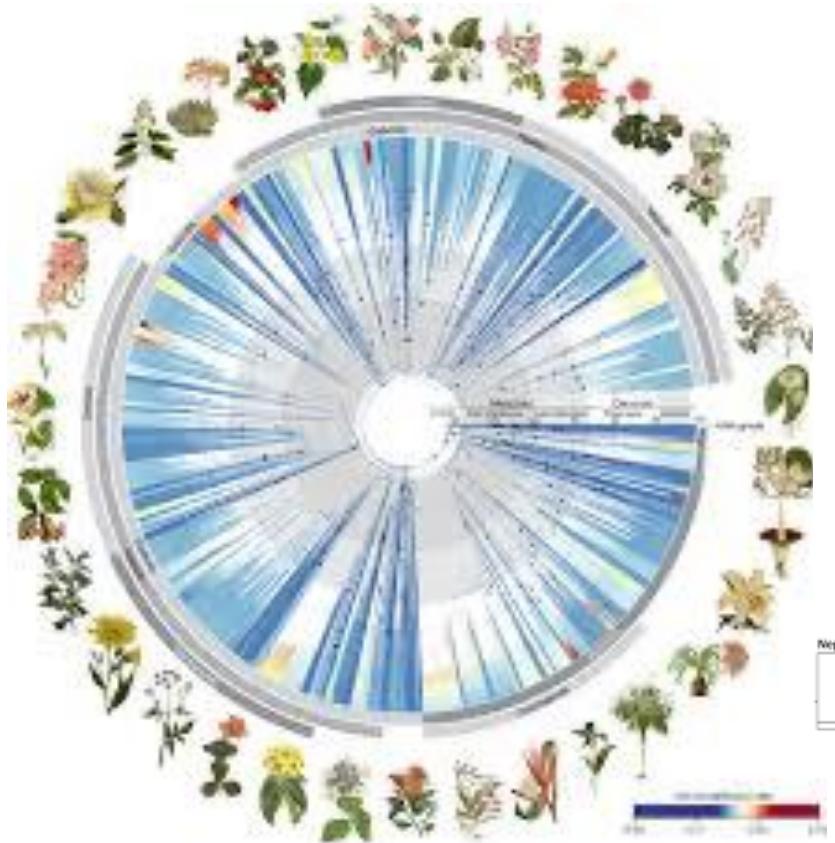


Environmental Data



Predicted Habitat

Trees



Ancestral Niche

Connecting Trees, Specimens, Tools

RESOURCES:



- Niche Models
- ecological niche modeling
 - biodiversity and range analysis
 - visualization



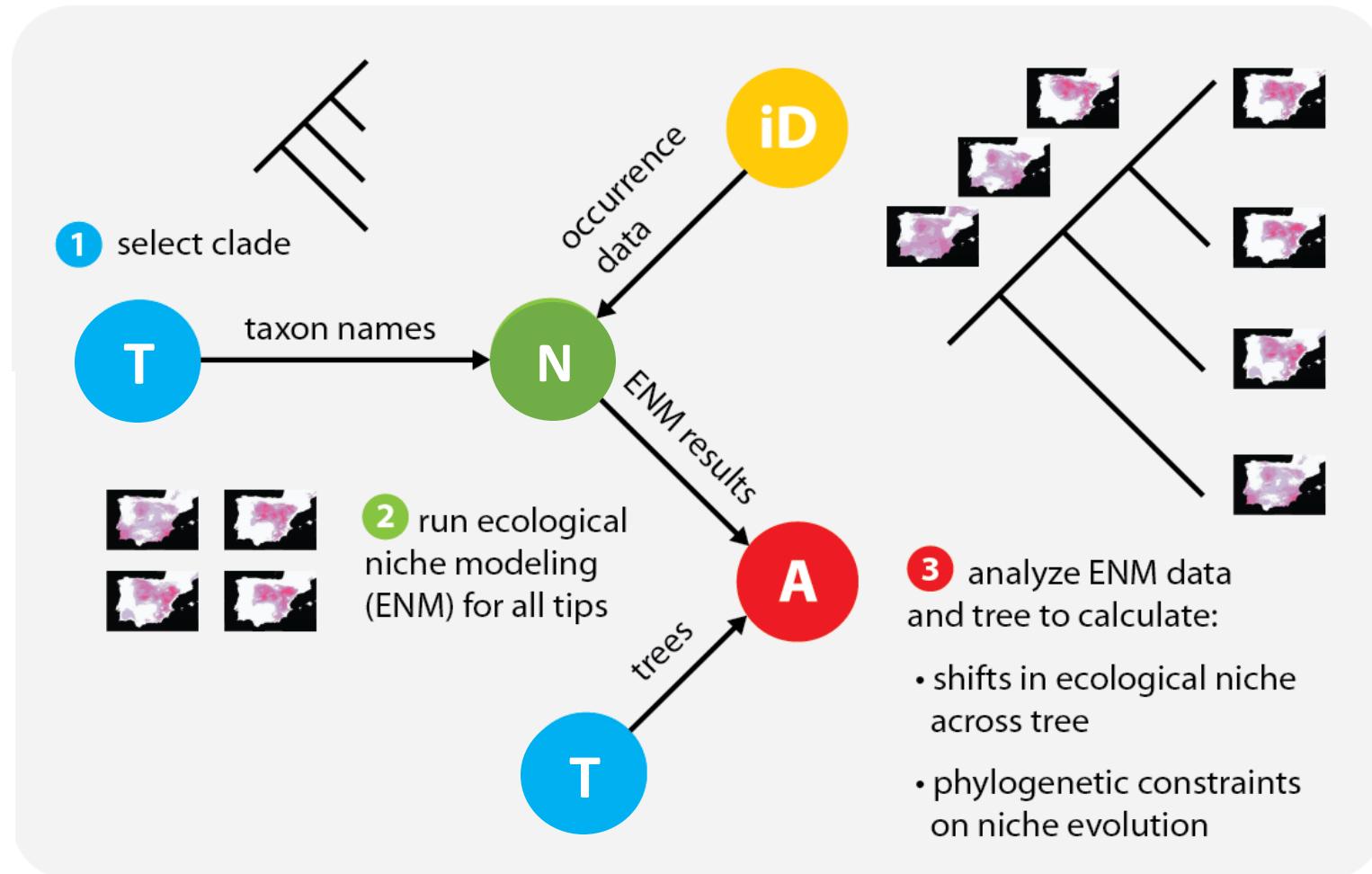
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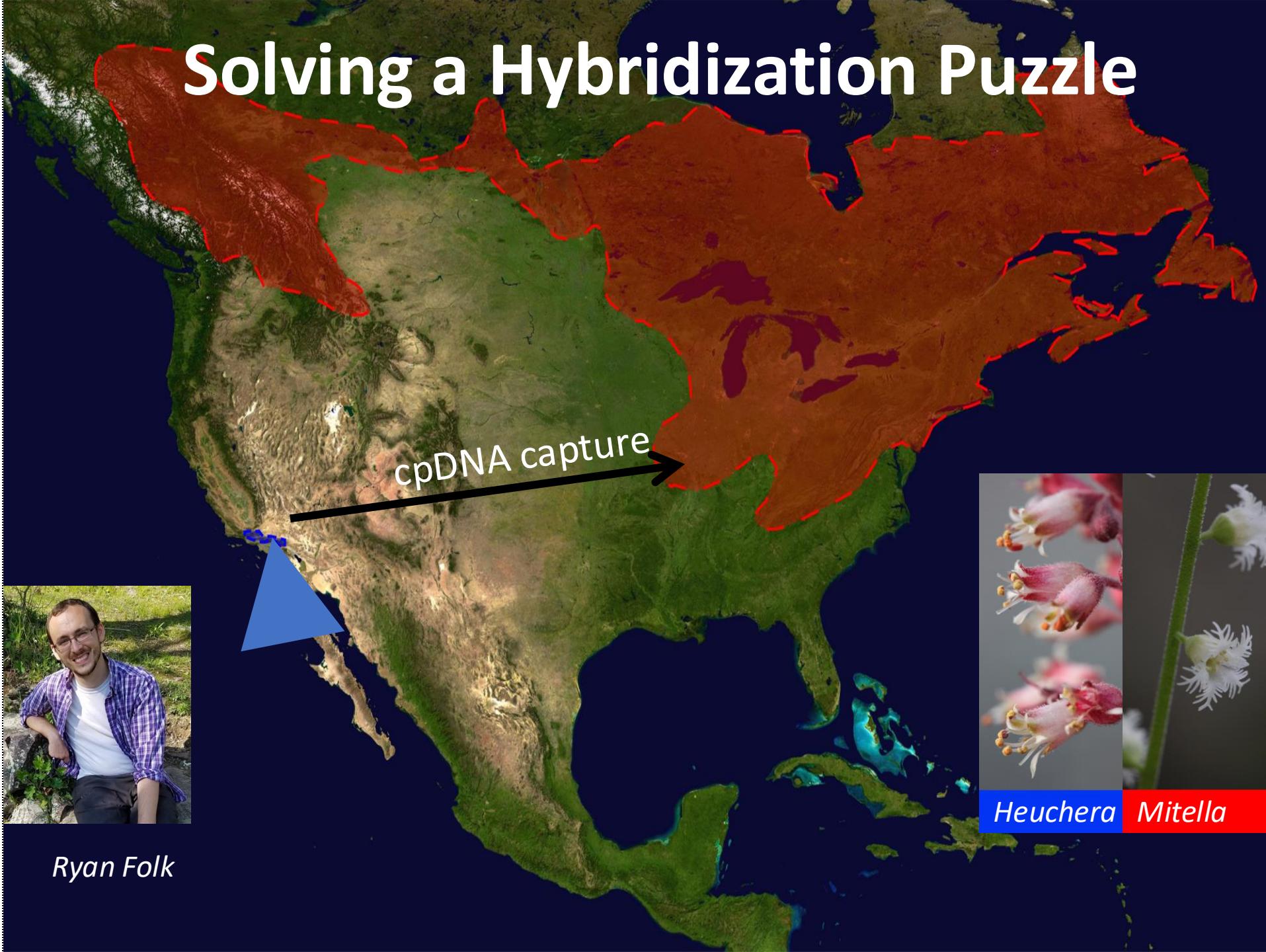
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Solving a Hybridization Puzzle

