Utah Shrubland Management

Greetings and Happy New Year!

Highlights of the 2013-2014 winter newsletter:

- An interview with the Weston family, owners and operators of a ranch near Bear Lake in northwestern Utah
- A look at two sagebrush Ecological Sites at the Weston ranch
- A discussion of mechanical shrub control
- Tebuthiuron (herbicide) history and applications

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Project Updates

We're in the midst of winter, and several inches of snow cover many of Utah's rangelands, the perennial shrubs and grasses dormant for the season. The project's study sites are currently a quiet scene compared to the activity of field work in the summertime! Before the close of October 2013, we wrapped up our first round of data collection and completed shrub reduction treatments in each of the eight small-scale study areas. Shrub reduction methods were low-rate herbicide applications (four different chemicals) and mowing, which reduced shrubs to a height of 20 cm above ground level.

At each of our eight experimental areas, we are testing all combinations of selected shrub reduction methods: herbicide alone, herbicide in combination with mowing, and mowing with no herbicide application. In summertime of the coming years, we will gather post-treatment data on shrub density, cover, and decadence, as well as cover and richness of grasses and forbs. The study will assess the efficacy of treatments for meeting management goals for big sagebrush, rubber rabbitbrush, snakeweed, and black greasewood sites. Our site-specific data will also be used to help improve the Ecological Site Descriptions managed by the Natural Resource Conservation Service.

The final phase of plot treatments will occur in fall of 2014, with the application of two seed mixes following the recommended wait times for the herbicides in the study (14 months).

Photographs show mowing treatments at the Bear Lake ranch study area. A tractor-mounted mower reduced shrubs to a height of 20cm. Soil disturbance was minimal following mowing of sagebrush plots at the Bear Lake study area.

Utah State University | USDA ARS

Interview with the Weston family ranch owners in Randolph, Utah

Rebecca Mann, Utah State University

Our Shrub Management project was lucky to find a partnership with the Weston family, who operates a large ranch east of Bear Lake in northeastern Utah. Their property stands apart as being the highest of our study areas, at 7,300 ft. elevation. In fact, starting in November, ranchers and researchers alike have to hedge bets on heavy snowfall that can limit access on the ranch's back roads until April the following year. Largely because of the cool, moderately wet climate, sagebrush—both Wyoming big sagebrush, and black sagebrush—dominate the rolling, loamy hills on their large property. One experimental study plot is set up on each of these sagebrush community types on the Weston ranch.

Diane Weston's grandfather was the original homesteader on the Bear Lake property, which has now been run by Monty and Diane Weston and their sons for 35 years. The Westons have a large operation, managing over 700 cattle a season. They graze about 200 head on their property from approximately May 10-Sept 15.

Monty and Diane are both active with the Utah Cattlemen's Association, and Monty served as president of the Association from 2004 through 2005. He is very interested in keeping up to date with modern range management techniques, to improve the condition of the land and its grazing capacity. Five years ago, the Westons were able to burn a portion of their property. They experienced good results, seeing an increase in perennial grasses. However, because the permitting process can be long and sometimes unpredictable, Monty is looking into other viable shrub management alternatives. In fall of 2012, Spike (tebuthiuron) was applied aerially across the majority of the Weston's sagebrush rangelands via our Shrub Management Project partnership. Spike can be a slow-acting chemical and we are now waiting to see how this treatment will affect shrub abundance and forage production on their property. On page 7, look for a discussion of the history and appropriate applications of this herbicide.

Representing three generations on the ranch are (left to right): Brett, Diane, Monty, and Joseph Weston, holding daughter, Winter Weston.

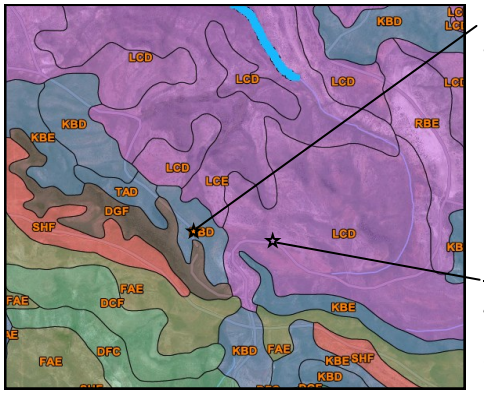
Ecological Sites at the Weston Ranch near Bear Lake, UT

Rebecca Mann, Utah State University

The Weston's ranch contains a patchwork of soils types, the variation due to soil forming factors such as landscape position, climate, slope, parent material, and feedbacks from existing vegetation. "Web Soil Survey" is a website (http://websoilsurvey.sc.egov.usda.gov) that can be used to obtain a soils map almost anywhere in the United States, and we use it here to identify the soils that occur at the Bear Lake study area on the Weston property (image on left). A close look at the map reveals that the outlines of soil types correspond to the patches of vegetation and surface color that are visible in the landscape image. At the Weston property, we see patches of deep, loamy red soil on hillsides; shallow, light-colored soils on ridge tops; and other soils defined by the dark green vegetation that occur on north-facing slopes and in the water-collecting valleys between hills.

