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

Overview

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.

Project Details

Lead entity types:

- Local Community or Cooperative Group

Partner Organizations:

USDA Forest Service (the Rocky Mountain Research Station (RMRS) and the Coconino National Forest), the Ecological Restoration Institute (ERI) at Northern Arizona University

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:

- Implementation

Project Start:

1996-01-01

Project End:

2008-06-19

Global Regions:

- Northern America
- Americas
- World

Countries:

- United States of America

Ecosystem Functional Groups / Biomes:

- Temperate-boreal forests and woodlands biome

Extent of project:

- Other

Extent of restoration:

- Other

Degradations:

- Deforestation
- Invasive species
- Extractive industry development
- Other forms of unsustainable agricultural practices

Description:

Prior to Euro-American settlement of Flagstaff in the late 1800s, the ponderosa pine ecosystems were considerably more open and park-like in their structure, with a low-intensity, high-frequency fire regime. This fire regime burned through the fine fuels on a regular basis, maintaining the open structure of the forest overstory. The arrival of livestock in the 1880s resulted in the removal of most of the fine fuels found in the forest, causing a disruption of the historic fire regime. Widespread timber harvesting began in the region at the same time, which radically altered the structure of the forest by removing the vast majority of large trees. Institutionalized fire suppression policies gained greater traction after the early 1900s, but fire suppression as a consequence of grazing had already been affecting the ecological trajectory of the forest in the last two decades of the 19th century. In 1917-1919 a series of very wet winters produced a massive increase in the amount of ponderosa seedlings throughout the forest, an event that is cited as the origin of the overstocked forest that is found in the area today. The coupling of fire suppression policies with this massive increase in the stem count of the forest resulted in the massively overgrown forests of today. In some studies, the stem counts were shown to have increased from 42-50 trees per acre to well over 1,000 trees per acre. This overstocked forest contributed to the dangerous fuel levels that were amplified in the periodic droughts that have happened in the region. The explosive rise in the number of catastrophic high-intensity crown fires in ponderosa pine ecosystems is one of the main motivations behind the Fort Valley project, where fire protection for the urban/wildland interface is of critical importance. The associated decline in native biological diversity, declining herbaceous and tree productivity, and the high mortality of old-growth trees were also seen as indicators of declining forest health.

Planning and Review

×

Goals and Objectives

×

Was a baseline assessment conducted:

unsure

Was a reference model used:

YES

How was the reference model constructed?:

- The reference model is based on historical and contemporary information about ecological attributes at the site prior to degradation.

were_goals_identified:

YES

Goals and objectives:

- Other

Goals Description::

The three primary goals of the GFFP are: 1) restore the natural ecosystem functions, within the range of natural variability, of the ponderosa pine forests in Flagstaff's Urban Wildland Interface; 2) Manage forest fuels within the Urban Wildland Interface to reduce the rise of catastrophic fire; and 3) research, test, develop, and demonstrate key ecological, economic, and social dimensions of restoration efforts.

Stakeholder Engagement

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Were Stakeholders engaged?:

unsure

Description of Stakeholder Involvement:

The Greater Flagstaff Forests Partnership (GFFP) is a collaboration between the Coconino National Forest, Grand Canyon Forests Foundation, Northern Arizona University (NAU), and a number of other governmental and non-governmental organizations. The Partnership is a collaborative effort intended to reduce the risk of catastrophic fire and restore forest ecosystem health through practices that are ecologically sound, economically viable, and socially acceptable. Recognizing the importance of these issues, the Coconino National Forest and the Greater Flagstaff Forests Partnership, Inc. (formerly the Grand Canyon Forests Foundation, a private, non-profit corporation) formed the partnership to undertake a series of projects to reduce fire risk and begin the long process of restoring local forests. Restoration plans are developed by the Partnership with the assistance of a Partnership Advisory Board, made up of scientists, local government officials, land managers, business representatives, conservationists, and concerned citizens. The formal Partnership is a cooperative agreement between the Forest Service and the non-profit Greater Flagstaff Forests Partnership, Inc., with the Forest Service retaining full decision-making authority over any activities taking place on lands they manage.

