Interspersion of cover types as related to pheasant use on a game management area in south-central Montana
by Richard Mario DeSimone

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
Pheasant use of different cover types relative to the interspersion of these types was studied during the summer and fall of 1974 and the spring of 1975 on a 1,352-acre area including the southern portion of the Isaac Homestead Game Management Area. The total spring population was estimated by using the sex ratio that indicated the highest proportion of hens for a two-week period (1:3.9) and the number of established crowing cocks on the area (29). A vegetational map of the study area was constructed under conditions existing during the spring of 1975. Croplands were categorized into six cultivated cover types and the rest of the study area was grouped into nine uncultivated cover types. Pheasant observations were designated as either feeding, crowing, or loafing and included 703 sightings. Ninety-three percent of the feeding observations occurred on cultivated cover types with positive selection indicated for barley and corn. Ninety percent of the crowing and loafing observations were recorded on uncultivated cover types, with those types of increasing vegetational diversity being used more than would be expected. Pheasants were more specific in their use of individual cultivated cover types for food than in their use of uncultivated cover types for cover. It appeared that the close association of any of the described uncultivated cover types, except possibly the grassland type, to a barley or corn field containing an available food source was sufficient enough to support pheasants.

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by

RICHARD MARIO DeSIMONE

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

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Approved:

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ABSTRACT

Pheasant use of different cover types relative to the interspersion of these types was studied during the summer and fall of 1974 and the spring of 1975 on a 1,352-acre area including the southern portion of the Isaac Homestead Game Management Area. The total spring population was estimated by using the sex ratio that indicated the highest proportion of hens for a two-week period (1:3.9) and the number of established crowing cocks on the area (29). A vegetational map of the study area was constructed under conditions existing during the spring of 1975. Croplands were categorized into six cultivated cover types and the rest of the study area was grouped into nine uncultivated cover types. Pheasant observations were designated as either feeding, crowing, or loafing and included 703 sightings. Ninety-three percent of the feeding observations occurred on cultivated cover types with positive selection indicated for barley and corn. Ninety percent of the crowing and loafing observations were recorded on uncultivated cover types, with those types of increasing vegetational diversity being used more than would be expected. Pheasants were more specific in their use of individual cultivated cover types for food than in their use of uncultivated cover types for cover. It appeared that the close association of any of the described uncultivated cover types, except possibly the grassland type, to a barley or corn field containing an available food source was sufficient enough to support pheasants.

INTRODUCTION

The ring-necked pheasant *(Phasianus colchicus)* in the United States is primarily associated with fertile agricultural land (MacMullan, 1961). In western states, pheasant ranges are confined largely to irrigated land and stream courses (Yeager et al. 1951). According to Leopold (1933), composition and interspersion of environmental types are the principle determinants of potential abundance of game. He concluded that the maximum population of game on a given piece of land depends upon the interspersion of these types in relation to the cruising radius of the species.

The primary objective of this study was to determine pheasant use of the various cover types relative to the interspersion of these types. In addition, the pheasant populations were determined as a baseline for evaluating the effects of future habitat modifications. This study was conducted on an area of approximately two square miles, located in south-central Montana, six miles northwest of Hysham. This region along the Yellowstone River has been intensively farmed for many years. Full time field studies were conducted from June to December, 1974, and from March through June, 1975.

STUDY AREA

The study area, consisting of 1,352 acres, is bordered on the east and south by the Yellowstone River and on the north by steeply dissected terrain (Fig. 1). The rest of the study area is adjacent to pastures and irrigated hayland. About one-half of the study area consisted of the southern portion of the Isaac Homestead Game Management Area. This area has been administered by the Montana Department of Fish and Game for six years, primarily for restoring habitat through natural recovery of native vegetation and manipulation of farming techniques. The remaining one-half of the study area consisted of land where agricultural practices typified farming for that portion of the state.

The area is level to gently rolling and lies at an altitude of approximately 2,645 feet above sea level. Moshier and Fielder (1967) described the area as having alluvial soils of high productivity which were deposited by the Yellowstone River. These soils fall into the Havre-Lohmiller-Glendive association and are characterized by deep, light colored loams, clay loams, and sandy loams. The region has a continental climate with chinook winds and a favorable distribution of precipitation during the growing season. Summers are hot and dry and winters are moderately cold and dry. Climatological data from Hysham (U. S. Department of Commerce) show an average annual precipitation of 13.31 inches. Spring precipitation during 1975 was 4.22 inches above

