THE ECOLOGY OF THE RING-NECKED PHEASANT (*Phasianus colchicus*, Linnaeus) IN NORTHWESTERN KANSAS

by

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INTRODUCTION

All true pheasants are so closely related that fertile hybrids between any two forms can be produced. Certain authors consider them all as subspecies of one species, while others consider the group as one large natural genus or superspecies. The pheasant is a native species of Asia and about the 10th century B.C. they were brought to Europe by the Argonauts from the Caucasus in southwestern Asia (McAtee, 1945).

In 1790, several pairs of English black-necked pheasants were transported from England to America by Governor Wentworth of New Hampshire (Wetmore, 1936). This first introduction did not succeed in establishing a breeding population. In 1881 and 1882, Judge O. N. Denny, United States Consul General at Shanghai, shipped 28 Chinese pheasants (18 hens and 10 cocks) to Oregon, where they were liberated in the Willamette Valley (Allen, 1953).

McAtee (1945) states, "The first real success in establishing pheasants was with the Chinese ring-neck in the Willamette Valley, Oregon, in 1881. From this stocking the pheasants multiplied until in 1892 a shooting season of two and one-half months was opened and 50,000 birds were reported to have been killed the first day."

Introductions of the Chinese ring-necked pheasant (Phasianus colchicus, Linnaeus) into Kansas began in 1905 (Cammack, 1932). Releases were made intermittently until 1939, when an annual program of stocking was begun (Table 11).

Since the first hunting season in Kansas in 1917, the status of the ring-necked pheasant as a game bird has continually increased in

importance until today it is one of the major game species of the state. In 1957 the Kansas Forestry, Fish and Game Commission statewide small game survey showed a total pheasant bag of 140,679 birds.

As this species has only recently attained prominence as one of the major game species of Kansas, little is known concerning certain aspects of its ecology in this area of the United States, such as practical methods of censusing, food habits, predation losses, motor vehicle destruction, etc. Basic information must in almost all circumstances be known before a game species can be adequately controlled, regulated, or increased. This study was therefore undertaken to add to the small amount of basic research previously accomplished. As far as is known, the only previous research in Kansas, on P. colchicus, was one graduate research project in Hamilton County, and one statewide survey by the Kansas Forestry, Fish and Game Commission in 1953. Yearly surveys are made by game protectors in their various regions, procuring from landowners information concerning pheasant population increase or decrease.

A majority of the information compiled during the course of this research project, was obtained in Norton County, in northwestern Kansas. In 1957, according to the Norton County Soil Conservation Office, there was a total of 538,723 acres in the county classified as farmland. Of this total, 327,367 acres were classified as cropland, 199,206 as non-cropland, and 12,149 as other lands (towns, highways, etc.).

Norton County was selected as the locale of this study project because of its relatively constant high pheasant population in

relation to the population as found elsewhere in the state.

Wheat and grain sorghums are the major crops produced in Norton County. Of lesser importance are corn, alfalfa, sweet clover, barley, oats, and cattle production.

As stated in the 1948 report of the state of Kansas Board of Agriculture, the average yearly precipitation total in Norton County is 20.82 inches, with an average annual snowfall of 23 inches. The annual normal temperature mean is 52.8° F.

A study area of one mile square was selected in the northwestern portion of Norton County. The area was a random sample of the square miles of Norton County. The section designation was R225, S14.

MATERIALS AND METHODS

The information contained in this paper was recorded during the course of 85 field days. One day spent in the field was considered as one field day. The study commenced September, 1957 and ended May, 1959. Transportation and facilities were furnished by the Kansas Forestry, Fish and Game Commission. Field trips were made to the area at a frequency of one to three per month. Two months were spent in the area during the summer of 1958. Except for federal and state highways and a few all-weather county roads, the rural area of Norton County has only unpaved roads; therefore field work was largely controlled by weather conditions

Because of the many facets of this study, each portion of the investigation will be described in detail as it is collocated in this paper: (1) comparison and evaluation of census methods; (2)

evaluation of hunting season data; (3) age determination; (4) evaluation of nesting season data; (5) determination of all food habits; (6) incidences of predation; (7) accidental kills caused by motor vehicles; and (8) parasitism of the intestinal tract.

Four census methods were used and compared during the twenty-one months covered by this project. Hunting season data was obtained from hunters in the field during both the 1957 and 1958 hunting seasons. Nesting habits were studied by observing harems and locating nests in the field, during the spring of 1958. The fall food habits of P. colchicus were studied by collecting and analyzing crops of 25 birds killed during the 1957 hunting season and crops of 100 from the 1958 hunting harvest. All crops were transported to Kansas State University where the contents were dried, removed, and the various foods identified.

Fall and spring sex ratios were determined by the separate recording of sexes, as observed in the various field counts. An attempt was made to determine possible coyote predation by collecting coyote scats. Incidence of parasitism of the intestinal tract was determined by collecting tracts of birds taken during the 1957 and 1958 hunting seasons. The incidences of accidental kills caused by motor vehicles were determined by recording mileages driven and observed pheasant roadkills during the various months of the year, in Norton County. Information concerning roadkills was collected by this writer while driving in Norton County and also by Clyde Ukele, game protector of Norton County.

REVIEW OF LITERATURE

A great number of articles have been written concerning the ecology of P. colchicus in regions of the United States other than Kansas. The papers reviewed herein were those selected for their pertinent relationship to this study.

Various censusing methods have been used and analyzed, in attempting to determine the most reliable, efficient and practical method of determining populating changes and densities (Bennett, 1938; Einarsen, 1945; Fisher, et al., 1947; Kimball, 1949; Klonglan, 1955; Kozicky, 1952; McClure, 1944; McClure, 1945; Nomsen, 1953; Randall, 1939; Stiles, 1946).

Hammerstrom (1936) in a nesting study in Iowa during three breeding seasons on 503 nests found the average number of eggs per clutch was 11.2 with a range between four and 26. Of the 503 nests, 76.9 per cent were unsuccessful. Of this total, man caused 52.3 per cent of the failures. Mowing of hay crops destroyed 29.8 per cent of the nests. The remainder of the failures resulted from harvesting, burning, grazing animals, dogs and cats, and plowing operations. Interruptions by the study project caused 2.1 per cent of the losses.

Baskett (1941) determined the mean clutch size for successful nests to be 10.4, the mean hatch to be 8.1 and the mean brood size to be 6.1 to 6.9 in early fall when pheasant young averaged five to eight weeks of age.

In a study conducted by Leedy (1949) the greatest abundance of nests was found in first cutting alfalfa. The next greatest concentrations were found in red clover, mixed hay, second cutting alfalfa,

sweet clover, wheat and oats. Leopold (1936) found hayfields were nested in for lack of better cover. Flushing bars, used to flush pheasants from the path of mowing machines, were not of much value.

Strode (1942) in a nesting study in Ohio consisting of 558 nests found that 79.4 per cent of nesting attempts were destroyed by man's activities. Randall (1939) showed that land usage practices destroyed 56.6 per cent of nesting attempts in Pennsylvania. As determined by Baskett (1942) in Iowa, nests placed in small grains were 40.3 to 80 per cent successful. In hay fields 20.3 to 34.6 per cent of the nests were successful and in fence rows only 4.8 to 21.1 per cent. As a result of disturbances by man in pursuing agricultural practices, nearly a third of all nests were deserted.

Pheasants are omnivorous feeders, but all investigators found that waste grain and various weed seeds were the predominant foods consumed. Dalke (1937) found that waste corn, wheat, and barley comprised 83 per cent of all grains consumed by pheasants in Michigan. Common wild weed seeds taken were ragweed, yellow foxtail, skunk cabbage, and green foxtail. In Ohio, Leedy (1939) determined that 91 per cent of the grain eaten by pheasants was waste grain, which normally would have remained in the field. In Minnesota, Fried (1940) found that cultivated grains comprised 81.3 per cent of the total food consumed. Corn was the most important single item in the diet and comprised 49.5 per cent of the total. Although pheasants are not large consumers of insects and other invertebrates, in comparison with plant foods eaten, grasshoppers and crickets were nearly 75 per cent of the total volume of animal foods consumed. McLaughlin (1942), in Massachusetts, found that grains comprised 26.3 per cent of all foods eaten

with wild seeds comprising 32.5 per cent of the total. Fruits comprised 10 per cent of the total. Insects were eaten most extensively in spring and summer and fruits in winter.

Various methods have been devised for the age determination of different wildlife species. It has long been known that cock pheasant spurs lengthen at a more or less standard rate during the first two years of life. From this fact Kimball (1944) and Linduska (1943, 1945) developed the spur length method of age determination of cock birds taken during the hunting season. A spur length measurement of 3/4 inch or less from the point of the spur to the opposite side of the tarsus denoted an age of less than one year. If the measurement was greater than 3/4 inch the pheasant was not a young of the year. Nelson (1948) enlarged this measurement to 25/32 inch (19.6mm.). At a ratio of 3:1 (number of young of season compared to those older than one year), Stokes (1957) found the 3/4 inch gauge gave an indication of the prevailing age ratio, but if the ratio was increased to 6:1 the diameter of the gauge had to be increased to 20mm. If the ratio was 15:1, the gauge size must be further extended to 20.4mm. Besides the actual age ratio of the kill, accuracy of the spur length method of age determination varied according to the length of the hatching season and latitudinal location of the study.

