

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

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Game Bird Investigations

QUAIL AND CHUKAR PARTRIDGES

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COLUMBIA, MISSOURI

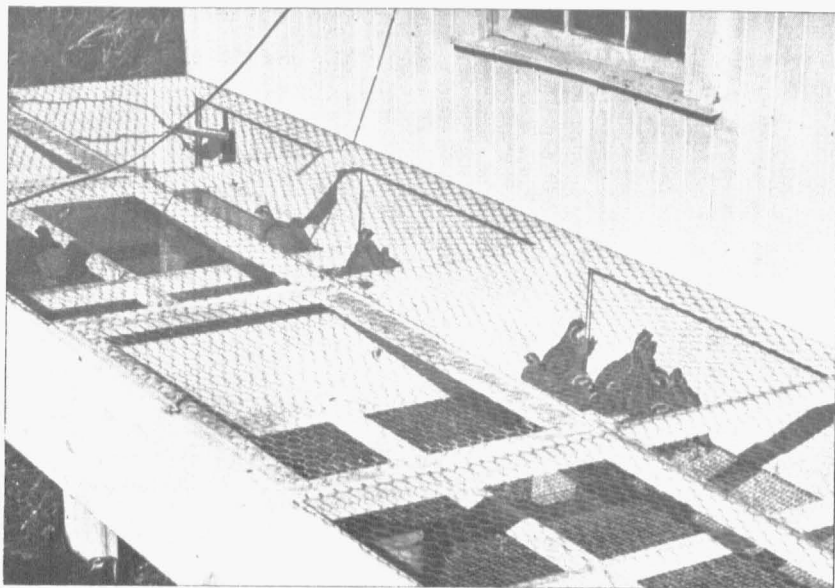


Fig. 1.—Missouri type colony brooder houses converted into breeding pens for quail and chukar partridges.



Fig. 2.—Pair of quail (Bob-White) in inside compartment of breeding pen.

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Information relative to game bird production is of increasing importance. Because of the widespread interest in game birds from the standpoint of sport and the beneficial influence of game birds on agriculture in general, there is a demand for additional knowledge relative to them.

As a result of increased interest and effort in game restoration, the propagation of game birds in the United States has developed into an industry of considerable magnitude. Many states operate game farms for the production of game birds to be used to restock depleted areas. In a number of states conservation commissions have been organized to encourage and promote the natural propagation of such birds.

THE NATURE OF THE EXPERIMENT

The object of this investigation was to study some of the factors affecting egg production, fertility, hatchability, egg size, clutch size, and feed consumption in quail and chukar partridges.

Three Missouri type colony brooder houses, 10 by 12 feet, were converted into breeding pens for quail and chukar partridges (Fig. 1). Twelve indoor pens about 2 feet long, 2 feet wide, and 1 foot high were constructed in each house (Fig. 2). A wire cover was fastened to the top of each indoor pen. A small door was cut in the side of the wall of each pen, and a pen about 2 feet square and 1 foot high with $\frac{1}{2}$ inch mesh wire floor and 1 inch poultry netting top was built as an outside runway for each pair of birds (Fig. 3). Watering and feeding equipment and nests were placed in the inside compartment. Sand was used for litter. One house was equipped with six 15-watt electric bulbs. An adequate all-mash ration was kept before the birds in open feeders. Feed consumption per month was recorded for each pair of birds.

Twelve pairs of quail were maintained in the breeding pens in 1937. Only egg production and egg size data were obtained on these birds.

In 1938, five pairs of chukar partridges and five pairs of quail were placed in the lighted house and five pairs of each species were placed in one control house. Ten pairs of quail also used as controls were placed in a second house. Each



Fig. 3.—Chukar partridges in outside compartment of breeding house.

species was divided by random selection into their respective groups. The lighted house was exposed to all-night light from January 9 to May 1. Other than the lights, both controls and all-night lighted birds were given identical treatment. Eggs were gathered, recorded, and weighed daily. Every fourteen days the eggs were set in an electrical forced-draft incubator in order to determine the fertility and hatchability.

