uncharismatic. Much of the land is dominated by the short-lived shrub burrowweed (Isocoma tenuisecta). The low rainfall of only 25 cm/year on average suggests that the prognosis for natural succession is slim. Earlier studies found that reestablishment of the dominant saltbush and creosotebush were highly variable, with some fields having no plant cover. Most of the old fields have annuals and short-lived perennials persisting, but still have few long-lived shrubs. Lowland Sonoran desertscrub has little in the way of ecosystem services, has little grazing potential, and as such has less incentive to restore these ecosystems. Agricultural and urban development in southern Arizona has considerably reduced the land cover in this type of ecosystem, so restoration was seen as a means to expand the area of this unique desert ecosystem. Restored saltbush desertscrub would benefit groundwater recharge, less flood damage to county roads, reduction in dust, and would be an increase of wildlife habitat. The project sought to determine historic species composition for a given site, acquiring seeds of those species, introduce them to the site, and provide them with extra water for establishment.

Learn More (https://app.ser-rrc.org/api/v1/project/9027)

## USA: Arizona: Fort Valley Restoration Project (https://app.ser-rrc.org/api/v1/project/9021)

**Country:** United States of America

**Activities:**

**Biomes:**

**Abstract:** The Fort Valley Project was an experiment designed to test forest treatments that were intended to restore natural ecological qualities and reduce the hazard of intense wildfire in the urban/wildland interface around Flagstaff, Arizona. The primary goal of the project was the reverse the degradation of ponderosa pine ecosystems by restoring their structure and function along with the natural disturbance regimes that were characteristic of their evolutionary environment. The project is a collaboration between the Greater Flagstaff Forests Partnership, the USDA Forest Service (the Rocky Mountain Research Station (RMRS) and the Coconino National Forest), and the Ecological Restoration Institute (ERI) at Northern Arizona University. The overall project is a landscape-scale restoration project that is being conducted over a 10,000 acre area, with an initial experimental phase that was conducted on 1700 acres.

Learn More (https://app.ser-rrc.org/api/v1/project/9021)

## USA: Arizona: Fossil Creek Watershed and Riparian Restoration (https://app.ser-rrc.org/api/v1/project/8936)

**Country:** United States of America

**Activities:**

**Biomes:**

**Abstract:** Fossil Creek is a spring-fed, travertine-forming riparian area in northern Arizona that is home to several endangered species of native fish, as well as many important species of birds, mammals and herptofauna. A diversion dam built in the early 1900s to supply water to two hydroelectric stations diverted almost the entire flow of the creek and drastically altered the ecosystem. In 1999, Arizona Public Service (APS) signed an agreement to decommission its hydroelectric facilities along Fossil Creek and allow the restoration of full flow to the streamcourse. In preparation for this measure, the Native Fish Renovation Project was implemented to eradicate nonnative species from the stream and help strengthen populations of native fish. The successful completion of this project and the ongoing deconstruction and restoration activities along the creek offer hope that this unique watercourse will soon be restored to its former splendor.

Learn More (https://app.ser-rrc.org/api/v1/project/8936)

## USA: Arizona: Gus Pearson Natural Area Restoration (https://app.ser-rrc.org/api/v1/project/8969)

**Country:** United States of America

**Activities:**

**Biomes:**

**Abstract:** Initiated in 1992 with National Science Foundation funding, the Gus Pearson Natural Area Restoration was an experimental project of Nothern Arizona University's Ecological Restoration Institute and is located approximately 7 miles (20 km) northwest of Flagstaff, AZ. The original experiment's aim was to compare three treatments: 1) tree thinning to emulate predisruption forest structure, followed by fuel reduction and prescribed burning (composite); 2) tree thinning only, without fire (thinning); and 3) control. The study also attempted to examine the response of the treatments to different "patch types" at the site, including presettlement stands, postsettlement stands, and remnant grassy patches. GPNA is the site of the Ecological Restoration Institute's oldest ecological restoration treatments utilizing thinning of small trees to emulate presettlement forest structure prior to reintroducing low-intensity fire (though the study site itself had to be decommissioned as a part of the GPNA to allow for cutting trees).

Learn More (https://app.ser-rrc.org/api/v1/project/8969)

## USA: Arizona: North Simpson Habitat Restoration Project (https://app.ser-rrc.org/api/v1/project/8981)

**Country:** United States of America

**Activities:**

**Biomes:**

**Abstract:** The North Simpson Habitat Restoration Project is a project of Tucson Audubon Society on lands owned by the City of Tucson, Arizona. The project involves the planting of numerous native tree, shrub, grass, and forb species on the floodplains of a near-perennial riparian area that came into existence since the 1970s as a consequence of municipal effluent discharge. The project's design is to use the newly available water resources to improve riparian habitat to offset riparian habitat elsewhere in the Tucson basin that was lost due to groundwater pumping , mis-management of the Santa Cruz River, and destroyed by urban development. The site itself did not historically have perennial water, but had been a very wide xero-riparian forest before the river was channelized and bermed to support extensive agriculture at the project site. The intention of project managers is

to create ecosystem functions that mesh with the now-available water resources, as well as structural diversity of the habitat to benefit wildlife in the area. Tucson Audubon has conducted classes in restoration at the site, offered birding tours, does ongoing monitoring of completed projects within the site to provide a clear picture of the results of their work and is continuing to work on new areas within the larger project site.

