

## Short-term Response of Bird Communities to Restoration Treatments Conducted at Woodland Sites

Steve Knick<sup>1</sup>, Steve Hanser<sup>1</sup>, and Matthias Leu<sup>2</sup>

*This is a follow-up to an article describing the SageSTEP bird work in Issue 17, pp. 4-5.*

Songbirds are often used as indicators of change in vegetation communities. Most songbirds have a high visibility and their numbers are relatively easy to estimate from surveys of calls by singing males during the breeding season. Any change in number of birds or species counted on these surveys then can provide evidence that habitats differ among locations or that the environmental template has changed either due to a long-term trend or a short-term response to a management treatment.

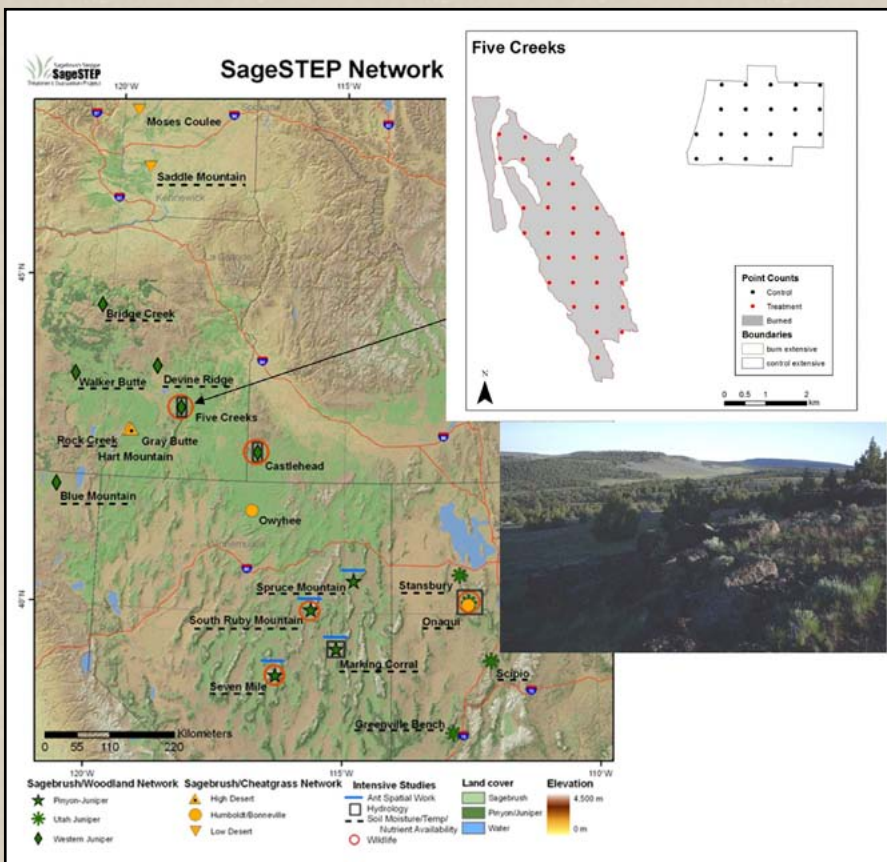


Fig. 1. Breeding bird survey points at the Five Creeks treatment and control study sites in southeastern Oregon.

