PNW
Pacific Northwest
Research Station

Science FINDINGS

issue one hundred forty one / april 2012

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"Science affects the way we think together."
Lewis Thomas

A Closer Look: Decoupling the Effects of Prescribed Fire and Grazing on Vegetation in a Ponderosa Pine Forest

Becky Kerns

Researchers examined the effects of prescribed reburns and grazing on understory vegetation in a ponderosa pine forest.

IN SUMMARY

Scientists have had little information about how prescribed fire and cattle grazing—common practices in many Western ponderosa pine forests—affect plant abundance and reproduction in the forest understory. Pacific Northwest Research Station scientists began to explore how these practices affect vegetation in a five-year study of postfire vegetation in eastern Oregon ponderosa pine forests where cattle have been routinely pastured from late June or early July through early to mid August. For this area of eastern Oregon, they found that excluding cattle grazing during peak growing season increased native plant cover and grass flowering capability in ungrazed areas compared to grazed areas. Because vegetation was measured prior to releasing cattle on the land, the study's results tend to reflect lasting grazing impacts rather than simple consumption.

Findings indicate that excluding cattle in areas that had been exposed to long-term grazing had more effect on vegetation than reintroducing frequent fire to the landscape. Neither spring nor fall burning increased native perennial plant cover or the number of plant species present; spring and fall reburns reduced sedge cover; fall reburns promoted early successional plant communities that included invasive species. This study is the first look at vegetation effects; a 10-year evaluation is planned in 2012.

"All the world is a laboratory to the inquiring mind."
—Martin H. Fischer

An ecological system cannot escape its history—it adapts and changes based on how it is used and managed. Our national forests are a case in point.

For most of the 20th century, a good-faith effort to preserve national forests for the public good led the Forest Service to suppress naturally occurring and human-caused forest fires whenever possible. In drier Western forests, this fire suppression, coupled with increased logging, dense regrowth, and various other land-use activities, led to major alterations in forested ecosystems. Climate change complicates things even more.

Throughout the West, dense tree growth crowded out the understory and increased the risk of severe wildfires, disease outbreaks, and insect infestations. By the latter part of the 20th century, the Forest Service was using prescribed fires to restore diversity and reduce wildfire risks.

Meanwhile, just as they have done since they were introduced to the West, cattle and sheep graze on the open range in Pacific Northwest forests. Concerns about the environmental impacts of overgrazing on public lands led to enactment of the 1934 Taylor Grazing Act, which introduced a permit system to manage private grazing rights in national forests while helping to stabilize the burgeoning livestock industry. Today about 91 percent of all federal forest lands are grazed in varying degrees by

domestic animals, including lands where fire has been reintroduced.

With prescribed fire and grazing implemented in tandem in national forests, scientists with Pacific Northwest Research Station wanted to know how the ecosystem responds to this mix of management practices. Until recently, studies in prescribed fire environments rarely applied controls for grazing or were limited to ecosystems other than ponderosa pine.

In 2002, Becky Kerns, a research ecologist, began studying the short- and long-term impacts of prescribed fire in grazed and ungrazed upland Western ponderosa pine forests. "Because cattle grazing is common in dry forests and researchers tend to conduct studies in the absence of grazing, I was concerned that our perception of the response of vegetation to fire might not be accurate in systems influenced by grazing," says Kerns. "I felt that we needed to decouple grazing effects from fire effects."

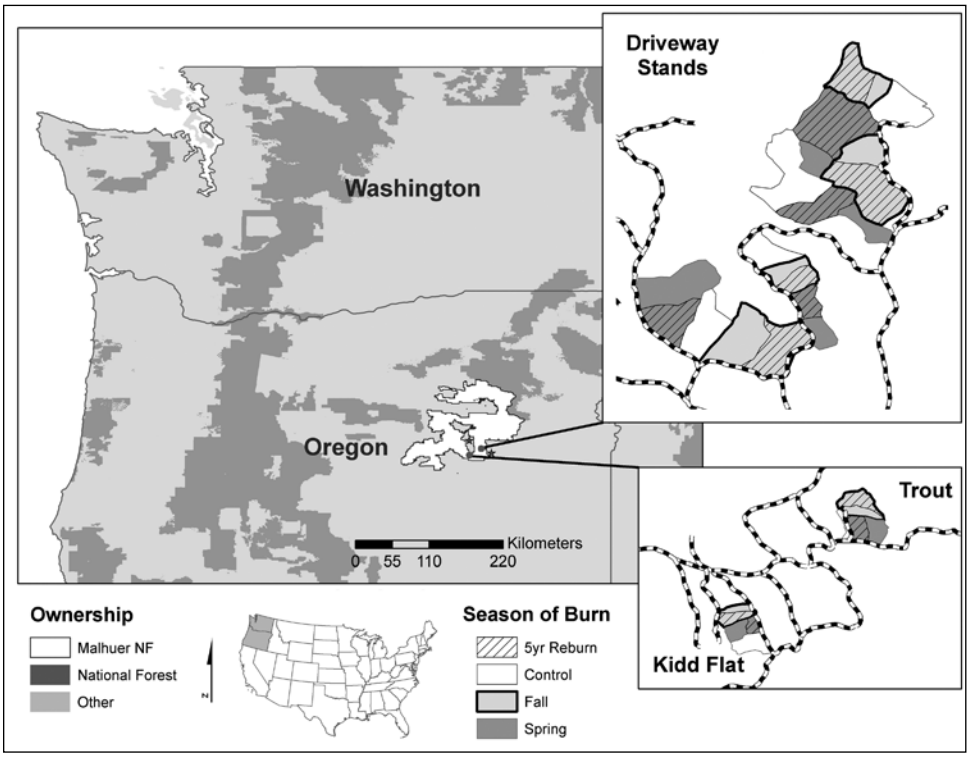
Kerns and her research team took advantage of previously established prescribed-burn plots in the Malheur National Forest near Burns, Oregon, to conduct the study. Four mixed-age forest stands, about 90 to 140 acres each and located at the southern end of the Blue Mountains in the Emigrant Creek Ranger District, provided diverse sampling areas.

