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The Big Comeback: Prefire Understory Plants Return after the Hayman Fire

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Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

The understory plant community returns as a mirror image of its prefire self in this five year study following the 2002 Hayman Fire in Colorado's Front Range. Credit: P. Fornwalt.

The Big Comeback: Prefire Understory Plants Return after the Hayman Fire

Summary

Researchers took advantage of data collected prior to Colorado's 2002 Hayman Fire to examine the effects of mixed-severity wildfire on understory plant community development during the first five postfire years. Some declines in species richness and cover were observed immediately following fire, but by postfire year five, they met or exceeded prefire levels, even in severely burned areas. Changes in upland community composition, where they were observed, were primarily due to the postfire recruitment of new species (particularly native short-lived forbs), rather than due to a loss of prefire species. While exotic richness and cover generally increased as fire severity and time since fire increased, the presence of exotics remained relatively low at the end of the study, and has not yet interfered with the recovery of the native understory community.

Key Findings

- Eighty percent of the plant species found in prefire surveys were also found in postfire surveys, regardless of fire severity or time since fire.
- Most of the common understory species had neutral or positive responses to the Hayman Fire.
- For all fire severities, fire-induced changes in community composition were primarily due to postfire recruitment of new species, particularly short-lived native forbs.
- Exotic species have not yet impacted the recovering native plant community, though continued monitoring is recommended.
- A flush of ponderosa pine and Douglas-fir regeneration occurred within low and moderate-severity areas of the Hayman Fire in 2006. Conifer regeneration was uncommon in severely burned areas where seed sources were unavailable.

Focus underfoot

Native plant communities in the Colorado Front Range have evolved as integrated components of their local fire regime. Their structure, distribution, reproduction and recovery mechanisms are adapted to work with the natural process of recurring wildfire. But like many natives, exotic plants can thrive after fire too. Once they're established they can displace or even replace native plant communities.

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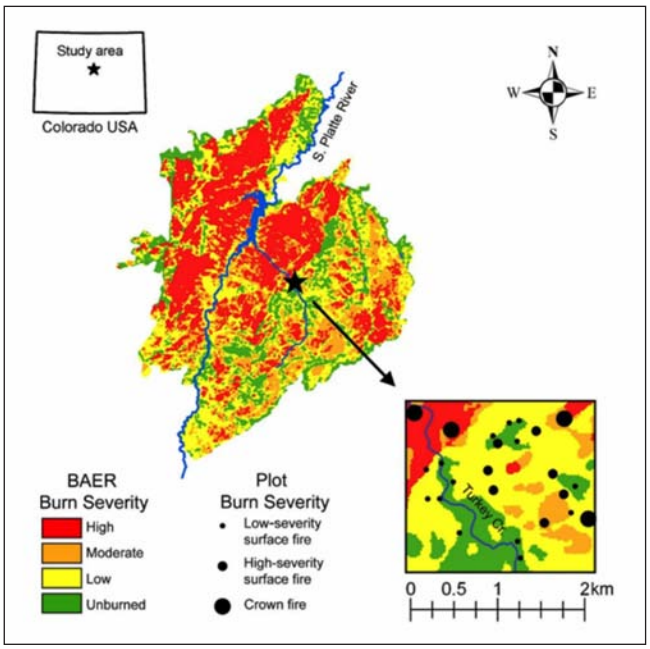
The Hayman Fire of 2002 burned over 130,000 acres of ponderosa pine - Douglas-fir forest in Colorado's Front Range. It was one of several recent mixed-severity fires to burn there since 1996, many of which contained large areas of stand-replacing, severe fire. These open areas can serve as reset buttons for native understory plant communities, letting in sunlight and clearing soil. But open conditions that accompany a disturbance like fire can sometimes be conducive to rapid colonization by exotic plants.

2002 Hayman Fire in Colorado's Front Range. Credit: Forest Service.

Elsewhere in the West, postfire colonization by exotics—particularly annual grasses like cheatgrass—has disrupted nutrient cycling and hydrology, altered fire regimes and caused the decline of native plant species. Little is known about how native and exotic understory plants respond to wildfire in this dry, relatively unproductive landscape. Most research in this unique ecosystem has focused on the impacts of fire on the forest overstory. As wildfires have increased in size and frequency over the last decade, it's become critical for forest managers to better understand fire's effects on understory plant communities.



The Hayman Fire provided researchers with a full range of burn severities to study and compare with prefire conditions.

Time machine: Rare prefire data

For this project, Paula Fornwalt, an ecologist with the Forest Service's Rocky Mountain Research Station in Fort Collins, Colorado, evaluated changes in forest understory plant communities that result from wildfire burning with a full range of severities. Understory data collected five years before the Hayman Fire presented her with a rare opportunity to compare the plants that grew before the fire

to those that grew during the first five postfire growing seasons.

