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A COMPARISON OF COCK PHEASANT HARVESTS AMONG AREAS HAVING
DIFFERENT HUNTING PRESSURES, CACHE COUNTY, UTAH

by

James C. Bartonek

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

of

MASTER OF SCIENCE

in

Wildlife Biology

Approved:



UTAH STATE UNIVERSITY
Logan, Utah

1962

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James C. Bartonek

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INTRODUCTION

Problem

Parsons (1953) found Utah's posted hunting unit system regulated hunting pressures over much of the state's pheasant range. He found inequalities of hunting pressure among the posted hunting units because of their individualistic methods used to determine the number of hunting permits to be sold. Utah State Department of Fish and Game personnel recommend the number of permits to be sold by the hunting unit; but often, the hunting unit officers use the desired level of hunting pressure, size of cock harvest, and revenue from permit sales as decisive factors. By regulating hunting pressure on their own lands the posted hunting units thereby regulate the hunting pressure on adjacent nonposted lands by excluding the supernumerary hunters from their units.

With cock-only hunts, the best short-term management policy for pheasants is the full utilization of the surplus crop of cocks. In pheasant hunting studies conducted in various parts of Cache County, Utah, Stokes (1955) concluded that cock harvests ranging from 71 to 86 percent were nearly adequate, but Reynolds (1956) concluded that the cock harvests of 69 and 75 percents were inadequate in his study area. Some Utah game biologists are of the opinion that the state's total cock harvest is inadequate during the short season of from 3 to 7 days; however, adequate harvests are possibly obtained in certain local areas having high hunting pressure.

Objectives

The objectives of this study were (1) to compare hunting data and

the size of cock harvests among the areas selected for their extremes in hunting pressure and (2) to compare hunting pressures on posted hunting units with that found on nonposted land.

Study areas

Four areas in southern Cache County, Utah, were selected because of their anticipated extremes in hunting pressure: high hunting pressures on the Young Ward Posted Hunting Unit and the nonposted land lying south of Logan, and low pressures on the Hyrum and Wellsville Posted Hunting Units (Figure 1).

The huntable land in each of the four study areas is as follows: Young Ward Posted Hunting Unit, 7,200 acres; nonposted land south of Logan, 12,400 acres; Hyrum Posted Hunting Unit, 11,600 acres; and Wellsville Posted Hunting Unit, 16,000 acres.

Much of the land in the four study areas is under irrigation with principal crops being alfalfa and grass hays, wheat, barley, oats, corn, and sugar beets. The remaining land is either in dryland crops on the foothills, brush along the many small rivers and streams, or marsh vegetation scattered about the valley bottom.

Dates of study

This study was conducted during the periods from October 1959 to May 1960, and October 1960 to February 1961. Hunting data were collected during the two pheasant hunting seasons of November 7-11, 1959, and November 5-9, 1960.

Terminology

Certain terms used, hereafter, in the text are defined as follows:

1. "Unit" - Any of the posted hunting units organized under the

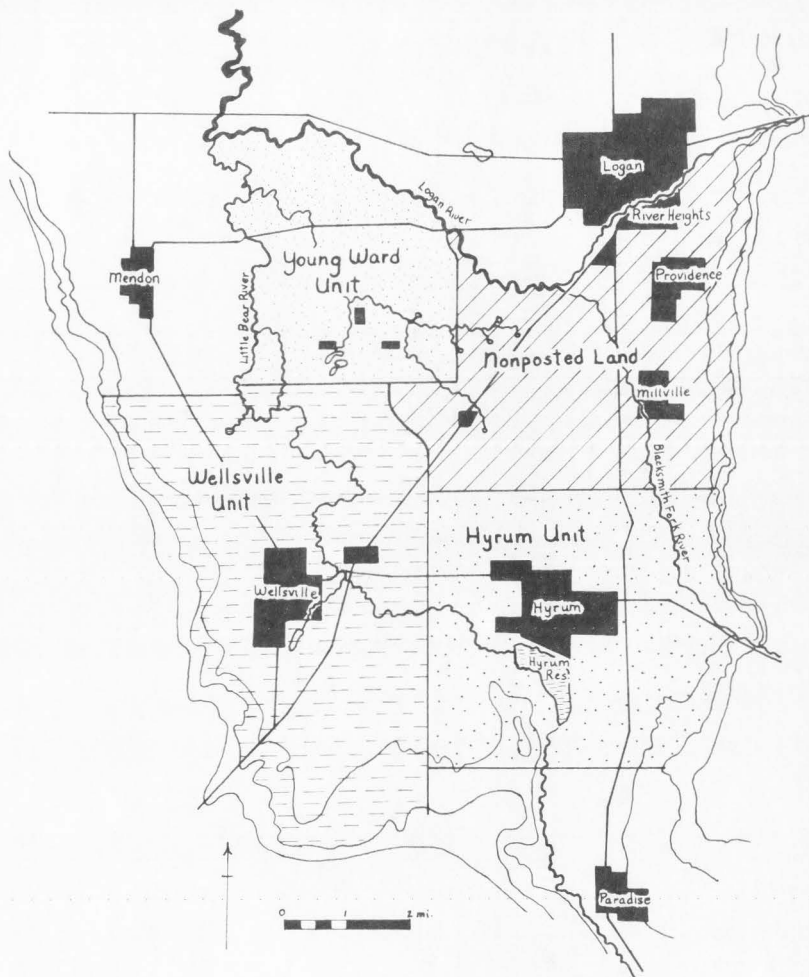


Figure 1. A map showing the locations of the four study areas, Cache County, Utah, 1959-60.

sanction of Utah State Law.

2. "Permit" - A permit purchased for trespass and hunting rights during the pheasant hunting season on a posted hunting unit. It is a paper tag that must be visibly worn while hunting.

3. "Nonposted Land" - That nonposted land lying south of Logan. It is further delimited by the boundaries shown on the map. This land is not included within any unit.

4. "Season" - The legal open-season for pheasant hunting.

REVIEW OF LITERATURE

Pheasant hunting and population studies are numerous. Among the more noted studies are those by Allen (1941), Nelson (1948), Ferrel et al. (1949), Harper et al. (1951), Shick (1952), Stokes (1954), Robertson (1956), and Mohler (1959). Friley (1954) studied daily patterns of hunting pressure. McAtee (1945) and Allen (1956) edited classic books containing the findings of many outstanding researchers.

In Utah, Rasmussen and McKean (1945) and Yeager et al. (1956) presented findings of studies made in the northern part of the state. Stokes (1955) studied cock harvests in the Young Ward and Benson Posted Hunting Units, and Reynolds (1956) studied the effect of season length on two comparable pheasant populations.

The use of aerial censuses of automobiles and hunters in the field to estimate hunter densities was demonstrated by Crissey (1949) in New York and by Ferrel et al. (1949) and Harper et al. (1951) in California.

The size of cock harvest can be estimated by using formulas presented by Kelker (1940) and Allen (1942b). Changes in pre- and postseason sex ratios provide an estimate of the percentage of harvest and when combined with bag data provide an estimate of the population size.

A great number of techniques have been used in determining the age of the cock pheasant. Those techniques which were perfected and are now in use with varying degrees of validity and reliability are those of spur characteristics as shown by Linduska (1943); the bursa of

Fabricius, Kirkpatrick (1944); and spur length and age gauge, Kimball (1944). Stokes (1957) cautions the use of spur length as a criterion in age determination.

Kimball (1949) developed the crowing count as a method for censusing spring cock populations. Zorb (1951) and Kozicky (1952) evaluated the influence of certain physical factors, such as weather, time of day, day of year, etc., on crowing counts. Carney and Petrides (1957) found that considerable bias occurred among individuals making crowing counts.

PROCEDURE

Hunting data

It was necessary to ascertain the hunting pressures on the areas of anticipated extremes in hunting pressure and to determine the hunting successes. The daily and total hunting data during the two seasons were determined from information obtained from hunting questionnaires and aerial censuses of automobiles.

Hunting questionnaires.--Hunting questionnaires on stamped, self-addressed postcards were used to obtain hunting pressure and bag data during the two seasons (Exhibit 1). The questionnaires were distributed to the hunters on the three units by attaching them to the permits; they were distributed to the hunters on the Nonposted Land during the course of hunter-contacts. Follow-up checks by letter and telephone of hunters failing to respond to the questionnaires were made shortly following both seasons.

Aerial censuses.--Aerial censuses of automobiles provided a comparative measure of hunter densities among the areas. The known numbers of hunters on the units, as determined from hunting questionnaire data and the known number of permits sold, were related to the densities of automobiles censused. This relationship provided a means of estimating the number of hunters on the Nonposted Land.

All vehicles, with the exceptions of buses, milk trucks, transports, and tractors, were included in the aerial censuses. The same flight pattern was flown each day during both years at a height of 800 - 1,200

feet above ground level. The flight time was scheduled so that censusing began over the first area at 8:00 a.m. on the opening day and at 7:30 a.m. on the remaining 4 days. Hunting legally began at 8:00 a.m. on the opening day and at 7:00 a.m. on the remaining 4 days. The flight times during the remaining 4 days of the season were one-half hour later than shooting times because of better light conditions.

The numbers of nonhunters' automobiles were estimated from aerial censuses conducted the day preceding and following the 1959 season and during a 5-day period corresponding with and beginning 1 week prior to the 1960 season.

Pheasant populations

The size of cock harvests and the total pheasant populations were estimated from bag data and changes in sex ratios (Kelker, 1940; Allen, 1942b). Daily cock age ratios from bag samples were obtained so that the effect of hunting pressure upon the vulnerability of year-classes might be evaluated. Relative densities of surviving cocks in spring were estimated by cock crowing counts.

Sex ratios.--Preseason sex ratio counts were conducted approximately 3 to 4 weeks before hunting. One or two persons, using from one to three dogs, conducted the counts by running or flushing the birds from cover. All birds observed were classified and recorded as cock, hen, or uncertain sex. The classification of "uncertain sex" was used only for juvenile birds which had not attained their postjuvinal plumage. In calculations, the sex ratio for the uncertain sex was assumed to be 1:1.

