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REPRODUCTIVE ECOLOGY OF NORTHERN BOBWHITE IN NORTH FLORIDA

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Abstract: Brood habitat use and summer mortality of northern bobwhite (*Colinus virginianus*) chicks and adults were studied from 1984 to 1986 at Tall Timbers Research Station near Tallahassee, Florida. Adult bobwhite (n = 134) were radio-tagged and monitored throughout the breeding season. Fifty-four nests were located and 227 bobwhite chicks were monitored to determine reproductive output and brood status. Counting chicks on the roost at night provided reliable estimates of brood size reduction. Chick loss rates were 62% to 2 weeks and 71% to 1 month posthatch. Adult mortality from 15 May to 15 October for combined years was 31%. Seventy-one percent of females surviving to 15 October produced a brood (defined as >1 chick surviving to 2 weeks of age). Fourteen percent of males which survived the summer incubated a nest and produced a brood. Brood locations were analyzed for vegetative structure, composition, and insect abundance and compared to random plots. An inverse correlation ($P < 0.05$) existed between insect abundance and brood home ranges at 2 weeks. However, there was no correlation between insect density and chick mortality ($P > 0.05$). Brood locations had a greater ($P < 0.05$) occurrence of *Compositae*, *Gramineae*, *Leguminosae*, *Rosaceae*, and shrubs than random locations. Preferred brood areas were old (>5 years), fallow fields with a scattering of shrubby thickets and a relatively open tree canopy. Two cases of double clutching occurred in which females successfully raised a brood to 1 month of age and subsequently were found incubating a second nest.

Key words: brood, *Colinus virginianus*, habitat, mortality, northern bobwhite, north Florida.

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Over 50 years of research has generated nearly 2,800 papers on the life history and management of northern bobwhite (Scott 1985). Many studies have concentrated on fall/winter habitat management, food habits, and population biology. Traditional bobwhite management is fairly well understood (Kellogg et al. 1972); however, knowledge of breeding season ecology and summer habitat use is limited. The ability of researchers to observe adults and broods in lush summer vegetation is one of the principal problems encountered in breeding-season research. Several studies have addressed nesting/brood chronology, nesting habitat, and adult mortality and attempts have been made to estimate recruitment of chicks into the fall population (Stoddard 1931, Lehmann 1946, Klimstra 1950, Speake and Haugen 1960, Dimmick 1972, Simpson 1972, Dimmick 1974, Roseberry and Klimstra 1984). Much of these data were gathered through intensive searches in nesting habitat, vegetative sampling of nest sites, brood observations throughout the summer, banding, and harvest data.

Hurst (1972) and Jackson et al. (1987) studied preferences of chicks for various insects and insect densities in various vegetation types thought to be good brood habitat. They emphasized the importance of insect abundance to survival of growing chicks.

Survival of juvenile bobwhite immediately posthatch is 1 of the most important but least documented aspects of quail biology (Roseberry and Klimstra 1984). The cryptic coloration and freezing behavior of young chicks make observation difficult. Group rearing, brood switching, double clutching, and adoption also appear to be more common than previously believed, thereby increasing variability in survival estimates (Curtis et al. 1993). It is generally agreed that the first 2 weeks of life are the most critical to survival of chicks due to flightlessness, lack of protective feathering, and high protein requirements (Stoddard 1931, Klimstra 1950, Fatora et al. 1966, Hurst 1972). Current estimates have been derived from brood surveys and based on average size of broods sighted of a given age throughout the breeding season. Estimated losses are highly variable but are commonly around 50% to 5 months of age.

In addition to the lack of brood/chick information, little data exist on survival and timing of

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mortality on adults during the reproductive season. The extent of adult mortality during nesting and brood rearing largely determines the size of the fall population (Roseberry and Klimstra 1984, Curtis et al. 1988). Although banding studies and analysis of fall population structure yield invaluable information, such data cannot fully describe the characteristics and importance of survival during spring-summer.

We monitored radio-tagged males and females through 3 breeding seasons to determine (1) adult survival June-October, (2) brood size reduction from hatch to 1 month of age, (3) adult and brood home range sizes, and (4) vegetative structure and insect abundance in brood locations compared to random sites.