The stands—two in the western part of the district and two farther east—contain primarily ponderosa pine with some western juniper and curl-leaf mountain mahogany. Bunchgrasses and rabbitbrushes dominate the understory in the eastern stands. Elk sedge, snowberry, and forbs such as heartleaf arnica, meadow-rue, and milk kelloggia are more abundant in the wetter western stands. Nonnative species and bunchgrasses are less prevalent in the western stands compared to the eastern stands, and the drier eastern stands have considerably less vegetation than the western stands.

"One of the strengths of the study is that we have a wetter site and a drier site—all in ponderosa pine—so we're encompassing a wider variability for what's out there when we're asking questions," says Michelle Buonopane, the study's lead botanist, analyst, and field crew leader.

KEY FINDINGS

- Grazing effects were the same in burned and unburned areas. This allowed scientists to evaluate the outcomes of grazing and fire independently.
- Excluding grazing for five growing seasons increased total vegetation cover, native perennial forb cover, grass height, grass flowering stem density, and the cover of some shrubs in both burned and unburned areas. No difference in the number of plant species was observed in grazed versus ungrazed areas.
- Cattle did not seem to preferentially select either spring or fall reburned areas over unburned areas.
- Reburning in spring or fall had little effect on native perennial plant cover or the number of species present, but reburns reduced sedge cover. Areas that were reburned in fall showed an increase in the cover and number of nonnative and early successional plant species.
- Application of a different postfire grazing regime, other than late June/early July through mid to late August, or resting the areas after the fires, may have resulted in a different outcome.



The study capitalized on a previously established prescribed burn study in the Malheur National Forest.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208

Send new subscriptions and change of address information to:

pnw_pnwpubs@fs.fed.us

Rhonda Mazza, editor; rmazza@fs.fed.us

C. Hugh Luce, layout; chluce@fs.fed.us

Science Findings is online at: http://www.fs.fed.us/pnw/publications/scifi.shtml

To receive this publication electronically, change your delivery preference here:

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CONTROLLING FOR CATTLE AND ASSESSING VEGETATION

Local land managers say that the study area has been grazed almost continuously since the late 1880s, although official recordkeeping did not begin until 1946. Cattle numbers were reduced and the grazing season considerably shortened about 10 years ago.

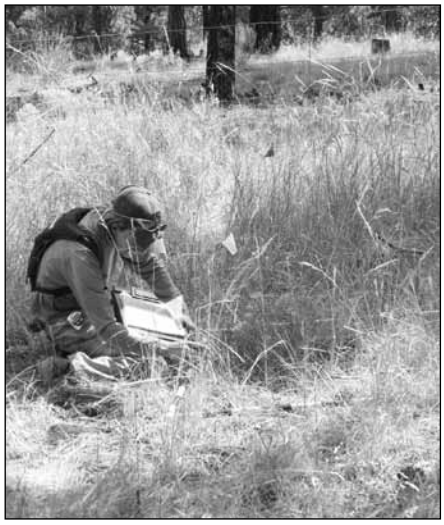
Today cattle are pastured in the area from late June or early July through early to mid August. They arrive when grasses and other species are at their peak and still flowering. The areas studied are both grazed and managed for multiple uses.

All stands in the study area received thinning treatments in the mid-1990s. Prescribed burns were initially applied to subplots in spring 1997 and fall 1998 as part of the pre-existing fire study. Before a 5-year prescribed reburn was completed in 2002, Kerns identified existing subplots within each of the four stands that would be open to grazing and randomly established other subplots that would be closed to grazing. Three subplots within each treatment area were fenced to exclude cattle, but not wildlife. Replicating the design within each of the four stands this way provided comprehensive data sets for analyzing results.

