SageSTEP News
Sagebrush Steppe Treatment Evaluation Project
Issue 13, Fall 2010

Plateau Pre-Emergent Herbicide Suppresses Invasive Exotics Following Fuels Treatments

One of the greatest challenges Great Basin land managers face when implementing fuel reduction treatments and post-fire rehabilitation is preventing the invasion of exotic vegetation such as cheatgrass. As part of the SageSTEP research, we are evaluating the use of the pre-emergent herbicide imazapic (trade name Plateau) in treated areas. We are looking for thresholds of perennial grass density and/or cheatgrass scarcity above which native vegetation will recover without seeding following fuels treatments. With some of our sites now in their fourth year post-treatment, we have seen distinct differences in subplots where Plateau was applied versus those that were left alone.

At the SageSTEP sagebrush study sites fuels treatments, including prescribed burning, sagebrush mowing, and aerial application of the herbicide tebuthiuron (Spike 20P), were applied to reduce the density of aging sagebrush stands and encourage understory growth. Plateau was then crossed with each of these treatments

A cheatgrass patch near one of the SageSTEP study sites. Researchers are studying the use of the pre-emergent herbicide Plateau to prevent the invasion of exotic species following fuels treatments.

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Sagebrush Steppe SageSTEP Treatment Evaluation Project
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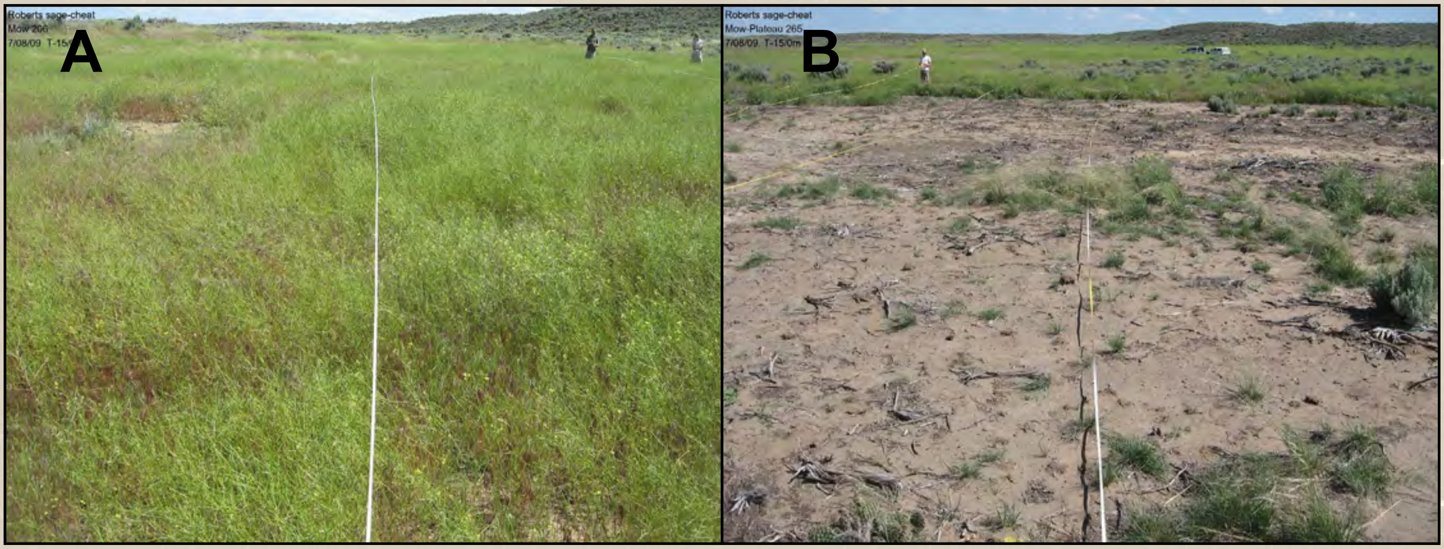
on half of the subplots to evaluate its effect on non-native invasive annual plants. A variety of methods were used for Plateau application including backpack sprayers, all-terrain vehicles, trucks and Rhino-mounted tanks. Each method maintained a rate of 6-8 oz/acre depending on the treatment plot and which state the site was in. We were unable to compare different application rates, but lower rates might be used effectively on different landscapes depending on soil depth and type, amount and type of litter, climate, and other factors.