Postseason sex ratios were obtained through roadside and flushing counts of single and flocked birds. Counts were made during January and the first part of February when the birds had flocked together and snow

on the ground made them easily visible. Only the classifications of cock and hen were used for the postseason sex ratio counts.

Cock age ratios.--Cock age ratios from bag samples were determined for the four study areas during each day of the seasons so that the vulnerability of year-classes might be evaluated. Aging the cocks was done by the examination of gross spur characteristics as demonstrated by Linduska (1943). All aging was done by myself so that the biases between individuals and seasons were eliminated. I gained experience in aging through the examination of the bursa of Fabricius and spur of many cocks before and during the season.

Cock crowing counts.--Spring crowing counts, as described by Kimball (1949), were conducted within each of the four study areas during 1960 to provide indices relative of the surviving cock populations. All crowing counts were conducted by the same person to eliminate the bias between individuals.

RESULTS

Hunting questionnaires

During the 1959 and 1960 seasons, respectively, responses of 47.8 and 46.8 percents of the postcard hunting questionnaires issued were made by the hunters as initial or follow-up responses (Table 8). The follow-up response data, elicited by letters and telephone calls, differed from those of the initial response; therefore, all data for hunters failing to respond initially were assumed to be similar to those obtained from follow-up responses. The weighted questionnaire data used in determining hunting pressures, hunting successes, and estimates of the pheasant populations are presented in Tables 9 through 12.

An attempt was made to determine the number of hunters coming onto a unit and hunting without a permit, but it was abandoned because many hunters were reluctant to volunteer information that would admit their guilt of committing a misdemeanor (i.e., illegal trespass onto a legally posted hunting unit). Because the hunting data from this group of hunters are not included in the data presented in the findings, totals of hunting pressure, hunting success, and population estimates are underestimations of the true values. This conclusion is made assuming the questionnaire data are valid. The data, however, are still considered valid for making comparisons among study areas.

Responses to the hunting questionnaires show that many respondents did not hunt even one day on the unit for which they purchased a permit. During the two seasons, only 89 and 83 percents of the respondents receiving questionnaires in the Young Ward Unit hunted at least 1 day

on that area; corresponding percentages on the other areas were 94 and 100 percents on the Nonposted Land, 89 and 90 percents on the Hyrum Unit, and 95 and 93 percents on the Wellsville Unit. In part, percentages less than 100 percent can be attributed to the following: (1) nonhunters buying permits as a civic responsibility, (2) nonhunters receiving permits as token payment for including their lands within the unit's area, (3) hunters having two or more permits and hunting on some other area, and (4) hunters unable to go hunting because of various reasons.

Hunting pressures

Aerial censuses of automobiles.--Plotting the daily numbers of automobiles counted per 1,000 acres provided patterns of density which were similar to those expected for hunting pressure (Figures 2 and 3). Densities were highest during the opening weekend, particularly the opening day, and then dropped rapidly during the weekdays. Densities were highest on the Young Ward Unit with 20.0 and 21.4 automobiles per 1,000 acres on the opening days of the 1959 and 1960 seasons, respectively; corresponding densities for the other study areas were 13.8 and 11.8 on the Nonposted Land, 7.8 and 5.4 on the Hyrum Unit, and 6.6 and 6.0 on the Wellsville Unit (Table 13). The estimated numbers of hunters hunting per automobile censused on the units during the first day of both seasons were 3.43 and 2.74 on the Young Ward Unit, 2.44 and 3.84 on the Hyrum Unit, and 2.97 and 3.77 on the Wellsville Unit; from these values, the numbers of hunters hunting per automobile censused on the Nonposted Land were estimated to be 3.02 and 3.28.

Densities of automobiles censused during the nonhunting days were relatively low; yet, the differences among the areas were primarily caused by either the presence or absence of highway traffic. Censuses

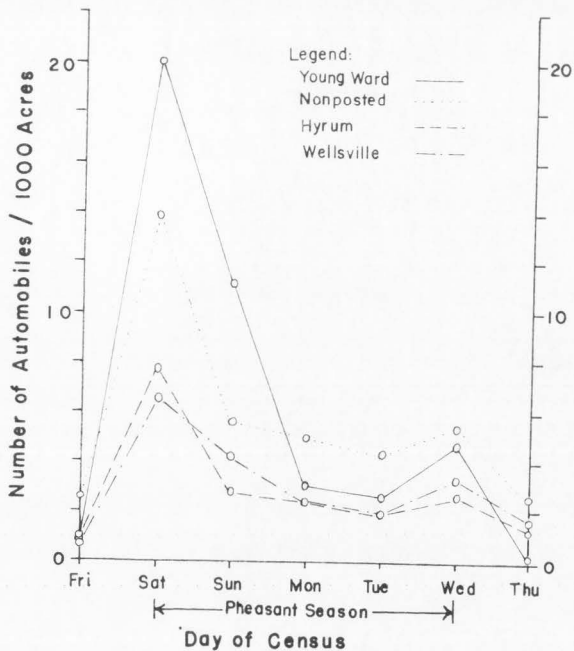


Figure 2. Densities of automobiles on four study areas as determined from aerial censuses conducted before, during, and after the pheasant hunting season November 6-11, 1959, Cache County, Utah.

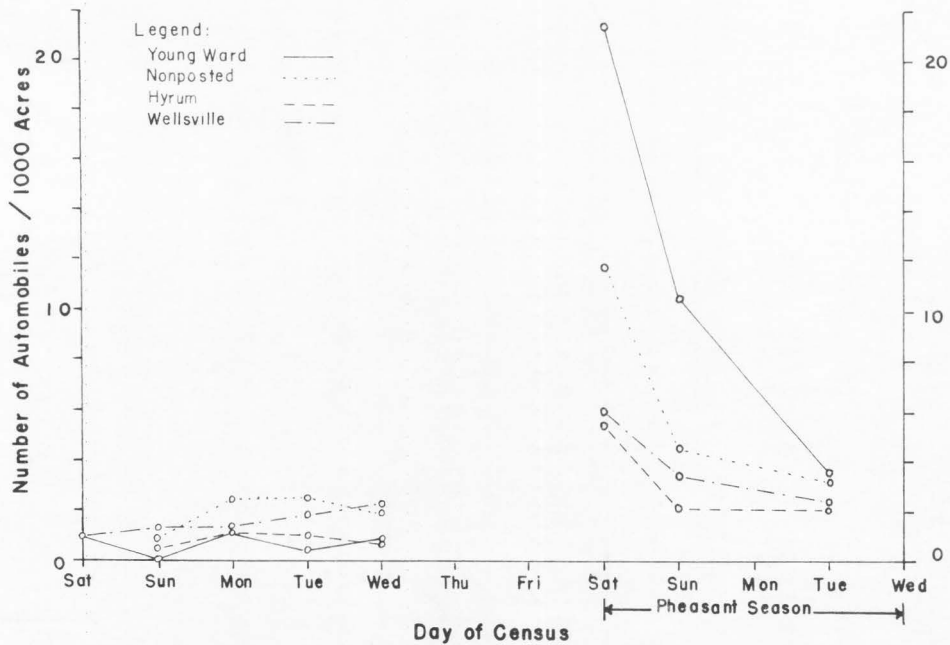


Figure 8. Densities of automobiles on four study areas as determined from aerial censuses conducted before and during the pheasant hunting season October 29-November 9, 1960, Cache County, Utah.

were not made during several days of the 1960 season because of unfavorable flying conditions.

Hunters per 1,000 acres.--Opening day densities of hunters were greatest on the Young Ward Unit with 68.5 and 67.0 hunters per 1,000 acres during the 1959 and 1960 seasons, respectively; corresponding densities for the other areas were 41.6 and 38.5 on the Nonposted Land, 18.9 and 20.9 on the Hyrum Unit, and 19.5 and 22.6 on the Wellsville Unit. Total hunter-days per 1,000 acres were greatest on the Young Ward Unit with 155.5 and 155.2; the densities on the other areas were 99.3 and 95.5 on the Nonposted Land, 53.4 and 44.4 on the Hyrum Unit, and 54.4 and 61.4 on the Wellsville Unit (Table 14).

Parsons (1953) estimated state-wide hunter densities to be 32 hunters per 1,000 acres on Utah's posted hunting units and 73 hunters per 1,000 acres on nonposted land. The most noticeable difference between Parsons' estimations and the findings of this study is that of the densities on the Nonposted Land. If hunters were truly excluded from the units, as Parsons suggested, the hunter density should be high on the Nonposted Land regardless of the number of birds or amount of land available to the hunter--this was not the case. The Nonposted Land was not used entirely by those hunters without permits, because 12 and 15 percents of the hunters on the Nonposted Land had permits for some unit exclusive of the three study area units.

The hunter densities of this study are relatively low when compared with the opening day densities of from 85 to 229 hunters per 1,000 acres on the Sartain Ranch and McManus area in California as reported by Ferrel et al. (1949) and Harper et al. (1951). However, hunter densities in the four study areas could be considered high when compared with South Dakota's state-wide average of 3.1 hunters per 1,000 acres as

reported by Nelson (1950). The densities reported by Leopold (1949) of 40 hunters per 1,000 acres on the Conway Ranch, California, are more nearly similar to those of this study.

Gun-hours per hunter.---The mean numbers of gun-hours per hunter during the two seasons on the four areas were as follows: Young Ward Unit, 11.9 and 11.4; Nonposted Land, 13.6 and 10.7; Hyrum Unit, 10.9 during both seasons; and Wellsville Unit, 11.8 and 13.4 (Table 15). Daily mean numbers of gun-hours were highest during the opening weekend, dropping to a low on the fourth day, and rising slightly on the last day (Figures 4-7). It is interesting to note that the hunter did not hunt all of the time on the area for which he purchased a permit or received a questionnaire. During the two seasons, only 72 and 62 percents of the gun-hours were spent hunting on the area by Young Ward Unit hunters; the corresponding percentages for the other areas were 79 and 86 percents for the Nonposted Land, 79 and 80 percents for the Hyrum Unit, and 83 and 90 percents for the Wellsville Unit.

