



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

© Copyright by Francis Gale Feist (1968)

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

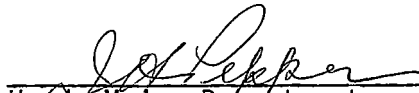
of

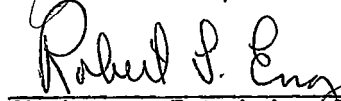
MASTER OF SCIENCE

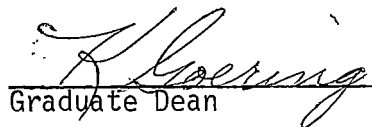
in

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

	Page
VITA	ii
ACKNOWLEDGMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	v
LIST OF FIGURES	vi
ABSTRACT	vii
INTRODUCTION	1
DESCRIPTION OF THE STUDY AREA	2
METHODS	5
RESULTS	8
Breeding Bird Populations.....	8
Nesting.....	17
Food Habits.....	21
DISCUSSION	25
APPENDIX	32
LITERATURE CITED	40

LIST OF TABLES

Table	Page
I. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE WINNETT DEFER CONTROL PLOT	9
II. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE WINNETT TOTAL KILL SPRAY PLOT	10
III. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE WINNETT STRIP SPRAY PLOT	12
IV. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE IVERSON OPEN CONTROL PLOT	14
V. ESTIMATED NUMBERS OF BREEDING BIRDS ON THE IVERSON PARTIAL KILL SPRAY PLOT	16
VI. THE HEIGHT ABOVE THE GROUND OF 27 BREWER'S SPARROW NESTS FOUND ON THE STUDY AREAS	17
VII. PERCENT CANOPY COVERAGE AND FREQUENCY OF OCCURRENCE OF VEGETATION AT 27 BREWER'S SPARROW NEST SITES AS DETERMINED BY MEASUREMENTS WITHIN 2 x 5 DECIMETER PLOTS...	35
VIII. CLUTCH SIZES OF 19 BREWER'S SPARROW NESTS FOUND ON THE STUDY AREAS.....	18
IX. PERCENT CANOPY COVERAGE AND FREQUENCY OF OCCURRENCE OF VEGETATION AT 11 VESPER SPARROW NEST SITES AS DETERMINED BY MEASUREMENTS WITHIN 2 x 5 DECIMETER PLOTS.....	37
X. FREQUENCY OF OCCURRENCE AND PERCENT OF DIET COMPRISED BY ITEMS FOUND IN GIZZARDS OF 42 BREWER'S SPARROWS DURING THE SUMMERS OF 1966 AND 1967.....	23
XI. FREQUENCY OF OCCURRENCE AND PERCENT OF DIET COMPRISED BY ITEMS FOUND IN GIZZARDS OF 47 VESPER SPARROWS DURING THE SUMMERS OF 1966 AND 1967.....	24
XII. ITEMS FOUND IN GIZZARDS OF ROAD-KILLED VESPER SPARROWS DURING JULY AND AUGUST 1966.....	39

LIST OF FIGURES

Figure	Page
1. Map showing the four sagebrush control study areas.....	4
2. The Winnett Study Area showing bird plots in relation to the proposed treatments.....	33
3. The Iverson Study Area showing bird plots in relation to the proposed treatments.....	34
4. Average percent canopy coverage of big sagebrush at nest sites of Brewer's and vesper sparrows.....	20

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 polyacantha*), 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.

Gieseke (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.

