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Micro to macroclimatic scaling effects on foundation plant species interaction with vertebrate protégé species.

Proposal

The Stress Gradient Hypothesis (SGH) proposes a switch from competition to facilitation with increasingly stressful environmental conditions¹. This hypothesis sparked the interest of many^{2,3} for examining positive interactions. Since, various studies have focused on positive interactions in harsh environments, including arid ecosystems⁴⁻⁶. Facilitation is a type of positive interaction where one interacting species benefits whilst none are harmed⁷. Thus, positive interactions are studied relatively well when discussing stress; however, many do not measure and report stress effectively. Climate in particular is a stressor typically not explored, nor reported. Thus, to ideally advance the relative importance in stress with global change, we need to measure interactions and climate at different scales, which can include micro (on site), meso (multiple sites in one location), and macro (multiple locations).

Foundational plant species or nurse plants are an integral part of facilitation research⁸. These include shrubs that benefit protégé species⁹ through various mechanistic pathways that include, but are not limited to, seed trapping, abiotic stress amelioration, and soil modification⁸. There is also capacity for the same interaction pathways to benefit animals in deserts¹⁰. An important agent of abiotic stress amelioration is shrub canopy, able to facilitate animals through direct and indirect shelter and refuge effects^{11,12}. This is important because deserts are home to many rare, endemic species of animals and biodiversity is high in drylands. These systems are under threat and many federally listed endangered species are in deserts, including some of the first ever to be listed in the USA¹³. Hence, it's crucial to study the diversity of such threatened ecosystems.

Desertification and arid region expansion is a critical global change issue¹⁴. The well-being and function of foundation plants species may depend on factors such as in temperature, variability in precipitation, extended drought periods, and radiation¹⁵⁻¹⁷. The changes in the above microclimatic parameters are primarily due to anthropogenic climate change¹⁸ that significantly modifies physical and biological systems in all continents¹⁹. Over the upcoming decades, global desertification will generally continue to increase²⁰. Climate-driven behavioural plasticity encourages shifts in habitat so behavioural regimes can continue to function²¹. Thus, closing this research gap by examining behavioural-ecological domains such as movement and spatial pattern, foraging and vigilance, social organization, and reproductive behaviour²² is important. Plants and animals in deserts will not only experience large scale changes such as droughts, but also small scale changes such as fluctuations in temperature and light, since for these organisms deserts are extremely heterogeneous at fine scales^{23,24}. Due to this, it's important to have data at both levels. Climate envelope models are common tools for species to understand how they respond to change and environmental drivers, though one cannot ignore the interactions that buffer their tolerances, as well²⁵.

What I'm most curious about and propose to do in this project is explore how temperature and light influence the association of vertebrates with shrubs. In addition, I want to re-construct my UV permeable shelters at a grand scale that mimic shrub canopy, which can be used for conservation purposes as new shrubs are grown.



Figure 1. An example model of the shelters to be built. Left: square shelter with 15% light blockage. Right: triangle shelter with 50% light blockage.

Budget

I'd like to re-construct my UV permeable shelters at a grand scale and pair it with camera trapping and temperature/light loggers. To re-construct these shelters, I would need three different percentages of shades, which I already have from last year's construction. Camera traps and temperature/light loggers from previous field seasons can also be used. Hence the things that need to be purchased are the PVC pipes, the connectors, zip ties and the stakes to secure the shelters to the ground. Field vehicle and lodging can be covered through my supervisor's grant. Below is a cost breakdown of the shelter parts:

Part	Approximate cost per unit (USD)	Number of units needed per shelter	X 30	Total
61cm ½ inch pipe	1.20	Square: 8 Triangle: 4	240 120	288 144
90° elbow	1.50	4	120	180
Adapter ½ to ¾	0.9	2	60	54
61cm ¾ inch pipe	2.00	1	30	60
3 way 90° elbow	1.60	2	60	96
Zip ties	12.00	2		24.00
Metal stakes	2.75	Square: 8 Triangle: 4	240 120	660 330
				\$1,836

The total to execute this project amounts to \$1,836. If I were to be awarded the \$1000, executing this project would be made much easier as my supervisor would only have to cover about \$800 worth of shelter equipment. This cuts back quite a bit of the cost of turning this grand-scale project into reality.

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