Breeding bird populations in relation to proposed sagebrush control in central Montana
by Francis Gale Feist

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
Montana State University

Abstract:
This study, conducted during the summers of 1966 and 1967 in central Montana, represents the pre-spray phase of a long term study designed to measure the effects of habitat alteration caused by spraying of sagebrush upon non-game bird populations. Five 40-acre study plots, each scheduled for a different type of treatment, were established on similar sagebrush-grassland habitat. The plots were censused at intervals throughout the height of the nesting season to obtain quantitative data on species composition and bird population densities. A general consistency in regard to both species composition and bird population densities was found among the plots. Four species nested on all five plots; two species nested on three plots; and one species nested on only one plot. Brewer's and vesper sparrows comprised 84.7 percent in 1966 and 91.6 percent in 1967 of the entire non-game bird populations on the plots. Quantitative measurements of canopy coverage of the vegetation and physical measurements of nests in relation to big sagebrush (Artemisia tridentata) were made at nest sites of Brewer's and vesper sparrows. All of 27 observed Brewer's sparrow nests were located off the ground (between 4 and 9 inches) within big sage plants which ranged,from 12 to 25 inches in height. Of 11 vesper sparrow nests observed, all were located on the ground under sagebrush plants ranging in height from 6 to 16 inches. Of 12 species of birds which nested on the study areas, all utilized big sagebrush to provide nesting cover with the exception of the horned lark. The summer food habits of Brewer's and vesper sparrows were determined by examination of gizzards from 42 Brewer's sparrows and 47 vesper sparrows collected on the study areas. Gizzards from 12 road-killed vesper sparrows supplemented the food habits data for 1966. Animal foods, primarily grasshoppers and beetles, constituted the bulk of the diet during early summer. A definite shift to plant foods occurred as the summer progressed and seeds became more available, especially in the case of the vesper sparrow. The seeds of grasses, especially Sandberg bluegrass in the case of the Brewer's sparrow and green needlegrass in the case of the vesper sparrow, constituted the most important plant foods.

159

BREEDING BIRD POPULATIONS IN RELATION TO PROPOSED SAGEBRUSH CONTROL IN CENTRAL MONTANA

by

FRANCIS GALE FEIST

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

Approved:

Head, Major Department

Chairman, Examining Committee

Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

June, 1968

ACKNOWLEDGMENT

To the following, among others, I wish to extend sincere appreciation for their contributions to this study: Dr. Robert L. Eng, Montana State University, for technical supervision and guidance in preparation of the manuscript; Dr. Richard J. Mackie, formerly with the Montana Department of Fish and Game, for initial project planning; Mr. Duane Pyrah, Montana Department of Fish and Game, for advice and field assistance; Dr. Don C. Quimby and Dr. William R. Gould, Montana State University, for critical reading of the manuscript; Mr. Thomas Mussehl and Mr. Kenneth Greer of the Montana Department of Fish and Game for assistance in various phases of the study; the other graduate students who worked on the project; and to my wife, Kay, for patience, encouragement, and assistance. During the study, the writer was supported by the Montana State Department of Fish and Game under Federal Aid Project No. W-105-R-1, No. W-105-R-2, and No. W-105-R-3, and the United States Department of Interior, Bureau of Land Management.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study, conducted during the summers of 1966 and 1967 in central Montana, represents the pre-spray phase of a long term study designed to measure the effects of habitat alteration caused by spraying of sagebrush upon non-game bird populations. Five 40-acre study plots, each scheduled for a different type of treatment, were established on similar sagebrush-grassland habitat. The plots were censused at intervals throughout the height of the nesting season to obtain quantitative data on species composition and bird population densities. A general consistency in regard to both species composition and bird population densities was found among the plots. Four species nested on all five plots; two species nested on three plots; and one species nested on only one plot. Brewer's and vesper sparrows comprised 84.7 percent in 1966 and 91.6 percent in 1967 of the entire non-game bird populations on the plots. Quantitative measurements of canopy coverage of the vegetation and physical measurements of nests in relation to big sagebrush (*Artemisia tridentata*) were made at nest sites of Brewer's and vesper sparrows. All of 27 observed Brewer's sparrow nests were located off the ground (between 4 and 9 inches) within big sage plants which ranged from 12 to 25 inches in height. Of 11 vesper sparrow nests observed, all were located on the ground under sagebrush plants ranging in height from 6 to 16 inches. Of 12 species of birds which nested on the study areas, all utilized big sagebrush to provide nesting cover with the exception of the horned lark. The summer food habits of Brewer's and vesper sparrows were determined by examination of gizzards from 42 Brewer's sparrows and 47 vesper sparrows collected on the study areas. Gizzards from 12 road-killed vesper sparrows supplemented the food habits data for 1966. Animal foods, primarily grasshoppers and beetles, constituted the bulk of the diet during early summer. A definite shift to plant foods occurred as the summer progressed and seeds became more available, especially in the case of the vesper sparrow. The seeds of grasses, especially Sandberg bluegrass in the case of the Brewer's sparrow and green needlegrass in the case of the vesper sparrow, constituted the most important plant foods.