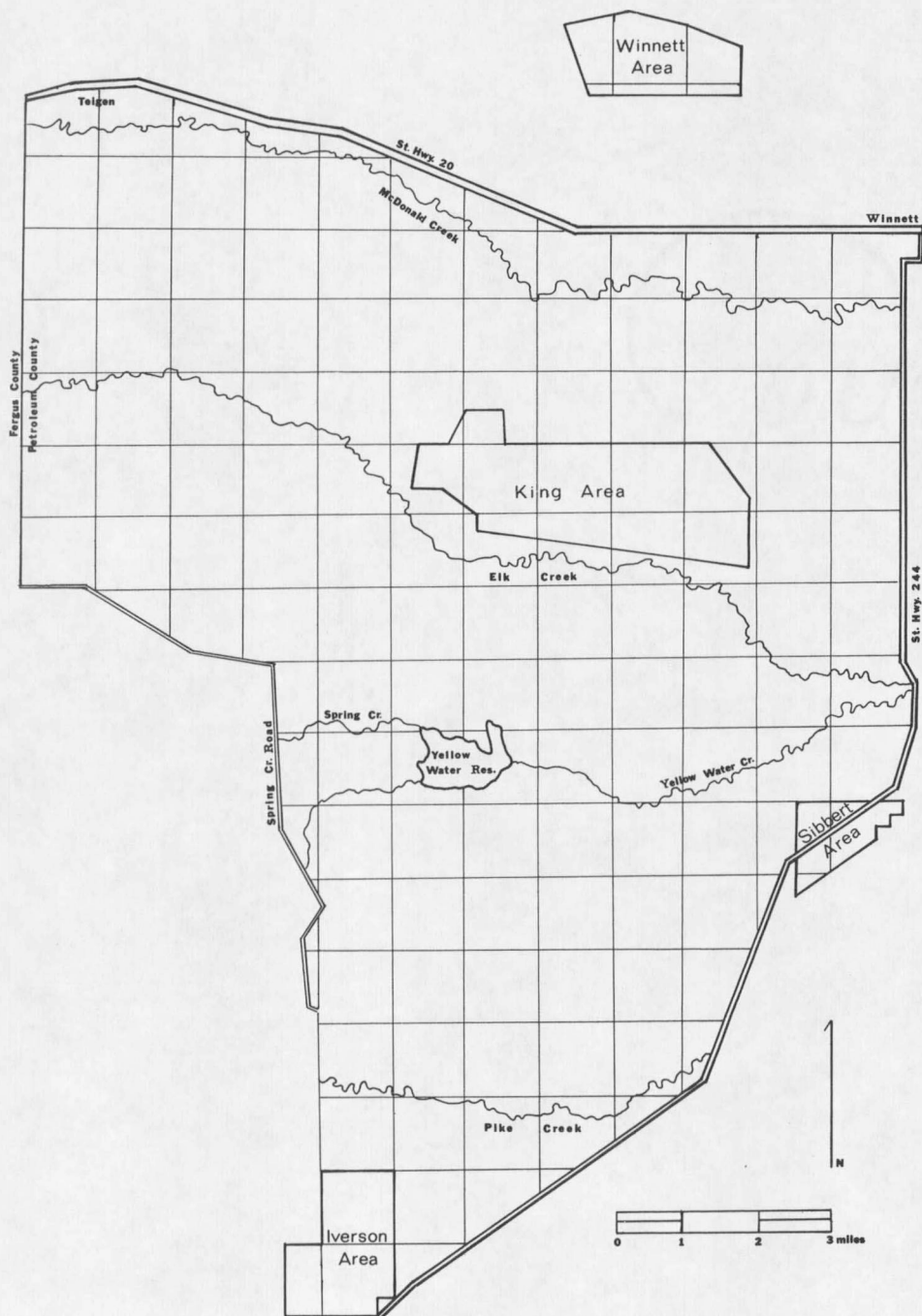


Figure 1. Map showing the four sagebrush control study areas.

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 (*Poocetes 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 coccinea*, 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*			1967**		
	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres	Average No. Obs./Census	Number Pairs	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	<u>2</u>	<u>1</u>	<u>2.5</u>	<u>2</u>	<u>1</u>	<u>2.5</u>
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*			1967**		
	Average No. Obs./Census	Number Pairs	Pairs Per 100 Acres	Average No. Obs./Census	Number Pairs	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	<u>3</u>	<u>1</u>	<u>2.5</u>	<u>--</u>	<u>--</u>	<u>--</u>
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	<u>1</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>
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.

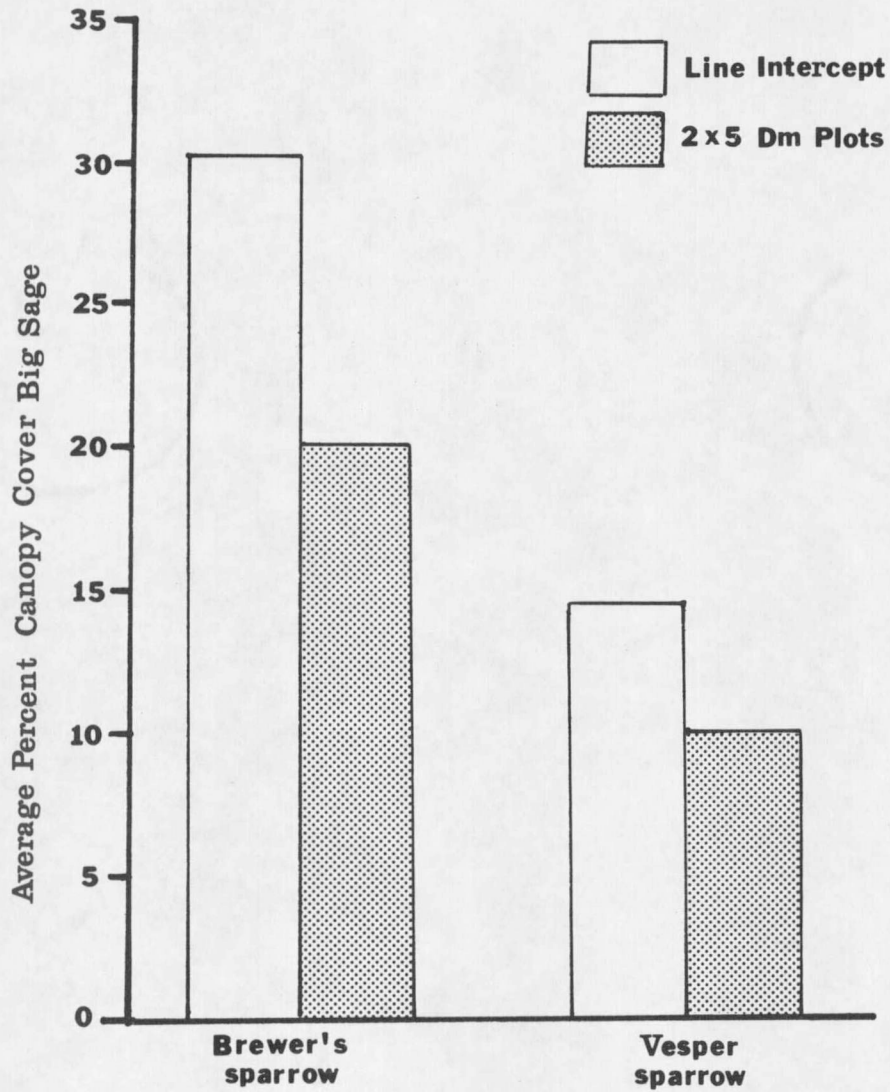


Figure 4. Average percent canopy coverage of big sagebrush at nest sites of Brewer's and vesper sparrows.

Food Habits

Brewer's Sparrow. - The frequency of occurrence and percent of total diet of the various food items in 42 gizzards collected from Brewer's sparrows during July and August of 1966, and June, July, and August of 1967 are given in Table X.

The predominant animal foods of Brewer's sparrows during both summers were grasshoppers (Acrididae), leaf beetles (Chrysomelidae), and snout beetles (Curculionidae). These food items comprised 49 percent in 1966 and 59 percent in 1967 of the total summer diet (Table X).

The seeds of bluegrass, especially Sandberg bluegrass (*Poa secunda*), green needlegrass (*Stipa viridula*), and blue grama (*Bouteloua gracilis*) were the principal plant foods taken by Brewer's sparrows. These foods comprised 22 percent in 1966 and 11 percent in 1967 of the total summer diet (Table X).

Vesper Sparrow. - Table XI lists the frequency of occurrence and percent of the total diet of the various food items found in 47 gizzards collected from vesper sparrows during July and August of 1966, and June, July, and August of 1967. The items found in gizzards of 12 road-killed vesper sparrows during July and August, 1966 are listed in the Appendix, Table XII.