CENSUS METHODS

In 1957 the cover crop acreages, on the study area, of grain sorghum, wheat, and corn were 118.5, 245, and 21 respectively. In 1958 grain sorghums were decreased to 53.5 acres, wheat decreased to

129 acres and corn increased to 59 acres. During both years perennial grasses covered 21 acres of the study area. Field counts were made on the study area before and after both the 1957 and 1958 hunting seasons (Table 1). Clyde Ukele, game protector from Norton, Kansas, assisted on all counts. In addition one or two Weimaraner hunting dogs were used. Census data were obtained by walking through the areas of dense cover, and the larger open grain sorghum and wheat stubble fields were driven with the transportation vehicle if possible. In 1957, one field count was made on the study area before the hunting season and one after the hunting season. Similar field counts were made on the study area in 1958, and in addition four smaller tracts were censused by the same method. These areas were all adjacent to the twenty-mile roadside count route except Field III (Table 1).

Table 1. Field counts of 1957 and 1958.

Date	Area	Acreage	Cocks	Hens	Sex undetermined	Total	Acres per bird
11-2-57	Study area	640	24	17	18	59	10.8
12-7-57	Study area	640	8	7	29	44	14.5
10-26-58	Study area	640	42	46	71	159	4.0
12-23-58	Study area	640	22	34	6	62	10.3
10-11-58	Field I	80	11	14	7	32	2.5
11-30-58	Field I	80	6	10	2	18	4.4
10-11-58	Field II	160	16	14	27	57	2.8
11-29-58	Field II	160	11	19	3	33	4.8
10-12-58	Field III	100	12	8	0	20	5.0
12-1-58	Field III	100	7	12	6	25	4.0
10-25-58	Field IV	320	30	17	8	55	5.8
11-29-58	Field IV	320	9	22	1	32	10.0

Field I, of 80 acres was three miles west of the study area. It was seeded to winter wheat with a center strip of grain sorghum in the

area of drainage. Also included in Field I was an abandoned farmstead.

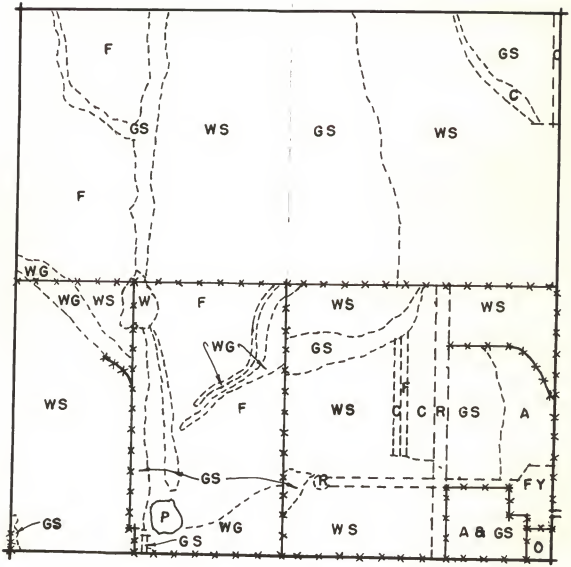
Field II, of 160 acres was adjacent to the southwest corner of the study area. The area was planted with wheat and as Field I, contained a center strip of grain sorghum. Between the grain sorghum and the wheat were strips of perennial grasses.

Field III, of 100 acres, was one and one-half miles south of the study area. This area was planted to winter wheat and had a center drainage area of sunflowers.

Field IV, of 320 acres, was one mile northwest of Norcatur, Kansas, adjacent to the last mile of the twenty-mile roadside count route. The area was planted in grain sorghum, perennial grasses and sweet clover.

In each field count on the primary study area there appeared to be a relationship between the number of pheasants located on the four quarter sections and the field crop present. In 1957, the pre-hunting season field count on the study area located 59 pheasants. In 1958, a similar pre-hunting season field count located 159 pheasants. Figures 1 and 2 show the various land cover types present on the study area during the falls of 1957 and 1958. Of the 59 pheasants located by the pre-hunting season count of 1957, the northwest quarter section had six, the southwest 29, the southeast four, and the northeast 20. Of the 159 pheasants located by the 1958 pre-hunting season field count on the study area, 43 were on the northwest quarter section, 76 on the southwest quarter, 40 on the southeast quarter and none on the northeast quarter.

The 1957 post-hunting season study area field count located 11 pheasants on the northwest quarter, 10 on the southwest quarter, four



LEGEND

WS	WHEAT STUBBLE
GS	GRAIN SORGHUM
F	SUMMER FALLOW
WG	WEEDS AND PERENNIAL GRASSES
R	RUNWAY
W	WEEDS

SEPTEMBER 1957

C	CORN
FY	FARMYARD
A	ALFALFA
O	ORCHARD
P	POND
×××	FENCE
----	FIELD BOUNDARY

Fig. 1. Land usage on the primary study area in 1957.

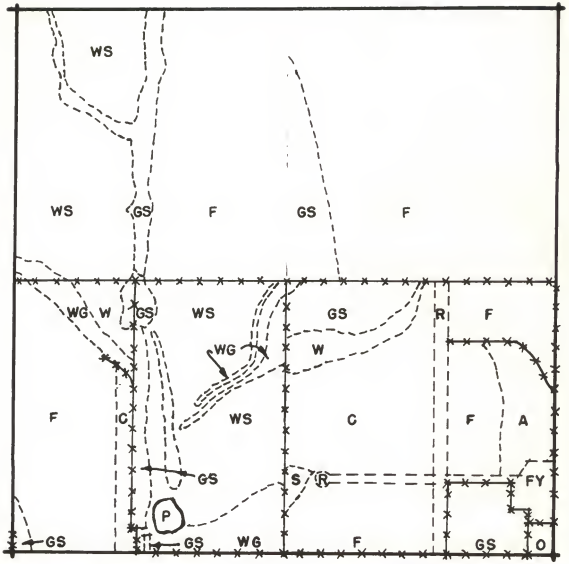


Fig. 2. Land usage on the primary study area in 1958.

on the southeast quarter and 19 on the northeast quarter section, for a total count of 44 pheasants. In contrast the 1958 post-hunting season census on the study area located 23 pheasants on the northwest quarter, 13 on the southwest quarter, 23 on the southeast quarter and three on the northeast quarter for a total count of 62 pheasants.

The roadside count censusing technique, employed to determine pre-and post-hunting season populations was similar to that described by Randall and Bennett (1939). A twenty-mile route was established, beginning six miles west and three miles north of Norton, Kansas. The route proceeded in a westerly direction, terminating one mile northwest of Norcatur, Kansas. An east-west route was chosen, to eliminate as nearly as possible the difficulties which would have been caused by driving into early morning sunlight. Roadside counts were begun within thirty minutes of sunrise, and the twenty-mile route driven at a rate of 15-20 miles per hour. Data on the total number of pheasants and number of each sex sighted were recorded. Those at a distance great enough to give inaccurate results, if sexing were attempted, were only recorded in the total number sighted.

Figure 3 is a graphic representation and comparison of fall roadside counts of 1957 and 1958. The portion of the 1957 curve between September 20 and December 8 shows a relatively stationary population. After the hunting season there was an indication of an actual population increase. This indication of increase was because of the removal of the grain sorghum crop and conceals the actual decrease in population caused by the hunting season. In 1957, because of rainfall the grain sorghum harvest was late. As the grain sorghum crop was harvested there was a concurrent loss of cover, and subsequently

pheasants were easier to locate during road counts. The 1958 grain sorghum harvest was most certainly responsible for the tremendous increase in birds sighted, beginning the forepart of October (Fig. 3). The decrease in population caused by the 1958 hunting season is clearly shown.

In agreement with other authors, the validity of the roadside count was found to decrease rapidly after the hunting season. A post-hunting season population is in all instances relatively stationary with only a small amount of decrease throughout the late fall and early winter months. The post-hunting season population curve of 1958 indicated a continual decrease rather than a stationary population. The 1957 population curve indicated a population decrease beginning the forepart of December.

In Nebraska, McClure (1945) found no method of censusing to have universal use in estimating the number of birds throughout the state under all conditions of habitat. The roadside count gave the best results if used before the hunting season and if used repeatedly.

Stiles and Hendrickson (1946) considered the roadside census successful in Iowa, but definite means of allowing for varying weather conditions, vegetative cover and general seasonal variation needed to be determined. In addition, they believed that personnel conducting the census should be better trained in order to help eliminate personal biases. Fisher, et al. (1947) did not consider the validity of the roadside censusing method to warrant the high degree of reliability given to it by other workers. They found the variability in results obtained by this technique to be sufficiently great as to make conclusions therefrom unreliable. More birds were found on days with

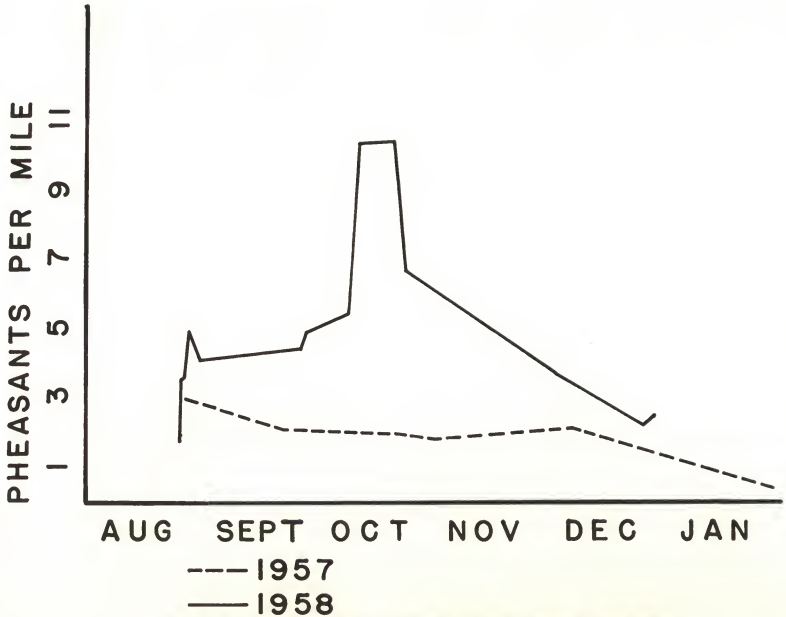


Fig. 3. Comparison of roadside counts of 1957 and 1958.

a dewfall than on dewless days. Clearness or cloudiness of the weather had little effect on the total count and birds were more in evidence on rainy or snowy days than on days with temperatures below freezing; therefore it appeared impossible to select any certain type of weather condition as optimal for censusing.