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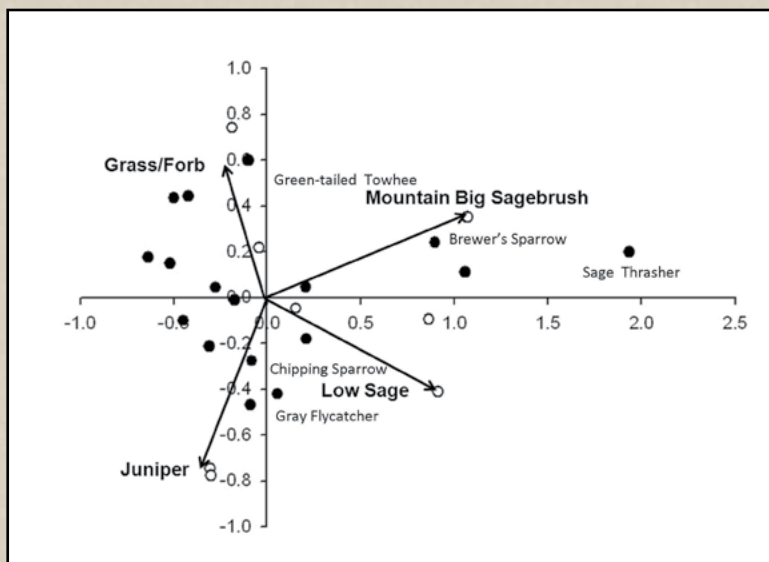
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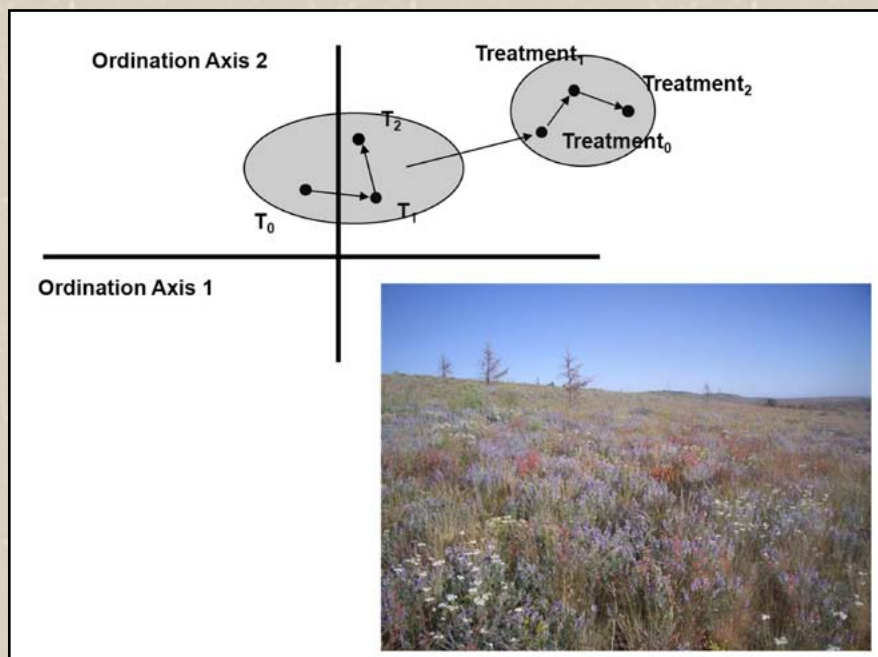
**Fig. 2.** The bird community at the Five Creeks study area in southeastern Oregon is arranged along primary gradients from juniper woodlands at one end to mountain big sagebrush and grass/forb communities at the other. Dark circles are ordination scores of individual bird species. Open circles are scores for environmental variables. Note that environmental gradients occur along multiple axes that are not always parallel to the major x and y axes.

We estimate the statistical center of the bird community for all species in the ordination from the average score on each axis for all surveyed points. The statistical location of this community score changes each year because slightly different numbers of each species will be counted on our surveys. By plotting the average score for each year, we can map how the community changes through time. We expect that for undisturbed study sites will be small and will fluctuate around some stable centroid that defines the bird community at that location (Fig. 3). Any shifts in the location of a centroid over time can be interpreted relative to the environmental axes defining the primary gradients. That shift might be gradual such as the passive changes in the bird community that occur with juniper expansion at a location over a long time. In contrast, our objective with land management actions is to actively change the vegetation in a relatively short period, which might push the bird community to a new centroid (Fig. 3).

