Report of the

S A G E G R O U S E S U R V E Y

Pittman-Robertson Project,
Colorado 4-R
Season 1941, with comparative
data of previous seasons.

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INTRODUCTION

This third season's work has followed much the same lines of study that have been reported in 1939 and 1940. In addition studies were made on Strutting Grounds and on Brood Counts. The field work was also spread to take in a new area at Craig, Colorado.

Work began on April first at North Park, and was continued until August eighth in that area. Studies at Craig were made during July and the first part of August. All data was secured by the Pittman-Robertson field crew of three men.

In order that the reader may acquaint himself with the symbols referring to cover type, the following extract is taken from last year's report:

"As a fundamental in every anagement study of wild game, it is necessary to classify the vegetation on the management unit being investigated into various "types" and to study the relationship of the game species to these types. No adequate discussion of findings is possible without frequent reference to these relationships; so before going further with this discussion, it seems desirable to outline briefly, classification of the vegetative types found on the sage chicken range in North Park. For the purpose of this study we classified them as follows:

A. Sagebrush (symbol-Art)
subtypes:
A1 - sagebrush under 7" tall
A2 - sagebrush 7" to 15" tall
A3 - sagebrush 15" to 30" tall
A4 - sagebrush 30" and over

B. Rabbitbrush (symbol-Chryso)
subtypes:
Same as for sagebrush.

C. Greasewood (symbol-Sarc)

D. Ridge - Windswept ridges dominated by vegetation less than 3" tall.

E. Grass - Areas other than the meadows, in which grasses are the dominant vegetation.

THE STRUTTING GROUND STUDY - NORTH PARK - 1941

The strutting ground study was undertaken for the purpose of determining sex ratio and also to see if a strutting ground census could be made similar to that used by V. E. Davison on lesser prairie chicken in Oklahoma. As the strutting season progressed it soon became evident that the strutting grounds were too large and irregularly placed to give accurate census figures. One ground was found that had 171 birds present at one time. If all the strutting grounds in an area were located, it might be possible to arrive at a population figure; however, this would be almost impossible to do because of the sporadic nature of the occurrence of birds on some grounds. For instance, one ground was located at Greene Springs, six miles west of Walden. On April 15th, forty-one birds were present. A few days later no birds were found by the observers although weather conditions were almost identical. However, the time spent on strutting ground observation was not wasted. Fairly reliable sex ratio data was obtained together with much valuable information on breeding and activity.

Procedure

Observations on strutting grounds were started on April 5, 1941, at which time strutting was at its height, and continued to May 31, 1941 at which time strutting had practically ceased.

The grounds were located during April by the following method: The observers drove slowly along roads from 3AM until about 6AM. Frequent stops were made to listen for booming. As soon as booming was heard the observers located the ground on foot. This often required several hours as the booming sound may carry for better than a mile and is ventriloquistic in its effect. Most of the time no definite direction could be taken but repeated circling almost always located the strutting birds.

Observations on the grounds were made by driving a car to within 25 to 100 yards of the birds and observing from the car. The birds were not unduly alarmed by the presence of the car, and the presence of the observers is not thought to affect the data obtained. Observations and counts were taken at half hour intervals, and general notes were taken at all times.

Description of the Grounds

The birds generally chose a grassy swale or some place where the vegetation was thinner than average. Several grounds were located in sagebrush. It cannot be said that the North Park birds prefer any one type as strutting grounds. Grounds were located on both ridges and depressions.

Activity

During the early part of the season strutting took place all during the night and lasted until about 8:00 AM. Toward the end of the season, as the days grew longer, the birds left the ground earlier in the morning. Several times they left as early as 6:00 AM.

The maximum number of birds was almost always counted as soon as it was light enough to see. The counts kept falling off as it became lighter, until all the birds had left. The males had a tendency to remain on the grounds much longer than the females. (See Graph No. 1) This characteristic makes it necessary to use the first count obtainable for sex ratio figures.

Maximum counts are obtained on days that are clear with little disturbance in the weather. Snow, rain, fog or wind seem to prevent the birds from coming to the grounds and also inhibits their activity. Most birds observed under adverse weather conditions did little strutting, but sat on the ground with little display of enthusiasm.

Breeding was observed on numerous occasions. In most cases the breeding was done by just a few of the males. In one case, one male was observed to cover five hens in 21 minutes. On the same day, another cock covered six hens in 61 minutes. These observations clearly indicate the polygamous nature of the Sage Grouse.

Sex Ratio

The sex ratio figures are presented in Table 1. These figures are obtained from the two largest grounds and are an average of several weeks observations. No observations after April 21 were used, because there was evidence that the hens started to nest at that date. The final average of one cock to 1.1 hens is verified by the data obtained by random observation in the field. The field observation figure is one cock to 1-3 hens.

These figures coupled with the observations on breeding, would seem to indicate a small surplus of male birds. There is no evidence that this surplus of males is in any way detrimental to the Sage Grouse in North Park.

TABLE NO. 1

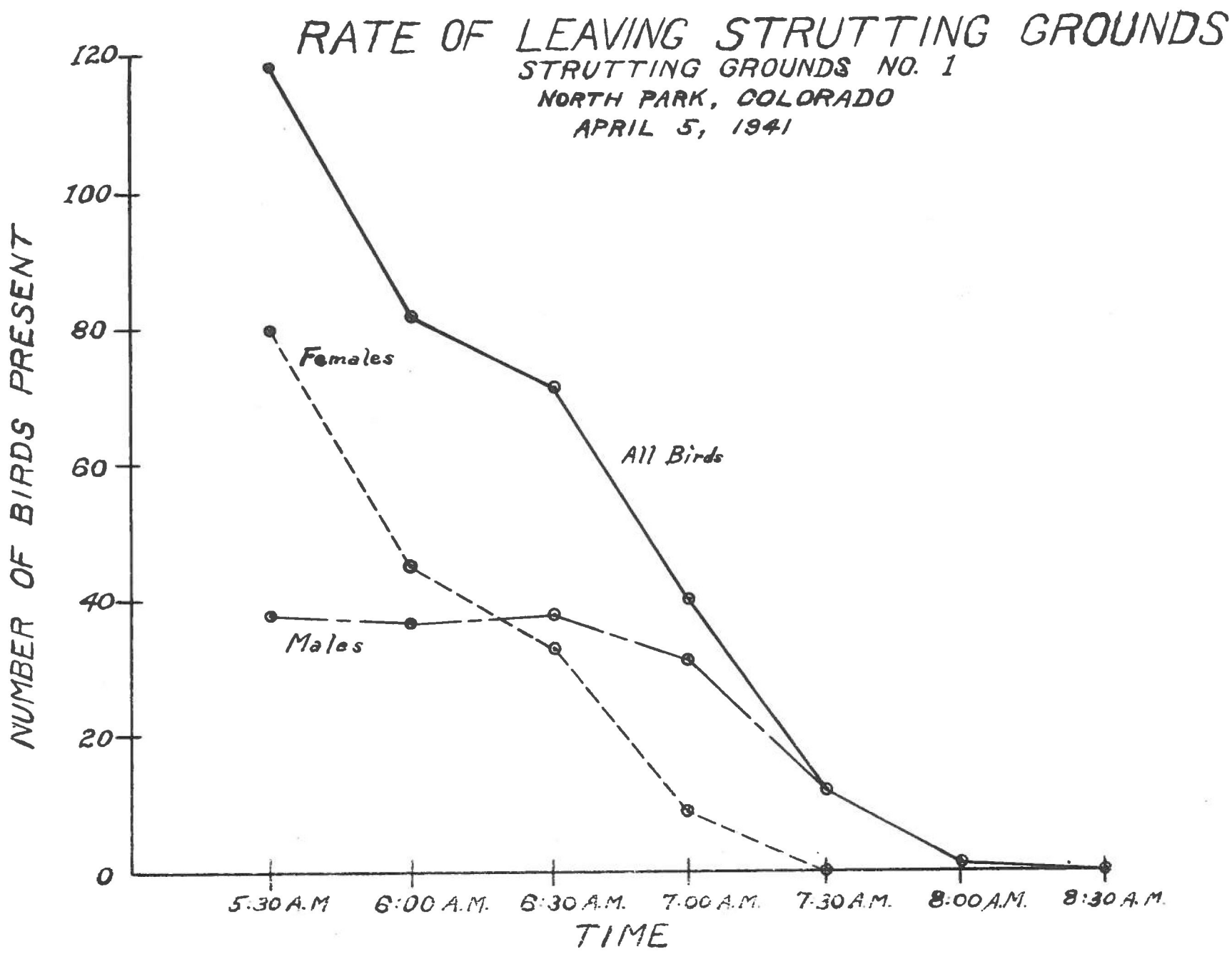
Strutting Ground No. 1

DATE:	Apr. 5	Apr. 8	Apr. 12	Apr. 16	Apr. 19	Apr. 21	Total	Sex Ratio
Males	38	48	17	49	48	69	269	1.00
Females	80	123	23	61	30	26	343	1.27

Strutting Ground No. 2

DATE:	Apr. 10	Apr. 17	Apr. 21	Total	Sex Ratio
Males	41	50	71	162	1.00
Females	42	71	19	132	0.81

Average Sex Ratio of both grounds is 1 male to 1.10 females.
Average Sex Ratio from general observations is
1 male to 1.3 females (77 observations)


RATE OF LEAVING STRUTTING GROUNDS
STRUTTING GROUNDS NO. 1
NORTH PARK, COLORADO
APRIL 5, 1941
NUMBER OF BIRDS PRESENT
120
100
80
60
40
20
0
Females
All Birds
Males
5:30 A.M
6:00 A.M.
6:30 A.M.
7:00 A.M.
7:30 A.M.
8:00 A.M.
8:30 A.M.
TIME

THE NESTING STUDY - NORTH PARK - 1941

In a nesting study, the first step is, of course, to find the nests.

