Exploring the biotic interactions hypothesis through the lens of extrafloral nectaries
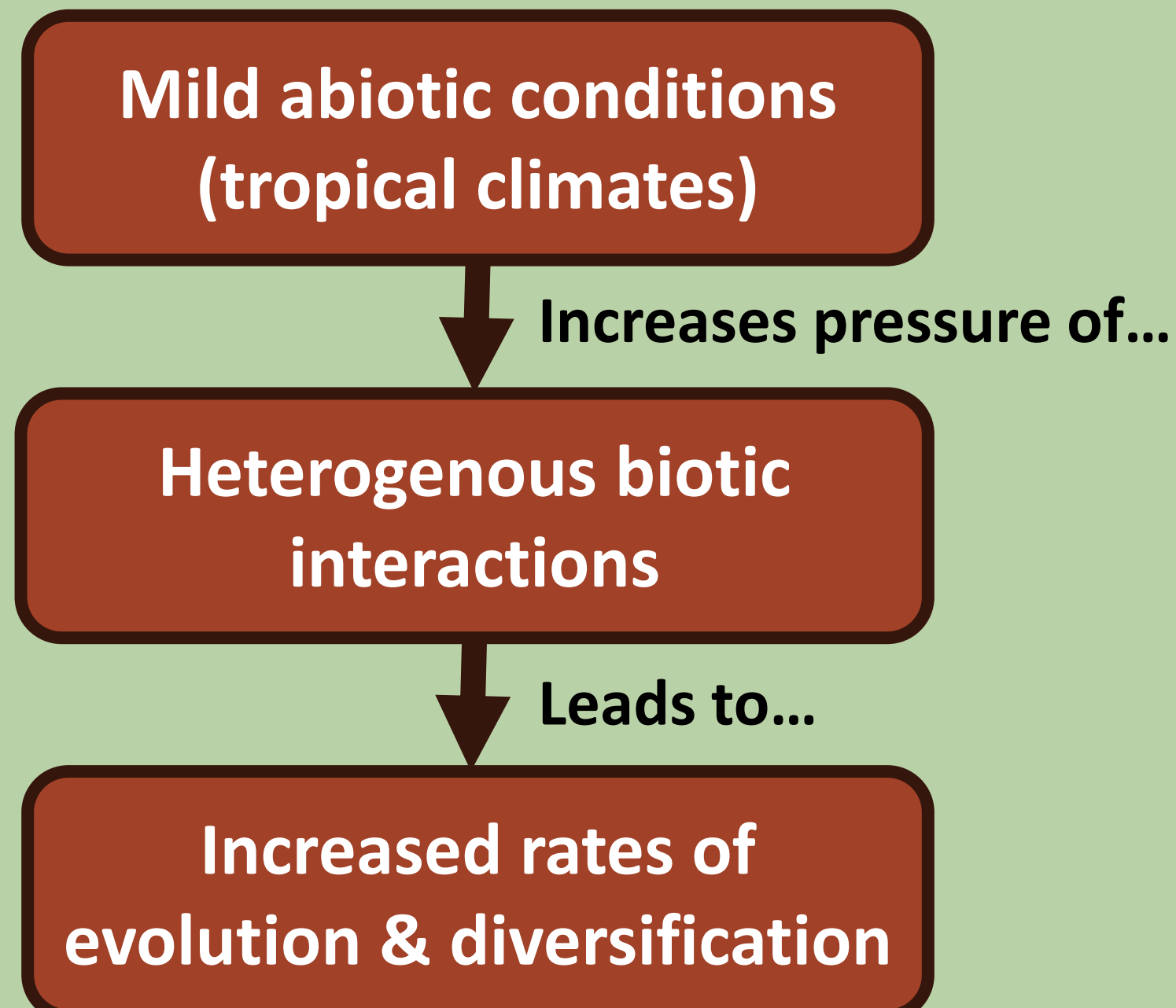
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Background

What drives high spp. richness in tropics?