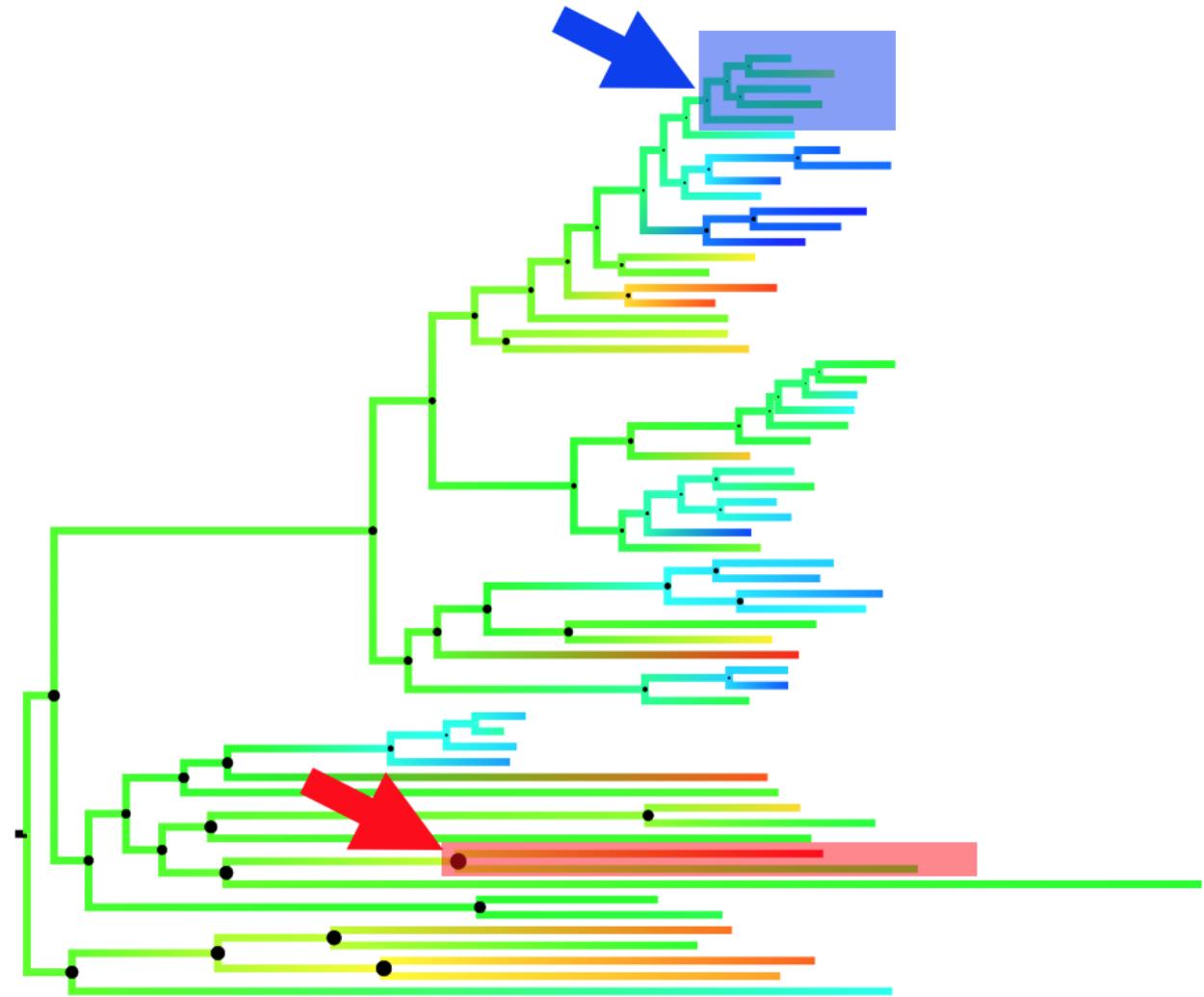


Hybridization & Ancestral Ecological Niche Space



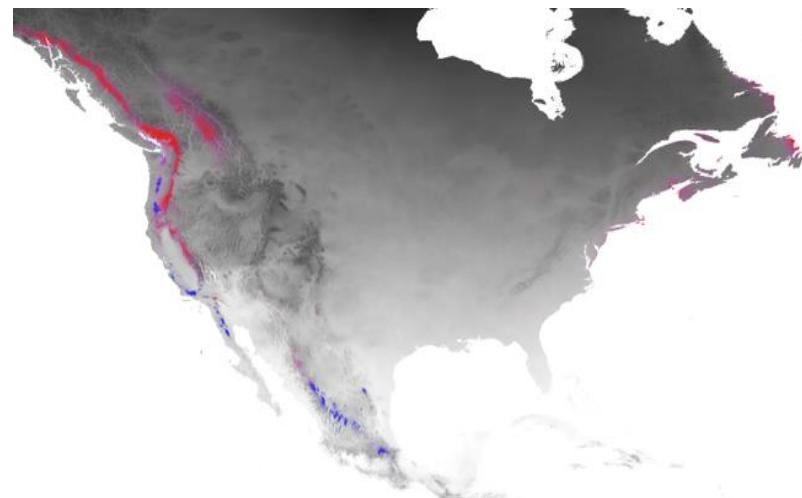
Heuchera

Mitella

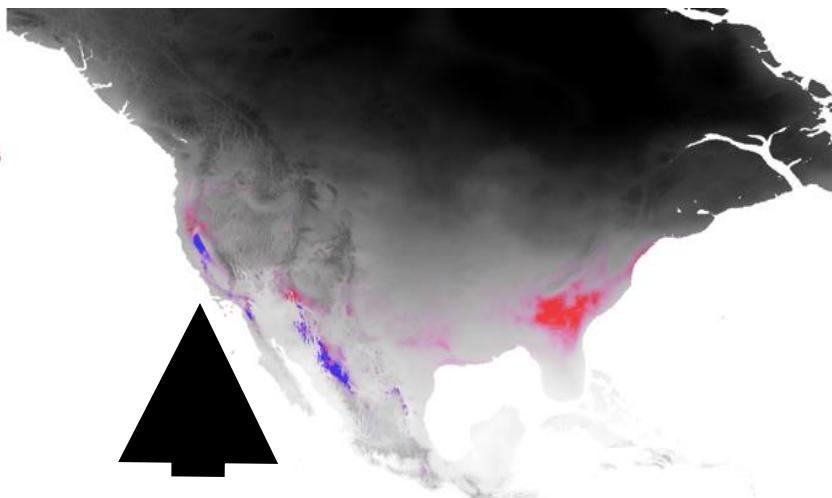


Ancestral Niche Reconstruction

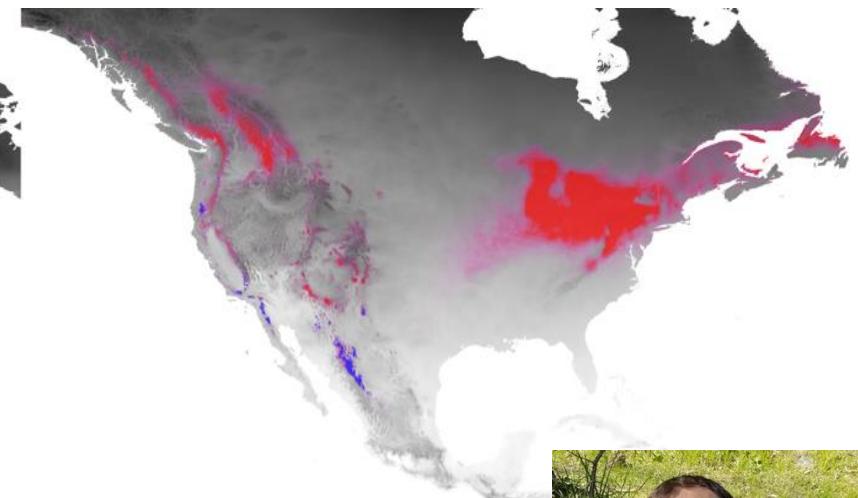
120-140 kya



22 kya



6 kya



Heuchera Mitella

Heuchera



Ryan Folk

Folk et al. 2023. Identifying climatic drivers of hybridization with a new ancestral niche reconstruction method. *Syst Biol.* 72: 856-873.

Spatial Phylogenetics

RESOURCES:



