RESTORING THE WEST 2007

Sagebrush Steppe Restoration

September 18-20, 2007
Utah State University
Logan, Utah

Utah State University

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Conference Co-chair
USU Forestry Extension and Department of Wildland Resources

Ron Ryel
Conference Co-chair
USU Department of Wildland Resources

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Conference Co-chair
USGS Utah Cooperative Fish and Wildlife Research Unit

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Agenda

Tuesday, September 18 - Oral Presentations, USU Eccles Conference Center	
7:30 to 8:30 am	Registration; continental breakfast (provided).
General Session ***Eccles Conference Center Auditorium***	
8:30 to 8:40 am	*Welcome*. **Dr. Mike Kuhns**, **Dr. Tom Edwards**, Professors, and **Dr. Ron Ryel**, Associate Professor, USU Department of Wildland Resources
8:40 to 9:30 am	*Sagebrush Steppe Restoration from an Ecological Perspective: What is Success and How Will We Know It?* **Dr. Steve Knick**, Research Ecologist, USGS Forest and Rangeland Ecosystem Science Center, Boise, Idaho
9:30 to 10:20 am	*Sagebrush Steppe Restoration from a Social Science Perspective.* **Dr. Mark Brunson**, Professor, USU Department of Environment and Society
10:20 to 10:40 am	**Break**
10:40 to 11:20 am	*Monitoring Restoration Effectiveness.* **Dr. David Pyke**, Plant Ecologist, USGS Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon
11:20 to 12:00 pm	*Dealing with Sagebrush Steppe Restoration's Long-term Consequences.* **Wendell Gilgert**, Acting National Wildlife Biologist, Natural Resources Conservation Service, Portland, Oregon
Noon to 1:00 pm	**Lunch (provided)**
Concurrent Session: Sagebrush Steppe Restoration and Wildlife ***(Eccles Conference Center Auditorium)***	
1:00 to 1:30 pm	*Sagebrush Steppe Restoration and Sage Grouse*. **Dr. Cameron Aldridge**, Research Scientist, Colorado State University - NREL & USGS, Fort Collins, Colorado
1:30 to 2:00 pm	*Sagebrush Steppe Restoration and Obligate Passerines.* **Dr. Steve Knick**, Research Ecologist, USGS Forest and Rangeland Ecosystem Science Center, Boise, Idaho
2:00 to 2:30 pm	*Sagebrush Steppe Restoration and Pygmy Rabbits.* **Dr. Janet Rachlow**, Assistant Professor, Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho
2:30 to 3:00 pm	*Sagebrush Steppe Restoration and Wild Ungulates.* **Dr. Michael Wolfe**, Professor, USU Department of Wildland Resources and **Rick Danvir**, Deseret Land & Livestock, Woodruff, UT
Concurrent Session: Sagebrush Steppe Restoration Ecology **(*Eccles Conference Center Rooms 205-207*)**	
1:00 to 1:30 pm	*Sagebrush Steppe Ecological Site Classification.* **Dr. Doug Ramsey**, Professor, USU Department of Wildland Resources
1:30 to 2:00 pm	*Sagebrush Steppe Restoration and Cheatgrass*. **Dr. David Pyke**, Plant Ecologist, USGS Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon
2:00 to 2:30 pm	*Sagebrush Steppe Restoration and Assisted Succession.* **Dr. Val Anderson**, Professor, Plant & Wildlife Sciences Department, Brigham Young University, Provo, Utah

Agenda, continued

2:30 to 3:00 pm	*Spatial Land Use Modeling for Sagebrush Shrubland Restoration.* **Dr. Louis Provencher**, Director of Conservation Ecology, The Nature Conservancy, Reno, Nevada
3:00 to 3:30 pm	**Break**
Concurrent Session: Sagebrush Steppe Restoration Techniques ***(Eccles Conference Center Auditorium)***	
3:30 to 4:00 pm	*Sagebrush Steppe Restoration Situations and Techniques.* **Dr. Bruce Roundy**, Professor, Plant & Wildlife Sciences Department, Brigham Young University, Provo, Utah
4:00 to 4:30 pm	*Plant Materials for Sagebrush Steppe Restoration*. **Dr. Tom Jones**, Research Geneticist, USDA Agricultural Research Service Forest and Range Research Lab, Logan, Utah
4:30 to 5:00 pm	*Using Grazing in Sagebrush Steppe Restoration*. **Ryan Woodland**, Lands Resource Specialist, Idaho Department of Lands, Idaho Falls, Idaho
Concurrent Session: Sagebrush Steppe Restoration and Society ***(Eccles Conference Center Rooms 205-207)***	
3:30 to 4:00 pm	*Community-Based Conservation and Sagebrush Steppe Restoration: Utah's Local Working Groups Take Action.* **Dr. Terry Messmer,** Professor, Jack H. Berryman Institute, USU Department of Wildland Resources
4:00 to 4:30 pm	*Why Think About Economics When Restoring the Sagebrush Steppe?* **Dr. John Tanaka**, Associate Professor, Oregon State University, Union, Oregon
4:30 to 5:00 pm	*Sagebrush Steppe Restoration at Deseret Land & Livestock: Maintaining Sagebrush Steppe While Watching the Bottom Line.* **Rick Danvir,** Deseret Land & Livestock, Woodruff, Utah
Poster Session	
5:30 to 7:30 pm	Poster session and reception (food and soft drinks provided; cash bar): Cafe Sabor at 600 West Center St. in Logan (the old train station)
Wednesday, September 19 - Sagebrush Steppe Restoration Field Trip *This will be a walking field tour. We will be traveling through sagebrush treatments over rough, uneven ground for distances of up to a mile at some stops. Please come prepared with sturdy footwear, sun protection, raingear if necessary, and a reusable water bottle.*	
8:00 am	Busses arrive in Logan at the Northwest corner of Romney Stadium, USU Campus (off 800 East between 1000 North and 1400 North)
8:15 am	Short presentation and handout on sagebrush identification: **Leila Shultz** (USU Botanist)
8:25 am	Load busses
8:30 am	Depart Logan and go up Logan Canyon past Bear Lake to Duck Creek

