Impacts of Altered Precipitation on Aboveground-Belowground Interactions in the Sonoran Desert

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Background

- Drylands make up about 45% of the land above water, and studies of soil often do not include drylands.
- Altered precipitation patterns resulting in larger, less frequent storms from climate change will affect desert ecosystems.
- Many studies seek to explore the interaction of above ground and below ground communities within ecosystems.
- Bursage and Creosote are ubiquitous in the desert Southwest, and each have unique properties that make them interesting to examine in the context of their potential impacts on below ground communities.
- In this experiment, we seek to add to the knowledge of soil mesofauna in different soil conditions within drylands.

About the plants:

**Bursage:**
- Shallow roots
- Smaller
- Deciduous – drops leaves under low water conditions
- High-quality food

**Creosote:**
- Shallow roots and deep roots
- Larger/more shade
- Drought tolerant
- Low-quality food/waxy leaves
- Allelopathic – releases toxins from roots to discourage other plants

Questions

- What are the soil communities of microarthropods in deserts?
- Is there the differences of soil microfauna below bursage, creosote, and bare soil?
- How do changes in precipitation affect microarthropod communities?

Methods

This study was done at White Tank Mountain Regional Park. It is a Central Arizona-Phoenix Long-Term Ecological Research (CAP-LTER) site to the west of the city. The area is dominated by two shrub types, Creosote and Bursage. We chose replicates of the two shrubs and bare soil areas from which we took the soil samples. 36 total soil sites were tagged: 12 Creosote, 12 Bursage, and 12 inter plant space (bare soil).

**Pulse Event Simulation:**
- Simulated precipitation was dispersed with garden sprayers
- Circumference around the plant basal area to be watered based: 1.57 m
- Half of the replicates of each plant type received a 5 mm water pulse (simulating average precipitation event size) and half received a 7.5 mm water pulse (simulating a 50% increase in event size).
- Frequency of precipitation: Of those plant types that received a 5 mm pulse, half were watered every four weeks and the other half every two weeks. The same frequency treatment was applied to the plant types receiving a 7.5 mm pulse. This represents the average frequency and the average frequency decreased by 50%.

**Sample Collection:**
- Scooped 550 g of soil from each site within 21 cm of base of plant (initial collection July, final collection September)
- Preserved 500 g of each sample in 95% ethanol

**Sample Analysis:**
- Microarthropod extraction via heptane flotation
- Identification of invertebrates under microscope to the Order level.

Results and Discussion

**Figure 1.**
- **Season matters**
  - Before monsoon season, bursage and creosote are both statistically the same and different from bare soil.
  - By September bursage no longer different from bare soil because richness in bare soils was increased by making it rains.
  - Abundance, richness, and diversity were all related to season.
- **Water matters**
  - Creosote and Bursage is better habitat for soil mesofauna than bare soil under all conditions except for evenness when water was applied...
  - Diversity and Evenness in bare soils were related to precipitation levels.
- **Statistically significant differences were determined with ANOVA**

**Figure 2.**
- **Type of critter matters**
  - Less predatory fauna are more likely to be found under Creosote than Bursage or bare soil.

Future studies

Future will gather data about characteristics of the soil including carbon, nitrogen, pH, and salinity in order to examine the relationship of those qualities as they relate to plant, soil mesofauna, and precipitation. Soil fauna is expected to be influenced by nutrient and microclimates related to these conditions.

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