Ground-dwelling arthropods associated with Ephedra californica

**ABSTRACT**

**INTRODUCTION**

Insect conservation is becoming increasingly important.

Shrubs are keystone facilitators in arid environments.

Shrubs can facilitate through direct and indirect interactions. Previous work has found that shrubs provide keystone structure to ground-dwelling arthropods in Patagonian shrub steppe ([Liu, Zhu et al. 2016](#_ENREF_1)). “In recent years, the relationship between the shrub canopy and soil arthropod communities has received an increasing amount of attention. Two general, positive features of shrub presence: (1) habitat creator–physical environment; and (2) niche refuge as energy sources, will play an important role in trophic composition beneath the shrub canopy (Groner and Ayal [2001](https://link.springer.com/article/10.1007/s11829-016-9450-z#CR10); Polis [1999](https://link.springer.com/article/10.1007/s11829-016-9450-z#CR28)). Sanchez and Parmenter ([2002](https://link.springer.com/article/10.1007/s11829-016-9450-z#CR32)), Seeber et al. ([2009](https://link.springer.com/article/10.1007/s11829-016-9450-z#CR36)), and Liu et al. ([2011](https://link.springer.com/article/10.1007/s11829-016-9450-z#CR18)) described the facilitative effect of the shrub canopy on arthropod communities in arid and semiarid ecosystems.” Shrubs are reported to protect arthropods in harsh arctic climates as well. Previous work in california has found L. tridentata supports annual and arthropod communities (Ruttan 2016, Braun in prep). However, these studies have been restricted to the spring season when annuals are actively growing.

In arid regions of California, the growing season as a short period. Land managers have developed a set of protocols to measure the residual dry matter and apply it to several questions relating to rangeland management. If there are indirect effects of shrub facilitation that scale through the annual plants, they may …

RDM…

Foundation plants play a central role in structuring arid environments. Microclimate amelioration and other mechanisms can affect survival, growth, and reproduction of annuals plants. The positive effects of vegetation can propagate through other trophic levels, including both primary and secondary consumers. Complex direct and indirect effects. Residual dry matter (rdm) is a common measure of productivity in drylands. It is comprised of both direct and indirect drivers on plant composition and structure including resource availability, plant-plant interactions, and interactions with consumers.

Facilitation of annual plants and grasses by shrubs in arid environments is well established.

We hypothesize that shrubs facilitate arthropods. Predictions 1. More arthropods are associated with shrubs in deserts (abundance and richness). 2) Greater RDM under shrubs. 3) RDM facilitates arthropods. 4) effect of shrubs is influenced by rdm under the canopy

**METHODS**

Site description

Between the dates of June 23rd and July 8th, 2019, I sampled 3 sites each within 3 desert regions.

Study species

Residual dry matter and vegetation characteristics

At each site, I chose 30 shrub open pairs. Shrub microsites were located on the northern aspect of the shrub, within the dripline. A 0.5 m by 0.5 quadrat was placed by randomly throwing it under the shrub and the open microsites were chosen by throwing the quadrat over my shoulder and were located at least 2 m away. Within in quadrat, I estimated cover of the residual dry matter, green veg cover, measured the height of the vegetation within the quadrat. I counted the number of burrows under the shrub within the dripline, and at open microsites within a 1.5m radius around the quadrat to approximate the size of the shrub. For shrubs, I measured the length of the longest axis, it’s perpendicular and the height. I collected all residual dry matter within a 20 cm quadrat placed at the center of the 0.5 m quadrat using scissors ensuring only plants rooted within the quadrat were collected. These were placed in paper bags, and then dried within a *blank* oven at 85º C for 75 hours. The samples were weighed using *blank* scale with a precision of 0.001 g.

Measuring ground-dwelling arthropod communities

At eight shrub/open pairs per site, pitfall traps were used to sample the arthropod communities. Clear plastic drink cups (10 cm tall, 7 cm diameter) were used. These were placed in the center of the 0.5 m quadrat so the top of the cup was flush with the ground. The traps were filled with a 50% propylene glycol and water mixture and left for 72 hours. They were checked during this time and topped up with water as needed. Residual dry matter was collected after the traps were collected. Arthropods were sieved and placed in labelled vials containing 95% denatured ethanol.

Insects were identified depending on the group (see Appendix) using keys. They were assigned to morphospecies where possible. Mutillidae were not morphotyped because of strong sexual dimorphism. Only worker and major caste Formicidae were included in analyses. Springtails and insects smaller were excluded due biases arising from sieve mesh size. Larval stages and hemipteran nymphs that could not be associated with the adult form were excluded.

Data analysis

Interaction strength between *E. californica* and the annual communities was estimated using RII. Treatment was the weight of residual dry matter under the shrub and control was the rdm in open areas. RII used x equation.

To test for differences in arthropod communities associated with *Ephedra californica*, we fit generalized linear mixed models (glmmTMB). For abundance, one sample was excluded as an outlier (it had 1200 individuals and everything else is below 350). Microsite and RDM were included as predictors, and the study site nested within the region was included as a random effect. Poisson was used for species richness and a negative binomial error distribution was used for abundances because overdispersion was detected.

To test for differences in the composition of arthropod community, RDA (vegan) was used with microsite, site, RDM and region as constraining variables. The species abundance matrix was Hellinger transformed to account for differences in sample abundance and provide more ecologically relevant information (citations).

**RESULTS**

Arthropod community responses: A total of ~6300 arthropods were collected. Ants were the most abundant group.

* Arthropod abundance and morphospecies richness greater under shrubs. No influence of RDM.
* RDM higher under shrubs.
* No arthropod response to RDM at all.
* RDA & CCA show community are different.
* Also betadispersion tests show same results.
* More burrows in open areas – likely because there is no shrub in way.

**DISCUSSION**

TABLES

Table 1: List of study sites surveyed for this project

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Region | Lat | Long | Elevation | MAT | MAP |  |
| Pan1 | Panoche Hills | 36.70654 | -120.812 | 611 | 14.4 | 377 | 2.618056 |
|  | Panoche Hills | 36.70554 | -120.812 | 596 | 14.4 | 377 | 2.618056 |
|  | Panoche Hills | 36.70001 | -120.801 | 656.3209 | 14.4 | 381 | 2.474026 |
|  | Cuyama Valley | 34.84873 | -119.483 | 848 | 13.4 | 533 | 3.701389 |
|  | Cuyama Valley | 34.85362 | -119.486 | 837 | 13.4 | 533 | 3.701389 |
|  | Cuyama Valley | 34.93824 | -119.481 | 827 | 13.4 | 533 | 3.701389 |
| M1 (Sheep hole valley) | Mojave Desert | 35.09405 | -116.835 | 496.02 | 19.7 | 135 | 0.652174 |
| M2 (Heart of the Mojave) | Mojave Desert | 34.6982 | -115.684 | 784.73 | 19.3 | 79 | 0.389163 |
| M3 (Ft. Irwin area) | Mojave Desert | 34.20568 | -115.72 | 545.92 | 20.9 | 109 | 0.497717 |

Table 2: GLMM showing arthropod community responses

Figure 1: Map of study sites across Southern California.

**LITERATURE CITED**

Liu, R., et al. (2016). "Changes in ground-dwelling arthropod diversity related to the proximity of shrub cover in a desertified system." Journal of arid environments **124**: 172-179.