10:30 am	***Duck Creek*** The private land around Duck Creek has had extensive sagebrush treatments with pasture aerators over the last several years, and the USU/UDWR ShrubMAP program has studied this area extensively. We will learn from the experience of managers, researchers, and ranchers who work in and own these properties, including: **Reed Groll**, landowner **Norm Weston**, CRM Chair, Rich County Commisioner, Rancher **Frank Howe**, Utah Division of Wildlife Resources **Danny Summers,** Utah Division of Wildlife Resources **Russ Norvell, Tammy Wilson, Roger Stringham, Craig Faulhaber, Julie Ripplinger,** and **Kate Peterson,** ShrubMap Program Graduate Students
Noon	Load busses and continue through Rabbit Springs, where we will view older sagebrush treatments that were disk and seeded with crested wheatgrass and examine the differences of the various treatment approaches
12:15 pm	**Rick Danvir,** Wildlife Biologist, Deseret Land and Livestock will speak about sagebrush restoration, looking at the non-example. Continue down South Eden Canyon to the east side of Bear Lake to lunch
1:00 pm	Outdoor dutch-oven lunch at ***Rendezvous Beach State Park***
2:00 pm	Short presentations by mountain man impressionist **Bryce Nelson** and Park Ranger **Brian House** on Bear Lake Natural History
2:30 pm	Load busses, return to Logan Canyon
3:00 pm	***The Sinks*** Busses drop us off at the Sinks Road turn-off, and pick us up one mile down the road at the Winter Recreation Parking Lot (with the USFS outhouse). The group is to walk this distance on a rough road through the treatment, stopping at a sink in the middle to gather and hear presentations by USDA Forest Service managers: **Janet Valle,** Logan District Ranger **Ann Robins,** Logan District Range Conservationist (fire pending) **Kreig Rasmussen,** Fish Lake National Forest, Richfield District Wildlife Biologist (invited)
4:00 pm	Load busses and return to Logan
5:00 pm	Back in Logan, meeting adjourned
Thursday, September 20: Optional Workshop ***Eccles Conference Center Rooms 303-305*** **(must be pre-registered)**	
8:00 am to noon	Restoration Monitoring Workshop (break provided)

Speaker Abstracts

In order of presentation,
presenting author in italics

Sagebrush Steppe Restoration from an Ecological Perspective: What Is Success and How Will We Know It?

Steven T. Knick, USGS Forest and Rangeland Ecosystem Science Center, Boise, ID

The decision by the U.S. Fish and Wildlife Service that Greater Sage-Grouse (*Centrocercus urophasianus*) did not warrant protection under the Endangered Species Act was greeted as a success by many individuals, groups, and agencies. The increased attention to sage-grouse as a result of the listing process highlighted the need for habitat restoration. Consequently, local, state, and national working groups developed management plans to improve sagebrush habitats. Subsequent opportunities, such as the National Healthy Lands Initiative, also are being developed to manage, restore, and conserve landscapes. The primary objective of these actions is ecological success. The Western Association of Fish and Wildlife Agencies Comprehensive Conservation Strategy states that their objective for success is to "maintain and enhance populations and distribution of sage-grouse by protecting and improving sagebrush habitats and ecosystems that sustain these populations." This deceptively simple definition masks a complex restoration challenge because most regions of the sagebrush biome have lost important components, have been invaded by new species, and have altered disturbance regimes.

How can we focus this activity into actions that restore sagebrush habitats? The ecological organization of sagebrush systems parallels management hierarchies. In sagebrush systems, individual sites interact with adjacent communities that together form components within a landscape. Landscapes then interact as part of a larger regional matrix. For sage-grouse, each of these components and levels are important. Similarly, we must address all levels if restoration is to be fully successful. At national levels, prioritizing efforts across regions could maximize limited resources. Within regions, coordinated site-specific actions conducted by local groups could avoid a checkerboard of unrelated efforts. The combined result of restoring individual sites ultimately will create functioning sagebrush landscapes. By focusing on each level in an integrated approach, we can restore sagebrush systems that maintain and enhance greater sage-grouse populations. We can achieve ecological success.

Steven T. Knick, USGS Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID 83706, Phone: 208-426-5208, Fax: 208-426-5210, E-mail: steve_knick@usgs.gov

Sagebrush Steppe Restoration from a Social Science Perspective

Mark Brunson**,** Utah State University, Logan, UT

Most of the West's sagebrush steppe ecosystems lie on public lands, where citizens have a right and ability to influence the course of land management activities. Therefore it is important to understand how citizens view restoration activities, as a general approach to management and also with respect to specific practices such as prescribed fire, grazing, mechanical treatments or herbicide application. I will review results of recent studies by myself and colleagues on this topic that explored attitudes and beliefs of the general public and members of important stakeholder groups. Our findings suggest that citizens are somewhat aware of problems facing the

sagebrush biome although they may not realize the degree of threat, and they have a generally positive outlook toward restoration. However, they are wary of some treatment approaches more than others, and they are skeptical about the ability of federal agencies to successfully implement restoration treatments.

Mark Brunson, Department of Environment and Society, Utah State University, 5215 Old Main Hill, Logan, UT, 84322-5215, Phone: 435-797-2458, Fax: 435-797-4048, E-mail: Mark.Brunson@usu.edu

Monitoring Restoration Effectiveness

David A. Pyke**,** USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR

Restoration in a simple sense is an attempt to adjust an ecosystem's structural and functional trajectory so it approximates as closely as possible its historical structure and function recognizing the current natural foundations found at the site, the current climate and soils. We often judge the need for restoration of an ecosystem by comparing the deviation of current abiotic and biotic factors to our knowledge of the range of variation in these factors for the climate and soils that once existed on that site. These initial evaluations provide us with an approximation of the objectives we need to set for success. Since most semiarid ecosystems may require decades to begin to reflect their former structure and function, we should set both short-term and long-term objectives for restoration projects. Short-term objectives should define the initial success for establishment of structural components and for the reduction in undesirable conditions. Long-term objectives may describe structural and functional conditions that approximate the desired conditions for the abiotic and biotic components needing to be restored. These objectives should be realistic and quantitative. Restoration projects should be prescribed to meet the conditions of the soils and microclimate of the site, thus monitoring should be stratified to meet those prescriptions. Monitoring techniques should be quantitative, cost effective and should provide data to address the objective. Control locations within the restoration project should be left untreated to determine if the restoration was truly needed and to determine the advantage that restoration projects provide in moving an ecosystem at least towards an objective even if it does not achieve the original objective. Restoration practitioners are encouraged to share their monitoring data by storing it in an archival data warehouse where their results could be queried and retrieved by future practitioners interested in techniques that have worked on similar sites.

David A. Pyke, USGS Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR, 97331, Phone: 541-750-7334, E-mail: david_a_pyke@usgs.gov

Sage Steppe Restoration: Reconciling Perspectives

Wendell Gilgert, USDA-NRCS-West National Technical Service Center, Portland, OR

The impacts of fragmentation, energy development, invasive plant species, agricultural development, exurban development, wild fires, and climate change are rapidly changing the face of the sage/steppe landscape. The proliferation of these and other environmental stressors have presented those who live and use the sage/steppe regions of the Intermountain West with increasing challenges related to managing, restoring, and in some cases, preserving these lands.

The lack of a unified vision for use of the sage/steppe biome further complicates management, restoration, and preservation decisions and actions. Some of the same age-old dichotomies that exist along the spectrum of preservation to exploitation for old growth forests, riparian woodlands, prairie grasslands and freshwater wetlands, also exist for the sage steppe biome. Further complicating decision-making related to management, restoration, or preservation of the sage steppe landscape is that there is no existing template to manage, restore,

or preserve the sage/steppe landscape in a sustainable manner. Where an older sagebrush community may be decadent, and thus in the eyes of some, unproductive, it may be viewed as essential habitat by others. How and when can divergent points of view be reconciled, if ever? An examination of traditional, existing, and evolving tools that offer promise for a more objective, and perhaps, less divisive framework for making informed decisions will be presented.