Actual indications of acres per bird from transferrence from birds per linear mile (from values of roadside count) apparently vary according to location. Bennett and Hendrickson (1938) found in Iowa that eight to ten birds per mile indicated a population of one bird per four or five acres. Two birds per mile indicated a population of one bird per seven to nine acres and one bird per mile a population of one bird per 18 acres. In Pennsylvania, Randall and Bennett (1939) believed six to eight birds per mile indicated a population of one bird per two acres. Two to three birds per mile indicated one bird per four acres; .70 to 1.82 birds per mile indicated one bird per six to seven acres and .25 to .60 birds per mile indicated one bird per 18 to 20 acres.

Einarsen (1945) developed a type of quadrat censusing method, from which was developed the technique used repeatedly during the fall and winter of 1957 in determining population on the study area. After walking approximately 100 feet inward from any periphery, a route 5,000 feet in length was traversed directly across the section. From this point, turning either left or right, the route was continued for 1,000 feet; then the section was again traversed to within 100 feet of the periphery and from this point to the starting point of the quadrat. The route thus traversed described a rectangle 5,000 feet long by 1,000 feet wide.

Theoretically all pheasants within 100 feet of either side of the line of travel were to be counted. By transposing the square feet under surveilance to acreage under surveilance, the population density was determined. Acreage was determined by the formula: perimeter in feet X 200 ÷ 43,560 = acreage.

$$\begin{array}{r} 5{,}000 \\ 1{,}000 \\ 5{,}000 \\ 1{,}000 \\ \hline 12{,}000 \end{array} \qquad \frac{12{,}000 \times 200}{43{,}560} = 55 \text{ acres}$$

Between 22 September, 1957 and 5 April, 1958, the pheasants on 12 different quadrat locations on the study area were censused. The average value of five pre-hunting season quadrats was 5.6 birds per quadrat, and the average value of seven post-hunting season quadrats was 4.0.

By expanding the average pre- and post-hunting season values from 55 acres to 640 acres of study area, the pre- and post-hunting season population was computed:

$$\frac{640}{55} = 11.64$$

11.6 X 5.6 = 65 (average number of pheasants on study area pre-hunting season), and

11.6 X 4.0 = 46 (average number of pheasants on study area post-hunting season).

Einarsen (1945) used a quadrat one mile long and 1/4 mile wide, in average pheasant habitat. The method proved practical, economical, and simple. As used in Oregon by Einarsen, representative samples of habitat were chosen, in order to obtain a good indication of average population density. Ten to thirty quadrats were censused in each geographical unit and at least one for each 20,000 habitat acres.

As used by the author in Norton County, all quadrat censuses were on the same section. Einarsen found the quadrat censusing method was most applicable in areas of dense human population and interference. Weaknesses of the method were the time involved to cover the quadrats and the necessity for sufficient samples to obtain accurate results.

The cock crowing count index was used during the spring of 1958. The cock crowing count is not an actual censusing method but is an index, which may be used in yearly comparisons. The twenty-mile roadside count route was driven, beginning within thirty minutes of sunrise. Stops were made each two miles. The engine of the transportation vehicle was stopped and a position taken at least twenty feet from the vehicle. If the wind was blowing at a velocity estimated to be greater than five miles an hour, the position taken was facing 90° from the source direction of the wind.

Pheasant crows were counted and recorded for a two-minute period and this procedure repeated every two miles until the entire route of ten stops was censused.

In Table 2 the results of the 1958 crowing count census index are presented. There was much variation in the number of crows heard, from day to day, and lesser variation between stops on any one day. A two-way analysis of variance determined that 4.4 per cent of the total variation present was due to differences in stops. Of the total variation, 70.7 per cent was between days and 24.9 per cent, residual or unknown. The regression of daily average crows on wind velocity (b) was 1.6 and r^2 (percentage of daily variation due to wind velocity differences) was 69. Wind velocities (Table 2) were obtained from the CAA station at Hill City, Kansas.

Table 2. Results of the cock crowing count census index taken during the spring of 1958.

Date	Stop No.										Wind Velocity (kts)
	1	2	3	4	5	6	7	8	9	10	
6-12	9	7	14	12	6	10	18	17	12	8	12
6-13	5	3	12	4	11	0	3	2	1	2	12
6-14	4	2	3	0	3	3	3	1	3	6	18
6-15	4	20	31	24	23	6	10	11	25	5	10
6-16	10	25	20	33	26	25	11	14	16	12	8
6-17	14	20	19	37	31	33	22	21	25	21	6
6-24	0	2	3	7	4	10	2	4	4	3	10
6-25	20	26	30	31	27	29	31	26	21	32	3
6-26	15	21	16	14	12	20	23	20	18	19	4
6-27	12	18	13	17	19	13	20	13	16	10	7

Table 3. Analysis of variance on pheasant crowing count census index.

Source	d.f.	S.S.	M.S.	F.	Σ(MS)
Stops	9	620.1	68.9		$\sigma^2_r + 10\ \sigma^2_s$
Days	9	6577.5	730.9		$\sigma^2_r + 10\ \sigma^2_d$
Residual	81	2005.8	24.8	29.4**	σ^2_r

Kimball (1949) found the crowing cock count censusing index applied equally well to a small area or an entire state, and to low as well as high populations.

A random sampling landowner survey was made on 28 September, 1958 Table 4). Questions asked included acreage under cultivation, comparison with total population of previous year, (if smaller, the same, or larger), and total estimated population. From these figures could be computed acres per bird on the various acreages. A statistical comparison of the ten values (acres per bird) of the landowner survey with the five pre-hunting season field counts of 1958 (acres per bird) gave a t value of 1.39 (probability of a larger value of t equals .19).

Table 4. Results of ten landowner interviews.

Acreage under cultivation	Comparison with total population of previous year	Brood size comparison	Total est. population	Acres per bird
240	+	+	100	2.4
480	+	+	200	2.4
600	+	+	500	1.2
320	+	+	200	1.6
720	+	0	200	3.6
1300	+	+	400	3.2
560	+	0	100	5.6
700	+	+	200	3.5
720	+	+	200	3.6
320	+	+	100	3.2
5960			2200	2.7

+ = increase
0 = no change

Sex ratios were computed from field counts and quadrat counts in 1957 and from field counts alone in 1958. The pre-hunting season 1957 sex ratio of 62 per cent cocks and 38 per cent hens was unbalanced. The reduction of pheasants caused by hunting season kill changed the ratio to 41 per cent cocks and 59 per cent hens. The 1958 pre-hunting season ratio was 53 per cent cocks and 47 per cent hens, becoming 36 per cent cocks and 64 per cent hens after the hunting season reduction.

HUNTING SEASON

In 1957, the primary study area was posted each quarter mile of the perimeter. The posters stated that the area could be hunted but hunting information was requested. This writer spent each day of the hunting season patrolling the perimeter of the study area and contacting all individuals hunting on the area. In addition other

hunters driving by the area were stopped and information concerning kill, hours hunted, number of hunters in their party, cripple loss and hen kill, was requested. The validity of the hen kill data (Tables 5, 6) is unknown as this information is extremely difficult to obtain. In every instance hunters appeared extremely reluctant to acknowledge the shooting of a hen pheasant.

Table 5. Results of hunter interviews of 1957 pheasant hunting season.

Date	No. of parties	No. of individuals	Man-hours hunted	Cock kill	Per cent of total kill	Cripple loss	Hen kill
11-9	A 16	37	40	9	100	5	1
	B 13	51	279	61	76	12	2
11-10	A 6	25	16	0	0	0	0
	B 11	43	144	12	15	8	0
11-11	A 1	5	2.5	0	0	0	1
	B 6	26	109.5	7	9	3	0
Totals	A 23	67	58.5	9	100	5	2
	B 30	120	532.5	80	100	23	2

A-Hunters contacted on study area.
B-Hunters contacted on other areas.

In 1958 the study area was not posted, inasmuch as it was believed that a more random sampling would be obtained if the study area was not advertised as being part of a pheasant study project.

In 1957, 67 hunters spent a total of 58.5 hours hunting on the primary study area and killed nine cocks, two hens, and lost five cripples (Table 5). In 1958, 62 hunters were contacted on the study area. These individuals, in hunting 49.7 hours, killed 14 cocks, three hens, and lost six cripples (Table 6). In 1957, 120 hunters

who had hunting returns from areas other than the square-mile study area, were interviewed. These individuals, in hunting 532.5 hours killed 80 cock pheasants. In 1958, 188 similar hunters were contacted. In killing 267 cock birds, they had hunted a total of 804 hours. On the different areas during the two hunting seasons, crippling rates varied between 23 and 55 per cent of the kill.

