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SageSTEP

SageSTEP News
Sagebrush Steppe Treatment Evaluation Project
Issue 9, Spring 2009

Effects of Prescribed Fire on Biological Soil Crusts and Their Subsequent Recovery in a Great Basin Juniper Woodland

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Biological soil crusts, comprised primarily of cyanobacteria, algae, lichens, and mosses living at or near the soil surface, are a key component of pinyon-juniper woodlands. They influence soil stability, hydrology, and cycling of macro- and micronutrients. They also affect the dispersal and germination of vascular plant seeds, as well as the survival and growth of seedlings. Research on the impacts of fire on biological crusts in pinyon-juniper woodlands is lacking, leaving managers to guess what effects they might be having on these important organisms when they conduct a controlled burn. To help provide answers, a study was conducted from 2006 to 2008 on the SageSTEP Onaqui woodland prescribed fire plot looking at the effects of fire on biological soil crust communities in pinyon-juniper woodlands. Results from this study provide information about the effects of fire on biological soil crusts and suggestions for managing encroaching woodlands in a manner that will not have long-term negative effects on the soil crust community.

The objectives of this study were to 1) determine the nature and extent of fire-related damage to biological soil crust communities by documenting changes in their cover, biomass, species composition and ecosystem function after a prescribed burn, and 2) document recovery dynamics over two subsequent years. A prescribed fire was implemented at the Onaqui woodland study site in October 2006 as part of the SageSTEP research project. Due to sub-optimal conditions, the fire did not successfully burn in mid- or late-successional tree stands; therefore, data collection for the biological crust study was limited to the early successional portion of the study site.

Prior to the burn, 0.5 x 0.5 m plots were established in the three vegetation patch types present in early successional juniper woodlands: juniper understory, sagebrush understory, and the interspaces between the scattered shrubs and trees. Aluminum tags painted with heat-sensitive paint were used to measure fire

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Please send questions or comments on this newsletter to summer.c.olsen@usu.edu.

Sagebrush Steppe SageSTEP Treatment Evaluation Project

www.sagestep.org

Typical views of juniper (above) and sagebrush (below) vegetation patch types present at the study site. Interspaces are visible in both photographs.

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intensity in the plots. After the burn, a duplicate set of plots was established in an unburned area for comparison purposes. Data were collected in burned and unburned plots soon after the prescribed fire took place in October 2006, and again in September 2007 and June 2008. Data collected included cover of vascular plants, mosses and lichens; algal biomass, density and species identities; and nitrogen fixation rates.

In general, results indicated that while the burn negatively affected some components of the crust community in some parts of the early successional stage of the juniper woodland, the overall impact on the crusts was minimal. Results showed that mosses were rare under juniper trees, so the effects of the fire were negligible there. The burn significantly reduced the cover of mosses under sagebrush and in shrub interspaces. Lichens were uncommon under juniper and sagebrush, and were more common in shrub interspaces, but because the fire was spotty and of low intensity in the interspaces, they were minimally affected. The burn significantly reduced the biomass of green algae and cyanobacteria under juniper and sagebrush, but it was unaffected in the shrub interspaces. Similar trends were seen in algal density. Nitrogen fixation was significantly reduced under juniper trees but not under sagebrush or in the interspaces. Nitrogen fixation was approximately an order of magnitude greater in the shrub interspaces than beneath juniper and sagebrush. Because the interspaces were generally not affected by the burn, there was no significant impact on nitrogen fixation.

For management plans that include prescribed fires to reduce juniper, it appears that burning of early successional juniper woodland is appropriate because most affected trees were killed. Control of sagebrush can likewise be accomplished by low intensity, cool season fires without eliminating the crust component. Due to the spotty nature of the fire in the shrub interspaces where the best-developed biological soil crusts occur, they were only minimally affected by the fire and may provide a good source of algal inoculants to re-colonize the soil in the juniper and sagebrush vegetation patch types that were more affected by the fire.

