The biology and ecology of Hungarian (European gray) partridge (Perdix perdix L.) in northcentral Montana

by John Paul Weigand

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

Abstract:
Population characteristics and seasonal ecological requirements of a Hungarian partridge population were determined on a 54 mi2 area in northeast Teton County, Montana during January, 1969-April 1974. A total of 2,873 observations and 17,736 partridge were recorded. (Cereal grains were major food items with green plant materials and forbs taken in high frequencies but low volumes. Dandelions were the major forb species eaten.) Partridge fed in early morning and late evening, the latter being most important. Pairs were the basic population unit; pairing began annually 7-18 February and was complete by 1 March. All observed, marked females and 81-83 percent of males paired. Surviving previous-year pairs remained paired and all adults tended to pair within coveys; 67 and 69 percent of subadult males and females, respectively, paired outside their winter coveys. The peak week of nesting was 13-19 May and 29 percent of all broods hatched during the peak week, 19-25 June. Mean brood sizes decreased 18 percent from time of hatching to observation in July, 21 percent July-August, and 7 percent August-September. @Positive correlations between mean brood sizes and numbers of adults accompanying broods was attributed to increased chick survival. Spring densities were significantly, positively correlated with percent females with young and inversely with mean brood size in August. Winter trapped birds averaged 17 percent adult males, 41 subadult males, 9 adult females and 33 subadult females. Observed winter sex ratios averaged 131 males per 100 females. Winter coveys were autonomous; only minor mixing of members occurred. Eighty-six percent of marked birds moved < 660 yd from winter trap-sites during their lifetime. Data suggested all adult males and subadult females returned to initial winter ranges in succeeding winters; 74 and 50 percent of subadult males and adult females returned, respectively. Subadult males were the most mobile segment and subadult females were the least. @Annual mortality was 73 percent with hunters taking 3 percent, 12 percent were victimized by accidents and the remainder were taken by predators. @Life expectancy was 1.8 yr for adults, 0.9 for subadult males and 0.8 for subadult females. Maximum longevity was 4 yr for adults and subadult males and 3 for subadult females. (Three habitat classes were identified with optimal seasonal areas including 34-52 percent grain, 20-26 fallow, 15-29 rangeland, 4-12 hayland, 4-5 agriculturally idle areas and 2 miscellaneous areas. Idle areas were critical components in all seasons; hayfields seemed least important.) Diversity of habitat used by partridge was greatest in winter and least in summer. Pair-habitat components changed continuously in March and April but were similar in May and June.

Brood habitats changed monthly, July-September, while adults-only habitat remained similar during this period. (Ninety-five percent of partridge were within 77 yd of three different land uses/sub-uses, 389 of a grain field, 983 of woody cover and 1,000 of a winter range.

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ABSTRACT

Population characteristics and seasonal ecological requirements of a Hungarian partridge population were determined on a 54 mi^2 area in northeast Teton County, Montana during January, 1969–April 1974. A total of 2,873 observations and 17,736 partridge were recorded. (Cereal grains were major food items with green plant materials and forbs taken in high frequencies but low volumes. Dandelions were the major forb species eaten.) Partridge fed in early morning and late evening, the latter being most important. Pairs were the basic population unit; pairing began annually 7-18 February and was complete by 1 March. All observed, marked females and 81-83 percent of males paired. Surviving previous-year pairs remained paired and all adults tended to pair within coveys; 67 and 69 percent of subadult males and females, respectively, paired outside their winter coveys. The peak week of nesting was 13-19 May and 29 percent of all broods hatched during the peak week, 19-25 June. Mean brood sizes decreased 18 percent from time of hatching to observation in July, 21 percent July-August, and 7 percent August-September. Positive correlations between mean brood sizes and numbers of adults accompanying broods was attributed to increased chick survival. Spring densities were significantly, positively correlated with percent females with young and inversely with mean brood size in August. Winter trapped birds averaged 17 percent adult males, 41 subadult males, 9 adult females and 33 subadult females. Observed winter sex ratios averaged 131 males per 100 females. Winter coveys were autonomous; only minor mixing of members occurred. Eighty-six percent of marked birds moved ≤ 660 yd from winter trap-sites during their lifetime. Data suggested all adult males and subadult females returned to initial winter ranges in succeeding winters; 74 and 50 percent of subadult males and adult females returned, respectively. Subadult males were the most mobile segment and subadult females were the least. Annual mortality was 73 percent with hunters taking 3 percent, 12 percent were victimized by accidents and the remainder were taken by predators. Life expectancy was 1.8 yr for adults, 0.9 for subadult males and 0.8 for subadult females. Maximum longevity was 4 yr for adults and subadult males and 3 for subadult females. (Three habitat classes were identified with optimal seasonal areas including 34-52 percent grain, 20-26 fallow, 15-29 rangeland, 4-12 hayland, 4-5 agriculturally idle areas and 2 miscellaneous areas. Idle areas were critical components in all seasons; hayfields seemed least important.) Diversity of habitat used by partridge was greatest in winter and least in summer. Pair-habitat components changed continuously in March and April but were similar in May and June. Brood habitats changed monthly, July-September, while adults-only habitat remained similar during this period. (Ninety-five percent of partridge were within 77 yd of three different land uses/sub-uses, 389 of a grain field, 983 of woody cover and 1,000 of a winter range.

INTRODUCTION

The Hungarian or European gray partridge *(Perdix perdix* L.*)* has been listed as one of three successful game bird introductions into the United States; attempts have been made with 35 species or subspecies (Bump 1970). All three successful species, Hungarian partridge, ring-necked pheasant *(Phasianus colchicus)* and chukar partridge *(Alectoris graeca)* are members of the family Phasianidae.

In Montana, Hungarian partridge presently inhabit all but the forested, mountainous habitats. They persist primarily in ring-necked pheasant and sharp-tailed grouse *(Pediocetes phasianellus)* range and overlap into sage grouse *(Centrocercus urophasianus)* and blue grouse *(Dendragapus obscurus)* summer habitats.

Intensive cultivation of extensive dryland areas and increased numbers of domestic livestock, primarily beef cattle, on irrigated crop and rangelands have resulted in a decrease in the quality and quantity of habitats requisite for pheasants (Weigand and Janson 1976) and sharptails (Brown 1966). To satisfy current and future demands for farmland game bird hunting in Montana, additional hunting pressure may be focused on the third farmland species, the Hungarian partridge. This species had not previously been intensively studied in Montana and only general interpretations could be extracted from extensive production and harvest chronology data which were available.

Recognition of the necessity for refined data needed to manage Hungarian partridge resulted in initiation of the present study in northcentral Montana in 1969. Purposes of this study were two-fold: to determine the population characteristics of Hungarian partridge on a study area basis; and, to determine the seasonal ecological requirements of partridge in relation to agricultural land uses and their attendant management practices.

