Impact of Wildfire on Three Perennial Grasses in South-Central Washington

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Highlight: *In a south-central Washington sagebrush-bluebunch wheatgrass community, bluebunch wheatgrass responded to burning by increased vegetative and reproductive performance. Burning decreased the vegetative and reproductive vigor of Cusick bluegrass and Thurber needlegrass.*

Wildfire is a common occurrence in the steppe region of south-central Washington. Knowledge of plant response to fire can be useful in managing for long-term productivity of important livestock forages. Fire can be detrimental to a plant community as reflected in a reduction of growth or reproductive vigor or it may improve the quantity and quality of forage by eliminating unpalatable fire-sensitive species.

Literature reviews on fire and its effects on western grasslands are presented by Daubenmire (1968); Vogl (1974); Vallentine (1974); and Daubenmire (1975). Blaisdell (1953), Pechanec and Stewart (1944) reported that yields of bluebunch wheatgrass (*Agropyron spicatum*) were considerably higher on burned than unburned areas. Wright and Klemmedson (1965) showed that season of burning was an important variable in the degree of damage to Thurber needlegrass (*Stipa thurberiana*), but bluebunch wheatgrass and Cusick bluegrass (*Poa cusickii*) were also deleteriously affected by burning. Mueggler and Blaisdell (1958) reported burning was initially deleterious to bluebunch wheatgrass, but it recovered within 3 years. Conrad and Poulton (1966) found that bluebunch wheatgrass lost 52% of its basal area following a burn. This study reports the effects of a wildfire upon a sagebrush-bluebunch wheatgrass community in the semiarid steppe region of south-central Washington.

Study Area and Methods

The study area is located on the Arid Lands Ecology (ALE) Reserve situated within the confines of the Energy Research and Development Administration's Hanford Reservation on the east-facing slopes of the Lower Rattlesnake Hills. The elevation is approximately 1,300 ft above mean sea level with an average annual precipitation of 23 cm. Rickard et al. (1975) described the study area as a homogenous plant community. The area was similar in species composition, biomass, slope, exposure, elevation, soil type, and chemical properties.

A wildfire initiated by a lightning strike in mid-August 1973 burned through a portion of a sagebrush-bluebunch wheatgrass community that had been studied as a control site in conjunction with the International Biological Program, Grasslands Biome. A paved roadway separated the community into two sections and this road prevented the fire from burning through the entire community. For the purpose of this paper, a 9-ha area served as the control (unburned) and another 9-ha area served as a burned site. The unburned site had not been burned for at least 30 years.

Sampling for aboveground phytomass was accomplished in the spring of 1974 by harvesting eight replicated areas in the burned and unburned study areas. Each replicate, 15 X 30 m, was randomly selected within each 9-ha area. Two circular 0.5-m^2 plot frames were positioned at random within each of the replicated areas and all plants were clipped by hand at ground level by species. The live and dead phytomass were separated by species, oven dried, and weighed.

Individual clumps of bluebunch wheatgrass, Cusick bluegrass, and Thurber needlegrass were measured for length of living (green) leaves, flowering culms, spikes, number of flowering culms, and clump area (length × width) when plants were reproductively mature but not dried from summer drought. For these measurements, two random points were located in each replicate and a 0.5 m^2 circular frame was placed at each point. A maximum of six clumps of bluebunch wheatgrass was chosen for measurement. If more than six clumps occurred inside the circular frame, six clumps were selected at random.

Cusick bluegrass and Thurber needlegrass were sparsely represented in both areas. The first six clumps encountered in a search within each replicate were chosen for measurement. All other measurements follow Rickard et al. (1975).

Table 1. Comparison of peak live and dead herbage (g/m^2 ± standard error) on burned and unburned communities during the spring of 1974.

Species	Burned	Unburned
Live herbage		
Bluebunch wheatgrass	61.0 ± 11.0	46.6 10.0
Cusick bluegrass	2.4 ± 1.1	4.2 3.8
Thurber needlegrass	0.8 ± 0.5	2.1 2.1
Dead herbage		
Bluebunch wheatgrass	0	58.6 ± 12.5
Cusick bluegrass	0	3.8 ± 3.4
Thurber needlegrass	0	1.0 ± 1.0

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Table 2. Leaf length (cm) and basal area (cm^2) of crowns of perennial grasses on a burned and unburned community in 1974.

