Northern Bobwhite Brood Habitat Use in South Georgia

Steven W. Yates, *Alabama Cooperative Fish and Wildlife Research Unit, Department of Zoology and Wildlife Science, Auburn University, AL 36849*

D. Clay Sisson, *Auburn University, Department of Zoology and Wildlife Science, c/o Pineland Plantation, Rt. 1 Box 115, Newton, GA 31770*

H. Lee Stribling, *Department of Zoology and Wildlife Science, Auburn University, AL 36849*

Dan W. Speake, *Department of Zoology and Wildlife Science, Auburn University, AL 36849*

Abstract: Providing habitat to recruit young into a population with high rates of annual turnover is vital if stable populations are to be maintained. We studied habitat selection using radio-tagged northern bobwhites (*Colinus virginianus*) with broods ≤2 weeks old on 2 intensively managed quail hunting plantations in southwest Georgia from 1992 to 1994. Habitat selectivity was analyzed using 1,443 locations from 75 broods. Fifty-eight of the 75 broods preferred fallow fields with use greater than expected ($P \leq 0.05$). Insect abundance in fallow fields was significantly ($P \leq 0.05$) greater than in other potential brood habitats. Fallow field management for bobwhite brood habitat is discussed.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 49:498–504

Providing habitat to recruit young into a population that experiences high rates of annual turnover is vital if the populations are to be maintained. Few species illustrate this principle more clearly than the northern bobwhite whose annual mortality in the southeast ranges from 70%–80% (Speake 1967, Simpson 1976). Bobwhites compensate for this high rate of annual turnover with reproductive efforts characterized by renesting attempts when nests are abandoned or depredated (Stoddard 1931, Lehmann 1946, 1984; Rosene 1969, Johnsgard 1973, Roseberry and Klimstra 1984) and production of second broods during the same reproductive season (Sermons and Speake 1987, Curtis et al. 1993, DeVos and Mueller 1993). Newly hatched bobwhite chicks rely on insects as a

source of protein during the first 2 weeks of life (Stoddard 1931, Nestler et al. 1942, Hurst 1972); therefore, habitats providing insects would be critical to any management scheme.

Although diet of bobwhite chicks has been studied and optimal feeding habitats have been described, little research has been conducted regarding actual brood use of habitat types in pyric pine forests of the southeastern coastal plain. Sermons (1987) and DeVos and Mueller (1993) included brood habitat use in studies of bobwhite reproductive ecology. Sermons (1987) reported that hens ($N = 12$) with broods preferred small cultivated plots in Alabama. DeVos and Mueller (1993) reported that 22 brood rearing areas in north Florida tended to be upland pine woods burned during the previous 2 years. The objective of this study was to evaluate habitat use by a large sample of brood-rearing adult bobwhites on plantations with a long history of intensive quail management.

We thank the staff of Pineland and Nilo plantations for their assistance, Alabama Agricultural Experiment Station Project ALA 13-0066, and the Alabama Cooperative Fish and Wildlife Research Unit. Assistance in data collection was provided by T. DeVos, T. English, J. Sholar, and D. Toole. We are especially indebted to the R. K. Mellon Family Foundation and Eugene Williams for providing funding for this project and granting access to their plantations. Additional funding and support was provided by numerous other plantations and individuals, several southeastern Quail Unlimited chapters, and the Georgia Department of Natural Resources, Wildlife Resources Division. This study published as Alabama Agricultural Experiment Station Journal Series 15-965216.

Methods

Brood habitat was studied using radio-telemetry and insect sampling by sweep net collection. Study areas were a 1,080-ha portion of Pineland plantation and a 516-ha portion of Nilo plantation located in Baker and Dougherty counties, respectively, in southwest Georgia. This portion of the upper coastal plain is typified by the Orangeburg-Lucy-Grady soil associations with slopes ranging from 0%–8%. The area is dominated by large privately-owned hunting plantations that have been managed for northern bobwhite for >50 years. Areas of intensive row crop agriculture are interspersed throughout the area.