In 1939 a group of quail was again placed on an experiment involving artificial lighting at night under the same conditions as in 1938, except that more birds were used. Ten pairs of quail were exposed to all-night light from February 4 to May 1, at which time lights were discontinued. Eleven pairs of quail were used as controls. Artificial lights were not used on chukar partridges during 1939.

In 1939 an attempt was made to determine the possibility of flock matings as a method of breeding chukar partridges and quail and in addition to determine the effect of the type of floor upon the hatchability of chukar partridge eggs. In the flock mating trials, five pens of quail, each containing one male and two females, were maintained. Individual matings were used

as controls. All birds were given similar treatment other than the difference in the mating. In the case of chukar partridges, one flock consisted of four females and one male, and in another flock there were three females and three males.

In the experiment designed to study the influence of the type of floor on fertility and hatchability of chukar partridge eggs, sixteen individual pairs, four on the ground and twelve on wire floors, were used. The flock matings and the four individual pairs on the ground were given identical treatment except that the dimensions of the wire pens for the flocks were 4 feet by 6 feet by 2 feet and the pens for the individual pairs on the ground were 4 feet by 2 feet by 2 feet. A small shed, open in front, was built at one end of the wire pen. This sheltered the feeders and nests and afforded protection for the birds. Twelve individual pairs were placed in the brooder house, which was divided into twelve individual compartments. These birds were selected from a group of birds of the same age and breeding stock and were fed the same rations. Aside from the type of mating and pen, they were kept under the same environmental conditions.

RESULTS

Influence of Artificial Light on Egg Production

1. **Chukar partridges.**—When chukar partridges were exposed to all-night lights they were stimulated into earlier egg production than were those receiving daylight only. The first egg laid by a chukar partridge under artificial lights was February 10, 31 days after all-night lights were first used. No eggs were laid by the control birds (exposed to daylight only) before May 1. It is thus seen that the birds exposed to lights started laying much earlier than did those not exposed to artificial lights. As shown in Figure 4, the chukar partridges under artificial lights reached a high peak in egg production during March and continued laying at a high rate until the latter part of July. The control birds started laying during May and reached their highest rate of production during July. During August both controls and artificially lighted birds decreased rapidly in egg production, no eggs being laid after September 15. The control birds did not equal the egg production of the artificially lighted birds during any month of the test period.

The use of all-night lights also increased the total egg production of the chukar partridges. The artificially lighted birds averaged 117.6 eggs for the 1938 season as compared to 50.4 eggs per bird for the controls. In spite of the fact that only a few birds were exposed to all-night light one can consider the data as being significant because each bird under artificial lights had a greater total egg production than any bird in the control

