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QUAIL MORTALITY AND MOBILITY STUDY

By LLOYD G. WEBB[1]

INTRODUCTION

Records maintained on quail shooting areas in South Carolina for several years showed the juvenile-adult ratio of harvested birds to be approximately 4 to 1. The annual harvest was estimated to be about one-fourth to one-third of the fall population. Consequently, there was some concern as to what happened to the excess unharvested quail that were not evident as adults in the quail harvest of the following year. Of concern also, was the question of when did the excess quail disappear from the population. Consequently, this study was designed so as to collect data on daily and seasonal activities and population levels of the quail utilizing an isolated developed range where no hunting was permitted.

TECHNIQUES

A study area consisting of approximately 10 acres of open land and adjacent woodlands was obtained from Clemson University in June of 1961 for conducting studies on quail. Adjoining woodlands were to receive no silviculture practices until the study was completed. This area was previously used for experimental work on various grain and truck crops. These land use practices provided a habitat conducive to the utilization of the area by two coveys of quail for several years prior to the initiation of the study.

The first quail habitat development practices were instigated during the fall and winter of 1961-62. This environmental development included the establishment of permanent plantings of bicolor lespedeza *(Lespedeza bicolor)* and Korean lespedeza *(Lespedeza stipulacea)* near the center of the study area. This operation included the establishment of one strip of bicolor lespedeza, approximately 300 by 15 feet, which was encircled by a 40-foot strip of Korean lespedeza. The survival and subsequent growth of these plantings throughout the study period were excellent. The remainder of the open area, excluding approximately two acres of serecia lespedeza *(Lespedeza serecia)* that was previously established in a narrow strip along a portion of the woodland border, was seeded during the spring of 1962 with browntop millet *(Panicum fasciculatum)*, iron cowpeas *(Vigna sinensis)* and oats *(Avena sativa)*. Annual plantings of browntop millet and cowpeas were continued each year thereafter while the study was in progress. In addition to the above plantings, two permanent 1/10-acre plots of ladino clover *(Trifolium*

[1] Project leader, S. C. Wildlife Resources Dept., and Associate Professor, Clemson University.

repens) were established within the browntop millet area in the fall of 1962. All terrace sites were left to develop with native weeds, grasses, etc., for use by the quail as travel lanes.

The maintenance of the Korean lespedeza was limited to occasional mowing, while the maintenance of annual plantings, following recommended fertilizing and planting procedures, was limited to mowing in strips. The strip mowing of annual plantings consisted of narrow strips (10 feet wide) which were initiated at the central observatioon tower, and were extended radially to the outer edges of the open portion of the study area. This was done as required to permit the detection and observation of quail that utilized the developed area.

In February of 1962, a 6 x 6 foot enclosed blind was constructed and placed on top of a 35-foot steel tower. The tower was permanently located at the southern end of the bicolor and Korean lespedeza plantings. Observation in all directions was made possible by sliding glass windows that surrounded the upper portion of the blind. This blind was wired electrically to permit heating, cooling, and food preparation when necessary. A second permanent blind was constructed from canvas and placed on top of a 25-foot high storage shed which was situated at the northerly end of the lespedeza plantings. Three temporary blinds were constructed in trees surrounding the open area and were used intermittently during 1962-63 in an attempt to observe the quail during periods when they were utilizing the woodland areas.

Observations from all blinds were confined primarily to the period of March to September inclusive during 1962 and 1963. Observations during 1962 were made three times each week with the daily observation period extending from 30 minutes before official sunrise until dark. During 1963 the observations were made once a week with the 11:00 a.m. to 2:00 p.m. period (approximately) being deleted as the quail were in the thick woods during this time and their movements could not be detected. Observations from all blinds were made with the use of binoculars and a spotting scope having turret mounted eyepieces of four different magnifications.

