Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

Non-native annual brome grasses have overcome native plants across much of Zion Canyon in Zion National Park, reducing native plant diversity and posing a fire hazard along the canyon's single access/egress route. Credit: U.S. Geological Survey, Western Ecological Research Center.

Taming Non-native Grasses in Zion National Park

Summary

Fine fuels from non-native, annual brome grasses have overcome native plants across much of Zion Canyon in Zion National Park. This invasion threatens the single road that provides access into—and escape from—the canyon, creating a threat to human life should a large wildfire occur there. In addition, native riparian plant communities in Zion Canyon have been degraded by non-native plants, and recurrent fire caused by annual grasses could further reduce native plant diversity. Results from this study suggest that burning can have a more lasting effect than annual mowing in reducing fine fuel loads, extending the period between repeated maintenance treatments. When burning is coupled with fall herbicide application, added control can extend the maintenance interval even further through reduction of brome grass density.

Key Findings

- Burning followed by herbicide application, every 2 to 3 years in autumn, prolonged fuel reduction effects well beyond those achieved with the long-standing practice of annual mowing.
- There was initial evidence of establishment by native seeded species, but their presence declined in subsequent years, suggesting that native perennials sprouting from seed can't compete with returning non-native annual grasses.

Tinderbox—Only one way out

Exotic annual grasses and weeds have increased fire risk across the western U.S. and constitute one of the greatest hazardous fuel concerns in this arid region. They out-compete the more fire-resistant, perennial native vegetation by germinating in the fall or winter, and consuming soil moisture and nutrients early during the subsequent growing season. When they set seed and die in late spring they create a continuous carpet of dry, fine fuel that can ignite easily and carry fire rapidly. In contrast, native vegetation tends to grow in separated clumps and remains green much later into the summer, resulting in lower potential for fire spread.

Non-native grass species now dominate the floor of Zion Canyon in the heart of southern Utah's Zion National Park—a unique blend of towering sandstone cliffs, slot canyons, river terraces and forested uplands. The Virgin River winds along the canyon floor and serves as the primary water source for the region. Zion Canyon has seen over 150 years of ground disturbing human activities like grazing, farming and logging that have made it ripe for invasion by disturbance-adapted non-native grasses. The park is still home however to diverse communities of plants and animals, making it a popular destination for tourists. Zion Canyon is the primary hub of activity in the park, drawing over 2.5 million visitors annually. Most of the park's campgrounds, trailheads, National Historic Register properties and park service buildings are spread out along a single, two-lane access road. It's this single, solitary road—combined with the wall-to-wall carpet of fine fuels—that has had park managers attacking fuels very aggressively and intensively for years. A fire start anywhere in the canyon represents a dangerous situation because there is only one way in and one way out.

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"That's what the fire concern stems from," explains Matt Brooks, principal investigator on this project and a research ecologist with U.S. Geological Survey at the Western Environmental Research Center. "If fire starts at the mouth of the canyon the concern isn't so much that it would spread up the walls and into upland areas of the park. It's that people have no way to escape. If there were another way out of the canyon, another road or exit—the issue wouldn't be nearly as pressing. But there's just one way out. Visitors and park staff have no alternatives."

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Managers have long needed effective techniques for simultaneously controlling non-native grasses and re-establishing native plants. This project addressed a significant research need that had hindered implementation of Zion's Fire Management Plan and other plans at land management units across western North America. Brooks and his colleagues sought to identify effective tools for reducing fine fuels created by non-native annual plant species, and restoring less flammable native perennial plant communities. Over one hundred non-native plant species occur in Zion National Park, twelve of which are a priority for control and eradication. Cheatgrass, red brome, and ripgut brome (so named because it was known to lacerate the bellies of the cattle it was introduced to feed) are the grasses of particular concern as they now infest over 8,000 acres within park boundaries. Previous testing has shown that these grasses can be reduced temporarily by mowing or prescribed fire. But they're disturbance-adapted and recover from disturbances more quickly than native species. The use of herbicide can reduce their density and spread, but when applications stop the plants rapidly return because residual seeds of non-native grasses remain. They get a jump on the natives by being the first to sprout. "They both start at the same starting line," Brooks says, "but the non-natives get out of the chute a lot faster."

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Fire-prone, non-native annual grasses dominate the floor of Zion Canyon.

Recent research studies and land manager experiences have indicated that the grass-specific herbicide *Imazapic*® can effectively control annual brome grasses which may provide a competitive advantage for existing and/or seeded perennial plants. Managers at Zion have used *Imazapic*® for small-scale control of brome grasses in the past, but they felt that the efficacy needed more robust testing before it was applied at larger scales. The researchers wanted to evaluate the timing of herbicide application to see whether this impacted effectiveness. Although pre-germination application is generally recommended, Brooks and his colleagues thought that the mild, wet winters and coarse-textured soils in Zion Canyon might result the herbicide moving too quickly through the soil, ending up below the rooting zone prior to brome grass growth. So this study was designed to evaluate *Imazapic*® application both before and after germination to see which was more effective.

To remove fine fuel biomass, Zion National Park managers have primarily relied on annual mowing, however, this can be very expensive and it's not consistent with many National Park Service policies. Additionally, mowing doesn't necessarily reduce fine fuel biomass. It just knocks it down to the ground and the resulting thatch can impede herbicide contact with the soil. While prescribed fire may be the best option for biomass removal prior to herbicide application, it cannot be used in all situations—such as near existing park structures or when air quality restrictions limit burning—and it can be more costly and logistically difficult to implement compared with mowing. So the study compared the effectiveness of *Imazapic*® application following both mowing and prescribed fire.