The data from this study suggest that intense fires should be avoided due to their greater potential for encroachment into the shrub interspaces that contain the most developed crust community. This information, in addition to the fact that late successional juniper woodlands are difficult to burn, suggests that burning of early successional juniper woodlands may be a preferred method for controlling juniper encroachment on western rangelands. Also, since wildfires in juniper woodlands typically burn very hot when they do burn, proactive treatment may be one way to avoid the more catastrophic consequences. A final report for this project can be viewed at http://www.firescience.gov/JFSP_Search_ProjectID_Results.cfm.

Photos for this article were provided by Steve Warren.

This study was conducted in collaboration with SageSTEP. A collaborative project is a study outside of the core SageSTEP study that takes place on or in relation to one or more of the SageSTEP study plots. More information about current collaborative projects and how to submit proposals can be found at http://www.sagestep.org/collaborative_projects.html.

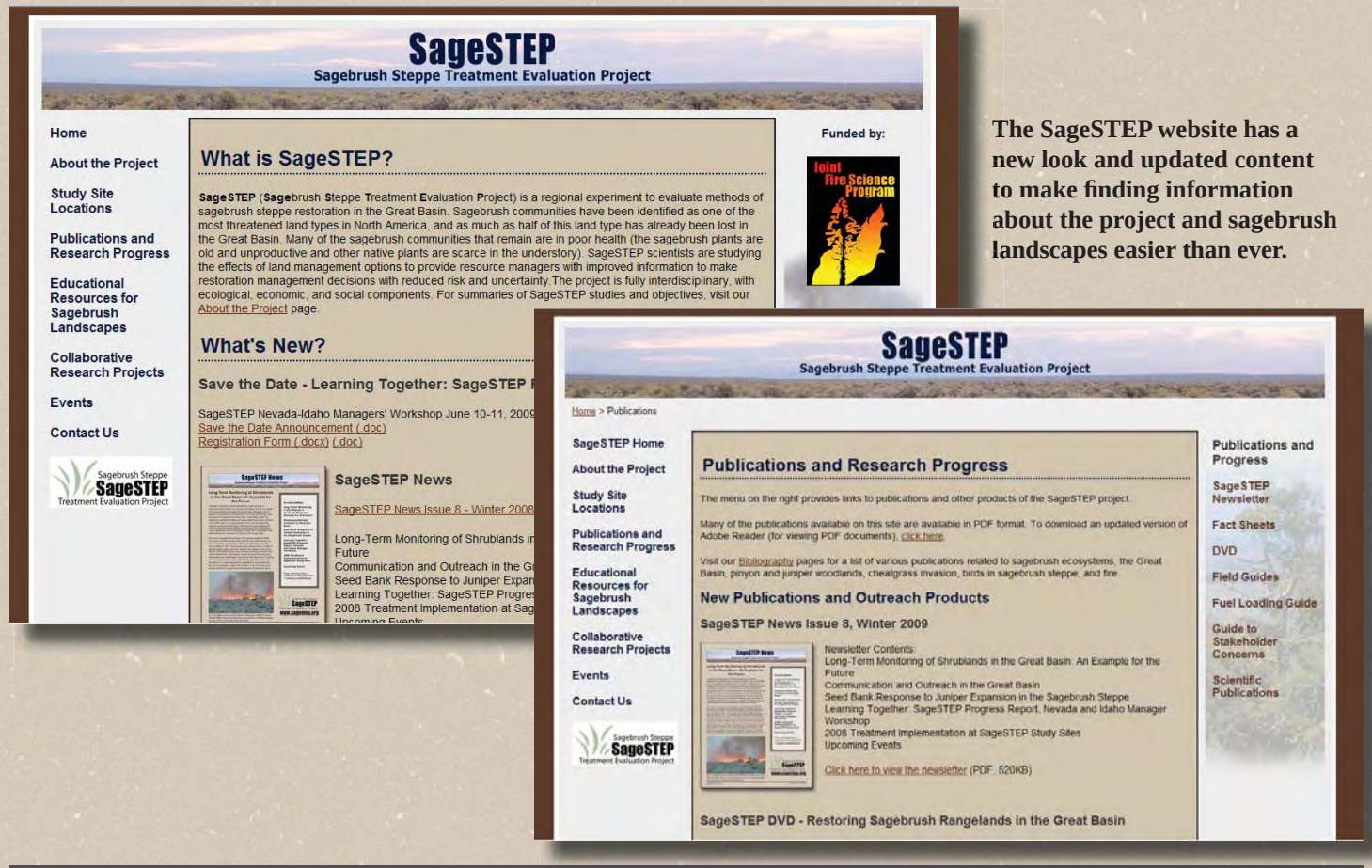
A New Look for the SageSTEP Website

In March 2009, the SageSTEP website (www.sagestep.org) got a new look. The purpose of the site is to provide information about the SageSTEP research and related projects, as well as general information about sagebrush landscapes. The new site includes much of the same great information as before as well as new information, and it has been updated and organized for easier navigation.

