Grazing Return Following Sagebrush Control in Eastern Oregon[1]

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Highlight

In the 17 years following chemical brush control of a 40-acre big sagebrush-bunchgrass range, grazed during or after seed maturity of the principal grasses, yearling days of grazing increased 1.9 times as much and per acre beef gains were 2.3 times that prior to brush control. Total herbage production averaged 227 lb./acre prior to treatment and 681 lb./acre in the years following treatment. The internal rate of return derived from the beef returns of this study and estimated costs was in excess of 50%. Brush return was slow during the first decade following treatment but is now rapidly approaching pretreatment numbers and dispersion characteristics.

Two decades ago a number of researchers (Elwell and Cox, 1950; Doran, 1951; Cornelius and Graham, 1951; Hull and Vaughn, 1951; Hull, et al., 1952; Hyder, 1953) were engaged in chemical brush control investigations. As a result of those and subsequent studies, chemical brush control is the most widely used technique for increasing forage production on brush range in the western United States today. The long-term response of controlled range is just now becoming available (Johnson, 1969). He found that (1) brush numbers and area of live brush crown cover on nongrazed portions of the treated range, 14 to 17 years after treatment, equaled or exceeded that on nongrazed control plots, (2) grazing following control reduced the life expectancy to nine years, and (3) increased herbage production was nullified within 6 years after grazing.

The grazing return of a 40-acre native sagebrush-bunchgrass range following chemical brush control in 1952 (Fig. 1) are presented in this paper.[2] The principal value of this study lies in its length of record even though the study provides only one estimate for a single vegetation type under a specified grazing program across years.

Demonstration Area and Procedure

The Squaw Butte Experiment Station is located near Burns in southeastern Oregon on high desert country (approximately 4,500 ft elevation). Thirty-year mean annual precipitation is 11.71 inches, most of which is received in the form of snow or rain in the winter months. Sagebrush-bunchgrass, sometimes in association with juniper, characterizes the landscape.

The demonstration area consists of a 40-acre native-range that was used as a holding pasture for animals of the Station herd prior to 1950. Big sagebrush (*Artemisia tridentata,* Nutt.) dominated the area. The principal grass species were bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. & Smith), Junegrass (*Koeleria cristata* (L.) Pers.), Idaho fescue (*Festuca idahoensis* Elmer), bottlebrush squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith), and Thurbers needlegrass (*Stipa thurberiania,* Piper).

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FIG. 1. Photos taken in 1970 inside the treated 40-acre pasture (left and right) and of the adjoining untreated area (center photo).

The pasture was sampled in 1950 and annually thereafter, prior to grazing, for herbage yield and species composition. The grazing capacity was based upon 50% utilization or 300 lb./acre residue remaining of forage species, whichever was the least with an allowance of 20 pounds of air dry forage/animal/day. Downy bromegrass (*Bromus tectorum* L.) was considered nonforage along with broadleaf weeds; the latter contributing less than 10% of the total yield in most years.

Grazing extended over a 15- to 30-day period, mostly in August and less often in July. Yearlings grazed the pasture at the outset of this study but other classes of animals were used in some of the later years. In all years except 1968, the animals were individually weighed in and out of the pasture following an overnight shrink, off feed and water.

Because old herbage accumulation made species separation of the yield harvest difficult, stocking pressure was intentionally increased in 1963 to graze off current growth of downy brome and accumulated herbage. Mature cows were used in September 1968 to clean the pasture a second time.

We treated the brush in 1952 with 2 lb. of 2,4-D (2,4-dichlorophenoxy acetic acid) in 20 gallons of water/acre, applied with a boom-type sprayer mounted on a 1.5 ton truck. Two areas, inaccessible to the truck, one of approximately one acre and another of 0.6 acre were not treated. No measurement of brush killed was taken, but a visual estimate of mortality in 1953 was in excess of 90%.

Samples to estimate return of brush were taken in 1959 and every four years thereafter. We counted big sagebrush plants under and over 6 inches tall in circular 200 ft^2 plots on a uniform 1 chain (66 ft) grid.

