

WINTER SURVIVAL OF THE BOBWHITE QUAIL
ON ITS INTERMEDIATE RANGE

by

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INTRODUCTION AND REVIEW OF PREVIOUS WORK

The results of this study, which was made to determine the winter survival of the bobwhite quail (*Colinus virginianus virginianus*) on its intermediate range, depend to a large extent upon a number of controlling factors and the natural habits of the quail themselves. Bobwhite quail form coveys, which consist of two or more (generally 15-20) birds which feed and roost together for mutual benefit. A covey may consist not only of birds hatched from a single clutch of eggs, together with the parents, but also of other birds inhabiting the same area. By early winter the chicks are usually full-grown and independent of their parents, but may continue to feed with them until the beginning of the breeding season the following spring. Quail, in their daily search for food, generally cover a more or less regular range uninhabited by any other covey although two or more ranges may overlap and coveys occasionally combine.

The roosting habit of quail is quite interesting as the birds form a closed circle on the ground, tails pointing inward. This arrangement not only provides warmth but as each bird faces outward it affords a better chance of detecting and escaping any approaching enemy. The small mound of droppings (Figure 19) is quite characteristic and are easily found in occupied range.

The winter survival of quail is controlled by the following important factors: food, cover, predators, temperature, precipitation, and disease. These factors are all more or less related and their action

or interaction determines the number of birds to survive the winter. For example, food may be plentiful but lack of suitable protection (cover) while feeding may result in excessive predator losses, or an unusually heavy and lasting snowfall (precipitation) may limit available food supply to the extent that birds more readily fall prey to disease or natural enemies. Some of the many foods eaten by quail are: seeds of lespedeza, ragweed, corn, wheat, trefoil, beggarweed, partridge peas, and the fruit of sumac and poison ivy.

According to Baldwin (1938) the most important sources of food are the native legumes followed by common ragweed, cultivated legumes and cultivated grains. He states further that native and cultivated legumes make up about 40% of the total winter food.

Cover may be any thick vegetation providing a "roof" for protection against winged predators, and at the same time open enough at the ground so the quail may walk about with ease. Some of the worst enemies of quail are the common house cat, dog, fox, skunk, man, Cooper's hawk, sharp-shinned hawk, and great horned owl. Parasites and diseases of quail are much like those of farmyard fowl; among them coccidiosis, blackhead, roundworms, tapeworms, quail disease, tularemia, lice and mites.

Stoddard and Handley (1924 - 1929) were the first to do any important work on quail survival. Their work was done in southern Georgia where the birds were trapped, banded, released, and retrapped to determine survival. Errington (1931 - 1933) conducted the same type of work in northern Wisconsin and Iowa but did this only by observation, not trapping

and banding. Handley (1932) released captivity reared quail at Camp Lee, Virginia, and reported on their survival. Newman (1937), while a graduate student at the Virginia Polytechnic Institute, reported on the winter survival of quail during the winters of 1935-1936 and 1936-1937.

While this problem, a continuation of Newman's work, is concerned mainly with winter survival and the factors controlling this survival, some attention is given to its practical application. The work on survival being done in an intermediate area as compared to that done in the southern limit of range by Stoddard and Handley, and the northern by Errington, will serve as a check on interpretation of the work of previous investigators as concerns conditions on the bobwhite's intermediate range.

DESCRIPTION OF AREA

The area on which this work was done consists of about 2,500 acres, known as the Blacksburg Quail Demonstration Area, comprised of lands owned or leased by the Virginia Polytechnic Institute in Montgomery County, Virginia (Figure 1). It enjoys the status of a state game sanctuary and no hunting or trapping is permitted except when deemed advisable, and then only under careful supervision. A map of this area will be found in the Appendix.

The Demonstration Area presents a wide variety of conditions. As a whole the area is well watered, and quail food, particularly as supplemented by the feed patches, is generally sufficient. Suitable cover, or the absence of it, is undoubtedly the limiting factor of quail distribution and population throughout most of the area. (Figures 7 and 8).

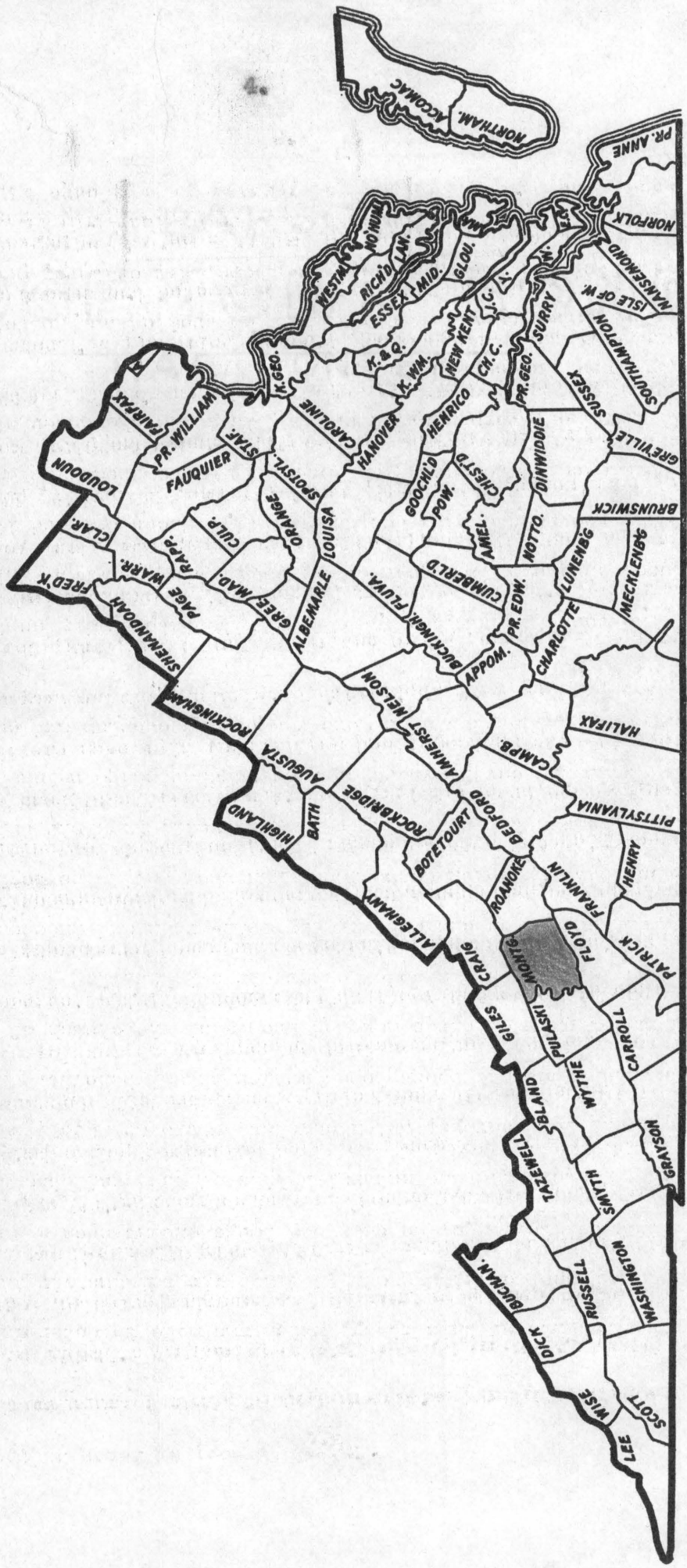


Figure 1. Map of Virginia showing location of county in which the investigation was made.

With the exception of several patches of woods, the balance of the area is divided roughly into equal portions of permanent pasture and cultivated lands. The latter is generally managed as a three-year rotation of corn, wheat, and clover. These crops do provide an appreciable amount of food, the distribution of wheat stubble in particular governs to a large degree locations and movements of many coveys. The pasture land is almost a complete loss so far as suitable quail habitat is concerned, so approximately only one-half of the area may be considered as being, normally, potential bobwhite covert. This has been somewhat augmented by the planting and fencing of cover and food plants in various locations (Figure 2). However, these food and cover patches in open pasture are still so isolated as to be used very little by quail during the crucial winter months. With these conditions typical of southwest Virginia farms, most of the suitable food and cover, and consequently quail, are found around the borders of ungrazed woodland (Figures 4 and 5), areas overgrown with crataegus and blackberry, swales or swamps, and bushy fence rows (Figure 3). Small areas fenced and set aside for control of erosion offer suitable habitat and the greatest opportunity for increasing quail population probably lies with similar fenced areas and development of fence rows.

Food patches, of which there are approximately thirty on the Area, may be of great value in increasing and holding quail. These patches consist of mixtures of annual grains such as Kaffir corn and millet, cow peas and lespedeza. Costs may be cut down by substituting reseeding annuals or perennials such as the lespedezas. Food patches are most effective when other cover is located nearby.



Figure 2. A typical planting to supply food and cover for quail. All patches on the College area are fenced to prevent destruction by livestock.



Figure 3. Bushy fence rows provide a welcome haven during the crucial winter months.



Figure 4. Three coveys used the edge of these woods for escape cover.

INVESTIGATION

Procedure

Method of Locating Coveys

Three methods of locating and counting coveys were used; namely, by flushing on foot, by the use of well trained bird dogs, and by trapping. Each has its advantages and a combination of the three proved very satisfactory. Generally speaking, the use of dogs (Figure 20) was the most efficient method of locating and enumerating coveys. Not only can more ground be covered but at times when the birds are sitting "close" they are much easier to locate. However, if dogs are unable to find birds in a particular location it does not necessarily mean there are none present. Also a man handling dogs is unable to search the dense thickets where the carcasses of birds killed by predators are usually found. Flushing on foot obviously eliminates this disadvantage. Trapping is fully discussed under "Baiting and Trapping".

Before arriving at a final definite figure of quail population and the number of coveys on the area, it was necessary first to become thoroughly familiar with the range and number of each suspected covey. This is particularly true when using dogs for census work. As mentioned before, quail ordinarily have a more or less definite range and, once located, can usually be found somewhere in the range. Upon flushing a covey a count was made and the point from which they were flushed was located on a map with an arrow indicating the direction of flight. Complete notes were kept on all observations and later transferred to a

journal for consolidation. Thus repeated flushings over a period of time seemed to locate quite accurately the range of each covey. However, it was often difficult to ascertain with certainty, at the beginning of the season, whether or not a certain covey was the same as had been previously flushed nearby. Overlapping ranges and neighboring coveys of the same number of birds made for more uncertainty. For example, around the "Middle Woods" the overlapping ranges and similar numbers of three coveys were so confusing that it took several weeks to secure accurate information regarding each. Coveys consisting of eighteen or more birds were also hard to count with exactness unless more than one observer was present. In cases such as this numerous flushings or work on singles was necessary. Coveys flushed in wooded areas were particularly difficult to count, not only because of limited vision, but in many cases the birds would alight in low trees and shrubs. This habit of alighting in trees was also noted in a covey frequenting a field of broom sedge where additional cover was scarce.