Habitat on these plantations consists of mature pine forests maintained in an open condition by frequent prescribed burning interspersed with a network of small fields and woodland "bird patches." Most timber is longleaf pine (*Pinus palustris*), but a significant portion also is mature planted slash pine (*Pinus elliottii*). Pine stands are interspersed with live oaks (*Quercus virginiana*), southern red oak (*Quercus falcata*), and water oak (*Quercus nigra*). Pine basal area is maintained at 9–14 m^2/ha, which combined with the frequent burning, provides a lush herbaceous understory. A network of fields is maintained in a system of rotational farming and seasonal disking in October resulting in lush herbaceous

vegetation in summer consisting mainly of ragweed (*Ambrosia* spp.) and partridge pea (*Cassia* spp.). Small plots, usually referred to as "bird patches," are scattered throughout the woodlands and are planted annually in small grains [i.e., milo (*Sorghum vulgare*) and browntop millet (*Panicum fasciculatum*)]. A detailed description of the Nilo study area can be found in Simpson (1976). The habitat is generally very productive for quail and supports some of the highest densities in the southeast (D. C. Sisson, unpubl. data).

In March and April 1992–1994, we live-trapped bobwhites in corn-baited funnel traps (Stoddard 1931). Captured birds were sexed, aged, weighed, and banded with sequentially numbered No. 7 aluminum leg bands, instrumented with a chest mounted radio transmitter similar to those described by Shields et al. (1982), except they had no body loop, and released near the capture site. Each individual was monitored at least weekly to determine location and occurrence of mortality until nesting activity was noted. Following onset of incubation, nests were flagged and monitored at least daily to determine fate of the nest. When the hen left the area, the nest was located and checked for hatching or depredation. If hatching had occurred we estimated number of chicks in the brood.

Intensive monitoring of brood habitat use began on the first day post-hatch and continued for 2 weeks. Brood locations were taken at least 3 times daily with 1 location taken in the morning, mid-day, and afternoon periods. Brood telemetry locations were determined using a hand-held directional antenna and receiver. Due to the small patch nature of much of the habitat present and the relatively short transmitter range, triangulation of readings did not provide clear habitat use data. Most telemetry locations were determined by approaching broods as closely as necessary to accurately determine habitat use without disturbing the broods (Sisson et al. 1991, Stauffer 1993). Vegetative cover was sufficiently thick in most cases that broods were not disturbed by our presence. Telemetry locations were plotted on aerial photographs as they were collected in the field.

We examined equality of percentage habitat use and availability using Chi-square analysis ($P \leq 0.01$). A family of 95% confidence intervals ($P \leq 0.05$) were computed for proportion of brood locations in a given habitat (Neu et al. 1974, Byers et al. 1984) and compared to values of habitat availability. We calculated use minus availability for each brood to measure variability among individuals (Thomas and Taylor 1990). Available habitat was defined as that area encompassing all brood locations. Percentages of each habitat type were measured by a planimeter on aerial photographs. Area of burned versus unburned pine woodlands was different each year and was mapped and measured following burning.

Insect samples were collected in 1994 to compare among potential brood habitats. Samples were collected following procedures modified from Sisson et al. (1991). Six replications of each of 4 potential brood habitats (fallow fields, corn strips on field edges, burned woods, woodland bird patches) were each

subjected to 100 sweeps from a 40-cm hoop diameter sweep net in early July. Invertebrates were killed in the field by immersion in isopropyl alcohol, then taken to the lab and measured volumetrically based on displacement of water in a 100 ml graduated cylinder. Volume of insects from each habitat was compared by analysis of variance (ANOVA). Duncan's New Multiple Range Test (DNMRT) was used to distinguish means that were significantly ($P \leq 0.05$) different.

Results

The study on Pineland included 3 reproductive seasons (1992–1994), while only 1 reproductive season was examined on the Nilo study area (1994). We monitored 86 broods which included 30 broods in 1992, 9 in 1993, and 47 in 1994. Brood habitat selectivity was based on 1,443 locations of 75 broods that were continuously monitored for ≥1 week.

Habitat use differed from expected use ($P \leq 0.01$). In each year of the study, brood use of fields was greater ($P \leq 0.05$) than expected while use of burned pine woods was less ($P \leq 0.05$) than expected (Table 1). Unburned pine woods were used proportional to availability or less in 2 years (1993 and 1994). In 1992, unburned pine woods were used more than expected.

Although habitat selection varied among broods, fields were used greater than available by 58 of 75 broods (77.3%). Annually, burned pine woods were used in greater proportion than their availability by 16 broods and unburned pine woods were used more than their availability by 17 broods.

We obtained 2,400 sweeps from 24 separate insect samples. The preferred

Table 1. Simultaneous confidence intervals using the Bonferonni approach for habitat use by northern bobwhite broods in Baker and Dougherty counties, Georgia, 1992–1994.

