



## Note

# Nest Site Fidelity and Dispersal of Rio Grande Wild Turkey Hens in Texas

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**ABSTRACT** Rio Grande wild turkey (*Meleagris gallopavo intermedia*) nests suffer high predation rates exceeding 65%, which may limit recruitment. We evaluated post-nesting movements of reproductively active female Rio Grande wild turkeys. We monitored 194 nesting attempts between 2005 and 2010 and documented 17% and 32% overall apparent nest success for the Edwards Plateau and Central Rio Grande Plains study regions, respectively. Rio Grande wild turkey hens move approximately 1.2 km (SD = 0.7) between nesting attempts within a nesting season and approximately 1.4 km (SD = 1.6) between initial nesting attempts among years. Rio Grande wild turkey hens selected open areas with moderate woody cover for nesting ( $\bar{x}$  = 37.7%; range = 3.0–88.2%). Patchiness of vegetation in the nesting landscape also was borne out by typically low edge-to-area ratios ( $\bar{x}$  = 0.20; range = 0.040–0.732). We found no clear pattern in movement distance and either landscape composition or edge-to-area ratio for within or between breeding season nest site selection for either the Edwards Plateau or Central Rio Grande Plains study region. Based on our results, movement distances post-nest failure do not seem to influence habitat selection. © 2012 The Wildlife Society.

**KEY WORDS** dispersal, habitat selection, *Meleagris gallopavo intermedia*, movements, nesting ecology, Rio Grande wild turkey, survival, Texas.

For ground nesting species such as wild turkeys (*Meleagris gallopavo* spp.), individuals frequently disperse after failed nesting attempts and subsequently re-nest in different locations (Badyaev and Faust 1996). If successful during a nesting attempt, we would expect an increased probability that an individual would select or return to an area with similar habitat conditions for future reproductive activities (Badyaev and Faust 1996). Some researchers have hypothesized that previous nest success at a location influences selection for future nesting attempts both within and between breeding seasons (Greenwood and Harvey 1982, Badyaev et al. 1996). If this is the case, then habitat conditions where reproduction was unsuccessful should cause avoidance of those conditions in future reproductive attempts. Turkeys that experience nest failure have 3 options: 1) re-nest at or within the immediate area of their initial nest, 2) disperse to a new area and re-nest, or 3) forego further reproductive activities during that reproductive season. Re-nesting has fitness and survival consequences (Badyaev 1995, Collier et al. 2009) such that relocation may prohibit hens from recognizing suitable habitat and lead to decreased reproductive performance and survival rates (Hopkins et al.

1982, McGuinness et al. 1990). For individuals that re-nest, the process driving the decision to disperse or remain near previous nesting location is not well understood, but habitat selection focused on predator avoidance may play a role (Greenwood and Harvey 1982). Because a substantial proportion of wild turkey nests fail because of predation (Rumble and Hodorff 1993, Badyaev 1995, Dreibelbis et al. 2011, Melton et al. 2011), local scale habitat factors that mitigate against nest predation are potentially one of the primary criteria females use when evaluating nesting habitat.

Our study objectives focused on evaluating post-nesting movements of reproductively active female Rio Grande wild turkeys (*Meleagris gallopavo intermedia*). We used radio-telemetry to evaluate movements after nest loss to determine whether generalities in habitat selection after nest loss exist. Specifically, we sought to determine whether post-nesting movement distance influenced subsequent nest success or failure, whether distances moved changed among or between breeding seasons, and whether habitat metrics of selected nest sites differed between nesting attempts within a season and between breeding seasons.

## STUDY AREA

We conducted our research in 2 Texas ecoregions, the Edwards Plateau in central Texas and the Central Rio

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Grande Plains in south Texas. Within the Edwards Plateau, we conducted our work on 4 private ranches in Bandera, Kerr, Medina, and Real counties and a public wildlife management area in Kerr County. These sites consisted of rolling hills and steep canyons, with elevation from approximately 30 m to 915 m above sea level (Gould 1962). The climate of the Edwards Plateau was subtropical to semi-arid and temperature ranged from 9° C to 27° C (Toomey et al. 1993) with an average growing season of 240 days (Wu et al. 2001). Mean annual precipitation varied from 84 cm on the eastern edge to 38 cm on the western edge (Larkin and Bomar 1983) with a bimodal peak occurring between April–June and August–October (Taylor 2008). The region was predominately rangeland with various species of bluestem (*Andropogon* spp.), grama (*Bouteloua* spp.), and panicum (*Panicum* spp.) with common overstory species including semi-evergreen live oak (*Quercus virginiana*) and evergreen ashe juniper (*Juniperus ashei*). Bald cypress (*Taxodium distichum*), cottonwood (*Populus deltoides*), and pecan (*Carya illinoensis*) were found along riparian areas (Larkin and Bomar 1983). The Edwards Plateau study sites were managed for white-tailed deer (*Odocoileus virginianus*) hunting; exotic ungulate hunting occurred on the private ranches. Livestock grazing occurred on 3 of the sites (Kerr, Medina, Bandera counties).

