# Testing the Phylogenetic Niche Conservatism Hypothesis with the genus *Escallonia*

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## INTRODUCTION

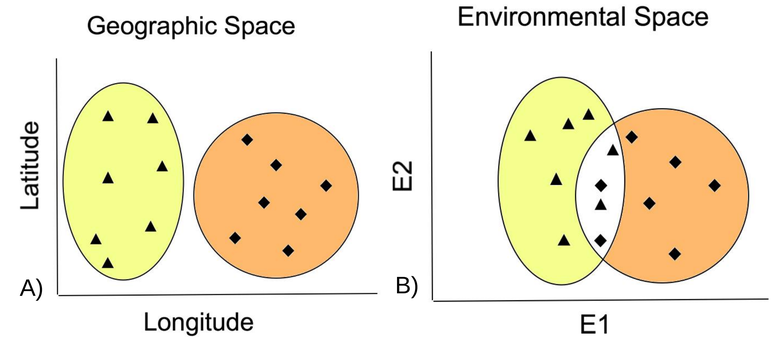


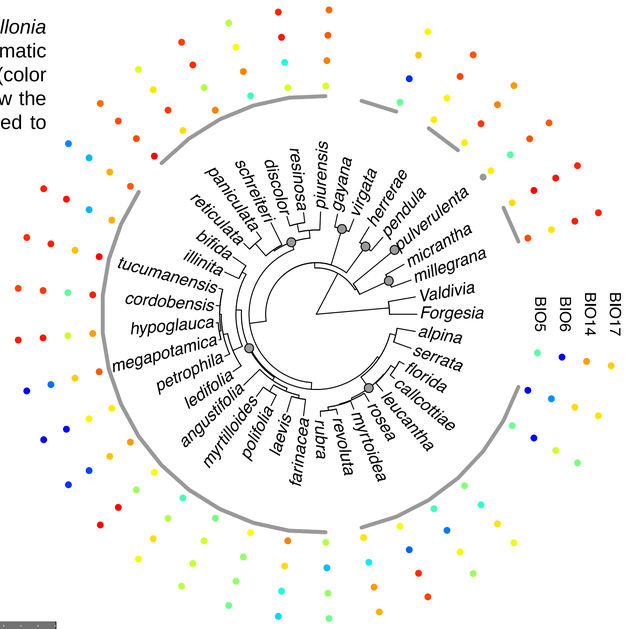

**Figure 1**. Theoretical depiction of species geographic ranges (A) and respective ecological niches[1] as defined by climatic variables E1 and E2 (B, C). The geographic region containing all occurrences of a species (circles in A) define the background environment (circles in B and C). Niche differences between species need to be interpreted in light of background environments. In B niche differences between species are less than expected from the background environment, while in C the opposite is true.

The phylogenetic niche conservatism hypothesis suggests that niche between species increase with phylogenetic distance[2]. We tested the climatic aspect of this hypothesis, taking into account the background environment (Fig. 1). The hypothesis predicts that closely related species tend to overlap more in niche than distantly related species.

## METHODS

Our study system was the plant Genus *Escallonia*, containing 39 species of small trees and shrubs that occur in Neotropical mountains, along the Andes, and also in highlands of Panama and southeastern Brazil. We characterized the ecological niche of these species based on known occurrences retrieved from the Tropicos® database and four climatic variables (Figs. 2, 3). We estimated ecological niche overlap between species with Schoener's D, which ranges between 0 (no overlap) and 1 (complete overlap)[4]. For each species pair also calculated 1,000 Schoener's D values by randomly sampling background environments (Fig. 1), using R package "Ecospat"[4]. We then calculated effect size of of Schoener's D as the difference between observed Schoener's D and the mean of 1,000 Schoener's D for the background environment. We also calculated standardized effect size of Schoener's D as the effect size divided by the standard deviation of 1,000 Schoener's D for the background environment.

**Figure 2**. Phylogeny of genus *Escallonia* showing mean values of four climatic variables for each species (color symbols and scale). Gray dots show the most basal nodes of the clades used to examine the phylogenetic niche conservatism hypothesis.

