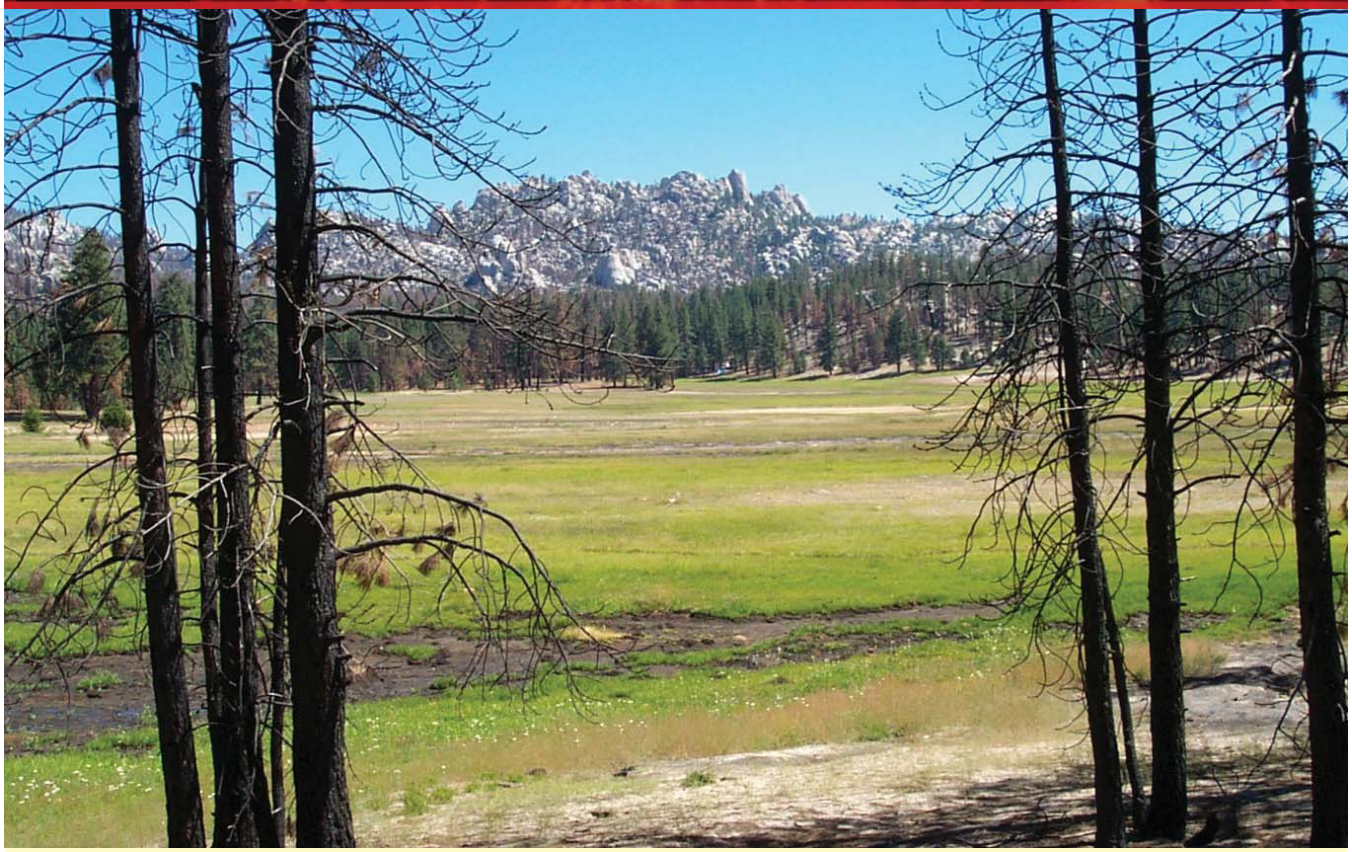
Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS



Fire had a dynamic and dramatic effect on short-term plant recovery.

