A STUDY OF THE WINTER SURVIVAL OF BORCHITE QUAIL
UNDER NATURAL CONDITIONS

By

James Preston Newman

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Head of Department of Biology

Approved

Supervisor

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INTRODUCTION AND REVIEW OF LITERATURE

Before considering the value of this study which was conducted to determine the winter survival of bobwhite quail (Colinus virginianus virginianus) under natural conditions, it is first necessary to review briefly the habits of this game bird during the winter months. A cock and a hen with their chicks form, after possibly joining-up with another brood, what is called a covey -- which may contain from 10 to 30 birds. With the coming of cold weather the chicks are usually full-grown but, in spite of the fact that they are no longer dependent on the parent quail, they all feed together for purposes of protection from their natural enemies and roost together in a circle, with tails pointing inward, for protection and warmth. During the day they move about on the ground, scratching for food and covering a regular daily range. When disturbed they flush to some nearby cover which will provide them protection, or "freeze" to the ground to escape being noticed.

The winter survival of a covey is controlled by three important factors: food, cover, and predators. Minor factors which may at any time become major are temperature, precipitation, and disease. The interaction of these factors determines whether a large or small number of birds will remain alive until spring.

Stoddard and Handley (1) did the first important work on the survival of quail. This investigation was done mainly in southern Georgia, where the birds were trapped, banded, released, and retrapped later to determine the survival and to study the controlling factors. Errington (2) studied the
winter survival of quail in northern Wisconsin and in Iowa. He did not band
the quail but simply located the coveys and kept them under observation.
Handley (3) released captivity-reared birds in the Camp Lee State Game Refuge
in Virginia and collected data on their survival.

The work reported here serves as a check on that done by Handley, Errington
and Stoddard. Survival studies by Handley and Stoddard in Georgia were
made at the southern extreme of the bobwhite's range, and the work of Errington
was carried out at the northern extreme. The Blacksburg Demonstration
Area, consisting of the property owned by the Virginia Polytechnic Institute,
and the Smithfield, Whitehorn, Kipps and McEvoye estates (on which the work
reported here was done) represents an intermediate zone. It differs from the
Camp Lee Refuge where Handley worked in being intensively farmed and grazed,
while Camp Lee was managed solely for the production of quail. The territory
here is a state game sanctuary and this study may help to determine the value
of such a sanctuary in supplying quail for hunting in the surrounding territory.
The main purpose of the winter survival study at the Virginia Polytechnic
Institute was, however, to determine the percentage of winter survival and
to observe the factors controlling this survival.
INVESTIGATION

Procedure

Method of Locating Coveys

During the early fall months the coveys of quail were located on the sanctuary area by the observer walking over likely-looking quail habitat until the birds were flushed or by using a bird dog. The latter method proved more efficient, though once a covey was located it was not so difficult thereafter to flush it once a week without a dog. As the quail were flushed they were counted and notes were made as to the point where they took wing and the point where they alighted.

Baiting and Trapping of Coveys

After the coveys were definitely located attempts were made to trap the birds. First, a small spot on the ground was cleared of brush and a mixture of cracked corn and wheat was placed there as bait. Then a "standard" type quail trap was propped-up over the spot until the quail became used to feeding under it. Finally, the trap was lowered in place and "set". This trap was 30 inches square and 8 inches high, being made of wire and having a modified confusion entrance.

Banding and Release of Coveys

The trapped birds were marked on the leg with aluminum leg bands of the Biological Survey type and issued by the State Game Department. The bands were numbered serially. After recording the sex and age (determined by examination of the first two primary feathers of each wing) the birds were released at the point of trapping. The weights of some of the quail were recorded before
release. Blood smears of a few were also obtained.

Observation of Coveys

The quail coveys, whether they had been banded or not, were kept under as close observation as possible. They were usually flushed at least once a week in order to study their movements and feeding habits and to keep a check on the number of birds in each covey. In some instances the quail were observed on the ground, making it unnecessary to flush them. The other before-mentioned limiting factors — cover, possible predators on the area, disease, and weather conditions — were studied as having a direct bearing on the winter survival of the birds.

Retrapping of Coveys

In the spring attempts were made to retrap the quail in order to have an accurate check on the number which survived the winter. This retrapping also indicated how much the coveys had moved and the amount of "shuffling" (interchange of coveys) had taken place since they were first trapped. Untrapped coveys were counted in the spring just before they broke up into mating pairs.
Winter of 1935-1936

Forty-five per cent of the quail under observation (including those banded and those unbanded) survived the winter of 1935-1936. An attempt was made to keep check on 15 coveys containing 195 birds. Unfortunately, all of the quail were not trapped and some of the coveys located in the fall "disappeared" later and could not be relocated in the spring. The survival percentage represents only those birds upon which data was closely kept, whether they were banded or not. Of the banded quail 97 were trapped in the fall and winter, and 25 of these were retrapped in the spring along with 11 previously untrapped birds. One hundred and eight in all were banded on the sanctuary. Seventy of these were cocks and 38 were hens. A statement of the significance of this cock-to-hen ratio and the survival percentage will be found under the heading, General Discussion of Results. Herewith follows a detailed report of the observations made on each covey during the first winter:

Covey No. 1

Survival: On October 22, 12 quail were flushed out of the Virginia pine plantation approximately 200 yards to the east of the Kipps' house. By November 22 the number of quail had been reduced to 10. These birds survived until January 20 when a worker on the Kipps' farm caught a crippled hen inside the orchard granary. This bird had been observed several days before as it limped with the covey which was at that time feeding near the pine and locust plantations. The crippled quail was brought to the laboratory. Its foot was found to be frozen and gangrene necrosis had set in. The toes were amputated and the bird was released the next day, wearing band number 25100.
It was never seen again. In all probability it was killed by some predator or froze to death. There was a light snow on the ground. Out of the 8 birds remaining on February 12, 5 were trapped and banded as follows:

- 25661 - young hen
- 25662 - young cock
- 25663 - young cock
- 25664 - young cock
- 25665 - young cock

None of these birds were retrapped in the spring and the covey, when last flushed on April 2, contained only 4 quail. Thus out of an original covey of 12, 6 were banded and 4 or 33% survived.

Movements: Covey No. 1 ranged closer to a dwelling place than any other covey under observation. Not only were they flushed from the pine and locust plantations but also down in the orchard not more than 50 yards from the Kipps' house. Cover in the orchard was scarce except for the small apple trees. When flushed in this vicinity they flew either toward the woods to the east or toward the Kipps' garden to the northwest. Often they were found in the edge of the woods or near the barns and the granary.

Food: The main factor which influenced covey No. 1 to range close to the Kipps' house was the granary corn. Kernels spilled near the door of this small wooden building were available to the birds. From reports of those connected with the farm they used this source of food extensively. Wild asters, ragweed, and beggarweed were the main quail food plants found near the Kipps' premises. Aside from the corn, however, food could not be characterized as abundant.