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STUDY AREA AND METHODS

Tall Timbers Research Station (TTRS) is located in northern Leon County, Florida, in what is commonly termed "the Red Hills." This area in southwest Georgia-north Florida has a long history of intensive bobwhite management. TTRS consists of approximately 1,300 ha of rolling hills vegetated primarily with loblolly (*Pinus taeda*) and shortleaf (*P. echinata*) pine. Hardwood bottoms interspersed throughout the property consist of sweetgum (*Liquidambar styraciflua*), hickory (*Carya* sp.), and oaks (*Quercus* spp.) with American beech (*Fagus grandifolia*) and southern magnolia (*Magnolia grandiflora*) in the larger "hammocks." Upland pine stands are maintained at a low basal area (5-15 m^2/ha) primarily through the use of annual prescribed fire. These fires also serve to reduce understory vegetation and promote optimum food and cover conditions for bobwhite. Groundcover vegetation is composed primarily of grasses and composites but is also rich in legumes; scattered food plots and fields are planted to small grain crops. A more detailed description of the study site can be found in Smith et al. (1982). Traditionally, the majority of this property has been managed specifically to maintain high bobwhite populations (Kellogg et al. 1972).

Bobwhite were captured using standard funnel traps baited with cracked corn (Stoddard 1931); trapping began in May and continued into July 1984-86. Additional birds were captured when needed by netting roosted pairs or groups of birds at night. All captured birds were banded and held overnight to allow crop contents to be ingested to facilitate transmitter attachment. The following morning, all birds were aged and sexed according to plumage characteristics (Rosene 1969), weighed, and instrumented with radio transmitters developed at TTRS (Shields et al. 1982). Transmitters were chest-mounted and weighed approximately 6 g; Mueller et al. (1988) detected no differential mortality between radio-tagged and unmarked bobwhite using this unit. We did, however, incorporate a 2-week adjustment period during which mortality of instrumented birds was discounted from survival analysis. We believe that this period is necessary for birds to fully adjust to transmitters. Birds radio-tagged in 1984 were used only for brood survival/brood home range analysis.

Survival rates of adult bobwhite were calculated using the Kaplan-Meier staggered entry design (Pollock et al. 1990) which allowed for incorporation of additional birds during the study and the censor of birds due to radio failure or emigration. Agents responsible for mortality were identified as nearly as possible by field sign left at kill sites and postmortem condition of transmitters. We used log rank tests (Pollock et al. 1990) to detect differences in adult survival between years and sexes. Differences in chick survival rates between years were tested by analysis of variance.

Individual birds were monitored 3-4 times a week from June to October each year or until radio-failure or mortality occurred. Nesting behavior was detected after incubation was initiated and a bird was located 2-3 times at the same site. Efforts were made to avoid flushing birds from nests. Incubating bobwhite were monitored once a day until hatch, nest loss, or adult mortality occurred. Eggs were counted during incubation recess periods whenever possible, and the number of chicks hatched per brood was determined from egg shell remains at the nest site. Chi-square analysis was used to detect differences in the number and hatchability of eggs.

Adults with broods were located twice a day until the chicks were 2 weeks old. Flags were tied on vegetation 30-50 m from estimated brood locations to avoid influencing brood movements. Location number and distance/direction to broods were recorded at each location. Brood counts were conducted at approximately 7 and 14 days of age.

Because of the difficulty in counting flightless chicks, we believe that true estimates of brood size could only be obtained by radio-locating the roosted parent at night. Once visual contact was made on the roost, the adult was gently, physically moved off the brooded chicks. Chick counts with this technique were quite successful; however, some adults, particularly males, did not allow close approach and accurate estimates were not attainable until chicks reached flight stage at approximately 2 weeks of age. Weekly flush counts were made of broods older than 2 weeks. Two observers were present on most chick counts to ensure consistency. Other problems encountered in brood counts included adults with chicks other than their own and brooding behavior exhibited by chicks 1 month old and older. Brood size reduction was assumed to be a direct indicator of brood mortality, and although some brood switching was apparent it occurred primarily in the more advanced aged broods (i.e., >2 weeks old).

Brood and adult home ranges were analyzed using Mohr's minimum range technique (Mohr 1947). Adult bobwhite with >20 locations were used in home range estimation. Differences in brood ranges between years were tested by analysis of variance.

