

A wide-angle photograph of a vast, flat landscape covered in a dense carpet of bright yellow wildflowers. In the far distance, a range of low, rolling mountains is visible under a clear, pale blue sky. The foreground is filled with the texture of the flowers, while the middle ground shows the expanse of the field stretching towards the horizon.

# **What's Past is Prologue**

**Ten years of vegetation re-  
sampling in the Carrizo  
Ecosystem Project**






RESEARCH ARTICLE

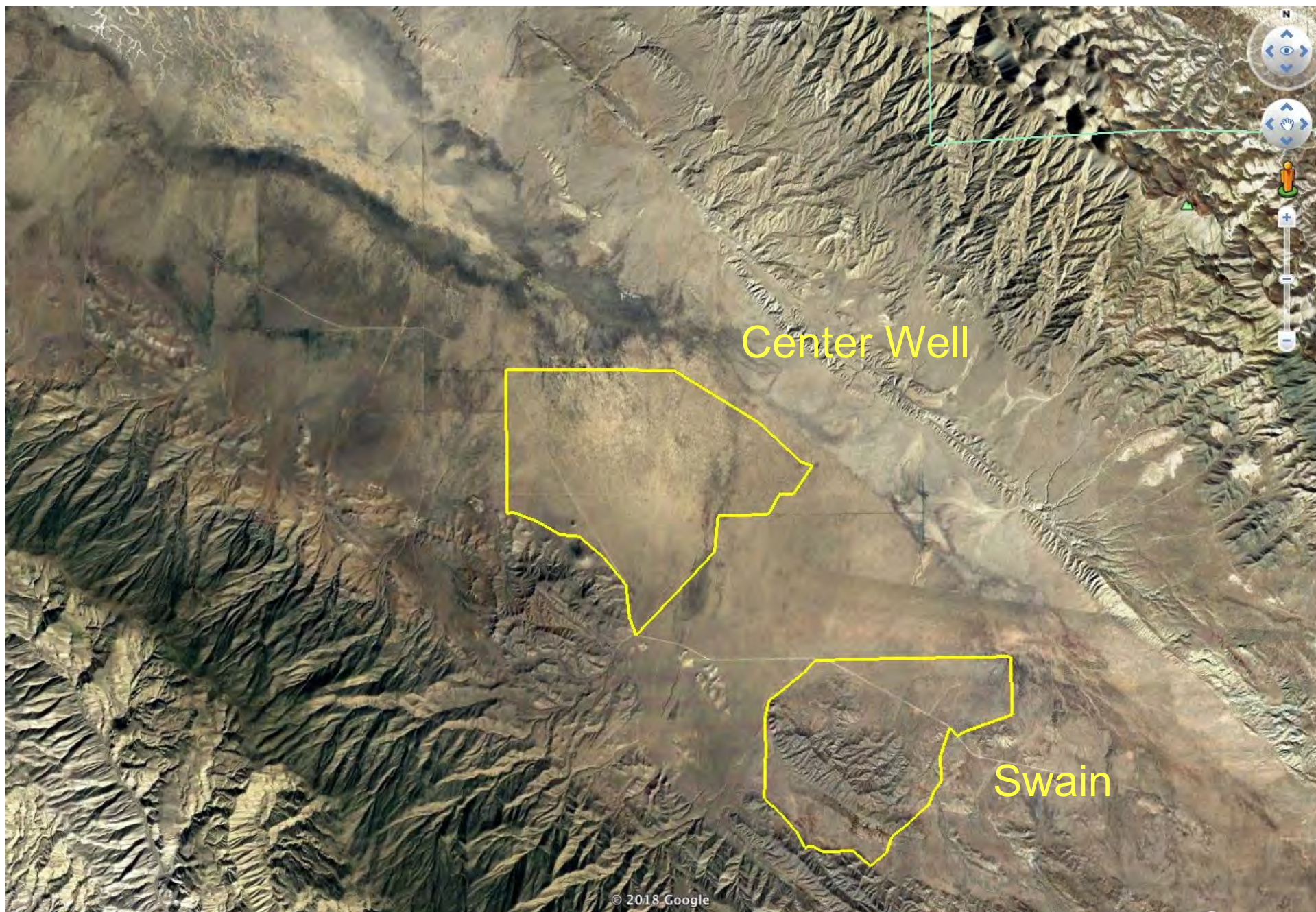
Journal of Ecology



## Animals alter precipitation legacies: Trophic and ecosystem engineering effects on plant community temporal dynamics

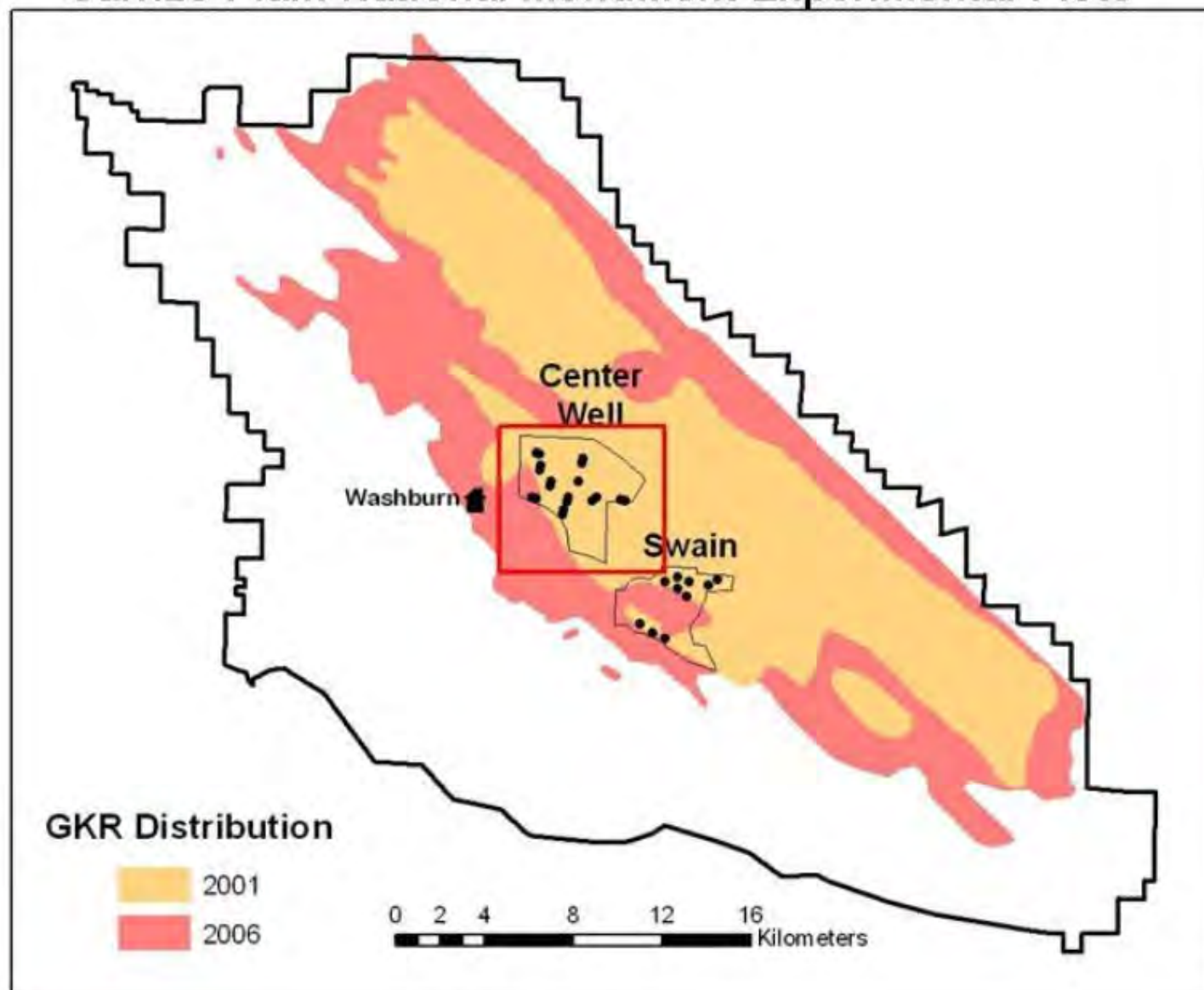
Joshua B. Grinath<sup>1,2</sup>  | Nicolas Deguines<sup>3,4</sup> | John W. Chesnut<sup>5</sup> |  
Laura R. Prugh<sup>4</sup> | Justin S. Brashares<sup>3</sup> | Katharine N. Suding<sup>2,6</sup>

