RESULTS

Desmodium spp. and the *Compositae* had the greatest coverage on the August-burned plots, *Galactia volubilis* had the greatest coverage on the January-burned plots, and *Pinus* spp. reproduction had the greatest coverage on the fire protected plots. *Lespedeza* spp., *Euphorbia corollata,* and *Tragia urticifolia* had a greater coverage on the burned plots regardless of time of burning. The most vacant space in the herbaceous stratum occurred on the August-burned plots.

Analysis of variance, from the standpoint of topography, showed a significantly higher occupancy of *Andropogon* spp. and *Smilax glauca* on the slope positions while more vacant space in the herbaceous stratum occurred on the ridges. An analysis of convariance of *Andropogon* spp. with canopy indicated an ever greater difference in the coverage of *Andropogon* spp. on the fire treatments and topographical positions.

DISCUSSION

Burning increased the area occupied by quail food plants, with the slightly highest occupancy on the August-burned plots. The August burns also produced a more open type of vegetation.

It is believed that August burning will result in a greater coverage of quail food plants and produce a type of vegetation open enough at the quail's level to permit easy feeding. However, these late summer burns occur during the fruit-maturing season of many legumes and may result in the destruction of much of the quail's winter food. Nesting habits and cover requirements as well as food requirements must be taken into account. Summer fires may destroy young quail as well as some late season nests. These August-burned areas are void of vegetation and are out of production twice as long as the winter burns, as far as quail management is concerned. Continued frequent burning in the summer may also result in the destruction of the pineland habitat.

On forested areas of this type that have grown up to a dense and unproductive type of vegetation, a system of summer burning may help get the area back into quail production and then be followed by winter burning for continued quail production and vegetational control.

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PROGRESS REPORT ON BOBWHITE NESTING IN SOUTHERN ILLINOIS

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Since 1950 Southern Illinois University and the Illinois Natural History Survey have been conducting cooperative investigations of the bobwhite quail, largely in the southern 34 counties of the state. These studies have been concerned with all aspects of the biology and management of quail. Part of this

program involved a 6-year (1952-57) evaluation of quail reproduction on an 1,800-acre tract of privately owned land near Carbondale, Illinois.

This 1,800-acre area includes farms operated by either tenants or land owners and represents soils and agricultural methods that are typical of south-central Illinois. Good and poor farm practices are represented. In general, the southwest two-fifths of the area are in permanent forage crops; the central two-fifths are in intertilled crops; and the northeastern one-fifth is largely idle, lying within the area of a strip mine operation. Woodlots on the area range up to approximately 20 acres in size and are rather evenly distributed throughout the area. A number of these wooded sites are associated with the main drainage pattern which extends from south to north through the middle of the research area.

The quail populations in the fall increased steadily from 1952 to 1957, and showed agreement with the direction of the population trend throughout southern Illinois. Quail management practices were not carried out on the research area.

An intensive area-wide search for nests was conducted each year during the period from May 1 to September 1. Before and after this period, the search for nests was limited to territories of paired quail. Nests were located by nest-hunting crews consisting of as many as eight men who searched with intention of finding every nest on the research area. The field workers, walking abreast at intervals of approximately 6 to 10 feet, moved across the area systematically searching all cover with the aid of a walking stick. During the 6-year study, the area was surveyed in this manner from three to five times each season. In addition, daily contact with the resident farmers yielded some information on nests which they observed during farming activities.

When found, nests were marked at some distance and a careful description of the exact site was noted. Return visits were made only as needed to follow the progress of the nest, usually not more than once every 3 to 5 days. After the nest was destroyed, deserted or hatched, a careful record of the vegetation at the nest site was prepared. This included the kinds of plants, their density and height, and the materials used in nest construction.

