Pack Creek Fire Restoration in the Pinyon-Juniper Forest: Year 2

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Figure 1: Utah State University student intern and Rim to Rim Restoration biologist survey a plot in the burn scar of the Pack Creek fire in June 2023.

Project Summary

In June 2021, the Pack Creek Fire burned over 9,000 acres in the La Sal Mountains near Moab, Utah, severely impacting the local community and creating an urgent desire for landscape restoration. Initial restoration efforts, led by the U.S. Forest Service in partnership with the local non-profit Rim-to-Rim Restoration, focused on lower-elevation pinyon-juniper (PJ) forests. Native plant seeding was conducted in fall 2021 with an emphasis on flowering forbs and native perennial grasses. Prior to the fire, the U.S. Forest Service had implemented forest thinning treatments in several areas of the Manti-La Sal PJ woodlands, including in numerous patches that later burned in the Pack Creek Fire. These pre-fire treatments done through chaining were suspected by managers to influence the trajectory of post-fire recovery, which this project attempts to directly address.

Through support from CNHA, this project investigates whether pre-fire thinning and post-fire seeding efforts have altered the timing or trajectory of understory recovery in PJ ecosystems following the Pack Creek Fire. Funding from the Canyonlands Natural History Association (CNHA) 2023 and 2024 Discovery Pool supported fieldwork costs, including technician time, salary support for Principal Investigator Rebecca Finger-Higgens, and logistical expenses associated with revisiting established plots during the 2023 and 2024 growing seasons. Fieldwork was conducted in mid-June of both years by personnel from the U.S. Geological Survey, Utah State University, Utah Valley University and Rim to Rim Restoration.

Key findings suggest that pre-fire thinning treatments, along with the Forest Service's seeding of rangeland grass species, are influencing post-fire recovery dynamics. Notably, hand seeding appears to be more successful in areas that were not thinned prior to the fire.

These findings are particularly relevant to our partners at the U.S. Forest Service, as the Manti-La Sal District is now seeking guidance on fire recovery and the effectiveness of hand seeding for restoration in the newly burned Deer Creek Fire scar, located in a nearby area of the La Sal Mountains.

Research Need and Questions Addressed

<u>Guiding Questions</u>

Do pre-fire fuels reduction programs (chaining) expedite or inhibit forest regrowth following a fire, both with and without restoration implementation?

Three years following the Pack Creek Fire, how do hand seeding treatments impact understory recovery for pinyon-juniper forests?

<u>Project Aims</u>

1. Coordinate field data collection through the development of methods and hire and train field technicians in plant identification, standard soil measurements, and field safety.
2. Conduct fieldwork to survey and measure vegetation species presence, cover and abundance, soil stability, and water infiltration at the 18 sites established in Fall in chained and control plots.

3. Analyze data and present findings with partners and the local community.
4. Use findings to pursue additional funding, outside of CNHA.

Methods

2024 Field Work

With field sites established, the next phase of the project focused on planning and organizing for the 2024 growing season. Technician training took place in spring 2024 during the USGS onboarding process for seasonal hires. During this time, technicians received training in plant identification, standard sampling methods, data entry, and field safety.

Fieldwork occurred during late June 2024 to capture peak growing season conditions. At each site, we repeated the sampling methods established in 2021, following a 'hub and spoke' transect design composed of three 25-meter transects. These methods were comparable to a similar project funded by the Joint Fire Science Program and lead by collaborators Duniway, Bishop, and Young that looked at unburned plots in similar Ecological Sites across the Colorado Plateau.

Species Cover and Abundance Estimates

We estimated species cover using the line point intercept method. Along each 25-meter transect, a pin was dropped every 50 cm. Every species that a pin intersected was recorded, along with the surface ground cover (e.g., litter, rock, biological soil crust). Field protocols followed standard operating procedures used in other USGS projects and the BLM's Assessment, Inventory, and Monitoring (AIM) program. Technicians also compiled a comprehensive list of all species present within each plot. This list included both species encountered during point frame sampling and additional species observed in the plot that were not intercepted by sampling pins.