Up to three years after Plateau application, cheatgrass cover has been strongly reduced in treated areas relative to controls. Cheatgrass cover decreased by an average of 79% the first year, 84% the second year, and 50% the third year after treatment, with reductions of up to 95% in some experimental plots. Density of exotic annual forbs has been suppressed by an average of 95% the first year post-treatment to 49% the third year post-treatment, including desert alyssum (up to 3 years) and bur buttercup (1-2 years). These results suggest that in areas where some perennial native understory is present, Plateau application could provide land managers with a recovery window during which seeding would be unnecessary in treated locations.

Up to three years after Plateau application, cheatgrass cover has been strongly reduced in treated areas relative to controls.



Mow subplots at the Roberts study site in eastern Idaho; sagebrush, tumble mustard and cheatgrass are present on both plots. Image A is a subplot without Plateau and image B shows the effects of Plateau on a nearby subplot.

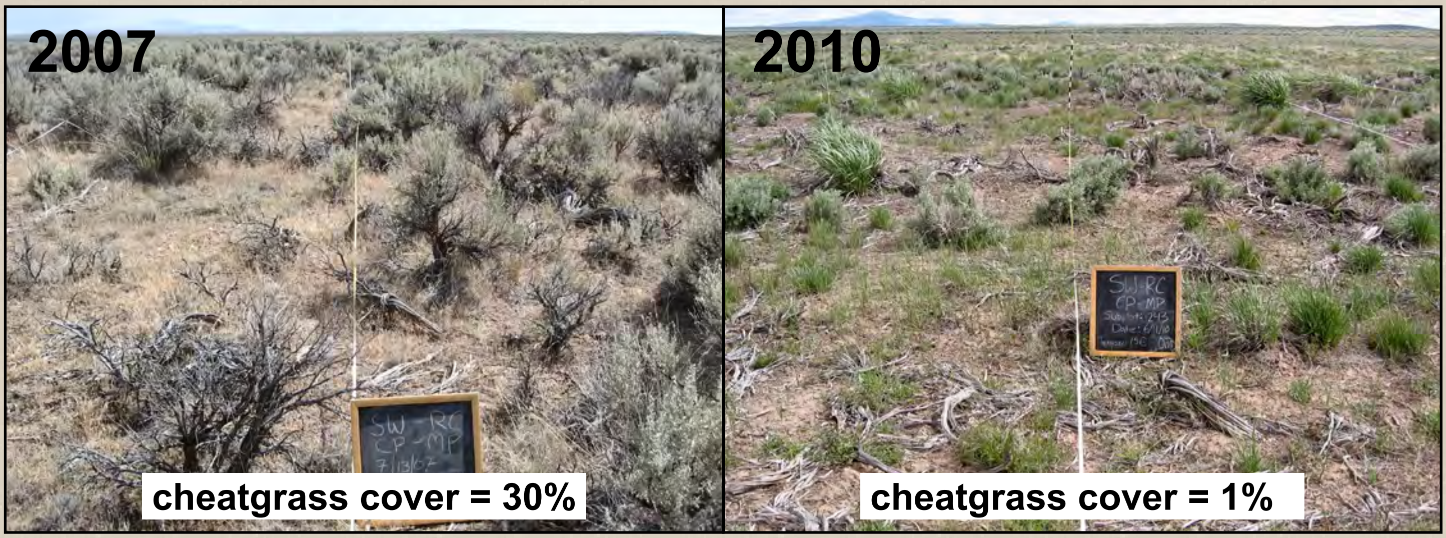
Shrubs appear to be unaffected by Plateau at our application rate. Perennial grass richness was not affected by the herbicide, though perennial grass cover fell somewhat in the first year post-treatment and then steadily increased in subsequent years in treated plots. (The control plot showed a slight drop and then no change.) Of the perennial grass species present at the SageSTEP study sites, Sandberg's bluegrass was the most negatively affected, though the effect was still relatively small (approximately a 4%-5% drop in cover).

Thus far, the most pronounced undesirable affect of Plateau that we have observed is a decline in native forbs. In the first year post-treatment, Plateau reduced native annual forb cover by about 80%. Perennial forbs have generally shown a slow decline in the years following treatment, and this has been more pronounced in the Spike plots, which might indicate an interactive effect of the two herbicides. More analysis is required to assess the strength of this phenomenon. Additionally, we observed a "shadowing" effect in the Plateau subplots where sprayers missed small strips of ground and the invasives were quick to fill in those areas.