Cover: Feeding cover was scarce in the Kipps' orchard, but excellent in the pine and locust plantations. The pines were of the scrub Virginia species
and although not tall were closely spaced. Supplementing this cover were thick weeds. Covey No. 1 was flushed from this area more frequently than any other place. However, when cattle were turned in the lot the weeds were somewhat trampled down. The woodland "escape" cover consisted of oaks and hickories with dogwood, wild grape, whitethorn, and similar shrubs and vines serving as underbrush.

Predators and Predation: The Red-tailed hawk which inhabited the Beth woods, and which is mentioned in connection with Coveys No. 2 and 3, must be considered as a predator of Covey No. 1. No actual predation, however, was observed. The only evidence of hawk activity in the area was the finding of dove remains in a honeysuckle thicket along the fence between the Kipps' farm and the Beth woods. Assuming that the death of the crippled bird (25100) came as the result of a predator, only one example of predation on quail can be cited. Dogs ran the woods and the Kipps' property, and livestock undoubtedly destroyed some of the cover for the birds.

Covey No. 2

Survival: Covey No. 2, originally containing 10 birds when first located on October 22, was, by January 11, reduced in number to 6. In accounting for this reduction the fact that the range of these birds probably carried them outside of the sanctuary area must be considered. They may have been shot. Up until February 12 the remaining 6 birds survived but with the coming of snow and cold weather their number was rapidly cut down to 5 and then to 4. Several flushings when snow was on the ground revealed that the birds flew weakly and only for short distances. Of the 10 birds in this covey 1 was trapped and banded:

25813 - young hen
The hen was later retrapped on April 16. At the same time 3 other unbanded birds were caught and banded as follows:

25705 - young cock
25706 - young cock
25704 - young hen

These birds may have been the other 3 of the 4, or from covey No. 3, as several birds from this group were caught at the same time. Assuming, however, that they belonged to covey No. 2, then 4 or 40% survived the winter.

Movements: The upper (northern) end of the Keth's woods, and more especially the small densely wooded triangular area where stag horn sumac was found in abundance, constituted a large part of the range of covey No. 2. The birds were also flushed several times from the broom sedge pasture just above these woods. They were never found except on Keth property but to the west lay of the land of the Linkous brothers and the birds may have ventured into this territory. The cover there was scarce.

Food: One interesting fact about covey No. 2 was observed on two different occasions. The birds were closely approached by the truck used in this work and watched while they fed on the undigested corn in the droppings of the cattle which grazed in the locust plantation at the north end of the woods. The covey could easily be seen scratching and pecking like chickens. Even when finally approached on foot they calmly walked off into the woods. Other food in the form of seed plants (with their abundance) was listed as follows: black locust (fruit not apparent), small ragweed (abundant), sumac (abundant), wild aster (fairly abundant), wheat (abundant stubble in field to west of woods), beggarweed (not very abundant), evening primrose (scarce) and golden rod (moderate amount). It is likely that covey No. 2 did not suffer
for lack of food until the ground was covered with snow.

Cover: Protection for these birds consisted of the small trees in the black locust plantation and the oaks and hickories of the woods. Undergrowth found in the woods were wild cherry, dogwood and sumac, beneath which grew blackberry vines and a thick stand of weeds. The cover in this particular spot was excellent but the woods offered no better protection than that offered by any ungrazed woodlot.

Predators and predation: The only likely predator of this covey and of covey No. 3 was a large red-tailed hawk. No actual predation by this large clumsy bird was observed, but it may have been highly possible that when there was snow on the ground and when the temperature was very low some quail may have been killed by it. Hunting outside the sanctuary, as has already been mentioned, must be considered as a likely explanation for the disappearance of some of the birds.

Covey No. 3

Survival: This covey was composed of 10 birds when originally flushed on November 15. Of this number 9 were trapped: 2 on December 28, 6 on January 24, and 1 on January 29. They were banded as follows:

25644 = young hen
25645 = young hen
25760 = old cock
25656 = young hen
25661 = old cock
25649 = young cock
25659 = young hen
25660 = young cock
25658 = young hen

On April 16 in the sumac thicket at the other end of the woods where covey No. 3 normally ranged the following of the above banded birds were re-trapped:
Three unbanded birds were also caught at this time and banded as follows:

25705 = young cock  
25706 = young cock  
25704 = young hen

Out of this covey then, 5 birds or 33% are definitely proved to have survived the winter, from January to April. Also trapped in the spring with this covey was a bird (25813) of covey No. 2, mentioned in the report on that group. This would indicate that the remains of the two coveys joined together in the spring. Counting two birds flushed on the outside of the trap there were 9 birds in the combined covey, which would give a total survival of 45%, probably the correct figure. That the two coveys were originally separate is proved by the fact that they were both flushed on the same days.

Movements: The range of this covey for the winter exceeded a quarter of a mile. This is shown by a check of the distance from the spot of the first trapping to the spot of the last. The birds moved up and down the edge of the Benth woods. One day they were seen crossing the road in front of the truck, but this was the only instance which might indicate that the covey ranged into the field on the other side — a pasture seemingly devoid of adequate food or cover. In general, it may be said that covey No. 3 only fed along the edge of the woods.

Food: Quail food plants available to covey No. 3 were the same as those for covey No. 2. Their ranges overlapped and consequently their food was much the same. Also they both possessed the same feeding characteristics already mentioned, that is, the scratching of undigested corn in cow droppings. Covey
No. 3 was flushed many times in the end of the woods nearest the barn where the cattle had been grazing.

**Cover:** The discussion of cover for covey No. 2 may also be applied to covey No. 3.

**Predators and Predation:** No predation observed. Possible predators are discussed under the heading of covey No. 2.

**Covey No. 4 and 5**

**Survival:** Coveys No. 4 and 5 of 12 and 17 birds respectively inhabited the same weedy draw at the eastern edge of the Beth land. The smaller covey disappeared early in the winter and could not be relocated. The larger covey, however, remained most of the time in its original position. The number of birds in covey No. 5 was reduced to 15 by January 24. Just before they were trapped on March 15 there were only 10 birds left. Of these 10 quail, 8 were trapped and banded as follows:

- 25614 = young cock
- 25615 = young cock
- 25616 = old hen
- 25617 = young cock
- 25618 = young hen
- 25619 = young cock
- 25620 = young cock
- 25621 = young cock

The trap which caught the above birds was located along the snakerail fence to the east of the draw. Attempts to retrap them in April proved fruitless and only one bird was caught. This quail (25621) was trapped in another draw approximately 200 yards to the east. Unbanded birds also caught and banded here were:

- 25701 = young cock
- 25702 = old hen
- 25704 = old cock
It hardly seems probable that only 1 bird out of the original 17 survived the winter and so because of lack of sufficient data no percentage figure can be given.

