



Effects of chemical control of sagebrush on the occurrence of sage grouse in Southwestern Montana
by Neil Sidney Martin

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Fish and Wildlife Management

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Abstract:

A study was conducted during the summers of 1962, 1963, and 1964 on a 1,900 acre allotment in Southwestern Montana. A total of 1,710 acres of the allotment had been sprayed in 1961 with 2,4-D to control sagebrush. A total of 190 acres of the allotment, consisting of three strips approximately one and one-quarter miles in length and five chains in width, as well as areas along streams, were left unsprayed. Objectives of my study were to obtain quantitative data on effects of chemical control of sagebrush on a sage grouse population. Canopy coverage measurements of vegetation in the 1,900 acre allotment revealed about 80 percent grasses and 20 percent forbs in sprayed strips and 60 percent grasses and 40 percent forbs in unsprayed strips. Low shrub canopy coverage in sprayed strips was reduced as compared with unsprayed strips, and 97 percent of the Big Sage plants evaluated were recorded as dead. Only eight percent were recorded as dead in unsprayed strips.

Sprayed strips provided only four percent of the 415 sage grouse observations made on the 1,900 acre allotment. Ninety-one percent of the 15 sage grouse observed in sprayed strips were within 95 feet of an unsprayed strip. Canopy coverage measurements of herbaceous vegetation at 137 sage grouse locations, most of which were outside the 1,900 acre allotment, consisted of approximately 60 percent grasses and 40 percent forbs. Low shrub canopy coverage was similar from year to year, and 92 percent of the Big Sage plants evaluated were recorded as living. The similarity of the vegetation composition at sage grouse locations and in the unsprayed strips led to the conclusion that the differences in numbers of sage grouse observed in sprayed and unsprayed strips were related to vegetation composition. Density, percent crown coverage, and maximum height of Big Sage plants were determined at each of 159 sage grouse locations. Broods, six weeks or less of age, were found on areas having a lesser density and lower percent crown coverage of Big Sage than were older broods and adults. Food habits were determined by analysis of the contents of 35 sage grouse crops. Sagebrush and three genera of forbs together constituted 94.6 percent of the total volume. Dandelion and sagebrush had the greatest total percent frequency of occurrence of all food items. These high frequency food plants were more abundant in unsprayed than in sprayed strips, which strengthened the conclusion that differences in numbers of sage grouse observed in unsprayed and sprayed strips were related to vegetation composition.

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ABSTRACT

A study was conducted during the summers of 1962, 1963, and 1964 on a 1,900 acre allotment in Southwestern Montana. A total of 1,710 acres of the allotment had been sprayed in 1961 with 2,4-D to control sagebrush. A total of 190 acres of the allotment, consisting of three strips approximately one and one-quarter miles in length and five chains in width, as well as areas along streams, were left unsprayed. Objectives of my study were to obtain quantitative data on effects of chemical control of sagebrush on a sage grouse population. Canopy coverage measurements of vegetation in the 1,900 acre allotment revealed about 80 percent grasses and 20 percent forbs in sprayed strips and 60 percent grasses and 40 percent forbs in unsprayed strips. Low shrub canopy coverage in sprayed strips was reduced as compared with unsprayed strips, and 97 percent of the Big Sage plants evaluated were recorded as dead. Only eight percent were recorded as dead in unsprayed strips. Sprayed strips provided only four percent of the 415 sage grouse observations made on the 1,900 acre allotment. Ninety-one percent of the 15 sage grouse observed in sprayed strips were within 95 feet of an unsprayed strip. Canopy coverage measurements of herbaceous vegetation at 137 sage grouse locations, most of which were outside the 1,900 acre allotment, consisted of approximately 60 percent grasses and 40 percent forbs. Low shrub canopy coverage was similar from year to year, and 92 percent of the Big Sage plants evaluated were recorded as living. The similarity of the vegetation composition at sage grouse locations and in the unsprayed strips led to the conclusion that the differences in numbers of sage grouse observed in sprayed and unsprayed strips were related to vegetation composition. Density, percent crown coverage, and maximum height of Big Sage plants were determined at each of 159 sage grouse locations. Broods, six weeks or less of age, were found on areas having a lesser density and lower percent crown coverage of Big Sage than were older broods and adults. Food habits were determined by analysis of the contents of 35 sage grouse crops. Sagebrush and three genera of forbs together constituted 94.6 percent of the total volume. Dandelion and sagebrush had the greatest total percent frequency of occurrence of all food items. These high frequency food plants were more abundant in unsprayed than in sprayed strips, which strengthened the conclusion that differences in numbers of sage grouse observed in unsprayed and sprayed strips were related to vegetation composition.

