

An inventory of the bird populations within the Sarpy Creek drainage, southeastern Montana
by Jeffrey Thomas Herbert

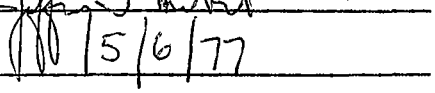
A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Fish and Wildlife Management
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Abstract:
Segments of the bird populations within the Sarpy Creek drainage were censused during the spring and summer of 1975 and 1976. These investigations were undertaken to provide baseline population data with which to measure potential changes resulting from the development of a strip mining operation. The distribution and status of the primary game bird species were determined during the peak of breeding activity from mid-April to mid-May. A pheasant crowing count route yielded an average of 8.7 and 13.7 recorded crows per 2-minute period for the 1975 and 1976 spring estimates, respectively. The enumeration of the maximum number of male grouse attending individual breeding grounds yielded averages of 13.7 and 9.5 sharp-tailed grouse and 14.0 and 18.0 sage grouse per ground per year. The relative abundance, species composition and breeding pair densities of non-game species were determined by censusing a 15-mile road route and four 40-acre breeding pair plots. Both the road route stations and breeding pair plots were classified into gross dominant-subdominant vegetational types. An upland type, characterized as a mixed grassland, timber, deciduous thicket association, had the greatest diversity in numbers of bird species represented and the highest breeding pair densities for the 2-year period. Conversely, the grassland association had the least diversity in species composition and the lowest breeding pair densities. The pattern indicated a direct relationship between the structural complexity of the vegetational life form cover-types and the diversity of birds utilizing these types.

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AN INVENTORY OF THE BIRD POPULATIONS WITHIN THE SARPY CREEK DRAINAGE, SOUTHEASTERN MONTANA

by

JEFFREY THOMAS HERBERT

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

of

MASTER OF SCIENCE

in

Fish and Wildlife Management

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ABSTRACT

Segments of the bird populations within the Sarpy Creek drainage were censused during the spring and summer of 1975 and 1976. These investigations were undertaken to provide baseline population data with which to measure potential changes resulting from the development of a strip mining operation. The distribution and status of the primary game bird species were determined during the peak of breeding activity from mid-April to mid-May. A pheasant crowing count route yielded an average of 8.7 and 13.7 recorded crows per 2-minute period for the 1975 and 1976 spring estimates, respectively. The enumeration of the maximum number of male grouse attending individual breeding grounds yielded averages of 13.7 and 9.5 sharp-tailed grouse and 14.0 and 18.0 sage grouse per ground per year. The relative abundance, species composition and breeding pair densities of non-game species were determined by censusing a 15-mile road route and four 40-acre breeding pair plots. Both the road route stations and breeding pair plots were classified into gross dominant-subdominant vegetational types. An upland type, characterized as a mixed grassland, timber, deciduous thicket association, had the greatest diversity in numbers of bird species represented and the highest breeding pair densities for the 2-year period. Conversely, the grassland association had the least diversity in species composition and the lowest breeding pair densities. The pattern indicated a direct relationship between the structural complexity of the vegetational life form cover-types and the diversity of birds utilizing these types.

INTRODUCTION

Increased energy demands have focused attention on the fossil fuel resources of many western states. Energy development in southeastern Montana has centered primarily on the strip mining of the Fort Union Coal Field. Recent federal legislation may further accelerate the removal of coal from this area. Strip mining in its present technological state may critically alter existing vegetational types and associated wildlife populations. Thus, there is a definite need for the establishment of baseline data on wildlife population parameters prior to the development of a mining operation.

Such a mining operation has been proposed by the Amax Coal Company for the Sarpy Creek area approximately 22 airline miles south-southeast of Hysham, Montana. The intent of this study was to inventory bird populations of the Sarpy Creek area. Specific study objectives were to determine the status and distribution of the game bird species and to record the species composition, relative abundance and breeding densities of non-game species in relation to the various vegetational types present.

Field work was conducted on a part-time basis during the spring (April-May) and a full-time basis during the summer months (June-August) of 1975 and 1976.

DESCRIPTION OF STUDY AREA

The study area is located in southeastern Montana within Treasure and Big Horn counties (Figure 1). Sarpy Creek, a small meandering stream, serves as the major drainage of the area. Two of its tributaries, East Fork Sarpy Creek and Horse Creek, are associated with the study area.

The study area comprised approximately 22 square miles and was situated adjacent to and east of Sarpy Creek. The linear boundaries as determined by Amax Coal Company, reflect probable distribution of subsurface coal deposits and potential mine sites. These boundaries are not indicative of any major change in land type or vegetational characteristics. Physiographic features of the study area boundary are Sarpy Creek road on the west, East Fork Sarpy Creek on the south, the divide between Sarpy Creek and Armell's Creek drainages on the east and a county road to the Wilson Ranch on the north. The area is owned almost entirely by private landowners and the uplands were accessible by vehicle only when the roads through the property were dry.

Geologically the area consists of disturbed beds of soft shale and sandstone of the Fort Union Formation which have been deeply eroded by the streams of the area (Moshier & Fielder 1967). This has resulted in the formation of rather narrow valleys (elevations 3150 to 3300 ft.) bordered in the southern and southwestern sectors of the area by abrupt, steep slopes and to the north and northwest by moderate to strongly

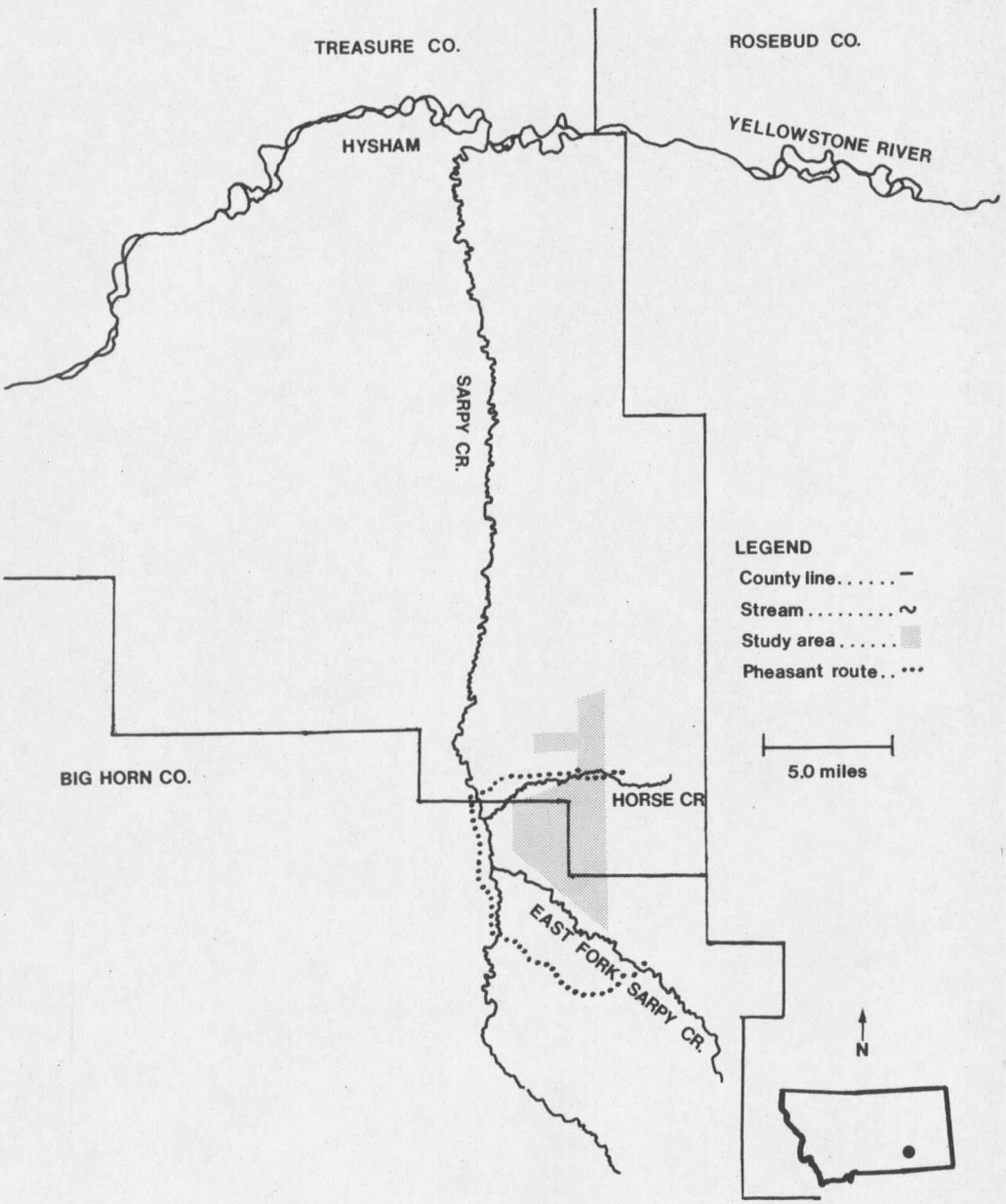


Figure 1. Map of the study area showing major features.

rolling hills. The upland portion of the area is characterized by rough, broken terrain and hills (elevations 3400 to 3600 ft.) which grade into the Little Wolf Mountains (peak elevation 4800 ft.) to the southeast. The major soils of the area are the Bainville-Flasher-Badlands and the Bainville-Midway associations (Southard 1973). The Bainville-Flasher-Badlands association is dominated by moderately deep to shallow soils, areas of shale, sandstone and siltstone outcrops and rough gullied lands. The Bainville-Midway association is one of light colored, shallow to moderately deep soils over sandstone, siltstone and shale. Drainage for the most part is excessive with rapid run-off.

The climate can be described as continental with chinook winds in the winter and a favorable distribution of precipitation during the growing season. Summers are hot and dry and winters moderately cold and dry (Moshier & Fielder 1967). From 1953-1967 the annual precipitation was 10-14 inches for lower elevations and 14-20 inches in the uplands (Jackson 1971). Average monthly temperatures and precipitation totals recorded at the United States Weather Bureau Station Hysham 25SSE for 1975 and 1976 are presented in Table 1. This station is located on Horse Creek road within the boundaries of the study area at an elevation of 3300 ft. The average frost-free season is approximately 105 days (Caprio 1965).

The following are gross vegetational types beginning with the riparian type found along the stream bottoms and progressing to types

TABLE 1. MONTHLY AVERAGE TEMPERATURES AND PRECIPITATION TOTALS RECORDED AT THE U. S. WEATHER BUREAU STATION HYSHAM 25SSE 1975, 1976.

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°F)												
1975	22.1	14.0	28.8[1]	36.0	50.0[1]	58.5	71.9	66.0[1]	55.2	45.1	29.2[1]	23.1
1976	20.3	32.1	30.5	46.3	55.0[1]	61.0[1]	71.8	69.3	58.9[1]	42.2	30.5	25.6
Precipitation Total (- inches)												
1975	1.69	.56	.84[2]	2.16	2.58	2.05	1.10	.24	.33	2.07	1.63	1.17
1976	.67	.91	.41	1.29	1.93	4.14	.27	.96	.92	1.52	.77	.23

[1]One or more days of record missing.
[2]Water equivalent of snowfall wholly or partially estimated, using ratio of 1" water equivalent to every 10" of new snowfall.

found at higher elevations. The creek bottom type is dominated by a deciduous overstory of box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*) and plains cottonwood (*Populus deltoides*). Areas immediately adjacent to this type have been developed for crop production, primarily cultivation of alfalfa for seed and hay, and as winter range for livestock. Those sections not disturbed by cultivation are represented by a silver sagebrush (*Artemisia cana*) type. Big sagebrush (*Artemisia tridentata*) predominates on the more xeric sites on the rolling hills of the western and northern sections and in scattered tracts throughout the study area. Stands of ponderosa pine (*Pinus ponderosa*) occur throughout the uplands and are characterized by Pfister et al. (1974) as typically even aged with a scattering of younger age and smaller size classes in old-growth stands. Deciduous trees and broadleaf shrubs in the uplands are largely limited to seeps and minor drainageways. Important species in these mesic sites are hawthorn (*Crataegus succulenta*), chokecherry (*Prunus virginiana*) and wild plum (*Prunus americanus*) with an occasional box elder or green ash. There are scattered stands of skunkbrush sumac (*Rhus trilobata*), snowberry (*Symphoricarpos* spp.) and sagebrush in association with either grassland or coniferous timber types. Herbaceous vegetation can be characterized as a mixed short- to mid-grass prairie type dominated by native bunchgrasses (*Agropyron* spp., *Stipa* spp., *Andropogon* spp.) and prairie forbs. Grazing pressure and cultivation

on the uplands has resulted in the introduction of exotic species and an increase in occurrence of species which are indicators of disturbed sites.

METHODS

Vegetation

Aerial photos, ocular estimates and specific sampling procedures were used in various combination to delimit and describe gross vegetational types. These types were defined along a pheasant crowing count route, a breeding bird survey route and on four plots established to census bird breeding pair densities.

A visual estimate was made of the vegetational physiognomy within a one-half mile radius of each pheasant route station and a one-quarter mile radius of each breeding bird route station. Data from stations with similar vegetational characteristics were combined and grouped into gross dominant-subdominant types.

Four 40-acre plots were established, one in each of four contrasting types: upland grassland; mixed grassland, ponderosa pine with hawthorn dominated drainages; ponderosa pine-mixed grassland; and a riparian creek bottom, silver sagebrush type. Each plot was gridded and staked throughout at 330-foot intervals. A composite map of prominent cover-types was constructed for each plot using a combination of aerial photos and ocular estimates. A dot grid was used to calculate the percentage composition of each important type.

Herbaceous vegetation was classified by using the pace-point method (Cottam & Curtis 1956). The species occurring on each of 200 points

established on three transect lines were recorded on each of the four plots. These data were later separated into the following categories: grasses, forbs, half-shrubs, or bare ground.

Species and canopy coverage of shrubs (Canfield 1941) were recorded along the same three transect lines. The location of dominant shrub and tree species on each of the plots was noted on a cover map. Diameter breast height (dbh) and relative densities of ponderosa pine were measured on Plots 2 and 3 using the point-quarter method described by Cottam and Curtis (1956), with a modification made to include saplings in density measurements.

A plant collection and subsequent species list for the area was compiled to facilitate vegetational analyses. Plant nomenclature follows Booth (1950, 1972) and Booth and Wright (1959).

Birds

Game Species

Of the five game bird species observed on the area, only the ring-necked pheasant (*Phasianus colchicus*), sharp-tailed grouse (*Pedioecetes phasianellus jamesi*), and sage grouse (*Centrocercus urophasianus*) populations were sampled quantitatively. Turkey (*Meleagris gallopavo merriami*) observations were limited but records were kept of birds seen or heard.