Table 6. Results of hunter interviews of 1958 pheasant hunting season.

Date		No. of parties	No. of individuals	Man-hours hunted	Cock kill	Per cent of total kill	Cripple loss	Hen kill
11-7	A	7	26	17.5	10	71	8	3
	B	26	117	579	200	75	42	6
11-8	A	5	19	17.25	2	14	0	0
	B	12	41	141	46	17	10	3
11-9	A	3	8	4.5	0	0	1	0
	B	6	18	44	13	5	7	1
11-10	A	2	9	10.5	2	14	1	0
	B	4	12	40	8	3	4	1
Totals	A	17	62	49.7	14	100	6	3
	B	48	188	804	267	100	63	11

A-Hunters contacted on study area.
B-Hunters contacted on other areas.

Tables 7, 8, 9, and 10 are comparisons of hunter success in 1957 and 1958, on the study area and other areas. The average time per kill was considerably reduced in 1958; from 6.5 hours on the study area in 1957 to 3.1 hours in 1958 and an average time per kill of 6.6 hours on other areas in 1957 to 3.0 hours in 1958. No hunters were located on the last day of either the 1957 or 1958 hunting season.

In Tables 7, 8, 9, and 10, the average values for kill per hunter, time hunted per hunter, and cripples per hunter, are average daily values.

Table 7. Hunter success on study area during 1957 pheasant hunting season.

Date	Average time per kill	Kill per hunter	Time hunted per hunter	Cripples per hunter
11-9	4.4 (hours)	.24	1.1 (hours)	.14
11-10	- -	0	.6	0
11-11	- -	0	.5	0
11-12	- -	0	0	0
Total average	6.5	.13	.8	.07

Table 8. Hunter success on study area during 1958 pheasant hunting season.

Date	Average time per kill	Kill per hunter	Time hunted per hunter	Cripples per hunter
11-7	1.7	.38	.6	.15
11-8	8.6	.10	.9	0
11-9	- -	0	.6	0
11-10	5.2	.22	1.1	.11
11-11	- -	0	0	0
Total average	3.1	.22	.7	.08

Table 9. Hunter success on other areas during 1957 pheasant hunting season.

Date	Average time per kill	Kill per hunter	Time hunted per hunter	Cripples per hunter
11-9	4.6	1.19	5.5	.23
11-10	12.0	.28	3.2	.18
11-11	15.6	.26	4.2	.12
11-12	- -	0	0	0
Total average	6.6	.66	4.4	.19

Table 10. Hunter success on other areas during 1958 pheasant hunting season.

Date	Average time per kill	Kill per hunter	Time hunted per hunter	Cripples per hunter
11-7	2.8	1.71	4.9	.35
11-8	3.1	1.12	3.1	.24
11-9	3.4	.72	2.4	.39
11-10	5.0	.66	3.3	.33
11-11	- -	0	0	0
Total average	3.0	1.42	4.3	.33

Table 11 is a tabulation of Kansas hunting season dates, counties open to hunting, bag limits, possession limits, and pheasant and egg releases during the various years.

As accurately as can be determined, pheasants were first released in Kansas in 1905. There were subsequent releases and by 1917 the population of P. colchicus had reached the level whereby it was possible to declare a hunting season.

Table 11. Tabulation of data on hunting seasons and pheasant stocking in Kansas

Year	Hunting season dates	Counties	Bag Limit	Possession Limit	Pheasants released	Eggs
1958	Nov. 7-11	58	4	8		
1957	Nov. 9-12	58	3	6	17,500	
1956	Nov. 3-5	55	3	6	24,500	
1955	Oct. 21-31	59	3	6	28,357	
1954	Nov. 6-15 A	62	3	6	31,894	
1953	Nov. 7-16	62	3	6	23,869	
1952	Oct. 24-Nov. 2	60	3	6	24,830	
1951	Nov. 14,16,17,18	51	3	6	25,000	
1950	Nov. 9,11,12,13	48	3	6	43,720 C	
1949	Oct. 29-31	44	3	6		
1948	Nov. 5-7	47	3	6	42,710 C	
1947	Oct. 30-Nov. 3 A	47	3	6		
1946	Nov. 7-11 A	47	3	6	21,110 C	
1945	Nov. 1-5 A	39	3 B	6		
1944	Oct. 26-29 A	38	3	6	14,660	
1943	Nov. 8-14 A	21	3	6	13,785	
1942	Nov. 8-11 A	21	3	6	16,500	
1941	Oct. 27-29	21	3 B	6	14,764	
1940	Nov. 1-3	21	3 B	6	7,500	
1939	Nov. 1-3	21	3 B	6	280	
1938						
1937					300	
1936						2,632
1935						4,019
1934					500	6,545
1933						6,715
1932					500	20,162
1931					5,575	33,310
1930					5,736	12,948
1929					2,264	10,221
1928						5,550
1927						3,980
1926					234	5,580
1925					1,332	6,090
1924					688	6,022
1923					288	4,030
1922					178	
1919	Dec. 1-10	105	10	10		
1917	Dec. 1-15	105	5	10		
1907					2,366	
1905					3,405	

A-afternoons only.
B-three cocks or two cocks and one hen.
C-for biennium ending on 30 June.

AGE DETERMINATION

Cock spurs were measured for an attempted aging, as to whether young of the year or older than one year. The spurs were measured from the point of the spur to the opposite side of the tarsus, with 19.5mm. being the point of demarcation between young of the year and birds older than one year. In 1957, 168 spur length measurements were taken from legs obtained from hunters contacted in the field and from pheasants that were being processed at the Norton, Kansas locker plant. In 1958, permission was granted by the Kansas Forestry, Fish and Game Commission to remove one leg and 309 pheasant legs were subsequently removed for later measurement in the laboratory.

Figures 4 and 5 are graphic representations of spur length measurements of 1957 and 1958. Figure 4 (1957) shows a definite decrease between 19 and 21mm. It therefore was assumed that pheasants with spur length measurements of 19mm. or less were young of the year, whereas those with spur lengths of 20mm. or more were older than one year.

Of the 168 spurs checked in 1957, there was none with a measurement of 24mm., whereas four measurements (two per cent of the total) were 25mm. or greater. This appears to indicate another yearly increment and these birds were probably older than two years. Of the total, 72 per cent had spur lengths of 19mm. or less and 26 per cent had measurements of 20mm. or greater, and less than 24mm. This indicates an age composition of 72-26-2 per cent of birds one-half, one and one-half, and two and one-half years old respectively.

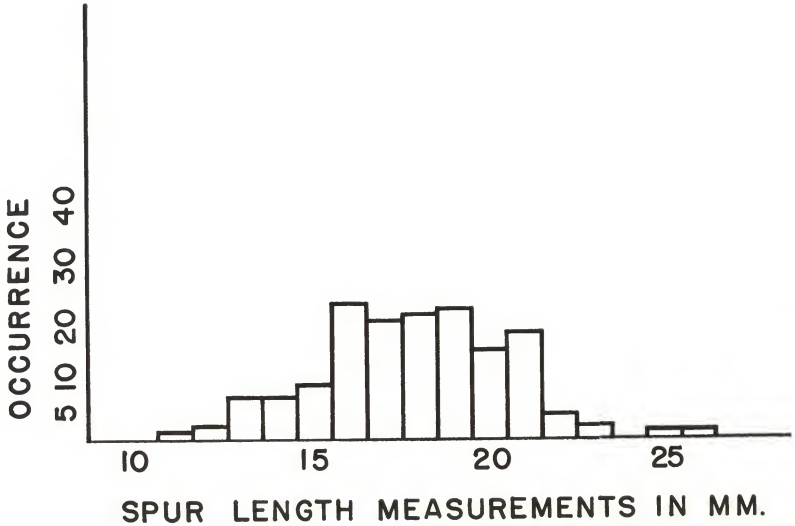


Fig. 4. Distribution of 168 spur length measurements of pheasants killed during the 1957 hunting season.

Leopold (1943) found in Wisconsin an age composition of 71-21-6-1-0 per cent of birds one-half, one and one-half, two and one-half, three and one-half, and four and one-half years old respectively, in a protected pheasant population (both cocks and hens). Likewise Leopold found the turnover period for cocks was three years and pheasants older than this were hens.

The distribution of spur length measurements in 1958 (Fig. 5) was almost binomial. Possibly the sample taken was too small, but more probably the discrepancy was caused by an unusual nesting season in 1958. Because of extreme snowfall during March of 1958 (24.4 inches) and subsequently an extremely wet topsoil in April, spring farming operations were restricted. When the farming operations were commenced, nesting was already well begun, thus producing much destruction of first nesting attempts.

NESTING SEASON

Nesting data were recorded during the spring and summer of 1958. A total of 44 harems was observed and of these 38 contained one cock and one hen, and six contained one cock and two hens. The sex ratio during this period was 41 per cent cocks and 59 per cent hens. This is an indication of a large cock surplus. Randall (1941) found with a spring sex ratio of one cock per seven hens that 94.1 per cent of eggs were fertile. Schick (1947) believed a spring sex ratio of one cock per ten to 12 hens was not out of proportion and Twining (1948) in a controlled test with a single cock mated to 50 hens found 75 per cent fertility.

