12-2007

SageSTEP News, Winter 2007/2008, No. 5

SageSTEP

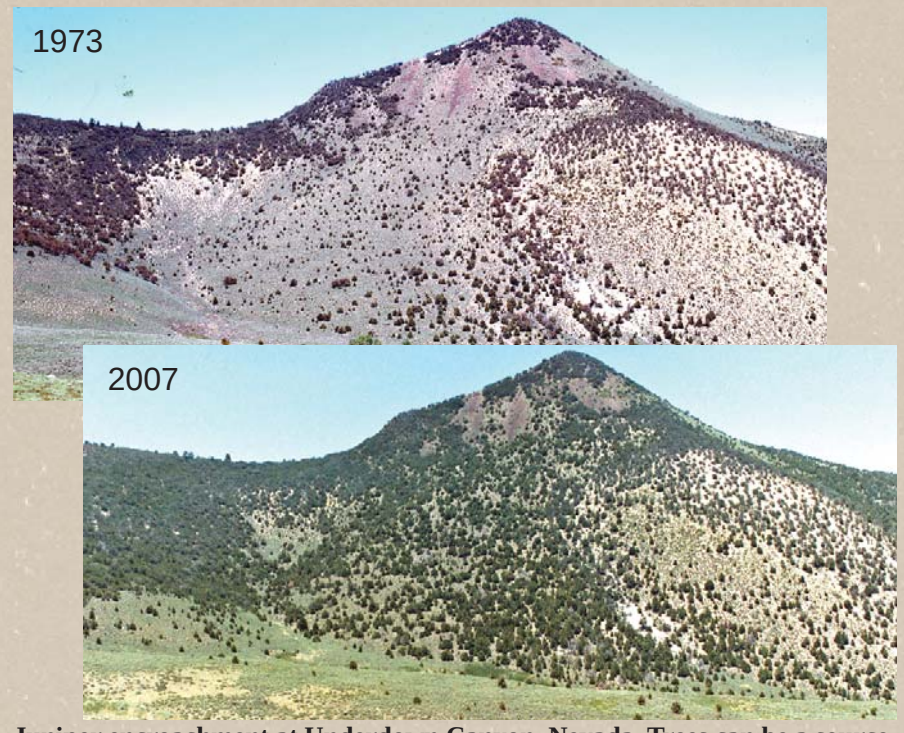
SageSTEP News

Sagebrush Steppe Treatment Evaluation Project Issue 5, Winter 2007/2008

Carbon Cycling and the SageSTEP Soils Research

As understanding of the causes and potential effects of climate change increases, scientists studying chemical processes and nutrient cycling are providing information that could help land managers incorporate climate change into their restoration decisions. Among them are the SageSTEP soils researchers, who are looking at a variety of soil characteristics, including carbon storage. Understanding the relationships among soil nutrients, fire, and restoration activities can help managers make better decisions about the types of restoration treatments to use in a particular area, and when and where to implement them.

Current knowledge of carbon storage in the Great Basin is limited. Arid systems have three main carbon pools: inorganic soil carbon (such as carbonate rocks and caliche), organic soil carbon (such as humus and plant and animal detritus), and aboveground biomass (such as litter and vegetation). Woodland encroachment has caused an increase in woody biomass and root mass, and thus a short-term increase in both aboveground and belowground carbon storage. This leads some to believe that woodland encroachment is beneficial in offsetting some of the effects of climate change. However, many years of fire suppression have caused a build-up of woody fuels on the landscape, and over the past 10 years there have been massive increases in the number of acres burned by wildfire (see graph on p. 2).



Juniper encroachment at Underdown Canyon, Nevada. Trees can be a source of carbon storage, however, they also release large amounts of carbon when they burn in high-intensity wildfires. Photos by Robin Tausch.

