Landscape Legacies Influence Rock and Succulent Distribution

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Introduction

Succulent species have been shown to be associated with surface rocks in drylands, as these soil features may provide favorable microclimates for colonizing plants (Warkus 2012). **However, the strength of rock-succulent association across heterogeneous landscapes is unclear**. This study was performed on Perry Mesa in Agua Fria National Monument, where ancient human agriculturalists moved rocks and cultivated succulent species, which is hypothesized to be driving succulent distribution today.

Questions

1. What factors control the distribution of succulents on Perry Mesa?
2. Are succulents associated with rocks more frequently than expected by chance across a heterogeneous landscape?
3. Is the distribution of succulents related to prehistoric structures or agriculture features?

Methods
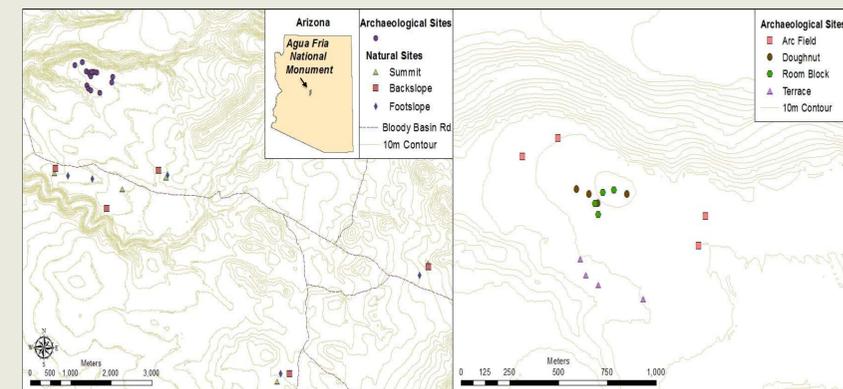
Figure 1 a.   **Figure 1 b.**

1. We measured surface rock cover and succulent abundance at 3 topographic positions (Fig. 1 a).
2. We took soil core samples along transects and near succulents.
3. We measured expected and actual succulent distance from surface rocks ≥10 cm in diameter.
4. We measured surface rock cover and succulent abundance at 3 archaeological categories and on a "control" area, where no prehistoric occupation has been documented (Fig. 1 b).
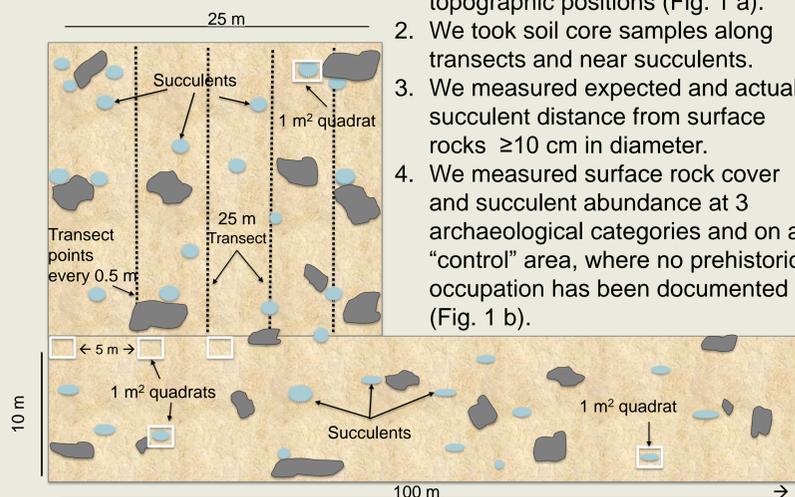
Figure 2. by E. Warkus "Spatial Associations Between Surface Rocks and Succulents in the Agua Fria National Monument"