The main menu previously found across the top of the screen has been moved to the left side with more descriptive titles. When users select an item from the main menu, a sub-menu appears on the right side of the screen. This allows for easy navigation throughout the various sections of the site, while still being able to return to the main menu at any time. Information on the site includes the following:

- **About the Project**: Information about research being conducted in various disciplines, implementation of land management treatments, contact information for SageSTEP researchers and partner organizations
- **Study Site Locations**: A map of the SageSTEP Network of study sites with a link for each site including locator maps and site-specific facts
- **Publications and Research Progress**: Links to publications and other products resulting from the SageSTEP research and collaborative projects
- **Educational Resources for Sagebrush Landscapes**: Information about the ecology of sagebrush landscapes, bibliographies of related publications with links to many articles and abstracts, photos of vegetation and wildlife, links to related sites
- **Collaborative Research Projects**: Information about additional studies conducted in conjunction with SageSTEP researchers and/or study sites, but not part of the original research proposal
- **Events**: Information about upcoming meetings, workshops and field tours, and links to information from past events
- **Contact Us**: Contact information for researchers and graduate students involved with SageSTEP

If you haven't been on the SageSTEP website recently, now is a great time to check it out and see what's new!



The SageSTEP website has a new look and updated content to make finding information about the project and sagebrush landscapes easier than ever.

Post-fire Recovery of Mountain Big Sagebrush Communities in Utah and Nevada

Fire plays an important role in structuring the mosaic of seral conditions found within mountain shrubland communities of the Intermountain West where mountain big sagebrush (*Artemisia tridentata* Nutt. ssp. *vaseyana* (Rydb.) Beetle) occurs as a dominant cover type. The importance of mosaic composition and structure has been highlighted in life history studies of wildlife that depend on one or more seral conditions for survival and reproduction (e.g. Greater Sage-Grouse). Many studies have gauged post-fire responses of mountain shrublands using only a dominant cover species, big sagebrush, as the benchmark for recovery. However, mountain shrub communities can be highly diverse, and the taxonomic diversity of woody species likely influences the distribution and density of wildlife. There are significant limitations to approaching plant community recovery from a single species perspective especially as it relates to managing landscapes for biodiversity. We introduce a different approach for assessing post-fire recovery of mountain shrublands at the level of plant communities composed of multiple species.

Research conducted by Zachary J. Nelson, Dr. Peter Weisberg (University of Nevada Reno) and Stanley G. Kitchen (Shrub Science Lab) is focused on quantifying post-fire community recovery of mountain shrubland ecosystems at a regional scale. One of the study objectives, which we will be reporting on here, is to quantify post-fire community recovery of mountain shrublands at a regional scale, along with salient environmental variables that influence rate of recovery. From 2007 to 2008, woody species cover was measured at 30 burned and "unburned" control sites within the eastern Great Basin, Utah highlands and Colorado plateau (Figure 1). Sites burned at different times in the past ranging from 3 to 36 years previous.

