2009

Lessons of the Hayman Fire: Weeds, Woodpeckers and Fire Severity

Marjie Brown
US Forest Service, marjie@marjiebrown.com

Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

Front Range beardtongue, a Colorado Front Range native, blooms from the ashes five years after the Hayman Fire. Credit: P. Fornwalt.

Lessons of the Hayman Fire: Weeds, Woodpeckers and Fire Severity

Summary

This project took advantage of pre-fire data gathered within the perimeter of Colorado's 2002 Hayman Fire. Researchers studied the unique fire regime of Front Range ponderosa pine forests, and fire effects on understory-plant communities and American Three-toed Woodpeckers. Results confirmed that historically, the diverse structure of these forests was maintained by a mixed-severity fire regime that included large areas of severe fire. In addition, researchers found that much of the burn meets habitat requirements for American Three-toed Woodpeckers, and that understory plant species that were present before the fire returned afterward, with only a slight increase in the number of exotic species.

Key Findings

- Most native understory plant species present before the fire were present afterward, regardless of burn severity.
- Mullein was the most abundant exotic plant before and after the fire and increased dramatically postfire, but was not abundant enough to impact the native plant community.
- The response of American Three-toed Woodpecker to burn severity was strongly scale dependent. The size and spacing of severely burned patches affected postfire distribution.
- Although the woodpeckers foraged and nested primarily in severely burned areas, they choose territories that included surviving trees.
- Historically, the fire regime in Front Range ponderosa pine forests was more mixed in severity in response to forest structure that was much more diverse.

Long-term presence of severe fire

Much of the scientific information about ponderosa pine-dominated forests and the natural processes that shape them has been sourced from studies in the southwestern U.S. Until recently it was assumed that this information could be applied to ponderosa ecosystems across the west. We now know that the forests in each region have evolved with different soil, topographical, and climate conditions, which translate into differences in the way wildfire has historically shaped each distinct system. It's known that before Euro-American settlement and eventual fire exclusion, southwest ponderosa ecosystems saw frequent, low-intensity surface fires every five to ten years fueled by grassy understories maintained by cyclic, monsoonal rains. The story is different for Colorado's Front Range according to Merrill Kaufmann, Research Forest Ecologist (Emeritus) with the USDA Rocky Mountain Research Station in Fort Collins, Colorado. Kaufmann has studied these forests since the early 1990s, building a thorough and influential understanding of their ecology, structure and development. His research has shown that historically this ponderosa ecosystem was more diverse and changeable. Fires were less frequent than in southwest ponderosa systems, dominated by a mixed-severity fire regime that included larger areas of severe fire.

Kaufmann says that because the Front Range lacks a consistent monsoonal rain pattern, accumulations of understory fuel are insufficient for carrying frequent surface fires that are historically common in the southwest. "The fire histories show that we had frequent understory fire *sometimes*," he explains, "but the fires that really made the difference on the landscape were more like forty to sixty years apart." Without frequent surface fires, fuels grew gradually over many decades. When this diverse structure combined with the right ignition source and weather, fires were mixed in severity. "They included large areas of severe fire that blew out patches of trees 5 to 100 acres in size—much larger than the openings created by fire in the southwest. These openings re-set the forest to a start-over condition," Kaufmann explains. Citing the long-protected, intensively studied Cheesman Reservoir area, he points to remnants of fire's ancient footprint signaled by large openings in old growth stands where trees killed by fire in1851 still remained—until much of it was consumed by the record-setting Hayman Fire that burned 139,000 acres in 2002.

"The fire histories show that we had frequent understory fire sometimes," he explains, "but the fires that really made the difference on the landscape were more like forty to sixty years apart."

Approximately half the Hayman Fire burned with mixed-severity. Overly dense forests and extreme fire weather caused the remainder to burn severely, creating unusually large areas where tree mortality was 100 percent. "There are areas out there thousands of acres in size that are now without a single living tree," Kaufmann says.

A portion of the Hayman Fire landscape, one year after the fire.

Was the size and scope of the severely burned area unprecedented? "We really don't know that," says co-principal investigator Tasha Carr, an ecologist with the U.S. Geological Survey, Fort Collins Science Center who studied the response of American three-toed woodpeckers to fire severity as part of this project. "There were some really large areas that burned severely in a single day. Without a doubt that was a significant event. Yet we're not seeing the expected, catastrophic ecological results. The system is adapted to severe fire." She points out that it's important to be aware of our tendency to judge a fire like the Hayman as good or bad, all or nothing, because of the inherent filter of

our human perspective. “You can have two people standing in the middle of a burn,” she says. “One will say, ‘Wow—this is terrible. Look at all those dead trees’ while the other person might be thinking, ‘Wow! Look at all the trees that are actually still living.’ Those are our human filters at work right there.”