The Biotic Interactions Hypothesis (BIH)[1]:

Mild abiotic conditions (tropical climates)

Increases pressure of…

Heterogenous biotic interactions

Leads to…

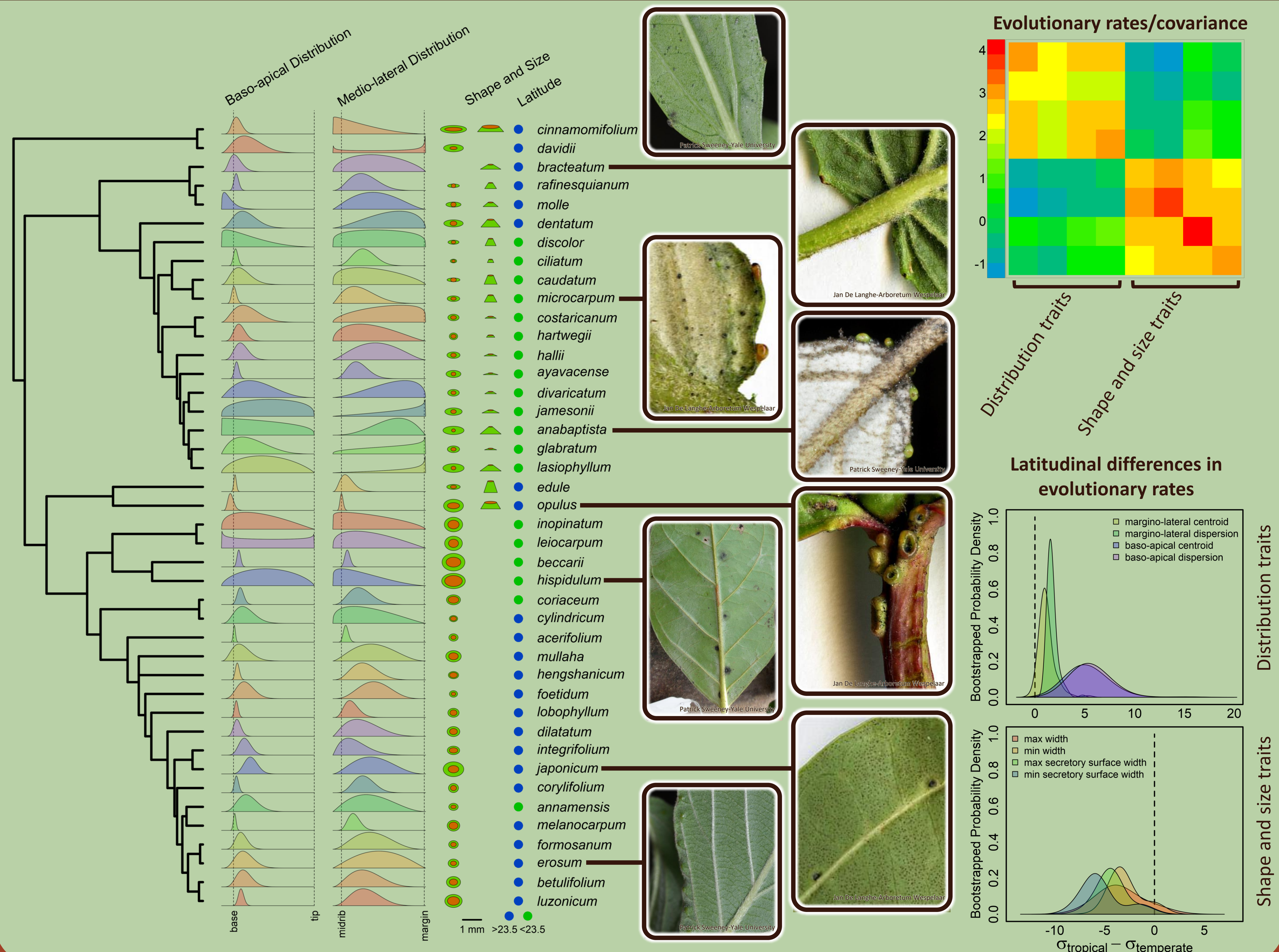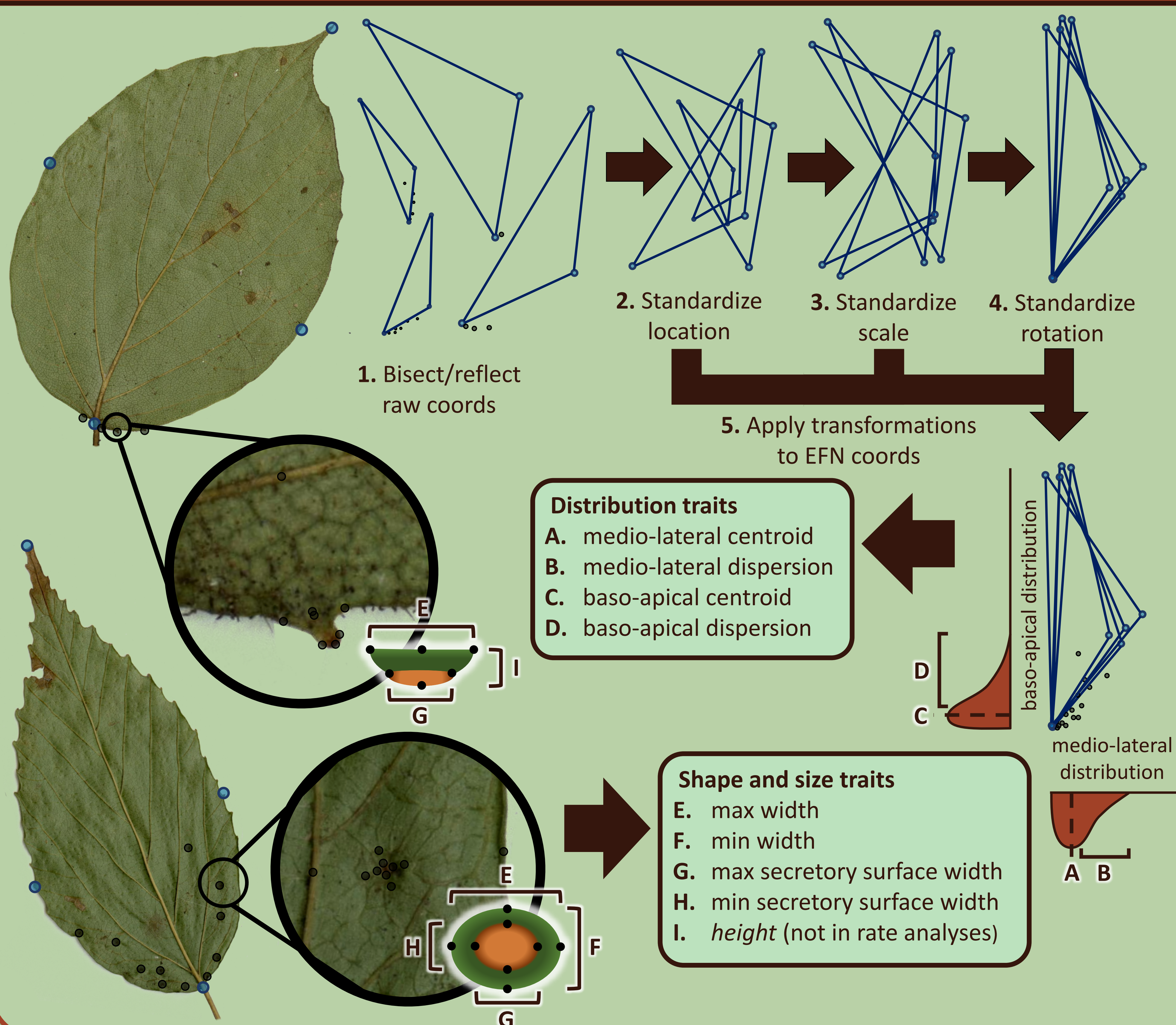Increased rates of evolution & diversification