Observations of the quail populations on the study area during the period of October through February of 1962-63, 1963-64, and 1964-65 were obtained through the use of bird dogs. The use of the bird dogs in the locating of coveys during the fall and winter months was necessary as only a few quail were observed to be using the open type farm land at any specific time. (On no occasion during the study period were both coveys observed to be out in the open developed area during the late fall and winter months at the same time.) During the spring and summer of 1964 observations from the blinds were discontinued on a regularly scheduled basis, and emphasis was placed on the trapping and/or retrapping of the quail on the area during the 1964-65 fall and winter months.

The trapping and banding program was initiated in the spring of 1962 to assist in covey identification and to supplement the data obtained by the observers who occupied the observation towers. Colored aluminum bands were used to band as many quail as possible so that the quail of one covey could be distinguished from those of the other covey during 1962-63, and to distinguish the quail of one year from those of another year during the remainder of the study. The attempts to trap quail for banding and recovery data during the 1963-64 and 1964-65 fall and winter months were unsuccessful, probably because of the abundance of food available in the study area. Retrapping and observation of banded quail permitted the collection of limited data on longevity.

All observations, either from blinds or by census of the area with bird dogs, were plotted daily on separate type cover maps. Data recorded on these cover maps included total daily population, the number of mated quail, the number of quail not mated, the number of juveniles present, roosting sites and at what time the

unmated adults joined the broods of the year. The attempts to locate quail nests for daily observation were unsuccessful.

Attempts to determine the causes of mortality were made by having 10 to 20 students from Clemson University search the area on three occasions during 1962 when daily observations had indicated that two to three birds were lost from one of the coveys during the previous night. This intensive searching technique failed to reveal any dead quail. No attempt was made during the study to remove any predator from the study area.

The location of seasonal and daily ranges during the spring and summer months were ascertained by superimposing, on a single sheet of acetate, the location and movements of each marked covey observed. Each concentration of daily use patterns was circumscribed to determine the seasonal range. Fall and winter ranges were determined by plotting all locations where quail were flushed by dogs and circumscribing such areas on the acetate sheet so as to include all areas known to be utilized.

FINDINGS

The quail population data obtained from March of 1962 through February of 1963 are shown in Table 1. This reflects the total quail population by months, with associated data to reflect the number of mated quail, the number of young quail of the year, the number of adult quail with broods of the year, the number of adults not associated with the young broods (considered as non-mated birds), and the number of birds of the previous year that utilized the study area. The same data for 1963-64 are shown in Table 2. The population data for 1962-63 and 1963-64 were combined and are presented in Table 3.

Trapping and banding data are shown in Table 4. These data include the number of quail banded during 1962 and 1963, along with the number of banded quail retrapped in later years and the highest number of quail observed with colored bands used in previous years. The number of coveys produced on or near the area each year is shown in Table 4. These young broods utilized the area each year until the following spring when mating started.

The cover type map of the study area, noting principal covey ranges by seasons, is shown in Figure 1.

RESULTS AND DISCUSSION

Mortality

The average high population of quail noted on the study area during each month of 1962-63 and 1963-64 varied from a high of 31 individuals in August to a low of 8.5 in the month of June (Table 3). However, there was no great decline in the observed population from August until the start of the mating season in the spring. The highest population noted in April of each year, 23 in 1962-63 and 27 in 1963-64 (Tables 1 and 2), reflect the largest number of quail observed during the month. Actually the decline was apparent in late April and the drop in the observed population continued until it reached a low in late June just prior to the appearance of young broods.

It is known that quail will shift considerable distances during the mating season and it is assumed that some of the study area quail did shift. At the same time, it is possible for the quail of other areas to shift into the study area. Since the study area was isolated and no other quail coveys were found within one half mile radius of the area, it must be assumed that some of these birds did leave the area during the mating season. Yet, checks on early morning whistling within a one-mile radius of the area during these mating seasons did not disclose sufficient mated pairs to account for all of the quail losses from the study area. Consequently, it is believed that some

Table 1. High quail population observed monthly on quail study area during 1962-63; noting the number of mated quail, the number of young quail, the number of adults associated with young quail, the number of adults not associated with young quail (some of which may have been mated), and the number of quail of previous years inhabiting the range by months.