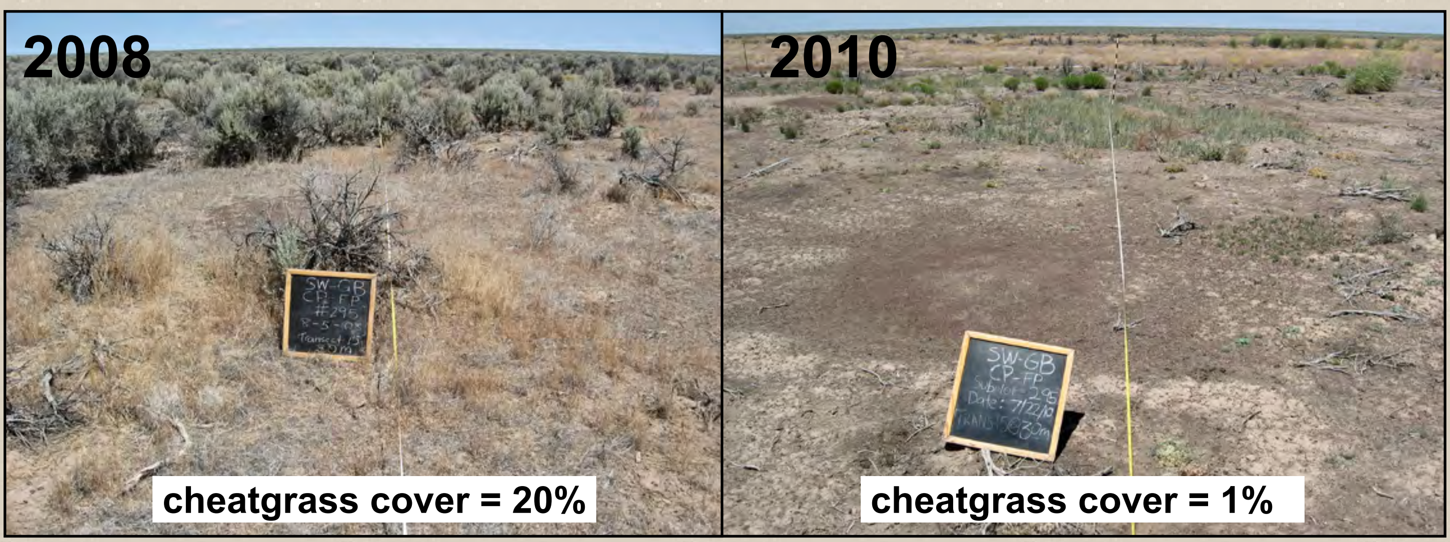
Preliminary data analysis and observations indicate that Plateau has been effective at reducing invasive exotics in the years immediately following fuels treatments. Native vegetation shows

This subplot shows a typical "shadowing" effect where Plateau was not applied evenly and patches of cheatgrass have returned.

limited effects from the herbicide, with forbs being most affected. It should be noted that the impact of Plateau on native forbs highlights the presence of trade-offs between the control of undesirable species and the unintended reduction of desirable species. Overall, results indicate that Plateau can be an effective tool for management of invasive species following disturbance, especially in the first three years, and thorough application is required for complete control of cheatgrass and other exotic annuals. For additional photos of subplots with and without Plateau, visit our website: http://www.sagestep.org/locations/onaqui.html#onaqui_map and click on links for any of the sagebrush plots.



Subplot at the Hart Mountain-Rock Creek study site in southeastern Oregon. This subplot was mowed in fall 2007 (after the photo was taken) and was subsequently sprayed with Plateau. In 2010, 3 years after treatment, cheatgrass cover is at 1%.



Subplot at the Hart Mountain-Gray Butte study site in southeastern Oregon. This subplot was burned in fall 2008 (after the photo was taken) and was subsequently sprayed with Plateau. In 2010, 2 years after treatment, cheatgrass cover is at 1%. Notice the cheatgrass in an untreated area in the background of the 2010 photo.