After completing the line point intercepts, we recorded canopy gaps for both annual and perennial plants, documenting any gap ≥ 20 cm. These measurements were used for erosion modeling and to estimate site recovery.

Soil Aggregate Stability

To assess plot susceptibility to water erosion, we conducted soil aggregate stability tests within each plot. At each site, six points were randomly selected along each of the three transects (total = 18) for sampling. A small portion of surface soil was collected from each point, submerged in water, and scored based on whether the soil aggregate remained intact after one to five dunks. Scores were averaged across the plot to produce a general stability score for analysis.

Data Processing and Analysis

After fieldwork was completed, technicians were responsible for data entry, quality assurance, and quality control. Once the dataset was finalized, Finger-Higgens analyzed the data using linear regression and analysis of variance statistical models. Key findings from the analysis will be shared with the USFS for agency review and consideration into ongoing management strategies. Additionally, Anna Knight (USGS, Ecologist) is currently working on a USGS ScienceBase Data Release for the Joint Fire Science Program lead by Mike Duniway that will include the 2024 Pack

Creek Fire Sampling Data. The Data Release is currently in progress and set to be published by November 2025.

Personnel

Rebecca Finger-Higgens (Research Ecologist, USGS Southwest Biological Science Center, Moab, UT) is the lead PI on this project. As an early career researcher, if awarded, this will be the first grant that she executes as lead PI. Dr. Finger-Higgens was responsible for the hiring and management of field technicians, establishing field protocols, and standardizing data collection. Additionally, Dr. Finger-Higgens analyzed the data and is preparing reports and manuscripts for information dissemination.

Kristina Young (Assistant Professor, University of Wisconsin-Madison and Board Member, Science Moab), Brooke Osborne (Assistant Professor, Utah State University Moab (USU)), and Tara B. Bishop (Assistant Professor, Utah Valley University (UVU)) are co-PIs on this project. Drs. Young, Osborne, and Bishop are contributors to project proposal development and collaborated on data collection and analysis. Additionally, Dr. Bishop assisted with data collection and undergraduate student mentorship during the 2024 field season.

Barb Smith (Wildlife Biologist, Manti-La Sal National Forest) serves as the project partner with the US Forest Service. Barb Smith compiled the CNHA-funded pollinator seed mix that was used in the restoration seeding trial and she has continuously collaborated with Drs. Finger-Higgens and Young to establish monitoring sites and seeding trial plots in the burn scar of the Pack Creek fire.

Kara Dohrenwend (Director, of Rim-to-Rim Restoration) serves as a consultant on this project. She assisted with procuring a Utah Watershed Restoration Institute grant (see below) which allowed for the purchase of seeds and a week of work from the Utah Conservation Corps to help with the seeding experiment set-up in August 2022.

Michael Duniway (Research Ecologist, USGS Southwest Biological Science Center, Moab, UT) is the supervisor of Rebecca Finger-Higgens and assisted with project and budget management.

Staff and Personnel Used for 2024 Research (8 people total)

<u>USGS Staff</u>
Rebecca Finger-Higgens
Anna Knight
John Severson
Audrey Malloy
Phillip Reeves
Phoebe Finch
Gayle Tyree
Erika Geiger

<u>Utah Valley University</u>
Tara B.B. Bishop
Ava Feltenberger
Christine Fowles

Findings

Findings from the Spring 2024 sampling revealed no significant differences in total foliar cover between previously chained and control areas (51.7% ± 6.3, 54.4% ± 8.8 respectively, Fig. 2A). However, differences emerged when examining specific plant functional groups. Perennial grass cover was significantly higher in chained plots (20.7% ± 2.9) compared to control plots (7.3% ± 4.2, Fig. 2B), largely due to the presence of non-native perennial grasses seeded during tree removal efforts. In contrast, forb cover was greater in control plots (21.15% ± 4.1) than in chained plots (11.4% ± 2.9, Fig. 2C). Despite these functional group differences, there were no notable differences in total number of observed species (Fig. 2D) or soil stability between treatment types. Tree cover was also slightly higher in control plots compared to chain, which were also the only locations where tree seedlings were observed in 2024.