The spring pheasant population was censused using the crowing count method described by Kimball (1949). Logistic problems and weather conditions hampered field work during both spring periods of the study. As a result, the crowing count route was censused on a restricted basis during the peak of breeding activity from late April to mid-May (Gates 1966, Desimone 1975). The route was sampled and the crowing averages calculated only on mornings when the skies were clear and the wind velocity did not exceed 5 miles per hour. The approximate sampling period for the entire route was 45 minutes before, to 45 minutes after sunrise.

Sharp-tailed and sage grouse observations were directed mainly toward locating breeding grounds and recording numbers of males in attendance. Accessibility was a major problem and most spring travel was restricted to county roads. Limited aerial observations were made from a fixed wing aircraft (Piper Supercub). Breeding ground locations and number of male birds in attendance were compared to and averaged with those compiled by Martin (pers. comm.) during 1975 and 1976 for the same area.

Non-game Species

Two basic approaches to determining and analyzing bird abundance are discussed by Kendeigh (1944). One approach is dependent upon deriving a species index which permits comparison of relative abundance

of different species. The second involves determining the actual number of birds of each species on an area of known size.

A road route was established through a major portion of the study area (Figure 2) to obtain an index of relative abundance of breeding birds as outlined by the Cooperative Breeding Bird Survey of North America (1975). The route length was 15 miles, the first 10 stations (1-10) being separated by 0.5 mile and the second 10 (11-20) by 1.0 mile intervals. Each station was sampled for a 3-minute period with both audible and visual observations of all species recorded (each species being recorded only once per station). Weather condition requirements were similar to those of the pheasant census. The route was started 0.5 hour before sunrise and took an average of 3.0 hours to complete.

A breeding pair census was conducted on the four 40-acre plots (Figure 2) that were established in contrasting vegetational types. Procedures were similar to that described by Williams (1936). Each plot was sampled once per week in sequence so that the four plots and the road route constituted a 5-day sampling period. The total sampling period for each summer began in mid-June and extended to mid-July. The census of each plot followed the grid pattern, beginning on and walking the north-south axis lines and then repeating along the east-west axis lines. This pattern was varied every other sampling period. Birds were recorded as to species, sex (if possible) and whether or not the

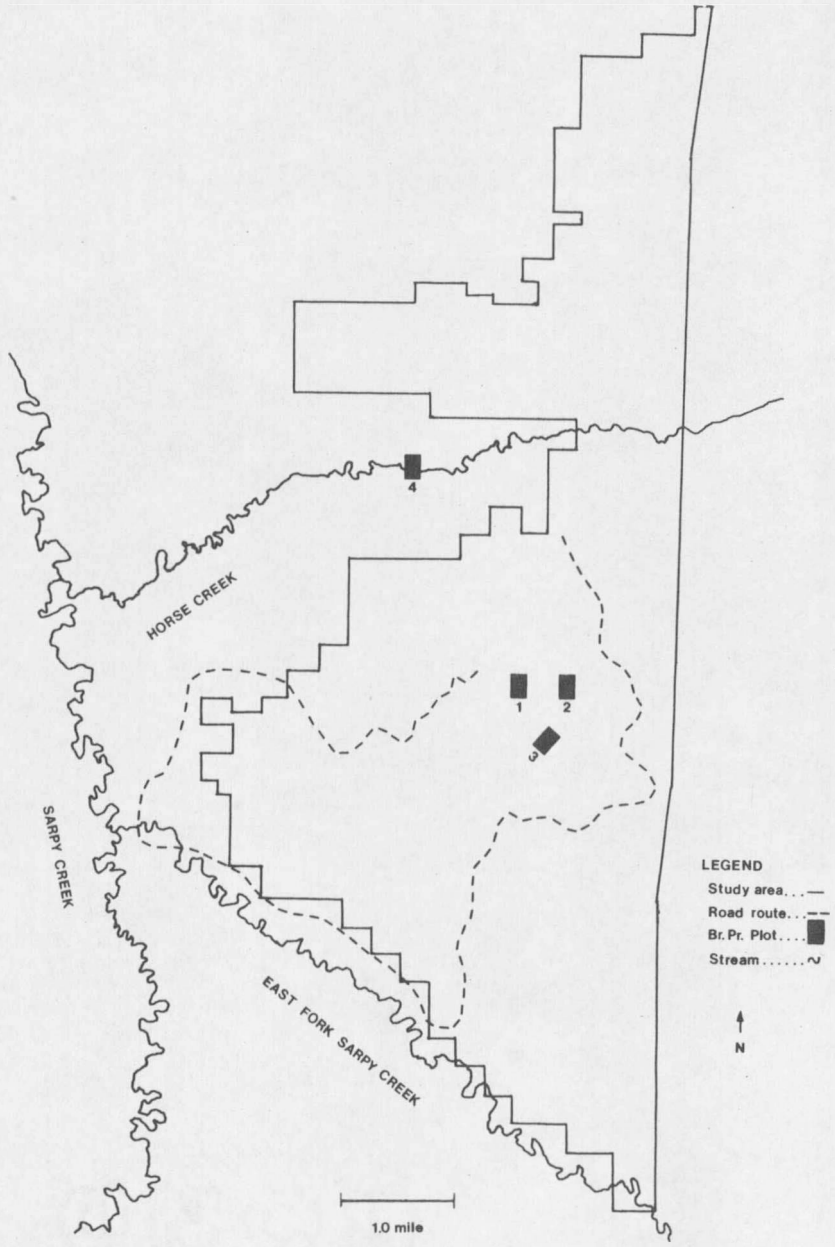


Figure 2. Map of the study area showing the location of the breeding bird road route and the four breeding pair plots.

male was displaying (singing). Behavioral aspects were used to distinguish non-territorial or transient individuals (Kendeigh 1944). The plots were sampled in the morning beginning about 0.5 hour before sunrise and only on days which met the specified weather requirements. Morning census data were supplemented with additional observations made on the plots at other times of the day.

Both the road route and breeding pair plot analyses were based on the documented routine of the morning activity period, which is timed to the illumination conditions of dawn and is very characteristic of passerines in general (Allard 1930, Saunders 1947). The male's song was fundamental in the establishment and maintenance of a territory. Furthermore, the quantity and quality of song was dependent upon the stage of the nesting cycle and the proximity of singing males in adjoining territories (MacQueen 1950).

RESULTS

Vegetation

Pheasant Crowing Count Route

Two broad vegetational types were present on the pheasant crowing count route. Fifteen stations were located in a mesophytic type found along the major stream bottoms and five were located in an upland type.

Variation among the bottomland series was mainly in the amount and type of streambank cover and the extent to which the adjacent land has been developed. Ten stations were associated with a persistent riparian overstory and adjacent cropland (primarily alfalfa). Variation within this complex was in the species composition of trees, tall shrubs and attendant shrub communities. Of the five stations lacking tree and shrub overstory, two were associated with adjacent croplands and two with pastures dominated by silver sagebrush.

The five stations of the upland series were largely in a mixed grassland-ponderosa pine type. Cultivated land was found immediately adjacent to two of the stations and a narrow thicket of deciduous shrubs near a third.

Breeding Bird Road Route

The vegetational complex adjacent to the 20 road route stations was classified into 6 major dominant-subdominant types. Two bottomland

types were represented. The first, a big sagebrush, silver sagebrush, agriculture type, is bisected by a road with the sagebrush to the north and the cropland to the south. The two station sites were located approximately 0.25 mile from the creek. The second type is an agriculture, creek bottom association with alfalfa fields found on both sides of the creek. The two stations included within this type are associated with well developed riparian vegetation dominated by box elder, green ash, chokecherry, woods rose (*Rosa woodsii*) and occasional willow (*Salix* spp.).

Three upland types were represented. The first of these types was characterized by tall, broadleaf shrubs found along the draws and seeps. Species composition was primarily fleshy hawthorn intermixed with chokecherry and plum. These shrubs form dense thickets 6 to 8 feet tall with an understory that was frequently well trampled by livestock. A sagebrush-grassland association was found adjacent to the thickets, with ponderosa pine on nearby slopes. As roads through the area tend to follow the drainage contour, a complex of this sort was sampled most intensively and included eight stations.

The second type was made up of a grassland-coniferous timber complex (Ross & Hunter 1976) with approximately equal composition of these two components. Major differences between these first two types were a greater amount of timber, a slightly drier aspect in the grassland association and the lack of a well-developed hawthorn shrub

community in the latter type. Four stations were classified as occurring within this type.

The third upland type was dominated by ponderosa pine in which the timber occupied at least 60 percent of the area. The geographical area has been described by Payne (1973) as a Ponderosa Pine Savannah in which pine tends to be irregularly distributed throughout rather than as scattered individuals with uniform distribution.

The last type represents an ecotone between the bottomland and upland types and was dominated by big sagebrush which has an apron-like distribution in the area. Two stations were classified as occurring within this type.

Breeding Pair Plots

Plot 1, an upland grassland type (Figure 3) was located on a large knoll above an abandoned homestead occupied from approximately 1900 through 1930. Although the main exposure was south, there was a gradual to moderate slope in all directions from the knoll. A disturbed site was present on the south section of the plot, an area which had been cultivated to dryland corn during the homestead occupation.



Figure 3. Mixed grassland association of Plot 1.

Figure 4 shows the prominent life form cover-types and their distribution. Percentage of occurrence as determined by dot grid overlay is 92 percent grassland, 6 percent shrub and 2 percent timber.

Herbaceous vegetation was classified as 62.2 percent grasses, 22.3 percent forbs and half-shrubs with 5.0 percent recorded as bare ground. The grasses were dominated by perennials, principally needle and thread (*Stipa comata*), bluegrass (*Poa* spp.) and crested wheatgrass (*Agropyron cristatum*). There was a high occurrence of cheatgrass brome, an annual whose presence is indicative of disturbance. Specific grassland communities recognizable on the plot were similar to those described by

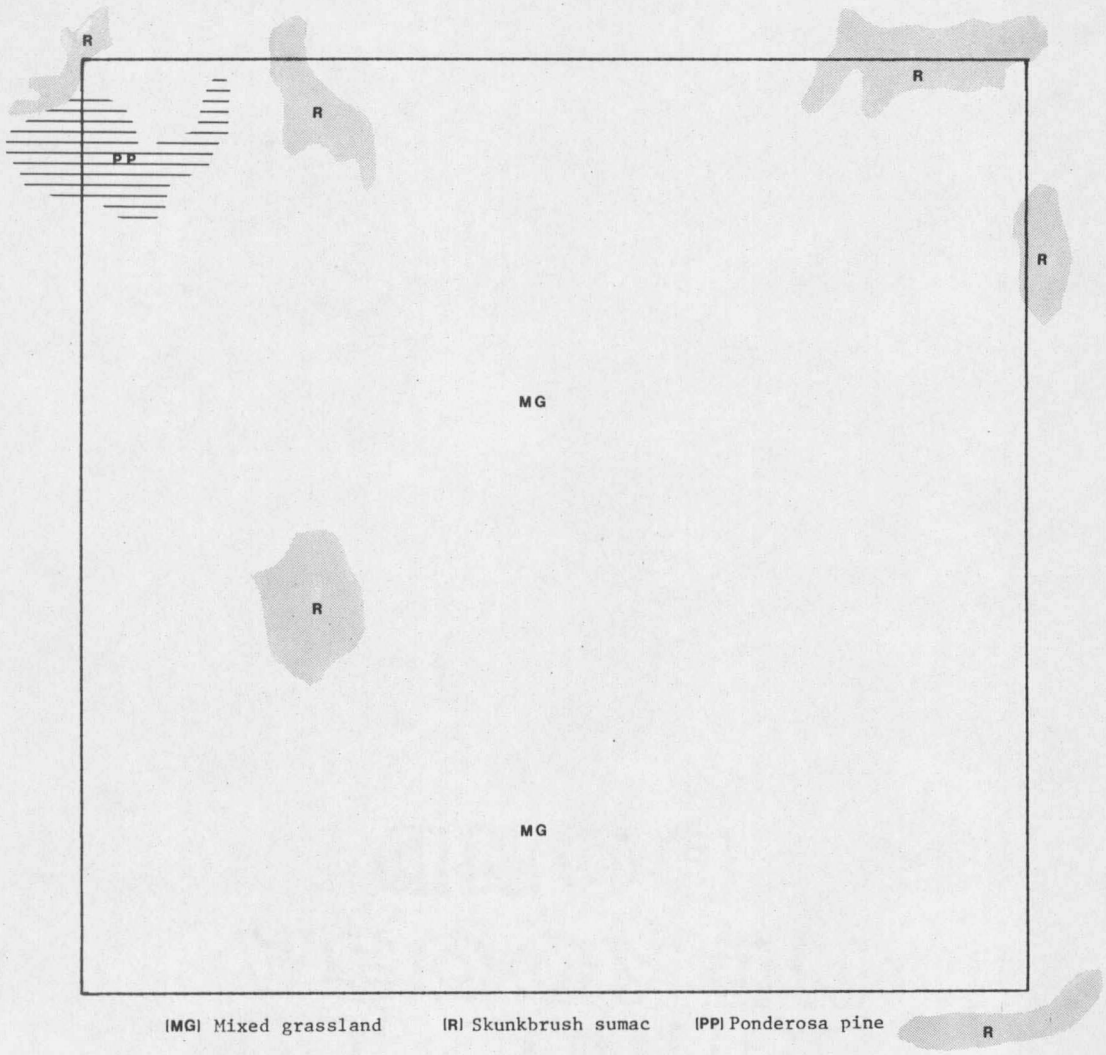


Figure 4. Map of prominent cover-types on Plot 1.

DePuit (pers. comm.) and Ecological Consulting Service (1975) but sampling procedure did not delimit them.

Important forbs and half-shrubs were western ragweed (*Ambrosia psilostachya*), prairie rose (*Rosa arkansana*), prairie sunflower (*Helianthus petiolaris*), false tarragon sagewort (*Artemesia dracunculus*) and golden aster (*Chrysopsis villosa*). The vegetation was sampled in mid-July, thus the ephemerals were documented much less than those species flowering later. Table 2 lists all species present on the transect lines and their frequency of occurrence.

Shrub canopy coverage along the transect lines was minimal, totaling 1.9 percent (Table 3). Species ranked in order of importance were skunkbrush sumac, yucca (*Yucca glauca*) and silver sagebrush. One small stand of timber occurred in the northwest corner of the plot. Together, shrubs and trees were minor in overall cover percentages, but provided some diversity in an otherwise monotypic vegetational type.

Plot 2 is described as an interspersion of mixed grassland, ponderosa pine and hawthorn dominated drainages (Figure 5). This plot was located to the east of Plot 1. Two drainage-seep plant communities of typically dense cover dominated by woody shrubs extended along the north-south axis of the plot. The timber, characterized by a patchy

TABLE 2. PERCENT FREQUENCY OF OCCURRENCE OF GRASSES, SEDGES, FORBS, HALF-SHRUBS AND BARE GROUND ALONG TRANSECT LINES ON PLOTS 1 THROUGH 4.

