SPATIAL ASSOCIATIONS BETWEEN SURFACE ROCKS AND SUCCULENTS IN THE AGUA FRIA NATIONAL MONUMENT

1. Introduction

- In arid and semi-arid ecosystems, facilitative “nurse” associations ameliorate temperature fluctuations, increase soil water availability and protect against physical disturbance.
- Nurse plant associations have been well-studied (e.g. leguminous trees and saguaro seedlings), but little research has explored the potential abiotic facilitation of plants by rocks.
- Facilitative associations may be abiotic (e.g. surface rocks), which can regulate succulent species composition and distribution.

In this study, we ask: Is the distribution of surface rocks associated with succulent distribution and composition within prehistorically active landscapes of the Agua Fria National Monument? We predict that succulent distribution will be more dense within a 2 cm buffer zone of surface rocks than expected by chance, and this association will be strongest within the globose, rossette and cylindrical succulent growth forms compared to shrub-like cacti.

2. Methods

Study Site: Agua Fria National Monument (AFNM)
- 25 m x 25 m plots on hillslope (high rock cover) and hillslopes (low rock cover)
- 4 parallel N-S transect lines
- Transect points every 0.5 m
- 1 m x 1 m subplots every 5 m

Microhabitat
- Three zones in relation to surface rock: buffer zone (0-2 cm), extended buffer zone (2-5 cm) and not associated (>5 cm)

Spatial association differs by succulent species (Fig. 2)
- A lower proportion of shrub-like cacti were found within 2 cm of a rock (94%), 0% were located within 5 cm of a rock and (8%) are not associated with a nurse rock (>5 cm)
- Data collected from around succulents were compared to expected values calculated from transect points and subplots

3. Results

Succulents are associated with surface rocks (Fig. 1)
We found a greater association between succulents and rocks than expected by chance. Nearly 70% of the succulents we encountered (N=122) are associated with rocks within a 2 cm buffer zone (~23%) are located within 5 cm of a rock and (8%) are not associated with a nurse rock (8%). Approximately equal proportions of our surveyed grid points were located within 2 cm and 5 cm of rocks (~22% each) while most were >5 cm away from rocks (~54%).

Spatial association differs by succulent species (Fig. 2)
- (94%) of Agave parryi (rossette) and (83%) Echinocereus fasciculatus (cylindrical) individuals grew within 2 cm of rocks (of 52 and 12 individuals of these species surveyed).
- A lower proportion of shrub-like cacti were found within 2 cm of surface rocks (Opuntia phaeacantha, 55%, Opuntia chilcotica, 71%; Cylindropuntia acanthocarpa, 63%; Cylindropuntia leptocaulis, 0%). A. paryi and O. chilcotica were always located within 5 cm of a rock.

4. Discussion

Succulents are associated with surface rocks
The majority of succulents are growing within a 2 cm buffer zone of a surface rock, fewer are located between 2-5 cm, and very few are located >6 cm away from surface rock. This pattern is different than the distribution of points as expected by chance.

Spatial association differs by succulent growth form
It appears that some succulent growth forms prefer nurse rock compared to others. A. paryi (rossette) and E. fasciculatus (cylindrical), appear to be associated with rocks more often than the shrub-like growth forms: C. acanthocarpa, C. leptocaulis, O. phaeacantha and O. chilcotica.

5. Future Research

Association between succulents and surface rocks
We plan to collect data from at least 15 hilltop-hillslope plot pairs before May, 2012. These data will be used to further support the potential role of surface rocks as nurses to facilitate succulent persistence in semi-arid grasslands.

Spatial association and succulent growth form
We hope to strengthen the preliminary patterns we see between surface rocks and succulent growth forms. We have not recorded all possible species or growth forms in our preliminary data.

Lasting effects of prehistoric agriculture in AFNM
If our preliminary hypotheses are supported, we plan to assess the effects of surface rock manipulation by prehistoric agriculturalists on succulent distribution and richness.

Acknowledgements
I would like to thank Dr. Sharon Hall for her years of mentoring me. I would not be where I am today without her support. I would also like to thank Dana Nakase for guiding my research efforts and spending numerous hours to help with planning, editing and field work. I thank Dr. Sala for his time and advice. Finally, I would like to thank all of the Hall Lab members for their unending support and enthusiasm.