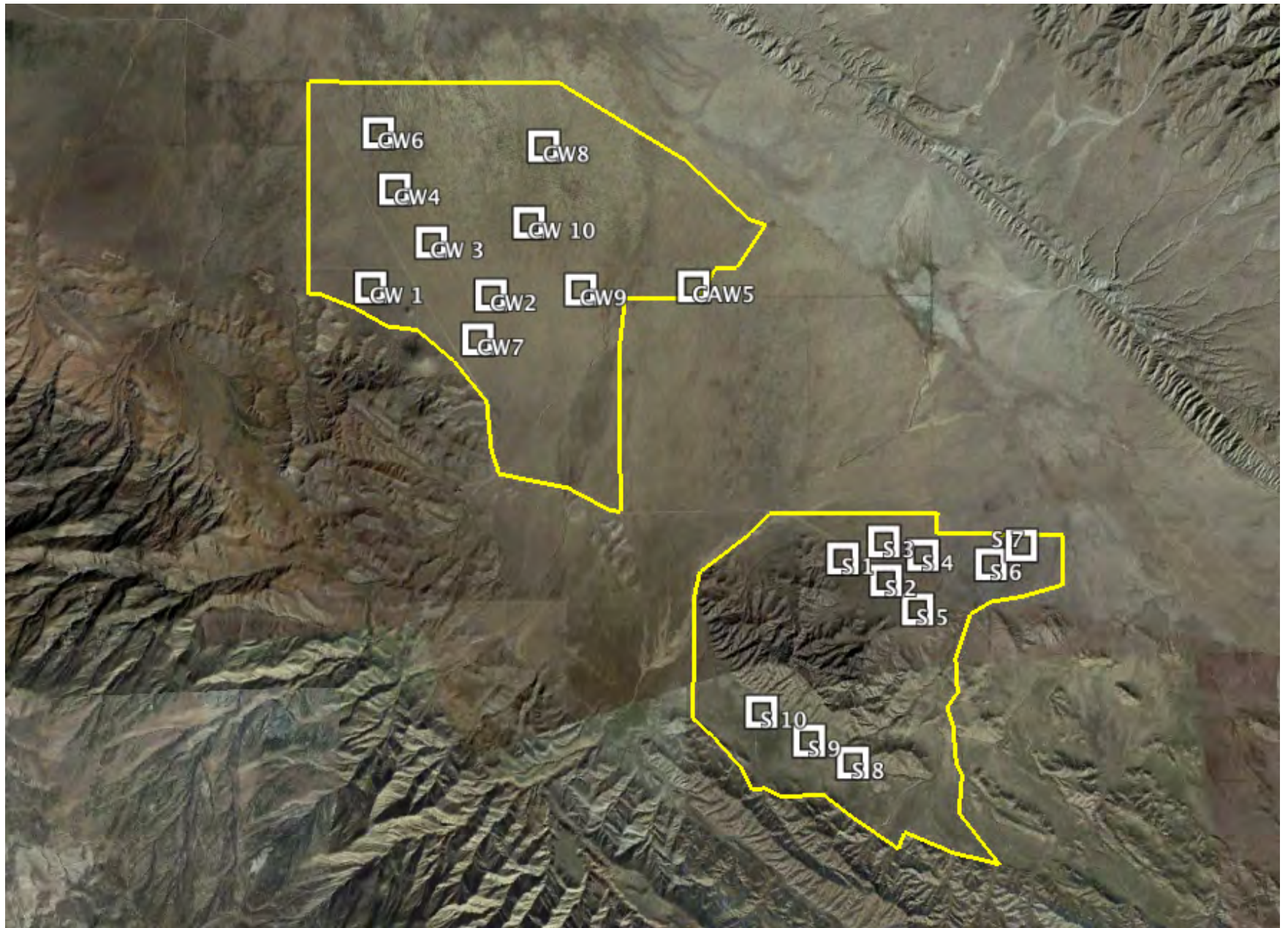






## Carrizo Plain National Monument Experimental Plots

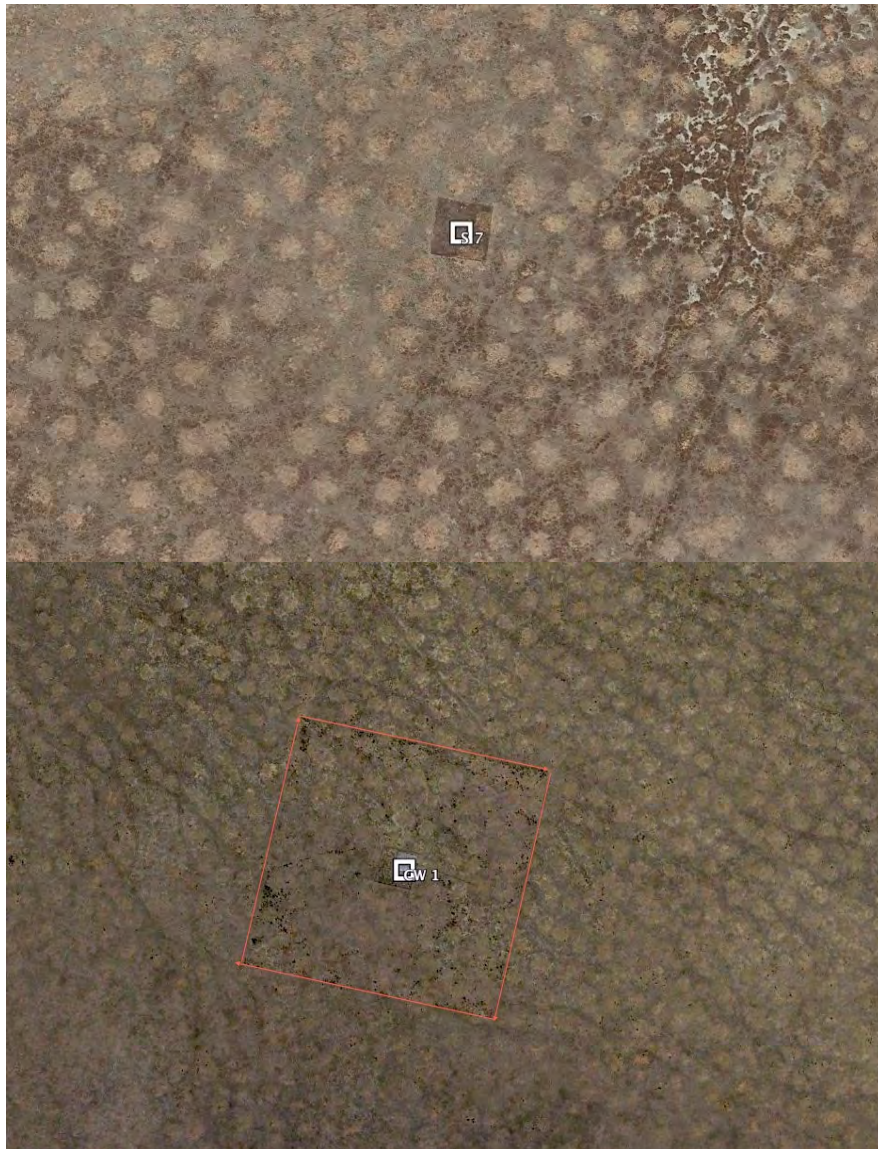