Grasshoppers, leaf beetles, and snout beetles were the predominant animal foods of vesper sparrows during both summers. These items constituted 59 percent in 1966 and 42 percent in 1967 of the total summer diet of vesper sparrows collected on the study areas (Table XI). These same

foods comprised 57 percent of the diet of 12 road-killed individuals found along the highway off the study areas (Appendix, Table XII).

A wide variety of plant foods, principally seeds of grasses, grass-like plants, and forbs was eaten by vesper sparrows (Table XI). The principal plant food during both summers was the seeds of green needlegrass, comprising 19 percent in 1966 and 21 percent in 1967 of the total summer diet. This same species also comprised 4 percent of the total diet of the road-killed vesper sparrows (Appendix, Table XII).

TABLE X. FREQUENCY OF OCCURRENCE AND PERCENT OF DIET COMPRISED BY ITEMS FOUND IN GIZZARDS OF 42 BREWER'S SPARROWS DURING THE SUMMERS OF 1966 AND 1967.

GIZZARD CONTENTS	JUNE			JULY				AUGUST				TOTAL			
	1967		Per- cent Diet	1966		1967		1966		1967		1966		1967	
	Fre- quency Occur	8* Per- cent Diet		Fre- quency Occur	13* Per- cent Diet	Fre- quency Occur	10* Per- cent Diet	Fre- quency Occur	4* Per- cent Diet	Fre- quency Occur	7* Per- cent Diet	Fre- quency Occur	17* Per- cent Diet	Fre- quency Occur	25* Per- cent Diet
ANIMAL FOODS															
Orthoptera (Acrididae)	100	34		100	34	80	31	100	16	100	38	100	30	92	33
Coleoptera (Curculionidae & Chrysomelidae)	100	37		92	21	100	26	100	15	71	11	94	19	92	26
Lepidoptera larva (Pieridae)	25	5	--	--	20	1	--	--	--	14	4	--	--	20	3
Hymenoptera (Eulophidae & Formicidae)	--	--	--	23	tr**	10	tr	--	--	--	--	18	tr	4	tr
Heteroptera (Membracidae)	--	--	--	--	20	1	25	tr	--	--	--	6	tr	8	tr
Diptera (Asilidae)	--	--	--	--	--	--	--	--	--	14	tr	--	--	4	tr
Arachnida	--	--	--	--	20	1	--	--	--	--	--	6	tr	4	tr
TOTAL ANIMAL FOODS	100	76		100	55	100	60	100	31	100	53	100	49	100	62
PLANT FOODS															
Poa secunda	--	--		62	15	70	12	25	tr	14	1	53	12	32	5
Stipa viridula	--	--		23	5	10	3	50	3	29	9	24	4	12	4
Euphorbia spp.	--	--		--	--	20	8	--	--	--	--	--	--	8	3
Bouteloua gracilis	--	--		--	--	--	--	100	25	43	8	24	6	12	2
Amaranthus spp.	--	--		--	--	--	--	25	3	--	--	6	tr	--	--
Stipa comata	--	--		--	--	--	--	25	3	--	--	6	tr	--	--
Potentilla spp.	--	--		--	--	--	--	25	tr	--	--	6	tr	--	--
Plantago purshii	--	--		--	--	--	--	--	--	14	1	--	--	4	tr
Chenopodium album	--	--		--	--	--	--	--	--	14	2	--	--	4	tr
TOTAL PLANT FOODS	00	00		85	20	80	23	100	34	86	21	88	22	56	14
GRIT	88	17		100	14	80	9	100	22	100	18	100	16	88	14
UNIDENTIFIED	38	7		100	11	60	8	100	13	43	8	100	12	60	8

* Sample size. ** Indicates value less than 1 percent.

TABLE XI. FREQUENCY OF OCCURENCE AND PERCENT OF DIET COMPRISED BY ITEMS FOUND IN GIZZARDS OF 47 VESPER SPARROWS DURING THE SUMMERS OF 1966 AND 1967.

GIZZARD CONTENTS	JUNE		JULY				AUGUST				TOTAL			
	1967		1966	1967	1967		1966	1967	1967		1966	1967	1967	
	Fre- 8*	Per- cent	Fre- 12*	Per- cent	Fre- 13*	Per- cent	Fre- 5*	Per- cent	Fre- 9*	Per- cent	Fre- 17*	Per- cent	Fre- 30*	Per- cent
	Occur	Diet	Occur	Diet	Occur	Diet	Occur	Diet	Occur	Diet	Occur	Diet	Occur	Diet
ANIMAL FOODS														
Orthoptera (Acrididae)	88	29	100	41	92	21	100	48	89	29	100	44	90	25
Coleoptera (Curculionidae & Chrysomelidae)	100	29	67	11	77	14	100	25	78	9	76	15	83	17
Lepidoptera larva (Pieridae)	50	8	--	--	--	--	--	--	11	1	--	--	13	2
Hymenoptera (Formicidae & Eulophidae)	13	tr**	50	1	15	tr	20	tr	11	tr	41	1	13	tr
Odonata	--	--	--	--	8	2	--	--	--	--	--	--	3	tr
Arachnida	--	--	--	--	8	tr	--	--	22	2	--	--	10	tr
Mallophaga	--	--	--	--	--	--	--	--	11	tr	--	--	3	tr
Heteroptera (Membracidae)	--	--	--	--	--	--	--	--	11	tr	--	--	3	tr
TOTAL ANIMAL FOODS	100	66	100	53	100	37	100	73	100	41	100	60	100	44
PLANT FOODS														
<i>Stipa viridula</i>	13	tr	92	24	85	31	80	8	56	26	88	19	57	21
<i>Carex</i> spp.	25	8	--	--	15	2	--	--	22	tr	--	--	20	3
<i>Viola</i> spp.	25	3	--	--	15	3	--	--	--	--	--	--	10	2
<i>Androsace septentrionalis</i>	13	3	--	--	--	--	--	--	--	--	--	--	3	tr
<i>Plantago purshii</i>	--	--	17	tr	--	--	--	--	--	--	12	tr	--	--
<i>Amaranthus</i> spp.	--	--	8	3	15	tr	--	--	11	tr	6	2	10	tr
<i>Thlaspi arvense</i>	--	--	8	tr	--	--	--	--	--	--	6	tr	--	--
<i>Camelina microcarpa</i>	--	--	8	tr	8	tr	20	tr	--	--	12	tr	3	tr
<i>Sporobolus cryptandrus</i>	--	--	8	tr	--	--	--	--	--	--	6	tr	--	--
<i>Poa</i> spp.	--	--	8	tr	--	--	20	1	--	--	12	tr	--	--
Portulacaceae	--	--	8	3	--	--	--	--	11	3	6	2	3	tr
<i>Euphorbia</i> spp.	--	--	--	--	46	12	--	--	--	--	--	--	20	5
<i>Bouteloua gracilis</i>	--	--	--	--	--	--	20	tr	--	--	6	tr	--	--
<i>Stipa comata</i>	--	--	--	--	--	--	--	--	44	19	--	--	13	6
<i>Chenopodium album</i>	--	--	--	--	--	--	--	--	22	tr	--	--	7	tr
TOTAL PLANT FOODS	63	14	100	30	100	48	100	9	100	48	100	23	87	37
GRIT	88	6	75	7	100	7	100	6	100	7	82	6	97	7
UNIDENTIFIED	63	14	100	10	62	8	80	12	22	3	100	10	80	10