Results and Discussion

Herbage yield fluctuations were closely dependent upon the amount of precipitation received in the crop year (Fig. 2). The opportunities to

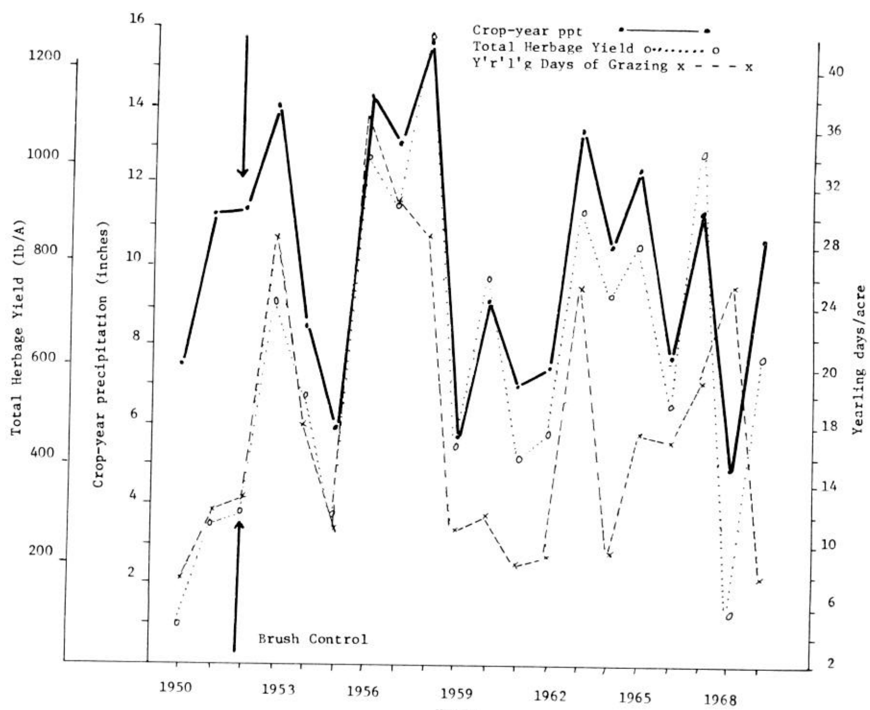

FIG. 2. Crop-year precipitation, total herbage yield, and yearling days of grazing before and after brush control.

Table 1. Crop-year precipitation (inches) (Sept. 1 to June 30), month of grazing, animal numbers and weight (lb.), daily gain (lb.), and gain per acre (lb.) for a 40-acre pasture treated for brush control in 1952.

Year	ppt	Month	No.	Wt[1]	ADG	Gain/acre
Pre-spray						
1950	7.5	Aug.	7	318	1.09[2]	6.1
1951	11.3	Aug.	14	613	0.58	5.6
1952	11.4	Aug.	15	625	0.74	8.4
Avg.	10.1		12	552	0.80	6.7
Post-spray						
1953	14.0	Aug.	90	598	0.62	17.6
1954	8.4	Aug.	32	672	1.37	21.9
1955	5.9	Aug.	12	627	1.18	9.9
1956	14.3	Aug.	55	680	0.53	20.0
1957	13.0	Aug.	45	616	0.43	13.6
1958	15.8	July	38	620	0.88	24.2
1959	5.8	July	12	677	1.80	16.2
1960	9.2	July	15	619	0.95	10.0
1961	7.0	July	10	648	0.87	6.0
1962	7.5	Aug.	10	768	1.41	10.5
1963	13.5	Aug.	39	728	0.34	8.8
1964	10.5	July	17	637	2.70	21.0
1965	12.5	Aug.	31	685	1.22	18.9
1966	7.7	Aug.	50	747	2.08[3]	29.0
1967	11.4	Aug.	33	717	0.76	14.4
1968[4]	4.9	Aug.	20	—	—	—
		Sept.[5]	131	—	—	—
1969	10.7	Aug.	14	899[6]	0.69	4.1
Avg.	10.1	—	31	684	1.05	15.4

[1] Mean animal weight into pasture.
[2] Immediately preceding this grazing period these animals had come from another range pasture and were out of water for two days.
[3] Yearlings were supplemented while grazing this pasture. Their weight gains are not included in computing averages.
[4] Animal weights were not taken because of short grazing periods.
[5] Cows used for clean-up. Yearling days computed as 1 day = 0.75 cow day.
[6] Replacement heifers used in this year.

utilize this relationship on semiarid ranges have been presented (Sneva and Hyder, 1962a; and Sneva and Hyder, 1962b). Following brush control, herbage yield ranged from 100 to 1,200 lb./acre and averaged three times as much as was produced prior to brush control (681 vs 227 lb./acre).