Three different methods were used to locate nests. They were:

1. Individual search
2. Cooperation of local residents
3. Systematic search of specified areas.

The individual search system was the least successful. The observers tried to find nests by walking in random traverses through areas where nests were thought to be. In one case three observers spent all day searching and found only one nest. Probably this more or less haphazard method of attack fails to keep the observer on the alert at all times and makes for poor results.

The local residents and especially the sheep herders, helped a great deal this year as well as last, by making note of nests found as their flocks grazed, and reporting to us. This method of attack was successful, but sufficient data could not be obtained by using it alone.

Most of the nests were located by traversing systematically those lands which were designated as study areas. The three observers crossed these areas in contiguous strips about fifty feet wide, so that when all such strips were traversed on a given area, there was practically a complete coverage. Even spacing of the observers was obtained by stretching a measured length of clothesline between them. Laths were stapled to the clothesline at intervals between the observers, and served to flush birds which would not have been flushed otherwise. An average of four to five nests per day were found by this method. It is felt that this system comes close to giving the approximate number of nests on any area so covered.

Form Used

A sample of the form used in recording data is shown on Plate 1. This form allowed the observer to take down all pertinent data and keep a running record of the progress of the nest. It was devised and first used in 1940 by Lucas Dargan.

Nesting Period

The first nest was found on April 28, 1941 and contained three eggs at that time. Incubation had not started because the hen kept laying until there were eight eggs on May 4, 1941. This would mean that the hen layed five eggs in six days. The second nest found was located on May 1, 1941. At that time it contained one egg. Incubation had not started, as the hen layed seven more eggs before the clutch was complete.

The great majority of the nests hatched during the last week in May and the first week in June. The last active nest under observation hatched on June 24, 1941. The next to the last nest hatched on June 20, 1941. These observations agree with those made in 1940 by Lucas Dargan. (See Vol. 2 Sage Grouse Survey Colorado Pittman-Robertson reports.) He states that the first active nest was found on May 6, 1940 and contained 8 eggs at that time. The period of heaviest hatch was the last week in May and the nesting period lasted until the third week in June.

Notes were kept on incubation period all through the nesting season. One nest started incubating on the sixth or seventh of May when a full clutch of 8 eggs was found for the first time. This nest hatched in the afternoon of May 30, 1941 giving an incubation period of 23 to 24 days. Another nest was recorded that started to incubate on May 5, 1941 and hatched on May 28, 1941. This also gives an incubation period of 24 days. In another case, on May 13, a nest was found with 9 eggs and incubation already started. This nest hatched at 9:10 AM on June 2, 1941 giving an incubation period of at least 21 days. Another case was recorded where the incubation period was at least 23 days and another where the incubation period was at least 22 days. All these data indicates that the incubation period is approximately 22 to 24 days. This evidence is at slight variance with other data previously presented. Grinner states in his "A Study of the Sage Grouse", a thesis for a master's degree from the Utah State Agricultural College, that "in the field it is difficult to tell just when the last egg was laid and when incubation began. This accounts for lack of complete information concerning the incubation period. Bent cites Bendire as believing the incubation period to be between 20 and 22 days; Gerard and other investigators all indicate that this period is the same".

Description of Nests

All nests found were in shallow depressions in the ground, and in almost all cases were located under a Sage bush. A few nests were found with grass or Chrysothamnus as the immediate cover. The average size of the nests was 8" in diameter by 2" deep. These data agrees with that collected last year and also with that reported by Grinner.

All nests found were lined with grass and small sage twigs with a few feathers and sage bark. More feathers were added as incubation progressed.

Environmental Relationships

Last year the average distance of nests from water was 0.66 miles. The data obtained this year averages 0.69 miles. This figure can be taken as accurate for conditions in North Park. Most of the nests found were from ¼ to 1 mile from water (see table 1). No definite grouping of nests along watered areas was shown by plotting nests on a map. These data bear out last years conclusions that water distribution does not affect the nesting site of Sage Grouse in North Park to any great extent.

Last year the following comment was made; "with regard to cover type, the sage hen showed a marked preference for the taller sagebrush....., many of the nests in the A2 type were located under plants of the A3 class and often were near the edge of the A3 type. None of the types listed..... were neglected in the field work; so we feel that the table gives a reasonably true picture of type preference. (See Vol. 2, Sage Grouse Survey) We have not attempted to estimate the proportion which each type comprises of the entire range. Next season, when a large part of the field work will be done on a systematic grid plan, we can secure quite accurate information on this subject."

A comparison of the two years data (see table 2) reveals that a much larger percent of the nests were found in A1 type in 1941 than in 1940. The number of nests found in A2 and A3 types is lower than in 1940. This difference in data may be explained by the fact that data in 1941 were obtained mostly by systematic covering of all areas chosen regardless of whether the observer thought he would find nests or not, in the strip he covered. In 1940 observations were made at random. It is natural that the A1 type would not have been covered as thoroughly as the other types because this type, consisting of very low sage brush, would not appear to be very productive of nests.

In general however the conclusion that most nests are in the areas of higher sagebrush is verified by the 1941 data.

All nests were recorded as to slope and exposure. Tables 3 and 4 give the results obtained this year as compared to last years data. In general it should be stated that preference is shown for North, North-east, East, and South-east slopes. However, more nests were found on flat land than on any one of the slopes during both years. Table No. 4 shows some differences from last years data but both years' data indicate a preference for the more moderate slopes. It should be stated that most of the land covered consisted of gently rolling topography so table No. 4 is not by any means conclusive.

In table 5 is shown the distance nests were found from meadow. It was thought that because juvenile birds spend so much of their time in this type it might alos influence the placing of the nests. However, no such preference is indicated. In fact the average distance to meadow is greater than it is to water. This is in part due to meadows being less common and less widely scattered than the areas where water can be obtained.

Nesting Density

Rasmussen and Grinner report in the "Life History and Management Studies of the Sage Grouse in Utah....." that in Strawberry valley, Utah the highest nesting density found in two years study was 23 nests located on 160 acres or a density of 1 nest per 6.95 acres."

An area of 1280 acres was covered by the Pittman-Robertson crew in a systematic search for nests. It was felt that while not all the nests were located, at least a large enough majority were found to give some fair density figures. Sixty-three nests were found on this area which gives a density of one nest per 20.32 acres. It is felt that this figure is fairly accurate because a census of the area revealed a bird population of one bird to 14.03 acres and as the cock-hen ratio was determined to be one cock to 1.10 hens this would give a hen population of 26.95 acres per hen. This figure is reasonably close to the nesting density figure of 20.32 acres per nest. This nesting density is considerably lower than the density cited by Rasmussen and Griner. It should be remembered that their citation is a maximum figure rather than the average of conditions as they found them in Strawberry valley, Utah.

The 1280 acres covered in this study consisted of 640 acres of fenced ungrazed land and 640 acres that was grazed by sheep, cattle, and horses. The sheep (1700 head) were kept on the 640 from May 6 until about May 14. Cattle and horses were put on after the sheep left. There were 35 nests on the ungrazed area giving a density of 18.28 acres per nest, and on the grazed area there were 28 nests giving a density of 22.86 acres per nest. This data would appear to indicate a slight preference for ungrazed land. There is not enough data here to test statistically however so no definite conclusions can be drawn at present.

Number of Eggs

The average number of eggs per clutch was 7.48 for 1941. This figure agrees very closely with the figure for 1940 which was 7.6 eggs per clutch. Grinner lists the average clutch in Strawberry valley Utah as being 6.82, this figure being a two year average of 147 nests. This data would seem to indicate that the Sage Grouse in North Park have a higher biotic potential than those in Strawberry valley, Utah. Most of the north park nests had either seven or eight eggs in them which checks with last years data and also Grinners data from Utah (See table 6). A comment was made in last year's report to the effect that "at many nests which were revisited soon after hatching occured, we found the shell of one less egg than were known to have been in the nest". This occurance was recorded only once this year out of the thirty-five hatched nests noted.

Weight of Eggs

A clutch of 5 eggs were weighed and found to weigh 8.5 pounds. This would be an average of 1.6 Oz. per egg. The average domestic hen's egg weighs around 2.0 Oz.

Pipping and Hatching

Two nests were observed while hatching took place. The first was observed at 8:30 PM on June 3, 1941. The hen sat still on the nest and would

not flush even when the observer approached to within two feet of her. Egg shells were scattered around the nest and one chick could be seen under her wing. This hen remained on the nest all night and went off with her chicks the next morning.

The other nest was observed the same evening as first mentioned. A blind was set up near the nest and the observer returned to the nest the next morning at 4:00 AM. The bird would not flush even when touched with the foot. The hen finally left the nest with her chicks at 7:00 AM. These observations agree with Grinners who states that his observations" .....tend to support the theory that the brood does not leave the nest immediately after hatching, but remain at the nest until dusk or until a time when excape protection is best."

Unhatched Eggs

Only five unhatched eggs were found in the 35 hatched nests observed. Of these two eggs contained embros and the other three were called infertile. This data compares very closely with that obtained by the Pittman-Robertson crew last year. (See table 7) It would seem that the loss from infertile eggs was very small, which in turn would indicate that there is no breeding problem at present due to lack of adequate cocks.

Eggs Deposited Outside of Nests

On several different occasions whole eggs were found laying on the ground with no nest in the vicinity. Two such instances are cited from the field notes.

May 13, 1941

1. 11:15 AM. A this years sage grouse egg was found in A3 type. The egg is intact but the top side is bleached indicating it has been laid for quite some time. There is no embyro in the egg so the egg probably had not been incubated.

June 10, 1941

2. A single sage grouse egg was found in A2 type. The egg was broken on the side as if it had been dropped. All the contents are still in the egg. No embyro is present. Possibly this is an egg deposited before the hen had a nest or after her nest had been destroyed or deserted."

No definite explanation can be given for these eggs being so found; however it does seem plausable that they may have been deposited before the hen had a nest or after she had left her old nest and before she constructed a new one.

