Research Note

Invertebrate Abundance at Rio Grande Wild Turkey Brood Locations

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ABSTRACT Abundance of Rio Grande wild turkeys (*Meleagris gallopavo intermedia*) has declined in the southeastern Edwards Plateau (EP) of Texas, USA, whereas abundance has remained stable in the northwestern EP. Invertebrates are a critical protein source for poults <6 weeks posthatch. We collected invertebrates at brood and paired locations in both the stable and declining regions. Our objective was to determine if differences in invertebrate abundance existed in regions typified by declining versus stable Rio Grande wild turkey abundance. We found no difference in invertebrate abundance between brood or paired locations within regions, but invertebrate abundance, whether measured as dry mass or frequency, was greater in the stable region. Decreased invertebrate abundance may have contributed to the decline in Rio Grande wild turkey abundance in the southeastern Edwards Plateau. (JOURNAL OF WILDLIFE MANAGEMENT 71(7):2417–2420; 2007)

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KEY WORDS broods, Edwards Plateau, invertebrate abundance, *Meleagris gallopavo intermedia*, Rio Grande wild turkey, Texas.

The Edwards Plateau (EP) of Texas, USA, historically was the geographic center of the Rio Grande wild turkey (RGWT [*Meleagris gallopavo intermedia*]) range and supported high turkey densities (Texas Game, Fish and Oyster Commission 1945, Glazener 1967). Beginning about 1930, the EP served as a primary source for RGWT translocations to other regions of Texas, other states, and nations (Glazener 1967; S. DeMaso, Texas Parks and Wildlife Department [TPWD], unpublished data). Turkey abundance apparently remained stable in the EP until the mid- to late 1970s when trends in abundance began to diverge, with northwestern counties remaining stable and abundance declining in the southeastern counties (Fig. 1). Despite these declines, little research on RGWTs occurred in EP or Texas during the 1980s and 1990s (Peterson 1998). A number of factors might be involved in declining RGWT abundance in the southeastern EP. Poult survival depends in part on food availability, and lack of invertebrates, a primary poult food (Hurst 1992), could be one possible cause for these declines.

Invertebrates are important sources of food for young galliforms in Europe, including grey partridge (*Perdix perdix*; Southwood and Cross 1969, Potts 1970, Green 1984, Itämies et al. 1996, Bro et al. 2000), black grouse (*Tetrao tetrix*; Starling-Westeberg 2001), willow grouse (*Lagopus lagopus*; Spidosø 1980), red grouse (*L. l. scoticus*; Moss 1972, Savory 1977, Park et al. 2001), and common quail (*Coturnix coturnix*; Badenhort and Kerley 1996). Studies on the effect of invertebrate availability on North American galliforms are limited to greater sage grouse (*Centrocercus urophasianus*; Klebenow and Gray 1965, Johnson and Boyce 1990), sharp-tailed grouse (*Tympanuchus phasianellus*; Mitchell and Riegert 1994), greater prairie-chickens (*T. cupido*; Svedarsky and Van Amburg 1996), and northern bobwhites (*Colinus virginianus*; Palmer et al. 2001). Dependence of galliform young on invertebrate matter during the initial 5 weeks posthatch ranges from 5% in red grouse (Moss 1972) to 90% in grey partridge (Southwood and Cross 1969). Invertebrate abundance has been positively correlated with increased body mass (Savory 1977, Spidosø 1980, Johnson and Boyce 1990, Bro et al. 2000, Park et al. 2001) and survival (Savory 1977, Johnson and Boyce 1990, Palmer et al. 2001) of galliform young.

As with other galliforms, invertebrates comprise a major portion of turkey (*Meleagris gallopavo*) poult diets, approximately 28% (Marsden and Martin 1955) through the fifth week posthatch (Hurst 1992), and provide a valuable source of protein for growing birds. Hurst (1992) noted that most diet studies of poults were based on eastern (*M. g. silvestris*) and Florida wild turkey (*M. g. osceola*), with few existing on the other subspecies. Studies of Merriam's wild turkeys (*M. g. merriamii*) in both New Mexico (Zeedyk 1982) and South Dakota (Rumble 1990) found the majority of poult diet was invertebrate matter. Based on the importance of invertebrates to the survival of other young galliform species, there is a need to determine whether invertebrate availability may be a factor in declining RGWT abundance on the southeastern EP of Texas.