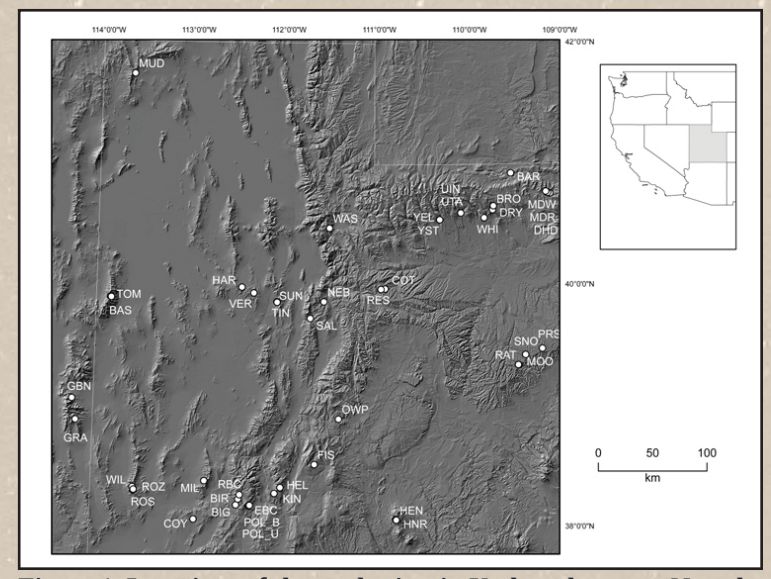


Figure 1. Locations of the study sites in Utah and eastern Nevada.

Mountain big sagebrush recovery: single-species approach

Analysis of mountain big sagebrush cover over time since fire indicated that it takes an average of approximately 35 years to reach pre-burn cover levels. However, there are fundamental problems with using the percentage of big sagebrush cover from paired control sites as the benchmark for recovery. For example, the cover of burned sites sometimes exceeded the percent big sagebrush cover from unburned controls. Mean mountain big sagebrush cover for control sites was about 24%. Linear regression of mountain big sagebrush cover at burned sites in relation to years since fire suggests this mean cover range is reached after 30 to 38 years (Figure 2). This relationship is highly variable across the regional scales of this study. This high variability, as demonstrated by many studies, suggests other factors are important in addition to time since fire. Surviving soil seedbank, burn pattern and size, and site productivity probably all contribute to the pattern of recovery of sagebrush cover. Though we had no information on sagebrush establishment from seedbank immediately following fire, we found that soil depth helped explain recovery rate.

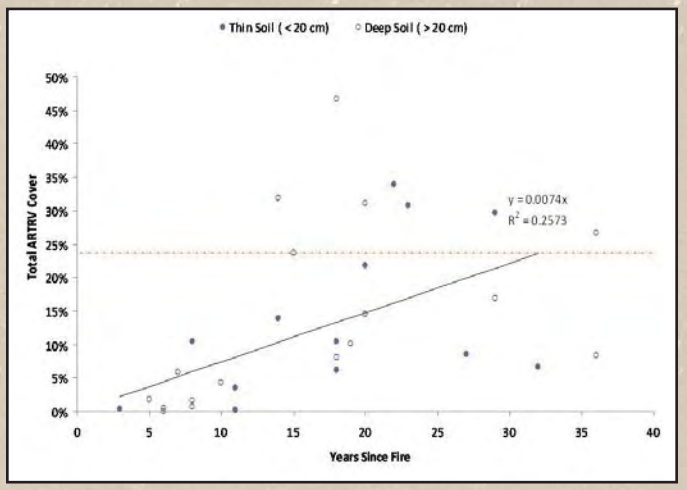


Figure 2. Mountain big sagebrush (ARTRV) cover plotted against time since last fire (years). Mean ARTRV cover for control transects was 24 ± 3% (indicated by orange dotted lines).

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Mountain sagebrush recovery: community-level approach

To analyze recovery in terms of all woody species measured, we used non-metric multidimensional scaling (NMS) to examine the species dissimilarity between burned and control sites (Figure 3). Each site was ordinated in 3-dimensional space according to the dissimilarity in species composition among sites. The Euclidean distances between burned and control sites were then used as an indicator of plant community recovery, and interpreted as a function of the number of years since fire (Figure 4).

The response function of mountain shrubland community recovery indicated rapid recovery in initial post-fire years that then leveled off. An additional analysis indicated separate response functions were needed for sites with varying soil depth, suggesting that post-fire recovery varies predictably along a soil productivity gradient. However, lack of a significant interaction between soil depth and time since fire implies that the soil depth difference is only apparent in the first years following fire, and later recovery is not statistically different among sites.

Allowing the minimum convex polygon (MCP), encompassing control sites (Figure 3), to represent a "recovered" plant community, we calculated the percentage of sites that had recovered with respect to time since fire. No site that had burned within the last 10 years had reached the recovery MCP. 27% of sites that had burned in the last 10-19 years had reached the recovery MCP and 63% of sites that burned within 20-36 years had reached the recovery MCP.

