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The Effects of Herbicidal Spraying Upon a North Central Utah Blue Grouse Population

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THE EFFECTS OF HERBICIDAL SPRAYING UPON A NORTH CENTRAL UTAH BLUE GROUSE POPULATION

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by

T. Barry Barnes

A thesis submitted in partial fulfillment
of the requirements for the degree

of

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in

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Approved:

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Major Professor

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Committee Member

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No research project is a one man job. Mine was no exception. To those named here, my thanks. To those not named, no less thanks is due.

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T. Barry Barnes

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ABSTRACT

The Effect of Herbicidal Spraying upon a North Central Utah Blue Grouse Population

by

T. Barry Barnes, Master of Science

Utah State University, 1974

Major Professor: Dr. J. B. Low
Department: Wildlife Science

The effects of herbicidal spraying upon a North Central Utah blue grouse population were studied. Baseline data were obtained in 1970 and 1971 prior to the spraying on June 2, 1972. The spraying was done to control wyethia (Wyethia amplexicaulis) and black sage (Artimesia nova) which covered 48 percent and 20 percent of the study area respectively.

No differences in blue grouse numbers occurred following spraying with 17 to 20 broods using the area in 1972 compared to 18 to 20 broods in 1971. Total population of blue grouse each year was between 90 and 104 birds. Distribution of blue grouse changed, with the birds using areas with trees and shrubs following spraying rather than open areas that were sprayed.

There was significantly more black sage on the control area than the spray area. These differences began before spraying, however, and cannot be attributed solely to the spray.

No differences occurred in insect numbers or songbird use of the spray and control area.

(56 pages)

INTRODUCTION

Justification

This study was contracted in part by the U. S. Forest Service to determine the effects of herbicidal spraying upon a population of blue grouse (Dendragapus obscurus (Say)). Other funding came from the Utah Cooperative Wildlife Research Unit and Utah State Division of Wildlife Resources. This bird is an important game species in Utah. In 1971 an estimated 13,749 blue grouse were killed by 13,363 sportsmen who also killed 18,152 ruffed grouse.[1]

The blue grouse winters in high elevation evergreen forest areas, particularly Douglas Fir (Pseudotsuga menzesii) throughout its range. These areas are used by the males from late summer (August) to early spring (February-March). During this time the male's diet is mainly conifer needles.

The females can be found in the conifers from early September to March. They also eat mainly conifer needles during this period.

In early spring (February-March) the males move down to their breeding areas. These usually consist of fairly open ground with protective cover, either bush or trees. The males remain here on a territory which they defend until the breeding period is over. They usually leave their territories and migrate back to the conifers in late July.

The females usually arrive on the breeding areas later than the males. They range quite freely and do not defend any territories. Any

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[1]Darrell H. Nish, personal communication, Utah Division of Wildlife Resources.

bonds with males are fleeting if present at all. Once bred, the females nest alone, and bring off their chicks in June. The females are not gregarious but if chance meetings occur two or more broods can be found together. The broods remain with the females through the summer and migrate to their uphill wintering areas in mid-August. The attachment of the juveniles to the female is broken somewhere during the winter.

The study area is one of the blue grouse summer ranges. In this instance, the blue grouse spend a great deal of their summer in the sagebrush - wyethia (Artimesia spp., Wyethia amplexicaulis) complex. This plant association is not desirable from the grazing viewpoint and thus large areas have been converted to grassland-shrub. The conversion, while benefiting some, may be harmful to the animals already present on the area.

This report is the second phase of a continuing study to determine the long term effects of herbicidal spraying upon a blue grouse population. It presents the first year results following spraying with 2, 4-D (2, 4 dichlorophenoxyacetic acid) at a rate of 2 pounds per acre acid equivalent. This rate has been found to be effective in controlling wyethia and sagebrush. Instead of diesel oil as a carrier for the 2, 4-D, water was used to lessen the effects of the spray on the grasses present. While the grasses will survive better (Evanko, 1951) there will be an equally good kill of wyethia and sagebrush (Tingey and Cook, 1955).

The actual proportions used in the spray were:

1 gal. Bivert emulsion

2 gal. No. 2 diesel fuel

3.5 gal. 2, 4-D concentrate (6 lbs acid equivalent)

23.5 gal. H_2O.

Significance

This study was initiated to provide information on numbers, distribution and use by blue grouse both before and after spraying of the habitat with a herbicide (2, 4 dichlorophenoxyacetic acid). Data were gathered for two years, 1971 and 1972. The control and experimental portions of the study area were both covered each year to provide comparison of data between 1971-1972. The results may be useful in guiding the future spraying policies of governmental and private agencies. Blue grouse habitat requirements may be further clarified as a result of this continuing study, leading to possible habitat improvement techniques. Improvement of habitat could lead to greater blue grouse production and hunting as demands for recreation increase.

Literature review

There have been three previous studies on blue grouse in Utah. Nygren (1962) reported on calls, breeding behaviour and brood size. He described both the overstory composition and the ground cover. Maestro (1971) working in the same general area, delineated habitat requirements more thoroughly. Weber (1972) studied the general ecology of blue grouse on the same study area as this project. His findings indicate the dependence of the blue grouse on the sage-wyethia.

There have been blue grouse studies elsewhere relating to habitat and use by broods. Mussehl (1960) found broods frequently in grass-forb areas where balsamroot (Balsamorhiza sagittata) was the dominant forb. This forb is comparable to wyethia in structure and canopy

coverage. Other workers have also reported the association of blue grouse broods with balsamroot. Mussehl (1963) reported the mean effective height of preferred brood cover to be 7 $\pm$ 2 to 8 $\pm$ 2 inches in Montana. His findings indicate grazing had detrimental effects on the broods in the area. He concluded that "herbaceous cover is particularly important during the first 6 weeks of brood life" (Mussehl, 1963). Balsamorhiza is also described as a plant associated with broods by Wing, Beer and Tidyman (1944) in Washington.

Herbicides have been found to be an effective means of eradication of forbs. 2,4-D is widely used for the removal of wyethia and sagebrush. The kill for wyethia is described as good using 2,4-D (USDA Bull. 2005). Evanko (1951) reports a loss of almost 100 percent of wyethia one year after spraying in Montana. Tingey and Cook (1955) report a decrease of 82 percent of the wyethia present 5 years after spraying with 2,4-D in Utah. All investigators report increased grass growth and density following spraying.

Control of sagebrush has been reported by many investigators to be detrimental to sage grouse. Patterson (1952), in his study, relates the dependence of the sage grouse on sagebrush. He states, "in areas heavily utilized for agriculture they have been either completely or partially displaced due to the elimination of sagebrush and associated plants." (p. 30). Klebenow (1970) reported that it took at least 5 years for sage grouse to re-use an area sprayed with herbicides. Martin (1970) reported only 4 percent of all sightings of sage grouse occurred in an area sprayed with 2,4-D. No sightings occurred the year following spraying with a gradual increase during the next two years (1.6 percent and 12.1 percent respectively).

Generally, manipulation of habitat resulted in decreased plant species composition and lower grouse numbers. Similar effects have been noted by Zwickel (1972) and Marshall (1946). These investigators found grazing by cattle and sheep and its subsequent lower of forb diversity to be detrimental to blue grouse population.

OBJECTIVES

The objectives of this study are as follows:

1. To determine the effects of herbicidal spraying of wyethia and other plant species upon the numbers and distribution of blue grouse.

2. To determine the effects of herbicidal spraying upon the vegetation and insect populations on the spray and control areas.