Results

1. Geophysical factors affect succulent distribution:
- Succulent abundance is positively correlated with surface rock cover (Fig. 3).
- Succulent abundance is positively correlated with silt and clay content *only* at the **summit** (Fig. 4).
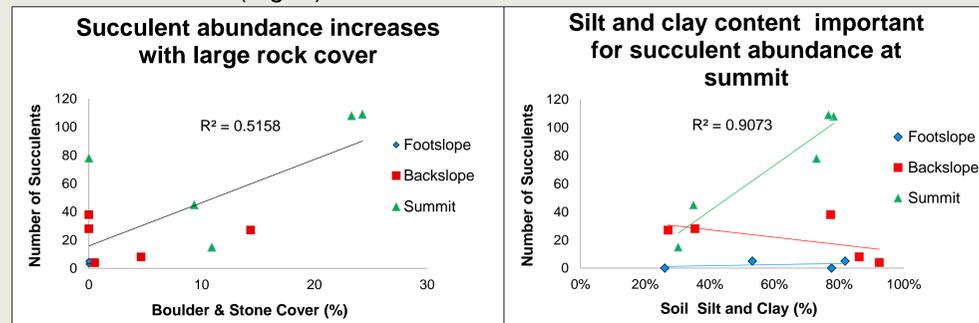
Figure 3. Number of succulents per transect (N=12) and rock (≥25 cm) cover within 1 m^2 of succulents.

Figure 4. Number of succulents per transect by silt and clay content within 0.5 m of succulents

2. Succulents are associated with rocks:
- Succulents are associated with rocks more frequently than expected by chance at the **summit**. (36.97% of succulents are within 2 cm of a rock)
- No difference was found between expected and actual values at backslope and footslope.
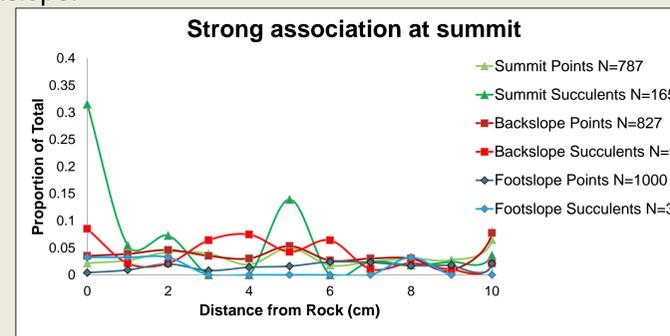
Figure 5. Proportion of expected distances (points) and actual distances (succulents) to rocks up to 10 cm away.

3. Archaeological features affect succulent distribution:
- When succulents are present their abundance is greatest in agricultural terrace fields, which have a high percentage of rock cover.
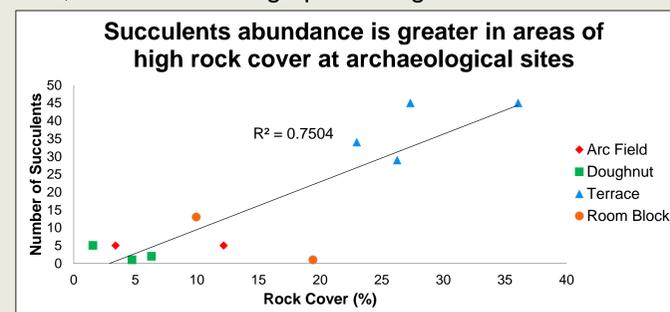
Figure 6. The number of succulents at archaeological features by the average percent rock cover in 1000 m^2 transect.

Discussion

1. Areas with high percent rock cover as well as high soil silt and clay content may create landscape patches that benefit succulent species (Figures 3 and 4).

2. **Only** on the summit of hills, **succulents are associated with surface rocks** more than expected by chance (Fig. 5).

3. Ancient human modifications to the landscape between 1250 and 1450 AD have had lasting effects on today's succulent distribution. Succulent abundance is greater at agricultural terrace fields where humans aggregated surface rocks in the past.

Future Directions

What are the mechanisms driving the relationships between rocks and succulents?
Other hypotheses to explore:
- Soil water retention/microclimate effects
- Seed trapping
- Soil support/ compaction

Has ancient cultivation of succulent species impacted the distribution of succulents today?

References Cited
Warkus, E. 2012. Spatial Associations Between Surface Rocks and Succulents in the Agua Fria National Monument