This 6-year investigation of bobwhite nesting has yielded records on a total of 352 nests (Table I). Twenty-five percent did not contain eggs. Approximately 60 percent of the nests containing eggs were found to have complete clutches ranging in size from 6 to 24 eggs and averaging 13.2 eggs per clutch. Hatching success for the 6 years was 39.4 percent with a range of 25.0 to 52.8 percent. These nests yielded a total of 1,223 chicks, an average brood size of 11.7. Ninety percent of the eggs in the 158 completed clutches hatched. The lowest hatchability of eggs was recorded in 1954 and was attributed primarily to unusually high temperatures during June. On several days temperatures in excess of 120 degrees were recorded at the nest level. Although temperatures tended to be high in 1952 and 1953, daily peaks in temperature did not reach those of 1954, and periods of high temperature were less continuous. The percent of nests hatching was lower during these 3 years than the following 3 years (Table I).

TABLE I

PRODUCTIVITY OF BOBWHITE QUAIL, CARBONDALE RESEARCH AREA, 1952-1957

Year	*Number of Breeding Birds*	*Number of Nests*	*% of Nests with Eggs*	*% of Nests with no Eggs*	*% Nests with Eggs Which Contained Complete Clutches*	*Av. No. of Eggs Per Completed Clutch*	*% of Hatch of Nests with Eggs*	*% of Eggs in Successful Nests Which Hatched*	*Total Chicks Produced*	*Average Number of Chicks Per Brood*
1952	44	33	72.3	27.3	54.4	12.8	25.0	97.3	76	12.7
1953	107	21	90.5	9.5	63.1	11.4	31.6	100.0	73	12.2
1954	72	29	79.3	20.7	78.3	13.8	26.2	73.2	60	10.0
1955	95	59	71.2	28.8	52.4	14.1	40.5	93.8	225	13.2
1956	101	70	75.7	24.3	67.9	14.5	52.8	86.0	338	12.1
1957	103	140	73.5	26.5	55.3	13.2	39.8	88.3	451	11.0
TOTALS		352	75.0	25.0	59.8	13.2	39.4	89.8	1,223	11.7

The fate of unsuccessful nests is admittedly difficult to determine, however, data believed to be representative were obtained. Approximately 36 percent of

the nests were abandoned; the most obvious causes of abandonment were mowing, rain, drought and excessive heat (Table II). Weather contributed to the abandonment of 9.1 percent and man's activity to 13.2 percent of the nests containing eggs.

TABLE II

FATE OF BOBWHITE NESTS, CARBONDALE RESEARCH AREA, 1952-1957

Category	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*Totals*	*% of All Nests Known to Contain Eggs*
Number of Nests Which Contained Eggs	24	19	23	42	53	103	264	100.0
Number of Nests Which Hatched	6	6	6	17	28	41	104	39.4
Abandoned:								
Observer	..	..	..	..	2	2	4	1.5
Drought and Heat	5	3	5	..	..	..	13	4.9
Rainfall	..	..	1	5	..	5	11	4.2
Fire	..	..	1	..	..	..	1	0.4
Road Patrol	1	..	1	..	..	1	3	1.1
Mowing	4	6	5	5	2	2	24	9.1
Plowing	..	..	..	..	1	2	3	1.1
Grazing Animals	..	1	..	..	..	6	7	2.7
Undetermined	2	..	2	2	11	11	28	10.6
TOTALS	12	10	15	12	16	29	94	35.6
Preyed Upon:								
Domestic Cat	..	2	..	3	2	13	20	7.6
Snakes	..	..	..	5	2	6	13	4.9
Striped Skunk	2	..	..	..	1	..	3	1.1
Birds	1	..	1	..	..	1	3	1.1
Unknown Carnivorous Mammals	1	1	1	3	4	9	19	7.2
Undetermined	2	..	..	2	..	4	8	3.1
TOTALS	6	3	2	13	9	33	66	25.0

Predation accounted for 25.0 percent of the losses, domestic cats being charged with 7.6 percent, unknown carnivorous mammals 7.2 percent, and snakes 4.9 percent. Most of the nests lost to predation were found in permanent pastures where feral houe cats were the chief cause of loss. In 1957, nine of 31 nests were destroyed in a pasture where at least six cats were active during the nesting period. The number of instances on which nests were preyed upon by snakes tended to be proportional to the level of the snake population. Nest losses charged to predation were more numerous than those charged to abandonment during 1955 and 1957 when populations of snakes and domestic cats were high.