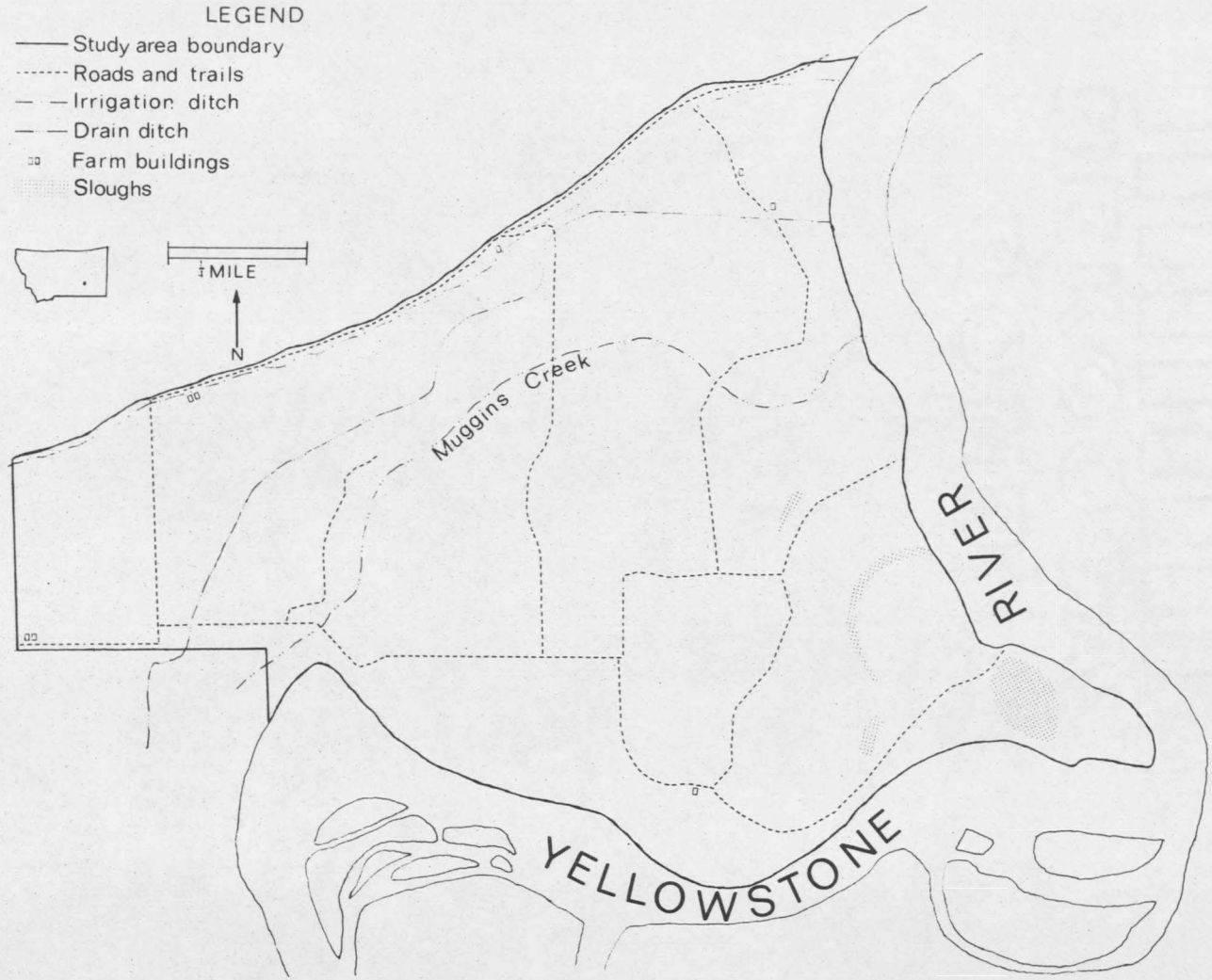

Figure 1. Map of study area showing location of roads and water system.

the normal of 4.39. Average temperature during this spring period was 4.1 degrees below the normal of 45.5 degrees F.

Irrigated cropland on the study area consisted of barley *(Hordeum* spp.), corn *(Zea mays)*, sugar beets *(Beta vulgaris)*, and hayfields, primarily of alfalfa *(Medicago sativa)*, or a mixture of alfalfa, smooth brome *(Bromus inermis)* and orchardgrass *(Dactylis glomerata)* (Fig. 2). Cottonwood *(Populus* spp.) dominated the overstory of the forested areas, with Siberian elm *(Ulmus pumila)* present in old shelter belts. Woods' rose *(Rosa woodsii)* and snowberry *(Symphoricarpos* spp.) were the most abundant shrub species, while Russian olive *(Elaeagnus angustifolia)*, buffalo-berry *(Shepherdia argentea)*, and willows *(Salix* spp.) were also common. Stream bottoms, sloughs, major irrigation ditches, and river banks contained willow, chokecherry *(Prunus virginiana)*, golden currant *(Ribes aureum)*, and buffalo-berry. Major grasses present on the area were Kentucky bluegrass *(Poa pratensis)*, quackgrass *(Agropyron repens)*, smooth brome, and cheatgrass brome *(Bromus tectorum)*. Major forbs included kochia *(Kochia scoparia)*, lamb's quarter *(Chenopodium album)*, Canada thistle *(Cirsium arvense)*, sweetclover *(Melilotus* spp.), and curlcup gumweed *(Grindelia squarrosa)*. Species present on dry and alkaline sites included silver sagebrush *(Artemisia cana)*, greasewood *(Sarcobatus vermiculatus)*, cheatgrass brome, Japanese brome *(Bromus japonicus)*, and dropseeds *(Sporobolus* spp.).

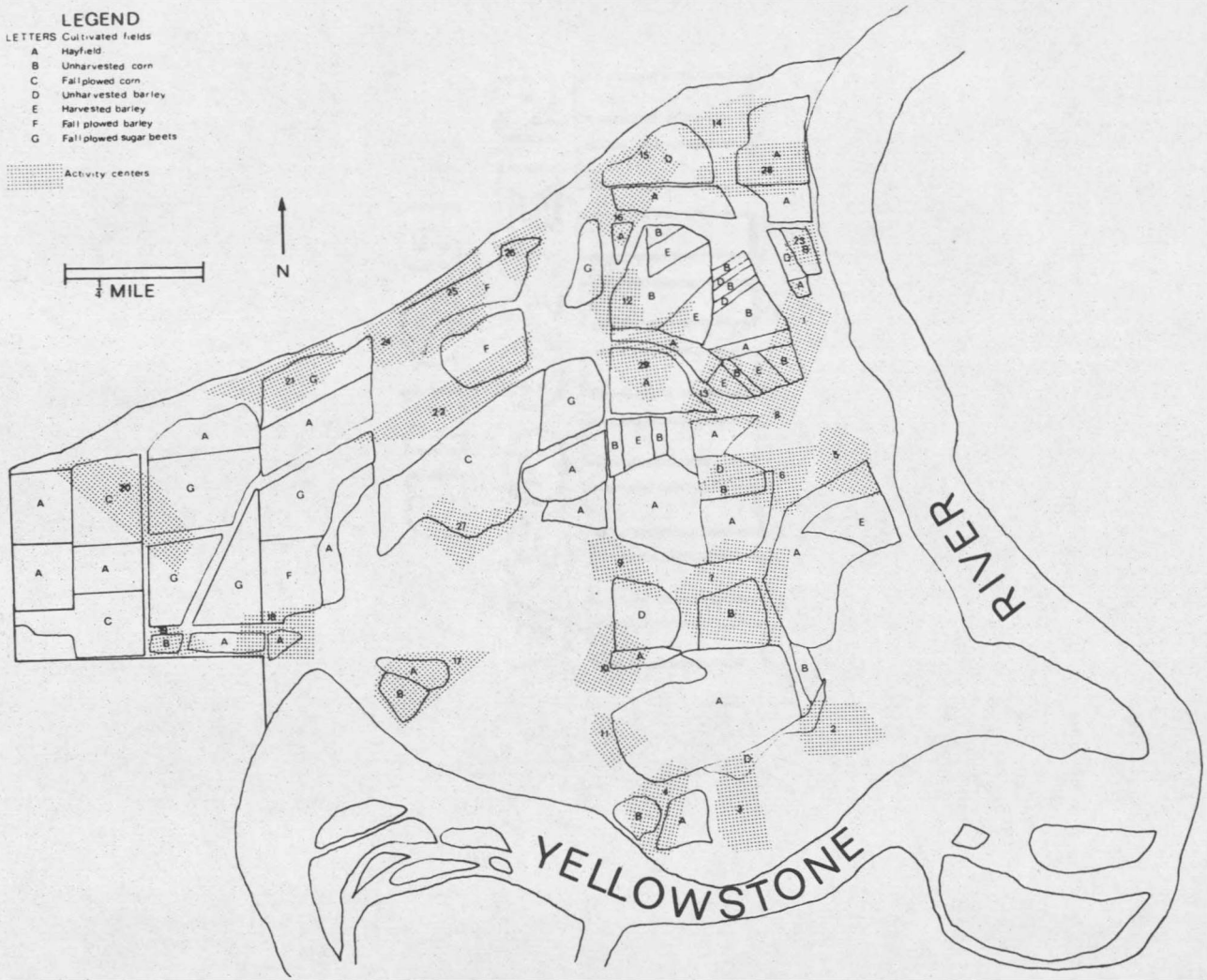

Figure 2. Map of study area showing location of cultivated fields and activity centers.