Niche Models

- ecological niche modeling
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- visualization



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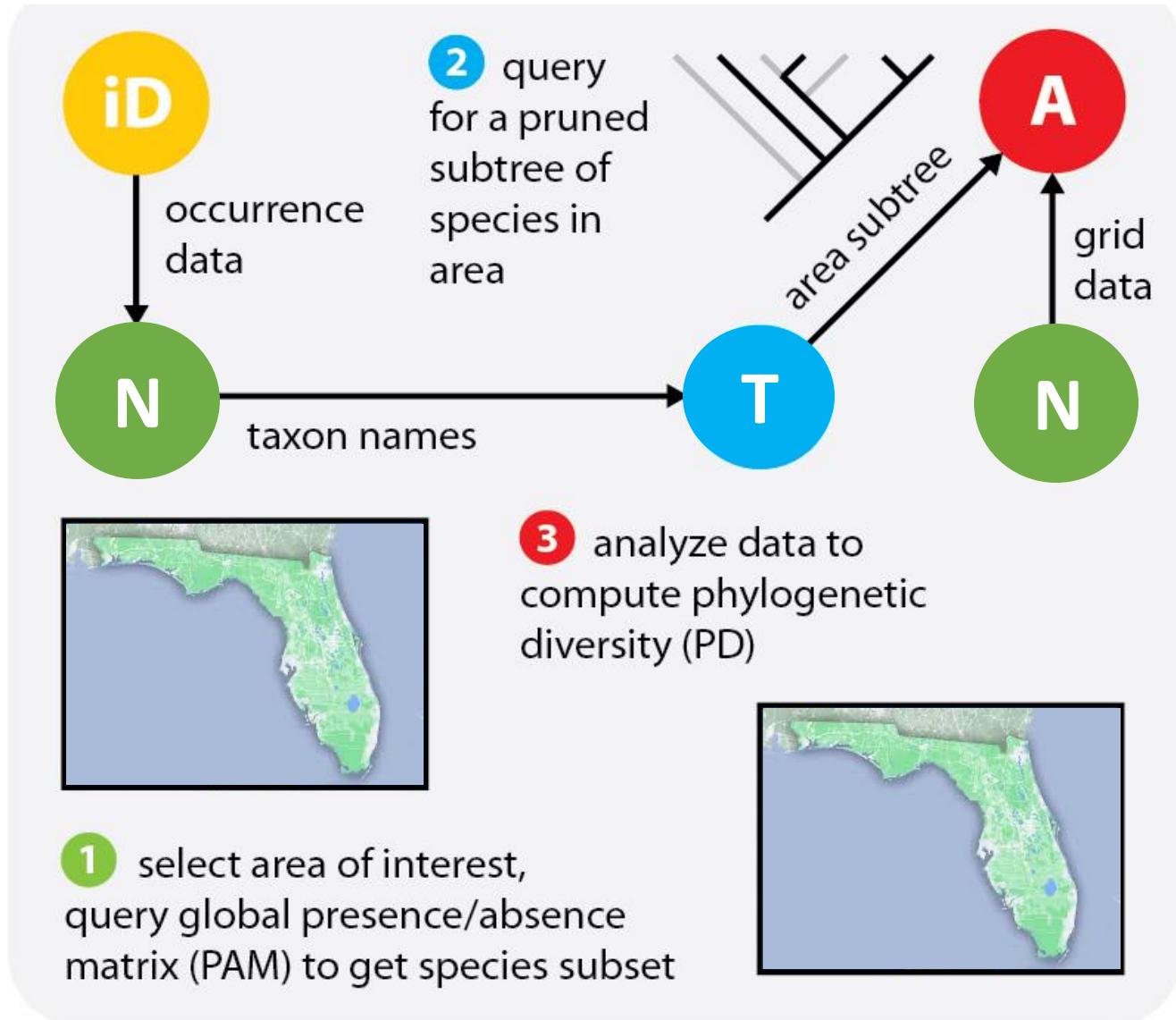
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iDigBio

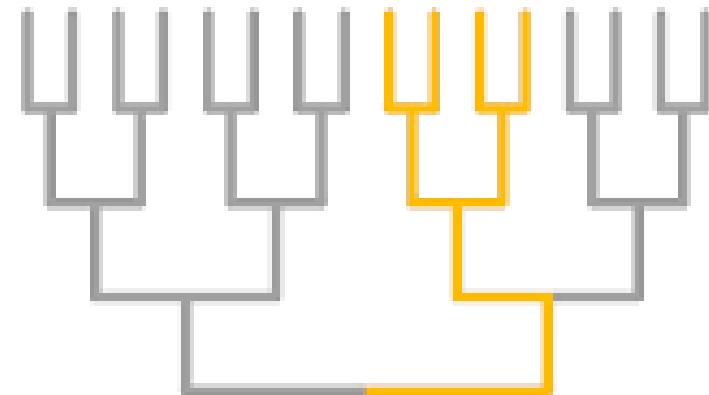
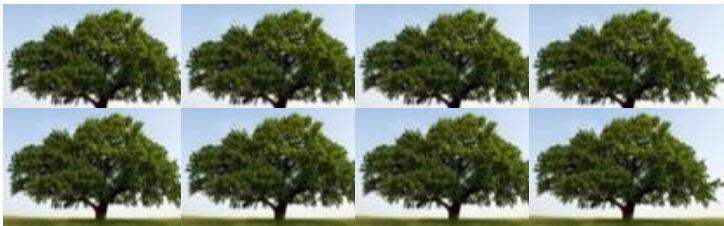
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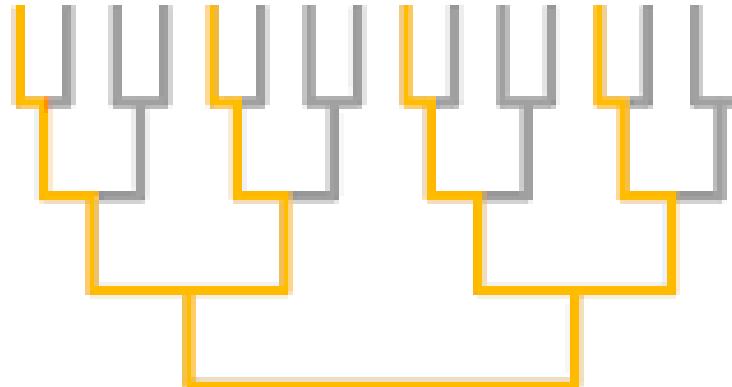
Phylogenetic Diversity (PD):

How much of the Tree of Life is present in an area?