The study area was selected in December, 1968 and preliminary trapping and marking of partridge occurred during January and February, 1969. Intensive field studies were conducted July, 1969 through September, 1972. Observations of partridge groups were continued during the summer, 1973 and winters of 1972-73 and 1973-74. Partridge were also trapped and marked during the winter of 1973-74.

METHODS

Population Analyses

Hungarian partridge, recorded along four observation routes, provided trend information on the study area's population (Fig. 1). Routes ranged in length from 12.3 to 19.5 mi (19.6 to 31.4 km) and were traversed by vehicle, traveling at 15-20 mph (24-32 kmph). Attempts were made to survey each route a minimum of three times per month or nine times each season; fewer surveys occasionally resulted in winter due to snow-drifting and closing of roads. Data from each route were combined into seasonal route indices and study area indices were derived by pooling route results for each season. Two indices, numbers of observations per mile and numbers of partridge per mile, were obtained each season; in summer, numbers of broods per mile were also determined. Seasons were designated as: spring, March-May; summer, June-August; fall, September-November; and winter, December-February.

Routes were regularly surveyed in early morning, starting 1/2-hr before sunrise each season except summer when surveys began at sunrise. Late morning, midday and evening (begun 1-hr before sunset) surveys were also conducted. Respective indices were compared statistically (x^2, P .10) between each of the applicable survey periods; nonsignificance permitted pooling of sample data for a given period,

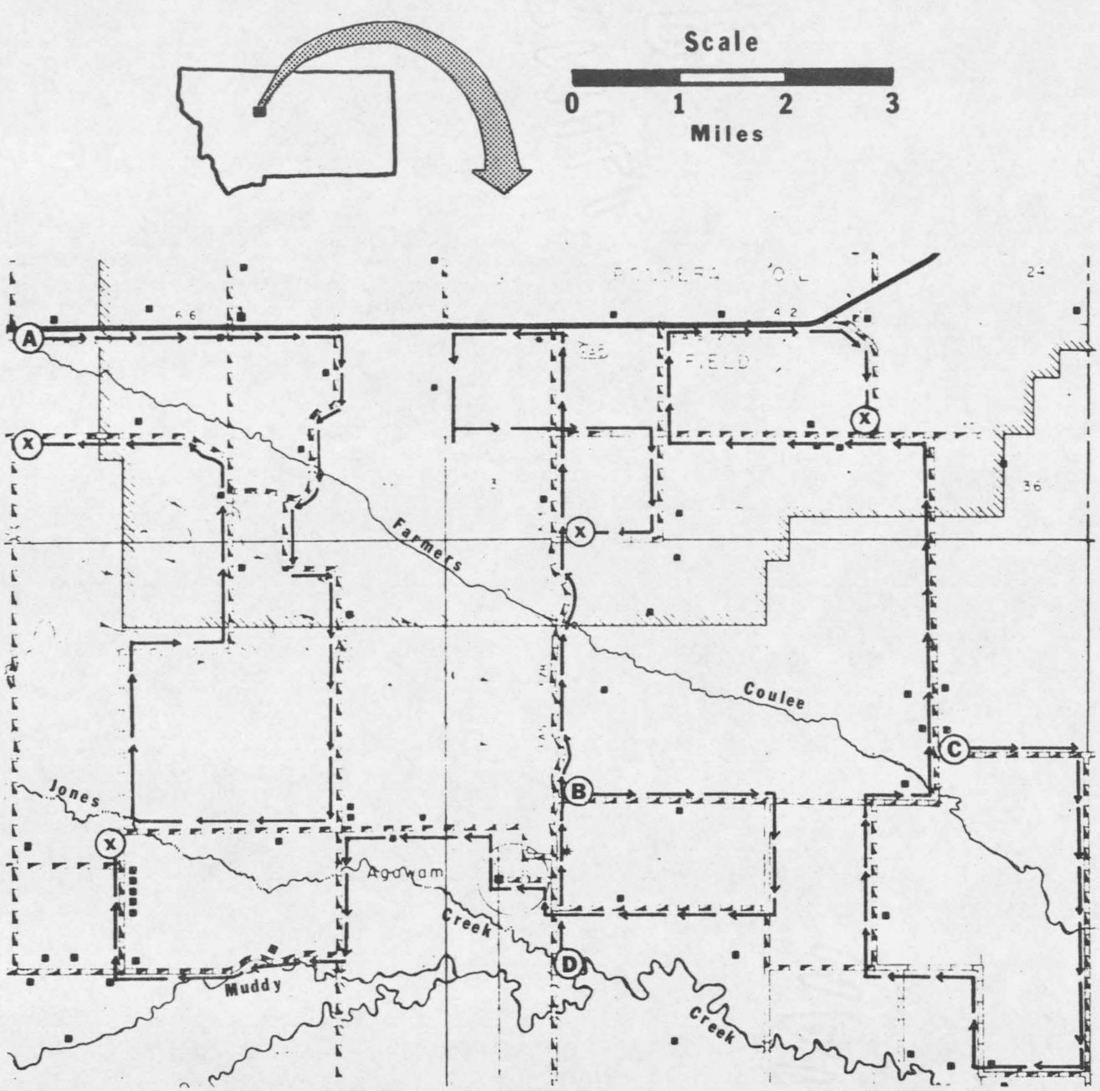

Figure 1. Location of four observation routes on the Agawam Study Area, Teton County, Montana.

route or the entire study area. Only early morning survey data were used in plotting trends unless otherwise specifed.

The sex and age of each partridge observed was recorded, whenever possible. Birds were flushed when heavy vegetation prevented complete counts. Bird activity, location by study area grid code and vehicle odometer readings were also recorded for each observation. Prevailing weather conditions (current temperature; percentage cloud cover; wind velocity and direction; atmospheric conditions and percent of ground covered by, and depth of, snow) were recorded at each observation site as well as at the beginning and end of each survey.

Partridge observed during other study activities, and similarly recorded, supplemented route observation data.

Route B was surveyed each week between completed winter-covey dissolution and anticipated commencement of egg hatching, 1970, to record numbers of calling partridge. Surveys began 30 to 45 minutes before sunrise on mornings having wind less than 12 mph (19.3 kmph). Since calls were heard up to an estimated 0.5 mi (0.8 km), individual calling partridge were counted during a 2-minute period at 0.5-mi intervals along the route. Paired male partridge did not call when the observer was within 50 yd (46 m) of the bird but were included as calling birds. Partridge observed during each survey were classified as previously described. The survey was a modification of the bobwhite

(Colinus virginianus) summer whistle count survey (Kabat and Thompson 1963).