METHODS

A map of the vegetation on the study area during the spring of 1975 was constructed from aerial photos, ground measurements, and ocular estimates. A cover unit was a homogeneous area which was separable from the surrounding areas of different vegetational types, vegetational composition, and farming practices. The size of cover units was determined by using a fine grid. Units were categorized into cover types based on: (1) species composition, (2) tree density, (3) shrub, grass and forb heights, and (4) percent canopy cover of shrubs. Vegetational height categories were measured within one-foot increments, and percent canopy cover was visually estimated as occurring in one of the following classes: under 5 percent, 5 to 10 percent, 10 to 25 percent, 25 to 50 percent, and over 50 percent. Croplands were grouped based on the type of crop and the condition of the field (unharvested, harvested, fall plowed). Plant nomenclature followed Booth (1950), Booth and Wright (1959), and Booth (1972).

Roadside crowing counts were conducted from March 18 to June 7 using modifications of the procedure described by Kimball (1949). Crowing counts were not conducted when wind velocity exceeded five miles per hour, when snow was on the ground, or on rainy or snowy days. Crowing counts were started forty minutes before and concluded about thirty minutes after sunrise. Twenty-four stops were established on the study area, but only twelve could be covered during each morning,

so route coverage was alternated. An attempt was made to record the number and general location of all crowing cocks on the study area. At each stop, arrows were drawn on a map to indicate the direction and approximate distance of crowing cocks. Directional arrows from several stops gave an indication of location and number of crowing cocks present. Crowing cock observations were recorded as such only when cocks were seen crowing or when crowing was followed by a wing flap indicating close proximity. In addition, visual observations of pheasants were made while driving and walking along routes to assess the use of different cover types. All pheasant observations were classified as either crowing, feeding, or loafing. Censuses made while driving were conducted on most mornings, and extended two hours beyond the time acceptable for a crowing count. Evening driving began about three hours before sunset and continued until dark. Walking routes were conducted during the day. A dog was used to locate and flush pheasants from dense cover while covering driving and walking routes. The date, time, number, sex, activity, and exact location of each observation was recorded. Areas were checked with the aid of binoculars (7x50) and a spotting scope (15x60 variable).

Areas in which pheasants were repeatedly observed crowing, feeding, and loafing, were designated activity centers. The size of each activity center was determined by connecting the outermost observation

points on a map and measuring the encompassed area with a fine grid. This same technique provided acreages and the percent of each cover type occurring within each activity center.

RESULTS

Vegetation

Acreages and percentages of each cover type occurring on the entire study area and within the cultivated and uncultivated portions during the spring of 1975 are presented in Table 1. Vegetational characteristics of the uncultivated cover types based on measurements made from mid-April until mid-May, 1975 are shown in Table 2. In each type, species of plants are listed in order of their relative abundance.

Cultivated Cover Types

Hayfields—Smooth brome, orchardgrass, and alfalfa, or alfalfa alone dominated the hayfields. Also present were red clover *(Trifolium pratensis)*, white clover *(Trifolium repens)*, common dandelion *(Taraxacum officinale)*, meadow fescue *(Festuca pratensis)*, and green bristlegrass *(Setaria viridis)*. Hayfields were grazed during late fall or winter, resulting in vegetational heights generally under six inches during spring.

Unharvested Corn—These fields contained an abundance of weeds (unwanted plants), including green bristlegrass, kochia, lamb's quarter, dock *(Rumex* spp.), Canada thistle, lettuce *(Lactuca serriola)*, false ragweed *(Iva xanthifolia)*, and common barnyardgrass *(Echinochloa crusgalli)*. These fields were utilized by cattle during the winter

TABLE 1. ACREAGES AND PERCENTAGE OCCURRENCE OF EACH COVER TYPE ON CULTIVATED AND UNCULTIVATED PORTIONS OF THE STUDY AREA DURING SPRING, 1975.

Cultivated Cover Types	Total Acres	Percent of Study Area	Percent of Cultivated Portion
Hayfields	288.9	21.4	43.6
Unharvested Corn	78.8	5.7	11.9
Fall Plowed Corn	75.3	5.6	11.4
Unharvested Barley	52.0	3.9	7.8
Harvested Barley	23.9	1.7	3.6
Fall Plowed Barley	39.8	3.0	6.0
Fall Plowed Sugar Beets	104.3	7.7	15.7
	663.0	49.0	100.0

Uncultivated Cover Types	Total Acres	Percent of Study Area	Percent of Uncultivated Portion
Grassland	32.4	2.3	4.7
Savanna	157.2	11.6	22.8
Groveland	177.2	13.1	25.7
Forest	62.8	4.6	9.1
Shrub	41.2	3.1	6.0
Forest-Shrub	53.6	4.0	7.8
Shrub-Woodland	68.4	5.0	9.9
Woodland-Shrub	54.0	4.0	7.8
Woodland	42.4	3.3	6.2
	689.2	51.0	100.0
Total	1,352.2	100.0	

TABLE 2. VEGETATIONAL CHARACTERISTICS OF UNCULTIVATED COVER TYPES DURING SPRING, 1975.

Cover Type	Percent Canopy of Shrubs	Trees per[1] acre	Percent of Shrub Canopy: Short[2] Shrubs	Tall[3] Shrubs	Height Short[4] Shrubs	Height Tall[4] Shrubs	Height of Grass[4] and Forbs
Grassland	<5	0	100	0	2-4	-	½-1
Savanna	5-10	< 1	100	0	2-4	-	1-2
Groveland	10-25	< 2	75-100	0-25	4-6	6-15	1-3
Forest	10-25	>20	75-100	0-25	4-6	6-10	1-3
Shrub	25-50	0	100	0	2-4	-	1-2
Forest-Shrub	25-50	10-20	50-75	25-50	4-6	10-15	2-4
Shrub-Woodland	25-50	2-10	25-50	50-75	4-6	10-15	2-4
Woodland-Shrub	>50	2-5	25-50	50-75	4-6	15-20	2-4
Woodland	>50	< 2	0-25	75-100	4-6	15-20	2-4

[1]Trees are classified as woody plants over 25 feet in height.
[2]Short shrubs are classified as woody plants 2-6 feet in height.
[3]Tall shrubs are classified as woody plants 6-20 feet in height.
[4]Height in feet.

resulting in trampling of corn stalks. Vegetational height was usually less than three feet.

Fall Plowed Corn--This type consisted of corn fields which were cut for silage during the fall of 1974 and plowed. This practice left no vegetation on this type the following spring.