Learn More (https://app.ser-rrc.org/api/v1/project/8981)

**USA: Arizona: Patagonia/Sonoita Creek Preserve Sacaton Restoration**

## Overview

Big sacaton (Sporobolus wrightii) once covered riparian floodplains throughout the southwestern United States and northern Sonora, Mexico. Today, these grasslands occupy less than 5% of their previous range. This restoration project evaluated the role of arbuscular mycorrhizae in the establishment and survival of sacaton at the Nature Conservancy's Patagonia/Sonoita Creek preserve near Patagonia, Arizona. The project evaluated the efficacy of using different sized transplants grown under greenhouse conditions and how mycorrhizae affected their subsequent survival in abandoned agricultural fields.

### Project Details

**Lead entity types:**

- Other

#### Adaptive management

Describe adaptive management processes and mid-course corrections taken to address unforeseen challenges and improve outcomes in each of the following categories:

**State of Progress:**

- Closed/completed, no further follow-up

**Project Start:**

1995-01-01

**Project End:**

1997-12-31

**Total budgeted expenses:**

- USD 50,000 - 100,000

**Main source of funds:**

- International donors (including foreign governments and intergovernmental organizations)

**Global Regions:**

- Northern America
- Americas
- World

**Countries:**

- United States of America

**Ecosystem Functional Groups / Biomes:**

- Savannas and grasslands biome
- Deserts and semi-deserts biome

**Extent of project:**

- Other

**Extent of restoration:**

- Other

**Degradations:**

- Other forms of unsustainable agricultural practices

**Description:**

The riparian floodplains in the southwestern United States were ideal locations for agriculture because of the access to water, the presence of deep alluvial soils, and the periodic flooding that brought fertile sediment into the floodplain. The aridity of the region promoted the development and use of these areas for both cultivation and pasturage. The demographic shift of these historic agricultural areas toward becoming more urbanized has resulted in the abandonment of many of the fields because of the increasing pressure on groundwater supplies. These ecosystems were locally wiped out by agricultural development and the cultivation of the floodplains.

## Planning and Review

## Goals and Objectives

**Was a baseline assessment conducted:**

unsure

**Was a reference model used:**

RM5

**were_goals_identified:**

YES

**Goals and objectives:**

- Other

**Goals Description::**

The abandonment of agricultural fields contributes to problems such as run-off and erosion, as well as contributing to regional air quality problems because of the lack of cover. Agicultural abandonment in the southwest is a problem also because of the exotic composition of these fields, ranging from Russian thistle to bindweed to exotic species of chenopodium. In the instance of the Patagonia/Sonoita Creek preserve, these abandonded fields were part of the preserve and the Nature Conservancy includes restoration as among its mandates. The area around Sonoita Creek also has significant levels of Johnson grass (Sorghum halepense), the potential spread of Johnson grass was a concern to preserve managers and it was thought that sacaton restoration would provide another potential tool for land management.

## Stakeholder Engagement

**Were Stakeholders engaged?:**

unsure

**Description of Stakeholder Involvement:**

The project occurred on an abandoned agricultural field owned by the Nature Conservancy and was carried out by the Center for Environmental Studes at Arizona State University. Some of the research monies came from the Arizona Water Protection Fund which has specific guidelines for what type of projects it will fund, specifically supporting research that benefits water resources directly.

## Ecosystem Activities and Approaches

General Activities: The project started by taking soil samples from the top 30 cm of the plot area at 15 regularly distributed points. Subsamples from each point were bulked and sent to a commercial laboratory (Laboratory Consultants, Ltd., Tempe, Arizona, U.S.A.) for analysis (pH and electrical conductivity in 1:1 water paste; nitrate-N by ion selective electrode; extractable phosphorus by Olsen method; organic matter by Walkley-Black method; soil texture by hydrometer). The soil was classified as a loam, with 48.8% sand, 30.6% silt, and 20.6% clay, with a pH of 8.0. Organic matter was 2%, nitrate was 12 ppm, bicarbonate phosphorus was 15 ppm, and exchangeable sodium was 42 ppm. Separate samples were collected and evaluated for mycorrhizal inoculum potential using the mean infection percentage method. Two samples were taken along