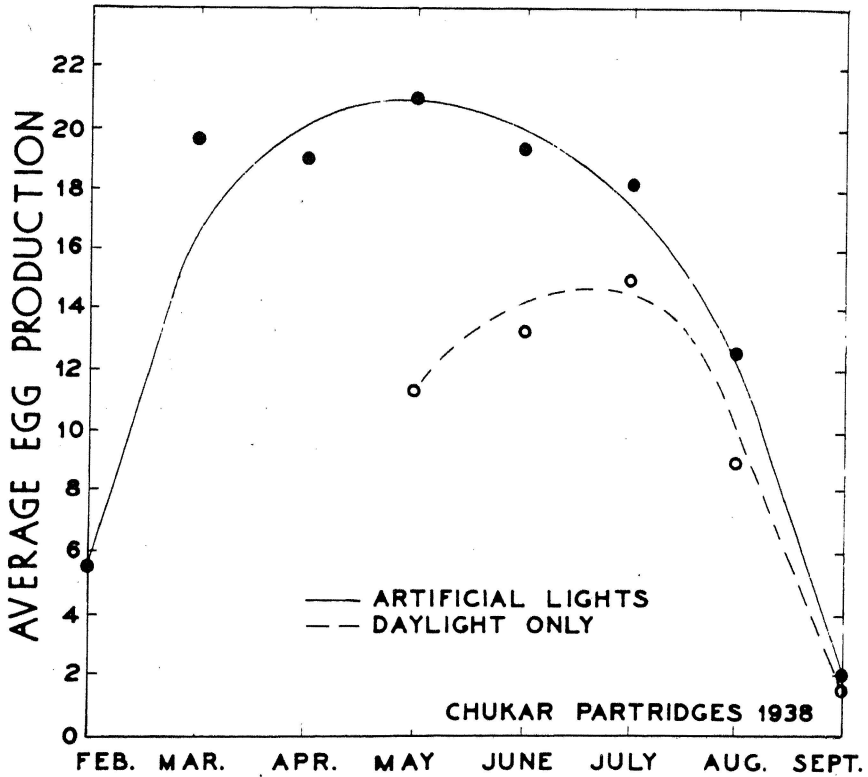


Fig. 4.—Influence of artificial light on egg production of Chukar partridges (1938). Artificially lighted birds were exposed to all-night light from Jan. 9 to May 1.

group. The increased total egg production of the artificially lighted birds may be attributed to the longer laying period due to early egg production and also to a higher rate of production.

2. **Quail.** The 1938 experiments showed that artificial lights at night stimulated the quail into early egg production, but the results from the all-night lights were not as significant for the quail as were those for the chukar partridges. Only one quail under artificial lights responded to the lights during February and March. Due to this bird's high rate of production, the average egg production for the artificially lighted birds was greater than the average for the controls from February to June. The controls (daylight only) exceeded the artificially lighted birds in egg production during July and August (Fig. 5).

The average total egg production for the quail under all-night lights was 95.6 eggs as compared to 71.9 for the controls.

The increased total egg production for the artificially lighted birds was due to the high record, 159 eggs, obtained from bird 3802. Apparently the other birds failed to respond to the lights.

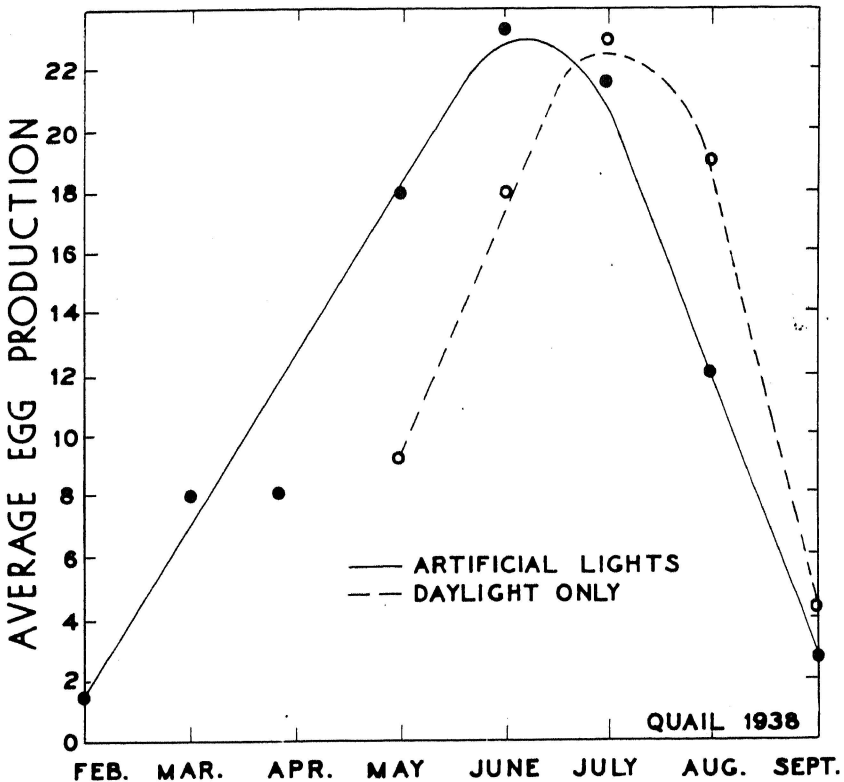


Fig. 5.—Influence of artificial light on egg production of quail (1938). Artificially lighted birds were exposed to all-night light from Jan. 9 to May 1.