In the Central Rio Grande Plains, we worked on 2 private ranches in Duval and Jim Wells counties. The region consisted of relatively flat terrain ranging in elevation from 75 m to 90 m above sea level (Gould 1962). The climate was subtropical with mild winters and hot summers and a mean annual temperature of 22.4° C and an average growing season of 289 days (Scifres and Koerth 1987). Annual precipitation ranged from 50 cm to 91 cm with a mean annual precipitation of 72 cm (Scifres and Koerth 1987). Peak precipitation occurred from August to October (Wilkins and Swank 1992). Vegetation consisted of thornscrub parklands with well-defined mosaic patterns of shrub clusters scattered throughout low-succession grasslands (Northup et al. 2005). Closed-canopy woodlands were intermittently present in clay loam drainages and consisted primarily of honey mesquite (*Prosopis glandulosa*), hackberry (*Celtis occidentalis*), and Texas persimmon (*Diospyros texana*; Archer 1995). Herbaceous species on the study sites included thin paspalum (*Paspalum setaceum*), fringed signal grass (*Brachiaria ciliatissima*), red grama (*Bouteloua trifida*), and coastal sandbur (*Cenchrus incertus*). The Central Rio Grande Plains sites were managed for white-tailed deer and northern bobwhites (*Colinus virginianus*), with limited seasonal cattle grazing. Prescribed fire and brush management (i.e., disking, shredding, and roller chopping) were used to maintain an early successional grassland matrix with significant interspersions of woody ground cover.

## METHODS

We captured female Rio Grande wild turkeys between January and March during the study years (2005–2007 in the Edwards Plateau, 2008–2010 in the Central Rio Grande Plains) using drop nets (Glazener et al. 1964) and walk-in

funnel traps (Davis 1994, Peterson et al. 2003). We aged (Pelham and Dickson 1992), weighed, and radio-tagged each captured individual using a backpack style radio transmitter (Kenward 1987; Advanced Telemetry Systems, Isanti, MN and Sirtrack Ltd., North Havelock, New Zealand). We located individual hens via triangulation, homing, and observation 3 times weekly (White and Garrott 1990) before the breeding season began and daily when hen behavior indicated that nest initiation had begun (Ransom et al. 1987, Collier et al. 2009). Upon suspected incubation, we located nests, collected nest-specific data (location, clutch size; Melton et al. 2011), and continued to monitor the nesting hen until nest success, failure, or abandonment. We classified nest fates for analysis as apparent success (i.e., hatching of  $\geq 1$  egg) or failure (via egg remains, lack thereof, or camera photos).

## Analysis

We incorporated nest location and nest fate data into an ArcGIS 10 (Environmental Systems Research Institute, Redlands, CA) database. We delineated deciduous woodland patches using 2008 National Agricultural Imagery Program imagery that maximized vegetative spectral differences. We conducted a supervised classification of woodlands across our study regions, aggregating land cover types into 2 classes (woodland and grassland). For each individual female wild turkey, we calculated the distance (m) between successive nesting attempts within a season, as well as distance between initial nesting attempts between years. For each nest location, we created a 100-m radius buffer as this radius was determined to capture landscape variation relevant to nesting Rio Grande wild turkey hens (Collier and Chamberlain 2011). Within each study site, we replicated 5 sets of random points in equal number to the number of nests within each study site, and estimated the same vegetative compositional values for a descriptive comparison between used and potential nesting areas. We calculated the size of each patch of woody vegetation, mean edge-to-area ratio for all patches of woody vegetation, and estimated landscape composition for the buffered area. We defined landscape composition as the percent of woodland habitat (e.g., woody brushland) within the 100-m radius circle surrounding a nest. We used the mean value for all pixels within the 100-m buffer as the landscape composition estimate for our analysis. We used analysis of variance (Venables and Ripley 2002) to evaluate whether habitat conditions at nest site locations were different between nesting attempts and years. We used logistic regression to determine whether nest fate (success or failure) was influenced by habitat structure selected by birds and distance moved between nesting attempts both within and between breeding seasons. We conducted all statistical analyses in R 2.15.0 (R Core Development Team 2012).