Wendell Gilgert, USDA-NRCS-WNTSC, 1201 NE Lloyd Blvd, Suite 1000, Portland, OR, 97232, Phone: 503-273-2426, Fax: 503-273-2401, E-mail:wendell.gilgert@por.usda.gov

Sagebrush Steppe Restoration and Sage-Grouse

Cameron L. Aldridge, Colorado State University & U.S. Geological Survey, Fort Collins, CO

Range wide, Greater Sage-Grouse (*Centrocercus urophasianus*) currently occupy only 56% of their historic pre-settlement range, and all monitored populations have experienced declines ranging from 15-90%. Remaining sagebrush habitats continue to be degraded and fragmented by conversion to agriculture, invasion by exotic plants, disturbances from energy exploration activities, intensive livestock utilization, fire, and climate change. A large body of research has focused on local-scale needs and habitat requirements, which are to some extent, well understood. However, effects of habitat quality and condition at a landscape-scale are poorly understood. I will briefly summarize the state of knowledge regarding sage-grouse habitat needs at the local scale, but focus primarily on landscape scale issues. Sage-grouse are a landscape-scale species, and current research suggests the species will require large tracts of contiguous and high quality habitats if populations are likely to be viable in the near future. While we must consider restoring sagebrush habitats for sage-grouse and other species, our first priority should be to maintain habitats that currently support populations.

Cameron L. Aldridge, NREL, Colorado State University & U.S. Geological Survey, 2150 Centre Avenue, Building C, Fort Collins, CO, 80526-8118, Phone: 970-226-9433, Fax: 970-226-9298, E-mail: cameron_aldridge@usgs.gov

Sagebrush Steppe Restoration and Shrubland Obligate Birds

Steven T. Knick and Steven E. Hanser, USGS Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID

Declining numbers of Greater Sage-Grouse (*Centrocercus urophasianus*) have focused management and conservation actions on restoring sagebrush habitats to maintain or enhance populations and their distribution. In addition to sage-grouse, other species of small passerine birds also depend on sagebrush and have been affected by the widespread loss and alteration of habitat. Brewer's Sparrows (*Spizella brewerii*) have declined at an annual rate of >3%/year across their range. Sage Sparrows (*Amphispiza belli*) and Sage Thrashers (*Oreoscoptes montanus*) have experienced local population declines and are considered species of conservation concern in all states within their range. As a group, birds living in grass- and shrublands are declining faster than species in other habitats. Reversing these downward trajectories will be difficult because of the complexity of processes in shrubland ecosystems, time-lags in bird responses, and the magnitude and variety of stressors across large areas. In addition, the benefit to the suite of other bird species from restoring habitats based on requirements for sage-grouse remains unknown. For small passerines, the composition of sagebrush habitats and their arrangement in the landscape are important factors when selecting a breeding range. Different habitat requirements among species allow the wide variety of habitats across the sagebrush biome to be fully occupied. At larger spatial scales, sage-grouse use numerous habitat configurations within their home ranges. Consequently, the variety of habitats included under the sage-grouse umbrella potentially spans a large portion

of the total gradient used by the smaller shrubland passerines. Although a single-species focus on sage-grouse might benefit the suite of other obligates, the full range of habitat variation is important in restoring sagebrush communities. If management focuses on only a narrow set of prescribed parameters to optimize sage-grouse populations, the umbrella contracts and benefits to other species are reduced.

Steven T. Knick, USGS Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID, 83706, Phone: 208-426-5208, FAX: 208-426-5210, E-mail: steve_knick@usgs.gov

Sagebrush Steppe Restoration and Pygmy Rabbits

Janet Rachlow, University of Idaho, Moscow, ID

Pygmy rabbits have been described as mammalian sagebrush specialists because sagebrush is their primary source of both food and cover. Although historic data are not available, there has been widespread concern that the species has declined with loss and alteration of sagebrush habitats. A disjunct population in Washington is listed as a federally endangered distinct population segment, and captive breeding is underway to conserve that population, known as the Columbia Basin pygmy rabbit. A petition for threatened or endangered status for the species across the range was denied in 2005, in part due to a lack of information about the status of the species. These events spurred interest in the species and renewed efforts to better understand its ecology and current distribution. Studies of habitat selection and use have focused on the two features thought to be most important for this species, shrubs and soils. Several studies have documented characteristics of sagebrush associated with presence of pygmy rabbits. In general, the rabbits occupy the tallest and densest sagebrush present in an area, although height and cover of shrubs vary markedly among occupied areas. Pygmy rabbits construct burrow systems that are used throughout the year, and hence, deeper soils with compositions that support burrow structures also are believed to influence the distribution of the species. Because taller sagebrush often is associated with deeper soils, an understanding of the relative importance of these two variables is incomplete. Our research suggests that vegetation cover and density of burrow systems influence patterns of movement, and that pygmy rabbit use relatively large areas and are capable of long-distance dispersal. Several questions remain regarding how pygmy rabbits relate to their habitat and consequently, how they might respond to sagebrush steppe restoration. On-going efforts to reintroduce the Columbia Basin pygmy rabbit provide examples of challenges for translocation that might follow sagebrush restoration efforts.

Janet Rachlow, University of Idaho, Department of Fish and Wildlife Resources, College of Natural Resources, Moscow, ID, 83844, Phone: 208-885-9328, Fax: 208-885-9080, E-mail: jrachlow@uidaho.edu

Sagebrush Steppe Restoration and Wild Ungulates

Michael L. Wolfe, Utah State University, Logan, UT and ***Rick Danvir***, Deseret Land and Livestock, Woodruff, UT

Sagebrush (*Artemisia* spp.) steppe communities provide in varying degrees winter or summer habitat principally for elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*). Habitat functions include forage and to a lesser degree security cover (especially for fawns of the latter species). The relative value of these habitats depends upon the plant species composition of the communities (shrub vs. herbaceous components), food preferences of the ungulates using them and, in the case of winter range, stature of the sagebrush in relation to snow depth. Although sagebrush may not be the most preferred browse species, it assumes particular importance under severe winter conditions, when snow may cover other more palatable species. Palatability of sagebrush varies among species and subspecies as well as by ecotypes and the maturity of individual plants. Historically, sagebrush treatments focused on large-scale removal and conversion to

grasslands. More progressive contemporary treatments are oriented toward emulation of natural disturbances and/or restoration of functionality in sagebrush steppe communities and are of greater potential benefit to big game animals. These typically involve a spectrum of procedures to reduce the canopy cover of decadent or over-mature sagebrush stands and encourage the diversity and growth of herbaceous understory vegetation frequently supplemented with planting of additional species. The projected benefits for big game animals of sagebrush restoration efforts are improved quantity, diversity and nutritional quality of forage and putatively elevated nutritional plane and fitness of the animals in question, presumably with population responses of greater fecundity and survival rates and possibly numbers. As with other species of vegetation conversion programs sagebrush restoration projects often demonstrate increased levels of utilization of treated areas and in some cases improved palatability and nutrient levels of the vegetation. Moreover, there exists considerable empirical evidence linking ungulate body condition with reproductive performance and possibly survival rates. However, actual benefits likely vary with scale and method of treatment as well as post-treatment management. Thus, while the expectation of positive population level responses is rational, empirical documentation of such responses is limited, largely due to the logistical problems of measuring body condition and demographic parameters on a meso- or management unit scale. In some instances the confounding influences of environmental variables such as drought and severe winter conditions may obscure treatment benefits. Some case histories of successful programs and strategies to maximize potential benefits for the three ungulates are discussed.