	Plot 1				Plot 2				Plot 3				Plot 4			
TAXA TRANSECT LINE	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$
GRASSES AND SEDGES:																
Agropyron cristatum	9.0	25.5	3.5	12.6	-	-	4.0	1.3	-	-	-	-	.5	-	.5	.3
Agropyron smithii	1.0	4.0	9.0	4.6	8.0	10.0	9.5	9.2	11.0	13.0	7.0	10.3	15.5	18.0	14.0	15.8
Agropyron spicatum	2.5	-	2.5	1.6	10.0	11.0	10.5	10.5	2.5	7.5	7.5	5.8	1.5	4.0	3.0	2.8
Andropogon gerardii	-	-	-	-	.5	-	-	.2	-	-	-	-	-	-	-	-
Andropogon scoparius	-	-	-	-	1.0	2.5	-	1.2	7.0	7.5	3.0	5.8	-	-	-	-
Aristida longiseta	1.0	.5	2.0	1.2	.5	1.0	1.0	.8	1.0	.5	-	.5	.5	3.0	3.5	2.3
Bouteloua curtipendula	.5	2.0	6.5	3.2	10.0	10.5	1.0	7.2	16.5	19.0	23.0	19.5	.5	1.5	2.5	1.5
Bouteloua gracilis	3.0	.5	2.0	1.8	5.0	6.0	3.5	4.8	2.5	2.5	4.5	3.2	11.0	5.0	4.5	6.8
Bromus japonicus	2.5	2.5	6.0	3.6	2.5	-	2.5	1.6	1.0	1.0	3.5	1.8	7.0	9.5	6.5	7.6
Bromus tectorum	18.0	8.5	11.0	12.5	2.0	5.0	9.0	5.3	.5	.5	.5	.5	11.5	3.5	3.0	6.0
Calamovilfa longifolia	-	-	-	-	2.0	3.5	2.5	2.6	3.0	5.0	2.5	3.5	-	-	-	-
Carex filifolia	-	-	-	-	1.0	-	-	.3	-	-	-	-	-	-	-	-
Carex spp.	-	-	-	-	5.0	-	-	1.6	-	-	-	-	2.0	5.0	5.5	4.2
Elymus cinereus	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	.5	.5
Festuca idahoensis	-	-	-	-	3.5	-	-	1.2	8.5	3.0	3.0	4.8	.5	1.0	1.0	.8
Hordeum jubatum	-	-	-	-	.5	-	-	.2	-	-	-	-	-	-	1.0	.3
Hordeum spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.5	1.2
Juncus nodosus	-	-	-	-	-	.5	-	.2	-	-	-	-	-	-	-	-
Koelaria cristata	2.5	-	3.5	2.0	3.0	3.5	1.0	2.5	1.0	.5	1.5	1.0	4.0	3.5	4.5	4.0
Muhlembergia racemosa	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	.5	.8
Orzyopsis hymenoides	1.0	-	-	.3	-	-	-	-	-	-	-	-	-	-	-	-
Phleum pratensis	-	-	-	-	-	-	-	-	-	-	-	-	1.0	.5	1.0	.8

TABLE 2. continued.

TAXA / TRANSECT LINE	Plot 1				Plot 2				Plot 3				Plot 4			
	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$
Poa pratensis	-	-	-	-	-	-	-	-	-	-	-	-	3.0	5.5	4.0	4.2
Poa spp.	1.0	-	.5	.5	.5	-	2.0	.8	1.0	.5	-	.5	-	-	-	-
Poa spp.	5.0	5.0	9.0	6.3	4.0	4.0	6.5	4.8	1.0	.5	2.0	1.2	4.5	2.5	2.5	3.2
Sitanion hystrix	1.0	1.5	1.0	1.2	1.0	1.0	1.0	1.0	-	-	-	-	-	2.5	2.0	1.5
Stipa comata	17.0	9.5	2.5	9.6	5.0	8.5	11.0	8.2	6.0	2.5	10.5	6.3	4.5	8.0	3.5	5.3
Stipa viridula	.5	1.5	1.5	1.2	1.0	-	1.5	.8	1.5	1.0	.5	.6	6.0	6.0	5.5	5.8
FORBS AND HALF-SHRUBS:																
Achillea millefolium	1.0	1.5	-	.8	1.0	3.0	3.0	2.3	1.0	3.0	3.0	2.3	2.5	1.5	1.5	1.8
Allium textile	-	-	.5	.2	-	.5	-	.2	-	-	-	-	-	-	-	-
Ambrosia psilostachya	4.5	7.0	6.5	6.0	4.5	2.0	5.0	3.8	2.5	2.0	4.5	3.0	-	.5	.5	.3
Antennaria rosea	-	.5	.5	.3	.5	-	-	.2	-	1.0	1.5	.8	-	-	.5	.2
Arnica sororia	-	-	-	-	-	-	-	-	1.5	.5	-	.6	-	-	-	-
Artemisia dracunculus	-	1.0	2.5	1.2	1.5	.5	1.0	1.0	-	.5	1.0	.5	1.5	2.0	.5	1.3
Artemisia frigida	1.0	-	1.0	.6	-	-	.5	.2	-	-	-	-	2.5	-	1.5	1.3
Artemisia ludoviciana	1.0	1.0	.5	.8	4.5	2.0	3.5	3.3	4.5	3.5	4.5	4.2	.5	-	1.5	.6
Asclepias speciosa	-	-	-	-	-	-	-	-	-	-	-	-	-	.5	-	.2
Asclepias verticillata	-	-	-	-	-	-	-	-	.5	-	-	.2	-	-	-	-
Astragulus gilviflorus	-	-	-	-	-	-	.5	.2	-	-	-	-	-	-	-	-
Balsamorrhiza sagittata	-	-	-	-	-	-	-	-	-	-	1.0	.3	-	-	-	-
Cerastium arvensis	1.0	-	-	.3	.5	-	-	.2	1.5	-	-	.5	-	-	-	-
Chrysopsis villosa	1.0	1.5	1.0	1.2	-	.5	-	.2	1.0	-	1.0	.6	-	-	.5	.2
Cirsium undulatum	-	1.0	-	.3	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 2. continued.

TAXA / TRANSECT LINE	Plot 1				Plot 2				Plot 3				Plot 4			
	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$
Erigeron spp.	-	-	-	-	.5	-	2.0	.8	-	-	-	-	.5	-	.5	.3
Euphorbia glyptosperma	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	.3
Glycyrrhiza lepidota	-	-	-	-	-	.5	-	.2	-	.5	-	.2	.5	.5	-	.3
Gutirrezia sarothrae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.5	.2
Helianthus petiolaris	-	3.0	3.0	2.0	1.0	1.0	.5	.8	2.5	3.0	1.5	2.3	-	-	-	-
Lactuca serriola	-	-	-	-	.5	-	-	.2	-	-	-	-	1.0	1.0	.5	.8
Liatris punctata	-	-	-	-	1.5	1.0	-	.8	-	.5	-	.2	-	-	-	-
Lithosperma incisum	-	-	2.0	.6	-	-	-	-	-	.5	-	.2	-	-	-	-
Linium perenne	-	-	-	-	-	-	-	-	.5	1.0	-	.5	-	-	-	-
Linium rigidum	-	-	-	-	-	-	-	-	-	.5	-	.2	-	-	-	-
Medicago lupulina	-	-	-	-	-	.5	-	.2	-	-	-	-	1.0	-	1.5	.8
Melilotus officinalis	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.0	.5	1.0
Monarda fistulosa	-	-	-	-	-	1.0	.5	.5	-	.5	-	.2	-	-	.5	.2
Opuntia polycantha	-	.5	-	.2	-	-	-	-	-	-	-	-	-	-	.5	.2
Oxytropis lambertii	-	-	1.0	.3	1.0	2.0	1.0	1.3	-	-	-	-	-	-	.5	.2
Oxytropis sericea	-	-	-	-	-	.5	1.0	.5	-	-	-	-	-	-	-	-
Plantago purshii	.5	-	1.0	.5	-	.5	.5	.3	-	-	-	-	-	-	-	-
Polygala alba	1.0	-	-	.3	-	-	-	-	-	-	-	-	.5	1.5	2.5	1.5
Psoralea argophylla	1.0	-	1.0	.6	-	2.0	.5	.8	3.0	1.0	.5	1.5	1.0	.5	1.0	.8
Psoralea tenuiflora	-	-	-	-	-	-	-	-	-	-	-	-	.5	1.0	.5	.6
Ratibida columnifera	.5	.5	.5	.5	1.0	2.0	.5	1.2	2.5	1.5	-	1.3	-	-	-	-
Rhus radicans	-	-	-	-	-	-	-	-	-	1.0	-	.3	-	-	-	-
Rosa arkansana	5.0	5.5	3.0	4.5	2.0	1.0	1.5	1.5	.5	.5	1.5	.8	-	-	-	-

TABLE 2. continued.

TAXA / TRANSECT LINE	Plot 1				Plot 2				Plot 3				Plot 4			
	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$
Solidago gigantea	-	-	-	-	-	-	-	-	-	-	-	-	1.0	.5	.5	.6
Solidago missouriensis	-	1.5	.5	.6	1.0	-	-	.3	.5	-	-	.2	.5	-	.5	.3
Taraxicum officinale	-	-	-	-	-	.5	.5	.3	-	-	-	-	-	-	-	-
Tragopogan dubius	-	1.0	.5	.5	1.0	-	.5	.5	.5	.5	.5	.5	-	-	-	-
Vicia americana	-	-	-	-	-	-	-	-	.5	-	-	.2	-	-	-	-
Viola nuttallii	-	-	-	-	-	-	1.0	.3	-	-	-	-	-	-	-	-
bare ground	18.0	13.5	13.5	15.0	10.5	12.0	10.0	10.8	10.5	12.0	14.0	12.2	11.0	8.5	9.0	9.5

($\bar{X}$) average species frequency of combined transect lines.

TABLE 3. PERCENT SHRUB CANOPY COVERAGE ALONG TRANSECT LINES ON PLOTS 1 THROUGH 4.

	Plot 1				Plot 2				Plot 3				Plot 4			
TAXA TRANSECT LINE	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$	A	B	C	$\bar{X}$
Artemisia cana	.5	.59	.14	.41	3.31	2.91	7.0	4.43	.62	.16	.33	.47	11.08	14.69	11.67	12.48
Artemisia tridentata	-	-	-	-	2.01	-	.55	.85	-	-	-	-	-	.16	1.43	.53
Crataegus succulenta	-	-	-	-	.83	1.66	-	.83	-	-	-	-	-	-	-	-
Juniperus scopulorum	-	-	-	-	-	.12	-	.04	.43	.44	-	.29	-	-	-	-
Prunus virginiana	-	-	-	-	-	.95	.79	.58	-	-	-	-	-	-	1.25	.42
Rhus trilobata	.18	.58	1.66	.80	4.36	4.92	7.35	5.54	1.58	4.50	7.57	4.55	-	.43	.81	.41
Ribes aureum	-	-	-	-	-	.11	-	.03	-	-	-	-	.83	-	.04	.29
Rosa woodsii	-	-	-	-	.04	4.58	1.6	2.07	-	-	-	-	.29	.50	1.79	.86
Symphoricarpos spp.	-	-	-	-	1.70	5.71	7.20	4.87	6.87	12.58	-	6.48	3.59	8.28	7.93	6.60
Yucca glauca	.61	1.29	.22	.71	-	-	.35	.12	-	-	-	-	-	-	-	-

($\bar{X}$) average species frequency of combined transect lines.



Figure 5. Mixed grassland-sagebrush, coniferous timber, hawthorn thickets of Plot 2.

distribution, was located on a rise between the two draws (Figure 6). Stands of snowberry and woods rose were present in the more moist sites adjacent to the draws. Silver sagebrush was scattered throughout the plot. Life form cover percentages determined by the dot grid overlay are 70 percent sagebrush-grassland, 17 percent timber and 13 percent shrub (woody thickets).

Herbaceous vegetation was classified as 66.3 percent grasses, 22.1 percent forbs and half-shrubs with 10.8 percent recorded as bare ground. The grassland aspect was dominated by bunchgrass perennials, especially western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass

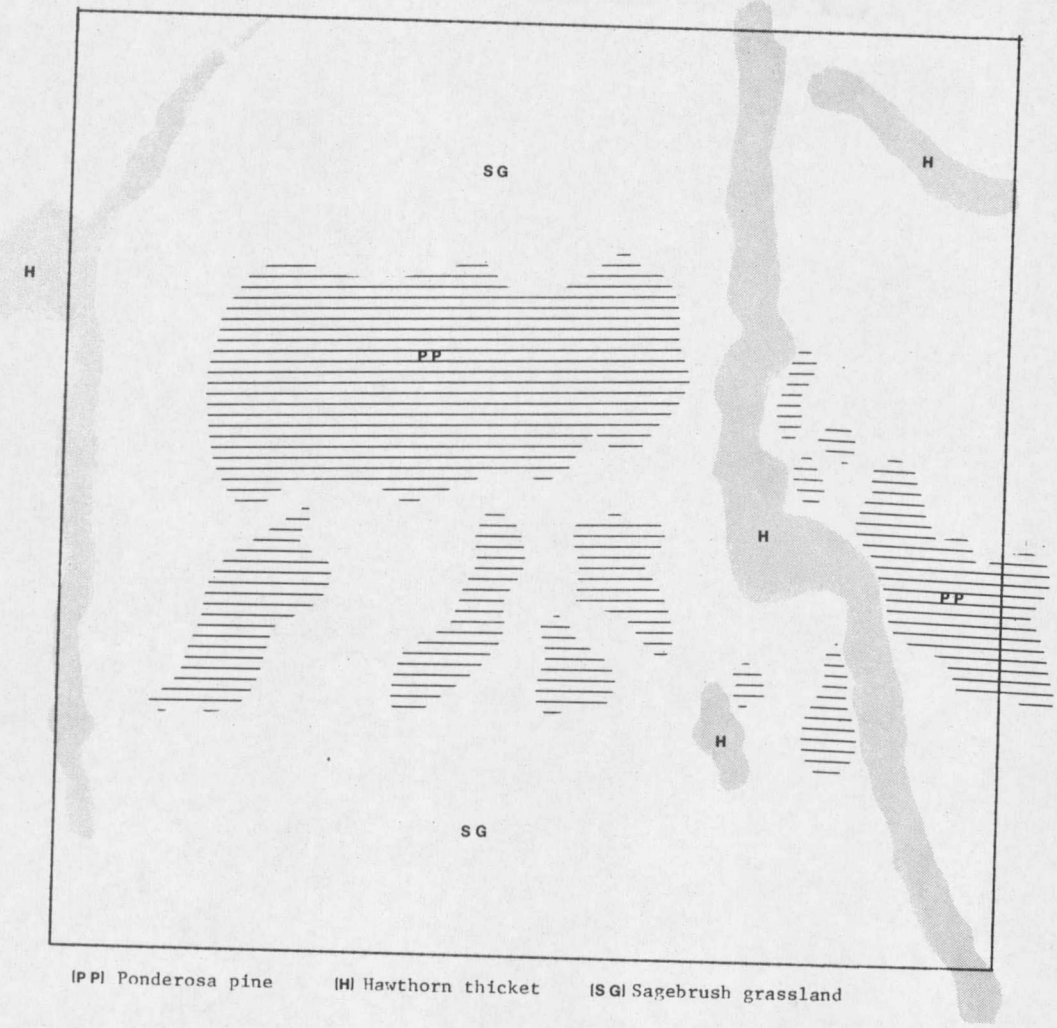


Figure 6. Map of prominent cover-types on Plot 2.