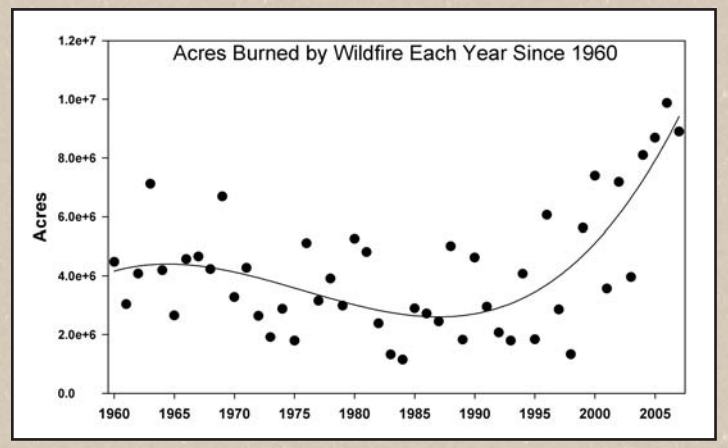
In this issue:

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

Sagebrush Steppe SageSTEP Treatment Evaluation Project

www.sagestep.org

Globally, anthropogenic burning and wildfires produce nearly as much CO_2 each year as fossil fuel emissions. Some scientists estimate that increases in wildfire in the U.S. are off-setting the carbon stored by increasing woodlands. Also, these wildfires could be releasing much of the carbon stored by fire suppression from 1910 to the present. While more information is needed to determine the exact balance, it is known that the high-intensity fires that are becoming more common are more detrimental to ecosystems, require more time and money for recovery, and volatize a lot more carbon than low-intensity fire.



High-intensity fires also increase the probability that arid landscapes will be invaded by exotic grasses, like cheatgrass. These annual grass ecosystems store considerably less carbon than either juniper and pinyon woodlands or sagebrush ecosystems. Annual grass systems are prone to more frequent wildfires, resulting in rapid turnover of carbon and very little long-term storage.

Restoration treatments, such as those being studied as part of SageSTEP, have the potential to reduce high-intensity wildfire and slow the rate of carbon turnover. Some treatments may even result in net gains in carbon storage.

Prescribed Fire: Although prescribed fire releases CO_2, the intensity of the fire is much lower than wildfire, and therefore releases less carbon initially. Prescribed fire also reduces the probability of high-intensity wildfire, therefore it may be effective at reducing carbon emissions. Additional carbon is released from incompletely consumed trees as they decompose, but it is possible that some of this is stored in soils (root biomass and litter converted to humus over time) and not returned to the atmosphere by microbial activity.

Mechanical (Cutting and Mowing): Mechanical treatments that thin trees and shrubs reduce the risk of wildfire and the related high CO_2 emissions. Carbon is released over time by microbial activity as the debris break down, but some carbon may be stored in soils.

Mechanical (Tree Mastication): This treatment reduces the risk of wildfire and has the best chance of storing carbon in soils although over time much is still lost by microbial activity.

Herbicide Application: Impacts of herbicide application to thin shrubs are similar to those of mechanical treatments.

At a minimum, most treatments will slow the rate of carbon turnover. In cases where exotic grass invasions can be prevented, further carbon losses can be avoided. In the most successful cases, some treatments may actually result in net gains of carbon stored if some carbon can be converted to less labile (more stable) soil carbon, and the native vegetation recovers over time.

SageSTEP soils researchers are working to develop a better understanding of current carbon storage in the Great Basin. Researchers are also collecting the most extensive data set of its kind, including one meter soil cores from across the region and detailed estimates of aboveground biomass. They are working to determine how much of the carbon in Great Basin juniper and pinyon woodland and sagebrush systems is tied up in soils and how much is available for more rapid turnover. Over time they will be able to provide information about which management strategies reduce the rate of carbon turnover or result in net gains in carbon storage.

Preliminary observations of the soils research indicate that, to date, the woodland encroachment of the past 160-120 years has very little influence on inorganic soil carbon or organic soil carbon. This is probably due to that fact that it takes a very long time for microbes to convert root exudates, dead fine roots, and litter into relatively stable soil humus. However, soil scientists have seen a relatively large increase in root biomass associated with woodland encroachment. These roots will not be removed by fire or any management activity, and could eventually become a long-term source of soil carbon storage. Additionally, a pilot project at Underdown Canyon in Nevada showed that plots in the late stages of woodland encroachment showed six to seven times more aboveground tree biomass than plots in the early stages of woodland encroachment.

For more information about the SageSTEP soils research, contact Ben Rau (brau@unr.nevada.edu) or Dale Johnson (dwj@cabnr.unr.edu).