When quail were exposed to artificial lights at night in 1939 they were stimulated into earlier egg production as shown in Figure 6. The artificially lighted birds laid approximately thirty days after lights were first used. The lighted birds increased their rate of production and reached their maximum production during the latter part of May. The controls commenced laying in April and reached their peak of production in June. After June 1 the controls exceeded the artificially lighted birds in egg production. No eggs were obtained from either group after August 15.

The total egg production of the quail was also increased by artificial lights. The birds under all-night lights averaged 55.41 eggs as compared to 46.9 eggs for the controls.

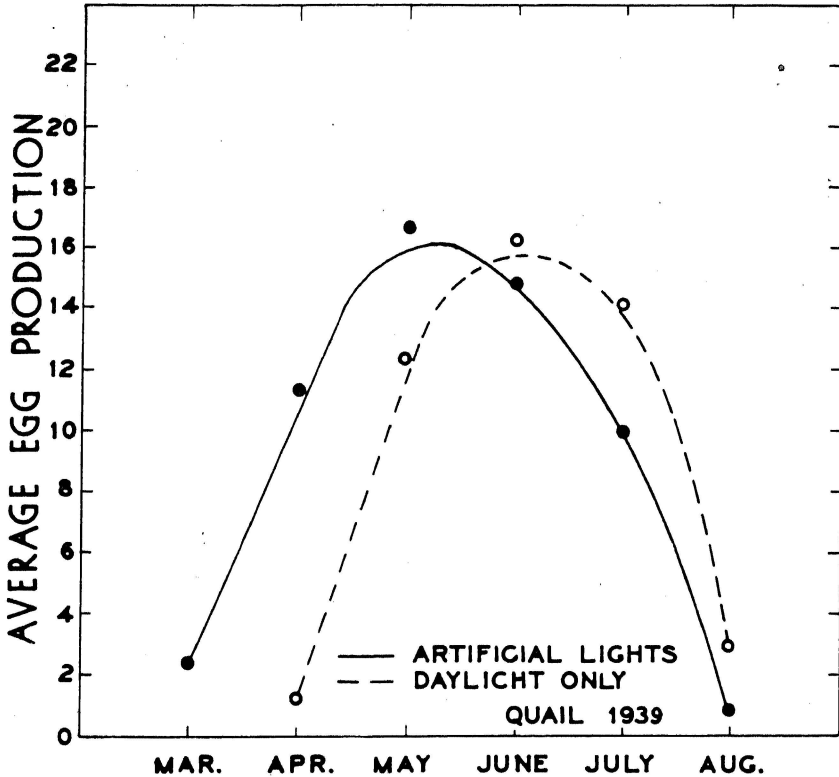


Fig. 6.—Influence of artificial light on egg production of quail (1939). Artificially lighted birds were exposed to all-night light from Feb. 4 to May 1.

Factors Influencing Fertility and Hatchability of Quail and Chukar Partridge Eggs.

1. **Variation between individual quail.**—The hatchability of quail eggs varies considerably. The lowest percentage of hatchability for any one quail for 1938 was 41.3 per cent and the highest 94.7 per cent. The birds under artificial lights varied from 41.3 per cent to 92.3 per cent. From the data one can conclude that exposure to artificial lights did not affect hatchability. The wide range in hatchability may be attributed to variability between individual birds.

Hatching results obtained in 1939 showed the same variability in fertility and hatchability between individual quail. Again there was no marked difference in the hatchability records of birds under artificial lights and those under daylight only.