Treatments conducted on the SageSTEP woodland study sites use fire as a large-scale disturbance to reduce the cover of pinyon or juniper. The long-term objective of these treatments is to change the vegetation community to one dominated more by sagebrush and bunchgrasses. These treatments should benefit birds (primarily sage-grouse) that depend

We counted the number of breeding birds at multiple survey points placed throughout each treatment and control site at each of 14 study areas in the woodland network of the SageSTEP project (Fig. 1). In this article, we use results from the Five Creeks study area in southeastern Oregon, which are typical of the other treatment locations.

We used a statistical technique called ordination that arranges bird species along an axis, or gradient, that can be defined by vegetation or other environmental characteristics. Birds seldom have completely exclusive niches. Instead, their habitat use often partially overlaps other species that have slightly different preferences. Ordinations provide a way to look at this species turnover from one end of an environmental axis to another. Our results delineate a gradient of birds dependent on grasslands (NW quadrant) through birds that use sagebrush (E quadrant) to those species associated with ecotone and woodland habitats (SW quadrant) and have provided insights into the primary vegetation characteristics that structure bird communities (Fig. 2).



**Fig. 3.** Changes in the yearly average score, measured by  $T_0$ ,  $T_1$ , and  $T_2$ , for a bird community can delineate the trajectory over time. Yearly scores for a community at a location that is stable over time will vary due to annual differences in productivity but will fluctuate around the centroid for that community (enclosed by a gray ellipsoid). Treatments, shown here by  $Treatment_0$  through  $Treatment_2$ , shift the community to a new location that ultimately stabilizes with its own unique centroid and annual dynamics.

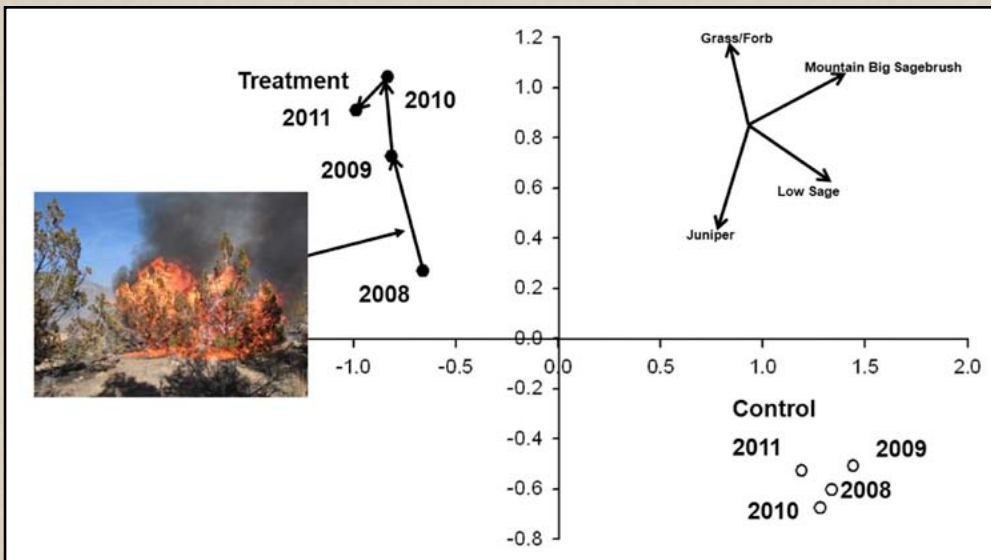


Fig. 4. Yearly scores for the bird communities in the treatment (black circles) and control (open circles) study sites at the Five Creeks study area. The bird community in the treatment area shifts away from one associated with juniper following the treatment in fall 2008 and is beginning to stabilize around a new centroid characterizing bird communities in more open grass/forb habitats. In contrast, the bird community at the control sites remained within a relatively small region around a centroid in habitats characterized by sagebrush and juniper habitats.

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*Our preliminary short-term results suggest that woodland treatments do influence the bird community and that the change in the community is in the direction that we would expect relative to the vegetation changes.*

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on these habitats. We are using yearly changes in average score of the bird community as one way to measure how closely birds are tracking the new vegetation structure created by treatments and to determine whether the community is changing in the expected direction.