A 2-mi^2 (5.2 km^2) area in the southcentral portion of the study area was intensively searched for partridge nests in 1970. Searches were conducted once each month during April, May and June. The area was searched by various combinations of one man and one dog to three men and two dogs. The area was again searched intensively for nests by the author, an assistant and 20 boy scounts on 30 May 1971. Records were kept of all partridge and each flushing site was searched for nests. Nest searches in various vegetation types were conducted during June and July, 1970 and 1971, elsewhere on the study area. A golden retriever was used by the author and an assistant in all nest searches.

Although sexes of partridge may be identified by covert color patterns (Saunders 1899; Yeatter 1934; and McCabe and Hawkins 1946), the technique is limited to use with birds in hand or to birds at extremely close range and no references to its accuracy were located. Saunders (1899), Ogilvie-Grant (1911/1912) and Westerskov (1949:16) presented a general technique which utilized plumage color patterns on the head and face for field-sexing partridge. This method has not been tested for accuracy and apparently has not been used to its potential in North American field studies; Ogilvie-Grant's (1911/1912) precautionary note about a possible "eclipse plumage" in males, July-August, may have contributed to non-use of this criterion.

Details of facial-head techniques are presented below with anatomical nomenclature taken from Pettingill (1970:10-11).

Males possess rust-colored feathers on their orbital, malar and auricular regions; the forehead, crown and occiput are uniformly slate gray. No differentially-colored superciliary line was noted for males. Females exhibited buff-colored orbital and malar regions; these areas terminated at about the posterior edge of the eye. The auricular region characteristically showed mottled gray and white feathers extending posteriorly from the eye to the neck. The forehead and crown of females was also mottled gray and white, with a frequently distinct white superciliary line separating the dorsal from the orbital region (Fig. 2).

Age of dead partridge was determined by the presence or absence of a Bursa of Fabricius (Gower 1939). Live birds in hand were classified to age by the molt progression of primsary feathers (Petrides 1945). However, in summer and fall, presence of either one or both outer juvenile primaries with faded coloration and/or fraying of vane edges signified a yearling bird. The presence of adult primaries in No. 9 and 10 positions in summer indicated the bird was at least 2-years-old; presence of these feathers in fall and winter signified an unknown-age adult.

Color of tibio-tarsal region scales was also used in combination with primary molt progression to confirm bird age. Gray or gray-blue

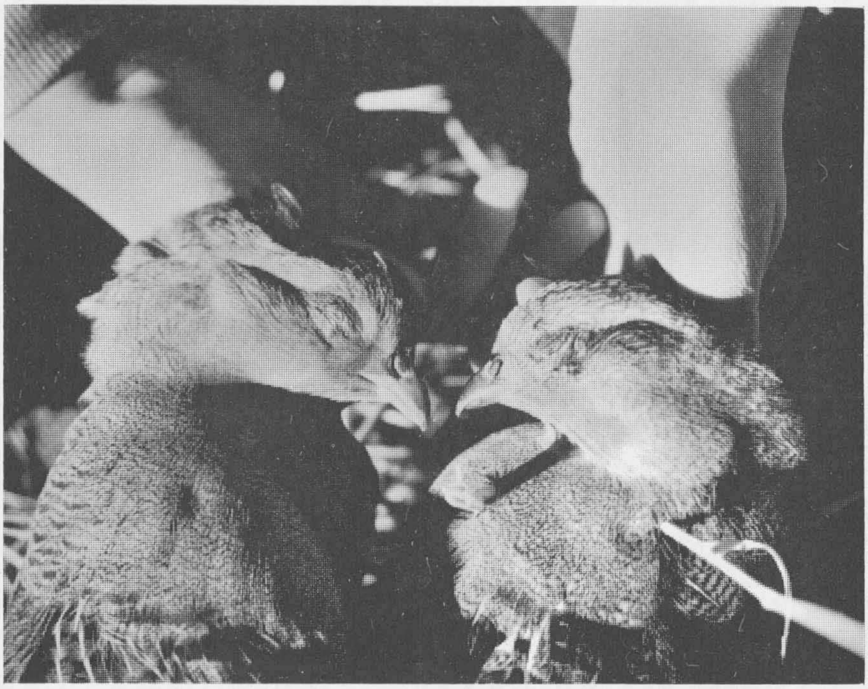

Figure 2. Facial plumages of the male (left) and female (right) Hungarian partridge.

color indicated an adult bird while yellow or yellow-tan signified a juvenile bird (Witherby et al. 1944).

Weekly age-classes (through 14 weeks) were assigned to juvenile partridge observed in the field by colored photographs and descriptions provided by Willard (1973 and pers. conv.).

Food habits data were obtained by examining contents of crops. Crops were taken from partridge examined in hunter bags, from vehicle mortalities and predator kills, from systematic collections during 1973 and 1974 and from birds collected during a study of the effects of mercurial fungicides on partridge. Empty crops were so recorded. The aggregate percentage method (Martin et al. 1946) was used to tabulate and compare food items by month and season.

Trapping and Marking

Hungarian partridge were trapped and marked during winter and summer months to provide identifiable individuals for determining movements, life expectancy, longevity and population turnover; they were also an aid in interpreting social structure of coveys and of local populations.

Two types of grain-baited, walk-in, funnel-entrance traps were used during winter periods. Semi-portable traps (Fig. 3), modified from Hamerstrom (1942), were used at sites where two or more coveys occurred. Chicken wire was used to cover traps in 1968-69; this was replaced by 2x2-5/8-in (5.1x6.7 cm) vinyl-coated wire mesh to minimize injury to partridge in 1969. Modified "lily-pad" traps (Gullion 1961) (Fig. 4) were used in single-covey areas or where frequent movement of traps was required to capture several coveys. Detailed description of trap types are presented by Weigand (1970).

Figure 3. Semi-portable traps used to trap partridge in winter.

Figure 4. Portable trap used to trap partridge in winter.

To permit three trap-checks daily, no more than ten traps were activiated at any given time. Bait corresponded to nearest waste grain sources. Whole barley *(Hordeum distichon)* or wheat *(Triticum aestivum)*, and occasionally a mixture of both, was used throughout the winter. Grain and unset traps were placed in partridge feeding and roosting sites to precondition the birds for trapping. Only sites actively used by partridge were pre-baited.

Attempts were made to trap partridge broods during the summer of 1969 by dragging the lower edge of a mist net, suspended loosely between two conduits, over vegetation containing the birds (Weigand 1971b). Upon flushing of the first bird, the entire net was dropped onto the vegetation in the direction of their flight. Attempts were also made to flush partridge toward standard mist net settings (Low 1957) (Fig. 5).

Efforts were made to trap partridge broods in late August-early September, 1971-73, with a truck-mounted cannon net modified (Weigand 1973a) from Lacher and Lacher (1964).