INTRODUCTION

An increasing trend toward sagebrush (Artemisia spp.) eradication and/or control on private and public rangelands in Montana and other parts of the western United States has become apparent in recent years. The principal objective is to release the growth of grasses and other herbaceous plants to improve grazing for domestic livestock. The dependence of sage grouse (Centrocercus urophasianus) on sagebrush is well known (Girard, 1937; Griner, 1939; Patterson, 1952; and others). In Montana, as elsewhere, many of these sagebrush ranges provide excellent habitat for this bird. Although various aspects of the effects of sagebrush control on wildlife populations have been studied, few references relating to sage grouse are available. Trueblood (1954) and Enyeart (1956) evaluated use of reseeded sagebrush ranges by sage grouse. Rogers (1964) determined the use of areas by sage grouse on which sagebrush had been removed by burning. Some adverse effects of chemical sagebrush removal on this species were noted by Rogers (op cit.).

The objective of the present study, conducted during three concurrent summers (1962 - 1964) in Southwestern Montana, was to determine effects of chemical manipulation (control) of sagebrush on a sage grouse population. Data on life history and ecology of the sage grouse were collected to aid in interpretation of the results.

DESCRIPTION OF THE AREA

The study area (Figure 1) encompassed approximately 90 square miles of an extensive mountain valley in southwestern Beaverhead County, Montana, locally known as Big Sheep Creek Basin. The area, bordered by the Continental Divide on the west and the Tendoy Mountains on the east, has numerous rolling benches ranging in elevation from 6,700 to 8,000 feet above sea level. It is drained dendritically by tributaries of Big Sheep Creek. The annual precipitation averages about 14 inches, most of which falls in winter and spring (Forest Service Report, 1961).

The vegetation was characterized by a sagebrush grassland type which occupied the major portion of the study area. Predominant shrubs included: Rubber Rabbitbrush (Chrysothamnus nauseosus), Green Rabbitbrush (C. viscidiflorus), Low Sage (Artemisia arbuscula), and Big Sage (A. tridentata), with the latter having the greater density in most situations. The principal grasses were Idaho Fescue (Festuca idahoensis), Bluebunch Wheatgrass (Agropyron spicatum), and various species of Bluegrass (Poa spp.). Pussetoes (Antennaria spp.) Phlox (Phlox spp.), Western Yarrow (Achillea millefolium), Fringed Sagewort (A. frigidia), and Sandwort (Arenaria spp.) were the dominant forbs. Various degrees of dominance and association between grass and forb species existed, particularly on areas with varying livestock grazing intensity. Stream bottoms and moist areas were characterized by a number of grasses, rushes,

