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DAILY AND SEASONAL ACTIVITY PATTERNS OF BOBWHITE QUAIL ON THE AEC SAVANNAH RIVER PLANT

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INTRODUCTION

While conducting a study of reptile activity and habitat-distribution on the Savannah River Plant, roadside census data were also gathered on bobwhite *(Colinus virginianus)*, mourning dove *(Zenaidura macroura)*, and several of the larger mammals. This paper summarizes daily and seasonal activity patterns of the bobwhite during the warmer months of the year on the Savannah River Plant (hereafter

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referred to as the SRP) in South Carolina. Fluctuations in activity attributable to variation in weather conditions are discussed. The mourning dove activity data are presented in a paper that appears in the published proceedings of this conference. Mammal activity patterns and distribution of game species on the area will be presented in subsequent papers.

Apparently, roadside sight-censuses have not been conducted on bobwhite to determine activity patterns as has been done for some other game species, *e.g.,* the mourning dove and cottontail rabbit *(Sylvilagus floridanus).* Information on the daily movements of bobwhite has been acquired through random field observations, live-trapping data (Loveless, 1958), and radio-telemetry studies (Bartholomew, 1967). Bobwhite are generally considered to be most active in the early morning and late afternoon. They are active during covey breakup and pairing in spring, sedentary during the summer months, and become active again in the fall with covey formation (Murphy and Baskett, 1952).

Scant data exists on the effect of weather on bobwhite. Rain appears to increase movement (Loveless, 1958; Bartholomew, 1967). Bennitt (1951) and Golley (1962) found that increasing temperature reduced the number of calling birds.

DESCRIPTION OF THE AREA

The SRP is located approximately 15 miles southeast of Augusta, Georgia, in Aiken, Barnwell, and Allendale Counties, South Carolina. The 315-square-mile tract is located in the Upper Coastal Plain physiographic province along the Savannah River.

Major climax forest types on the SRP include several hardwood associations and the longleaf pine *(Pinus palustris)*-scrub oak *(Quercus spp.)* association on the dry sand ridges. Man-dominated environments, including roadsides, can usually be classified as mixed forb, grass-forb, or upland grass types (Golley *et al.*, 1965). In addition, much of the area has been planted to pine since the area was closed to the public.

METHODS

Bobwhite were censused along a 58-mile route from 3 May to 16 October, 1965, except for the week of 10 to 17 July. The census route followed a paved road for its entire length. Only birds observed crossing the road or on the maintained roadside were recorded.

The census was designed to include the entire day by dividing it into five time periods which were sampled as follows: Monday, 0449-0936; Tuesday, 0001-0448; Wednesday, 0937-1424; Thursday, 1913-2400; Friday, 1425-1912. The census route was covered at a speed of 20 to 30 mph, and was completed in three to six hours, the length of time varying with the number of reptiles encountered. The direction of traverse was reversed each week. The census was conducted regardless of weather conditions. Time was recorded to the nearest five-minute interval.

An observation consisted of the sighting of a single bird, or group of birds acting as a single unit. Observations were recorded as single birds, pairs, broods (adults with young), or coveys. Activity, for the purpose of this paper, is defined as the movement or presence of birds on the road or roadside.

The daily and seasonal activity data were tested for significant differences by the Duncan's new multiple-range test (Duncan, 1955). The daily activity data were grouped into two-hour periods. The seasonal activity data were grouped both into weekly and 23-day periods.

Weather data for each census day were obtained from monthly summaries from the United States Weather Bureau station in Augusta, Georgia. A least-squares multiple regression was used to determine if any correlation existed between weather conditions and bobwhite activity. The ten weather factors considered in the analysis were: average, maximum, and minimum temperature; maximum and minimum relative humidity; total rainfall; average barometric pressure; average wind velocity; average percentage cloud cover; and the presence of light or heavy fog.

RESULTS

Daily Activity Pattern—A total of 199 bobwhite observations were recorded during the study period. Only one was observed after sunset, and only two prior to sunrise (Figure 1). These three observations were of single individuals active within one-half hour after sunset in May and before sunrise in September. The observations indicate that the roadside activity of bobwhites from the beginning of May to mid-October is limited to the daylight hours between official sunrise and sunset.