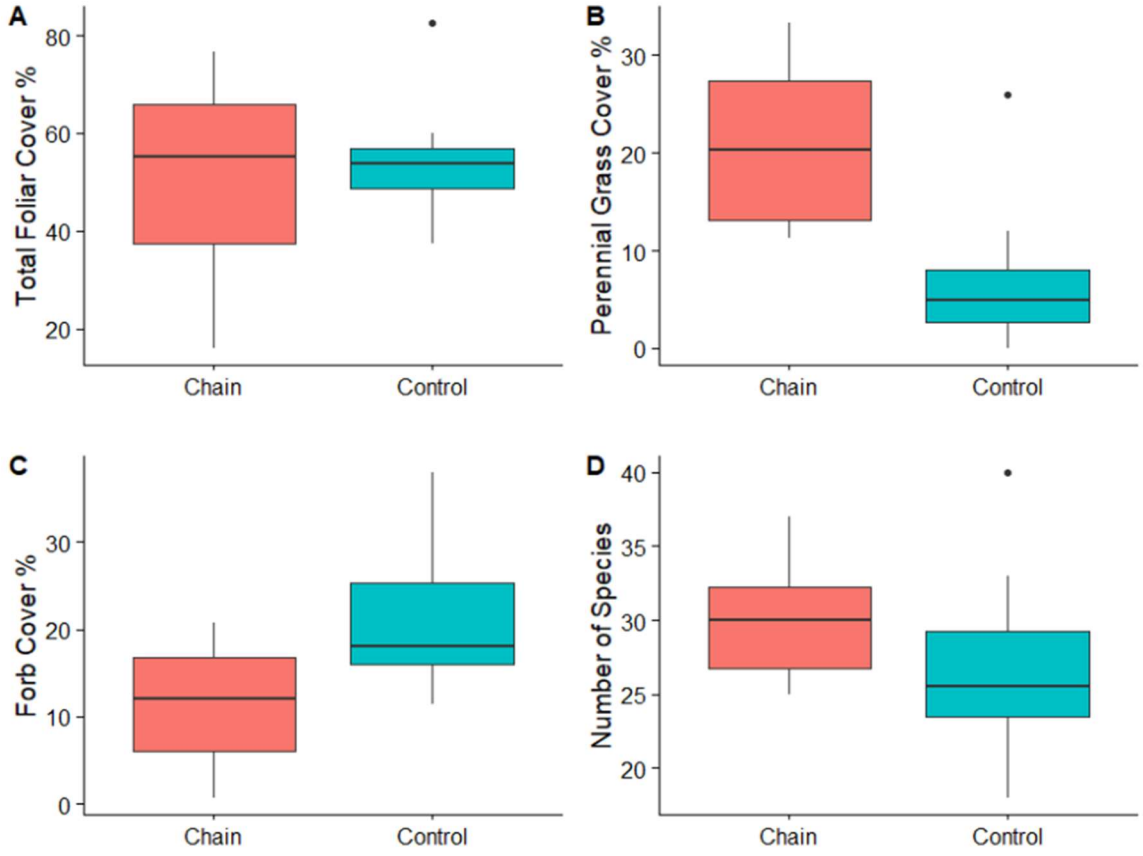

Figure 2: Total foliar cover percentage (A), perennial grass cover percentage (B), forb cover percentage (C), and total number of observed species (D) at chain and control plots (n=16 for both treatments).