Parsons (1953) noted that hunters hunted where they wished during the last 2 days of a 3 1/2-day season. He attributed this to the units failing to maintain checking stations during the last days of the season and, thereby, permitting hunters access to a unit even though they did not have the proper permit. During the two seasons, an average for the four areas of 21 and 18 percents of the gun-hours were spent off the study areas during the first 2 days of the season and 34 and 24 percents were spent off the study areas during the remaining 3 days. The increased percentage of gun-hours spent off the study areas during the last 3 days of the season over that percentage during the first 2 days would substantiate the observations made by Parsons. In certain areas of Utah where 3-day

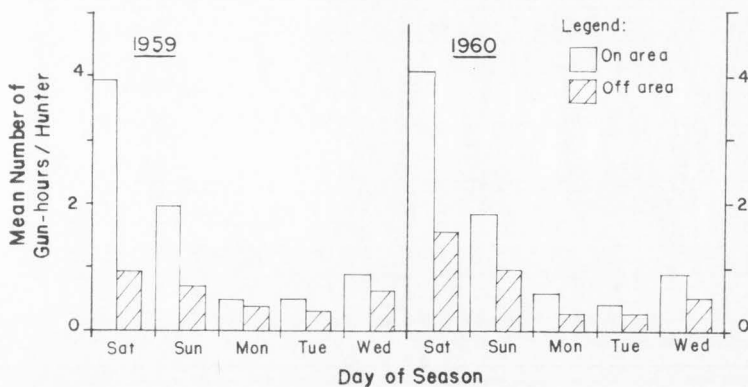


Figure 4. Mean number of gun-hours per hunter spent hunting on and off the area, Young Ward Unit, Cache County, Utah, 1959-60.

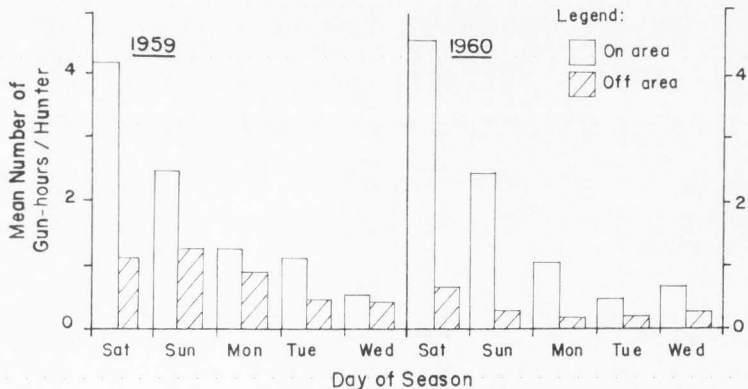


Figure 5. Mean number of gun-hours per hunter spent hunting on and off the area, Nonposted Land, Cache County, Utah, 1959-60.

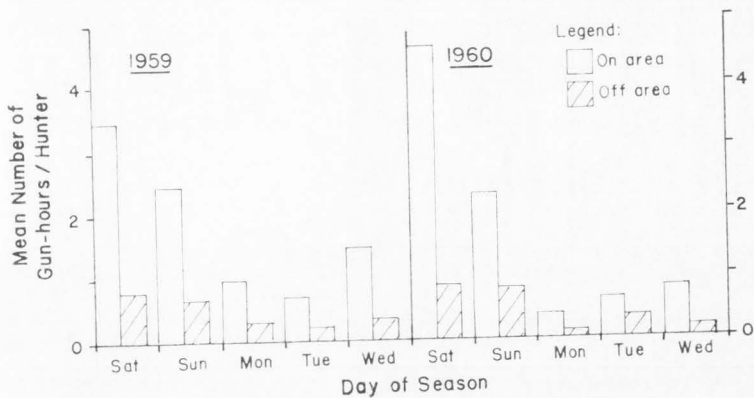


Figure 6. Mean number of gun-hours per hunter spent hunting on and off the area, Myrum Unit, Cache County, Utah, 1959-60.

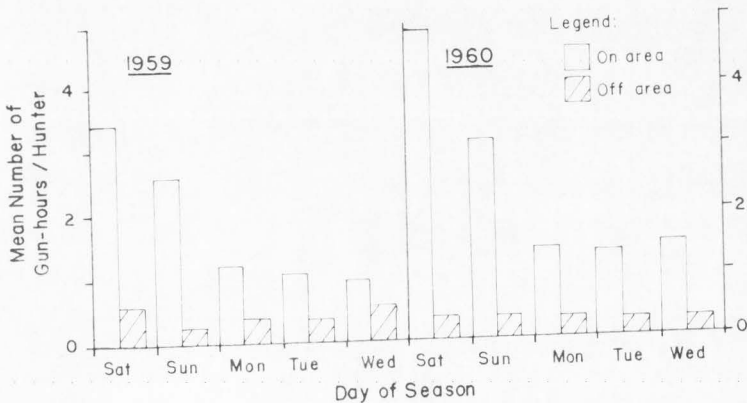


Figure 7. Mean number of gun-hours per hunter spent hunting on and off the area, Wellsville Unit, Cache County, Utah, 1959-60.

seasons are common, the breakdown of the unit's control of hunter access after the second day would be more important in restricting the errant hunter than in those areas of a 5-day, or longer, season.

Gun-hours per 1,000 acres.---The patterns of cumulative gun-hours per 1,000 acres rise rapidly during the first 2 days and level off during the remaining 3 days; a slight rise is noted on the last day (Figure 6). During the two seasons the mean hunting pressures for the four areas were 383 and 372 gun-hours per 1,000 acres with 71.0 and 74.1 percents of all the gun-hours occurring during the first 2 days. The cumulative numbers of gun-hours per 1,000 acres during the 1959 and 1960 seasons, respectively, were as follows: Young Ward Unit, 637 and 620; Nonposted Land, 480 and 378; Hyrum Unit, 202 and 208; and Wellsville Unit, 215 and 283 (Table 14).

As in this study, Stokes (1955) and Reynolds (1956) found that Utah's short pheasant hunting season concentrated the majority of the hunting pressure into the opening weekend and particularly Saturday, which is traditionally the opening day. In California, Hart et al. (1951) found 69 to 84 percent of the gun-hours were during the first 3 days of the 10-day season. Similar heavy opening weekend hunting pressures were observed by Allen (1947) in Michigan and Robertson (1958) in Illinois.

By far, the Young Ward Unit and the Nonposted Land each received more total hunting pressure than did either the Hyrum or the Wellsville Units. The total hunting pressures on any of the four areas were far less than those reported in other studies; this, in part, may be attributed to the short season in Utah. Shick (1952), on the Prairie Farm in Michigan, reported total gun-hours per 1,000 acres to be 959 and 1,675 during two 17-day seasons and from 1,785 to 2,557 during four

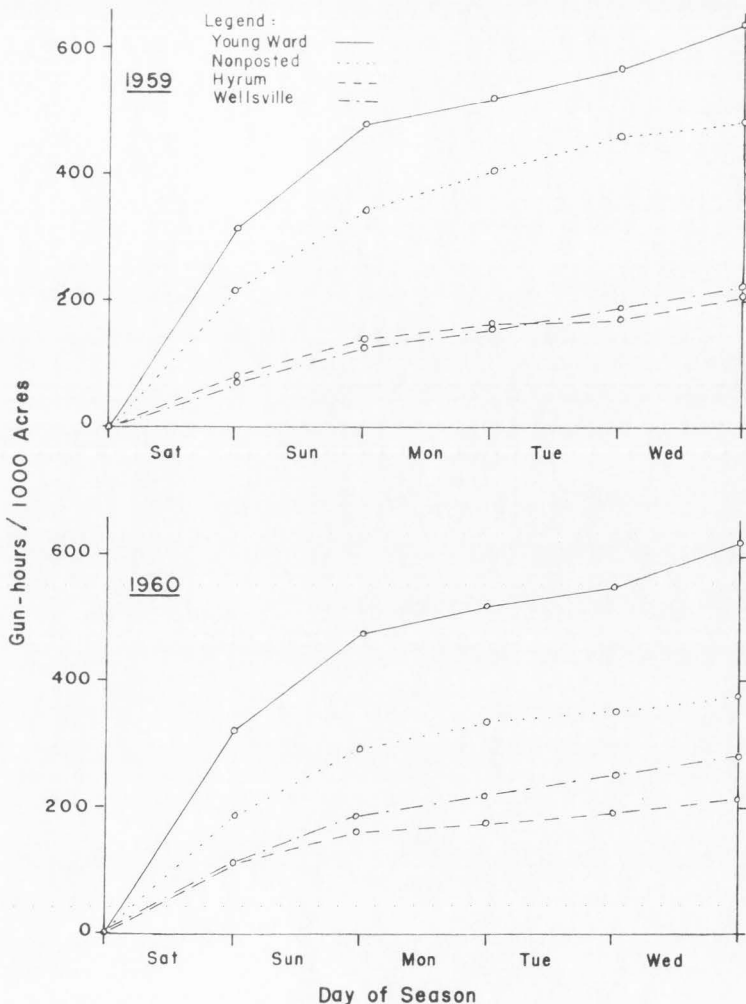


Figure 8. Cumulative hunting pressure (gun-hours per 1,000 acres) during a 5-day pheasant hunting season on four study areas, Cache County, Utah, 1959-60.

22-day seasons. Ferrel et al. (1949) and Harner et al. (1951) reported the high hunting pressures on the Sartain Ranch and McManus area of California to be 2,949 and 2,009 gun-hours per 1,000 acres, respectively, during a 10-day season. Stokes (1954), on Pelee Island, Ontario, reported hunting pressures of 1,050 gun-hours per 1,000 acres during a 3-day season, 830 and 930 gun-hours per 1,000 acres during two 2-day seasons, and 1,860 gun-hours per 1,000 acres during a 2-day split season.

Hunting successes

The average hunter on all four areas during the 1959 and 1960 seasons, respectively, bagged 2.54 and 3.05 birds on the study areas and 0.76 and 0.82 birds off the study areas for season total bags of 3.30 and 3.87 birds per hunter. Thus, hunting successes were generally better during the 1960 season than the 1959 season. Young Ward Unit hunters averaged 2.72 and 2.31 birds per hunter on the unit during the 2 years; birds bagged per hunter on the other areas were 2.46 and 3.28 on the Nonposted Land, 2.40 and 2.26 on the Myrum Unit, and 3.22 and 4.21 on the Wellsville Unit (Table 1).