Unharvested Barley--This type consisted of fields which were planted in late spring in 1974 and grazed during the winter. Herbicides were not used and most of the barley plants were stunted and overtaken by weeds. Present were kochia, lamb's quarter, green bristlegrass, Canada thistle, wild oat *(Avena fatua)*, dock, western ragweed *(Ambrosia psilostachya)*, and tall ragweed *(Ambrosia trifida)*. Vegetation height was generally under three feet.

Harvested Barley--This type consisted of barley fields harvested during the fall, not fall plowed, but grazed during the winter. This practice resulted in a sparse stubble under six inches in height during the spring.

Fall Plowed Barley--This type consisted of harvested barley which was fall plowed. This practice left no vegetation on this type the following spring.

Fall Plowed Sugar Beets--Fields of this type were harvested for beets during the fall. The beet tops were grazed and the field fall plowed, leaving no vegetation on this type the following spring.

Uncultivated Cover Types

Grassland--Areas of this type were characterized by poor quality soils which were sandy and sometimes alkaline (Fig. 3). These areas were periodically burned and grazed when cattle used adjacent harvested fields during the fall. Cheatgrass brome and Japanese brome were the dominant grasses. Also present were Kentucky bluegrass, foxtail barley *(Hordeum jubatum)*, sand dropseed *(Sporobolus cryptandrus)*, alkali sacation *(Sporobolus airoides)*, large dropseed *(Sporobolus asper)*, needle-and-thread *(Stipa comata)*, prairie sand reedgrass *(Calamovilfa longifolia)*, and kochia. Shrubs, consisting of silver sagebrush and snowberry, had been partially burned and were in poor condition.

Savanna--Most of this type was used for summer pasture, although portions were also grazed during the winter (Fig. 4). Cottonwood trees were scattered (Table 2) and shrubs occurred in patches. Snowberry was the most common shrub. Kentucky bluegrass, western wheatgrass *(Agropyron smithii)*, and cheatgrass brome were the dominant grasses. Also present were quackgrass, smooth brome, Japanese brome, crested wheatgrass *(Agropyron cristatum)*, sweetclover, sand dropseed, Canada thistle, and curlcup gumweed.

Groveland--This type included most of the field edges, roadsides, and areas associated with farm buildings (Fig. 5). Some parts were burned during the late fall while others were used for winter grazing. Scattered cottonwood trees were present. Short shrubs included Woods'

Figure 3. Grassland cover type.

Figure 4. Savanna cover type.

Figure 5. Groveland cover type.

Figure 6. Forest cover type.

rose and snowberry while tall shrubs included Russian olive and buffaloberry. The understory was variable, but cheatgrass brome, Japanese brome, Kentucky bluegrass, curlcup gumweed, western ragweed, timothy *(Phleum pratense)*, lamb's quarter, kochia, fringed sagewort *(Artemisia frigida)*, tumblemustard *(Sisymbrium altissimum)*, and smallpod tumblemustard *(Sisymbrium loeselii)* were common.

Forest--This type included the dense cottonwood forests adjacent to the Yellowstone River which were extensively flooded during the late spring of 1974 (Fig. 6). It also included old shelter belts of Siberian elm. This type was not burned and received little grazing pressure. Shrubs included snowberry, Woods' rose, and Russian olive. The understory was dominated by sedge *(Carex* spp.), but also present were quackgrass, Canada thistle, Canada wildrye *(Elymus canadensis)*, creeping wildrye *(Elymus triticoides)*, blue wildrye *(Elymus glaucus)*, horsetail *(Equisetum* spp.), prairie cordgrass *(Spartina pectinata)*, and reed canarygrass *(Phalaris arundinacea)*.

Shrub--This type typically occurred on poor quality, often sandy or alkaline soils (Fig. 7). Most of these areas were grazed during the winter and portions were burned during the spring. Greasewood and silver sagebrush were the dominant shrubs. The understory included cheatgrass brome, Japanese brome, Kentucky bluegrass, dropseeds, shadscale saltbrush *(Atriplex confertifolia)*, spear saltbrush *(Atriplex patula)*, needle-and-thread, and bluebunch wheatgrass *(Agropyron spicatum)*.

Figure 7. Shrub cover type.

Figure 8. Forest-Shrub cover type.

Forest-Shrub--This type was characterized by cottonwood forests which were partially flooded during the spring of 1974 (Fig. 8). No burning and little grazing occurred on this type. Short shrubs were snowberry and Woods' rose while tall shrubs included buffalo-berry, Russian olive, and Tamarix *(Tamarix gallica)*. The understory included sedge, Kentucky bluegrass, smooth brome, Canada wildrye, wild grape *(Vitis riparia)*, climbing nightshade *(Solanum dulcamara)*, goldenrods *(Solidago* spp.), and poison ivy *(Rhus radicans)*.

Shrub-Woodland--No burning and little grazing occurred on this type (Fig. 9). Woods' rose, snowberry, buffalo-berry, Russian olive, and willows were the primary shrubs. Cottonwoods and an occasional green ash *(Fraxinus pennsylvanica)* constituted the tree species present. The understory included Kentucky bluegrass, smooth brome, kochia, sweetclovers, prairie sand reedgrass, Canada wildrye, blue wildrye, Canada thistle, quackgrass, alfalfa, and asparagus *(Asparagus officinalis)*.

Woodland-Shrub--This type characteristically occurred on poorly drained soils (Fig. 10). No burning and little grazing occurred. Tall shrubs consisting of willows, chokecherry, Russian olive, and buffalo-berry, dominated this type. Short shrubs included Woods' rose and snowberry. Cottonwood trees were scattered or clustered. Also present were sedge, prairie cordgrass, smooth brome, Canada thistle, Canada wildrye, horsetail, and tall ragweed.

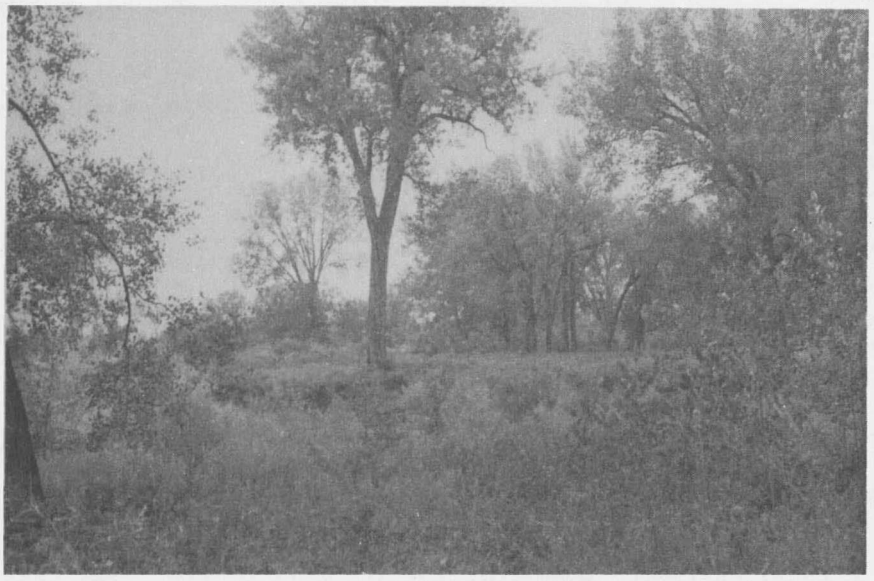

Figure 9. Shrub-Woodland cover type.

