SageSTEP News
Sagebrush Steppe Treatment Evaluation Project
Issue 17, Winter 2012

Gaps Between Perennial Plants May Indicate Invasibility of Sagebrush Systems

Land managers throughout the Intermountain West are acutely aware of the growing problem of cheatgrass invasion into sagebrush rangelands. Both scientists and managers are searching for ways to combat this problem, and part of the solution is to understand how sites respond to disturbance (whether intended or unintended). SageSTEP researchers* are examining the influence of gap size between perennial plants as an indicator of a sagebrush system's resilience, or of a site's ability to recover from disturbance versus converting to cheatgrass. While we can never predict precisely how a particular site will respond, short-term results of this work indicate that gap size between perennial plants (Figure 1) and bare ground may provide an early warning indicator of invasion potential.

Fuel treatments being evaluated as part of this study include prescribed fire, mechanical thinning of sagebrush by mowing, and aerial application of the herbicide tebuthiuron (Spike 20P) to thin sagebrush. Additionally, imazapic (Plateau) pre-emergent herbicide was applied within fuels treatments to reduce cheatgrass. None of the sites were seeded.

* Dr. Dave Pyke (USGS), Dr. Gene Schupp (USU), Dr. Paul Doescher (OSU), Scott Shaff and Andrew Lindgren (USGS), Jeff Burnham (USU)

Figure 1. Wyoming big sagebrush with native perennial grass understory. The blue arrow indicates a gap between perennial plants, which could affect the site's ability to recover from disturbance versus converting to cheatgrass.

In this issue:

For questions, comments, or to subscribe to this newsletter contact summer.c.olsen@usu.edu.

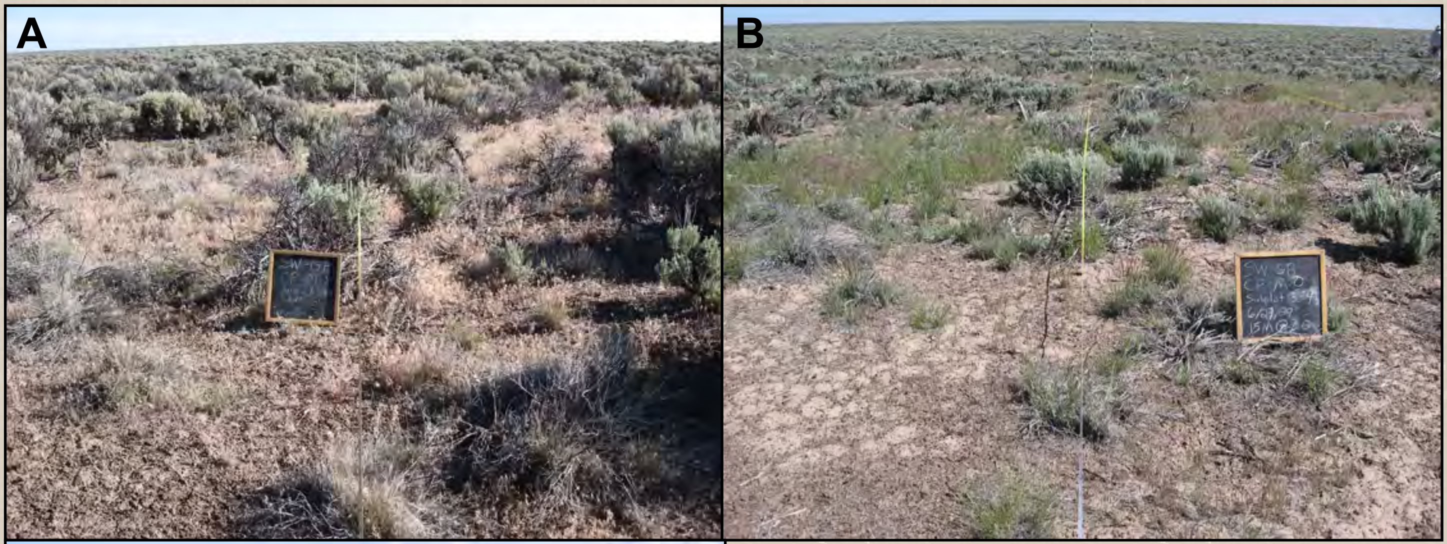
Sagebrush Steppe SageSTEP Treatment Evaluation Project
www.sagestep.org