The accumulation of droppings around roosting and dusting spots (Figure 18), as well as other signs, while not entirely dependable because of the difficulty in estimating their age, were used to good advantage in determining whether or not quail were using a certain range.

Baiting and Trapping of Coveys

As soon as a covey of birds was definitely located trapping was attempted. A spot of about four feet in diameter was scraped clean and a mixture of cracked corn and wheat used as bait (Figure 9). After it was determined that this had been visited by quail a trap was propped over the



Figure 5. A dense growth of weeds along the edge of a woods provides excellent winter cover.



Figure 6. Quail frequently feed and roost in such open cover as this.

spot (Figure 10) until the birds had become used to feeding underneath. The trap was then lowered to the ground and set. (Figures 11 and 12).

Bait spots were located in the most likely looking places such as fence rows, on the edge of a wood, or within a feed patch. Of these, best results were obtained from the fence rows, poorest from the feed patches, probably because of the abundance of feed in the latter. Small rodents were very annoying, often stealing the bait or ruining a set by their burrows.

The trap used was very similar to the "standard" type (Figure 13) used by Stoddard and Handley. However, instead of the usual funnel entrance a door was made of pronged wires soldered to an axle. This door was hinged so that it was easily forced from the outside and seemed to give much better results than the funnel type of entrance.

The greatest difficulty in trapping was trying to overcome what seemed to be a fear of the unnatural, such as a trap. Time after time quail would completely clean up a bait spot only to leave it strictly alone once a trap was propped overhead. In one instance a covey took bait from under the propped trap but would not enter once it was set, although signs showed they had scratched the ground in the immediate vicinity. This evident "trap fright" did not hold for all coveys however, as one group of birds came back to the trap the day after being caught, and one particular quail was caught two days in succession at the same place. The ability of quail to remember a bait spot is evidenced by one covey that scratched through a completely covering layer of snow and ice to take bait, although they could not be induced under a trap and



Figure 7. Deficient food and cover
except for the grown-up swale and
food patch.



Figure 8. Typical south-west Virginia
grazing farm. No food or cover for quail
except the fenced area in middle foreground.



Figure 9. A typical bait spot.



Figure 10. Trap in propped position.

were never caught. Injuries during trapping were slight, possibly because trapped quail were quietly covered with a blanket (Figure 13) and worked into a collecting box with as little disturbance as possible (Figure 14). The collecting box (Figure 15) proved to be the ideal means of removing trapped quail and undoubtedly prevented much injury. In only one instance were birds seriously injured, two being found dead when the trap was visited and the remaining two badly scalped. That these birds had been frightened by a winged predator and injured themselves by flying against the trap walls seemed evident as the inside of the trap was literally covered by feathers. This assumption was further borne out by finding crow droppings on a trap which held a rabbit. Squirrels and rabbits, incidentally, caused quite some trouble. The former would often gnaw out and both would ruin the entrance by forcing it from the inside. Rabbits were frequently caught and in one instance had evidently allowed a trapped covey to escape by spreading the entrance, as but one quail was found in a trap that had obviously held a rabbit. That this one bird did not also escape was pure luck as the entrance was practically wide open.

Banding of Coveys

The trapped birds were brought into the laboratory if weather did not permit the work to be done in the field and aluminum band, numbered serially and supplied by the State Game Commission, attached to the leg of each. Data were taken on the weight, age (as determined by the first two primary feathers of each wing), and sex of each quail (Figure 17). Birds were carefully examined for abnormal conditions such as disease or injuries, and blood smears of a few were obtained. In no case was any indication of



Figure 11. A fence row "set".



Figure 12. Close-up of a "set".

disease found. The quail were released near the point of capture and seemed to suffer no ill effects from being held overnight in the collecting box.

Marking of Coveys

One of the most interesting phases of this work was the marking of trapped birds by means of glued-on white feathers. As mentioned before, one of the difficulties of quail observation was to know whether or not a covey flushed from a certain spot was the one normally inhabiting that range, or a covey from an overlapping range. In attempting to overcome this difficulty and to aid in tracing the movements of individual birds or coveys the marking system was inaugurated.

The procedure was simply to fasten a white chicken feather underneath the upper coverts but over the tail or wing feathers (Figure 16). DuPont's Household Cement was used as adhesive. Each covey had an individual marking, such as one feather in the tail, two feathers in the tail, one feather in a wing, or some distinctive combination.

The marked birds were easily distinguished in the field and much valuable information was obtained from these observations, especially as regards covey combinations and movements.

Further remarks on marking of quail will be found in Conclusions and Recommendations.

Observation of Coveys

All coveys, whether or not they were banded and marked, were kept under as close observation as possible. Most coveys were flushed at least once a



Figure 13. Trap containing quail. The trap is darkened to reduce possible injury.



Figure 14. Removing trapped quail. Note the collecting box.

week, although this was not possible in all instances. Observations were made as to movements, ranges, feeding habits, and predators. All other pertinent information such as carcasses found, food and cover conditions was also carefully recorded.

Retrapping of Coveys

Attempts were made in the spring to retrap the quail, but results were even more disappointing than those obtained during the winter. Poor trapping results, both winter and spring, were probably somewhat due to the comparatively mild season and the consequent ample (in most cases) supply of food.

RESULTS

Winter of 1935-1936

The following is quoted from Newman, "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 13 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".

Winter of 1936-1937

From Newman, "Sixty-seven per cent of the quail upon which accurate data was kept survived winter. description of 11 individual coveys originally contained 146 birds and ending up with 99 is given"



Figure 15. Collecting box used for removing quail from trap. Note flap which can be lowered to darken box after the quail have entered. Metal sliding door on opposite end.



Figure 16. Quail marked with two white feathers in the tail.

Winter of 1937-1938

Sixty per cent of the quail under observation throughout the winter survived until the beginning of the nesting season. A fall population of 21 coveys comprising 293 birds dwindled to 20 coveys totaling 176 birds by spring. The loss of the one covey was more or less a technical loss as it resulted from two coveys' combining in mid-winter. Two other coveys which were reported in the fall but later "disappeared", are not included in these figures. Forty-three birds were caught, banded, and marked with feathers during the fall and winter. Two of these were retrapped in the spring together with one other previously untrapped bird. Of the 44 banded during the year, 23 were cocks and 21 were hens. An interpretation of the information gained through trapping is given fully under the heading General Discussion of Results.

A detailed description of each covey follows:

Covey No. 1.

Trapping: Five bait spots were used in attempts to catch this covey, four being established in October and one in April. Two of the former were discontinued after about a month because they were never disturbed by quail. The remaining two were continued until spring, one of them with no results whatever, while the other, established along the fence row a short distance above feed patch #31, resulted in a catch of 15 quail on November 19. These were marked with one white feather in the tail and banded as follows:

Band Number	Age	Weight
25077	Immature cock	182.7 grams
25078	" hen	176.7 "

31.

Band Number	Age	Weight
25079	Immature cock	173.1 grams
25080	Mature "	173.1 "
25081	Immature hen	172.9 "
25082	Mature cock	182.8 "
25083	Immature cock	190.1 "
25084	" "	182.8 "
25085	" "	186.9 "
25086	" "	175.7 "
25087	" hen	191.5 "
25088	" "	171.8 "
25089	" cock	174.5 "
25090	" "	184.0 "
25091	" hen	167.9 "

Two of these birds were retrapped on April 7 in feed patch #31. They were 25080 and 25091, weighing 163.9 and 170.3 grams respectively. The white feather was missing from the tail of the former and was replaced. The other had the entire tail missing. It is interesting to note that 25080 had a natural white feather in the left wing.

On April 6 one quail, evidently a member of Covey No. 20 (which combined with Covey No. 1 at times), was caught along the fence row. It was marked with a white feather in each wing and the tail and banded as follows:

Band No.	Age	Weight
25028	Mature cock	166.6 grams



Figure 17. Weighing and banding trapped quail prior to release. Note covered collecting box and banding outfit.

All of the above birds were released at the point of capture and all had full crops when removed from the trap.

Several interesting observations were made during the trapping of this covey. The entire covey after being caught seemed to have little fear of the trap as they had cleaned up the bait from underneath the propped-up trap by November 30. The quail last caught (25023) was re-trapped at the same place on April 8, indicating that some quail, at least, learn little by being trapped. The reason for this being the only bird caught was probably due to the fact that the coveys had broken up at the time and this cock was evidently unmated. When the trap was visited on November 18 it was found to contain a shrike and the decapitated body of a song sparrow the head of which was impaled on a projecting wire inside the trap. After an absence of about five minutes to secure the collecting box the sparrow's head had disappeared, evidently eaten by the shrike. The shrike was banded B-157368 and released. An interesting sidelight on the behavior of birds towards traps was furnished by a song sparrow caught in food patch #31 on April 3. This bird was released on the spot after making note of the band it wore, B157356. It was caught again the following morning (April 4), and released on the spot. It was in the trap again the same evening and this time was released on the V. P. I. campus, a distance of about two miles. The following day (April 5), it was taken from the same trap and released on the spot, which was the last time it was seen, making a total of four times the bird was trapped.

Survival: On October 18 a covey of more than ten (an accurate count, as in many following instances, was impossible due to lines of flight and

obstructions), quail was flushed from along the fence row where they were later caught. The trapping of this covey established the true number at 15. On February 6 more than ten were seen along the same fence row. About two weeks later (February 18 and 21), this number was reduced to seven. During the latter part of February and the first of March the number fluctuated from seven to 14, the higher number undoubtedly being due to some members of Covey No. 20 with which, as mentioned before, this covey sometimes combined. On March 5, the last time they were accurately counted, there were seven left out of the original 15, giving a survival of 46%.

Movements: Early in the fall this covey was seen on the hill between feed patches #31 and #32. However, as they were not seen here again or after frost had destroyed the scant vegetation, this area is not included in their range. The territory used most was the fenced swale surrounding feed patch #31 and also the brushy fence row running west from this patch. Occasionally they would cross over into the swale leading from patch #32, which was normally part of the range of Covey No. 20. When flushed Covey No. 1 would invariably fly up the fence row or down the swale previously mentioned.