Web Soil Survey can also call up a map of Ecological Sites. Each soil type will link to a specific Ecological Site, although an Ecological Site will contain multiple soil types. Soils are grouped into an Ecological Site based on their physical properties and associated environmental attributes. By definition, soils within an Ecological Site will "produce a distinctive kind and amount of vegetation" as compared to those in other Ecological Sites.

Soils at the Bear Lake study area. 3-letter code indicates soil type. Map generated from Web Soil Survey.



Colors represent Ecological Sites overlain on soil type (coded by 3-letters). Map generated from Web Soil Survey.

West Experiment Area

Soil: Kearl Loam

Ecological Site: Upland Loam (Wyoming Big Sagebrush)

East Experiment Area

Soil: Lonjon Silt Loam

Ecological Site: Upland Stony Loam (Black Sagebrush)

Two experimental areas are established on the Weston property for the Shrubland Management Project. The western study area is situated on Kearl Loam soil, which has a natural reddish hue (coded "KBD" in the soil map on the left). Kearl Loam corresponds with the Ecological Site named "Upland Loam (Wyoming Big Sagebrush)", represented by the purple patch in the map on the right. The project's eastern experimental area is situated on Lonjon Silt Loam soil, which has a lighter brown hue and coded "LCD" on the soil map. This soil belongs to the "Upland Stony Loam (Black Sagebrush)" Ecological Site, which is colored blue on the right-hand map.

Upland Stony Loam (Black Sagebrush) vs. Upland Loam (Wyoming Big Sagebrush)

The two Ecological Sites studied at the Bear Lake ranch have many commonalities. Both are characterized by moderately deep (20-40 inches to bedrock), well-drained soils on sides and summits of mountain foothills. The sites coexist at 7,300 ft. elevation, and receive 12-17" of precipitation annually, primarily as spring rain and winter snow. However, some key differences in the soils and landforms of these Ecological Sites influence their vegetation and management.

The name ***Upland Stony Loam (Black Sagebrush)*** says it all: this Ecological Site is "Stony", characterized by at least 15% stones, cobbles, or gravels in the soil matrix. At our study area, there are up to 50% rock fragments in the soil. Rocks take up space that might otherwise be occupied by soil particles and pore space. Pore space is essential to plants, providing not only room for roots to grow, but reservoirs for water and air resources.

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Ecological Sites at the Weston Ranch near Bear Lake, UT (continued)

The landforms on which the Upland Stony Loam Ecological Site occur exacerbates the challenge of the rocky soils. This Ecological Site typically occupies ridge tops and hillsides with slopes up to 50%, where water can be easily lost as surface runoff during intense storms. The restricting aridity of this Ecological Site is evident in the limited range of plants it supports. Smaller, drought-tolerant black sagebrush is the dominant shrub. Common perennial grasses include squirreltail, western wheatgrass, bluebunch wheatgrass, and Sandberg bluegrass; arrowleaf balsamroot, carpet phlox, and other mat-forming plants are common forbs. The typical distribution of plant functional groups is 50% grasses, 40% shrubs, and 10% forbs. As expected, the productivity on this site is limited, with approximately 550-650 pounds per acre produced in an average year on a good-quality site. This area does provide benefits to wildlife, such as winter forage and brood-rearing habitat for sage grouse.

The Upland Stony Loam site can be contrasted to the second area at Bear Lake: ***Upland Loam (Wyoming Big Sagebrush).*** At this Ecological Site, we see 900 pounds per acre produced in a typical year, with a usual distribution of 70% grasses, 20% shrubs, and 10% forbs. This site is associated with loamy soils that have fewer than 15% rock fragments. They also occur on hill slopes, ridges, and remnants of alluvial fans, but slopes are typically less than 20%. Again, the dominant vegetation reflects the site's relatively higher water availability. Wyoming Big sagebrush is the characteristic shrub species. Grasses include Thurber's needlegrass, Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass; forbs include spiny phlox, low pussytoes, shortstem buckwheat, and groundsel. Because of its higher productive capacity, the Upland Loam site offers better grazing for sheep and cattle, in addition to wildlife forage and cover.

Ecological Site Fluctuations and Response to Management

Existing vegetation and soil characteristics are not the only factors a land manager needs to know to make effective decisions. Understanding site capacity, site limitations, and a site's potential response to environmental conditions or to management actions will enable targeted and realistic goal setting. The best available information about Ecological Site response to disturbance is available in the NRCS Ecological Site Descriptions (see below). In some cases, State and Transition Models are included with the Descriptions. The Models, written by regional experts and researchers, are diagrams that illustrate the expected changes a site will go through under common climatic regimes and management actions.