Young Ward Unit hunters bagged 0.32 and 0.31 birds per gun-hour on the unit; the successes for the other areas were 0.24 and 0.36 on the Nonposted Land, 0.27 during both seasons, and 0.32 and 0.37 on the Wellsville Unit. The number of birds bagged per gun-hour remained at a high level throughout the season, especially during the 1960 season. Averages of 0.28 and 0.33 cocks per gun-hour were bagged on the four areas during the two seasons. On the first day of the two seasons, 0.37 and 0.36 bird per gun-hour were bagged; and during the last day of the season the hunting successes were down to only 0.22 and 0.29 birds per gun-hour.

Table 1. Numbers of cocks bagged per hunter and per gun-hour on the four study areas, Cache County, Utah, 1959-60.

| Day of season | Number of cocks bagged per hunter | | | | Number of cocks bagged per gun-hour | | | |
|-----------------|-----------------------------------|-------------|-------------|-------------|-------------------------------------|-------------|-------------|-------------|
| | Young Ward | Nonposted | Hyrum | Wellsville | Young Ward | Nonposted | Hyrum | Wellsville |
| <u>1959</u> | | | | | | | | |
| 1 | 1.77 | 1.73 | 1.32 | 1.79 | 0.38 | 0.34 | 0.30 | 0.46 |
| 2 | 0.97 | 0.75 | 1.01 | 1.06 | 0.25 | 0.14 | 0.23 | 0.29 |
| 3 | 0.96 | 0.84 | 0.73 | 1.20 | 0.32 | 0.23 | 0.24 | 0.28 |
| 4 | 0.80 | 0.44 | 0.75 | 1.03 | 0.26 | 0.08 | 0.29 | 0.24 |
| 5 | <u>0.93</u> | <u>1.02</u> | <u>0.86</u> | <u>0.62</u> | <u>0.22</u> | <u>0.27</u> | <u>0.26</u> | <u>0.17</u> |
| Mean for season | 2.72 | 2.46 | 2.40 | 3.22 | 0.32 | 0.24 | 0.27 | 0.32 |
| <u>1960</u> | | | | | | | | |
| 1 | 1.91 | 1.78 | 1.45 | 2.11 | 0.35 | 0.37 | 0.27 | 0.43 |
| 2 | 1.24 | 1.04 | 0.99 | 1.40 | 0.29 | 0.28 | 0.22 | 0.30 |
| 3 | 0.82 | 1.51 | 0.95 | 1.25 | 0.26 | 0.45 | 0.34 | 0.28 |
| 4 | 1.14 | 1.30 | 1.13 | 1.09 | 0.33 | 0.45 | 0.30 | 0.26 |
| 5 | <u>0.82</u> | <u>0.92</u> | <u>1.37</u> | <u>1.38</u> | <u>0.21</u> | <u>0.34</u> | <u>0.32</u> | <u>0.32</u> |
| Mean for season | 2.81 | 3.28 | 2.86 | 4.21 | 0.31 | 0.36 | 0.27 | 0.37 |

This study and previous Utah studies by Stokes (1955) and Reynolds (1956) show that hunting success remains relatively high throughout the season. Stokes (1955) found hunting success to be 0.42 cocks per gun-hour during the first day of the season and 0.31 during the last day. He attributed the high level of success during the last days of the season to either less wary birds or a greater percentage of skilled hunters in the field. Utah's hunting success could be considered poor when compared with 0.89 cocks per gun-hour average in Nebraska, as reported by Mohler (1959).

The effect of weather on hunting pressure.--The excellent weather experienced by the hunters during the 1959 season was in sharp contrast to the poor weather of the 1960 season (Table 2). Clear skies and warm days were found during the 1959 season; while rain and snow, accompanied by wind, prevailed during 4 of the 5-day season in 1960.

The total number of gun-hours spent by all the hunters from the four areas was 22,288 in 1959 and 19,973 in 1960. Apparently inclement weather did not greatly deter the hunter from hunting.

Table 2. Daily maximum and minimum temperatures and precipitation during the day preceding and the 5 days of the 1959 and 1960 seasons, from U. S. Dept. of Commerce Bulletin of Climatological Data for the Utah State University station, Logan, Utah.

| Time | 1959 | | 1960 | |
|----------------------|--------------------|-------------------|--------------------|-------------------|
| | Temp. Max.-Min. | Precip. inches | Temp. Max.-Min. | Precip. inches |
| Day preceding season | 39-13 | none | 43-31 | 0.55 |
| Days of season: | | | | |
| 1 | 47-28 | " | 39-24 | 0.05 |
| 2 | 54-26 | " | 45-26 | none |
| 3 | 54-28 | " | 54-37 | 0.48 |
| 4 | 56-30 | " | 41-34 | 0.25 |
| 5 | 56-31 | " | 39-22 | 0.06 |

Population characteristics of the harvest

Sex ratios.--Preseason sex ratios, expressed as the number of cocks per 100 hens, during the 2 years were as follows: Young Ward Unit, 74 and 67; Nonposted Land, 61 and 91; Hyrum Unit, 55 and 92; and Wellsville Unit, 98 and 55. Postseason sex ratios on the four areas were as follows: Young Ward Unit, 9 and 21; Nonposted Land, 14 and 10; Hyrum Unit 9 and 19; and Wellsville Unit, 12 and 16. Total mean pre- and postseason sex ratios for all four areas were higher in 1960 than in 1959; preseason sex ratios were 69 and 74 cocks per 100 hens; and postseason sex ratios were 11 and 17 cocks per 100 hens (Table 3). More birds were counted during the 1959 postseason sex ratio counts than in 1960 because of snow being on the ground throughout the census period and the birds were more gregarious; the samples were considered adequate in both years.

Sportsmen question whether enough cocks will survive hunting to insure fertility of the eggs. Shick (1947) felt that sex ratios among game farm pheasants of 8-10 cocks per 100 hens would not reduce egg fertility. Twining et al. (1948) concluded that legal hunting has little effect on fertility and that sex ratios of 2 cocks per 100 hens were adequate for wild pheasants. Postseason sex ratios of from 5 to 12 cocks per 100 hens were reported by Ferrel et al. (1949) and Harper et al. (1951) in California. In northern Utah, Stokes (1955) and Reynolds (1956) found postseason sex ratios ranging from 12 to 21 and 22 to 23 cocks per 100 hens, respectively. Mohler (1959) pointed out the great variations in sex ratios depending upon the month in which they were taken as well as the method of census. He reported postseason sex ratios during several years in Nebraska which were nearly even and some with a greater proportion of cocks than hens.

Table 3. Pre- and postseason sex ratios of pheasants on four study areas, Cache County, Utah, 1959-60.

| Season | Study area | Preseason | | | | Postseason | | |
|-------------|------------|-----------|------------|-------------------|--------------------|------------|------------|--------------------|
| | | No. cocks | No. hens | No. uncertain sex | No. cocks/100 hens | No. cocks | No. hens | No. cocks/100 hens |
| <u>1959</u> | Young Ward | 121 | 164 | 7 | 74 | 101 | 1099 | 9 |
| | Nonposted | 88 | 144 | 1 | 61 | 78 | 555 | 14 |
| | Myrum | 57 | 104 | - | 55 | 19 | 209 | 9 |
| | Wellsville | <u>63</u> | <u>64</u> | <u>2</u> | <u>98</u> | <u>98</u> | <u>792</u> | <u>12</u> |
| | Total | 329 | 476 | 11 | Mean 69 | 296 | 2655 | Mean 11 |
| <u>1960</u> | Young Ward | 125 | 187 | 1 | 67 | 117 | 564 | 21 |
| | Nonposted | 164 | 180 | - | 91 | 37 | 357 | 10 |
| | Myrum | 88 | 96 | - | 92 | 48 | 250 | 19 |
| | Wellsville | <u>92</u> | <u>172</u> | <u>1</u> | <u>55</u> | <u>58</u> | <u>368</u> | <u>16</u> |
| | Total | 476 | 642 | 2 | Mean 74 | 260 | 1539 | Mean 17 |

None of the postseason sex ratios found in this study fell below those suggested as safe ratios. In a cock-only hunt, where the hen population is virtually unharvested, the importance of a "safe" post-season sex ratio can be questionable.

Percentage of cocks harvested.—Patterns of cock harvest on the four areas were typified by a large harvest on the opening day and then tapering off gradually during the remaining days of the season (Figure 9). There was a gentle rise in the harvest on the last day in most areas which coincided with a corresponding rise in hunting pressure. Percentages of cock harvest assuming a 5 percent illegal hen kill for the four areas averaged 84.5 percent in 1959 and 77.6 percent in 1960. Percentages of cock harvest during the two seasons on each of the areas were as follows: Young Ward Unit, 88.1 and 69.5; Nonposted Land, 77.5 and 89.6; Hyrum Unit, 84.0 and 80.2; and Wellsville Unit, 88.2 and 71.5. These percentages of cock harvest compare similarly with those high harvest values presented in other studies (Table 4).