Educational Resources on the SageSTEP Website

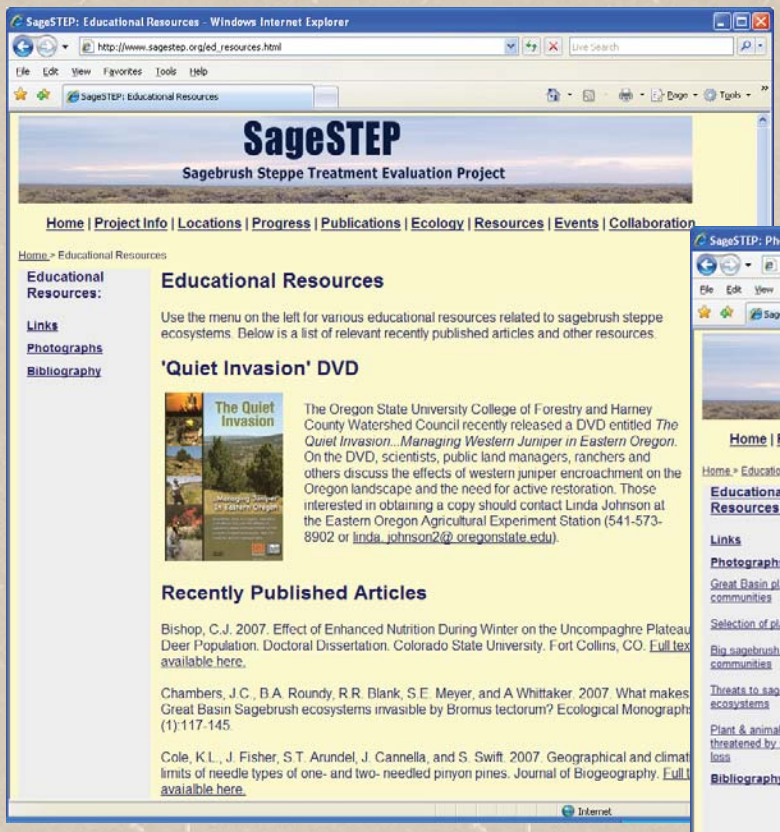
Many people may not be aware that in addition to providing detailed information about the SageSTEP study, our website contains various educational resources for users interested in learning more about sagebrush steppe ecosystems in general. This information is provided for a variety of audiences and can be accessed from the *Educational Resources* homepage at www.sagestep.org/ed_resources.html.

The homepage contains references to recently published articles and other current resources related to sagebrush-steppe systems. This page is updated regularly as new information is published. The educational resources menu has three sections: 1) Links to related websites; 2) Photographs; and 3) Bibliographies.

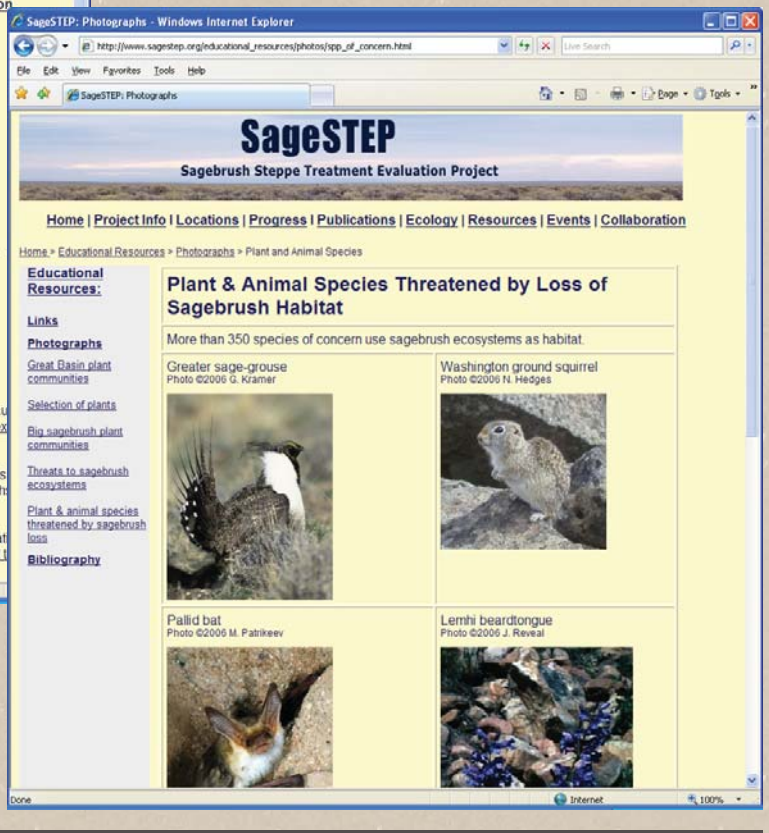
The *Links* page connects users with projects and organizations working on sagebrush-related issues throughout the Great Basin. This page includes a list of these projects and organizations with a short blurb about each and a link to the relevant website. The *Photographs* pages give visual representations of many of the plants and animals found in Great Basin sagebrush systems. Photographs are from the book *Habitat Threats in the Sagebrush Ecosystem: Methods of Regional Assessment and Applications in the Great Basin*, edited by Dr. Michael Wisdom and others.