Movements: Covey No. 5 moved up and down in length of the draw and along the rail fence parallel to it. Once they were flushed 100 yards toward the woods to the north. As has already been stated, 1 bird was caught in another draw to the east. This is proof of the wide range which these birds were forced to travel in search of food. The weedy draw which they normally inhabited became flooded after rains and thaws. The quail moved out on such occasions. Consequently covey No. 5 must be considered as very unstable, and this fact may account for the scattering of the birds. Ring-necked pheasants (4 of which were flushed in one day out of the draw and seemed to be living in apparent harmony with the quail) remained even with the flooding was at its worst.

Food: Corn shocks stood on either side of the draw. During the fall before the ears were shucked and carted away the shocks served as an excellent source of food for the birds. Hogs which roamed up and down the draw and from which the draw received its name, carried the corn nubbins into the birds and so they were not forced to leave cover in order to secure the grain. Ragwood, beggarweed and wild asters were abundant in the area.

Cover: During the fall the weeds in the draw furnished excellent waist-high cover but as the winter progressed the plants were blown down by the wind and bent down by the hogs and heavy snows. Finally the quail gave up this habitat entirely. For escape cover there was only the woods over 100 yards to the north and a description of which can be found under the heading, Covey.
No. 6. The draw to the east where the one quail from covey No. 5 was trapped in the spring had only broom sedge and scattered whitethorn bushes to offer as cover. Coveys No. 4 and 5 had less protection than any other birds under observation.

Predators and Predation: Three quail carcasses were found in the draw; all 3 had been killed and eaten in the characteristic manner of a Cooper's hawk, one of which was frequently noted in the area. A dove's remains were also found in the draw. Dogs ran over the range of these coveys and the den of an opossum was located in a nearby hollow tree.

Coveys No. 6 and 10

Survival: Eighteen birds composed covey No. 6 at the time it was located on November 15. Of these 12 were caught and banded. They are listed as follows:

24679 - young cock
24680 - young cock
24681 - old cock
24682 - young cock
24683 - young cock
24684 - young cock
24685 - young hen
25001 - young hen
25002 - young cock
25003 - young cock
25004 - young cock
25005 - young hen

How many of these birds survived is not known. It is quite probable that the remains of covey No. 6, 11 when last flushed, joined up with part of another covey to form covey No. 10, which contained 23 birds in January and 21 in March. These birds were not trapped. Taking the survival of covey No. 6 to March, however, 11 or 61.2% came through the worst of the winter.

Movements: Covey No. 6 moved up and down along the southeastern edge
of the College woods. In the fall the birds also ranged the wire fence perpendicular to the woods and separating Smithfield from Whitethorn. If the assumption that covey No. 6 subsequently became covey No. 10 is true, then their range must be extended to include the stubble field from the College sewer to the College woods. Such movements would cover a greater distance than any other covey on the Quail Demonstration Area. From the sewer to the most western edge of the woods is almost three-quarters of a mile. When there was snow on the ground covey No. 10 was tracked extensively and found to have walked from corn shock to corn shock in the field to the southeast of the woods. They were evidently very badly in need of food. During the fall the quail of covey No. 6 were in the habit of flushing from the Smithfield-Whitethorn fence line back into the woods. Later, as covey No. 10, they were frequently flushed out of the stubble field just back of the sewer.

Food: When there was snow on the ground covey No. 10 could be easily tracked. These observations revealed that the birds ate beggarweed growing in the College woods. In the fall covey No. 6 subsisted to a large extent on corn. Food plants available to these coveys were as follows: wild aster (very abundant), wild rose (scarce), beggarweed (fairly abundant), bush lespedeza (scarce), sumac (Plantation near college sewer), and evening primrose (fairly abundant).

Cover: Blackberry thickets supplied cover for covey No. 6 along the Smithfield-Whitethorn fence line. In the woods, which were used for escape cover, were found such trees and shrubs and vines as white oak, hickory, wild cherry, whitethorn, wild rose, plum, crab apple, wild grape, and smilax. Covey No. 10, in its range from the sewer to the woods, was afforded only
meager protection. The stubble field was practically bare and the lower end of the woods, while containing blackberry thickets, was not especially suited to quail.

Predators and Predation: No predation was observed in covey No. 6, but two carcasses were found from covey No. 10: one consisted mainly in a mass of feathers in the snow along a snakerail fence. Dog tracks were in evidence about the spot, but marks on the feather ribs indicated that the predator which had eaten the bird was winged. The other bird was probably killed in the same manner after the snow had begun to melt.

Covey No. 7

Survival: In the weedy draw below the buckwheat stack east of Eth's old barn 15 quail were flushed on October 31. An abundance of food there made trapping of these birds practically impossible and it was not until February 13, when the covey had dwindled to 4, that any birds were caught:

25667 = old cock
25668 = old hen

These birds were not retrapped later and as far as is known, only the 4 birds survived. On January 17 there were 9, on February 8 there were 5, and on February 10 there were 4. No carcasses could be found. According to a local sportsman this particular draw was frequented by quail each year but the birds always disappeared before spring. He attributed their disappearance to a lack of food.

Movements: Covey No. 7 ranged the short draw and the open field just above it. When flushed in the field they flew to the edge of the woods. Only once were these birds actually flushed from the buckwheat stack which stood between the woods and the draw. There was about 3 inches of snow on the ground
that day. The bare stubble surrounding the stack probably kept the birds
from more frequently utilizing such an excellent source of food. Covey No. 7
also ranged along the edge of the woods, but at no time were they ever found
in the adjoining weed field where Covets No. 3 and 9 were located.

Food: In spite of the assertion that covey No. 7 suffered from a lack
of food the following winter seed plants were found in the draw inhabited by
the birds: giant ragweed (abundant), wild aster (very abundant), evening prim-
rose (scarce), goldenrod (very abundant), and staghorn sumac (fairly abundant).
Poison oak and poison ivy were scattered throughout the woods but except for
these quail food was scarce. The buckwheat stack must be considered as being
available to the birds. In summarizing the food of covey No. 7 it may be said
to have been abundant during the fall but rather scarce during the late winter.

Cover: The weeded draw afforded excellent cover for a while. In the
spring (April) the weeds had become thinned to a large extent, though, of course
the several shrub thickets (elder, whitethorn, and crab) remained in their
original condition. The woodland, being of the broadleaf type (oak-hickory
association), contained smilax thickets, wild grape tangles, and undershrubs
consisting mainly of dogwood and wild cherry. No better escape cover could
be had.

Predators and Predation: Predators seen or indicated in the vicinity of
covey No. 7 were an opossum (observed as he walked in the woods by daylight),
the tracks of a pair of foxes, and a dead opossum in the draw. There were
numerous dens nearby but they did not seem to be in use during the winter.
The remains of a ring-necked pheasant (a cock that shared the draw with covey
No. 7 and may possibly have eaten many of the seeds which otherwise would have
been available to the quail) was also discovered in the edge of the woods. The ring-neck had evidently been killed by a fox. This same fox was responsible for the death of a rabbit. His tracks following those of the rabbit and ending in a mass of fur and blood could be seen across the snow.