Searching, Witnessing, Testing: Plants and Fire in Southern California

Summary

Scant knowledge exists on how threatened, endangered, and sensitive (TES) plants on wildlands in southern California respond to fire. With little information to go on, land managers face difficulties in deciding when to apply prescribed fire as a fuel reduction tool in sensitive habitats. By looking at the postfire landscape of the Manter Fire in the southern Sierra Nevada, which shares rare species with mountains farther south, scientists found the dramatic and dynamic effect of fire on short term recovery. Profuse wildflower displays and other annuals thrived in the first two years postfire, then diminished. Perennials persisted, including previously rare species. The effects of fire on other endangered plants can be tested in fire cages developed by the scientists, prior to using fire on larger scales.

Key Findings

- Plants that thrive after fire burgeoned in the first couple of years after the Manter Fire. Fire had a dramatic and dynamic effect on short-term recovery.
- After roughly three years postfire, annuals lost dominance, but perennials remained.
- Some previously rare plants increased in abundance after fire, suggesting that more open conditions are to their liking.
- Four species of grasses growing after the Manter Fire were so vigorous and widespread, they might be useful for postfire seed mixes.

Introduction

Sometimes the closer we are to a place, the less we know it. As the most populous state in the union, California has more residents that can consider public lands their backyard wilderness, and development continues to expand communities up to and along the edges of these boundaries. As is true all around the West, the increased exposure of communities to wildfire has prompted studies and experiments to address fire hazards, with prescribed fire and other treatments used to reduce fuel loads in chaparral, woodlands and conifer forests. But as close as many people are to wildlands in southern California, scientists have little information about how the area's plant species, many of which are unique to the region, respond to fire. Fire shapes the vegetation of southern California, and many plants are adapted to this disturbance in their habitat. But what kind of fire? And how do land managers apply fire appropriately?

Recognizing that prescribed fire may differ from wildfire in intensity, severity of effects and season of burn, and that a lack of knowledge exists about the responses of threatened, endangered, and sensitive (TES) species to fire in general, Jan Beyers, plant ecologist, and Marcia Narog, ecologist, with the Forest Service's Pacific Southwest Research Station, conducted a number of studies to address this knowledge gap. After the Manter Fire on the Sequoia National Forest, for example, they discovered which plants thrive.

Searching the literature for fire's effects

As the search began, Beyers, Narog and their team found few of the federally listed and sensitive plants on southern California lands profiled in the national Fire Effects Information System (FEIS) database. In scrutinizing the scientific literature for 474 species in 262 genera, the scientists could find no information on how most of these plants respond to fire. For thirty species, however, the scientists found enough information to enable them to create FEIS accounts. These accounts provide readily accessible, up-to-date information about fire effects on plants and animals and make knowledge-gathering easier for managers as they plan for the land.

Witnessing how plants respond after fire

With little to go on in the existing literature, Beyers and Narog took advantage of wildfires to examine how plants responded to fire. For example, the Manter Fire burned over 75,000 acres in 2000 on the Kern Plateau in the southern Sierra Nevada, affecting the Sequoia National Forest and adjoining lands managed by the Bureau of Land Management. The Manter Fire area shares both rare and common species with southern California mountain ranges. From 2001 through 2005, local botanist Eve Laeger, supported by the researchers, surveyed returning plants for the land management agencies. Her five-year inventory documented rare, sensitive, and potentially noxious plants, as well as noting the changing plant communities and recovery trends. During the study years, Laeger visited six sites, chosen for their diverse ecological characteristics, in June and August.

Fire consumed the former mature pinyon pine forest at Johnson Meadow. Five years later, the area will be dominated by shrubs for years to come.

At Johnson Meadow, fire consumed the former mature pinyon pine forest located at 6,760 feet of elevation. Taking advantage of nutrients and sunlight, annuals, perennials, and grasses exploded, with fineflower gilia growing thick. By 2005, despite a deluge, the brilliant flowers—fineflower gilia, Indian tobacco, prickly poppy, tansy mustard, blazingstar and poodle-dog bush—were nearly gone.