The *Bibliography* pages are organized by topic and provide references to relevant literature in a variety of areas including wildlife in sagebrush ecosystems, wild and prescribed fire, sociopolitical and economic aspects of restoration and fuels management, and more. Many of the publications have links to abstracts or full text. New publications are added to these lists on a regular basis to provide up-to-date information on research taking place in these systems.

The SageSTEP research team is committed to providing quality, timely information on sagebrush steppe ecosystems and restoration to a variety of audiences. If you have questions about where to find information, or you would like to comment on our website, please e-mail summer.c.olsen@usu.edu.



SageSTEP website Educational Resources Homepage (left). With links to various websites, photographs and publications, this part of the SageSTEP website can be useful to a variety of audiences interested in learning more about sagebrush steppe ecosystems.



SageSTEP website Educational Resources Photos Page. This example (right) shows a page with photographs of plant and animal species threatened by loss of sagebrush habitat.

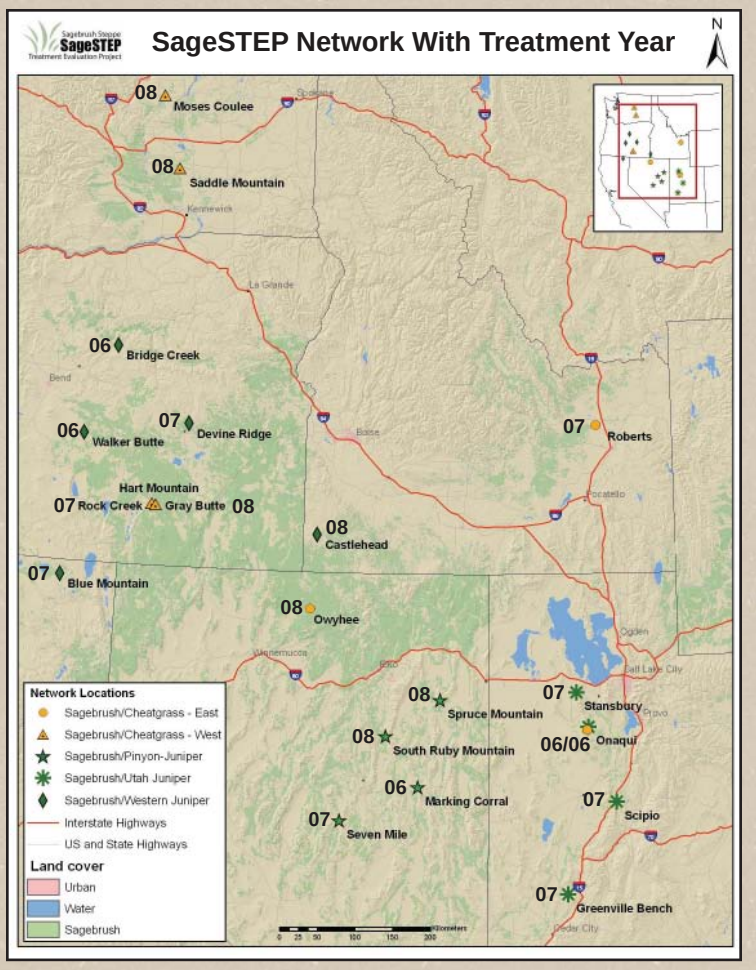
Additional SageSTEP Treatments Implemented in 2007

Firefighters implement a prescribed burn at the Hart Mountain-Rock Creek site in Oregon, fall 2007.

As part of the ongoing SageSTEP experiment, treatments were implemented at eight study sites in the fall of 2007 (see map below). Treatments at sagebrush sites invaded by cheatgrass included prescribed burning, mowing to thin the sage, and herbicide application to thin sage. Plateau herbicide was applied in half of the subplots of each treatment at sagebrush sites to assess its ability to prevent the growth of cheatgrass. At woodland sites, treatments included prescribed burning, mechanical removal of trees using the Bull Hog (Utah only), and chainsaw cutting. Treatment implementation at the SageSTEP sites was successful thanks to the planning and hard work of our partner offices and the individuals involved on the ground.