In collaboration with park fire and vegetation managers, Brooks and his colleagues implemented the study in 2005. They evaluated a series of treatments that included mowing, herbicide and seeding. The seed mix consisted of locally collected native seed in an effort to preserve the genetic integrity of plant life in the park. The project focused on the riparian zone along the canyon floor, where researchers established 140 test plots in four locations. The initial biomass reduction treatments of mowing and burning took place in the fall of 2005. The idea was to remove dead vegetation so the herbicide treatments would be more effective, and to allow some openings for the seeds to get established. In some plots, *Imazapic*® was applied shortly after burning or mowing in October. The other plots were sprayed in February of 2006 after grasses had started to grow.

Prescribed fire and herbicide application. Credit: JFSP Final Report.

Fall treatments win out

All treatments proved to be effective for reducing the grasses to some degree and existing native species in general were not affected. The overall winner was a combination of burning every few years in fall, closely followed by herbicide spray.

The fuel reduction effects of this one-two punch lasted up to three times longer than annual mowing.

The fuel reduction effects of this one-two punch lasted up to three times longer than annual mowing. There was some increase in species richness in seeded plots in the short term, but the slow growing, native perennials haven't seen enough growing seasons for complete evaluation of their success or failure. Whether competition from the grasses was reduced enough to allow for their regeneration has yet to be determined. "We thought that using an herbicide that targets annual grasses might give the native perennial species a few years head start," Brooks says, "but there's only so much you can tell from these first few post-treatment years. There was some evidence of establishment of seeded species initially, but they dropped off in the next two years suggesting that the seeded species still might not be able to compete with the returning grasses."

Landscape view showing differences among treatment plots after the first year. Credit: JFSP Final Report.

More research is needed to determine if reintroduction of native plants can slow further non-native invasion, and to compare the costs and risks of the annual mowing regimen with the longer lasting burning/herbicide combination. "The manpower is a little higher with burning and herbicide vs. mowing," says Brooks, "but because you only need to do it every three years there can be a cost savings. Burning has additional inherent hazards, but even mowing can be hazardous when fire risk is high because it can generate sparks and fire."

Results put to use immediately

Early success of the postfire herbicide application was compelling enough for managers and burned area emergency response (BAER) teams to put the technique to use before the study was even complete. In 2006, the Kolob Fire, the largest in park history, burned over 10,000 acres in the upland areas of the park populated with pinyon-juniper, oak brush, manzanita, sagebrush and grass. In 2007, the Dakota Hill Complex Fire burned nearly 6,000 acres of similar upland forest in the northeast section of the park. These upland areas make up most of the park's acreage and this is where fire usually burns. BAER teams that assessed the immediate and long-term effects of these fires determined that non-native invasive species were a major threat to the native plant communities in and outside the fire perimeters, so they called the treatment from the study into action based on Brook's early success. "There was concern that the cheat grass in particular would go gangbusters after these big fires," Brooks says. "We told them to be very cautious because we only had our initial results from the first year. But they considered the results good enough to justify using it. So our original study led to management use of the treatments in the upland areas and to an additional Joint Fire Science Program (JFSP) project to monitor the effects of upland use."

The 2006 Kolob Fire, the largest in the park's history, burned 17,000 acres total, with over 10,000 acres burned within park boundaries. The size of the fire catalyzed immediate use of the study's herbicide treatments, leading to subsequent, landscape scale research on their effectiveness against postfire invasion of non-native grasses.

An ongoing battle

Brooks continues to be involved with the subsequent studies of landscape scale treatments in upland areas as well as in the riparian study areas where this initial project took place. The Zion Canyon study area will be maintained by the National Park Service as a demonstration site so that long-term effects can be observed and evaluated. The U.S. Geological Survey is helping to develop interpretive materials and a project website to improve educational value for managers, scientists and the public. In the mean time, managers throughout the west remain on the offensive against non-native grasses, which is still a one step forward—two steps back battle. "The only real hope here is to facilitate establishment of native species," Brooks says. "This will be a big step toward creating a fuel bed that better approximates historical conditions, promoting restoration of the fire regime that existed before non-native plants altered it."

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Management Implications

- Burning may have a more lasting effect than mowing in reducing fine fuel loads, at least extending the period between repeated maintenance by a few years versus the current annual program of mowing in Zion Canyon.
- When burning is coupled with fall herbicide application, additional control of brome grasses might extend the maintenance interval even further due to reduction of brome grass densities.
- The effects of seeding were not significantly manifested during the initial few years. The ultimate effects might not be obvious for a number of additional years.
- Annual cursory monitoring of the study plots will track any latent effects.

Further Information: Publications and Web Resources

Project website: http://www.firescience.gov/JFSP_Search_Results_Detail.cfm?jdbid=%23%27J%3F%3C%0A

Scientist Profile

Matt Brooks is a Research Botanist, with the U.S. Geological Survey, Western Ecological Research Center. His research is focused primarily on the ecology and management of fire and invasive plants in western North America. Recent studies have focused on evaluating effects of land use, ecological restoration techniques, potential future climate change scenarios, and altered fire regimes.

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The information in this Brief is written from JFSP Project Number 05-2-1-13, which is available at www.firescience.gov.

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JFSP *Fire Science Brief*
is published monthly.
Our goal is to help managers
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