Food: The feed patch, containing an annual grain mixture and lespedeza seemed to be the principal source of food. Jewelweed was abundant in the draw and ragweed, beggarweed, poison ivy, wild rose, black locust, panicum grass and black haw were distributed along the fence and swale. In general this covey did not suffer from lack of food.

Cover: The cover available for the use of this covey can be classed as

considerably below average, principally because of its limited extent. The fence row west of the feed patch #31 and the patch itself comprised the available escape cover. The fence row was sparsely covered with poison ivy vines and this, together with ragweed, blackberry, poke, foxtail and panicum grass, comprised the low-growing cover. Smooth sumac, black locust and black haw were also present.

Predators and Predation: While no quail carcasses were found that definitely were known to have come from this covey, an assumption that winged predators were responsible for much of the loss seems to be well taken. On November 27 a female Cooper's hawk was flushed from the body of a quail it had killed and plucked. This quail was probably from this covey or covey No. 15 as the dead bird was located about midway between the normal ranges of the two coveys. A female Cooper's hawk, probably the same one, was seen several times during October, November and March, flying over the feed patch which was the headquarters of the covey. A red-tailed hawk and a marsh hawk were also observed in the same vicinity during October, November and December.

A pair of gray foxes which were seen twice in the daytime near the Heth residence could very well have ranged into the territory occupied by this covey. A weasel, seen on February 26 in a brush pile in the feed patch may also have been responsible for some loss. In addition cats from nearby farms undoubtedly included this area in their hunting grounds.

Covey No. 2.

Trapping: As approximately two-thirds of the range of this covey was off the area under intensive observation, only one bait spot was used in an attempt to trap the covey. This was located in a small grove of black

locust near the entrance to the Beth residence off Route 411.

The bait spot was established in late October but it was not until November 20 that the bait was taken by quail and the trap, which had been placed near the spot for some time, propped in position. The following day some bait had been taken, although not from under the trap itself, but the trap was nevertheless set about 1:00, P. M. At dusk the trap was visited and, as signs showed the covey had been in the vicinity but were evidently afraid of the trap, it was again propped up and baited. This was continued until November 30 when the bait was again cleaned up and the trap set. On December 2 the trap contained six quail when visited at 6:00, P. M. These were kept overnight in a collecting box and were released the next morning after placing a white feather in the left wing of each. All crops contained about one gram of food. The band numbers, weights and ages are as follows:

Band Number	Age	Weight
36-411078	Immature cock	174.9 grams
36-411079	" "	171.2 "
36-411080	" hen	175.9 "
36-411081	Mature "	187.3 "
36-411082	Immature cock	178.9 "
36-411083	" "	192.3 "

Although the bait spot was continued for another month the bait was never again taken and was finally discontinued.

Survival: In November this covey had been seen along the board fence on the east side of Route 411 near the entrance to the Beth residence and the number established at 18. Infrequent observations through the winter

placed the number in the vicinity of 15. These birds trapped on December 2 were obviously not the entire covey as one report in middle December gave information of two quail with a white feather in the left wing in a large covey across the highway from where they were trapped. On March 18 the covey was accurately counted as containing 15 birds which was taken as the survival number, giving a survival per cent of 83. As this covey ranged off the College area the possibility of a combination with another unknown covey must not be overlooked.

Movements: Not too much is known concerning the movements of this covey as the larger part of their range was off the area worked intensively. As far as the College property is concerned, the movements were confined entirely to the brushy fence along Route 411, north of the Heth residence property, and to a small grove of black locust in the same vicinity. Across the highway, and off the College property, they frequented a swale bordered on one side by a broom-sedge field and on the other by a cornfield. When flushed at least a portion of this covey would invariably fly across the road.

Food: Poison ivy along the fence previously mentioned undoubtedly comprised almost entirely the food available to the quail on the College property. Some locust seed was available in the small grove.

Cover: The lack of suitable cover is thought to be primarily the reason for the covey's infrequent appearances on the College property. Besides the fence row which was well covered with poison ivy, eupatorium, thistle and asters provided a poor understory in the locust grove. In all, cover

was unusually poor and much less survival would have been expected had it not been for the range off the College area.

Predators and predation: The cause of the disappearance of the three birds lost from this covey could not be determined as no carcasses were found. However, the female Cooper's hawk, marsh hawk, red-tailed hawk and the gray foxes noted under Covey No. 1 probably ranged over the covert occupied by this covey.

Covey No. 3.

Trapping: Three bait spots were used in the trapping operations for this covey, two of which were located within the fenced area comprising feed patch #25 and the other several hundred feet to the west along an overgrown fence row. All bait spots were established on December 3. Three days later, December 6, nine quail were flushed from one of the bait spots within the feed patch and a trap was placed nearby the following day. On the morning of December 11 all bait had been taken by quail and the trap was set. At 5:45, P. M. the trap was visited and contained four quail. One of these was dead and the remaining three were severely injured around the head. The inside of the trap, both sides and top, was almost completely covered with feathers, obviously from the struggles which had produced the birds' injuries. The gate of the trap was also bent from the inside to the extent that some of the wires had become impaled in the wooden frame, indicating that the birds had exerted considerable pressure in their efforts to escape. This was the only instance during the entire year where quail had killed or inflicted serious injuries on themselves in the trap even when being removed. Therefore it would seem that they had been frightened

by some predator which repeatedly attempted to attack them. As there were no tracks on the surrounding soft ground it must be concluded that some winged predator was responsible. At the time the birds were removed there was a number of crows nearby but none was seen at the trap itself. The three birds were taken to the laboratory where one died as a result of its injuries and the remaining two were marked with a white feather in the right wing and banded as follows:

Band Number	Age	Weight
25092	Mature hen	(Crop full) 219.9 grams
25093	" "	(" ") 208.4 "

The above birds were released at the point of capture the next morning and had recovered sufficiently to take vigorous flight. At the same time the trap was removed for cleaning and repairs.

The same bait spot was continued but not until January 9 was the bait again taken by quail and the trap set. On the morning of January 12 the trap contained one quail; however, a rabbit had entered and in forcing the gate to escape (probably before the quail entered), had so opened it that a quail could easily walk out. Signs indicated that more than the one bird had been in the trap but evidently had escaped. The trapped bird was wearing band 25021 which showed that it was one of Covey No. 4, which at times ranged over the territory normally occupied by Covey No. 3. This bird, when originally trapped on December 11, had weighed 175.2 grams and now weighed 169.0 grams, a loss of 6.2 grams over a one month period. When originally trapped it had also been marked with a white feather in the left wing and in the tail. When retrapped on January 12 the wing feather was

intact but the one placed in the tail was missing. This was replaced before the bird was released.

This bait spot was continued until mid-February but with no results. The other two were dropped at the end of December as no bait was ever taken by quail.

Survival: As this covey combined with Covey No. 4 in mid-winter and as the ranges of the two overlapped it was difficult to separate the coveys for the purpose of establishing the fall number of each covey and, of course, the survival must be based on the combined number. It was not until December 6 that Covey No. 3 was definitely established as being separate from Covey No. 4 and accurately counted. At that time there were nine birds in the group. A larger number had been observed earlier but this could very well have been Covey No. 4 and therefore nine is taken as the pre-winter number. A survival of 55% is figured for this covey as Coveys No. 3 and 4 (counted separately), totaled 22 birds in the fall and had combined by spring into one covey of 12 birds.

Movements: During early fall this covey at times would range over to feed patch #25. The southern edge of the Middle Woods was frequently used as escape cover and when flushed from patch #25 would fly in this direction. However, by January, when the coveys had combined, their use of patch #11 stopped in favor of patch #25 and the edge of the woods.

Food: There seemed to be no serious lack of available food even during the winter months. In addition to feed patches #11 and #25, the draw in which they were usually found included giant ragweed, wild aster,

Covey No.	No. of Birds in Fall	No. of Birds in Spring	Survival Per Cent
1	15	7	46
2	18	15	83
3	9	12	55
4	13		
5	7	7	100
6	11	5	45
7	14	8	57
8	8	5	62
9	12	11	91
10	17	16	94
11*	-	-	-
12	19	12	63
13	13	5	38
14	13	4	30
15	20	11	55
16	16	11	68
17	14	7	50
18	20	7	35
19	10	7	70
20	17	12	70
21	13	7	53
22	14	7	50
23*	-	-	-
Total....293		176	60 (Average)

* Reported only, not included in figures.

Figure 17a. Summary of covey losses and survival per cent.

evening primrose, staghorn, sumac, poison ivy and goldenrod. In addition there was wheat stubble between patch #25 and the woods.

Cover: The weeded and brush area of patch #25 afforded excellent cover until mid-winter and even then it was of considerable value. Probably the best escape cover, as evidenced by use, was the edge of the woods. Here the broadleaf-type trees were understoried by thickets of smilax, dogwood, wild cherry and wild grape.

Predators and Predation: One quail from this covey is known to have been killed by a Cooper's hawk which was flushed from its kill in patch #25 on December 29. This was the only loss actually accounted for from this covey. A Cooper's hawk was frequently seen in the vicinity as well as an immature and a mature marsh hawk.

Covey No. 4

Trapping: Only one bait spot was used in trapping for this covey. This was established on September 22 in feed patch #12. It was not until December 7 that the bait was taken so that a trap could be placed nearby, although the birds had been seen in the vicinity on several occasions. On the morning of December 11 the bait had been cleaned up again and the trap contained 13 quail which were taken to the laboratory to be marked and released, the next morning. All had full crops when weighed. A white feather was placed in the tail and left wing of each bird and they were banded as follows:

Band Number	Age	Weight
25010	Immature cock	204.5 grams
25011	" hen	213.4 "

33.

Band Number	Age	Weight
25009	Mature cock	200.5 grams
25012	" "	195.1 "
25013	" hen	202.6 "
25014	Immature hen	203.0 "
25015	" cock	185.9 "
25016	" hen	188.8 "
25017	" "	222.8 "
25018	" "	240.8 "
25019	" cock	181.1 "
25020	Mature "	193.9 "
25021	Immature "	175.2 "

The bait that produced the above results was continued until mid-January but with no further success. It was not used in attempting to retrap the birds as the covey had moved into the normal range of Covey No. 3. As noted elsewhere, one of these birds was retrapped on January 12 while trapping for Covey No. 3.

Survival: In early October this covey was counted as having "more than 10 birds". The same notation is made for early December and therefore the trapping of the 13 quail is taken as being the pre-winter number as it was indicated that the whole covey was trapped. As noted under the description of Covey No. 3, an accurate spring count was not available due to the combining of the two coveys. Therefore, the survival of Covey No. 4 must also be given as 55%.