Prescribed burning continues to present challenges at some of the SageSTEP study sites and throughout the west. Securing resources for prescribed burning and finding an optimal time to burn were often difficult tasks due to the large and numerous wildfires burning throughout 2007. Other challenges of treatment implementation included pending litigation and unsuitable weather conditions.

Treatments are planned for the remaining SageSTEP study sites in fall 2008. Post-treatment vegetation, soils, hydrology, wildlife, and other data will be collected at all treated sites in the summer of 2008. Pre-treatment data will continue to be collected at untreated sites. SageSTEP researchers will use these data to provide information about when, where, and how to restore sagebrush-steppe systems. Additional information and photos of treatments can be found at http://www.sagestep.org/about_the_project/treatments.html.



A Bull Hog mulches juniper trees at the Stansbury site.

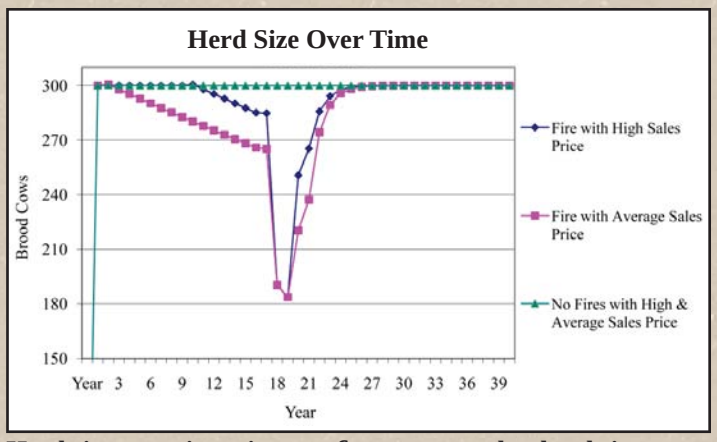
SageSTEP Economics Research: The Economic Impacts of Sagebrush Steppe Wildfires on an Eastern Oregon Ranch

Anna Maher, a graduate student working with John Tanaka at Oregon State University (OSU), recently completed her thesis, *The Economic Impacts of Sagebrush Steppe Wildfires on an Eastern Oregon Ranch*. The purpose of this project was to provide an estimate of the economic impacts of cheatgrass-associated wildfires on the public land allotment of a representative 300 cow-calf ranch in Oregon. Decisions regarding public policy and land management practices on cheatgrass-infested Great Basin sagebrush steppe lands require knowledge of the costs and benefits of cheatgrass as a forage source. Cheatgrass invasion implies an increase in the risk of fire, which increases the likelihood that ranchers will be denied temporary access to public lands.

This study considered both the contribution of cheatgrass to spring forage and the economic cost of a typical minimum two-year grazing exclusion following a wildfire. Results indicated that fires on public lands impose costs affecting the economic viability of a ranch, and that failure to recognize this underestimates the costs of invasion. Restoration efforts may therefore provide a significant financial benefit to a ranching enterprise which may outweigh the benefit of cheatgrass as a spring-time forage source.

The ranch-level economic model utilized biological data, gathered as part of the SageSTEP study, to describe a hypothetical Bureau of Land Management (BLM) allotment in Oregon that exhibits ecological characteristics typical of sagebrush steppe that is vulnerable to continued cheatgrass invasion (15% percent cheatgrass cover and a 20 to 40 year fire return interval). The model was subjected to randomly generated fire regimes. During the two years following a fire, the BLM allotment was assumed to be unavailable for grazing and the representative ranch was forced to choose a substitute forage source and/or limit its herd size. The model incorporated a 40-year planning horizon and a 7% discount rate, and assumed sale prices remained constant.

In this model, the representative ranch reacted to the temporary loss of permitted Animal Unit Months (AUMs) by forage substitution and reducing its herd size. The ranch impacts of a fire went beyond the time-line of the two years of exclusion from the BLM allotment. The enterprise "planned ahead" by reducing its herd size prior to a fire and required some years to recover (see graph below). The decrease in access to BLM AUMs resulted in an even greater decline in the average use of deeded range AUMs and a decrease in the Net Present Value (NPV) of the firm. The ranch did experience bankruptcy under certain circumstances. The probability of bankruptcy given either a higher than average sales price or an average sales price, depended upon the number of fires that occurred within the forty-year time line (see table below) and the timing of the fire(s).