Non-native cheatgrass was increasing, as well as the native squirreltail grass. With only a very few pinyon pine seedlings growing at the edge of the burn, Laeger noted the area will be a Mojave ceanothus and rabbitbrush shrubland for years to come.

The South Fork of the Kern experienced a moderate burn. Needle-and-thread grass dominated in the first Spring after the fire, but it was replaced by other grasses and shrubs in succeeding years.

Along the South Fork of the Kern River, the lowest elevation plot, where a moderate burn affected the sagebrush community located at 6,000 feet elevation, seeds released from the native needle-and-thread grass allowed this plant to dominate. By 2005, however, needle-and-thread grass, as well as the abundant wildflowers of the immediate postfire years, had declined. Non-native cheatgrass and tumble mustard were increasing, part of a community where yellow rabbitbrush, Bailey's buckwheat, rubber rabbitbrush and sagebrush dominate.

Fire burned intensely through the Jeffrey pines and riparian vegetation in Fish Creek. Willows and roses recovered quickly, and by 2005 lustrous foliage covered the area.

Fire burned intensely and thoroughly in Fish Creek at Mahogany Flat, consuming Jeffrey pines and riparian vegetation in this area located at 7,300 feet of elevation. Laeger found that willows and wild roses recovered quickly, and as with other sites, the greatest diversity of plants occurred in the year immediately after the fire. After a slight decline in the number of species in 2004, possibly due to drought, by 2005 willows were maturing, the native grass known as meadow barley was thriving, sedges and grasses were flourishing along the creek, duckweed was growing in the water, and the water was running clear. In 2001, Laeger noted Fish Creek was an area of cinders and ash. By 2005, she was documenting lustrous foliage that included mugwort and tarragon. Water was the reason plants were growing quickly, thickly, and in astonishing numbers of different species.

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A moderate burn damaged most of the plants at Bald Mountain, but despite the harsh conditions of the sub-alpine zone, plants were vigorously recovering.

A moderate burn damaged most of the plants at the Bald Mountain site, a mountain ridge at the highest elevation of 9,300 feet, but despite the harsh conditions of this sub-alpine zone, the plants were vigorously recovering. Native grasses—burgeoning, spreading—with sagebrush and sulfur-flower buckwheat doing the same, nearly covered the ground. It appeared to Laeger that this area showed the least physical impact from the Manter Fire. Fremont's goosefoot exploded with the rains, Kern Plateau horkelia and grey-leaved violet—both Forest Service Sensitive species—grew sumptuously on the summit ridge. Sagebrush, squirreltail grass, yellow rabbitbrush and sulfur-flower buckwheat dominated by 2005, with the two rare species still abundant.

The hottest, most intense crown fire of the 2000 event destroyed the Jeffrey pine forest on the west side of Manter Meadow. Laeger observed little diversity among plants in

The most intense crown fire destroyed the Jeffrey pine forest on the west side of Manter Meadow. After profuse wildflowers displays postfire, the area has developed into a montane chaparral community.

the first year after the fire at this site located at 7,200 feet elevation. Most plants were annuals such as fineflower gilia and diffuse gayophytum, with very few chaparral seedlings establishing. By 2005, Laeger saw a different picture. Snowbrush ceanothus dominated, with the former pine forest developing into a montane chaparral community, supporting manzanita, Parry's rabbitbrush, increasing numbers of the previously rare grey-leaved violet, and a few pine seedlings at the edges of the meadow. Laeger also found water on the surface of the meadow where thick sedges and forbs were thriving. Willows were nearly mature, and wildflowers such as yarrow, columbine, western mountain aster, shootingstar, and willowherb contributed to the complexity.

Fire, severe and intense, torched the south end of Manter Meadow, the point of origin of the wildfire. The number of different plant species exploded postfire, and the area will revert to its former lushness in a short period of time.