Table 4. Percentages of cock harvests as found in this and other studies.

| Area | Percent harvest | Study |
|--|-----------------|---|
| Cache County, Utah | 70-90 | This study |
| Cache County, Utah | 71-86 | Stokes (1955) |
| Cache County, Utah | 69-75 | Reynolds (1956) |
| Rose Lake, Michigan | 49-76 | Allen (1947) |
| Sartain Ranch and McManus area, California | 73-86 | Harper <i>et al.</i> (1951), Ferrel <i>et al.</i> (1949) |
| Prairie Farm, Michigan | 53-90 | Shick (1952) |
| Pelee Island, Ontario | 78-93 | Stokes (1954) |
| Kendall County, Illinois | 45-60 | Robertson (1958) |

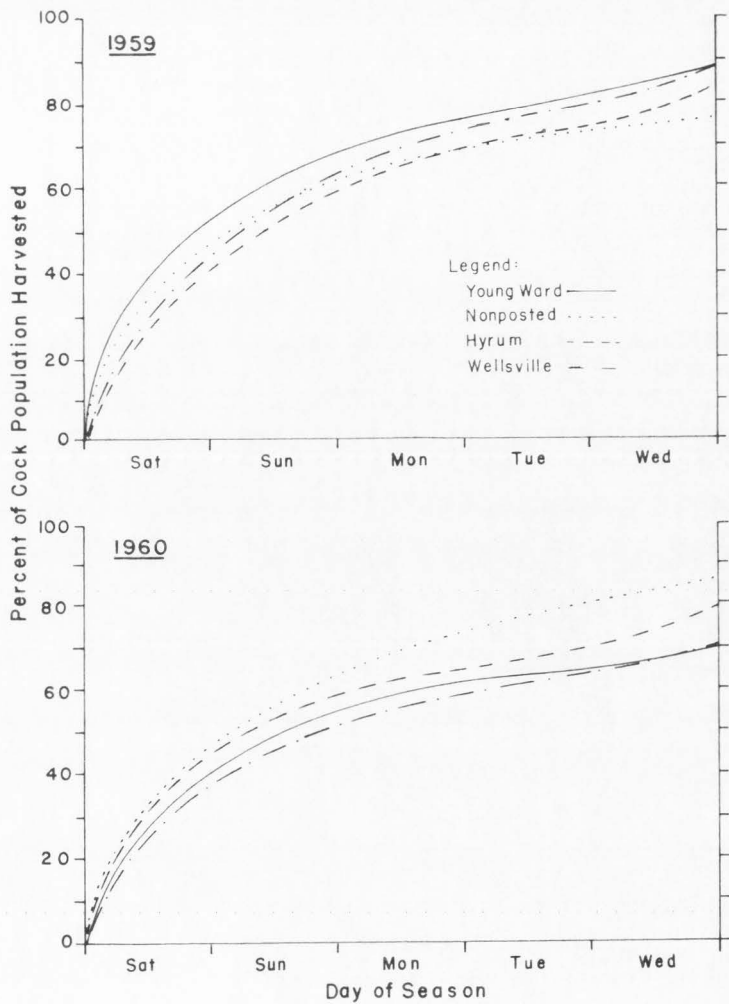


Figure 9. Patterns of cock harvest on four study areas, Cache County, Utah, 1959-60.

During the two seasons, 55 and 52 percents of the cocks harvested were bagged during the first day. Stokes (1955) in Utah found approximately 50 percent of the total cock harvest was taken on the first day; and Harper *et. al.* (1951) found that 80 percent of the total cock harvest occurred by either the third or fourth day of the season.

Estimates of the harvested pheasant populations.---Despite a smaller percentage of harvest on all areas, more birds were bagged in 1960 than in 1959 (5,267 compared to 4,644). The numbers of birds bagged per 1,000 acres during the two seasons were as follows: Young Ward Unit, 202 and 193; Nonposted Land, 116 and 135; Hyrum Unit, 56 and 55; and Wellsville Unit, 70 and 98 (Table 5). The numbers of cocks bagged per 1,000 acres on these study areas are similar to the average values found in other studies (Table 6). The Young Ward Unit, by far, had the most productive pheasant

Table 6. Number of cocks bagged per 1,000 acres as found in this and other studies.

| Area | Number cocks bagged per 1,000 acres | Study |
|--|-------------------------------------|-----------------------------|
| Cache County, Utah | 55-202 | This study |
| Cache County, Utah | 74 | Yeager <i>et al.</i> (1956) |
| Boxelder County, Utah | 90 | McKean (1942) |
| Boxelder County, Utah | 107 | Yeager <i>et al.</i> (1956) |
| Rose Lake, Michigan | 28-174 | Allen (1947) |
| Sartain Ranch and McManus area, California | 340-467 | Ferrel <i>et al.</i> (1949) |
| South Dakota (state-wide) | 38-46 | Harper <i>et al.</i> (1951) |
| Miner County, South Dakota | 206 | Kirsch (1951) |
| Prairie Farm, Michigan | 73-206 | Kirsch (1951) |
| | | Shick (1952) |

land with estimated pre-season cock populations of 229 and 278 cocks per 1,000 acres; the other areas had cock populations of 150 and 151 on the Nonposted Land, 67 and 69 on the Hyrum Unit, and 79 and 137 on the

Table 5. Estimates of pheasant populations per 1,000 acres on the four study areas, Cache County, Utah 1959-60.

| Population estimates | Pheasants per 1,000 acres | | | | | | | |
|------------------------------|---------------------------|-----------|-------|------------|------------|-----------|-------|------------|
| | 1959 | | | | 1960 | | | |
| | Young Ward | Nonposted | Hyrum | Wellsville | Young Ward | Nonposted | Hyrum | Wellsville |
| Number alive before season: | | | | | | | | |
| Cocks | 229 | 150 | 67 | 79 | 278 | 151 | 69 | 137 |
| Hens | 308 | 244 | 122 | 80 | 425 | 166 | 75 | 247 |
| Number killed during season: | | | | | | | | |
| Cocks | 202 | 116 | 56 | 70 | 193 | 135 | 55 | 98 |
| Hens | 15 | 12 | 6 | 4 | 21 | 8 | 4 | 12 |
| Number alive after season: | | | | | | | | |
| Cocks | 27 | 34 | 11 | 9 | 85 | 16 | 14 | 39 |
| Hens | 293 | 232 | 116 | 76 | 404 | 158 | 71 | 235 |
| Percent harvested: | | | | | | | | |
| Cocks | 88.1 | 77.5 | 84.0 | 88.2 | 69.5 | 89.6 | 80.2 | 71.5 |
| Hens | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |

Wellsville Unit.

These estimates of the populations are probably less than those which actually existed because of at least two factors: (1) the numbers of birds killed by hunters not receiving a questionnaire were unknown, and (2) no allowances were made for crippling losses.

Dale (1952) and Stokes (1954) point out that a greater percentage of cocks is removed from a densely populated area than from a sparsely populated area. Allen (1942a) says that the law of diminishing returns would make it difficult to completely harvest the cocks. Yet, these four populations were still subject to increases in hunting pressure as indicated by the increased harvest on the last day.

Cock age ratios in the bag.--The mean cock age ratios in hunters' bags for the four areas were 8.3 and 13.4 juveniles per adult as determined from 1,193 and 995 legs collected and examined during the two seasons (Table 16). The mean age ratio of 8.4 juveniles per adult taken on the first day of the 1959 season was not significantly different (5 percent level of significance) from that ratio of 8.2 juveniles per adult taken during the remaining 4 days of the season; however, the differences between 16.0 and 10.5 juveniles per adult ratios taken during the 1960 season were significant (Table 7). During 1959, on the Wellsville Unit significant changes in age ratios from 8.1 to 4.2 juveniles per adult were noted; similarly, a change in ratios from 15.0 to 5.7 juveniles per adult occurred on the Nonposted Land during 1960; in all other seasons and areas the differences were not significant.

A factor possibly influencing the size of cock harvest is a different vulnerability of year-classes. Significant changes in age ratios taken from shot samples as the season progresses indicates a

Table 7. Cock age ratios in the bag during the first day and the second to fifth days of the season on four study areas, Cache County, Utah, 1959-60.

| Day of season | Number of juveniles per adult | | | | |
|---------------|-------------------------------|-------------|------------|-------------|--------------|
| | Young Ward | Nonposted | Watum | Wellsville | Mean |
| <u>1959</u> | | | | | |
| 1 | 9.7 | 9.4 | 4.6 | 8.1 | 8.4 |
| 2-5 | <u>10.1</u> | <u>8.1</u> | <u>8.5</u> | <u>4.2*</u> | <u>8.2</u> |
| Mean | 10.0 | 8.6 | 5.8 | 6.1 | 8.3 |
| <u>1960</u> | | | | | |
| 1 | 16.4 | 15.0 | 16.2 | 14.7 | 16.0 |
| 2-5 | <u>15.3</u> | <u>5.7*</u> | <u>9.0</u> | <u>9.1</u> | <u>10.5*</u> |
| Mean | 16.1 | 9.0 | 12.2 | 11.3 | 13.4 |

*Significantly different (5 percent level) from first day.

different vulnerability between juvenile and adult cocks. This difference in vulnerability has long been recognized in certain areas. In South Dakota, Kimball (1948), Nelson, (1949), and Seubert (1956) reported progressive changes in the cock age ratios in the bag. Stokes (1954), during a split season hunt on Pelee Island, Ontario, observed a change in cock age ratios from 29.3 to 19.3 juveniles per adult. Similar changes were noted by Mohler (1943, 1951, and 1959) in Nebraska, Allen (1941 and 1947), Shick (1952), and Eberhardt and Elouch (1955) in Michigan, and Leopold (1949) in California. Robertson (1958) in Illinois, and Ferrel et al. (1949) and Harper et al. (1951) in California, did not notice the progressive changes in age ratios.

Stokes (1954), Hart (1954), and Wagner (1959) feel the difference in vulnerability between the adult and juvenile cocks will generally result in the biasing of the age ratio obtained in the bag from that ratio found in the population. The degree of bias is inversely proportional to the hunting pressure. Wagner (1959) says that this bias exists through the interaction of three factors: (1) variations in the intensity of hunting pressure, (2) proportion of cock population that is harvested, and (3) hatching phenology.

Although not statistically proven different in most cases, there appears to be a differential vulnerability of year-classes in the study areas with the exception of the Young Ward Unit. As suggested, this differential vulnerability may be a result of light hunting pressures and its lack of a differential vulnerability a result of heavy hunting pressures. The 1960 age ratios were much higher than those of 1959 and could be explained by the following reasons: (1) the higher percentage of cocks harvested during the 1959 season left few adult cocks that could

be taken during the 1960 season, and (2) from population estimates there was an increase in the pre-season cock population during 1960 over 1959 which would occur from a successful breeding season during the summer of 1960.

Cock pheasant crowing counts in relation to harvest.--Crowing counts as described by Kimball (1949) were conducted between April 21, and May 15, 1960. Counts were highest on the Young Ward Unit with a peak of 35.9 crows per 2-minute interval. Peaks of crowing for the other areas were 14.5 on the Nonposted Land, 13.9 on the Hyrum Unit, and 23.6 on the Wellsville Unit (Figure 10).