Movements: Until early January the range of this covey was extremely lim-

ited, their movements being confined almost entirely to a very short radius around feed patch #12 with occasional visits to feed patch #11. December 14 was the last time the birds were seen in this vicinity and it is possible that the severe snow and sleet which was present at that time was largely responsible for their movement into the range of Covey No. 3. From the time of the union with Covey No. 3, which may be assumed as early January, the range, of course, was the same as Covey No. 3.

Food: In early winter the food of this covey was entirely found in food patches #11 and #12. There was very little other food available as all of the range outside of the food patches was closely grazed. After combining with Covey No. 3 the food supply was materially increased.

Cover: Until December the cover available for this covey might be classed as good but limited. As food patches #11 and #12 supplied this cover and, in common with most of the food patches, lost much of its protection by early winter, it is thought that lack of cover was the principal reason the birds combined with Covey No. 3. After this union the available cover, and food, were considerably better.

Predators and Predation: No losses are known to have occurred before these quail united with Covey No. 3 and the potential and actual sources of predation must be considered as the same for both coveys.

Covey No. 5.

Trapping: On December 29 a bait spot was established within the range of this covey and on January 2 the birds had scratched and eaten most of the bait under the trap which had been placed in a propped-up position

a few days before. The trap was then set and on January 10 seven birds were caught. These were marked with a white feather in the tail and the right wing. The numbers of the bands placed on them, together with weight, sex and age is as follows:

Band Number	Age	Weight
25000	Immature hen	200.6 grams
25022	" cock	217.7 "
25023	Mature hen	190.8 "

(There was an old wound on this bird which was quite well healed. It was about one inch in diameter and located on the lower breast in front of the right leg.)

25024	Immature hen	216.7 grams
25025	" cock	207.5 "
25026	" hen	215.9 "
25027	" "	190.1 "

(The tail feathers on this bird were only about one inch long. There was also a small wound on the scalp which had healed but the feathers were still absent.)

The above quail were released the next morning near the place where they had been caught and although efforts, extending into March, were made to retrap the covey none was successful.

Survival: Covey No. 5 enjoys the unique distinction of being the only covey under observation which lost no birds during the winter. In early December this covey was accurately counted as having seven individuals.

The successful trapping of this same number on January 10 would seem to confirm this observation. Seven birds were again seen on February 18 and the last time they were accurately counted, March 20, the number was still seven. The survival, therefore, is 100%.

Movements: This covey, although having what might be called a "linear" range as extensive as most of the other coveys under observation, was confined to a rather short radius from this "linear" range as the birds were never very far from the fences, both rail and wire, that they followed. As shown by the map, the fence rows near the Heth cattle barns were covey headquarters and in the few instances when the birds were flushed a short distance from the fence they would invariably fly in one direction or another along the fence. After this covey was originally located it became one of the easiest to find at any time, due to the narrow strip which would have to be covered.

Food: Apparently food was always quite plentiful and available from the many plants which comprised the fence growth within the covey range. Ragweed, poison ivy, beggarweed, evening primrose and black locust are some of the more common species. This covey also had access to a good supply of corn, both from that fed cattle and from the undigested kernels in the cattle droppings. Newman (1937) mentions quail near this vicinity as having frequently utilized this latter source of food. It should be noted that this covey did not have access to any food plantings or created cover, yet came through the winter without loss.

Cover: Like food, cover was ample and seemed much above average during

the entire winter. Many of the food plants listed above provided much shelter and in addition wild aster, goldenrod, greenbriar, blackberry and small, bushy trees of wild cherry and dogwood all contributed to supplying the escape cover which was principally responsible for the 100% survival.

Predators and Predation: It is interesting to note that this covey, which lost no birds during the winter, was subject to as much potential predation as the majority of the other coveys, all of which lost a part of their numbers. The gray foxes, cats, red-tailed hawks, marsh hawks, and Cooper's hawks noted elsewhere undoubtedly included the range of this covey, at least occasionally, in their search for food yet were evidently never successful in making a kill. The kill made by a female Cooper's hawk and noted under Covey No. 1 occurred within a very short distance of the range of Covey No. 5, adding additional evidence that while no birds were lost it was not because there was no opportunity.

Covey No. 6.

Trapping: Six bait spots, established at different times from September to December were used in an effort to trap this covey but without any success. On several occasions the quail would take all bait but as soon as a trap was placed nearby they would no longer approach the location. Although none of these birds was trapped, the bait spots were of considerable assistance in helping to determine the number in the covey as the birds were flushed from various bait spots on several occasions.

Survival: During October the number of individuals in this covey was twice estimated, or inaccurately counted, as being from 10 to 12. On December 9 the birds were accurately counted and the number fixed as 11. This was taken as the pre-winter number as it conformed with the counts taken in October. By the middle of January the number was reduced to ten; by February 1, to nine; by March 13, to five. This latter number, five, was again confirmed on March 31 and taken as the survival number. The reduction then was from 11 to 5, or a survival of 45%.

Movements: As was the case with the other four coveys ranging the edge of the Middle Woods, much confusion originally existed, not only as to the movements of each covey but also as to the number of coveys. This was occasioned by the fact that four of the coveys, Nos. 3, 6, 7 and 13, occupied a very close or overlapping range and also the number of birds in each covey was similar. It was early in the winter before the number of coveys and individuals could be worked out definitely. Covey No. 6 made cover patch #24 its headquarters, generally roosted on the comparatively open hill slope to the north of this, and also used the west tip of the Middle Woods. When flushed the birds would fly into the cover patch, along the edge of the woods or into the woods.

Food: Evening primrose, ragweed, wheat stubble, beggarweed, poison ivy and susac seemed to be the principal available foods with the exception of the miscellaneous material present in the woods. Some Korean lespe-
desa was present on the hill slope and was undoubtedly important when the ground was not covered by snow.

Cover: Cover patch #24 and the tangle of blackberry, wild grape, green-brier and woody shrubs provided all available cover with the exception of the woods themselves. Of these the cover patch, a fenced gully, was probably the best escape cover but even this was definitely below average and the birds must have been quite canny to have escaped predation as well as they did.

Predators and Predation: On December 20 a quail, undoubtedly from this covey and killed by a hawk, was found near the northern edge of the cover patch. A marsh hawk was frequently seen in this vicinity and it is thought that this individual may have made the kill. This hawk was flushed from the cover patch on January 6. On January 11 a Cooper's hawk was seen near the same place after it had flushed the covey. This was the first time the Cooper's hawk had been observed nearby while the marsh hawk was a frequent visitor. However, an investigation disclosed that the Cooper's hawk had killed, plucked and was eating a full grown quail. On March 17 a pile of quail feathers was found under a thorn bush along the tip of the woods, probably the work of a Cooper's hawk. This made three birds definitely known to have been killed by hawks out of the total of six lost. It is probable that the others suffered this same fate, although an occasional cat and dog covered the area.

Covey No. 7.

Trapping: Three bait spots were established on the north central edge of the Middle Woods in the attempt to trap this covey. The bait spots were established early in December, after the range of the covey had

been worked out and were continued until the middle of April. As was the case so many other times, the quail would take the bait at times, but would not come near after the trap was put in position. Thus the efforts to trap this covey were unsuccessful.

Survival: During the latter part of October this covey was first counted as "at least 15". It was flushed at various times up to and through December but due to the thick woods which made counting difficult an accurate count was not obtained until January 27. On this day the birds were flushed from the wheat stubble at a distance considerably farther than usual from the woods and they were counted as being 14 individuals. This was taken as the pre-winter figure as counts previous to this time were never less than 10 nor more than 15. During February the number was reduced to 13 and by early April only eight were left which was used as the survival number, giving a survival of 57%. There is a possibility that some of the birds had voluntarily left the covey by this time, as the reduction in numbers seemed quite sudden. However, this could not be proven.

Movements: This covey seemed to be "woods birds" as they ranged almost entirely along the edge, and into the center, of the Middle Woods. They were frequently found in the field of wheat stubble, directly to the north, which seemed to be their principal source of food, but when flushed would invariably fly to the woods. On several occasions, when snow was on the ground, they would fly into the low-growing trees and alight on the branches.

Food: As has been mentioned before, the field of wheat stubble provided the principal source of food. There was also a quantity of Korean lespedeza close to the woods in addition to several patches of honeysuckle, poison ivy, etc., along the edge of the woods. There seemed to be no lack of food and probably one of the reasons this covey did not respond to baiting was the abundance of natural food.

Cover: Cover was considered as being somewhat below average, as the woods are quite open and practically all the escape cover afforded is concentrated at the edge. Here the honeysuckle and tangles of wild grape, greenbriar, blackberry and poison ivy, together with small bushy trees, provided good but limited cover.

Predators and Predation: While no direct evidence is at hand, indications are that this covey was subjected to hawk predation. Cooper hawk kills are known to have occurred within three coveys surrounding this group and there seems to be no reason to believe that cover, or other protection, was better on this range. Marsh hawks were frequently seen in the vicinity, as well as a Cooper's hawk.

Covey No. 8.

Trapping: Four bait spots, two of them located in the western tip of the Middle Woods, and the other two located directly opposite feed patch #26 on the north and south edge of the woods, were used in trapping operations. These bait spots were established in early December and continued until March 1 but only twice during this time was the bait ever taken by quail. This was not sufficient to make trapping possible and no birds were caught.

Probably the abundance of food in patches #26 and #27 made the birds more cautious of bait spots than would otherwise be expected.

Survival: Early in December this covey was accurately counted as having eight birds. Two months later only one bird had been lost and by March 15, the date of the last count, the number had been reduced to five or a survival of 62%.

Movements: This was another typical "woods covey", in fact, they were very seldom seen outside of the wooded area and on these rare occasions would be found only a very short distance from the edge of the woods. The birds often flew into the woods and perched on the trees when they were flushed. The western tip of the Middle Woods is quite open and there is some cleared land around the cattle barn. This, together with food patches #26 and #27 probably supplied sufficient covert and it was not necessary for the birds to venture into the fields. This covey was located several times along the fence running northwest from the upper edge of the woods but was never found in the field to the south of the woods.

Food: Food was undoubtedly plentiful and much above the average. The food patches above supplied all that was necessary in addition to the various plants previously mentioned along the edge of the woods. A quantity of poison ivy grew along the fence described above.

Cover: Cover was also ample and can be classed as slightly above average. Several patches of giant ragweed and honeysuckle were frequently used. Plum thickets were scattered throughout the covert and even in

early spring afforded excellent escape cover.

Predators and Predation: While no direct evidence is to be had, this covey probably suffered from hawk predation. Marsh hawks, red-tailed hawks and Cooper's hawks were frequently observed close to the covey range and the Cooper's hawk kills reported for Coveys No. 6 and No. 3 occurred only a short distance away.