INTRODUCTION

The increasing trend toward sagebrush (*Artemisia* spp.) manipulation on private and public lands in the West has caused concern among wildlife biologists. One result of this concern is a 10-year research project, initiated jointly in 1965 by the Montana Fish and Game Department and the Bureau of Land Management. This project is designed to measure ecologic changes induced by various methods of sagebrush control.

As part of the above project, this study is designed to determine the effects of habitat alteration upon non-game bird species. This paper presents quantitative data gathered by the author during the summers of 1966 and 1967, the pre-spray phase of the project.

DESCRIPTION OF THE AREA

Four areas (Figure 1), all located on lands administered by the Bureau of Land Management, were selected for intensive study. These areas, located in central Montana within 20 miles of the Town of Winnett, lie within or adjacent to an area locally known as the Yellow Water Triangle Area. The principal land use in this area is livestock grazing.

The vegetation was characterized by a sagebrush-grassland type. Predominant shrubs included: broom snakeweed (*Gutierrezia sarothrae*), rubber rabbitbrush (*Chrysothamnus nauseosus*), and big sage (*Artemisia tridentata*), with the latter having the greater density in most situations. The principal grasses were western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), June grass (*Koeleria cristata*), various species of bluegrass (*Poa* spp.), especially Sandberg bluegrass (*Poa secunda*), needle and thread (*Stipa comata*), and green needlegrass (*Stipa viridula*). Threadleaf sedge (*Carex filifolia*) was also abundant. Yarrow (*Achillea millefolium*), fringed sagewort (*Artemisia frigida*), plains prickly pear (*Opuntia polycantha*), plantain (*Plantago* spp.), American vetch (*Vicia americana*), and Hood's phlox (*Phlox hoodii*) were the dominant forbs. Various degrees of dominance and association between grass and forb species existed throughout the area. A more quantitative description of the vegetation on each plot is presented in a later section.

Gieseker (1940) describes the climate for the area as semiarid, characterized by moderately low rainfall, low humidity, and great extremes in summer and winter temperatures. The average annual precipitation for the

area is 12.57 inches. The mean average annual temperature is 45.4 degrees F. (United States Department of Commerce Weather Station at Flat Willow). A more complete description of the area is given by Bayless (1967).

Precipitation on this area for the study period June through August totaled 2.23 inches in 1966 and 6.49 inches in 1967.