Treatments were applied at seven sites in five states from 2006 to 2008. Vegetation and fuels data were collected prior to treatment and then for two consecutive years following treatment. Before treatment all seven sites were occupied by an overstory of Wyoming sagebrush with an understory consisting of varying levels of native perennial bunchgrasses, forbs, and cheatgrass. Results reported here include short-term (2-year) post-treatment effects (Table 1). We expect that as vegetation recovery continues over time many of these short-term effects will change, and we plan to continue collecting data at these sites on a less-frequent basis over time to more fully understand the long-term implications of these management actions.

Table 1. Short-term treatment results

Treatment	Decreases:	Increases:
Fire	Shrubs Perennial Grasses Mosses	Gap Size Bare Ground
Mow	Shrubs	Cheatgrass Perennial Grasses
Plateau	Cheatgrass Perennial Grasses Perennial Forbs Annual Forbs Number of Gaps	Bare Ground Gap Size

To help us understand what happened to vegetation and to gap size after the various treatments were implemented, we grouped individual species into functional groups to analyze trends occurring at SageSTEP sagebrush sites. Functional groups are groups of plant species that play a similar role in the



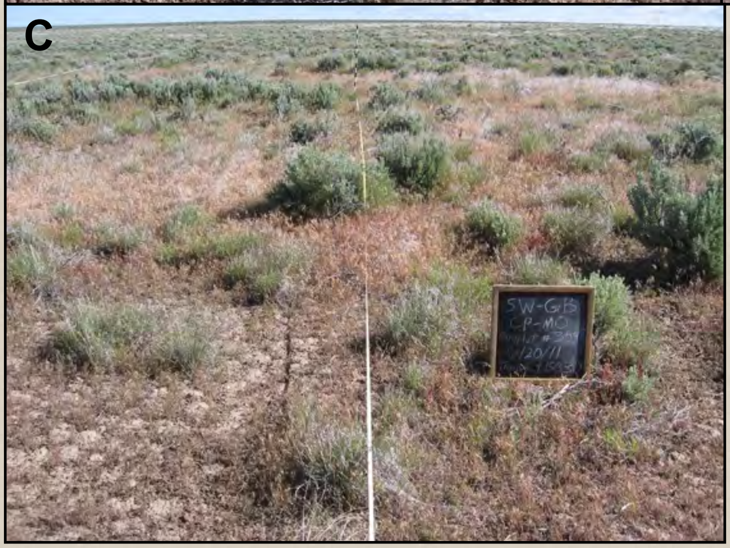


Figure 2. Sagebrush mow subplot at the Hart Mountain study site in southeastern Oregon (A) in 2007, prior to treatment; (B) in 2009, one year post-treatment; (C) in 2011, three years post-treatment. Notice cheatgrass establishing in cracks in the soil in lower left corner of image C. Disturbance from tractor may have broken up biological soil crust, which prior to treatment kept cheatgrass from establishing.

	A	B	C
Sagebrush	19%	7.7%	8.7%
Cheatgrass	13%	11%	57%
Perennial tall grass	10%	10%	15%
Perennial short grass	0%	0%	1%
Average gap	107 in. (272 cm)	153 in. (388 cm)	97 in. (246 cm)

ecosystem. The functional groups that have the most influence on gap size are shrubs, perennial tall and short grasses, and perennial forbs. The functional group of perennial tall grasses consists of relatively taller and deeper-rooted grasses, such as bluebunch wheatgrass, squirreltail, Thurber's needlegrass, and Idaho fescue. The perennial short grass functional group is a shallower rooted group, consisting mostly of Sandberg's bluegrass.

An increase in bare ground and gap size does not guarantee an increase in cheatgrass cover, but it opens an ecological niche that increases invasion potential...

Across the SageSTEP sagebrush sites, it was found that following the prescribed burn treatment, cover of perennial tall grasses was reduced the first year (7% to 4%), but they recovered quickly in the second year back to almost pre-treatment levels (6%). Prescribed fire also reduced shrub cover, as expected, as well as moss cover due to the fact that most moss resides under shrubs and burned along with the shrubs. The loss of cover in these functional groups due to prescribed fire has led to an increase in distances among perennial plants (gap size 79 in. to 109 in. [200 cm to 275 cm]).