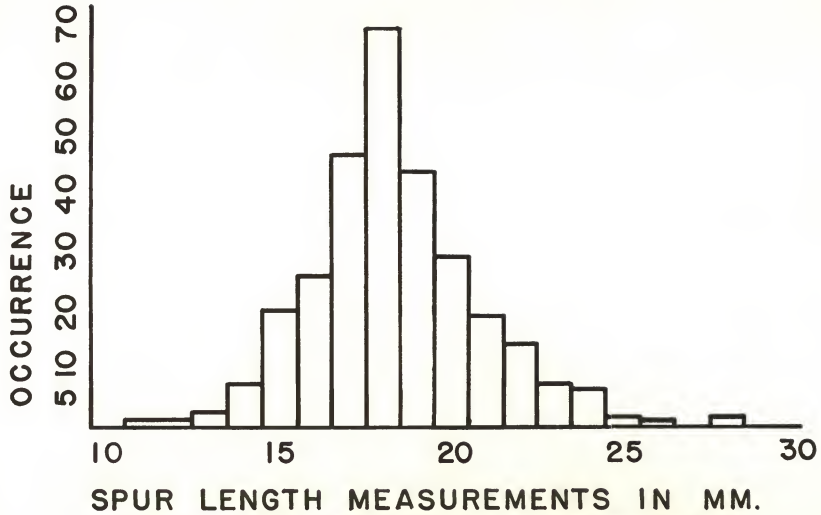


Fig. 5. Distribution of 309 spur length measurements of pheasants killed during the 1958 hunting season.

Various methods were used in attempting to locate pheasant nests. Dogs were of absolutely no value, as pheasant hens remaining upon a nest apparently gave off little or no "scent", and boyscouts were likewise of no value. The systematic search of a number of small areas provided data on only three nests. The method which provided any appreciable results whatsoever, was to contact various landowners and inform them to note the location of any nest seen during the cultivation of their land. By this method and the systematic search of a number of small areas, information was recorded on a total of 19 nesting attempts (Table 12). Of the total, 11 (58 per cent) were destroyed by some unknown predator or by land usage practice, or were deserted before hatching. Eight (42 per cent) had a partial or complete hatch. Twelve nests (63 per cent of the total) were found in stubble fields, three (16 per cent) in alfalfa, two (11 per cent) in perennial grasses, one in a cornfield, and one in a sweet clover field.

The average number of eggs, in all nests where an egg count was possible, was 10.1. The average number, in those nests that hatched, (partial or complete hatch) was 11.6.

A five point averaging (first five values averaged; numbers two, three, four, five and six averaged, etc.) of 139 broods seen during the spring and summer months of 1958 showed three distinct brood size apices (Fig. 6).

If the first or second nesting attempt of a hen pheasant is destroyed, the bird will renest. The increase in average brood size caused by second nesting attempts represented the population peak

Table 12. Pheasant nests located during the spring of 1958.

Nest Number	Number of eggs	Vegetation utilized	Hatched (partial or complete), deserted or destroyed
1.	8	Perennial grasses	Deserted
2.	14	Perennial grasses	Hatched
3.	11	Wheat stubble	Hatched
4.	5	Wheat stubble	Destroyed by plowing
5.	10	Alfalfa	Hatched
6.	3	Wheat stubble	Deserted
7.	13	Sweet clover	Deserted
8.	9	Cornfield	Hatched
9.	12	Alfalfa	Deserted
10.	8	Alfalfa	Deserted
11.	12	Wheat stubble	Destroyed by plowing
12.	10	Wheat stubble	Hatched
13.	12	Wheat stubble	Hatched
14.	15	Wheat stubble	Hatched
15.	unknown	Wheat stubble	Hatched (shells found)
16.	unknown	Wheat stubble	Destroyed by plowing
17.	unknown	Wheat stubble	Destroyed by plowing
18.	unknown	Wheat stubble	Destroyed by plowing
19.	unknown	Wheat stubble	Destroyed by plowing

present during mid-August. A third peak was present during the latter part of September and forepart of October.

FOOD HABITS

Crops were taken from 25 pheasants killed during the 1957 hunting season and an additional 100 crops were collected during the 1958 season. The crops were dried, the contents removed and the various foods identified. The volume of each individual food species or other material was recorded in cubic centimeters. Amounts less than one-tenth cubic centimeter were recorded as a trace. Materials such as seed coats, stems and straw were recorded as miscellaneous.

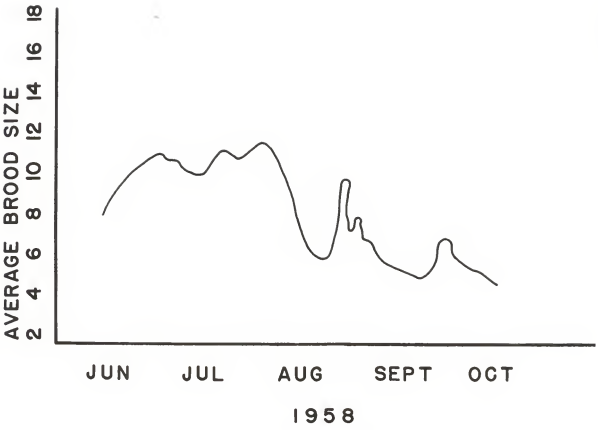


Fig. 6. Five point moving average of 139 broods seen during the summer and early fall of 1958.

To determine measurements of materials such as grasshopper and cricket bodies, an elimination method was used. The total volume was determined, and the various components removed and measured as to volume. By subtraction of the measureable volume from the total volume, the value for the irregularly shaped materials was determined. If only irregularly shaped materials were present in the crop the volume was estimated from previous known volumes of the content.

Table 13. Pheasant crop analyses of 1957.

Crop Number	Composition	Volumetric measurement	Total Volume
1.	Grain sorghum* (Sorghum vulgare)	.4 (cc.)	
	Cricket (Gryllus assimilis)	1.5	
	Sunflower (Helianthus assimilis)	.2	
	Curled dock (Rumex crispus)	Tr.	2.1 (cc.)
2.	Corn (Zea indentata)	6.0	6.0
3.	Grain sorghum	8.2	
	Grasshopper (Melanoplus spp.)	.5	
	Wild ground cherry (Physalis spp.)	Tr.	
	Pigweed (Amaranthus retroflexuus)	Tr.	
	Sunflower	Tr.	
	Grit	Tr.	8.8
4.	Grain sorghum	5.5	
	Miscellaneous	3.0	
	Grasshopper	.5	
	Corn	.5	
	Sunflower	Tr.	9.5
5.	Sunflower	Tr.	
	Grain sorghum	Tr.	Tr.
6.	Grain sorghum	4.9	
	Curled dock	Tr.	
	Ticklegrass (Panicum capilare)	Tr.	5.0
7.	Grain sorghum	.8	
	Pigweed	Tr.	
	Wild ground cherry	Tr.	
	Curled dock	Tr.	
	Ticklegrass	Tr.	
	Grit	Tr.	.9

Table 13 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
8.	Sunflower	Tr.	Tr.
9.	Grain sorghum	5.8	
	Grasshopper	4.0	
	Wheat (Triticum vulgare)	2.5	
	Wild ground cherry	Tr.	
	Pigweed	Tr.	12.4
10.	Grain sorghum	Tr.	
	Corn	Tr.	Tr.
11.	Corn	4.5	4.5
12.	Grasshopper	4.0	
	Corn	2.5	
	Sunflower	1.5	
	Cricket	1.0	
	Curled dock	.5	
	Wild ground cherry	Tr.	
	Ticklegrass	Tr.	9.5
13.	Empty		0
14.	Grain sorghum	2.8	
	Ticklegrass	Tr.	
	Curled dock	Tr.	2.8
15.	Grain sorghum	Tr.	Tr.
16.	Grain sorghum	.3	
	Sunflower	Tr.	.3
17.	Empty		0
18.	Sunflower	8.7	
	Cricket	.4	
	Pigweed	Tr.	9.1
19.	Grasshopper	.8	
	Curled dock	.2	
	Pigweed	Tr.	1.0
20.	Empty		0
21.	Sunflower	.4	
	Grain sorghum	Tr.	
	Pigweed	Tr.	.5

Table 13 (concl.)

Crop Number	Composition	Volumetric measurement	Total Volume
22.	Grasshopper	.4	
	Wild ground cherry	Tr.	
	Ticklegrass	Tr.	.5
23.	Grain sorghum	9.6	
	Sunflower	1.0	
	Cricket	.8	11.4
24.	Empty		0
25.	Sunflower	1.0	
	Wild ground cherry	.1	
	Grain sorghum	Tr.	
	Ticklegrass	Tr.	
	Pigweed	Tr.	1.2

* nomenclature given only on first recording of food species.

Table 14. Pheasant crop analyses of 1958.