(*Agropyron spicatum*) and needle and thread. Also important were bluegrass, cheatgrass brome, blue grama (*Bouteloua gracilis*) and side oats grama (*Bouteloua curtipendula*). There was a noticeable reduction from Plot 1 to Plot 2 in the amount of crested wheatgrass present. Visible community types showed a preponderance of bluebunch wheatgrass in association with the timber, a concentration of western wheatgrass in more mesic sites and a combination of needle and thread and bluegrass on sites comparable to Plot 1.

Important forbs and half-shrubs were western ragweed, cudweed sagewort (*Artemisia ludoviciana*), yarrow (*Achillea millefolium*), pointloco (*Oxytropsis* spp.) and prairie coneflower (*Ratibida columnifera*). Species present and their frequency of occurrence are listed in Table 2. Forb production on the Tanner Creek study area (Depuit, pers. comm.) showed a high biomass and annual production in the upland drainages. Had the transect lines on Plot 2 been routed parallel instead of perpendicular to the woody thickets, forbs may have shown a higher frequency of occurrence. There was a noted increase in the number of different forb species present as compared to Plot 1 (Table 2).

Shrub transect data presented in Table 3 show important species to be skunkbrush sumac, snowberry, silver sagebrush and woods rose. Skunkbrush was prominent on the more xeric sites, snowberry in the mesic swales and silver sagebrush on the sites with a moisture gradient

somewhere between the two. Transect line C on this plot sampled vegetation along a fence line which may have resulted in the noted increase in several species.

Timber density and average dbh were calculated for the 20-acre section of the plot that included the forested type. The calculated density was 8.1 individuals per acre with an average dbh of 8.3 inches per tree. Ponderosa pine on this plot was characterized by relatively mature trees with very little reproduction.

Plot 3 was situated in a rather continuous stand of ponderosa pine with a southern exposure and gentle slope (Figure 7). Variation in the



Figure 7. Coniferous timber - grassland association of Plot 3.

distribution and density of timber was affected by edaphic characteristics on the plot. Generally, the density of timber was greater than that found in the Plot 2 stands and there was a noticeable increase in the amount of reproduction and interspersion of younger age class trees. Pfister et al. (1974), in classifying eastern Montana ponderosa pine forests, delimited several habitat types which were found on this plot or in timbered sections throughout the area.

Included in the Ponderosa Pine Series are several types. One, the PP/*Agropyron spicatum* type was present on some of the driest sites within the pine series. It is usually found on south facing slopes near lower timberline and the understory is dominated by bunchgrasses and prairie forbs. Idaho fescue (*Festuca idahoensis*) may replace the bluebunch wheatgrass under more mesic conditions. The PP/*Andropogon scoparius* type was also present in isolated but dense stands. A fourth type, PP/*Symphoricarpos* spp., represents a more moist type within the pine series. This type was found along the swales with the snowberry forming a rather dense but patchy understory. Western snowberry (*Symphoricarpos occidentalis*) was more frequently encountered than common snowberry (*Symphoricarpos albus*). A fifth type, PP/*Prunus virginiana* was restricted to moist, north facing slopes. The understory of this type was characterized by Oregon grape (*Berberis repens*) and northern bedstraw (*Galium boreale*). This type occurred on the study area at a lower gradient in the drainage contour than the PP/

Symphoricarpos spp. type. Life form cover percentages determined by the dot grid overlay were 74 percent timber and 26 percent open park grassland (Figure 8).

Herbaceous vegetation was classified as 65.3 percent grasses, 21.6 percent forbs and half-shrubs with 12.2 percent recorded as bare ground. Important grass species were western wheatgrass, needle and thread, bluebunch wheatgrass and little bluestem. Side oats grama occurred in a much higher frequency than was recorded on any of the other plots.

Important forbs and half-shrubs were cudweed sage, western ragweed, yarrow, prairie sunflower and scurf pea (*Psoralea* spp.). Species such as balsamroot (*Balsamorrhiza sagittata*), rose pussytoes (*Antennaria rosea*) and narrow-leaf gromwell (*Lithospermum incisum*) which are listed by Pfister et al. (1974) as important understory species of the pine series, occurred in amounts less than 1 percent.

Timber density as determined for the entire plot showed an average of 31.8 individuals per acre. Densities for Plots 2 and 3 may have been greater if the transects had been run through representative stands of timber as opposed to recording densities for the entire plot (3) or half plot (2). The average dbh was 6.1 inches per tree. Histograms of 2-inch dbh classes for timber on Plots 2 and 3 are found in Figure 9.

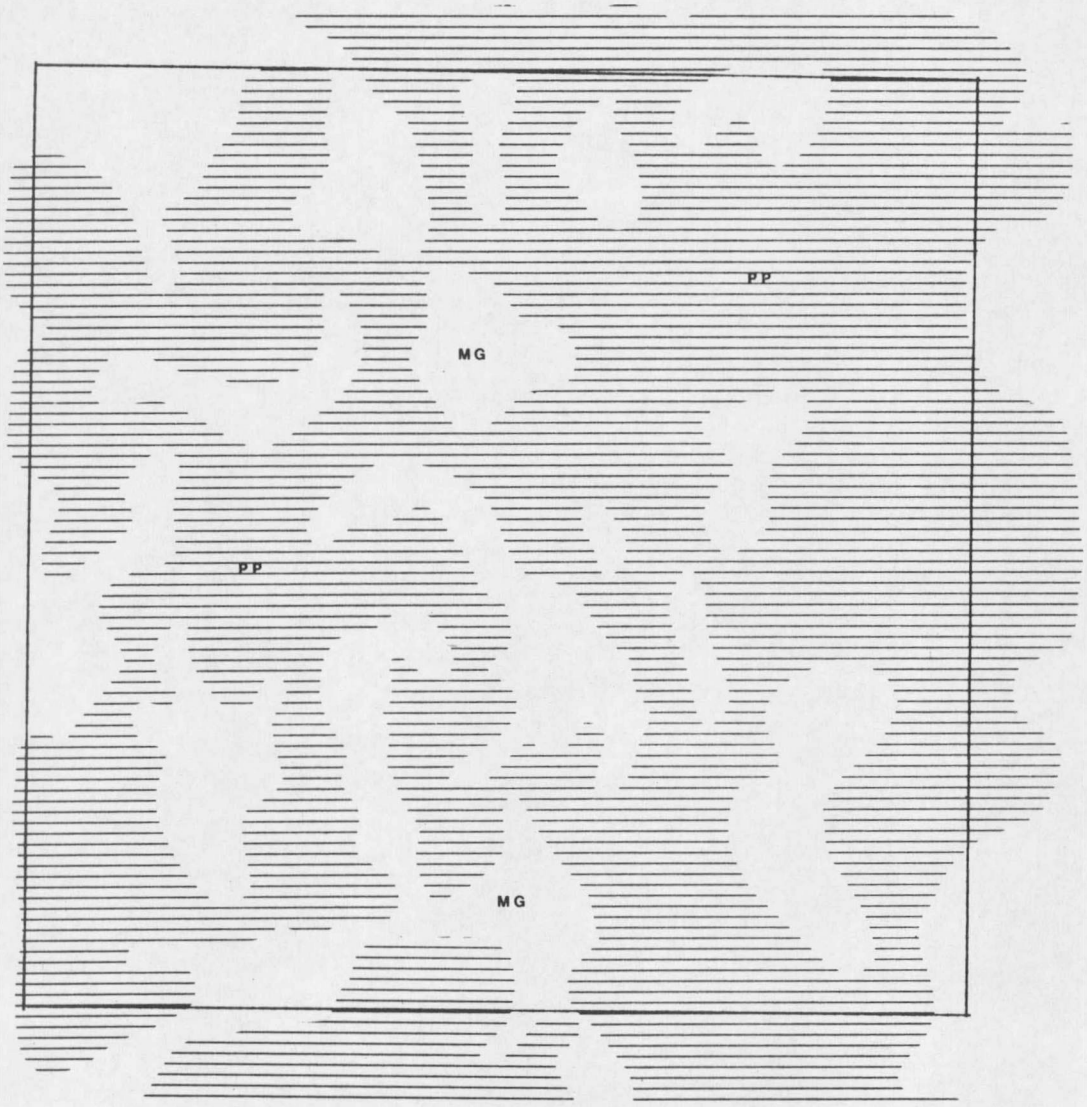
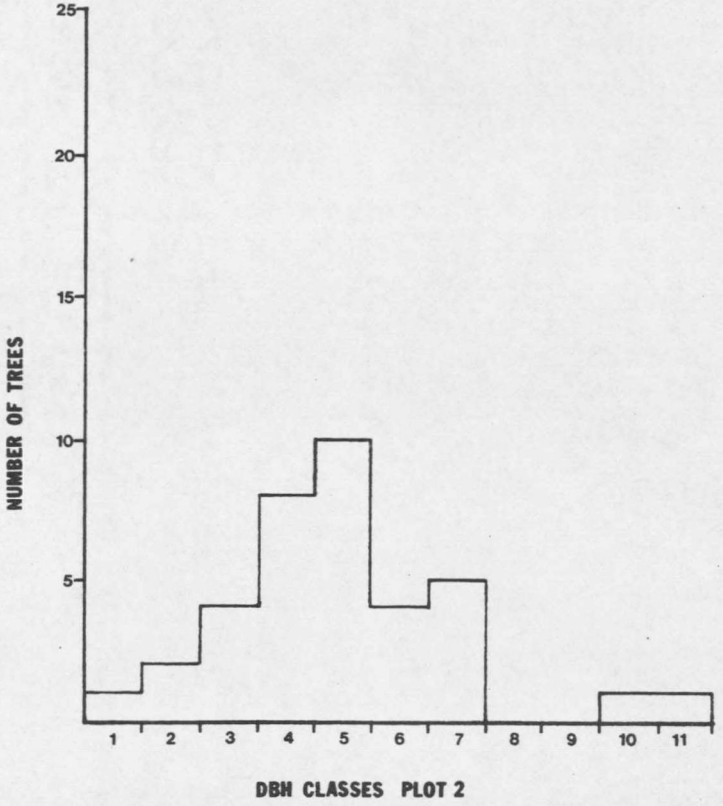


Figure 8. Map of prominent cover-types on Plot 3.



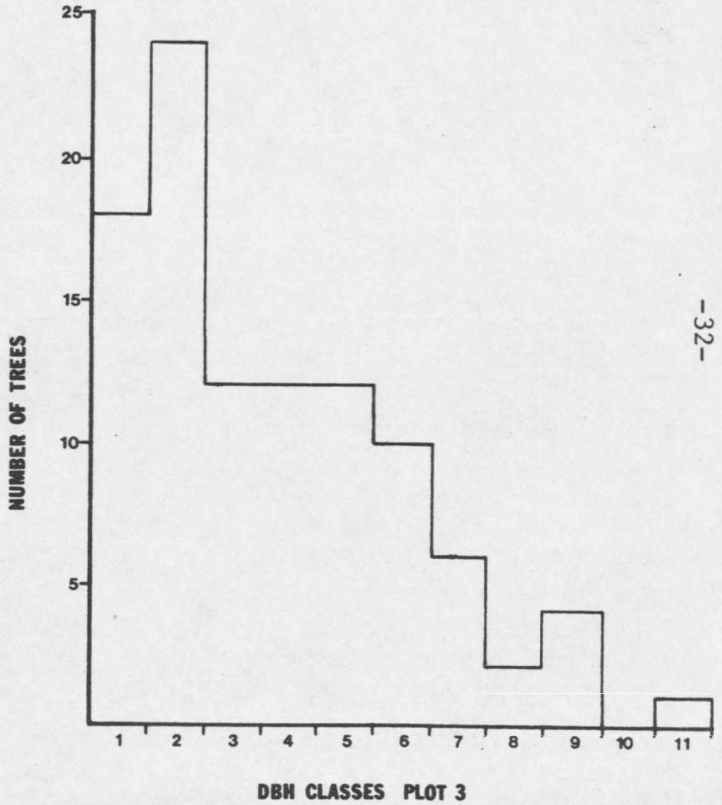


Figure 9. Distribution of timber by 2-inch dbh classes on Plots 2 and 3.

Plot 4 was staked to include a segment of the Horse Creek drainage through the center of the plot (Figure 10). This segment of the creek was chosen because very little of the adjacent land had been developed for crop production. A composite map (Figure 11) shows the distribution of life form cover-types and the dot grid overlay gave cover percentages of 86 percent sagebrush-grassland, 13 percent riparian and 1 percent cropland.

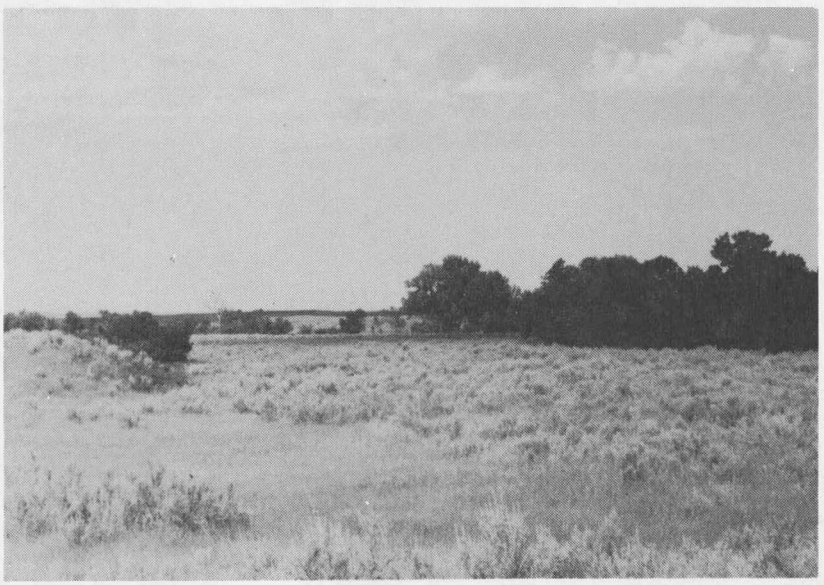


Figure 10. Sagebrush-grassland, riparian association of Plot 4.