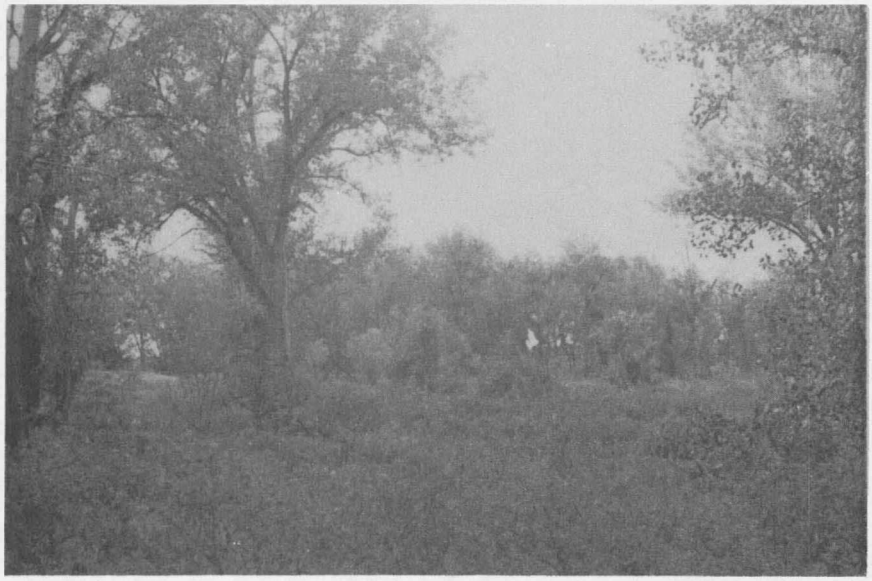

Figure 10. Woodland-Shrub cover type.

Woodland--This type was found along stream bottoms, sloughs, riverbanks, and major irrigation ditches where no burning and little grazing occurred (Fig. 11). Tall shrubs, primarily willow, dominated this type. Also present were golden currant, chokecherry, buffalo-berry, wild plum *(Prunus americana)*, red dogwood *(Cornus stolonifera)*, snowberry, and Woods' rose. A few cottonwood trees were present. The understory included smooth brome, sedge, colored smartweed *(Polygonum coccineum)*, cattails *(Typha latifolia)*, prairie cordgrass, horsetail, tall ragweed, and Canada wildrye.

The Pheasant Population

Establishing a population estimate for the study area under the existing vegetational conditions is a useful tool in evaluation of population changes which may occur as a result of future habitat modifications.

The crowing count has been employed to establish an index to the annual abundance of cocks. Pheasant crowing on the study area (Fig. 12) reached a peak between April 28 and May 11 when an average of 14.6 crows were heard per two-minute period. The highest average number of crows per two-minute period was 16.2 and was heard on May 2. Crowing counts conducted on the study area during 1973 and 1974 by Eustace (unpublished data) indicated the peak of crowing occurred during this same time. This consistency within the three years, even

Figure 11. Woodland cover type.

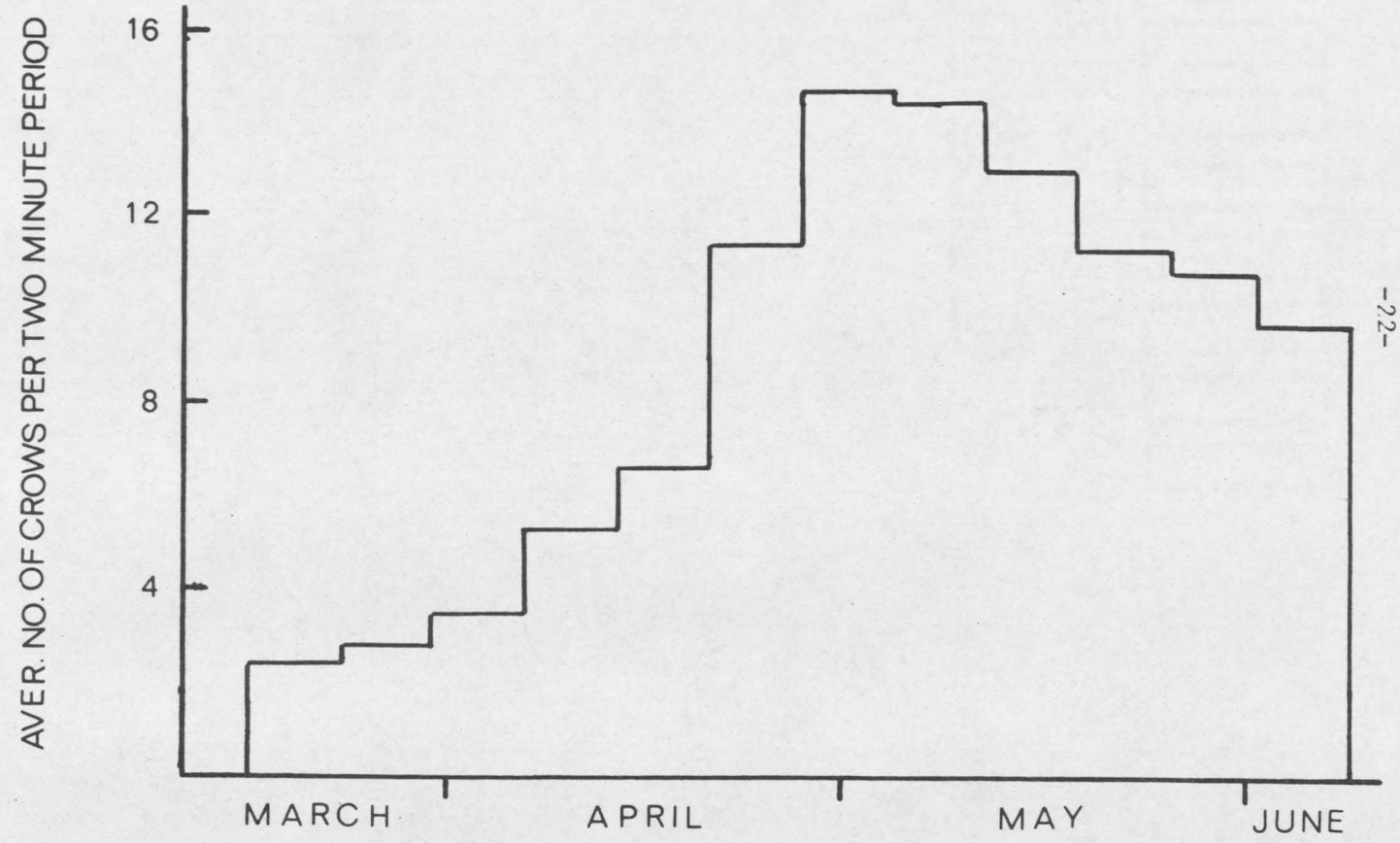

Figure 12. Pheasant crowing count census during spring 1975.

though the spring of 1975 was unusually wet and cool, confirms Gates (1966) findings that the major influence of spring weather was in delaying or advancing the start of crowing, but not in displacing the peak.