Our objective was to determine whether areas typified by differential trends in RGWT abundance (northwestern vs. southeastern EP) were associated with differences in invertebrate availability for poults. Specifically, we determined whether invertebrate dry mass at brood-location sites and random sites differed between study areas in these regions.

STUDY AREAS

We selected one study area within a region of stable RGWT abundance (Kerr and Real counties, TX; 5,827 ha) and another within a region of declining RGWT abundance (Bandera County, TX; 11,768 ha). The EP had a

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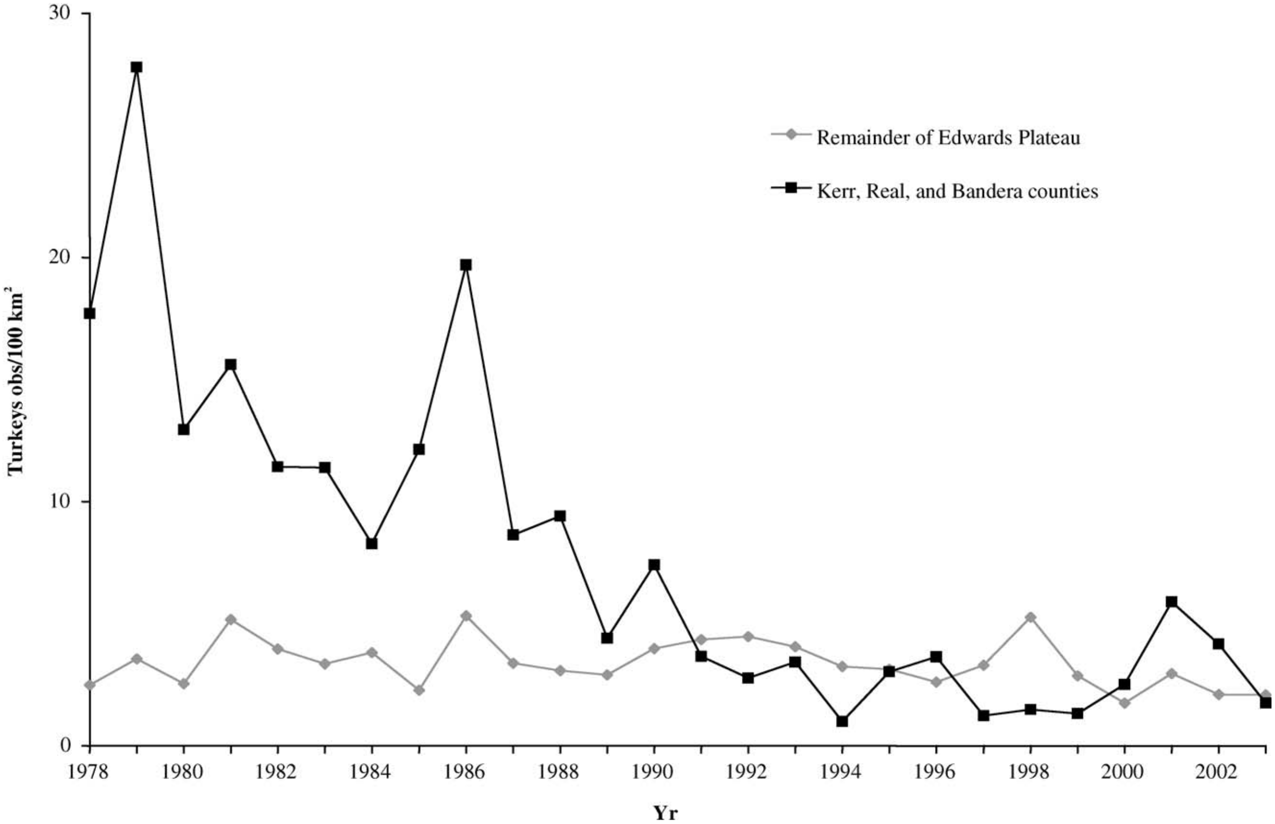

Figure 1. Number of Rio Grande wild turkeys observed per 100 km^2 by Texas Parks and Wildlife Department biologists during summer production surveys for Bandera, Kerr, and Real counties, Texas, USA, and the remainder of the Edwards Plateau (including several counties that have never supported significant turkey populations), 1975–1999 (Schaap et al. 2007).

precipitation range of 38.1–83.8 cm from west to east (Gould 1962). Typically, rainfall was abundant in May–June and September.

