Ghazian Progress Report

York University, Toronto, ON

Spring 2021

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

Lets work on thesis title.

The relative importance of shelter on microclimate, plants, and animals in desert communities.

Snap!!! GO big right.. haha

**Examination Committee:**

Dr. Suzanne MacDonald

Dr. Christopher Lortie

Dr. Laura McKinnon

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Chapter** | **Title** | **Timeline** | **Theory** |
| **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. | Sampling theory |
| **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. | Microclimatic amelioration & shrub canopy mimic |
| **3** | **Real title here -** | * Spring-summer 2022-24 field seasons. | **List key theories test** |
| **4** | **A synthesis of the shelter-amelioration facilitation by shrubs in deserts for animals.** | * Systematically review the literature Spring-Summer 2021. * Conduct a meta-analysis. | **Mechanistic analysis of facilitation effects of shrubs on animals** |

**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). Changes in environment at fine-scales can push species beyond the point of no return and force local extirpations because of the relative climate envelopes of some species (citations) and/or their capacity to adapt to a changing climate (Citations) or to migrate (citations). - these are the ideas BUT how fine-scale has this been tested? Hence, it is simply unrealistic to rely on the ecosystem to restore itself to its original equilibrium eh? How does this relate to scale set up you just did - cit. 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. Sure - Revise - not sure the point of this paragraph - too many ideas mixed together pick one of two - disturbance at different scales.. but we are not testing that - climate at different scales matters for species - yes MUCH better to set up for that etc then link to the capacity species can address these changes

The presence of vegetation is key for ecosystem resilience because?? . Define resilience with citations. 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). Vegetation can also provide cooler temperatures during the hottest times of the day and thus provides refuges for species and is thus an important driver of habitat selection for many vertebrate species (Kline et al. 2019). *Ephedra Californica* (Mormon Tea) is a common foundation shrub and native to the Southwestern regions of California (Sawyer, Keeler-Wolf, and Evens 2009). It can facilitate other plant species (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 after often frequently cleared by ranchers for livestock farming (Webb and Stielstra 1979). Develop ideas here more clearly before you get shelters.. how much can shrubs make a difference, reorder ideas and out ephedra at after you clean up and introduce big ideas well first.

So para 1 - climate change at MANY scales including finer-scales is a BIG deal for species because…

Para 2- shrubs and actually likely many plant species that are perennial with a canopy can provide benefits to other plants and animals… develop.. then one of the benefits is abiotic amelioration (citation) likely a dominant mechanistic pathway of interactions in deserts. Shrubs do this…etc and this helps plants and animals address climatic extremes at the scales that matter to them - fine-scales… then end with ephedra is a good example in the SW deserts of cali etc.. bc it does that for other plants, animals, etc..

Then YES now you are set up - BIG picture remember Shelters have a relatively extensive use???eh? Shelter is thus an important form of ecological interaction in deserts but it is also a physical presence or natural and artificial form of architecture etc… then get to this next stuff.. Shrubs, solar farm deploys, and artificial shelters can increase spatial heterogeneity of the landscape for plants or animals?? Citations - what is spatial heterogeneity introduce idea first then stat how shelters can provide it.. … so I LOVE this idea - but make it clear - SHRUBS and artificial shelters can thus do two things right? Provide novel or limiting habitat through physical spatial heterogeneity (that is ONE thing) and ALSO provide direct benefit through microclimatic amelioration (ie what you just set up in last paragraph). 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). We recently completed a pilot study using artificial shelters and found that they can provide a stable temperature regime and less direct solar radiation (Ghazian, Zuliani, and Lortie 2020). These shelters can be used as a restorative solution - particularly if the canopy is made from more eco-friendly materials. However, we have not tested its ecological impacts on other plant and animal species. The general and overarching hypothesis of thesis is thus that….. To test this thesis-level objective, we first determine the relative sampling efforts needed to estimate biodiversity in animals through a meta-analysis. Secondly, to ensure that artificial shelters are ecofriendly. we…. Then - main chapter - we test in the field the microclimatic AND spatial heterogeneity benefits of deploying shelters at X sites and measure both fine-scale climate, vegetation responses, and animal use through cam trapping. SNAP - THEN it is SUPER Clear how it ALL ties together - because it all does…. If you want, add final sentence stating… Providing their is time and depending on fieldwork, we will also do broad scientific synthesis to explore the generality of the microclimatic amelioration of shrubs for animals in a meta-analysis. This will frame the experimental findings from this region in global research trends.

