Title:

Authors:

Target Journal:

Abstract:

Keywords:

Introduction

Explaining the co-occurrence of related species in diverse assemblages is a persistent aim of community ecology (Colwell, Fine, Brown). The balance between differences in species mean fitness and niche overlap lead to observed patterns of presence within local assemblages (Chesson, Adler, Kraft). In tropical plant assemblages, the observed co-occurrence of many congeneric species has suggested that co-occurrence may be related to niche-based (Swenson, Cavender-Bares), non-equilibrium (Jetz), or neutral processes (Hubble). Analysis of species communities tend to focus on species occupancy as the primary window into mechanisms of co-occurrence. Fewer studies have evaluated the importance of species interactions as mediating patterns of co-occurrence at local and regional levels. This is largely because gathering data on species interactions is time-consuming and labor-intensive. Here we analyze a multi-year dataset of co-flowering and pollinator overlap among related Gesneriaceae species in a diverse cloud-forest assemblage. Combining data on floral morphology, evolutionary relatedness, and observed pollinator visitation, we can test a diverse set of candidate models to assess seasonal flowering communities.

For flowering plants, interactions with pollinators can yield insight into the potential roles of competition in maintaining co-occurrence. Two dominant hypotheses have been proposed for co-flowering among related species in diverse assemblages. Competition among closely related species should lead to low co-flowering, thereby reducing heterospecific pollen transfer and potentially negative impacts of hybridization. Alternatively, co-flowering among related species could lead to pollinator facilitation, in which the local abundance of resources attracts many pollinators, leading to increased fitness for all species. Evidence …

The complex interplay between phylogenetic relatedness, morphological diversity, and species interactions complicates quantitative analysis of species co-occurrence. We follow the general philosophy of phylogenetic generalized linear mixed models presented in Helmus, Ives, Pearce. We make several adjustments and prefer Bayesian MCMC estimation for handling uncertainty in parameter estimation. Our quantitative approach, 1) estimates models of phylogenetic and trait co-variance in flowering, 2) accounts for the between year variance in flowering phenology, 3) models both the strength and uncertainty of co-flowering, 4) generates testable predictions for model comparison. This final point is crucial in assessing the model fit, given the high risk of overfitting due to the highly variable nature of flowering timing. While identifying the mechanisms promoting niche differences among related species remains a challenging task, by focusing on out of sample model evaluation, we can measure our ability to generalize from our particular dataset.

Methods

* Data Collection
  + Transects
  + Cameras
  + Traits
  + Phylogeny
* Pollinator overlap and relatedness
  + Detection probabilities?
  + Pagels Lambda
  + Niche Overlap
* Predictive Models of co-flowering
  + Training-testing split
  + Baseline model
    - We have intentionally left out elevation and julian day as a predictor of co-flowering. The models of covariance outlined below describe the correlation in intensity of flowering among sampling periods. If we use these predictor, for example as a proxy of environmental conditions, the phylogenetic and trait variance will be captured by the variation in response to date. In practice, it is not possible to differentiate the phylogenetic effect on the timing of flowering, versus the phylogenetic effect of co-occurrence. Both parameterizations represent changes among sampling periods.
  + Models of Covariance for phylogenetic and trait distance
    - Attraction
    - Repulsion
  + Model evaluation
* Results
* Figure 1
  + Conceptual: Co-flowering competition and facilitation with raw data, flowchart to show how data comes together
* Figure 2
  + Pollinator niche overlap matrix
* Figure 3
  + Discrepancy in covariance models and observed data
* Figure 4
  + Discrepancy in covariance models and predicted data