Nesting Success

Almost exactly the same percent of nests were destroyed this year as last. In 1940, 52.9% of the total nests found were destroyed. This year 56.7% of the total nests located were destroyed. Comparable figures are also obtained for desertion with 10.9% being deserted in 1940 and 8.3% deserted in 1941. (See Table 8) The fact that the figures from the two years are so nearly the same would indicate that the loss of nest by predation and desertion is a more or less stable figure and could be relied on for management purposes. Griner in his thesis on Sage Grouse in Strawberry valley, Utah, states that the nest loss from destruction amounted to 25.46% and the nest loss from desertion was 14.29%. Griner's figures are a two year average (1936-1937) of 161 nests. Comparison of North Park figures with Griner's figures indicate that while loss from desertion is approximately the same the loss from destruction is much greater in North Park. From these figures it would appear that management of North Park birds should include measures that would curb nest depredations to increase nesting success.

It was stated in last years report that at least three-fourths of the predation was mammalian in its nature. This statement was verified by this seasons results. Two methods were used to determine these predators. Whenever a destroyed nest was found the bushes around the nest were carefully examined for hair. These hair samples were sent to Mr. C. C. Sperry of the Food Habits Laboratory, Fish and Wildlife Service and were identified by him. Table 9 gives the results of these hair collections. The great majority of the samples were from badger. The two samples called Mustellid could have been badger, skunk, weasel, or mink. The rabbit and Citellus (Ground Squirrel) hairs are probably contaminations and have no significance other than these mammals were present at some time.

The other method of nest predator determination was by putting out dummy nests. Three types of dummy nests were employed. Dummy trap nests were constructed by placing two to four domestic hens eggs in an old sage grouse nest and concealing traps around the entrances to the nest. A similar technique was employed by using an automatic camera which was focused on the dummy nest. The shutter was triped by an electrical device which made contact when an egg in the dummy nest was disturbed. This camera nest technique had formerly been used by Mr. E. R. Kalmbach of the Fish and Wildlife Service and we are indebted to him for help in the construction of our equipment. (See table 10 for results with this method)

The third type of dummy nest was made by placing poisoned domestic hen eggs in old Sage Grouse nests. The following technique was used in preparing the poisoned hens eggs:

> A hole was punched in each end of the egg using an 18 gauge hypodermic needle for a punch. Next 2 to 3 cc of hot 3% Strychnine sulphate solution was injected in the large end of the egg using a 5 cc hypodermic syringe for the injection. Excess

egg material ran out the hole in the small end of the egg as the strychnine solution was forced in. At times it was necessary to poke a needle in the hole at the small end of the egg to keep the egg material flowing freely. The holes in the injected egg were then closed by dipping the ends of the egg in melted paraffine. Very few eggs were broken using this technique.

Whenever a dead predator was discovered in the field the stomach was taken and examined for egg and egg shell before any conclusions were drawn. In almost all cases the dead predators were found within 100 yards of the destroyed dummy nest. Two cases were recorded where badgers moved less than two feet after poisoning. (See picture 1) One skunk was found dead lying on top of the nest he had just robbed.

Table 10 shows the results from these dummy nests. The high incidence of Ground Squirrels should not be taken as an indication that they are the most serious nest predators. Most all ground squirrels were taken in traps and may or may not have had designs on the dummy nest. In the cases where three ground squirrels were taken because they fed on poisoned eggs, the eggs were not broken but the squirrels had eaten egg material that had leaked out of the injection holes. Observations tend to show the Ground Squirrels were guilty of moving eggs and digging in the nests which may account for some desertions.

Two accounts from the general notes indicate that Ground Squirrels probably bother eggs through curiosity rather than the desire to destroy them. The observations are as follows:

June 4, 1941--"Census Area No. 1--Weather--Calm, Warm Clouds cover ¼ of sky.

"1. 4:00 PM A hen egg was placed on the mound of a ground squirrel hole. In about three minutes the squirrel came out and after eyeing the observers car for a few minutes went up to the egg and smelled it. The squirrel then ran off about two feet and began eating rabbit brush. Finally the squirrel left the vicinity of the hole and the egg.

"2. 4:30 PM A hen egg was placed on the mound of a ground squirrel hole. The squirrel came out in a few minutes and sat within 6 inches of the egg, but did not give it any attention. The squirrel then ran about 15 feet from the hole and ate rabbit brush for a few minutes then came back and sat down by the egg and searched for fleas. The squirrel finally ran away and left the vicinity of the hole."

A record was kept of the kinds of animals which trap, poison, and hair sample evidence showed had visited the dummy nests. A total of 97 visitations were recorded. Of this number 74 or 76.2% of the visitations were

made by ground squirrels, 15 or 15.5% were made by badgers, 2 or 2.1% by magpies, 1 individual or 1.0% by crows, 2 or 2.1% by skunks, and 3 or 3.1% of the visitations had been made by unknown birds. As all evidence gathered in this study seems to indicate, ground squirrels are not a factor in actual nest destruction so that their visitations may be considered as having been prompted mostly by curiosity. If all the other animals, except squirrels shown to have visited the nests did so bent on nest destruction then from these data on nest visitation badgers are indicated to be responsible for 65.2% of sage grouse nest destruction.

This figure compares closely with that obtained by hair samples (74.2%). It also agrees with the figure of 73.5% destruction by Badger of all destroyed nests encountered this year (See table 11) Another figure which seems to bear out previous figures is the percent of Duck nests destroyed by Badger. Approximately 70% of the duck nest destruction is attributed to Badger. Most of the duck nests found were in the same general types and locations as the Sage Grouse nests.

This year of the fifty nests on which destruction was by predation and observation of the destruction caused them to be listed as destroyed by badger; sixteen were positively identified as badger work by hair samples. The other thirty-four nests were such typical work that identification was almost positive without any additional check. Typical Badger work exhibits some or all of the following characteristics.

1. Ground disturbed around the nest; sometimes an Area of several square feet is scratched and dug.

2. Nest dug out and eggs removed.

3. Egg shells or whole eggs buried around the nest. (See Picture 2)

4. Eggs thoroughly crushed or else a large hole in the side of the egg. Teeth marks generaly present where animal has bitten into the shell.

Skunk predation is not thought to be serious. Few skunks were seen by the observers and only two were taken in the dummy nests.

Avian predation evidently is not nearly so common as was once supposed. Only 2.9% of the nest predation in North Park is listed as bird work. Crows were not as numerous in North Park in 1941 as in 1940 according to general notes on abundance and opinions of local residents.

It is thought that this data on predation is reliable and represents a true picture of the nesting predators of North Park. If this is the case it would seem necessary to control the badger, at least in nesting areas, if any large increase in Sage Grouse is to be expected.

Relation of Cover Types to Nesting Success

Table 12 gives the figures obtained this year for success of nests in the various types. This year's data does not compare with last years and it is suspected that cover type does not greatly effect the nesting success. Most of the nest destruction is by nocturnal mammals which would rely on the sense of small rather than sight. This would account for erratic behavior of the data. In other words the predator, for instance a badger, could find a nest in A3 type just as easily at night as he could in A1 type.

Relation of Grazing Practice to Nesting Success

Table 13 gives data from both 1940 and 1941 on nesting success as compared to land use. The interesting point presented here is the apparently higher nesting ratio on grazed land. This indications shows up during both years. Cattle and horse grazed land are indicated as having a higher success ratio than sheep grazed land. There is not enough data from cattle and horse range however to draw this conclusion. No Sage Grouse nests were observed this year to be destroyed by sheep, although most of the nests were found on heavily grazed sheep range.

Renesting

It is highly probable that some of the hens renest if their nests are destroyed. This would almost certainly be true if destruction took place while the hens were still laying. Evidence which seems to support this theory is as follows:

> On June 20, 1941 while taking notes on dummy nests, the observer came upon a nest destroyed by badger than contained two eggs. Destruction had taken place within the last day or so as the predators tracks were still evident. It appeared that this nest had just recently been built because the nest lining was of very fresh looking material. No hens had been observed on the strutting ground since June 1, so it is almost certain that this nest was probably a renesting attempt rather than a late nesting. As the majority of the hens started nesting in early May this latter possibility does not seem plausable.

TABLE 1
Distance Nests Were Found from Water

Distance	¼ Mile or less	¼ Mi. to ½ Mi.	½ mile to 1 mile	1 mile to 2 miles	Over 2 miles	Average
Number of Nests	16 (16.8%)	34 (35.8%)	30 (31.6%)	14 (14.7%)	1 (1.1%)	0.69 Miles

TABLE 2
Relation of Nests to Cover Type

Type	A1	A2	A3	Rabbit-Brush	Sage brush & Rabbitbrush	Mixed Unclass. Sagebrush
1940 Data	2 (1.7%)	55 (46.2%)	49 (41.2%)	1 (0.8%)	2 (1.7%)	10 (8.4%)
1941 Data	16 (16.5%)	60 (61.9%)	21 (21.6%)	0	0	0

TABLE 3
Relation of Nests to Slope

SLOPE	Flat	Very Gentile (2% or less	Gentile (2° to 6°)	Moderate (6 to 15°)	Mod. Steep (15° to 20°)	Unclass.
Percentage Of nests 1940	28.6%	12.6%	44.5%	12.6%	0.8%	0.8%
Percentage Of Nests 1941	25.0%	40.6%	28.1%	6.3%	0.0%	0.0%

TABLE 4
Relation of Nests to Exposure

Exposure	Flat	North	North-east	East	South-east	South	South west	West	North-west	Unclass.
Percentage of nests 1940	26.9%	14.2%	10.6%	15.9%	12.6%	5.8%	3.3%	6.7%	1.7%	2.3%
Percentage of nests 1941	25.3%	3.2%	25.3%	11.6%	21.0%	4.2%	0.0%	2.1%	7.3%	0.0%

