Ghazian Progress Report

York University, Toronto, ON

Spring 2021

**Exploring the effects of artificial deploys on dryland communities in California.**

**Examination Committee:**

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Table 1. Ph.D. Research chapters and timeline.

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| **Chapter** | **Title** | **Timeline** |
| **1** | **Finding the sweet spot in camera trapping: a review of camera trap papers to test for reported sampling effort in population estimates.** | * Manuscript is done. * Going to submit it to the journal of Methods in Ecology and Evolution as a mini-review paper. |
| **2** | **Effects of eco-friendly fabrics on canopy microclimate and annual plant germination rates.** | * Trials are currently being conducted in the lab. * Preliminary data are collected. |
| **3** | **Mega chapter: Animal-shelter/artificial deploy Interactions.** | * Spring-summer 2022 field season. * Discussed in the previous progress report. |
| **4** | **Effects of shelters on understory plant growth.** | * Either Spring 2022 or 2023 field season. * Dicussed in the previous progress report. |
| **5**  **Bonus Synthesis** | **A synthesis of the use of shelters as a tool facilitate plants and animals.** | * Systematically review the literature Spring-Summer 2021. * Conduct a meta-analysis. |

**Background**

The incidence and strength of anthropogenic disturbances are globally increasing in all systems. These changes reduce biodiversity by decreasing the amount of available terrestrial habitat for both plants and animals (Nopper et al. 2018; Irwin et al. 2010; Elmqvist 2013). If we continue with the current trends, likely, resident species can no longer behaviourally mitigate climate and land-use changes, such as urbanization and agriculture dryland systems (Germano et al. 2011). Many organisms in drylands are not only sensitive to large-scale changes, but also small, fine-scale fluctuations (Shrode and Gerking 1977; Hadley 1970), which can further push species beyond the point of no return. Hence, it is simply unrealistic to rely on the ecosystem to restore itself to its original equilibrium. Efforts need to be placed on actively examining restoration strategies for post-disturbed land, one of which can be the use of artificial canopies for microclimatic amelioration.

The presence of vegetation is key for ecosystem resilience. In drylands, shrubs are the dominant vegetation (Miriti, Joseph Wright, and Howe 2001; Throop et al. 2012). Foundation shrubs can function as structural agents of facilitation and provide benefit to other taxa through the canopies (Filazzola et al. 2017) that are generally a cooler, more humid microhabitat that experiences less direct solar radiation (Filazzola et al. 2017; Holzapfel and Mahall 1999). Additionally, the use of vegetation, when it means cooler temperatures especially during the warmest times of the day, is an important driver of habitat selection by vertebrate species (Kline et al. 2019). *Ephedra Californica* (Mormon Tea) is a common foundation shrub, native to the Southwestern regions of California (Sawyer, Keeler-Wolf, and Evens 2009), able to benefits other plants (Lortie et al. 2018) and animals (Ivey et al. 2020). Foundation shrubs in dryland systems are typically slow-growing (Sawyer, Keeler-Wolf, and Evens 2009), difficult to establish in areas impacted by climate change (Meyer and Pendleton 2005), and frequently cleared by ranchers for livestock farming (Webb and Stielstra 1979). Previously conducted a study using artificial shelters that offered more stable temperatures and less direct solar radiation; hence, reducing the amplitude of variation throughout the day (Ghazian, Zuliani, and Lortie 2020). These shelters can be used as a restorative solution, especially if the canopy is made from more eco-friendly materials. Currently, we are investigating the use of three eco-friendly fabrics, including burlap, cotton canvas, and seedling nursery fabrics in how they impact the understory temperature, radiation, and relative humidity, in hopes of updating our previous design for an environmentally friendly one with similar prospects.

Shelters have a relatively extensive use. Shrubs, solar farm deploys, and artificial shelters can increase spatial heterogeneity of the landscape for plants or animals. For example some birds use shelters for perching (Athiê and Dias 2016), whilst some snakes use them to thermoregulate (Lelièvre et al. 2010). Shelters, whether natural or artificial, can also facilitate other vegetation growing in their understory by increasing plant production and Leaf Area Index (LAI) of understory plants, mainly due to their windbreak abilities (Sudmeyer et al. 2002). Herein, we propose a synthesis of shelters as a tool to promote plant restoration post-disturbance to examine shelter types/benefactor species, protégé species, some measure of protégé facilitation such as survival or mortality, growth, and abundance, as well as the ecosystems where studies are conducted. We plan on systematically reviewing the literature and running a meta-analysis to test for vegetation restoration following the use of shelters

Integrating compositional and configurational heterogeneity into conservation practices may be key in future management strategies. Furthermore, it is important to test facilitative interactions while taking processes linked to abiotic change into consideration to develop frameworks that incorporate the inevitable anthropogenic changes that are occuring all around us.