Because much of the area involved in the Hayman had been extensively studied and surveyed prior to the fire, the question of “what was there before?” had already been answered—making this postfire work exceptionally valuable. “We had done all of the right work beforehand,” Kaufmann says. Ecologist Paula Fornwalt, with the Rocky Mountain Research Station, used some of this valuable prefire data to investigate how native understory plants fared vs. exotics during the first year following the fire, while Carr wanted to know more about what beetle-munching woodpeckers require of postfire landscapes.

Postfire encore for prefire plant species

“One of the huge questions surrounding Hayman, and all the big fires, is what’s going to happen to invasive species—and how well will the native species do?” Kaufmann says. “The ones that are the most trouble are not just noxious but highly invasive, and really capitalize on disturbance. Some native plants do the same thing. There’s kind of a natural succession.” So Paula Fornwalt took advantage of the prefire information and went to work. She focused on postfire native vs. exotic species richness and abundance in the understory because of concerns surrounding the potential influx of exotic plants, and because understory response to a wide range of fire severity had received little study.

She found that species that were present before the fire were the most significant determinant of species that appeared after. Fire severity did not appear to influence the composition of the postfire native plant community, but it did come into play when it came to postfire exotic abundance and species richness. Overall, it was minimal. “We didn’t have many exotics to begin with, and we don’t have that many now, but they are increasing somewhat,” Fornwalt says. Before the fire, 156 of the species were native and 13 were exotic. After the fire, 140 of the species were native, and 18 were exotic.

Species either re-sprouted from surviving roots, sprouted from seed that blew in from offsite or they were ‘seed-bankers’—plants with short life spans whose seeds lurk in the litter, duff or soil until conditions are right for them to burst into life. In this case seeds needed contact with bare soil and nothing between them and the sun. The fire provided this by burning away both shading vegetation and surface debris that separated seeds from soil. The most common postfire exotic was mullein, a well known, seed banking, noxious weed. This tall, spiked plant drops hundreds of thousands of seeds that can remain viable in the soil for over a century.

Fornwalt says that the success of this plant should be monitored. Data confirm that even though there wasn’t a big exotic problem a year following fire, there may be one in the future if current trends continue, especially in the large areas that burned with high severity. More study is needed to determine long-term outcomes. Because prefire composition appears to drive postfire native/exotic plant communities in this ecosystem, Fornwalt says the best time for proactive management is before fire. She suggests that creating accurate up to date inventories of current species is an important first step. “Accurate inventories may be the best way to predict if something will become a problem after a fire. We now know that it’s very important to be aware of what existed before. That way if it burns you’ll know what to expect. It gives you the opportunity to start thinking about what to do.”

“We now know that it’s very important to be aware of what existed before. That way if it burns you’ll know what to expect. It gives you the opportunity to start thinking about what to do.”

Three years postfire the noxious weed mullein grows among vigorously re-sprouting native understory plants. Credit: P. Fornwalt.

Woodpeckers—wildfire sidekick

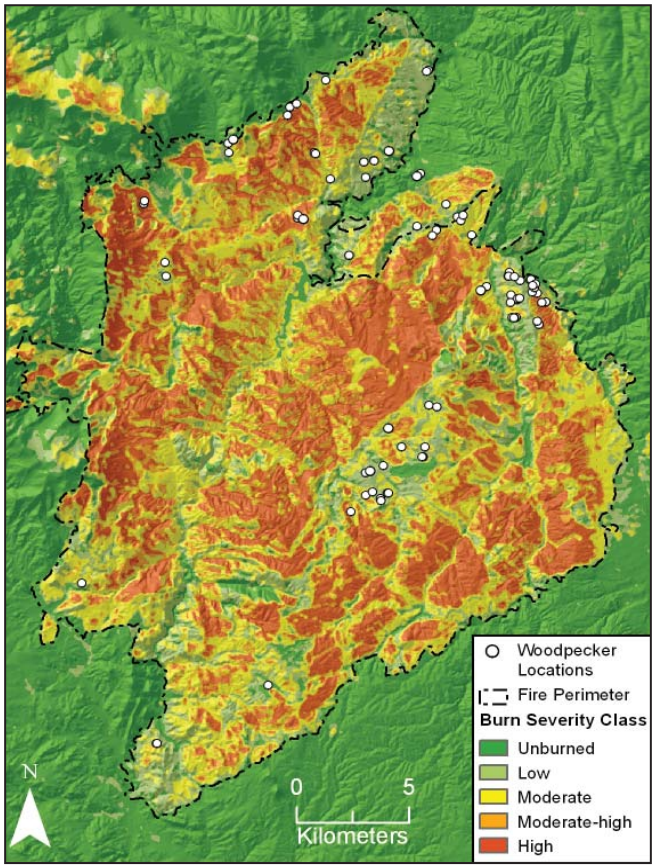
The American Three-toed Woodpecker is a frequent inhabitant of severely burned forests. The newly killed and dying trees create good habitat where the birds forage in high concentrations for their primary food source—wood boring and bark beetles. But our understanding of how they used burned landscapes beyond this is limited. Managers want to know more about the details, particularly with regard to postfire management.