TABLE 5
Distance Nests Were Found From Meadow

Distance	¼ Mile or less	¼ Mile to ½ Mile	½ Mile to 1 Mile	1 Mile to 2 Miles	Over 2 Miles	Unknown
Number of Nests	5 (5.1%)	19 (19.4%)	38 (38.8%)	31 (31.6%)	4 (4.1%)	1 (1.0%)

TABLE 6
Number of Eggs per Clutch

No. of Eggs in Clutch	5	6	7	8	9	10	Average Size of Clutch
Clutch Frequency (34 Nests) 1940	0	4	12	12	5	1	7.6 eggs
Clutch Frequency (35 Nests) 1941	3	0	13	15	4	0	7.48 eggs

TABLE 7
Unhatched Eggs Left in Nest

No. of Unhatched Eggs Left in Nest	1	2	3	Total Unhatched Eggs	Average per nest
Frequency of Occurrence (1940) (28 Nests)	5	2	1	12	0.43
Frequency of Occurrence (1941) (42 Nests)	3	1	1	5	0.12

TABLE 8
Nesting Success

Total No. Nests Found	Hatched	Deserted	Destroyed	Fate in Question
(1940) 119	42 (35.3%)	13 (10.9%)	63 (52.9%)	1 (0.9%)
(1941) 120	42 (35.0%)	10 (8.3%)	68 (56.7)	0 (0.0%)

TABLE 9
Identification of Hair From Destroyed Nests
by C. C. Sperry
U. S. Fish and Wildlife Service

SPECIES	Badger	Mustellid	Citellus	Rabbit	Unknown
Total samples Examined 31	23 74.2%	2 6.5%	1 3.2%	4 12.9%	1 3.2%

TABLE 10
Species Recorded As Visiting Dummy Nests

SPECIES	Citellus	Badger	Magpie	Crow	Skunk	Bird Unknown
Taken in Traps	66	7	0	1	0	3
Taken with Strychnine	3	8	1	0	2	0
Photographs Taken	5	0	1	0	0	0
Totals	74 (76.2%)	15 (15.5%)	2 (2.1%)	1 (1.0%)	2 (2.1%)	3 (3.1%)
	Badger is 65.2% if Ground Squirrels are not counted					

TABLE 11
Causes of Sage Grouse Nest Destruction

Cause:	Badger	Coyote	Bird (Crow-Magpie)	Other	Unknown
Number of Nests-68	50 (73.5%)	1 (1.5%)	2 (2.9%)	1 (1.5%)	14 (20.6%)

TABLE 12

COVER TYPE	Hatched	Deserted	Destroyed	Total
A1	6 (35.3%)	0 (0.0%)	11 (64.7%)	17
A2	12 (22.2%)	8 (14.8%)	34 (63.0%)	54
A3	10 (40.0%)	2 (8.0%)	13 (52.0%)	25

TABLE 13
Relation of Grazing Practice to Nesting Success

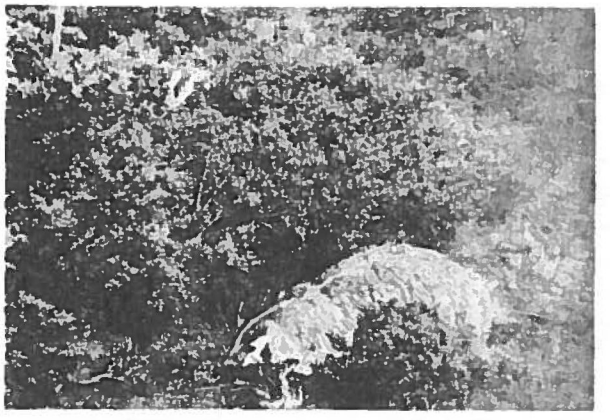
1940 DATA

Grazing Practice	Nests Hatched	Nests Deserted	Nests Destroyed	Fate in Doubt	Total
Ungrazed Range	1	0	9	1	11
Spring Sheep Range	11	1	5	0	17
Other Range	2	0	3	0	5

1941 DATA

Grazing Practice	Hatched	Deserted	Destroyed	Total
Ungrazed Range	8 (22.9%)	5 (14.3%)	22 (62.8%)	35 100%
Sheep Range Spring & Fall	22 (39.3%)	3 (5.4%)	31 (55.3%)	56 100%
Cattle & Horses Summer	8 (53.3%)	0 (0.0%)	7 (46.7%)	15 100%

PICTURE 1



Poisoned Badger that had eaten an injected egg under the bush marked with the flag and died within eighteen inches of the dummy nest.

Picture 2

Poisoned badger that had eaten one poisoned egg and was burying another when the strychnine took effect.

MISCELANEOUS DATA

est Construction_____

ize of Nest_____

ere eggs concealed when hen was Away?_____

id cock assist in nest construction or incubation?_____

NESTING STUDY FORM

Species_____Nest No.___
Date_____District_____
Locality_____

Cover Type_____
Description of Nest & Surrounding Vegetation_____

Range Use_____

Exposure_____Slope_____
Distance from Water_____
Distance from Meadow_____
No. Eggs_____Hen on Nest?_____
Has incubation begun?_____

Remarks_____

Observer_____

Colo.P.R.-L.M.D. Form No. 7.

Return Visits to Nests

1. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

2. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

3. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

4. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

5. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

6. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

7. Date_____Time_____
   No. Eggs_____Hen on Nest?_____
   Remarks_____

   Observer_____

Final Observation on Nest:
Date_____Time_____
Fate of Nest_____
DAte of Hatch_____
Incubation Period_____days
No. Eggs: Hatched_____
Fertile_____
Infertile_____

THE BROOD STUDY-NORTH PARK-1941

The brood study was started about the first of June and lasted until the observers left the field in North Park on August 8, 1941.

All broods located were tabulated as to numbers and as to the vegetative type where located. During the first week or so, while the juveniles were very young, it was extremely difficult to get complete counts as the young grouse would hide and it was next to impossible to flush the entire brood. Some success in counting the very young chicks was obtained by approaching the hen and brood in a car and waiting until the hen had called her chicks to her. The observers then drove toward the hen and counted the chicks as they ran into the surrounding cover. This method of observation may take in individual instances quite some time. One hen with very young chicks was observed for three hours before a count was obtained.

Size of Broods

The average number of chicks per brood for the entire season was 3.51 chicks per hen. This figure should not be used to determine the rate of increase because of the progressive loss of chicks during the months after the chicks have hatched. This trend is shown in Table 1 and also in the accompanying graph. By the time the first part of August is reached the average brood size is only 2.33 chicks per hen, and it is entirely probable that by the time winter starts the figure would be much lower than this. Add to this the winter loss and the necessity of starting with a larger number of broods becomes clearly evident. It should be mentioned that hens without broods were not used in obtaining the brood figures. It was thought that this method would give too low a figure because many of the hens did not succeed in hatching any chicks, and the objective in this portion of the study was to determine the loss in broods after what were hatched were off the nests.

The nature of the chick loss was not determined. Three theories of loss are advanced. The chicks may become predator victims. They may die of disease. Another probability is that they become separated from the old hen and die from exposure. The fact that several chicks were found by themselves with no hen in the immediate vicinity tends to bear out the latter theory. No chicks were found dead from disease although several cases of predation were located.

At any rate the fact remains that, if nesting loss was cut down, we would have more birds to start with and would run a greater chance of finishing the summer season with an acceptable juvenile crop.

Types Where Broods Were Found

In table 2 is shown the types where broods were found. These figures show clearly that most of the young broods time is spent in sagebrush type

while older broods shift to the meadow types. This shift to meadow type takes place about the same time that the older birds come down into the meadow.

The first few days of the chicks life are probably spent in the area of the nest. Movement is very slow for the first few days. The field notes for June 2, 1941 indicate this to be true. These notes show that a hen with 7 chicks had moved only 300 yeds. in 18 hours. The chicks probably were only 1 or 2 days old as a nest in the same area as the chicks were found had hatched one or two days before the observation was made. The nest had contained seven eggs so it was thought that this brood was from this nest.

TABLE 1

NUMBER OF YOUNG PER BROOD

NO. YOUNG	1	2	3	4	5	6	7	8	9	Average
June 1 to June 15	0	0	1	3	5	3	2	1	1	5.56(16 Broods)
June 16 to June 30	6	1	2	3	1	1	3	1	0	3.67(18 Broods)
July 1 to July 15	2	2	6	5	4	2	1	0	1	4.00(23 Broods)
July 15 to July 31	14	12	8	2	6	6	0	0	0	2.83(48 Broods)
Aug. 1 to Aug. 8	5	3	2	1	0	0	1	0	0	2.33(12 Broods)
Totals	27	18	19	14	16	12	7	2	2	3.51(117 Broods)