Ecosystem Activities and Approaches

General Activities: The Forest Service and Greater Flagstaff Forests Partnership established three experimental blocks (EB1, EB2 and EB3), each consisting of four different treatments, during the summer of 1998 within an approximately 688 ha area (1700 ac) of the Fort Valley Experimental Forest (EB1) and adjacent Coconino National Forest (EB2 and EB3). Experimental blocks were laid out in cooperation with Forest Service staff, subject to constraints of other experimental studies and wildlife habitat. Due to these constraints, the treatment units in experimental blocks 1 and 2 could not be contiguous. All treatments were randomly assigned. Each treatment unit was approximately 16 ha (40 ac) in size. Treatment units within each block were randomly assigned one of four treatments, consisting of three levels of thinning intensity, followed by prescribed burning, and an untreated control treatment. Tree thinning was based on the pattern of tree structure prior to European settlement ("presettlement"�), determined by: (1) living trees of presettlement origin, characterized by larger size and yellowed bark, and (2) remnant material from snags, logs, and stumps of presettlement origin, which were well-conserved in the dry environment in the absence of fire. All living presettlement trees were retained. In addition, wherever evidence of remnant presettlement material was encountered, several of the largest postsettlement trees within 9.15 m (30') were retained as replacements. If suitable trees were not found within this distance, the search radius was extended to 18.30 m (60'). The three thinning treatments had different replacement tree densities: (1) 1.5-3 replacements, replace each remnant with 1.5 trees (i.e., 3 replacements for every 2 remnants) if the replacements were 40.64 cm (16"�) dbh or larger, otherwise replace each remnant with 3 trees. Since relatively few >16"� postsettlement trees were encountered in any of the sites, all the thinning treatments tended to retain the higher number of replacement. The 1.5-3 treatment, called "full restoration,"� reduced tree density most closely to presettlement levels. (2) 2-4 replacements, replace remnants with 2 trees > 16"� dbh, otherwise 4 trees. (3) 3-6 replacements, replace remnants with 3 trees > 16"� dbh, otherwise 6 trees. (4) Control treatment: no thinning, no burning. Pre-treatment understory data was collected from August-November 1998, prior to initiation of restoration activities. All three units were then thinned in the fall of 1998 through the spring of 1999. At the outset the project contractors completed the thinning by felling and bucking the trees into logs initially, however a second company utilized a feller/buncher and skidded the trees to a landing where they were de-limbed and topped. Slash piles that had been piled using a small dozer were burned in the winter of 2000 for all three blocks. EB3 was broadcast burned in April 2000, EB2 was burned in May 2001, and EB1 was burned in May and July of 2001. Besides collecting understory data in 1998 (pre-treatment), study plots were re-measured in 1999, 2000, 2001, 2002, and 2006 using belt and point-intercept transects. The point-intercept method uses a 50-m transect laid parallel to the environmental gradient. The primary objective of the point-intercept transect is to quantify plant foliar frequency, as a surrogate for plant cover/abundance. At every 30 cm increment along the transect, for a total of 166 point measurements, present plant species were recorded (if any) along with substrate (litter, rock, wood, or bare mineral soil). Plant abundance was determined by dividing the number of first plant hits by 166 points. Individual species abundance was determined by dividing the number of individual species' hits by the total number of plant hits. A 10 x 50 meter belt transect was also centered over each 50-m point-intercept transect. In each belt transect, all vascular plants present were identified, including trees less than breast height (1.4 m or 55 in), with the objective being to obtain a comprehensive species list of the area. Researchers did not record any plant cover or substrate data in these belts. Collecting vegetation data using quadrats has been shown to be a superior method compared to the point-intercept method in southwestern ponderosa pine forests. The point-intercept method tends to over-estimate plant cover (due to the inherent difficulty in sampling at a dimensionless point) and underestimate species richness (due to the overall miniscule area sampled). Therefore, in 2006 researchers additionally sampled ten 1-m2 quadrats per plot arranged along the center of the point - intercept transect. They measured species presence and foliar cover (%) to the nearest quarter percent using cardboard cutouts of known sizes as visual guides. Ocular estimation of plant cover is a commonly used method for determining plant dominance, succession, and treatment response in vegetation analysis. The estimates can total > 100% because percent cover was estimated independently for each species and independent of canopy position. The percent cover of litter, rock, wood, and bare mineral soil was also determined for each plot. Plant cover was averaged across the 10 quadrats per plot. Researchers continued using belt transects in 2006 for species richness, and point-intercept transects for consistency in detecting relative changes from pretreatment conditions.