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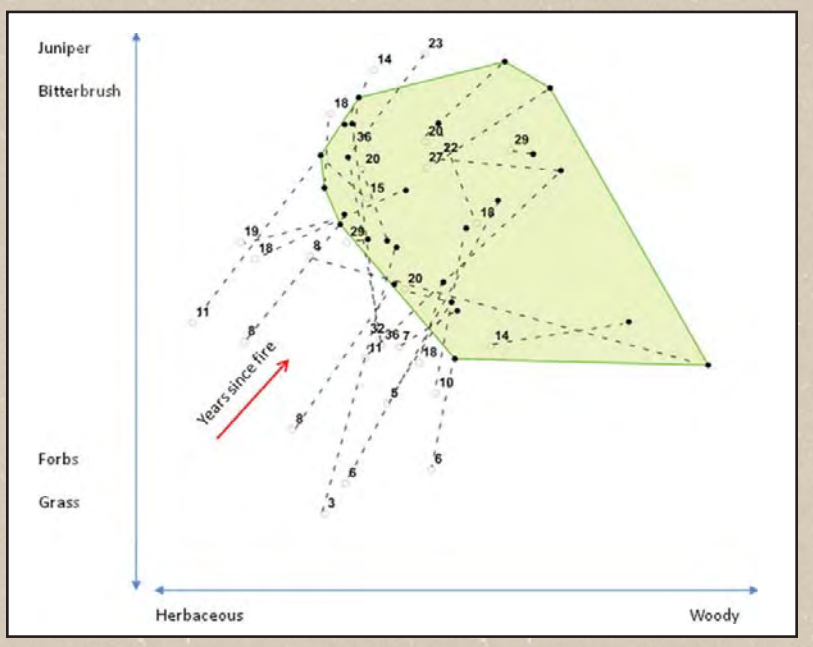

Figure 3. Non-metric multidimensional scaling (NMS) of burned (○) and unburned (●) sites based on species dissimilarity. Minimum convex polygon (green) shows the area in ordination space encompassing the control sites. Dotted lines show the direction in ordination space between paired burned and control sites. Most sites followed a post-fire trajectory from herbaceous dominance to dominance by woody, late-seral taxa such as juniper and antelope bitterbrush. Distances between burned and control sites in NMS space are used in further analyses as a measure of recovery. Each burned site is labeled with the number of years since fire.

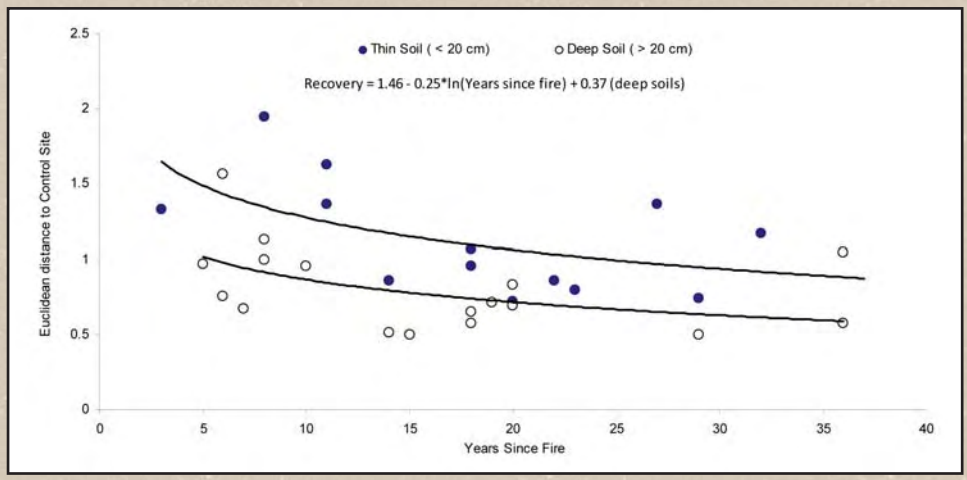

Figure 4. The degree of plant community recovery represented by the distance (species dissimilarity) in species composition between burned and control sites. Soil depth was a significant variable contributing to increased rate of recovery for sagebrush communities.