There was a marked variation in fertility of quail eggs. The range of infertility was from about 3.5 per cent to 100 per cent. The introduction of different males to females which produced infertile eggs failed in many cases to improve the fertility. All eggs were incubated under the same conditions. The results obtained suggest the possibility of breeding for increased fertility and hatchability in quail.

2. The effect of flock matings on fertility and hatchability of chukar partridges and quail.—Monogamy seems to be natural in quail, but there has been a considerable difference of opinion as to whether male Bobwhites will mate with more than one female. Stoddard reported that observation made in the field showed that quail usually pair off and remain mated throughout the season and may also remain mated or remate in a following season. Stoddard also reported that in captivity a male quail will fertilize the eggs of several hens. Fertility was as high in eggs produced by females mated in the ratio of 4 males to 12 females as it was in eggs from individual pair matings.

In the wild, chukar partridges are generally considered monogamous and are usually mated in pairs when artificially propagated.

The expense of maintaining breeding birds could be greatly reduced if flock matings were possible. This saving would result from reducing both the number of males and the amount of equipment necessary.

(a) *Chukar partridges.*—In February 1939 experiments were initiated to determine the possibility of flock mating as a method of breeding chukar partridges. As previously stated, flock 1 was composed of one male and four females. Flock 2 contained three males and three females.

TABLE 1.—THE EFFECT OF FLOCK MATINGS ON FERTILITY AND HATCHABILITY OF CHUKAR PARTRIDGE EGGS (1939).

	Eggs set	Infer-tile	Eggs Hatched	Per cent hatch of	
				All Eggs	Fert. Eggs
Flock I*	49	5	33	67.3	75.0
Flock II**	51	5	29	56.9	63.0
Pairs	34	3	19	55.9	61.3

*1 Male and 4 females.

**3 Males and 3 females.

The results of this work suggest that flock mating of chukars may have a place in artificial propagation. As shown in Table 1, the best results were obtained when one male was mated to four females. To determine the proper ratio of males to females these experiments should be repeated on a much larger scale.

(b) *Quail.*—A similar experiment was conducted in the summer of 1939 with quail, the object being to determine the

possibility of mating one male quail with more than one female. In this trial, five flocks, each containing 1 male and 2 females were maintained. Individual pair matings were used as controls. Similar treatment other than the difference in the mating was given to all birds. Fertility and hatchability records were obtained from these birds.

TABLE 2.—THE EFFECT OF FLOCK MATINGS ON FERTILITY AND HATCHABILITY OF QUAIL EGGS (1939).

	Eggs set	Infertiles		Number Hatched	Per cent hatch of	
		No.	Per cent		All Eggs	Fert. Eggs
Flocks*	224	18	8.04	132	58.9	64.1
Pairs**	843	200	23.72	441	52.3	68.6

*1 Male and 2 females.

**1 male and 1 female.

As shown in Table 2, from 224 eggs set from the mating having two females and one male, 8.04 per cent were infertile. The infertility of the eggs from the individual pairs was 23.72 per cent. Evidently fertility was increased by flock matings. Sixty-four per cent of the fertile eggs hatched from the flock matings as compared to 68.6 per cent from the individual pairs. It would appear that one male quail will mate with more than one female, thus supporting Stoddard's observations. But to answer the question as to the number of females one male will accommodate requires further investigation.

3. The effect of type of floor on fertility and hatchability of chukar partridge eggs.—In 1939 a trial was made to determine the effect of the type of floor upon the fertility and hatchability of chukar partridge eggs. Two general types of breeding pens were used, one type being equipped with a wire floor, whereas the other type had an earth floor. In the wire-floor houses, the birds were never allowed on the ground, but in the other pens the birds were on the ground during the entire breeding season.

TABLE 3.—THE EFFECT OF TYPE OF FLOOR ON THE FERTILITY AND HATCHABILITY OF CHUKAR PARTRIDGE EGGS (1939).

Type of Floor	Eggs set	Infertile	Eggs Hatched	Per cent hatch of	
				All eggs	Fert. eggs
Earth*	34	3	19	55.9	61.3
Wire*	154	50	49	31.8	47.1

*Birds mated in pairs.