Results of repeated triangulations and observations, indicated that 29 crowing cocks were established on the study area during the spring of 1975. The density of crowing cocks within the study area boundaries was computed to be one cock per 46.6 acres or 13.8 crowing cocks per square mile.

Crowing cock numbers, together with spring sex ratios permitted an estimate of the total spring population. Sex ratios calculated from all field observations (Table 3) showed consistently smaller proportions of hens than those calculated from observations of harem groups. This may be explained by the differences in the behavior and subsequent observability of cock as compared to hen pheasants during this time of the year (Taber 1949, Shick 1952, Robertson 1958). The highest representation of hens was recorded between March 30 and April 12 and steadily declined thereafter. This steady decline in the sex ratio after early April was also noted by Weston (1954) and Stokes (1954). Stokes concluded that the decline was a result of the onset of egg laying and incubation causing fewer hens to appear in the open where they could be counted.

TABLE 3. SEX RATIOS OF PHEASANTS DURING THE SPRING OF 1975 CALCULATED FROM ALL FIELD OBSERVATIONS AND FROM OBSERVATIONS OF HAREM GROUPS ONLY.

Period	Number of Observations	Number of Males Seen	Number of Females Seen	Sex Ratio Male:Female
All Observations				
3-16 to 3-29	40	38	11	1:0.29
3-30 to 4-12	23	22	45	1:2.05
4-13 to 4-26	104	94	116	1:1.23
4-27 to 5-10	96	89	60	1:0.67
5-11 to 5-24	76	76	29	1:0.38
5-25 to 6-7	104	99	24	1:0.24
Totals	443	418	285	1:0.68
Harem Observations[1]				
3-16 to 3-29	3	3	8	1:2.67
3-30 to 4-12	10	10	39	1:3.90
4-13 to 4-26	25	25	90	1:3.60
4-27 to 5-10	26	26	51	1:1.96
5-11 to 5-24	17	18	25	1:1.39
5-25 to 6-7	16	16	18	1:1.13
Totals	97	98	231	1:2.36

[1]Includes only hens observed in association with cocks.

Due to the problems of observing hen pheasants, it was concluded that the highest sex ratio recorded, one male to 3.9 females, was a minimum estimate of the true sex ratio existing on the study area during this spring. This sex ratio coupled with 29 crowing cocks on the study area suggests a minimum spring population of 142 pheasants.

Pheasant Use of Cover Types

Numbers of pheasants observed in cover types by activity are presented in Table 4. In addition, the numbers of pheasants one might expect to observe were computed based on the proportional availability of each cover type (Table 1).

Crowing Observations

Observations of crowing cocks were made during the crowing count routes and during early morning driving routes. One hundred and twenty-nine cock pheasants were observed crowing with 81 percent of these occurring on the uncultivated cover types. Hayfields, which made up over 21 percent of the study area, included less than 2 percent of the crowing observations. Over 64 percent of all the crowing observations occurred on the Groveland, Shrub-Woodland, Woodland-Shrub, and Woodland uncultivated cover types, which comprised 25.4 percent of the whole study area. This suggested that crowing cocks were positively associated with areas of more complex layers or increasing vegetational diversity (Table 2).

TABLE 4. NUMBERS OF PHEASANTS OBSERVED USING VARIOUS COVER TYPES FOR CROWING, FEEDING, AND LOAFING AS COMPARED WITH EXPECTED.

Cover Type	Crowing Observed	Crowing Expected[1]	Feeding Observed	Feeding Expected[2]	Loafing Observed	Loafing Expected[3]
Cultivated Portion						
Hayfields	3	34	102	160	3	-
Unharvested Corn	8	9	83	44	0	-
Fall Plowed Corn	5	9	4	42	0	-
Unharvested Barley	3	6	69	28	0	-
Harvested Barley	2	3	21	13	0	-
Fall Plowed Barley	3	5	69	22	0	-
Fall Plowed Sugar Beets	6	12	18	57	0	-
Subtotal	30	78	366	366	3	
Uncultivated Portion						
Grassland	3	4	0	-	0	7
Savanna	6	19	21	-	19	34
Groveland	38	21	1	-	52	39
Forest	5	7	0	-	8	14
Shrub	5	5	2	-	12	9
Forest-Shrub	8	6	0	-	8	12
Shrub-Woodland	30	8	0	-	20	15
Woodland-Shrub	20	6	0	-	24	12
Woodland	14	5	0	-	8	9
Subtotal	129	81	24		151	151
Total	159	159	390		154	

[1]Calculated by multiplying the percentage of the cover types on the study area by the total number of crowing observations.
[2]Calculated by multiplying the percentage of the cover types on the cultivated portion by the total number of observations on the cultivated portion.
[3]Calculated by multiplying the percentage of the cover types on the uncultivated portion by the total number of observations on the uncultivated portion.

Feeding Observations

Literature concerning food habits of adult pheasants generally shows that agricultural crops were the major food items throughout the year (Dalke 1937, Hiatt 1947, Stollberg and Hine 1952, Trautman 1952, Korschgen 1964, and Kopischke and Harris 1969). During this study over 93 percent of the 390 feeding observations were recorded in cultivated cover types. Because pheasants are not as readily observable in uncultivated types, expected values for feeding observations (Table 4) are computed on the basis of observations occurring only on the cultivated portion of the study area. Among the cultivated cover types, positive selection is indicated for unharvested corn and barley fields, where more than twice the feeding observations occurred than would be expected.

Loafing Observations

Loafing observations were recorded while systematically walking and driving the study area during the day. Of the 154 observations, only 3 were recorded in the cultivated cover types. No definite preference is indicated for loafing sites, within uncultivated types, although there appears to be a positive selection for areas of increasing vegetational diversity.

Activity Centers

During the breeding season, it is generally agreed that individual cock pheasants associate themselves with groups of hens (harems), and are found in the same general location throughout the spring (Leedy and Hicks 1945, Wight 1945, Baskett 1947, Taber 1949, and Robertson 1958). Several differences of opinion have been expressed concerning territoriality in male pheasants. In areas characterized by considerable amounts of cultivated land and small amounts of established cover, the territorial boundaries appear to be quite plastic (Baskett 1947, Taber 1949, and Robertson 1958). This may be a result of pheasant response to a changing habitat caused by farming activities. In other areas where cultivation was less intense and the habitat more stable, the territory appears to be sharply bounded (Randall 1940, Wight 1945, and Sharp and McClure 1945).