Year	Habitat type[a]	Expected proportion of usage	Actual proportion of usage (P)	Bonferonni interval for P
1992	F	0.1825	0.3898	$0.3218 \leq P \leq 0.4578$[b]
	PA	0.7014	0.3661	$0.2989 \leq P \leq 0.4333$[b]
	PR	0.1161	0.2441	$0.1842 \leq P \leq 0.3040$[b]
1993	F	0.1762	0.4660	$0.3483 \leq P \leq 0.5837$[b]
	PA	0.5674	0.2718	$0.1668 \leq P \leq 0.3768$[b]
	PR	0.2563	0.2621	$0.1583 \leq P \leq 0.3659$
1994	F	0.1800	0.4165	$0.3665 \leq P \leq 0.4665$[b]
	PA	0.5155	0.4057	$0.3559 \leq P \leq 0.4555$[b]
	PR	0.3045	0.1777	$0.1389 \leq P \leq 0.2165$[b]
1994[c]	F	0.1403	0.5558	$0.4996 \leq P \leq 0.6120$[b]
	PA	0.5312	0.2746	$0.2241 \leq P \leq 0.3251$[b]
	PR	0.3285	0.1696	$0.1271 \leq P \leq 0.2121$[b]

[a]Habitats: F = fields, PA = annually burned pine woods, PR = unburned pine woods.
[b]Indicates a difference at the 0.05 level of significance.
[c]Indicates data from the Nilo study area.

Table 2. Mean invertebrate abundance (ml of insects/100 sweeps) for sweep net samples from 4 potential bobwhite brood habitats in Baker and Dougherty counties, Georgia, 1994.

Fallow Fields	Bird Patches	Burned Pine Woods	Corn Strips
27.2A[a]	10.3B	9.5B	3.2B

[a]Means followed by the same capital letter are not different ($P \geq 0.05$)

brood habitat (fallow fields) had a volume of insects 2.6 times ($P \leq 0.05$) greater than any other habitat type (Table 2). There was no difference ($P \leq 0.05$) among bird patches, burned woods, and corn strips.

Discussion

Importance of insects to northern bobwhite broods is well documented (Stoddard 1931, Nestler et al. 1942, Hurst 1972), and methods of producing this important food resource have been examined (Hurst 1972, Manley et al. 1994). However, actual use of habitats by quail broods in the southeastern coastal plain has not been well documented.

Sermons (1987) reported a preference for small cultivated patches on a study area in south Alabama, and DeVos and Mueller (1993) reported broods using burned pine uplands in northern Florida. On our study areas in south Georgia, a large sample of broods distinctly preferred rotationally farmed fallow fields. Very little use of small cultivated "bird patches" was observed. Additionally, insect samples revealed fallow fields had significantly ($P \leq 0.05$) more insects than other available habitats.

Previous studies of wild turkey brood habitat have shown these same trends of more abundant insect populations in forest openings (Martin and McGinnis 1975, Healy 1985). This has also been documented in the coastal plain fire-type pine forests (Sisson et al. 1991), with fields having higher insect populations than either winter or growing season prescribed burns (Sisson and Speake 1994).

Our research with bobwhite broods indicates that where fields, burned woods, and cultivated patches are available in close proximity, weedy fields are strongly selected for. These fields were managed by a system of rotational corn planting and disking in October. During summer, fields consisted of the previous year's corn crop, the current year's corn crop, and "weeds" stimulated by October disking. These "weedy" areas consisted primarily of ragweed and partridge pea and were where most of the actual feeding by quail broods took place. Corn plantings were used primarily for cover, shade, loafing, and dusting, and appeared to be an important component of the system. Broods were found

often in the "weed" part of the field, but close to the security and cover of the corn plantings. This rotational farming also may have served to maintain the pH and fertility of these fields and contributed to the high insect populations.

The high quail densities associated with the historical era of small patch farming (Stoddard and Komarek 1941), along with more recent research on insect density and abundance and our results emphasize the importance of early successional fields in bobwhite management. We recommend that management of fields for bobwhite broods should consist of a combination of rotational plantings of a fertilized grain crop and fallow areas on alternating parts of the field. This combination provides a weedy, insect-rich field environment while maintaining field fertility.