Cheatgrass cover did not increase during the first year post-treatment in any treatment, but in the second year, when Plateau was not applied, cheatgrass levels increased in the mow (5% to 10%) and fire (3% to 5%) treatments. The fire and mow treatments reduced shrub cover by the same amount (20% to 5%). The larger increase in cheatgrass cover in the mow treatment is most likely due to the ground disturbance caused by the mower blades occasionally digging into the undulating ground, which gives cheatgrass safe sites for establishment. In the mow treatment perennial tall grass cover showed a slight increase (6% to 8%) during the second year post-treatment. It will be interesting to follow this trend to see if cheatgrass cover will continue to increase in the mow treatment in subsequent years. The tebuthiuron treatment had no effect on cheatgrass levels.

Plateau has been very effective at reducing cheatgrass levels from 7% to less than 1% cover during the first two years post-treatment, but it has some secondary effects that land managers should consider when planning an application. Plateau has a strong negative effect on species richness, perennial short grass (4% to 3% cover), perennial forbs (1.6% to 1.3% cover) and annual forbs (3% to 1% cover), some of which might be a food source for sage grouse. While these reductions seem minimal, combined they results in close to a 4% increase in bare ground, which causes an increase in average gap size from 67 in. (170 cm) to 91 in. (230 cm).

An increase in bare ground and gap size does not guarantee an increase in cheatgrass cover, but it opens an ecological niche that increases invasion potential, and the spatial structure of perennial plants has been shown to be strongly related to cheatgrass dominance. To reduce the risk of cheatgrass invasion, managers might consider maintaining the smallest gaps possible, and measuring gap size between perennial plants could be a great early warning indicator of invasion potential. Our preliminary results show that if disturbance is minimized or if Plateau is applied, an increase in cheatgrass cover could be avoided, at least in the short-term.

We look forward to continuing to monitor these plots and discovering how these relationships develop in the long-term. Dr. Gene Schupp will be presenting a webinar on this research, including time for questions, on January 25. For more information visit http://greatbasin.wr.usgs.gov/gbrmp/SD_webcast.aspx or email Génie Montblanc (emb@cabnr.unr.edu).

A Manager's Perspective:
Using Scientific Information to Improve Land Management Decisions

Land managers in the Intermountain West face many challenges, and yet are responsible for making important decisions on a regular basis that affect land health. These challenges include budget cuts, increased workloads, biological invasions, increased frequency and intensity of wildfires, uncertainty on how management actions will play out, diversity of stakeholder opinions, and more. So where does science fit into the picture? Scientists in the region, including those that are part of SageSTEP, are working hard to provide information that can reduce uncertainty, and thereby help with the planning and decision-making process on the ground. Managers must study and use this information, but must also work equally hard to balance the many demands on their time and efforts as public servants.

As part of our SageSTEP outreach program, we believe that it is essential to request feedback from our outreach audiences to improve both our science and our communication efforts. We recently conducted an interview with Brad Jessop, a Fire and Fuels Natural Resources Specialist at the BLM West Desert District Office, to get a manager's perspective on how research information is typically used by public land managers and how continued long-term monitoring of our study plots could be useful to managers. Our questions and his responses can be found below.

How do you view the role of science in your work as a public land manager?

Land managers have been manipulating vegetation to achieve various management objectives for a long time and have a pretty good feel for what to expect. However, due to limited budgets and time, monitoring often focuses primarily on whether management objectives were met rather than the ecological impacts of the treatment. Land management agencies simply aren't designed to focus on how the entire ecosystem responds to a treatment. This type of understanding comes from science and is a vital part of adaptive management. Results from scientific experiments not only validate what land managers already know about vegetation manipulation, they also provide a greater understanding of the processes that influence ecosystem recovery. This knowledge helps managers design better projects with a clearer understanding of the potential benefits and consequences of a particular treatment type. Thus science provides the basis for sound management decisions and support for the planning and NEPA process.

How can land managers use information provided by SageSTEP in project planning and decision-making?