Predominate climax grasses included switchgrass (*Panicum virgatum*), bluestems (*Andropogon* spp., *Bothriochloa* spp., and *Schizachyrium scoparium*), gramas (*Bouteloua* spp.), Indiangrass (*Sorghastrum nutans*), wildrye (*Elymus* spp.), curly mesquite (*Hilaria belangeri*), and buffalograss (*Buchloe dacytloides*; Gould 1962, Correll and Johnson 1970). Due to decreased fire frequency, dense stands of Ashe juniper (*Juniperus ashei*) interspaced with live-oak (*Quercus fusiformis*) savanna now are common (Fowler and Dunlap 1986, Miller et al. 1995). Land managers use practices such as high-intensity, low-frequency grazing and prescribed fire to reduce Ashe juniper and create a mosaic landscape thought to be beneficial for wildlife (B. Armstrong, TPWD, personnel communication).

METHODS

We trapped RGWTs using funnel traps (Davis 1994, Peterson et al. 2003) from December to February, 2001–2003. We baited traps with a mixture of cracked corn and milo adjacent to known roost sites and travel paths. We aged (10th primary), sexed, massed, banded with TPWD leg bands, and radiotelemetered (Advanced Telemetry Systems, Isanti, MN) all individuals. After release, we radiolocated birds $\geq$3 times per week; once nesting began, we located females $\geq$4 times per week to determine nest fate and hatching date. After hatching, we located females with broods $\geq$4 times per week during daylight hours for the first 6 weeks posthatch; we collected invertebrates when we observed broods feeding. In addition to radiotagged females, we opportunistically collected invertebrates when we observed untagged females with feeding broods if poult feathering and body size reflected an age of $\leq$6 weeks.

We collected invertebrates at brood locations and random paired locations using sweep-nets (35-cm aperture; Forestry Suppliers, Jackson, MS), with a sweep-netting transect (10 m) consisting of 25 sweeps resulting in a 10-m^2 sampling area (Randel et al. 2006). We made paired-invertebrate collections at a random distance (200–800 m) and direction from associated brood-location sites. We placed invertebrate samples in sealed plastic storage bags marked with date, Global Positioning System (GPS) coordinates, and individual frequency of radiotagged females or unknown if an untagged female, then placed samples in a freezer overnight to facilitate processing.

We sorted invertebrates by taxonomic orders, massed them, and dried them to a constant mass. We counted invertebrates and determined frequency of occurrence of each order for comparison between stable and declining study regions. We compared invertebrate dry mass for brood locations and paired locations in regions of stable and declining RGWT abundance using a 2-sample *t*-test (Ott and Longnecker

Table 1. Invertebrate dry mass (g) and frequency of occurrence (λ) at brood-locations in regions of stable and declining Rio Grande wild turkey abundance, Edwards Plateau, Texas, USA, 2001–2003.

Order	Stable			Declining		
	$\bar{x}$	SE	λ (%)	$\bar{x}$	SE	λ (%)
Arachnidae	0.004	0.001	50	0.002	0.001	34
Coleoptera	0.006*	0.002	45*	0.002*	0.001	20*
Diptera	0.001	0.000	33	0.002	0.001	32
Hemiptera	0.010	0.003	40*	0.004	0.002	20*
Homoptera	0.003	0.003	23	0.002	0.001	24
Hymenoptera	0.005	0.001	33	0.002	0.001	22
Lepidoptera	0.002	0.001	18*	0.001	0.001	6*
Nueroptera	0.000	0.000	3	0.000	0.000	6
Odonata				0.000	0.000	2
Orthopera	0.138*	0.025	80*	0.039*	0.010	42*
Total	0.170*	0.028		0.055*	0.012	

* Significant at $P < 0.05$.

2001); we similarly compared brood- and paired locations within regions. We compared invertebrate order frequencies in regions of stable and declining RGWT abundance using chi-square tests. We conducted all statistical analyses with Minitab 10 (MINITAB, State College, PA) and we considered differences significant at $\alpha \leq 0.05$.