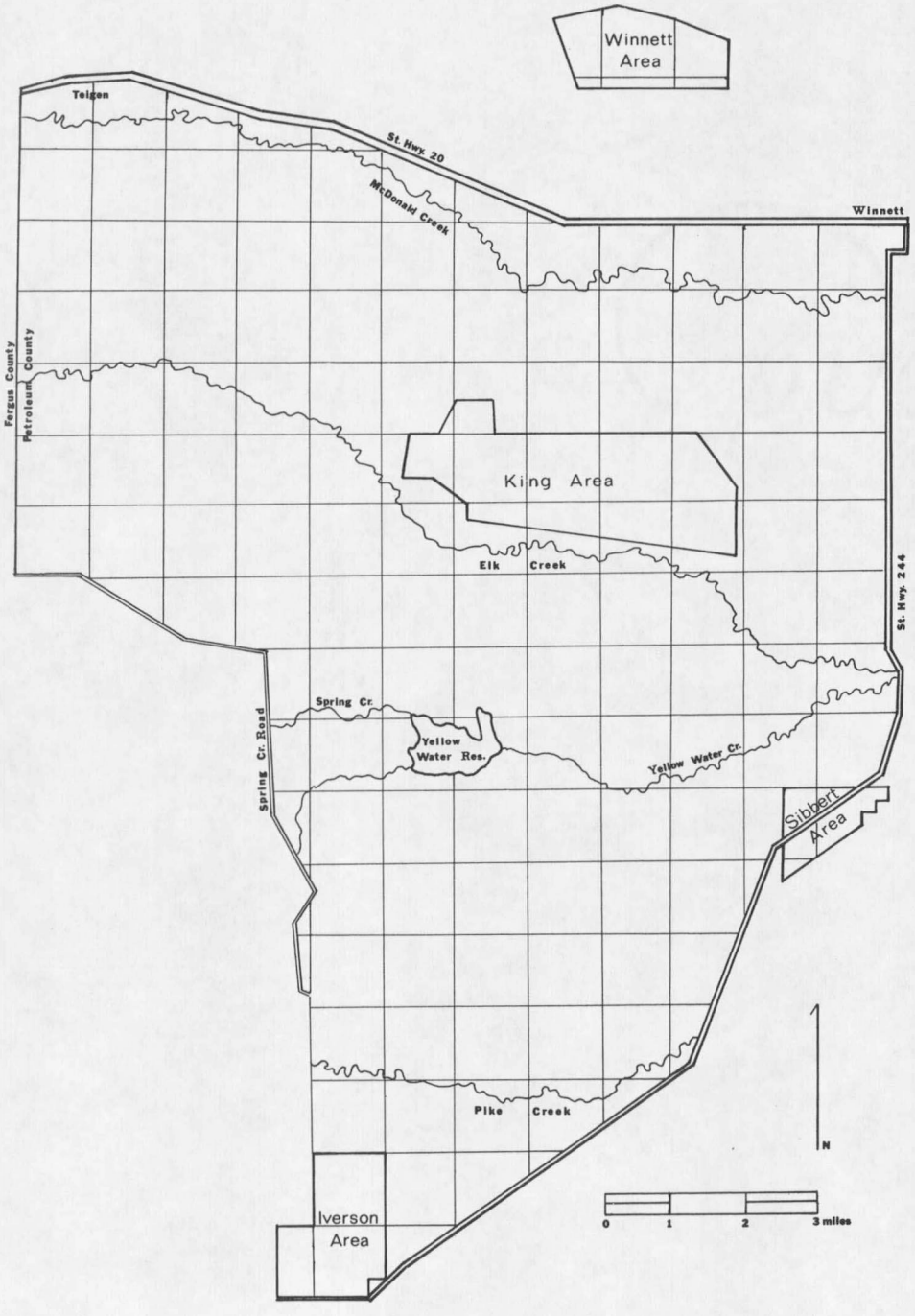

Figure 1. Map showing the four sagebrush control study areas.

METHODS

Five different sagebrush manipulation treatments were scheduled for the overall study. Bird study plots were established on treatment areas scheduled for total kill and strip spray on the Winnett Area (Appendix, Figure 2), and partial (60 percent) kill on the Iverson Area (Appendix, Figure 3). Two control plots were also established, one on which grazing is to be deferred and one on which grazing is to be continued.