As shown in Table 3, maintaining the breeding chukar partridges on earth floors resulted in a higher percentage of fertility and hatchability than when birds were maintained on wire floors. However, the birds kept on the ground had greater access to direct sunshine and this is probably responsible for the improvement in the hatchability of the eggs, since exposure to direct sunshine is an important factor influencing the hatchability of chicken eggs.

Factors Affecting Egg Weight in the Quail and Chukar Partridges.

Many investigators have shown that there is considerable variation in the size of eggs produced by the domestic fowl. It has been shown that there are seasonal fluctuations in egg weight; that eggs of pullets increase in size during the early period of production; and that intensity of production, body weight and sexual maturity may effect egg size.

The purpose of this study was to consider the effects of the period of production, the temperature, and the position of the egg in the clutch upon egg weight of quail and chukar partridges.

1. Change in weight of chukar partridge and quail eggs by weeks of production.—The weights of chukar partridge and quail eggs laid during the different weeks were obtained for the production season of 1938. The object was to determine at what period in egg production the chukar partridge and quail eggs reached their maximum size. The egg weight for the various weeks of production was also determined on a percentage basis to make a comparison of the two species. The percentage was determined by dividing the weekly egg weight average by the average weight for the 14 week period and multiplying by 100.

It has been found that egg size in chickens varies according to the month egg production commences. If the chicken begins laying before February the egg size gradually increases until the maximum is generally reached in February. Pullets which begin laying in February lay their largest eggs during that month. It is the tendency of chickens eggs to vary considerably in size from month to month during the laying season.

The weight of chukar partridge eggs increased slightly from the first week to the third week of production, but the eggs reached their average size during the second week. The egg weights remained approximately the same from the second week of production to the end of the 14th week period. The smallest chukar partridge eggs were laid during the first week, and the largest eggs were laid during the third week.

The quail did not reach their average egg weight until the fifth week. The smallest quail eggs were laid during the first week of production. The quail egg size remained fairly even from the fifth to the fourteenth week. It is of interest to note the small variation in the size of eggs laid by the chukar partridge and quail. A much greater variation occurs in chicken eggs.

2. The effect of temperature on egg weight in quail, chukar partridge, and White Leghorn pullets.—In determining the effect of temperature on egg size, the mean monthly egg weight of the birds under study was compared with the mean monthly