RESULTS

We collected invertebrates at brood locations from 24 radiotagged females ($n = 52$) and at 8 brood locations from nonradioed RGWT females in the stable region and at broods of 28 radiotagged females ($n = 45$) and 5 other females ($n = 5$) in the declining region. Because of small sample sizes, we combined invertebrate collections from all 3 years within regions for analysis.

Invertebrate dry mass ($\bar{x} = 0.170$, SE = 0.03) at brood locations in the stable region ($n = 60$) was greater ($P = 0.02$) than invertebrate dry mass ($\bar{x} = 0.055$, SE = 0.01) at brood locations ($n = 50$) in the declining region (Table 1). We found no differences between brood and paired locations in stable ($P = 0.28$) or declining ($P = 0.68$) regions. Similarly, after we combined both stable and declining regions, we found no differences in invertebrate dry mass between brood locations ($\bar{x} = 0.079$, SE = 0.03) and random paired sites ($\bar{x} = 0.052$, SE = 0.02). Orthoptera ($P < 0.001$), Coleoptera ($P = 0.032$), and total invertebrate dry mass ($P < 0.001$) were 3.5, 3.0, and 3.1 times greater at brood locations in the stable region than at brood locations in the declining region, respectively. Coleoptera ($P = 0.002$), Hemiptera ($P = 0.009$), Lepidoptera ($P = 0.014$), and Orthoptera ($P < 0.001$) occurred with 2.3, 2.0, 3.0, and 1.9 times greater frequency at brood sites in the stable as opposed to the declining region, respectively (Table 1).

DISCUSSION

Frequencies of Coleoptera, Hemiptera, Lepidoptera, and Orthoptera were greater at brood locations in the stable region as opposed to the declining region (Table 1); 3 of these orders (Coleoptera, Orthoptera, and Lepidoptera) have previously been identified as critical to prefledging-poult diets (Nenno and Lindzey 1979, Healy 1985, Hurst 1992) and have significant amounts of digestible protein (Beck and Beck 1955). Sufficient protein is required for both body growth and feather development in poults (Healy and Nenno 1980, Hurst and Poe 1985), and reduced availability of invertebrate matter, a major source of protein to developing poults (Marsden and Martin 1955), within the declining region may be contributing to reduced recruitment of young into the declining region. Hurst (1992) determined invertebrate matter comprised a major component of wild turkey poult diets through the fifth week posthatching so it is reasonable to assume that differences we found in invertebrate dry mass could be biologically significant. Additionally, decreased protein available to poults in the declining region could lead to delayed poult development and, thus, increased predation risk.

Although Randel et al. (2007) noted that stable region had a lower nesting rate than did the declining region (20.8% and 37.8%, respectively), nest success did not vary between stable and declining regions (35.3% and 35.9%, respectively). Randel et al. (2007) documented that females from the declining region had nesting rates higher than those on the stable region during all years. However, TPWD female:poult ratios (S. DeMaso, TPWD, unpublished data) during the study period (2001–2003) confirmed greater poult production in the stable region (1 F:6.38 poults; $n = 91$) as compared to the declining region (1 F:1.6 poults; $n = 6$). We expect the lower nesting rate in the stable region was due to the greater number of juvenile females produced there as compared to the declining region; juvenile females have lower nesting rates than do adults (Reagan and Morgan 1980, Keegan and Crawford 1999). For example, Reagan and Morgan (1980), also working in the EP, found 31.3% ($n = 32$) of juvenile and 85.7% ($n = 21$) of adult females initiated a nest during 1973–1978. The similar nest success in both regions and the greater brood survival in the stable region could simultaneously explain the higher nesting rate in the declining region and also the reason (lower brood survival) for the decline of RGWT in the declining region.

MANAGEMENT IMPLICATIONS

Our results are consistent with the hypothesis that habitats with lower invertebrate biomass lead to lower survival of RGWT poults and broods, at least within the EP of Texas. For this reason, we suggest managers attempting to increase RGWT abundance in the southeastern EP implement management actions (e.g., grazing, prescribed fire, mechanical treatments) adaptively so they can determine whether these activities lead to 1) increased availability of desirable invertebrate orders (e.g., Orthoptera, Lepidoptera, Coleoptera), 2) increased poult survival, and 3) increased recruitment into the reproductive population.

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