Our first year of data on the bird community at the Five Creeks study area was collected prior to the prescribed fire in fall 2008 and provided the initial community score for treatment and control sites (Fig. 4). The average score for the bird community in the first year following treatment (2009) showed a large shift along the gradient away from juniper and towards grass/forb vegetation. This trend continued in 2010 followed by a much smaller shift in 2011. Where the bird community will stabilize remains to be seen from surveys conducted in future years, but the community clearly has shifted from the 2008 score and in the direction that we would expect from the vegetation changes caused by the treatment.

Our results also indicate that bird communities at Five Creeks were very different between treatment and control study sites before any treatment occurred (Fig. 4). Although this limits our ability to draw conclusions from statistics based on paired-site analyses, the yearly trajectory measured for birds at control sites provides a reference against which to assess the community experiencing the treatment. In comparison, the bird community at control sites remained in a relatively small statistical space and yearly shifts in average

community scores were not correlated either to the statistical distance or the directions observed for the treatment sites.

Changes in the average community score can result either from decreases or increases in a species relative to the other birds counted at a site. Because the woodland treatments were conducted, in part, to improve habitat conditions for birds that depend on sagebrush and bunchgrasses, we looked at the response by individual species. The number of Brewer’s sparrows, the dominant sagebrush-obligate species, did not change and even had a slight but statistically insignificant decrease in response to the treatment. Rather, the primary change in the bird community was caused by decreases in number of chipping sparrows, gray flycatchers, and green-tailed towhees, the species using the ecotone habitats that changed when juniper cover was reduced.

Our preliminary short-term results suggest that woodland treatments do influence the bird community and that the change in the community is in the direction that we would expect relative to the vegetation changes. However, the initial response appears to be caused by lower counts of bird species that lose habitat instead of any increases in those birds intended to benefit from the treatments. We will need more time to define the full effect of the treatment as the yearly scores for the bird community shift and eventually settle around a new centroid.

# The Importance of Resilience and Resistance to the Restoration of Sagebrush Rangelands

Jeanne Chambers, USDA-FS Rocky Mountain Research Station  
 Rick Miller, Oregon State University  
 Jim Grace, US Geological Survey

Sagebrush ecosystems in the Great Basin face ever-increasing risks of exotic species invasion, pinyon and juniper encroachment, and larger and more severe wildfires. Land managers are addressing these widespread risks with management plans and projects that encompass large areas with a wide variety of ecological conditions. As a result, the capacity of sagebrush ecosystems to recover following disturbance (planned or unplanned) and to resist invasive species often differs considerably even within single project areas. Understanding the factors that contribute to ecosystem resilience (to disturbance) and resistance (to invasive species) can help managers to prioritize projects across these large areas and determine the most appropriate management treatments for particular sites.

SageSTEP researchers have been both collecting and synthesizing information on the ecosystem factors and processes that determine resilience and resistance and that result in threshold crossings for sagebrush ecosystems exhibiting pinyon and juniper encroachment and at risk of cheatgrass invasion. Definitions of these concepts are in Table 1.

**Resilience** = the capacity of an ecosystem to maintain its fundamental structure, processes and functioning when subjected to stress, disturbance or invaders. As such, resilience is a measure of the recovery potential of an ecosystem.