Herd size over time given no fires compared to herd size over time given that a fire occurs in year 17.

Number of Fires	Probability of Bankruptcy (High Sales Price)	Probability of Bankruptcy (Avg. Sales Price)
1	7%	11%
2	25%	100%
1 and 2	11%	32%

The ranch's calculated probability of bankruptcy compared by the number of fires and the sales price.

This study indicates that policy-makers and land managers confronting this impending risk to the ranching community, along with limited financial resources, may want to prioritize restoration activities according to those areas that are at the highest risk of experiencing an increase in fire frequency. This risk would be defined as an area's vulnerability to crossing an ecological threshold into an increased state of invasion.

Anna's thesis will be available soon on the publications page of the SageSTEP website. She plans to continue the ranch modeling research as part of her Ph.D. program at OSU. Anna can be reached at mahera@onid.orst.edu.

Collaborative Project Highlight

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. Each issue of SageSTEP News highlights a different collaborative project. More information about current collaborative projects and how to submit a proposal can be found at http://www.sagestep.org/collaborative_projects.html. We welcome proposals for non-invasive research on aspects of sagebrush ecosystems that are not covered in the SageSTEP proposal. If you are interested, please contact Jim McIver, SageSTEP Project Coordinator, at (541)562-5396 or james.mciver@oregonstate.edu.

Soil and Hydrologic Response to Mastication of Juniper Woodlands

Nathan Cline, a master's student at Brigham Young University, is working with Dr. Bruce Roundy at BYU and Dr. Fred Pierson with the Agricultural Research Service in Boise, Idaho, to study the impacts of juniper mastication (using a Bull Hog) on soil compaction and hydrologic response in Utah. This study measured differences in soil water infiltration rates between soils tracked by the Bull Hog tractor and those not tracked, as well as infiltration rates of soils covered and not covered with mastication residue.

This study took place on the SageSTEP Onaqui woodland site (see map on p. 4), which has a gravelly loam soil texture. Plots of two different sizes or scales were measured; microsites (0.5 m^2 plots), and canopy/intercanopy sites (13 m^2 plots). Rain simulations were applied at two different rates as part of a larger SageSTEP hydrology study. Pre-treatment data were collected in the summer of 2006. Bull Hog mastication of juniper trees took place in fall 2006. First-year post-treatment data were collected in summer 2007.

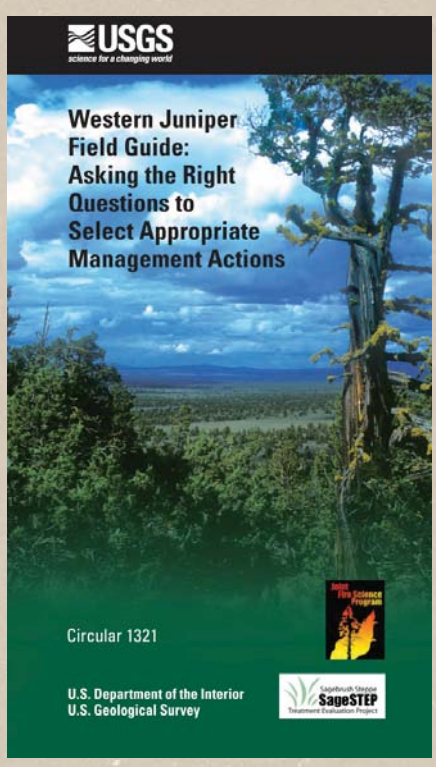
Tracked bare ground microsite.

Study results show that plant microsites had higher infiltration rates than bare ground microsites between the plant microsites. Soils tracked by the Bull Hog had similar infiltration rates as untracked soils on this hill slope. Soils covered with residue had higher infiltration rates than bare soils. Compaction, as measured by penetration resistance, was greater on tracked than untracked soils for all microsites except tree microsites. Although Bull Hog tracking did compact soils, infiltration rates of both tracked and untracked soils were high in this study. Because compaction could reduce infiltration rates on other soils and sites with greater slopes and finer soil textures, land managers should monitor post-mastication responses and avoid mastication when soils have high soil water content.

Residue left behind after juniper mastication.

Results from this study will be presented at the Society for Range Management annual meeting in Louisville, KY, January 31, 2007. Information about this project can be found at http://www.sagestep.org/collaborative_projects/projects/cline_bullhog_hydro.html.