Month	Total High Population	Number of Mated Quail	Young of the Year	Adults Associated With Young	Adults Not Associated With Young	Number Quail of Previous Years	Remarks
March	30	4	0	0	30	30	March-Sept.
April	23	10	0	0	23	23	counts made
May	18	14	0	0	18	18	from blind
June	13	10	0	0	13	13	with use of
July	18	6	10	2	6	8	80 power
Aug.	31	4	22	3	6	9	spotting
Sept.	29	0	20	3	6	9	scope.
Oct.	28	0	20	8	0	8	Oct.-Feb.
Nov.	27	0	ND	ND	ND	ND	counts made
Dec.	29	0	ND	ND	ND	ND	by use of
Jan.	28	0	ND	ND	ND	ND	bird dogs
Feb.	29	0	ND	ND	ND	ND	

NOTE — ND indicates months when young quail were not distinguishable from adults when flushed.

Table 2. High quail population observed monthly on quail study area during 1963-64; noting the number of mated quail, the number of young quail, the number of adults associated with young quail, the number of adults not associated with young quail (some of which may have been mated), and the number of quail of previous years inhabiting the range by months.

Month	Total High Population	Number of Mated Quail	Young of the Year	Adults Associated With Young	Adults Not Associated With Young	Number Quail of Previous Years	Remarks
March	29	0	0	0	29	29	March-Sept.
April	27	6	0	0	27	27	counts made
May	12	8	0	0	12	12	from blind
June	4	4	0	0	4	4	with use of
July	15	2	10	2	3	5	80 power
Aug.	31	2	24	4	3	7	spotting
Sept.	29	0	22	3	4	7	scope.
Oct.	29	0	22	3	4	7	Oct.-Feb.
Nov.	28	0	ND	ND	ND	ND	counts made
Dec.	28	0	ND	ND	ND	ND	by use of
Jan.	28	0	ND	ND	ND	ND	bird dogs
Feb.	28	0	ND	ND	ND	ND	

NOTE — ND indicates months when young quail were not distinguishable from adults when flushed.

of the losses during this season could have been due to mortality and not entirely to a shifting of the population.

The mortality or loss of quail that has been reported to occur in late winter was not apparent during this study. If such mortality did occur there was sufficient ingress of other quail to maintain rather static populations up until the breeding seasons of 1963 and 1964. In view of the fact that no quail were known to exist close by, it appears that the greatest mortality or loss otherwise occurred during the breeding season. It was noted however, that the mating activities in this area of high populations were carried out with much less caution than was ever observed by the writer in areas where hunting had reduced the population to a much lower level.

Number of Mated Quail

The high number of mated quail was observed during May of 1962 when seven separate pairs (14 birds) were observed on the study area at the same time (Table 1). The highest number of paired quail observed during 1963 was four pairs (Table 2). This observation also occurred during the month of May. However, only two coveys of young quail were ever known to utilize the area during the course of the study. Since there was no increase in the adults associated with the young broods and there was no increase in the number of adults *not* associated with the young broods (old coveys of the previous year), (Tables 1 and 2), it appears that some of these mated quail left the area completely or died from unknown causes.

As to the time that "pairing off" started, the first isolated pair of quail was observed on March 23 in 1962, whereas, the first mated pair in 1963 was observed on April 14.

Young of the Year

The highest number of young quail observed on the study area was during August of 1962-63 and 1963-64 (Tables 1 and 2) when 22 and 24 young quail, respectively, were observed. However, during both years the second covey located (in August) was of sufficient age to have been observed during July had they been utilizing the area. Since roosting places and daily ranges were fairly well limited at this time, it is believed that only one covey of young quail were utilizing the open study area each year when the birds were very young.