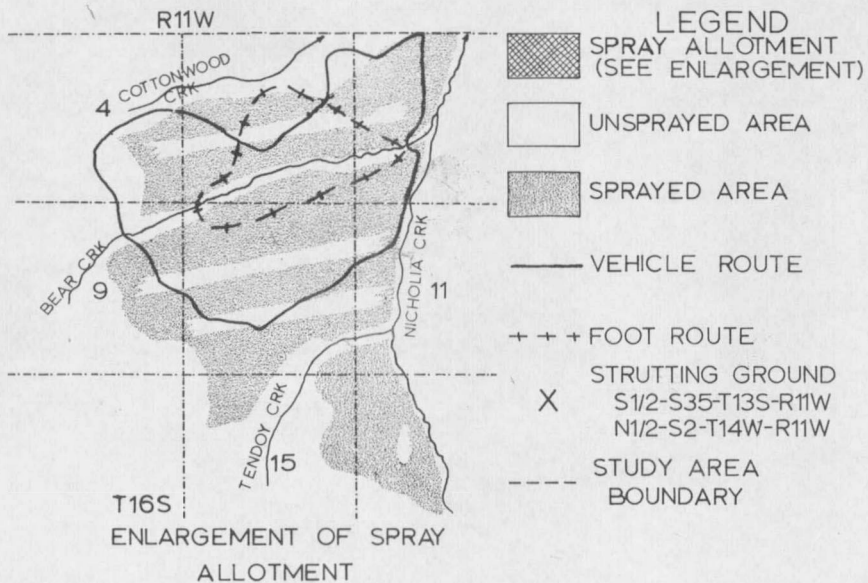
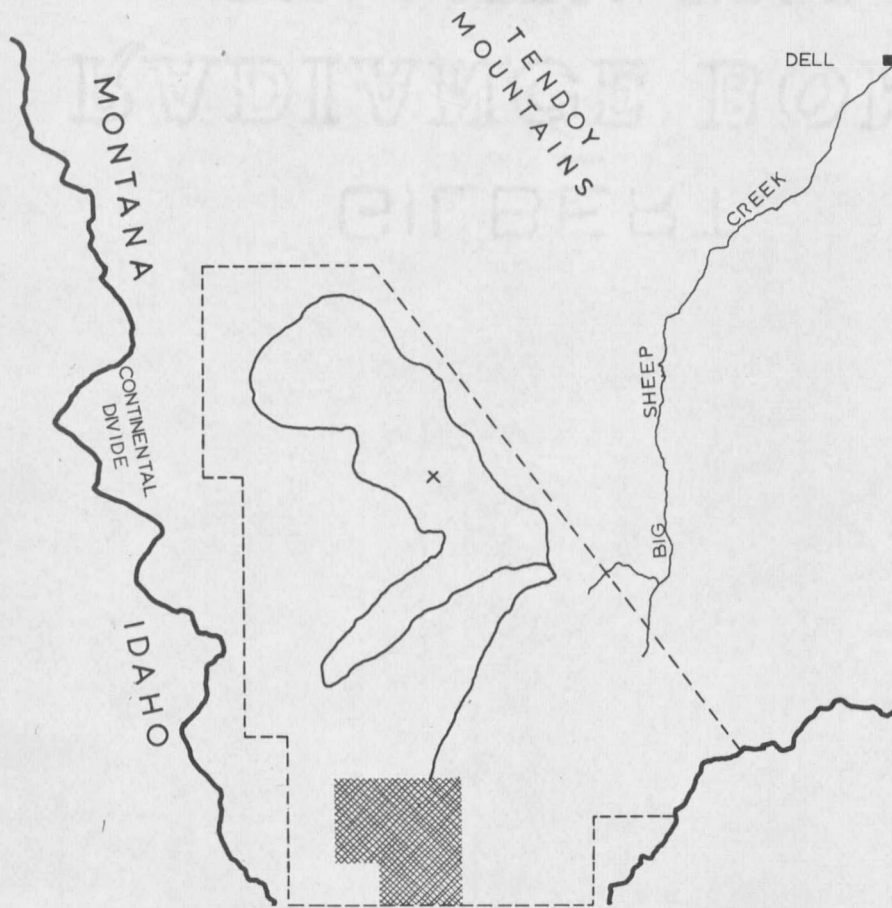


Figure 1. Map of Big Sheep Creek Basin Study Area.

willows, and succulent forbs. A more quantitative treatment of the vegetation is presented in a later section. The main economy of the area was grazing by livestock. Approximately 1,594 cattle and 3,500 sheep graze on National Forest lands in Big Sheep Creek Basin between July 1 and November 10, under a permit system.

Principal study was conducted on 1,900 acres of the area's southwestern corner, of which 1,710 acres had been sprayed in 1961 with 2,4-D at the rate of one and three-fourths pounds, acid equivalent, per acre to control sagebrush (Figure 1). Three east-west strips, approximately one and one-quarter miles in length and five chains in width as well as strips of 300 feet on each side of streams, were left unsprayed. Grazing by livestock was deferred on the 1,900 acre spray allotment for two years after spraying.