## RESULTS

We monitored 194 Rio Grande wild turkey nesting attempts between 2005 and 2010 (Table 1). Overall nest success for the Edwards Plateau and Central Rio Grande Plains was 17% and 32%, respectively. The Central Rio Grande Plains

**Table 1.** Fate of Rio Grande wild turkey nests (total hens tracked) from study sites in the Edwards Plateau and Central Rio Grande Plains ecoregions of Texas, USA during 2005–2010.

Fate	Edwards Plateau			Central Rio Grande Plains		
	2005	2006	2007	2008	2009	2010
Successful	9	6	11	1	0	7
Failed	34	35	61	4	23	3
Total	43 (56)	41 (55)	72 (45)	5 (41)	23 (31)	10 (10)

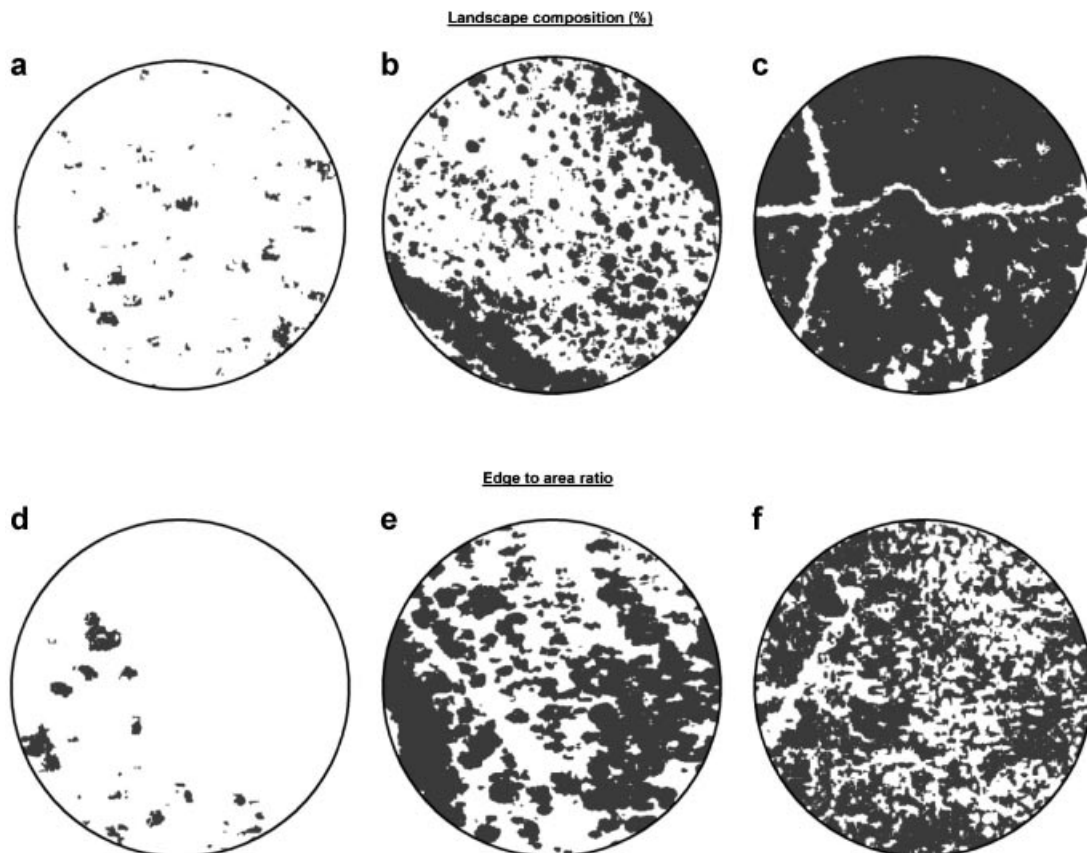
study site had a limited sample size of hens attempting to nest because of low turkey density and low numbers of marked hens during 2010 because of 3 breeding seasons (2007–2009) of sustained drought and poor reproduction. We found no difference in the landscape composition of areas selected for nest sites relative to distance moved between successive nesting attempts ( $F_{2, 58} = 0.05$ ,  $P > 0.50$ ), but we did see variation between years ( $F_{4, 56} = 0.02$ ,  $P < 0.001$ ). The mean distance (m) females moved between nesting attempts within each reproductive season was similar among years (2005: 1,312, SD = 867; 2006: 1,123, SD = 525; 2007: 1,138, SD = 893; 2008: 0 [no reneesting attempts]; 2009: 1,278, SD = 1,337; 2010: 1,148, SD = 0 [only 1 reneest attempt]). The mean distance females moved between their initial nest location in year  $t$  relative to year  $t + 1$  was consistent ( $\bar{x} = 1,407$ , SD = 1,644), but exhibited a more variable range (101–8,766 m). For 194 nesting attempts, the probability of having a suc-

cessful nest was not significantly influenced by the distance moved between nesting attempts either within ( $\beta_{\text{Within}} = 0.00008$ , SE = 0.0003; odds ratio = 1.00, 95% CI = 0.99–1.00) nor among ( $\beta_{\text{Between}} = 0.00031$ , SE = 0.0003; odds ratio = 1.00, 95% CI = 0.99–1.00) years of our study.

