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# INVERTEBRATE ABUNDANCE AT NORTHERN BOBWHITE BROOD LOCATIONS IN THE ROLLING PLAINS OF TEXAS

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## ABSTRACT

Northern bobwhite (*Colinus virginianus*), a bird of significant ecological and economic importance throughout the Rolling Plains region of Texas, has experienced significant population declines. Bobwhites have been the focus of extensive research for decades but little is known about foraging ecology of adults and chicks during post-hatch. Invertebrates are a key summer diet component for chicks, and supply the necessary proteins and minerals needed to fuel rapid body development. We examined brood-foraging sites to investigate invertebrate abundance. We radiomarked 121 bobwhite hens during winter-spring 2008 and 2009 and subsequently monitored 14 broods post-hatch. We collected invertebrate samples from 34 brood points and random paired-locations using sweep nets. Samples were sorted by Order to ascertain abundance and diversity. There was no difference in total abundance, abundance of Coleoptera, Hemiptera, Orthoptera, and Order diversity between brood and random locations. Northern bobwhite hens do not appear to select foraging sites based upon invertebrate abundance in the Rolling Plains of Texas.

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***Key words:*** broods, chicks, *Colinus virginianus*, feeding ecology, invertebrates, northern bobwhite, Rolling Plains, Texas

## INTRODUCTION

Northern bobwhite populations are declining throughout their range (Brennan 1991, Church et al. 1993). Populations in Texas have been considered more stable but their long-term status is not assured. The USGS Breeding Bird Survey estimates a 3.68% decline per year of northern bobwhites between 1967 and 2009 in Texas (Sauer et al. 2011). Examination of the Texas Parks and Wildlife Department quail roadside count data (TPWD 2009) reveals steep declines in bobwhites in the Cross Timbers ecoregion with the 5-year average between 2004 and 2008 equaling 22% of the long-term mean since 1978. Northern bobwhite counts in the Rolling Plains are more stable around the long-term mean, but are trending downward. Populations in this ecoregion have only peaked significantly (at least 35% > than the long-term mean) once during the past 13 years. Significant peaks occurred almost every 5 years during the period between 1978 and 1994 with consecutive peak years not uncommon (TPWD 2009). These estimates reveal an east to west decline in bobwhite populations in the northern half of Texas.

This decline has emphasized the importance of understanding factors that influence northern bobwhite demographics. There is relatively little information available concerning bobwhite chick demographics although this metric has a major influence on population growth (Sandercock et al. 2008). Food availability, in the form of invertebrates, likely has a major influence on chick survival. Bobwhite chicks rely on invertebrates for an important source of protein during the first few weeks of life (Stoddard 1931, Nestler et al. 1942, Hurst 1972). We hypothesized brooding northern bobwhite hens would select foraging sites with the greatest invertebrate diversity and abundance to maximize opportunities for bobwhite chicks to acquire sufficient nutrition. Studies of black grouse (*Tetrao tetrix*), capercaillie (*T. urogallus*), and ruffed grouse (*Bonasa umbellus*) suggest hens select sites to take their broods where invertebrate abundance is greater than at random sites (Baines et al. 1996, Haulton et al. 2003, Wegge et al. 2005). In contrast, wild turkeys (*Meleagris gallopavo*) did not select sites with greater invertebrate abundance in Texas (Randel et al. 2007). Foraging studies using imprinted chicks have been conducted across the bobwhite's range (Palmer et al. 2001, Smith and Burger 2005, Doxson and Carroll 2010), but we do not know of attempts to quantify the relationship between invertebrate diversity and abundance and brooding northern bobwhite hen-feeding site selection in the Texas Rolling Plains nor using wild broods. Our objective was to investigate if brooding northern bobwhite

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Table 1. Invertebrate abundance and diversity at brood and random locations in the Texas Rolling Plains, 2008 and 2009, pooled.

| Order | Brood ($n = 34$) $\bar{x} \pm$ SE | Random ($n = 34$) $\bar{x} \pm$ SE |
|---|---|---|
| Coleoptera | 2.029 ± 0.541 | 1.97 ± 0.495 |
| Hemiptera | 1.558 ± 0.327 | 1.441 ± 0.280 |
| Orthoptera | 11.617 ± 1.537 | 12.176 ± 1.848 |
| Total | 15.647 ± 1.985 | 16.441 ± 2.188 |
| Diversity | 2.911 ± 0.232 | 3.205 ± 0.238 |

hens used feeding sites which contained greater invertebrate diversity and abundance than areas that were readily available but not selected.

## STUDY AREA

Study sites were selected on private grazing lands within the Rolling Plains ecoregion in Gray County, in the eastern Texas Panhandle. The climate in this region is semi-arid with 84% of the 51.13 cm of average annual precipitation falling in the growing season of April–October (Williams and Welker 1966). Yearly precipitation varies widely and droughts are common with annual precipitation in Amarillo ranging from 24.28 to 100.97 cm (U.S. Department of Commerce 2010).

