EEB 485: Discussion 03: Testing competition in the field

Tamara Milton and Haiqing Xu

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Vannette, R. L., & Fukami, T. (2014). Historical contingency in species interactions: towards niche-based predictions. Ecology Letters, 17(1), 115-124.

Summary: Vannette and Fukami argue that the prediction of priority effects, or effects of species on one another based on their order of arrival, can be improved by decomposing species niches into three components-niche overlap, impact niche, and requirement niche. Niche overlap includes resource similarity among co-occurring species, and is independent of the rate of resource consumption; niche impact is the species per capita influence on the environment through resource consumption and other methods of environmental modification; requirement niche includes the environmental conditions that affect a species survival, growth and reproduction. Three new hypotheses around niche components are proposed; priority effects should be strong when 1) there is high niche overlap, 2) early-arriving species have high impact niche, and 3) late-arriving species have high requirement niche. Coupling with the conventional hypothesis that focuses on the role of environmental harshness on priority effects, these new hypotheses provide a foundation for developing a general framework to predict historical contingency in species interactions.

An experiment using four species of yeast that inhabit floral nectar was conducted to evaluate the niche-component hypotheses stated above. Population growth and the changes imposed by yeast species on each environment were measured to quantify the niche components and link these metrics to the measured strength of priority. To investigate how measured niche components relate to the strength of priority effects, Vannette and Fukami build up a multiple linear regression model with predictors for niche overlap, impact niche, requirement niche, environmental harshness and error. Non-significant predictors were sequentially removed. The results show that early-arriving yeast species negatively affected late-arriving species, and priority effects were stronger in benign environments. All three niche components significantly predicted the strength of priority effects. Together with environmental harshness, they provide an explanation for much of the variation in the strength of priority effects.

Four areas for possible improvement by further research are proposed, including integrating phylogenetic information, talking interspecific competition into account, taking niche change over time into account, and considering higher-order interactions as opposed to just pairwise species interactions. Vannette and Fukami claim that this new framework for analyzing priority effects can have many real-world applications, such as ecosystem restoration, pest prevention using microbial systems, and human disease prevention.

Pre-Discussion Questions:

1. Describe their experimental design and their reasons for it. How many treatment combinations do they have? Why is sucrose used as a measure of environmental harshness and not as a resource?
2. Is it reasonable for phylogenetic information be integrated into this framework as a predictor for niche components? Why or why not?
3. If we want to apply this niche conceptual framework to real-world scenarios such as those mentioned in the discussion, what are some other factors that would need to be considered? Is this model general enough to be widely applied?