Crop Number	Composition	Volumetric measurement	Total Volume
1.	Grain sorghum* (Sorghum vulgare)	9.0	
	Miscellaneous	Tr.	
	Grit	Tr.	9.1
2.	Wheat (Triticum vulgare)	9.6	
	Sunflower (Helianthus spp.)	.2	
	Wild ground cherry (Physalis spp.)	Tr.	
	Miscellaneous	Tr.	9.9
3.	Empty		0
4.	Corn (Zea indentata)	6.0	
	Sunflower	.3	
	Grain sorghum	.2	
	Pigweed (Amaranthus retroflexus)	Tr.	6.5
5.	Wheat	10.6	
	Sunflower	Tr.	10.6
6.	Empty		0
7.	Corn	7.0	7.0

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
8.	Wheat	3.3	
	Grain sorghum	Tr.	
	Feather (pheasant down)	Tr.	3.4
9.	Corn	9.5	
	Sunflower	Tr.	9.5
10.	Wheat	Tr.	
	Grain sorghum	Tr.	Tr.
11.	Grain sorghum	10.0	
	Sunflower	.3	
	Wild ground cherry	Tr.	10.3
12.	Grain sorghum	5.8	
	Miscellaneous	1.6	
	Wheat	1.6	
	Grasshopper (Melanoplus spp.)	1.0	
	Wild ground cherry	Tr.	
	Grit	Tr.	10.0
13.	Sunflower	2.1	
	Grasshopper	2.1	
	Miscellaneous	.3	
	Wheat	Tr.	
	Grit	Tr.	4.6
14.	Empty		0
15.	Wheat	7.9	
	Sunflower	.2	
	Grit	.1	
	Grain sorghum	Tr.	
	Ticklegrass (Panicum capillare)	Tr.	8.3
16.	Wheat	13.1	
	Sunflower	.1	
	Grain sorghum	Tr.	
	Curled dock (Rumex crispus)	Tr.	13.3
17.	Wheat	10.0	
	Grain sorghum	2.3	
	Miscellaneous	1.0	
	Grasshopper	.8	
	Wild ground cherry	.1	
	Sunflower	Tr.	
	Grit	Tr.	14.3

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
18.	Grain sorghum	7.7	
	Sunflower	.8	
	Ticklegrass	Tr.	
	Grit	Tr.	8.5
19.	Corn	13.0	
	Sunflower	2.9	
	Grain sorghum	Tr.	
	Pigweed	Tr.	
	Ragweed (Ambrosia coronopifolia)	Tr.	
	Wheat	Tr.	16.0
20.	Grain sorghum	6.2	
	Sunflower	.1	
	Pigweed	Tr.	
	Grit	Tr.	6.3
21.	Wheat	7.0	
	Miscellaneous	1.2	
	Grasshopper	.6	8.8
22.	Empty		0
23.	Miscellaneous	1.7	
	Sunflower	Tr.	
	Wheat	Tr.	1.7
24.	Grain sorghum	6.7	
	Wild ground cherry	Tr.	
	Sunflower	Tr.	
	Pigweed	Tr.	
	Grit	Tr.	6.8
25.	Wheat	2.1	
	Sunflower	.8	
	Grasshopper	.6	
	Pigweed	Tr.	
	Grit	Tr.	3.7
26.	Wheat	6.8	
	Sunflower	6.0	
	Grasshopper	.2	
	Swamp smartweed (Polygonum coccineum)	Tr.	
	Grit	Tr.	13.0
27.	Sunflower	.6	.6

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
28.	Sunflower	Tr.	
	Wheat	Tr.	
	Grit	Tr.	.1
29.	Wild ground cherry seed pod	1.0	
	Wheat	.2	
	Wild ground cherry	Tr.	
	Miscellaneous	Tr.	1.3
30.	Corn	2.0	
	Grain sorghum	Tr.	
	Wild ground cherry	Tr.	
	Ticklegrass	Tr.	2.1
31.	Grain sorghum	23.0	
	Ant (Monomorium minimum)	.2	
	Sterile sorghum florets	Tr.	
	Wild ground cherry	Tr.	
	Wheat	Tr.	23.3
32.	Corn	9.5	
	Wheat	.3	
	Miscellaneous	.2	
	Ticklegrass	Tr.	
	Sunflower	Tr.	10.0
33.	Grain sorghum	5.1	
	Wild ground cherry	.1	
	Ticklegrass	Tr.	
	Pigweed	Tr.	5.2
34.	Wild ground cherry	Tr.	
	Grain sorghum	Tr.	
	Sunflower	Tr.	
	Wheat	Tr.	.1
35.	Grain sorghum	25.9	
	Wheat	Tr.	
	Pigweed	Tr.	
	Lead shot	Tr.	
	Grit	Tr.	26.0
36.	Grain sorghum	13.0	
	Corn	6.0	
	Wild ground cherry seed pod	5.0	
	Wild ground cherry	2.5	26.5

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
37.	Wheat	1.9	
	Wild ground cherry seed pod	1.5	
	Sunflower	.6	
	Wild ground cherry	.1	
	Miscellaneous	.1	4.2
38.	Grain sorghum	12.4	12.4
39.	Empty		0
40.	Grain sorghum	9.5	
	Wheat	.4	
	Grit	Tr.	9.9
41.	Empty		0
42.	Grain sorghum	2.3	
	Sunflower	Tr.	
43.	Wheat	4.2	
	Sunflower	.8	
	Grit	.3	
	Wild ground cherry	Tr.	
	Miscellaneous	Tr.	5.4
44.	Sunflower	14.5	
	Wheat	1.3	
	Grasshopper	1.0	
	Pigweed	Tr.	16.8
45.	Grain sorghum	.2	
	Lead shot	Tr.	
	Sunflower	Tr.	
	Wild ground cherry	Tr.	.3
46.	Grain sorghum	4.3	
	Wheat	Tr.	
	Ant	Tr.	4.4
47.	Wheat	13.9	
	Grain sorghum	Tr.	
	Sunflower	Tr.	
	Grit	Tr.	14.0
48.	Wheat	4.2	
	Sunflower	.2	
	Lead shot	Tr.	4.4

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
49.	Lead shot	Tr.	Tr.
50.	Miscellaneous	.8	
	Grain sorghum	.2	
	Wild ground cherry	Tr.	
	Sunflower	Tr.	
	Wheat	Tr.	
	Grit	Tr.	1.1
51.	Empty		0
52.	Sudan grass (Sorghum sudanese)	1.9	
	Barley (Hordeum sativum)	1.2	
	Wheat	1.0	
	Corn	.4	
	Sunflower	Tr.	4.5
53.	Wheat	9.5	
	Alfalfa leaves (Medicago sativa)	5.5	
	Grasshopper	5.0	
	Sunflower	.1	
	Pigweed	Tr.	
	Grit	Tr.	
	Grain sorghum	Tr.	20.2
54.	Wheat	4.3	
	Miscellaneous	2.0	
	Sunflower	Tr.	6.3
55.	Wheat	24.4	
	Grain sorghum	Tr.	24.4
56.	Wheat	5.0	
	Grasshopper	1.5	
	Wild ground cherry	.2	
	Sunflower	.1	
	Pigweed	Tr.	6.8
57.	Wheat	15.5	
	Corn	10.0	
	Wild ground cherry seed pod	4.0	
	Sunflower	.6	
	Cricket (Gryllus assimilis)	.5	
	Snail (Physa)	.5	
	Wild ground cherry	.2	
	Grit	Tr.	31.3

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
58.	Grain sorghum	8.6	
	Wild ground cherry	.6	
	Sunflower	Tr.	
	Barley	Tr.	9.3
59.	Sunflower	5.5	
	Grasshopper	.5	6.0
60.	Empty		0
61.	Grain sorghum	3.4	
	Wild ground cherry seed pod	.5	
	Wild ground cherry	Tr.	
	Sunflower	Tr.	
	Wheat	Tr.	
	Grit	Tr.	4.0
62.	Wheat	19.7	
	Sunflower	.1	
	Wild ground cherry	Tr.	
	Ticklegrass	Tr.	19.8
63.	Corn	9.5	
	Barley	1.9	
	Stinkbug (Mezara viridula)	.2	
	Miscellaneous	.1	
	Wheat	Tr.	11.7
64.	Grain sorghum	2.0	
	Sunflower	Tr.	2.0
65.	Wheat	1.6	
	Sunflower	.1	1.7
66.	Grain sorghum	9.0	
	Ticklegrass (1379 seeds)	2.6	
	Wild ground cherry	.1	
	Sunflower	Tr.	
	Pigweed	Tr.	11.8
67.	Wheat	4.1	
	Corn	2.3	
	Sunflower	Tr.	6.4
68.	Wild ground cherry	Tr.	
	Grit	Tr.	Tr.

Table 14 (cont.)

Crop Number		Volumetric measurement	Total Volume
69.	Grain sorghum	3.8	
	Wild ground cherry seed pods	1.5	
	Wild ground cherry	.2	
	Pigweed	Tr.	
	Wheat	Tr.	5.5
70.	Grain sorghum	13.0	
	Grasshopper	.3	
	Ticklegrass	Tr.	
	Sunflower	Tr.	13.4
71.	Empty		0
72.	Sunflower	.5	
	Pigweed	Tr.	
	Grit	Tr.	
	Grasshopper	Tr.	.6
73.	Grain sorghum	4.0	
	Wheat	1.0	
	Sunflower	Tr.	5.0
74.	Corn	5.5	
	Grain sorghum	2.8	8.3
75.	Grasshopper	.3	
	Sunflower	.1	
	Wild ground cherry	Tr.	
	Wheat	Tr.	.5
76.	Grasshopper	.5	
	Wheat	.4	
	Grain sorghum	.2	
	Wild ground cherry	.1	
	Sunflower	Tr.	1.2
77.	Grain sorghum	2.6	
	Wheat	1.8	
	Wild ground cherry seed pod	.5	
	Wild ground cherry	.3	
	Grasshopper	.2	
	Sunflower	Tr.	
	Pigweed	Tr.	5.4
78.	Grain sorghum	2.7	
	Grasshopper	2.5	
	Wild ground cherry	Tr.	
	Ticklegrass	Tr.	
	Pigweed	Tr.	
	Wheat	Tr.	5.3

Table 14 (cont.)