Soils encompassing the region are Likes-Springer-Tivoli and Miles-Springer (Williams and Welker 1966). Common grasses and shrubs include: big sandreed (*Calamovilfa gigantea*), eastern gamagrass (*Tripsacum dactyloides*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), sand bluestem (*Andropogon hallii*), sand lovegrass (*Eragrostis trichodes*), sideoats grama (*Bouteloua curtipendula*), switchgrass (*Panicum virgatum*), Chickasaw plum (*Prunus angustifolia*), Havard shinoak (*Quercus havardii*), sand sagebrush (*Artemisia filifolia*), sumac (*Rhus* spp.), and yucca (*Yucca glauca*) (Williams and Welker 1966, McMahon et al. 1984).

## METHODS

We trapped bobwhite hens in February-April 2008 and 2009. Collapsible walk-in funnel traps (Stoddard 1931) were baited using a mixture of cracked corn and milo. Each hen was weighed, banded, and fitted with a 6-g necklace-style radio transmitter (American Wildlife Enterprises, Monticello, FL, USA). Hens were tracked $\geq 2$ times weekly during the breeding season; nest and brood locations were recorded with a Global Positioning System (GPS) unit. Nest fate was ascertained upon nest termination, and hens were located during morning hours to avoid stress associated with high summer temperatures. Chicks $\leq 2$ weeks of age were assumed to be foraging when the hen exhibited brooding behavior upon approach, flushed, or when chicks were directly observed due to difficulty in observing behavior in dense vegetation. Invertebrate samples were collected on the ensuing day where broods were observed.

Invertebrate samples were collected following Randel et al. (2007). Sample sites were sweep-netted along a 10-m transect with 25 sweeps (38-cm diam) (Sweep nets, Forestry Suppliers, Jackson, MS, USA) to encompass an area of 10-$m^2$ (Randel et al. 2006, 2007). Random site invertebrate collection was conducted at locations based on a random number generator for bearing (1°–360°) and distance (100–400 m) from the paired brood site. All samples collected were marked as brood or random, frozen, and stored in sealable plastic bags until sorted in the laboratory.

Samples were sorted by Order and counted to ascertain abundance and diversity between brood and random sites, and years. Diversity was calculated as the number of Orders present per sample. Shapiro-Wilks' test for normality indicated non-normal distribution of errors ($P > 0.05$) and a Wilcoxon signed-rank test was used to analyze the data. Statistical analyses were conducted using PASW 18 (SPSS Inc., Chicago, IL, USA).

## RESULTS

Invertebrate samples were collected from 6 and 8 radio-marked females with broods in 2008 and 2009, respectively. Samples were pooled (Table 1) over both years for analysis due to limited quantity of brood locations ($n = 34$). Coleoptera, Hemiptera, and Orthoptera were selected for analysis from 14 collected orders because of high frequency of occurrence ($\lambda > 0.55$).

Total invertebrate abundance at brood locations did not differ from random locations ($P = 0.925$). Differences were not detected between random and brood sites for abundance of Coleoptera ($P = 0.990$), Hemiptera ($P = 0.888$), and Orthoptera ($P = 0.911$). No differences between invertebrate Order diversity ($P = 0.469$) were detected between random and brood sites.

## DISCUSSION

Studies have shown invertebrates provide essential proteins and nutrients for chick muscle and feather development during their first 2 weeks of life (Hurst 1972, Savory 1989, Lusk et al. 2005). DeVos and Mueller (1993) found brooding adults used areas with higher invertebrate density, but our results do not support their finding. Rio Grande wild turkeys in the Edwards Plateau of Texas also did not select brood sites based on invertebrate abundance (Randel et. al 2007). In contrast, studies of black grouse, capercaillie, and ruffed grouse suggest hens select sites based upon invertebrate abundance (Baines et al. 1996, Haulton et al. 2003, Wegge et al. 2005).

Abundance of Coleoptera, Hemiptera, and Orthoptera in our study ranked highest among all Orders collected at both brood and random locations. DeVos and Mueller (1993) noted greater volumes of these Orders sampled at brood locations compared to random locations while Jackson et al. 1987) found Coleoptera, Hemiptera, and Hymenoptera ranking among the top three Orders selected by imprinted chicks. Similar results were reported among adult scaled quail (*Callipepla squamata*) based on fecal samples in the western Texas Panhandle with Orthoptera, Coleoptera, Hymenoptera, and Hemiptera comprising $\sim$ 50% of their summer diet (Ault and Stormer 1983). We found no difference in abundance or diversity between brood and random locations, but Coleoptera, Hemiptera, and Orthoptera, all important foods for chicks, comprised 97 and 95% of brood and random samples, respectively. The main components of $\leq$ 2 week old chick diets were well represented in our samples.