3. To determine habitat use by songbirds on the experimental and control areas.

DESCRIPTION OF THE STUDY AREA

The study area, known as the Public Grove hollow, is located approximately 25 miles south of Logan in the Cache National Forest in Cache County, Utah (Figure 1). The study area ranges in elevation from 6,120 to 6,634 feet above sea level. The land on the eastern boundary of the study area is privately owned. The area was heavily overgrazed until the early 1960's when the United States Forest Service purchased the land. This overgrazing allowed the wyethia and sagebrush to become established at their current densities. While this plant community is not conducive to grazing it is beneficial to the blue grouse (Weber, 1972). Whether blue grouse were present on the area prior to grazing and the resultant wyethia dominant vegetation has not been documented.

The study area covers approximately 1.25 square miles. It is divided into an experimental component of 622 acres and a control area of 156 acres. The experimental component was sprayed in June of 1972. The study area is an open rolling parkland with patches of trees, mainly along the western edge (Figure 2 and 3). The major part of the vegetation includes wyethia, black sage (A. nova) and big sagebrush (A. tridentata). Grasses are present in the area including needlegrasses (Stipa sp), bluegrasses (Poa spp) and wheatgrasses (Agropyron spp). The forbs in the area are numerous, including wild onion (Allium spp), and lupine (Lupinus spp).

The major tree species, clumps of mountain maple (Acer grandidentatum), aspen (Populus tremuloides), Gambel's oak (Quercus gambelli),

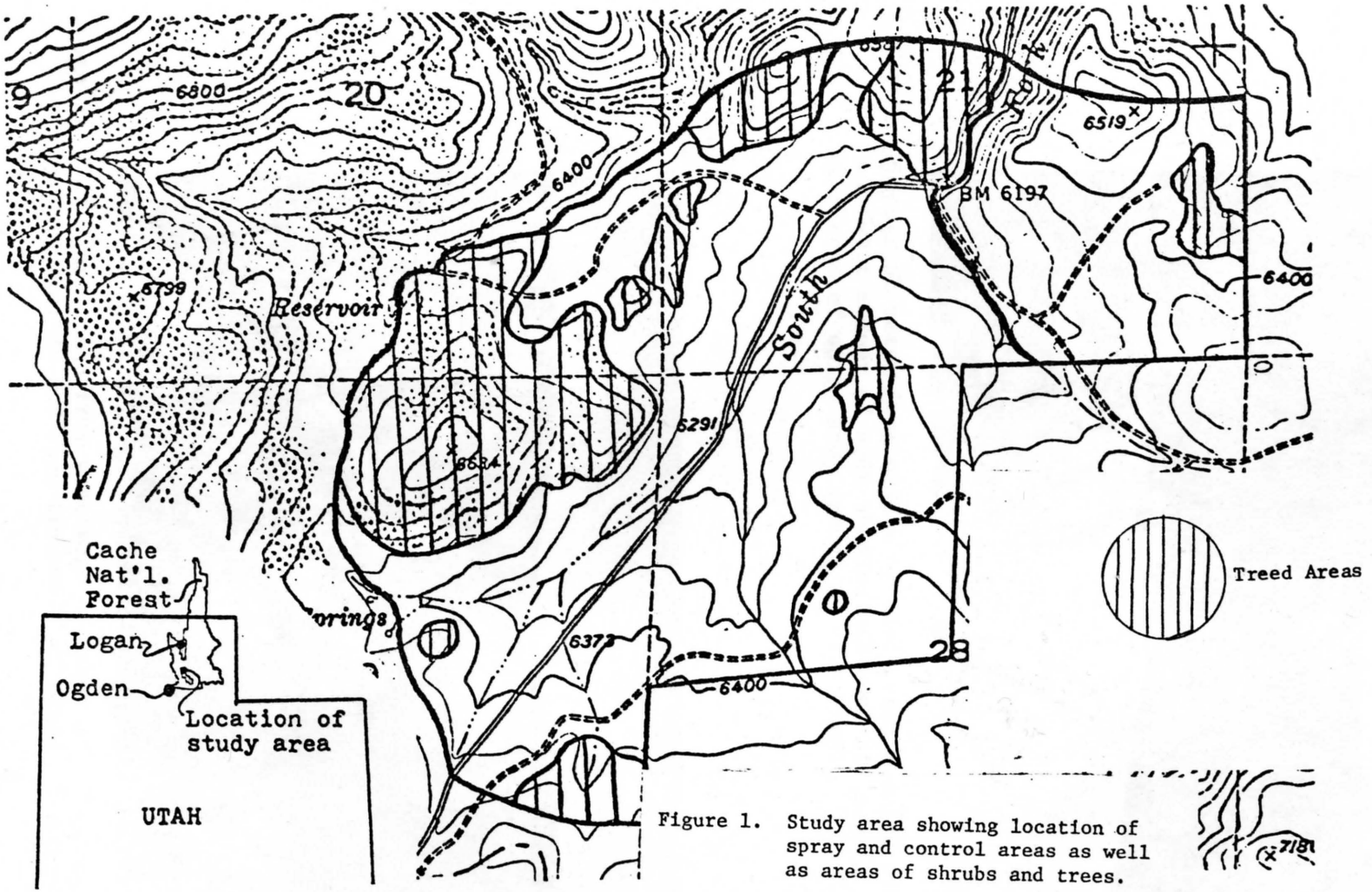

Figure 1. Study area showing location of spray and control areas as well as areas of shrubs and trees.

Figure 2. Photograph taken from middle of study area looking toward northwest corner of area showing oak-mountain mahogany along west edge of spray area (photo by J. B. Low).

Figure 3. Photograph taken from west edge of study area looking south showing wyethia and open component of study area (photo by J. B. Low).

mountain mahogany (Cercocarpus ledifolius) and Rocky mountain juniper (Juniperus scopulorum) are found along the western side of the study area.

When first visited in early March both years snow covered the area. In 1971 three to four feet of snow was over most of the area. In 1972 the area had begun to clear of snow on the ridgetops by mid-March. Summer temperatures are mild, averaging 82 degrees. Rainfall is low during the summer, 6 to 8 inches, with occasional thundershowers occurring over James Peak to the east of the area.

The fauna of the area was quite diverse. The Mule deer (Odocoileus hemionus hemionus) and coyote (Canis latrans) were the only large mammals on the area and were rarely seen. Smaller mammals present include porcupine (Erethizon dorsatum), striped skunk (Mephitis mephitis), yellow-bellied marmot (Marmota flauiventris), deer mouse (Peromyscus maniculatus), vole (Microtus spp.), the northern pocket gopher (Thomomys talpoides) and various chipmunks (Eutamius spp.) and squirrels (Tamiasciurus spp. and Citellus spp.).

Various reptiles and amphibians inhabited the area. Snakes present included the rubber boa (Charina botlae), the Great Basin rattlesnake (Crotalus viridis), and the garter snake (Thamnophis spp.). The only lizard seen on the area was the fence lizard (Sceloporus (prob. graciosus)). Frogs (Rana spp.) and salamanders (Ambystoma tigrinum) were common in the ponds on the area.

Many birds species were seen on the area during the study. Blue grouse, sage grouse (Centrocercus urophasianus), hungarian partridge (Perdix perdix) and one male pheasant (Phasianus colchicus) were the game birds present on the study area. Raptorial birds present included

sparrow hawks (Falco sparverius), marsh hawks (Circus cyaneus) and an occasional gashawk (Accipiter gentilis) in the fall. Other bird species present included robins (Turdus migraterius), chickadees (Parus atricapillus), lazuli bunting (Passerina amoena), western tanager (Piranga ludoriciana), red-shafted flicker (Colaptes cafer), mourning dove (Zenaidura macroura), Brewers blackbird (Euphagus cyanocephalus) and Vesper sparrow (Pooecetes gramineus). Other birds were seen on the area but not consistently.