Covey No. 8

Survival: The number of birds in this covey varied almost from day to day. Its average composition was 18 but the number seen at different flushings fluctuated from 16 to 22 without any steady downward or upward trend. When last located in April there were 15 quail in the covey. This would give 72% survival. Fifteen of the original 18 birds were actually trapped and banded but out of the 13 remaining in the spring only one was caught and that by mistake; the props under the trap that was placed by the snakerail fence around the field became dislodged and the trap was automatically set. Those birds caught in late January and early February are listed below:

25652- young cock
25657- young cock
25696- young hen
25655- young cock
25699- young hen
25647- young hen
25668- young hen
25693- young hen
25695- young cock
25690- young cock
25691- young cock
25689- young cock
25676- young cock
25675- young hen

The bird unintentionally trapped on March 28 was 25698. While attempts to recatch the other quail were fruitless, one interesting incident did occur during the spring; a female towhee entered the trap and was later followed by a squirrel. When the rounds were made just before dark it was found that the
squirrel had killed, but had not eaten, the towhee.

Movements: Covey No. 8 ranged up a little gully in the large weed field and along the snakersail fence that marked the western boundary of the field. When flushed in the gully they either flew toward the woods on the east or toward the fence. When the field was plowed up in the spring the quail were forced to range along a little undisturbed strip and into the woods on the northwest. The woods was that utilized by covey No. 7 during the fall. The range of covey No. 8 seemed to be very short, due probably to the fact that there was no necessity for them to move about to any great extent.

Food: Jimson weed, smart weed, wild aster, ragweed, poison ivy, goldenrod, and evening primrose were the main plants found near the range of covey No. 8. Probably no other covey had the variety and abundance of food which was available in this area. The healthy condition of the birds and their high percentage of survival resulted from this fact. Not only were there many food plants but also someone not connected with the Quail Demonstration work was responsible for placing a pile of wheat in the little gully dividing the field. The wheat was evidently intended as a feeding station. A trap placed over the pile resulted in the trapping of the birds which came frequently to the spot during periods of severe cold and snows.

Cover: The weed field furnished excellent cover. In fact, taking food, cover, and predators into consideration, it can be stated that coveys No. 8 and 9 were favored with a better environment than any other birds under observation. When disturbed the birds would fly either to the woods on the northeast or the woods on the northwest. The rail fence along which they ranged in the spring was well-protected by dogwood, locusts, and thorn bushes.
Predators and Predation: The same red-tailed hawk that watched over covey No. 7 may be considered a possible predator of covey No. 8. No predatory action by a red-tailed hawk, however, was observed during the winter's work. Along the rail fence there were numerous animal dens apparently in use, but their occupants were never identified and did not venture out in snowy weather. Dogs ran loose in the range of covey No. 8 but no particular disturbance of the birds by them was noted.

Covey No. 9

Survival: This covey contained 15 birds. However, it was also counted as having 6 and then 12. On the date of the first trapping (February 14) there were 14 birds in all, 12 being caught and 2 being flushed on the outside of the trap. An attempt was made to force these two birds into the trap by easing the truck up on them but one flushed away and the other (a hen) wandered around the outside but could not be enticed to go in. The queer variation in the number of birds composing this covey seems to indicate that there was a great deal of "shifting" between coveys Nos. 8 and 9 or between covey No. 9 and some other source. The following birds were trapped and banded February 14:

- 25301 = young cock
- 25302 = young cock
- 25303 = old cock
- 25304 = young hen
- 25305 = young cock
- 25306 = young cock
- 25307 = old cock
- 25308 = young cock
- 25310 = old hen
- 25311 = young cock
- 25312 = old cock

On April 14, exactly two months later, 8 birds were trapped in the draw filled with thorn bushes which lay to the west of the weed field. Three were
flushed outside the trap. On April 17, 5 were caught at the same place, 4 having already been caught on the 14th. Thus out of the original 14 birds 7 or 50% are definitely proved to have survived, but assuming that 2 of the new quail caught on April 14 were the same as those flushed outside of the trap on February 14, the winter survival is raised to 64%. The birds retrapped are as follows:

25805
25801
25810
25812
25802
25809
25803

New quail trapped and banded were:

25703 - young cock
25702 - young hen

Movements: Covey No. 9 ranged throughout the same large weed field as covey No. 8 and several times the two groups of birds were flushed not more than 30 or 40 yards apart. Covey No. 8, however, seemed to range throughout the western half of the field while covey No. 9 confined itself generally to the eastern half. Several times during the winter covey No. 9 was flushed over the rail fence and down into the little draw where the thorn trees grew. In the spring when the weed field was plowed the quail were forced out and their range was extended to include the length of the draw (grazed extensively by sheep) and the surrounding hill sides. The greatest distance between any two flushings was not more than 300 yards.

Food: The same food in the weed field was available to this covey as to covey No. 8, with the possible exception of the wheat pile in the gully. While
covey No. 9 was flushed nearby this unauthorized feeding station they were never actually seen feeding on it. In March and April the source of food for the birds became somewhat of a mystery; the main vegetation in the thorn draw consisted of broom sedge and dewberry vines.

Cover: Covey No. 9 was protected by the thick growth in the weed field. Along the fence, as stated under the heading Covey No. 3, there were wild plum and thorn bushes. Unlike covey No. 3, however, they did not use the woods to the east for escape cover, but when disturbed flushed down into the draw which later became their habitat for the spring. Cover there and on the hillsides was comparatively scarce; occasional slumps of whitethorn and short weeds providing but little protection.

Predators and Predation: The same predators as applied to covey No. 3 will apply to these birds also. However, the carcass of one bird was actually found under a thorn bush in the draw. The spot was only a few feet from the second location of the trap. A mass of feathers and a picked portion of the scalp were found and led to the assumption that the predation was the work of some winged enemy. The rest of the carcass could not be located to determine if the quail had been banded.

Incidentally, it might be stated that the thorn draw was also inhabited by one hen ring-necked pheasant. The pheasant was flushed several times, once from beneath the propped-up trap.