The time of nesting was related to reproductive success. Nests hatching prior to July 1 showed not only a higher hatching success (41.8 percent) but also produced larger broods (12.8 birds) compared to those which hatched (36.1 percent and 10.2 birds) after this date. Completed clutches of nests found in April and May contained from 15 to 24 eggs; those found in August and September contained 10 to 13.

Nest success was related to the land-use category in which the nest was located. Forty-nine and three-tenths percent of the nests on idle land were successful while 25.9 percent were successful on agricultural lands. Inasmuch as the use of agricultural land for nesting shows an increase of approximately 29 to 44 percent from the first one-half of the nesting season to the last one-half, it is apparent that the successfulness of nests in the agricultural area becomes increasingly important as the season progresses.

Nest densities were correlated with land use. Approximately 80 percent of all nests were located in the southwest two-fifths of the research area which characteristically consisted of permanent cover, primarily permanent and rotation pastures, idle land, and fallow areas. Fifteen percent were located in the

extreme northeast portion of the area where the bulk of the land was permitted to lie idle. The remainder of the nests (5 percent) were found within the more intensively cultivated section where again idle land constituted the primary nesting cover. As would be expected, the breeding population showed a similar distribution.

Within these three general areas, however, the location of nests reflected specific types of land use. Where over-grazing and burning occurred, or where pasture renovation was in process, there was little or no use by nesting birds. Of the 352 nests, 52.6 percent were in idle land and 47.4 percent in agricultural land (Table III). The idle land-use category included fencerows, right-of-ways, garden plots and formerly cultivated fields up to 20 acres in area. In agricultural areas, greatest use was made of permanent pastures followed by fallow areas and hayfields. Only one nest was found in intertilled crops during the 6 years of the investigation. The location of nests in any land-use category was related to "edge." Approximately 90 percent of all nests found were associated with an identifiable break in cover at a distance of not more than 60 feet. Such edges might actually be nothing more than a cow path, ditch, or clump of trees. Seemingly, there was less association with edge in the permanent pasture areas than in other land-use types. This is believed to reflect the more open nature of ground cover in the permanent pasture as compared to areas which have remained idle for a number of years.

TABLE III

UTILIZATION OF LAND USE TYPES BY BOBWHITES FOR NESTING, CARBONDALE RESEARCH AREA, 1952-1957

Category	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*Totals*
Idle:							
Fence-Row	4	9	..	5	9	14	41 (11.6 %)
Rights-of-Way	..	1	5	4	8	5	23 (6.5 %)
Miscellaneous	14	3	7	27	23	47	121 (34.4 %)
TOTALS	18	13	12	36	40	66	185 (52.6 %)
Agricultural:							
Hayfield	4	6	5	3	1	4	23 (6.5 %)
Pasture	11	2	2	17	16	49	97 (27.6 %)
Fallow	..	..	10	3	13	20	46 (13.0 %)
Intertilled	..	..	..	..	..	1	1 (0.03%)
TOTALS	15	8	17	23	30	74	167 (47.4 %)
GRAND TOTALS	33	21	29	59	70	140	352 (100.0 %)

Nest distribution and the distribution of breeding birds showed a rather remarkable relationship to the presence of open, mature, pastured woodland, and wooded drainage ways with open under-stories. During routine field observations, it was from these sites that the bulk of the singles and pairs were flushed and from which the calls of the birds came. It also seemed important to nesting quail that the cover be open at the ground level so that the birds might move freely through the vegetation. Again this seemed to be most evident in idle areas where the vegetation frequently became extremely dense.