METHODS

Objective 1--Determining the numbers and distribution of blue grouse on the study area before and after herbicidal spraying

This was accomplished by two separate estimates of populations. Male territories and female distribution were both determined. The area was searched with a dog at least five days a week both in 1971 and 1972.

Determining males by locating territories. Various methods for locating male territories were used. Random searching with a trained pointing dog (Brittany Spaniel) proved to be the most successful. The dog used covered an area at least 500 feet wide in whichever general direction the investigator was walking. Since different routes were taken at random the entire study area was covered every few days at most. The dog was rarely out of sight and when it was, its progress could be followed through brushy areas by listening. Any birds found in these areas generally did not flush until disturbed by the investigators. Thus, almost all birds found were identified by actual sightings. Subsequent plotting of all males located in this way led to determining male territories. Listening for male calls (hooting) as a sign of territoriality proved fruitless. The males on the study area do not hoot as loudly as those studied by Bendell (personal experience). Bendell and Elliott's (1967) study found that males can be heard hooting at distances of up to 1500 feet. The males on this study could be heard only at distances less than 50 feet and often only 20 feet.

Usually, at this distance, the male was silent during this study. Therefore, hooting could not be used as a criteria for territoriality. Recorded female precopulatory calls were played as suggested by Stirling and Bendell (1966). These were not as successful as on Bendell's study area (personal experience). Stirling and Bendell (1966) reports the efficiency of this method and conclude it to be better than random search. This was not found to be the case during this study.

Searching for male territories began in early spring (March both 1971 and 1972) and continued until the males left the study area (early July both years).

Determining the number of females and broods on the study area. Female blue grouse and broods were best located by random searching with a trained pointing dog. Since the area was searched daily the broods were found over a short time period. The youngest birds found were determined to be approximately four days old. Others were located gradually with no sudden appearance of a large number of broods. This suggests that the broods did not suddenly migrate to the area from some other site. While the broods do not remain in a single spot, they do remain in the same general area. Individual differences in age, size and number of chicks per brood aided in recognition of various broods. The most reliable method of determining female brood numbers was to capture and mark as many birds as possible. Once located, noosing of birds was attempted as described by Zwickel and Bendell (1967). If a bird was captured, aluminum leg bands obtained from the Utah Division of Wildlife Resources were placed on the birds. Colored neck bands or ponchos were placed on the birds. Subsequent resighting

of marked broods and sightings of broods helped establish the estimates presented. The variations in brood size, chick age, marked or unmarked, and location all aided in determining the number of broods on the study area.

Objective 2--Determining numerical descriptions of the pre- and post-spraying vegetation and insect populations on the sprayed area and a control area

Determining vegetational changes before and after spraying. Six line transects were set up by Weber (1972) to monitor vegetational changes that took place during the course of this study. They were all located in areas representative of the area to be sprayed. Four of the six were on the spray area while two were on the control portion of the study area. Each transect was 400 yards long. The vegetation was determined using a method developed by Daubenmire (1959). Total canopy coverage for each species within a 20 x 50 cm frame was determined at 10 yard intervals along each transect. Forty estimates were thus obtained along each transect for later statistical analysis. Average percent canopy coverage was determined for each plant species located (detailed in Weber, 1972). The number of samples taken resulted in accurate statistical analysis of the data. The 0.05 significance level was used for all statistical analysis pertaining to this study.

The vegetational transects were run the first weeks of May, June and July 1971 and 1972.

Determining insect populations before and after spraying. Insect population analysis were divided into three categories: small insects, mound ants and grasshoppers.

Small insect collections were made following the hatching of the young blue grouse. Small insects were defined as those sampled by the portable back-pack vacuum. They are intended only as an indicator of increase or decrease in the entire insect population. Chicks depend heavily on insects for the first six weeks of their lives. The samples were taken along the same transects as set up for vegetational analysis. A portable back-pack vacuum was used to sample the insects. Eight sites at 50 yard intervals were sampled. This consisted of taking 10 samples at each of the eight sites. Each sample was 1 square foot in area. Total weight of insects per sample collected was determined. Average number of insects per sample collected was determined.

Grasshoppers proved to be an important food item during late summer. Both hens and chicks eat this insect. Numbers of grasshoppers were determined using the U.S. Department of Agriculture accepted method (USDA, 1969; Weber, 1972). Grasshopper counts were made twice each summer during August.

Fifty ant mounds were marked in 1971 to determine the effect of spraying on them. Young blue grouse eat ants and the mounds may have been a ready source of food. The mounds were checked for activity twice during 1971 and again twice in 1972. This method did not show any increase in ant mound numbers if they occurred. Activity of ant mounds was the criterion used to determine the effects. The marked mounds were observed to determine whether or not they were being used by ants. Since activity was dependent on temperature, humidity and other factors, actual numbers of ants were not counted. Rather, if any ants at all were observed this constituted an active mound.

Objective 3--Habitat use by songbirds of the sprayed and unsprayed areas

During the search for grouse other bird use of the area was noted, particularly nesting. All nests found were located on maps and marked with surveyor's plastic ribbon. Any obvious differences in nest numbers between the sprayed and unsprayed areas were noted.

The bird nests located were rechecked for activity at a later date. Abandoned or destroyed eggs were noted. Successful nests were also recorded.

RESULTS

Number and distribution of blue grouse

Male territories. During 1971 eight territories were found on the spray area (Weber, 1972). One possible territory was located on the control part of the study area. In 1972 eight territories were located on the control area. Territories for each year were plotted on a map (Figure 4).

Of the eight territories found in 1972, only two were in the area actually sprayed (Figure 4). The others on the sprayed area were located either in areas with trees and shrubs or in "edge" areas which were not sprayed. Little or no effect from spraying is expected on these territories because of their location. Weber (1972) describes the male territories in detail.

Female and brood numbers. During 1971 and 1972 a total of 24 birds were caught, color marked, banded and released. Subsequent resightings as well as brood differences in size and number gave rise to estimates of total brood numbers on the area. Since broods do not usually travel more than one-half mile before leaving their summer range (Mussehl, 1960), the estimates are believed to be accurate. Eighteen to 20 broods used the area in 1971 (Weber, 1972). Seventeen to 20 broods were determined to be using the area in 1972. In 1971, 3 or 4 broods were found on the control area and 14 to 16 broods on