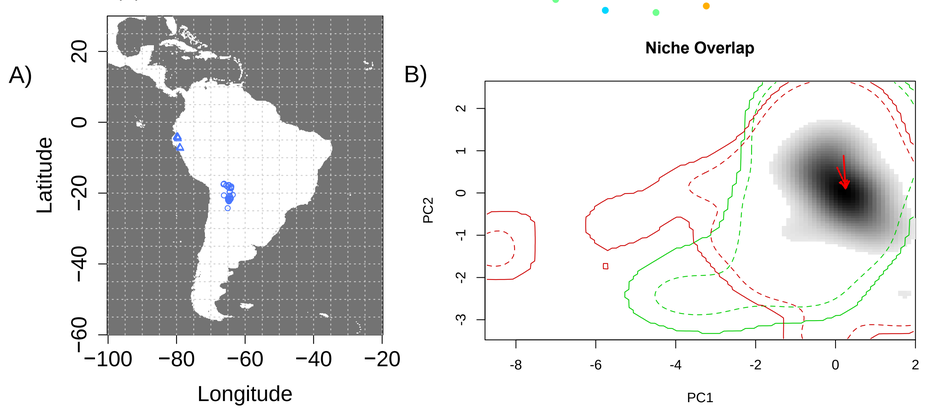



**Color Scale**:

BIO5 and BIO6
- Red: High Values
- Green : Intermediate Values
- Blue: Low Values

BIO14 and BIO17
- Red: Low Values
- Green: Intermediate Values
- Blue: High values

**Figure 3**. Geographic range of *E. micrantha* and *E. millegrana* (A) and respective ecological niche overlap in terms of climatic variables (B) .




## RESULTS AND DISCUSSION

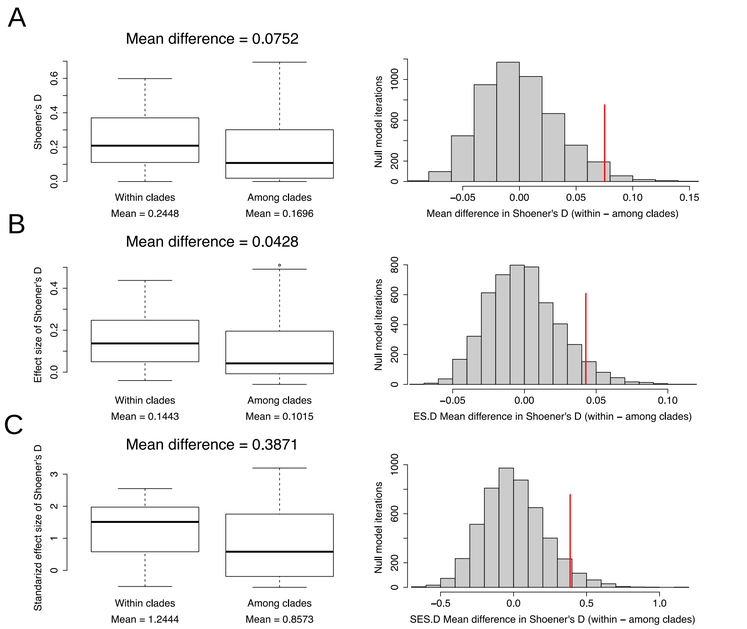



**Figure 4**. Panes A-C show niche overlap for species pairs within and among clades (defined by gray dots in Fig. 2). Panels D-F show respective null distributions of differences in niche overlap between species pairs within and among clades, calculated by randomizing species across the phylogeny (Fig. 2). Observed values shown as vertical dotted red lines.

We found support for the prediction that closely related *Escallonia* species tend to overlap more in niche space than distantly related species (Fig. 4). The results were similar for indices of niche overlap that ignore (Fig. 4A) and account for (Fig. 4B and C) differences between species in background environment. Ecological niche conservatism in *Escallonia* was higher than expected by background environments (Fig. 4A and B). Thus, it is not simply a reflection of spatial autocorrelation in climatic variables[5].

## REFERENCES

1. Guisan, Antoine, Blaise Petitpierre, Olivier Broennimann, Curtis Daehler, and Christoph Kueffer. "Unifying Niche Shift Studies: Insights from Biological Invasions." *Trends in Ecology & Evolution* 29, no. 5 (2014): 260-269.
2. Harvey, Paul H., and Mark D. Pagel. *The Comparative method in Evolutionary Biology*. Vol. 239. Oxford: Oxford university press, 1991.
3. De Queiroz, Kevin. "The General Lineage Concept of Species, Species Criteria, and the Process of Speciation A Conceptual Unification and Terminological Recommendations." (1998).
4. Olivier Broennimann, Valeria Di Cola and Antoine Guisan (2016). ecospat: Spatial Ecology Miscellaneous Methods. R package version 2.1.1.
5. Zapata, Felipe. "A multilocus phylogenetic analysis of Escallonia (Escalloniaceae): diversification in montane South America." *American journal of botany* 100, no. 3 (2013): 526-545.