METHODS

Cannon nets, similar to those described by Dill and Thornsberry (1950), were used to trap mating birds on strutting grounds in late April and early May. After hatching, broods were readily captured using hand hoop nets of a type used by Mussehl (1960). Rectangular metal-supported cotton mesh nets utilized successfully by Patterson (1952) were relatively ineffective in this area. In 1962 and 1963, captured grouse, 11 weeks and older, were marked with aniline dyes in combination with four numbered leg bands of various colors to permit individual recognition in the field. In 1964, colored naugahyde neckbands, each with a number, supplemented the aniline dyes. Numbered aluminum bands attached to the patagium of each wing of chicks less than 11 weeks old permitted later identification in the hand.

Two observation routes, one vehicle and one foot, 7.4 and 4.5 miles long, respectively, were established in the 1,900 acre spray allotment. One vehicle route, 37.5 miles long, traversed most of the basin. Vehicle routes were driven weekly at 15 mph beginning at sunrise or in the evening starting at a time necessary to complete the route just prior to darkness. Direction and time (morning or evening) of travel for each route were reversed weekly. The foot route was traveled once each week beginning at sunrise. A German Short Hair Pointer accompanied the observer. In addition to the above routes, all roads and areas passable to vehicle travel

were covered once or more a week depending upon bird concentrations. All sage grouse observations were recorded and each location marked with a numbered red plastic flag for subsequent vegetation analyses. Observations were made with the aid of a 7 x 35 binocular or 20X spotting scope. Many sightings, including most broods and all nesting hens, were initially made by the dog.

A measure of vegetation cover at sage grouse locations was obtained on the same or following day of sighting by a modification of Daubenmire's (1959) canopy coverage method. Frequency of occurrence and canopy coverage for grasses, forbs, and low shrubs in twenty 2 x 5 dm plots, five each, along 30 foot radial lines of a circle's cardinal points were evaluated at each site. Density and average height of sagebrush at bird locations were determined by counting and measuring plants in the four quadrants of a 1/100 acre circle (radius 11.7 feet). Sagebrush canopy coverage at these same locations was obtained by the line intercept method, Canfield (1941). Canopy of plants was recorded in tenths of a foot along radial lines of the circle's cardinal points. A transect, with forty 2 x 5 dm Daubenmire plots, was established in the sprayed sagebrush strips to measure plant production changes. A like transect with an equal number of plots was established in the unsprayed strips. The vegetation in the plots, located at approximately one chain intervals along the

transects, was evaluated every two weeks.

During July, August, and September of 1963 and 1964, a total of 39 sage grouse were collected to determine food habit preferences. Collections were made in late evening prior to darkness to obtain birds with full crops. Crops were examined individually and the percent by volume of identifiable material recorded. The percentage of crop contents for each month was computed by the aggregate percentage method (Martin, et al., 1946). Four crops, each of which contained less than 3 cc of material, were not considered in the evaluation.

Hunter success information and wings from hunter killed birds for determining age were collected at a checking station operated on weekends during September and October.

RESULTS

Vegetation of Sprayed and Unsprayed Areas

Mean percent canopy coverage of vegetation, litter, and bare ground for sprayed and unsprayed areas of the 1,900 acre spray allotment, as revealed by evaluations in forty 2 x 5 dm plots in each of the areas, is presented in Table 1. The vegetation in the plots was evaluated on each of the following dates for both 1963 and 1964: July 9 and 23, August 7 and 12, and September 4.

TABLE I. MEAN PERCENT CANOPY COVERAGE FOR VEGETATION, LITTER, AND BARE GROUND IN FORTY 2 x 5 DM PLOTS IN SPRAYED AND FORTY IN UNSPRAYED STRIPS, 1963 AND 1964.

	1963		1964		1963-1964	
	S	US	S	US	S	US
Grasses	47	34	54	38	51	36
Forbs	12	23	13	29	13	26
Total herbaceous	59	57	67	67	64	62
Low shrubs ¹	9	13	9	18	9	16
Litter	19	18	25	28	22	23
Bare ground	17	17	17	19	17	18

S = Sprayed strip; US = Unsprayed strip

¹ includes both dead and living plants

Although the mean percent canopy coverage for total herbaceous vegetation in 1963 and 1964 was similar in sprayed and unsprayed strips, there was a greater canopy coverage of grasses and a lesser canopy coverage of forbs in the sprayed strips. The two year average canopy coverage for forbs in the

sprayed plots was only about one half that of the unsprayed plots. Forb reduction or destruction following application of the chemical 2,4-D to control sagebrush has been reported by Blaisdell, 1956; Hyder, 1954; and others. The average percent canopy coverage for total herbaceous vegetation increased from 1963 to 1964 in both sprayed and unsprayed plots. The increase in unsprayed plots resulted mostly from forbs, while the increase in sprayed plots was due mainly to grasses.