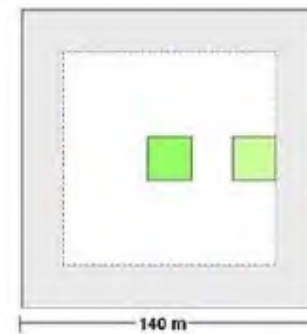




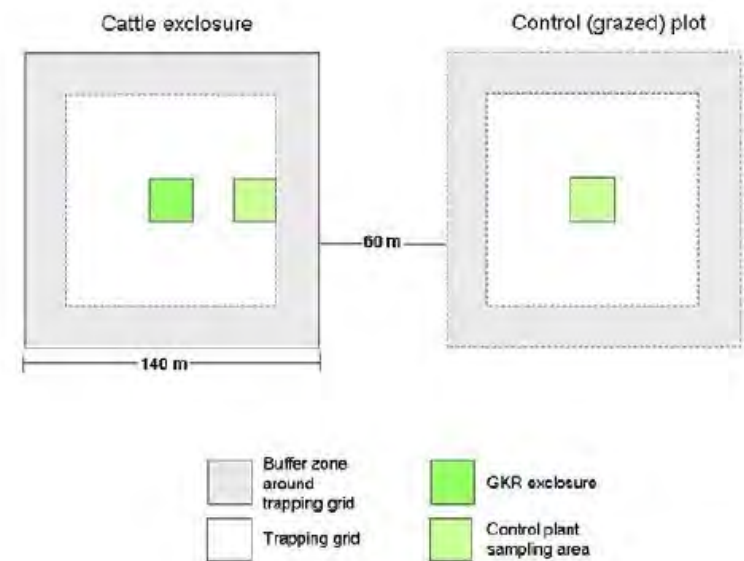




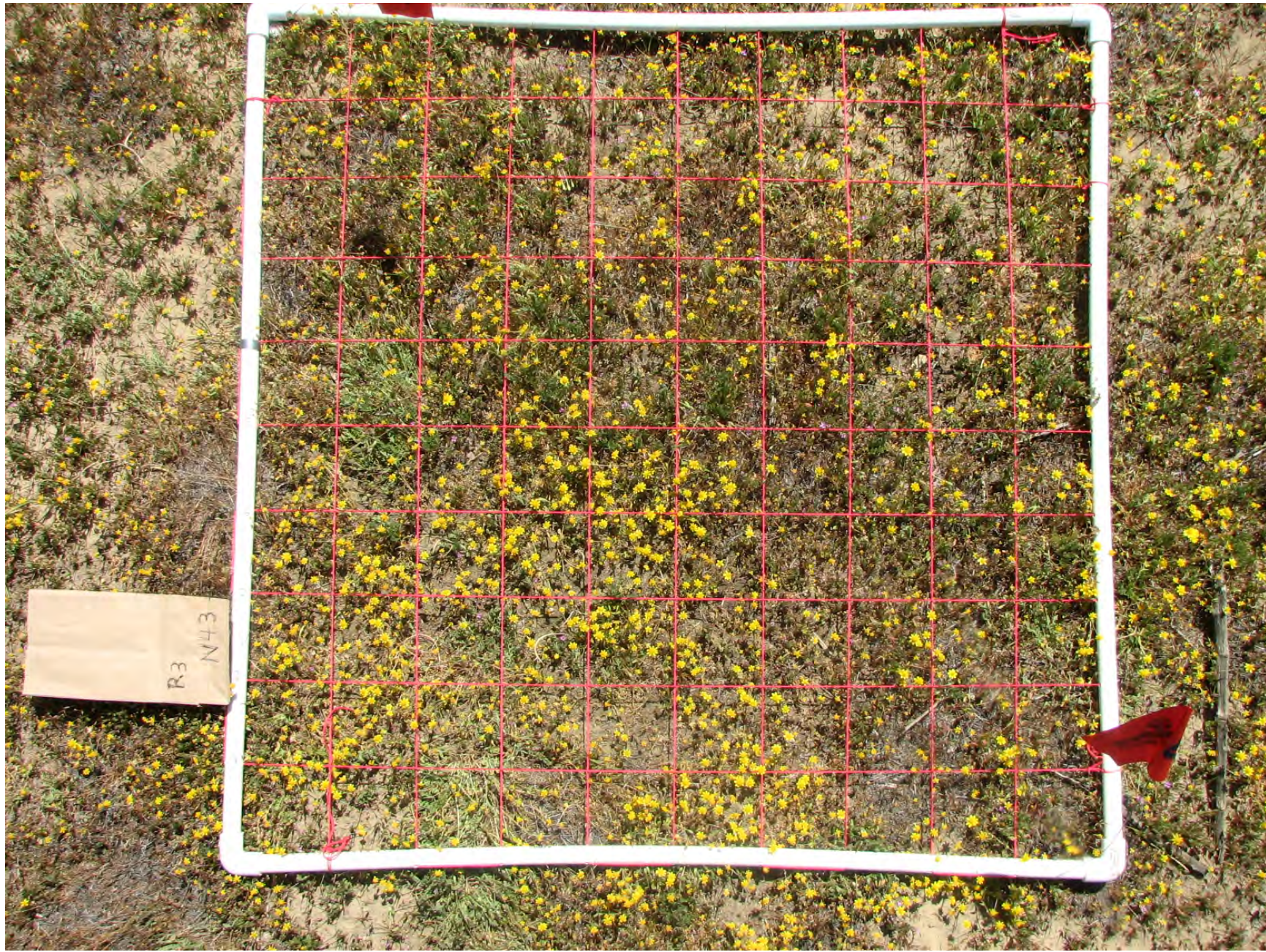