Carrying capacity (yearling days of grazing) increased from an average 360 to 658 days, 1.8 times as much. Fluctuations in carrying capacity also depended upon the amount of precipitation received (Fig. 2) but they were also altered considerably by the varying amounts of nonforage plants present, principally downy bromegrass. This grass, after brush control, varied annually from 1 to 59% of the total herbage yield. Thus, in some years stocking was computed on less than half of the total herbage produced.

No measurements of actual range utilization were made during the course of this study. A stocking rate, to achieve 50% utilization of forage species, was employed in all years except 1953, 1956, 1957, 1958, and 1967; in those years utilization was heavier, varying from 54 to 68%. In 1963 and 1968, stocking was intentionally increased to clean up the old accumulated herbage, mostly downy bromegrass, that was making species separation difficult. Utilization of current season growth in 1963 and 1968 may have approached 100%.

Nonforage plants (principally downy bromegrass) contributed approximately 32% of the total herbage yield over the 17-year period. Utilization estimates based upon total herbage production would be considerably lower than those based on production of forage species. Stocking rates over the 17 years have been at a level that should have provided for optimum ecological development. Further, stocking levels should not have depressed animal gain, except in one of the two years of planned heavy grazing.

Grazing on this mature forage did not produce high daily gains in most years (Table 1) but should have provided for minimum grazing impact on the grasses. The increase in post-spray daily gain resulted, primarily, from those years in which grazing occurred during July when nutrient quality was higher. The extremely low daily gain of 0.34 lb./day resulted from a planned, heavy stocking pressure that forced animals to graze downy bromegrass as well as herbage carried over from previous years.

Beef production per acre increased 2.3 times following brush control (Table 1). The beef produced varied from 4.1 to 24.2 lb./acre, with higher gains associated with earlier grazing periods. This suggests that greater returns might be obtained by earlier grazing in all years; however, this would most likely enhance the rate of brush return.

Beef gain per acre does not tell the complete story of this pasture following brush control. The average weight of the animals was 130 lb. heavier toward the end of the study than at the beginning; thus, more forage was consumed for maintenance requirements of the heavier animals in the later years. Soil surface protection by litter and soil enhancement by organic matter additions have likely increased because, on the average, more herbage remained after grazing follow-

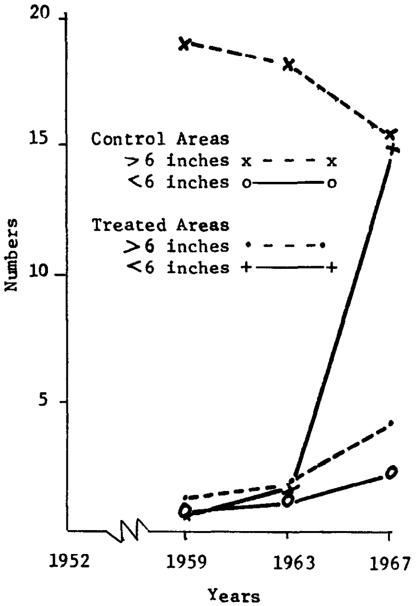

FIG. 3. Big sagebrush plants per 200 ft^2 under 6 inches and over 6 inches on treated areas after brush control in 1952, and under 6 inches and over 6 inches on untreated areas.

