TECHNICAL NOTES

Effect of a Wildfire on Idaho Fescue and Bluebunch Wheatgrass[1]

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Highlight

The accidental burn of a research site in sagebrush-grass vegetation created an opportunity to investigate some factors which affect the susceptibility of Idaho fescue and bluebunch wheatgrass to damage by fire. The former was more susceptible than the latter. Factors associated with relief increased and those associated with grazing prior to the burn decreased the detrimental effects of fire.

Fire! Both a friend and enemy of the range man. Shortly after completion of field work on what was to have been a long-term study of range condition and trend, a hot wildfire raced across our study area in northeastern Oregon. The fire occurred in July, 1960; by then, the plants had produced seed and had dried.

Two of the important plant associations in the study area were *Artemisia tridentata/Festuca idahoensis* (big sagebrush/Idaho fescue) and *Artemisia tridentata/Agropyron spicatum* (big sagebrush/bluebunch wheatgrass. A partial characterization of these associations, as they were before the fire, is shown in Table 1. Knowledge of these associations and availability of an 80-acre livestock exclosure in the study area led us to feel that information should be obtained to improve our understanding of the susceptibility of the two dominant grasses to fire damage.

The livestock exclosure was established in 1940 and most all livestock have been excluded since that time. The long protection from grazing had resulted in marked range improvement with considerable accumulation of old growth and consequently of fuel supply. Grazing outside may, in addition, have produced some differences in vigor of the plants at the time of the burn. The opportunity, thus, existed to consider the net influence of protection and grazing on the effects of a wildfire. Relief variation was such that comparable directions of slope could also be considered both inside and outside of the exclosure.

Blaisdell (1953) and Pechanec, Stewart, and Blaisdell (1954) have reported on work in southeastern Idaho which shows that Idaho fescue was severely damaged by fire with a strong carryover of the detrimental effect. Bluebunch wheatgrass, on the other hand, was only slightly damaged and in three years had exceeded its preburn production.

Table 1. Foliar-cover and soil-surface features (in percent) for the plant communities prior to burning.

Item	Plant Community Artr/Feid	Artr/Agsp
Big sagebrush	9	1
Idaho fescue	46	4
Bluebunch wheatgrass	6	42
Cheatgrass	10	30
Stone & Gravel	20	27
Bare soil	10	8

Methods

In August, after the wildfire, and before any rain had fallen on the area, groups of 25 plants each of Idaho fescue and bluebunch wheatgrass were staked and measured on different aspects both within and outside the exclosure. All Idaho fescue groups were marked in the sagebrush/fescue association and all bluebunch wheatgrass in the sagebrush/wheatgrass association. Separate Idaho fescue groups were marked on north, northwest, northeast, and ridgetop aspects. The north aspect was grazed and the other three were both grazed and ungrazed. Bluebunch wheatgrass plants were marked on southeast and ridgetop exposures with grazed and ungrazed conditions possible only for the southeast exposure. In each case, the plants were selected by walking along a line through the center of the relief condition being sampled. In each association, the sample plant was determined by taking the nearest member of the selected species at every fifth step. Each plant was marked with a wooden stake.

To avoid additional injury when the plants were selected, tentative identification was made in August, 1960. Because of the distinctive morphological characteristics of these two species, identification of the burned material was reasonably good; but some errors were made. Upon re-examination the following year, identification of all marked plants was checked on living material where possible. For plants killed by the fire, identification was verified by root characteristics. Bluebunch wheatgrass is the only grass in these associations that produces rhizomes and Idaho fescue has much

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darker roots than the other grasses. Our final sample included 20 to 25 bluebunch wheatgrass plants and 16 to 25 Idaho fescue plants per group. Data were summarized on the basis of the number of correctly identified plants.

Unfortunately, data were not available on the basal area or diameter of the individual plants prior to the burn so two measurements of the basal diameter of each plant were made at the time they were marked. This was taken as an estimate of the pre-burn diameter. In the case of all low-intensity classes of burn, these measurements gave essentially the pre-burn diameters.

We measured the distance to the nearest shrub if it was 6 ft or less. We felt this distance may have influenced the effect of the fire on the grasses. Identification of the shrub species was not attempted, but nearly all were big sagebrush. The only other possibilities would have been a rare occurrence of antelope bitterbrush *(Purshia tridentata)* or of rabbitbrush *(Chrysothamnus* spp.) plants. In many cases, the intensity (heat) of the fire was so great that the stems of shrubs were burned into the ground.

The intensity of burn was rated for each grass plant according to the following scale:

1. Plants unburned, but may be scorched.
2. Plants partially burned, but not within two inches of the root crown.
3. Plants severely burned, but with some unburned stubble less than two inches.
4. Plants extremely burned, all unburned stubble less than two inches and mostly confined to an outer ring.
5. Plants completely burned, no unburned material above the root crown.