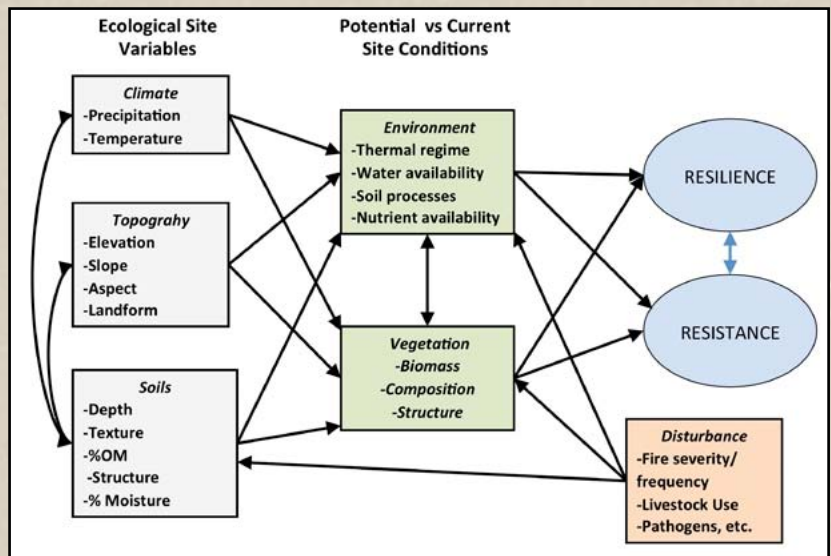
**Resistance** = the abiotic and biotic factors and ecological processes in an ecosystem that limit the establishment and increase of an invasive species.

**Thresholds** are an important and related term. Within the context of resilience, thresholds describe the limits of natural variability within ecosystems. When thresholds are crossed, an ecosystem may not return to the original state via natural processes. When stress, disturbance or invasion lead to transitions to a new alternative state, active management will be required to restore natural system condition.

**Table 1. Definitions of resilience, resistance and thresholds for sagebrush ecosystems as used in this article.**

## Factors that Influence Resilience & Resistance

The factors that determine the inherent resilience and resistance of an ecosystem are similar to the

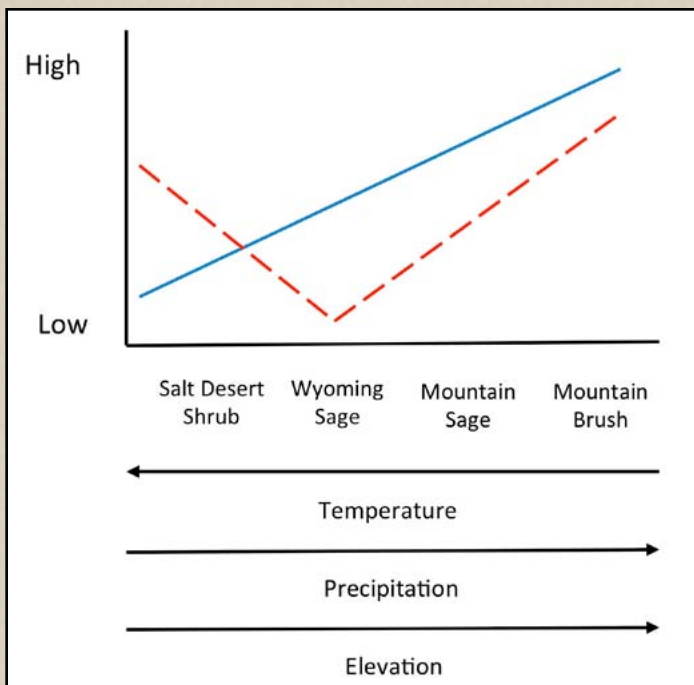


**Figure 1. The ecological site variables and site conditions that influenced resilience and resistance. Disturbances can decrease ecological site conditions and negatively affect resilience and resistance.**

ones used in ecological site and plant community descriptions. Resilience and resistance are determined by climate, topography and soils and, in turn, by the potential versus current environmental and vegetation characteristics (Fig. 1). Decreases in both resilience and resistance result from factors that influence ecological conditions including:

- Reduced soil stability as indicated by past or present soil erosion;
- Altered species composition and declines in the abundances of native plants, seed banks, and seed sources;
- Presence of invasive species capable of increasing following disturbance;
- Inappropriate livestock grazing that results in a decrease in perennial herbaceous species;
- Conditions conducive to large or high severity fires like high tree biomass; and
- Fire return intervals less than the historical interval as often occur following annual grass invasion.