Vegetation was inventoried on all plots before the fire treatments and exclusion of cattle. Over 5 years, the botanical field team conducted vegetation inventories most summers, immediately preceding the grazing season.

Buonopane says that because measurements are taken before some species bloom, identification can be more challenging than it would be if the flowers and fruits were visible. But that hasn't deterred the team from seeking a thorough analysis. "If there's one blade of grass, I try to figure out what it is—it's very detailed," she says. Experts from the Oregon State University Herbarium helped to identify certain species when classification was difficult.

The team recorded 217 species in the study area. They measured plant cover by species to indicate abundance, and grass height and flowering densities to indicate grass vigor and reproductive capability. A 10-year assessment is planned for 2012, given that 5 years time in the current study may provide only an early snapshot.



Becky Kerns

A researcher inventories vegetation growing in a study plot where cattle were excluded.

RESPONSE TO GRAZING

Within the first few years, researchers noticed distinct differences in the vegetation inside the fenced areas compared to outside, and they confirmed their visual assessment through detailed inventories. "Inside the exclosures, there is more plant cover, the grasses are taller and have more flowers," says Kerns. "These metrics indicate more vigorous plant communities inside the exclosures than outside." Their analysis revealed that excluding cattle resulted in a 12-percent increase in vegetation cover by the fifth year of study.

Kerns is careful to point out that the study was not just an exercise to document the obvious: that cows eat plants. Rather, it shows the extent to which grazing may affect the ecosystem's ability to thrive over time. "Because the measurements were taken prior to seasonal utilization, these data suggest that grazing is impacting plant abundance, vigor, and recovery," she says.

At the five-year interval, the study did not show strong, statistically meaningful differences in composition—the suite of species that grow in particular areas—but Kerns says that is not surprising given the relatively short study period. "We didn't see strong differences in the plant community composition between grazed and ungrazed areas" she says. "But we did detect a weak difference at the end of study."

She says that changes in plant community composition may take much longer than 5 years to occur. "What you tend to see first is a change in abundance. Whether or not these changes will play out in terms of species loss or gain in an area in response to something like grazing exclusion is a key question," says Kerns.

It was clear, however, that the cows were munching on the smorgasbord available to them. "Cattle prefer grass, but they will eat lots of different species, depending on what is available," says Kerns. The researchers found evidence that the cattle were eating some of all the plant groups they measured.

Kerns points out that her study attempts to address some uncertainties than can plague exclosure studies. "A major strength of the study is that we randomly placed the exclosures on the landscape, which can be

Becky Kerns

The fencing around study plots excluded cattle but not wildlife.

logistically challenging," she says. "Also, using plant canopy cover as a measure of abundance is controversial in some circles, but we controlled for many of the issues people have expressed concern about." For example, sites are measured at the same time each year by the same researchers, treatment differences are assessed within a single year only, and statistical techniques control for the different sampling periods across the sites.

The scientists also observed deeper litter layers on the forest floor inside compared to outside the exclosures, which could mean that decaying vegetation is helping to sequester carbon. Future studies could explore this situation further. In addition, soil pH was higher inside the exclosures. "We think the higher pH is due to the grass input—grass tends to be higher in pH than something like pine litter," says Kerns, pointing out that in acidic forest soils, a higher pH could be an indication of more nutrients in the soil.

Becky Kerns

Neither spring nor fall reburns increased native perennial plant cover or the number of species present. Reburning did reduce sedge cover and fall reburning promoted early successional plant communities that included nonnative species.

PLANT RESPONSE TO FIRE

The team was able to observe specific outcomes attributable to the fire treatments. For example, spring burns didn't affect plant composition, but fall burns promoted early successional communities that included nonnative species such as cheatgrass and bull thistle. "We tend to see more vegetative response with fall burning because the conditions are usually drier and fires are hotter," she says. "After a few years, areas that were burned in the spring tended to look similar to when there was no burn at all."

Both spring and fall reburns also decreased overall cover of sedges (grass-like plants that tend to grow in clumps and have long, narrow, sometimes sharp leaves). It is generally believed, however, that sedges, particularly elk sedge, are resilient to fire damage. "This is important if you're interested in sedges, which are critical browse for wildlife," says Kerns. "Frequent fire might reduce their abundance."

Prescribed fire is a valuable management tool but it's worth acknowledging that context matters. "When we re-introduce fire in areas that have experienced significant changes related to human land use, it might not be the best expectation to assume that the plant community is going to quickly return to what it was like 130-plus years ago. Things are a lot different these days—it's a lot more complicated," says Kerns.