All brood locations were sampled for vegetative composition and structure as soon as broods reached 15 days of age. Brood locations were assumed as plot center of a 0.04 ha plot. Flags were tied 10 m from center in the 4 cardinal directions. Insects were collected with 40 sweeps of a sweep net on the compass lines of each brood plot. All vegetation and insects collected in nets were put in 3.8 L glass jars with a 50/50 mixture of alcohol and water. Insects were later separated to orders, and volume displacement for each order was recorded. Chi-square analysis was used to detect differences between brood ranges and random locations. We related 2-week brood home ranges to insect abundance within brood ranges by regression analysis.

Vegetative parameters measured for plots included percent overstory (>2 m) canopy cover by ocular estimate, distance of plot center to ecotone, and number of vegetative intercepts at 1.5 m. A 0.5-m^2 grid was placed 4 times, at equal spacing, on both compass lines; percent chick cover at 15 cm, percent bare ground, species composition, and percent species coverage were recorded in each grid. In 1986, 6 broods used a relatively small area, referred to as the "Gay field" (18 ha), and were analyzed separately. Random plots were sampled identically to brood locations. Chi-square analysis was used to detect differences between brood locations and random plots.

RESULTS

Adult Survival

One hundred and thirty-four adult northern bobwhite were captured and radio-tagged during the 1984-86 field seasons. One hundred and fourteen bobwhite surviving > 2 weeks post release in 1985-86 (n = 60 males and 54 females) were used in mortality analyses (Table 1).

There was no difference in adult summer survival between 1985 (0.664) and 1986 (0.729) (X^2 = 2.689, $P > 0.10$). Female survival from 24 June to 25 August 1985 (0.548) was less (X^2 = 4.069, $P < 0.05$) than that of females surviving the same time period in 1986 (0.819). Survival of females was lower (X^2 = 4.296, $P < 0.05$) than that of males in both years combined. Predation was implicated in all bobwhite deaths; of the 29 total mortalities which occurred over both years, we were able to determine the predatory agent responsible for 27 (93%) of the deaths. Of these, 16 (59%) were caused by avian predators and 11 (41%) were mammalian predation. The proportion of deaths

Table 1. Kaplan-Meier survival estimates ($\hat{S}$) for male and female northern bobwhite radio-tagged at Tall Timbers Research Station, Tallahassee, FL 1985–86.

	Females			Males			Total		
	n	$\hat{S}$	SE	n	$\hat{S}$	SE	n	$\hat{S}$	SE
15 May -11 Jun	54	0.9773	0.0225	51	1.0000	0.0000	105	0.9881	0.0118
12 Jun - 9 Jul	53	0.7921	0.0633	53	0.9219	0.0387	106	0.8559	0.0372
10 Jul - 6 Aug	42	0.8715	0.0574	50	0.9120	0.0442	92	0.8935	0.0347
7 Aug - 3 Sep	32	0.9310	0.0517	39	0.9688	0.0317	71	0.9508	0.0294
4 Sep - 1 Oct	23	1.0000	0.0000	28	1.0000	0.0000	51	1.0000	0.0000
2 Oct -15 Oct	15	1.0000	0.0000	18	0.9444	0.1323	33	0.9697	0.0700

was similar among predatory agents responsible for kills (X^2 = 0.4501, P = 0.5023).

Adult Home Ranges

Summer adult ranges for 1985 and 1986 (n = 53) averaged 16.0 ha, and varied from 3.4 to 47.7 ha. Mean adult ranges were larger (t = 2.91, P = 0.0053) in 1985 (n = 26, 19.8 ± 2.18 ha[SE]) than 1986 (n = 27, 12.3 ± 1.39 ha[SE]).

Nesting and Nest Loss

Fifty-four nests were found during incubation; the fate of 51 could be determined. Clutch size ranged from 4 to 32, and averaged 12.8 eggs. Clutch sizes (X^2 = 0.453, P = 0.562) and success rates (X^2 = 0.318, P = 0.670) for early (before 15 July) and late (after 16 July) nests were similar: early nests (n = 28) averaged 14.1 eggs per nest while late nests (n = 23) averaged 11.3. Early nests had a 39% success rate, late nests 52%, and overall nest success was 45% (36% in 1985 and 54% in 1986). Male bobwhite incubated 19% of the nests found.

Predation on females or nests was the principal cause of nest failure. These factors accounted for 89% of unsuccessful nesting attempts, with nest abandonment accounting for the remainder. We believe that the principal cause of abandonment was researcher disruption. Based upon sign left at or near destroyed nests, we attributed the majority of nest predation to mammals (52%), snakes accounted for 28%, and the predatory agent was unknown for 10% of nest predation. Three females killed during incubation accounted for 10% of both adult deaths and nest failures.