**Main thesis objectives**

1. Identify key sampling designs with cam traps.
2. 2.Record microclimatic impacts of ecofriendly materials and their influence on plant species under controlled conditions.
3. Demonstrate ecological effects of shelter in the field.
4. Compile fréquency and ecological strength of microclimate facilitation reported in literature.

Chapter 1.

Draft attached.

Purpose

Hypothesis

Key findings

Just a few sentences total.

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

**Purpose:** To test the capacity of natural fabrics to ameliorate heat and rh? And estimate effects on native and exotic seeds and seedlings.

**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: start with m.climate first -** 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. - revise..

**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.

revise… needs to be specific and testable.

More permeable fabrics??

Size?

Color…

Then 1-2 preds on impacts. Is there a ‘sweet spot’ for fabrics too? Haha on their benefit?

**Methods**

**Experimental system**

Controlled lab conditions etc… set

**Design**

Lay out design

**Materials**

List fabrics and explain how they differ

**Proposed analyses**

All data for repeated trials will be aggressed in X way etc… Then, GLMMS will be used etc. do not need a lot just some details

Trials are currently being conducted in the lab. We selected three environmentally-friendly fabrics: burlap, 100% cotton canvas, and seedling nursery fabric. What is burlap? Define or describe fabrics just a bit.. fiber count, weight, etc, whatever people use to measure fabrics… thread count for sheets haha stuff like that.. were there any dyes in them? 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. Revise

**Preliminary Results**

* Germination only occurred for *Phacelia* under the canvas fabric and not in the open or under burlap.
* Logged temperatures were very similar between the two different brand loggers.
* Humidity was recorded at higher percentages under burlap followed by canvas.
* Light intensity recorded under burlap and canvas are very similar, with canvas having slightly lower intensities.

Turn into paragraph and write like results - same content etc.. super simple fine.

OK in general - All ideas great just develop more, add more precision in the framing and concepts, and tighten writing. Like 2-3 days work at most. Plus look up how you measure fabrics and the new citations we need above for intro etc.

**Chapter 3: Animal-shelter interactions. - need solid title - The impact of artificial shrub deployment on microclimate, plant establishment? Or persistence, and patterns in animal habitat usage.**

**SNAP - if that is what you are doing.**

**Purpose:** To examine wildlife interactions with artificial shelters and to investigate how artificial shelters impact the soil microbial community.

**Questions:** How do UV permeable artificial shelters modify the soil microbial community richness and abundance? How often do vertebrates interact with artificial shelters? Which species interact with shelters the most often? What are they doing when interacting with shelters? Do arthropods interact with shelters? If yes, which species do most often? Does the richness and abundance of microbes differ between shelters, shrubs, and the open gap? Is the frequency and direction of vertebrate and arthropod interaction with shelters different from shrubs and the open?

**Hypothesis:** The magnitude and direction of association of vertebrates, arthropods, and soil microbes will be similar between natural shrubs and artificial shelters, and both will significantly differ from the open. - this is the outcome NOT an explanation of how the system works - ie need a crystal clear hypothesis..

**Predictions:**

* Artificial shelters increase RH, soil moisture, and reduce microclimatic extremes.
* Soil microbial community composition under established shrubs and artificial shelters will be similar and both differ from non-canopied microsites… etc tighten up all predictions like this,
* Differences in microbial community between natural shrubs and shelters is will most-likely be due to that fact that shrubs provide different nutrients otherwise not provided by shelters.? cut.
* Vertebrates will positively associate with shelters as temperature and drought increase to take refuge from direct sunlight and extreme temperatures. See title etc. MAKE super clear

**Methods**

**Write like you would for the paper -just easier then a big blog of text :)**

**Study sites**

**NOT at Carrizo? Can we do two sites? Why here? Why not a semi-arid site, ie Panoche and a really arid site like near the Mojave and then see where it matters the most. I proposed the same ideas to Mario - instead of poking down right in the middle of a gorgeous gradient the the ends of it - you know the repo**

