

## ACTIONABLE SCIENCE

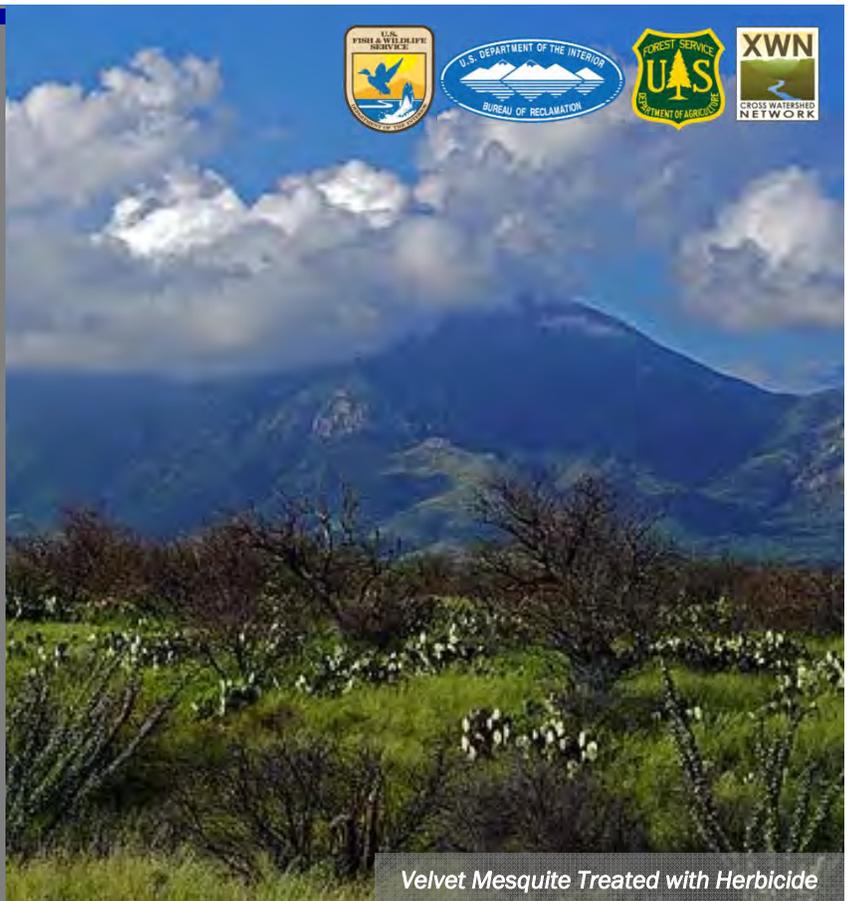
# Assessing the Impacts of Brush Management on Herbaceous Plant Diversity and Primary Production in Southern Arizona Grasslands



COLLEGE OF AGRICULTURE  
AND LIFE SCIENCES  
SCHOOL OF NATURAL RESOURCES  
AND THE ENVIRONMENT



Using four instrumented rangeland watersheds on the Santa Rita Experimental Range near Green Valley, Arizona, our work is addressing critical uncertainties related to woody plant encroachment (WPE) and brush management (BM) of velvet mesquite (*Prosopis velutina*). These include the role of WPE on the global carbon cycle, the effects of BM on carbon storage potential, biodiversity, and rangeland ecosystem stability and resilience. With this information, we can provide land managers with an objective basis for differentiating among the consequences and cost-benefits of both WPE and BM, as well as developing appropriate timing and location of BM interventions for maximum benefit.



Velvet Mesquite Treated with Herbicide

## KEY ISSUES ADDRESSED

Woody plant encroachment (WPE) into North American grasslands has been ongoing since the mid 1900s due to a combination of domestic livestock grazing and fire suppression. Land managers have traditionally used various brush management (BM) techniques to reverse shrub encroachment, restore lost forage production, and reduce erosion. The limited success of BM in meeting these goals has raised questions about its economic feasibility as a management tool. However, numerous other ecosystem services—including forage production, carbon storage, and soil retention—are potentially impacted by WPE and BM, and accounting for them would provide a more complete evaluation of BM as a conservation practice.

## PROJECT GOALS

- Compare ecosystem services between treated and control sites on four mesquite-encroached watersheds by monitoring a suite of response variables
- Collect and integrate field-based ecosystem service data with gas exchange data and drone-based aerial photography

## TREATMENT IMPACTS

This work will advance our understanding of the impacts of brush management on forage production, carbon storage, and nutrient cycling at watershed scales.



Monitoring Tower at the Study Site

## PROJECT HIGHLIGHTS

**Quantifying Ecosystem Services:** Several variables are being quantified on control and treated watersheds before and after herbicide application. Variables include herbaceous diversity, forage production, coarse wood debris, litter, soil organic carbon and nitrogen, and others. Each variable provides information about ecosystem services that could be affected by WPE and BM. For example, herbaceous diversity and primary production have important implications for livestock forage production and quality.

**Herbicide Treatment:** We worked with Crop Production Services, LLC and Tri Rotor Ag, LLC to apply an herbicide mixture to velvet mesquite via helicopter in June 2016. The mixture consisted of the chemicals clopyralid, aminopyralid, and triclopyr. Following treatment, 214 trees were monitored for 22 months to measure mortality by recording the development of new foliage and basal shoots.

**Interdisciplinary Collaboration:** This project integrates field, geospatial, and modeling techniques to assess the biological and physical effects of brush management. Because the project assesses several ecosystem services at once, it requires collaboration of people with different sets of expertise to properly interpret and communicate results.

## Collaborators and Funding Partners

- See online for full list of collaborators and funding partners

Case study support provided by the US Fish and Wildlife Service, US Bureau of Reclamation, US Forest Service, and Cross Watershed Network. Updated August 2018. Photos courtesy of Dr. Adam Naito, University of Arizona

## LESSONS LEARNED

Preliminary results indicated an increase in herbaceous diversity on the treated area. This was primarily the result of an increase in native and non-native annuals.

Herbaceous primary production increased during the growing season following herbicide application, with the contribution of non-native perennials (primarily Lehmann lovegrass) far exceeding that of native perennials.

Early results suggest mesquite herbicide treatment in this desert grassland may shift the community composition in favor of non-native perennials and native annuals over native perennials.

Mesquite mortality following herbicide treatment was very low (~5%). If herbicide treatment alone is a viable option for velvet mesquite management, there is a clear need to determine the herbicide mixture composition, environmental conditions, and timing that maximizes mesquite mortality and cost-effectiveness.

## NEXT STEPS

- Compare small mammal and arthropod communities on treated and control watersheds
- Share results with local land managers through in-person workshops and with the scientific community through conferences and technical publications

## PROJECT RESOURCES

For more information on this project, contact Dr. Adam Naito: [anaito@email.arizona.edu](mailto:anaito@email.arizona.edu)

For additional project resources and case studies, visit the Collaborative Conservation and Adaptation Strategy Toolbox: [WWW.DESERTLCC.ORG/RESOURCE/CCAST](http://WWW.DESERTLCC.ORG/RESOURCE/CCAST)



Aerial Herbicide Application