Swain, ungrazed



Center Well, grazed













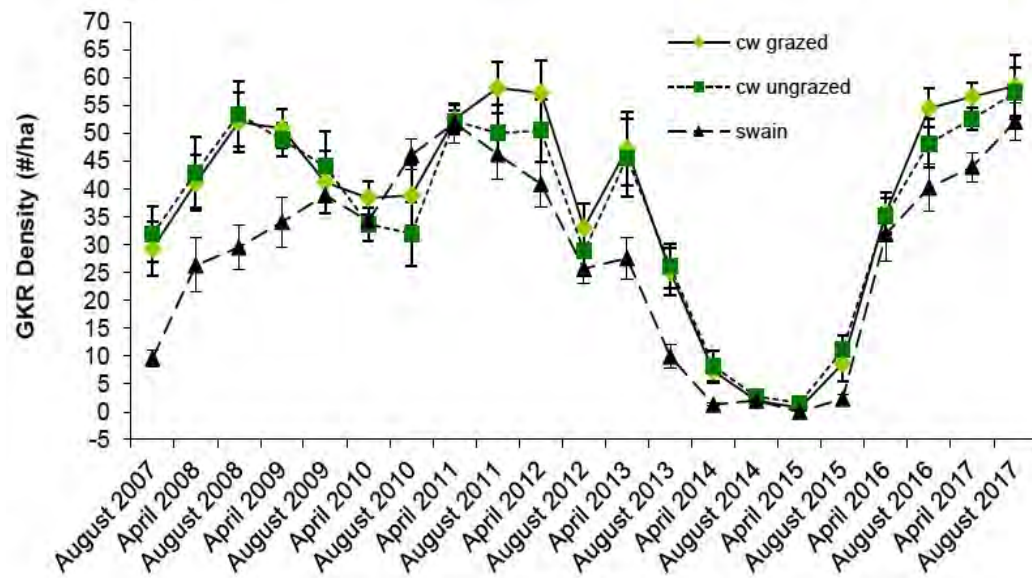
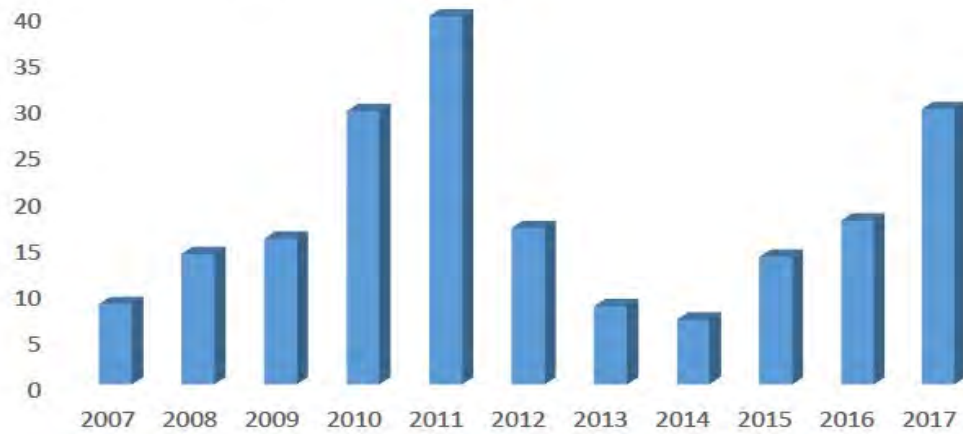