Oaks

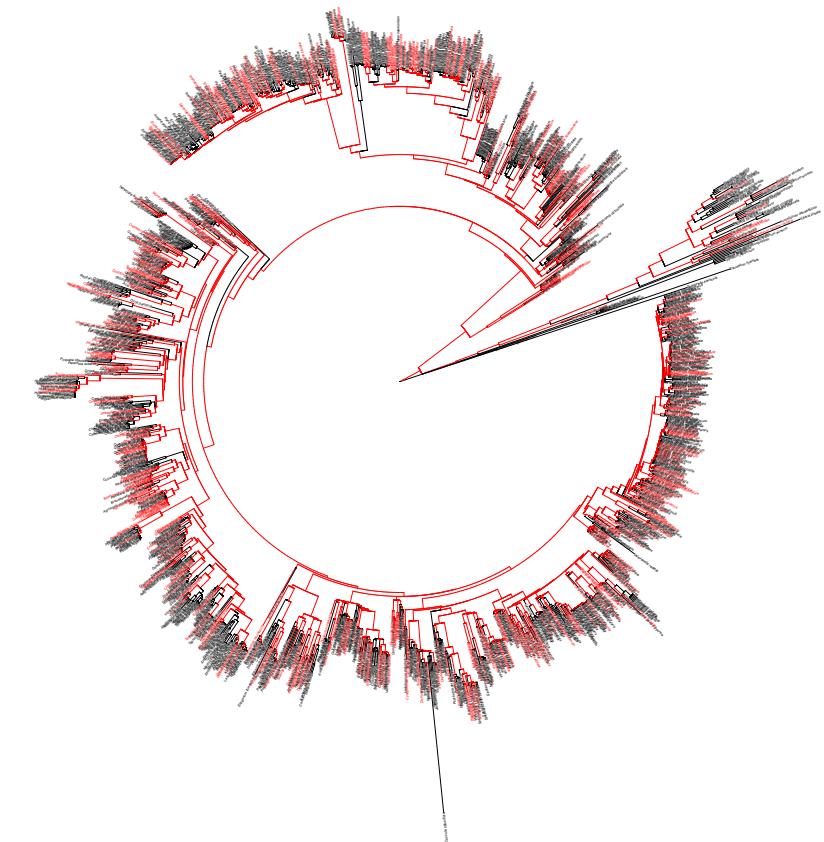
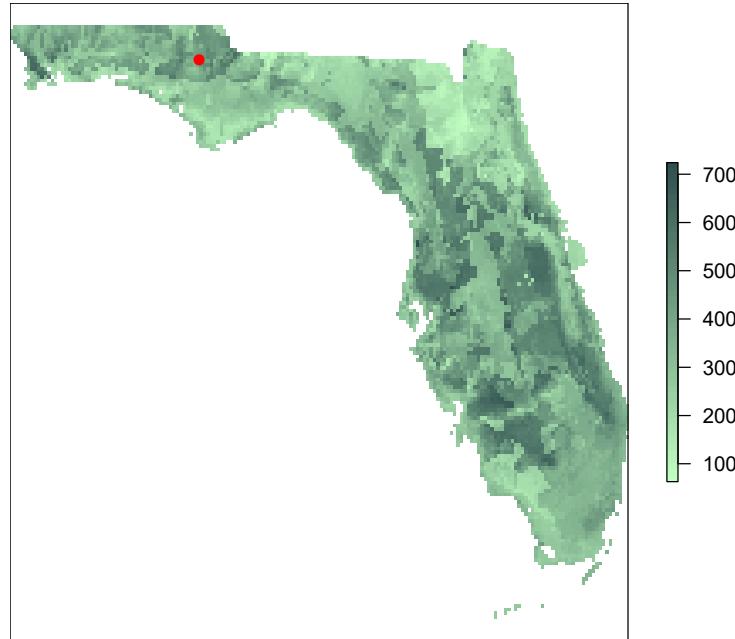


Vs.

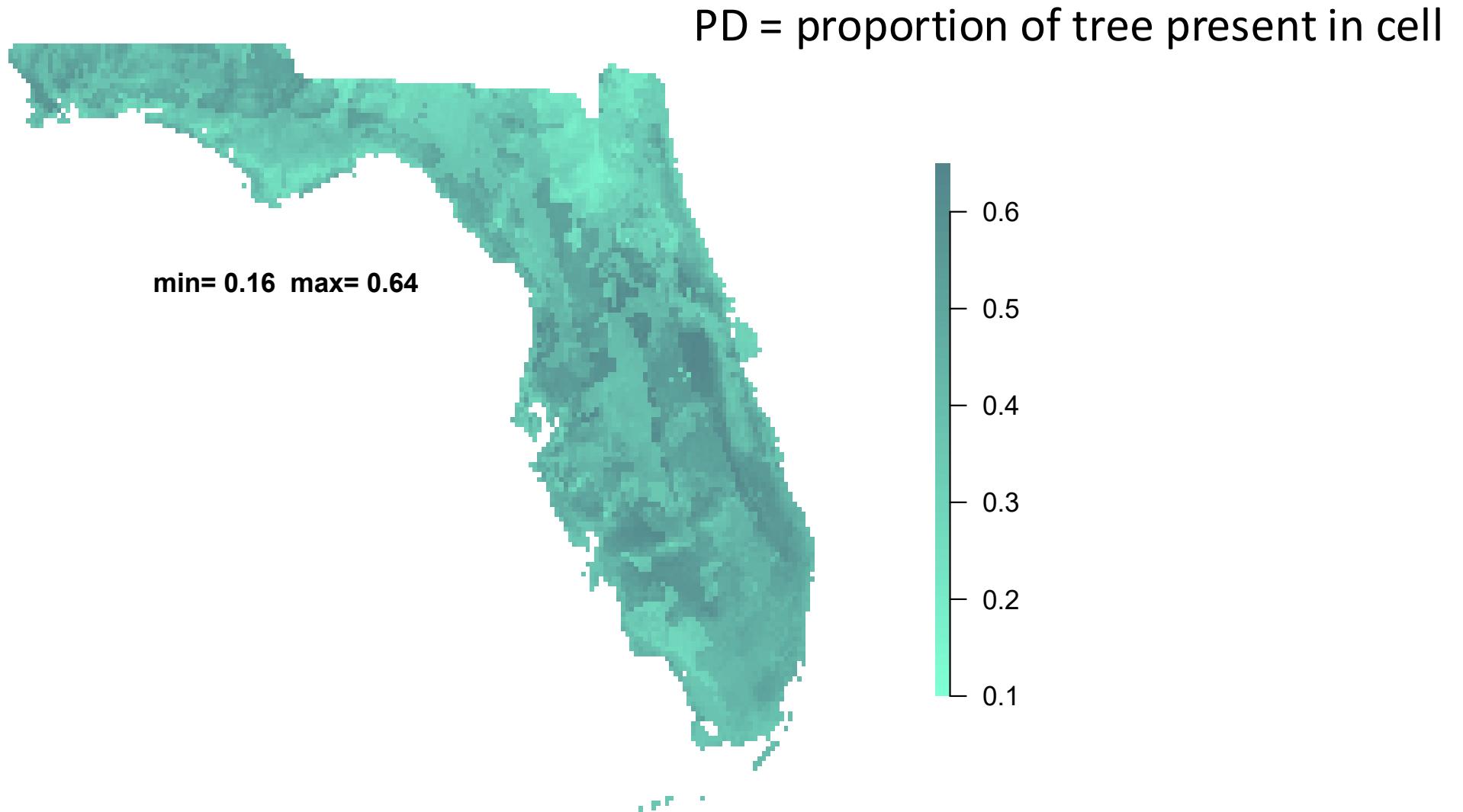


Phylogenetic Diversity (PD):

How much of the Tree of Life is present in an area?