Literature Cited

Byers, C. R., R. K. Steinhorst, and P. R. Krausman. 1984. Clarification of a technique of analysis of utilization-availability data. J. Wildl. Manage. 48:1050–1053.

Curtis, P. D., B. S. Mueller, P. D. Doerr, C. F. Robinette, and T. DeVos. 1993. Potential polygamous breeding behavior in northern bobwhite. Pages 55–63 *in* K. E. Church and T. V. Dailey, eds. Quail III: national quail symposium. Kan. Dep. Wildl. Parks, Pratt.

DeVos, T. D. and B. S. Mueller. 1993. Reproductive ecology of northern bobwhite in north Florida. Pages 83–90 *in* K. E. Church and T. V. Dailey, eds. Quail III: national quail symposium. Kan. Dep. Wildl. Parks, Pratt.

Healy, W. M. 1985. Turkey poult feeding activity, invertebrate abundance, and vegetation structure. J. Wildl. Manage. 49:466–472.

Hurst, G. A. 1972. Insects and bobwhite quail brood habitat management. Pages 65–82 *in* T. A. Morrison and J. C. Lewis, eds., Proc. First Natl. Bobwhite Quail Symp., Okla. State Univ., Stillwater.

Johnsgard, P. A. 1973. Grouse and quails of North America. Univ. Neb. Press, Lincoln. 553pp.

Lehmann, V. W. 1946. Bobwhite quail reproduction in south Texas. J. Wildl. Manage. 10:111–123.

———. 1984. Bobwhites of the Rio Grande Plain of Texas. Texas A&M Univ. Press, College Station. 371pp.

Manley, S. W., R. S. Fuller, J. M. Lee, L. A. Brennan. 1994. Arthropod response to strip disking in old fields managed for northern bobwhite quail. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 48:227–235.

Martin, D. D. and B. S. McGinnes. 1975. Insect availability and use by turkeys in forest clearings. Proc. Natl. Wild Turkey Symp. 3:70–75.

Nestler, R. B., W. W. Bailey, and H. E. McClure. 1942. Protein requirements of bobwhite quail chicks for survival, growth, and efficiency of feed utilization. J. Wildl. Manage. 6:185–193.

Neu, C. W., C. R. Byers, and J. M. Peek. 1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38:541–545.

Roseberry, J. L. and W. D. Klimstra. 1984. Population ecology of the bobwhite. South. Ill. Univ. Press, Carbondale. 259pp.

Rosene, W. 1969. Bobwhite quail: its life and management. Rutgers Univ. Press, New Brunswick, N.J. 418pp.

Sermons, W. O. 1987. Reproductive ecology of the bobwhite quail in southern Alabama. M.S. Thesis, Auburn Univ., Auburn, Ala. 55pp.

——— and D. W. Speake. 1987. Production of second broods in northern bobwhites. Wilson Bul. 99:285–286.

Shields, L. J., R. Darling, and B. S. Mueller. 1982. A telemetry system for monitoring bobwhite quail activity. Pages 112–115 *in* Seventh Intl. Symp. Biotelemetry. Stanford Univ., Stanford, Calif.

Simpson, R. C. 1976. Certain aspects of the bobwhite quail's life history and population dynamics in southwest Georgia. Ga. Dep. Nat. Resour. Tech. Bul. WL1. 117pp.

Sisson, D. C., D. W. Speake, and J. L. Landers. 1991. Wild turkey brood habitat use in fire-type pine forests. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 45:49–57.

——— and D. W. Speake. 1994. Spring burning for wild turkey brood habitat: an evaluation. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 48:134–139.

Speake, D. W. 1967. Ecology and management studies of the bobwhite quail in the Alabama piedmont. Ph.D. Diss., Auburn Univ., Auburn, Ala. 187pp.

Stauffer, D. F. 1993. Quail methodology: where are we and where do we need to be? Pages 21–33 *in* K. E. Church and T. V. Dailey, eds. Quail III: national quail symposium. Kan. Dep. Wildl. Parks, Pratt.

Stoddard, H. L. 1931. The bobwhite quail: its habits, preservation, and increase. Charles Scribner's Sons, New York. 559pp.

——— and E. V. Komarek. 1941. The carrying capacity of southeastern quail lands. Trans. N. Am. Wildl. Conf. 6:148–155.

Thomas, D. L. and E. J. Taylor. 1990. Study designs and tests for comparing resource use and availability. J. Wildl. Manage. 54:322–330.