Larrea tridentata indirectly interacts with co-blooming annuals with species-specific effects that map onto arthropod and plant communities

Introduction

Foundational plants have positive structural influences onto their associated plant communities. Research in this area is dominated by the study of direct interactions, however these pairwise interactions are often inadequate to predict actual observed outcomes in natural ecosystems (Callaway and Pennings, 2000). In arid environments, shrubs can act as keystone facilitators, directly benefiting associated plants via multiple mechanistic pathways across all life stages (Filazzola and Lortie, 2014), such as stress amelioration, improved water and nutrient availability (Whitford et al, 1994) and seed trapping (Flores and Jurado, 2003). However, less attention has been given to the indirect interactions associated with growing in close spatial proximity. Indirect interactions arise when a third species alters the interaction between two other species (Wootton, 1994, Callaway and Pennings 2000, Callaway and Walker, 2007). These interactions may be mediated by another plant, or by organisms belonging to other trophic levels such as mycorrhizae (File et al, 2012) and pollinators (Rathcke, 1983).

Interactions for pollinators between plants forms a continuum from competition to facilitation. If they both flower, then they likely interact for pollinators. Shrubs can facilitate other plants by acting as a magnet, increasing floral display size or diversity. However, the same attributes that make a plant act as a magnet are the same that may cause it to compete. This is an indirect interaction, which is mediated by insects. Facilitation of shared pollinators can be particularly important in deserts because harsh environmental conditions can lead to large spatial variation in floral abundances and pollinator populations (Rathcke, 1983).

Creosote bush, *Larrea tridentata* (Zygophyllaceae) is a generalist shrub - the full pollinator guild contains 22 specialist pollinators and more than 80 generalists (Minkley et al, 1999). The associated guilds are highly variable over space and most shrubs only interact with 20% of the full guild, but there is a stable core guild (Cane and Minkley). L. tridentata has a large range and abundance. It has been a dominant flowering shrub for 25 000 years (Batancourt 1990), and individuals that are several thousand years old have been documented (Vasek, 1980). It both competes through allelopathy. It has been documented to act as a nurse shrub as well. It is a very reliable flowerer. Whether it competes for pollinators is not known. If they facilitate their understory, than they may be able to buffer their associates from a pollinator decline. But if they outcompete them, then their associates may be extra vulnerable.

In the Mojave, shrubs (Ambrosia dumosa, windpollinated) positively influenced the seed set of annuals growing under the canopy (Holzapfel, 1999).

Here we test for the influence of larrea onto its commonly co-occurring annual *Malacothrix glabrata*. To disentangle effects via blooms, we tested before and during full bloom. If larrea acts as a magnet, we expect to see an increase in arthropod abundance in pan traps. Larrea may also facilitate. This project seeks to contrast the relative contributions of these foundational plants on the pollination of their associated annuals. Bruno et al. (2003) predicts temporal flips in relative interactions from competition to facilitation, however few studies have documented the effect. Another major objective of this study is to test for relative changes in interactions when foundational plants shift into a reproductive life stage. Therefore, we also look for responses in the associated arthropod communities. I predict that they will compete prior to Larrea blooming due to interference, and that Malacothrix will show increased visitation when larrea is blooming. More visits underneath than in open areas.

Study site and weather.

The Mojave Desert is a biodiversity hotspot supporting 659 species of bees (Saul-Gershenz et al, 2012) and 1680 species of vascular plants (Rundel and Gibson, 2005). It’s desert, below precipitation etc. etc. The study site is located in Sunset Cove on the USNRS reserve Granites, elevation. The most abundant shrub is Acamptappus spheorpus, but larrea likely has the greatest biomass. Also common is ambrosia salsola, eriogrnum fascilatum, the chollas, thamnosa montana. The most common flowering annuals present during the study period were small Boraginace, crpythanta sp, Fremont phacelia, wallaces wooly daisy, gilia. Later more phacelia, Malacothrix, fremonts pincushion were common. The study took place between April 10th, 2017 and May 5th, 2017.