Study plots were 40 acres in size. Each plot was gridded throughout at intervals of 330 feet. Small flags, projecting just above the level of the sagebrush, marked the boundaries.

Bird censuses were conducted between 5:00 a.m. and 9:00 a.m. from June 17 through July during both summers by the territory-mapping technique employed by Williams (1936), Warbach (1958), and Finzel (1964). Two hours were required to census one plot, consequently two adjoining plots were usually censused each day. A study plot censused during the first census period (5:00 a.m. to 7:00 a.m.) on the first day was censused during the second (7:00 a.m. to 9:00 a.m.) on the following day. Each study plot was censused at least three times in 1966 and five times in 1967 during the height of the breeding season. The procedure consisted of walking along the five north-south lines of the plot and returning to the starting point along the five east-west lines. The census route was constant throughout both summers. To aid in bird identification the author used a 9 x 35 binocular. A map similar to that described by Kendeigh (1944) was used for recording the location of all birds seen and heard. A new map was used for each census. Also noted on the map

were locations of nests, direction of flight if birds flushed, and behavior, especially breeding bird activities.

To obtain breeding bird population density estimates, a composite map for each study plot was constructed at the end of the seasonal censusing period. Most of the breeding birds maintained a "Type A" territory (Nice 1941), whereby the defended area was used for mating, nesting, and feeding of adults and young. Consequently the adult birds remained in a restricted area for an extended time. The recorded observations were clustered into groups which represented the general limits of a territory of one pair of birds. By counting these territories an estimate of the number of breeding pairs of each species residing on the plots was obtained. Breeding bird densities are expressed as pairs per 100 acres (Kendeigh *op cit.*).

Vegetational measurements were taken at nest sites of Brewer's sparrows (*Spizella breweri*) and vesper sparrows (*Pooecetes gramineus*), the two most abundant bird species on the study plots. Nomenclature is that of Booth (1950) and Booth and Wright (1959).

A modification of the method described by Daubenmire (1959) was employed, whereby five 2 x 5 dm plots were placed at regular intervals along each of four 25-foot lines on cardinal compass points from the nest site. The percent canopy coverage of each taxon, and percentages of bare ground, rock and lichens were also recorded for each plot. Classes were: Class 1 = 0-5 percent; Class 2 = 5-25 percent; Class 3 = 25-50 percent; Class 4 = 50-75 percent; Class 5 = 75-95 percent, and Class 6 = 95-100 percent. The midpoint of each class was the value used

in data tabulations.

The canopy coverage of sagebrush occurring along the four 25-foot lines was measured at each nest site. Also recorded were the height and diameter of sagebrush plants selected as nesting sites, height of nests above ground, and number of eggs or young in nests.

Brewer's and vesper sparrows were collected from sagebrush-grassland habitat during evening for analysis of food habits. During the time of censusing, all birds were collected at least one-half mile from the study plots.

Gizzards were preserved in a 10 percent formalin solution for later analysis by the author at the Montana Fish and Game Research Laboratory in Bozeman. Road kills in the vicinity of the study areas supplemented the food habits data.

The total food volume in passerine birds is so small that measurement of individual items is impractical (Martin *et al.* 1946). Food items were visually estimated as a percent of the total gizzard contents. These percentages were totaled and averaged using the aggregate percent method (Martin *op cit.*).

Seeds from gizzards were identified with assistance from Mr. Loren Wiesner of the Montana Grain Inspection Laboratory at Bozeman, and the staff of the Federal Seed Laboratory in Sacramento, California. Dr. Norman L. Anderson, Professor of Entomology at Montana State University, and Mr. John Banfill, a student at Montana State University, assisted in identification of insects and fragments found in gizzards.

RESULTS

Breeding Bird Populations

Winnett Defer Control Plot. - Five species of birds utilized this study plot for breeding (Table I). A brood of eight sage grouse (*Centrocercus urophasianus*) was observed during each of two successive censuses in 1967.

