College of Social and Behavioral Sciences
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Multiple Approaches to Measure Mesquite – Grass Dynamics on a Semi-arid Grassland in Southern Arizona

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Introduction

- Many semi-arid grasslands around the world face woody encroachment.
- Past research has shown that the encroaching mesquite in our region have a competitive relationship with grasses.
- Our research aims to study the effect of woody plant management has on a suite of ecosystem services like overall carbon storage, the potential for grasses to thrive in the absence of mesquite, and water cycling.

Methods

Starting two days after a helicopter applied herbicide to the treatment area we measured:

Photosynthesis:
Using a LI-6400, leaf-level photosynthesis measurements were taken on the south side of mesquite.

For mesquite: Measurements were taken on the same branch throughout the sampling period.

For grasses: Measurements were taken on the same plant directly in the middle of the base of the measured mesquite and its dripline.

Normalized Difference Vegetation Index (NDVI):
Using a multispectral camera attached to a DJI Phantom type drone, continuous photos were taken along a flight path from about 15 meters above the study area.

Driving Questions

The working hypothesis in the management community is that mesquites are competitive with range grasses, but the implications of woody plant management has not been tested in a controlled setting. **This means our management schemes are based on assumptions, not data!** Therefore, we ask:

1. **Does mesquite removal influence the function and growth of grasses?**
2. **Can we use new technologies associated with unmanned aerial vehicles (UAV) to remotely sense treatment effects?**

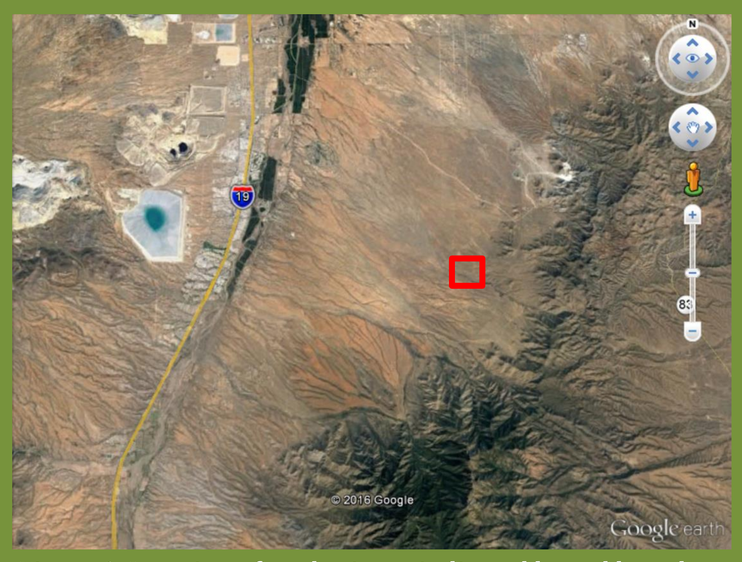

Figure 1. Location of study site as indicated by red box about 40 miles south of Tucson, AZ located within the Santa Rita Experimental Range.

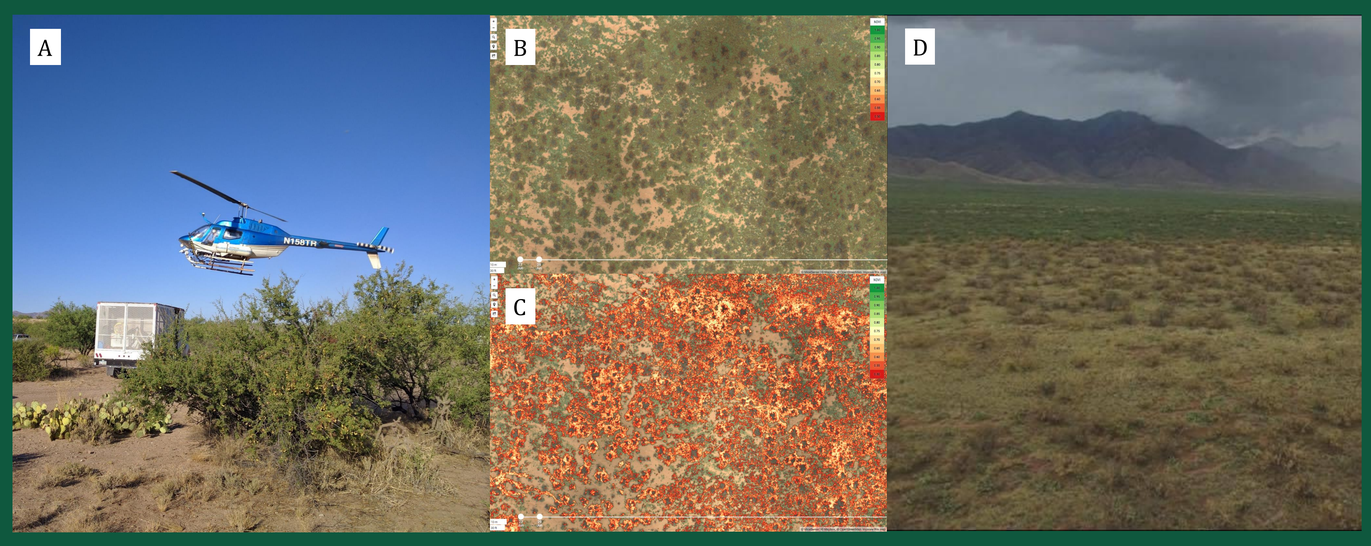

Fig 2. (A) Helicopter used for herbicide application, (B) Normalized Difference Vegetation Index (NDVI) of pre-treatment, (C) NVDI of post-treatment, and (D) herbicide treated area in the foreground with untreated area in the background as seen from a UAV.