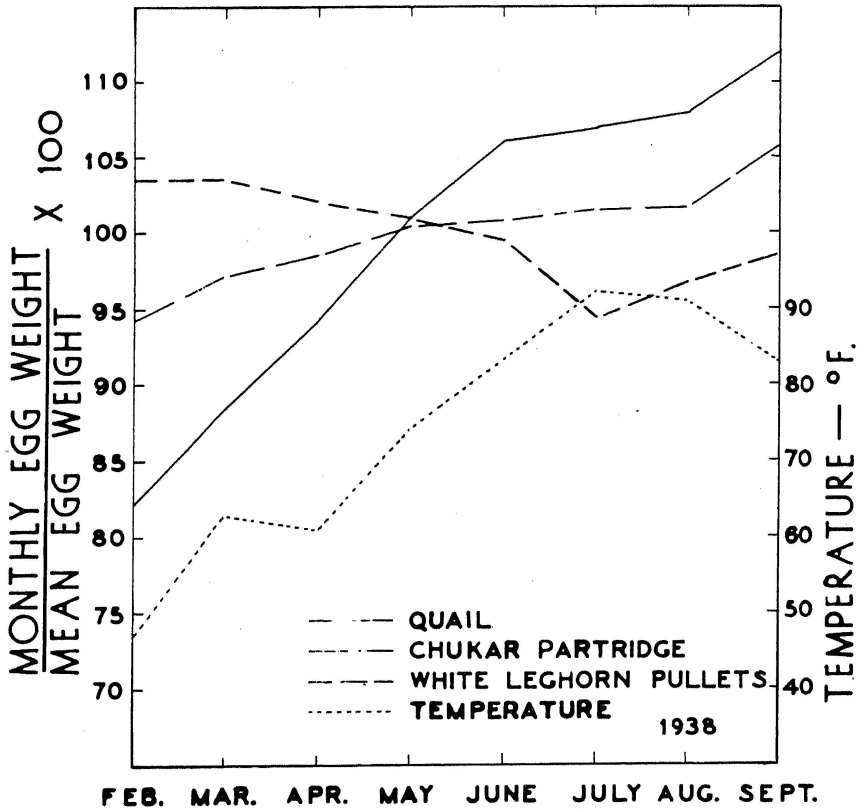


Fig. 7.—The effect of temperature on egg weight of quail, Chukar partridges, and White Leghorn pullets (1938).

maximum temperature for the period from February to September, inclusive. The relationship between the temperature and egg weight of the quail, chukar partridges and White Leghorns during their first laying year is shown in Figure 7. The egg weight for the various months was determined on a percentage basis to facilitate a comparison of the three species. The data for the curves were calculated by using the following formula:

$$\frac{\text{Mean monthly egg weight} \times 100}{\text{Mean egg weight (Feb.-Sept.)}}$$

From February to June there was a slight decrease in egg weight of White Leghorn pullets. In the latter part of June the temperature was above 90 degrees F. and there was a sharp decline in the egg weights of eggs laid by these pullets. The lowest egg weight for the chickens was obtained during July which was the hottest month during the experiment.

Hot weather apparently does not have a depressing effect on egg weight in quail and chukar partridges as it does on the eggs from chickens. The quail and chukar partridges showed an increase in egg size each succeeding month, whereas the egg weight of chickens declined to a low point in July.

3. Position of the chukar partridge and quail eggs in the clutch in relation to egg weight.—The results of an experiment in 1938 showed that the weight of chukar partridge and quail eggs was influenced by the position of the egg in the clutch (group of eggs laid on consecutive days). It was found that the first egg laid in a clutch was usually the largest egg laid in that particular clutch. When the average weights of a representative number of eggs in the clutch were compared, the first egg was slightly larger than the eggs laid on succeeding days.

Relation of Clutch Size and Egg Production in Quail.

TABLE 4.—RELATIONSHIP OF CLUTCH SIZE AND EGG PRODUCTION IN QUAIL.

Year	Total clutches	Total eggs	Avg. clutch size	Average production
1937	227	450	1.98	37.50
1938	462	1286	2.78	67.68
1939	517	1187	2.29	51.61
Total	1206	2923	2.42	54.13

As indicated by the results shown in Table 4, when egg production is high quail tend to lay eggs in longer clutches than when production is low.

Effect of All-Night Light on Clutch Size.

TABLE 5.—EFFECT OF ALL-NIGHT LIGHT ON CLUTCH SIZE IN QUAIL AND CHUKAR PARTRIDGES (1938-39).

Treatment	Total Clutches	Total eggs	Average clutch size	Average production
Quail (1938)				
All-Night Light	114	377	3.31	75.40
Daylight Only	462	909	1.97	64.93
Quail (1939)				
All-Night Light	271	665	2.45	55.41
Daylight Only	246	522	2.12	47.45
Chukar Partridges (1938)				
All-Night Lights	179	353	1.97	117.60
Daylight Only	116	212	1.83	70.60

The average clutch size for birds under all-night light was larger than for birds under natural light. There was also an increase in egg production under artificial lights at night.

It is of interest to note there was very little difference in the clutch size of the lighted and unlighted chukar partridges even though the birds exposed to all-night light laid 47 more

eggs per bird than did the controls. This difference in egg production was not due so much to an increase in the rate of laying such as was experienced by the quail but was largely due to the longer laying period afforded by exposing the partridges to all-night light.