The greatest bird densities in 1966 occurred on June 27 when 114 observations were recorded, and in 1967 on July 12 when 121 observations were recorded.

Brewer's and vesper sparrows were the two most abundant species. Each of these species comprised 44.4 percent in 1966, and 53.3 and 33.3 percent, respectively, in 1967, of the total breeding bird populations.

Horned larks (*Eremophila alpestris*) were present during both summers, but established a territory only during the summer of 1967.

The percent canopy coverage of the vegetation, based on eight Daubenmire transects, was 76.4. Of this vegetative cover, grasses and grass-like plants comprised 35.2, forbs 15.7, and shrubs 24.2 percent. Lichens made up the remaining 1.3 percent. The principal grass was *Agropyron smithii*, followed by *Koeleria cristata* and *Poa* spp. The predominant forbs were *Vicia americana*, *Phlox hoodii*, *Sphaeralcea coccinae*, and *Artemisia frigida*. *Artemisia tridentata* was the dominant shrub.

Winnett Total Kill Spray Plot. - With the exception of the lark bunting (*Calamospiza melanocorys*) for which only one observation was recorded, the species composition of breeding birds on the Winnett total kill spray plot was identical to that of the Winnett defer control plot (Tables I and II).

TABLE I. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE WINNETT DEFER CONTROL PLOT.

Species	1966*			1967**		
	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres
Brewer's Sparrow	40	12	30	56	16	40
Vesper Sparrow	46	12	30	29	10	25
W. Meadowlark	5	2	5	5	2	5
Lark Bunting	2	1	2.5	2	1	2.5
Horned Lark	--	--	--	2	1	2.5
TOTALS	93	27	67.5	94	30	75.0

* Data obtained from three censuses: June 27, July 6, and July 10.
**Data obtained from four censuses: June 19, June 21, July 7, and July 12.

TABLE II. ESTIMATED NUMBERS OF BREEDING BIRDS ON WINNETT TOTAL KILL SPRAY PLOT.

Species	1966* Average No. Obs./Census	1966* Number Pairs	1966* Pairs Per 100 Acres	1967** Average No. Obs./Census	1967** Number Pairs	1967** Pairs per 100 Acres
Brewer's Sparrow	15	5	12.5	38	15	37.5
Vesper Sparrow	35	10	25	29	11	27.5
W. Meadowlark	2	1	2.5	2	1	2.5
Horned Lark	2	1	2.5	2	1	2.5
TOTALS	54	17	42.5	71	28	70.0

* Data obtained from four censuses: July 11, July 12, July 14, and July 23.
**Data obtained from six censuses: June 19, June 20, June 24, June 29, July 6, and July 14.

Because of a delay in establishing this study plot, censusing was not begun until July 11, 1966, allowing only four late censuses to be taken. The density estimates included only late nesters and thus are not comparable to densities found in 1967.

Of the total breeding bird population Brewer's and vesper sparrows comprised 29.4 and 58.8 percent, respectively, in 1966 and 53.6 and 39.3 percent, respectively, in 1967.

The greatest bird densities were recorded during the first census, July 11, 1966 when 78 were recorded, and on June 20, 1967 when 86 were recorded. A census on July 23, 1966, revealed only four Brewer's and 18 vesper sparrows.

Canopy coverage of the vegetation on this plot measured 85.3 percent. Grasses and grass-like plants comprised 49.0, forbs 17.6, shrubs 16.7, and lichens 2.0 percent. *Agropyron smithii*, *Agropyron spicatum*, and *Stipa viridula* were the principal grasses. Dominant forbs were *Phlox hoodii* and *Vicia americana*. *Artemisia tridentata* was the most important shrub.

Winnett Strip Spray Plot. - Of the six species of birds which nested on the Winnett strip spray plot, only the Brewer's sparrow and the vesper sparrow were present during both summers (Table III). The horned lark, sage thrasher (*Oreoscoptes montanus*), western meadowlark (*Sturnella neglecta*), and mourning dove (*Zenaidura macroura*) were present as breeding pairs for only one summer. One sage grouse and one sage thrasher observation were made in 1967.