Phylogenetic Diversity (PD)



Allen et al. 2019. Spatial phylogenetics of Florida vascular plants:
The effects of tree uncertainty and ultrametricity. *iScience*11: 57–70.

Evolutionary History of the Angiosperm Flora of China

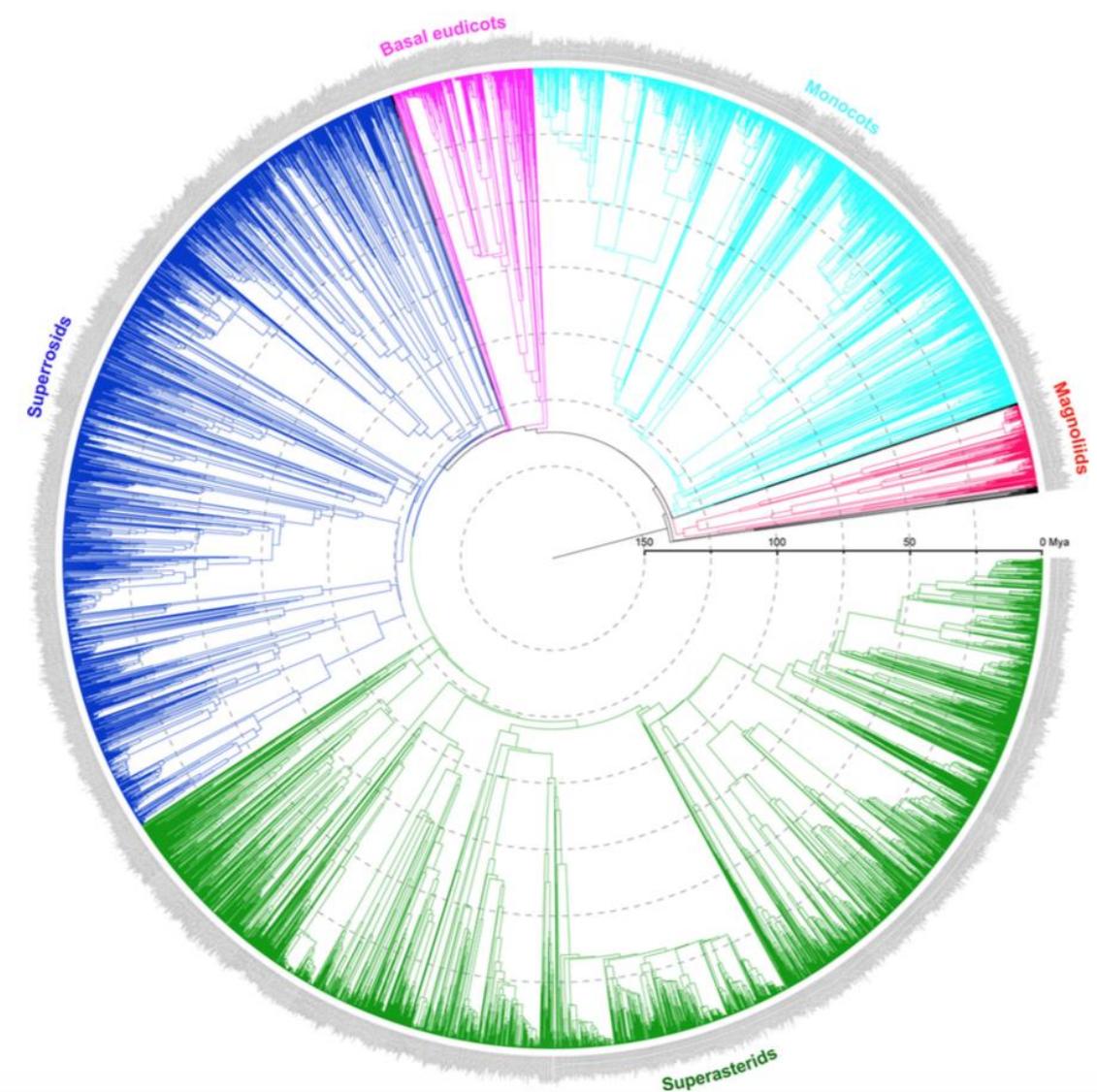
- 30,000 species of vascular plants
- 3176 genera
- 92% of genera sampled
- 26,978-species tree

LETTER

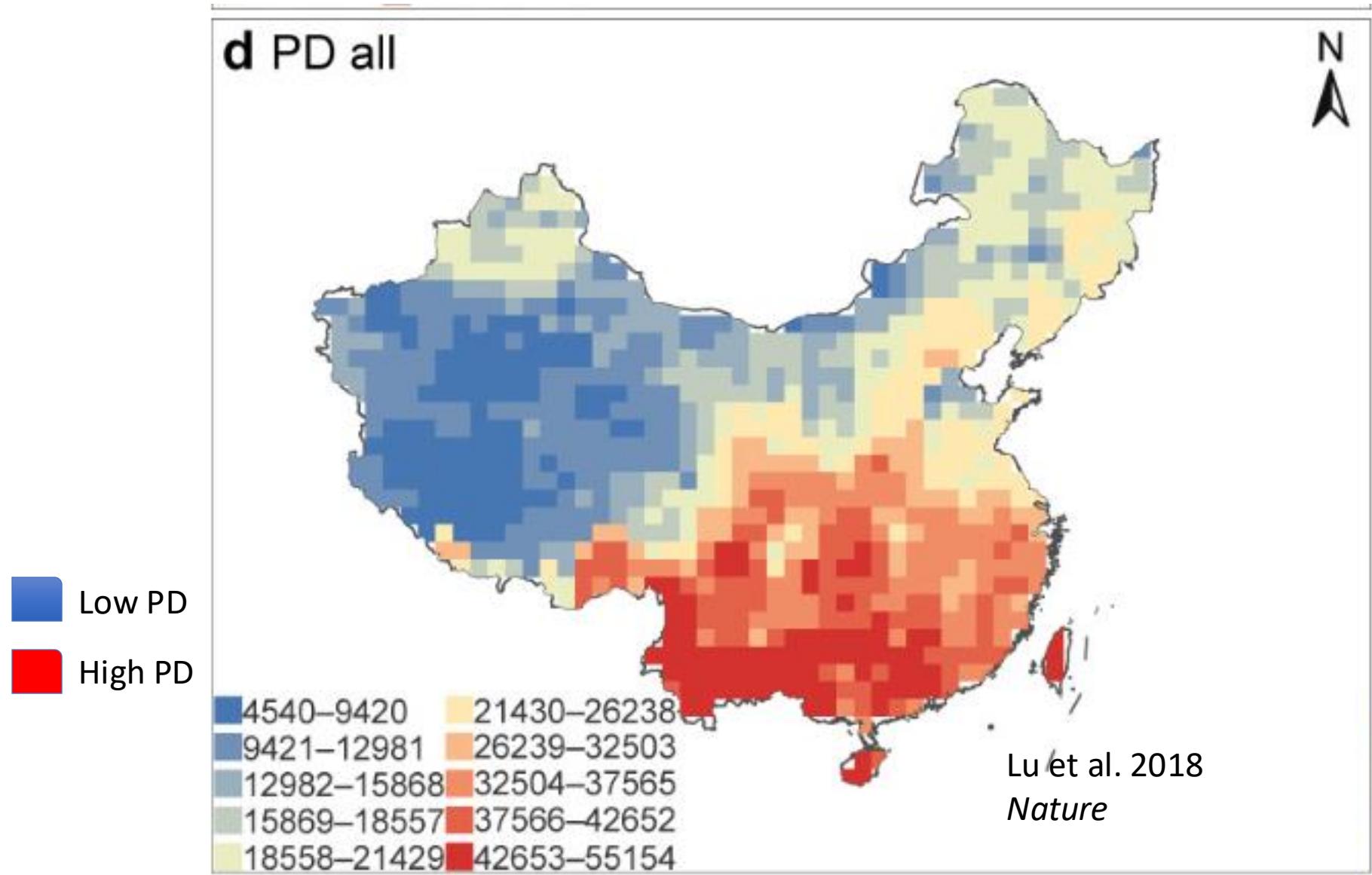
[doi:10.1038/nature25485](https://doi.org/10.1038/nature25485)