* Sample size. ** Indicates value less than 1 percent.

DISCUSSION

Breeding Bird Populations. - A comparison of the breeding populations of non-game birds on the five study plots revealed a general consistency with regard to the species composition. Four species, the Brewer's sparrow, vesper sparrow, meadowlark, and horned lark, nested on all five study plots; two species, the lark bunting and sage thrasher, nested on three plots; and one species, the mourning dove, nested on only one plot. The similarity in species composition of breeding birds on plots located on the same study areas is even more striking. The entire non-game bird populations on both study plots located in the Iverson area were comprised of the same six species in 1966, and the same three species in 1967. The plots located on the Winnett area show a slightly greater variation in species composition. Four species were common to all three plots, while each of three species nested on only one plot.

Brewer's and vesper sparrows were the most abundant nesting birds comprising 84.7 percent in 1966 and 91.6 percent in 1967 of the total breeding bird populations. Baldwin (1956) in northwestern Montana, and Huey and Travis (1961) in New Mexico, also found Brewer's and vesper sparrows to be the most common non-game birds in sagebrush areas.

Yearly fluctuations in breeding bird densities on plots located on the Winnett area were quite small (1966 census data from the Winnett total kill spray plot excluded because of late censusing). However, a substantial reduction in breeding bird densities (20 and 25 pairs per 100 acres) as well as a 50 percent reduction in species composition occurred on both plots located on the Iverson area in 1967. These reductions were undoubtedly a result of excessive rainfall (over 6 inches) which fell in

this area in a relatively short time early in June, 1967, causing flood conditions throughout this area. This severe interruption of nesting activities measurably suppressed nesting of horned larks, lark buntings, and sage thrashers on these plots.

A comparison of breeding bird populations on the study plots (excluding census data from the Winnett total kill spray plot) during 1966 reveals a general consistency both in regard to the average number of observations per census (range: 93-84) and the number of pairs per 100 acres (range: 77.5-55). The 1967 census data show a somewhat greater variability among plots due to the decrease in breeding bird population densities on the plots located on the Iverson area. When the total number of pairs of breeding birds per 100 acres from each plot (excluding Winnett total kill spray plot) during 1966 are averaged, the result is 66.8 pairs per 100 acres. This figure compares favorably with the 65 pairs per 100 acres found by Saunders (1936) in shrublands (brushy pastures) in the Allegheny State Park of southwestern New York. The 1967 census data yield an average of 59.5 pairs per 100 acres. This lower figure is a result of the decrease in bird population densities on the two plots located on the Iverson area.

Nesting. - Of 12 species of birds which utilized the study areas for nesting during the summers of 1966 and 1967, all were ground nesters with the exception of the Brewer's sparrow and the sage thrasher which constructed their nests off the ground within big sage plants. All of the ground nesters utilized big sage to provide overhead cover except the horned lark which nested on bare or sparsely covered ground.

The data show that the Brewer's and vesper sparrows utilized two distinct niches for nesting in this sagebrush-grassland habitat. Although the presence of sagebrush appears to be a nesting requirement for both species on the study plots, the data indicate more specific nesting requirements with regard to sagebrush in the case of the Brewer's sparrow. Whereas the vesper sparrow tolerated a wide range of sagebrush abundance (canopy coverage of big sage ranged from 3 to 32 and averaged 14.5 percent), the Brewer's sparrow apparently preferred more dense sagebrush situations (canopy coverage of big sage ranged from 15 to 49 and averaged 31 percent). Although there was some overlap in regard to the height of sage plants used by these species in nesting, the taller (12-25 inches) sage plants were preferred by Brewer's sparrows, while vesper sparrows utilized the shorter (6-16 inches) plants. The apparent versatility of the vesper sparrow in its nesting requirements may help to account for the wide distribution of this species throughout the northern half of the United States, whereas the Brewer's sparrow is much more restricted, due perhaps to its more rigid nesting requirements (Martin, Zim, and Nelson 1951).

Although in this study the Brewer's sparrow utilized only big sage, since it was the only large shrub available on the plots, Hardy (1945) and Wing (1949) found a variety of shrubs including greasewood (*Sarcobatus vermiculatus*) used in nesting by this species.

Food Habits. - The data show considerable overlap in food habits between Brewer's and vesper sparrows. Both species generally followed similar broad shifts in regard to food items utilized throughout the summer.

These shifts apparently occurred as a result of preferences and of changes in availability of the various food items.

