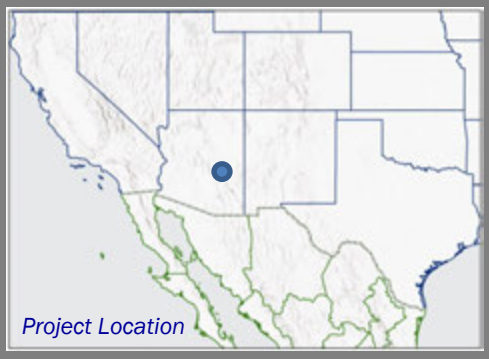
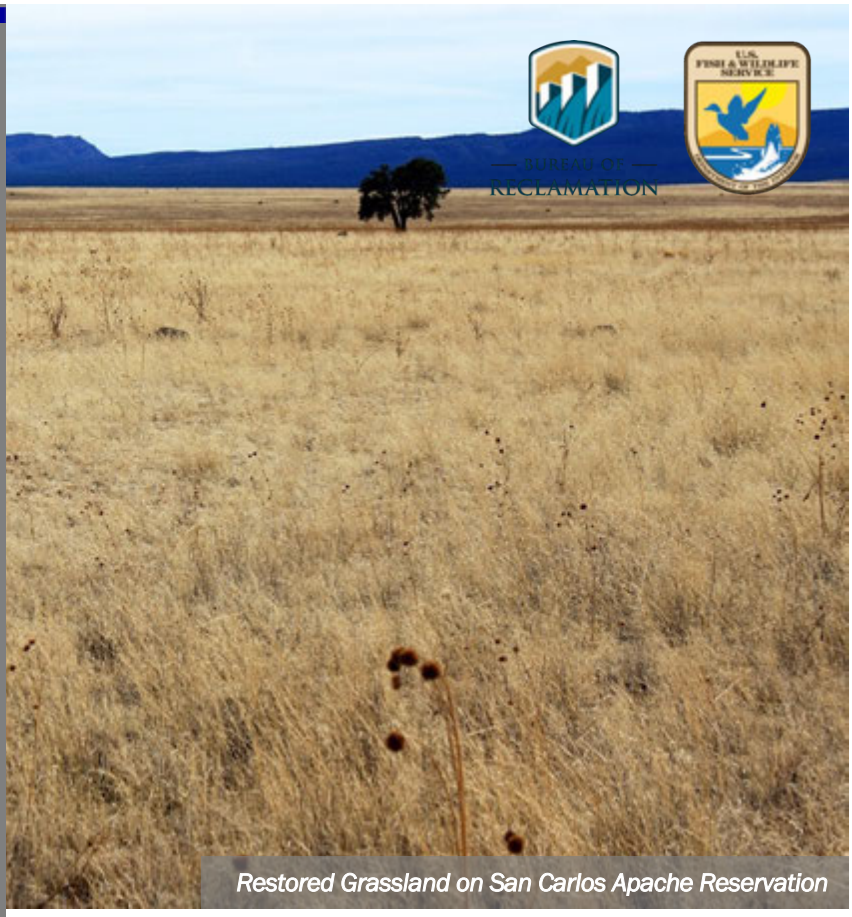
ACTIONABLE SCIENCE

Remote Sensing to Quantify Woodland Canopy Cover on the San Carlos Apache Reservation

USGS science for a changing world

The San Carlos Apache Reservation contains unique and diverse grasslands, savannas, woodlands, and forests. The San Carlos Apache Forest Resources Program (SCAFRP) stewards these ecosystems for their cultural, food, economic, medicinal and wildlife value. Traditional Ecological Knowledge (TEK) of community elders, and tree ring data indicate that historical grasslands were larger, low-intensity fires more frequent, and woody cover lower. The SCAFRP strives to return the land to historical pre-reservation (pre-1872) conditions. Limited data about landscape conditions impedes the development of quantitative management goals. The Western Geographic Science Center (USGS) and the SCAFRP responded by analyzing aerial photos (1935) and remote sensing data (2017) to map the extent of historical and current grasslands, savannas, and woodlands.