Covey No. 11

Survival: Twelve out of the original 13 birds in this covey were trapped and banded in the winter. When spring came, however, the birds could not be definitely relocated and they did not respond to the old baiting spots. A
covey of quail of "about 15" was reported in a certain woods only a short distance to the east from the range of covey No. 11 during the fall. Efforts to trap these birds were in vain, but it is more than likely that some of the 15 must have been from covey No. 11. Quail originally banded are as follows:

25689 = young cock
25687 = old hen
25686 = young cock
25685 = young cock
25682 = old cock
25678 = old cock
25681 = young hen
25680 = young hen
25683 = young cock
25684 = young cock
25679 = old hen
25677 = old hen

Movements: Along the edge of the woods which lie in front of the Crumpacker's house was the main range of covey No. 11. Also, several times they were flushed from the field to the east of the woods and they moved extensively around the edge of Crumpacker's garden, as was evidenced by their tracks in the snow. If the aforementioned birds in the woods to the southeast were partly composed of covey No. 11 then the rail fence between the trees and Crumpacker's backyard must also be included in their winter's range. Here again, as in the case of covey No. 1, is presented a case of almost "domesticated" quail living partially dependent on a farm house and its surroundings. The birds, however, were just as wild as any other quail. One interesting incident involving this covey occurred as follows: One morning, the day before a heavy snow, the quail were flushed from the stubble in the weed field at 10:30 a.m. They had not moved from their roosting position. Similar experiences with other coveys lead to rather queer conclusions. They are discussed under the general summary of the winter survival work.
Food: Grumpacker's garden contained a few corn shocks which covey No. 11 visited in the fall. Once when there was snow on the ground the birds were tracked across the weed field and it could be seen where they had eaten beggarweed, wild aster, and Spanish needles. The birds must have been very hungry, for Spanish needles are not considered a good quail food and are not possessed of much nutritional value.

Cover: Along the edges of the woods which furnish feeding and escape cover for the woods there were numerous blackberry and wild grape thickets. The open weed field over which covey No. 11 ranged extensively could not be considered, however, as providing very good protection. The quail must have been very canny in camouflaging their movements, especially when snow was on the ground. The scattered food plants were few and far between.

Predators and Predation: No other covey suffered more frequent flushings by dogs than covey No. 11. A pair of hounds kept the quail stirred up constantly, forcing them to escape to the tops of the high trees in the woods.

One bird out of covey No. 11 died before the quail were trapped. It was caught by hand after making two short weak flights across the snow and died as it was being carried back to the laboratory. A careful autopsy there revealed nothing abnormal except slight diarrhea.

A red-tailed hawk and a Cooper's hawk were seen in the vicinity of covey No. 11.

Covey No. 12

Survival: The Midhurst Covey, when first located on October 29, contained 16 quail, but this number varied from as high as 18 birds and as low as 14. It is an established fact that two coveys, a large one and a small one, worked
this area and intermingled with each other. Trapping was very successful:

23 quail were caught and banded as follows:

491866 = hen
491867 = cock
491868 = undeveloped ju.
491869 = cock
491870 = hen
491871 = undeveloped ju.
24876 = cock
24677 = hen
24678 = cock
25099 = hen
25098 = cock
25097 = cock
25096 = hen
25095 = hen
25094 = cock
25093 = cock
24876 = cock
24881 = hen
24882 = cock
24880 = hen
24883 = cock
24884 = cock
24885 = hen

Birds retrapped after April 1:

24677
25097
491869
24883
491867
491865
24885
24876
24881
24882
24880
24884
Fifteen out of the original covey of 16, which was the larger of the two
and the covey that was more closely checked, lived through the winter; these
figures give a survival of 94%.

 Movements: Covey No. 12 ranged mainly in the large weed field surround-
ing the Midhurst residence. Frequently the birds flew across the Price's Forks road into the College orchard. It is highly probable also that the birds ventured across the macadam on foot. The fence bordering the yard of the residence was also a favorite feeding and roosting place of the birds. On the east side of the yard was a hedge of large privet bushes where the birds were frequently flushed. The extent of the range of the covey back into the weed field is not exactly known, for the birds had a habit of seemingly "disappearing" during certain periods only to be flushed later in their normal habitat.

Food: Quail 29065 was killed by an automobile on the Price's Forks road. An analysis of its crop revealed corn grains and privet seeds. Thus we have a good idea of the kind of food which covey No. 12 was in the habit of eating. The corn probably came from the shocks in the field to the east of the Midhurst residence. Another possible source of food was an old wheat pile containing much chaff and the birds were frequently noted there and also in the honeysuckle thicket mentioned under the heading Movements. The weed field proper was full of ragweed, on which the quail undoubtedly fed to a large extent in the fall and early winter.

Cover: Protection in the weed field could only be classed as "fair". Certain spots, such as, down the little low drains for the area, were full of high and thick vegetation, but for the most part the weeds were rather scanty. The privet hedge on the east, however, provided excellent cover and so did the honeysuckle vines to the west. The range of the birds included no wooded areas unless the apple orchard across the road could be so classified. The orchard was cleanly kept except for one patch of weeds which the birds are likely to
have visited, although several attempts to flush them there were of no avail.

Predators and Predation: The dead quail found on the Price's Forks road represents the result of the first case of an automobile as a predator -- at least as far as the Quail Demonstration Area is concerned. Another carcass of a bird (unbanded and probably from the smaller covey) was located in the honeysuckle thicket. Just what was responsible for its death is not known. The carcass was evidently several days old but, because of the snow on the ground and the cold weather, was in a good state of preservation. A female Cooper's hawk was noted near Midhurst.

Winter of 1936-1937

Sixty-seven per cent of the quail upon which accurate data was kept survived winter. Again there was trouble with "disappearing" coveys and trapping activities were less successful than those of the winter before, only 11 birds being caught. Ten of these had to be banded and the other was a bird from covey No. 11 (1935-1936 series) which had been trapped before. Further information on the second winter's study will be found under the heading, General Discussion of Results. A detailed description of 11 individual coveys originally containing 146 birds and ending up with 99 is given below. Also there is a discussion of coveys on which insufficient data was kept.

Covey No. 1

Survival: Early in the fall a covey of 9 birds ranged near the feed patch in the woods east of the Kipps' house. These birds later moved to the Heth's garden, though by January 15 their number had been reduced to 4. These 4 were flushed once or twice a week in the vicinity until March 19 when only 3
quail remained. Thus 53% survived.

Movements: The range of this covey has been partially discussed above. After the birds took up in the garden they sometimes moved out into the Heth orchard and the edge of the woods. Usually they were flushed near the orchard or the garden and scattered into the trees. Their range, while including varied types of habitat, did not cover a great distance.

Food: Clover, plantain, and yarrow furnished green food available to these birds and some ragweed was present. It was reported by help on the place that the quail fed on corn in the Heth barn and about the Heth residence. A food shelter of kafir corn was constructed in the northwest corner of the orchard and the birds were several times flushed near this feeding station.

Cover: The cover for the quail was much better than the food. There was brush in the garden and a briar patch and, of course, the orchard trees. The woods offered good escape and when flushed a second time the quail usually flew deep into the underbrush.

Predators and Predation: Six birds were lost from this covey and the cause of their disappearance was not determined. In the spring, however, a Cooper’s hawk’s nest, with one bird setting, was found in Heth’s woods. Crows were very abundant and ate much of the available fruit in the woods by mid-winter.

Covey No. 2

Survival: Eighteen birds were counted in this covey on October 7. In early December the number had been reduced to 16 and by the last of February there were only 14 left. Thus out of the original covey, 14 quail or 77% survived until March 1.
Movements: These quail moved along the rail fence running from Heth's road eastward to the draw where the mutant pheasants were released. They were also flushed in the weeded wheat-stubble fields nearby. In the early fall, however, they remained close to the small corn field on the east of Heth's road and worked along the fences bounding this field. It is probable, but not definitely proved, that the birds may have at times moved into the pheasant draw and been a part of the 50 quail which could not be accounted for in that area.