Extrafloral Nectaries (EFNs):
- Nectar-secreting glands on non-flower plant tissues that recruit arthropod 'bodyguards'[2]
- Phylogenetically-widespread; **'model trait' for linking ecology to macroevolution**[3-5]
- EFN phenotypic evolution poorly understood

I am using a heavily-modified geometric morphometrics approach to **describe how EFN morphology varies across *Viburnum* spp.** In conjunction with phylogenetic comparative methods, I am using these data to explore **associations between latitude and rates of EFN morphological evolution.**

Patterns of morphological evolution
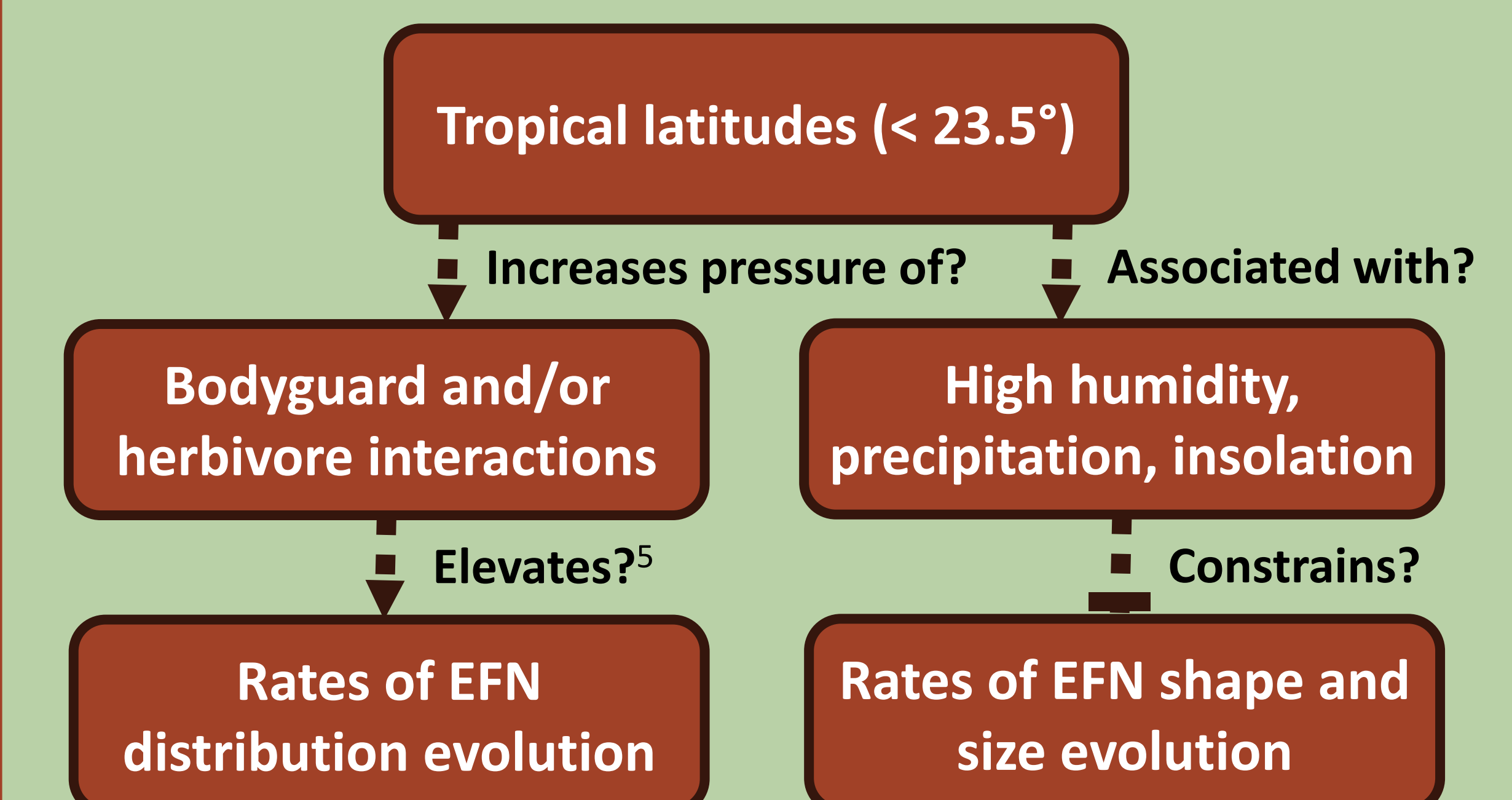

Landmarking a complex, plastic trait

1. Bisect/reflect raw coords
2. Standardize location
3. Standardize scale
4. Standardize rotation
5. Apply transformations to EFN coords

Distribution traits
A. medio-lateral centroid
B. medio-lateral dispersion
C. baso-apical centroid
D. baso-apical dispersion

Shape and size traits
E. max width
F. min width
G. max secretory surface width
H. min secretory surface width
I. *height* (not in rate analyses)

Conclusions & outlook

EFN morphological evolution can be separated into "distribution" and "shape and size" modules

EFN morphological evolution appears to exhibit rate heterogeneity across temperate and tropical latitudes

Divergent trends and equivocal support for BIH:

Tropical latitudes (< 23.5°)

Increases pressure of? — Associated with?

Bodyguard and/or herbivore interactions — High humidity, precipitation, insolation

Elevates?[5] — Constrains?

Rates of EFN distribution evolution — Rates of EFN shape and size evolution

Future work
- More complete spp. sampling
- Evolution of infraspecifc variation
- More elegant/realistic modeling solutions
- Field work → bodyguard association data

References: 1) Dobzhansky T. *Am Sci.* 1950. 38: 209-221. **2)** Marazzi B, Bronstein J, Koptur S. *Ann Bot.* 2013. 111(6): 1243-1250. **3)** Weber M, Keeler K. *Ann Bot.* 2013. 111(6): 1251-1261. **4)** Weber M, Agrawal A. *Proc Natl Acad Sci.* 2014. 111(46): 16442-16447. **5)** Weber M, Clement W, Donoghue M, *et al.* 2012. 180(4): 450-563.
Software: 'Fiji': Schindelin J, Arganda-carreras I, Frise E, *et al.* 2019. 9(7): 676-682. **'phytools':** Revell L. 2012. 3: 217-223.
'mvMORPH': Clavel J, Escarguel G, Merceron G, *et al.* 2015. 6: 1311-1319.