During the first year of study a numbered, No. 10 aluminum leg gand was placed on one leg and a colored plastic, No. 5 leg bandette was placed on the other. In subsequent years an aluminum leg band was placed on each leg. Partridges were fitted with vinyl bibs (Weigand 1970), a modification of ponchose described by Pyrah (1970) which positioned the strip onto the bird's breast (Fig. 6). The use of nine

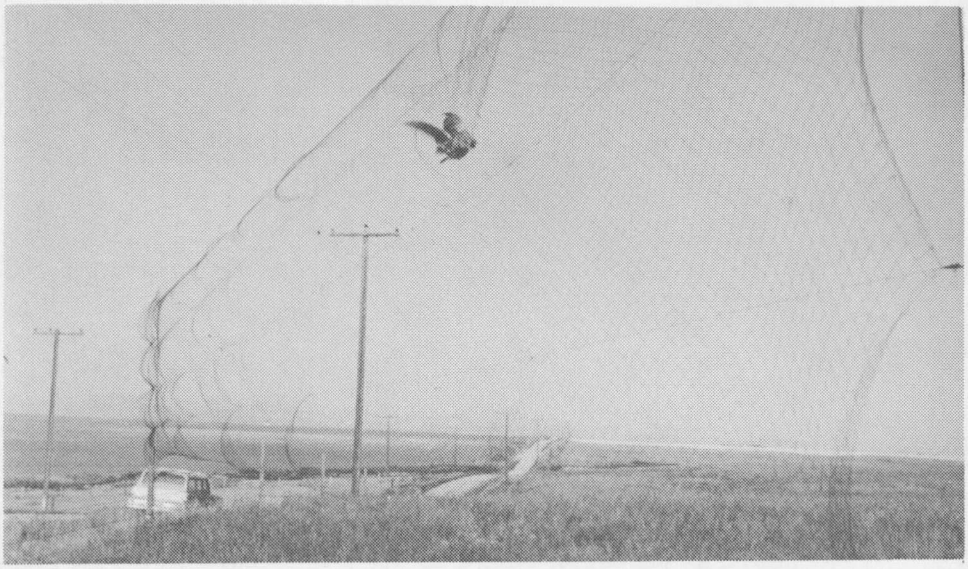

Figure 5. Standard mist-net set used in partridge trapping attempts in summer.

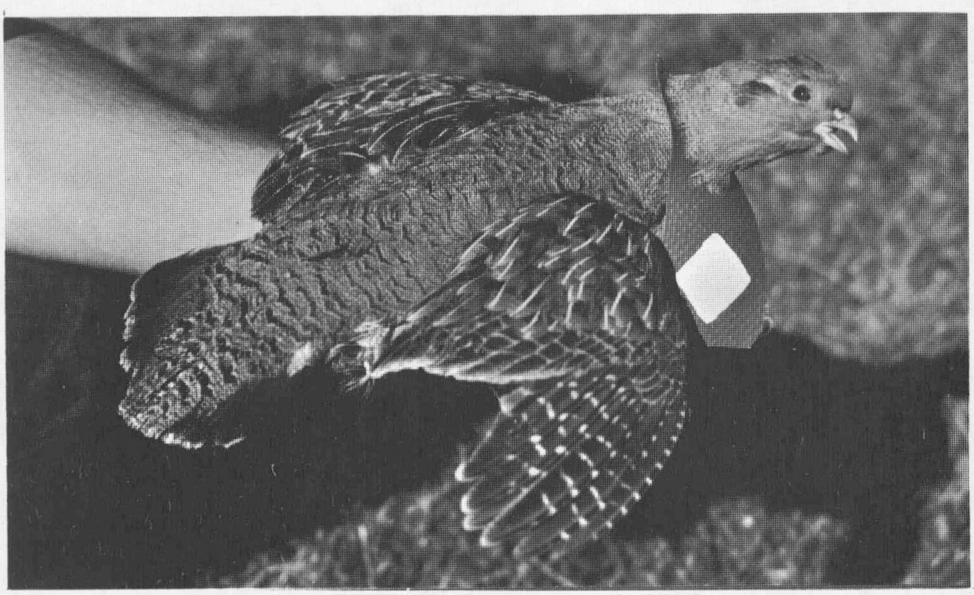

Figure 6. Mounted partridge displaying vinyl bib.

different bib colors, four symbol colors and 35 symbols permitted 525 readily identifiable combinations.

Nine female partridge, captured during January and February, 1974, were instrumented with radio transmitter, modified for Hungarian partridge from standard grouse units (Sidney L. Markusen, Electronic Specialties, Esko, Minnesota). The twelve frequencies used ranged from 150.815 to 150.890 mH_z and 151.010 to 151.085 mH_z at .015 mH_z intervals. Movements and activities of instrumented birds (Fig. 7) were monitored with a VHF tracking receiver (also Electronic Specialties) and a truck-mounted or hand-held antenna. The birds were monitored at 2- to 5-day intervals from time of release until they died or until signal transmission terminated.

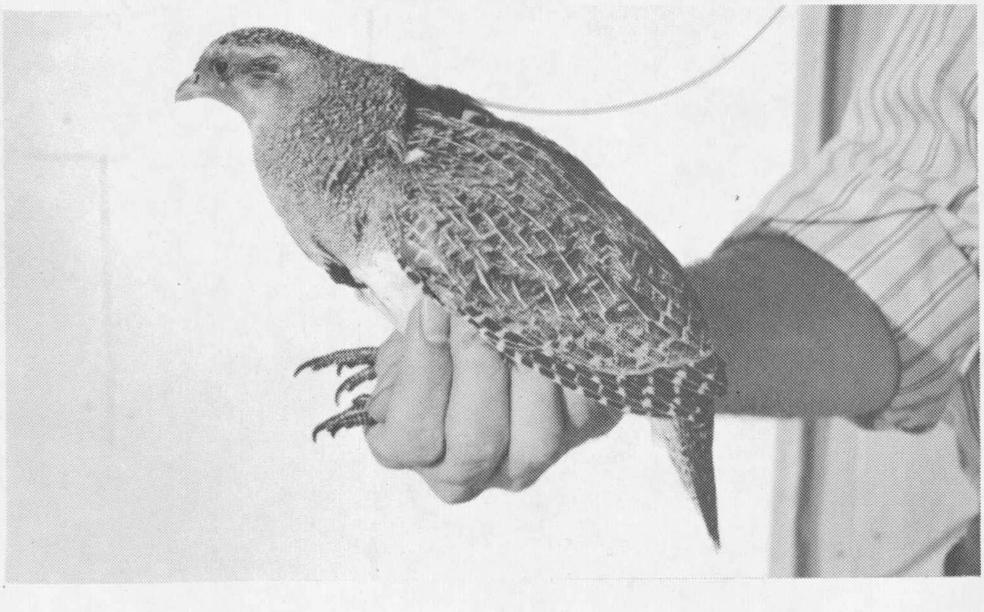

Figure 7. A radio-instrumented female partridge.