In our Great Basin ecosystems, inherent resilience typically increases with elevation due to higher levels of resources (water and nutrients) and greater productivity (Fig. 2). For example, higher elevation mountain big sagebrush systems have a greater capacity to recover following disturbance and compete with invaders than lower elevation Wyoming sagebrush systems. Resistance to widespread invasive species like cheatgrass often reflects their ability to establish and persist under a given set of environmental conditions (Fig. 2). Prior research shows that



**Figure 2. The relative resilience of typical Great Basin ecosystem types over an elevation/productivity gradient (solid line), and the resistance of those same ecosystem types to cheatgrass over that gradient (dashed line).**

cheatgrass is limited at lower elevations due to low soil water availability and at higher elevations due to cold soil temperatures. Wyoming sagebrush ecosystems are least resistant to cheatgrass invasion because of a combination of low resilience to disturbances like fire and low resistance to cheatgrass invasion.

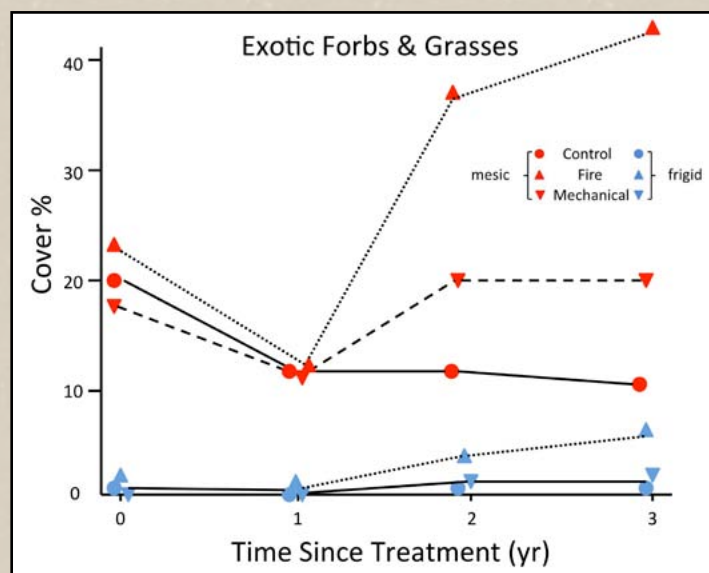
### What Recent Studies Tell Us about the Resilience and Resistance of Sagebrush Ecosystems

SageSTEP and other Joint Fire Science Projects (JFSP) provide insights into the resilience and resistance of sagebrush systems exhibiting pinyon-juniper encroachment. A prior JFSP study examined the response of different ecological site types exhibiting tree encroachment to prescribed fire over an elevation gradient that included Wyoming big sagebrush, mountain big sagebrush, and snowberry and mountain big sagebrush (Dhaemers and Chambers, in progress). On sites with similar tree cover, biomass of herbaceous perennial grasses and forbs, the primary determinants of recovery following fire, increased with elevation before and after burning. These results indicate that higher productivity over elevation gradients with increased water availability can result in greater resilience.

The SageSTEP project is evaluating the effects of soil water/temperature regimes and the stage of woodland development on resilience and resistance following removal of pinyon and juniper. Soil water/temperature regimes, which are both mapped and available in soil surveys, are closely associated with the thermal regime and water availability on the site (Fig. 1). In the Great Basin region, mesic and frigid

soils are related to elevation and reflect the dominant temperature regimes. Abundance of non-native annual cover (cheatgrass) was significantly greater on mesic than frigid soils, even with similar levels of deep-rooted perennial grass cover (Fig. 3) (Miller et al. in progress). Sagebrush recovery (cover and density) on burned plots was greater on the frigid soils in the first three years. Percentage of shrub and perennial grass cover decreased as tree cover increased. These results indicate that resilience to management treatments generally decreases as tree cover increases, but resistance to cheatgrass depends on soil temperature and the ecological site type.