Evolutionary history of the angiosperm flora of China

Lu et al. *Nature*, 2018



Phylogenetic Diversity: China



Conservation: Protected Areas vs. High PD in China



Blue and Pink =
conservation areas

Spatial Phylogenetics of the North American Flora

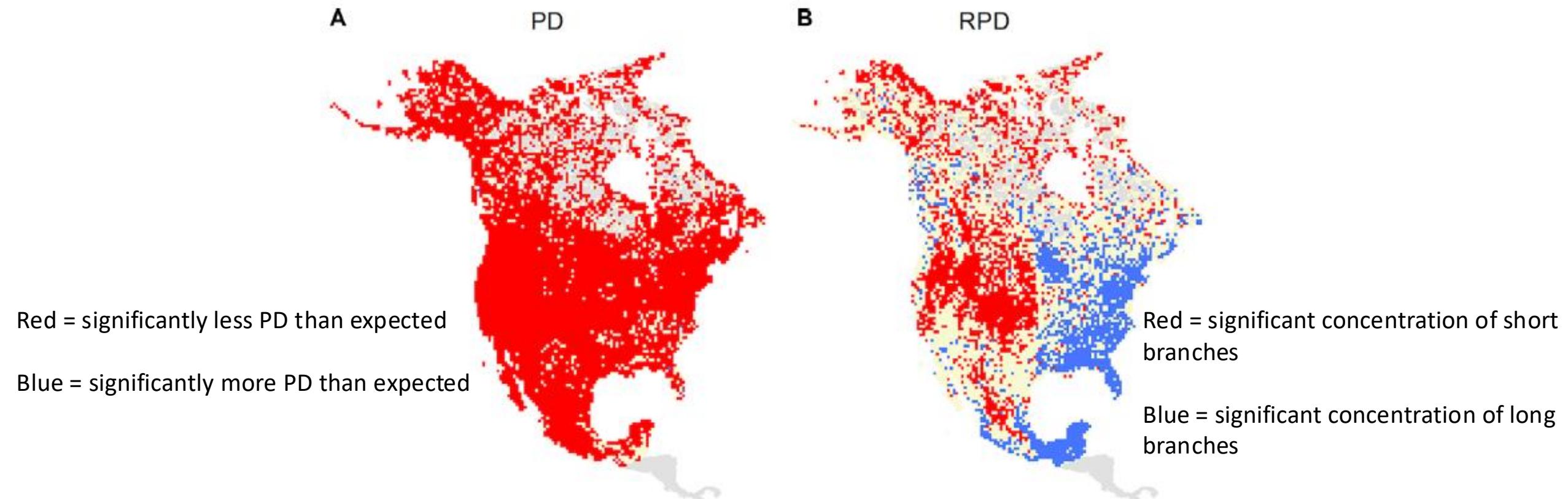


Fig. 4. **A**, PD significance with an unconstrained randomization. Virtually the entire continent is significantly low in PD, meaning that taxa are more closely related than expected by chance. **B**, RPD significance with an unconstrained randomization. Areas in blue have a concentration of significantly longer branches than expected; areas in red have a concentration of significantly shorter branches than expected. There is a striking difference between the western and eastern parts of the continent. PD, phylogenetic diversity; RPD, relative phylogenetic diversity.

Relative Phylogenetic Diversity

RPD - *relative phylogenetic diversity*=

PD on the original tree

PD on a comparison tree with
all branch lengths equal

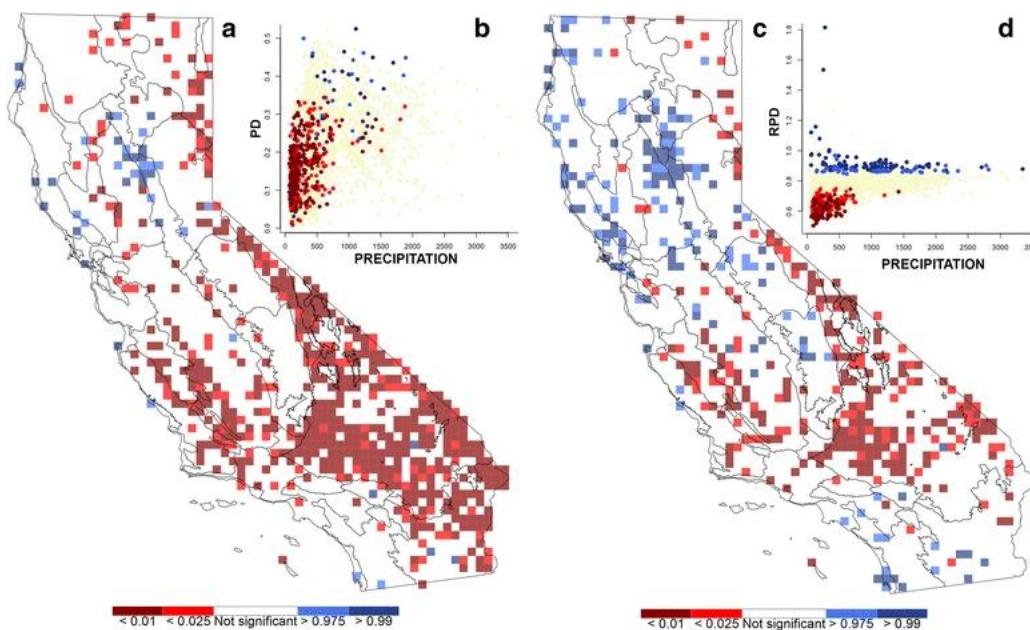
significant concentration of short branches

VS

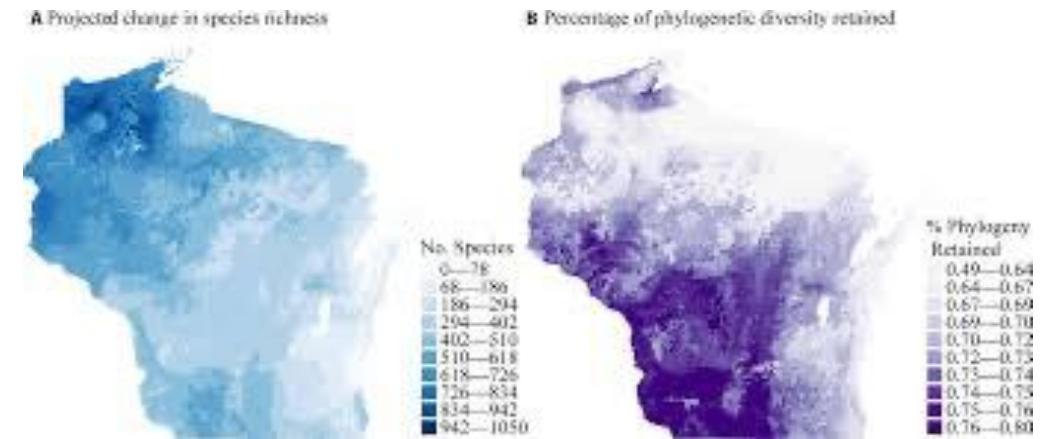
significant concentration of long branches

RPD: identify and distinguish areas of phylogenetic overdispersion and clustering that reflect signals of biogeographic history and ecological processes

Phylogenetic Diversity

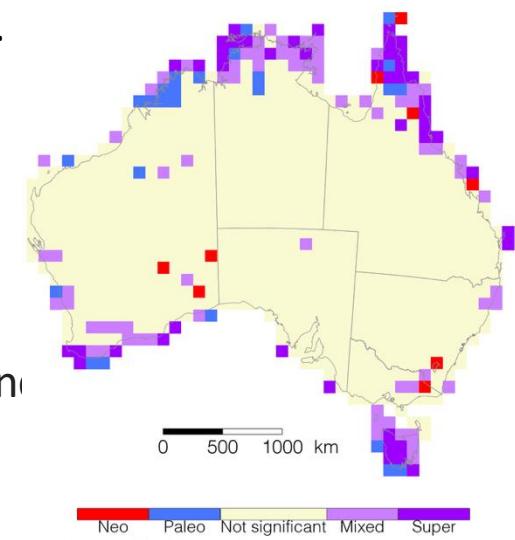


Thornhill et al. 2017. Spatial phylogenetics of the native California flora. *BMC Biology* **15**: 96.