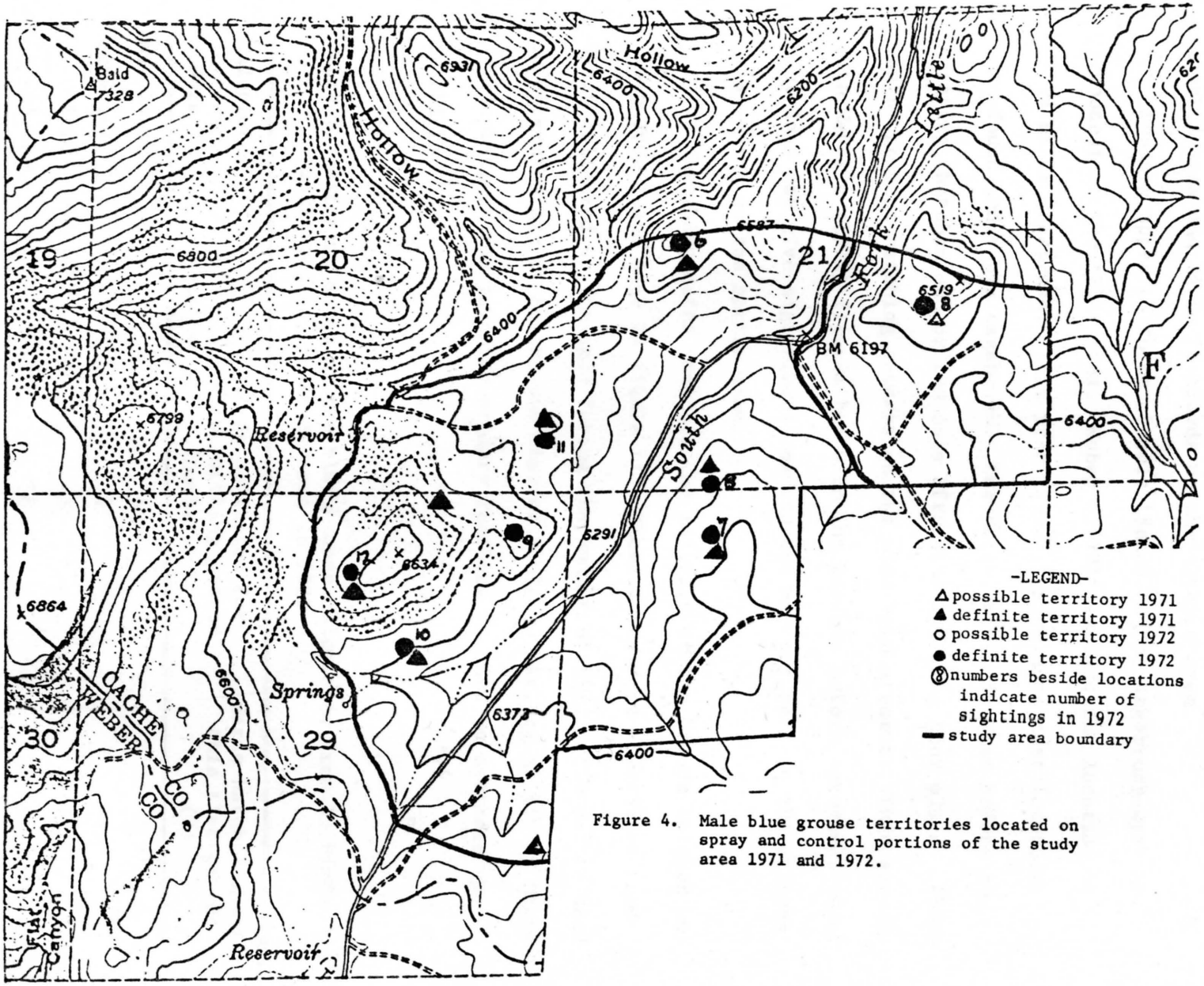

Figure 4. Male blue grouse territories located on spray and control portions of the study area 1971 and 1972.

the spray component. During 1972 3 or 4 broods were located on the control area and 14 to 16 broods on the sprayed area.

Nesting appeared to be closely linked to the sagebrush-wyethia component of the study area. Weber (1972) mentions the location of nests under sagebrush. This year (1972), three more nest locations were found under big sagebrush. One active nest, located before the spraying, hatched one or two days after the spraying took place. There was 67 percent hatching success on the nine eggs present. This agrees with Weber's (1972) figures for hatching success before spraying. One nest does not give significant results and may not reflect the effects of spraying on the entire area.

The hatching dates indicate the majority of the broods hatched between June 1 and June 22 (Table 1). These dates were calculated from birds collected on the area during the summer of 1972. The method used to determine age of chicks was that of Schladweiler, et al (1970) where development of the juvenile primary feathers is used to estimate age of chicks.

Table 1. Hatching dates of the blue grouse calculated from 13 birds collected on the study area in 1972

Calculated hatching date	Birds collected for this hatching period (number)	Birds hatched during this time period (%)
May 24-31	1	7.7
June 1-7	4	30.8
8-14	3	23.1
15-21	4	30.8
22-28	1	7.7

From the number of territorial males and the number of females present on the study area a ratio of approximately one male to two females was noted. The actual ratios were 1 male:2.0-2.22 females in 1971 and 1 male:1.89-2.22 females in 1972. This ratio may be applicable to this and comparable areas as a census technique. The ratio of males to females found by Bendell and Elliott (1967) in British Columbia was 1 male:3.57-3.75 females. By determining the number of males, the number of females may be estimated.

One chick banded in 1971 was seen as a yearling female with a brood in 1972 and still retained the chick neck tag. At least one chukar partridge (Alectoris graeca) retained a similar backtag 1-1/2 years (Shaw, 1971). No differential mortality was noted between marked and unmarked birds.

In 1972 the average brood size in August was 3.14 chicks per hen. This figure compares to other studies by Zwickel and Bendell (1967) where they found brood sizes of 2.5-4.1 chicks per brood. Caswell (1954) found an average brood size of 3.51 chicks per hen. An average brood size of 2.9 was found by Fowle (1960). Wing, Beer and Tidyman (1944) found an average brood size of 3.65 in late summer in Washington.

Total production for our area was calculated at between 90 and 103 birds (Table 2). This figure includes those collected during the study, territorial males, females and chicks.

The density of males on the study area was one male for every 97.2 acres. These figures, coverted to birds per acre become 0.01 territorial males per acre. These figures are low compared to Bendell and Elliott's (1967) study where they found between 0.13 and 0.44 males per acre

on two different areas. Zwickel and Bendell (1967) found 0.02, 0.04, 0.05 and 0.16 males per acre on 4 areas respectively. The density of broods on our area was one brood for every 38.9 to 45.8 acres. The overall density of grouse was one bird for every 7.6 to 8.6 acres. This density was constant for the two years of this study.

Table 2. Calculation of total numbers of blue grouse using the study area during 1972

	Total population of birds calculated for 17 broods	Total population of birds calculated for 20 broods
Birds collected	12	12
Territorial males	8	8
Brood females	17	20
Chicks*	53	63
Total number of blue grouse	90	103

*Chick numbers are calculated by multiplying the number of brood females by the average August brood size. In this case 17 x 3.14 = 53.38 or 53 chicks.

The major difference between 1971 and 1972 in the blue grouse populations was their distribution. In 1971 11 broods were found in the open area eventually sprayed in 1972. In 1972 only one brood was found in the open component of the study area and this was found along a streambed which had not been sprayed.

No effect was noticed due to spraying in 1972 on the location of male territories.

Vegetation and insect numbers

Vegetation analysis. All plants occurring in at least 15 percent of all 240 plots sampled per month were listed by Weber (1972). Since this study is a continuation of his, the same list of plants will be used for comparison. Weber's (1972) lists are used for percent occurrence as well.

Wyethia and black sage were the two most abundant plant species on the study area according to canopy cover. Wyethia covered almost 50 percent of the study area in June (47.8 percent on the experimental area and 49.1 percent on the control area). It was near that figure on the control area in July (49.1 percent) and covered 58.3 percent of the experimental area in that month. Black sagebrush covered over 20 percent of both areas in May. In June and July sage covered 19.48 and 15.0 percent of the spray area respectively. The control area had 27 percent coverage in both these months. No other single plant species covered over 14 percent of the area at any sampling period.

The most common plant species according to percent occurrence were again wyethia and black sage. Wyethia occurred in over 70 percent of the plots on all three sampling dates. Black sage occurred in over 70 percent of the plots on the control area and in 40 percent or more of the plots on the spray area.

No other species occurred consistently in the samples. This was probably due to either early spring blooming and subsequent early death or late emergence after sampling was finished. There were statistically significant differences between the control and spray areas in the cases of the two dominant plant species. Wyethia was significantly

higher on the spray portion of the area in July (58.3 percent compared to 49.1 percent on the control area). Black sage was significantly lower on the spray portion of the area than the control area (15.04 percent compared to 27.63 percent on the control area in July). This difference began in June, however, before the spraying, and continued through July. Spraying may not have been the reason for the difference as the statistical difference occurred before spraying.