Results - Photosynthesis

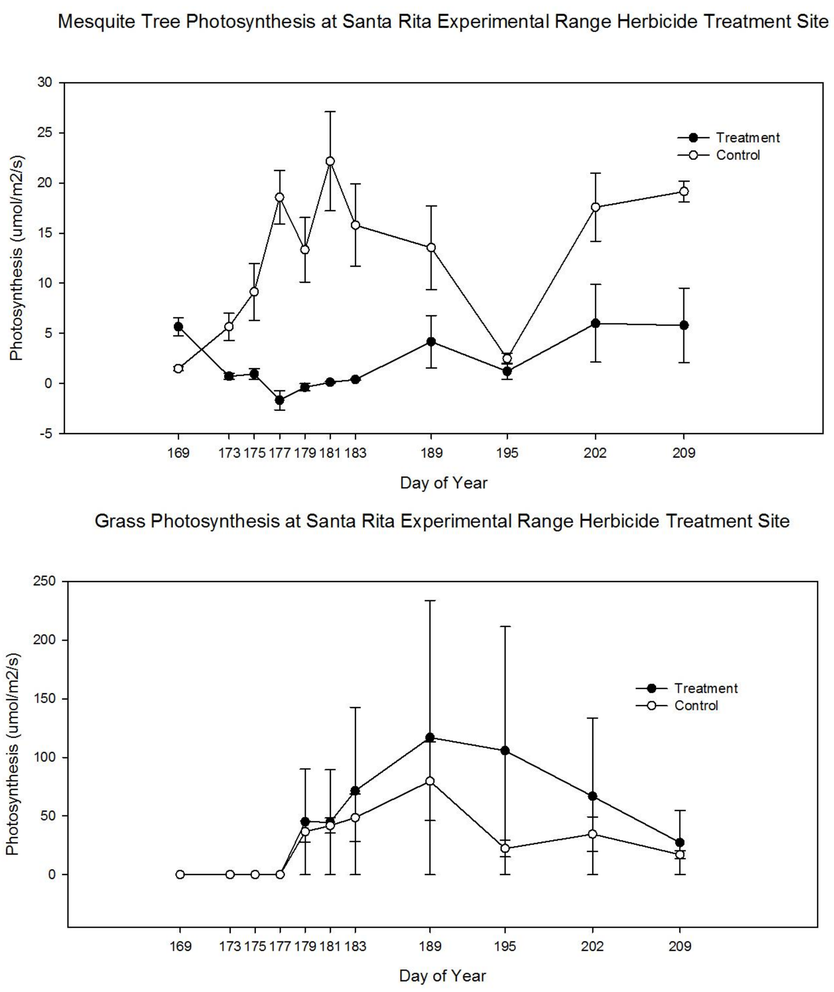

Figure 3. (A) Measure of photosynthesis for mesquite and (B) measure of photosynthesis for grasses.
** Error bars are the standard error of the mean*

Results - Continued

- **Day of Year (DOY) 169 (17June2016) Herbicide treatment applied.**
- **DOY 177 (25June2016) Largest reduction of photosynthesis of treated mesquite trees with measurements at near 0.**
- **DOY 179 (27June2016) Grasses began to grow, enabling measurement.**
- **DOY 209 (27July2016) Continued separation of mesquite tree photosynthesis, but no noticeable effect on grass photosynthesis.**
- **Through calculation of NDVI with the use of a drone, it was very clear where mesquite die-off was occurring. *See Fig 2 (c)**

Conclusions

- **Throughout the study, some trees that appeared to have been killed, actually started to leaf back out.**
- **There was no significant difference between treated and control grass photosynthesis.**
  - Variation within the control and treatment areas was very high.
- **New measurement techniques should be considered when determining the effectiveness of mesquite treatment.**
  - Remote sensing is faster and less labor intensive than traditional field methods.
- **More time is required to assess the effectiveness of the treatment.**
  - With mesquite regrowth evident after only one week of assumed death, it is unclear exactly how effective the treatment is.

Acknowledgments:

Thank you to Enrique Sánchez-Cañete, Patrick Murphy, and Rebecca Minor for LI-6400 training; Dr. Adam Naito for his assistance with field site access and information; Mariah Moe for design input; Sarah Wolsiffer for her assistance with field campaigns.

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