Species	Average leaf length		Basal area	
	Burned	Unburned	Burned	Unburned
Bluebunch wheatgrass	**23.9 ± 0.3[1]	31.1 ± 0.3	243.7 ± 41.1	257.1 ± 46.6
Cusick bluegrass	**14.1 ± 0.2	21.9 ± 0.2	**219.9 ± 23.3	381.7 ± 35.5
Thurber needlegrass	**14.3 ± 0.2	27.5 ± 0.3	** 52.5 ± 5.9	89.9 ± 8.4

**Significantly different from unburned at $\alpha \leqslant 0.01$.
[1] Mean ± standard error of the mean.

Table 3. Culm, spike length (cm), and number of flowering culms per clump of perennial grasses on a burned and unburned community during the spring of 1974.

Species	Culm length		Spike length		Number of flowering culms per clump	
	Burned	Unburned	Burned	Unburned	Burned	Unburned
Bluebunch wheatgrass	**51.9 ± 0.4[1]	43.4 ± 1.0	**8.1 ± 0.1	6.5 ± 0.2	31.4 ± 7.1	19.1 ± 5.2
Cusick bluegrass	46.6 ± 0.8	46.9 ± 0.6	**5.7 ± 0.1	6.4 ± 0.1	**4.3 ± 0.9	9.5 ± 2.0
Thurber needlegrass	**37.9 ± 0.5	44.7 ± 0.5	9.9 ± 0.1	9.9 ± 0.2	13.6 ± 1.1	15.4 ± 1.6

**Significantly different from unburned at $\alpha \leqslant 0.01$.
[1] Mean ± standard error of the mean.

All comparisons were subjected to *t*-tests according to procedures described by Snedecor and Cochran (1967).

Results and Discussion

Harvests of the three important cattle forage grasses in burned and unburned plant communities are shown in Table 1. Clearly, burning stimulated the growth of bluebunch wheatgrass. The burned community yielded a 24% increase over the unburned community during the first post-burn season. However, Daubenmire (1975) reported a 50% reduction in dry matter production during the first post-burn season. Blaisdell (1953) and Mueggler and Blaisdell (1958) reported that several years after a fire, bluebunch wheatgrass will increase in dry-matter production. There was not enough Cusick bluegrass or Thurber needlegrass to make a quantitative assessment of the effect of burning on phytomass production of these species. All of the dead plant material from the previous years was burned by fire on the burned community. The standing dead material for bluebunch wheatgrass in the unburned community was approximately 59 g/m^2. Cusick bluegrass and Thurber needlegrass had an average of 4 and 1 g/m^2, respectively.

Burning decreased the average leaf lengths for all species of grasses (Table 2). The greater yield of bluebunch wheatgrass in the burned community is attributed to either more leaves or leaves with greater dry weights. Cusick bluegrass had shorter leaves than either bluebunch wheatgrass or Thurber needlegrass. Burning decreased the basal area of Cusick bluegrass and Thurber needlegrass, but the basal area of bluebunch wheatgrass was not affected by burning. The average basal area of Thurber needlegrass was less than that of bluebunch wheatgrass or Cusick bluegrass.

The data shown in Table 3 indicate that the number of flowering culms per clump was reduced after burning for Cusick bluegrass; however, bluebunch wheatgrass and Thurber needlegrass showed no effects from burning. Burning promoted elongation of flowering culms in bluebunch wheatgrass but reduced the length of culms in Thurber needlegrass. The culm length of Cusick bluegrass was not affected by burning. Burning promoted longer spike lengths in bluebunch wheatgrass and shorter spikes for Cusick bluegrass. Spikes of Thurber needlegrass were not affected by burning.

These data show that the responses of perennial bunchgrasses to burning depend upon the species and the particular parameter measured. In general, bluebunch wheatgrass responded to burning by increasing vegetative growth and by superior reproductive performance. Burning was detrimental to vegetative and reproductive performance of Cusick bluegrass but had little effect on Thurber needlegrass other than a reduction in basal area.

Burning was expected to have less of a deleterious impact on the perennial grasses than cattle grazing because burning occurred in late summer when the plants were dry and mature while grazing occurred during the growing season (Rickard et al., 1975). The effect of burning on Cusick bluegrass and Thurber needlegrass was similar to spring grazing by cattle. However, the growth of bluebunch wheatgrass was enhanced by burning and deleteriously affected by grazing.

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