Postseason cock densities as determined from population estimates were expected to be in the same relation as the peaks of crowing; however, this was not the case. Cock densities (number of cocks per 1,000 acres) following the 1959 season were estimated as follows: 27, Young Ward Unit; 34, Nonposted Land; 11, Hyrum Unit; and 9, Wellsville Unit (Table 5). The most noticeable deviation from the expected peaks was that of the Nonposted Land. These differences in residual cock densities could be attributed to bird movement and, more probably, inaccuracies in the techniques used.

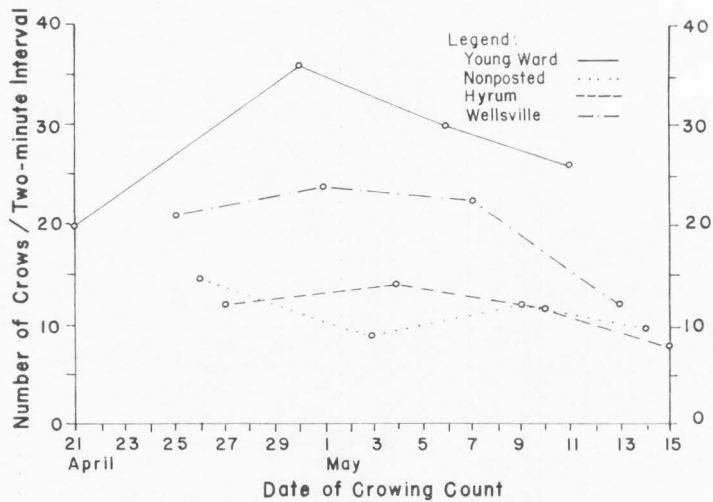


Figure 10. Cock pheasant crowing counts on four study areas, April 21-May 15, 1960.

DISCUSSION

The law of supply and demand for the birds rather than the availability of permits seemed to govern the hunting pressures on the four areas. Those areas receiving the higher hunting pressures also had the greater pheasant populations. Gower (1942) pointed out that Michigan hunters were attracted to various portions of the state in proportion to the density of pheasants. Total bag and hunter density varied considerably from county to county but the average bag per hunter was fairly consistent. Greenhalgh (1959) presents a county-by-county breakdown of Utah's total cock harvest and hunting pressure (hunter-days). The percentages of harvest correspond closely to those of hunting pressure; this suggests that the law of supply and demand holds true for the entire state.

It was interesting to note that an area such as the Hyrum Unit with a relatively low initial cock density could have such a thorough harvest and still maintain fairly high hunting success rates throughout the season. Areas such as the Young Ward Unit and Nonposted Land were not able to obtain a much higher percentage of harvest as was expected with greater cock densities and higher hunting pressures. Assuming the law of diminishing returns to be a function of all hunted populations, then there appears to be considerable variation in its rate of action among areas and populations.

The total percentages of cock harvest did not appear to be influenced as much by hunting pressure or the size of the cock population as by the weather. Inclement weather throughout most of the 1960 season either made the birds seek heavier cover and, thereby, escape the hunter

or dampened the enthusiasm of the hunters. Nearly similar total hunting pressures during both seasons would make the former suggestion more probable. Reynolds (1956) also considered the relatively low percentages of cock harvest found during one of two seasons to be attributed to inclement weather conditions during the season.

CONCLUSIONS AND RECOMMENDATIONS

The law of supply and demand for pheasants rather than for available hunting permits seemed to govern the hunting pressures on the four study areas. Those areas receiving the higher hunting pressures also had the greater pheasant populations. The Nonposted Land should receive the greatest hunting pressure if the hunters were truly being excluded from the units--this was not the case. Therefore, I conclude that the nonposted lands, at least in Cache County, are not subjected to extreme hunter densities and hunting pressure.

I recommend that each unit sell an unlimited number of permits. The hunter would then be left with the decision of whether to hunt where the highest bird and hunter densities were found or to hunt where there were fewer birds and also fewer hunters. He could obtain as many permits as he could financially afford, rather than as before, only as many as he could find available.

Inclement weather seemed to have a far greater effect upon the extent of harvest than did either hunting pressure or the size of the pheasant population.

Postseason sex ratios were well above that suggested as a safe ratio for insuring adequate egg fertility.

Although not statistically proven different in most cases, there was a differential vulnerability of cock year-classes in all areas but the Young Ward Unit. These differences in vulnerability were attributed to relatively light hunting pressures. The lack of difference in the Young Ward Unit was attributed to heavy hunting pressures.

SUMMARY

1. The objectives of this study were: (1) to compare hunting data and the size of cock harvests among the areas selected for their extremes in hunting pressure and (2) to compare hunting pressures on posted hunting units with that found on nonposted land.

2. This study was conducted during the 1959 and 1960 hunting seasons on the Young Ward, Hyrum, and Wellsville Units and the Nonposted Land in Cache County, Utah.

3. Aerial censuses of automobiles indicated that automobile densities were highest on the Young Ward Unit and the Nonposted Land. Patterns of density were similar to those normally found for hunting pressure.

4. Hunter densities on the opening day ranged from 18.9 to 68.5 hunters per 1,000 acres.

5. The mean number of gun-hours per hunter ranged from 10.7 to 13.4. Unit hunters spent from 62 to 90 percent of their gun-hours on the area for which they purchased a permit.

6. Young Ward Unit received the highest hunting pressures with 637 and 620 gun-hours per 1,000 acres. Pressures on the other areas were as follows: Nonposted Land, 480 and 378; Hyrum Unit, 202 and 208; and Wellsville Unit, 215 and 283.

7. The average bag per hunter on all areas was 3.30 in 1959 and 3.87 in 1960.

8. Inclement weather during the 1960 season did not greatly reduce the hunting pressure.

9. Pre- and postseason sex ratios for all areas were higher in 1960 than in 1959.

10. Percentages of cock harvest for the four areas averaged 84.5 percent in 1959 and 77.6 percent in 1960.

11. Fifty-five and 52 percents of the cocks harvested were bagged during the first day.

12. Harvests ranged from 55 to 202 cocks per 1,000 acres on the four study areas.

13. Significant changes in cock age ratios in bag samples were noted in certain areas. The differences were attributed to light hunting pressure.

14. Crowing counts were conducted in the spring of 1960. From these counts the residual cock population was determined to be highest on the Young Ward Unit.

15. The law of supply and demand for the birds rather than the availability of permits seemed to govern the hunting pressures on the four areas.

16. The total percentages of cock harvest were more greatly influenced by weather than by hunting pressure or the size of the cock population.

17. It is recommended that each unit sell an unlimited number of permits.

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APPENDIX

Exhibit 1. Stamped, self-addressed postcard hunting questionnaire issued to the hunters on the four areas, Cache County, Utah.

UTAH STATE DEPARTMENT OF FISH AND GAME
1596 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH

| <u>Day of Season</u> | Questionnaire No. | | | | |
|--|-------------------|-----------|-----------|-----------|-----------|
| | Sat. Nov. 5 | Sun. 6 | Mon. 7 | Tue. 8 | Wed. 9 |
| No. Cocks Bagged <u>on</u> Posted Unit | _____ | _____ | _____ | _____ | _____ |
| No. Cocks Bagged <u>off</u> Posted Unit | _____ | _____ | _____ | _____ | _____ |
| No. Hours Hunted <u>on</u> Posted Unit | _____ | _____ | _____ | _____ | _____ |
| No. Hours Hunted <u>off</u> Posted Unit | _____ | _____ | _____ | _____ | _____ |
| Names of Units and Other Areas Hunted | _____ | | | | |
| Did you buy a permit for a Posted Hunting Unit? Yes ___ No ___ | | | | | |

Dear Pheasant Hunter:

You can provide vital information which will allow more effective management of your state's pheasants by mailing to us the legs from pheasants which you or your hunting companions have shot. Please follow the instructions listed below.

THANK YOU!

Instructions:

1. Place only one leg from each pheasant in the envelope.
2. Only the legs from pheasants shot on the same day and in the same area should be placed in the envelope.
3. Use another envelope for sending legs from pheasants shot either on a different day or in a different area.
4. Complete the necessary information below by circling the appropriate items.
5. Seal the envelope and drop it into the nearest mailbox.

THE FOLLOWING INFORMATION IS REQUESTED: (Circle the appropriate items.)

1. These legs came from birds shot in: Hyrum Unit, Wellsville Unit, Young Ward Unit, College Ward, Millville, Nibley, Providence, Other _____
(Please specify).
2. These legs came from birds shot on: Sat. Sun. Mon. Tue. Wed.
Nov. 5 6 7 8 9

Exhibit 2. The backside of the envelope used to obtain legs from cock pheasants shot on the four study areas, Cache County, Utah, 1959-60.