Covey No. 9

Trapping: No attempt was made to trap this covey as their location was too isolated for efficient trapping operations.

Survival: On December 4 an accurate count was obtained which placed the number of birds in this covey at 12. The birds frequently ranged off the College area into a pine plantation, although they were more often located on the north edge of the woods on College property.

During January and February no loss occurred from the covey but in early March the number dropped to 11. The last time the birds were counted, April 10, the number was still 11. Thus, starting with 12 birds in the covey and losing only one during the winter gives a survival figure of 91%.

Movements: Practically the entire range of Covey No. 9 was in woods, either the "Far Woods" or the pine plantation adjoining but off College property. The birds sometimes would venture a short distance into the field north of the woods but when flushed would always fly into the woods or through them if flushed in the rather open woodland. The com-

paratively small area which this covey occupied is shown on the map.

Food: Mast, produced by the mixed hardwoods and the pine plantation, evidently comprised the greater source of food supply. Not only was the field heavily grazed by cattle but the woods themselves were open to stock and had little cover or feed. It is probable that the high woods around the pine plantation supplied food and cover during the time when snow covered the ground.

Cover: As has been mentioned above, the "Far Woods" supplied little cover and seemingly the birds had to rely mainly on the area off College property for their best escape cover. Here tangles of grape, honeysuckle, blackberry and poison ivy were much in evidence, besides the protection offered by low-growing pine trees.

Predators and Predation: As is the case with Covey No. 10, a marsh hawk was the only predator observed in this area. As this slow, clumsy bird is not considered a serious predator, the absence of predators, as discussed under Covey No. 10, rather than abundance of cover, is held as the principal reason for the high survival per cent. This is further borne out in that, while the covey was most frequently located in the woods, this was not the area of greatest cover protection. It would seem that, had the birds been subject to heavy attempted predation, they would have been found more often in the pine plantation where cover was considerably better. No evidence is at hand to indicate the reason for loss of one bird, but as the covey ranged off College property and was thus open to hunting it is rather surprising that some birds were not

lost to hunters.

Covey No. 10.

Trapping: As was the case with Covey No. 9, no attempt was made to trap these birds. As time was limited and the area under observation large, it was thought better to concentrate trapping efforts on those coveys which could be quickly reached by use of a truck.

Survival: On November 26 when Covey No. 10 was first located 13 birds were actually counted in addition to "several" others which flew at an angle and could not be counted. Although the covey was seen, or reported, several times after this, an accurate count was not made until late December. This count set the number of birds at 17. The covey was infrequently observed throughout the winter but on April 9 was counted as having 16 birds. This same count was again made the following day which showed a loss of only one bird or a survival of 94%.

Movements: The covey ranged over a considerable area, in fact, covered as much ground as any covey under observation. They were flushed several times from the lower part of Struble's Creek and followed the several fence rows in the vicinity. Although not too much is known concerning movements off College property, they were flushed on several occasions near Linkous' Store, close to the small pond, and would fly toward the top of the mountain.

Food: No planted feed patch was available for this covey, yet, as evidenced by the high survival per cent, there was obviously no short-

age of food or cover. Poison ivy, ragweed, beggarweed, wild aster, evening primrose and goldenrod were abundant along the fences and on the creek banks. Some mast was also available from the scattered pines and black locust trees on the side of the mountain. Wild cherry, dogwood and sumac were also present along the fence rows.

Cover: Many of the food plants mentioned above also served as satisfactory cover and the tree species were understoried by tall weeds. Although cover was sparse over much of the extensive range occupied by this covey, it is probable that the birds stayed close enough to the patches of good escape cover to take advantage of its shelter when needed.

Predators and Predation: For no good reason there seemed to be fewer predators in the range of this covey than any other under observation. A marsh hawk, frequently seen on the lower part of Struble's Creek was the only predator ever observed in the vicinity. It is entirely likely that in the above statement lies the reason for the excellent survival per cent as available cover and food certainly were no better than available for many coveys suffering a much greater winter loss. The only explanation that can be advanced for the apparent lack of predators is the fact that this covey was quite isolated and possibly predators, winged predators in particular, concentrated their attention on those parts of the farm where coveys were much closer together.

Covey No. 11.

Covey No. 11 is one of the two coveys which were located, or reported,

in the fall but then disappeared and so no records are available. This covey was reported twice during early fall but, although considerable time was spent in attempting to locate it by use of dogs, it was never actually seen by the writer. Therefore, it is merely mentioned but does not appear in any of the figures for the survival study.

Covey No. 13.

Trapping: Although several bait spots were established and continued for over two months, no bait was ever taken by quail.

Survival: Nineteen birds comprised Covey No. 13 when first located on December 14. By the middle of January the number was reduced to 15 and the covey was still at this figure by February 5. By March 17 only 14 remained and on March 19, the last time the covey was observed, the number was further reduced to 12. Thus, from an original 19, seven birds were lost or a survival of 63%.

Movements: The birds in this covey generally stayed within 300 yards of the McBryde house; however, at times they would cross Price's Fork Road into the College orchard. A thick hedge of privet was located on the east side of the residence and the birds were frequently found here. A fence in the rear of the overgrown yard was a favorite roosting place.

Food: The privet hedge, mentioned above, alone furnished more food than the covey could possibly utilize. In addition, some corn was available near the farm buildings and wheat from a stubble field directly east of the privet hedge. A large thicket of honeysuckle was available along a

fence to the west of the house. Some ragweed and Korean lespedeza were present in the fields within the covey range. In all, it might be said that food was ample at all times of the year.

Cover: The privet hedge and honeysuckle thicket mentioned above were excellent cover. The privet alone provided cover that was much above average. However, the orchard, which was occasionally used, was cleanly kept and of little value.

Predators and Predation: With the excellent food and cover available to this covey one would normally expect a much higher survival, especially since no hawks were ever observed in the vicinity. Although the heavily traveled highway and the farm buildings possibly discouraged hawks, they were attractive to house cats and dogs. No direct evidence of any kill was found but cats, of which there were at least three around the house, must be suspected as responsible for at least part of the loss.

Covey No. 13.

Trapping: Early in December two bait spots were established in an effort to trap this covey. One was located along the fence running north through the Middle Woods and the other along the edge of the woods. The latter bait spot never produced results as the covey was not attracted by the bait. The other bait spot was cleaned up by quail on January 16 and the trap propped in position on the same day after rebaiting. On January 24 the bait was again cleaned up and the trap set. This was continued for several days but the quail had evidently stopped using the

area as the bait was never again disturbed.

Survival: On October 16, 13 birds were flushed from the fence row and flew southwest into the woods. This same number was again counted on December 6 when the birds were flushed from the fence but closer to the woods. On December 29 only 11 were left as was verified by careful check on two flushes. On January 16 only ten birds could be counted and on February 6 this was reduced to nine. On March 8, the last time they were accurately counted, only five remained. As 13 birds comprised the covey in October and five remained by March, the survival figure is 38%.

Movements: As has been indicated previously, this covey frequented the fence row on the northeast end of the Middle Woods. When flushed from here they would most often fly into the woods but occasionally would go directly west into the stubble field. If flushed from the field they would invariably fly into the woods. During the early part of the winter the fence row was more often used; however, toward February and March they could most often be located along the edge of the woods or a short distance away in the stubble field. As shown by the map, the range of Covey No. 13 overlapped that of Covey No. 7.

Food: As was the case with Covey No. 7, the stubble field and the woods' edge were primary sources of food and the plants available were the same for both coveys. Covey No. 13, however, had the fence row (Figure 9) in addition and this had a plentiful supply of poison ivy.

The food available for this covey might be classed as average.

Cover: In addition to cover of the same composition as that available to Covey No. 7, the fence row (Figure 9) was of considerable assistance, particularly during times of deep snow.

Predators and Predation: The discussion of predators and predation under Coveys No. 6, 7 and 8 also applies to Covey No. 13.

Covey No. 14.

Trapping: A total of seven bait spots was used and continued from September to February, yet only once during this time was there any reason to suspect that quail had responded to them. Five of the bait spots were established in food patches and two in cover patches. At only one bait spot, that located in feed patch #21, was the bait ever taken so that a trap might be set. However, the first night the trap was set it was entered by a rabbit and the quail did not again take the bait. Several interesting observations were made in connection with trapping operations for this covey. On October 1 a meadow-lark was found dead on the bait spot in food patch #13. There was not a mark on the bird, nor any disturbance of the ground around it, and the cause of its death could not be determined. On several occasions fresh quail dust spots were found near, or even in, bait spots but with no evidence that any bait had been taken. Fresh quail droppings were found in two bait spots, showing that quail had found the bait, but there was no evidence to indicate that any had been taken. With the negative results

in trapping for this covey, and others, in food patches it is doubtful that it is worth the time consumed. This is discussed more fully later.

Survival: Thirteen birds comprised Covey No. 14 when they were first accurately counted. While the covey was located during October and flushed several times afterward, it was not until December 11 that the accurate determination was made. During January and February the number was reduced to five and at the time of the last count, April 10, only four remained out of an original 13, a survival of only 30%.

Movements: Covey No. 14 ranged over the area containing food patches #13, #14, #21 and #22. They also used the small clumps of trees west of patches #21 and #22 and overlapped the range of Covey No. 13. There is some evidence to indicate that this covey at times combined with Covey No. 13 and the possibility exists that the survival figures for both coveys are thus distorted. However, there is not enough data to make any concrete statement and it is assumed, for the purpose of survival figures, that there was no permanent combination.

Food: While the food patches probably provided the main source of food, the range used by this covey also contained dewberry, Jimson weed, smartweed, wild aster, evening primrose, poison ivy and ragweed. Food seemed to be ample throughout the winter and should not be held responsible for the low survival figure.

Cover: As was the case with so many coveys, cover was woefully inadequate during middle and late winter. Outside of the protection afforded

by the food and cover patches, only small clumps of wild plum and thorn bushes in the draw and a few scattered blackberry tangles were available. The miscellaneous plants listed under food were so scattered that they were of little value as cover, even in early winter.

Predators and Predation: While no quail carcasses which might have come from this covey were found, on December 3 the remains of a rabbit were found in feed patch #14. The animal had been killed and partly eaten, evidently by a winged predator as there were no tracks in the soft ground. A good many hawks were observed in the vicinity at different times. The Cooper's hawk mentioned in the description of Coveys No. 3, No. 4 and No. 6 undoubtedly worked the range of Covey No. 14 and a marsh hawk was frequently seen along the small creek.