Insect populations

Small insect populations. The two parameters measured in the small insect sampling were the average weight of insects per sample and average number of insects per sample on each of the six transects. The insects were sampled June 27 and 28 and July 13, 1972. During the June sampling period two spray transects (1 and 6) had statistically significantly higher average weights of insects than the control transects (Table 3). F tests were used to determine significance. In July no significant differences occurred. The average number of insects per sample was higher on the sprayed area than the control area for both sampling periods in 1972 except for Homoptera (Table 4). Homoptera were significantly higher on the experimental sprayed area in 1971. This indicates no detrimental effects on the majority of the insect species due to spraying.

Grasshopper counts were made on the area on two dates in 1972, August 10 and 17. The density ranged from 3 to 6 grasshoppers per square yard over the entire area. The control transects had the lower average number of grasshoppers during both counts, 3.0 and 3.9

Table 3. Average dry weights of small insects per sample on the study area for the two sampling periods in 1972. Average weights are for a 10 square foot area

Sprayed area transects	June 27-28		July 13	
	Total weight (mg)	Average weight (mg)	Total weight (mg)	Average weight (mg)
1	205.6	25.7 ± 6.94	23.7	2.96 ± 2.42
2	87.0	10.88 ± 5.26	52.8	6.6 ± 4.26
5	72.3	9.04 ± 5.68	69.9	8.74 ± 8.19
6	240.6	30.01 ± 16.63	55.4	6.92 ± 4.68
Control transects				
3	114.9	14.36 ± 7.86	94.8	11.85 ± 9.53
4	85.3	10.66 ± 4.43	34.7	4.34 ± 3.18

The number following the ± is the 95 percent confidence interval for the mean.

Table 4. Average number of insects per sample by families on the sprayed and control transects of the study area for the two sampling periods, 1972*

	27 June 1972				13 July 1972			
	Spray		Control		Spray		Control	
	No.	%	No.	%	No.	%	No.	%
Hymenoptera								
Formicidae	4.93	44.5	3.7	41.3	2.13	58.1	1.63	52.0
SF Chalcoididae	.18	1.7	0	0	.09	2.6	0	0
Unid. Hymenoptera	.28	2.5	.17	1.4	.09	2.6	.3	10.0
Homoptera								
Cicadellidae	.87	7.9	2.2	24.5	.4	11.1	.25	8.
Membracidae	.72	6.4	0	0	.2	5.2	.3	10.
Ortheziidae	0	0	0	0	0	0	0	0
Unid. Homoptera	.56	5.0	1.2	13.3	.16	4.3	0	0
Orthoptera								
Gryllidae	0	—	0	--	0	--	0	--
1st Instar-grasshoppers	.15	2.25	.06	.7	0	--	.06	2.
Other grasshoppers	.53	4.8	.43	4.9	.06	1.7	.20	6.
Hemiptera								
Nabis spp.	0	--	0	--	0	--	0	--
Miridae	.06	.6	0	--	0	--	0	--
Tingidae	0	--	0	--	0	--	0	--
Unid. Hemiptera	.20	1.7	.06	.7	.03	.9	0	--
Coleoptera								
Curculionidae	.03	.3	0	--	.03	.9	0	--
Unid. Coleoptera	.53	4.8	.20	2.1	.03	.0	.13	4.
Lepidoptera								
Lepidoptera Larvae	0	--	.06	.7	0	--	0	--
Unid. moths	.28	2.5	.20	2.1	0	--	0	--
Diptera								
Chironomidae	.03	.3	0	--	0	--	0	--
Tipulidae	.06	.6	0	--	0	--	0	--
Unid. Diptera	.47	4.2	.20	2.1	0	--	.06	2.
Thysanoptera								
Machilidae	.16	1.4	.13	1.4	0	--	0	--
Arachnida								
Spiders	.56	5.0	.25	2.8	.25	6.8	.06	2.
Ticks	.03	.3	0	--	0	--	0	--
Unid. Insects	.53	4.8	.20	2.1	.2	5.2	.13	4.

*Note: Table format same as Weber (1972) for comparison purposes since this is a continuation of his study.

respectively, while the spray area averaged a slightly greater number of grasshoppers during both counts, 4.9 and 4.6 respectively. There were no significant differences between the areas (Table 5).

Table 5. Average number of grasshoppers per square yard on the study area for all six transects on August 10 and 17, 1972

	Number of grasshoppers per square yard	
Transect number	August 10	August 17
Transects on spray area		
1	4.5 ± 2.36	4.6 ± 2.23
2	6.0 ± 2.72	4.75 ± 2.57
5	4.75 ± 2.12	5.0 ± 2.46
6	4.25 ± 1.85	5.0 ± 2.24
Transects on control area		
3	3.0 ± 1.63	3.9 ± 1.78
4	3.0 ± 2.06	3.75 ± 2.11
All six transects	4.25 ± .85	4.37 ± .88

The figure following the ± is the 95 percent confidence interval for the mean.

All 50 ant mounds marked in 1971 were still active following the spraying. Activity, the criteria used, was checked July 4 and again August 22, 1972. There was no change in numbers of active mounds, indicating no detrimental effect due to the spraying. The ants building mounds were mostly Formicidae spp. Mound building is not peculiar only to one species but included Formica subnitens, F. altipetens and F. fusca (Weber, 1972). It is possible other species also were present in mounds not checked.

Use of area by songbirds

Many species of songbirds used the study area during the summer. Most abundant of these included the lazuli bunting (Passerina amoena), vesper sparrow (Pooecetes gramineus), western tanager (Pironga ludociviana), Brewers blackbird (Euphagus cyanocephalus), meadowlark (Sturnella neglecta), mourning doves (Zenaidura macroura), and the black-capped chickadee (Parus atricapiklus). Other species were also present but are not mentioned here. The three most common species were the mourning dove, Brewers blackbird and the vesper sparrow. The nests of these three birds were used to determine use of the study area by songbirds. In all, 21 nests of these three species were found (Table 6), fourteen on the sprayed area and seven on the control (Figure 6). The spray area is just over twice the size that of the control area so the ratio of nests seems logical. Of the 15 nests found on the sprayed area, 11 were found after the spraying occurred, indicating no nest abandonment due to spraying. This agrees with Best's (1972) findings in Montana regarding vesper sparrows and Brewer's sparrows (Spizella breweri). All nests were rechecked during the summer and were all found to be successful.