50% Rain-out shelters



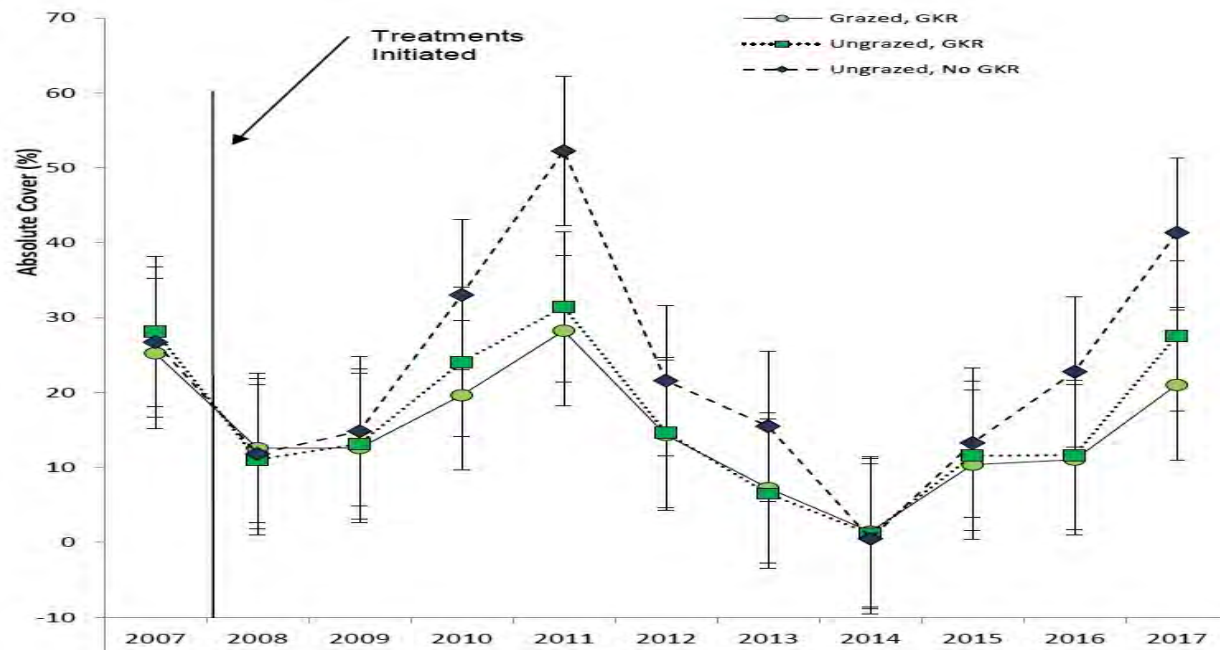
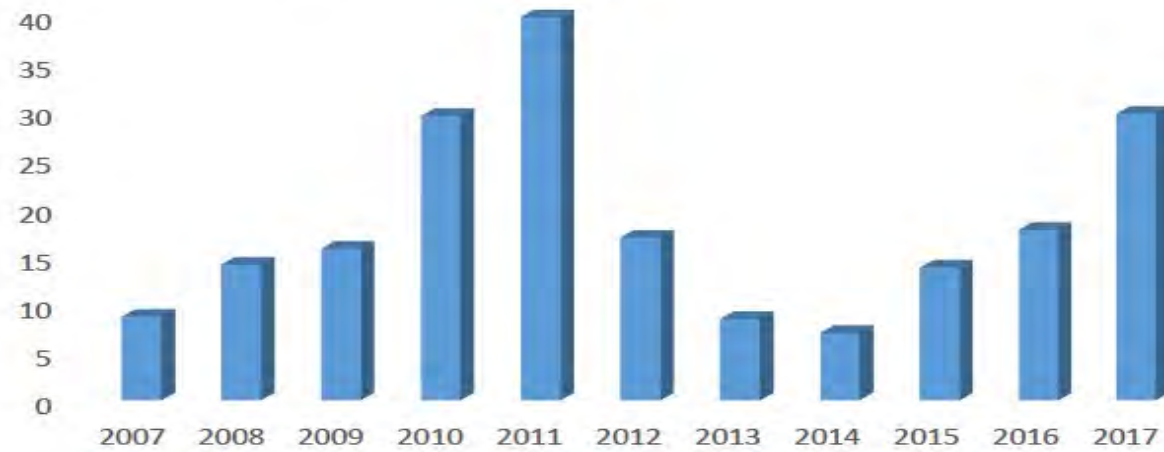