Vegetational Analyses

Hungarian partridge habitat was defined by comparing individual land uses and vegetation types used by partridge with those which were available. Terminology used in the study was:

land use: grain, fallow, hay, rangelands, agriculturally idle areas and roads and borrow pits (roadside ditches);

land sub-use: the basic unit; e.g. = a winter wheat field, a fallowed field, an alfalfa field, an upland range, an irrigation ditch;

habitat: that combination of several land uses or sub-uses which, at that particular time, were available to a given partridge population.

Characteristics of habitats on the study area were subsequently determined from three progressively broadening aspects: land use and vegetation measurements at each bird observation site; land use and vegetation type mapping along observation routes; and, land use mapping of the study area from aerial photographs.

Vegetation types associated with partridge observations were measured at four locations: observation site (OS); nearest different land use (NLU); second-nearest different land use (2NLU); and, nearest woody cover (NWC). Land uses were recorded at the first three points because: (a) large numbers of observations on roads and in borrow pits were anticipated; these special land uses were not subject to agricultural management procedures nor changes to other uses; (b) agricultural land-use associations with partridge were requisite to evaluating land use preferences by the birds; and (c) information on severl land uses or vegetation types associated with partridge was desirable to detect preferred juxtapositions of these uses. "Different" was defined as that land use having compositions or conditions identifiable from the type in which the bird group was observed. Distances were measured to the NLU, 2NLU and NWC by pacing or by vehicle odometer. To avoid damage to growing crops or at distances exceeding 0.25-mi (0.40-km), distances were computed by triangulation.

Each vegetation type was classified by three criteria:

(1) composition: the dominant and one subdominant plant species were recorded in heterogeneous stands; in relatively homogeneous stands only the dominant plant species was noted;

(2) condition: referred to grain and hay crop phenology and harvest, to grazed (by livestock) vs. ungrazed and to other treatments of all vegetation types; and

(3) height: the mean height of vegetation was determined from measurements at five random sites within that vegetational type.

Woody cover was defined as woody vegetation containing sufficient area, height and density to deter capture by predators. It consisted primarily of tree and shrub plantings (i.e. shelterbelts), rose *(Rosa* spp.) snowberry *(Symphoricarpos albus)* or willow *(Salix* spp.) clumps, and cottonwood *(Populus deltoides)* groves.

Distances were also measured to the nearest winter range (NWR), an area of known-use by partridge in winter (primarily shelterbelts and/or buildings).

Vegetation characteristics were measured annually along each of the four routes in late July-early August. The length of each land-use adjacent to roads (excluding borrow pits) was determined by vehicle odometer readings interpolated to the nearest 0.025-mi (0.04-km). Land use-vegetation type availability when compared with use, yielded partridge preference indices for given land-uses and vegetation types.

Partridge habitat was defined by clustering and discriminant analyses of land uses/sub-uses of 16 - 40 a (16 ha) compartments centered about each partridge observation, 1969-72. Two variables, numbers of units and proportions of each compartment of each of 24 land uses/ sub-uses, were determined from 1 in:9,000 in (1 cm:9,144 cm) aerial photographs. Mean occurrence and proportions of individual land uses/ sub-uses were combined from the 16 compartments in a home range to provide single values for each land use/sub-use. Occurrence and proportion of each land use/sub-use were then summed to yield a single mean and standard deviation.

Samples of observations were selected from each season for further testing: every 4th observation in spring and summer; every other one in fall; and every 5th one in winter.

Initially, clustering procedures searched a season's sample observations, by switching and joining, to reveal "best-fit" of habitat variables (Hartigan 1975, Ward and Hook 1963). The 3-cluster level was deemed appropriate for distinguishing among partridge habitat classes on this study area. Values of habitat variables resulting in these clusters were subjected to discriminant analysis and re-clustered where necessary (Anderson 1958; Dixon 1973). Unsampled observations were then individually assigned to clusters according to their land use/sub-use variable values. The step-wise discriminat analysis also indicated, by rank order, which land uses/sub-uses were decisive in placing a given observation in a given cluster.

Mean values for land use/sub-use variables were determined by month for pairs (March-June), broods (July-September) and adult-only groups (July-September). Each observation was centered within four 40 a compartments to detect more subtle differences among habitats utilized by these different social groups. All observations were used to describe habitats of these groups. Differences between habitats, by social group and month, were indicated from multivariate testing (Hotelling t^2, Anderson 1958). A source of error in these analyses could have resulted from associating habitat components from the 1972 aerial photographs to partridge observed during 1969-71.

Farming and livestock grazing activities were monitored along the four observation routes at weekly intervals from early May through early October, 1970-72 and at less frequent intervals during the same periods, 1973-74. Results of this sampling were interpreted as indicative of activities on the entire study area. Periodic survey results were supplemented by timely pre- and post-farming season route surveys and by random observations.

Utilization of grasses, grasslike plants and forbs by cattle was determined during the 1971 summer grazing season. Eight modified agronomy cages (Weigand, 1973b) were placed on separate ranges (one seeded, two upland and five lowland sites) prior to grazing (U. S. Forest Service 1963). Cages were placed a minimum of 50 yd (45.7 m) from fences (1 exception) and more than 100 yd (91.4 m) from any water sources (2 exceptions). Vegetation was clipped to within 0.5-in (1.3-cm) of ground level following removal of cattle from each range unit. Clippings were made from five to ten 0.96-ft^2 (0.09-m^2) loops inside, with a corresponding number outside, each cage. Outside loop sites were randomly selected 25-yd (22.9-m) from each cage. All clipped vegetation was separated into grass-and-grasslike plants and forbs. Separated samples were permitted to dry at room temperature for an average of 40 days (range, 23 to 56 days), then weighed to the nearest 0.5 gm.

Production and utilization of each plant group was obtained by comparing inside-cage with outside-cage vegetation weights.

Heights of 100 grazed and 100 ungrazed grass or grass-like plants were measured to the nearest 0.01-ft (0.3-cm) near each cage site. Plant measurements and determination of forage utilization were adapted from Cole (1958).

Scientific nomenclature for birds was from the A.O.U. Checklist of North American birds (1957), for mammals from Hoffman and Pattie (1968) and for vegetation from Booth and Wright (1959) and Booth (1972). Statistical methods were from Snedecor and Cochran (1967) unless otherwise indicated.

HISTORICAL BACKGROUND

Hungarian partridge and agriculture share relatively recent histories in Montana. Accounts of partridge introductions were compiled from minutes of Montana Fish and Game Commission meetings, and Department publications and biennial reports. Agricultural statistics were compiled from federal and state agencies responsible for these records.