Crop Number	Composition	Volumetric measurement	Total Volume
79.	Grain sorghum	13.4	
	Wheat	.9	
	Wild ground cherry seed pod	2.0	
	Wild ground cherry	.5	
	Pigweed	Tr.	16.6
80.	Sunflower	Tr.	
	Wild ground cherry	Tr.	Tr.
81.	Grain sorghum	.1	
	Sunflower	.1	
	Wheat	.1	
	Wild ground cherry	Tr.	
	Grit	Tr.	.4
82.	Grain sorghum	.6	
	Sunflower	.1	.7
83.	Empty		0
84.	Wheat	4.6	
	Sunflower	Tr.	4.6
85.	Grain sorghum	4.6	
	Sunflower	Tr.	
	Wheat	Tr.	4.7
86.	Corn	9.0	
	Wheat	.3	9.3
87.	Wheat	6.4	
	Sunflower	.9	
	Grain sorghum	.6	
	Lead shot	Tr.	7.9
88.	Corn	1.5	
	Grain sorghum	Tr.	
	Sunflower	Tr.	1.6
89.	Wheat	2.6	
	Miscellaneous	.2	
	Grain sorghum	.1	
	Sunflower	Tr.	2.9

Table 14 (concl.)

Crop Number	Composition	Volumetric measurement	Total Volume
90.	Grain sorghum	4.3	
	Miscellaneous	3.9	
	Curled dock	Tr.	
	Pigweed	Tr.	
	Wheat	Tr.	
	Snail	Tr.	8.3
91.	Grain sorghum	3.6	
	Sunflower	Tr.	
	Pigweed	Tr.	
	Wheat	Tr.	3.7
92.	Sunflower	.5	
	Corn	.2	
	Ladybug beetle (Hippodamia convergens)	Tr.	
	Wheat	Tr.	.8
93.	Empty		0
94.	Wild ground cherry	Tr.	
	Grain sorghum	Tr.	
	Sunflower	Tr.	Tr.
95.	Grain sorghum	Tr.	
	Wheat	Tr.	Tr.
96.	Corn	4.0	
	Grasshopper	.3	
	Grain sorghum	.2	
	Wild ground cherry	.1	
	Sunflower	Tr.	
	Wheat	Tr.	4.6
97.	Grain sorghum	Tr.	
	Sunflower	Tr.	
	Wheat	Tr.	.1
98.	Wheat	3.2	
	Wild ground cherry	Tr.	
	Sunflower	Tr.	3.2
99.	Grain sorghum	5.4	
	Sunflower	.2	
	Wild ground cherry	.1	5.7
100.	Sunflower	.4	
	Grit	.1	
	Wild ground cherry	Tr.	
	Grain sorghum	Tr.	
	Wheat	Tr.	.6

In both 1957 and 1958, grain sorghums made up the largest percentage by volume (44 per cent in 1957 and 38 per cent in 1958) of the total crop contents. In 1957, corn ranked second and sunflower seeds third (Tables 15, 16). Wheat ranked second in percentage by volume in 1958 and corn ranked third.

The average total volumetric measurement of the 15 crops taken during the 1957 hunting season was 3.4 cubic centimeters. The 100 crops taken during the 1958 hunting season averaged 6.1 cubic centimeters.

Table 15. Analysis of 25 crops collected during the 1957 hunting season.

Crop contents	Cubic cc.	Per cent by volume	Per cent by occurrence
Grain sorghum (Sorghum vulgare)	38.1	44.5	52
Corn (Zea indentata)	13.5	15.8	20
Sunflower (Helianthus spp.)	12.9	15.1	44
Grasshopper (Melanoplus spp.)	10.7	12.5	24
Cricket (Gryllus assimilis)	3.7	4.3	20
Wheat (Triticum vulgare)	2.5	2.9	4
Curled dock (Rumex crispus)	.8	.9	24
Wild ground cherry (Physalis spp.)	.2	.2	28
Ticklegrass (Panicum capillare)	.1	.1	24
Pigweed (Amaranthus retroflexus)	.1	.1	24
Grit	.1	.1	8
Miscellaneous	3.0	3.5	4
	85.7	100.0	

Grain sorghums ranked first in occurrence in 1957. Sunflower seeds ranked second (Table 15). In 1958, sunflowers ranked first, wheat was second and grain sorghums third (Table 16).

Four crops, of the 25 examined in 1957, were empty and 11 of the 100 analyzed in 1958 were likewise. One crop examined in 1958

Table 16. Analysis of 100 crops collected during the 1958 hunting season.

Crop Contents	Cubic cc.	Per cent by volume	Per cent by occurrence
Grain sorghum (Sorghum vulgare)	233.8	38.4	55
Wheat (Triticum vulgare)	177.5	29.2	61
Corn (Zea indentata)	95.4	15.7	16
Sunflower (Helianthus spp.)	39.9	6.6	63
Grasshopper (Melanoplus spp.)	17.9	2.9	8
Wild ground cherry seed pod (Physalis spp)	13.0	2.1	18
Alfalfa leaves (Medicago sativa)	5.5	.9	1
Ticklegrass (Panicum capillare)	2.8	.5	9
Wild ground cherry (Physalis spp.)	2.6	.4	36
Barley (Hordeum sativum)	1.9	.3	3
Sudan grass (Sorghum sudanese)	1.9	.3	1
Grit	1.0	.2	23
Snail (Physa)	.5	.1	2
Cricket (Gryllus assimilis)	.5	.1	1
Pigweed (Amaranthus retroflexus)	.3	+	18
Ant (Monomorium minimum)	.2	+	2
Stink bug (Nezara viridula)	.2	+	1
Lead shot	.2	+	5
Curled dock (Rumex crispus)	.1	+	3
Ground beetle (Harpalus caliginosus)	.1	+	1
Feather (Pheasant down)	Tr.	+	1
Ragweed (Ambrosia coronopifolia)	Tr.	+	1
Ladybug beetle (Hippodamia convergens)	Tr.	+	1
Smartweed (Polygonum coccineum)	Tr.	+	1
Sterile sorghum florets	Tr.	+	1
Miscellaneous (sorghum leaves, wheat straw)	12.3	2.0	16
Totals	607.7	100.0	

contained 1379 ticklegrass seeds, 253 grain sorghum seeds, 46 wild ground cherry seeds, 13 pigweed seeds and one sunflower seed. The total volumetric measurement was 11.8 cubic centimeters and the crop contained 1692 individual seeds (Crop no. 66, Table 14).

Eleven crops were taken from pheasants killed during a time of the year other than the hunting season. When pheasant roadkills were found in good condition, the crop was removed and the contents analyzed. Most roadkills were found to be empty or nearly so, indicating

possible movement towards a feeding area when run down by an automotive vehicle. The only apparent difference in crop contents between roadkills and hunting season kills was the persistent presence in roadkills (in those that contained any food materials whatsoever) of grit. Grit was present in only eight per cent of hunting season kills in 1957 and 23 per cent in 1958.

COYOTE PREDATION

An attempt was made to determine coyote predation on the pheasant in Norton County. Coyote feces were collected while doing field work. They were allowed to dry and when in a completely dry condition were broken apart to determine content. No evidence was found of pheasant remains in 2.25 pounds of dried feces. Much evidence was found of rabbits, mice, rats and certain beetles.

Coyotes undoubtedly do decimate a portion of the pheasant population, particularly immediately after the hunting season when many pheasants have been crippled. No coyote scats were collected immediately after either the 1957 or 1958 hunting seasons.

From the results of the coyote scats examined, it was believed that coyotes were not responsible for any appreciable predation on the pheasant population in Norton County.

ROADKILLS

A total of 48 roadkills was recorded during 9100 miles of driving in Norton County, during the 21 months of this project. This is a

yearly average value of one roadkill per 191 miles of paved roads. The roadkills were recorded by either the author or Clyde Ukele, game protector from Norton, Kansas. Of the total, 38 were cock birds and ten were hens. The incidence of roadkills was extremely variable and appeared to be much higher during the winter months than during the summer months.

PARASITISM OF THE INTESTINAL TRACT

During the 1957 hunting season 25 intestinal tracts were taken for parasitological examination. During the 1958 season a similar number was collected.

Fifteen pheasant intestinal tracts (60 per cent of the total) collected during the 1957 hunting season contained the cecal ascheIminth Heterakis gallinarum, Gmelin. There was almost complete infection (92 per cent of the total) in 1958 by H. gallinarum and two (eight per cent of the total) were infected with the cestode Choanotaenia infundibulum, Bloch (Plate II, Fig. 1).

Pheasant parasites reported by other authors in the United States include Heterakis isolonche (Beaudette, 1942) Dispharynx spiralis, Molin (Goble and Cheatum, 1943), Prosthogonimus macrorchis, Macy (Gower, 1939), Hexamita sp. (Hinshaw and McNeil, 1942), Cytodites nudus, Vizioli, Davainea proglottina, Davaine, Goniocotes gallinae, Nitzsch, Syngamus trachea, Montagu, Trichostrongylus tenuis, Mehlis (Lapage, 1956), Oxyspirura petrowi, Cobbold (McClure, 1949), and Echinoparyphium recurvatum, Linstow, Echinoparyphium contiguum, Dietz, and Eimeria phasiani (Olsen, 1938).

SUMMARY

The pheasant is a native species of Asia. About the tenth century B.C. pheasants were imported into Europe. According to the literature, the first introduction into the United States was in 1790, when several pairs were transported from England to New Hampshire. Pheasants were not successfully established in the United States until 1881 and 1882. From an original release of 28 Chinese ring-necked pheasants in the Willamette Valley in Oregon, it was possible to harvest an estimated quarter million birds during a two and one-half month hunting season in 1892.

Introductions of the pheasant into Kansas began in 1905 and the first hunting season declared in 1917.