Food: The grain from corn nubbins must have formed a good portion of the early fall diet of this covey. That they were well-fed is evidenced by the fact that they would not eat the grain used to bait them, even though they flushed once or twice very near the baiting spots.

Cover: Escape cover for the quail was poor. They were not seen near any heavily wooded areas and the fence-rows along which they ranged were fairly-well grown-up. The stubble-field provided satisfactory feeding cover.

Predators and Predation: A mass of quail feathers, probably belonging to one of the birds in covey No. 2, was found near the base of a fallen tree on January 9. What killed this bird is not known. The Cooper's hawk which ranged the area, and was finally caught, could have preyed on this covey. On January 10, a cock quail was caught in a steel trap set for a skunk in a ground-hog hole under a log among the clump of trees in the stubble field on the hill above the pheasant area. Both legs were broken. The bird was killed. (See stomach No. 942-943)

Covey No. 3

Survival: On September 19 a covey of 11 quail were flushed out of the
draw running northeast to southwest in Heth's front pasture. There was one old bird in this covey and the rest were young chicks, barely able to fly. All the quail were not flushed on this date and later the covey was found to be composed of 24. Close check was kept on these birds and before they mated in the spring they had been reduced to 15. Numerous attempts were made to trap this covey but the attempts were unsuccessful. Sixty-two per cent survived the winter.

Movements: Covey No. 3 ranged up and down the draw where the one bird out of covey No. 4 (1935-1936) was caught in the spring of 1936. Frequently they moved into the broom sedge pasture land on either side of the draw and once or twice they were flushed in the weedy stubble-field to the east. Most of the time, however, they were flushed within 200 yards of the feed-patch provided for them.

Food: No other covey studied used the food planted for them as extensively as covey No. 3. Several roosting places were seen in the middle of the millet and kafir corn. What these birds ate in the broom sedge on either side of the draw is not known. The weed field to the east may have contained some wheat kernels on the ground. The weeds were mostly wild aster and ragweed the same food plants were available to this covey as to covey No. 6 (1935-1936).

Cover: Protection for these birds was very scarce. There were only a few thorn bushes and some scattered oak trees to which the quail might escape. The broom sedge in the fields was fairly thick and kept the quail hidden but broom sedge at best is only good for roosting cover. The draw itself was swampy with a knee-high weed-growth. All in all the cover for these birds must
be classed as poor.

Predators and Predation: A Cooper's hawk ranged near this covey. Once the bird was flushed out of the feed-patch with the quail. In January this Cooper's hawk was caught by means of a pole-trap and its predation was stopped. The remains of 5 birds were found in this area. One on November 28 and 2 on January 9 and 1 on January 11 which seemed to have been killed by a dog. On December 20, a Cooper's hawk was flushed from the food patch from the carcass of a partially-picked quail. (See crop and gizzard No. 932)

Covey No. 4

Survival: Covey No. 4 was the only covey under observation which survived the winter 100%. In early December the tracks of 15 quail were seen in the wooded area near the transient camp and these birds were flushed regularly until spring, when the count was still 15.

Movements: The extremes of this covey's range were the middle of the experimental plots on the east and the point of the college woods on the west. The range is perhaps more clearly shown on the map (see appendix). This range, of course, included the woods in which the transient camp is located.

Food: Evening primrose, Korean lespedeza, Japan clover, bush lespedeza, wild aster and beggarweed were among the plants available to this covey. The wheat-stubble field along the border of which the covey ranged, was sown to Korean lespedeza in the spring of 1935. An abundant supply of this food was available throughout the winter. In the woods itself not much food was to be found but in certain areas of the experimental plots and in the stubble-field to the south of the woods there was a fair weed growth.

Cover: These quail were amply supplied with good cover. In the woods
there were many blackberry thickets which provided excellent protection. The rail fence along the southern edge of the woods was well grown-up with vines and briars. The birds could work along this fence and venture out into either the woods or the weed field. It is probable that the excellent cover accounted, to a large extent, for the 100% survival of these quail.

Predators and Predation: No predation was made on covey No. 4.

Coveys No. 5 and 6

Survival: Two coveys were located near the college spring. They contained 22 and 17 birds respectively. The covey of 17 soon unaccountably disappeared and there is not sufficient data on these birds to warrant their inclusion in the survival study. Close check, however, was kept on the covey of 22. Ten of these birds were trapped and banded on February 2:

25623 - cock
25622 - cock
25621 - hen
25620 - cock
25619 - cock
25618 - hen
25617 - hen
25616 - cock
25615 - hen
25614 - hen

One bird, 25686-cock, was also caught and had been banded during the last winter. This quail was from covey No. 11 (1935-1936).

Several of the above-listed birds were retrapped (25617, 25618, 25623, 25614) but efforts to catch any more unbanded were fruitless. Out of this covey of 22 birds, 12 survived until April 12. This gives a survival figure of 54%.

Movements: The quail in these two coveys moved along the east side of the road running from the water tank to the spring. The soil conservation
plot and the fields in the vicinity as far east as the railroad tracks were ranged by the coveys. During bad weather they seemed to shift into the woods lying just to the east and north of the spring. They ranged the full length of this woods and used the fields back of Prof. A. B. Massey's house.

Food: There was prostrate lespedeza on the south side of the woods and the Korean lespedeza patches planted in the spring of 1936 did well. Buckwheat planted nearby was used by the covey as indicated by tracks in the snow. Some grain, of course, was provided for the birds during trapping operations. The nearby fields contained pigweed, ragweed and other quail foods.

Cover: Stubble fields, a corn field with weeds grown up in it, and the brushy areas in the woods provided the cover for these quail. Their range, however, crossed practically open pasture lands. The woods consisted mainly in large oak trees but in places the undergrowth of blackberry vines and coral bushes was dense and provided excellent escape.

Predators and Predation: A Cooper's hawk was the most dangerous predator in this area. On December 26, it was seen to carry off the carcass of some bird, the dropped feathers of which proved to be a quail. In a blackberry patch near one of the food plots, the remains of two quail were found and the predation was ascribed to the Cooper's hawk. The feathers of birds other than quail were also observed to be scattered about in the region near the college spring. One cock quail, when flushed, flew against the side of the Holdaway's white house and was killed instantly, it was reported. Two other quail were found which had been killed by an unidentified predator. One bird, 25686, was killed by a dog training on the area. These records account for the disappearance of 7 of the 10 quail lost from this covey. Here are the dates and further
explanation of some of the quail deaths: During a period of snow and sleet the coveys in the area frequented several brush piles. On the morning of December 24, the remains of a quail was found in the snow near one of these brush heaps. Tracks in the snow showed clearly that the bird had been killed by a house cat as it came from a hole beneath the brush heap. (See stomach No. 935) On January 8, a Cooper's hawk was flushed from the well-picked and partly-eaten carcass of a bobwhite in the clover stubble to the south of the woods. Another of the quail was found January 13. (See stomach No. 941)

Covey No. 7

Survival: On November 15 quail were flushed from the thicket along the lower fence of Hoth's big corn field (see map for location of these birds) and their number was gradually reduced to 13 by February 6 and 11 by March 27. Seventy-three per cent survived.