The south end of Manter Meadow exhibited a severe and intense fire. In this riparian area, located at 7,150 feet of elevation, Laeger observed rapid regrowth of willows, sedges, grasses and rushes except, notably, in the area where straw mulch had been placed to control erosion. In the treated area, no plants were growing the first year after fire. Elsewhere, the number of different plant species exploded. Jeffrey pine seedlings emerged. In the upland areas, golden-yarrow, miner's lettuce, and woodland-star grew with several new grasses such as slender hairgrass and alkali rye. Snowbrush ceanothus, diffuse gayophytum, and Wood's rose found conditions hospitable. Grey-leaved violet was spreading along the drier edges of the meadow. In the riparian area, new species such as gilyflower, bedstraw, and speedwell emerged. Thickets of willows, gooseberries, lupines, and nettles burgeoned, and at the creek edge, sedges and grasses were tall and thick, mixed with gooseberries and arroyo willow. Laeger noted that this riparian area continued to quickly recover, with an array of diversity she found impressive, as was the case in the upland areas she examined. She expects all the riparian areas in the Manter Meadow area to revert back to their former status in a short period of time.

Lessons learned

In looking at the five years Laeger studied the effects of fire on these plants, a number of factors stand out. As with each fire in any locale, variables particular to that time and place limit scientists' and managers' ability to extrapolate to other fires. With this in mind, fire planners can consider these revelations from the Manter Fire: The drought that helped this fire to burn catastrophically continued for another two years after the fire. Laeger recorded eleven species of fire-following plants. Fineflower gilia, Indian tobacco, prickly poppy, Fremont's goosefoot and common goosefoot grew profusely in the first years after the fire.

The brilliant flower displays the researchers observed in the first two years postfire, despite drought, emphasized "the dramatic and dynamic effect of fire on short term recovery."

The brilliant flower displays the researchers observed in the first two years postfire, despite drought, emphasized "the dramatic and dynamic effect of fire on short term recovery." Even though 2005 was a very wet year—192 percent of normal precipitation was recorded, and the extensive snow pack lasted well into summer—annuals dropped from the scene, but shrubs such as flannelbush, bushmallow, and Wood's rose continue to thrive. Laeger also counted eighteen species of grasses, four of which were so vigorous and widespread, she recommended them for possible use in seed mixes considered for erosion reduction after fires. Only four non-native grasses appeared, with cheatgrass spreading. Of the nine non-native plants, only broadleaved pepperweed was explosive.

The Manter Fire brought surprises as well in the riparian areas—cottonwood and aspen seedlings grew for one or two seasons, and cattails appeared where none grew before, persisting for five years. After five years, the areas treated with mulch are still barely growing.

Some rare species aren't so rare after fire

Two Forest Service Sensitive species that were rarely seen pre-fire increased in abundance each year after the fire. Grey-leaved violet and Kern Plateau horkelia are both small perennial plants that just may need more open conditions, like those after fire, to thrive.

Testing in cages to understand timing of burns

Prescribed fire is a familiar tool to land managers, effective at reducing fuel loads on wildlands that have experienced fire regimes altered from their historic patterns. But without knowing how some rare plants respond to fire, applying this management tool could be positive or negative. Complicating the issue for land managers is not knowing whether wildfire, burning possibly hotter, more intense and more severe in this altered landscape, will decimate rare plants already at the edge of extinction. Beyers, Narog, and the team chose one plant and three study sites to try to address the knowledge gap.

Johnston's rock cress, a small, herbaceous perennial plant in the mustard family, grows in southern California mountains, blooms between February and June, and sits dormant during the dry summer and fall. Much of the San Jacinto Mountains (Riverside County) habitat of this rare plant, designated a Regional Forester's Sensitive species, was planned for treatment with prescribed fire to protect human communities. In cooperation with national forest biologists, Beyers, Narog and their team designed a small-scale test to learn how fire affects this rare plant, as well as two other rare plants they found in many of their plots—California penstemon and Munz's mariposa lily. Prior to the test burn, the researchers collected data on the plants—number per plot, height, cover, number of flowers, flowering stalks and seed pods.