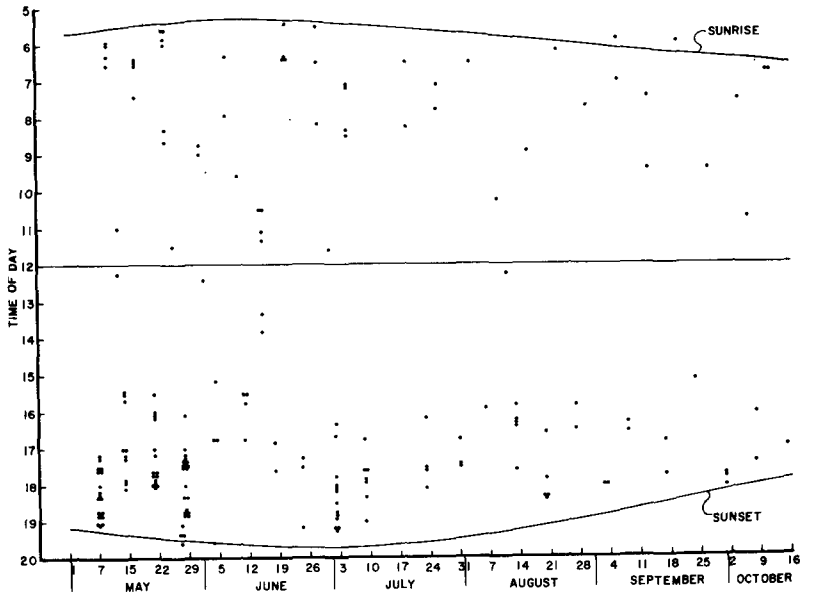

Figure 1. Times of the day and year of 199 bobwhite roadside observations recorded on the census route on the Savannah River Plant from 3 May to 16 October, 1965. Each point represents an observation of a single bird, pair, or group of birds.

The roadside activity pattern was bimodal, with one peak of activity in the morning and another in late afternoon (Figure 2). Roadside activity was low during midday. No bobwhite were observed from 1400 to 1500 or at night during the study period.

There was considerably more activity in the afternoon than in the morning. Only 30 per cent of the observations occurred from sunrise to 1300, while 70 per cent were recorded from 1301 to sunset. Over one-fourth (26 per cent) of the observations occurred from 1701 to 1800, with 13 and 17 per cent of the observations occurring in the hours immediately before and after, respectively. The morning activity peak occurred from 0601 to 0700 (8 per cent). Singles, pairs, and groups of birds follow this same general pattern throughout the season (Figure 3).