It will be observed that in general the clutch size for the quail tended to be slightly larger than for the chukar partridges which suggests that the quail lay at a slightly faster rate. The reason for the lower egg production for the quail was due to a shorter laying period.

Size of Chukar Partridge and Quail Eggs

In 1938 all eggs laid by 9 chukar partridges and 18 quail were weighed in grams, and the length and width were determined in centimeters. Measurements were obtained for a total of 610 chukar partridge eggs and 1263 quail eggs.

The average weight of all chukar partridge eggs was 22.37 grams and the average weight for the quail eggs was 9.13 grams. The chukar partridge eggs varied from an average of 21.5 grams for one bird to a 23.46 gram average for another bird. The smallest average egg weight for a quail was 7.6 grams and the largest 10.1 grams.

The average size of all chukar partridge eggs was 4.207 cm. in length and 3.154 cm. in width. The quail eggs averaged 3.095 cm. in length and 2.401 cm. in width.

Feed Consumption of Chukar Partridge and Quail.

It should be of interest to game bird breeders to know the approximate quantity of feed necessary to maintain breeding birds.

Feed consumption data were obtained on 10 pairs of chukar partridges and 10 pairs of quail in the breeding season for 1938. Feed consumption records were also kept on 12 pairs of quail during 1939.

The data accumulated show that the average feed consumption for each pair of chukar partridges, under all-night light, was 2275 grams or 5 pounds per month. Each pair of controls (daylight only) ate an average of 1789 grams or approximately 4 pounds of feed per month.

The feed consumption for each pair of quail during the breeding season of 1938 was 2.15 pounds per month for birds under artificial light at night and 2.05 pounds for the control (daylight only) birds. Each pair of quail under all-night light during the 1939 breeding season consumed 2.15 pounds of feed per month.

SUMMARY

Experiments were conducted in 1938 and 1939 to study the effect of all-night light on egg production of quail and chukar partridges, and to study some factors affecting fertility and hatchability in these species. Egg production records were kept and egg measurements were made. Data were obtained to show factors affecting egg weight and clutch size. Feed consumption records were secured on the birds during the breeding season.

CONCLUSIONS.

1. The total egg production of quail and chukar partridges was increased by the use of all-night light. The larger egg production for the lighted birds was attributed to a longer laying period due to early egg production and also to a higher rate of production.
2. Results obtained on variation between individual quail suggest the possibility of breeding for increased fertility and hatchability in quail.
3. Based on a single trial, flock matings of chukar partridges produced more satisfactory results than did mating in pairs. Best results were obtained when one male was mated to four females.
4. In captivity, a male quail will mate with more than one female. Eggs from flocks where one male was mated with two females showed a fertility of 91.97 per cent.
5. Maintaining breeding chukar partridges on earth floors resulted in a higher percentage of fertility and hatchability than was experienced when birds were maintained on wire floors.
6. Chukar partridges produced eggs of average size after the first week of laying. Quail laid eggs of average size in their fifth week of laying.
7. Hot weather apparently does not have the depressing effect on egg weight in quail and chukar partridges which is experienced in chickens. Quail and chukar partridge eggs increased in size each succeeding month, whereas the weight of chicken eggs declined to a low point in July.
8. The weight of chukar partridge and quail eggs was influenced by the position of the egg in the clutch. The largest egg was usually the first egg in the clutch.
9. Results indicated that an increase of egg production in quail and chukar partridges was accompanied by an increase in the size of clutch.

10. The average chukar partridge egg was 22.37 grams in weight, 4.207 cm. in length, and 3.154 cm. in width. The average quail egg was 9.13 grams in weight, 3.095 cm. in length, and 2.401 cm. in width.
11. Chukar partridges under all-night lights consumed an average of 5 pounds of feed per pair for each month of the breeding season. The unlighted birds ate an average of approximately four pounds of feed per pair for each month. Each pair of all-night lighted quail ate 2.15 pounds of feed, whereas, each pair of unlighted quail ate 2.05 pounds per month.