Spalink et al. 2018. Spatial phylogenetics reveals evolutionary constraints on the assembly of a large regional flora. *American Journal of Botany* **105**: 1938–1950.

Mishler et al. 2014. Phylogenetic measures of biodiversity and neo- and paleo-endemism in Australian *Acacia*. *Nature Communications* **5**: 4473.



Trait Evolution

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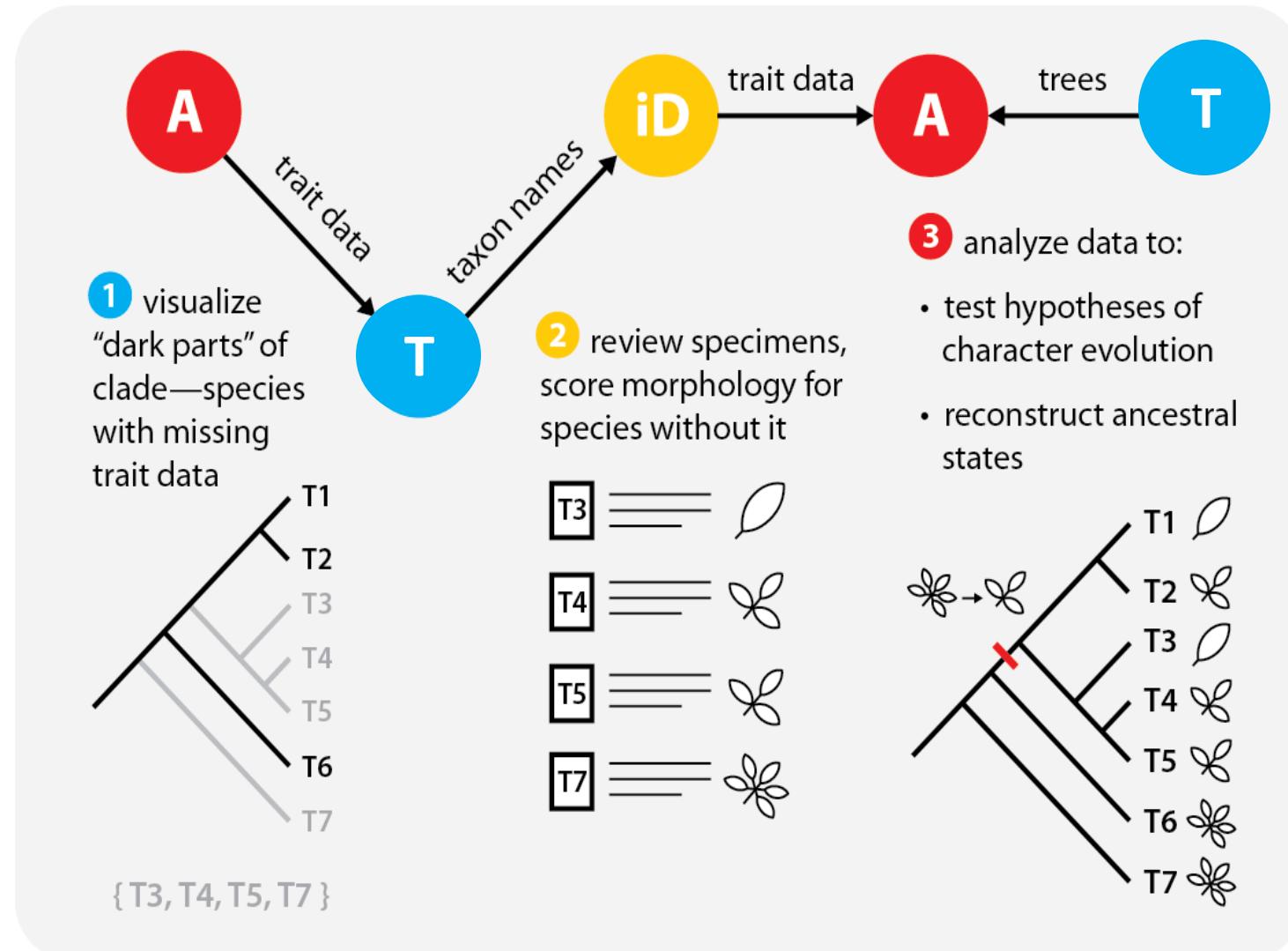
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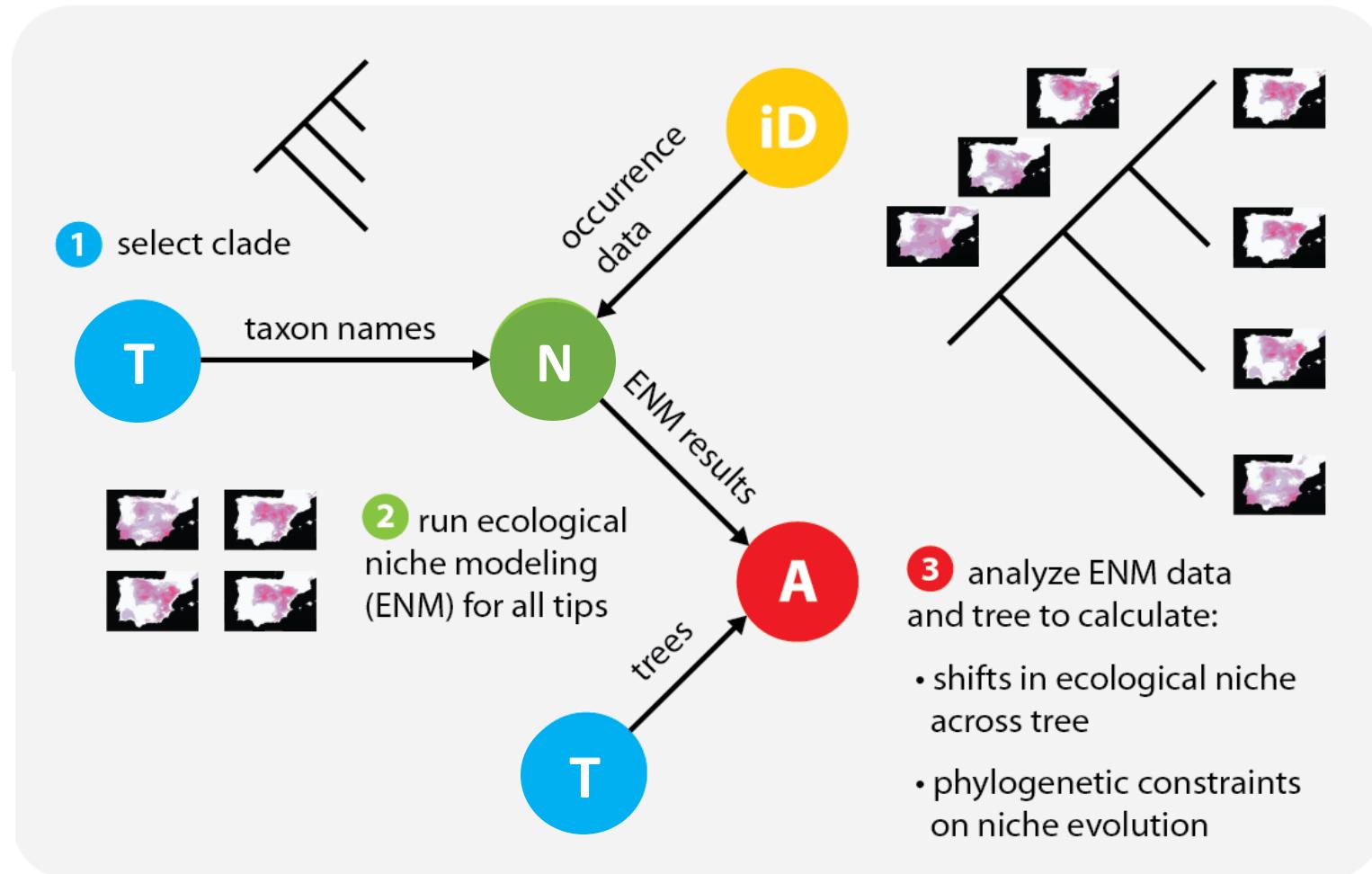