**Chapter 2: Effects of eco-friendly fabrics on canopy microclimate and annual plant germination rates.**

**Purpose:** To quantify the extent to which different natural fabrics facilitate the understory annual plant growth in comparison to the open gap.

**Questions:** How do different natural fabrics such as burlap, cotton, and nursery seedling cloth affect microclimatic parameters such as RH, temperature, and light? How do different fabrics affect understory annual growth? Are annuals and foundation plants facilitated to the same extend?

**Hypothesis:** Germination rates of annual plants and foundation species do not differ between different fabrics and it will all be higher than the open gap. This advances the community assembly theory of context dependence that is variability in processes linked to changes in abiotic and/or biotic conditions.

**Predictions:**

* Artificial shelters increase humidity and create a windbreak environment, which in turn aids in understory plant growth.
* Artificial shelters create a barrier from direct solar radiation; hence, creating shade for the young seedlings, so germination can occur more effectively compared to the open.

**Materials & Methods**

Trials are currently being conducted in the lab. We selected three environmentally-friendly fabrics: burlap, 100% cotton canvas, and seedling nursery fabric. Fabrics were set-up at an angle to the ground to create shade. Approximately 300-400 seeds of the annual species *Phacelia tanacetifolia* (fiddleneck) were planted in seedling propagation trays with the dimensions 53.34 x 27.94 x 6 cm. Seeds of *Cylindropuntia acanthocarpa* (buckhorn cholla) were planted in a tray with the same dimension at the density of 0.5 seed/cm2. Tray soil mix was made from ~50% sand and 50% succulent/cacti soil mix. Trays were watered weekly. One tray of each species was placed under the fabric and one was placed in the open for a total of 3 fabric-open replicates. Data loggers were attached to pegs using zipties and placed in cups filled with sand under each fabric and in the open measuring RH, light intensity, and temperature at 1-hour intervals. LED lamps provided UV for a total of 12hours/day (suggested in the manual for dryland species). 60-watt heat lamps were used to create artificial heat and remained lit for the entire duration of the study. Fabrics are tested for one month.

**Preliminary Results**

**Chapter 5: A synthesis of the use of shelters as a tool to facilitate plants and animals.**

**Purpose:** To systematically review the relevant literature on artificial shelters to test the frequency of the use of shelters to promote plant restoration or animal habitat amelioration.

**Questions:** How often are artificial shelters used in the literature for animal habitat amelioration or plant germination? What species are most commonly examined? How were the shelters used (i.e. thermoregulation, shade, perching etc.)? What parameters are most often reported in shelter studies?

**Predictions:**

* Artificial shelters can create a windbreak effect, which is useful for plant restoration during germination.
* Artificial shelters, such as fake rocks, can be used as a form of habitat restoration to promote the re-introduction of endangered species to an area.
* Shelters can aid in thermoregulatory behaviour during peak sunlight and temperature hours of the day.

**Methods**

Figure 1 represents the workflow for extracting relevant data. Literature will be obtained through keyword searches in ISI Web of Science (WoS) using a mixture of the keywords artificial shelter\* AND habitat restoration; artificial shelter\* AND plant\*. Google Scholar and book chapters will also be reviewed to validate the publication coverage of WoS. The list of papers will be exported as a CSV file. Abstracts will be reviewed and all opinion, review, and idea papers will be removed so that the focus remains on empirical studies. Data such as the location of the study, reported taxa and species, type of shelter, as well as function will be recorded.

Papers obtained through database searching (Web of Science) Keywords:

Artificial shelter\* AND habitat restoration; artificial shelter\* AND

plant\*

(n= 233)

(n= 515)

(n = 1090)

## Identification

Papers obtained from other sources, such as book chapter bibliographies

(n= )

## Eligibility

Records after duplicates removed   
(n = )

Records excluded for: relevance, review, opinion or idea paper, qualitative, not written in English.

Records screened by abstract (n = )

## Screening

Full-text articles excluded

Full-text articles assessed for eligibility (n = )

(n = )

Include in synthesis

(n = )

## Included

Extracted data:

Location (latitude, longitude), year of study, type of shelter, function/purpose of shelter, taxa of study, and study species.

If plant, germination/restoration success recorded via survival or mortality, growth, abundance, and percent cover.

**Figure 1. PRISMA adapted from Moher et al. (2009).**

**Work Cited**

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