Hungarian Partridge

Introductions of Hungarian partridge in North America have been widespread. Westerskov (1964) reported partridge were released in 46 states and all Canadian provinces except Newfoundland and Quebec. Although first introductions were made in the late 1700's (Oldys 1910, Phillips 1928), all attempts to establish the species were unsuccessful until the early 1900's (Taverner 1934).

The most successful introduction of partridge in North America occurred near Calgary, Alberta where a total of 800 birds were released by sportsmen in a limited area, 1908-1910 (Gordon 1935). By early November 1921, partridge were observed near Rutland, Saskatchewan, about 20 miles east of the Alberta border (Dexter, 1922). The average annual spread rate for these partridge was 28 miles for the 14-year period (Leopold 1933:80).

Based on Leopold's (1933) calculated average spread rate for Calgary birds, partridge could have reached Montana by 1914 (minimum distance of 125 mi or 201 km to Montana's northern border).

Coincidentally, the desirability of adding Hungarian partridge to Montana's list of upland game birds was first expressed by the Montana Fish and Game Commission in 1914 (Anonymous 1914). Marlowe (1922) reported partridge had drifted southward into Montana from Alberta by 1922; they were reported in the northern tier of counties and observed in the Sweetgrass Hills (in Toole and Liberty Counties), along the Milk River and as far south as the Marias River.

The Montana Fish and Game Commission authorized purchasing Hungarian "pheasants" in 1920 (Montana Fish and Game Commission 1920) and the first shipment was released about 1 May 1922 (Marlowe 1922). Approximately 1,000 birds from Europe were distributed to predetermined release sites in 45 of the existing 54 counties. Two thousand additional birds were imported in 1923, and in 1924 Jakways (1924) stated Hungarian partridge were "now a proven success in Montana. They are increasing rapidly in all parts of the state." Stocking of partridge imported from Czechoslavakia, Hungary and other central European countries (Anonymous 1929), continued up to about 1928-29; 2,000 were released in 1925, 1,000 in 1926, and a minimum of 600 after 1926 (Anonymous 1929). Marlowe (1926) indicated partridge had been released into every Montana county by 1926.

Construction of Montana's first Fish and Game Commission game farm was completed at Warm Springs in 1929. Hendricks (1929) stated it was then difficult to purchase good brood stock of partridge so wild birds were trapped in Deer Lodge County. Ten pairs of breeding stock were retained each year at the game farm until 1933 (Hendricks, 1932). In 1933, apparently the last year of game farm releases, three counties received a total of 52 partridge (Montana Fish and Game Department 1934).

The North Dakota Game and Fish Department released partridge from Czechoslavakia in 1923 (Upgren 1970). The same year, releases were made by the Wyoming Game and Fish Commission (Johnson 1960). It is possible that interchange of partridge occurred between Montana and both of these states.

Hungarian partridge were established in Montana by 1927 and sportsmen petitions for open and continued closed hunting seasons were received by the State Fish and Game Commission. Teton County residents asked for a hunting season on partridge in 1927 because of depredations on crops near Choteau. Since the Commission could legally regulate seasons only for native upland game birds, they could not authorize hunting of partridge, or ring-necked pheasants, without appropriate legislative action.

State legislative authorization was obtained and the first Hungarian partridge season in Montana, which included Teton County, was 24-28 November 1929. The daily limit was 3, with a possession limit of 6 after the first day; these limits could be comprised of partridge only or in aggregate with pheasant cocks. In the 44 succeeding years there were 7 years with closed seasons (1937-39, 1946-48 and 1950).

Hunting season lengths ranged from 5 (1929-32, 1940 and 1949) to 79 days (1974). Partridge hunting season dates coincided with those of pheasants through 1957. During 1958-73, partridge seasons ran concurrently with sharp-tailed grouse and pheasant seasons. Hunting of partridge during the double-season years ranged from 28.5 to 73.5 days. In 1974 partridge hunting opened with the grouse season and extended through the last day of the pheasant season.

Daily bag limits ranged from 2 (1953) to 6 partridge (1959-74). During 1929-33 daily limits applied to partridge, pheasant or any combination of the two species. Daily limits in 1953 applied to partridge, sharptails or 1 of each species. Possession limits during 9 of the 38 hunting seasons included a single day's limit; a 2-day limit comprised possession limits during the other years.

Annual hunting seasons and daily bag and possession limits for Hungarian partridge in Teton County are presented in Appendix I.

Harvest questionnaires were mailed to 6,656-18,585 licensed upland game bird hunters in Montana each year, 1958-74 (Weigand and Janson 1976). Completed and returned questionnaires from a mean 68 percent of the hunters revealed Hungarian partridge harvests ranged from a peak 163,760 in 1964 to a low 32,630 in 1972 (Table 1). They comprised a mean 14 percent of the total upland game bird harvest and ranked between third and fourth of eight species. Most of the Hungarian partridge harvest occurred in northcentral and northeast Montana.

Table 1. Total upland game bird[1] and Hungarian partridge harvests in Montana, 1958-74.

Year	Total Birds Harvested	Hungarian Partridge Harvested	Hungarian Partridge Percent of Total	Species with Greater Harvests[2]
1958	442,550	77,010	17.4	P,
1959	350,300	41,900	12.0	P
1960	401,100	49,400	12.3	P, BG
1961	422,400	37,470	8.7	P, RG, BG
1962	487,530	45,290	9.3	P, RG, BG
1963	727,750	111,490	15.3	P
1964	905,380	163,760	18.1	P
1965	358,790	40,520	11.3	P, RG, ST, BG
1966	700,230	123,530	17.6	P, ST
1967	433,860	70,620	16.3	P, ST
1968	373,750	70,160	18.8	P
1969	441,500	69,090	15.6	P, ST
1970	353,360	49,560	14.0	P, ST
1971	332,420	36,660	11.0	P, ST, SG
1972	339,400	32,630	9.6	ST, P, RG, SG, BG
1973	406,430	40,690	10.0	ST, P, BG, RG, SG
1974	339,620	45,190	13.3	ST, P, BG, RG

[1]Excludes Merriam turkey harvests.
[2]In order of harvest: P = pheasant; BG = blue grouse; RG = ruffed grouse; ST = sharp -tailed grouse; and, SG = sage grouse.

Agriculture

Settlement of Teton County began in the late 1800's (Giesecker et al. 1933:15) and there were 347 farms in the county by 1900 (U. S. Department of Commerce 1932). The high of 1,187 farms was reached by 1910, decreased to 1,032 farms by 1930, and remained relatively stable at about 1,050 until 1940. Mean farm size increased from an average of 541 a (219 ha) in 1920 to 1,019 a (413 ha) in 1940 (U. S. Department of Commerce 1936, 1942). Numbers of farms were not recorded by county after 1940.