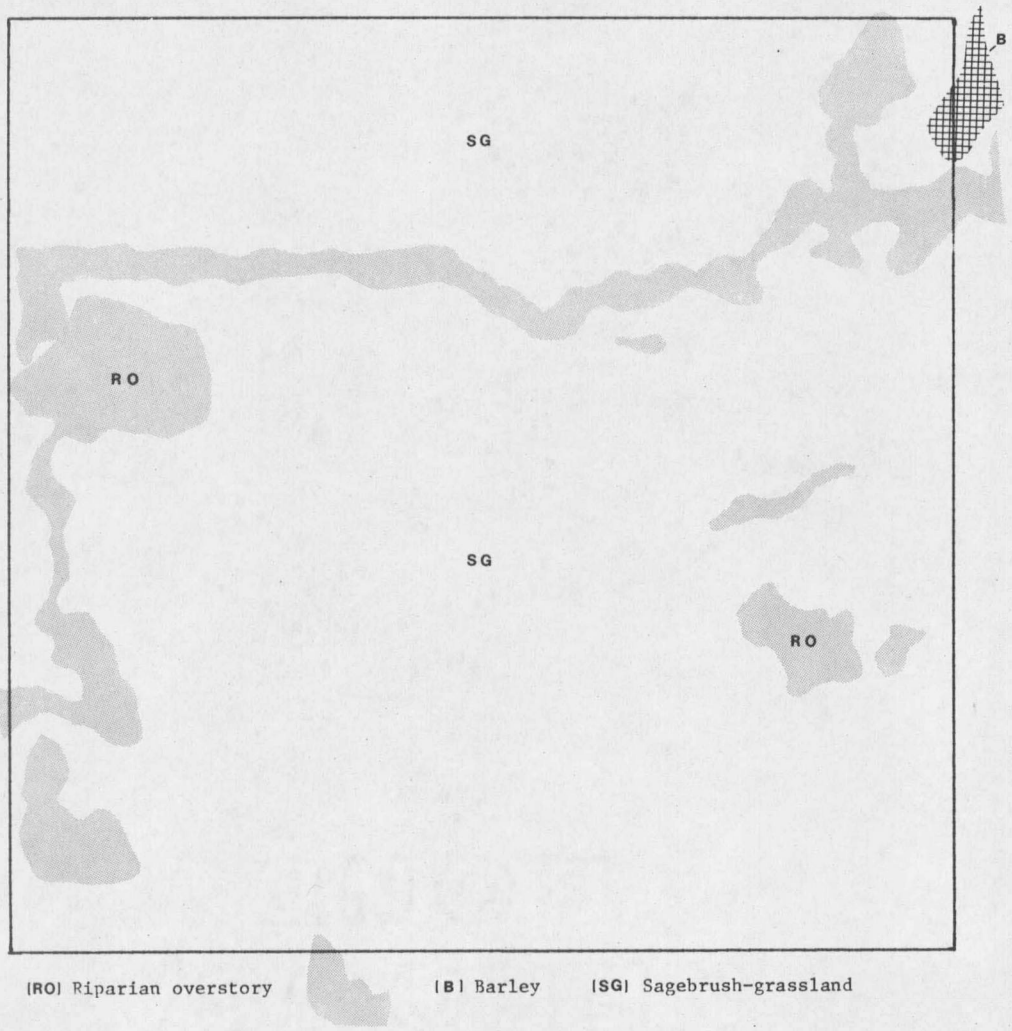


Figure 11. Map of prominent cover-types on Plot 4.

Herbaceous vegetation was classified as 75.8 percent grasses, 14.0 percent forbs and half-shrubs with 9.5 percent recorded as bare ground. Important grass species were western wheatgrass, green needlegrass (*Stipa viridula*), needle and thread, blue grama, bluegrass and Japanese brome (*Bromus japonicus*).

Important forbs and half-shrubs were fringed sagewort (*Artemisia frigida*), false tarragon sagewort, yarrow, white milkwort (*Polygala alba*) and yellow sweetclover (*Melilotus officinalis*). There was a noticeable reduction in the amount of western ragweed present relative to that recorded on the other plots. The overall reduction in frequency of occurrence of forbs was due to the high incidence of perennial grasses especially western wheatgrass on the mesic silver sagebrush dominated sites.

Shrub transect data presented in Table 3 show silver sagebrush, snowberry, woods rose and big sagebrush to be important species. The southern quarter of the plot is the beginning of the big sagebrush type characteristic of the foothills. The snowberry forms dense, rather tall patches adjacent to the creek bottom.

Quantitative measurements of the deciduous tree and tall shrub community along the streambank was not attempted. A qualitative description shows box elder and green ash to be well represented and plains cottonwood present to a lesser extent. Important tall shrubs were chokecherry and hawthorn. Minor amounts of golden current were

present. Although the riparian type occupied a small percentage of the total area on the plot, it provided a high quality edge-effect (Leopold 1933) readily utilized by the wildlife in the area.

Birds

Game Species

Ring-necked Pheasant.--Pheasant range in the United States west of the 102 Meridian, is confined largely to irrigated land or bottomland having a comparable water relationship (Yeager et al. 1951). Montana's major pheasant range largely coincides with irrigation projects and major waterways (Weigand & Janson 1976). The distribution of the pheasant population within the Sarpy Creek drainage is consistent with the above in that the birds are associated predominantly with the stream course habitat but extend into the uplands where suitable woody cover is found.

The crowing averages were calculated for two of the four censuses conducted during 1975. The average number of crows heard per 2-minute period for these routes (May 5 and May 15) was 8.7 and was considerably lower than that recorded for the same time period in 1976. The snow and sleet total for January through April was 62.5 inches and this may have adversely affected pheasant survival during this period. Casual observations of production that year suggested a potential increase in the 1976 breeding population.

The average number of crows per 2-minute period for the entire route, run five times between April 24 and May 15, 1976, was 13.7. The average for the 15 stations found along the bottomland series was 16.5 and for the 5 upland sites it was 5.1. The highest daily average of 17.4 was recorded on May 9, 1976, and included the greatest number of recorded crows per individual station (33 crows at station 9). Pheasants were not heard crowing either year in the vicinity of station 5, a dry upland site with very little woody shrub cover. Figure 12 illustrates the relative stability of the cock pheasant distribution by comparing the high and low counts recorded during the peak of breeding activity.

Martin (1975, 1976) documented yearly peak averages of 13.3 and 16.7 for the Sarpy Basin extending to the confluence of Sarpy Creek and the Yellowstone River. He further separated this unit into the upper and lower Sarpy Creek areas with the lower area showing a much higher density of crowing cocks (24.7 compared to 11.8 in 1975). Desimone (1975), in the Hysham area, recorded a peak average of 14.6 crows per 2-minute period.

It was not possible to sample the interior portion of the area during the spring periods. However, individual cocks were heard crowing in the uplands throughout June. These birds were repeatedly flushed from rather specific locations and appeared to have established territories in these areas of rather marginal habitat.

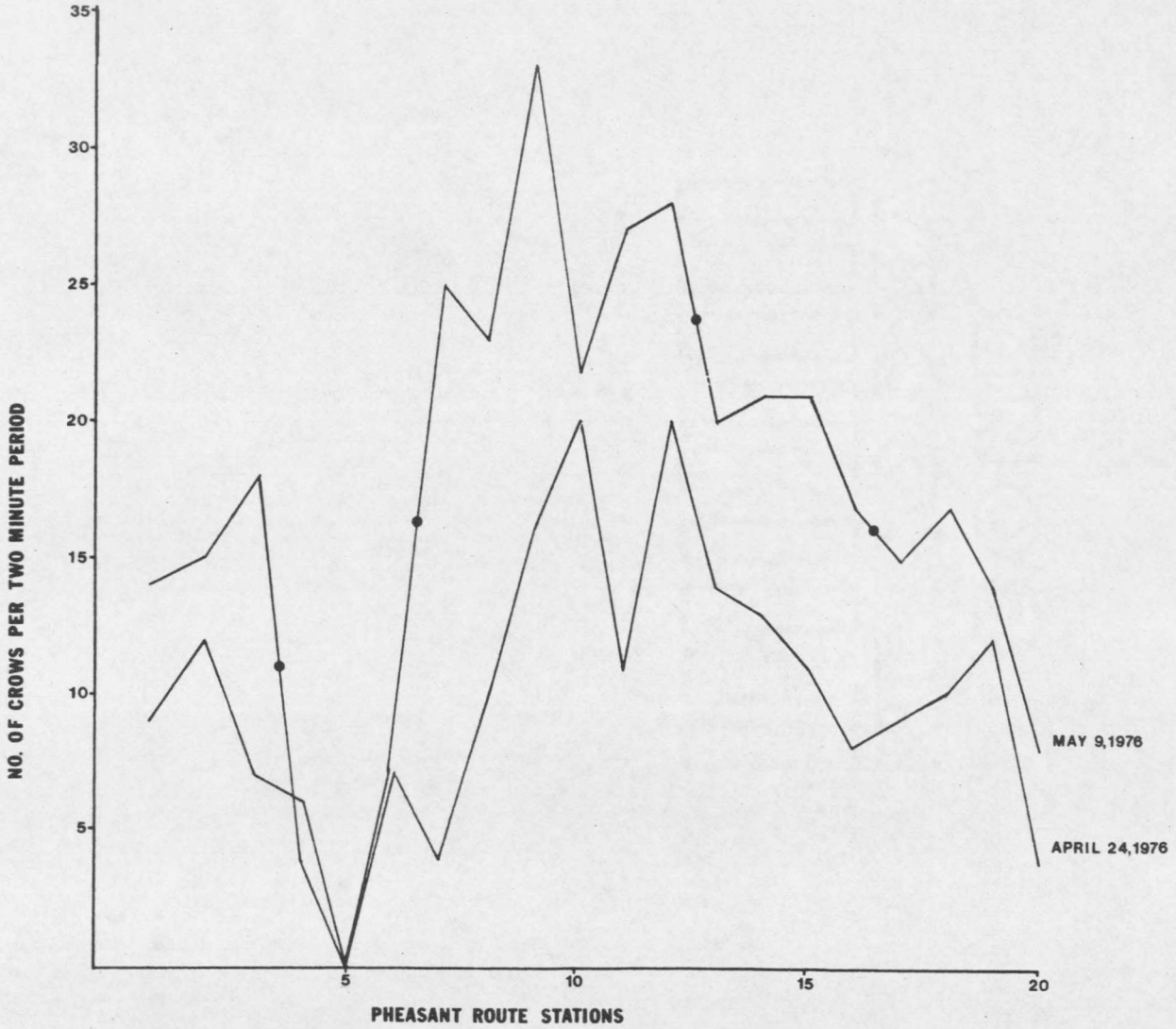


Figure 12. Distribution of male ring-necked pheasants as indicated by high and low crowing counts recorded during the peak of breeding activity.

Attendance by hens was recorded at only one location and no broods were observed in the uplands.

Sharp-tailed and Sage Grouse.--The plains sharp-tailed grouse is a native tetraonid occurring in the mixed prairie foothill habitat (Aldrich 1963). Brown (1971) states that the populations of this grouse in Montana are most secure on the upland prairie where heavy grazing or cultivation has not completely altered the native upland grasses and shrubs. Enumeration of spring population densities is facilitated by the congregation of these birds on traditional breeding grounds or leks (Lumsden 1965, Sisson 1976).

Nine sharp-tailed grouse dancing grounds and one sage grouse strutting ground were located on or adjacent to the area during the springs of 1975 and 1976. The location of these breeding grounds is shown in Figure 13. The spatial distribution of the grounds represents a comparable distribution of a grassland type preferred by these birds. Each of the grounds serves as a focal point for a discreet segment of grouse and these units, when combined, comprise the grouse population of the area (Rippin & Boag 1974).

The maximum number of displaying male grouse recorded on the individual grounds during the peak of breeding activity (mid-April to mid-May) are presented in Table 4. The average number of males per ground was 13.7 in 1975 and 9.5 in 1976. These densities compare

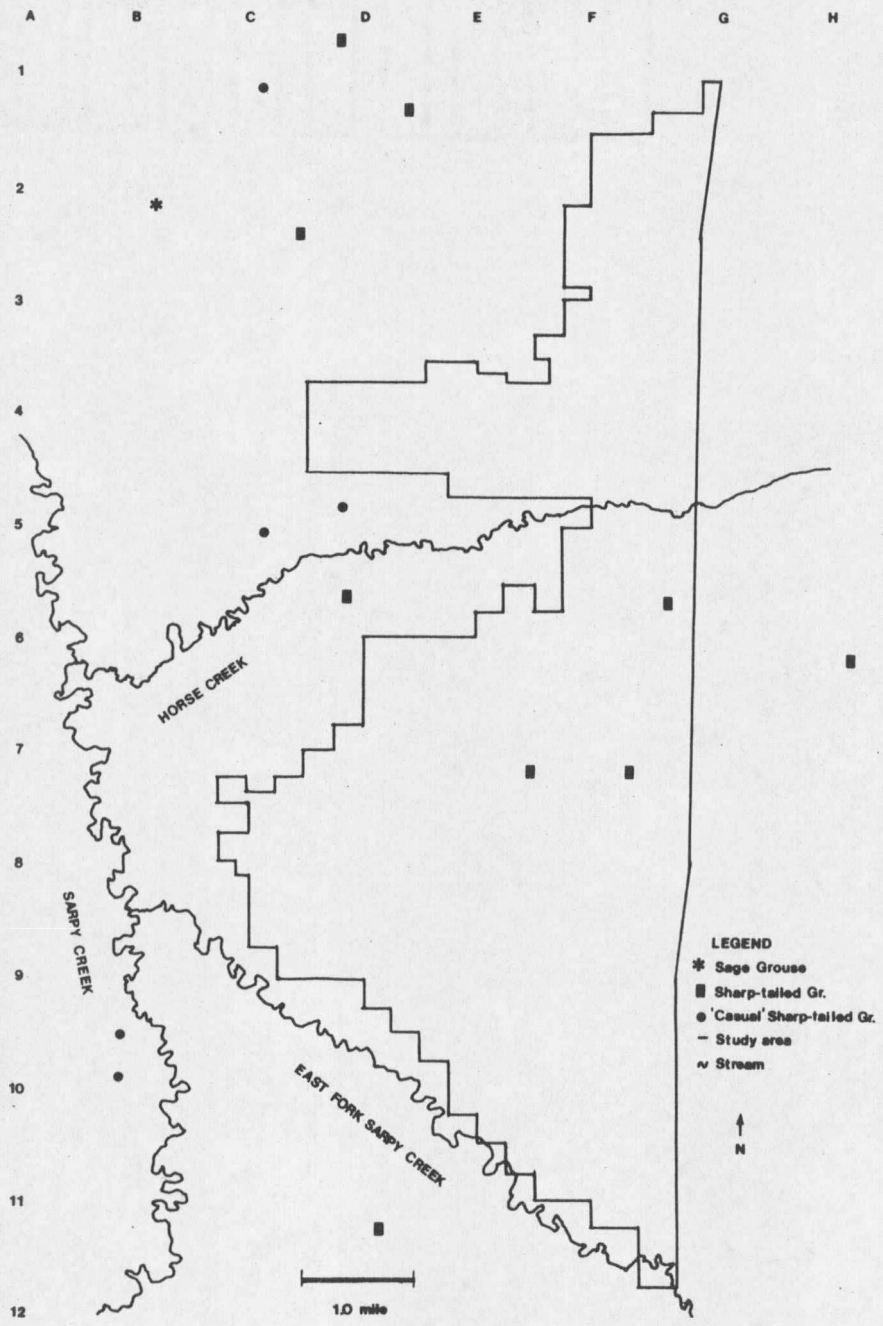


Figure 13. Map of the study area showing the location of sage grouse and sharp-tailed grouse breeding grounds.