Michael L. Wolfe, Department of Wildland Resources, Utah State University, 5230 Old Main Hill, Logan, UT, 84322-5230, Phone: 435-797-2533, E-mail: michael.wolfe@usu.edu; Rick Danvir, Deseret Land & Livestock, P.O. Box 250, Woodruff, Utah, 84086, Phone: 435-793-4161, Fax: 435-793-4280, E-mail: rdanvir@fmc-slc.com

Sagebrush Steppe Ecological Site Classification

R. Douglas Ramsey, Katherine Peterson, Alexander Hernandez, Neil E. West, Lisa Stoner, John Lowry, and Samuel Rivera, Utah State University, Logan UT

An Ecological Site is a distinctive kind of land, with specific physical characteristics, which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management. Ecological Site Descriptions developed for rangeland and forestland are basic components of conservation planning on wildlands. Proper management of natural Soil, Water, Air, Plants, and Animal (SWAPA) resources requires a knowledge and understanding of these ecological subdivisions and their dynamic interrelationship to each other on the landscape.

This project focuses on the improvement of ecological site descriptions (ESD) for Rich County, Utah and the comparison of ESDs to current land cover conditions in Box Elder County, Utah. The improvement of ESD's in Rich County uses a combination of potential land cover models coupled with field investigations and "paper correlations" to assign the proper ESD to soil map units as defined by the Rich County soil survey. The comparison of ESDs correlated to soil map units in Box Elder County to current land cover conditions employs the current SWReGap land cover map as well as modeled distributions of current percent canopy cover of sagebrush, bare ground, juniper, and herbaceous vegetation.

R. Douglas Ramsey, Department of Wildland Resources, Utah State University, 5230 Old Main Hill, Logan, UT, 84322-5230, Phone: 435-797-3783, Email: dougramsey@usu.edu

Sagebrush Steppe Restoration and Cheatgrass

David A. Pyke**,** USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR

Cheatgrass (*Bromus tectorum*) is the greatest threat to the sagebrush steppe ecosystem and it becomes the primary roadblock for successful restoration of the structure and function of the sagebrush steppe. Structurally, the invasion and spread of cheatgrass has lead to the destruction of the dominant shrub of the ecosystem, sagebrush. This destruction occurs by cheatgrass providing a continuous fuel source across the landscape. This is the greatest problem for Wyoming big sagebrush. This sagebrush is incapable of resprouting after being burned and its seeds are thought to be short-lived, but in the past this was not likely the problem it is today because fires likely consumed less area. Islands of sagebrush would likely remain unburned and would provide a seed source for recovery. Now, the continuous fuels provided by cheatgrass mean larger fires and greater distances for seeds to travel to re-establish throughout the burned area. So structurally the system has changed from one having shrubs to one often lacking shrubs. Functionally, cheatgrass germinates earlier than most native herbaceous plants and it may impact both the water (drier) and nutrient cycles (rapid turnover of nitrogen and more labile sources of carbon) in the ecosystem. These appear to influence the soil microbial communities as well, shifting microbes from fungal to bacterial-dominated. We generally believe that cheatgrass is more competitive than native species seedlings, but that competitive advantage may not be just its superior ability to access and use resources. It may also create a soil environment that provides a positive feedback for cheatgrass growth that enhances its dominance over that of native species. Restoration may require more than just reintroducing the desired species; it may require soil amendments to balance the competitive field.

David A. Pyke, USGS Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR, 97331, Phone: 541-750-7334, E-mail: david_a_pyke@usgs.gov

Increasing Native Plant Abundance and Diversity Through Assisted Succession

Val Anderson and Robert Cox, Brigham Young University, Provo, UT

Given the goals of land managers to restore native plant diversity and curb the ever increasing invasion of exotic annuals, the procedural questions of how to make the conversion is central to current management discussions. One possible solution may be to combine earlier strategies of reclamation using introduced perennials with a subsequent infusion with native plant species. The approach utilizes the seeding of non-native perennial plants to recapture the site away from invasive annual weeds and then requires perturbation of the non-native perennial community to open niches for the insertion of native species. These non-native perennials such as crested wheatgrass have demonstrated their ability to establish and out-compete the invasive annuals to their near extirpation on a site. On western rangelands this site recapture represents a shift back to a former perennial ecology of resource utilization and fire frequency. In a pristine ecosystem this would often be accomplished by early seral, weak perennial species that facilitate the subsequent establishment and eventual dominance of long-lived perennials as secondary succession runs its course. The disruption of these natural processes by changes in the disturbance regime and subsequent invasion of exotic annuals arrests the successional process. Early season resource preemption and higher fire frequencies reduce the establishment window. Using more aggressive non-native plants as surrogates for early colonizers creates a fire resistant vegetative cover that can suppress annuals; unfortunately, they also provide resistance to the recovery of native perennials. Once a site is recaptured to a perennial cover, significant perturbations of the stand are required to open niches for the insertion of native species. These perturbations can most effectively be achieved through the use of mechanical or herbicide treatments. The niche opening treatments are designed to weaken the existing community's hold on site resources by reducing the density and health of these plants while at the same time facilitating the establishment of seeded native species. The greatest risk to this process is the proximity of reinvading

populations of annual exotic weeds. Significant buffers should be left in place around restoration treatments to preempt reinvasion by weeds.