Table 8. Numbers and percentages of respondents replying to the postcard hunting questionnaires, Cache County, Utah, 1959-60.

| Study areas | No. of questionnaires issued | Responses to hunting questionnaires | | | | | |
|-------------|------------------------------|-------------------------------------|-------------|------------|-------------|------------|-------------|
| | | Initial | | Follow-up | | Total | |
| | | Number | Percent | Number | Percent | Number | Percent |
| <u>1959</u> | | | | | | | |
| Young Ward | 600 | 189 | 31.5 | 100 | 16.6 | 289 | 48.1 |
| Nonposted | 200 | 50 | 25.0 | 21 | 10.5 | 71 | 35.5 |
| Hyrum | 300 | 67 | 22.3 | 61 | 20.3 | 128 | 42.3 |
| Wellsville | <u>365</u> | <u>96</u> | <u>26.3</u> | <u>111</u> | <u>30.4</u> | <u>207</u> | <u>56.7</u> |
| Total | 1465 | 402 | 27.4 | 293 | 20.0 | 695 | 47.4 |
| <u>1960</u> | | | | | | | |
| Young Ward | 595 | 207 | 34.7 | 78 | 13.1 | 285 | 47.8 |
| Nonposted | 96 | 47 | 48.9 | 29 | 30.2 | 76 | 79.1 |
| Hyrum | 297 | 60 | 20.2 | 58 | 19.5 | 118 | 39.7 |
| Wellsville | <u>400</u> | <u>117</u> | <u>29.2</u> | <u>54</u> | <u>13.5</u> | <u>171</u> | <u>42.7</u> |
| Total | 1388 | 431 | 31.0 | 219 | 15.8 | 650 | 46.8 |

Table 9. Numbers of hunters, gun-hours, and cocks bagged both on and off the study area, as determined from postcard hunting questionnaire data, Young Ward Unit, Cache County, Utah, 1959-60.

| Day of season | Number of hunters hunting | | | Number of gun-hours | | | Number of cocks bagged | | |
|---------------|---------------------------|------------------|--------------------|---------------------|------------|------------|------------------------|------------|------------|
| | On area | Off area | Total ^a | On area | Off area | Total | On area | Off area | Total |
| <u>1959</u> | | | | | | | | | |
| 1 | 493 | 147 | 560 | 2281 | 561 | 2842 | 871 | 180 | 1051 |
| 2 | 294 | 109 | 370 | 1147 | 401 | 1584 | 286 | 115 | 401 |
| 3 | 99 | 63 | 144 | 301 | 231 | 532 | 95 | 53 | 148 |
| 4 | 108 | 52 | 144 | 332 | 194 | 526 | 86 | 56 | 142 |
| 5 | <u>125</u> | <u>78</u> | <u>190</u> | <u>528</u> | <u>354</u> | <u>882</u> | <u>116</u> | <u>76</u> | <u>192</u> |
| Total | 534 ^b | 197 ^b | 579 ^b | 4589 | 1741 | 6630 | 1454 | 480 | 1934 |
| <u>1960</u> | | | | | | | | | |
| 1 | 422 | 218 | 544 | 2315 | 897 | 3212 | 808 | 363 | 1171 |
| 2 | 245 | 162 | 348 | 1056 | 554 | 1610 | 305 | 207 | 512 |
| 3 | 111 | 65 | 150 | 343 | 149 | 492 | 91 | 90 | 181 |
| 4 | 70 | 58 | 108 | 243 | 185 | 428 | 80 | 70 | 150 |
| 5 | <u>130</u> | <u>100</u> | <u>209</u> | <u>503</u> | <u>290</u> | <u>793</u> | <u>106</u> | <u>121</u> | <u>227</u> |
| Total | 494 ^b | 285 ^b | 571 ^b | 4460 | 2075 | 6535 | 1390 | 851 | 2241 |

^aTotals are the numbers of hunters hunting that day, either on or off the study area.

^bTotals are the numbers of hunters hunting either one day or more during the season.

Table 10. Numbers of hunters, gun-hours, and cocks bagged both on and off the study area, as determined from postcard hunting questionnaire data, Nonposted Land, Cache County, Utah, 1959-60.

| Day of season | Number of hunters hunting | | | Number of gun-hours | | | Number of cocks bagged | | |
|---------------|---------------------------|------------------|--------------------|---------------------|------------|------------|------------------------|-----------|------------|
| | On area | Off area | Total ^a | On area | Off area | Total | On area | Off area | Total |
| <u>1959</u> | | | | | | | | | |
| 1 | 516 | 146 | 587 | 2636 | 687 | 3323 | 895 | 127 | 1022 |
| 2 | 304 | 183 | 444 | 1576 | 799 | 2375 | 227 | 246 | 473 |
| 3 | 211 | 140 | 218 | 768 | 559 | 1327 | 177 | 43 | 220 |
| 4 | 127 | 74 | 140 | 678 | 258 | 936 | 56 | 65 | 121 |
| 5 | <u>74</u> | <u>50</u> | <u>84</u> | <u>292</u> | <u>255</u> | <u>547</u> | <u>81</u> | <u>22</u> | <u>103</u> |
| Total | 584 ^b | 267 ^b | 622 ^b | 5950 | 2558 | 8508 | 1436 | 503 | 1939 |
| <u>1960</u> | | | | | | | | | |
| 1 | 476 | 100 | 502 | 2309 | 315 | 2624 | 850 | 101 | 951 |
| 2 | 339 | 49 | 355 | 1265 | 141 | 1406 | 354 | 27 | 381 |
| 3 | 152 | 46 | 169 | 512 | 90 | 602 | 230 | 5 | 235 |
| 4 | 92 | 32 | 120 | 265 | 103 | 268 | 120 | 43 | 163 |
| 5 | <u>125</u> | <u>60</u> | <u>168</u> | <u>341</u> | <u>130</u> | <u>471</u> | <u>115</u> | <u>54</u> | <u>169</u> |
| Total | 508 ^b | 128 ^b | 508 ^b | 4692 | 779 | 5371 | 1669 | 230 | 1899 |

^aTotals are the numbers of hunters hunting that day, either on or off the study area.

^bTotals are the numbers of hunters hunting either one day or more during the season.

Table 11. Numbers of hunters, gun-hours, and cocks bagged both on and off the study area, as determined from postcard hunting questionnaire data, Hyrum Unit, Cache County, Utah, 1959-60.

| Day of season | Number of hunters hunting | | | Number of gun-hours | | | Number of cocks bagged | | |
|---------------|---------------------------|-----------------|--------------------|---------------------|------------|------------|------------------------|-----------|-----------|
| | On area | Off area | Total ^a | On area | Off area | Total | On area | Off area | Total |
| <u>1959</u> | | | | | | | | | |
| 1 | 219 | 46 | 245 | 953 | 218 | 1171 | 290 | 71 | 361 |
| 2 | 155 | 40 | 179 | 671 | 182 | 853 | 157 | 58 | 215 |
| 3 | 90 | 18 | 95 | 272 | 81 | 353 | 66 | 22 | 88 |
| 4 | 77 | 17 | 85 | 202 | 63 | 265 | 58 | 13 | 71 |
| 5 | <u>78</u> | <u>23</u> | <u>95</u> | <u>256</u> | <u>100</u> | <u>356</u> | <u>67</u> | <u>15</u> | <u>82</u> |
| Total | 266 ^b | 59 ^b | 275 ^b | 2354 | 644 | 2998 | 638 | 179 | 817 |
| <u>1960</u> | | | | | | | | | |
| 1 | 242 | 65 | 264 | 1282 | 233 | 1515 | 352 | 109 | 461 |
| 2 | 139 | 56 | 179 | 641 | 223 | 864 | 138 | 49 | 187 |
| 3 | 37 | 4 | 37 | 103 | 24 | 127 | 35 | 8 | 43 |
| 4 | 45 | 22 | 63 | 171 | 79 | 250 | 51 | 24 | 75 |
| 5 | <u>51</u> | <u>16</u> | <u>66</u> | <u>220</u> | <u>44</u> | <u>264</u> | <u>70</u> | <u>23</u> | <u>93</u> |
| Total | 266 ^b | 85 ^b | 278 ^b | 2417 | 603 | 3020 | 646 | 213 | 859 |

^aTotals are the numbers of hunters hunting that day, either on or off the study area.

^bTotals are the numbers of hunters hunting either one day or more during the season.

Table 12. Numbers of hunters, gun-hours, and cocks bagged both on and off the study area, as determined from postcard hunting questionnaire data, Welleville Unit, Cache County, Utah, 1959-60.

| Day of season | Number of hunters hunting | | | Number of gun-hours | | | Number of cocks bagged | | |
|---------------|---------------------------|-----------------|--------------------|---------------------|------------|------------|------------------------|-----------|------------|
| | On area | Off area | Total ^a | On area | Off area | Total | On area | Off area | Total |
| <u>1959</u> | | | | | | | | | |
| 1 | 312 | 48 | 333 | 1211 | 200 | 1411 | 558 | 95 | 653 |
| 2 | 248 | 44 | 266 | 916 | 67 | 983 | 264 | 54 | 318 |
| 3 | 97 | 33 | 118 | 421 | 126 | 547 | 116 | 34 | 150 |
| 4 | 87 | 35 | 111 | 366 | 120 | 486 | 90 | 23 | 113 |
| 5 | <u>128</u> | <u>45</u> | <u>150</u> | <u>529</u> | <u>196</u> | <u>725</u> | <u>83</u> | <u>14</u> | <u>102</u> |
| Total | 346 ^b | 67 ^b | 353 ^b | 3443 | 709 | 4152 | 1116 | 220 | 1336 |
| <u>1960</u> | | | | | | | | | |
| 1 | 362 | 34 | 370 | 1789 | 115 | 1904 | 753 | 48 | 811 |
| 2 | 248 | 45 | 274 | 1164 | 112 | 1276 | 346 | 31 | 377 |
| 3 | 119 | 30 | 136 | 531 | 109 | 640 | 149 | 28 | 177 |
| 4 | 119 | 24 | 130 | 499 | 89 | 588 | 130 | 7 | 137 |
| 5 | <u>126</u> | <u>22</u> | <u>131</u> | <u>548</u> | <u>91</u> | <u>639</u> | <u>174</u> | <u>14</u> | <u>188</u> |
| Total | 371 ^b | 76 ^b | 372 ^b | 4531 | 516 | 5047 | 1562 | 128 | 1690 |

^aTotals are the numbers of hunters hunting that day, either on or off the study area.

^bTotals are the numbers of hunters hunting either one day or more during the season.