SageSTEP Butterflies: Charismatic Macrofauna

by Jim McIver and Euell Macke

Few serious entomologists would travel to upland sagebrush steppe lands in search of butterflies. The reason is fairly simple—being dry and only productive for very short periods of time during the year, upland sagebrush steppe lands support relatively few butterfly species. In fact, even after hundreds of hours of watching and recording butterflies at SageSTEP sites for the past five years, my sidekick Euell Macke and I have seen an average of just four species per sample at our woodland sites, and only about three species per sample at our sagebrush-cheatgrass sites. Furthermore, the productivity of most sites, as reflected by the number of butterflies counted in a slow one hour walk through our plots, is also very low, averaging just 12 individuals per sample. Compared to the more productive places people go to find butterflies—like riparian areas and mountain meadows—our SageSTEP plots are so boring that I actually had one butterfly expert in Utah turn me down when I offered him a lucrative contract to help us monitor our juniper-pinyon plots!

So why do we spend so much time out there on the ground, walking our 1000-meter transects for so low a yield? Of course, the need to visit each SageSTEP plot twice per year puts me in close touch with many other things that are happening in the field, and this experience gives me more insight on the study as a whole. In the course of my wanderings in search of butterflies, I have managed to visit every SageSTEP plot on numerous occasions, seen firsthand the results of all of the treatments, and have kicked the dirt with many field crews, researchers, and managers along the way. I am quite sure that these experiences make me a better advocate for the overall study, and better able to keep the various facets of the study in some kind of order.

But aside from that, despite their relatively low productivity, butterflies are really very good indicator organisms for evaluating treatment effects over time. First, all butterflies have two very different active stages (larva and adult), and so any management treatment has twice the potential for impacting a species that lives and reproduces in a plot. Second, butterfly larvae require fairly specific host plants on which they need to feed, in order to grow into healthy adults. So their response to treatment will in part reflect what happens to their host plants. Third, we know a lot about most of the species, especially compared to other insects—we know their seasonal patterns of abundance, their larval host plants, and their nectaring habits. We can often predict why we see changes in their abundance over time, given our observations about their plant habitat. Finally, butterflies are usually about the only type of insect that most people care about enough to be concerned about their fate. Think about it—am I likely to get a sympathetic response from somebody if I express concern about my favorite *earwig* species?

So now let's have a look at the butterflies we're finding at our SageSTEP sites. Figure 1 shows the major groups of species we've seen at the various sites, superimposed on the familiar

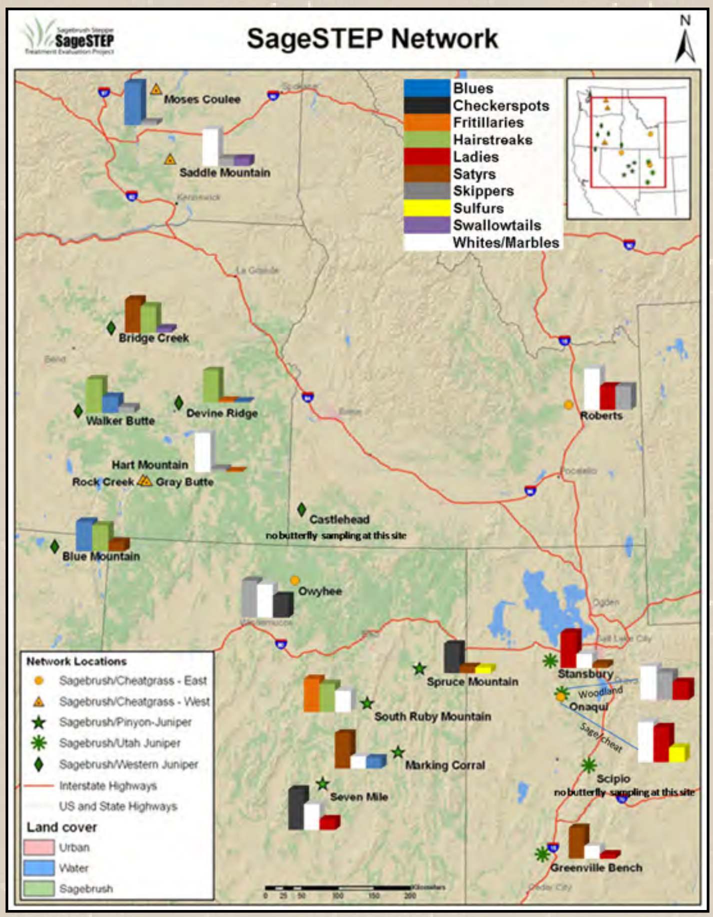


Figure 1. SageSTEP Network Map showing groups of butterfly species documented at each site.