(Historical ⬇ Change)

For instance, the Upland Stony Loam Ecological Site Description illustrates what a historically undisturbed example of this Ecological Site looks like (top photo). Black sagebrush is present, intermixed with perennial grasses and low forbs. The State and Transition Model shows that with "Historic Change", (i.e. the introduction of non-native plants and animals, and a slightly different climate), the herbaceous component of the Upland Stony Loam will have fewer perennial grasses and some exotic annual grasses (lower photo). The effects of other stressors are also described in the State and Transition Model. One such case: continuous soil compaction and soil erosion on this site can lead to loss of shrubs and perennial grasses, resulting in dominance of low "cushion" plants, rock pavement, and curly cup gumweed.

Ecological Site Descriptions

Much more information can be found on the NRCS website: *https://esis.sc.egov.usda.gov/Default.aspx*
Follow the link to the Ecological Site Description Page, and click on the Approved ESD Reports link in the upper left corner. From there, site descriptions can be found by searching for the MLRA and Ecological Site of interest.

Upland Stony Loam (Black Sagebrush)	MLRA 047X	State Utah	Ecological Site ID R047XA332UT
Upland Loam (Wyoming Big Sagebrush)	MLRA 025X	State Utah	Ecological Site ID R025XY314UT

Mechanical control of sagebrush

Rebecca Mann, Utah State University

Mechanical shrub thinning treatments on rangelands have been conducted at least as early as the 1930s, with the goal of increasing forage production for livestock. Early treatments include trenching and basin pitting, meant to increase water retention on the site (Barnes 1950). Land practitioners have sought to improve shrub removal technology, and the machinery has advanced remarkably over the past several decades. Today, mechanical treatments can be sorted into three categories, as described by Jeffrey Beck and colleagues in their 2012 article:

- Methods to remove top-growth of woody species: aerating, bulldozing, blading, chaining, cabling, railing, roller chopping, shredding/mulching, mowing, and pipe harrow.
- Methods to remove entire plants: plowing, disking, disk chaining, root plowing, root raking, spring-tooth harrow, and chisel plowing.
- Aerators and the Dixie harrow are methods that are capable of thinning out only older shrubs, leaving small, younger shrubs, grasses, and forbs in place.

There are positives and negatives associated with each mechanical treatment method. Practical concerns will include cost, availability, and labor requirements. Terrain, soil, and woody vegetation can limit the operation of machinery. An excellent, comprehensive description of specific mechanical treatments can be found at the Revegetation Equipment Catalog that is hosted by the Texas A&M University Website: http://reveg-catalog.tamu.edu/

Due to variation in site conditions and climate factors, outcomes of mechanical treatments can sometimes be unexpected. Although research shows that perennial grasses and forbs typically increase immediately following shrub removal (e.g. Mueggler & Blaisdell 1958, Harniss & Murray 1973), some studies have seen little increase in grass production following treatment (e.g. Davies et al. 2011). In addition, mechanical treatments may have unintended consequences such as increased soil erosion (Miller 2012) or harm to wildlife habitat (Peterson 1995). It becomes important to clearly define management expectations (objectives), and to understand how specific site characteristics will interact with potential mechanical treatments.

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At the experimental areas for the shrub management project, a subset of treatment plots was trimmed to a height of 20cm with a tractor-mounted mower. This treatment represents one method of thinning shrubs through mechanical means. We will assess the effect of mowing, alongside other categories of range treatments, on the range vegetation across the eight studied Ecological Sites.

Wyoming big sagebrush at the Bear Lake ranch prior to mowing in October 2013.

Big sagebrush after mowing to 20cm. Soil was minimally disturbed during treatment.

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Mechanical control of sagebrush, continued

Ecological Site descriptions, as well as field observations, provide site-specific information that will be crucial for choosing an appropriate range treatment method. When factors such as those listed below (adapted from Herbel 1987) are considered before management actions are taken, results will be closer to expectations and unintended costs will be minimized.

Landscape Topography: If mechanical treatment is conducted on steeply sloped terrain, there is a high potential for soil and water runoff if vegetation isn't quickly established on site. Some slopes are also too steep to access with equipment.

Soil: Fine soil textures, in addition to steep slopes and sparse cover of rocks on the soil surface, will increase erosion potential following disturbance. Soil rockiness can also preclude some mechanical treatments. Shallow soils generally do not have the production capacity to warrant mechanical treatment.

Vegetation: The biological properties of target and non-target species will be an important consideration. For instance, the target shrub may be sagebrush, but if it co-occurs with rabbitbrush (a re-sprouting shrub), disking the sagebrush might only result in increased rabbitbrush abundance.