Covey No. 15.

Trapping: Four bait spots were used in trapping operations. One of these was located in the locust grove near the entrance to the Beth residence. This was also within the range of Covey No. 2 and resulted in a catch of six birds from that covey as has been previously described. The other three bait spots were located along fence rows within the covey range and, although bait was taken on several occasions, the birds stopped using the place when a trap was placed nearby.

Survival: Twenty quail were counted in this covey on December 27. This agreed quite well with previous counts made since October which placed the number at "more than 18". In March, the number had been reduced to

18 and on April 2 only 11 were left. Thus out of the original covey 11 quail or 55% survived.

Movements: These quail moved along the rail and wire fences in the southwestern corner of the Heth pasture and were frequently flushed from the nearby stubble fields. They also infrequently used the small locust grove as well as feed patch #30, and ranged as far south as the edge of the Heth woods.

Food: Food seemed quite plentiful, although limited to wheat stubble, black locust, mast and the assortment of food plants growing along the fences.

Cover: Escape cover for the quail was quite poor. After mid-winter the locust thickets were useless for cover as were many of the fence rows. A briar patch at the upper end of the range was fairly good cover but, as mentioned later, even this allowed some predation.

Predators and Predation: A red-tailed hawk and a marsh hawk were frequently observed in the area and a Cooper's hawk, less frequently. On November 27, a female Cooper's hawk was flushed from the briar patch where it had killed and plucked a quail, evidently from this covey. The gray foxes previously mentioned undoubtedly ranged over the area and on more than one occasion a cat was seen following the fence row.

Covey No. 10.

Trapping: No effort was made to trap this covey as the presence of sev-

eral cats and dogs which were always in the vicinity offered too much of an opportunity for predation loss if the birds entered a trap. The abundance of food, especially waste grain from the farm buildings, made it seem unlikely that the covey would respond to baiting.

Survival: Early in the fall a covey of 16 birds ranged the edge of the woods and in the small field to the west of the Heth residence. These birds later moved closer to the house and spent most of the winter in the garden or within a short radius of it. While there were 16 birds in this covey during October, their number was reduced to 11 by the middle of January and remained at this figure until March 18, the last time they were accurately counted. This gives a loss of five quail or a survival per cent of 68.

Movements: As indicated above, the Heth residence seemed to be the center of the covey's range. After the birds took up in the garden they sometimes moved out to the edge of the woods, the Heth orchard or in some of the small fields nearby. While their range included a varied habitat, it did not cover much distance.

Food: Food seemed to be ample, in fact, abundant throughout the entire winter. In addition to the variety of native plants present, there was much honeysuckle and privet close to the residence. One of the principal sources of food, as reported by the farm hands, was the supply of corn and wheat about the Heth barn and other outbuildings. It

was reported that this never-failing source of food was utilized practically every day.

Cover: This has been partially discussed above and, like food, cover was abundant. The privet and honeysuckle hedges alone offered much better cover than was available to the majority of the coveys and, in addition, the garden and orchard, both of which were partially overgrown, offered good escape cover. A patch of cultivated blackberries in the garden had escaped cultivation for a few years and provided a retreat that certainly was hawk-proof.

Predators and Predation: Of the five birds lost during the winter the cause of loss is definitely known for only one bird. This quail was killed by flying against a picket fence near the Beth residence and was found by a farm worker with its head caught between two pickets. It is interesting to note that Newman (1937) reports the loss of one quail which killed itself by flying into a house. The presence of several dogs and cats has been mentioned before and it is thought that the latter were probably responsible for some loss. The two gray foxes mentioned previously seemed to have their headquarters in the Beth woods and it is known that some chickens were killed by them during the winter.

Covey No. 17.

Trapping: Four bait spots were established in October and continued throughout the winter in an effort to catch this covey. One of these never produced any results and was abandoned in December. The large

number of squirrels in the woods made baiting more difficult as they frequently took the grain and a mutant pheasant which ranged over the area also consumed some of the bait. The other three bait spots never produced any definite results, although on two occasions the quail had made dusting spots in or near the baited area. During November crow droppings were found in one bait spot, the only instance recorded of crows taking bait intended for quail. The apparent lack of fear of quail for a truck was well illustrated early in October when a truck was driven to within 20 feet of one bait spot where the covey was dusting and feeding. They were observed for several minutes and seemed to be unconcerned over the presence of the truck.

Survival: Early in October a report was received of "about 16 quail" in this vicinity. However, only 14 were observed when they were first actually counted in early November and this figure was taken as the pre-winter number. The covey remained at 14 through December, was reduced to 11 by January, nine in February, and to seven by March 8. There were still seven birds in the covey on March 31, the date they were last counted. Thus seven birds were lost from an original 14 or a survival of 50%.

Movements: In the main this covey ranged through and along the edge of the woods in the vicinity of the transient camp on Route 114. They also used the experimental plots to the east of the woods and frequented the bushy fence rows on both sides of the woods. They were sometimes

observed in the field of wheat stubble but always close to the protective cover of the woods.

Food: A fairly abundant source of food was available to this covey. Along the fences honeysuckle, wild aster, grape and beggarweed were quite plentiful. Korean lespedeza, Japan clover and wheat stubble were among the planted foods available. It is assumed that the experimental plots also furnished some feed as the variety of plants there, including hemp and buckwheat, were not harvested at any time.

Cover: Cover could probably be classed as above average and certainly was good enough to furnish more protection than the survival figure would indicate. The woods contained many small patches of thorn bushes and briars and the fences on either side were unusually good for cover. Honeysuckle, grape, briars and various weeds in the fences provided a travel lane which the birds used to work out into the nearby fields.

Predators and Predation: The transient camp probably offered the most potential source of predation as it harbored a large number of mongrel dogs and cats. The possibility of poaching can not be overlooked as numerous rabbit traps were found in the woods and it is entirely possible that an occasional quail might have been caught in these. A Cooper's hawk was frequently observed working over the area but no trace of any kill was ever found.

Covey No. 18.

Trapping: As has been recorded before in trapping operations for other coveys, Covey No. 18 never responded to baiting. Four bait spots were established entirely within the covey range while several others could have been used by Covey 14 as well, as their ranges overlapped. The bait spots were established at intervals from October to December but there was never any definite indication that the bait was ever taken by quail.

Survival: This covey originally contained 20 birds. However, twice during the winter it was counted as having more than this number which indicates that it sometimes combined with Covey No. 14. While such combination presents the possibility of "shuffling" with consequent changes in number, it was arbitrarily assumed that this did not happen as there seemed to be no other way in which any survival figure, even though empirical, could be obtained. This is mentioned as the poor survival figure would seem to indicate some unusual loss, possibly from "shuffling" with another covey. However, this assumption is evidently not borne out in this case as the overlapping covey also suffered a loss of practically the same per cent as this covey. Therefore, it would seem that the loss, from both coveys, was a true loss, probably from predation. By January 8 the 20 birds originally counted had been reduced to nine and by February 8 to seven. On March 21 there were still seven birds in the covey which presents a survival figure of only 35%.

Movements: The range of this covey is best shown by the map in the

Appendix. It extended from food patch #21 up the swale and following a fence to food patch #7. Ordinarily headquarters was in the vicinity of the food patch #22 and along the rail fence a short distance to the east.

Food: Although limited principally to the various food patches, food was quite plentiful. In addition, the fence rows were quite well covered with poison ivy and contained a number of dogwoods and wild cherries. Some Korean lespedeza had been planted in the pasture as well as in the fenced areas of the food patches.

Cover: Cover was very definitely limited and, in the middle of the winter, consisted almost entirely of small areas in food patches #7, #22 and #23. The only additional cover was that provided by the fence row near food patch #7. It is reasonable to assume that lack of sufficient cover was the principal reason for the heavy winter loss.

Predators and Predation: In addition to the sources of predation given for Covey No. 14, which also apply to this covey, one dead quail was found in food patch #7 on January 11. It was discovered by a dog which was being used for census work and may have been killed by it as the quail was still warm when found. However, the bird was very thin and evidently had suffered from lack of food.

Covey No. 19.

Trapping: No attempt was made to trap this covey as its range was not definitely worked out until late in the season.

Survival: On October 19 ten birds were counted along Route 114 on the western edge of the College woods near the road which enters the woods at this point. Although many efforts were made, the covey was not located again until early January. Subsequently it was determined that this covey had evidently spent most of this time across Route 114 and off the College property and as this area was worked infrequently they were not discovered. However, after this had been determined the covey was flushed several times until late March. At this time seven birds were left from an original ten or a survival of 70%.

Movements: As has been noted above, this covey ranged off the College area; in fact, was found more often off College property. The birds were found a few times in the vicinity of the Obenshain house to the north of Route 114 and ranged back of the house into a small garden and a rather large and overgrown gully. When on College property they were most frequently found in the fence row along the highway and when flushed would fly south into the woods. As indicated on the map, it is probable that the covey ranged for an unknown distance north of the highway.

Food: A limited amount of mast was offered by the college woods and this, together with a small patch of honeysuckle and some poison ivy on the fence along the highway, constituted the principal food present on the College property.

Cover: Cover was quite scarce on the College property and consisted of scattered clumps of thorn bushes and the patch of honeysuckle. Of

course, the woods themselves offered some escape cover as evidenced by the birds flying in this direction when flushed. The lack of cover was probably the reason the birds spent so little time on the south side of the highway. Cover was much better on the north side, off the area under intensive observation.

Predators and Predation: In addition to the cats and dogs noted for Covey No. 17, which ranged throughout the entire College woods, a red-tailed hawk was frequently observed in the vicinity. No actual evidence of predation was observed and no definite reason for the winter loss can be given.

Covey No. 20.

Trapping: The two bait spots used in trapping attempts proved quite unsuccessful and both were discontinued during late December. As both bait spots were located in feed patches, this is another indication that trapping attempts in areas of plentiful food supply are generally not worthwhile.

Survival: On October 25 a covey of 17 birds was flushed from the lower end of feed patch #32. Their number gradually dropped through the winter and by March 15 only 12 were left. Seventy per cent survived the winter.

Movements: Covey No. 20 confined itself quite closely to the immediate vicinity of feed patch #32 and along the swale to the east and west. On a very few occasions they were flushed from the heavily grazed pasture

on the hillsides and when this happened would fly into the swale or the food patch.

Food: Food patch #32 was the principal source of food, together with some Korean lespedeza along the edge of the patch but in the pasture. The almost total absence of any natural food plants in the covey range indicates that these birds could not possibly have survived, had it not been for the food patch.