Figure 2. *Euchloe lotta* (Desert Marble) common at lower elevation treeless sites.

Figure 3. *Lycaeides melissa* (Melissa Blue) uncommon, seen only at woodland sites.

Figure 4. *Collophrys gryneus* (Juniper Hairstreak) common at woodland sites.

SageSTEP map. You can see several things on this map. First, each site has a set of bars of different colors, with each color depicting the relative abundance of a 'type' of butterfly—green for 'hairstreaks', brown for 'satyrs', white for 'whites', yellow for 'sulfurs', red for 'ladies', etc. For example, a typical 'white' is the desert marble, shown in Figure 2, and a typical 'blue'' is the melissa, shown in Figure 3. You can see right away that sites differ markedly on the basic types of butterflies seen there over the years. Among the sage-cheat sites, Moses Coulee is dominated by blues, Saddle Mountain, Rock Creek, Gray Butte, Onaqui, and Roberts are dominated by whites, while Owyhee has a mix of species. Most western juniper sites have a strong component of juniper hairstreaks, most Utah juniper sites have many painted ladies, while the pinyon-juniper sites are a mixed bag. Despite these among-site differences, most sites tend to have fairly consistent patterns of species over the years—once a 'hairstreak' site, always a 'hairstreak' site. This consistency in year-to-year pattern allows for a greater potential to see treatment effects. Yet so far, we have seen only very subtle effects.

Statistically, the only short-term treatment effect we've seen so far is the predictable decrease in the abundance of juniper hairstreaks (Figure 4), when we remove their primary larval host plant (juniper), either by cutting or by fire. The other major effect we've seen is a 'bulls-eye' effect noticeable at several sites, in particular the apparent attraction of adult butterflies to increased nectar resources in some of the treated plots, especially ones that have experienced a significant fire treatment. At Gray Butte for example, we have noticed much higher abundance of desert marbles in the burn plot, relative to the adjacent herbicide plot, and to a lesser extent, the other two plots. Similarly, at Walker Butte the burn plot has consistently exhibited the greatest overall abundance and richness of butterflies, followed by the mechanical and then the control plot. Presumably, in the absence of treatment, some plots produce very limited nectar resource, and thus the removal of woody vegetation can increase the water resources necessary for enhanced flower production. Of course, not all flowers are created equal in terms of their attractiveness as nectar resource—buckwheat, onion, and most composites tend to attract many adult butterflies, while lupine, paintbrush, and milkvetch tend to be relatively unattractive.

As far as long-term predictions go, I expect that for the woodland sites, we will see an increasing shift toward butterfly species that rely on forbs and grasses for their larval host plants (e.g. ochre ringlets), while species that rely on woody vegetation (hairstreaks) will experience a relative decline. For the sage-cheat sites, I would also expect species that feed on grasses (many of the skippers) to increase, just like the woodland sites. I would also expect a greater overall concentration of adults in plots that have relatively more of the right kind of nectar flowers, even though many of these adults probably developed on adjacent plots, or in adjacent untreated lands. Only a very long-term perspective however (15-20 years post-treatment), will allow us to ultimately understand how land management treatments influence patterns of butterfly distribution and abundance across the sagebrush sea. Perhaps in time, if we tell a good enough story, we will manage to convince some of the real butterfly experts to come out to the sagebrush steppe and look at butterflies with us.

Impacts of Fuels Treatments on Soil Moisture Availability and Vegetation


Solar-powered weather station with soil moisture sensors buried in the surrounding area.

The focus of SageSTEP research is to understand effects of fuel-reduction treatments on sagebrush rangelands. One way we are doing that is by measuring the time of soil water availability in untreated, burned, and mechanically-treated areas. Dr. Bruce Roundy, a range ecologist from Brigham Young University, and his team have placed 140 soil moisture and temperature stations at 19 sites throughout the SageSTEP network, including 12 pinyon and juniper woodland study sites. In addition to collecting precipitation and air temperature data at each site, the stations collect soil temperature and soil moisture data at soil depths between 1 and 30 cm on plots that are untreated, prescribed burned, or where trees have been cut or shredded.