There appeared to be only a small loss of young quail from the time they were first observed until November when the young could no longer be distinguished from the adults by sight. The average number of young quail of the year observed in 1962 and 1963 on the study area by months is shown in Table 3. No data is presented after October, as young could not be distinguished from adults by sight.

Adults Associated With Young

During 1962 the first covey of young quail observed was escorted by a pair of adult birds; whereas, the second young covey observed was accompanied by only one female adult (Table 1). These adults were the only adults noted with the young until October. At this time five adults (3 males and 2 females) that had not mated during the year joined the covey with one adult. It is believed that these five additional adults remained with the young brood of the year until the following spring.

Both young coveys of 1963 were accompanied by a pair of adult quail at first. However, one of the adults disappeared in late August or early September (Table 2). The separate adults (those not having mated) did not join a young brood in 1963 until about mid-November after ages could not be distinguished by sight. This conclusion is based on an increase in the size of one covey by four quail as observed when checked with the use of bird dogs on November 17, 1963. Since it was not possible to attract the quail into traps for aging, and since the total high population observed during the fall of 1963

Table 3. Average high quail population observed monthly on quail study area during 1962-63 and 1963-64; noting averages of the number of mated quail, the number of young, the number of adults associated with young, the number of adults not associated with young (some of which may have been mated), and the number of quail of previous years inhabiting the range by months.

Month	Average Total High Population	Average Number of Mated Quail	Average Young of the Year	Average Adults Associated With Young	Average Adults Not Associated With Young	Average Number Quail of Previous Years	Remarks
March	29.5	2.0	0	0	29.5	29.5	March-Sept.
April	25.0	8.0	0	0	25.0	25.0	counts made
May	15.0	11.0	0	0	15.0	15.0	from blind
June	8.5	7.0	0	0	8.5	8.5	with use of
July	16.5	4.0	10.0	2.0	4.5	6.5	80 power
Aug.	31.0	3.0	23.0	3.5	4.5	8.0	spotting
Sept.	29.0	0	21.0	3.0	5.0	8.0	scope.
Oct.	28.5	0	21.0	5.5	2.0	7.5	Oct.-Feb.
Nov.	27.5	0	ND	ND	ND	ND	counts made
Dec.	28.5	0	ND	ND	ND	ND	by use of
Jan.	28.0	0	ND	ND	ND	ND	bird dogs
Feb.	28.5	0	ND	ND	ND	ND	

NOTE — ND indicates months when young quail were not distinguishable from adults when flushed.

Table 4. Annual observations and banding data obtained from two coveys of quail that were isolated and not shot from March 1962 to June 1965. Quail on surrounding woodlands within one and one half mile radius of study area were not hunted while study was in progress.

Year	Number of Coveys Produced*	Number of Adult Quail Banded**	Number of Quail Recovered that were Banded in Previous Years	Most Number of Quail Observed at One Time That Were Banded in Previous Years***
1962	2	14	0	
1963	2	18	4	7 (4 yellow & 3 red)
1964	2	0	0	4 (1 red & 3 blue)
1965 (to June 1)	1	0	0	4 (4 blue)

*Two coveys were produced in 1962, 1963, and 1964, even though some coveys were not observed until after June 30. Coveys were assumed to have been hatched prior to July 1 due to the age of the young when observed.

**Red and yellow colored bands were used in 1962, whereas blue bands were used in 1963.

***Observations during 1964 and 1965 were limited to dates on which trapping was being attempted.

(Table 2) did not fluctuate appreciably, this conclusion that the non-mated adults did join one of the young broods appears sound.

The average high number of adults (quail of the previous years) known to be associated with broods of the year during 1962-63 and 1963-64 by months is shown in Table 3. These data in some instances included both parent birds and quail that did not mate, but later joined the young coveys.