Following the 1930 national census, Giesecker et al. (1933:17) reported: "The land not in farms is partly suitable and available for grazing, but much of it is wasteland with such scant vegetation that it has little or no value for grazing." The increased farm size through 1940 indicated additional acreages of previous rangeland were being cultivated for grain crops. The amount of land in farms increased from 613,506 a (248,470 ha) in 1920 to 1,101,500 a (446,108 ha) in 1940. Flax was an important crop on newly broken sod. Spring wheat was the principal cash-grain crop. Fall-planted rye was occasionally cultivated but winter-killed. Oats, barley and rye were grown and harvested principally for livestock forage; oats was the primary hay crop on some higher tablelands.

Horses and mules were the main power source for pulling farming implements during early settlement of the region. Mr. Paul Rice, a study area resident since 1910, stated the first mechanized grain thresher appeared in 1911; there were 695 tractors in Teton County by 1930 (Giesecker 1933:18). During the 1969-74 partridge study, all crop cultivation and hay mowing utilized self-propelled vehicles.

Grain crop acreages, numbers of livestock and livestock grazing-pressure means were determined for 5-year periods beginning with 1920-24. Grain crop acreage-means included acres harvested for barley, corn, flax, oats, rye, spring wheat and winter wheat. Acres of hay and numbers of livestock, by class, were available for individual years except during 1919-35 when 5-year interval figures only were recorded. Since numbers of livestock within the different types varied, livestock grazing-units were approximated using animal unit conversion factors (Range Term Glossary Committee (1964:7-8):

1 = 1 adult cow or cow plus calf;

0.2 = 1 adult sheep or ewe plus lamb; and

1.25= 1 adult horse.

Grain crop acreages increased steadily in Teton County from 1920-24 (136,000 a or 55,080 ha) through 1955-59 (258,000 a or 104,490 ha), except for a slight decline 1925-34 (Fig. 8). Since 1959, acreages cultivated for grain have stabilized at about 240,000 a (97,127 ha). Hay acreage also increased, 1920-74, but at a much lower level than that of grain. A low of 26,520 a (10,741 ha) hay was harvested in 1919 while a high of 75,300 a (30,497 ha) was cut in 1972. Livestock grazing peaked during 1935-39 at 67,120 livestock grazing units. The 1935-39 decrease in grazing pressure was attributed to drastically reduced numbers of sheep. The decrease could have been more severe, but was partially compensated for by increasing cattle numbers. The increase in grazing pressure since 1960 was virtually entirely due to increased cattle numbers. During 1970-74, a mean 65,600 livestock units were grazed annually.

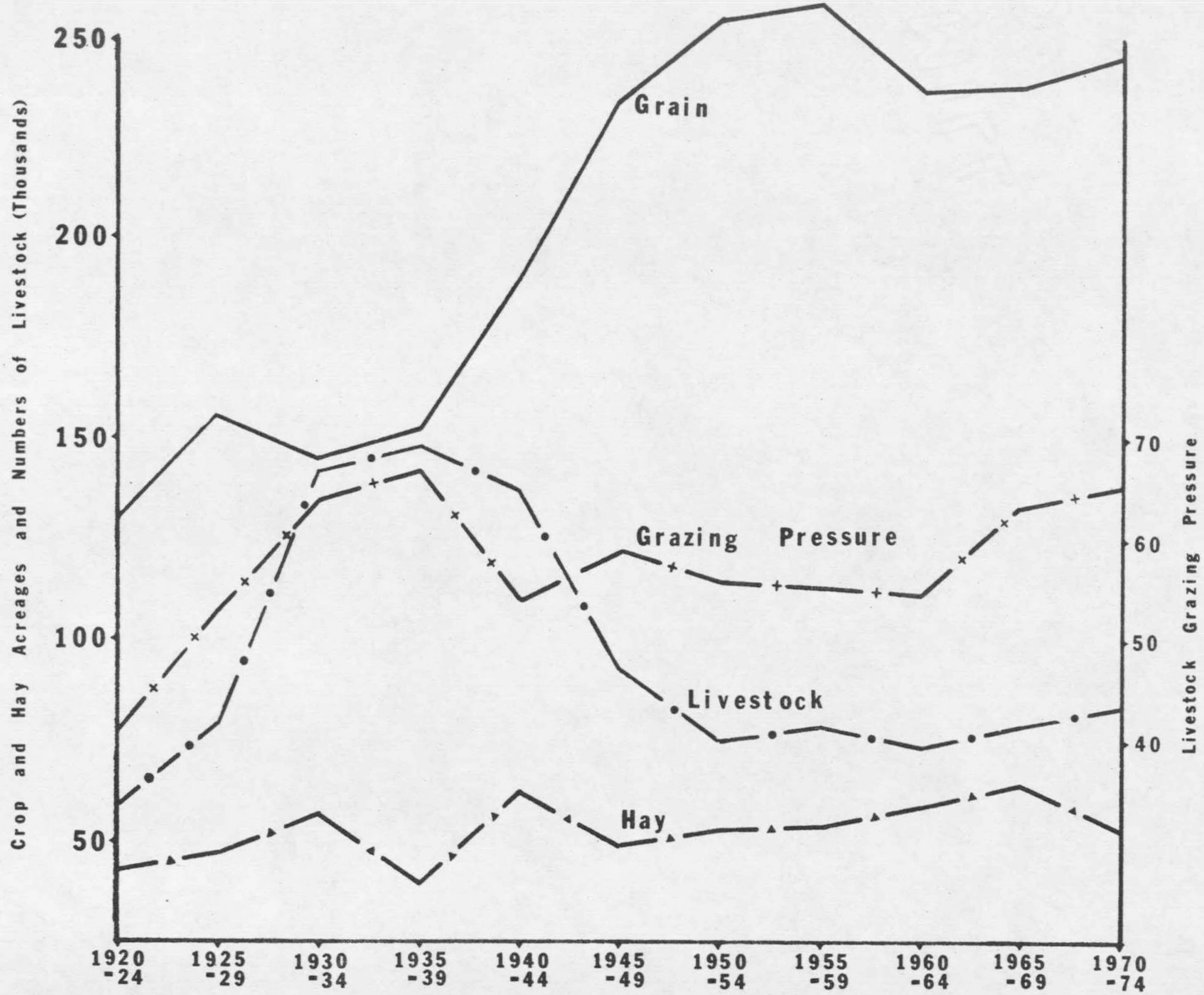

Figure 8. Grain, hay and livestock trends, by 5-year means, in Teton County, 1920-74.