Hatchability rates of successful nests among years were similar: for 1985 it was 0.82 (n = 9) and 0.92 (n = 14) in 1986. The difference between years was not significant (X^2 = 0.421, P = 0.517). Two females which died during brood rearing accounted for 7% of adult deaths. Overall, 13 (72%) females (n = 18) and 3 (14%) males (n = 21) surviving to 31 September produced broods. Two instances occurred in which a female successfully raised at least 1 chick to 1 month of age and was subsequently located incubating a second clutch of eggs. Neither second attempt was successful.

Brood Losses

The 2-week fates of 22 broods could be determined. No difference in 2-week (F = 0.62, P = 0.549) or 1 month (F = 0.29, P = 0.753) chick losses occurred among the 3 years; therefore, all years were combined for analysis of chick mortality. Chick loss rates to 2 weeks between the Gay field broods (78%) and the remaining 1986 broods (46%) (X^2 = 2.77, P = 0.096) was similar. Overall brood success rate was 0.80 (defined as >1 chick surviving to 2 weeks of age). Chick losses averaged 62% to 2 weeks and 71% to 1 month of age. Two-week brood losses ranged from 18 to 100%.

Brood Ranges and Habitat Use

Brood ranges for the 3 years combined averaged 6.5 ha in the first 2 weeks and 10.0 ha to 1 month posthatch. No differences in brood home range size were noted among years (F = 1.61, P = 0.226). Gay field broods had smaller 2-week ranges (3.5 ha) than other broods (7.8 ha; F = 5.53, P = 0.029).

Vegetation in brood habitat (Table 2) was characterized by a higher occurrence of *Compositae* and *Gramineae* (X^2 = 14.802), *Leguminosae* (X^2 = 5.996), *Rosaceae*, and shrubs (X^2 = 5.655) than random plots. Brood locations (Table 3) had less overstory canopy coverage (X^2 = 11.955) and vines (X^2 = 35.890), and more vegetative intercepts at 2.5 m (X^2 = 75.608). Brood rearing areas tended to be fallow fields, burned during the previous 2 years, with patches of shrubby thickets.

The importance of insect abundance to brood habitat quality was apparent. Adults with broods utilized areas of higher insect density (Table 4) than present in random plots (X^2 = 66.770) and occasionally made considerable movements (>0.4 km) to brood-rearing areas. Brood locations had greater volumes of Orthoptera and Homoptera (X^2 = 51.000), Coleoptera (X^2 = 4.882), Hymenoptera and Diptera (X^2 = 4.387), and Hemiptera (X^2 = 5.034) compared to random locations. Insect

Table 2. Frequency of occurrence and vegetative characteristics measured in brood locations and random plots on Tall Timbers Research Station, Tallahassee, FL, 1985-86.

Vegetation type	Brood locations (n = 2,824)	Random plots (n = 768)	P^a
Leguminosae	2,385	557	0.0143
Compositae/ Gramineae	2,716	584	0.0001
Rubiaceae	397	100	0.5196
Rosaceae/shrubs	1,728	399	0.0174
Euphorbiacea	293	82	0.6319
Vines	258	137	0.0000
Miscellaneous	1,618	571	0.0000

[a] P based on X^2 test of hypothesis of no difference in frequency of occurrence between brood and random locations.

volumes in brood locations were higher in 1986 compared to 1985 (X^2 = 108.293, P < 0.001). No differences in insect volumes were noted between 1985 and 1986 random locations (X^2 = 108.293, P = 0.157). Insect volumes in Gay field brood locations were greater than in the remaining brood ranges in 1986 (X^2 = 13.219, P = 0.013). However, non-Gay brood ranges in 1986 had less insect volume than 1985 ranges (X^2 = 33.172, P < 0.001).

An inverse correlation existed between brood home range size and insect densities within brood ranges in 1985 and 1986 (1985, r^2 = 0.521, P = 0.008; 1986, r^2 = 0.479, P = 0.013). Although areas selected by brood-rearing adults had relatively higher insect densities, no correlation between insect densities and 2-week chick loss rates was detected (1985, r^2 = 0.029, P = 0.716; 1986, r^2 = 0.056, P = 0.511; Gay broods, r^2 = 0.415, P = 0.229).