The somewhat constant percent of shrub canopy coverage in sprayed strips, as compared with the increase in unsprayed strips for the two year period, was possibly due to impaired growth and/or dead sagebrush plants. The latter is suggested by the percent frequency of Big Sage (Artemisia tridentata) in sprayed strips (Table II).

Relatively small difference in the average percent canopy coverage of litter was noted for sprayed and unsprayed strips. Litter increased from 1963 to 1964 for both the sprayed and unsprayed strips.

The average percent frequency of occurrence of plants in the plots for 1963 and 1964 is presented in Table II.

The average percent frequency of occurrence of all grasses recorded except Idaho Fescue (F. idahoensis) was greater in sprayed than in unsprayed plots. Four of the eight forbs recorded were most common in the unsprayed strips, while three were most common in the sprayed strips.

TABLE II. AVERAGE PERCENT FREQUENCY OF OCCURRENCE OF PLANTS IN FORTY 2 x 5 DM PLOTS IN SPRAYED AND FORTY IN UNSPRAYED SAGEBRUSH STRIPS, 1963 AND 1964.

Plant taxa ¹	1963		1964		1963-1964	
	S	US	S	US	S	US
GRASSES						
<u>Agropyron spicatum</u>	65	42	68	58	66	51
<u>Festuca idahoensis</u>	93	100	93	100	93	100
<u>Koeleria cristata</u>	32	29	33	15	32	23
<u>Poa spp.</u>	45	29	50	49	49	39
FORBS						
<u>Achillea millefolium</u>	17	12	18	10	17	11
<u>Antennaria spp.</u>	41	59	41	60	41	59
<u>Arenaria congesta</u>	29	29	24	18	26	25
<u>Astragalus miser</u> ←	26	32	28	35	27	34
<u>Lupinus sericeus</u> ←	7	23	9	25	8	24
<u>Phlox caespitosa</u>	26	21	22	19	24	21
<u>Phlox longifolia</u>	18	14	11	10	13	13
<u>Sedum stenopetalum</u> ←	3	16	4	16	3	16
LOW SHRUBS						
<u>Artemisia tridentata</u> ²	4	45	4	56	4	50

¹ All taxa in both sprayed and unsprayed strips with less than ten percent frequency of occurrence were excluded (See Table IX, Appendix).

² Dead plants were not included

Frequency of occurrence of grasses, except June Grass (Koeleria cristata), increased or remained about constant in both sprayed and unsprayed areas from 1963 to 1964. June Grass decreased substantially in unsprayed plots. No general pattern was indicated for increase or decrease of the forbs from 1963 to 1964 in either the sprayed or unsprayed plots. Some increased others decreased.

The only low shrub that occurred in either the sprayed or unsprayed strips with a greater percent frequency than ten for living plants was Big Sage. The frequency of this plant in unsprayed plots was several times that in sprayed plots. It increased significantly in unsprayed plots from 1963 to 1964, but not in sprayed plots. Big Sage plants were recorded as 100 percent dead in 8 and 97 percent of the unsprayed and sprayed plots, respectively.

Figures 2 and 3 depict the vegetation characteristics in sprayed and unsprayed strips.

Observations of Sage Grouse in Sprayed and Unsprayed Strips

Numbers of sage grouse in sprayed and unsprayed strips, as determined by observations made from a vehicle or while on foot in the 1,900 acre spray allotment, are presented in Table III. Observations were made from June 15 to September 14, during each of the years 1962 through 1964.

Despite the fact that more than proportionately equal time was spent in the sprayed strips, which were approximately nine times the unsprayed in area, they provided only four percent of the sage grouse observed. Rogers (op cit.) reported that spraying of 1,300 acres surrounding a 1,700 acre sagebrush range, sprayed two years previously, caused sage grouse to emigrate the area. During any month or year, the greatest numbers of sage grouse observed on my study area