Part of the NEPA process required by land management agencies entails identifying and analyzing potential impacts, either positive or negative, of a proposed action on a particular resource (e.g. soils, wildlife, vegetation). Because publications from SageSTEP come from experiments examining vegetation treatments commonly used by land managers throughout the Great Basin, they provide much needed data and references to support land managers in the NEPA and decision-making process. Additionally, publications such as the *Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* provide more accurate fuel load measures for Great Basin communities than other fuel photo series, which makes them more relevant in modeling predicted fire behavior for prescribed burning and assessing fuel loads before and after treatments.

The SageSTEP social science research has brought to light the public's general distrust of land managers and their ability to implement treatments successfully. Resulting information has helped us understand which treatment types are more acceptable to the people we serve and emphasizes the need for us to educate people and help them understand why we do what we do.

As a land manager you soon realize that it's impossible to please everybody, but having scientific data that support your decisions can increase support. I've found that there are a lot of people who simply don't understand what we as land managers do (E.g. How there could be any possible benefit to killing trees?). Some, due to their distrust of anything related to the federal government, or their single-focus agendas will never be pacified even with education. Others will come around if they can understand logically what we're trying to accomplish. I've seen skeptical individuals become receptive once they know that the management actions undertaken are backed by sound science.

Do you think any of your colleagues use SageSTEP information?

Many of my colleagues in BLM fuels, range and wildlife programs throughout Utah routinely read the SageSTEP newsletter. While attending a meeting to discuss ways to restore sagebrush habitat a member of our staff referenced an article in the previous SageSTEP newsletter about sagebrush longevity in seed banks. The newsletter has been a great means of disseminating information to managers in a format that's readily available and easily consumable. I have also given away quite a few copies of the *Piñon and Juniper Field Guide* to individuals in our office. It has been helpful for educating other BLM staff not involved with vegetation management about the problems relating to PJ encroachment and potential options for dealing with the issue.

Incorporating science into our planning not only improves the quality of management decisions but can also improve ecosystem health and aid in building public trust.

What can scientists and science communicators do to better meet your needs on the ground?

One of the things that makes SageSTEP unique is its focus on providing land managers with tools and information designed to assist in the decision-making process; to bridge the gap between science and land management. Still, there is some disconnect between land managers and the research community regarding the processes and limitations that each other work under. Land managers may not fully understand or appreciate the constraints of experimental design whereas researchers typically do not understand the time, effort, and budget commitment associated with planning and implementing treatments on public land.

Unfortunately for land managers, there are times when manipulation based research, no matter how relevant, becomes a burden due to constraints tied with funding or timing restrictions due to experimental design especially when the land management agency has not had sufficient time to incorporate the project into their annual workload. Participating in field tours and having regular research updates has been a valuable means of cross-pollination between land managers and researchers. This one-on-one interaction provides opportunities to form unified partnerships and build trust between entities that unfortunately sometimes view each other with a cynical eye. Understanding the constraints land managers operate under is one of the keys for scientists to better meet our needs on the ground. There has been considerable outreach from SageSTEP and others in recent years to make science more available to land managers. Websites, webinars, newsletters, and the development of partnerships that join managers and scientists as collaborators on the big issues have also helped bridge the gap.

Looking toward the future, how important is long-term monitoring information from SageSTEP plots?

One of the downfalls of both science and monitoring done by land managers is the lack of long-term data following vegetation treatments. It's relatively easy to measure the short-term results of a treatment, but we don't know what's going to happen 10 or 20 years down the road. Are there unintended consequences of the management actions we're currently implementing that will manifest themselves over time? If so, then how will we detect and quantify these changes without long-term studies? Looking to the future we know that fuel loading will continue to increase leading to ecosystem degradation and creating potentially extreme fire conditions. Managers will continue to implement treatments in response to these factors based on their experience and the best science available. The way in which the SageSTEP network was designed will enable it to systematically gather and process long-term data in a way that no other project could. The data collected will be extremely important to both scientists and land managers within the Great Basin who are attempting to understand the impacts of management actions and how ecosystems respond to disturbance.

What advice would you give to other managers on incorporating science into their decisions?

Make the effort to do it. As land managers we operate under the premise of adaptive management. Whereas our own monitoring is mostly driven by whether or not our treatment objectives were met, science and research can enable greater understanding of ecological benefits and consequences to actions we routinely implement. As knowledge increases, changes can be made to improve and refine project design, and confidence in management decisions increases. Incorporating science into our planning not only improves the quality of management decisions but can also improve ecosystem health and aid in building public trust.