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Conclusions

Definitions of plant community recovery are often not well articulated, yet there is a need to be explicit about the effects of fire and site productivity on plant community succession over time. Both structure and floristic diversity are important considerations in managing landscape mosaics for persistence of native flora and fauna. Based on initial results from this work, we suggest that single species recovery does not necessarily equate to community recovery because most wildlife species use features of many plant species for cover, food and reproduction.

Future Directions

We continue to investigate the value of using this community-level analysis of recovery for quantifying fire effects at landscape scales, including scaling each site by productivity and developing regional measures of recovery in relation to the local species pool. We are developing a computer simulation model that tracks the persistence of woody species given rates of recovery dependent on seed dispersal and productivity gradients. We aim to quantify, in a probabilistic sense, the persistence of woody species given different scenarios of fire frequency, size and shape. We will use the model to then quantify the likelihood of avian species persistence in relation to the landscape dynamics generated from particular fire regime scenarios. These results will lend insight into the feedback between (1) fire regimes and vegetation mosaics and (2) avian species persistence with respect to disturbance regime and scale.

For additional information about this study go to http://www.cabnr.unr.edu/weisberg/research/landscape05/index.htm or contact Peter Weisberg at pweisberg@cabnr.unr.edu.

Acknowledgments

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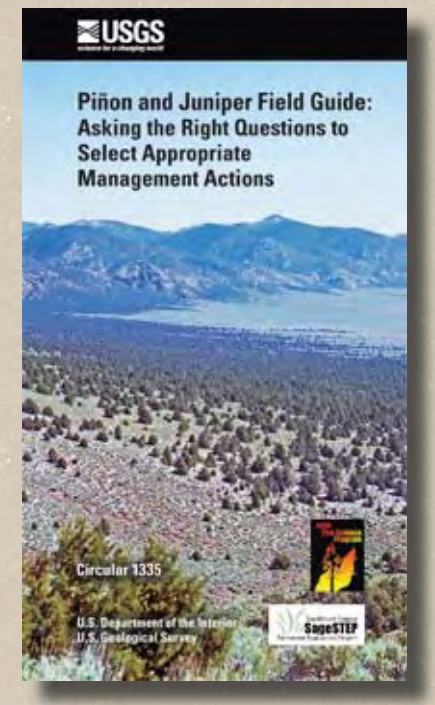
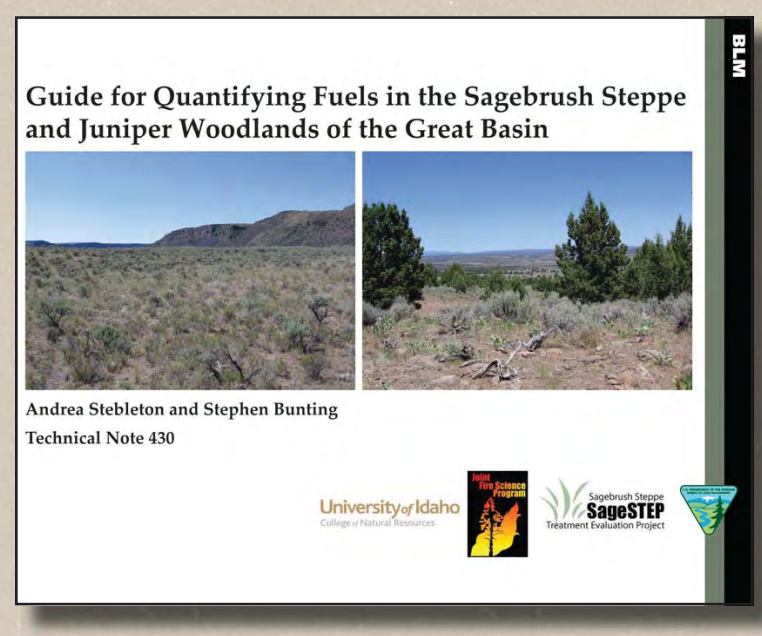
New Field Guide Assists Managers of Piñon-Juniper Woodlands



Piñon and juniper trees often form unique old-growth woodlands, but over the last century they have also expanded into some sagebrush ecosystems in the Great Basin of the western United States. Woodland expansion and tree infilling decrease the abundance and recovery potential of sagebrush vegetation and can affect soils, water, nutrients, fire, livestock, and wildlife. A new publication, *Piñon and Juniper Field Guide: Asking the Right Questions to Select Appropriate Management Actions*, produced by SageSTEP and the US Geological Survey, helps biologists and land managers consider how to look at expansion of woodlands and determine what questions to ask to develop a management strategy, including prescribed fire or other practices.