Table 6. Nests of songbirds located on the spray and control portions of the study area, 1972

Species	Nests found	Spray	Control
Mourning dove	9	5	4
Brewer's blackbird	7	6	1
Vesper sparrow	5	3	2
Totals	21	14	7

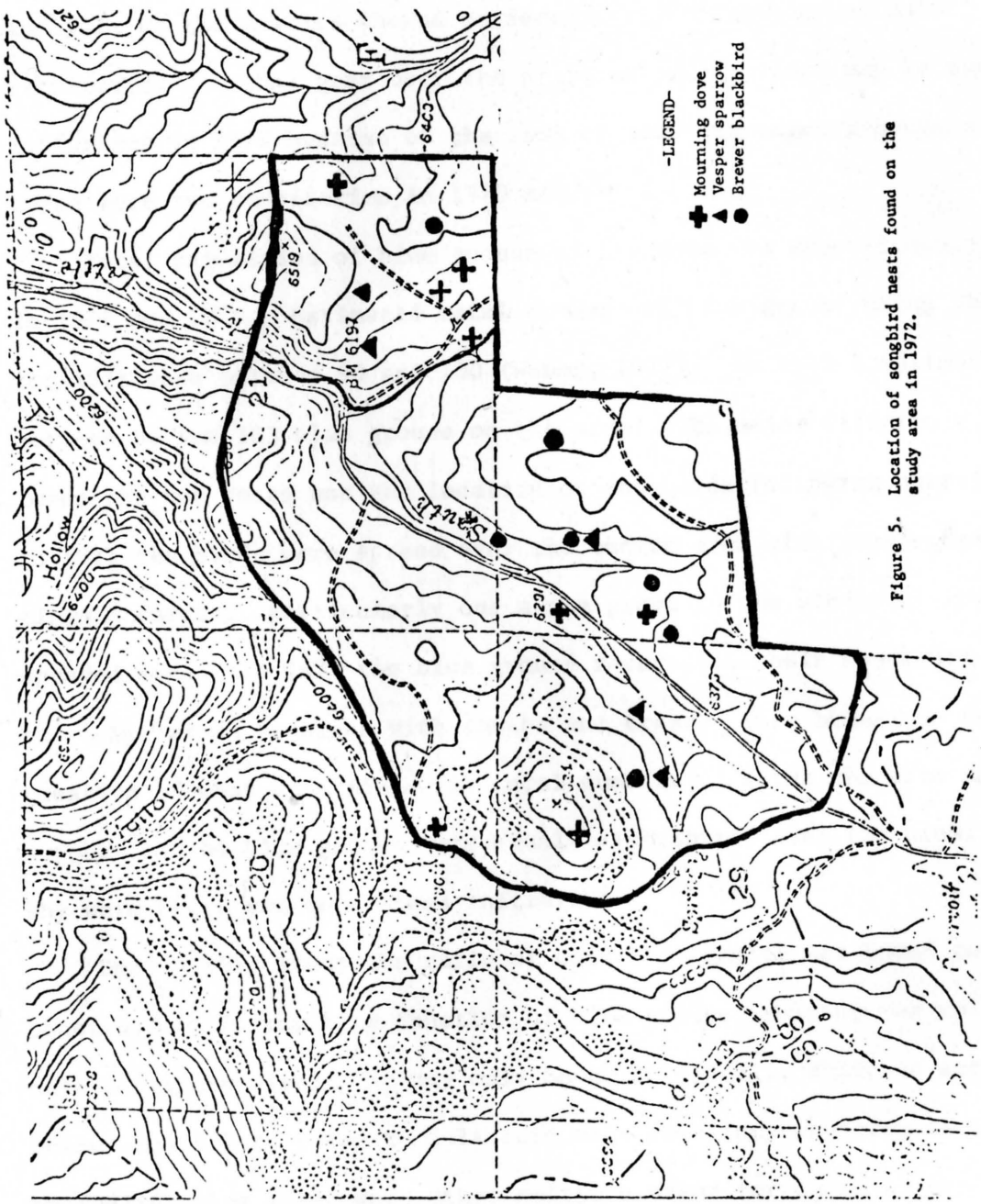

Figure 5. Location of songbird nests found on the study area in 1972.

DISCUSSION

The area was sprayed on June 2, 1972 with 2,4-D. Subsequent analysis of the results showed no decrease in the number of male territories for this year over the previous year. There may be some difference in 1973 because of the loss of some big sagebrush where there were two territories in 1970 and 1971.

Total population of blue grouse on the area was approximately equal in 1971 and 1972. Estimated total numbers of blue grouse using the area for 1971 were between 90 and 100 (Weber, 1972). In 1972 I estimated between 90 and 103 blue grouse on the area. The major difference between the two years was the location of the birds following spraying. In 1971 the birds were spread over the entire area with some concentrations occurring, particularly one aspen grove in the middle of the sprayed area. In 1972 the blue grouse restricted their movements to the "edge"areas or areas with shrubs and trees. This brings up the question of what determines the total numbers of birds the area could support if the blue grouse were evenly distributed over the area. Also, why were there not more birds initially?

During this study the ratio of males to females was found to be constant. This may be a function of blue grouse behavior or suitable male territory sites. It may only be coincidental. While no actual measurements were taken to delineate male territory preferences it is my feeling that there were other suitable areas for males to set up territories. The common factors between territories seemed to be the openness at ground level coupled with a good canopy cover of a taller

species. The canopy ranged from only a few feet (big sagebrush) to over 6 feet (mountain mahogany). Areas other than those occupied by territorial males met these requirements. There may have been other factors more important but less obvious to me that determine the male territory sites however. If the male territories are the important factor determining blue grouse use of an area then the spray operation will probably not affect the population noticeably as most of the male territory sites were in areas not sprayed.

There were no major changes in vegetation during the summer despite the spraying. This fact does not correlate with the change in distribution of the blue grouse. I can speculate on one aspect of the vegetational change which may have affected the distribution of the blue grouse. There were some structural changes noted, particularly in wyethia. The plants, after spraying, curled and sprawled over the ground more than in the unsprayed area. This structural change may have made travel through the spray area more difficult for the ground dwelling birds. Other explanations for the avoidance of the sprayed area are, of course, possible. Among these may be smell or taste of the vegetation and insects after spraying.

There will undoubtedly be more effects in 1973 on the blue grouse due to the loss of wyethia and sagebrush from the area. These two plant species accounted for approximately 50 and 20 percent of the canopy cover respectively.

The expected increase in grasses may affect the blue grouse populations. Whether this increase will be beneficial or detrimental is open to some speculation. These birds are considered very opportunistic (Weber, 1972) and may be able to adapt to the new vegetation

type. While it appears they now use big sagebrush exclusively for nestings, other investigators have found the blue grouse using clumps of grass as well as other shrubs for nest sites. Most investigators working on blue grouse in the inter-mountain region have noted a dependence on arrowleaf balsamroot. Mine and Weber's (1972) study revealed a correlation between wyethia and blue grouse occurrence. Wyethia and arrowleaf balsamroot are similar in height, canopy coverage and general morphology, which may point to common denominators delineating blue grouse habitat selection. It is my speculation that the blue grouse in this situation will adapt to the decreased vegetation diversity by nesting under other shrubs species and raising their broods in areas not sprayed.

The large open grass areas that should be created by this spraying may become suitable habitat for raising blue grouse in a few years when the canopy height and coverage increase. If not, other species of ground birds may be able to use the area. Hungarian partridge or sharp tailed grouse (Pediocetes phasianellus) utilize grassland areas as their natural habitats. One pair of hungarian partridge was on the study area in 1972 and raised a brood of young. These birds remained on the area through the summer and may increase in subsequent years. The sharp tailed grouse is also a bird of the grassland areas. Its habitat usually consists of native grass stands, brush and forbs. Hart, et. al., (1950) says the sharptail in Utah utilized areas of native "bunchgrass and associated species". They describe the topography and former range of this species. At one time the range overlapped this study area and it is probable there were birds present in former times. Other investigators report habitat of sharptails between 6000 and 9000

feet in Colorado (Evans, 1968) and ranging from open grasslands to sagebrush-grass-weed mixtures with brushy areas (Hart, et al., 1950). The spraying operation on this study area and resultant vegetation could prove beneficial to this species. The major hurdle would be getting the first birds on the area. The sharptail in Utah has declined rapidly, mainly due to man's actions (Hart et. al., 1950). Few have been reported in recent years and none have been seen near this area during the course of this study. This area seems to be quite suitable for the sharptails and may prove a good refuge for this rare species. The rolling topography, elevation and location are all within former sharptail range.