Bird communities as indicators of change at SageSTEP woodland sites

Steve Knick[1], Steve Hanser[1], and Matthias Leu[2]

[1]US Geological Survey, Forest and Rangeland Ecosystem Science Center, Snake River Field Station, Boise, ID 83706
[2]Biology Department, College of William and Mary, Williamsburg, VA 23185

Land management treatments often are conducted to create suitable habitat for wildlife. Many of the current treatments to restore sagebrush communities are being driven primarily by the need to provide habitat for greater sage-grouse. Sage-grouse are the poster child for sagebrush ecosystems because their population declines have made them a candidate for listing as an endangered species due to habitat loss. In what has been called the "great squeeze", woodlands are encroaching into sagebrush from higher elevations, and cheatgrass is invading from lower elevations. Both of these changes in vegetation structure and composition create unsuitable habitat for sage-grouse as well as many other bird and wildlife species that depend on sagebrush for nesting, foraging, or cover.

Figure 1. We survey the bird community at each site in the juniper woodland network during the spring and early summer by counting all birds seen or heard at specific points spaced throughout treatment and control areas.

The objectives of the SageSTEP wildlife research are to determine how bird communities respond to large-scale treatments designed to remove juniper and pinyon woodlands and restore sagebrush habitat. Ideally, we would have studied the response of sage-grouse because of their public prominence and significance to treatment objectives, but sage-grouse have a number of life-history characteristics that make it challenging to measure responses to our treatments. First, sage-grouse have very large home ranges. Treatments studied as part of the SageSTEP research are large from a management perspective (1,000 acres), but are very small compared to sage-grouse home ranges that can vary from 150,000 to 600,000 acres. Any change in vegetation—especially at the fringe of habitats that sage-grouse rarely use—will not create a measurable response in increased use of treated areas or in movement patterns. Second, sage-grouse are quick to abandon areas that have been disturbed but often are slow to recolonize areas that have been restored. For example, sage-grouse in Oregon did not use burned areas until 30 years after disturbance or longer, even though sagebrush had recovered to pre-burn levels much earlier. At SageSTEP study sites we have

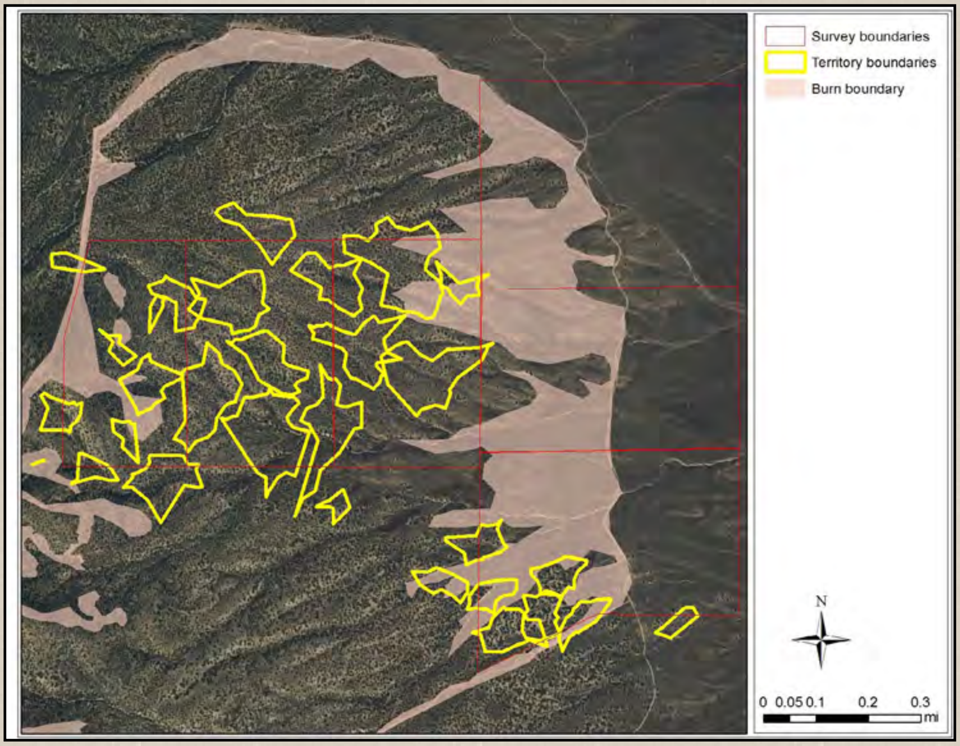


Fig. 2. Outlines of territories for gray flycatchers at the Onaqui study site. Territory boundaries are delineated by mapping the movement locations of individual males.