Animal foods comprised the bulk of the diet in early summer, but gradually declined in importance as insect numbers declined and seeds became available. The entire diet of Brewer's sparrows collected during June, 1967 consisted of animal matter while these same foods comprised only 53 percent of the diet of Brewer's sparrows collected during August of the same year. Animal foods comprised 66 percent of the diet of vesper sparrows collected during June, 1967 as compared with 41 percent in August of the same year. Grasshoppers and beetles comprised the bulk of the animal foods for both species throughout the summer. Lepidoptera, which were taken primarily in the larval stage, comprised a significant portion of the animal diet only during the early summer, and use decreased as the summer progressed. Beetles comprised the bulk of the animal diet early in the summer; however, their importance decreased as grasshoppers became more available during July and August.

Plant foods appeared to be taken as they became available. The variety of seeds consumed as well as the percent of the total diet comprised of plant foods generally increased for both species as the summer progressed. 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, were the principal plant foods.

The data show considerable differences between the two summers in relative importance of plant and animal foods comprising the diets of both species. These differences may be explained on the basis of avail-

ability resulting from moisture conditions throughout the summer.

As a result of the unusually dry summer of 1966 (61 percent below normal precipitation), most grasses and forbs became desiccated relatively early during the summer, and seed production was drastically reduced. By August, two of the more abundant food sources available were adult grasshoppers and the seeds of the late maturing grass, blue grama. The lack of grasshopper nymphs could account for the low percentage (16) of grasshoppers in the diet of Brewer's sparrows in August, 1966 as compared with 38 percent in August, 1967, since it is a relatively small bird and possibly not capable of taking large adult grasshoppers. Since abundant insect food was not available, the Brewer's sparrow apparently resorted to any seeds which were available, especially the seeds of blue grama. According to Martin, Zim, and Nelson (1951), the summer diet of the Brewer's sparrow is comprised primarily of animal foods, only 16 percent of the diet consisting of plant foods. This agrees closely with my 1967 data which show 14 percent of the summer diet of the Brewer's sparrow composed of plant foods.

The summer of 1967 was characterized by abundant rainfall with the majority (73.8 percent) occurring during June. The large amount of precipitation during June may have set back the phenology of the area. Since both plant and animal foods were abundant throughout the summer of 1967, one might expect a more accurate picture of food preferences. Since grasshopper nymphs were apparently more abundant during August, 1967 due to the later spring, a large bulk of the diet (38 percent) of Brewer's sparrows consisted of grasshoppers. Thus for the entire summer

of 1967 animal foods comprised 62 percent of the diet of the Brewer's sparrow as compared to 49 percent for the summer of 1966.

According to Judd (1901), Martin, Zim, and Nelson (*op. cit.*), and Evans (1964), plant foods comprise a much larger portion of the total summer diet for the vesper sparrow than they do for the Brewer's sparrow. However, during the summer of 1966 when few plant foods were available, animal foods supplied the bulk of the diet (60 percent in 1966 as contrasted with 44 percent in 1967). Since it is a somewhat larger bird than the Brewer's sparrow, the vesper apparently was able to take adult hoppers as food, although the data show a large increase in numbers of beetles taken also. During the summer of 1967 when both plant and animal foods were available, plant foods comprised 37 percent of the diet contrasted with 23 percent during 1966. During August, 1966 when seeds were not readily available, only 9 percent of the diet consisted of plant foods. This contrasts sharply with the 48 percent plant foods taken during August, 1967 when seeds were abundant. The portion of the total summer diet for 1967 comprised by plant foods (37 percent) compares closely with the 44 percent found by Martin, Zim, and Nelson (*op. cit.*).

Road-killed vesper sparrows during July and August of 1966 also showed a high percentage of the diet composed of animal matter (65 percent). Insects, especially grasshoppers, were extremely abundant along roadside ditches since these low areas contained lush vegetation while most of the grasses and forbs on the uplands had become desiccated. This insect abundance may possibly have attracted birds to roadways.

Prickly lettuce, which comprised 5 percent of the diet of road-kills, was abundant along these roadside ditches.

Grit was found in 90.3 percent of vesper sparrow and 94 percent of Brewer's sparrow gizzards.

APPENDIX

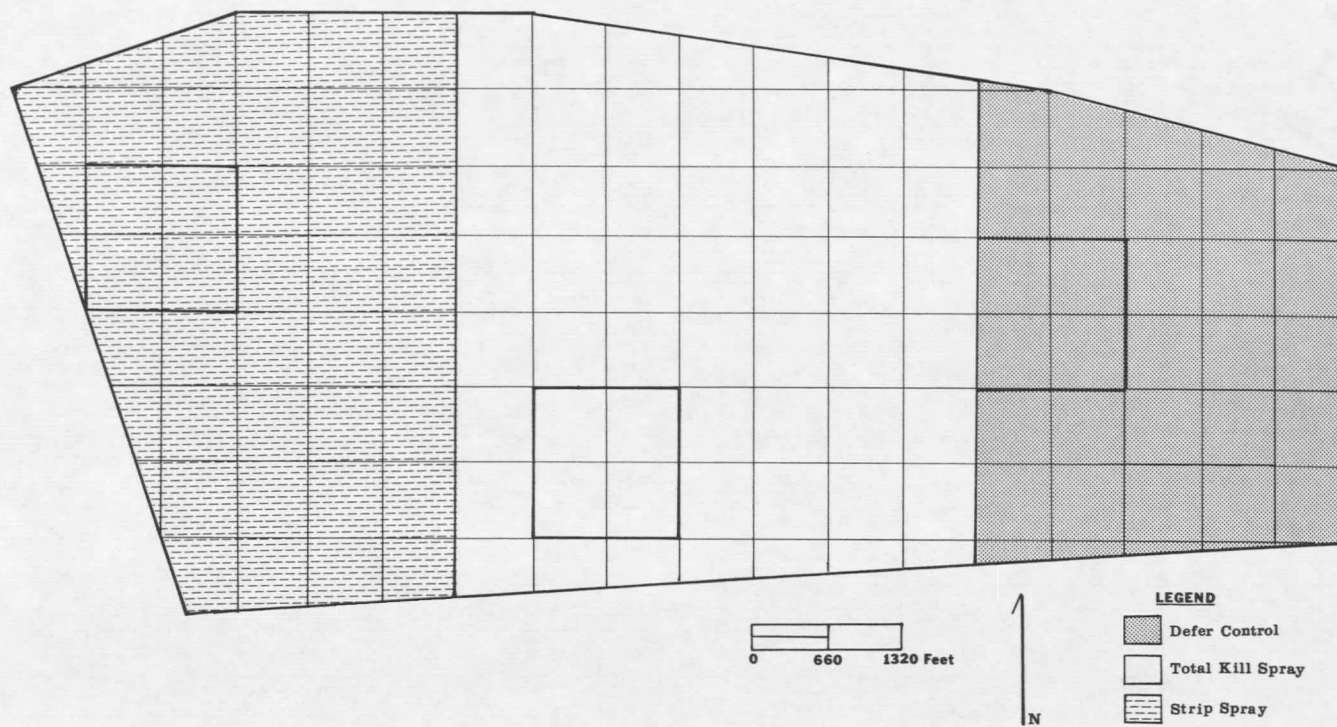


Figure 2. The Winnett Study Area showing bird plots in relation to the proposed treatments.