Total Growing Season Precipitation (cm)





Total Growing Season Precipitation (cm)






## Species Point / Quadrat data matrix

Filtered to remove “singletons”

1782 observations among 287 quadrats

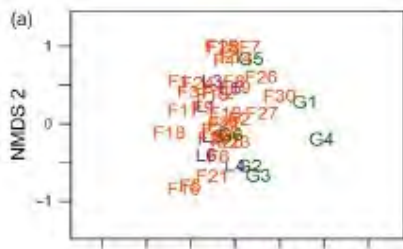
1	
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Transform cover data using  $\ln(x) + 1$

Assign species to three “functional groups” and quadrats to on or off precincts (P or N coding).

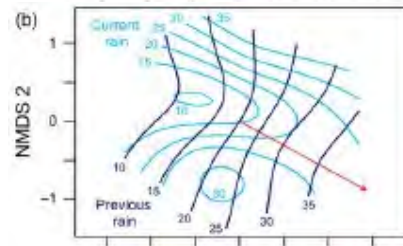
Generate a Repeated Measures Linear mixed effect Model (RM-LMEM) using current and past year precipitation as the predictor term.


Calculate a per site, per position (P or N), per year mean community composition using a permutational Anova function yields a data frame with 480 communities



Calculate a “dissimilarity” index for the data frame of 480 communities

Ordinate the dissimilarity using NMDS (non-metric multidimensional scaling)



Evaluate the dissimilarity as a function of current year precipitation, past year precipitation, GKR foraging, GKR burrowing, and as stacked effects



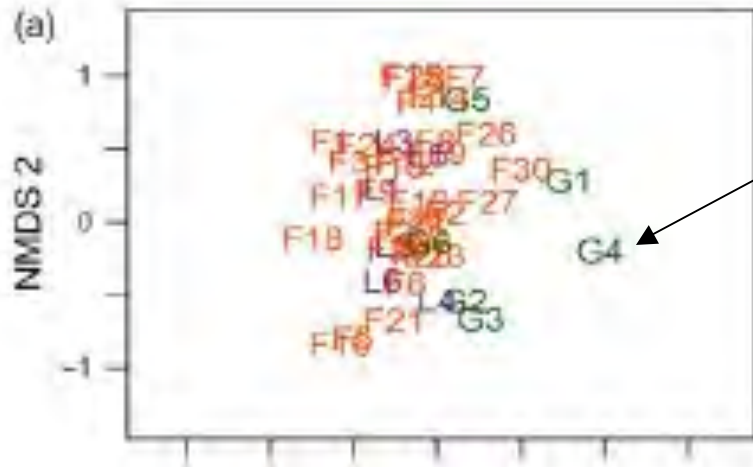

Performed Indicator species analysis of grouped plant communities based on Fidelity and abundance to extract specific taxa that drive the community composition


Expanded the linear effects model to include litter production and longevity



# Results

- Forb relative cover, as a functional group, had a strong negative relationship with previous year precipitation and a weak negative relationship with current year precipitation.
- Grass relative cover strongly positive in response to previous year precipitation.
- Grass cover greatest when previous precipitation was high and current precipitation was lower.
- Legume cover lowest when previous precipitation was high and current precipitation was lower.