collected data over a longer period than most studies, but it still is too short from a sage-grouse perspective. Finally, sage-grouse have a relatively low reproductive rate so any increases in population size would be difficult to detect with any statistical precision. We likely would see little response had we focused on sage-grouse even though treatments could benefit this species. In six years, we have had only a few sightings of sage-grouse. One female sage-grouse possibly nested on the Castlehead study site, and several males and females were seen and a nest was found at the Onaqui site—certainly not enough information to draw any conclusions about the effect of management treatments.

Fig. 3. Brewer's sparrow young (photo by Erin Strasser).

We instead have focused on the smaller birds at each of the 14 sites in the juniper-woodland network of SageSTEP project. We have detected 144 different bird species by conducting point counts each spring at these sites (Fig. 1). Of these, between 15 and 30 species at each site have sufficient numbers to reliably relate changes in numbers to treatment effects.

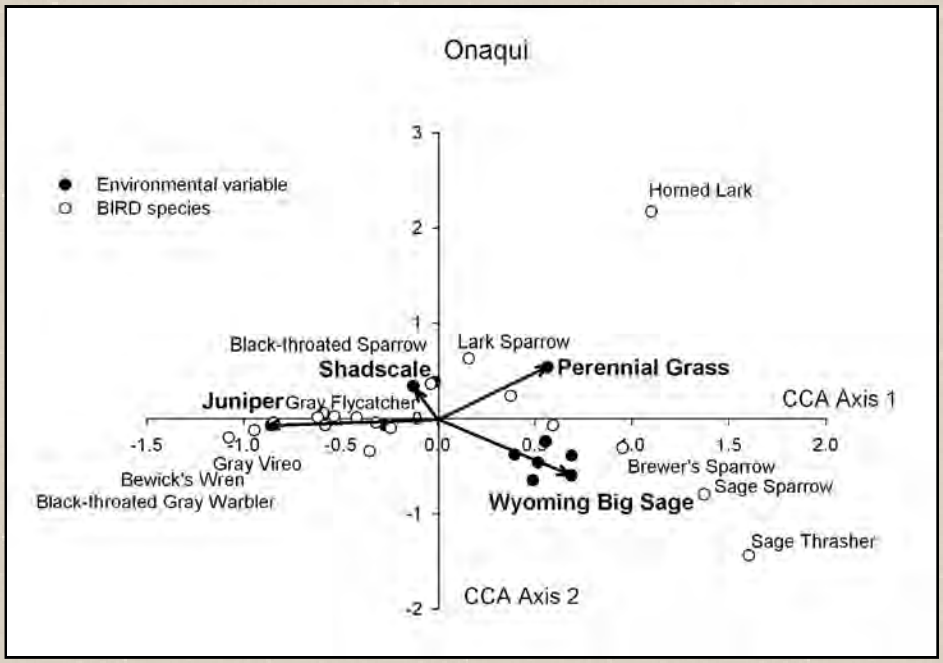


Fig. 4. We used an ordination technique (CCA) to arrange species in the bird community along the primary habitat gradients. Arrows pointing to plant species or group (bold) indicate the direction or axis of the habitat gradient. The length of the arrow provides information on the relative importance of the gradient in structuring the bird community.

We estimate that densities of all bird species combined range from 1 to almost 2 birds per acre on individual study sites. These birds generally have small home ranges (<3 acres) so many individuals are affected within the treatment areas. We have mapped between 23 and 42 individual home ranges for gray flycatchers and between 19 and 37 ranges for sage sparrows in the treatment area in each year at the Onaqui study location in Utah (Fig. 2). These species also have relatively high reproductive rates and often raise more than 1 brood each season. We have monitored between 14 and 25 nests for Brewer's sparrows each year on the Onaqui study site (Fig. 3) in addition to nests found for other species. Therefore, we have the sample sizes for number of birds and measures of productivity to conduct the statistical analyses of treatment effects, at least on the more common species.