During the present study, areas habitually used by groups of pheasants early in the spring appeared to remain in use at the close of the study. This may have been a result of the unfavorable spring weather which caused farm work to be delayed and this area being characterized by a moderate amount of established cover, which provided stability in the habitat.

Areas habitually used by individual crowing cocks in association with groups of hens were designated as activity centers (Fig. 2). These centers formed the nucleus of the breeding season activities.

The number of pheasants observed crowing, feeding, and loafing on each activity center is given in Table 5. The percentages of the different cover types present in each activity center are presented in Table 6, the size, number of cover types and miles of edge of each are given in Table 7.

Activity center number 21 (Table 7), was not included in the computing of the average number of cover types and miles of edge for the activity centers. A silage pit, where cattle were fed during the spring, was located near this activity center creating an artificial food source for the pheasants.

The activity centers ranged in size from 4.5 to 30.0 acres, averaging 12.4. The number of cover types found on each activity center ranged from 3 to 7 averaging 4.89, and the miles of edge ranged from 0.195 to 0.850 averaging 0.451. The activity centers composed 24.6 percent of the study area, while 32.2 percent of the total miles of edge on the study area was present within them. The activity centers also included over 51 percent of the unharvested corn, over 44 percent of the unharvested barley, and over 48 percent of the fall plowed barley.

To compare the activity centers to the available habitat, a map of the study area was gridded into 119 twelve acre plots (based on the 12.4-acre average size of the activity centers). The number and kinds of cover types and the miles of edge on each 12 acre plot were noted.

TABLE 5. NUMBERS OF PHEASANTS OBSERVED DURING DIFFERENT ACTIVITIES ON THE ACTIVITY CENTERS DURING THE SPRING OF 1975.

Activity Center	Crowing	Feeding	Loafing	Total
1	6	10	4	20
2	6	7	6	19
3	8	7	8	23
4	5	11	0	16
5	4	7	7	18
6	9	7	1	17
7	8	15	2	25
8	9	6	0	15
9	8	6	6	20
10	4	8	13	25
11	3	5	15	23
12	7	29	7	43
13	8	24	11	43
14	4	15	4	23
15	3	26	13	42
16	5	8	3	16
17	3	11	7	21
18	6	9	2	17
19	5	24	0	29
20	5	6	2	13
21	4	15	1	20
22	9	5	2	16
23	5	9	0	14
24	3	28	7	38
25	4	29	8	41
26	3	7	5	15
27	7	7	4	18
28	4	28	12	44
29	4	21	4	29
Total	159	390	154	703

TABLE 6. PERCENTAGE OF COVER TYPES OCCURRING WITHIN EACH ACTIVITY CENTER.

Activity Center	Size in Acres	Percentage of Cover Types Composing Each Activity Center																
		Hayfields	Unharvested Corn	F.P. Corn	Unharvested Barley	Harvested Barley	F.P. Barley	F.P. Sugar Beets	Grassland	Savanna	Groveland	Forest	Shrub	Forest-Shrub	Shrub-Woodland	Woodland-Shrub	Woodland
1	11.2	.125	.357	-	-	.036	-	-	-	.018	.464	-	-	-	-	-	-
2	12.4	-	.016	-	.113	-	-	-	-	.016	.258	-	-	-	.420	.177	-
3	12.8	-	-	-	.141	-	-	-	-	-	-	.141	-	-	-	.718	-
4	13.8	.333	.261	-	-	-	-	-	-	.130	.102	.029	-	-	.145	-	-
5	11.7	.308	-	-	-	.014	-	-	-	-	.069	.027	-	.137	.445	-	-
6	16.8	.119	.190	-	.179	-	-	-	-	.167	.107	-	-	.143	.095	-	-
7	30.0	.227	.373	-	-	-	-	-	-	.107	.107	-	-	-	-	.186	-
8	9.6	.083	.125	-	-	.167	-	-	-	.167	-	-	-	-	-	-	.458
9	10.0	.030	-	-	.180	-	-	-	-	.110	.500	-	-	.180	-	-	-
10	11.2	.143	-	-	.161	-	-	-	-	.285	.411	-	-	-	-	-	-
11	6.4	.312	-	-	-	-	-	-	-	.219	.281	-	-	-	.188	-	-
12	9.2	.044	.587	-	-	-	-	.065	.022	-	.065	-	-	-	-	.217	-
13	13.4	.328	.105	-	-	.284	-	-	-	.015	-	-	-	-	.134	-	.134
14	10.4	.115	-	-	.154	-	-	-	-	.539	.192	-	-	-	-	-	-
15	8.8	-	-	-	.500	-	-	-	-	-	-	-	.386	-	-	.114	-
16	11.0	.309	-	-	.309	-	-	.018	-	.073	-	-	-	-	-	.291	-
17	16.0	.275	.275	-	-	-	-	-	-	-	.250	-	-	-	.200	-	-
18	11.8	.372	-	-	-	-	.068	.068	-	-	.186	.094	-	-	.094	-	.118
19	5.4	.134	.433	-	-	-	-	.060	-	.134	.090	-	-	.037	.112	-	-
20	18.9	.058	-	.529	-	-	-	.254	-	.032	-	-	.032	.095	-	-	-
21	13.6	-	-	-	-	-	-	.559	-	.206	.235	-	-	-	-	-	-
22	17.6	-	-	-	-	-	.318	.045	-	-	.273	-	.364	-	-	-	-
23	4.5	-	.531	-	.133	-	-	-	-	.159	-	-	-	.177	-	-	-
24	15.6	-	-	-	-	-	.359	.026	-	-	.154	-	.333	-	.128	-	-
25	8.6	-	-	-	-	-	.465	-	-	-	.279	-	-	-	.256	-	-
26	7.0	-	-	-	-	-	.457	-	.144	-	.343	-	.086	-	-	-	-
27	12.1	-	-	.397	-	-	-	-	-	.330	.182	.025	-	-	-	-	.066
28	15.2	.657	-	-	.092	-	-	-	-	.145	.053	.053	-	-	-	-	-
29	14.2	.620	.056	-	.141	-	-	-	-	-	-	-	-	-	.183	-	-

TABLE 7. SIZE, NUMBER OF COVER TYPES, AND MILES OF EDGE OF EACH PHEASANT ACTIVITY CENTER ON THE STUDY AREA.

