

Trout Creek 1999 Burn

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Abstract—A small prescribed fire near the mouth of Trout Creek in Strawberry Valley, Wasatch County, Utah, on the Uinta National Forest provided an opportunity to compare production and vascular plant composition in unburned and burned areas. At four years post burn, production of herbaceous plants was about four times greater in the burned area than in the unburned area. Most plants found in the unburned area were found in the burned area at four years post burn.

Study Area and Methods

In 1999 a prescribed fire near the mouth of Trout Creek, Strawberry Valley on the Uinta National Forest was controlled after it burned about 20 acres. This fire burned in a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community. The fire consumed fuels including sagebrush stems to ground level. At the south end of the fire, an abrupt boundary between the burned and unburned areas (fig. 1) provided an opportunity to measure production and determine composition in similar sites in the unburned area (fig. 2) and in the burned area (figs. 3 and 4). Areas measured in and out of the burn were of similar gradient, exposure, and landform. They are adjacent to each other and are reasonably expected to have a similar history of ungulate use.

Production was measured by clipping and weighing all herbaceous growth of the season in transects inside the burn and outside the burn on 14 October 2003 or at four years post-burn. Clipped plots were taken along parallel transects with transects located about 50 ft inside the burn (fig. 3) and about 50 ft away from burn in the unburned sagebrush community (fig. 2). Plot size was 9.6 ft². Ten plots were clipped and weighed in each of the burned and unburned areas. Clipping took place after growth of herbaceous plants had mostly ceased. Thus the standing crop at the time of clipping likely represented most of the graminoid production of the year, but it likely under represented forb production. Production was measured in grams. Measurements in grams from 10 plots of 9.6 ft² convert directly to pounds per acre as reported in table 1.

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All standing crops of herbaceous species were clipped to ground level. However, sagebrush production was clipped and weighed from parts of some of the plots and the remainder was estimated based on the percent clipped. Thus production of herbaceous species is based on 100 percent clipping, and sagebrush production is based on partial clipping.

Samples of clipped material of various species were placed in paper bags. These samples were weighed in the field and left in the cab of a vehicle for a few days to dry where temperatures went well over 90 degrees Fahrenheit in the day. After a few warm days, they were weighed again to determine air-dry weight. Production values listed in table 1 are based on air-dry weight.

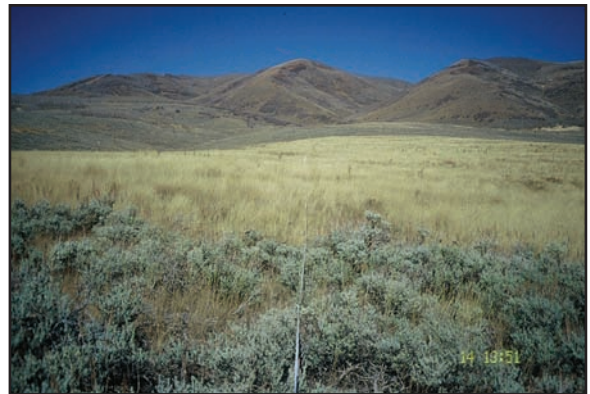


Figure 1—Abrupt boundary between unburned site dominated by sagebrush (foreground) and burned site with high production of graminoids (photo taken on 14 October 2003).



Figure 2—Clip-plot transect in unburned area with 35 percent crown cover of mountain big sagebrush and low production of herbaceous plants (photo taken 14 October 2003).



Figure 3—Clip-plot transect inside the burn with high production of herbaceous plants. The mountain big sagebrush plant just to the right of the hoop established from seed after the fire. By year 4 post burn it is mature and producing abundant seed. Area of the hoop is 9.6 ft². It was used to delineate clip-plots (photo taken 14 October 2003).



Figure 4—Burned site on 6 August 2003 at 4 years post burn. Native, perennial graminoids dominate the burned area.

Table 1—Production (lbs/acre air dry weight) at 4 years post burn.

	Not burned	Burned
Graminoid	193	1,088
Forb	59	22
Total herbaceous	252	1,110
Sagebrush	787	0
Yellowbrush	3	43
Total shrub	790	43
Total production	1,042	1,153

Crown cover of shrubs was determined by measuring crowns of sagebrush along 500 ft of line intercept in both the burned and unburned areas following procedures outlined in the *Rangeland Ecosystem Analysis and Management Handbook* (USDA FS 1993). Crown cover of all species was estimated in a 1/10 acre macro plot in each of the burned and unburned areas. Data from the macro plots provides a species list or composition of plants present in the burned and unburned areas.