The bird communities at our study sites are comprised of species that are obligates to sagebrush steppe, species that use the ecotone or transition zone between sagebrush and woodlands, and species that are associated with woodland-dominated habitats (Fig. 4). Each of these species has a different set of habitat requirements and should be affected differently by management treatments. By studying the entire community instead of focusing on a single species, we are able to measure the response not only from species that potentially benefit from treatments, but also those that will lose their primary habitats. That range of information will provide managers a more complete understanding of the ecology of birds living in these transition zones and the effects of their treatments.

Stay tuned for the next issue of our newsletter, which will include an article describing the short-term effects of treatments on the bird species we've observed in our study.

Disturbance, Resilience and Thresholds in Sagebrush Ecosystems

SageSTEP Symposium at SRM Annual Meeting

SageSTEP will host a symposium at the Society for Range Management 65th Annual Meeting on February 2, 2012 in Spokane, Washington. A central component of the SageSTEP research has been to identify conditions under which sagebrush steppe ecological communities recover on their own following treatment versus those crossing ecological thresholds that will need expensive active restoration. Several features of SageSTEP have made it ideal for testing hypotheses from state-and-transition and resilience theory: it is long-term, experimental, multi-site, and multivariate, and treatments are applied across condition gradients, allowing for potential identification of biotic thresholds. In this symposium we will offer a series of presentations describing how our research results over the past six years can inform the development of management considerations and principles for sagebrush rangelands in an era of accelerating global change.

SageSTEP Symposium, February 2, 2012, 8am-noon

Introduction, James McIver, Ecologist and SageSTEP Project Coordinator, OSU

Understanding the importance of resilience and resistance to restoration of sagebrush rangelands, Jeanne Chambers, Plant Ecologist, USDA Forest Service

Human behavior as a factor in ecosystem resilience, Mark Brunson, Social Scientist, USU

Soil moisture-temperature regimes: Influence on ecological resilience, resistance, and site response following piñon-juniper removal, Rick Miller, Plant Community Ecologist, OSU

Resistance and resilience of bird communities to pinyon-juniper removal by prescribed fire, Steve Hanser, Wildlife Biologist, USGS

Discussion: Resilience as an ecological concept: Do our results reflect the experience of other professionals?

Effects of fuel treatment disturbances on soil water availability and potential resilience and resistance to weed invasion of sagebrush communities, Bruce Roundy, Plant Ecologist, BYU

Assessing Resilience: What is the potential for a state change and how might we assess it? Dave Pyke, Plant Ecologist, USGS

Bunchgrass community structure as a factor influencing resilience of sagebrush steppe ecosystems, Michael Reisner, University of Wisconsin-Stevens Point

Hydrologic response of sagebrush steppe to woodland encroachment and subsequent tree removal: implications for assessing sagebrush steppe hydrologic stability and resiliency, Fred Pierson, Research Hydrologist, USDA-ARS

SageSTEP as an integrative study of resilience and thresholds: Challenges, application, and next steps, James McIver, Ecologist and SageSTEP Project Coordinator, OSU

For more information about the meeting and to register, visit http://www.rangelands.org/spokane2012/.

Upcoming Events

Do Wyoming big sagebrush communities respond similarly to fuel reduction treatments across the northern Great Basin?
Dr. Gene Schupp
January 25, 2012, 11:30am-12:30pm PST
emb@cabnr.unr.edu

Society for Range Management 65th Annual Meeting: Lessons from the Past, Strategies for the Future
January 29-February 3, 2012
Spokane, Washington
http://www.rangelands.org/spokane2012/

Great Basin Native Plant Selection and Increase Project Annual Meeting
February 21-22, 2012
Salt Lake City, Utah
http://www.fs.fed.us/rm/boise/research/shrub/greatbasin.shtml

SageSTEP 2012 Field Days
May 2012
Oregon and Nevada
More information coming in early 2012!
http://www.sagestep.org/events.html

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

Funded by:

For more information visit our website:
www.sagestep.org

Thanks to everyone who contributed to this issue of SageSTEP News: Mark Brunson, Steve Hanser, April Hulet, Brad Jessop, Steve Knick, Jim McIver, Summer Olsen, Dave Pyke, Scott Shaff