Climate: We cannot control the whether but we can take into account precipitation averages and recent climatic trends. Drier sites will be more sensitive to site disturbances, and seeding dry sites will be more challenging.

Timing: Seasonal factors will limit when range treatments can be conducted. For instance, heavy machinery can not be used on wet soils in the spring, and range seeding will be most effective if seeds are spread in fall.

In our forthcoming Utah Shrubland Management Handbook, there will be a comprehensive discussion of mechanical treatments for rangelands and technical details will be provided for commonly used rangeland equipment.

Citations

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A brief introduction to tebuthiuron: A surface applied, soil-active herbicide for control of woody plants

Dr. Tom Monaco, USDA-Agricultural Research Station

Ranchers and land-resource managers choose to manipulate sagebrush stands because they seek greater productivity from grasses and forb species within the plant community. In the case of reducing sagebrush, the general assumption is that reducing its relative abundance in the community will enable these herbaceous species to gain greater prominence in the plant community.

Tebuthiuron is a pelletized herbicide that is broadcast applied to the soil surface. Subsequent precipitation is required to move the active ingredient into the root zone where it is taken up by woody plant species. Thus, it is typically applied in the fall, and effects on the target species include chlorosis (yellowing of leaves) and eventual defoliation. Because it is a soil active herbicide, desired results depend on the susceptibility of the target species, soil characteristics, and precipitation amount and timing. For rangeland and pasture control of big sagebrush, the product label suggests "a low rate of 2.5 lb per acre on sites with shallow, rocky and coarse textured soils having low organic matter content, or where partial control is desired" (Anonymous 2013). In general, rates on rangelands are typically less than 10 lbs/acre, but may be increased for treatment areas with greater precipitation and deep, medium-to-fine textured, or high organic matter soils. Low rates to partially control big sagebrush are also necessary to avoid undesired injury to perennial grasses and other non-target forb species. In order to promote the recovery of grasses and forbs following big sagebrush control, it may be necessary to defer grazing for at least one year.

Tebuthiuron is frequently used in to achieve partial control of big sagebrush. Take for example a study carried out by Renee Chi and Terry Messmer from Utah State University in 2000. Within dense stands of sagebrush on Parker Mountain in south-central Utah, these researchers aerially applied tebuthiuron to 100-acre plots at a lower rate (~1.4 lbs/acre) than that used by Mr. Monty Weston at his ranch (2.5 lbs/acre). Within two years, Chi (2004) found that, even at this lower rate, the combined cover of grasses and forbs was significantly greater in tebuthiuron plots relative to untreated control plots. Conversely, too high of application rates can be problematic if they cause injury to non-target species. For example, using application rates four-times greater than Mr. Weston, Britton and Sneva 1983) increased mortality of big sagebrush, but also decreased the herbaceous biomass yield by the end of the second growing season in eastern Oregon.

A section at the Bear Lake study area where tebuthiuron was applied. Dieback on Wyoming big sagebrush can be seen.

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A brief introduction to tebuthiuron, continued.

In contrast, using rates similar to Mr. Weston, McDaniels and Balliette (1986) found that big sagebrush density was reduced between 84 and 92% after 28 months and significant increases in grass production occurred during the second and third growing seasons following tebuthiuron treatment in New Mexico's northern desert.

Given the time required to assess the effects of tebuthiuron on sagebrush and herbaceous species, we expect that symptoms of mortality will begin to be noticeable in 2014 at the Weston property experiment sites. Based on vegetation monitoring and measurements in summer of 2013 at the Weston property, it is still too early to determine how tebuthiuron impacted canopy cover or density of sagebrush and other plant species. However, visual effects of the herbicide were detected during June of 2013 as the canopy of many shrubs appeared desiccated and gray in color (see photo, previous page). We expect that consecutive dry winter conditions in 2013 and 2014 may increase the time required to partially control big sagebrush and consequently slow the recovery response-time of herbaceous grasses and forbs.

Citations

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Chi, R.Y. 2004. Greater sage-grouse reproductive ecology and tebuthiuron manipulation of dense big sagebrush on Parker Mountain. Masters Thesis, Utah State University, Logan, Utah.

McDaniels, K.C., and J.F. Balliette. Control of big sagebrush (*Artemisia tridentata*) with pelleted tebuthiuron. Weed Science 34:276-280.

Ecological Site Webinars!

If you would like to learn more about Ecological Sites and land management, search for the term "NRCS Ecological Site Description Webinars" in your browser, to locate this web address: *http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/ecoscience/desc/?cid=stelprdb1119794*

There are 8 full length educational videos available at the link, that cover topics ranging from:

- History, uses, and relationship of Ecological Sites to soil maps
- Concepts and components of State-And-Transition Models: resilience, disturbance, and management effects
- Utilizing Ecological Site Descriptions as a standard reference for land management, monitoring, & assessment

This is a valuable free resource that anyone may use.