Table 3. Physical parameters measured in brood locations and random plots on Tall Timbers Research Station, Tallahassee, FL, in 1985-86.

Physical parameter	Brood locations (n = 353)	Random plots (n = 96)	P^a
% bare ground[b]	204.74	53.41	0.8284
% overhead chick cover[b]	211.80	48.14	0.3617
% overstory cover[b]	151.79	76.90	0.0050
Distance to ecotone (m)	953.10	277.00	0.6196
Intercepts	18,356.00	1,865.00	0.0000

[a]P based on X^2 test of hypothesis of no difference between brood and random locations.

[b]Values are the sum of proportion per plot.

Table 4. Volume displacement (mL) of insect orders collected in brood and random plots on Tall Timbers Research Station, Tallahassee, FL, in 1985-86.

Insect order	Brood locations	Random plots	P^a
Orthoptera and Homoptera	1,041	157	0.0000
Coleoptera	43	4	0.0271
Hymenoptera and Diptera	23	1	0.0362
Hemiptera	75	10	0.0249
Arachnids	55	9	0.1328
Miscellaneous and larvae	86	16	0.1337
Total	1,326	197	0.0000

[a]P based on X^2 test of hypothesis of no difference in volume displacement of insects in brood plots (total sweeps = 14,320) and random locations (total sweeps = 4,000).

DISCUSSION

Successful reproduction is paramount to huntable fall densities of bobwhite. Little can be done to offset inherently high mortality rates of adult bobwhite in the winter/spring; therefore, providing quality brood rearing habitat is essential. Although reproduction is broadly regulated by uncontrollable climatic conditions (Lehmann 1946, Speake and Haugen 1960, Rosene 1969, Klimstra and Roseberry 1975), efforts should be made to provide quality escape cover for adults, patchy nesting sites, and high insect density areas for brood production.

Our summer adult mortality estimates (30%) were somewhat lower than those reported by other researchers. Roseberry and Klimstra (1984) estimated average summer mortality to be nearly 40% over a 16-year period, while Rosene's (1969) estimate was a range of 52-63%. Speake and Sermons (1987) reported summer female mortality in a radio-tagged sample at 64%, with avian predators responsible for 54% of known bobwhite deaths. Cantu and Everett (1982) reported breeding season mortality in radio-tagged females to be 44% in 1980 and 57% in 1981. Our female mortality estimates (45 and 30% in 1985 and 1986, respectively) are similar to the preceding 2 researchers' estimates of radio-tagged female mortality.

Early spring mortality associated with migrating hawks may contribute to seasonal variation in productivity if losses are not compensated for in the breeding season. Losses in early- and mid-summer, such as found in our study in 1985, can have substantial impacts on overall production (Stoddard 1931, Roseberry and Klimstra 1984, Simpson 1972, Speake and Sermons 1987) by removal of reproductively active adults. Stoddard (1931), Simpson (1976), Speake and Sermons (1987), and Curtis et al. (1988) noted that mortality rates of females during summer are higher than those of males and speculated that reproductive stress associated with nesting/brood rearing duties were primarily responsible for increased vulnerability. It was also interesting to note that 47% of the 1985 mortality was associated with 2 nesting pairs of Cooper's hawks (*Accipiter cooperii*) which, combined, accounted for 27 known bobwhite deaths (based on breastbone counts and not limited to radio-tagged birds) in June, July, and August. Bobwhite represented >70% of the identifiable remains in these 2 nests. Although survival of adults, in particular females, was not different throughout the summer, mortality in 1986 was spread more evenly through the season.

Nest success rates also depend upon a variety of environmental parameters including weather, predator densities, nest concealment, and number and size of nesting areas. Simpson (1972) reported an average nest success rate of 18% in south Georgia, and Dimmick (1974) recorded a 23% rate for Tennessee. Stoddard (1931) examined 602 nests in north Florida and south Georgia and found a 36% success rate. However, these estimates included nests which were not yet at incubation stage. Roseberry and Klimstra (1984) found 33% of all used nests were successful and varied from 25 to 53%. Speake and Sermons (1987) reported a 52% incubated nest success rate during 1984-86 in central Alabama. We found similar postincubation results in our study with success rates of 36% in 1985 to 52% in 1986.