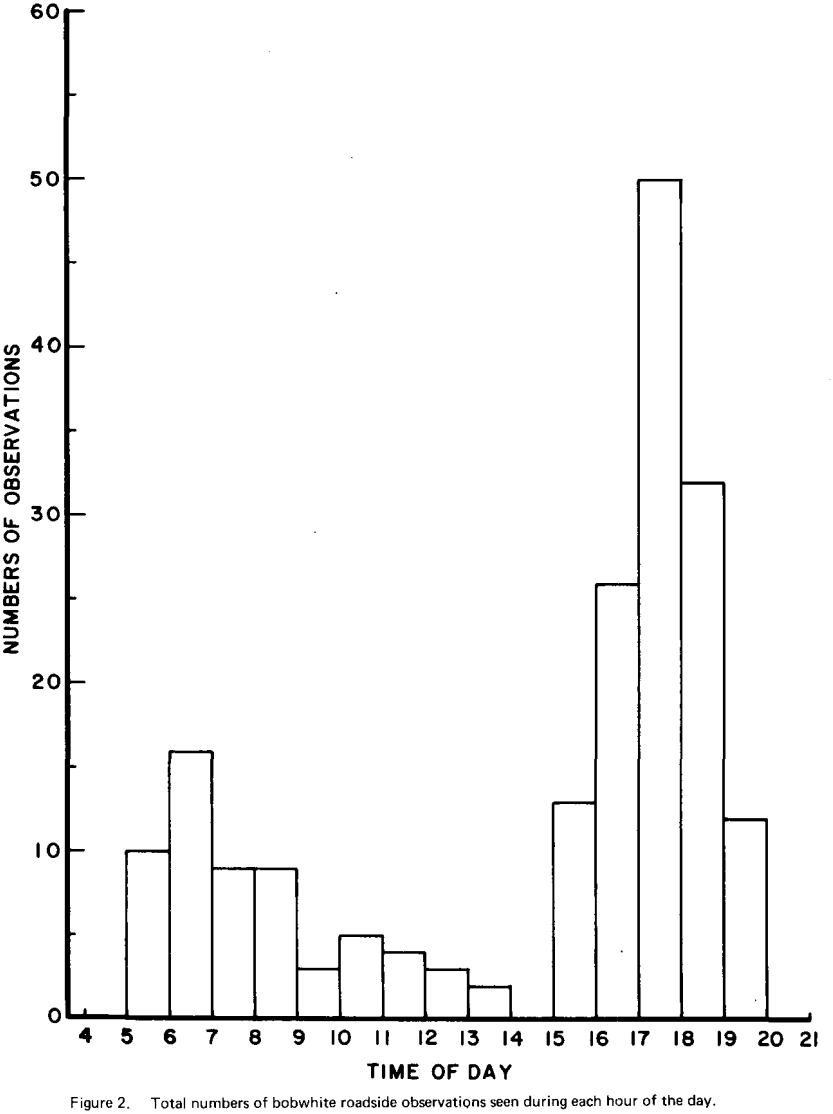

Figure 2. Total numbers of bobwhite roadside observations seen during each hour of the day.

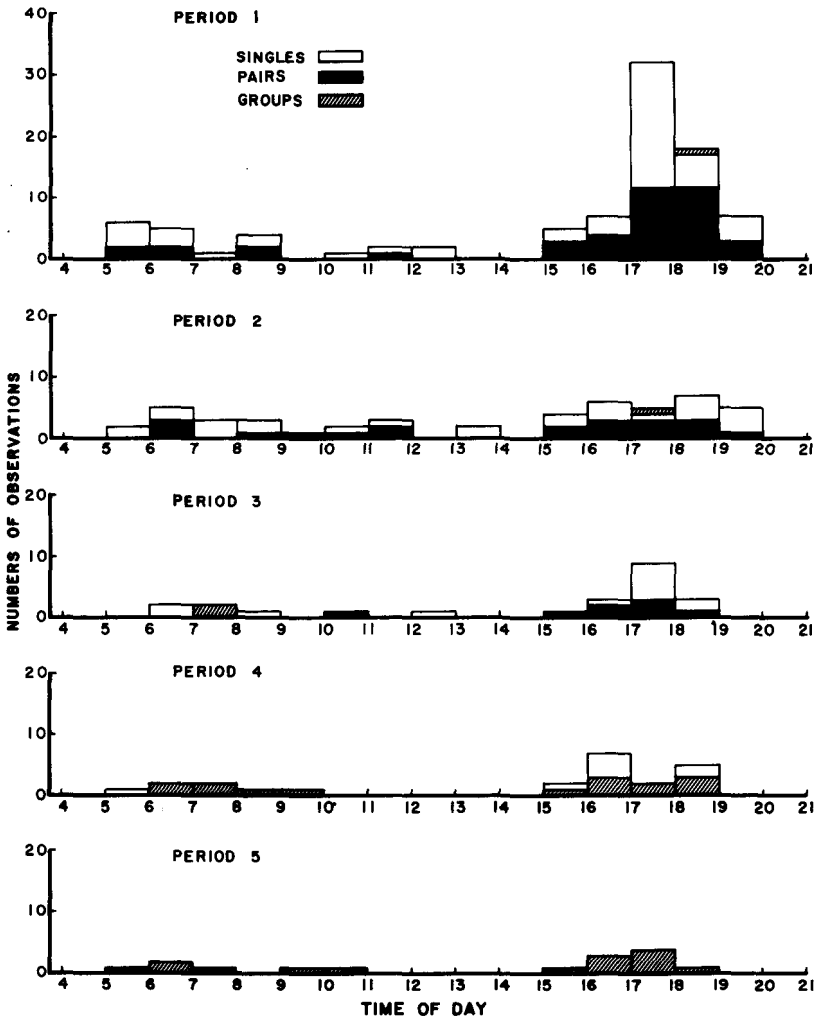

Figure 3. Total numbers of bobwhite roadside observations seen during each hour of the day within each 23-census-day period of the study. Groups include adults with broods during the breeding season and coveys. (Period 1, 3 May–2 June; Period 2, 3 June–5 July; Period 3, 6 July–12 August; Period 4, 13 August–14 September; Period 5, 15 September–16 October).

The two-hour period 1701-1900 contained significantly more observations than any other two-hour period (Table 1). Low activity from 0901-1500 was not significantly different from nighttime activity from 1901-0500.