Brewer's and vesper sparrows constituted 54.5 and 36.4 percent, respectively, of the total breeding bird population in 1966. In 1967

TABLE III. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE WINNETT STRIP SPRAY PLOT.

Species	1966*			1967**		
	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres
Brewer's Sparrow	46	12	30	41	14	35
Vesper Sparrow	34	8	20	16	5	12.5
Sage Thrasher	2	1	2.5	--	--	--
Horned Lark	2	1	2.5	--	--	--
Mourning Dove	--	--	--	1	1	2.5
W. Meadowlark	--	--	--	2	1	2.5
TOTALS	84	22	55	60	21	52.5

* Data obtained from three censuses: July 6, July 10, and July 14.
**Data obtained from six censuses: June 20, June 22, June 24, July 6, July 9, and July 15.

these same species comprised 66.7 and 23.8 percent, respectively.

The highest total bird count in 1966 was on July 6 when 107 were recorded, and on July 9, 1967 when 80 were recorded.

The canopy coverage of the vegetation totaled 76.4 percent. Grasses and grass-like plants comprised 42.9 percent of this total. The most abundant grasses were *Agropyron spicatum*, *Agropyron smithii*, *Bouteloua gracilis*, and *Koeleria cristata*. Forbs, especially *Vicia americana*, *Plantago* spp., and *Achillea millefolium*, made up 12.5 percent. Shrubs, especially *Artemisia tridentata*, comprised 14.5 percent. Lichens constituted 6.5 percent.

Iverson Open Control Plot. - Although six species of birds utilized the Iverson control plot for breeding in 1966, only three species nested on this plot in 1967 (Table IV).

Brewer's and vesper sparrows were the two most abundant species comprising 51.6 and 25.8 percent, respectively, in 1966, and 66.7 and 23.8 percent, respectively, in 1967 of the total breeding bird population.

In 1966 the greatest number of birds was recorded on June 21 when 104 were recorded. The highest total count in 1967 (100 observations) was made July 10.

The percent cover of the vegetation on this plot was 86.7 Of this total, grasses and grass-like plants comprised 39.6, forbs 11.2, shrubs 29.3, and lichens 6.6 percent. The most abundant grasses were *Agropyron spicatum*, *Agropyron smithii*, *Bouteloua gracilis*, *Koeleria cristata*, and *Stipa comata*. *Vicia americana*, *Lepidium densiflorum*, and *Plantago* spp. were the principal forbs. *Artemisia tridentata* was the most important shrub.

TABLE IV. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE IVERSON OPEN CONTROL PLOT.

Species	1966* Average No. Obs./Census	1966* Number Pairs	1966* Pairs Per 100 Acres	1967** Average No. Obs./Census	1967** Number Pairs	1967** Pairs Per 100 Acres
Brewer's Sparrow	50	16	40	44	14	35
Vesper Sparrow	24	8	20	23	8	20
W. Meadowlark	5	2	5	2	1	2.5
Lark Bunting	6	3	7.5	--	--	--
Horned Lark	2	1	2.5	--	--	--
Sage Thrasher	3	1	2.5	--	--	--
TOTALS	90	31	77.5	69	23	57.5

* Data obtained from four censuses: June 17, June 18, June 21, and June 26.
**Data obtained from five censuses: June 17, June 18, June 23, July 8, and July 10.

Iverson Partial Kill Spray Plot. - The species composition of non-game breeding birds on the Iverson partial kill spray plot was identical to that of the Iverson control plot during both summers (Tables IV and V). One game species, the sage grouse, also used this plot for nesting in 1966.

Brewer's and vesper sparrows were the most abundant species comprising 51.9 and 29.6 percent, respectively, in 1966, and 58.8 and 35.3 percent, respectively, in 1967 of the total breeding bird population.

The highest total count in 1966 was made on June 26 when 99 were recorded, and in 1967 on June 17 when 58 were recorded.