Results

Total production was similar in the burned (1,153 lbs/acre) and the unburned (1,042 lbs/acre) areas (table 1). A range of annual production 350 to 1,261 pounds/acre) is indicated for mountain big sagebrush communities (Goodrich and Huber 2001; Harniss and Murray 1973; Jensen 1989; Tart 1996; Tew 1988). The trout creek sites are near the upper end of this range.

Herbaceous production in the burn was 1,110 lbs/acre compared to 252 lbs/acre in the unburned area. There was 858 lbs/acre (4.4 times) more herbaceous production in the burned area. Graminoid production was 895 lbs/acre (5.6 times) greater in the burn than in the unburned area. Forb production was 37 lbs/acre less in the burned area than in the unburned area. However, nearly all of this reduction is attributed to a single forb species. Ballhead sandwort (*Arenaria congesta*) contributed 55 of the 59 lbs/acre of forb production in the unburned area. Production of this species was 27 lbs/acre in the burned area. The list of species made at these sites in August 2003 (table 2) indicates that sampling earlier in the summer would likely improve the production data for forbs.

Although forb production measured in October was 37 lbs/acre less in the burned area, 17 forb species were found in the burned area in August compared to six forb species in the unburned area. As might be expected, a greater number of annual forb species was found in the burned area. However, there were also more perennial forb species in the burned area (table 2). Twelve graminoid species were found in the burned area compared to eight in the unburned area. Foxtail wheatgrass (*Elymus saxicola*), recognized as a hybrid cross of squirrel tail (*Elymus elymoides*) and bluebunch wheatgrass (*Elymus spicatus*), was one of the grasses of much greater cover in the burned area compared to the unburned area (table 2). I have noted plants of this taxon to be comparatively common in other recent burns.

Four forbs of the Chicory Tribe of the sunflower (Asteraceae) family that are likely of high value for sage grouse were found in the burn. Only one of these was found in the unburned area (table 2). All of these are well adapted to fire.

Crown cover of mountain big sagebrush was measured at 35.5 percent in the unburned area and zero percent in the burned area. Crown cover of yellowbrush (*Chrysothamnus viscidiflorus* var. *lanceolatus*) was 2.8 and 2.2 percent, respectively, in and out of the burn (table 3).

Table 2—Estimated crown cover of species found in 1/10 acre plots on 6 August 2003.

Common name	Scientific name	% Crown cover	
		Burned	Unburned
Shrubs			
Mountain big sagebrush	<i>Artemisia tridentata vaseyana</i>	0.2	38.0
Yellowbrush	<i>Chrysothamnus viscidiflorus lanceolatus</i>	2.0	3.0
Oregon grape	<i>Mahonia repens</i>	0.1	—
Graminoids			
Liddon sedge	<i>Carex petasata</i>	0.8	—
Ross sedge	<i>Carex rossii</i>	0.2	1
Squirreltail	<i>Elymus elymoides</i>	14.0	0.1
Foxtail wheatgrass	<i>Elymus saxicola</i>	6.0	0.2
Bluebunch wheatgrass	<i>Elymus spicatus</i>	10.0	5
Thickspike wheatgrass	<i>Elymus lanceolatus</i>	6.0	—
Junegrass	<i>Koeleria macrantha</i>	—	0.1
Muttongrass	<i>Poa fendleriana</i>	1.0	—
Kentucky bluegrass	<i>Poa pratensis</i>	0.1	1
Sandberg bluegrass	<i>Poa secunda</i>	0.2	2
Needle-and-thread	<i>Stipa comata</i>	1.0	—
Letterman needlegrass	<i>Stipa lettermanii</i>	1.0	1.0
Columbia needlegrass	<i>Stipa nelsonii</i>	0.5	—
Perennial forbs			
Mountain dandelion	<i>Agoseris glauca</i> ^a	0.1	—
Pussytoes	<i>Antennaria microphylla</i>	—	0.1
Ballhead sandwort	<i>Arenaria congesta</i>	2.0	4
Cainville thistle	<i>Cirsium calcareum</i>	0.5	0.1
Whorled buckwheat	<i>Eriogonum heracleoides</i>	0.7	0.1
Pale stickseed	<i>Hackelia patens</i>	0.4	—
Hoary aster	<i>Machaeranthera canescens</i>	0.5	—
Watson penstemon	<i>Penstemon watsonii</i>	—	0.2
Longleaf phlox	<i>Phlox longifolia</i>	0.1	—
Munro globemallow	<i>Sphaeralcea munroana</i>	2.0	—
Common dandelion	<i>Taraxacum officinale</i> ^a	0.2	—
Annual and biennial forbs			
Musk thistle	<i>Carduus nutans</i>	0.1	—
Mountain goosefoot	<i>Chenopodium atrovirens</i>	0.2	—
Autumn willowherb	<i>Epilobium brachycarpum</i>	0.1	—
Groundsmoke	<i>Gayophytum</i> sp.	0.2	—
Western stickseed	<i>Lappula occidentalis</i>	0.1	—
Prickly lettuce	<i>Lactuca serriola</i> ^a	0.1	—
Douglas knotweed	<i>Polygonum douglasii</i>	0.1	—
Yellow salsify	<i>Tragopogon dubius</i> ^a	0.2	0.1