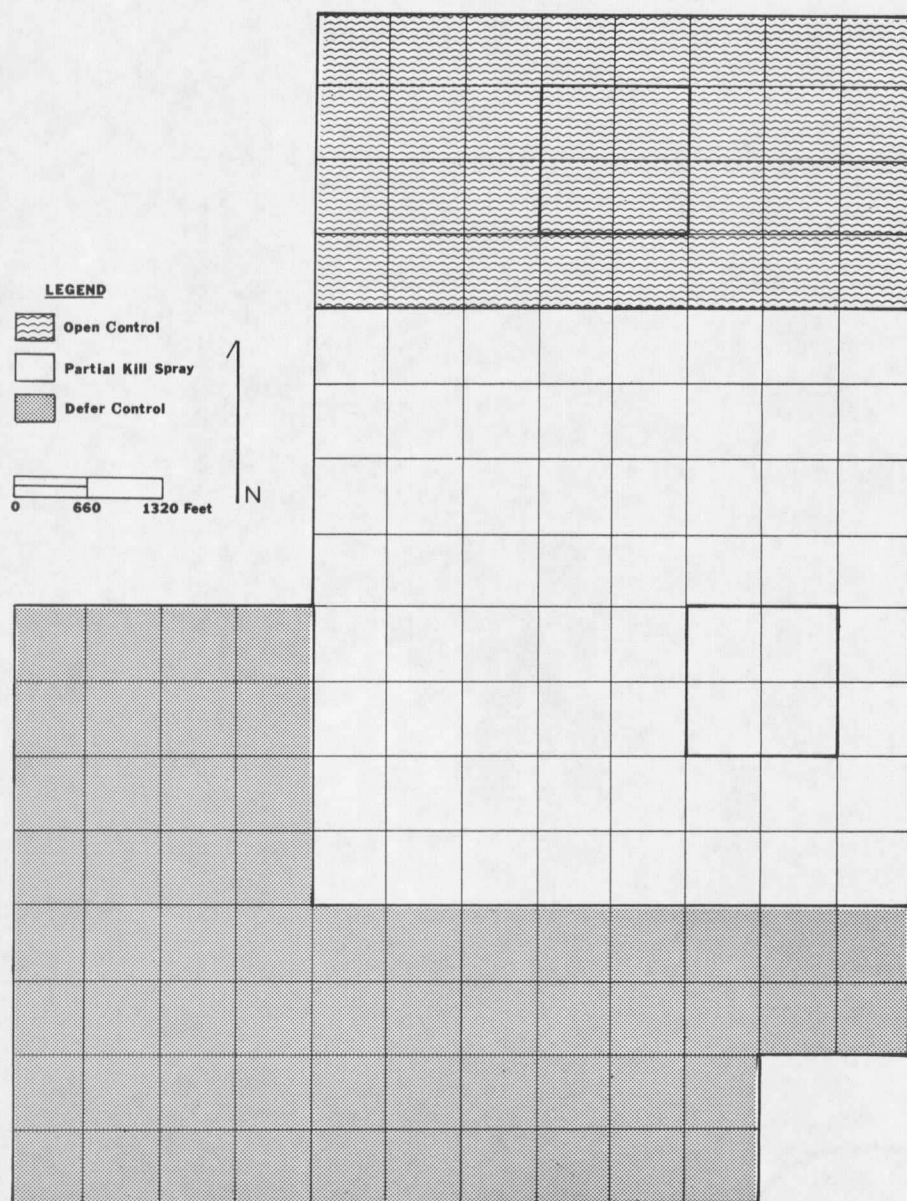


Figure 3. The Iverson Study Area showing bird plots in relation to the proposed treatments.

TABLE VII. PERCENT CANOPY COVERAGE AND FREQUENCY OF OCCURRENCE OF VEGETATION AT 27 BREWER'S SPARROW NEST SITES AS DETERMINED BY MEASUREMENTS WITHIN 2 x 5 DECIMETER PLOTS.