The scientists constructed a portable, cylindrical "fire cage" (4 foot diameter x 2 feet tall) using 8 x 8 mesh stainless steel woven wire cloth as a firewall, and capped it with the same material. They placed the cage—large enough to include a 4 inch burned buffer zone around each plot—on four equally spaced fire-resistant bricks. Scratching down to inorganic soil, and placing fire shelters around the cages, they were ready to burn. Using a butane torch inserted under the mesh near the bricks, the researchers ignited the fuel. As trials conducted in the Riverside Fire Lab using natural fuels and 7 mile-an-hour winds demonstrated the fire cage contained all firebrands and sparks, they were confident in testing burns within the cage on the landscape. They recorded weather, fuel conditions, fire behavior, and temperatures at the surface and below the surface of the burned plots. Plants may be subjected to different fire effects in wildfires, but the scientists experimental burn within their fire cage test imitated complete burn-over, the fire condition most detrimental to plant survival.

Management Implications

- Fire cages can be used to test the responses of rare plants to burning before prescribed fire is applied to sensitive habitat.
- Some rare plants in fire-prone habitats respond positively to fire. Observational studies also help discover such surprises.
- Straw mulch applied to burned areas to prevent erosion may inhibit plant regrowth. Managers should consider this when deciding to use this treatment.
- Some native species respond vigorously enough after fire to be considered for postfire erosion-reduction seed mixes.

The impacts of burning out-of-season, such as using prescribed fire in the cooler months, are not known for many plants. "Winter burning over moist, cool soils may not generate sufficient heat to stimulate seed germination in some species, while the seeds of other species may suffer adversely from being heated while wet," Beyers offers. As information on the seed germination requirements of the three plants studied did not exist, Beyers, Narog and the team planned their test burns for late summer and winter to compare the effects of a natural season fire to a typical prescribed burn. They discovered that fire may be neutral or even beneficial to Johnston's rock cress, like grey-leaved violet, both small-statured perennial plants. Three years after the test burns, the number of plants in burned plots had increased, while in unburned plots, the number declined or remained the same. This information reassured San Bernardino National Forest managers, and the needed fuel-reduction prescribed fires were carried out recently.

By employing different ways of looking, and doing, the scientists work to deliver data that will help managers predict how plants respond to burning. With this knowledge, managers can minimize negative impacts from prescribed fire to rare plants.

The fire cage allows researchers to test rare plants' responses to burning before prescribed fire is applied widely in sensitive habitats.

Further Information: Publications and Web Resources

Beyers, Jan L., Marcia G. Narog, Christie Sclafani, and Christina Escobar. 2003. Using a "fire cage" to test the response of *Arabis johnstonii* to fire. Proceedings of 5th Symposium on Fire and Forest Meteorology Joint with 2nd International Wildland Fire Ecology and Fire Management Congress, November 16-20, 2003, Orlando, FL (on CD). P2.16. http://ams.confex.com/ams/FIRE2003/techprogram/paper_67255.htm

Narog, Marcia G, Christie J. Sclafani, Christina Escobar, Kate A. Kramer and Jan L. Beyers. 2007. Initial response of *Arabis johnstonii* Munz to fire. In: Southwestern Rare and Endangered Plants: Proceedings of the Fourth Conference, March 22–26, 2004; Las Cruces, New Mexico. Proceedings RMRS-P-48CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. http://www.fs.fed.us/rm/pubs/rmrs_p048.html

Riverside Fire Lab website: www.fs.fed.us/psw/rfl

Scientist Profiles

Jan L. Beyers joined Pacific Southwest Research Station in 1991; her research focuses on effectiveness of postfire rehabilitation treatments and fire responses of native plants, predominantly in chaparral.

Marcia G. Narog joined PSW in 1980 and currently studies postfire recovery of oak, chaparral, desert and riparian ecosystems.

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