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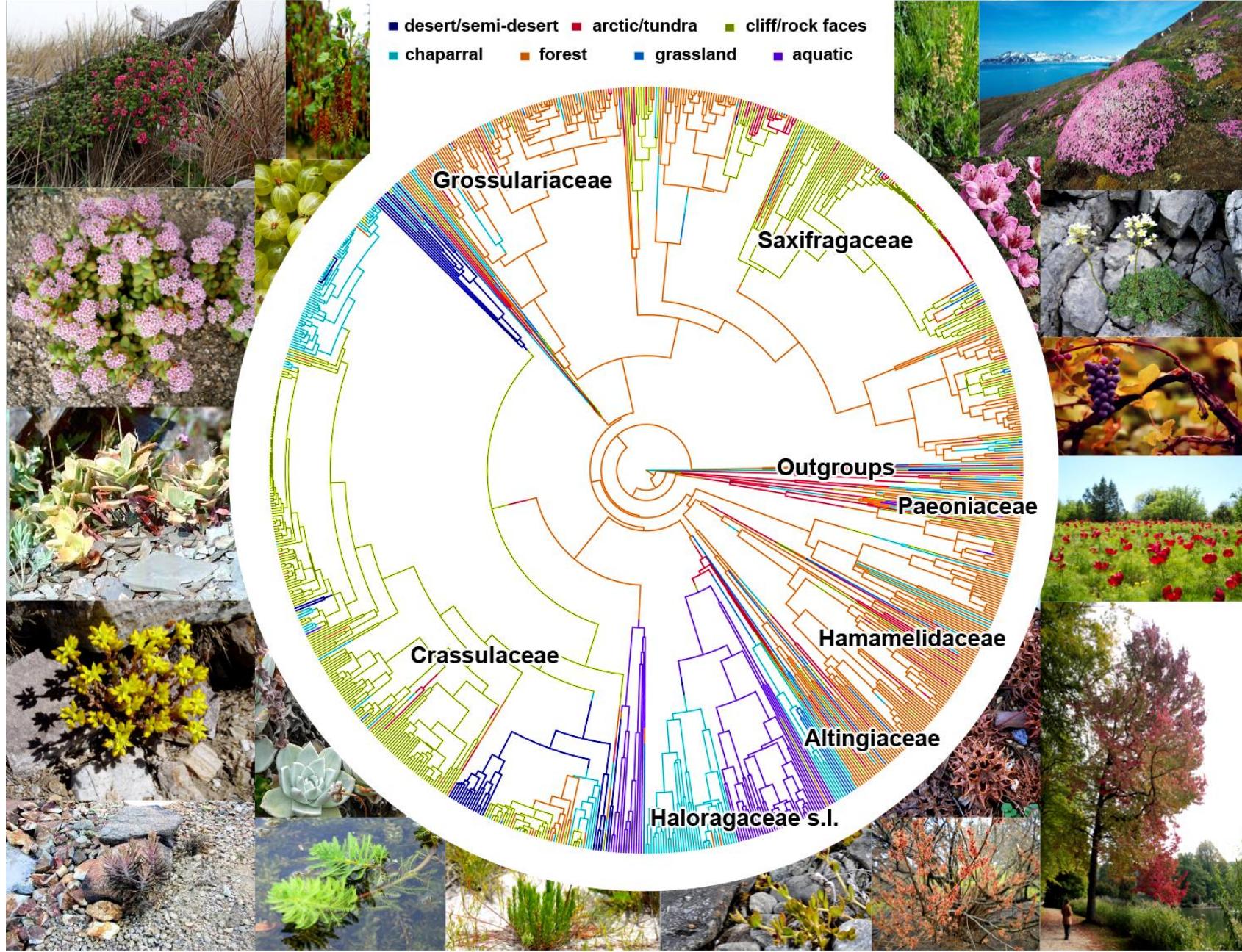
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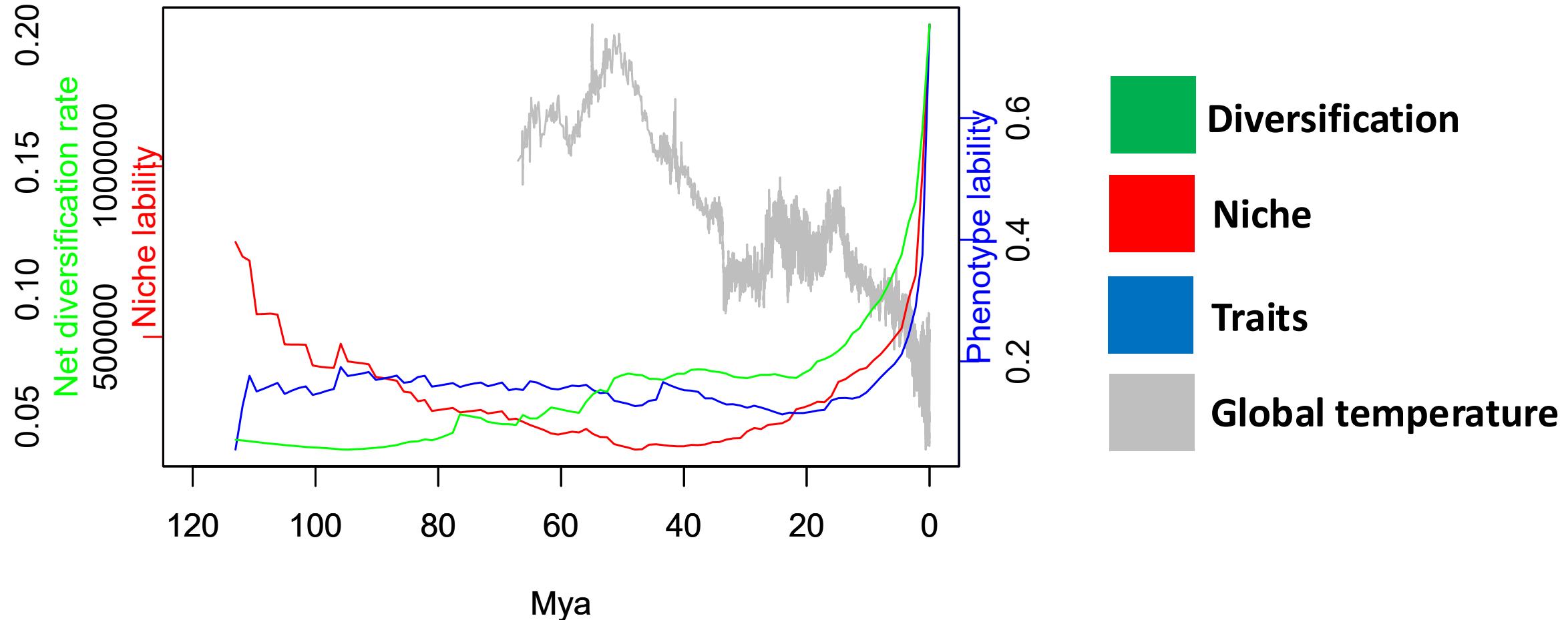
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Saxifragales: Hyperdiverse



A Temperate Radiation: Mid-Miocene Cooling



Response of Saxifragales to Climate Change

- Mean annual temperature
- Shifts are rare



Hot



Cold



Ryan Folk

Thanks

