Testing the "Allopatry-to-Sympatry" Hypothesis in *Escallonia*

Madalyn Stoecker,
Felipe Zapata,
Iván Jiménez

Center for Conservation and Sustainable Development
Missouri Botanical Garden

Introduction

Speciation is the process by which one species (a segment of a metapopulation-level lineage[1]) splits into two. An unresolved issue is the extent to which diverging species overlap geographically during this process[2].

The "Allopatry to Sympatry" hypothesis states that speciation tends to start in allopatry (no range overlap) and then transitions to sympatry (range overlap) as intrinsic barriers to gene flow develop (Fig. 1). It predicts that sympatry is higher among distantly, rather than closely, related species.

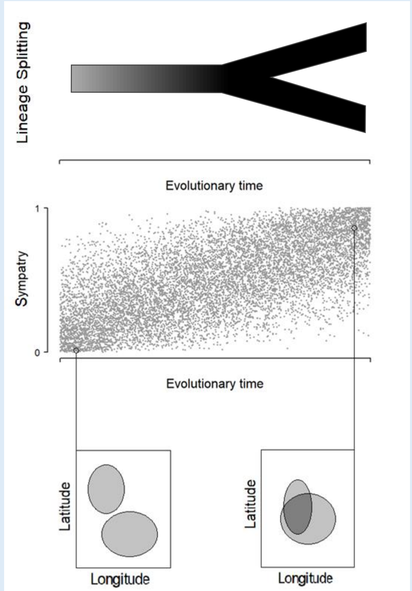

Figure 1. The "Allopatry to Sympatry" hypothesis.

Materials and Methods

Study system
Escallonia is a plant genus that occurs in Neotropical mountains (Fig. 2). Species delimitation by Sleumer[3].

Estimating range overlap
Species' geographic distributions were estimated with species distribution modelling (SDM's) using the MaxEnt software in R[4,5] (Fig. 3).

Degree of sympatry for each species pair was measured as:

Area of geographic range overlap/
Area of geographic range of species with smaller range

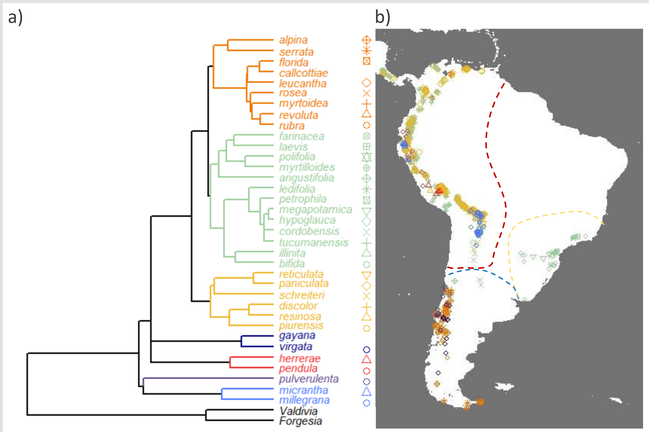

Figure 2. a) Phylogeny of *Escallonia* with colors showing clades. **b)** Locality points of *Escallonia* with colors and symbols showing species. Dashes separate Tropical Andes (red), Southern Andes (blue), and Brazil (yellow).

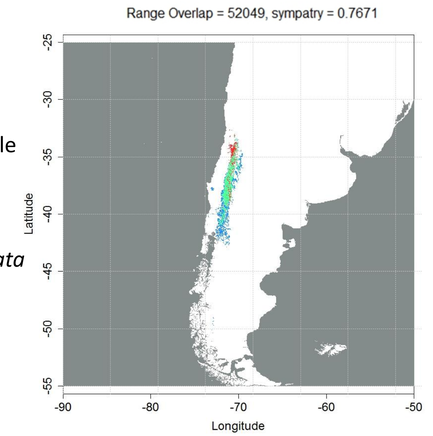

Figure 3. Example of range overlap (green) using species *E. alpina* (red) and *E. virgata* (blue).

Results and Discussion

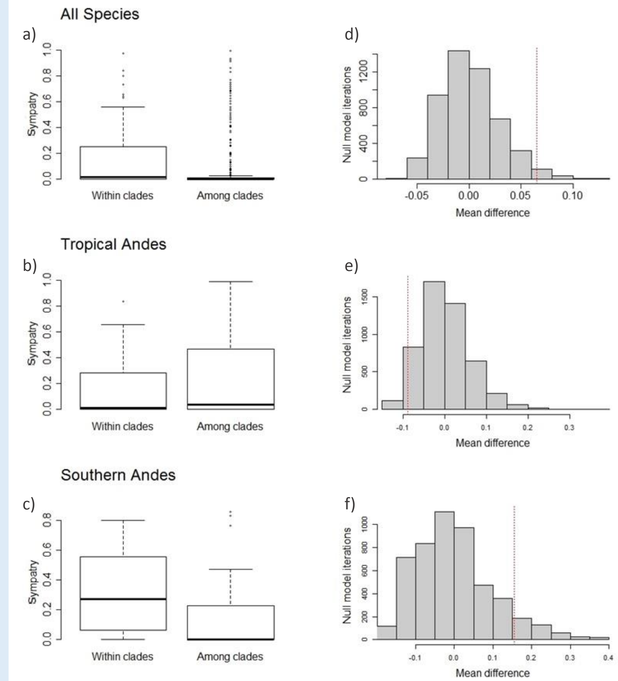

Figure 4. Sympatry for species pairs within and among clades (Fig. 2 a for definition of clades). Analysis for (a) Neotropics, (b) Tropical Andes and (c) Southern Andes. Panels d-f show associated null distributions of difference between mean sympatry of within and among clades, calculated by randomizing species across the *Escallonia* phylogeny. Observed values shown as vertical red dotted line.

Results
Only the analysis for the Tropical Andes (Fig. 4 b and e) supported the prediction of higher sympatry among distantly related, rather than closely related, species (p-value = 0.4).

Discussion
Limited support for the "Allopatry to Sympatry" hypothesis may be due to limited dispersal ability of *Escallonia* species. Clades are largely restricted to geographic regions (Fig. 2). However, several clades occur in the Northern Andes, where there was support for the hypothesis.

References

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4. Merow, C., Smith, M.J., and J.A Silander, Jr. 2013. A practical guide to MaxEnt for modeling species' distributions: what it does, and why inputs and settings matter. Ecography 36: 1058–1069.
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