TABLE 4. MAXIMUM NUMBER OF MALE GROUSE OBSERVED ON THE BREEDING GROUNDS BY YEAR.

	1975	1976
Ground Location		
*B2	14	18
■C2	--	20
■C5	26	20
■D0	18	--
■D1	16	7
■D11	9	2
■E7	9	8
■F5	12	7
■F7	6	--
■H6	--	3
'Casual' Ground Location		
●A9	2	--
●A9	3	--
●C1	--	1
●C4	--	1
●C5	--	2

*Sage grouse.

■ Sharp-tailed grouse.

● 'Casual' sharp-tailed grouse.

closely to those of Martin (pers. comm.) who recorded 12.7, 13.8 and 10.3 male birds per ground during 1974, 1975 and 1976, respectively, for the entire Sarpy Creek drainage.

Pepper (1972) documented the fidelity of established male grouse to a particular dancing ground and Brown (1966), the importance of yearling or subdominant males in the establishment of new grounds. Twenty-five percent of the grounds located in 1975 were unoccupied in the spring of 1976. Twenty-five percent of the grounds located in 1976 were not observed in 1975. Ground H6 had 16 males in attendance in 1974, zero males in 1975 and 3 males actively displaying in 1976. Admittedly this was a small sample, however it appears that in an area of relatively stable habitat conditions, breeding ground abandonment and establishment seem to occur in approximately equal percentages.

Five casual grounds (Hamerstrom 1939, Lumsden 1965) were located during the study, two in 1975 and three in 1976. The location of these grounds and the numbers of males observed displaying are presented in Figure 13 and Table 4. Only one observation was made of hen attendance on these grounds, that of two hens with a single male on C4. Casual grounds C4 and C5 were peripheral to the permanent ground C5 and may have represented males unable to establish on C5, yet too dominant to remain as non-breeders.

Sage grouse habitat, as documented by several authors (Martin 1970, Peterson 1970, Wallestad 1975), was restricted to the area north of

Horse Creek and west of Sarpy Creek Road. The only ground (B2) located within this vicinity exhibited stabilized numbers, recorded as 16, 14 and 16 males for the 1974, 1975 and 1976 spring estimates, respectively.

Non-game Species

Breeding Bird Road Route.--The breeding bird road route was censused four times, three during the summer of 1975 and once during the summer of 1976. Fifty-two different species were recorded along the route. This was approximately 75 percent of the total number of species recorded on both the road route and the breeding pair plots.

A species list of birds observed during the study is presented in Appendix Table 14. Avian nomenclature follows the American Ornithologists Union checklist of North American Birds (1957).

The species observed within each of the six gross vegetational types are presented in Tables 5 through 10. In addition to species found in each type, the corrected number of observations, percent frequency of occurrence and rank in frequency are also presented.

The number of stations within each of the types was unequal, therefore, application of a correction factor was necessary to standardize the potential number of observations for any particular species in all types. Since a species could be recorded only once per station, the greatest number of stations within a type (8) was multiplied by a

TABLE 5. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE I.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	31	96.8	A
Mourning Dove	17	53.1	M
House Wren	17	53.1	M
Lark Sparrow	15	46.8	M
Ring-necked Pheasant	15	46.8	M
Rufous-sided Towhee	13	40.6	M
Common Flicker	11	34.3	M
Black-billed Magpie	11	34.3	M
American Robin	9	28.1	U
Eastern Kingbird	8	25.0	U
Black-capped Chickadee	8	25.0	U
Chipping Sparrow	7	21.8	U
Western Wood Pewee	6	18.7	U
Killdeer	6	18.7	U
Brown-headed Cowbird	5	15.6	U
Black-billed Cuckoo	5	15.6	U
Pinon Jay	3	9.3	R
Yellow-breasted Chat	3	9.3	R
Brewer's Blackbird	3	9.3	R
Red Crossbill	3	9.3	R
American Goldfinch	2	6.2	R
Yellow Warbler	2	6.2	R
Western Kingbird	2	6.2	R
Red-winged Blackbird	2	6.2	R
Mountain Bluebird	2	6.2	R
Black-headed Grosbeak	2	6.2	R
Common Yellowthroat	1	3.1	R
Northern Oriole	1	3.1	R
Red-headed Woodpecker	1	3.1	R
Loggerhead Shrike	1	3.1	R
Sharp-tailed Grouse	1	3.1	R
Brown Thrasher	1	3.1	R
Solitary Vireo	1	3.1	R
Dark-eyed Junco	1	3.1	R
Turkey	1	3.1	R
Red-tailed Hawk	1	3.1	R
Vesper Sparrow	1	3.1	R
Common Crow	1	3.1	R
American Kestrel	1	3.1	R

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%)

TABLE 6. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE II.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	30	93.7	A
Lark Sparrow	24	75.0	C
Mourning Dove	18	56.2	M
Common Flicker	18	56.2	M
House Wren	16	50.0	M
Rufous-sided Towhee	14	43.7	M
American Robin	14	43.7	M
Chipping Sparrow	8	25.0	U
Upland Sandpiper	8	25.0	U
Black-capped Chickadee	6	18.7	U
Eastern Kingbird	6	18.7	U
Western Wood Pewee	6	18.7	U
Northern Oriole	6	18.7	U
Brown-headed Cowbird	4	12.5	U
Pinon Jay	4	12.5	U
Brewer's Blackbird	4	12.5	U
Brown Thrasher	4	12.5	U
Ring-necked Pheasant	2	6.2	R
Black-billed Magpie	2	6.2	R
Black-billed Cuckoo	2	6.2	R
Yellow-breasted Chat	2	6.2	R
Yellow Warbler	2	6.2	R
Mountain Bluebird	2	6.2	R
Red-headed Woodpecker	2	6.2	R
Sharp-tailed Grouse	2	6.2	R
Solitary Vireo	2	6.2	R
Dark-eyed Junco	2	6.2	R
Red-tailed Hawk	2	6.2	R
Vesper Sparrow	2	6.2	R
American Kestrel	2	6.2	R

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%).

TABLE 7. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE III.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	32	100.0	A
Black-billed Magpie	24	75.0	C
Mourning Dove	20	62.5	C
Common Flicker	20	62.5	C
House Wren	12	37.5	M
Lark Sparrow	12	37.5	M
Ring-necked Pheasant	12	37.5	M
American Robin	12	37.5	M
Black-capped Chickadee	12	37.5	M
Red Crossbill	12	37.5	M
Chipping Sparrow	12	37.5	M
Rufous-sided Towhee	8	25.0	U
White-breasted Nuthatch	8	25.0	U
Eastern Kingbird	4	12.5	U
Western Wood Pewee	4	12.5	U
Brown-headed Cowbird	4	12.5	U
Pinon Jay	4	12.5	U
Mountain Bluebird	4	12.5	U
Red-headed Woodpecker	4	12.5	U
Hairy Woodpecker	4	12.5	U

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%).

TABLE 8. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE IV.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	32	100.0	A
Ring-necked Pheasant	24	75.0	C
Black-billed Magpie	24	75.0	C
Red-winged Blackbird	20	62.5	C
House Wren	12	37.5	M
Brewer's Blackbird	12	37.5	M
Black-billed Cuckoo	8	25.0	U
Yellow-breasted Chat	8	25.0	U
Common Yellowthroat	8	25.0	U
Mourning Dove	4	12.5	U
Lark Sparrow	4	12.5	U
Rufous-sided Towhee	4	12.5	U
Common Flicker	4	12.5	U
American Robin	4	12.5	U
Savannah Sparrow	4	12.5	U
Great Blue Heron	4	12.5	U

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%).

TABLE 9. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE V.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	32	100.0	A
Yellow Warbler	28	87.5	C
Common Yellowthroat	28	87.5	C
Ring-necked Pheasant	24	75.0	C
Black-billed Magpie	24	75.0	C
American Robin	20	62.5	M
Yellow-breasted Chat	20	62.5	M
Lazuli Bunting	16	50.0	M
Barn Swallow	16	50.0	M
House Wren	12	37.5	M
Mourning Dove	8	25.0	U
Common Flicker	8	25.0	U
Killdeer	8	25.0	U
Black-billed Cuckoo	8	25.0	U
Brewer's Blackbird	8	25.0	U
Brown Thrasher	8	25.0	U
American Kestrel	8	25.0	U
Wilson's Warbler	8	25.0	U
Eastern Kingbird	4	12.5	U
Black-capped Chickadee	4	12.5	U
American Goldfinch	4	12.5	U
Red-winged Blackbird	4	12.5	U
Black-headed Grosbeak	4	12.5	U
Northern Oriole	4	12.5	U
Common Crow	4	12.5	U
Indigo Bunting	4	12.5	U
House Sparrow	4	12.5	U

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%).

TABLE 10. SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF BIRDS IN TYPE VI.

Species	No. of Corrected Observations	Percent Frequency	Rank in Frequency(1)
Western Meadowlark	28	87.5	C
Lark Bunting	16	50.0	M
Vesper Sparrow	8	25.0	U
Mourning Dove	8	25.0	U
Sharp-tailed Grouse	4	12.5	U
Western Kingbird	4	12.5	U
Ring-necked Pheasant	4	12.5	U
Prairie Falcon	4	12.5	U
Rock Wren	4	12.5	U
Savannah Sparrow	4	12.5	U

(1) R (1-9%); U (10-30%); M (31-64%); C (65-89%); A (90-100%).

constant number of samples (4). Thus the potential number of observations per species was corrected to 32 in all types and this may unfairly weight observations made in those types occurring less frequently.

The percent frequency is equal to the number of actual observations divided by the total number of possible observations. The rank in frequency was based on the following percentage breakdown: Rare (R) 1-9%; Uncommon (U) 10-30%; Moderately common (M) 31-64%; Common (C) 65-89%; and Abundant (A) 90-100% (White 1942).

Type I, a deciduous thicket, grassland, pine association, was the most diversified in the number of species present; 39 species were recorded. The amount of diversity exhibited by the birds within this type was related to and a reflection of the structural diversity of the vegetation present. The species observed in Type I were ranked in terms of relative abundance as follows: Rare (23), Uncommon (8), Moderately common (7), Common (0) and Abundant (1). Figure 14 illustrates the tendency for a large number of species to occur with a low frequency and a much smaller number of species to occur with a high frequency. This is a basic concept of Raunkaier's Law of Frequence as stated by Linsdale (1924, 1936) and Winterbottom (1936, 1940). There were two species present that were not observed in the other types and 3.5 species were represented by the highest frequency recorded in any of the types for that particular species. The fraction

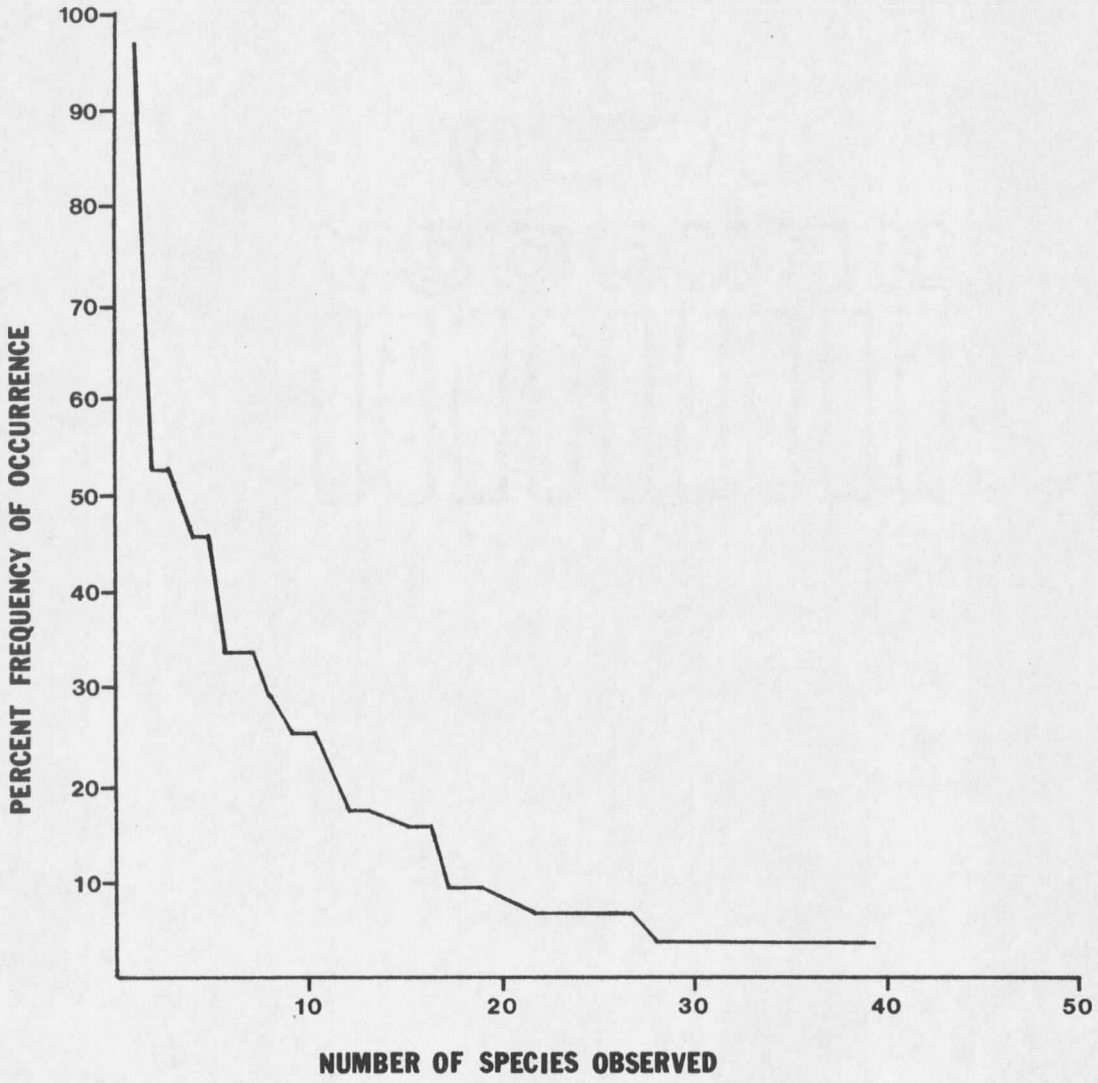


Figure 14. Frequency distribution of birds observed in Type I.

results when a particular species frequency of occurrence is equal in more than one type.