Movements: Covey No. 7 stuck closely to the fence mentioned above during the early fall. Later they began to be found in the permanent pasture field to the east and when last flushed they had moved into the woods to the south of the corn field and had become very difficult to locate.

Food: Corn dropped in the field was very abundant. There were no feed patches close enough to these quail to be of value to them. Korean lespedeza, however, had been planted in the old road running along the lower end of the field. Seed on these plants was not very good.

Cover: The fence row used by covey No. 7 was fine feeding cover for the quail so long as they were not disturbed. When flushed they were forced to fly either further along the fence or into an open pasture where the grass was not more than 3 inches high. The permanent pasture field provided better cover.
and the woods was near enough for escape.

Predators and Predation: No predation was observed on this covey. Dogs were seen in the vicinity which may have kept the quail in an unsettled condition. A red-tailed hawk ranged the woods.

Covey No. 8

Survival: In the middle of December, 12 birds were flushed out of the old AAA field. Later 9 were seen along the rail fence bounding its southern edge. These 9 were reduced to 3 by the latter part of December, at which time the covey "disappeared". While a good part of the winter was yet to come after December, the survival can be figured as 41%.

Movements: Covey No. 8 ranged up and down the field using the rail fence mentioned above. It is possible that the remnants of this covey may have formed covey No. 9, but as there is no definite proof of this the two coveys must be considered separately.

Food: On the old AAA field food was not as abundant as the year before. Corn, however, had been planted in the spring of 1936 and the quail could have eaten the grains on the stubbles. A food shelter was provided.

Cover: The rail fence was well grown-up. Dogwood trees, wild cherries, poison ivy, and some planted lespedezas formed good cover. The field itself was mostly bare. A description of the cover in the surrounding fields may be found under the discussion of the other coveys in this region. (See map)

Predators and Predation: A pile of feathers was found on November 28 along the rail fence. No carcass was discovered but the bird had evidently been killed. The finding of the feather pile was on a morning after a night in which there had been a sharp temperature drop.
Covey No. 9

Survival: One quail out of an original 3 was left in this covey. Thus 33% survived. This covey was the smallest one kept under observation during the two years work. It was flushed frequently and close check was kept on it. Originally located in January the covey slowly dwindled to its lone survivor, which was last seen on March 16.

Movements: This covey kept a rather consistent range, staying close to feed patch No. 13 and moving out from it into the pasture field and possibly to the little wooded knoll on the north. When flushed the quail flew to the centrally located stream-bed running through the pasture.

Food: Aside from the millet, lespedezas, cowpeas and kafir corn artificially provided for these birds there was wild rose, smilax, and the other plants mentioned in the food description of this area which appears in connection with coveys No. 8 and 9 (1935-1936). The poisonivy vines of the area bore but very few seeds.

Cover: Except in the food patches which stood up well over the winter there was little cover for the quail. Frequently they were flushed out of sparse broom sedge; and the stream-bed, which was damp and often flooded, had but a scanty weed growth. On the nearby hillside there were a few blackberry thickets and occasional thorn bushes to which the birds might escape. On the whole, cover for the quail was definitely poor.

Predators and Predation: On January 30, a large quantity of quail feathers and fresh blood was found in one of the feed patches. The carcass of the bird was missing and the work seemed to be that of a hawk. Red-tails and Cooper's had been observed in the region. On September 26, a small quail, which had
evidently flown into a fence, was found dead in this vicinity.

Covey No. 10

Survival: The highest number of quail reported in this covey was 20, flushed on February 5. As low as 11 birds were reported at one time and the constant fluctuation in number seemed to indicate that there were two coveys in this area which sometimes combined to form one large covey. Out of 20 reported in January and February, 18 lived through to the middle of March. This would give a survival percentage of 90%.

Movements: The birds in this covey usually stayed within two or three hundred yards of the McEryde house. They ranged, however, like the corresponding covey of 1935-1936, into the college orchard on the other side of the Price's Forks road. They were never located further than one-quarter of a mile from the McEryde house.

Food: No artificial food was provided for this covey. Food conditions were practically the same as for the quail which ranged this territory in 1935-1936 (see covey No. 12), except that the weed growth in the field to the left of the house was not as high nor as thick and consequently seeds were not as abundant. Wheat stubble in the field to the right of the house (the area was in corn in previous years) provided excellent food and cover. The border of the field was sown to Korean lespedeza in the spring of 1936 and these plants produced an abundance of seed. Ragweeds were over the entire field.

Cover: Cover, like food, was rather scarce in the fields surrounding the house. Honeysuckle thickets and a privet hedge however, served well as a refuge to which the birds might escape.

Predators and Predation: No predation was observed in this area. The
Cooper's hawk of the previous year was not seen.

Covey No. 11

Survival: A covey of 10 quail from the State Game Farm was released in the fall in the old road bed leading south from the Smithfield house. The numbers and weights of these birds in grams are as follows:

- 24894 - cock - 121.7
- 24895 - cock - 154.2
- 24896 - cock - 153.0 had scaly leg
- 24897 - cock - 119.3
- 24898 - cock - 156.7
- 24899 - cock - 132.3
- 24900 - cock - 126.7
- 25629 - hen - 145.3
- 25632 - hen - 161.7
- 25637 - cock - 135.4

In December they were reduced to 7 and when last flushed they contained this number. Thus 70% survived.

Movements: This covey was released in the old road because it seemed like a good unused quail habitat. They quickly moved out, however, and ranged the western part of the old AAA field and the eastern part of the old buckwheat field. When disturbed they flushed to the woods (see map).

Food: There was a food patch and a feeding shelter in this area. In the buckwheat field there were high growths of evening primrose and ragweed.

Cover: These quail had good feeding and escape cover. In some places in the old buckwheat field the weeds were so thick that birds had difficulty in flushing. This, perhaps, made moving about on the ground difficult also.

Predators and Predation: The cause of the loss of the birds from this covey is not known. A Cooper's hawk and a red-tailed hawk ranged this area.

Other Coveys on Which Insufficient Data Was Kept

Coveys which either "disappeared" or could not be checked or which joined-
up with others are as follows: A covey of captivity-reared quail were banded and turned out between the college lakes and the college quarry. Their numbers, sex, and weights in grams are given below:

25624 = hen = 141.9
25635 = cock = 138.9
25626 = cock = 143.5 = had scaly leg
24887 = hen = 117.7
24888 = hen = 125.1
24889 = cock = 116.8
24890 = cock = 133.7
24891 = cock = 125.0 = right leg missing below knee
24892 = hen = 125.7
24893 = hen = 131.7

This covey stayed for a few days under the porch of M. S. Kipps' house and then disappeared.