Non-Mated Quail

During the breeding seasons of 1962 and 1963 there were a number of adult quail that apparently had no desire to mate. In 1962 six adults (3 males and 3 females) remained together as a small covey throughout the season until October when five of the quail joined an adult female and her brood (Table 1). One of the six adults, a crippled bird, was lost just prior to the joining of the adults with the young brood of the year. The same was true in 1963 when four adults (1 male and 3 females) remained separated as a small group during the breeding season. However, in this case the adults apparently did not join a young brood until some time during early November (Table 2). This observation was based on the increased number of quail that was in one covey when flushed with bird dogs on November 17, 1963.

The average high population of adult quail that were not mated during 1962-63 and 1963-64 by months is shown in Table 3.

Total Adult Population
(Quail of Previous Years)

All quail observed on the study area in March of each year were considered to be adults. The gradual decline in the number of adults observed utilizing the area from March to June varied between 1962 and 1963. The decrease in adult quail was noted to occur somewhat earlier in 1963 than in 1962 (Tables 1 and 2). This is contradictory to the assumption that the mating season was a season of high loss. Actually the greatest decline in the adult quail population occurred during 1963 when mating activities were considered to be less than that observed during the previous year (Tables 1 and 2). A reasonable explanation for this variance is not available since data were not obtained on all of the factors that affect animal behavior. It should be pointed out though, that these data are concerned with the highest nunmber of quail observed during any one month. Observations that noted a high number of mated quail during 1962 could have been made during an unusual warm period, while observations during 1963 could possibly have been made during cool periods. Quail are known to "pair off" for short periods during warm days and still go back with the covey for a short period of time.

The average adult population (quail of previous years) observed on the study area during 1962-63 and 1963-64 by months is shown in Table 3. (The total population and the total number of quail of previous years are the same until young appeared in June of each year.)

Banding and Trapping

The data obtained from banding and trapping are negligible and not consistent. Two normal sized coveys were observed utilizing the area each year the study was in progress, yet, only 14 and 18 quail could be trapped during 1962 and 1963 respectively from winter and early spring populations of approximately 28 quail. The situation was worse during 1964 and 1965 when no quail were trapped. The failure to trap quail during the late winter and early spring of 1964 and 1965 is attributed primarily to the abundance of other foods produced on the study area. Quail were observed on several occasions to walk through "scratch feed" bait to feed in the domestic plantings that were on the area. The bicolor and Korean lespedeza areas appeared to be the favorite feeding places for both coveys of quail during this time.

It should be pointed out, that the banding of quail with different

colored bands was very helpful in distinguishing the quail banded in one year from those banded in another year. From such observations it was observed that more adult quail were utilizing the study area than those adults required to produce the two coveys observed on the area. For example, seven quail banded during March of 1962 were observed on the study area at one time during 1963 (Table 4). Yet, only two of the three adults that were found initially with the two young broods in 1962 were banded quail.

In addition to the seven quail banded during 1962 and observed in 1963, four quail banded in previous years were observed in 1964. One of these four quail was banded in 1962 while the other three were banded in 1963. Observations in early 1965 noted four quail on the area that had been banded in 1963 (Table 4). At least one of the banded quail observed in 1965 was from a mated pair that produced the only covey observed by July 1 when observations were terminated.

The retrapping of quail banded the previous year was limited to four quail trapped during February and March of 1963 that were banded in March of 1962. All trapping attempts were limited to the periods from January to early April of each year so as not to interfere with nesting.

Daily and Seasonal Ranges

Observations during 1962 and 1963 could not determine the daily range as a heavy undergrowth of honeysuckle *(Lonicera japonica)* and other miscellaneous vines prevented the observing of quail once they entered the woodlands. Consequently, observations were limited to the time when quail were in the open area, or when flushed with the use of bird dogs during the fall and winter seasons. However, the two coveys utilizing the study area during the spring and summer seasons were observed only once to intermingle. Each covey appeared to remain closer to the side of the study area in which its roosting site was located.