A second JFSP study illustrated exactly how resistance to cheatgrass is affected by increases in elevation, fire and removal of native grasses and forbs (Chambers et al. 2007). Establishment of cheatgrass decreased over an elevation gradient that again included Wyoming big sagebrush, mountain big sagebrush, and mountain big sagebrush and snowberry. Although cheatgrass germinated at higher elevations, growth and reproduction were limited by frigid soils. Site characteristics and growing season conditions had greater effects on establishment of cheatgrass than fire or herbaceous species removal. In contrast, biomass and seed production were affected by both fire and removal. Removal alone resulted in a 2 to 3 fold increase in cheatgrass, fire alone a 2 to 6 fold increase, and the combination a 10 to 30 fold increase. Disturbances that increase resource availability by removing grasses and burning woody species have additive effects on cheatgrass growth and reproduction, but perennial herbaceous vegetation can greatly increase resistance. A SageSTEP study that was detailed in Issue 17 indicates that the gap size between perennial herbaceous species is a valuable indicator of the resistance of sagebrush ecosystems to cheatgrass (Pyke 2012).



**Figure 3. Percent cover of exotic forbs and grasses following prescribed fire, cut-and-leave, and control on mesic soils (red) and frigid soils (blue).**



**Figure 4.** A Frigid/xeric mountain big sagebrush/Idaho fescue-bluebunch wheatgrass site. Dominant species three years after fire include Idaho fescue, bluebunch wheatgrass, Thurber's needlegrass, Sandberg bluegrass and yarrow. Percent cover of non-native forbs and grasses was control: 1%, mechanical: 4%, and prescribed burn: 8%.

### Management Implications

A basic approach for managing and restoring these ecosystems using the concepts of resistance and resilience includes the following:

- Develop an understanding of the factors influencing ecological resistance and resilience for ecological site types at risk and of how these factors differ across the landscape.
- Assess the environmental characteristics and current ecological conditions of the ecological site types at landscape scales.
- Prioritize management activities and determine appropriate treatments based on relative resilience and resistance.

Additional information about this work can be viewed in the online versions of Jeanne Chambers', Rick



**Figure 5.** A mesic/xeric basin big sagebrush and bluegrass wheatgrass site. Dominant species three years after a cut and leave treatment include bluebunch wheatgrass, Sandberg bluegrass and cheatgrass. Percent cover of non-native forbs and grasses was control: 9%, mechanical: 14%, and prescribed burn 27%.

Miller's and Dave Pyke's presentations from the SageSTEP symposium at the SRM Annual meeting in February 2012: [www.sagestep.org/events/2012-SRM-symposium.html](http://www.sagestep.org/events/2012-SRM-symposium.html).

### References

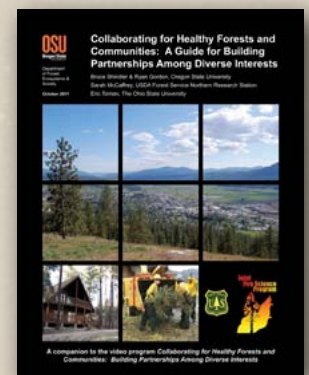
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- Dhaemers, J., and J.C. Chambers. *In progress*. Vegetation recovery following spring prescribed fire in piñon-juniper woodlands: Effects of elevation and tree cover.
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## New DVD and Guide Available for Land Managers: Collaborating for Healthy Forests and Communities

Forest and rangeland health, along with wildfire, currently dominate management decisions on public lands across much of the United States. Changing conditions on the ground, as well as government initiatives such as the National Fire Plan, the Healthy Forests Restoration Act, and the Cohesive Wildfire Management Strategy, are prompting agency personnel and the public to work together on management issues. The DVD *Collaborating for Healthy Forests and Communities: Building Partnerships Among Diverse Interests* showcases on-the-ground experiences of federal and state land managers, as well as community leaders, who are working together to overcome barriers, find common ground, and build partnerships.

An accompanying field guide provides more detail and a practical, stepwise approach that managers and community members can use to adapt the most useful tools and strategies to the needs of their own communities.