The bobwhite seemed to show a preference for particular species of plants in which to nest, although, rather than reflecting the specific kind, it possibly indicated more particularly the growth habit of the plant. Although a great variety of plants were utilized for specific nest sites, cheat, *Bromus secalinus*, was utilized in 27.8 percent, broom-sedge, *Andropogon virginicus*, in 18.5 percent, bluegrass, *Poa compressa* and *canadensis*, in 16.5 percent, and miscellaneous grasses in 9.1 percent. The greatest densities of nests were found in broom-sedge because it was limited to land which had been left idle for 2 to 3 years. Cheat and bluegrass were probably the most common grasses on the area with the former yielding the greatest quantity as it is not a particularly desirable forage plant. Broom-sedge was utilized throughout the nesting season

with probably the greatest use occurring during the first half of the season as was the tendency for bluegrass. Cheat, however, being extremely abundant and one of the earliest plants to develop, became increasingly important as the season progressed because it reaches maturity in late May and early June, slightly in advance of bluegrass. Dense stands of broom-sedge were not utilized except at their edges, and the most desired site appeared to be where this plant was growing in isolated clumps. Likewise, the use of cheat, bluegrass and other grasses was restricted largely to those sites where the grass matured and became lodged. In virtually all cases, only the dead vegetation from the previous or the current year's growth was used in nest construction. The importance of the effects of burning, over-grazing, mowing or pasture renovation to utilization of cover by nesting quail is apparent.

During the course of the investigation, there has been a general increase in the removal of idle and permanent cover. This has resulted in 220 acres being taken out of this classification. In addition, 8½ miles of hedge have been removed, with the bulk of this occurring in 1956. A part of the loss of idle and permanent cover has been offset by the practice of fallowing, which has shown in several cases to provide rather ideal nesting cover. This is particularly true of corn fields which are left idle for a period of 1 to 2 years following the harvest. The extent to which the quail populations can withstand the loss of edge and permanent cover is not yet apparent. However, it is believed that a depressing effect of these practices must become evident in the relatively near future.

THE FRANCIS MARION TURKEY PROJECT
(A Progress Report)

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In June, 1948 the United States Forest Service entered a cooperative agreement with the South Carolina Wildlife Resources Department for the Department to undertake a game management program on the newly created Francis Marion National Forest Wildlife Preserve. The Preserve, with its adjacent Cooperative Wildlife Management Area, contains 60,000 acres of diversified cover including dense bays, gum and cypress swamps, hardwood transitions, and pine uplands in South Carolina's famous lowcountry. The objectives of this new program were to increase the number of wild turkeys and deer in order to insure the perpetuation of the native strain of eastern wild turkeys, provide an overflow of game onto surrounding lands both public and private to improve hunting, produce game for restocking other suitable sections of the state, and fulfill a portion of the need for quality public hunting. This paper is an up-to-date report on the progress toward these objectives.

The preserve has been subdivided into two units for management purposes. The Waterhorn Tract contains 17,000 acres, has no private holdings or public roads, is entirely surrounded by a twenty-six (26) mile stock proof fence, and contains our very best wild turkey range. Since livestock can be excluded this has been the area of most intensive development. Management has consisted chiefly of clearing, planting, prescribed burning, and protection. Three hundred and fifty (350) acres of clearings have been created as one hundred seventy-nine (179) fields and two (2) rights-of-way. About two hundred twenty-five (225) acres of permanent and annual pasture, chufas, corn, and brown top millet are planted and maintained each year. The remaining acreage is left as unsown openings. Prescribed burning of all pine lands is accomplished on a three-year rotation. Domestic stock and animals destructive to plantings have been controlled. Nearly eight hundred (800) feral hogs have been removed since 1948. In addition, large numbers of raccoons have been live trapped and released in upstate counties where they are important game animals. This tract now has very high populations of both wild turkeys and deer. The competition between these species for native and cultivated foods has become severe. It is from this tract that they have been trapped for restocking.