The guide was authored by SageSTEP scientists Robin Tausch and Jeanne Chambers from the USDA Forest Service Rocky Mountain Research Station, Rick Miller of Oregon State University, and Bruce Roundy of Brigham Young University. The publication is available online at http://pubs.usgs.gov/circ/1335/, and hard copies can be ordered by sending an email to summer.c.olsen@usu.edu.

Guide for Quantifying Fuels Now Available



Fuels and resource specialists and other land managers working in the Great Basin are often required to estimate fuel loadings to predict fire behavior, recommend fuel treatments, or restore an area to its natural fire regime. These tasks have become more difficult due to invasive species and woodland encroachment that have caused extensive changes in the fire regimes of sagebrush steppe over the past 150 years. SageSTEP researchers Andrea Stebleton and Steve Bunting have recently produced a *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* (BLM Technical Note 430) to help users better estimate percent cover, stem density and fuel loadings for a particular site.

The *Guide for Quantifying Fuels* is based on vegetation and fuels data collected by SageSTEP researchers at study sites in six states throughout the Great Basin for two years prior to implementing land management treatments. Designed similar to the Natural Fuels Photo Series produced by USDA Forest Service Fire and Environmental Research Applications team (FERA), this guide provides the necessary landscape-level inputs required by fire behavior and fire effects models along with building custom fuelbeds. Using photographs and tables that provide the range of values for each vegetation type, users should be able to quickly appraise a site by fuel stratum.

The *Guide for Quantifying Fuels* is based on the user's ocular estimate of the vegetation and fuels on the site. Multiple variables are included, and the utility of the guide extends across many disciplines beyond fire. Other applications could include habitat assessment for wildlife, restoration monitoring, grazing allotment allocation and assessment, and application to carbon sequestration models.

An online version of the guide is available at http://www.cnr.uidaho.edu/GBFuelsGuide, and a PDF can be viewed at http://www.sagestep.org/pdfs/SageSTEPFuelsGuide.pdf. To request a hard copy, send an email with your mailing address (no P.O. Boxes), phone number, and desired number of copies to BLM_NOC_PMDS@blm.gov.

Don't Forget!

Learning Together: SageSTEP Progress Report
June 10-11, 2009
Winnemucca, Nevada
http://www.sagestep.org/events.html
Register by May 22.

Upcoming Events

Utah Section SRM Summer Field Trip
Rush Valley and Skull Valley, Utah
June 4-5, 2009
http://www.usu.edu/range/upcomingevents/meetings.htm

Learning Together: SageSTEP Progress Report Nevada and Idaho Manager Workshop
Winnemucca, Nevada
June 10-11, 2009
http://www.sagestep.org/events.html

SRM PNW Summer Field Workshop
John Day, Oregon
June 25-27, 2009
June 24, OSU Range Field Day, Burns Oregon
http://pnw.rangelands.org/pnwmeetings.html

94th Ecological Society of America Annual Meeting: Ecological Knowledge and a Global Sustainable Society
Albuquerque, New Mexico
August 2-7, 2009
http://www.esa.org/albuquerque/

Utah SRM Section 2009 Fall Meeting
Cedar City, Utah
November 5-6, 2009
http://www.usu.edu/range/upcomingevents/meetings.htm

4th International Fire Ecology and Management Congress: Fire as a Global Process
Savannah, Georgia
November 30-December 4, 2009
http://www.fireecology.net/Congress09/Home.html

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

Funded by:

For more information and updates, visit our website:

www.sagestep.org

Special thanks to everyone who contributed to this issue of SageSTEP news: Mark Brunson, Jim McIver, Zach Nelson, Summer Olsen, Andi Stebbleton, Steve Warren, Peter Weisberg