Activity Center	Size in Acres	Number of Cover Types	Miles of Edge
1	11.2	5	0.385
2	12.4	6	0.415
3	12.8	3	0.195
4	13.8	6	0.730
5	11.7	6	0.335
6	16.8	7	0.665
7	30.0	5	0.850
8	9.6	5	0.415
9	10.0	5	0.325
10	11.2	4	0.445
11	6.4	4	0.335
12	9.2	6	0.405
13	13.4	6	0.610
14	10.4	4	0.260
15	8.8	3	0.310
16	11.0	5	0.375
17	16.0	4	0.655
18	11.8	7	0.660
19	5.4	7	0.355
20	18.9	6	0.600
21[1]	13.6		
22	17.6	4	0.445
23	4.5	4	0.195
24	15.6	5	0.595
25	8.6	3	0.345
26	7.0	4	0.360
27	12.1	4	0.450
28	15.2	5	0.375
29	14.2	4	0.530
Average[2]	12.4	4.89	0.451
Average for 12 acre plots	12.0	3.42	0.328

[1]Number of cover types and miles of edge not computed for this activity center (see text).

[2]Averages based on 28 activity centers, number 21 not included.

The average number of cover types and the miles of edge for the 12 acre plots is given in Table 7. Table 8 shows the percentage of all activity centers and the 12 acre plots having each of the cover types present on them.

Comparing the activity centers to the 12 acre plots, over 89 percent of the activity centers had more than three cover types and more than 0.30 miles of edge, while the 12 acre plots had only 45 and 53 percent respectively. Over 96 percent of the activity center included a barley or corn cover type, while these types were found in less than 60 percent of the 12 acre plots.

TABLE 8. PERCENT OF ALL ACTIVITY CENTERS AND ALL 12 ACRE PLOTS HAVING INDIVIDUAL COVER TYPES OCCURRING ON THEM.

Cover Type	Activity Centers	12 Acre Plots
Cultivated Portion		
Hayfields	67.9	51.1
Unharvested Corn	42.9	26.9
Fall Plowed Corn	7.1	9.2
Unharvested Barley	39.3	16.0
Harvested Barley	14.3	9.2
Fall Plowed Barley	17.9	11.8
Fall Plowed Sugar Beets	25.0	18.5
Uncultivated Portion		
Grassland	7.1	11.8
Savanna	60.7	44.5
Groveland	71.4	48.7
Forest	21.4	13.5
Shrub	17.9	13.5
Forest-Shrub	21.4	14.3
Shrub-Woodland	42.9	23.5
Woodland-Shrub	21.4	15.1
Woodland	14.3	9.2

DISCUSSION

The availability of food in close association with cover appeared to be the determining factor in the utilization of portions of the study area during the spring of 1975. The data presented in Table 4, shows that cultivated cover types were used primarily for feeding while the majority of pheasants were found in uncultivated cover types during other times of the day. There appeared to be greater selection for individual cultivated cover types for feeding than for individual uncultivated cover types for crowing and loafing.

The majority of feeding observations occurred on barley and corn fields. The importance of these two types as food items is also implied since virtually all such fields had activity centers associated with them. The few that did not, either lacked uncultivated cover types in juxtaposition or food during the spring. Each individual barley and corn field had its own set of circumstances prior to and after harvest that determined the amount of food material available during the spring and to what degree the field was utilized by pheasants. In harvested fields, weather during the growing season, the time of harvest, and the efficiency of the harvesting method determined the amount of food material available after harvest. The degree and type of plowing applied to the field after harvest determined how much of the food material was available in the spring. Unharvested corn fields had a

great deal of food material available during the spring. Observations of pheasants in these fields and indicated use (droppings, tracks, feathers, etc.) showed that only the periphery was used with the majority of the field not being utilized. It would appear that the lack of security and/or diversity in the center of these fields made much of the field unattractable to pheasants even though there was an abundant food supply.

The presence of food in a field did not insure use by pheasants unless this food supply was in close association with cover (uncultivated cover types). The occurrence of uncultivated cover types within the activity centers corresponds closely to their proportional availability over the whole study area (Table 8). Crowing and loafing observations were recorded in all uncultivated cover types (Table 4), except no loafing pheasants were observed in the Grassland type. This implies that the close association of any of the uncultivated cover types, except possibly the Grassland type, to an available food source is sufficient enough to support pheasants during this time of the year. Observational data (Table 4) tend to show that when the opportunity for selection occurs, areas of increased vegetational diversity are more attractive for loafing and crowing but these areas are not necessary.

The size and the number of cover types found in each activity center (Table 7), is largely a reflection of the amount of area needed by pheasants to fulfill their requirements for food and cover. As the size and the number of cover types increased the miles of edge found in that activity center correspondingly increased. Pheasants forced to range far between food and cover tended to have a large activity center and be associated with a greater number of intervening cover types. This was the case with activity center number seven, (Table 6), where pheasants utilized the periphery of an unharvested corn field. In other instances where a food source was localized close to cover, the activity center was small and the uncultivated cover types utilized tended to be small in number as in activity center number 23.

MANAGEMENT IMPLICATIONS

Information gathered during the nine months of this study indicated spring data were more useful in determining the abundance and distribution of pheasants than data collected during the summer and fall. Pheasants were most observable during the month of April, when courtship activity was at its height and the vegetational conditions such that pheasants were less likely to be obscured by vegetation. The sex ratio computed during April provides an indication of the cock harvest during the previous fall and when coupled with the number of crowing cocks permits a good estimate of the total pheasant population present at that time. The locations of crowing cocks and their associated hens permits determinations of what areas pheasants are using. An understanding of the food-cover relationships on these areas aids in directing future habitat modifications.

During the present study, pheasants were most attracted to areas where either barley or corn, as food, were available in close association with cover. Current agricultural practices involved with sugar beet farming results in these fields being foodless during the spring. Hayfields also do not have sufficient food to maintain a pheasant population, as implied during this study and indicated in literature concerning food habits of adult pheasants (Hiatt 1947, Korschgen 1964, and Kopischke and Harris 1969). Barley and corn fields left

unharvested is neither financially practical nor necessary to insure pheasant utilization. Information from this study showed that pheasants utilized only the periphery of these fields, probably because of security reasons. Barley and corn fields that are harvested and not fall plowed or not intensively plowed, situated close to cover should provide sufficient food for pheasants.

During this study large areas of either food or cover were not fully utilized. Pheasants generally do not go any farther into a cultivated field than necessary to fulfill their requirements for food. When considerable cover was adjacent to a food source, only the 25-50 foot strip of cover associated with the edge was used. During the study pheasants utilized all the uncultivated types as cover with those of increasing vegetational diversity being selected when available. This may not be true during winter when snow conditions may require the more dense and continuous uncultivated cover types to be available.

Pheasants probably would continue to use areas that were used in the spring as long as this food-cover relationship persisted. Pheasants changing their areas of use during the summer and fall is largely caused by differences in maturation and times of harvest of various crops (Hanson and Progulske 1973). A management plan that included the growing of several crops used by pheasants as food (barley, corn,

wheat, oats, alfalfa, soybeans, etc.) and insured that cover was available close to these crops year around, should enhance the survival of young and add to the overall carrying capacity of pheasants in that area.

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