^aThese four species of the Chicory Tribe of Asteraceae with milky juice are likely highly selected by sage grouse. All of these appear to be well adapted to fire.

Table 3—Percent crown cover of shrubs based on 500 ft of line intercept.

	Not burned	Burned
Sagebrush	35.5	0
Yellowbrush	2.2	2.8
Total shrub crown cover	37.7	2.8

Management Implications

The strong contrast of herbaceous production between the burned and unburned sites is a clear demonstration of increase of herbaceous production that can be achieved by burning in mountain big sagebrush communities. The contrast strongly supports a concept of competitive relationships between sagebrush and its herbaceous understory as suggested by Winward (1991).

However, the mountain big sagebrush ecosystem is extensive and highly variable. Results achieved at Trout Creek are likely typical of many areas, but perhaps not typical of others.

Work in Idaho (Jensen 1984) and Utah (Woodward 1981; Woodward and others 1984) strongly suggests that sites with high K-Mg ratios in the soil favor the growth of shrubs and sites with low K-Mg ratios favor grass production. On sites deficient in magnesium but having adequate potassium, plant species having large root cation exchange capacity may be at a competitive advantage. In the Utah study dicots were found with high root cation exchange capacity and monocots (grasses) were found with low cation exchange capacity. Big sagebrush was found with about 2.6 times greater root cation exchange capacity than bluebunch wheatgrass and other perennial grasses included in the Utah study (Woodward and others 1984).

These relationships are likely factors in varied responses to burning that might be found within sagebrush areas. McArthur and Plummer (1978) suggested range managers will benefit by learning as much as they can about variation in sagebrush. Such differences as adaptation, palatability, height, and other features should be considered in management decisions. The same can be said of learning more about sites on which sagebrush grows. The more known about specific sagebrush sites, the more likely desired outcomes will result from management actions.

Winward (1991) suggested release of understory is related to crown cover of sagebrush prior to burning. He suggested comparatively little release of the herbaceous understory where crown cover of mountain big sagebrush was less than about 20 percent. Crown cover of mountain big sagebrush in the burned area was 0 percent. Crown cover of this shrub in the unburned area was 35.5 percent. This is well within the range of sagebrush cover suggested by Winward (1991) where release of understory species might be expected.

The fourth year post burn production measurements taken at this site likely represent the peak in contrast between the burned and unburned areas. Measurements of production in additional years would give a more complete history of response of production to burning.

As reported by Goodrich and others (this proceedings), fire can be used as a tool to create diversity in crown cover of shrubs. The Trout Creek burn demonstrates diversity in herbaceous production and species composition where burned areas are adjacent to unburned areas.

All but three species found in the unburned area were found in the burned area at four years post burn. This indicates resilience and fire adaptability of plants found in the mountain big sagebrush communities of this area. Although mountain big sagebrush was killed across all of the burn, sagebrush reestablished in the burn from seed, and by 2003 (four years post burn) mature plants of sagebrush were producing seed (fig. 3).

The Trout Creek Fire burned in a large sagebrush area where potential for fire was in the thousands of acres. That this burn was controlled after it burned only about 20 acres is evidence that small burns are possible within mountain big sagebrush areas. This control was achieved by pre-ignition preparation and heavy presence of suppression equipment and personnel during the burning (Schoppe, personal communication). This example is not suggested as reason to ignore the potential for prescribed burns to grow beyond planned size. However, the Trout Creek Burn stands as evidence that small burns can be achieved in this type.

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