Western Juniper Field Guide Now Available



The publication *Western Juniper Field Guide: Asking the Right Questions to Select Appropriate Management Actions* is now available as part of the U.S. Geological Survey (USGS) Circular Series. This guide is the first of a set of three 'User's Guides' being produced as part of the SageSTEP outreach program. The other two guides will focus on sagebrush ecosystems threatened by pinyon-juniper woodland encroachment and cheatgrass invasion and will be available later this year.

The western juniper field guide uses a series of questions to help both public and private land managers make more informed decisions as they consider how to apply land management treatments under a wide variety of conditions. The guide contains information to help managers identify the type and current state of sites they may be considering treating. It also contains information about landscape-scale considerations, treatment options, and post-treatment management. This is a pocket guide (4" x 7") that can be taken out in the field for quick reference.

This guide was published with support from the USGS Forest and Rangeland Ecosystem Science Center, USDA Agricultural Research Service Northwest Watershed Research Center and Eastern Oregon Agriculture Research Center, and the Bureau of Land Management Washington and Oregon State Office. If you have already requested a copy of the guide you should be receiving it soon. If you would like a copy of the guide, please contact one of the offices listed above, or e-mail Summer Olsen at summer.c.olsen@usu.edu.The guide is available in PDF format at http://pubs.usgs.gov/circ/1321/.

2008 Spring Manager Workshop

SageSTEP will be hosting a workshop for managers in Burns, Oregon, May 6-7, 2008. The purpose of this workshop is to provide an opportunity for scientists and managers to come together and discuss the progress of the project at the western sagebrush/cheatgrass and western juniper sites, lessons learned from working together, and plans for the remainder of the experiment. Similar workshops were held in Utah and Nevada in 2007.

Managers and researchers discuss the SageSTEP study during a field tour.

The Oregon workshop will include a half-day of presentations and discussion on the morning of May 6. That afternoon, weather permitting, we will visit the Devine Ridge study site located on land managed by the Bureau of Land Management Burns Field Office. Devine Ridge is a western juniper woodland site where prescribed fire and mechanical thinning treatments were implemented in the fall of 2007.

The following day will be an all-day field trip to the Hart Mountain study sites. These two sites are located in sagebrush shrublands with various stages of cheatgrass invasion and are on land managed by the U.S. Fish and Wildlife Service Hart Mountain National Antelope Refuge. Restoration treatments, including prescribed fire, mechanical thinning, and herbicide application, were implemented at one of the Hart Mountain sites in fall 2007 and are planned for the remaining site in fall 2008.

The workshop will focus on SageSTEP research at study sites in Oregon, Washington, California, and Idaho. We would like to remind managers at our partner offices in these states to put this workshop on your calendars. Others who are interested in attending any portion of the workshop, please contact Nora Devoe, BLM Science Coordinator, at nora_devoe@nv.blm.gov.

Upcoming Events

Society for Range Management and American Forage and Grassland Council
2008 Joint Annual Meeting
Louisville, Kentucky
January 26-31, 2008
http://www.rangelands.org/louisville2008/louisville2008_index.shtml

Great Basin Environmental Program NGO Workshop
Sparks, Nevada
February 20-21, 2008
https://naes.agnt.unr.edu/ngo_workshop/

15th International Congress of the International Soil Conservation Organization
Budapest, Hungary
May 18-23, 2008
http://www.isco2008.com/

Association for Fire Ecology Regional Conference 2008
Fire in the Southwest: Integrating Fire Into Management of Changing Ecosystems
Tucson, Arizona
January 28-31, 2008
http://www.humboldt.edu/swfire/

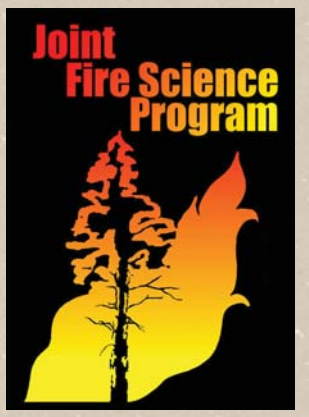
SageSTEP Manager Workshop
Burns, Oregon
May 6-7, 2008
Nora_Devoe@nv.blm.gov

15th Wildland Shrub Symposium
Bozeman, Montana
June 17-19, 2008
http://eu.montana.edu/shrublands

SageSTEP is a collaborative effort among the following agencies and universities:

- 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