Project Outcomes

Eliminate existing threats to the ecosystem: Treated units were consistently found to have higher cover and richness than controls and the responses were correlated in "stairstep"� fashion with progressively increasing thinning intensity. Plant cover (%) in the 1.5-3 restoration treatments was over three times greater than in control treatments, five years following treatments. The 2-4 and 3-6 restoration treatment also increased in plant cover 2.3 and 1.8-times, respectively, when compared to control treatments. Species richness was 74% greater in restoration treatments than control treatments. On average, there were 15 more species in treated units compared to non-treated units, with slight differences among the treated units. Overall, researchers detected 162 vascular plant species in 2006 across all treatment units of which 60% were found within control treatments compared to 73% found in the 1.5-3 treatments. Native plant species (primarily composed of graminoids and perennial forbs) dominated the understory in terms of both abundance and number of species among each treatment: approximately 95% of the total cover and 90% of the herbaceous species in the 1.5-3 replacement treatments were natives. Squirreltail (Elymus elymoides), sedge (Carex sp.), mountain muhly (Muhlenbergia montana), Wheeler's thistle (Cirsium wheeleri), and groundcover milkvetch (Astragulus humistratus) were the most common species among treatments. When evaluating individual species response to restoration treatments, Canadian horseweed (Conyza canadensis), pineland marshtail (Laennecia schiedeana), clammy cudweed (Pseudognaphalium macounii), wild barley (Hordeum jubatum), little bluestem (Schizachyrium scoparium), and showy goldeneye (Heliomeris multiflora) appeared to respond the most favorably. Although non-native (introduced) species were scarce and did not differ (p = 0.1258) among treatments in 2006, seven introduced species exhibited frequencies greater than 5 % in the restoration treatments compared to three species in control treatments. Wooly mullein (Verbascum thapsus), Dalmatian toadflax (Linaria dalmatica), and bull thistle (Cirsium vulgare) occurred the most frequently within restoration treatments, whereas Dalmatian toadflax occurred the most frequently in control treatments. The understory plant community responded strongly to inter-annual climatic differences, though the change was less apparent in the control treatments. Species richness in restoration treatments varied significantly through time (p <.0001), though it consistently remained higher than pre-treatment levels. Species richness decreased in all treatments in 2002 and increased in 2001 and 2006. Differences existing among blocks before treatment (especially the much larger old-growth component in Block 1) were reflected in differential responses to the thinning and burning treatments. Changes observed since treatment were more pronounced in understory vegetation within each individual block than at the treatment level. In general, treatments tended to increase plant cover and species richness, although this effect varied in each individual block. Changes in plant cover for all three blocks varied significantly with pre-existing differences among treatment units. In Block 3, there were significant differences between treatments with the 1.5-3 treatment having the highest plant cover, followed by the 2-4 treatment. There were no differences in plant cover between the control and 3-6 treatments, though they were significantly lower than the 1.5-3 and 2-4 treatment units. Change in species richness between 1998 and 2006 was significantly greater in the 1.5-3 and 2-4 treatment than the control and 3-6 treatments. Native species were the most prevalent in terms of abundance (92%) and composition (72%). There were increases in introduced species among the restoration treatments, increasing five-fold in species richness in the 1.5-3 restoration treatment, and from well below to just over 1% in plant cover. Graminoids were the most dominant functional group among all treatments, comprised of approximately two-thirds C3 grasses. Similar differences were evident in Block 1 as well. Plant cover was significantly greater in all three restoration treatments than the control, but we did not find the expected differences among treatments. Change in species richness increased in general due to treatment effect, however only the 2-4 and 3-6 replacement treatments were significantly higher than the control. Introduced species were rarely found among treatments and graminoids were the dominant functional group. In Block 2, the overall model that included treatment and pre-existing treatment differences was significant but individual treatment means did not differ significantly (p =0.0626). Plant cover tended to be greater in all three restoration treatments