The study took place within the fire perimeter in the Upper South Platte Watershed of the Pike National Forest approximately 35 miles southwest of Denver, Colorado. Conveniently, the fire burned with a full range of severities throughout the study area, which contained twenty 0.25-acre plots. Researchers measured understory species composition and cover annually from 2003 to 2007 and compared it with information gathered in the same area in 1997.

Postfire natives mirror prefire presence

Results indicate that the Hayman Fire had little effect on native understory plant communities, even in areas that burned with high-severity. "This was one of the most important and interesting findings for me," she says. "Almost 80 percent of the species that were there before came back after. It shows that these species are really troopers in the face of fire. It didn't matter if the plot burned with low- or high-severity." Perennials are driving most of the comeback, but many species have other adaptations that allowed their return, like seed banking and long distance seed dispersal. Some species or groups of species returned with such vigor that they reached or exceeded their prefire cover by the end of the study. For example, grasses recovered to prefire levels by the 3rd postfire year. Forbs were back to prefire levels by the second postfire year, and are "off the charts now," Fornwalt says. Woody shrubs grow more slowly and are still struggling to recover to prefire cover levels.

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Fornwalt saw a short term increase in species richness, which she attributes to the recruitment of new native short-lived forb species that tend to come and go quickly. One of the most abundant was a yellow flowering plant known as 'golden smoke' or 'scrambled eggs.' It was found in only one plot before the fire, but was found in nearly all the plots in the first and second postfire years. By the third year it was largely gone from the landscape. This species re-establishes after fire from seeds that lay dormant in the soil. It's suspected that the seeds of golden smoke need smoke or other fire-related cues to germinate. Fornwalt refers to it as a 'first responder' after disturbance. It fills an important ecological role by quickly covering the ground, helping to control erosion and provide shade for new understory germinants. If it were all to burn again tomorrow this species would likely be among the first to return.

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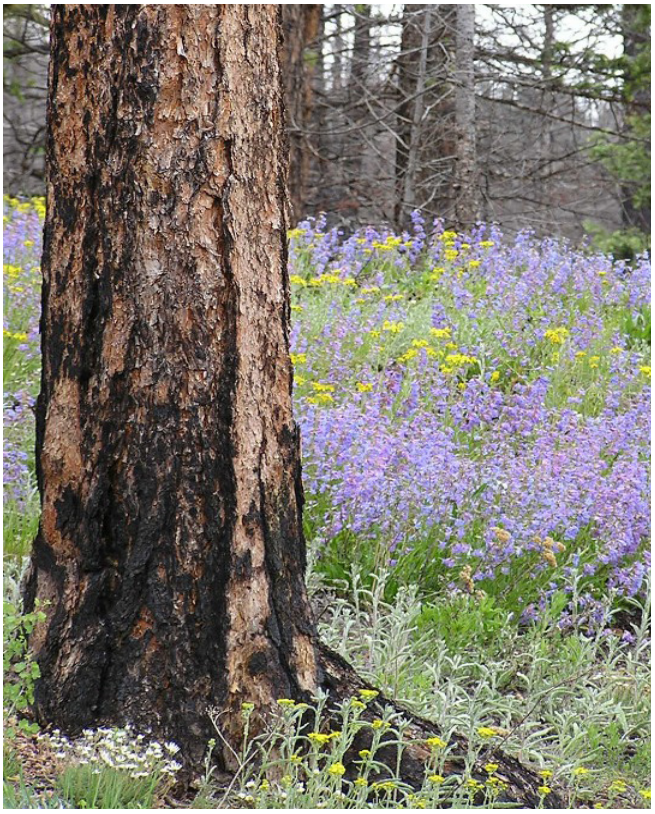
Not 'exotic mayhem'

Few of the exotic species found over the course of the study were widespread and abundant. In contrast to the natives—whose response didn't appear to be related



Almost 80 percent of understory plant species that were present before the fire were present afterward including Front Range beardtongue and Fendler's ragwort.
Credit: P. Fornwalt.

The native forb known as 'golden smoke' or 'scrambled eggs' fills an important ecological role by quickly covering the ground after fire, providing shade for understory germinants, and stabilizing the soil.
Credit: Jennifer Anderson, 2002.

to fire severity—richness and cover of exotics was highly dependent on fire severity and time since fire. Exotics were least stimulated by fire in lightly burned areas where less than 50 percent of the forest overstory was killed, while they were most stimulated in moderately and severely burned areas where overstory mortality was 50 percent or more. The presence of exotics in lightly burned areas changed little over the course of the study. Exotics became increasingly abundant in moderately and severely burned sites as time since fire passed. Some postfire exotic species were truly new invaders that were not found in any prefire surveys. The most notable were prickly lettuce, triticale, and in 2007—cheatgrass. While prickly lettuce likely established via long-distance seed dispersal, both triticale and cheatgrass are known to have been introduced in the Hayman Fire during postfire rehabilitation activities. Triticale was seeded intentionally to help stabilize the soil in severely burned areas, while cheatgrass was unintentionally dispersed as a contaminant in postfire rehabilitation materials. The arrival of cheatgrass is particularly unwelcome, as it has proved to be an aggressive, flammable, postfire invader in many areas of the West.