Spraying also had no immediate effect on the insect populations on the study area. Density and species composition of the insects showed no significant change over the 1971 data. There may be some changes in 1973 from loss of much of the living plant material. While there may be some compensation by the increase of some annual plant species, the perennial grasses will probably not increase significantly one year after spraying.

In general, this study showed no overall detrimental effects on the blue grouse present on the area during the first year of spraying. Total numbers of male territories, brood numbers and overall production remained comparable to 1971. No significant change was noted in the insect populations monitored or in the vegetation present. No differences were observed in songbird use on the control and spray areas.

RECOMMENDATIONS

1. Further studies should be made in 1973 and 1974 to determine the effects of the 2,4-D spray on the area. Wyethia and the two sage species should not grow in 1973 possibly resulting in a more dramatic response by the blue grouse than found in 1972. Despite a possible flush of new growth from the released water and nutrients the vegetation is not expected to compensate entirely for the loss of wyethia and sagebrush.

2. Male blue grouse territories should be checked in early spring, particularly those located in sagebrush areas, to determine the pattern of territories following the spray program.

3. An effort to locate nests should be made from early May to mid-June during the first year following spraying. All 10 nests located so far (1970-1972) have been under big sage. This plant species may be the single most important factor determining blue grouse production. The blue grouse may compensate by nesting under some other plant species, depending on canopy cover and height.

4. The number of male territories may be determined to calculate total numbers of birds on the area. The ratio of two females per territorial male may be used to calculate breeding and total populations.

5. If larger, more homogeneous areas of wyethia-sage are to be sprayed in the future,"islands" of big sage should be left for nesting and hiding cover. The size of these "islands" can best be determined

by further study but I recommend a ratio of at least one acre for every 50 acres sprayed.

6. Vegetation changes should be monitored in 1973 in an effort to correlate any changes with blue grouse numbers and production attempted. Vegetation should also be measured in a few years to determine long-term effects of the spraying.

7. Since the spraying operation should result in a grass dominant vegetation, grazing may be considered in the future. As pointed out by other studies grazing can be detrimental to blue grouse. A decision will have to be made as to the relative worth of grazing versus blue grouse.

SUMMARY

The study area consisted of a high open rolling area covered largely with undesirable plant species from the grazing aspect. It was located in North Central Utah approximately 25 miles south of Logan in Cache County on Cache National Forest lands. The study area was divided into an experimental portion of 622 acres and a control area of 156 acres. The experimental component of the study area was sprayed with a mixture of 2,4-D on June 2, 1972. The effects of this spraying were determined on three aspects on the area: (1) the numbers and distribution of blue grouse, (2) the vegetation changes and insects available, and (3) the use of the area by songbirds.

No difference was found in the number of male territories between 1971 and 1972. One possible territory in 1971 was verified in 1972 and one definite territory in 1971 was not found to exist in 1972. No differences were found in the number of broods using the area in 1971 and 1972. Eighteen to 20 broods used the area in 1971 and 17 to 20 broods used the area in 1972. Total number of grouse (males, females and chicks) remained constant both years. In 1971 between 90 and 100 blue grouse used the area, and in 1972 between 90 and 103 blue grouse were on the area. The major difference between 1971 and 1972 was the location and distribution of the broods. In 1971 they roamed the entire spray and control areas. Following spraying in 1972 the blue grouse roamed the entire control area and only the wooded or brushy portions of the sprayed area. This difference may be attributed

to the morphology of the plants on the spray area, those having been sprayed tended to be more prostrate than those not sprayed.

There were no significant differences in the vegetation on the area either between 1971 and 1972 or between experimental and control areas. Insect numbers and weights were comparable between 1971 and 1972. However, the two components of the area, spray and control, did show significant differences. The experimental area had higher insect weights and higher average numbers of insects both years. This difference was not reflected in use of the area by blue grouse.

Songbird use of the spray and control components of the study area was comparable both before and after spraying.

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APPENDIXES

Table 7. Average percent canopy cover of the more common plant species found on the spray and control portions of the study area for the three sampling periods, 1972

Plant species	Spray area			Control area		
	May 1-3 %	June 1-3 %	July 1-3 %	May 1-3 %	June 1-3 %	July 1-3 %
Litter	63.69(2.3)[1]	64.41(3.7)	65.22(3.9)	64.04(5.2)	58.58(5.8)	66.0 (5.1)
Bare Ground	15.91(3.8)	15.63(2.2)	16.42(2.5)	17.5 (2.9)	22.44(4.1)	14.69(3.2)
Rock	17.21(2.5)	15.95(2.7)	15.63(2.7)	15.65(4.0)	15.88(3.6)	14.94(3.4)
Forbs:						
Achillea millefolium	1.83(.83)	2.34(.82)	4.22(1.6)	3.92(1.9)	3.97(1.9)	5.06(2.1)
Allium spp.	8.95(1.8)	1.06(.39)	.66(.38)	6.42(2.6)	.22(.16)	.63(.42)
Claytonia lanceolata	3.38(.88)	---	---	4.63(1.4)	---	---
Collinsia parviflora	2.41(.57)	1.49(.35)	.59(.29)	3.21(.9)	4.41(1.1)	6.0(2.03)
Floerkia proserpinacoides	2.41(.53)	1.4 (.85)	---	.53(.53)	.34(.39)	.031(.06)
Gauophytum diffusum	.016(.03)	1.87(.86)	1.47(.26)	.37(.39)	1.97(.94)	1.43(.27)
Lithophragma glabra	1.80(.83)	.03(.04)	---	1.08(.74)	---	---
Lupinus spp.	.52 (.29)	2.09(.91)	1.61(1.4)	2.1 (1.3)	3.84(2.1)	2.78(1.8)

Table 7. Continued

Plant species	Spray area			Control area		
	May 1-3 %	June 1-3 %	July 1-3 %	May 1-3 %	June 1-3 %	July 1-3 %
Microseris nutans	1.83(.64)	1.42(.57)	.05(.05)	1.7 (.94)	1.03(.65)	---
Ranunculus spp.	.81(.42)	---	---	1.08(.56)	---	---
Senecio spp.	3.67(1.1)	3.56(1.2)	.016(.03)	3.09(1.6)	.75(.55)	.063(.09)
Viola purpurea	1.09(.52)	1.48(.69)	.91(.59)	.96(.74)	.88(.65)	.16(.14)
Wyethia amplexicaulis	7.0 (1.54)	47.8 (5.14)	58.3 (2.67)	13.3 (3.1)	49.1 (7.15)	49.1 (7.4)
Grasses:						
Agropyron spp.	.68(.59)	1.5 (1.77)	4.98(2.0)	1.38(1.8)	1.6 (1.4)	5.7 (2.7)
Poa spp.	3.18(1.5)	13.38(3.2)	7.9 (2.8)	1.84(1.5)	9.8 (2.9)	7.9 (4.0)
Stipa spp.	1.49(.57)	7.0 (2.0)	8.4 (2.2)	2.31(1.7)	4.8 (2.4)	3.98(2.3)
Shrubs:						
Artemisia Nova	21.67(4.2)	19.48(4.1)	15.04(4.1)	25.03(6.5)	27.18(6.1)	27.63(6.3)

[1]The figure in parentheses is the 95% confidence interval for the mean. This means that for example 63.69(2.3), the canopy coverage for litter is 63.69% plus or minus 2.3%.