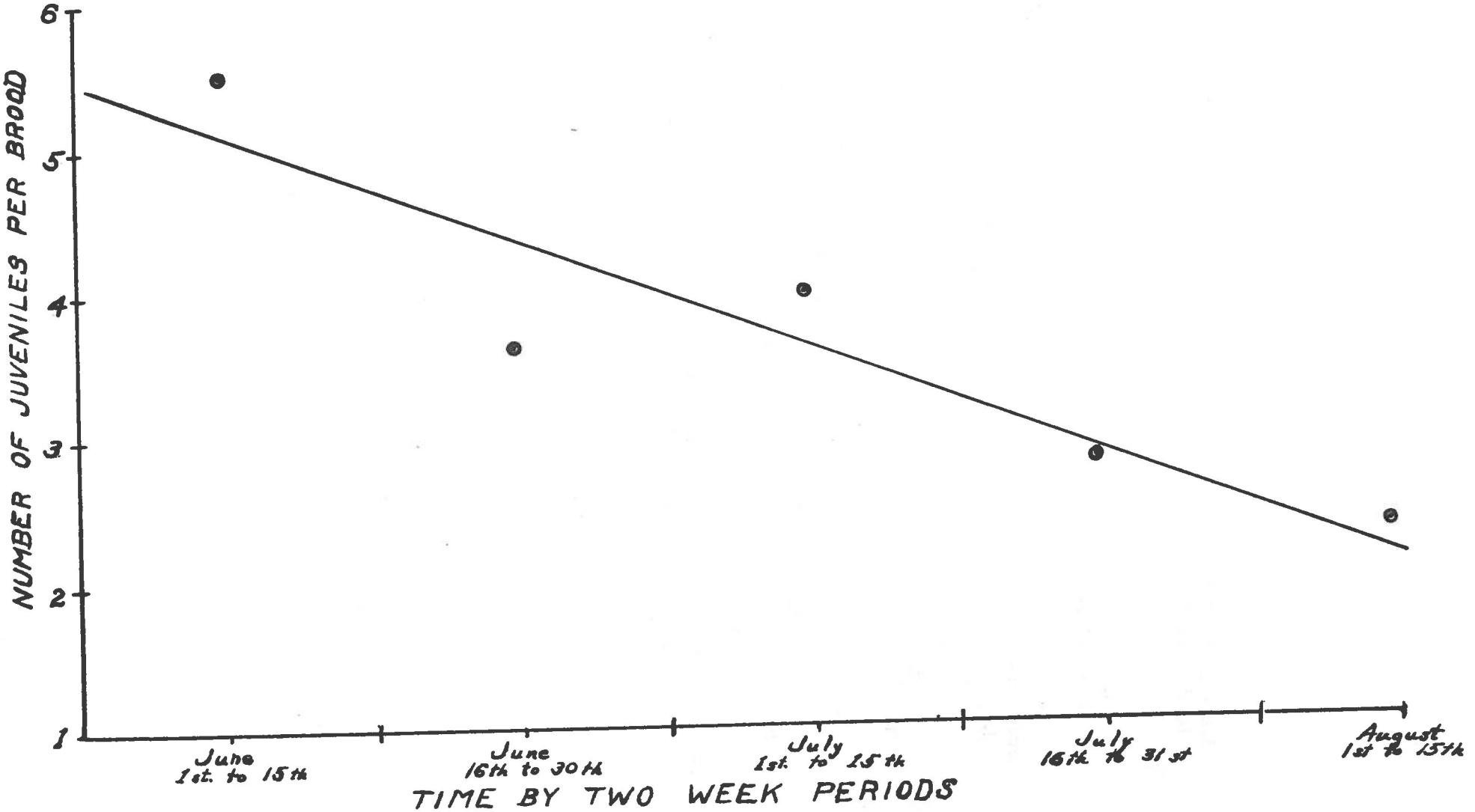
TABLE 2

TYPES WHERE BROODS WERE FOUND

TYPE	A 1	A 2	A 3	Meadow	SARC	Total
June 1 to June 30	10	5	7	0	1	23
July 1 to Aug. 8	0	0	0	77	1	78

BROOD SIZE BY TWO WEEK PERIODS

SAGE GROUSE STUDY, 1941
NORTH PARK, COLORADO



SAGE GROUSE POPULATION STUDIES-NORTH PARK-1941

The only census method used this year other than the strutting ground counts, which proved unsuccessful, was King's census method. This method is described in last years report as follows:

"King's method of strip census (developed by Dr. Ralph T. King in Minnesota), has been proven by carefully regulated experiments, to be a highly satisfactory method of censusing ruffed grouse.

"The basic principle of King's method lies in selecting representative areas to be censused and traversing them on predetermined lines in a grid pattern. The lines must be close enough together to insure an adequate sampling of all types of range, yet far enough apart to avoid making duplicate counts of birds flushed. As the worker traverses the grid, following a compass, he records the number of birds flushed, the location in the area and the cover type from which each individual or group is flushed, and the exact flushing distance for each bird or group of birds. The flushing distance is paced off at each flush when the field count has been completed, the worker can calculate the average flushing distance of all birds flushed on the area, which theoretically, when doubled, will give the actual width of the strip which he covered. This flushing distance must be recorded faithfully in each plot and each time a plot is run. Average figures gained on previous occasions cannot be substituted, as the flushing distance of birds varies with weather, time of day, time of year, and other factors. Having, then, the length and width of the strip covered (meaning all the lines in the grid), and the number of birds per acre or acres per bird for the entire area. If the census plot contains a variety of types for which the birds show different degrees of preference allowance must be made for this condition."

Last years figures taken from Aug. 30, 1940 to Oct. 26, 1940 average 17.9 acres per bird on census area No. 1. This same area was run from April 9 to Aug. 5 in 1941 with an average population of 14.03 acres per bird. While these figures are not strictly comparable because they were taken at different times in the year, they at least indicate that the population is increasing very slowly or is almost stationary. The average of a new area taken in 1941 (Census Area No. 2) was 17.17 acres per bird. This area was used as a control and verifies the data taken on census area Number 1. (For population by months refer to tables 1 and 2 and also the related graph)

It was hoped that this method would prove accurate enough to indicate monthly population trends. This trend did not show up when final figures were compiled. The data does tend to group around the mean so it is thought that the average figures for the season can be used for a year to year comparison if similar censuses are run in succeeding years. Both of the census areas chosen are typical of average conditions as they exist in North Park.

TABLE 1

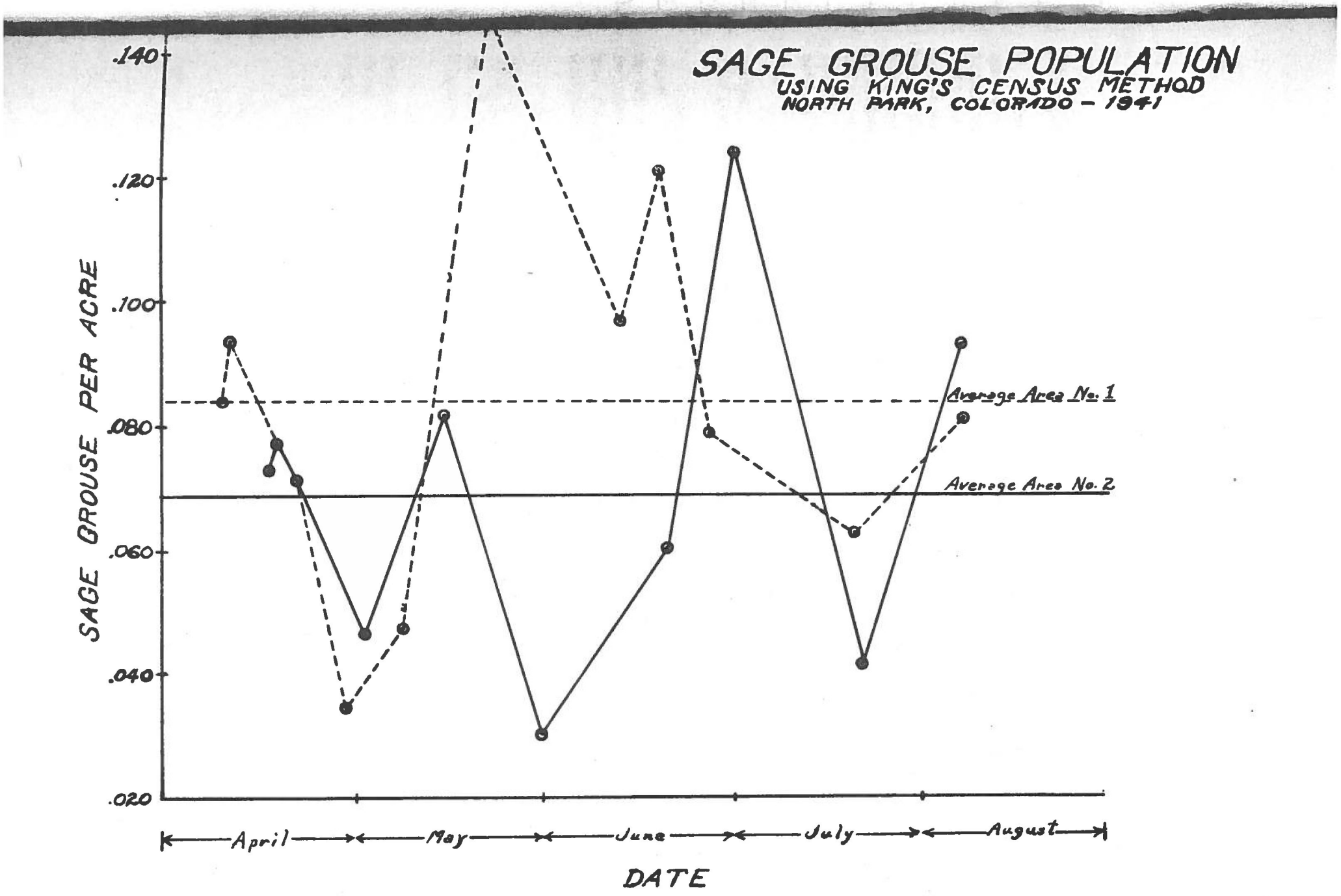
Population-Census Area No. 1

Date	No. Birds Flushed	Average Flushing Distance (Weighted)	Calculated Birds per Acre	Pop. Density Acres per Bird
4/9/41	106	61.6 yds.	.083	12.07
4/10/41	60	44.1 yds.	.093	10.70
4/21/41	33	31.66 yds.	.071	14.02
4/29/41	37	72.69 yds.	.034	29.37
5/8/41	18	25.72 yds.	.047	21.33
5/22/41	74	34.74 yds.	.146	6.83
6/12/41	62	44.32 yds.	.096	10.40
6/18/41	70	40.06 yds.	.120	8.32
6/26/41	16	14.06 yds.	.078	12.78
7/17/41	47	52.00 yds.	.062	16.09
8/5/41	22	18.86 yds.	.080	12.47
Average	--	----	.083	14.03

TABLE 2

Population Census Area No. 2

Date	No. Birds Flushed	Average Flushing Distance (Weighted)	Calculated Pop. Density: Birds Per Acre	Calculated Pop. Density: Acres Per Bird
4/16/41	56	54.37 yds.	.073	13.77
4/18/41	69	61.68 yds.	.077	13.00
5/2/41	15	21.72 yds.	.046	21.72
5/15/41	36	30.60 yds.	.081	12.36
5/29/41	6	14.00 yds.	.029	33.94
6/19/41	10	11.50 yds.	.060	16.73
6/30/41	9	8.11 yds.	.123	8.11
7/18/41	27	44.78 yds.	.041	24.12
8/5/41	45	33.42 yds.	.092	10.80
Average	--	---	.069	17.17


SAGE GROUSE POPULATION
USING KING'S CENSUS METHOD
NORTH PARK, COLORADO - 1941
SAGE GROUSE PER ACRE
.140
.120
.100
.080
.060
.040
.020
Average Area No. 1
Average Area No. 2
April
May
June
July
August
DATE

DEATH LOSS STUDY-NORTH PARK-1941

Dead Birds Found

Every time a dead bird was located in the field it was examined and the cause of death was determined if possible. (See Table 1) A total of 54 birds were found, of which twenty-two, or about half, were believed to be predator kills. These kills recorded as predations all had some definite proof such as tracks, treatment of bones and feathers, etc. The observers had no proof that the predator actually killed the bird but a least the evidence, although highly circumstantial, is indicative. From signs it was thought that almost all of these predations were coyote work. One case of definite raptor predation was found. Bird predation (Hawks and Eagles) probably is not nearly as common as mammal predation.