These findings suggest that pre-fire fuels reduction treatments coupled with seeding with non-native forage grasses can have lasting impacts in post-fire recovery. However, regardless of the prevalence of prior seeded forage grasses, we did not observe that these plants inhibited the total number of species in post-fire recovery but may have limit the total cover of smaller herbaceous forb species. This highlights the importance of carefully evaluating the long-term ecological consequences of pre-fire management strategies in PJ woodlands, especially as these ecosystems

are frequently targeted for fuels management and developments throughout the southwestern United States.

Application of Research Results (to future educational or interpretive efforts)

Throughout the duration of this project, the research team has strived to incorporate students, early-career researchers, and the public. Following the 2023 field season, co-PIs Drs. Osborne and Bishop hosted a group of students involved in The Nature Conservancy Native American Tribes Upholding Restoration and Education (NATURE) program. NATURE participant visited the fire scar and visited seeding plots to observe and discuss the role of land managers and restoration practitioners (i.e. Rim-to-Rim Restoration) in post-fire understory recovery.

During the 2024 field season, Dr. Bishop mentored two undergraduate students from UVU, who assisted the team with data collection. Through this mentorship, UVU students were trained in commonly used ecological research methods, collaborated with USGS researchers and technicians, and gained a better understanding of fire ecology and forest dynamics.

For the 2025 Fall Semester, Dr. Finger-Higgens is coordinating a guest lecture with Dr. Bishop for her UVU course on Nature Resource Management to discuss key findings from the CNHA funded Pack Creek Fire Research. The instructors will provide the students with an overview of the objectives and key findings from the research and provide an analytical workflow to demonstrate statistical methodologies and scientific reasoning.

Future Research Needs

Pinyon-Juniper woodland recovery following fire remains a topic of significant interest across much of the American Southwest (Phillips et al. 2024). This study an important first step toward understanding how past land management decisions in the Manti-La Sal distric, such as forest thinning and the seeding of non-native perennial grasses, may influence post-fire forest recovery. However, to build a more comprehensive understanding, this work should be expanded to include additional PJ woodlands and fire events.

For instance, our agency partner Barb Smith has expressed interest in evaluating whether post-fire native plant seeding is effective in areas dominated by non-native perennial grasses. This question is particularly relevant to ongoing recovery efforts in the Manti-La Sal Ranger District, where managers are actively considering restoration strategies for the 2025 Deer Creek Fire. Discussions with practitioners are already underway, and proposals are currently under review by Utah's Watershed Restoration Initiative to support post-fire restoration activities, including hand-seeding of native forbs as this is often considered to be the best restoration strategy (Floyd and Romme 2012).

Across the Colorado Plateau, and especially in Utah, PJ thinning is a common management strategy (Redmond et al. 2013). Managers often view PJ encroachment as a challenge in rangeland systems, where dense woodlands are thought to limit access for grazing and browsing animals, including both domestic livestock and wildlife (Hartsell et al. 2020). Our research indicates that PJ treatments can lead to increased perennial grass cover both before and after fire, but the implications of this shift for animal activity and habitat use remain poorly understood. Further research is needed to explore how livestock and wildlife utilize post-fire PJ ecosystems and how the prevalence of

perennial forage grasses may influence habitat quality. Yet, it should also be noted that ungulate grazers and browsers are not the only species dependent on these ecosystems. An observed increase in forb cover in non-chained, control plots suggest potential benefits for pollinators and broader biodiversity.

This work lays the foundation for a deeper understanding of how management legacies shape post-fire recovery in PJ woodlands. As restoration efforts continue across the region, especially in the wake of large wildfires, it is essential to consider both ecological outcomes and the diverse needs of wildlife, livestock, and land managers. Continued collaboration and research will be key to developing effective, science-based restoration strategies that support resilient and biodiverse landscapes. To achieve this, the PI team is actively involved in other PJ fire projects and will continue to search for ways to build on this experience with future research endeavors.

We thank the CNHA for their continued support on this project and we look forward to future support from the organization.

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