Taxa	1966 ^{1/}		1967 ^{2/}	
	Cover- age ^{3/}	Fre- quency ^{4/}	Cover- age	Fre- quency
GRASSES AND GRASS-LIKE PLANTS				
<i>Agropyron desertorum</i>	--	--	tr.	3
<i>Agropyron smithii</i>	6	76	18	88
<i>Agropyron spicatum</i>	4	41	1	5
<i>Bouteloua gracilis</i>	7	42	8	32
<i>Bromus tectorum</i>	tr.	15	tr.	6
<i>Carex</i> spp.	tr.	3	2	24
<i>Distichlis stricta</i>	tr.	6	--	--
<i>Festuca octoflora</i>	--	--	tr.	2
<i>Koeleria cristata</i>	1	24	2	37
<i>Poa</i> spp.	tr.	21	1	33
<i>Schedonardus paniculatus</i>	--	--	tr.	4
<i>Stipa comata</i>	tr.	18	2	22
<i>Stipa viridula</i>	tr.	16	2	12
FORBS				
<i>Achillea millefolium</i>	tr.	12	tr.	1
<i>Allium textile</i>	--	--	tr.	4
<i>Androsace septentrionalis</i>	tr.	4	tr.	3
<i>Arenaria hookeri</i>	tr.	10	tr.	1
<i>Artemisia frigida</i>	1	26	2	24
<i>Aster canescens</i>	tr.	8	tr.	1
<i>Astragalus bisulcatus</i>	tr.	x	--	--
<i>Astragalus gilviflorus</i>	tr.	1	tr.	x
<i>Astragalus gracilis</i>	--	--	tr.	x
<i>Astragalus missouriensis</i>	--	--	tr.	x
<i>Bahia oppositifolia</i>	--	--	tr.	3
<i>Camelina microcarpa</i>	tr.	3	tr.	5
<i>Collomia linearis</i>	--	--	tr.	x
<i>Draba brachycarpa</i>	--	--	tr.	1
<i>Erigeron pumilus</i>	tr.	1	tr.	1
<i>Gaura coccinea</i>	--	--	tr.	1
<i>Grindelia squarrosae</i>	--	--	tr.	2
<i>Haplopappus nuttallii</i>	tr.	4	--	--
<i>Hymenoxys acaulus</i>	tr.	3	tr.	x
<i>Iva axillaris</i>	1	17	tr.	1
<i>Lappula redowskii</i>	--	--	tr.	1
<i>Lepidium densiflorum</i>	--	--	tr.	13
<i>Lomatium orientale</i>	--	--	tr.	x
<i>Opuntia polycantha</i>	tr.	4	tr.	4
<i>Penstemon albidus</i>	--	--	tr.	x
<i>Phlox hoodii</i>	1	16	2	32
<i>Plantago</i> spp.	tr.	27	tr.	20

TABLE VII. (CONTINUED).

Taxa	1966		1967	
	Cover- age	Fre- quency	Cover- age	Fre- quency
<i>Potentilla</i> spp.	--	--	tr.	x
<i>Psoralea argophylla</i>	--	--	tr.	x
<i>Selaginella densa</i>	1	9	tr.	1
<i>Sisymbrium loeselii</i>	--	--	tr.	6
<i>Sphaeralcea coccinea</i>	tr.	21	1	24
<i>Taraxacum officinale</i>	tr.	6	tr.	4
<i>Thelasperma marginatum</i>	tr.	6	--	--
<i>Tragopogon dubius</i>	--	--	tr.	4
<i>Vicia americana</i>	tr.	11	3	50
Unknown Forbs	--	--	tr.	4
SHRUBS				
<i>Artemisia tridentata</i>	10	67	23	72
<i>Atriplex nuttallii</i>	--	--	tr.	3
<i>Gutierrezia sarothrae</i>	tr.	11	tr.	6
<i>Sarcobatus vermiculatus</i>	--	--	tr.	x
Rock	tr.	11	2	24
Lichens	1	49	4	54
Bare ground	56	100	28	98

1/ Seven Daubenmire transects.

2/ Twenty Daubenmire transects.

3/ Canopy coverage (percent of area covered by foliage). Tr. indicates canopy coverage value less than 1 percent.

4/ Average frequency (percent occurrence among plots). X indicates frequency value less than 1 percent.

TABLE IX. PERCENT CANOPY COVERAGE AND FREQUENCY OF OCCURRENCE OF VEGETATION AT 11 VESPER SPARROW NEST SITES AS DETERMINED BY MEASUREMENTS WITHIN 2 x 5 DECIMETER PLOTS.

Taxa	1966 ¹		1967 ^{2/}	
	Cover- age ^{3/}	Fre- quency ^{4/}	Cover- age	Fre- quency
GRASSES AND GRASS-LIKE PLANTS				
<i>Agropyron smithii</i>	9	91	32	99
<i>Agropyron spicatum</i>	4	29	tr.	1
<i>Bouteloua gracilis</i>	4	26	tr.	14
<i>Bromus tectorum</i>	tr.	8	tr.	1
<i>Carex</i> spp.	tr.	6	tr.	18
<i>Festuca octoflora</i>	--	--	tr.	1
<i>Hordeum jubatum</i>	--	--	tr.	1
<i>Koeleria cristata</i>	2	31	tr.	8
<i>Muhlenbergia cuspidata</i>	tr.	1	1	3
<i>Poa</i> spp.	3	57	1	30
<i>Schedonnardus paniculatus</i>	tr.	2	--	--
<i>Stipa comata</i>	2	30	2	20
<i>Stipa viridula</i>	3	31	4	20
FORBS				
<i>Allium textile</i>	--	--	tr.	5
<i>Androsace septentrionalis</i>	tr.	6	--	--
<i>Antennaria rosea</i>	tr.	1	1	13
<i>Arabis glabra</i>	--	--	tr.	5
<i>Arenaria hookeri</i>	tr.	4	tr.	5
<i>Artemisia frigida</i>	tr.	10	1	13
<i>Aster canescens</i>	tr.	5	--	--
<i>Astragalus bisulcatus</i>	tr.	x	--	--
<i>Astragalus gilviflorus</i>	--	--	tr.	3
<i>Astragalus missouriensis</i>	--	--	tr.	3
<i>Camelina microcarpa</i>	tr.	2	tr.	11
<i>Commandra umbellata</i>	--	--	tr.	5
<i>Crepis occidentalis</i>	tr.	x	tr.	4
<i>Gaura coccinea</i>	--	--	tr.	1
<i>Grindelia squarrosae</i>	--	--	tr.	3
<i>Haplopappus nuttallii</i>	tr.	1	tr.	1
<i>Hymenoxys acaulus</i>	--	--	tr.	3
<i>Hymenoxys richardsonii</i>	--	--	tr.	4
<i>Iva axillaris</i>	tr.	6	--	--
<i>Lepidium densiflorum</i>	--	--	tr.	13
<i>Lesquerella alpina</i>	tr.	1	--	--
<i>Linum lewisii</i>	--	--	tr.	7
<i>Lomatium</i> spp.	--	--	tr.	3
<i>Opuntia polycantha</i>	tr.	8	tr.	3
<i>Orobanche fasciculata</i>	--	--	tr.	1

TABLE IX. (CONTINUED).