The survival of young chicks and their recruitment into the fall population is important not only for summer habitat management, but for harvest strategies as well (Roseberry and Klimstra 1984). Based on long-term records, Roseberry and Klimstra (1984) estimated chick loss rates to be 25-47% from hatch to fall. Brood mortality studies using radio-tagging yield much higher mortality rates of chicks. Cantu and Everett (1982) studied radio-tagged females in Texas and the fate of 5 broods from hatch to 2 weeks of age. Out of 55 chicks recorded to have hatched, 7 (13%) survived to 2 weeks of age (87% loss). In a radio-tagging study of females and 20 associated broods in Alabama, Speake and Sermons (1987) found that 64% of chicks hatched were lost by 2 weeks of age and 75% were lost within 1 month. Undoubtedly, chick losses are neither consistent from brood to brood nor year to year. Our results support the higher chick mortality rates found by Cantu and Everett (1982) and Speake and Sermons (1987); however, other factors such as double clutching and male/single parent broods may offset these high losses (Curtis et al. 1993).

Annual TTRS adult survival estimates (Curtis et al. 1988), coupled with our data on summer reproductive output, yield a realistic example of a stable population. Low chick mortality estimates previously reported from observational surveys indicate a high rate of population increase, which is undoubtedly not the case across the majority of the bobwhite's range. In addition, higher summer mortality rates reported in other telemetry studies may be overestimations due to excessive predation caused by transmitter design or mounting technique.

Brood habitat management is rarely defined, because individual components of quality brood range are relatively unknown. Cantu and Everett (1982) felt that woody cover for shade and protection and high percentages of bare ground were of most importance to young broods. Speake and Sermons (1987) found 51% of brood locations were in fire-managed upland pine woodlands, and Hurst (1972) showed that burning increases densities of certain insects. We also noted that most of our principal brood-rearing areas and high insect densities were found in fire maintained upland pine habitat types, especially those where fields were left fallow for several years and were being incorporated back into the woodland management system (i.e., burning and mowing).

The importance of high densities of available insects to chick survival cannot be overstated. Bobwhite with broods appeared to select for brood-rearing areas which had higher concentrations of insects. Brood areas had higher insect densities in 1986; however, one reason for this may have been the superior brood habitat utilized in the Gay field area. Although no differences in chick mortality were noted in high brood use areas, it may be advantageous for females to avoid brood concentration areas due to prey specific searching by predators who "learn" of these areas. Our data characterize quality brood range as open, fire-maintained uplands with greater than average densities of composites, legumes, grasses, *Rosaceae*, shrubs, and lower coverage of vines. Brood habitat includes 50% bare ground and 50% overhead chick cover, <40 m from an ecotone (especially field borders) with approximately 40% overstory canopy coverage and high insect densities.

MANAGEMENT IMPLICATIONS

The ability of northern bobwhite, across their range, to successfully nest, hatch broods, and raise a portion of their young to be incorporated into fall populations is paramount to offsetting inherently high adult losses throughout the year. High mortality rates of chicks less than 2 weeks of age indicate that, prior to reaching flight stage and homeothermic independence, they are preyed upon heavily, primarily by ground predators (Stoddard 1931) or may succumb to environmental factors possibly including starvation. The importance of insects in the diet of these young chicks has been reported. Insect availability, low-growing vegetation with a high percentage of open ground for ease of movement, and overhead cover for chicks may be the most important components. Tiny insects must also be concentrated at approximately 0-10 cm above the ground and chick movement must be relatively unrestricted. Quality brood habitat must also be well distributed to avoid concentrations of broods into small patches, yet also be in close proximity to optimum nesting areas. Large movements or high concentrations of broods may serve to increase their chances of mortality. Finally, adults must survive long enough in the breeding season to successfully nest and raise young to make a contribution.

Bobwhite densities were reported to be unusually high during the tenant farming era in the South (Stoddard 1931), probably due to the many scattered, weedy fields; an abundance of open cover; strong use of prescribed fire; and predator control. He also noted that these tenant "management" systems created "enormously increased food supply, and with lessened natural enemies, the bird in this early stage of agriculture experienced favorable conditions that perhaps never before or since have been equalled." Faced with current declines in bobwhite populations across the Southeast (Johnson 1985), a reevaluation of our management techniques may be in order and a look back to the "good old days" may reveal some forgotten ideas.

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