The authors wish to acknowledge the contributions of the U. S. Bureau of Land Management to this study. The exclosure, where the work was done, was built by the Civilian Conservation Corps and has been maintained by the Bureau. It was made available to Oregon State University to use in grazing succession studies.

Results

In August, 1960, after the burn, the area appeared completely desolate. Eleven months later, June, 1961, there was considerable green growth but islands of dense cheatgrass brome *(Bromus tectorum)* were obvious. Most of these islands could be traced to areas that were barren of bluebunch wheatgrass before the fire. As a result, cheatgrass was dominant and remained so after the fire.

As evidence of the heat of the fire, iron pipes used for staking plots on an earlier study had turned to the bluish cast characteristic of overheated metal. In the few unburned patches, leaves on some sagebrush plants were curled, were brittle, and fell at the slightest touch. Some of these plants were not alive in June, 1961.

Based on the above burn-intensity classes, the average burn-intensity index was 3.2 on 150 staked Idaho fescue plants, with the majority of plants in classes 3 and 2. Item 4 in Table 2 shows the average burn intensity by aspect and grazing history. The fire originated northwest of the exclosure and apparently was driven by wind from that direction. The Idaho fescue plants that received the least intense burn were on the north and northwest slopes and those most intensely burned were on the ridgetop and northeast slope. The burn intensity on Idaho fescue also tended to be higher on the ungrazed than on the grazed, northerly aspects. Survival of the Idaho fescue plants (Table 2, Item 5) followed a somewhat different pattern from that of burn intensity. The ridgetop was the only area where survival of fescue dropped below 65%, but survival did not exceed 82% in any location. Survival on the ridgetop was poorer on the ungrazed area even though burn intensity was lower than on the grazed area. This apparent inconsistency caused us to look back at the field data. We found all of the dead plants on the grazed ridgetop

Table 2. Some effects of slope and grazing on the severity of a wildfire on Idaho fescue and bluebunch wheatgrass. Fire occurred July, 1960, in northeastern Oregon.

Item	Idaho fescue								Bluebunch wheatgrass			
1. Slope direction[1]	N	NW	NW	NE	NE	RT	RT	ALL	SE	SE	RT	ALL
2. Grazing history[2]	G	G	U	G	U	G	U	....	G	U	U	....
3. Number of plants	24	22	21	21	25	21	16	150	20	25	22	67
4. Average burn intensity	2.70	2.50	3.00	3.40	3.70	3.70	3.30	3.20	3.40	3.30	3.60	3.40
5. Percent of plants alive 11 months after burn	79	82	71	71	80	62	56	73	95	100	100	99
6. Estimated preburn basal diameter of living plant material (ft)	0.17	0.15	0.19	0.15	0.22	0.19	0.15	0.18	0.68	0.66	0.51	0.62
7. Percent of preburn basal diameter living 11 months after burn, excluding dead plants	80	67	63	86	62	67	53	71	94	58	45	71

[1]Slope direction: N = north>50% slope, NW = northwest>40%, NE = northeast>40%, RT = ridgetop<5%, SE = southeast>40%.

[2]G = grazed moderately in recent years; U = ungrazed, protected for about 19 years by a livestock exclosure.

were in burn intensity classes 4 and 5. In contrast, some plants in each of classes 2, 3, 4 and 5 on the ungrazed ridgetop died. In these latter instances, the fire may have smoldered in the plant crowns because of accumulated debris. This "slow" burn may have been more damaging than the average burn intensity for the ungrazed ridgetop would indicate.

The average burn intensity on 67 bluebunch wheatgrass plants was 3.4 (Table 2, Item 4). Burn intensity on this species was less variable than on Idaho fescue. Compared with the intensity on the grazed, southeast slope, it was a little higher on the ungrazed ridgetop and lower on the ungrazed, southeast slope. Bluebunch wheatgrass plants in these comparisons almost all survived the burn (Table 2, Item 5).

Change of basal diameter in the first year after the fire was used as an index of vigor. Item 7 in Table 2 shows the effect of the fire on living basal diameter. Only the plants that were still living in June were used to calculate change in basal diameter.

The most severe reduction in basal diameter of Idaho fescue occurred on the ridgetop. Diameter reduction of plants on comparable slopes was decidedly less under grazed conditions, 27%, than under ungrazed conditions, 40%. Thus, here are two important effects of fire on Idaho fescue—(1) reduction of plant numbers and (2) reduction of plant size—and these were influenced by grazing and slope.