Four instances of hawks or eagles attacking Sage Grouse were recorded. In all cases the attempt was unsuccessful. The Sage Grouse outflew and out manuvered their attackers in every case.

Only one bird was found that was thought to be a victim of disease. This bird, an adult male, was found on April 4, 1941 laying under a bush in a typical resting form. The bird was in a natural resting position and no evidence of bruised tissue or broken bones was found. This bird had decayed to some extent and the nature of the disease could not be determined.

Eight of the birds were found along highways where they had been killed by cars. This figure is not comparable with other death loss figures because birds along highways are more easily picked up. Four of these highway kills were brought to the field crew by local people. Highway loss probably is not serious.

Eight birds were found that had been killed by running into wire fences. This loss is thought to be fairly common. Two observations from the field notes are cited here:

April 7, 1941

1. "Mr. Malone (a local resident) says that he often finds birds which have collided with his fence. He cited one instance where a cock flew into his fence and tore its head completely off. He also said that it was not unusual to find five or six dead birds around his fence. The fence is four miles long."

April 16, 1941

1. "A record was kept of all the feathers present on the barb-wire fence in this area (vicinity of the State fish hatchery). All feathers were removed from the fence so new casualties could be determined. Thirty-eight of the instances were recorded where feathers only were caught

on the fence. Eleven cases where feathers and flesh were present were recorded and in addition nine complete carcasses were found. These fences are four-wire fences. The majority of the fence is put in with steel posts which are painted a dark green. (See Picture). These fences would be very difficult to see under certain light conditions."

Evidently this loss is quite serious at least in local areas. Most instances of this form of loss were found in April with few cases occuring during the latter part of the investigation.

One juvenile bird was found that had drowned. This bird had evidently flown into a pond and was unable to regain land. It is thought that this form of loss would be confined to juveniles that are too young to fly well. Loss of this type probably would not be great enough to cause appreciable damage.

Postmortem Examinations

A total of 52 birds were examined in the five months of the study. These birds were taken at intervals all through the season so the figures presented would be typical of conditions as we found them. See Tables 2 and 3 for the results of the study. The one common endoparasite that showed up this year and also in 1940 was the tapeworm. This parasite was found more frequently as the season progressed (See Table 4).

These tapeworms were identified by Dr. F. X. Gassner of the Veterinary Division of Colorado State College as Raillietina centrocerci, Raillietine cesticillus, and another species of the genus Raillietina that is probably a new species. In addition a different, very small, tapeworm was found this year that has the appearance of the chicken tapeworm. This latter parasite has not been positively identified as yet.

The tapeworm Raillietina centrocerci is evidently a wide spread parasite. The following extract is from Griner's thesis on Sage Grouse in Strawberry valley, Utah: "A tapeworm, Raillietina centrocerci Sky (13), is very frequently found in the sage grouse. This tapeworm is found in and near the central part of the small intestine. This parasite is most common during the spring and summer months. During the mating season it is not at all uncommon to find several proglotids in the droppings of the sage grouse. This has been especially noticeable on the strutting grounds".

In North Park a series of five dropping samples were collected from April 5th to May 15th on the Strutting grounds. These samples were submitted to Dr. Gassner and the following comment was made by him concerning

them. "Droppings are negative for parasite eggs with the exception of ova possibly belonging to the new species (Raillietina sp.)".

Regarding the pathogenicity of these parasites the book "Veterinary Helminthology and Entomology" by Monning, has this to say about them. "The pathogenicity of tapeworms to poultry appears to depend very much on the state of nutrition, the age and the general condition of the birds. The different species of tapeworms of poultry vary greatly in pathogenicity. Davainea proglottina, although it is the smallest is the most harmful. It penetrates deeply into the mucosa and produces a marked enteritis, which is frequently haemorragic in heavy infections. Raillietina tetrogona and R. echinobothrida follow next in order of pathogenicity".

It should be noted that the tapeworms found in sage grouse belong to the same genus as the second tapeworms mentioned.

On August ninth a male adult sage grouse was shot for examination. This bird was only in fair condition with hardly any fat. The bird did not seem to be normally active. It was on of a large group of birds in meadow type and flushed at 20 yards. All the rest of the birds flushed at around 200 yards. Examination showed about 80 large tapeworms in the small intestine. No other abnormality was noted. It would seem from this evidence that the presence of tapeworms definitely was detrimental to this bird. Additional information is necessary to prove or disprove this theory.

The only ectoparasite found this year was a biting louse. This same parasite was found also last year. Only twelve of the fifty-two birds examined had this parasite. Last year 11 birds out of 32 were infested.

Specimens of the louse were submitted to the Rocky Mountain Laboratory at Hamilton, Montana and were identified as a species of the genus Lagopoecus by Dr. William L. Jellison of the laboratory. Additional specimens sent to the Veterinary Division at Colorado State College were identified as Lagopoecus perplexus.

This louse is evidently a wide spread parasite as Griner also reports it occuring on the sage grouse in Strawberry valley, Utah.

Probably the lice do not cause much damage as there is an abundance of soil suitable for dusting in all the areas where sage grouse were found in North Park.

Buffer Species

From general observations it is thought that the two main buffer species in North Park are jackrabbits and the Wyoming ground squirrel. A census of jackrabbits was taken on the same areas as the sage grouse

census. (See Table 5) An average population of 27.40 acres per rabbit was obtained on census are number 1 and a figure of 25.37 acres per rabbit was obtained on the check area. Since these figures are reasonably close it is thought that they represent average conditions as they exist in North Park. No accurate census could be made on ground squirrels, however they are numerous throughout the sage grouse range.

With this abundance of buffer species, it seems likely that predator pressure on sage grouse is kept at a minimum.

Table No. 1

Sage Grouse Found Dead

Predation		Fence Kill	Road Kill	Disease	Unknown	Total
Mammal	Bird					
21	1	16	8	1	6	53

Table No. 4

Tapeworm Occurrence by Months
from 52 birds
Percent of Birds infected

	April	May & June	July	August	Total-Average
Adults	17%	31%	60%	60%	34%
Juveniles	-	0%	43%	100%	57%

Table No. 5

Rabbit Population
Census Area No. 1

Date	Rabbits per Acre	Acres per Rabbit
4/9/41	.036	27.38
4/10/41	.027	37.40
4/21/41	.037	26.90
4/29/41	.033	30.29
5/8/41	.014	73.30
5/22/41	.061	16.36
6/12/41	.078	12.85
6/18/41	.061	16.24
6/26/41	.041	24.33
7/17/41	.046	21.58
8/5/41	.068	14.76
Total Ave.	.046	27.40

Table No. 5 cont.

Rabbit Population
Census Area No. 2

Date	Rabbits per Acre	Acres per Rabbit
4/16/41	.066	15.20
4/18/41	.051	19.70
5/2/41	.017	58.00
5/15/41	.016	61.67
5/29/41	.042	23.48
6/19/41	.073	13.64
6/30/41	.105	9.53
7/18/41	.079	12.70
8/5/41	.069	14.49
Average	.057	25.37

SUMMARY OF POSTMORTEM OF JUVENILE BIRDS

North Park, Colorado-1941

Table No. 2

	P.M. No.	Date	Sex	External Parasites	Tapeworms	Other Abnormal Conditions	Remarks
G	22	6/1/41	Male	None	None	None	Chick is approximately 3 days old
G	26	6/10/41	Male	None	None	None	Approximately 2 weeks old
G	31	7/1/41	Male	Biting Lice	None	None	Shot by Collector
G	32	7/1/41	Female	Biting Lice	None	None	Shot by Collector
G	33	7/14/41	Female	Lice Numerous	None	None	Shot by Collector
G	34	7/14/41	?	Lice Numerous	None	None	Shot by Collector
G	36	7/23/41	Female	Lice present	1-large tapeworm	None	Bird was stepped on while counting Broods
P	37	7/23/41	?	Lice Present	Tapeworms present	Skin removed from top of head and skull fractured	Caught by hand
?	42	7/18/41	Female	None	7-tapeworms	Thyroids appear small	Shot for specimen and examined in Fort Collins by Dr. Gassner
G	48	8/11/41	Female	None	9-tapeworms	None	One of large brood shot for specimen
F	49	8/11/41	Female	None	12-tapeworms	None	Shot for specimen
G	50	8/11/41	Female	1-Bitin's louse found	Tapeworms present	Spleen Blotched but normal in size	Shot for specimen
F	51	8/11/41	Male	None	Tapeworms numerous	None	Shot for specimen
F	52	8/11/41	Male	Many lice	Few small tapeworms present	None	Shot for specimen