An American Three-toed Woodpecker feasts on a bark beetle grub. Credit: ©Bill Schmoker at www.schmoker.org.

Carr, with graduate student Elizabeth Reynolds from San Diego State University, evaluated American Three-toed Woodpecker response to a wide range of burn severity and prey availability over multiple scales. One and two years postfire she quantified response to burn severity, beetle occurrence, and tree size at three scales: home-range (approximately 90 acres), foraging patch (approximately 2.5 acres), and individual trees within foraging patches.

Carr found that woodpecker response to burn severity was strongly scale dependent. The birds were most common in moderately burned areas containing patches of live and dead trees. They were uncommon in large, severely burned areas lacking live trees and in unburned forests. At the home range scale, burn severity best accounted for three-toed woodpecker use, whereas tree size and beetle occurrence played a stronger role at the scale of individual trees. At the foraging patch scale, all of these factors were important in explaining woodpecker use. These results indicate that the scaling of burn severity patterns can affect the woodpeckers' use of burned forests and demonstrate the importance of evaluating burn severity across a broad range of spatial scales.

The birds were most common in moderately burned areas containing patches of live and dead trees.



This map of the 2002 Hayman Fire shows the locations of foraging or nesting American Three-toed Woodpeckers in 2003 and 2004.

Based on her previous experience with finding this species at the edges of severely burned patches Carr wasn't sure how far the birds would venture from live trees. She was surprised to find that despite the large size of the crown fire areas the majority of the burn provided potential habitat for three-toed woodpeckers. The birds used large, severely burned areas without a single live tree, but they were less common there than in severely burned areas that had live trees remaining, or in areas burned with mixed-severity. "They like patches of severely burned trees. They were often found foraging or nesting there. But they also appear to need live trees," she says. "There isn't a whole lot of the burn that isn't potentially going to be used by them. We don't know that they wouldn't use all of the burn to some degree. It's just that they were more common in areas that had a mixture of burn severities." She speculates that in the short-term, live tree foliage may serve to conceal the birds, protecting them from predators and the more aggressive hairy woodpeckers that outnumber three-toeds in large, severe-burns.

She adds that there may be another, longer term benefit: choosing dead trees adjacent to live trees may be a way of looking ahead. Carr notes that beetles come and go relatively quickly after fire—within three to five years—and that many trees that initially survive fire eventually die during that period from stress or fire injury. These trees provide a follow-up food supply and additional nest sites for the coming years. "These birds live a boom and bust lifestyle," she explains. "Right after fires, the pickings are great, but after a few years the woodpeckers probably have to range over much larger areas of the forest to find the same amount of food." She emphasizes that it's important for managers to consider the longer-term food supply when managing postfire landscapes for the preservation of three-toed woodpeckers and recommends that more snags and dying trees be retained to provide extended foraging opportunities.

A ponderosa seedling signals new beginnings in an area of the Hayman where overstory trees survived. Credit: L. Herman.

Stepping outside our human perspective

When we view the Hayman Fire through our human perspective we see that the historic Cheesman area may take 25 human generations to regain its former old growth stature. But other areas of mature forest, already a few

hundred years old, survived the fire. They now have openings in them—much like those in the old growth consumed in the Hayman where Kaufmann had documented fire-made openings from centuries ago. In a couple more centuries these mature areas are poised to take their place as the old growth component. It's also possible they will burn before then, or after. "It's a shifting mosaic across the landscape," Carr explains, "because things don't stay the same forever. These forests burn. In a mixed severity regime like we have here most everything could burn severely eventually. It's only a matter of time. If we can scale out to a broader perspective in time and space we can begin to see things differently than when we're standing right smack in the middle of a burn and it's all dead trees as far as the eye can see. It's actually rebirth."