Val Anderson, Department of Plant and Wildlife Sciences, 275 WIDB, Brigham Young University, Provo, UT, 84602, Phone: 801-422-3527, Fax: 801-422-0008, E-mail: val_anderson@byu.edu

Spatial Land Use Modeling for Sagebrush Shrubland Restoration

Louis Provencher, The Nature Conservancy, Reno, NV; Elaine York and Gen Green, The Nature Conservancy, Salt Lake City, UT; and Leonardo Frid, ESSA Technologies, Vancouver, BC, Canada

Fire regimes of the 1.1 million-acre Grouse Creek Mountains and Raft River Mountains landscape in northwest Utah may be outside their ranges of natural variability. Stakeholders from the Utah Partners for Conservation and Development (UPCD) shared a mutual interest in quantitatively modeling the cumulative impact of past land management projects and exploring alternative future management scenarios on the integrity of ecological systems of this landscape. As a result of two UPCD workshops using NRCS soil surveys and LANDFIRE biophysical settings (general potential vegetation types) descriptions and models, 17 biophysical settings were first described and state-and-transition management models developed with a-spatial computer simulation software. Partners developed 7 spatial management scenarios, 3 sensitivity analyses, and 2 control scenarios, each encompassing management actions and constraints applied to the 17 management models and a vegetation condition map based on remote sensing detection of classes from the 17 state-and-transition models. Management scenarios included whether or not: a) budgets were restricted to ownership boundaries (BLM, USFS, private), b) biophysical settings were prioritized for treatment action, c) fuels breaks were placed along roads, d) restoration treatments were placed adjacent to existing desirable vegetation classes, e) restoration treatments were placed to increase successional complexity, f) the costs of archeological surveys, plant seed, and mechanical treatments were reduced, and g) restoration treatments were only adjacent to human communities-at-risk. Sensitivity scenarios were performed for: a) cheatgrass dispersal, b) exotic forb dispersal, and c) intensity of excessive herbivory. Two control scenarios were to simulate: a) the spatial natural ranges of variability and b) the landscape with 2002's vegetation until 2007 without management. Preliminary results show that a-spatial and spatial natural ranges of variability were similar despite large temporal changes in patch age. Restoration budgets that respected ownership affected similarity of biophysical settings to their ranges of natural variability.

Louis Provencher, The Nature Conservancy, 1 E. First Street, Suite 1007, Reno, NV 89501, Phone: 775-322-4990 ext.20, Fax: 775-322-5132, E-mail: lprovencher@tnc.org

Community-Based Conservation and Sagebrush Steppe Restoration: Local Working Groups Take Action

Terry A. Messmer, Todd Black, Sarah Lupis, and S. Nicole Frey, Utah State University, Logan, UT, and Dean L. Mitchell, Utah Division of Wildlife Resources, Salt Lake City, UT.

Sage-grouse (*Centrocercus spp*.) populations have declined throughout much of the western United States. In Utah, sage-grouse occupy only 50% of their original habitat and are one-half as abundant as they were prior to 1850. These declines parallel increased loss and fragmentation of sagebrush (*Artemisia spp*.) habitats. The mosaic of land ownership in Utah complicates sage-grouse conservation efforts. A given sage-grouse population in Utah may use habitats administered by several federal, tribal, state agencies, and private landowners. Privately-owned lands currently constitute over 40% of habitat occupied by sage-grouse in Utah.

Utah's Sage-grouse Strategic Management Plan, approved in 2002 by the Utah Wildlife Board, provided a framework for establishing 13 local working groups (LWGs). Utah State University Extension (USUEXT) entered into a long term agreement with the Utah Division of Wildlife Resources (UDWR) to develop a program to enhance local community involvement in sensitive species conservation. Currently, specialists from Utah's Community-Based Conservation Program (http://utahcbcp.org/htm/who) facilitate efforts of LWGs to develop area-specific management programs to maintain, improve and restore local sage-grouse populations and their habitat. The LWGs consist of private landowners, local elected officials, federal land permittees and lessees, oil and gas industry, state and federal wildlife and land management agency personnel, and representatives from non-governmental organizations. As of August 2007, 11 LWGs have completed plans that identify strategies to improve overall rangeland habitat and watershed conditions, increase sage-grouse populations, and sustain local economies. Learning by doing (adaptive management) is a major component of each LWG plan. Concomitantly, management projects are implemented using replicated experimental designs and monitored to document the effects of the actions. The partners believe this cooperative effort has increased local governance and ownership in developing and implementing proactive strategies to better manage sensitive species and natural resource issues while addressing local socio-economic concerns.

Terry A. Messmer, Jack H. Berryman Institute and Utah State University Extension, UMC 5230, Logan, UT, 84332, Phone: 435-797-3975, Fax: 435-797-3796, E-mail: terrym@ext.usu.edu

Why Think About Economics When Restoring the Sagebrush Steppe?

John A. Tanaka, Agricultural and Resource Economics, Oregon State University, Eastern Oregon Agricultural Research Center – Union Station, Union, Oregon.

Economics is one tool that can be used in making decisions about restoration activities whether on public or private lands. Economic models can help identify the impacts of the restoration activity on different entities. We have built multi-period linear programming models to assess the effect of different projects on typical ranch operations in the Great Basin. The models seek to balance cattle herd size with available forage resources within economic returns and costs. We have used random cattle prices within a cattle price cycle to simulate risk. Other sources of risk (e.g., precipitation and fire) are being investigated along with the price risk.

While the models are for private ranches, they include the capability to assess some public impacts. Models have been developed that examine the effects of western juniper removal, different restoration practices for cheatgrass-dominated rangelands, and fire and fire-surrogate effects. Initial results indicate that most practices for addressing cheatgrass related restoration cause the profitability of the ranch to decline and put them at greater risk of going out of business. The other practices have resulted in varying impacts on both the ranch and the environment.

John A. Tanaka, Agricultural and Resource Economics, Oregon State University, Eastern Oregon Agricultural Research Center – Union Station, P.O. Box E, Union, OR, 97883, Phone: 541-562-5129, Fax: 541-562-5348, E-mail: John.Tanaka@oregonstate.edu.

Sagebrush Steppe Restoration at Deseret Land & Livestock: Maintaining Sagebrush Steppe While Watching the Bottom Line

Rick Danvir, Deseret Land & Livestock, Woodruff, UT

For twenty years Deseret Land & Livestock ranch (DLL) has remained profitable while maintaining diverse, abundant wildlife populations in Northern Utah sagebrush steppe. Wildlife and livestock are viewed as

codependent – the economic and ecologic health of the ranch requires that both prosper. A holistic, adaptive strategy evolved to manage for multiple, complex and interspersed age classes of sagebrush habitat using two intensities of disturbance: 1) time-controlled grazing (alternating ≤1 month of herbivory with 12 or more months of rest) and 2) periodic range treatments. Treatments included burning, planting, mechanical and chemical brush-thinning techniques implemented to increase herbaceous species richness and cover, reduce brush cover, or both. Approximately 1-2% of DLL's shrub-steppe rangelands have been treated annually since 1993 (generally 200-800 ha annually). Some mechanical treatments included planting functionally desirable species of grasses, forbs and shrubs. Monitoring indices of wildlife abundance, species richness, habitat use and condition, cattle production and ranch profitability helps measure program effectiveness and guide subsequent management efforts. Time-controlled grazing and range treatments have increased landscape complexity and herbaceous plant cover on both upland and riparian habitats. Wildlife abundance and species richness have remained high as the cattle stocking rate increased. The ranch supports over 275 avian species and was designated an Audubon Utah Important Bird Area in 2003. Density of both pronghorn antelope (*Antilocapra americana*) and greater sage grouse (*Centrocercus urophasianus*) have increased under this management strategy. DLL range-restoration and management expenses are being recovered through increased livestock production and recreation revenues. We suggest time-controlled grazing is functionally and esthetically preferable to either season-long grazing or livestock removal. Further, managing for a productive system and diverse landscape can be economically self-sufficient and ecologically sound - simultaneously enhancing at-risk wildlife populations and ranching.