Thirty species were recorded for the mixed grassland-timber association of Type II. The minor variation in the species composition between Types I and II illustrates the problem encountered when describing a vegetational type by the different bird species present. The habitat requirements of certain species distributes their activities into various types. However, the upland types are components of the Ponderosa Pine Savannah and the general species composition was somewhat typical of this broad climax type. Any variation recorded in the relative abundance of a particular species was due to the increase or decrease of the vegetational types it was associated with.

The species observed in Type II were ranked in terms of relative abundance as follows: Rare (13), Uncommon (10), Moderately common (1), Common (1) and Abundant (1). There was a noticeable increase from Type I in the relative abundance of lark sparrows, a species which seems to prefer the edge common to the grassland-timber association. One species, the upland sandpiper, was found only in this type. The frequency of occurrence recorded for eight species was the highest for any of the types.

Twenty species were recorded in the ponderosa pine forest characteristic of Type III. The species composition of this type is indicative of a less diverse habitat with fewer species common to the more

diversified areas being found in this type. Thus in a type where niche breadth is more restricted (Pitelka 1941), most of the birds encountered are those which are most specifically associated with the timber in their breeding and feeding patterns.

The species observed in Type III were ranked in terms of relative abundance as follows: Rare (0), Uncommon (9), Moderately common (7), Common (3) and Abundant (1). Throughout the frequency classes of Type III, those species that were recorded were quite representative of this particular type (i.e., "birds of the forest"). Comparison of the low frequency classes of Types II and III reveals that uncommon to rare species may serve as the best indicators of vegetation diversity.

The hairy woodpecker and white-breasted nuthatch were the two species recorded only for Type III. Excluding the previous two, there were 7.16 species representing the highest frequency of occurrence recorded for those particular species in any of the types.

Sixteen species were recorded for the sagebrush, agriculture association of Type IV. This type is essentially an ecotone with the pine grading into the sagebrush and the cropland into the riparian vegetation along the creek bottom. That certain species associated with the pine or riparian vegetation were recorded in this type, was due in part, to their characteristically loud song or their preference for the sagebrush or cropland areas as feeding and display sites.

The species observed in Type IV were ranked in terms of relative abundance as follows: Rare (0), Uncommon (10), Moderately common (2), Common (3) and Abundant (1). One species, the great blue heron, was recorded only in this type and 4.2 species were present in the highest frequency recorded for any type.

Twenty-seven species were recorded for the agriculture, creek bottom association characteristic of Type V. When comparing the various types (I-V), the deciduous tree-shrub community that dominated Type V and the coniferous forest of Type III provided the most structurally different habitats available to the birds of the area. The representative bird species of the two types were quite type-specific and the species composition of each showed a striking inter-type difference (Tables 7 and 9).

The species observed in Type V were ranked in terms of relative abundance as follows: Rare (0), Uncommon (17), Moderately common (5), Common (4) and Abundant (1). Five species were recorded only in this type, two of which, the barn swallow and house sparrow, were associated with some ranch buildings in the vicinity of the station sites. A total of 11.6 species were represented by the highest frequency of occurrence recorded in any of the types. Certain species including the yellow warbler, yellowthroat and pheasant that were found in Type V, and apparently selected for it, were more numerous than some species

such as the chickadee, flicker and housewren which utilized Type V but were associated primarily with a different type (Yeaton 1974).

Ten species were recorded for the sagebrush-grassland association of Type VI. This was the lowest number of species recorded for any of the six vegetational types. As the vegetation composition of the area became less polytypic, there was a corresponding decrease in the diversity of bird life. This was similar to the patterns of bird diversity observed throughout the other types.

The species observed in Type VI were ranked in terms of relative abundance as follows: Rare (0), Uncommon (8), Moderately common (1), Common (1) and Abundant (0). This was the only type where the meadowlark was not rated an abundant species. Of the three species that were recorded only for this type, the rock wren and prairie falcon were associated with the sandstone bluffs in this specific area. A total of 3.5 species were recorded as having the highest frequency of occurrence within this type.

Breeding Pair Plots.--The selective use of different vegetational types by birds during their breeding season is a reflection of their specific food habits and nest site requirements (Saunders 1914). With the establishment of territories by most species, the bird population of the area stabilized, and thereby facilitated a quantitative measurement of different segments of this population.

A composite map of identifiable territories was constructed by year for the individual species on each of the separate plots. A number of territory types have been described previously by Nice (1941). Important to this study were the very numerous Type A typical of most passerines, in which the defended territory includes both nesting and feeding sites, the less common Type B where food was obtained off the nesting area and Type C characterized by a communal sharp-tailed grouse lek. Most of the territories were designated primarily by the relocation of displaying males with supplemental data provided in the form of nest locations and observations of females.

Table 11 presents the total number of daily observations recorded on each of the plots, the subtotals for the 1975-1976 breeding seasons and the combined 2-year total. The 2-year total for all 4 plots was 2006 observations. An apparent trend in the 1975 data showed a reduction in number of observations by the first week of July on all four plots. The greatest number of observations was recorded on Plot 3 on June 12, 1975. A similar trend was apparent on only two of the four plots (3 and 4) in 1976. The greatest number of daily observations was recorded on Plot 2 on June 30, 1976. The evident increase from 1975 to 1976 in the number of daily observations per plot was probably due to increased observer efficiency.

TABLE 11. TOTAL NUMBER OF BIRD OBSERVATIONS BY DAY FOR THE BREEDING PAIR PLOT CENSUS FOR 1975 AND 1976.

Plot	Date	No. of Observations
Plot 1 (Upland grassland)	June 10, 1975	35
	June 24, 1975	75
	July 1, 1975	28
	Subtotal	138
	June 18, 1976	51
	June 23, 1976	59
	June 29, 1976	71
	Subtotal	181
	Two-year Total	319
Plot 2 (mixed grassland, pine and hawthorn thickets)	June 11, 1975	113
	June 25, 1975	94
	July 3, 1975	66
	Subtotal	273
	June 20, 1976	112
	June 24, 1976	106
	June 30, 1976	143
	Subtotal	361
	Two-year Total	634
Plot 3 (pine)	June 12, 1975	135
	June 27, 1975	92
	July 4, 1975	58
	Subtotal	285
	June 19, 1976	123
	June 26, 1976	117
	July 1, 1976	93
	Subtotal	333
	Two-year Total	618
Plot 4 (riparian, sagebrush-grassland)	June 30, 1975	70
	July 2, 1975	32
	July 5, 1975	46
	Subtotal	148
	June 21, 1976	111
	June 27, 1976	108
	July 2, 1976	68
	Subtotal	287
	Two-year Total	435

The total number of observations for the 2-year period on Plots 2 and 3 were nearly equal. This similarity in the number of observations recorded for the two plots contrasts with the very different vegetation associations characteristic of each. Plot 2 offered the most diversified life form association, while Plot 3 was rather monotypic. Furthermore, the monotypic timber association of Plot 3 appeared to be much more heavily utilized than the relatively monotypic grassland association of Plot 1.

During 1975, 16 species were observed on Plot 1. Of these, 7 were classified as potential breeders with an established territory on the plot and 14 breeding pairs were recorded. In 1976, 12 species were observed on the plot, 7 were classified as potential breeders and 16 breeding pairs were recorded. Although the number of breeding species remained the same, there was a slight shift in species composition (Table 12). The species composition of this grassland association was made up primarily of birds that nested and fed on the ground; these birds may use an elevated song perch if available but it is not required (Kendeigh 1945). Most observations of displaying males showed these birds were using the skunkbrush, sagebrush, pine or a fence line as display sites, which implies that these males preferred an elevated song perch. Certain species, most notably the meadowlark, also made use of the flight song in the maintenance of their territory.

TABLE 12. SPECIES COMPOSITION AND BREEDING PAIR DENSITIES ON PLOTS 1 THROUGH 4 DURING 1975 AND 1976.

Species	Plot 1			Plot 2			Plot 3			Plot 4		
	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$
Great Blue Heron				*	0	0						
Mallard										*	1	0.5
Blue-winged Teal										*	0	0
Marsh Hawk										*	0	0
American Kestrel	*	0	0				0	*	0	*	0	0
Ring-necked Pheasant				1	1	1				2	1	1.5
Upland Sandpiper	*	*	0	*	1	0.5						
Mourning Dove	1	1	1	1	2	1.5	2	2	2	1	1	1
Black-billed Cuckoo				1	0	0.5				2	0	1
Great Horned Owl							1	0	0.5			
Poor-will							0	1	0.5			
Common Night Hawk							*	0	0			
Common Flicker	*	*	0	2	2	2	2	1	1.5	1	1	1
Red-headed Woodpecker							0	1	0.5			
Hairy Woodpecker							*	*	0			
Eastern Kingbird	1	0	0.5	3	3	3						
Say's Phoebe							1	0	0.5			
Western Wood Pewee				1	1	1	3	5	4			

TABLE 12. continued.

Species	Plot 1			Plot 2			Plot 3			Plot 4		
	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$
Tree Swallow							*	0	0			
Cliff Swallow	*	0	0									
Black-billed Magpie				0	1	0.5	*	0	0	0	1	0.5
Pinon Jay							*	0	0			
Black-capped Chickadee				5	3	4	4	6	5	1	1	1
White-breasted Nuthatch				1	0	0.5	2	2	2			
House Wren	1	0	0.5	4	3	3.5	6	6	6	1	*	0.5
Grey Catbird				1	1	1						
Brown Thrasher				2	3	2.5				1	1	1
American Robin	*	0	0	1	2	1.5	3	3	3			
Mountain Bluebird	*	*	0	0	1	0.5	2	2	2	0	*	0
Loggerhead Shrike				0	1	0.5						
Solitary Vireo							*	3	1.5			
Yellow Warbler				4	6	5				2	3	2.5
Yellow-rumped Warbler							3	4	3.5			
Common Yellowthroat				1	0	0.5				5	5	5
Yellow-breasted Chat				3	3	3				2	3	2.5
Western Meadowlark	5	6	5.5	8	9	8.5	5	3	4	5	5	5
Red-winged Blackbird				3	2	2.5				1	0	0.5

TABLE 12. continued.

Species	Plot 1			Plot 2			Plot 3			Plot 4		
	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$	1975	1976	$\bar{X}$
Northern Oriole				1	1	1				0	1	0.5
Brewer's Blackbird	*	0	0	1	1	1	*	*	0	*	*	0
Brown-headed Cowbird				1	1	1	1	1	1	1	1	1
Western Tananger							*	*	0			
Black-headed Grosbeak				1	0	0.5				0	1	0.5
Indigo Bunting										1	1	1
Lazuli Bunting										2	3	2.5
Pine Siskin							*	*	0			
American Goldfinch				0	1	0.5				1	2	1.5
Red Crossbill	*	0	0				*	*	0			
Rufous-sided Towhee	*	*	0	4	6	5	3	5	4	2	4	3
Lark Bunting	*	0	0									
Savanah Sparrow										0	1	0.5
Vesper Sparrow	2	4	3	1	1	1				2	2	2
Lark Sparrow	3	2	2.5	4	4	4	2	4	3	0	*	0
Dark-eyed Junco				1	0	0.5	0	1	0.5			
Chipping Sparrow	1	1	1	2	2	2	4	6	5			
Clay-colored Sparrow	0	1	0.5									
Brewer's Sparrow	0	1	0.5									

(*) Species present, but male not observed displaying.

($\bar{X}$) two-year average.

The calculated number of breeding pairs per 100 acres on Plot 1 was 35 in 1975 and 40 in 1976, yielding a 2-year average of 37.5 pairs per 100 acres. This density of potential and/or actual nesting pairs was the lowest recorded on any of the four plots. Qualitative assessment of the size of the meadowlark territories, showed these birds using a more expansive area in the grassland types found on Plots 1 and 2 than when associated with the timbered sections of Plots 1, 2 and 3.

During the 1975 breeding season, 28 species were observed on Plot 2. Of these, 26 were classified as potential breeders with a total of 58 breeding pairs recorded. During the 1976 season, 26 species were observed on the plot. All were classified as potential breeders with a total of 62 pairs recorded. The approximate 1:1 ratio of species observed on the plot to species recorded as potential territorial breeders during both years differs markedly from the ratios of 2.3:1 in 1975 and 1.7:1 in 1976 observed on Plot 1.

The general composition and pair densities on Plot 2 appeared relatively stable from the 1975 to 1976 breeding season, with a minor shift in species composition noticeable among those birds encountered less frequently (Table 12). The number of breeding species recorded, 26, represented the most diverse composition observed on any of the plots and provided the greatest number of breeding pairs (62). These data substantiate the pattern established with the route census, that

an increase in the complexity of the vegetational structure (particularly life form types) would reflect an increase in the diversity of bird species (Beecher 1942, Hardy 1945).

Kendeigh (1941), in his work on a midwestern prairie, documented a decline in the densities of meadowlarks and other grassland species with the invasion of trees and shrubs on the prairie. This trend was noticeable for the grassland sparrows in comparing Plot 1 to Plot 2, however, the meadowlark densities increased significantly with an increase in the tree-shrub cover percentages. The pair densities of the yellow warbler, yellow-breasted chat and brown thrasher which are specifically associated with deciduous thickets, were equal to or higher than that recorded for the same species in the deciduous tree-shrub association on Plot 4. This variation was related to the structural difference between the hawthorn thickets of Plot 2 and the box elder-green ash association of Plot 4, the former exhibiting a more dense structure and a greater amount of edge.

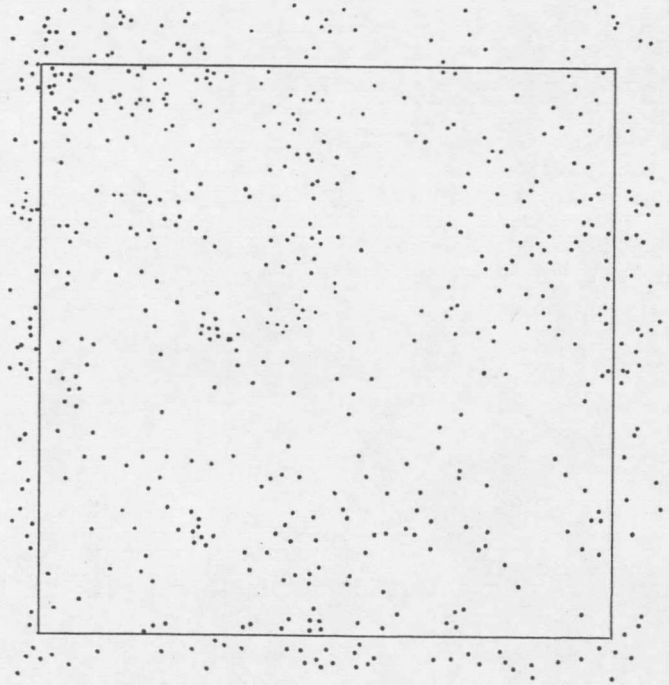
The calculated number of breeding pairs per 100 acres on Plot 2 was 145 in 1975 and 155 in 1976, yielding a 2-year average of 150 pairs per 100 acres. This was the highest breeding pair density recorded on any of the four plots.