Table 8. Average percent canopy cover of the less common plant species found on the study area for the three sampling periods, 1972

Plant species	May	June	July
Forbs:			
Anaphalis margaritacea	--		1.0
Antennaria rosea	.4	4.0	8.1
Arabis sp.	8.	2.	3.
Arenaria kingii	2.	4.	3.
Astragalus spp.	2.	3.	3.
Cammassia quamash	6.	8.	1.
Delphinium nelsoni	7.	4.	--
Eriogonum umbellatum	--	1.	1.
Erythronium grandiflorum	1.	1.	--
Fritillaria pudica	2.	--	--
Geranium fremontii	--	1.	.4
Grindelia squarrosa	--	4.	2.
Hydrophyllum capitatum	5.	1.	--
Lomatium grayii	3.	3.	.83
Lomatium simplex	9.	7.	--
Madia glomerata	--	--	3.
Navarettia intertexta	--	6.	5.
Orogenia linearifolia	3.	1.	--
Polemonium spp.	--	1.	1.
Taraxacum sp	1.	1.	--
Thlaspia sp.	1.	2.	2.
Tragopogon sp.	--	1.	--

Table 8. Continued

Plant species	May	June	July
Forbs cont.:			
Trifolium sp.	--	.4	--
Veronica campylopoda	--	4.	--
Zigadenus paniculatus	7.	7.	1.
Shrubs:			
Artemisia tridentata	1.	--	--
Berberis repens	--	--	1.
Symphoricarpos oreophilus	--	.4	--
Grasses:			
Danthonia spp.	--	5.	12.
Koeleria spp.	--	1.	6.
Melica bulbosa	.4	5.	10.
Sedges:			
Carex sp.	1.	.4	3.

Table 9. Percent occurrence of the most common plant species found on the spray and control portions of the study area for the three sampling periods in 1972

Plant species	Spray area			Control area		
	May	June	July	May	June	July
Litter	100	100	99	100	100	100
Bare Ground	92	92	84	99	93	88
Rock	93	92	84	93	90	91
Forbs:						
Achillea millefolium	30	35	33	35	38	39
Allium spp.	65	30	14	43	9	19
Claytonia lanceolata	44	--	--	63	--	--
Collinsia parviflora	62	51	18	79	88	86
Floerkca proserpinacoides	28	29	--	9	8	58
Gayophytum diffusum	1	38	56	9	61	58
Lithopkragma glabra	26	1	--	19	--	--
Lupinus spp.	14	23	13	30	29	26
Microseris nutans	33	26	2	25	23	--
Ranunculus spp.	17	--	--	31	--	--
Senecio spp.	39	33	1	28	18	3
Viola purpurea	19	26	15	14	16	6
Wyethia amplexicaulis	73	86	83	71	86	84
Grasses:						
Agropyron spp.	6	16	31	8	10	33
Poa spp.	19	68	45	14	73	41
Stipa spp.	29	50	51	15	34	34
Shrubs:						
Artemisia nova	74	64	49	76	76	69

Table 10. Food taken from crops of blue grouse collected during the summer of 1972

Month	June		July		August		September	
Number of birds collected	5		5		4		2	
	Total	Average	Total	Average	Total	Average	Total	Average
Dry weight of Insects (mg)	758.1	151.6	22405.3	4481.1	17.1	4.3	0	0
Volume of Insects (ml)	4	0.8	37	7.4	trace	trace	0	0
Number of Insects	32	6.4	46	9.2	6	1.5	0	0
Formicidae	10	2	11	2.2	5	1.25	0	0
Grasshoppers	3	0.6	35	7	1	0.2	0	0
Unidentified Coleoptera	4	0.8	0	0	0	0	0	0
Lepidoptera Larvae	13	2.6	0	0	0	0	0	0
Unidentified Insects	2	0.4	0	0	0	0	0	0
Dry weight of plant material (mg)	149.6	29.9	1522.7	304.5	7800.9	1950.2	2182.5	1091.2
Volume of plant material (ml)	2.0	0.4	9.0	1.8	40.0	10.0	7.0	13.5

Table 11. Food items from blue grouse collected on the grouse study area, Cache County, Utah, 1972

Bird number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Date Collected	21 June	26 June	27 June	27 June	28 June	17 July	17 July	17 July	25 July	28 July	4 Aug.	10 Aug.	23 Aug.	23 Aug.	12 Sept.	24 Sept.
Dry weight of insects (mg)	218.6	60.8	469.0	0	10.0	0	280.7	3748.0	6.6	18510.0	1.7	9.3	2.0	4.1	0	0
Volume of insects (ml)	1	0	3	0	0	0	1	17	0	19	0	0	0	0	0	0
Dry weight of plants (mg)	10	82.4	55.5	1.7	0	47.6	18.5	16.6	1409.0	31.0	1454.8	597.5	2440.8	3507.8	157.1	2025.4
Volume of plants (ml)	0	1	1	0	0	1	0	0	8	0	9	3	17	11	1	6
Age of Bird	Chick	Chick	Chick	Chick	Chick	Adult	Chick	Chick	Chick	Chick	Chick	Chick	Chick	Chick	Yearling	Yearling
Composition of plants	Seeds	Seed pods	Seed pods (numerous)	1 seed pod	-	Leaves	Leaves	Leaves (putr) Small twigs	Rose tips Seeds-grain	Leaf material	Rose tips Stems-grass-like	Rose tips	Leaves Liliaceaea grass stalks Rs.tips	Rose tips Some leaves Small seeds	Rose tips leaves	Abund. of Doug. fir needle Rs.tip
Composition of Insects:																
Formicidae (numbers)	3	7	0	0	0	0	3	0	7	0	1	0	2	2	0	0
Grasshoppers (numbers)	0	0	3	0	0	0	6	16	0	13	0	1-Femur, Tibia & Tarsus	0	0	0	0
Lepidoptera Larvae (numbers)	6	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0
Unidentified Coleoptera(numbers)	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Insects	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. List of blue grouse caught and marked on Public Grove study area, Cache County, Utah, 1972

Age and Sex	Date	Bird #	Bands LL	Bands RL	Other Marks
Yearling Female	5-11-72	1611	FG 1611	Gold 31414 Green 31276	Yellow Poncho
Chick	7-25-72	1610	FG 1610	Green 31207 Gold 31417	Yellow-green neck tag
Chick	7-26-72	1678	FG 1678	- - -	Yellow-blue stripe neck tag
Chick	7-26-72	1613	Gold 31411	Green 31275 FG 1613	Green and white stripe neck tag
Chick	7-26-72	1682	FG 1682	- - -	White and green stripe neck tag
Chick	8-7-72	1667	FG 1667	- - -	- - -
Chick	8-3-72	1676	- - -	FG 1676	Green and blue stripe neck tag
Chick	8-7-72	1615	FG 1615 Gold 31410	Green 31202	Yellow, green and red stripe neck tag
Chick	7-20-72	1616	Gold 31416 FG 1616	Green 31247	Red neck tag
Adult Female	7-27-72	1675	FG 1675	- - -	White poncho #1
Chick	7-27-72	1677	- - -	FG 1677	White and yellow stripe neck tag

VITA

T. Barry Barnes

Candidate for the Degree of

Master of Science

Thesis: The Effects of Herbicidal Spraying Upon a North-Central Utah Blue Grouse Population

Major Field: Wildlife Biology

Biographical Information:

Personal Data: Born in Vancouver, British Columbia, Canada, March 26, 1945, second son of Leonard H. and Hilda M. Barnes.
Married to Marilyn A. Cranna, December 27, 1970; no children.

Education: Elementary Education in Vancouver, British Columbia; graduated from John Oliver Secondary School, Vancouver, British Columbia in 1964; received Bachelor of Science degree from University of British Columbia, majoring in Zoology, in 1967; received teaching certificate from University of British Columbia in 1969; completed requirements for the Master of Science degree in Wildlife Biology at Utah State University in 1974.

Professional Experience: 1968 to 1970, worked as field assistant for 3 summers on blue grouse on Vancouver Island, British Columbia, under Dr. J. F. Bendell.