Taxa	1966		1967	
	Cover- age	Fre- quency	Cover- age	Fre- quency
<i>Penstemon nitidus</i>	--	--	tr.	1
<i>Petalostemum purpureum</i>	--	--	5	23
<i>Phlox hoodii</i>	1	34	3	45
<i>Plantago</i> spp.	tr.	22	tr.	11
<i>Polygonum ramosissimum</i>	--	--	tr.	1
<i>Potentilla</i> spp.	tr.	1	--	--
<i>Psoralea argophylla</i>	tr.	2	3	19
<i>Selaginella densa</i>	1	11	tr.	1
<i>Sisymbrium loeselii</i>	--	--	tr.	6
<i>Sphaeralcea coccinea</i>	tr.	13	1	29
<i>Taraxacum officinale</i>	tr.	x	tr.	3
<i>Thlaspi arvense</i>	tr.	4	--	--
<i>Tragopogon dubius</i>	tr.	1	--	--
<i>Vicia americana</i>	1	26	3	38
Unknown Forbs	tr.	2	tr.	9
SHRUBS				
<i>Artemisia tridentata</i>	7	53	11	33
<i>Atriplex nuttallii</i>	tr.	3	--	--
<i>Gutierrezia sarothrae</i>	tr.	11	3	25
Rock	tr.	6	--	--
Lichens	1	49	1	24
Bare Ground	48	100	16	98

1/ Data from seven Daubenmire transects.

2/ Data from four Daubenmire transects.

3/ Canopy coverage (percent of area covered by foliage). Tr. indicates canopy coverage value less than 1 percent.

4/ Average frequency (percent occurrence among plots). X indicates frequency value less than 1 percent.

TABLE XII. ITEMS FOUND IN GIZZARDS OF 12 ROAD-KILLED VESPER SPARROWS DURING JULY AND AUGUST, 1966.

Gizzard Contents	Percent Occurrence	Percent of Diet*
ANIMAL FOODS		
Orthoptera (Acrididae)	100	41
Coleoptera (Curculionidae & Chrysomelidae)	75	16
Hymenoptera (Formicidae & Eulophidae)	42	7
Lepidoptera Larva (Pieridae)	8	1
Mallophaga	8	tr.
Arachnida (Araneida)	<u>8</u>	<u>tr.</u>
TOTAL ANIMAL FOODS	100	65
PLANT FOODS		
<i>Lactuca serriola</i>	33	5
<i>Stipa viridula</i>	33	4
<i>Thlaspi arvense</i>	17	1
<i>Plantago purshii</i>	17	tr.
<i>Melilotus</i> spp.	8	tr.
Portulacaceae	8	tr.
<i>Bouteloua gracilis</i>	8	tr.
<i>Lepidium densiflorum</i>	8	tr.
<i>Chenopodium album</i>	8	tr.
<i>Poa</i> spp.	<u>8</u>	<u>tr.</u>
TOTAL PLANT FOODS	100	10
Grit	92	10
Unidentified	100	13

*Tr. indicates value less than 1 percent.

LITERATURE CITED

- Baldwin, P. H. 1956. Breeding record of the Brewer's sparrow in north-western Montana. *Wilson Bull.*, 68(3): 251.
- Bayless, S. R. 1967. Winter range use of pronghorn antelope in central Montana. Unpubl. thesis (M.S.), Montana State University. 65 pp.
- Booth, W. E. 1950. Flora of Montana, Part I, Conifers and Monocots. Research Foundation at Montana State College, Bozeman, Montana. 232 pp.
- _____ and J. C. Wright. 1959. Flora of Montana, Part II, Dicotyledons. Montana State College, Bozeman, Montana. 280 pp.
- Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. *Northwest Sci.*, 33: 43-64.
- Evans, F. C. 1964. The food of vesper, field, and chipping sparrows nesting in an abandoned field in southeastern Michigan. *Amer. Midland Naturalist*, 72(1): 57-75.
- Finzel, J. E. 1964. Avian populations of four herbaceous communities in southeastern Wyoming. *Condor*, 66(6): 496-510.
- Giesecker, L. F. 1940. Soil survey of central Montana. *Mont. Agri. Expt. Sta. Bull. No. 9*. 133 pp.
- Hardy, R. 1945. Breeding birds of the pigmy conifers. *Auk*, 62(4): 523-542.
- Huey, W. S. and J. R. Travis. 1961. Burford Lake, New Mexico, revisited. *Auk*, 78(4): 607-626.
- Judd, S. D. 1901. The relation of sparrows to agriculture. *U. S. Dept. Agri., Div. Biol. Survey Bull. No. 15*. 98 pp.
- Kendeigh, S. C. 1944. Measurement of bird populations. *Ecological Monog.*, 14(1): 67-106.
- Martin, A. C., R. H. Gensch, and C. P. Brown. 1946. Alternative methods in upland game bird food analysis. *Jour. Wildl. Mgmt.*, 10(1): 8-12.
- _____, H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants. McGraw-Hill Book Co., New York, N. Y.
- Nice, M. M. 1941. The role of territory in bird life. *Amer. Midl. Nat.*, 26(3): 441-487.

- Saunders, A. A. 1936. Ecology of the birds of Quaker Run Valley, Allegheny State Park, New York. State Museum, Albany, N. Y. Handbood No. 16. 174 pp.
- Warbach, O. 1958. Bird populations in relation to change in land use. Jour. Wildl. Mgmt. 22(1): 23-28.
- Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. Ecological Monog., 6(3): 317-408.
- Wing, L. 1949. Breeding birds of virgin palouse prairie. Auk, 66 (1): 38-41.



3 1762 10013685 0

N378 Feist, F.G.
 F327 Breeding bird pop-
 cop.2 ulations in relation
 to proposed sage-
 brush control in central Mont.

NAME AND ADDRESS	
2/1/71	Dick Toans 6155 Hedges
	2-2-71

FEB 24 '71

FEB 24 '71

MAY 24 '72

INTERLIBRARY LOAN

NOV 1 '73

INTERLIBRARY

APR 11 '74

INTERLIBRARY

SS HAP

AUG 22 '74

2 WEEKS USE

2 WEEKS USE

N378

12-3

F327

DF

Cop. 2

 Basement Stack
 12-3