Grain Crops

Spring wheat was the principal grain in Teton County until 1940 (Fig. 9). The highest 5-year mean acreage was 138,000 a (55,890 ha) in 1925-29, the lowest acreage was 29,200 a (11,826 ha) in 1965-69 and there was a mean 46,600 a (18,873 ha) spring wheat, or 19 percent of all grain acreage, during the current study. Winter wheat, the second major grain crop, increased from 3,900 a (1,580 ha) in 1925-29 to a high of 128,800 a (52,164 ha) in 1965-69. Winter wheat comprised 36 percent of county grain crops during 1969-74. Barley was the third important grain crop and attained a 5-year peak of 104,900 a (42,485 ha) during the present study. Acreages of oats increased to a 5-year peak of 13,800 a (5,589 ha) in 1940-44 and declined to the 55-year low of 4,300 a (1,742 ha) during 1965-69. Oats comprised 2 percent of the county's grain harvest, 1970-74. Flax cultivation increased from 3,100 a (1,256 ha) in 1920 to 20,800 a (8,424 ha) in 1943; less than 700 a (284 ha) flax was harvested 1969-71 and no flax was recorded in 1972-74. Corn and rye were minor cash crops; during the current study, up to 600 a (243 ha) corn and 200 a (91 ha) rye were harvested.

Proportions of annual harvests of major grains occurring on irrigated land, 1945-73; were: spring wheat, mean of 10 percent; winter wheat, mean of 6 percent; barley, mean of 14 percent; oats decreased from 56 to 9 percent annually; and, flax decreased from 82 to 29 percent annually.

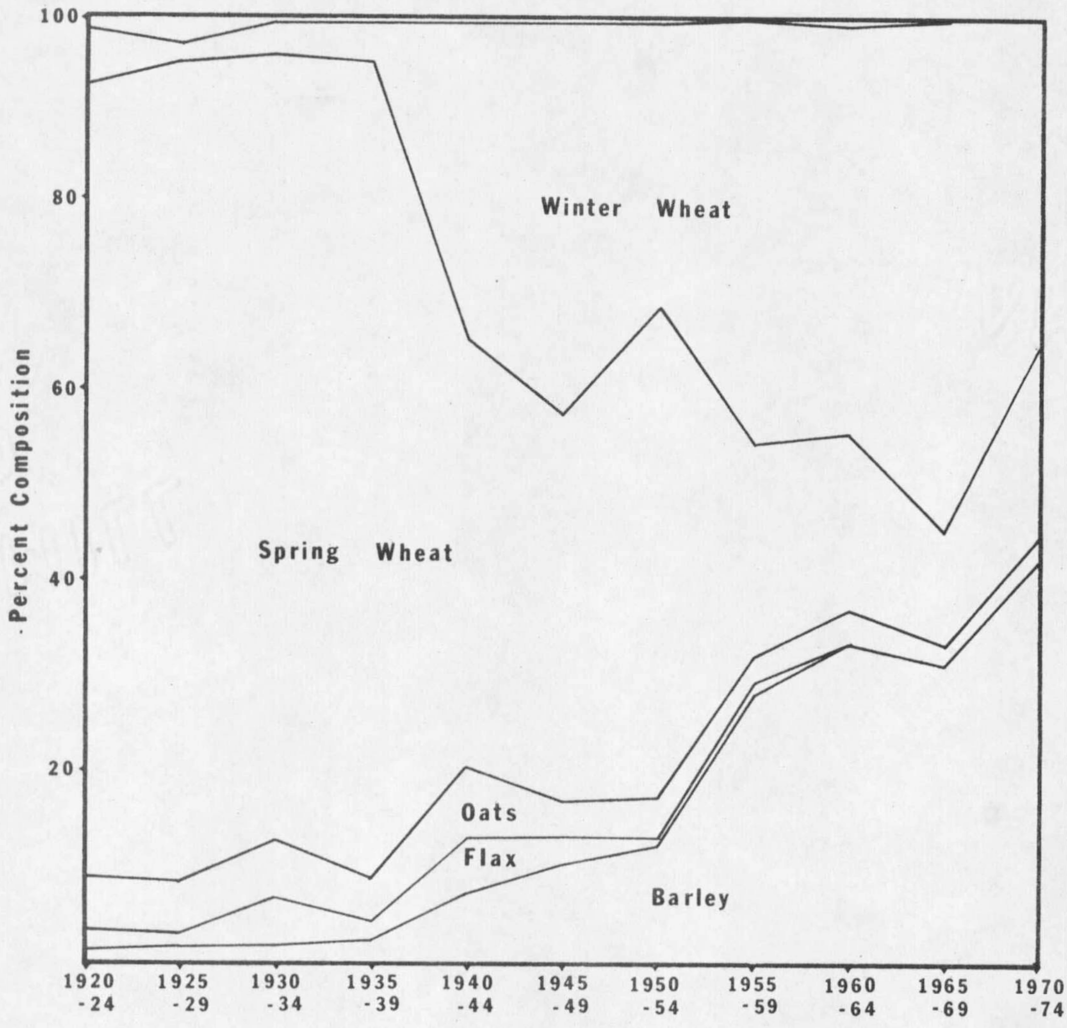

Figure 9. Mean proportions of the five principal grain species in Teton County, 1920-74.

Other seed crops harvested in Teton County (1946-63 records only) included mustards, sweet clover *(Melilotus* sp.) and crested wheatgrass *(Agropyron cristatum)*. Maximum annual harvests for these respective crops occurred on 4,800 a (1,944 ha) in 1946, 3,400 a (1,337 ha) in 1950 and 1,100 a (446 ha) in 1950. Peas were harvested from 400 to 5,200 a (162-2,106 ha) annually, 1944-48. Sugar beets and potatoes were cultivated on maximum acreages of 870 a (352 ha) and 360 a (146 ha), respectively, during 1945-51 and 1944-69, respectively.

Hay Crops

Hay acreages reflected the combined effects of moisture conditions and demands for winter livestock forage. Wild grasses, primarily on moist soils near streams and rivers, provided the major portion of vegetation harvested as hay (Fig. 10). While wild hay acreage increased from 20,000 a (8,100 ha) in 1919 to 35,800 a (14,499 ha) in 1959, the proportion of wild grass in total hay harvests decreased.

Alfalfa *(Medicago sativa)* represented the major cultivated hay crop since about 1929. It increased from a low of 2,400 a (972 ha) in 1919 to 46,700 a (18,914 ha) in 1973. The proportion of alfalfa in hay harvests also increased from the 1919-low (9%) to a high of 69 percent in 1973. During the present study (1974 acreages unavailable) alfalfa acreage ranged from 23,000 to 46,700 a (9,315 to 18,914 ha). Most harvested alfalfa (91%) was grown on irrigated land, 1944-73.