<https://github.com/cjlortie/California_desert_ecology/blob/master/data/regional_sites.csv>

**Most arid sites - pick Sheep hole or Tecopa - great spots to work etc.**

**Least is actually the northern Cuyama sites - NICE open BLM lands, Panoche or some spots in Carrizo**

**You do NOT have to pick the same sites as Mario of course - however chat with Jenna, Mario, maybe even Steph and think whereto want to work - if Sheep hole or heart of Mojave, can stay at MNP then just drive over. If Cuyama, hmm camp at that nice campground etc… OR just Carrizo - fine - but be nice to branch out here and address larger climate drivers too - aridity is one order of magnitude different between sites within San Joaquin.**

**Species**

**Ephedra California…**

**Microbial species are..**

**Vertebrate are these … up to 81 likely to be observed etc.https://github.com/cjlortie/California\_desert\_species/blob/gh-pages/data/animals.csv**

**Vertebrates:** The study will take place in Carrizo Plain National Monument, California, U.S.A (35.1899° N, 119.8633° W) or any other field site deemed fit. UV permeable shade cloth shelters will be built using Ghazian et al. (2020) protocol, with a modified eco-friendly design. The study will take place near medium shrub-cover areas from mid-May to mid-June to allow for seasonal variabilities. There will be a total of 12 shelters: 6 of each of the two best fabrics determined in the laboratory experiment (i.e. canvas, nursery seedling cloth, or burlap). We will select microsite triplets which will include a shelter, a shrub, and the equivalent open. Cameras will be mounted on pegs and set up facing the microsite at a 2-meter distance. All microsites will be georeferenced. There will be a 1-minute gap between when cameras are triggered until when they’re re-triggered to avoid repetitive images of the same individual. All images will be downloaded from SD cards and saved as Joint Photographic Expert Group (JPEG) files and data such as the presence and absence of animals will be recorded and compared across microsite. RH and temperature loggers will also be placed at microsite triplets and record data as described above.

**Arthropods:** Yellow-coloured pan-traps (As *E. califronica* flowers are yellow-orange) will be placed at microsite triplets and will contain soapy-water to trap insects. Insects will be collected every 3 days and will be preserved in ethanol and shipped back to Canada for expert identification.

**Microbial Community**: Soil core samples will be taken from all georeferenced microsites once at the beginning of the study and once following the completion of the study. Samples will be sent to an expert lab group at UC Davis, California for composition and abundance analysis.

Plants

**Proposed analyses**

How will you compile data and them use GLMMS or whatever you will do

**Anticipated results**

Propose what you think you will find.

**Chapter 4: A synthesis of the use of shelters as a tool to facilitate plants and animals. See table for title**

**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. Revise

**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? How effective are they, ie effect size measures?

OK - these questions are NOT what I thought - IF we are just taking my systematic review and the one pathway from Alex’s ie amelioration - it is not really the same things as your questions..

**Predictions:**

* Artificial shelters can create a windbreak effect no cut
* 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. Hmm no
* Shelters can aid in thermoregulatory behaviour during peak sunlight and temperature hours of the day. No to - I think we are on a different page - your questions are also not at this level..

So it seems like there are THREE options here

1. Synthesis of shrub facilitation lit from my FE paper and Alex’s one pathway
2. A synthesis of applied research how people use shelters (not shrubs at all) to do things for animals - are there many papers?
3. A synthesis of things shelters do ecological or environmental and how animals respond…

as you know from keywords and synthesis these there are very different things and #3 might be two sets of really different studies as well - ie effects versus responses… I love them all but best to be clear and pick one of the three.

**Methods**

**Explain a bit more…**

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)**

BIG PICTURE - GREAT SHAPE - zero issues here however be nice to set yourself up super well for fun and steer them to the ideas you want so

1. Select and highlight the theories you want to tackle
2. Need some design visuals here - even one showing design
3. Need more specificity in writing and some spots the ideas just to ensure you are nailing it - this is actually easy - just writing refinements and a few more paper citations. That’s it.

**Work Cited**

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