*Exotics became increasingly abundant in moderately and severely burned sites as time **since fire passed.***

Mullein was the most abundant postfire exotic plant although it never covered more than 2 percent of any study plot during the study. Credit: P. Fornwalt.

Common mullein was by far the most prevalent exotic species. It continues to expand its presence in moderately and severely burned areas, although its cover never exceeded 2 percent in any plot during the study. "That one should be sending up some flares," Fornwalt says. "Managers should be thinking about what might need to be done to control mullein in the Hayman Fire. My thought is—what's to stop it at this point? If mullein needs bare soil and lots of sun—there's plenty of that out there now, especially in severely burned areas." Overall though, exotics were still keeping a low profile by the end of the study, and didn't appear to be outcompeting native species. Fornwalt points out that people often assume high-severity fire equals exotic mayhem, but that hasn't turned out to be the case in the Hayman, even five years after the fire.

Rare summer deluge births a batch of seedlings

A flush of ponderosa pine and Douglas-fir regeneration occurred within the fire perimeter late in 2006. Tree regeneration is very episodic in Front Range ponderosa pine—Douglas-fir forests. It can take decades for a productive seed year to line up with enough precipitation for the seeds to germinate. When low or moderate-severity fire takes place and trees are stressed but not killed, seed production is often stimulated, so the presence of seeds wasn't surprising—but the rain that allowed them to germinate was unexpected. July of 2006 brought an unusually heavy rainstorm to the region that Fornwalt describes as a deluge. It completely washed out study area access roads. Late that summer through the following spring, a flush of conifer seedlings appeared within the fire perimeter, but was limited to low and moderate-severity portions of the fire. They saw very few seedlings in high-severity plots because they weren't typically near a live seed source. "These patterns of conifer regeneration are going to have some interesting implications for how long these severely burned areas stay open," she says, "especially in the large, high-severity patches where it's literally miles to the closest seed source."

Precipitation and seedfall came together to produce a flush of pine seedlings near surviving overstory trees in the summer of 2006. Credit: L. Herman.

Prefire inventory key to postfire planning

Fornwalt's study provides evidence that understory plant communities at both the local and the landscape scales strongly influence the composition of the postfire communities in the Colorado Front Range ecosystem. Native plants bounced back with unexpected vigor and have thus far held their own against postfire invasions of exotics seen frequently elsewhere in the West. However as fires continue to burn in the region, exotics will remain a threat to the recovery of burned areas, and this study shows that

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it's important for managers to know what they've got *before* it burns. "Since we found that what was there before the fire largely dictated what was present after the fire—it seems to me we need to have accurate maps of species distributions, especially of exotic species," Fornwalt says. That way you can monitor the species after fire and determine whether or not it's becoming a real nuisance."

Fornwalt stresses that our understanding of the interaction between fire and exotics in Colorado's ecosystems is far from clear, and more work is needed. In the mean time, understory plants in the Hayman Fire appear to be alive and well.

Management Implications

- Exotic plants do not appear to be threatening native understory plant community development at present, but monitoring should be continued to evaluate if they will pose a threat in future years.
- Because species present before a wildfire are such a strong indicator of what will return after, the creation and maintenance of accurate, understory plant surveys is recommended, particularly for exotic species or other species of concern.

Further Information: Publications and Web Resources

Fornwalt, P.J. 2009. Disturbance impacts on understory plant communities of the Colorado Front Range. PhD Dissertation, Colorado State University, Fort Collins, CO.

Fornwalt, P.J., M.R. Kaufmann, and T.J. Stohlgren. 2010. Impacts of mixed severity wildfire on exotic plants in the Colorado Front Range. Biological Invasions. DOI 10.1007/s10530-009-9674-2.

Project web resource: http://www.firescience.gov/JFSP_Search_Results_Detail.cfm?jdbid=%23%27*%2F9%0A

Scientist Profile

Paula Fornwalt has worked for the USDA Forest Service, Rocky Mountain Research Station in one capacity or another since 1999. Currently she is an Ecologist in Fort Collins, Colorado. Her research addresses questions about current and historical overstory structure, surface fuel loading, and understory species composition in Colorado forests, and their relationships with both natural and human-caused disturbances.

Paula earned her B.S. degree in Environmental Science from the University of Delaware in 1996. She also has an M.S. in Forestry (1999) and a Ph.D. in Ecology (2009), both from Colorado State University.

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