TABLE 1

Comparison of numbers of bobwhite observations seen within two-hour intervals during the day from 3 May to 16 October.

Hours	Observations	
0101-0300	0	e*
0301-0500	0	e
0501-0700	26	bc
0701-0900	18	cd
0901-1100	8	de
1101-1300	8	de
1301-1500	2	e
1501-1700	39	b
1701-1900	86	a
1901-2100	12	de
2101-2300	0	e
2301-0100	0	e

*Means having similar letters are similar at the $P \leqslant .05$ level.

Considering bobwhite activity in relation to times from sunrise and sunset, they were most active in the first two hours following sunrise and over a three-hour period before sunset (Figure 4). Although a small peak in activity is indicated by the data, the number of observations are similar in the three hours prior to sunset.

Seasonal Activity Pattern — A total of 520 individual birds were observed during the study period. The statistical tests indicated no significant differences in the number of birds observed when the data were grouped on a weekly or 23-census-day basis. The data indicated high roadside activity during May when grouped into bi-weekly periods (Figure 5). Roadside activity decreased in June and remained relatively low to mid-August. After mid-August, the number of birds seen along the road increased to a level similar to that observed during May.

Effect of Weather on Activity—The least-squares multiple regression indicated that none of the ten weather factors considered in the analysis had a significant effect on bobwhite activity.

DISCUSSION

Throughout the study period from 3 May to 16 October, bobwhite maintained two daily activity peaks, one in early morning and the second in late afternoon. Trapping data from April to December from southern Florida (Loveless, 1958) and observations from Iowa (Klimstra, 1950) also demonstrated early morning-late afternoon activity peaks. Whereas our data indicated over twice as much activity in the afternoon as in the morning, Loveless concluded that bobwhite were more active in early morning. However, unpublished trapping data from the SRP indicated greater afternoon activity.

Brood observation data from the SRP (Fatora *et al.*, 1966) and nest and brood data from studies in adjoining regions (Stoddard, 1931; Speake and Haugen, 1960) have illustrated that there are more pairs incubating during May than at other times during the breeding season. Our data indicated that most pairs (83 per cent) were active in late afternoon during this period. Stoddard (1931) and Klimstra (1950) have observed that cocks usually wait for the incubating hen, and the pair participates in the "recreation" period together. The "recreation" period, during which they feed, water, and dust, occurs primarily in late afternoon, particularly in late stages of incubation (Klimstra, 1950).