Cover: Protection for these birds was quite scarce and limited almost entirely to the food patch. The clumps of thorn bushes and the tall grass in the swale offered some protection but very poor escape cover. Throughout the winter it was observed that the covey very often roosted in the food patch. In view of the limited cover it is rather surprising that the survival figure ran as high as it did.

Predators and Predation: The predators noted under Covey No. 1 may be considered as also applying to Covey No. 20. It is definitely known that this covey was subject to Cooper's hawk predation as a quail was observed making a successful escape from a pursuing Cooper's hawk by flying into the food patch.

Covey No. 31.

Trapping: As this group of birds ranged largely off College property, only one bait spot was used in the attempt to trap them. Because of the overlapping ranges the bait was also used for Covey No. 15, but with

no results except that each covey was flushed nearby during the winter.

Survival: The first indication places the number of birds in this covey at 13. This was reduced to eight by early February and when last seen, on April 1, only seven were left. From this information 53% survived. There is good evidence that some of this covey may have been shot when it was off College property.

Movements: When located on College property the birds were generally in the vicinity of feed patches #29 and #30. They also used the woods to some extent as well as the small thicket of sumac and black locust near patch #30. Their movements off College property are known only through reports that they were frequently seen in the broom-sedge field west of the woods.

Food: Besides the food patches, sumac and black locust, ragweed, yarrow, clever, plantain and mast from the woods seem to have been the only available food. What food the birds could have obtained from the broom-sedge field is not known.

Cover: The cover available for Covey No. 21 might be classed as average. The black locust and sumac thickets mentioned elsewhere afforded quite good escape cover, as did the woods. Food patches #29 and #30 supplemented this as well as some honeysuckle and briars along the boundary fence.

Predators and Predation: While no actual case of predation was observed

from this covey, it was open to the same sources as listed under Coveys No. 2 and No. 15. As stated previously, there is some evidence that some of the birds may have been lost to hunters while off College property. A report by the owner of Linkous' Store stated that a covey in this general vicinity, and presumably this one, had been hunted on at least two occasions.

Covey No. 22:

Trapping: Two bait spots, one located in the College orchard and the other near the Kipp's barn, were established in October in an attempt to trap Covey No. 22. The latter bait spot was established because of a report that the covey was using the vicinity but field information, obtained later, did not bear this out. Possibly the covey did range that far south in early fall. Neither bait spot was ever visited by quail and both were discontinued late in the winter.

Survival: The highest number of quail recorded for this covey was 16, flushed in mid-September. By December this was reduced to nine and on February 26 only seven were counted. They were last counted on March 21 when the number was still seven. This would give a survival of 50%.

Movements: Until December there was some doubt as to whether or not this was a distinct covey or merely Covey No. 12 "off range". The similarity in numbers added to this confusion as there was the possibility of a mis-count, for one covey or the other, although reports

received consistently gave a smaller number of birds in this area than in the vicinity of the McBryde house, the range of Covey No. 12. After it was definitely established that two coveys were present the range was quite easily worked out. One peculiarity of this covey was that, although they flew across Price's Fork Road into the College orchard as did Covey No. 12, they were always flushed from a grass swale in the orchard rather than from among the apple trees. The range, on both sides of Route 114, is quite well indicated on the map.

Food: Poison ivy and ragweed were quite abundant along the fence and on the edge of the orchard as well as a small amount of honeysuckle. Korean lespedeza and wheat stubble were available on the northern edge of the covey range.

Cover: Protection in the orchard could be classed as only fair and the nearest escape cover, the overgrown fence row. On the other side of the highway cover was somewhat better but not more than average. Certain low spots were quite thick with tall vegetation but except for the fences herbaceous cover was rather scarce.

Predators and Predation: No predation was observed in this area but the potential predators given for Covey No. 12, particularly the cats, will also apply to Covey No. 23.

Covey No. 23.

Covey 23 does not appear in any of the survival figures as it is known only from reports. Early in the fall a covey was reported as ranging

66.

in the vicinity of the College sewage disposal works and from there into the vicinity of feed patches #5 and #6. However, it never could be located and the possibility exists that it was Covey No. 17 "off range" or searching for more desirable covert.



Figure 18. Quail dusting spot.

GENERAL DISCUSSION OF RESULTS

Newman (1937) states that cover, rather than food appeared to be the limiting factor on the Demonstration Area during the first winter (1935-1936) of his study, when 45% of the quail under his observation survived. During the second winter of his study (1936-1937) 67% of the quail survived and this increase is attributed to a much milder winter, together with development of food and cover patches.

While the results of this study bear out that cover is the limiting factor, the average survival per cent of 60 is seven per cent lower than Newman's last figure and in view of the development of even more food and cover, together with a still milder winter, would seem to need some explanation. Probably the explanation lies in the number of birds under observation. As shown by Figure 21, Newman could find only 195 and 146 quail respectively, during the two years of his study, while the present study was made on the basis of a fall population of 293 quail. Whether or not the increase in birds was due to more intensive observation or to natural increase would seem to make little difference in the final results. It should be pointed out that the average survival per cent for the three years is 57 and this includes the winter of 1935-1936 which, according to Newman, was "the hardest in twenty years".

Undoubtedly some correlation exists between the weather and the winter survival of quail, although possibly not to the degree one would ordinarily expect. From the work of Errington (1931-1936) it would seem that winter loss is almost constant, within a given covert, unless an

unusually severe period brings into play certain factors not usually encountered. Such a factor might be unusually low temperatures and deep snow extending over a much longer period than average. Several attempts were made to correlate weather conditions and quail population by means of graphs and charts. However, these efforts were abandoned as, while exact data were available for the weather, it was very seldom that even an approximation could be had of the total quail population for a period of time of one week or more. If more time could be spent on a more intensive observation of a smaller number of coveys it should be possible to graph rather accurately the relation of temperature, precipitation and population fluctuation. Leopold (1937) prepared graphs as an index to the hardness of winters and from the graphs obtained empirical results in terms of "lethal units" on quail populations. Graphs of this kind seem to offer the most promise in measuring the effect of weather on the winter survival of quail.

That insufficient cover is mainly responsible for the winter loss of quail is further confirmed when one considers the theory of predation and the definite limits of carrying capacity. Errington (1935c) states that only a rather definite maximum of quail can get through the winter under the most favorable of conditions for a given territory. Furthermore that this carrying capacity is relatively constant and that it is possible to say in advance that no more than a certain number will survive. This is quite well supported by the comparatively small variation from the average survival figure for the three years' work. It is probable that there would have been even less variation had one person com-



Figure 19. Quail roosting spot after a night of snowfall.



Figure 20. Dogs used for census work.

ducted the study for the entire three years and with the same degree of thoroughness.

Most of Errington's (1931-1936) writings bring out the fact that predation is serious only where the quail population is top-heavy when compared to environment. The question of winter losses may be approached in two different ways: (1) the quail population is too large for a given piece of environment or (2) the environment is not sufficient to support the quail population. In either case the effect is the same; namely, that those birds in excess of the carrying capacity will be lost in one way or another. Errington (1935a) states it very nicely, "heavy predation upon winter bobwhite is a symptom rather than a cause of biological imbalance". From the known causes of loss which occurred during this study hawks were responsible for the great majority of kills. However, according to the previous discussion, it follows that, had the hawks been under such severe control that none would have been present to prey upon the quail, the birds lost would have been approximately the same but lost for causes other than hawk predation.

Errington and Hammerstrom (1935) also conducted some very interesting experiments in Wisconsin on the comparison between the winter survival of quail on shot and unshot areas. Roughly, nearly three times as many quail were lost from the unshot area as from the area on which the population had been reduced about 30% by pre-winter shooting. Of course, this, too, tends to confirm the theories stated above.

In many of the individual covey descriptions some reference has been made to the difficulties encountered in trapping the quail. Prob-

Season	Quail in Fall		Quail in Spring		Per Cent Survival	No. Quail Trapped		No. Quail Trapped		Previously Banded		
	No. of Coveys Birds	No. of Coveys Birds	No. of Coveys Birds	Coveys Birds		Fall and Winter	Early Spring	Early Spring	Quail Retrapped	Quail Retrapped	Cocks Hens Total	Cocks Hens Total
1935-												
1936												
(Newman)	13	195	12	88	45	61	36	97	23	13	36	-
									(7 new)	(4 new)		-
1936-												
1937												
(Hessman)	11	146	10	99	67	13	7	20	1	3	4	1
1937-												
1938												
	21	293	20	176	60	24	21	45	2	1	3	0
							(2 died)		(1 new)			0
												0
												0
												1
												72.

Figure 21. Tabular summary of results. For accurate interpretation of these data the individual covey descriptions should be studied. Data for seasons 1935-1936 and 1936-1937 are only approximate because of incomplete information.

ably the amount of time available for trapping operations has some bearing on the matter as it could be assumed that results might be in rather direct ratio to the efforts expended. However, this is not wholly true as the skill and experience of the trapper would influence to a large degree the success of his efforts. Many other factors beyond the control of the trapper also enter the picture. Considerable difficulty was experienced with rodents (mice, squirrels and rabbits), taking bait from the bait spots or disturbing it to the extent that it no longer seemed attractive to quail. Even when a trap was set these mammals would frequently force the entrance and ruin the result of several weeks of patient work. Probably the location of trapping sites has much to do with the results obtained as there seemed to be a definite trend to failure when trapping was attempted in, or near, cultivated feed patches. It has been demonstrated that most quail are quite wary of a trap and will usually enter it only when need for food is great. If food is readily available from the food patch, within a very short distance, it would seem logical that there is certainly less inducement for quail to enter the trap. That some quail seem to have a very definite fear of a trap is quite well shown by Covey No. 4, which scratched through several inches of snow to get at a well established bait spot but would not venture near another bait spot covered by a propped trap.

While trapping undeniably has much, if not indispensable, value in certain studies, its worth in a strictly census study is open to serious question. Trapping operations are undoubtedly time-consuming and when a group of birds is trapped it does not prove that the number trapped con-

stitutes the entire covey. Neither does it aid in establishing range unless the same covey is trapped in more than one location, a very difficult procedure.

Attention is called to the fact that Newman (1937) trapped and banded a total of 108 quail during the winter of 1935-1936 from a total fall population of 195. He trapped and banded 24 from a total population of 146 the following winter but of the 67 birds trapped, only one banded bird of the previous year was retrapped. During the winter of 1937-1938, 45 quail were trapped, banded and released and no birds were caught which had been banded during either of the two previous years. This leads to some interesting assumptions, as follows: (1) that quail previously trapped are very difficult to retrap, (2) that quail on the Demonstration Area have a very short life span, possibly not more than one year, (3) that the fall populations during the winters of 1935-1936 and 1936-1937 were considerably larger than the figures would indicate.