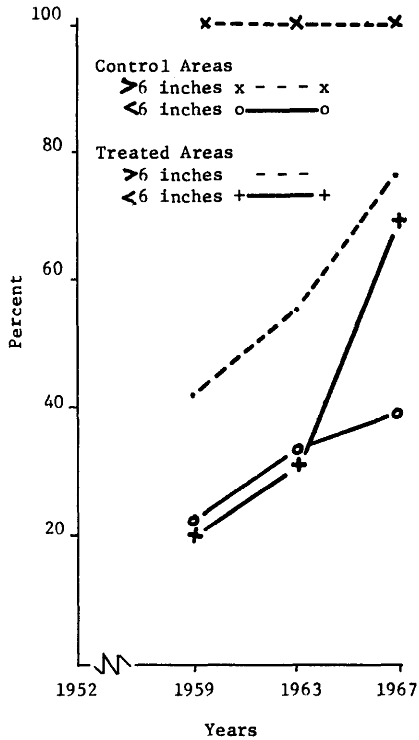

FIG. 4. Percent of plots occupied by big sagebrush under 6 inches and over 6 inches tall on treated areas after brush control in 1952, and under 6 inches and over 6 inches tall on untreated areas.

Table 2. Per acre costs and returns of brush control for computing the internal rate of return.

Item	Value
Initial cost of spraying	$2.90[1]
Annual cost of spraying	0.05
Additional annual operating cost	0.29[2]
Total annual cost	0.34
Additional annual income	2.18[3]
Net additional annual income	1.84

[1] Includes initial costs of fencing, water developments, and nonuse prorated to a 17-year life.
[2] Estimated as 10% of initial cost.
[3] 8.7 lb. of beef/acre (from Table 1) valued at $0.25/lb.

ing brush control than was produced prior to brush control.

The fact that brush will increase on treated range in the intermountain area is seldom questioned. The rate of brush return in this pasture is shown in Figures 3 and 4. Data collected in 1959 indicated no border effect due to the three sides of this pasture being adjacent to mature big sagebrush. The increase in young sagebrush by 1959 is apparently the progeny of plants missed at the time of treatment. Brush numbers and distribution increased exceedingly slowly until the mid '60's. By 1967, 15 years after treatment, the number of sagebrush 6 inches or less in height on the treated area approached the number of mature sagebrush (6 inches or taller) present on nontreated areas. In 1967, these small plants were well distributed throughout the 40 acres, occupying about 70% of the plots sampled. Their continued growth and eventual domination of this pasture will, most likely, depend upon the amount of precipitation received in the coming years.

The results of this study do not permit generalizing about the economics of big sagebrush control. However, the results obtained can be compared with those of other studies. For this purpose the internal rate of return from this study has been computed. Neilsen (1967) defines this rate as, "That rate of return which makes the discounted income stream over the life of the project equal to the rate at which money can be borrowed . . . . ."

Table 2 presents the pertinent information needed to compute the internal rate of return. Neilsen's cost estimates were used for fencing, water development, and nonuse. These differ from his in that they are prorated to a 17-year return. Annual cost for spraying was set at $2.00/acre since 25,000 to 40,000 acres of big sagebrush in Harney County, Oregon have been treated annually in the past 10 years for not more than $2.00/acre. The estimate for additional annual operating costs is an approximation based on values presented in Neilsen's table. The $2.18 additional income is derived from the annual beef return per acre from the demonstration reported herein and valued at $0.25/lb.

The internal rate of return for the above exceeded 50%. Neilsen's estimate for chemical brush control with meadow fertilization to balance the operation was 36%. Both of these estimates of return are high compared with rates for borrowed money. These internal rates of return confirm what many ranchers and range managers have come to realize—that chemical brush control brings an exceptional rate of return on the investment.

The productive length of this brush control demonstration (17 years, and with the end not yet reached) contrasts to that reported by Johnson (1969). Brush return on these 40 acres has been slower than that which he recorded. A longer life expectancy of brush-controlled areas in the Great Basin area might be expected because of the more intense summer drouth which may slow brush establishment. It also is noted that the stocking rate and the season of grazing during these 17 years has been controlled to favor ecological development of the grasses.

This study suggests that even when managed for minimal ecological impact that the brush will return. Thus, chemical brush control is not a permanent management feature but rather is a tool that creates a holding action against brush domination similar to that caused by wild fires prior to white man's entry onto the western range. The duration of brush control can be extended to several decades as is evidenced in this study but may also be shortened by management and by the frequency of years favorable toward brush seedling establishment following treatment.

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