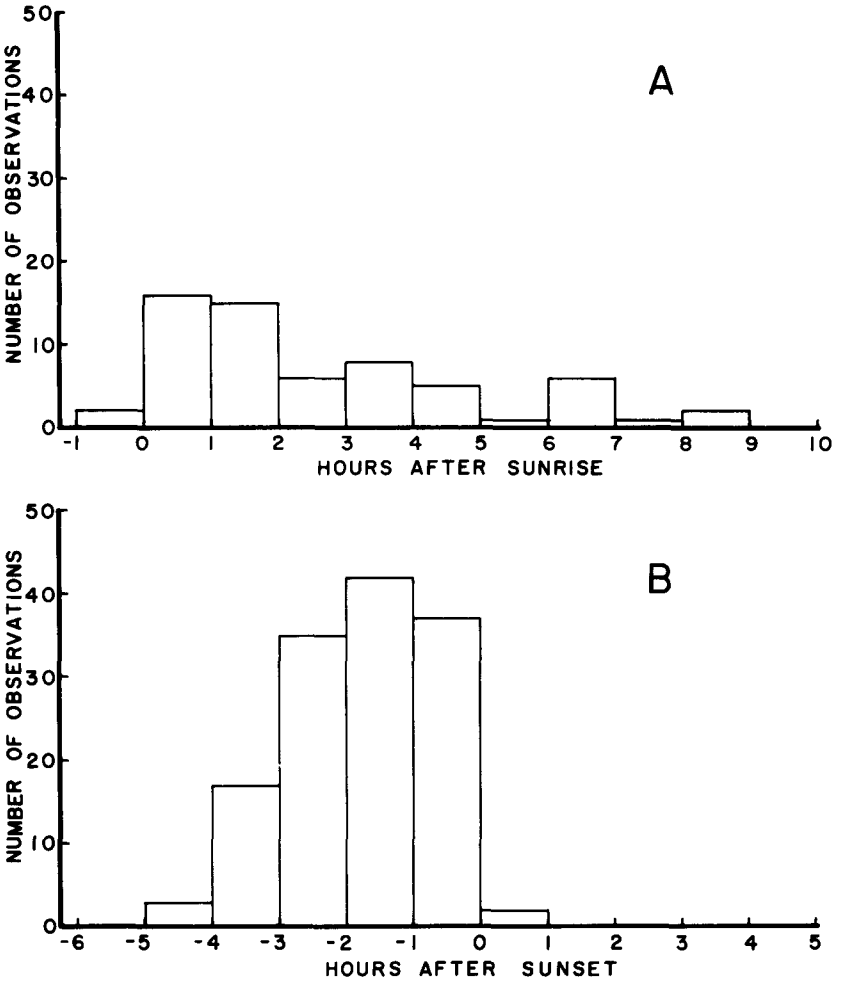

Figure 4. Total numbers of bobwhite roadside observations seen within hourly intervals from times of official sunrise (A) and sunset (B). Time of official sunrise and sunset was set at zero (0).

Many observations during May were of single birds. Although one member of a pair could have escaped detection due to the observer not leaving the vehicle to flush the bird, most of these were probably unpaired. The sex of these single birds was not recorded on the road censuses, but unpublished data from the SRP and from Iowa (Klimstra, 1950) showed that most of these single birds are males, apparently unmated. Contrary to Robinson's (1963) results, which showed that breeding males preferred brighter light intensities, these unmated males exhibited an activity pattern similar to paired birds.

Bobwhite on the SRP moved little during midday. Loveless (1958) found midday trapping so unproductive that it was terminated. Robinson (1957) in Kansas and Bartholomew (1967) in Illinois observed that coveys had specific areas for midday loafing. Klimstra (1950) noted that during the breeding season unmated males were usually dusting, loafing, or sunning during midday.

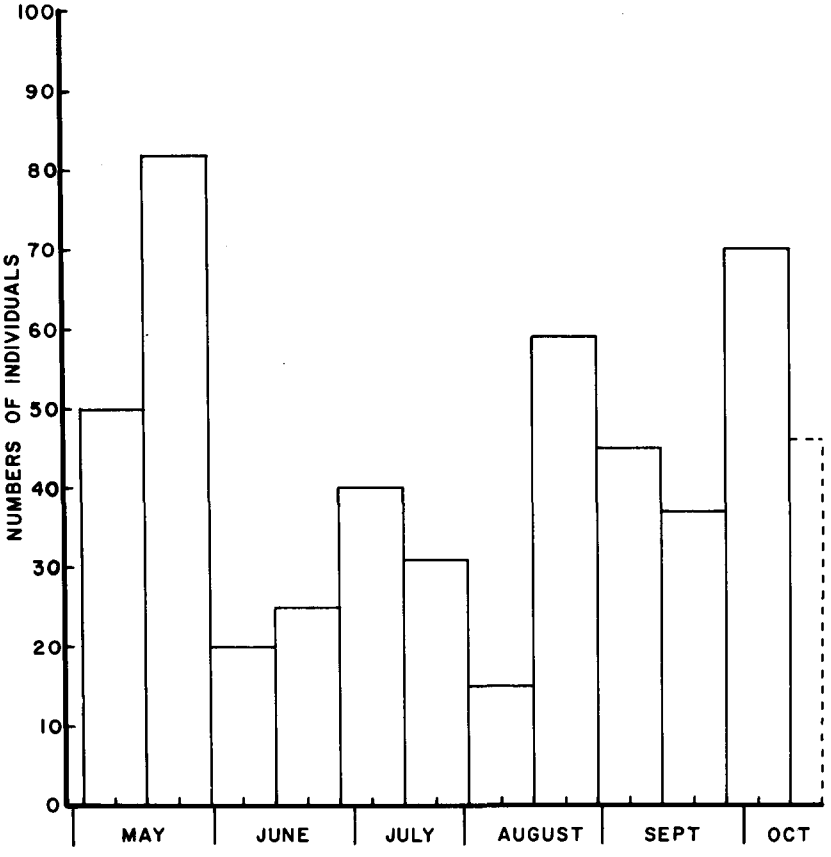

Figure 5. Total number of bobwhite seen within two-week intervals along the census route on the Savannah River Plant from 3 May to 16 October, 1965. The week of 10-17 July was not sampled. The dashed bar in October represents a one-week interval.