Rick Danvir, Deseret Land & Livestock, P.O. Box 250, Woodruff, Utah, 84086, Phone: 435-793-4161, Fax: 435-793-4280, e-mail: rdanvir@fmc-slc.com

Sagebrush Steppe Restoration Situations and Techniques

Bruce A. Roundy**,** Brigham Young University, Provo, UT

Sagebrush steppe communities are at risk due to increased wildfire and weed dominance, as well as sagebrush decadence and mortality. Post-fire rehabilitation techniques have been most successful when introduced or native grasses have been sown using methods such as drilling or broadcasting and chaining to cover seed. Mechanical methods to renovate decadent stands of sagebrush in conjunction with seeding may help diversify these communities, but there appears to be an inverse relationship between sagebrush mortality from mechanical treatments and herbaceous species seeding success. Increasing native plant diversity after mechanically and chemically treating crested wheatgrass stands is being studied on a number of sites. Use of fire, chemical, and mechanical treatments to restore big sagebrush communities across a range of residual native perennial understory and pinyon-juniper overstory densities is being tested across the Great Basin.

Bruce A. Roundy, Department of Plant and Wildlife Sciences, 275 WIDB, Brigham Young University, Provo, UT, 84602, Phone: 801-422-8137, Fax: 801-422-0090, E-mail: bruce_roundy@byu.edu

Plant Materials for Sagebrush Steppe Restoration

Thomas A. Jones, Utah State University, Logan, UT

An increasing number and diversity of plant materials are becoming available for restoration of sagebrush steppe lands. Some species that have previously been available only from wildland harvest are now more economically produced with better seed quality in cultivated fields. Others are now available at much reduced expense following breakthroughs in seedling establishment, seed yield, and/or seed retention. Some of these materials are increases of natural populations, while others are genetically selected and/or hybridized from

natural populations according to standard plant breeding procedures. Some intentionally possess enhanced genetic variation, while others are intentionally more limited. Most of these plant materials are of the more common grass species, but forb materials are becoming more available as well. On the other hand, impacts of developed shrub plant materials have been minimal, and seed supplies are limited to wildland harvests.

The severity of sagebrush steppe environments, their concomitant modification by increased wildfire frequency and invasive weeds, and the specter of climate change combine to create a daunting task for plant materials developers. Given these challenges, rangeland plant materials' ability to establish, to compete with invasive weeds, and to overcome environmental stresses is paramount for on-the-ground success. Yet equally important, but often overlooked, is the need for these materials to be acceptable in terms of seed production, which entails a whole suite of traits important in a cultivated setting. The issues of genetic diversity within plant materials, matching of material to site, and selection and hybridization in plant material development continue to be controversial in some quarters. Nevertheless, natural materials, i.e., non-genetically manipulated, that would have been acceptable products in the past, may no longer be suitable. Thus, there is merit in the development of both natural and genetically manipulated materials, and this choice should depend on the intended objectives of the restoration effort.

Thomas A. Jones, USDA-ARS Forage and Range Research Laboratory, Utah State University, Logan, UT, 84322-6300, Phone: 435-797-3082, Fax: 435 797-3075, E-mail: Thomas.Jones@ars.usda.gov

Effects of Supplemented Fall Sheep Grazing on a Plant Community Dominated by Wyoming Big Sagebrush

Ryan D. Woodland, Idaho Department of Lands, Idaho Falls, ID, Neil E. West and Frederick D. Provenza, Utah State University, Logan, UT

Traditional chemical and mechanical treatments of Wyoming Big Sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) are costly and have typically focused on increasing forage for livestock production. Managing these systems biologically with grazing can potentially reduce costs and increase both biodiversity and understory production as well as rejuvenate Wyoming Big Sagebrush (ARTRWY). This experiment occurred on Deseret Land & Livestock in northern Utah in October 2003. We used 120 dry ewes to graze 3, 60 m X 40 m plots (40 sheep/plot). Sheep were provided a protein-energy supplement to offset the negative effects of the terpenes found in ARTRWY. We used the reference unit method, to estimate ($g \cdot m^{-2}$) the following categories immediately before, immediately after, and one year following grazing: total phytomass, Current Annual Growth (CAG) of ARTRWY, woody portion of ARTRWY, CAG of other shrubs, woody portion of other shrubs, grasses, forbs, litter (woody and herbaceous), and standing dead (woody and herbaceous). Plant species richness and abundance as well as estimates of the age class structure of sagebrush were also measured. Sheep used 98% of the total available forage. One year following grazing, in the grazed plots, total phytomass decreased by 48%, CAG of ARTRWY decreased by 66% while grasses increased by 43% and forbs increased by 60%. One year following grazing, the number of species encountered in the grazed plots had increased by 42%. Considering the short time frame of our ongoing measurements, it is less clear what effect grazing will have on the age class structure of ARTRWY.

Ryan Woodland, Idaho Department of Lands, 3563 Ririe Highway, Idaho Falls, ID, 83401, Phone: (208)525-7167, Fax: (208)525-7178, Email: rwoodland@idl.idaho.gov

Poster Abstracts

Presenting author in italics

Shell's Pinedale Anticline Sage Grouse Habitat Restoration Project, WY

Richard S. (Dick) Carr, III, C-M Environmental Group, Inc., Pinedale, WY, H. James Sewell, Shell Exploration & Production Company, Denver, CO, Aimee Davison, Shell Rocky Mountain Production Company LLC, Pinedale, WY, and John Steinbacher, Summit Associates LC, Boise, ID

With the recent proliferation of natural gas drilling and extraction in the Pinedale Anticline gas field of western Wyoming and elsewhere in the West, the restoration of disturbed lands to benefit native species has become a major issue. Previous interim reclamation regulation guidelines emphasized various grass species suitable for creating areas for grazing, but were not conducive to restoring, and improving the health of, sage grouse and ungulate habitat.

In the fall of 2004, Shell Rocky Mountain Production Company LLC in conjunction with the Pinedale, Wyoming BLM office initiated a voluntary pilot project to reintroduce native plant species supportive of sage grouse and ungulate habitat to numerous reclaimed drill locations over the full length of the Pinedale Anticline gas field. Seeding of various interim reclaim locations was carried out in the fall of 2004, with the intent of testing a number of variables, including seeding techniques, organic soil amendments, seed mixes and the effectiveness of fencing. The project is ongoing, with fall seeding of additional locations in 2005 and 2006. An unanticipated project variable proved to be a large difference in precipitation rates for the three successive years.