Although this study was specifically designed to measure impacts in postfire environments, it revealed that the effects of grazing did not change depending on whether an area was burned or not burned. This finding allowed scientists to evaluate the outcomes of grazing and fire independently.

"We didn't find that different things happened with grazing depending on whether you burned or not," says Kerns. Some studies in prairie or savannah systems have shown a greening effect after a burn that attracts cattle and produces more changes in the vegetation cover, but our data do not support that." Kerns adds, "However, the controls are next to areas that burned within the pastures, and the herbivores could be drawn to the area as a whole, including the controls."

"In our study, we found when you exclude grazing, you get similar results in burned and unburned plots with your plant community: an increase in cover, and an increase in grass height and flowering density," Kerns says. "In areas where you have grazing and you're thinking about restoration, that's something to consider."

Becky Kerns

An unburned sampling plot.

NOT SO BLACK AND WHITE?

For this study, Kerns specifically asked land managers in the district to maintain their normal management routines so the team could test "real world" grazing. In keeping with ongoing practices, the cows were released every year on the landscape in late June or early July, when the grasses and other species were at their peak and still flowering. As a result, vegetation may have been affected more than if the plants had already dropped their seeds or become dormant. Additionally, the area received no rest period after the fires.

Kerns would like to test various grazing intensities in the future. "For example, you might let the land rest for a year or two or graze in a different season," she says. "It would be very interesting and beneficial to land managers to see what results we would get if we tested a different grazing regime."

Results of this study may be applicable to similar upland bunchgrass and elk sedge-dominated ponderosa pine forests in the West that have experienced similar prescribed fire regimes and grazing patterns, but only continuing study will determine to what extent. "Every site is different and has a different land-use history," says Kerns. "This area has a long history of grazing, with little respite. In an area with a different history, you might get different results."

The exclosures were made with low cattle fencing and gated only when cattle were present, which means that deer, elk, and antelope had access to them year-round. Kerns and Buonopane observed fresh dung from ungulate species and evidence of browsing within the exclosures each year during the study period. "There could be something going on with wildlife—that's something we're going to look at in a future study," says Kerns. "We know that there is some utilization by wildlife within the exclosures, but whether or not that utilization is the same as outside the exclosures is not clear."

A 2004 study by station scientists found that elk and mule deer used pastures not grazed by cattle more than cattle-grazed pastures, but Kerns says that in the case of her study, wildlife may be deterred because the exclosures are small. "This might mean our grazing effect is more of a combination of cattle and wildlife," she says.

Becky Kerns

Researchers plan to continue the study to learn what long-term differences there may be in understory response to prescribed fire and grazing.

"Because things are the way they are, things will not stay the way they are."
—Bertolt Brecht

LAND MANAGEMENT IMPLICATIONS

- If one goal of restoration in ponderosa pine forests is to increase understory cover and the reproductive capacity of native perennial grasses, managers might consider excluding cattle grazing, whether or not prescribed fire is used.
- Excluding livestock could cause a greater degree of change for the understory than reintroducing fire.
- Results may be applicable to similar upland bunchgrass and elk sedge-dominated ponderosa pine forests in the West where similar prescribed fire and summer grazing regimes are applied.

FOR FURTHER READING

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WRITER'S PROFILE

Marie Oliver is a science writer based in Philomath, Oregon.

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Pacific Northwest Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890

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SCIENTIST PROFILES

BECKY KERNS is a research ecologist with the Pacific Northwest Research Station in Corvallis, Oregon. She earned a B.S. in geology from University of California at Santa Barbara and an M.S. in quaternary science and a Ph.D. in forest ecosystem science from Northern Arizona University. Her research is focused on understanding the effects of disturbances such as fire (wild and prescribed), fuel reduction treatments, grazing, climate change, and the interaction of land-management practices on the structure and composition of forest plant communities in space and time.

Kerns can be reached at:
USDA Forest Service
Pacific Northwest Research Station
3200 SW Jefferson Way
Corvallis, OR 97331
Phone: (541) 750-7497
E-mail: bkerns@fs.fed.us

MICHELLE BUONOPANE was a biological science technician with the Pacific Northwest Research Station. She is now a faculty research assistant at Oregon State University, where she earned an M.S. in botany and plant pathology. Her ecological field experience has included research in the bogs and salt marshes of Maine, the deserts of New Mexico, and various forested landscapes in Oregon. She currently provides science support to a variety of research studies, including botanical expertise, quantitative and statistical analysis, database management, and GIS.

Buonopane can be reached at:
Oregon State University
Corvallis Forestry Sciences Laboratory
3200 SW Jefferson Way
Corvallis, OR 97331
Phone: (541) 758-7768
E-mail: michelle.buonopane@oregonstate.edu

COLLABORATORS

Walter F. Thies, Douglas Westlind, and Christine Niwa, USDA Forest Service, Pacific Northwest Research Station

Malheur National Forest, Emigrant Creek Ranger District

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