This study was undertaken to increase the small amount of information concerning the habits and attributes of the pheasant in Kansas. Known previous research in Kansas includes one graduate student research project in Hamilton County in 1951, one state survey by the Kansas Forestry, Fish and Game Commission in 1953, and yearly game warden-landowner interviews concerning population decrease or increase.

Study on the ecology of the ring-necked pheasant in northwestern Kansas extended over a period of 21 months (September, 1957 to May, 1949). Field work was conducted principally in Norton County. Norton County was selected because of its relatively constant high pheasant population. A primary study area was located in the northwestern portion of Norton County. The section designation was R22E, S14.

Four census methods were compared and evaluated. A twenty-mile roadside count route was established in Norton County and this route

was censused during the fall months of 1957 and 1958. The 1958 roadside counts gave indication of more than 100 per cent increase over the 1957 fall population. According to the 1957 roadside counts, the fall population apparently was almost stationary. There was indication of an actual increase in population after the 1957 hunting season. The indication of increase was caused by post-hunting season removal of a large proportion of the grain sorghum crop. After the grain sorghum crop was removed pheasants were more readily seen. Both the 1957 and 1958 roadside counts attested to a significant early winter decrease. It is doubtful whether this decrease was as great as indicated and more probably a smaller percentage of the total pheasant population was seen during the early winter counts. From late fall until early spring much of the daily activities of individual pheasants is with others of the species in what is termed "winter concentrations". While the pheasants are in the larger winter groups there apparently is less noticeable daily movement by or near roadsides.

The second censusing method used was a quadrat sampling inventory covering 55 acres of the study area. The average value of five pre-hunting season quadrats was 5.6 pheasants per quadrat (65 when expanded to study area acreage) and the value of seven post-hunting season quadrats was 4.0 (46 when expanded to study area acreage).

The cock crowing count index was used during the spring of 1958. The cock crowing count is not an actual censusing method but is a method giving average total population index values. Pheasant crows were recorded for two minute periods each two miles of the 20-mile roadside count route. Of the total variation in the results, 4.4 per cent was due to differences in stops, 70.7 per cent was between

days and 24.9 per cent residual or unknown. The percentage of daily variation due to wind velocity differences was 69.

Field counts were made on the study area before and after both the 1957 and 1958 hunting seasons. In 1958, four smaller tracts were also censused before and after the hunting season. The 1957 pre-hunting season field count on the primary study area located 59 pheasants (10.8 acres per pheasant), and the post-hunting season count located 44 (14.5 acres per pheasant). In 1958, there was a pre-hunting season field count variation in acres per pheasant (on the five areas censused) between 2.5 and 5.8. The variation on the same areas after the hunting season was between 4.0 and 10.3 acres per pheasant.

A landowner interview made during September of 1958 showed that all landowners interviewed believed the total pheasant population was greater in 1958 than 1957. Eight out of ten landowners believed that average brood sizes in 1958 were larger than in 1957. After averaging, population density was 2.7 acres per pheasant (range between 1.2 and 5.6 acres per pheasant).

In both 1957 and 1958 all individuals hunting on the study area were contacted immediately after the end of their hunt. In addition other hunters driving by the area were stopped and information requested concerning kill, hours hunted, number of hunters in their party, cripple loss and hen kill.

In 1957, 67 hunters spent a total of 58.5 hours hunting on the study area and killed nine cocks, two hens and lost five cripples. In 1958, 62 hunters spent 49.7 hours hunting on the study area and killed 14 cocks, three hens and six cripples. In 1957, 100 per cent of the total cock kill on the study area was on the opening day of

the hunting season. In 1958, 71 per cent of the total cock kill was on opening day.

In 1958, 120 hunters contacted outside the study area, in hunting a total of 532.5 hours killed 80 cock birds and lost 23 cripples. In 1958, 188 hunters killed 267 cocks and lost 63 cripples while hunting 804 hours. In 1957, 76 per cent of the kill (not on study area) was on opening day. In 1958 the hunting pressure was almost identical, being 75 per cent. The average hunting success on the study area in 1957 was 6.5 hours per kill, and 1958 was 3.1 hours per kill. On other areas there was a similar reduction in average time per kill from 1957 to 1958, requiring 6.6 hours in 1957 and 3.0 hours in 1958. During both years cripple losses averaged 26 per cent of the total kill.

Using the spur length method of aging, 168 spurs were measured in 1957 and 309 in 1958. In 1957, 72 per cent of those checked were less than one year old (spurs less than 19.5mm. in length) and in 1958 indications were that 73 per cent were young of the year.

A total of 44 harems was observed during the spring and summer of 1958, and of the total 38 contained one cock and one hen and the remaining six contained one cock and two hens. Nineteen nests were located during the spring and summer of 1958. Of the total, 11 (58 per cent) were completely destroyed by some unknown predator or by a land usage practice or they were deserted before hatching. Eight (42 per cent) had a partial or complete hatch. Twelve nests (63 per cent) were found in stubble fields, three (16 per cent) in alfalfa, two (11 per cent) in perennial grasses, one in a cornfield and one in a sweet clover field.

The average number of eggs, in all nests where an egg count was possible, was 10.1. The average number, in those nests that hatched (partial or complete hatch) was 11.6.

Contents of 25 crops were analyzed from pheasants killed during the 1957 hunting season, and during the 1958 season an additional 100 were collected. In both 1957 and 1958, grain sorghums made up the largest percentage by volume of the total crop contents. Corn and sunflower seeds ranked second and third in 1957, while wheat and corn ranked second and third in 1958. Grain sorghums ranked first in occurrence in 1957 with sunflower seeds ranking second. In 1958, sunflower seeds were first and wheat second in occurrence. Four crops, of the 25 examined in 1957, were empty and 11 out of the 100 analyzed in 1958 were likewise. Grit was present in eight per cent of hunting season kills in 1957 and 23 per cent in 1958.

Coyote feces were examined in attempting to determine possible coyote predation. No conclusive evidence was found to substantiate belief of any appreciable coyote predation on the pheasant population in Norton County.

A total of 48 roadkills was recorded, while driving 9100 miles in Norton County during the 21 months of this project. The average incidence of roadkills was one per 191 miles of paved roads. Of the 48 kills, 38 were cock birds and ten were hens.

Parasitic infection of the intestinal tract was determined by removing and examining 50 intestinal tracts. In 1957, only Heterakis gallinarum, Gmelin, was present in those examined and 15 (60 per cent) contained the parasite. In 1958, 23 contained H. gallinarum (92 per cent) and two (eight per cent), contained Choanotaenia infundibulum, Bloch.

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APPENDIX

EXPLANATION OF PLATE I

Fig. 1. The Ring-necked Pheasant, adult cock.

PLATE I

Fig. 1.

EXPLANATION OF PLATE II

Fig. 1. Photomicrograph of scolex and anterior proglottida of *Choanotaenia infundibulum*. Magnification 78X.

PLATE II

Fig. 1.

EXPLANATION OF PLATE III

Fig. 1. View from south border of primary study area showing excellent fall food and cover on this area. Taken in October of 1958.

Fig. 2. A pair of satisfied hunters with returns of one morning's hunt. Taken November 7, 1958.

PLATE III

Fig. 1.

Fig. 2.

THE ECOLOGY OF THE RING-NECKED PHEASANT (*Phasianus colchicus*, Linnaeus) IN NORTHWESTERN KANSAS

by

JERVIS CHESTER ROWE

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Study of the ecology of the ring-necked pheasant (Phasianus colchicus, Linnaeus) in northwestern Kansas extended over a period of 21 months (September 1957 to May 1959). Norton County was selected as the locale of the study primarily because of its relatively constant high pheasant population. A primary study area of 640 acres (Section R225, S14) was selected in northwestern Norton county.

Four types of censusing methods were compared and evaluated. The 20-mile roadside count was used during the fall months of 1957 and 1958. The fall roadside counts of 1958 gave indication of more than 100 per cent increase in population as compared to the 1957 fall population. Quadrat sampling inventories on the study area during the fall and early winter of 1957 indicated an average pre-hunting season population of 65 pheasants on the 640 acre study area and 46 post-hunting season.

The cock crowing count index was used during the spring of 1958. Differences in daily wind velocities caused much variation in average daily results. Field counts were made on the study area in 1957, and in 1958 four additional areas were censused. Field counts indicated more than 100 per cent increase in population in 1958.

In 1957, 67 hunters spent 58.5 hours hunting on the study area and killed nine cocks, two hens and lost five cripples. In 1958, 62 hunters spent 49.7 hours hunting on the study area and killed 14 cocks, three hens and lost six cripples. In 1957, 120 hunters contacted outside the study area killed 80 cock pheasants and lost 23 cripples. In 1958, 188 hunters contacted outside the study area killed 267 cocks and lost 63 cripples.

Using the spur length method of aging, 72 per cent of the 1957 hunting season kill were found to be young of the year, and 73 per cent of the 1958 kill.

Of 19 nests located during the spring of 1958, 58 per cent were destroyed or deserted before hatching. The average clutch size was 10.1.

In both 1957 and 1958 grain sorghums comprised the greatest percentage by volume of all food materials. Grain sorghums ranked first by occurrence in 1957 and sunflower seeds first by occurrence in 1958.

No evidence was found of coyote predation on the pheasant in Norton County.

The average incidence of roadkills was one per 191 miles of paved roads.

The parasite Heterakis gallinarum was found in the intestinal tract of 1957 hunting season kills and in 1958, Heterakis gallinarum and Choanotaenia infundibulum.