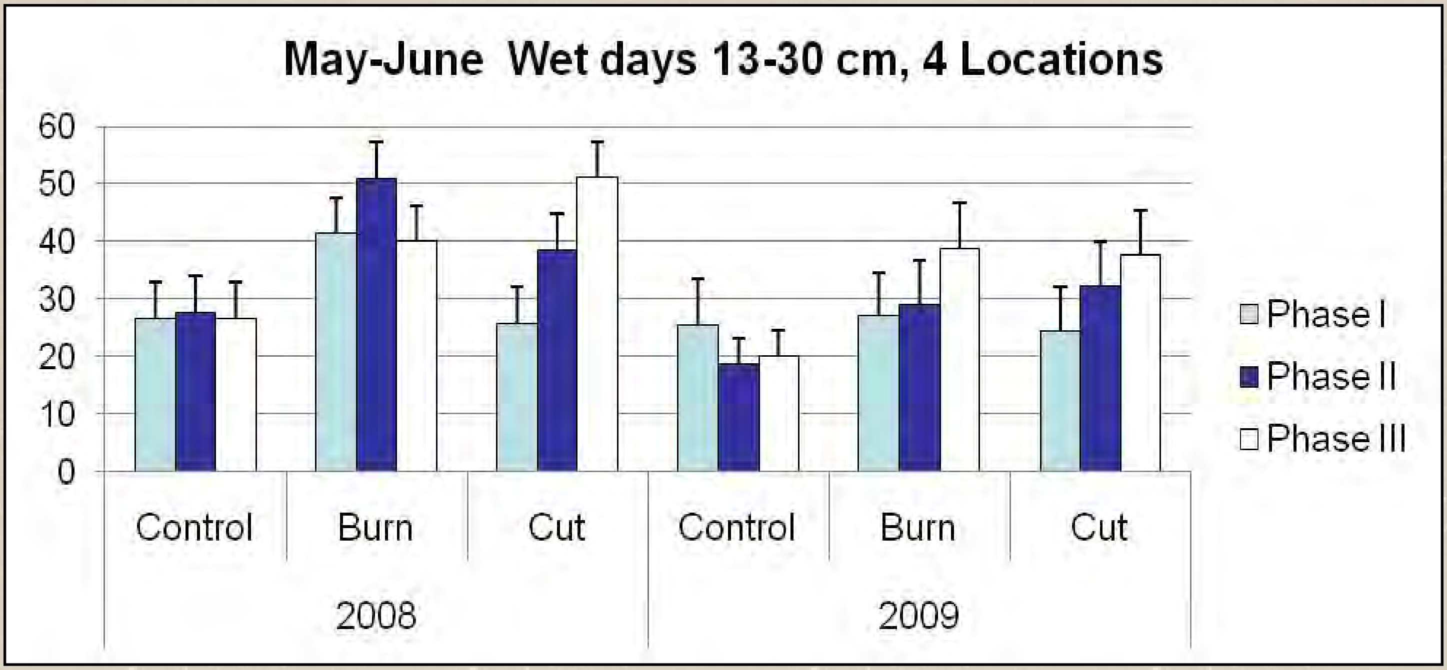
An important question Roundy is studying is whether vegetation treatments that kill trees and shrubs will make more soil water available for invasive species like cheatgrass. The answer depends on how treatments affect the vegetation that is already there and how selective the treatment is. Sagebrush areas that have been invaded by trees can be categorized into 3 phases based on stand characteristics as described by Rick Miller and others*. In phase 1 few trees are present and understory shrubs, grasses or forbs dominate the landscape. In phase 2 trees and understory vegetation are equally dominant, and in phase 3 areas, trees are the dominant vegetation.

Mechanical treatments—like cutting or shredding trees—reduce soil water use by trees but leave understory shrubs, perennial grasses, and forbs to use the water. Mechanical treatments at phases 1 and 2 leave more understory plants to use the soil water that was once used by trees than treatments in areas that have reached phase 3. Burning generally kills trees and shrubs, but leaves perennial grasses and forbs to use the water. So, either waiting to mechanically treat until trees are at phase 3 or burning at any phase results in fewer shrubs to use the soil water made available by killing trees.

In order to invade, annual weeds like cheatgrass must have seeds available to germinate and resources like soil water available to grow and produce seeds for the next year. The concern is that treatments like fire that kill shrubs, or mechanical treatments at phase 3 when few shrubs are left may free up soil moisture that could be used by cheatgrass to invade and dominate.