Restored Grassland on San Carlos Apache Reservation

KEY ISSUES ADDRESSED

Woody plant encroachment, especially of juniper (*Juniperus* spp.) in grasslands and savannas reduces grass cover, increases erosion, degrades habitat for wildlife and diminishes forage for cattle. The SCAFRP needs effective methods to maintain the condition of grasslands and savannas. Data about the historical extent of grasslands and savannas is lacking. This impedes development of baseline conditions and quantitative goals. Limited resources for monitoring ecological conditions make it difficult to know if management actions are meeting restoration goals. The history of broken agreements between government agencies and sovereign Tribal nations make repairing and maintaining relationships of trust critical.

PROJECT GOALS

- Establish baseline conditions and canopy cover of woody plants to develop quantitative management goals and evaluate changes in woody plant cover over time
- Evaluate effectiveness of recent grassland restoration and management treatments and develop effective treatments for grassland restoration activities
- Maintain relationship between SCAFRP and USGS

TWO DECADES OF COLLABORATION

USGS and SCAFRP have been working together to produce land management tools since 2004. Consistent communication, annual visits, and collaborative problem-solving processes have been fundamental to this partnership.

Field Work at San Carlos Apache Reservation with Wild Horses

PROJECT HIGHLIGHTS

Unique Analysis: Researchers combined two programs, ERDAS Imagine and Adobe Photoshop, to delineate and quantify canopy cover of woodland trees on the reservation. This helped the SCAFRP develop baseline, historical conditions and quantitative goals about where to remove woody plants and what the restoration target for woody plant cover may be for a given area.

Increase in Woody Plant Canopy Cover: Cover of juniper increased dramatically in almost all areas that were savannas and grasslands in 1935. The percent canopy cover of woodland trees more than doubled (from 18.3% to 38.5%) in one study area, and increased from 28.3% to 43.3% in another.

Denser Juniper: Juniper canopy cover increased in many savanna and woodland areas between 1935 and 2017, possibly due to reduced frequency of low intensity fires.

Less Pine: Many areas dominated by ponderosa pine in 1935 have less pine canopy cover in 2017, possibly due to recent wildfires that killed stands of ponderosa pine.

Juniper Branches Carries Fire: Mangers found that it is optimal to implement prescribed burns six to nine months after juniper removal. This allows juniper slash to be dry, but still have needles attached which helps carry fire across the landscape.

Collaborators

- USGS
- SCAFRP

CCAST Authors: Ariel Léger & Nicholas Katz, University of Arizona, October 2022.
Photos courtesy of Barry Middleton/USGS.
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Visit CCAST:

LESSONS LEARNED

The long-term partnership between the SCAFRP and USGS fostered trust. The USGS listens and responds to Tribal priorities and lets the SCAFRP dictate the scope of work. Co-development of research questions makes results highly applicable to land management. The Tribe reviews data and potential publications for information they deem sensitive and the USGS redacts materials based on their decisions.

Analysis of aerial photos and remote sensing data indicate that grasslands and savannas under active management retain historical levels of woody plant canopy cover. This supports the TEK of tribal members that indicates loss of grasslands to woody plants and indicates that, without intervention, woody plant canopy cover in grasslands and savannas on the Reservation is likely to increase.

The SCAFRP developed an effective Integrated Brush Management approach to grassland management that combines mechanical shredding, hand chainsaw crews, and herbicides. Using a mechanical brush shredder reduced costs from ~$400/acre to $75-100/acre compared to using saw crews alone. Applying glyphosate to cut stumps greatly reduced the rate of juniper resprouts. The woodchip slash left behind from shredding acts as a mulch retaining soil moisture and protecting grass seedlings from grazing.

NEXT STEPS

- Locate additional areas to initiate intensive management
- Determine which management techniques (tree removal, prescribed burning, reseeding, etc.) are appropriate at each location

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Savanna Restoration on the San Carlos Apache Reservation