SUMMARY OF POSTMORTEM OF ADULT BIRDS

North Park, Colorado-1941

Table No. 3

P M No.	Date	Sex	External Parasites	Tapeworms	Other Abnormal Conditions Found	Remarks
1	4/1/41	Male	None	None	Liver slightly blotched	In full mating plumage
2	4/1/41	Female	None	None	None	None
4	4/3/41	Male	None	None	Liver blotched-probably P.M. changes. Sides appear bruised probably P.M. changes	None
5	4/7/41	Female	None	1-½" Tapeworm	Spleen twice normal size	Shell gland enlarged
6	4/7/41	Male	None	None	None	None
7	4/9/41	Female	None	None	None	None
8	4/11/41	Male	None	None	None	Bird dead at least 3 days. Neck broken and torn off.
9	4/15/41	Female	None	None	Caeca have whitish blotches spleen smaller than normal	Probably would have laid its first egg within a week
10	4/16/41	Male	None	None	Tarsus-Sternum-Carocoid, broken, Right carotid and Aorta broken	
11	4/16/41	Male	None	None	Liver blotched-Probably P.M. changes	Dead at least a day
12	4/21/41	Female	None	20 tapeworms largest 13 3/16" long	None	Dead at least a a day
13	4/21/41	Female	None	None	Kidney with light areas	None
14	5/1/41	Female	None	Tapeworms numerous	None	Would have laid egg in a day or so
15.	5/9/41	Male	None	Tapeworms numerous	Spleen three times normal size	Intestine sent to Dr. Gassner for examination of Tape-Worms

POSTMORTEMS OF ADULT BIRDS (cont.)

North Park, Colorado-1941

Table No. 3

P M No.	Date	Sex	External Parasites	Tapeworms	Other Abnormal Conditions Found	Remarks
16	5/9/41	Male	None	None	Spleen enlarged	None
17	5/17/41	Male	Lice present	None	None	None
18	5/17/41	Male	Lice Numerous	1-small tape worm	Liver blotched, probably P.M. change	None
19	5/20/41	Male	None	None	Liver, spleen & lungs, blotched probably P.M. changes	None
20	5/20/41	Male	None	37-tapeworms	None	None
21	5/21/41	Female	None	None	None	None
23	6/2/41	Male	None	None	Joint of Right Wing dislocated and pus pocket formed	None
24	6/2/41	Male	None	None	Spleen enlarged and almost black in color. Liver blotched probably P.M. changes	None
25	6/2/41	Male	Lice Numerous	None	Spleen enlarged and dark in color	None
27	6/7/41	Female	None	None	None	None
28	6/14/41	Male	None	None	Spleen enlarged	None
30	6/25/41	Female	None	None	Enlarged spleen	None
38	7/28/41	Female	None	None	None	None
39	7/18/41	Male	None	15-tapeworms	None	Examined at Fort Collins
40	7/18/41	Male	None	48-tapeworms	Thyroids enlarged-slight colitis and Enteritis	Examined at Fort Collins
41	7/18/41	Male	None	8-small tapeworms	slight colitis	Examined at Fort Collins

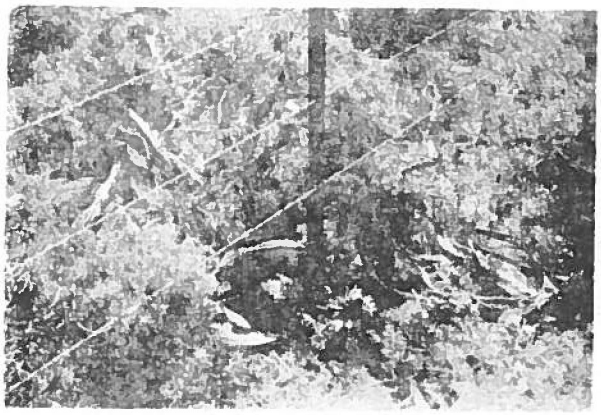
POSTMORTEMS OF ADULT BIRDS (cont.)

North Park, Colorado-1941

Table No. 3

P M No.	Date	Sex	External Parasites	Tapeworms	Other Abnormal Conditions Found	Remarks
43	8/ 9/41	Female	None	11-small tapeworms	Spleen twice normal size caeca with whitish spots	None
44	8/9/41	Female	None	None	Spleen enlarged. Caeca with whitish spots that are cheesy internally	None
45	8/10/41	Male	Lice present	Est. 80 large Tapeworms	Spleen slightly enlarged	Appeared reluctant to fly
46	8/10/41	Male	None	4-small tapeworms	Spleen enlarged two times	None
47	8/10/41	Male	None	None	Spleen enlarged	None

FENCE LOSS



Adult Male Sage grouse that was killed by flying into a barb-wire fence.

ENVIRONMENTAL RELATIONSHIPS

Sage Grouse-North Park-1941

Cover

All observations from April until the middle of July from the census areas were plotted on maps which the observers carried in the field. After the middle of July almost all the birds were flushed in the meadows or from willow clumps in or bordering meadows. Later all observations were taken from the field maps and ploted on an overlay sheet. The overlay sheet was then placed on a type map of the area and the number of observations recorded for each cover type. Table 1 gives the data from these observations recorded for each cover type. Table 1 gives the data from these observations. All observations were thrown out that were doubtful or recorded on days where severe weather conditions existed. In other words data was used that most nearly approximated average conditions.

Probably the most surprizing thing about these data is the large number of observations from A1 type. No really striking preference is shown, however, because most of the area studied consists of A1 type. Probably other factors are much more important in North Park than cover type.

Water

Sage Grouse were seen drinking at several different times. One time they were seen to eat snow. Almost all the drinking observations were made on the strutting grounds. It was a fairly regular practice for some birds to drink when the strutting was about over and before the birds left the ground.

Water is available at frequent intervals all through North Park. It is not thought that any water problem exists in this area. There is no tendency for the observations to group themselves around the available water on the study areas.

Food

Stomach samples were taken from all birds that were examined. These samples are now being osamined and data will be added to this report when compiled. As yet no figures are available from the stomachs sent over a year since to the food habits laboratory in Washington.

Table 1

Types Where Sage Grouse Were Found

TYPE	A1	A2	A3	CHR	Ridge	Grass	Meadow	Total
Number Obs.	47	21	1	2	2	0	5	76
Percent of total Area	60.8	35.0	0.1	0.4	1.9	0.6	1.2	100%

NESTING STUDY-CRAIG AREA-1941

The same techniques used on the North Park study were used in the Craig area. Incubation had already been completed at Craig when the observers arrived on July 1st so no data could be obtained as to incubation period and observation of hens on the nest. Hatched nests could be easily told however because of the egg caps left at the nest.

A total of twenty-six 1941 nests were found. Of these nests 14 or 53.8% had hatched. This represents a much higher rate of hatch than at North Park where only 35.0% of the nests hatched. All unhatched nests (12 nests) were destroyed when found. There was no way of telling how many of these nests were deserted before being destroyed. All the destroyed nests of 50% of the destroyed nests were identified as badger work. The other predations could not be identified other than as mammal predations.

Badgers are fairly common although not as plentiful as in North Park. Two badgers were seen by the observers on field trips during the month of July.

Twelve dummy nests were set out using domestic hens eggs injected with Alkaloid strychninne. Traps were also set around some of these nests. From these dummy nests one badger and nine ground squirrels were obtained. In addition two of the nests were destroyed by what appeared to be bird predations. (Probably Crow or Magpie)

From these limited data and observations it seems that nest predation in the Craig area is similar to that found in North Park with the key predator being the badger. Nest predation is not nearly as serious here and a success of 53.8% is fairly good for ground nesting birds. There is much room for improvement however and steps should be taken to reduce nest predation.

Of the nests found only two were thought to contain the remains of the full clutch of eggs. One of these nests had seven eggs and the other contained eight eggs. A local resident said that he had seen quite a few nests and that he saw seven eggs in a nest the most often. The number of eggs per clutch is probably about the same as the North Park area.

All nests were recorded as to slope and exposure. Additional data on slope and exposure was obtained from old nests found and this data used to supplement slope and exposure data from 1941 nests recorded in North Park. (See Tables 1 and 2). A preference for Sage brush of the higher classes is noted here as in North Park. The table on distance to water further indicates that nesting is not influenced by the immediate closeness of water to any marked extent. Most of the nests were found on ridges or near the tops of ridges. No evidence of stream bottom use

for nesting was found by the observers. It is clear that water must be obtainable but nests need not be in a limiting proximity to water.

Four unhatched eggs were found in the fourteen hatched nests. This would be an average of 0.28 unhatched eggs per nest. This figure agrees with that found in North Park (0.12 eggs per nest.) Two of the unhatched eggs were infertile and the other two contained partly formed chicks. This would indicate that no breeding problem exists in the Craig area at present.

Table 1

Cover Type Where Nests Were Found

Craig Area 1941

A1	A2	A3	A4	Meadow	Amelanchier	Stream Bottom	Total
0	3	36	4	0	0	0	43 Nests

Table 2

Distance Nests Were From Water

Craig Area 1941

¼ Mile or Less	¼ to ½ Mile	½ to 1 Mile	1 to 2 Miles	Over 2 Miles	Average
14	11	12	1	1	39 Nests .47 Miles

THE BROOD STUDY-CRAIG AREA-1941

The brood study in the Craig area was made during the month of July. All broods were counted as they were seen. In several cases during the later part of the month, large groups of chicks and hens were seen. These figures were averaged in with the rest by counting the number of hens and the number of chicks and getting the average brood for the group. For instance if a group of three hens and 15 chicks were seen the observation would be tabulated as three broods of five chicks each. These figures compare favorably with those obtained from single broods.