During the 1975 breeding season, 26 species were observed on Plot 3, 16 were classified as potential breeders with an established territory and 44 breeding pairs were recorded. During the 1976 season,

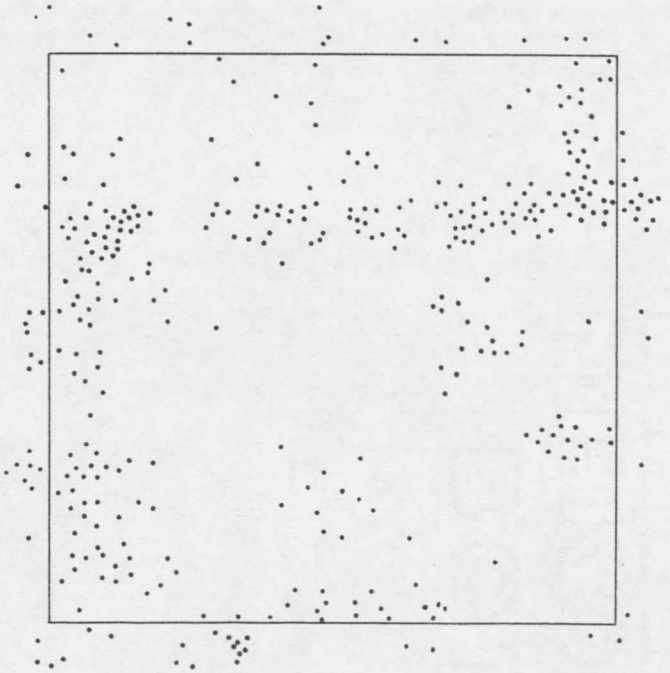
24 different species were observed on the plot, 18 were classified as potential breeders and 56 breeding pairs were recorded. Species composition and breeding pair densities for Plot 3 are presented in Table 12. The ratios of the number of species observed to the number of species classified as breeding territorial pairs were 1.6:1 and 1.3:1 for 1975 and 1976, respectively. These values imply that more species used this plot for certain activities and nested elsewhere than those species utilizing the plot exclusively. However, this discrepancy was due mainly to the behavior of some species which made it difficult to differentiate their territory type. Both the territorial and "non-territorial" species were birds observed primarily in association with the forested type. Figure 15 compares the relatively uniform distribution of bird observations on Plot 3 with the concentrated observation distribution on Plot 4.

The calculated number of breeding pairs per 100 acres on Plot 3 was 110 in 1975 and 140 in 1976, yielding a 2-year average of 125 pairs per 100 acres. This was the second highest breeding pair density recorded for the four plots.

During the 1975 breeding season, 26 species were observed on Plot 4; 18 were classified as potential breeders and 33 breeding pairs were recorded. During the 1976 breeding season, 25 species were observed, 20 were classified as potential breeders and 39 breeding pairs were



Plot 3



Plot 4

Figure 15.- Distribution of bird observations on Plots 2 and 3 during 1975 and 1976.

recorded. Species composition and breeding pair densities for Plot 4 are presented in Table 12. The ratios for the number of species observed to the number of species classified as breeding territorial pairs were 1.4:1 in 1975 and 1.2:1 in 1976.

The calculated number of breeding pairs per 100 acres on Plot 4 was 82.5 in 1975 and 97.5 in 1976, yielding a 2-year average of 90.0 pairs per 100 acres. Plot 4 ranked third overall in the density of breeding pairs.

Comparison of the composite cover map of Plot 4 (Figure 11) reveals that a high percentage of the birds were associated with the riparian type. The horizontal and vertical juxtaposition of territories was more discernible in the riparian vegetation of Plot 4 than on any of the other plots.

Using a method described by Odum (1951), the percentage of difference between the average number of breeding pairs per 100 acres by plot can be calculated. This involves calculating the absolute value of the differences in pair densities for all species on the two plots which are being compared, dividing that total by the combined breeding pair densities of the two plots and then multiplying by 100 (Table 14). The percentage of difference thus obtained is a rough index of the differences in species composition and density for an area. Thus, Plots 2 and 3 with a 9-percent difference are the most similar in

TABLE 13. PERCENTAGE OF DIFFERENCES BETWEEN AVERAGE NUMBER OF PAIRS OF BREEDING BIRDS PER 100 ACRES ON PLOTS 1 THROUGH 4.

$$\frac{\text{Plot 1} - \text{Plot 2}}{\text{Plot 1}^{1} + \text{Plot 2}^{2}} \times 100 = 60.0\%$$

$$\frac{\text{Plot 1} - \text{Plot 3}}{\text{Plot 1} + \text{Plot 3}^{3}} \times 100 = 53.8\%$$

$$\frac{\text{Plot 1} - \text{Plot 4}}{\text{Plot 1} + \text{Plot 4}^{4}} \times 100 = 41.1\%$$

$$\frac{\text{Plot 2} - \text{Plot 3}}{\text{Plot 2} + \text{Plot 3}} \times 100 = 9.0\%$$

$$\frac{\text{Plot 2} - \text{Plot 4}}{\text{Plot 2} + \text{Plot 4}} \times 100 = 25.0\%$$

$$\frac{\text{Plot 3} - \text{Plot 4}}{\text{Plot 3} + \text{Plot 4}} \times 100 = 16.2\%$$

[1]Density of plot 1 was equal to 37.5 pairs per 100 acres.

[2]Density of plot 2 was equal to 150.0 pairs per 100 acres.

[3]Density of plot 3 was equal to 125.0 pairs per 100 acres.

[4]Density of plot 4 was equal to 90.0 pairs per 100 acres.

terms of breeding pair densities. Plots 1 and 2 with a 60-percent difference are the most dissimilar in terms of breeding pair densities.

DISCUSSION

The number of pheasants within the Sarpy Creek drainage as documented by the peak crowing count averages, appears to be representative of the pheasant population levels throughout southeastern Montana. Recorded numbers were quite high prior to the winter of 1964-65 which severely depressed the population level in this section of the state. A re-establishment of the population to the previous high is questionable considering present agricultural practices in which emphasis has switched from cereal grain production to a predominantly alfalfa-cattle interest.

Pheasants in the area sampled seem to maintain their distribution in the absence of any widespread cereal grain production. The meandering course of the streams in the area and the associated woody cover provide relatively secure habitat except during the most severe winters. The interspersion of woody cover, residual herbaceous vegetation and alfalfa cropland seem to meet the territorial requirements of cock pheasants during the breeding season. The repeated observations of cock pheasants crowing in the uplands may be indicative of a saturated level of territorial cocks in the bottomland type. The displacement of juvenile birds to areas of marginal habitat during the breeding season was documented by Taber (1949). This may also be recognized in terms of hens nesting in hayfields and the subsequent mortality that occurs due to an early-June mowing, a factor which may be potentially limiting.

Sharp-tailed grouse are much more abundant than sage grouse in the area, a direct reflection of the distribution of vegetational types required by each species. Maintenance of the proper interspersion of life form cover-types, particularly the inter-mixed tree, shrub and grassland association, should maintain a viable sharp-tailed grouse population. Further encroachment by agricultural interests on the expansive areas dominated by big sagebrush will result in the deterioration of sage grouse habitat and further depress their already low numbers.

Although the distribution of sharp-tailed grouse breeding grounds appears somewhat localized, the actual observations of groups of males and females with broods represented a much more uniform distribution throughout the study area. A cohort group of males associated with a particular ground were recognizable as a group well into late July. Very conceivably this social unit was maintained through the autumn re-establishment on the breeding ground with recruitment of juveniles replacing the summer mortality. This implies that a group of birds form a nucleus of breeding males for a particular ground and are associated with the ground and each other for a large part of the year.

A successful introduction of the Merriam's turkey in 1957 has resulted in a population productive enough to allow a fall hunting season. The upland vegetational types in which the bulk of turkey observations were recorded, are quite similar to the specific habitat

requirements described by Eng (1961), Jonas (1966), and Greene and Ellis (1971) for this species. Specific parameters of this population were not determined.

Apparently the life form cover-types, either in a monotypic or polytypic situation, determine the distribution and abundance of birds during the breeding season. The association by different bird species to the various vegetational types was documented grossly by the road route census and much more specifically by the plot census. A direct relationship existed between the structural complexity of the vegetation and the diversity of bird species present. As the amount of edge common to different life form cover-types increased, so did the number of species utilizing the area. In the monotypic associations represented by the grassland, riparian or coniferous types, there was a reduction in the number of bird species represented but an increase in the breeding densities of type-specific species. Such species may serve as the most sensitive indicators of diversity in vegetational types.

Selection for the grassland, shrub or timber associations during the breeding season was dependent on the physical and behavioral requirements of a species. Those selecting for a shrub or timber type preferred an elevated position for display, nesting, and feeding sites and were not as tolerant of high light intensities as were the grassland species (Kendeigh 1945). Territory size was noticeably smaller in the deciduous tree-shrub type and to a lesser extent in the coniferous

timber type. Daily movements of particular species utilizing these types were correspondingly reduced.

Comparison of mapped territories for certain individual species reveals a consistent amount of overlap in territory distribution from one year to the next, particularly so in the deciduous tree-shrub types of Plots 2 and 3. The fact that the breeding pair densities on each plot remained relatively constant from 1975 to 1976, infers that the most secure territories in the different vegetational types of the area were consistently occupied by breeding pairs. Considering the high annual turnover rate in a passerine population, recruitment from the surplus of non-established birds was probably responsible for the continued occupancy of these preferred sites. That such a surplus exists is obvious but to quantitatively measure its parameters is quite difficult.

APPENDIX

TABLE 14. SPECIES LIST OF BIRDS OBSERVED ON OR ADJACENT TO THE STUDY AREA.

Horned Grebe (*Podiceps auritus*)
Western Grebe (*Aechmophorus occidentalis*)
Great Blue Heron (*Ardea herodias*)
Mallard (*Anas platyrhynchos*)
Gadwall (*Anas strepera*)
Pintail (*Anas acuta*)
Green-winged Teal (*Anas crecca carolinensis*)
Blue-winged Teal (*Anas discors*)
American Wigeon (*Anas americana*)
Northern Shoveler (*Anas clypeata*)
Redhead (*Aythya americana*)
Ring-necked Duck (*Aythya collaris*)
Lesser Scaup (*Aythya affinis*)
Goshawk (*Accipiter gentilis*)
Sharp-shinned Hawk (*Accipiter striatus*)
Cooper's Hawk (*Accipiter cooperii*)
Red-tailed Hawk (*Buteo jamaicensis*)
Swainson's Hawk (*Buteo swainsoni*)
Ferruginous Hawk (*Buteo regalis*)
Golden Eagle (*Auquila chrysaetos*)
Marsh Hawk (*Circus cyaneus*)
Prairie Falcon (*Falco mexicanus*)
American Kestrel (*Falco sparverius*)
Sharp-tailed Grouse (*Pedioecetes phasianellus jamesi*)
Sage Grouse (*Centrocerus urophasianus*)
Ring-necked Pheasant (*Phasianus colchicus*)
Gray Partridge (*Perdix perdix*)
Turkey (*Meleagris gallopavo merriami*)
American Coot (*Fulica americana*)
Killdeer (*Charadrius vociferus*)
Common Snipe (*Capella gallinago*)
Upland Sandpiper (*Bartramia longicauda*)
Spotted Sandpiper (*Actitis macularia*)
Willet (*Catoptrophorus semipalmatus*)
Lesser Yellowlegs (*Tringa flavipes*)
Rock Dove (*Columba livia*)
Mourning Dove (*Zenaida macroura*)
Black-billed Cuckoo (*Coccyzus erythropthalmus*)
Screech Owl (*Otus asio*)

TABLE 14. continued.

Great Horned Owl (*Bubo virginianus*)
Long-eared Owl (*Asio otus*)
Poor-will (*Phalaenoptilus nuttallii*)
Common Nighthawk (*Chordeiles minor*)
Belted Kingfisher (*Megaceryle alcyon*)
Common Flicker (*Colaptes auratus*)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)
Hairy Woodpecker (*Picoides villosus*)
Downy Woodpecker (*Picoides pubescens*)
Eastern Kingbird (*Tyrannus tyrannus*)
Western Kingbird (*Tyrannus verticalis*)
Say's Phoebe (*Sayornis saya*)
Western Wood Pewee (*Contopus sordidulus*)
Horned Lark (*Eremophila alpestris*)
Tree Swallow (*Iridoprocne bicolor*)
Barn Swallow (*Hirundo rustica*)
Cliff Swallow (*Petrochelidon pyrrhonota*)
Black-billed Magpie (*Pica pica*)
Common Crow (*Corvus brachyrhynchos*)
Pinon Jay (*Gymnorhinus cyanocephalus*)
Black-capped Chickadee (*Parus atricapillus*)
White-breasted Nuthatch (*Sitta carolinensis*)
Red-breasted Nuthatch (*Sitta canadensis*)
House Wren (*Troglodytes aedon*)
Rock Wren (*Salpinctes obsoletus*)
Gray Catbird (*Dumetella carolinensis*)
Brown Thrasher (*Toxostoma rufum*)
American Robin (*Turdus migratorius*)
Swainson's Thrush (*Catharus ustulatus*)
Mountain Bluebird (*Sialia currucoides*)
Loggerhead Shrike (*Lanius ludovicianus*)
Starling (*Sturnus vulgaris*)
Solitary Vireo (*Vireo solitarius*)
Yellow Warbler (*Dendroica petechia*)
Yellow-rumped Warbler (*Dendroica coronata*)
Common Yellowthroat (*Geothlypis trichas*)
Yellow-breasted Chat (*Icteria virens*)
Wilson's Warbler (*Wilsonia pusilla*)
American Redstart (*Setophaga ruticilla*)
House Sparrow (*Passer domesticus*)

TABLE 14. continued.

Western Meadowlark (*Sturnella neglecta*)
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)
Red-winged Blackbird (*Agelaius phoeniceus*)
Northern Oriole (*Icterus galbula*)
Brewer's Blackbird (*Euphagus cyanocephalus*)
Brown-headed Cowbird (*Molothrus ater*)
Western Tananger (*Piranga ludoviciana*)
Black-headed Grosbeak (*Pheucticus melanocephalus*)
Indigo Bunting (*Passerina cyanea*)
Lazuli Bunting (*Passerina amoena*)
Evening Grosbeak (*Hesperiphona vespertina*)
Pine Siskin (*Carduelis pinus*)
American Goldfinch (*Carduelis tristis*)
Red Crossbill (*Loxia curvirostra*)
Rufous-sided Towhee (*Pipilo erythrophthalmus*)
Lark Bunting (*Calamospiza melanocorys*)
Savannah Sparrow (*Passerculus sandwichensis*)
Vesper Sparrow (*Pooecetes gramineus*)
Lark Sparrow (*Chondestes grammacus*)
Dark-eyed Junco (*Junco hyemalis*)
Chipping Sparrow (*Spizella passerina*)
Clay-colored Sparrow (*Spizella pallida*)
Brewer's Sparrow (*Spizella breweri*)

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