The canopy coverage of the vegetation totaled 67.5 percent of which grasses and grass-like plants comprised 31.7 percent. The most important grasses were *Bouteloua gracilis*, *Agropyron smithii*, *Stipa comata*, and *Poa* spp. Forbs, primarily *Phlox hoodii*, *Artemisia frigida*, and *Plantago* spp., constituted only 5.1 percent of the total coverage. Shrubs, especially *Artemisia tridentata*, comprised 27.0 percent, and lichens made up 3.7 percent of the total coverage.

TABLE V. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE IVERSON PARTIAL KILL SPRAY PLOT.

Species	1966*			1967**		
	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres
Brewer's Sparrow	55	14	35	29	10	25
Vesper Sparrow	24	8	20	16	6	15
W. Meadowlark	2	1	2.5	2	1	2.5
Horned Lark	4	2	5	--	--	--
Lark Bunting	3	1	2.5	--	--	--
Sage Thrasher	2	1	2.5	--	--	--
Sage Grouse	1	--	--	--	--	--
TOTAL	91	27	67.5	47	17	42.5

* Data obtained from four censuses: June 17, June 18, June 21, June 26.
**Data obtained from six censuses: June 17, June 18, June 23, July 8, July 10, and July 18.

Nesting

Brewer's Sparrow. - Twenty-seven Brewer's sparrow nests were found on the study areas. All were located off the ground within big sage plants (Table VI). Individual sagebrush plants containing Brewer's sparrow nests ranged in height from 12 to 25 inches and averaged 18.5 inches. Twenty nests, or 74 percent, were found between 6 and 8 inches above the ground.

TABLE VI. THE HEIGHT ABOVE THE GROUND OF 27 BREWER'S SPARROW NESTS FOUND ON THE STUDY AREAS.

Height of Top of Nest Above Ground in Inches	Number Nests
3	0
4	1
5	2
6	8
7	7
8	5
9	4
10	0

The canopy coverage of big sage at nesting sites of Brewer's sparrows, based on the 100-foot line intercept method, averaged 31 percent (Figure 4). The canopy coverage of big sage at nesting sites, based on 27 Daubenmire transects, averaged 20 percent (Figure 4).

A detailed description of the vegetation found at the nesting sites of 27 Brewer's sparrows is given in the Appendix, Table VII.

The number of eggs in completed clutches of 19 Brewer's sparrow nests ranged from two to four and averaged 3.26 (Table VIII).

TABLE VIII. CLUTCH SIZES OF 19 BREWER'S SPARROW NESTS FOUND ON THE STUDY AREAS.

Number Eggs in Nest	Number Nests	Percent
1	0	0
2	1	5.2
3	12	63.2
4	6	31.6
5	0	0

Vesper Sparrow. - All of 11 vesper sparrow nests found on the study areas were located on the ground directly under big sage plants which ranged in height from 6 to 16 and averaged 12.9 inches.

Abundance of sagebrush at nesting sites of vesper sparrows varied greatly. Based on the line intercept method, the canopy coverage of big sage ranged from a high of 32 to a low of 3 and averaged 14.5 percent (Figure 4). The percent canopy coverage of big sage also varied greatly according to the Daubenmire method, ranging from 21 to 1 and averaging 10 percent (Figure 4).

Four vesper sparrow nests containing completed clutches were found. Each of three nests contained three eggs, and one contained four, averaging 3.25 eggs per clutch.

A detailed description of the vegetation comprising 11 vesper sparrow nest sites is given in the Appendix, Table IX.

Other Species. - With the exception of the horned lark which nested on bare or sparsely covered ground, all other species which nested on the study plots, meadowlark, lark bunting, sage thrasher, mourning dove, and sage grouse, established nests either within or directly under big sage plants.

Four species, the Brewer's blackbird, mallard, pintail, and widgeon, nests of which were found on the study areas but not on the study plots, also utilized big sage plants as nesting cover.