To see if this could happen, Roundy has compared the time of available water or number of “wet days” among different treatments and phases. His comparisons are focused on springtime when temperatures are warm enough for plants to actively grow and use soil moisture stored from winter and spring storms. “Wet days” for a season are the total number of 24-hour periods that the soil was wetter than -1.5 MPa (megapascal) water potential. Water potential is a measure of how tightly water is held in the soil pores. Although wildland plants may take up soil water below -1.5 MPa water potential, there is only a small amount of actual water left in the soil pores

*Miller, R.F., J.D. Bates, T.J. Svejar, F.B. Pierson and L.E. Eddleman. 2005. Biology, Ecology, and Management of Western Juniper. Oregon State University Agricultural Experiment Station Technical Bulletin 152. 77pp.



This graph shows the number of "wet days" at four SageSTEP juniper and pinyon woodland study sites broken down by fuels treatment type and woodland vegetation phase. Late spring (May and June) soil moisture was available longer in plots of all phases that were burned and in phase 2 and 3 chainsaw cut plots, depending on the year.

at this level and it becomes even more tightly held as more of it is used. Therefore, the number of days when soil water potential is above -1.5 MPa is a good measure of how long soil water is relatively available for plant growth. Although trees, shrubs and herbs can use water at depths greater than 30 cm, they all use water from the 13–30 cm soil depth.

Roundy found that burning to kill shrubs and trees resulted in more "wet days" at 13–30 cm soil depth in May and June than in untreated plots at all 3 phases of tree dominance (see graph). Mechanically killing trees resulted in more "wet days" at phases 2 and especially phase 3 than for untreated plots or phase 1 plots.

[This study] provides strong evidence that it is better to control trees at phases 1 and 2 than phase 3 and that weed invasion will be most limited on sites with good shrub and perennial grass understories.

Did this extra time of soil water availability result in more cheatgrass on the burned and mechanically treated phase 2 and 3 areas? Yes and no. On some SageSTEP sites cheatgrass seeds were more available than others. On these sites, cheatgrass is seen in patches, but is much less dominant where there are patches of perennial grasses to use the soil water and other resources like soil nitrogen. Roundy explains, "Weeds need resources to invade. If we mechanically treat at phase 3 or we burn at any phase and lack perennial grasses or herbs to use the water, we may make soil water available for weed invasion." Although this is an ongoing study and results may vary as time goes on, current analysis provides strong evidence that it is better to control trees at phases 1 and 2 than phase 3 and that weed invasion will be most limited on sites with good shrub and perennial grass understories.

As Roundy and his team continue to collect and analyze their data, we will gain a better understanding of how, when and where to implement fuels treatments in Great Basin systems. For more information about this study, you can view a presentation with audio at http://www.sagestep.org/events/ut_workshop_10/Roundy_Woodlands/Roundy_Woodlands.html or email bruce_roundy@byu.edu.

Upcoming Events

International Association of Wildland Fire 3rd Fire Behavior and Fuels Conference
Learning from the Past to Help Guide Us in the Future
October 25-29, 2010
Spokane, Washington
http://www.iawfonline.org/spokane2010/

Restoring the West Conference 2010
Managing Plant and Animal Conflicts in the Intermountain West
October 26-27, 2010
Logan, Utah
http://www.restoringthewest.org

Society of American Foresters National Convention
October 27-31, 2010
Albuquerque, New Mexico
http://www.safnet.org/natcon10/index.cfm

ASA, CSSA, and SSSA 2010 International Meeting
Green Revolution 2.0: Food+Energy and Environmental Security
October 31-November 4, 2010
Long Beach, California
https://www.acsmeetings.org/

Society for Range Management Utah Section 2010 Winter Meeting
November 4-5, 2010
Logan, UT
http://www.usu.edu/range/upcomingevents/meetings.htm

American Geophysical Union 2010 Fall Meeting
December 13-17, 2010
San Francisco, California
http://www.agu.org/meetings/fm10/

SageSTEP is a collaborative effort among the following organizations:

- Brigham Young University
- Oregon State University
- University of Idaho
- University of Nevada, Reno
- Utah State University
- Bureau of Land Management
- Bureau of Reclamation
- USDA Forest Service
- USDA Agricultural Research Service
- US Geological Survey
- US Fish & Wildlife Service
- The Nature Conservancy

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For more information and updates, visit our website:

www.sagestep.org

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