During the spring and summer seasons, the quail generally entered the study area soon after sunrise and remained until approximately 10:00 a.m. Quail fed constantly during this period and would usually visit all of the various plantings during the time they were in the developed area. At mid-morning the quail would return to the woods and would remain there until afternoon temperatures dropped. On unusually hot afternoons, the coveys would appear just before sundown or would not enter the open area at all.

As to seasonal movements, the ranges were determined as previously described and are plotted on Figure 1. It is believed that these ranges are fairly accurate as the quail were observed frequently during spring and summer months and were found in nearby woods or on the edges of the study area in the same general location. One covey roosted just off the study area to the east and the other covey roost was constantly found in the sericea lespedeza on the opposite side of the study area. The roosting sites were probably limited to these specific areas since roosting cover with little overhead growth was scarce elsewhere.

RECOMMENDATIONS

From the foregoing discussion it would appear that the over protection or no hunting of quail at all is not advisable. Certainly all of the adults that survive the winter season on areas where hunting is limited are not needed to reproduce sufficient young to fully utilize the carrying capacity of a range during the following year. This is based on the assumption that nothing is being done to the environment to increase the carrying capacity of the specific area. Thus, it is a firm belief that quail coveys could be shot rather heavily to permit greater harvest of a population that will otherwise be lost due to other factors. This is substantiated by the fact that fall quail populations on hunted areas usually have a juvenile-adult ratio of 4 to 1; whereas, the non-shot study area during 1962 and 1963 had