Laboratory studies by Robinson (1963), in which birds were placed in an environmental chamber with a continuous illumination gradient demonstrated that bobwhite prefer low light intensities. In earlier field observations, Robinson (1957) found birds primarily in situations where incident light was of low intensity, although they rarely select the darkest situations available. He suggested that movements cease at approximately one foot-candle, which could account for the apparent limiting effect of sunrise and sunset. Robinson (1963) further suggested that 1000-2000 foot-candles of incident light, or 10-20 per cent of that available at midday under a clear sky in middle latitudes, is a reasonable estimate of the upper tolerance limit when breeding males were excluded. Afternoon activity on the SRP appeared to commence at approximately the same time, regardless of the fluctuating time of sunset. This could suggest that activity is initiated when light intensity falls below the maximum light tolerance level.

Bobwhite were very active during the early part of the breeding season in May. During this time the mated pairs would be involved in selecting nesting sites and in constructing nests. The roadside count includes many unmated males. Loveless (1958) suggested that unmated males move about to a greater extent than females. Their extensive movements and other activities, *i.e.*, persistent calling (Stoddard,

1931), which make them conspicuous, would increase the chance of being seen during the censuses. Activity then decreased through June when the young were beginning to hatch to a low in July and early August. Many pairs would have broods of young with them during this latter period. During this time, birds with young are extremely difficult to locate (Fatora *et al.*, 1966), as they keep to dense cover. Mobility then increased from mid-August to mid-October as the young grew older, and the "fall shuffle" commenced. Murphy and Baskett (1952) in Missouri also found bobwhite to be sedentary during the summer with an increase in mobility occurring in the fall.

The lack of correlation between weather conditions and bobwhite activity may be attributable to two factors: (1) the weather data were daily means or totals rather than the existing weather conditions at the time of the census; and, (2) the length of the census route and the distance of the Weather Bureau station from the SRP may have obscured any relationships between daily activity and weather conditions along the route.

Other studies have shown that certain weather factors have an influence on activity. Bartholomew (1967) determined that heavy rain caused lengthy movements in Illinois bobwhite, although they sought shelter from prolonged rain. Loveless (1958) captured more birds on cool, cloudy days with light precipitation than on clear, hot, dry days. These included a few midday captures, which could have been the result of the low light intensities normally associated with these weather conditions. Unpublished observations from the SRP indicate that birds are less active immediately preceding a storm.

Thus, bobwhite appear to be more active during rainy weather, although this could be the result of lower light intensities under these conditions.

SUMMARY

Bobwhite were censused along a 58-mile route on the Savannah River Plant in South Carolina from 3 May to 16 October, 1965, to determine daily and seasonal activity patterns. Activity was limited to the daylight hours between official sunrise and sunset. Bobwhite maintained two activity peaks throughout the study period, one in early morning and another in late afternoon, with considerably more activity in the afternoon. The morning peak occurred from 0601-0700 and the afternoon peak from 1701-1800. Midday activity was low. Afternoon activity appeared to commence at about the same time throughout the study period. During the breeding season, both paired birds and unmated males had similar activity patterns. Roadside activity was high during May, decreased in June remaining relatively low to mid-August, and increased from mid-August to mid-September to a level similar to that observed in May. None of the ten weather factors examined had a significant effect on activity.

ACKNOWLEDGMENTS

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FLUCTUATIONS IN TESTICULAR CONDITION OF COTTONTAIL RABBITS IN GEORGIA[1]

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ABSTRACT

A total of 500 male cottontail rabbits were collected over a two year period from the Coastal Plain, Piedmont, and Mountain physiographic regions of Georgia. Adult testes weight, volume, length, and diameter were recorded, epididymides checked for convolutions and presence of viable sperm, and relative condition of the testes noted as to flaccidity or turgidity and ascended or descended. Regression analysis was performed on young of the year testes growth (volume and weight) and increasing age (eye lens weight).

The data revealed that weight and volume were more sensitive indicators of testes condition than length and diameter. No significant seasonal differences were noted in weight and volume between regions and between Georgia and northern states. A close correlation existed between testes volume and percentage of females pregnant. Males in the Coastal Plain and Piedmont regions were apparently capable of breeding by January of 1966 and 1967. A notable decline in testicular activity was observed the last of June and first of July in 1966 and 1967. No significant relationship was found between increasing age of young of the year and increasing testes weight and volume.

INTRODUCTION

With the exception of the work by Heard (1962) and Hill (1965) in Mississippi and Alabama respectively, information is scarce concerning cottontail rabbit

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