The average brood was 4.90 chicks per brood for the month of July. No significant difference was found during the first half of July as compared to the last half of July. These figures vary greatly from those obtained in North Park where a drop of 1.17 chicks per brood was experienced during July. (See Table 1)

From these rather limited figures it would seem that the loss of young chicks is not nearly so great in the Craig area as in North Park. The average number of chicks per brood is also higher during July. (Craig-4.90, North Park-3.21)

Whenever a brood was located the type where found and the distance to water was recorded. These figures are presented in Tables 2 and 3. The figures on type must not be taken too literally as many birds flushed in Sagebrush were near stream bottom types. However, a difference is shown from North Park where almost all broods were found in meadows at this time. Meadows are scarce in the Craig study area and this probably accounts for the difference.

Water is much scarcer at Craig than in North Park. The group-of broods around water is clearly shown in Table 3. Sixty-two percent of the broods were within a quarter of a mile of water. The observers spent about as much time away from water areas as close to water so the data here presented can be considered reliable. From this data it appears that water development is important in the management of the Sage Grouse in this area. Much work has been done by the Soil Conservation Service along this line and their efforts Should greatly help management of Sage Grouse population.

Table 1

Number of Chicks per Brood

Craig Area-1941

No. CHICKS	1	2	3	4	5	6	7	8	9	10	Average
July 1st to July 15th	6	6	10	27	20	13	16	6	2	1	4.88 107-Broods
July 16th to July 31st	2	3	3	7	9	7	3	4	1	0	4.97 39-Broods
Total	8	9	13	34	29	20	19	10	3	1	4.90 146-Broods

Table 2

Cover Type Where Broods Were Found

Craig Area-1941

A1	A2	A3	A4	Meadow	Alfalfa	Stream Bottom	Other	Total
2	14	53	2	5	6	9	8	99
(2.0%)	(14.1%)	(53.5%)	(2.0%)	(5.1%)	(6.1%)	(9.1%)	(8.1%)	(100%)

Table 3

Distance Broods Were From Water

Craig Area-1941

$\frac{1}{4}$ Mile or Less	$\frac{1}{4}$ to $\frac{1}{2}$ Mile	$\frac{1}{2}$ to 1 Mile	1 to 2 Miles	Over 2 Miles	Average
60	29	6	1	0	96-Broods
62.5%	30.2%	6.3%	1.0%	0%	428.5 yds.

DEATH LOSS STUDY-CRAIG AREA-1941

A total of seventeed dead birds were found in the Craig area during the study. Four of these birds were highway kills; five were predations; two were killed by poachers; one was a fence kill; and five died of disease. These figures are too limited to give an idea of which death cause is most important.

Predators are fairly common. Coyotes were seen three different times and are probably more common than at North Park. Swainsons hawks are the most common avian predator. During the study two Swainson's hawk nests were found but neither contained any evidence of sage grouse predation. The following notes were taken at one nest.

July 23, 1941--Two miles south of Great Divide, Colorado.

1. "Swainson hawk nest near spring contains two, one fourth, grown young. Ground squirrel remains were found in the nest but no sage grouse remains were present. A sage grouse with nine chicks is within 20 yards of the hawk nest. These sage grouse show no alarm when the hawk flies over.

Mr. Pratt, Biologist for the Soil Conservation Service, reported seeing the remains of a juvenile bird in a Swainson hawk nest about the first of July. The nest contained two young hawks at that time.

Highway kills and fence kills are not very common. These losses are probably not serious.

Poaching is probably a common loss. This area is well covered by roads with opportunities for overlooking vast areas from vantage points. The nature of these roads make the are area very diffiqult to patrol. Another factor that aids the poacher is the fact that the birds consentrate along draws that have roads following them, thus making it easy for poachers to do their shooting from the road.

During the early part of August the observers had reports of sick birds in Axial Basin which lies about twenty-four miles south of Craig. Investigation of the area revealed four dead birds and one sick bird. All dead birds were found in an alfalfa field on the James ranch. Mr. James says that he has seen quite a few of these birds and also has seen a few sick birds.

The sick bird was taken to the Veterinary department at Colorado State College and a postmortem examination was made by Dr. Deem of that institution. He diagnosed the sickness as Trichomoniasis. Since that time another sick bird has been secured which also contained Trichomonads together with numerous coccidia. This disease seems to confine itself

almost entirely to the juvenile birds. Dr. Deem recommended scattering the birds in the areas of concentration as a control measure.

Parasites found in the Craig area were tapeworms and biting lice. The comments made on the North Park parasites also hold for the Craig birds.

ENVIRONMENTAL RELATIONSHIPS-CRAIG AREA-1941

Several areas along stream bottoms in the Great Divide area have been fenced to prevent grazing in areas beneficial to wildlife. These fences were built under a cooperative agreement between the Game and Fish Department and the Soil Conservation Service. The observers undertook to show the value of these areas by laying out a mile square census plot with the fenced area in the center of the plot. The fenced area selected was located about $\frac{1}{4}$ mile North-west of Great Divide, Colorado. This plot was layed out on a quarter mile grid system and King's census method used to determine the population. The results of this census are shown in Table 1.

In three of the five days on which counts were made the population inside the fenced area was much higher than outside the fenced area. In the other two days no birds were flushed in the fenced area so they cannot be used for comparison. The average population for the whole plot was 5.40 acres per bird. This represents almost double the population per unit area found in North Park. It should be remembered that this represents a concentration area rather than the average of conditions for the Craig unit.

From these data it would seem that these fenced areas are used to a marked extent. Their use by sage grouse will probably increase as cover and food improve due to nongrazing.

Table 1.

Effect of Grazing on Population Density
of Sage Grouse in Craig Area

Population shown as acres
per bird

Date	Ave. Flush.Dist. (yds)	Pop. Total	Pop. inside non-grazed Area	Pop. in surrounding grazed Area
7/23/41	16.0	3.07	0.25	4.04
7/25/41	13.6	5.08	1.39	5.27
7/28/41	16.5	2.71	0.22	1.06
7/30/41	14.6	3.93	--	3.93
8/1/41	21.7	12.20	--	12.20
Average	--	5.40	0.62	5.30

SUMMARY SAGE GROUSE REPORT-1941

1. A strutting ground census similar to that used by V. E. Davison on lesser prairie chicken in Oklahoma cannot be used on Sage Grouse in North Park, Colorado because of day-to-day fluctuations in strutting grounds use.

2. Strutting ground counts can be used to obtain sex ratio figures if the birds are counted as soon as it gets light and only counts made prior to the nesting season are used.

3. The sex ratio in North Park is 1-cock to 1.1 hens, or about a 50-50 ratio.

4. The most successful method of finding sage grouse nests was complete coverage of study areas by using the rope-lath-drag on strip traverses by competent observers.

5. The nesting period lasted from May 1, 1941 until June 20, 1941. The period of heaviest hatch was the last week in May and the first week in June.

6. The incubation period was determined to be approximately 22 to 24 days.

7. The average distance nests were found from water in the North Park area was 0.69 miles. Within reasonable limits adjacency of water was not found to influence nesting to any marked extent.

8. Sage grouse prefered the taller sagebrush for nesting cover.

9. No marked preference was shown for any exposure.

10. Sage grouse seem to prefer the more moderate slopes for nesting.

11. Nesting density in North Park was determined to be 20.32 acres per nest on a 1280 acre area.

12. Nesting density was higher on ungrazed land than on grazed land.

13. The average number of eggs per clutch was 7.48 in North Park.

14. Eggs weighed on an average of 1.6 oz. per egg.

15. The hen does not leave the nest immediately after the brood is hatched and may remain on the nest over night.

16. The average number of unhatched eggs per nest was 0.12 eggs per nest.

17. Of the nests found 35.0% hatched, 56.7% were destroyed and 8.3% were deserted.

18. The key nest predator was determined to be the badger.

19. Cover type is not thought to influence nesting success to any marked extent in North Park.

20. Nesting success was greater on grazed land than on ungrazed land.

21. It is probable that some hens renest after their nests are destroyed.

22. From the hatching time to later summer brood size shows a difinite downward trend in North Park.

23. The Average sized brood was 5.56 during the first half of June and 2.33 during the first part of August.

24. Broods were found mostly in sagebrush types during June and almost entirely in meadow types after July 1, 1941.

25. An average population of 14.03 and 17.17 acres per bird was found on two census areas by using King's census technique.

26. Sage grouse population is about static in North Park.

27. About half the bird loss in North Park occuring during the study period was attributed to predation. Fence kill is another important form of loss.

28. No evidence of wide spread disease was found.

29. The common parasites are tapeworms and biting lice.

30. Tapeworms become more numerous as the summer advances.

31. Heavy infestations of tapeworms are thought to weaken the birds and lower their vitality.

32. Buffer species are common and probably keep predations at the minimum.

33. Cover and water are abundant in North Park and do not present any problems.

34. Nesting success was found to be 53.8% in the Craig area.

35. All unhatched nests in Craig area had been destroyed.

36. Most of the nest destruction in the Craig area was attributed to badgers.

37. An average of 0.28 unhatched eggs per nest was found in the Craig area.

38. Sage grouse in the Craig area prefered areas of higher sagebrush for nesting.

39. The average distance Craig nests were found from water was 0.47 miles. No grouping of nests around water was found.

40. The average number of chicks per brood in the Craig areas was 4.90 during the month of July.

41. No decline in the number of chicks from the first half of July to the last half of July was noted.

42. Craig broods showed preference for areas near water.

43. Water is scarce in the Craig area and presents a management problem.

44. Predation, poaching, and disease are the most common forms of loss in the Craig area.

45. Two sick birds were found and the sickness diagnosed as Trichomoniasis by Dr. Deem of the Colorado State College Veterinary Division.

46. Death due to disease is found almost entirely in the juvenile class.

47. Tape worms and biting lice are the common parasites in the Craig area.

48. The use and value of stream bottom fenced areas was established by using King's census technique on a sample area containing the fenced area.

49. A much higher bird population was found inside the fenced areas than on surrounding areas.