Monitoring of the reclaimed drill locations is also ongoing, and has been completed for the 2005, 2006 and 2007 growing seasons. The results indicate that timely restoration of native habitat suitable for sage grouse in developing gas fields IS possible. An overview of the project and results to date are shown in this poster presentation.

Dick Carr, C-M Environmental Group, Inc., 1019 Gordon Avenue, Reno, NV, 89509, Phone: 775-240-5032, Fax: 775-201-0058, E-mail: rcarr3@charter.net

Restoring Sage-Grouse Habitats in North East Wyoming Lake DeSmet Conservation District

Phil Gonzales, Natural Resources Conservation Service, Buffalo, WY

The need to work with private landowners to develop conservation technologies, practices, systems, procedures, and approaches to conserve sage grouse habitats is urgently needed in the Powder River Basin. Most of the Powder River Basin is experiencing and will experience coal-bed natural gas development within the next few years. This development continues at an unprecedented scale and rate. The Bureau of Land Management's (BLM) proposed action includes drilling, completing, operating and reclaiming more than 50,000 new wells and constructing, operating, and reclaiming various ancillary facilities needed to support them in the Wyoming portion of the Powder River Basin. Drilling will continue for a minimum of ten years. This development has negative consequences for sage grouse; mitigation can only come from working with private landowners, energy developers and public land managers

The Lake DeSmet Conservation District (LDCD) has partnered with private landowners, Natural Resource Conservation Service (NRCS), Wyoming Game and Fish Department (WGFD), oil and gas industry, conservation groups and federal and state agencies to restore the productivity of sagebrush/grassland communities in northern Johnson County. This community-based program has had tremendous success. So far, ~300,000 acres are enrolled, with 14 private landowners, to enhance important habitats for sagebrush obligates, mule deer, pronghorn antelope, other wildlife, as well as livestock. Ranch management plans have been prepared for these livestock producers, which includes; resource inventories, conservation strategies, infrastructure needs (to implement conservation strategies), grazing procedures and monitoring needs, etc. Contractors are employed to accelerate the data gathering to assist livestock producers with developing progressive plans that will benefit both livestock and wildlife.

Phil Gonzales, NRCS, 621 West Fetterman, Buffalo, WY 82834, Phone: 307-684-2526, ext 106, Email: phil.gonzales@wy.usda.gov

Diversification of Crested Wheatgrass Stands in Utah

April Hulet, Bruce Roundy, and Brad Jessop, Brigham Young University, Provo, UT

To determine effective ways to diversify crested wheatgrass seedings while minimizing weed invasion, we mechanically and chemically treated 2 sites followed by seeding native species. The study is replicated for 2 years as a randomized block split plot design with 5 blocks. Within each block, 0.4 ha main plots were either left undisturbed or received a mechanical (1-way or 2-way disking) or herbicide treatment (1.1 L/ha or 3.2 L/ha. Roundup Original Max) to reduce (partial control) or eliminate (full control) crested wheatgrass. Following wheatgrass control, main plots were divided into 0.2 ha subplots that were either seeded or unseeded. Herbicide treatments were applied in late May 2005 and 2006 while mechanical treatments were applied in early June 2005 and 2006. Plots were seeded in October of each year with a Truax Rough Rider rangeland drill. The drill was specially configured to drill or broadcast seed in alternating rows with the goal of drilled species being planted no deeper than 1.3 cm. Brillion packer wheels placed immediately after the drop tubes pressed broadcast species into the ground. Density data were collected in spring 2006 and 2007 for crested wheatgrass, perennial grasses and forbs, weeds, and sown species. Cover data was collected for crested wheatgrass and cheat grass. Two-way disking was most effective in controlling crested wheatgrass, however weed invasion was also greatest on mechanically-treated plots. Native grasses and 'Appar' flax emerged best from seeding although survival of first year seeded species was limited. Emergence of sown Wyoming big sagebrush, rabbitbrush, and other forbs for both treated years was limited.

April Hulet, Brigham Young University, 467 WIDB, Provo, UT, 84602, Phone: 435-590-1192, E-mail: huletapril@hotmail.com

Watering Frequency, and a Hydrogel Effect on the Emergence and Survival of Coated and Uncoated Crested Wheatgrass Seeds

Jane M. Mangold, Roger L. Sheley and ***Clare L. Poulsen,*** USDA Agricultural Research Service, Burns, OR

Revegetation of degraded shrub-steppe often fails due to intense competition from weeds, highly variable environmental conditions, and limited soil moisture. The objective of this study was to test whether a commercially available seed coating and a water-retaining acrylamide copolymer hydrogel would increase seedling emergence and establishment of crested wheatgrass (*Agropyron cristatum*) under three watering frequencies and two soil textures. Pots were filled with one of four soil treatments: field soil, two parts field soil mixed with one part sand, field soil plus hydrogel, or field soil plus sand plus hydrogel. We seeded the

pots with coated or uncoated seed and placed them in a greenhouse for 66 days. The pots were assigned one of three watering treatments: 4.5 oz (150 ml) applied one time per week, 1.5 oz (50 ml) applied three times per week, or 0.9 oz (30 ml) applied five times per week. We recorded seedling emergence at three and six weeks. At the end of 66 days, the numbers of seedlings that survived were counted and above ground biomass was collected, dried, and weighed. We found that uncoated seed had 1.6 times greater seedling density than coated seed. Incorporation of the acrylamide copolymer hydrogel into the potting medium conferred some benefit to emergence, biomass, and survivorship of crested wheatgrass seedlings. However, it was watering frequency that produced the most consistent influence on seedling emergence, survival, and biomass. Watering three or five times per week increased emergence more than watering one time per week, but watering one time per week generally led to greater survivorship and biomass. This suggests that the use of water-retaining hydrogels may help to overcome soil moisture limitations and improve seedling establishment during revegetation of degraded shrub-steppe.

Clare Poulsen, USDA Agricultural Research Service, 67826-A Hwy 205, Burns, OR, 97720, Phone: 541-573-8929, Email: clare.poulsen@oregonstate.edu

Expanding Methods in Historical Ecology to Understand Vegetation and Disturbance Regime Change Over the Past 200 years in the Great Basin Region

Lesley Morris, Ron Ryel, and Neil West, Utah State University, Logan, UT

Historical ecology seeks to explain how change is manifest upon the landscape over time. The interdisciplinary synthesis of information drawn from human and biological archives helps characterize reference conditions, define historic range of variability, and guide restoration efforts. Since human actions are rapidly becoming the drivers of ecosystem change, restoration requires an understanding of pre-settlement conditions and alterations from land use history as well as the influence of climate change. The first goal of this research was to reconstruct an ecological history of the City of Rocks National Reserve, Idaho, US since settlement in the 1800s. The human archive was rich with information regarding historical environmental conditions over the past 200 years. Journals, photos, field notes and oral interviews all offered a glimpse of how the Reserve has changed over time. However, gleaning information from the biological archive for the last 200 years was limited to dendrochronology. This method cannot provide information about other plants or communities such as sagebrush steppe. Therefore, the second goal of this research was to expand biological methods for examining vegetation and disturbance regime changes in the Great Basin (e.g., sagebrush steppe and pinyon juniper woodlands) by analyzing the vertical distribution of phytoliths in soils. Phytoliths are silica microfossils of plant cells that are deposited in soils upon death and decay of vegetation. We catalogued phytoliths from 130 native and introduced flora species of the Great Basin region. We then used known historical changes in vegetation and disturbance (e.g. woodland encroachment and fire history) to test the sensitivity of the soil phytoliths to record these events and for inference back in time. Our results indicate that soil phytolith analysis is a useful biological tool for inferring historic vegetation and disturbance regime change within this time frame in the Great Basin.