the center line of the plot area, one-third of the way in from the north and south ends. Zea mays L. (corn) was grown as a host in a one-fourth dilution of the sample soil, and roots were stained in trypan blue. One hundred 1-cm root segments were examined for colonization using a light microscope. The mean infection percentage values ranged from 31.9% in the south end of the field to 9.7% in the north end. Transplants were made on 22 - 23 July 1998, 2 weeks after the onset of the summer monsoon rains. A blocked design was used for planting, consisting of four blocks of 10 tall pot plants and eight blocks of 21 cone-tainer grown plants. Plants were spaced at 1-m intervals with 2 m between blocks. Six mycorrhizal and six non-mycorrhizal blocks were arranged in alternating treatments. Water was supplemented only when plants showed signs of severe drought stress (leaf rolling and die-back) during the remainder of the growing season. This occurred twice: On 8 September each plant received 1 L of water by hand watering, and on 15 October each plant received 1.8 L. Weeds were managed during the growing season by hand removal within blocks but not in the corridors between blocks. Data were collected 2, 4, and 10 months after transplanting. Height, basal diameter, and number of tillers were recorded for all tall pot plants and a subsample of 80 cone plants (all plants in the interior of each block), and survival was recorded for all plants. Five tall pot plants and three cone plants in each block were designated for collection of root cores. Cores 2 cm in diameter and 12 cm deep were taken 10 cm from the center of the plant. The same plants were cored at each data collection; cores were taken from different sides of the plants each time. Cores were placed in plastic vials and taken back to the laboratory, where roots were removed and stored in 50% ethanol for mycorrhizal examination. At 12.5 months, final data were collected on height, basal diameter, and number of panicles for every plant.

## Project Outcomes

Eliminate existing threats to the ecosystem: Inoculation with AM fungi during the transplant production stage had a significant effect on plant growth after plants were transplanted into an abandoned agriculture field (Table 2). Tiller production and basal diameter were significantly greater in pre-inoculated plants than in uninoculated plants at all measurement dates. Heights were significantly greater in pre-inoculated plants at the 2-month and 1-year measurements and were significant at p = 0.057 at 10 months. The type of container used during the transplant production stage also had a significant effect on plant growth after plants were transplanted into an abandoned agricultural field. Plants started in cone-tainers had significantly greater heights and tiller production at all measurement dates and greater basal diameters at all but the 1-year measurement. There were no treatment x container interaction effects for height, tillers, or basal diameter at any measurement time. Plant survival was high for all treatments, but the only treatment with 100% survival at final data collection (12.5 months) was pre-inoculated plants started in cone-tainers. Pre-inoculation had a significant effect on mean panicle production. The percent of plants with panicles and the mean number of panicles on those plants that produced panicles also appeared to be greater in pre-inoculated plants, but differences were not significant. Pre-inoculation appeared to have a greater effect on the survival of plants at the edges of blocks in comparison with the center. When survival percentage data were arcsine transformed, there was a significant interaction effect between treatment and position; however, even with transformation the data set was not normal. Interaction effects (treatment x position) were significant for final basal diameter (p= 0.023) and panicle production (p=0.047). Pre-inoculation had a greater effect on basal diameters and panicle production in the center of blocks, whereas plants at the edge were uniformly smaller with lower panicle production. Data from the project showed that pre-inoculated plants showed greater growth and survival rates than uninoculated plants 1 year after they were transplanted into an abandoned agricultural field. The continued benefit of pre-inoculation seen in this project, even after uninoculated plants became colonized, could indicate that the AM fungal assemblage present in the abandoned field transplant site did not confer the same benefits as the assemblage that was collected from an existing grassland and used to inoculate plants in the greenhouse. It is also possible that the sustained differences between pre-inoculated and uninoculated plants are the result of a "head start"□ in pre-inoculated plants. In this case, pre-inoculation enabled plants to recover from transplant shock more quickly than uninoculated counterparts, and the differences in growth that were established during the first 2 months lingered. The head start hypothesis would not, however, explain differences in survival, because most mortality occurred over the winter and early spring. Most surprising among the results of this study was the effect of container type on transplant growth. Monitoring of an earlier sacaton transplant project that had no mycorrhizal treatment showed that plants started in tall pots had out-performed plants started in cone-tainers. In this project plants grown in the smaller cone-tainers consistently out-performed plants grown in tall pots. The differing results between the two transplant projects could be due to differences between the studies during the transplant production stage. Factors limiting recovery of the ecosystem: The project showed that restoration of sacaton is possible within its historic range, however it also illustrated that drought can be a limiting factor. Sacaton requires water in the course of its establishment phase and the necessity of watering the transplants during a particularly dry year illustrated this.

## Monitoring and Data Sharing

**Does the project have a defined monitoring plan?:**

NO

**Open Access URL:**

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## Long Term Management