compared to the control. Change in species richness in Block 2 was only significantly higher in the 3-6 treatment. Native species were the primary vegetation among all treatments. Introduced species were infrequent. Factors limiting recovery of the ecosystem: Cover of introduced species was fairly low, though some individual introduced species did increase in frequency across the study area. These included Dalmatian toadflax (Linaria dalmatica), common dandelion (Taraxacum officinale), bull thistle (Cirsium vulgare), wooly mullein (Verbascum thapsus), yellow salsify (Tragopogon dubius), prickly lettuce (Lactuca serriola), and possibly cheatgrass (Bromus tectorum). Several of these species are of management concern, but the total average cover of introduced species did not exceed 0.4% in any treatment and did not exceed 8% of all plant cover in any treatment. These low values contrast with exotic cover of 15% or more following severe wildfires in some areas of northern Arizona. Introduced species richness as a whole did not increase significantly following restoration treatments, although there was a trend toward more introduced species. Economic vitality and local livelihoods: Species richness in Fort Valley did not differ significantly between treatments. However, the data showed a strong and unexpected trend toward increasing richness in treated areas; Fort Valley had a species richness of approximately 12-20 species per 500-sq m in the control treatments, but 30 to nearly 40 species per 500-sq m in the thinned treatments. A significant difference between these means might have been found if it were not for the low number of replicates. There are some species that were tentatively thought to be positively affected by thinning and burning. Among the biennial/annual forbs, these species include ragleaf bahia (Bahia dissecta), fetid goosefoot (Chenopodium graveolens), goosefoot (Chenopodium sp.), bull thistle (Cirsium vulgare [introduced]), annual willowherb (Epilobium brachycarpum), trailing fleabane (Erigeron flagellaris), pineland marshtail (Laennecia schiedeana), Douglas' knotweed (Polygonum douglasii), yellow salsify (Tragopogon dubius [introduced]), and wooly mullein (Verbascum thapsus [introduced]). Many of these species are in the Asteraceae (composite) family and are wind-dispersed, supporting the hypothesis that early-successional species would be favored in the post-treatment environment. There were no species in this group that seemed to be negatively affected by the restoration treatments. Perennials that appear to be increasing with restoration treatments include common yarrow (Achillea millefolium), small-leaf pussytoes (Antennaria parvifolia), showy goldeneye (Heliomeris multiflora), Bigelow's rubberweed (Hymenoxys bigelovii), Huachuca Mountain morning-glory (Ipomoea plummerae), prickly lettuce (Lactuca serriola [introduced]), Dalmatian toadflax (Linaria dalmatica [introduced]), Lambert's locoweed (Oxytropis lambertii), Flagstaff ragwort (Senecio actinella), and common dandelion (Taraxacum officinale [introduced]). Again, the majority of these species are wind-dispersed members of the composite family and most increases in the presence of these species happened in both treatments and controls. Three species/genera that appear to be decreasing with restoration treatments include mountain goldenbanner (Thermopsis montana), clover (Trifolium sp.) and beardlip penstemon (Penstemon barbatus). Graminoid species remained relatively stable through time. Cheatgrass (Bromus tectorum [introduced]), Fendler's flatsedge (Cyperus fendlerianus), wild barley (Hordeum jubatum), deergrass (Muhlenbergia rigens), and little bluestem (Schizachyrium scoparium) appeared to increase with thinning and burning. There were no species that seemed to be decreasing in frequency with these treatments and no differences were evident between C4 and C3 grasses. Buckbrush (Ceanothus fendleri) increased across the landscape after thinning and burning, while rabbitbrush (Ericameria nauseosa) and Woods' rose (Rosa woodsii) decreased in both treatments and controls. This could be an effect of long-term drought or grazing. Woods' rose is heavily browsed by deer and elk following fire and other species of Ericameria are also eaten by ungulates (FEIS database). Ponderosa pine (Pinus ponderosa) seedlings had a productive year in 2006. They were found in 100% of the treated plots (180 total plots) and 80% of the control plots. Gambel oak (Quercus gambelli) seedlings have been found in small numbers throughout the duration of the study, but they don't appear to be increasing or decreasing across the landscape.

Monitoring and Data Sharing

Does the project have a defined monitoring plan?:

NO

Open Access URL:

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Long Term Management

STAPER

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)