Bluebunch wheatgrass plants lost almost half of their basal diameter, 52%, in the ungrazed areas of the burn. On the southeast slopes that were both ungrazed and grazed, the loss of diameter was 6% against 42%, respectively. Thus, the primary effect of fire on bluebunch wheatgrass is reduction of plant size, not plant density. This effect was influenced by grazing and possibly by slope.

Some of the data were rearranged according to burn intensity (Table 3). These data indicate strong relationships between the burn-intensity index and both percent of plants killed and reduction of basal diameter. Idaho fescue is much more easily killed than bluebunch wheatgrass and is particularly sensitive to intensity of burn on individual plants (Table 3, Item 3)—especially when the above-ground material is extremely to completely burned. The same conclusions are supported by the basal diameter data (Table 3, Item 4).

The effect of fire on the relative vigor of these two species is indicated by the change in basal diameter (Table 3, Items 4 and 5). The values given in Item 4 include all plants whether they lived or died. If the plant died, its diameter was zero. Since the dead plants were eliminated in the calculation of values in Item 5, these percentages index the relative impact of burning on living material of each species, or on plant vigor. If there were no effect of burn intensity on plant vigor, the values in Item 5 should all be the same. This is essentially true for bluebunch wheatgrass, but the vigor of living Idaho fescue plants is apparently reduced by the extreme and complete burn intensities.

Some loss may also have occurred soon after the fire due to broken summer dormancy of plants of both species. Some plants had sprouted and sent up weak, green growth which died within a month after the fire even though there had been no rain. This phenomenon may have affected plant diameter more than to have been the cause of complete death of the plant.

The measurements of distance to nearest shrub showed no relationship to severity of burn or impact on the plants. This may have resulted from at least two things: (1) the low cover of big sagebrush in each of the communities (Table 1), and (2) the way our data were taken. In retrospect, we believe that the distance from each staked plant to the single, nearest shrub provides insufficient data to show a relationship between shrub density and the effect of fire. A truer index of the density of shrubs surrounding each staked plant may have enabled detection of possible relationships between amount of woody material and the effects of fire on individual staked plants. A better index of density could have been obtained by measuring the distance from each staked grass to all shubs within a six-foot radius.

Conclusions

The following conclusions are suggested by the results of our examination of Idaho fescue and bluebunch wheatgrass plants following the wildfire.

1. Idaho fescue is more critically affected by fire than is bluebunch wheatgrass. The adverse effect on Idaho fescue is both in complete mortality and reduction of basal diameter of plants left alive. The effect on bluebunch wheatgrass is primarily limited to a reduction of basal diameter.

A basic difference exists between these two species in northeastern Oregon, which may explain the greater death loss of Idaho fescue. Idaho fescue is characterized by a compact root crown area where the budding zone is confined to a rela-

Table 3. Some effects of burn intensity on the severity of a wildfire on Idaho fescue and bluebunch wheatgrass.

Item	Idaho fescue						Bluebunch wheatgrass					
	Burn intensity classes					All	Burn intensity classes					All
	1	2	3	4	5	Classes	1	2	3	4	5	Classes
1. Number of plants	1	54	38	29	28	150	0	8	26	28	5	67
2. Percent of total plants	1	36	25	19	19	100	0	12	39	42	7	100
3. Percent of plants alive 11 months after burn	100	96	92	52	21	73	0	100	96	100	100	99
4. Percent of preburn basal diameter living 11 months after burn—including zero for dead plants	100	73	65	33	4	50	..	73	75	64	78	71
5. Same as item 4 except dead plants excluded	100	80	74	59	18	71	..	73	76	64	78	71

tively small area as compared to bluebunch wheatgrass. In addition, the budding areas of Idaho fescue plants are at or above the surface of the ground. On the other hand, bluebunch wheatgrass has short rhizomes that produce buds below the ground surface. This results in the heat of the fire being more directly on living material of Idaho fescue than of bluebunch wheatgrass.

2. Grazing Idaho fescue and bluebunch wheatgrass before a fire may reduce loss of individual plants.

This conclusion is particularly supported by the effects on plant diameter. Where particular slope aspects were grazed, the loss of plant diameter was lower than where comparable slopes were ungrazed. If this conclusion is correct, one would expect moderate to heavy grazing on the year before burning to benefit the plants. If the plants were grazed, however, some rest in at least the second year before grazing would be needed to let the plants become as vigorous as possible.

3. The intensity of a burn tends to be greater on ridgetops and northeasterly slopes, but the impact on the plants is consistently greatest only on the ridgetops.

As evidence for this conclusion, the burn-intensity index was highest on the ridgetops and next highest on the northeasterly facing slopes. In addition, the greatest loss of Idaho fescue and the greatest reduction of basal diameter of bluebunch wheatgrass occurred on the ridgetops.

LITERATURE CITED

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