Lesley Morris, Utah State University, 5230 Old Main Hill, Logan, UT 84322-5230, Phone: (435) 512-2248, Fax: (435)797-3796, Email: lesleymorris@cc.usu.edu

SageSTEP: Evaluating the Effects of Fire and Fire Surrogate Treatments in Sagebrush Communities of the Great Basin

Summer Olsen and ***Mark Brunson*****,** Utah State University, Logan, UT

Healthy sagebrush steppe communities in the Great Basin are rapidly disappearing due to invasion of non-native plants (especially cheatgrass), catastrophic wildfires, and encroachment of pinyon-juniper woodlands. Many remaining sagebrush communities are in poor health, with a preponderance of old shrubs and a scarcity of native plants in the understory. The Sagebrush Steppe Treatment Evaluation Project (SageSTEP) is a 5-year study that will explore ways to restore sagebrush communities. Experimental sites have been established across the Great Basin to evaluate effects of land management options including prescribed fire, mechanical thinning of shrubs and trees, and herbicide application, that can reduce the potential for wildfire and restore healthy and diverse native plant communities. The project is fully interdisciplinary with ecological, economic, and social components. Results of this project will provide resource managers with information that can reduce the risk and uncertainty of restoration decisions. This poster outlines study objectives, describes experimental treatments, and discusses how information will be disseminated through academic, agency, and public channels.

Summer Olsen, Utah State University, 5215 Old Main Hill, Logan, UT 84322-5215, Phone: 435-797-8455, Fax: 435-797-4048, E-mail: summer.c.olsen@usu.edu; Mark Brunson, Utah State University, 5215 Old Main Hill, Logan, UT 84322-5215, Phone: 435-797-2458, Fax: 435-797-4048, E-mail: Mark.Brunson@usu.edu

Using GIS and Remote Sensing to Predict Dominant Plant Species Distributions in Rich County, Utah

Kate Peterson, Utah State University, Logan, UT

Attempts are being made to spatially model the distribution of key plant species in Rich County, Utah. Vegetation data was collected in the field at 245 sites during the summer of 2007. Field sampling sites were stratified by using a GIS-derived 25-cluster map based upon 9 abiotic data layers and a geology map. Field data collection sites were chosen opportunistically where vegetation seemed to be in a relatively natural condition, mainly on public lands or on the Deseret Ranch, usually between 90 and 250 m from roadways. Data from an additional 25 conifer-dominated sites, collected during 2000 and 2001, were added to the dataset from the Southwest Regional Gap (SWRGAP) analysis project database.

A GIS was used to extract 6 abiotic factor variables and 3 variables derived from Landsat ETM+ reflectance values at field data collection locations. Extracted variables include: elevation, annual average precipitation, slope, curvature, upslope contributing area, and modeled potential annual average solar radiation. Also included were Tasseled Cap 'brightness' and 'greenness' values derived from an October 2000 Landsat image of the area, and thermal band reflectance values from the same image.

For each field site and key plant species, data has been coded as 0 - indicating that the species was not present, common, or dominant, or 1 - indicating that the species was a dominant or common species. I have been attempting to fit logistic models to the data for several common species using the extracted abiotic variables. Preliminary accuracy assessments of models have been done using 509 SWRGAP data points. For the most part, maps generated from preliminary models appear reasonable, but accuracy assessments indicate that models still show room for improvement. More careful data analysis and/or different modeling techniques will be attempted in the near future.

Kate Peterson, Department of Wildland Resources, 5230 Old Main Hill, Logan, UT, 84322, Phone: 435-797-4482, E-mail: katapeterson@cc.usu.edu

Modeling Vegetation Dynamics of Black Sagebrush (*Artemisia nova*) in Northern Utah Using VDDT and LANDSAT Imagery.

Samuel Rivera, A.J. Hernandez, and R. Douglas Ramsey, Utah State University, Logan, UT

State and transition models (STM) are being developed as an alternative to the traditional linear climax model to better explain vegetation dynamics of semi-arid landscapes. State-of–the-art monitoring tools are being developed in order to better document, visualize, and understand the spatial-temporal variations in these ecosystems. The Vegetation Dynamics Development Tool (VDDT) is a computer based modeling environment developed to provide a framework for examining the role that various disturbances and management prescriptions have on vegetation changes at the landscape level. Vegetation change and dynamics of black sage brush (*Artemisia nova*) were modeled in VDDT using a recently developed STM for the NRCS ecological site named 047AY332UT: Upland stony loam black sagebrush. Remote sensing and GIS techniques were used to estimate change probabilities used by the VDDT based model. A multitemporal analysis, using medium resolution LANDSAT imagery, allowed us to estimate the probability of black sagebrush conversion into another land cover or use category. The output spatial data layers depicted the potential distribution of black sagebrush's plant communities over the landscape under different management or natural scenarios. We found that the linkage to a GIS allowed the testing of the model through spatially explicit simulations, and we also found that models, such as VDDT associated with GIS-remote sensing techniques, could be very useful to visualize and rank alternatives at the landscape scale.

Samuel Rivera, Remote Sensing/GIS laboratories, Department of Wildland Resources, College of Natural Resources, Utah State University, Logan, UT, 84322-5230, Fax: 435-797-4488, E-mail: srivera@cc.usu.edu

Intermountain West Ecosystem Conservation Activities at the Aberdeen Plant Materials Center

Derek J. Tilley and Loren St. John, USDA-NRCS Plant Materials Center, Aberdeen, ID

Since 1939 the Aberdeen Plant Materials Center (PMC) has collected and evaluated plants and new conservation technologies in real-world situations and found solutions for a large variety of natural resource challenges. To date the PMC has cooperatively released 44 conservation plants. The PMC has also developed a number of new conservation technologies including strategies for battling invasive species (especially during times of drought and potential wildfire), bioengineering techniques to improve stream-side and riparian areas, and planting techniques and equipment for windbreaks, shelterbelts, riparian areas and constructed wetland systems.

Derek J. Tilley, USDA-NRCS Plant Materials Center, PO Box 296, Aberdeen, ID, 83210, Phone: 208-397-4133, E-mail: derek.tilley@id.usda.gov

Notes

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