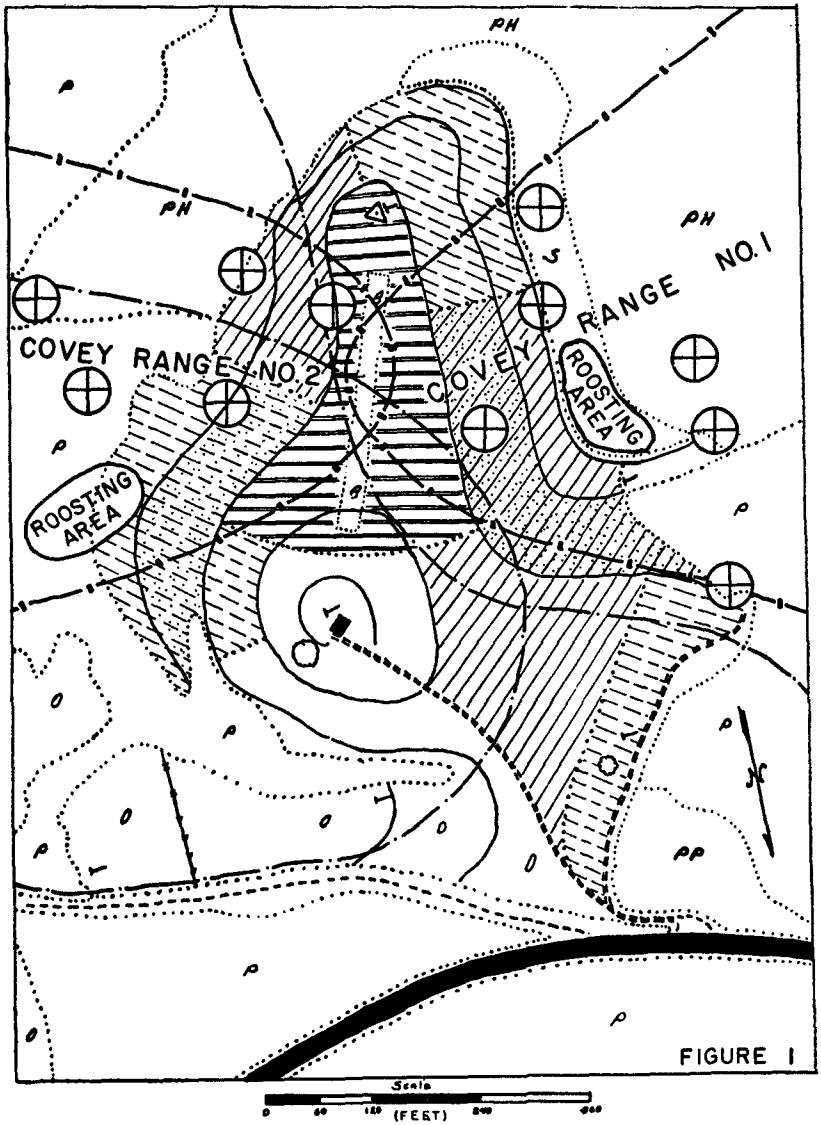

FIGURE 1

CLEMSON WILDLIFE RESEARCH PROJECT

QUAIL STUDY AREA

LEGEND

P PINE	UNIMPROVED DIRT ROAD	KOREAN LESPEDEZA
O OPEN	BLACK TOP ROAD	BROWNTOP MILLET
S SERICEA	ABANDONED ROAD	BROWNTOP MILLET W/ LADINO CLOVER
B BICOLOR	SHED	COWPEAS
PH PINE - HARDWOOD	FENCE	COWPEAS W/ LADINO CLOVER
PP PINE PLANTATION	TOWER	SPRING / SUMMER RANGE
TYPE LINE	TREE	FALL / WINTER RANGE
TERRACE	POLE	APPROX. LOCATION OF COVEYS, FALL AND WINTER

a fall juvenile-adult ratio of approximately 3 to 1 (Table 3). Certain other recommendations are as follows:

(1) Landowners should be encouraged to harvest more of the quail produced each year. The fear of over shooting quail coveys can be minimized by realizing that many unshot coveys persist through the winter season in rough areas where hunters do not hunt. These quail will move to unoccupied ranges to produce young during the following year.

(2) Additional covey ranges must be added to an area if an appreciable increase in the quail production is to be expected. The high development of the study area did not increase the carrying capacity because of the limited amount of range. It was believed, however, that sufficient food and cover were available on the study area throughout the year to have supported another covey.

(3) A similar study should be run on an area where hunting pressure is high and the data collected should include that of other factors such as diseases, climate, etc., that effect the quails' survival.

SUMMARY

Studies on quail mortality, mobility and daily and seasonal activities were initiated during the fall of 1962 on a study area containing approximately 10 acres of open land. The open area was maintained in a high state of development as a quail range. No hunting was permitted on the area and the surrounding areas were not hunted for a radius of approximately one mile.

Observations of the two coveys of quail inhabiting the area were made from tall blinds with the use of binoculars and a spotting scope during the period of March through September. Data were collected on the quail coveys during the period of October through February with the use of bird dogs and by trapping and banding.

The greatest loss of quail occurred during April, May and June of each year. The causes of the losses, be it mortality or a shift in the population, could not be determined.

Approximately 16 per cent (about 5 out of 30) of the adults occupying the range at the start of the two mating seasons concerned (1962 and 1963) spent the remainder of the spring and summer months in small covey groups on the study area without mating. These adults joined the broods of the year during October and November. Only two coveys of quail were known to utilize the area although sufficient food and cover were believed available to support another covey throughout the study period.

Trapping and banding results were negligible due to failure to attract quail into the traps after the study area was highly developed.

Seasonal ranges were found to vary slightly during the fall and winter as compared to the spring and summer season. Quail coveys utilized the developed open land more during the spring and summer than they did in the fall and winter. The daily range approximated that of the seasonal range on the highly developed study area. In no case were the resident coveys found to move over 100 yards from the outer edge of the 10-acre open portion of the study area.

SOME EFFECTS OF WEATHER ON COTTONTAIL REPRODUCTION IN ALABAMA

BY EDWARD P. HILL III

(A Contribution from Federal Aid in Wildlife Restoration Project-Alabama W-36-R)

In the many good publications on cottontail *(Sylvilagus floridanus)* reproduction, relatively little has been reported comparing specific weather data with the commencement, continuity, and duration of the breeding season. The purpose of the first portion (Part I) of this paper is to present an analysis of some of the effects late winter