"If we can scale out to a broader perspective in time and space we can begin to see things differently than when we're standing right smack in the middle of a burn and it's all dead trees as far as the eye can see. It's actually rebirth."

Kaufmann concludes, "If we were going to lose this museum piece of landscape, we had done just about all of the right work beforehand to get as much as we could learn out of it. We had ideal prefire condition information. Without it, asking or answering any of these questions would have been a lot more difficult. Now we can take advantage of all these different findings so that we end up with a restored forest that represents good ecology—ecology that's very different than the science has been showing for ponderosa pine in other places."

Management Implications

- Because prefire plant species and richness was the primary indicator of what grew in the understory after fire, accurate prefire inventories can help determine postfire species composition and distribution.
- Mullein was the most abundant postfire exotic plant. Managers should plan for management of this noxious weed as it banks hundreds of thousands of seeds in the soil and thrives in open areas created by severe fire.
- Variations in burn severity create islands of surviving trees that may improve habitat for American Three-toed Woodpeckers over the longer term, even within a very large crown fires.
- When managing burned landscapes for a diversity of species, including American Three-toed Woodpeckers, sufficient snags should be left standing to provide for both nesting and foraging needs.
- The prevalence of breeding three-toed woodpeckers found in mixed-severity areas with both lightly and severely burned trees highlights the importance of mixed-severity regimes to such fire-dependent species and the need for fire management that includes a range of fire behaviors, including high-severity fires.

Further Information: Publications and Web Resources

Pre-fire condition, fire severity, and post-fire effects in the Hayman Burn. Final Report to Joint Fire Science: http://www.firescience.gov/projects/03-2-3-08/project/03-2-3-08_final_report.pdf

Kotliar, N.B., E.W. Reynolds, D.H. Deutschman. 2008. American three-toed woodpecker response to burn severity and prey availability at multiple spatial scales. *Journal of Fire Ecology* 4:26-45. http://fireecology.net/Journal/pdf/Volume04/Issue02/026.pdf

Scientist Profiles

Dr. Merrill Kaufmann was the Rocky Mountain Research Station's team leader for ecosystem management research in the Colorado Front Range. Since the mid -1990s, and continuing as an emeritus scientist since 2006, he has worked extensively with land managers to blend new basic science on historical ecosystem structure into management actions that restore sustainable ecological conditions.

Merrill Kaufmann can be reached at:
2836 Blue Leaf Drive
Fort Collins, CO 80526
Phone: 970-282-0163
Email: mkaufmann@fs.fed.us

Paula Fornwalt is an Ecologist at the Rocky Mountain Research Station. Her work addresses questions about the historical and current condition of Colorado Front Range ponderosa pine forests. Her research focuses on overstory structure, surface fuel loading, and understory species composition, and their relationships with both natural and human-caused disturbances.

Paula Fornwalt can be reached at:
USDA Forest Service
Rocky Mountain Research Station
240 West Prospect Road
Fort Collins, CO 80526
Phone: 970-498-2581
Email: pfornwalt@fs.fed.us

Natasha Carr is an Ecologist with the U.S. Geological Survey, Fort Collins Science Center. Her research has focused on the importance of disturbance and ecosystem dynamics to the ecological integrity of forest, grassland, and wetland systems. Currently, she is examining the effects of energy development on wildlife populations in sagebrush systems across Wyoming, Colorado, and New Mexico.

Natasha Carr can be reached at:
U.S. Geological Survey
Fort Collins Science Center
2150 Centre Avenue, Building C
Fort Collins, CO 80526
Phone: 970-226-9446
Email: carrn@usgs.gov

Results presented in JFSP Final Reports may not have been peer-reviewed and should be interpreted as tentative until published in a peer-reviewed source.

The information in this Brief is written from JFSP Project Number 03-2-3-08, which is available at www.firescience.gov.

An Interagency Research, Development, and Applications Partnership

JFSP *Fire Science Brief*
is published monthly.
Our goal is to help managers find and use the best available fire science information.

Learn more about the Joint Fire Science Program at
www.firescience.gov

John Cissel
Program Manager
208-387-5349
National Interagency Fire Center
3833 S. Development Ave.
Boise, ID 83705-5354

Tim Swedberg
Communication Director
Timothy_Swedberg@nifc.blm.gov
208-387-5865

Writer
Marjie Brown
marjie@marjiebrown.com

Design and Layout
RED, Inc. Communications
red@redinc.com
208-528-0051