Table 13. The numbers and densities of automobiles as determined from aerial censuses on four study areas, Cache County, Utah, 1959-60.

| Day of census | Time of census | Number of automobiles | | | | | | | |
|------------------|----------------|-----------------------|---------------|----------------|------------|------------|-----------------|---------|------------|
| | | Young Ward | Nonposted | Censused Hyrum | Wellsville | Young Ward | Per 1,000 acres | | |
| | | | | | | | Nonposted | Hyrum | Wellsville |
| <u>1959</u> | <u>A.M.</u> | | | | | | | | |
| Fri ^a | 8:00 | 7 | 32 | 11 | 10 | 1.0 | 2.6 | 0.9 | 0.6 |
| Sat | 8:00 | 144 | 171 | 90 | 105 | 20.0 | 13.8 | 7.8 | 6.6 |
| Sun | 7:30 | 30 | 70 | 33 | 67 | 11.1 | 5.6 | 2.8 | 4.2 |
| Mon | 7:30 | 22 | 62 | 28 | 39 | 3.0 | 5.0 | 2.4 | 2.4 |
| Tue | 7:30 | 19 | 53 | 23 | 32 | 2.6 | 4.3 | 2.0 | 2.0 |
| Wed | 7:30 | 34 | 67 | 30 | 54 | 4.7 | 5.4 | 3.4 | 3.4 |
| Thu ^b | 7:30 | 1 | 31 | 14 | 25 | 0.1 | 2.5 | 1.6 | 1.6 |
| <u>1960</u> | | | | | | | | | |
| Sat ^c | 8:00 | 7 | - no flight - | | 14 | 1.0 | - no flight - | | 0.9 |
| Sun ^c | 7:30 | 0 | 11 | 6 | 21 | 0.0 | 0.9 | 0.5 | 1.3 |
| Mon ^c | 7:30 | 8 | 30 | 12 | 22 | 1.1 | 2.4 | 1.0 | 1.4 |
| Tue ^c | 7:30 | 3 | 31 | 12 | 31 | 0.4 | 2.5 | 1.0 | 1.9 |
| Wed ^c | 7:30 | 6 | 24 | 8 | 36 | 0.8 | 1.9 | 0.7 | 2.2 |
| Sat | 8:00 | 154 | 146 | 63 | 96 | 21.4 | 11.8 | 5.4 | 6.0 |
| Sun | 7:30 | 76 | 56 | 24 | 55 | 10.6 | 4.5 | 2.1 | 3.4 |
| Mon | | - - - - | - no flight - | - - - - | - | - - - - | - no flight - | - - - - | - - - - |
| Tue | 7:30 | 26 | 40 | 24 | 36 | 3.6 | 3.2 | 2.1 | 2.2 |
| Wed | | | | | | | | | |

^aThe day preceding the 1959 season.

^bThe day following the 1959 season.

^cOne of the 5 days preceding the 1960 season by 1 week.

Table 14. Numbers of hunters and gun-hours per 1,000 acres on four study areas, Cache County, Utah 1959-60.

| Day of season | Number of hunters per 1,000 acres | | | | | Number of gun-hours per 1,000 acres | | | | |
|---------------|-----------------------------------|-------------|------------|------------|-------------|-------------------------------------|-----------|-----------|------------|-----------|
| | Young Ward | Nonposted | Hyrum | Wellsville | MEAN | Young Ward | Nonposted | Hyrum | Wellsville | MEAN |
| <u>1959</u> | | | | | | | | | | |
| 1 | 68.5 | 41.6 | 18.9 | 19.5 | 37.1 | 317 | 212 | 82 | 76 | 172 |
| 2 | 40.8 | 24.5 | 13.4 | 15.5 | 23.6 | 159 | 127 | 58 | 57 | 100 |
| 3 | 13.8 | 17.0 | 7.8 | 6.1 | 11.2 | 42 | 62 | 23 | 26 | 38 |
| 4 | 15.0 | 10.2 | 6.6 | 5.4 | 9.3 | 46 | 55 | 17 | 23 | 35 |
| 5 | <u>17.4</u> | <u>6.0</u> | <u>6.7</u> | <u>8.0</u> | <u>9.5</u> | <u>73</u> | <u>24</u> | <u>22</u> | <u>33</u> | <u>38</u> |
| Total | 155.5 | 99.3 | 53.4 | 54.5 | 90.7 | 637 | 480 | 202 | 215 | 383 |
| <u>1960</u> | | | | | | | | | | |
| 1 | 67.0 | 38.5 | 20.9 | 22.6 | 37.2 | 321 | 186 | 110 | 112 | 182 |
| 2 | 38.9 | 27.3 | 12.0 | 15.5 | 23.4 | 147 | 102 | 55 | 73 | 94 |
| 3 | 17.6 | 12.2 | 3.2 | 7.7 | 10.2 | 48 | 41 | 9 | 33 | 33 |
| 4 | 11.1 | 7.4 | 3.9 | 7.7 | 7.5 | 34 | 21 | 15 | 31 | 25 |
| 5 | <u>20.6</u> | <u>10.1</u> | <u>4.4</u> | <u>7.9</u> | <u>10.8</u> | <u>70</u> | <u>28</u> | <u>19</u> | <u>34</u> | <u>38</u> |
| Total | 155.2 | 95.5 | 44.4 | 61.4 | 89.1 | 620 | 378 | 208 | 283 | 372 |

Table 15. Mean number of gun-hours per hunter spent hunting on and off the study area.

| Day of season | Gun-hours | | | | | | | | | | | |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | Young Ward | | | Nonposted | | | Hyrum | | | Wellsville | | |
| | On | Off | Total | On | Off | Total | On | Off | Total | On | Off | Total |
| <u>1959</u> | | | | | | | | | | | | |
| 1 | 3.9 | 1.0 | 4.9 | 4.2 | 1.1 | 5.3 | 3.5 | 0.8 | 4.3 | 3.4 | 0.6 | 4.0 |
| 2 | 2.0 | 0.7 | 2.7 | 2.5 | 1.3 | 3.8 | 2.4 | 0.7 | 3.1 | 2.6 | 0.2 | 2.8 |
| 3 | 0.5 | 0.4 | 0.9 | 1.2 | 0.9 | 2.1 | 1.0 | 0.3 | 1.3 | 1.2 | 0.4 | 1.6 |
| 4 | 0.6 | 0.3 | 0.9 | 1.1 | 0.4 | 1.5 | 0.7 | 0.2 | 0.9 | 1.0 | 0.3 | 1.3 |
| 5 | <u>0.2</u> | <u>0.6</u> | <u>1.5</u> | <u>0.5</u> | <u>0.4</u> | <u>0.9</u> | <u>0.2</u> | <u>0.4</u> | <u>1.3</u> | <u>1.5</u> | <u>0.6</u> | <u>2.1</u> |
| Total | 7.9 | 3.0 | 10.9 | 9.5 | 4.1 | 13.6 | 8.5 | 2.4 | 10.9 | 9.7 | 2.1 | 11.8 |
| <u>1960</u> | | | | | | | | | | | | |
| 1 | 4.0 | 1.6 | 5.6 | 4.5 | 0.6 | 5.1 | 4.6 | 0.8 | 5.4 | 4.8 | 0.3 | 5.1 |
| 2 | 1.8 | 1.0 | 2.8 | 2.5 | 0.3 | 2.8 | 2.3 | 0.8 | 3.1 | 3.1 | 0.3 | 3.4 |
| 3 | 0.6 | 0.3 | 0.9 | 1.0 | 0.2 | 1.2 | 0.4 | 0.1 | 0.5 | 1.4 | 0.3 | 1.7 |
| 4 | 0.4 | 0.3 | 0.7 | 0.5 | 0.2 | 0.7 | 0.6 | 0.3 | 0.9 | 1.3 | 0.2 | 1.5 |
| 5 | <u>0.2</u> | <u>0.5</u> | <u>1.4</u> | <u>0.7</u> | <u>0.2</u> | <u>0.9</u> | <u>0.3</u> | <u>0.2</u> | <u>1.0</u> | <u>1.5</u> | <u>0.2</u> | <u>1.7</u> |
| Total | 7.7 | 3.7 | 11.4 | 9.2 | 1.5 | 10.7 | 8.7 | 2.2 | 10.9 | 12.1 | 1.3 | 13.4 |

Table 16. Cock age ratios obtained from bag samples during each day of the season on four study areas, Cache County, Utah, 1959-60.

| Day of season | Young Ward | | | Nonposted | | | Hyrum | | | Wellsville | | | MEAN No. juv./ adult |
|---------------|------------|----------|--------------------|-----------|----------|--------------------|-----------|----------|--------------------|------------|----------|--------------------|----------------------------|
| | No. juv. | No. ad. | No. juv./ adult | No. juv. | No. ad. | No. juv./ adult | No. juv. | No. ad. | No. juv./ adult | No. juv. | No. ad. | No. juv./ adult | |
| <u>1959</u> | | | | | | | | | | | | | |
| 1 | 253 | 26 | 9.7 | 75 | 8 | 9.4 | 41 | 9 | 4.6 | 129 | 16 | 8.1 | 8.4 |
| 2 | 303 | 27 | 11.2 | 39 | 8 | 4.9 | 17 | 3 | 5.7 | 42 | 6 | 7.0 | 9.1 |
| 3 | 22 | 3 | 7.3 | 23 | 1 | 23.0 | 8 | 1 | 8.0 | 17 | 3 | 5.7 | 8.8 |
| 4 | 16 | 2 | 8.0 | 13 | - | - | 5 | - | - | 7 | 3 | 2.3 | 8.2 |
| 5 | <u>24</u> | <u>4</u> | <u>6.0</u> | <u>14</u> | <u>2</u> | <u>7.0</u> | <u>4</u> | <u>-</u> | <u>-</u> | <u>13</u> | <u>6</u> | <u>2.1</u> | <u>4.6</u> |
| Total | 618 | 62 | 10.0 | 164 | 19 | 8.6 | 75 | 13 | 5.8 | 208 | 34 | 6.1 | 8.3 |
| <u>1960</u> | | | | | | | | | | | | | |
| 1 | 378 | 23 | 16.4 | 60 | 4 | 15.0 | 65 | 4 | 16.2 | 88 | 6 | 14.7 | 16.0 |
| 2 | 104 | 8 | 13.0 | 22 | 2 | 11.0 | 17 | 3 | 5.7 | 40 | 5 | 8.0 | 10.2 |
| 3 | 18 | 1 | 18.0 | 38 | - | - | 9 | - | - | 10 | 1 | 10.0 | 22.5 |
| 4 | 26 | 2 | 13.0 | 7 | 3 | 2.3 | 5 | 1 | 5.0 | 17 | - | - | 9.2 |
| 5 | <u>20</u> | <u>-</u> | <u>-</u> | <u>3</u> | <u>2</u> | <u>1.5</u> | <u>14</u> | <u>1</u> | <u>14.0</u> | <u>15</u> | <u>3</u> | <u>5.0</u> | <u>8.7</u> |
| Total | 546 | 34 | 16.0 | 100 | 11 | 9.0 | 110 | 9 | 12.2 | 170 | 15 | 11.3 | 13.4 |