In the pheasant draw inhabited by coveys No. 4 and 5 of the 1935-1936 series, there were at one time 50 or more birds comprising two coveys. Part of the birds probably were from coveys No. 2 and 3. It was reported that a part of these quail ranged across the Price's Forks road onto the property of Mr. Hugh Linkous.

A group of 12 or 14 quail were found in late summer and early fall to be using feed patch No. 5. These birds moved out, however, probably going to form one of the two coveys located near the college spring.

In the old buckwheat field where covey No. 7 (1935-1936) was located, 14 birds only three-fourths grown were flushed on October 5. In December there were 12, but because of the confusion which resulted in trying to keep track of the quail in this covey and covey No. 11 it is not quite clear just happened to these birds. The ranges of the two coveys overlapped.

A covey of 15 were found on October 6 in Beth's bahk pasture. Apparently they moved over behind the airport and were lost sight of. This covey was
flushed from feed patch No. 5 on December 12. One bird, a cock, failed to flush with the others, but tried to escape and was caught. Examination revealed that the tip of one wing was dangling as the result of an injury to the wrist point. The wing had apparently been injured by striking some sharp object, possibly the bark on the inclosure fence. The bird was brought to the laboratory, kept over winter, and released in April in Roanoke Creek Valley.

At the end of the woods near the Heth beef cattle barn a covey was found on December 10 containing 2 birds. These birds were seen near the feed patch there until later in the winter when they disappeared.
GENERAL DISCUSSION OF RESULTS

The 1935-1936 coveys were subjected to a winter which has been termed the "hardest" in twenty years. The survival figure (45% of quail under observation, including those banded and those unbanded) cannot be considered as normal. It does, however, show the effect of such low temperatures and unusual snows on the birds. The second winter was milder and this fact combined with the feed patches and feeding shelters provided for the quail, must account for the increase in the survival percentage (67%).

Covey, rather than food or predators, appeared to be the limiting factor on the Quail Demonstration Area during the first winter. There were simply not more birds present because there was not enough suitable protection. The covey was short in 1936-1937 as a result of the semi-drought condition in the summer and fall of 1936. Quail were more exposed to predation by hawks because of this fact. However, more cover was made available to the birds by the feed-patch plantings. While it cannot be said that food was abnormally abundant either year there was certainly no shortage. The abundance of grain and seed made trapping of the quail in the early fall very difficult.

The many instances of "shuffling" and "disappearing" and "joining-up" among the coveys indicates that there is more exchange of birds than the work of Errington (2) would indicate.

Concerning predators it may be said that dogs running loose over the area during breeding season and during the winter months was a disturbing factor of considerable importance. Several of the coveys observed were kept stirred-up and in an unstable condition as a result of constant flushing by the dogs. There were not as many red-tailed hawks present in 1936-1937 as in
1935-1936 but there were as many or more Cooper’s hawks.

One interesting fact brought out by the study was that out of 109 quail banded on the Quail Demonstration Sanctuary in 1935-1936, 70 were cocks and 39 were hens. While this numerical relationship was merely a by-product of the main work, nevertheless it is a very interesting fact upon which to speculate. For many years some sportsmen have maintained that if coveys are not "shot-up" the cocks will, in the course of time, out-number the hens and an improper breeding balance will result. Game technicians have claimed that this belief is unfounded; they hold that quail on a sanctuary area where no hunting is allowed will breed not only just as well but better than those depleted by shooting. Not enough birds, however, trapped on this area to warrant drawing any conclusion on either side, though Stoddard (1) says the usual ratio is 52% cocks and 48% hens.
<table>
<thead>
<tr>
<th>Common</th>
<th>Generic</th>
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</thead>
<tbody>
<tr>
<td>Apple, crab</td>
<td>Pyrus</td>
</tr>
<tr>
<td>Aster, wild</td>
<td>Aster</td>
</tr>
<tr>
<td>Baggarweed</td>
<td>Bidens</td>
</tr>
<tr>
<td>Blackberry</td>
<td>Rubus</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>Pogopyrum</td>
</tr>
<tr>
<td>Broom sedge</td>
<td>Andropogon</td>
</tr>
<tr>
<td>Cherry, wild</td>
<td>Pumus</td>
</tr>
<tr>
<td>Clover</td>
<td>Trifolium</td>
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<tr>
<td>Clover, Japan</td>
<td>Lespedeza</td>
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<tr>
<td>Corn</td>
<td>Zea</td>
</tr>
<tr>
<td>Corn, kefir</td>
<td>Holcus</td>
</tr>
<tr>
<td>Coral bush</td>
<td>Symphoricarpes</td>
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<tr>
<td>Cowpeas</td>
<td>Vigna</td>
</tr>
<tr>
<td>Dogwood</td>
<td>Cornus</td>
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<tr>
<td>Dewberry</td>
<td>Rubus</td>
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<tr>
<td>Elder</td>
<td>Sambucus</td>
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<tr>
<td>Grape, wild</td>
<td>Vitis</td>
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<tr>
<td>Hickory</td>
<td>Caryya</td>
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<tr>
<td>Honeysuckle</td>
<td>Lonicera</td>
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<tr>
<td>Ivy, poison</td>
<td>Rhus</td>
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<tr>
<td>Jimson-weed</td>
<td>Datura</td>
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<tr>
<td>Lespedeza, bush</td>
<td>Lespedeza</td>
</tr>
<tr>
<td>Lespedeza, Korean</td>
<td>Lespedeza</td>
</tr>
</tbody>
</table>
Common
Millet
Needles, Spanish
Oak
Oak, poison
Pigweed
Pine, scrub
Plantain
Plum, wild
Primrose, evening
Privet
Ragweed, giant
Ragweed, small
Rose, wild
Smartweed
Sumac
Thorn, white
Wheat
Yarrow

Genus
Panicum
Bidens
Quercus
Rhus
Chenopodium
Pinus
Plantago
Prunus
Genothera
Ligustrum
Ambrosia
Ambrosia
Rosa
Polygonum
Rhus
Crataegus
Triticum
Achillea
<table>
<thead>
<tr>
<th>Common</th>
<th>Scientific</th>
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</thead>
<tbody>
<tr>
<td>Dove</td>
<td>Zensaída macroura carolinensis (Linn.)</td>
</tr>
<tr>
<td>Hawk, Cooper's</td>
<td>Accipiter Cooper (Bonaparte)</td>
</tr>
<tr>
<td>Hawk, Red-tailed</td>
<td>Buteo borealis borealis (Gmelin)</td>
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<tr>
<td>Pheasant, ring-necked</td>
<td>Phasianus colchicus torquatus (Gmelin)</td>
</tr>
<tr>
<td>Towhee</td>
<td>Pipilo erythrophthalmus erythrophthalmus (Linn.)</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

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