During the three years covered by the work of Newman (1937) and this study, a total of 179 quail were trapped and banded. Of this number 107 were cocks and 72 hens. The possibility exists that the traps operate selectively against the hens as Leopold, Lee and Anderson (1938) found in trapping Wisconsin pheasants or that the sex ratio on the Demonstration Area is considerably out of balance. Stoddard (1931) says the usual ratio is 52% cocks and 48% hens. However, it is considered that not enough quail were trapped to justify the drawing of any conclusions in this matter.

It is felt that the marking of trapped quail, by means of white or colored feathers, is very worthwhile, if trapping operations are to be con-

ducted. However, the method used in this study was not wholly satisfactory and can be much improved. Unfortunately, two of the best papers describing feather-marking technique, Edminister (1938) and Leopold Lee and Anderson (1938) were not published until this study was concluded and the excellent processes described therein were not known until too late to be applied. Since the methods described in the above papers were not used, no statement can be made regarding their effectiveness. However, the failings of the method that was used would seem to be largely overcome by using the techniques described in either of the above papers.

CONCLUSIONS AND RECOMMENDATIONS

1. Lack of sufficient and suitable cover is the limiting factor governing quail populations on the Blacksburg Quail Demonstration Area.
2. The normal fall quail population of the Area exceeds the normal carrying capacity by an average of 43%, based on the three year study.
3. During the average winter the fall quail population will be reduced by an average of 43%.
4. According to accepted theory, the control of predators on the Area would not result in any material quail population increase.
5. Trapping of quail is not worthwhile in a study primarily designed to secure population figures.
6. The theory of predation advanced by Errington should be checked by the pre-winter removal of approximately 40% of the total quail population.
7. Several selected coveys should be kept under very intensive observation and the population drop correlated to weather, preferably over a period of years.
8. For extensive observation the use of dogs is to be recommended

for census work, provided the handler is thoroughly familiar with the range of each covey.

9. For best results quail trapping should be confined to those portions of quail range where feed is least abundant.
10. Trapped quail should be marked by feathers following techniques described elsewhere.
11. Winter survival studies of quail have practical application in quail management in figuring the allowable shootable surplus.

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APPENDIX

LIST OF ANIMALS MENTIONED IN THESIS

<u>Common</u>	<u>Scientific</u>
Crow.....	<i>Corvus brachyrhynchos brachyrhynchos</i>
Fox, gray.....	<i>Urocyon cinereoargenteus</i>
Hawk, Cooper's.....	<i>Accipiter cooperi</i>
Hawk, marsh.....	<i>Circus hudsonius</i>
Hawk, red-tailed.....	<i>Buteo borealis borealis</i>
Hawk, sharp-shinned.....	<i>Accipiter velox</i>
Meadowlark, eastern.....	<i>Sturnella magna magna</i>
Owl, great horned.....	<i>Bubo virginianus virginianus</i>
Pheasant, ring necked.....	<i>Phasianus colchicus torquatus</i>
Quail.....	<i>Colinus virginianus virginianus</i>
Rabbit.....	<i>Sylvilagus floridanus</i>
Shrike, migrant.....	<i>Lanius ludovicianus migrans</i>
Skunk.....	<i>Mephitis nigra</i>
Sparrow, song.....	<i>Melospiza melodia melodia</i>
Squirrel.....	<i>Sciurus carolinensis</i>
Weasel.....	<i>Mustela sp.</i>

APPENDIX

LIST OF PLANTS MENTIONED IN THESIS

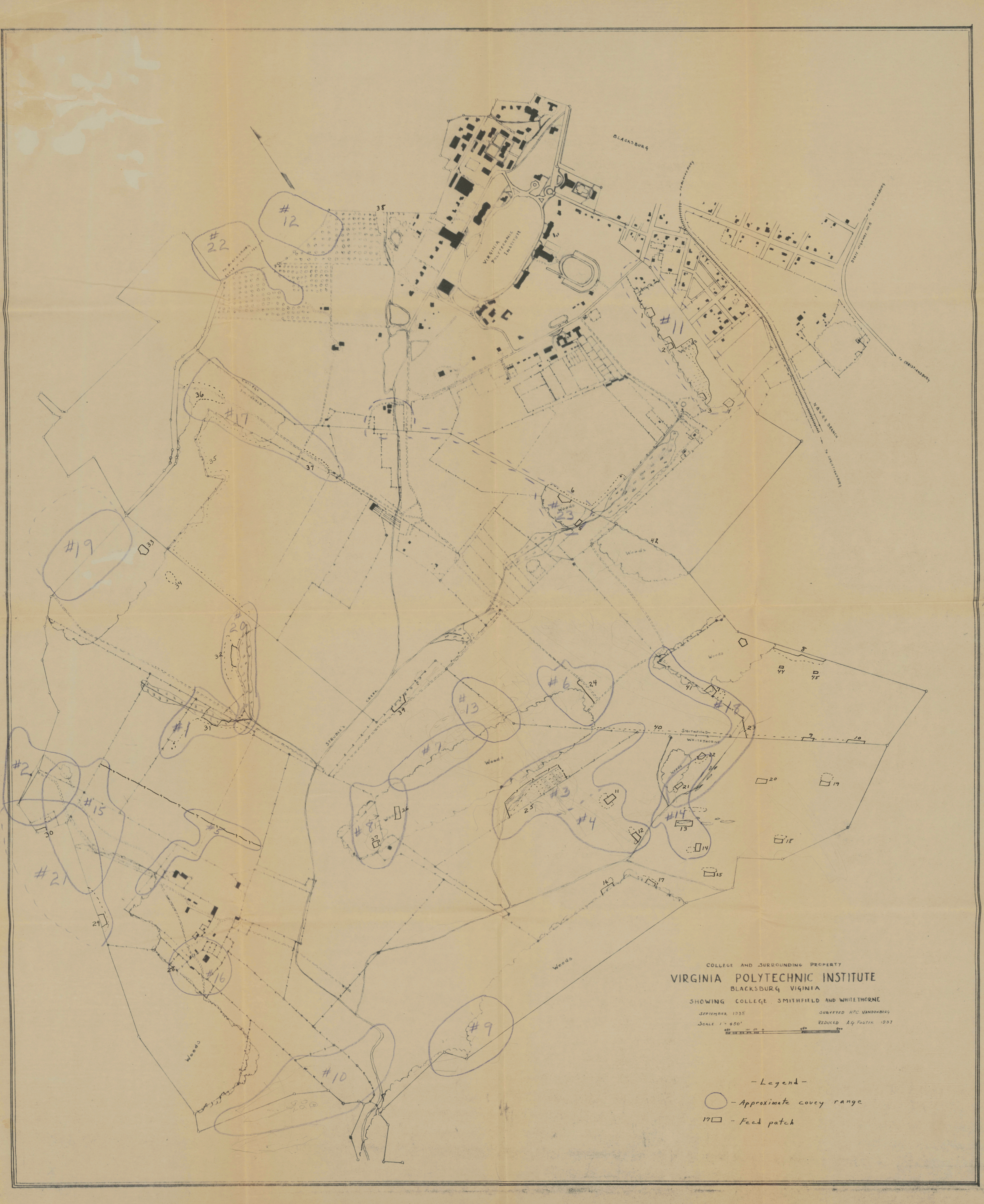
<u>Common Name</u>	<u>Botanical Name</u>
Apple.....	<i>Pyrus malus</i>
Aster.....	<i>Aster</i> spp.....
Beggarsweed.....	<i>Desmodium</i> spp.....
Blackberry.....	<i>Rubus</i> spp.....
Broomsedge.....	<i>Andropogon virginicus</i>
Cherry, wild.....	<i>Prunus serotina</i>
Glover.....	<i>Trifolium</i> spp.....
Corn.....	<i>Zea mays</i>
Corn, Kaffir.....	<i>Sorghum</i> sp.....
Cowpeas.....	<i>Vigna sinensis</i>
Crataegus.....	<i>Crataegus</i> spp.....
Dogwood.....	<i>Cornus florida</i>
Dewberry.....	<i>Rubus villosus</i>
Eupatorium.....	<i>Eupatorium</i> sp.....
Foxtail.....	<i>Setaria</i> spp.....
Goldenrod.....	<i>Solidago</i> sp.....
Grape, wild.....	<i>Vitis</i> sp.....
Grass, panicum.....	<i>Panicum</i> spp.....
Greenbriar.....	<i>Smilax</i> spp.....
Haw, black.....	<i>Viburnum prunifolium</i>

APPENDIX

<u>Common Name</u>	<u>Botanical Name</u>
Honeysuckle, Japanese.....	Lonicera japonica.....
Ivy, poison.....	Rhus toxicodendron.....
Jewelweed.....	Impatiens biflora.....
Jimsonweed.....	Datura Stramonium.....
Lespedeza, Korean.....	Lespedeza stipulacea...
Locust, black.....	Robinia pseudoacacia...
Millet.....	Panicum sp.....
Partridge-pea.....	Cassia spp.....
Pine.....	Pinus spp.....
Plantain.....	Plantago spp.....
Pokeweed.....	Phytolacca decandra....
Primrose, evening.....	Oenothera spp.....
Privet.....	Ligustrum vulgare.....
Ragweed, common.....	Ambrosia artemisiifolia
Ragweed, giant.....	Ambrosia trifida.....
Rose, wild.....	Rosa spp.....
Smartweed.....	Polygonum sp.....
Smilax.....	Smilax spp.....
Sumac, smooth.....	Rhus glabra.....
Sumac, staghorn.....	Rhus typhina.....
Thistle.....	Cirsium spp.....

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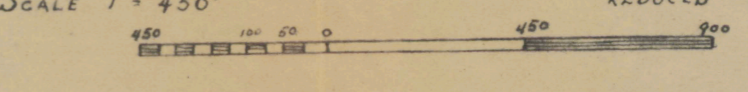
<u>Common Name</u>	<u>Botanical Name</u>
Trefoil.....	Desmodium spp.....
Wheat.....	Triticum aestivum...
Yarrow.....	Achillea Millefolium



COLLEGE AND SURROUNDING PROPERTY
VIRGINIA POLYTECHNIC INSTITUTE
 BLACKSBURG VIRGINIA

SHOWING COLLEGE, SMITHFIELD AND WHITETHORNE

SEPTEMBER 1935 SURVEYED H.P.C. VANDERBEEK
 SCALE 1" = 450' REDUCED A.G. FOSTER 1937



- Legend -
- - Approximate covey range
 - - Feed patch