A link to the guide and an online version of the video can be found on the SageSTEP website at [www.sagestep.org/ed\\_resources.html](http://www.sagestep.org/ed_resources.html). Copies of these materials can also be obtained free of charge by contacting Bruce Shindler ([Bruce.Shindler@oregonstate.edu](mailto:Bruce.Shindler@oregonstate.edu)) in the Department of Forest Ecosystems & Society at Oregon State University.



# 2012 SageSTEP Field Days



In 2012, we will be holding two one-day field tours in partnership with the Great Basin Science Delivery Project and the Great Basin Chapter of the Society for Ecological Restoration. The tours will provide opportunities to visit both treated and untreated areas in sagebrush (ID & CA) and juniper woodlands (CA), including SageSTEP and other research plots. Our goal is to facilitate an environment in which researchers and land managers can share information about wildfire, cheatgrass invasion, woodland encroachment and the implications of management actions. We hope you will join us!

## **Woodlands, Sagebrush & Fuels Treatments Field Day May 30, 2012 7:30am–4:30pm Northeastern California**

We will visit the SageSTEP Blue Mountain study site, a western juniper site on Forest Service land where prescribed fire and cut-and-drop treatments were implemented in fall 2007. We also plan to visit other sites, including sagebrush and juniper, where fuels treatments have been implemented. This area is just a short drive from Tulelake or Alturas, California, and southern Oregon.

We will discuss the impacts of treatments on a variety of ecosystem components and also look at untreated areas. Rick Miller will demonstrate how to use the *Western Juniper Field Guide* to guide the decision-making process when planning management actions.

We will send additional information about a meeting spot to registered participants. This is a great opportunity to get out in the field and discuss important issues in land management so click on the link below for registration information.

## **Sagebrush & Fire Field Day June 7, 2012 7:30am–4:30pm Idaho Falls, Idaho**

We will meet at the BLM Upper Snake River Field Office from which we will travel to the SageSTEP Roberts study site as well as a University of Idaho sagebrush study site.

The Roberts site was treated with prescribed fire, sagebrush mowing and herbicide treatments in fall 2007. In July 2010, the Jefferson wildfire burned through the prescribed burn plot, mow plot, and part of the herbicide plot (but not the control). This gave us an unanticipated opportunity to learn more about the effects of fuels treatments on wildfire behavior and subsequent recovery.

Participants will include SageSTEP researchers working on the Roberts plots, BLM managers with range and fuels experience, and USGS ecologist Matt Germino, an expert in fire ecology and cheatgrass invasion. There will be plenty of time for questions and discussion so plan on attending!

**For more information about the field days and to register, visit <http://www.sagestep.org/events/2012-Field-Days.html>.**

# Upcoming Events

## **SageSTEP Webinar Series hosted by the Great Basin Science Delivery Project**

For more information and to register contact Genie Montblanc at [emb@cabnr.unr.edu](mailto:emb@cabnr.unr.edu).

- March: *Short-term vegetation responses to pinyon-juniper fuel control treatments: How does tree dominance at implementation affect understory responses?*, Dr. Bruce Roundy
- April: *SageSTEP Hydrology*, Dr. Fred Pierson and Jason Williams

## **Landscape Conservation Cooperative National Workshop: Defining conservation for the 21st century**

March 27-28, 2012

Denver, Colorado

<http://nationallcc2012.com>

## **17th Wildland Shrub Symposium: Humans in Changing Landscapes**

May 22-24, 2012

Las Cruces, New Mexico

<http://jornada.nmsu.edu/wildland-shrub-symposium>

## **SageSTEP 2012 Field Days**

<http://www.sagestep.org/events.html>

*Woodlands & Fuels Treatments Field Day*

May 30, 2012

Tulelake, California

*Sagebrush & Fire Field Day*

June 7, 2012

Idaho Falls, Idaho

## **Eastern Nevada Landscape Coalition Annual Meeting**

June 7-8, 2012

Ely, Nevada

<http://www.envlc.org>

## **SageSTEP is a collaborative effort among the following organizations:**

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

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For more information visit our website:

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