## MANAGEMENT IMPLICATIONS

There was no detectable difference between hen-selected sites and random sites in invertebrate abundance or diversity. Thus, habitat management solely for the purpose of increased invertebrate abundance and diversity without regard to other living requirements may not necessarily benefit post-hatch brood survival and development. We suggest further examination of foraging behavior and resource selection of wild populations is needed.

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## LITERATURE CITED

Ault, S. C., and F. A. Stormer. 1983. Seasonal food selection by scaled quail in northwest Texas. Journal of Wildlife Management 47:222–228.

Baines, D., I. A. Wilson, and G. Beeley. 1996. Timing of breeding in black grouse *Tetrao tetrix* and capercaillie *Tetrao urogallus* and distribution of insect food for the chicks. Ibis 138:181–187.

Brennan, L. A. 1991. How can we reverse the northern bobwhite population decline? Wildlife Society Bulletin 19:544–555.

Church, K. E., J. R. Sauer, and S. Droege. 1993. Population trends of quails in North America. Proceedings of the National Quail Syposium 3:44–54.

DeVos, T., and B. S. Mueller. 1993. Reproductive ecology of northern bobwhite in north Florida. Proceedings of the National Quail Symposium 4:83–90.

Doxon, E. D., and J. P. Carroll. 2010. Feeding ecology of ring-necked pheasant and northern bobwhite chicks in Conservation Reserve Program fields. Journal of Wildlife Management 74:249–256.

Haulton, G. S., D. F. Stauffer, and R. L. Kirkpatrick. 2003. Ruffed grouse (*Bonasa umbellus*) brood microhabitat selection in the southern Appalachians. American Midland Naturalist 150:95–103.

Hurst, G. A. 1972. Insects and bobwhite quail brood habitat management. Proceedings of the National Bobwhite Quail Symposium 1:65–82.

Jackson, J. R., G. A. Hurst, and E. A. Gluesing. 1987. Abundance and selection of invertebrates by northern bobwhite chicks. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 41:303–310.

Lusk, J. J., F. S. Guthery, S. A. Cox, S. J. DeMaso, and A. D. Peoples. 2005. Survival and growth of northern bobwhite chicks in western Oklahoma. American Midland Naturalist 153:389–395.

McMahon, C. A., R. G. Frye, and K. L. Brown. 1984. The vegetation types of Texas. Bulletin 7000-120. Texas Parks and Wildlife Department, Austin, USA.

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. Journal of Wildlife Management 6:185–193.

Palmer, W. E., M. W. Lane II, and P. T. Bromley. 2001. Human-imprinted northern bobwhite chicks and indexing arthropod foods in habitat patches. Journal of Wildlife Management 65:861–870.

Randel, C. J., R. B. Aguirre, M. J. Peterson, and N. J. Silvy. 2006. Comparison of two techniques for assessing invertebrate availability for wild turkeys in Texas. Wildlife Society Bulletin 34:853–855.

Randel, C. J., R. B. Aguirre, M. J. Peterson, and N. J. Silvy. 2007. Invertebrate abundance at Rio Grande wild turkey brood locations. Journal of Wildlife Management 71:2417–2420.

Sandercock, B. A., W. E. Jensen, C. K. Williams, and R. D. Applegate. 2008. Demographic sensitivity of population change in northern bobwhite. Journal of Wildlife Management 72:970–982.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski Jr., and W. A. Link. 2011. The North American Breeding Bird Survey, results and analysis 1966–2009. Version 3.23.2011. USGS, Patuxent Wildlife Research Center, Laurel, Maryland, USA. www.pwrc.usgs.gov

Savory, C. J. 1989. The importance of invertebrate food to chicks of gallinaceous species. Proceedings of the Nutrition Society 48:113–133.

Smith, M. D., and L. W. Burger Jr. 2005. Use of imprinted northern bobwhite chicks to assess habitat-specific arthropod availability. Wildlife Society Bulletin 33:596–605.

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

Texas Parks and Wildlife Department. 2009. Quail forecast 2008–2009; revised 25 September 2008. Austin, USA. www.tpwd.state.tx.us/huntwild/hunt/planning/quail_forecast/forecast/

U.S. Department of Commerce. 2010. Yearly precipitation for Amarillo, TX. National Oceanic and Atmospheric Administration, National Weather Service, Amarillo, Texas, USA. www.srh.noaa.gov/ama/?n=yearly_precip

Wegge, P., T. Olstad, H. Gegersen, O. Hjeljord, and A. Sivkov. 2005. Capercaillie broods in pristine boreal forest in northwestern Russia: the importance of insects and cover in habitat selection. Canadian Journal of Zoology 83:1547–1555.

Williams, J. C., and A. J. Welker. 1966. Soil Survey of Gray County, Texas. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C., USA.