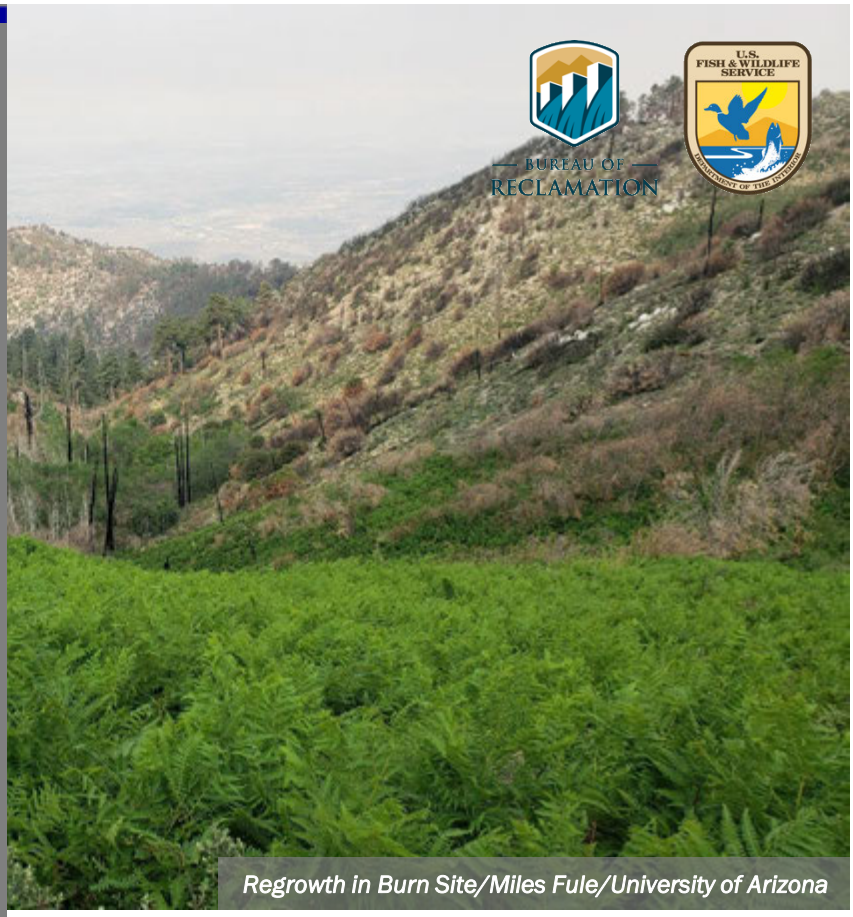
ACTIONABLE SCIENCE

Measuring the Effects of Fire Severity on Forest Resilience in the Santa Catalina Mountains

THE UNIVERSITY OF ARIZONA

Over the last 20 years, the Santa Catalina Mountains (the Catalinas) have experienced multiple severe forest fires. Climate change has increased the frequency of fires that spread rapidly and burn at high temperatures, consuming more of the affected vegetation. As a consequence, water run-off speeds are higher and erosion rates increase. To better understand the effects of the increasing frequency and severity of forest fires, a team of scientists from the University of Arizona measured several post-fire environmental conditions and aimed to assess how past fires influence an area's resilience to change.

Project Location



Regrowth in Burn Site/Miles Fule/University of Arizona

KEY ISSUES ADDRESSED

There are varying standards for what constitutes a healthy post-fire forest ecosystem, making it difficult to determine whether a site is recovering well. Additionally, it is unclear how previous fires affect the rate and trajectory of post-fire recovery.

Severe fires can reduce the soil's ability to efficiently absorb water. Severely burned areas are at high risk of increased erosion and flooding due to an increased likelihood of hydrophobic layer formation. While fire, erosion, and flooding are all natural processes, when they reach the wildland-urban interface, their threat to human life and human-made structures increases significantly.

PROJECT GOALS

- Collect field data as a baseline to evaluate future changes in forest resilience
- Measure soil properties that influence water infiltration rates to assess fire impact
- Collaborate with local land managers to develop appropriate management decisions based on study results

MULTI-BENEFIT RECOVERY

Many high-severity burn areas are recovering, which is important for species' habitats and people's connections to forested places.

Field Crew En Route to Study Site/Miles Fule/University of Arizona

PROJECT HIGHLIGHTS

Seedlings and Recovery: Field crews visited and measured 56 plots in the Catalinas, all with varying fire severity and time since the last fire, and observed their response to fire. More than half of the plots affected by the Bullock and Aspen fires of 2002 and 2003 were noted to be recovering. Plots that burned at low to moderate severity had many established conifer seedlings, and their soils appeared intact.

Tree Rings and Resistance: Researchers used tree-ring analysis to confirm that the trees exposed to low-severity fire in the Bullock and Aspen did not experience significantly reduced growth rates. This indicates that the tree species in question are well-adapted.

Soil Still Stabilizing: Teams collected soil samples and placed 15 mini disc infiltrometers at each plot to measure the infiltration rate of soil at different burn sites one year after the Bighorn fire. Results indicate that soil properties have not stabilized to the point where predictions can be made about the relationship between burn severity and soil's ability to absorb water.

Vegetation Transitions: Vegetation communities often change after fire, either temporarily or persistently. The team found that fire severity was a strong factor determining whether an area would recover to its pre-fire state, or reorganize with a different dominant species.

LESSONS LEARNED

A forest community's shift in species diversity and richness following a fire is difficult to measure in the short term. This is because these changes may not be evident immediately after a fire, even where there has been significant mortality. For example, some severely burned areas in the Catalinas became dominated by ferns after the Bighorn fire. Other areas became dominated by canopy-forming grasses or shrubs, even 18 years after the Bullock and Aspen fires.

The variation in post-fire water infiltration rates may be a consequence of varied fire severity, and it should be noted that soil properties may take years to stabilize following fire. Comparing multiple sites within a vegetation zone with similar fire legacies would be helpful for understanding the relationship between burn severity and infiltration rates.

It is important that post-fire management regimes focus on ensuring the establishment of conifer seedlings to replace trees killed during fire. Managers should also monitor landscape changes, recognizing that the landscape may be a mosaic of burned and unburned areas for many years following a fire.

NEXT STEPS

- Continue monitoring the burned areas, annually if possible, and share results through webinars and lectures
- Secure funding necessary for resampling sites for several consecutive years to build on the established database
- Educate stakeholders on the benefits of naturally occurring fire and encourage land management practices that facilitate more resilient forests

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Field Crew in Burn Site/Miles Fule/University of Arizona

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