*Hordeum murinum* was an community outlier. Strongly increasing due to prior year precipitation, and reduced by GKR foraging.

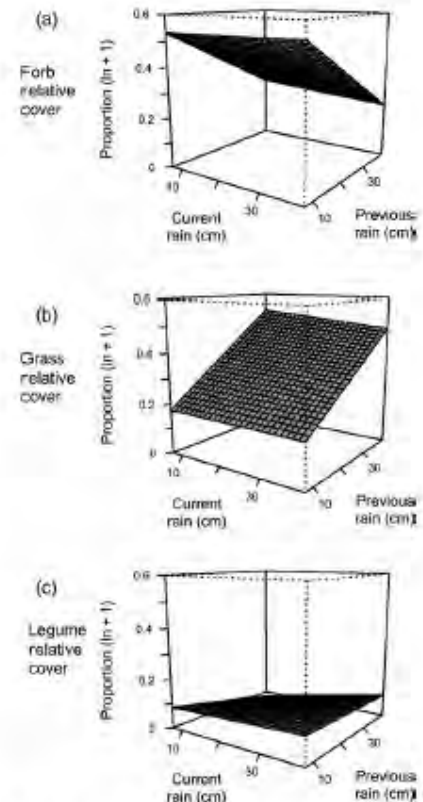


FIGURE 2 Functional composition response to precipitation in the current and previous growing season. The community was composed of (a) non-leguminous forbs, (b) grasses and (c) legumes. Functional group cover was relativized to evaluate compositional changes, and relationships with rainfall are visualized as average response surfaces.

















S 3  
4/11/18









CR4

4/4/18







## Products of the Carrizo Plain Ecosystem Project

2017

- 60) Waianuhea, L. 2017. Do giant kangaroo rats display a saturating functional response to food availability? Report for NSF REU internship.
- 59) Grinath, J. B., G. Casto, L. R. Prugh, J. S. Brashares, & K. N. Suding. 2017. Resource cascades: evaluating effects of burrowing herbivores and rainfall on basal resources and higher trophic levels. In Preparation.
- 58) Grinath, J. B., L. R. Prugh, J. S. Brashares, & K. N. Suding. (In Submission) Rodent-generated niche space rescues grassland diversity from rainfall-driven dominance. *Nature Plants*.
- 57) Grinath, J. B., N. Deguines, J. W. Chesnut, L. R. Prugh, J. S. Brashares, & K. N. Suding. (In Press) Animals alter precipitation legacies: trophic and ecosystem engineering effects on plant community temporal dynamics. *Journal of Ecology*.
- 56) Prugh, LR, N Deguines, JB Grinath, KN Suding, WT Bean, R Stafford, JS Brashares. In review. Ecological winners and losers of extreme drought. *Nature Climate Change*.
- 55) Casto, G. 2017. Title: Burrowing herbivore, precipitation and plant community effects on invasive grass germination. Honors Thesis, U Colorado.
- 54) Deguines N, et al. 2017. Precipitation alters interactions in a grassland ecological community, Functional Ecology and Environment Conference, July 11-12th, 2017, Toulouse (France).
- 53) Deguines, N., Brashares, J.S., Prugh L.R. 2017. Precipitation alters interactions in a grassland ecological community. *Journal of Animal Ecology* 86:262-272.
- 52) Deguines, N. 2017. Effets du climat sur un écosystème aride californien (Climate effects on an arid ecosystem in California"). Talk presented at the National Museum of Natural History. Paris, France.
- 51) Gabbert, W. 2017. Title: Disentangling a plant-herbivore interaction: spittlebug effects on the alkali goldenbush. Honors Thesis, U Colorado.
- 50) Waianuhea, L\*, L Prugh, R Endicott. Do giant kangaroo rats display a saturating functional response to food availability? Poster presented at the National Diversity in STEM Conference, Salt Lake City Utah October 2017.
- 49) Moran, M. 2017. Nighttime Investigation. 1<sup>st</sup> grade science book developed by the Learning Design Group at the University of California, Berkeley's Lawrence Hall of Science. Brooklyn: Amplify. Print.





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Questions ?