Rio Grande wild turkey hens selected nest sites in open areas with a moderate proportion of woody cover with a mean landscape composition of 37.7% (range = 3.0–88.2%; Fig. 1). Patchiness of the nesting landscape also was borne out by typically low ( $\bar{x} = 0.20$ ; range = 0.040–0.732) edge-to-area ratios (ratio of woody cover edge to total patch area). We found no clear pattern in nest success for either landscape composition ( $\beta_{\text{LScomp}} = 1.09$ , SE = 0.91; odds ratio = 2.98, 95% CI = 0.49–17.7) or edge-to-area ratio ( $\beta_{\text{Edge Area}} = 2.28$ , SE = 1.54; odds ratio = 9.80 (95% CI = 0.47–201.1) for hen nest site selection for our Edwards Plateau or Central Rio Grande Plains study sites. Mean landscape composition of nesting sites (37.7%) was slightly less than landscape composition estimates from random locations (46.3%), whereas edge-to-area ratio of nest sites (0.20) was equivalent to edge-to-area ratio estimates at random locations ( $\bar{x} = 0.21$ ).

## DISCUSSION

Rio Grande wild turkey nest success rates in the Edwards Plateau were similar to rates reported by others for this



**Figure 1.** Minimum (a and d), mean (b and e), and maximum (c and f) landscape composition and edge-to-area ratio for Rio Grande wild turkey nests in the Edwards Plateau and Central Rio Grande Plains, Texas, 2005–2010.

region and in Texas (Cook 1972, Ransom et al. 1987, Huffman et al. 2006, Randel et al. 2007). We found greater rates of nest success in the Central Rio Grande Plains than those published previously for this region (Ransom et al. 1987) even though this region suffered from drought in 2008 and 2009 and had unusually high precipitation during 2010. During the exceptional rainfall year (2010), nest success was 100%, whereas during the drought year, few hens attempted to nest at all, which is similar to what Collier et al. (2009) documented on the Edwards Plateau. We suggest this partially explains the results of a positive effect of landscape composition as our logistic predictions were likely skewed by irregularly high nest success across all sites because of relatively high precipitation in 2007 and 2010 (Collier et al. 2009, Melton et al. 2011).

Avian ecologists typically maintain that increasing vegetative edge has a negative influence on avian nest survival (e.g., Patton 1994, Faaborg et al. 1995, Manolis et al. 2002). Thogmartin (1999) documented mixed results regarding the impacts of edge on nest success for eastern wild turkeys (*M. g. silvestris*) in Arkansas. We suggest that in the semi-arid regions where we worked, female wild turkeys selected areas with high edge-to-area ratios and avoided areas without vegetative edges. Because many nest predators are sight-based (Liebezeit and George 2002), increased environmental edge-to-area ratio increases the amount of area necessary for predators to search, thus potentially decreasing nest predation (Angelstam 1986). Based on the distribution of nests within various landscape composition values from our study, our data indicate likely minimum (approx. 20%) and maximum (approx. 60%) thresholds for habitat interspersions represent optimal Rio Grande wild turkey nesting habitat.

Interbreeding dispersal among years was similar to those distances Flake and Day (1996) reported (0.9 km) for Merriam's turkeys (*M. g. merriami*) in South Dakota, but their estimate was based on a relatively small sample size of re-nesting birds ( $n = 9$ ). We documented shorter female movements between nesting attempts both within and among nesting seasons than others reported for eastern wild turkeys (Badyaev et al. 1996 [ $2.05 \pm 0.66$  km], Thogmartin 2001 [ $2.4 \pm 1.1$  km]). Badyaev (1995) reported marked shifts in habitat used between first and subsequent nesting attempts for eastern wild turkeys. Conversely, we found that Rio Grande wild turkeys selected habitats with similar landscape composition and similar edge-to-area ratio estimates for subsequent nesting attempts both within the nesting season and between years regardless of previous nest fate.

## MANAGEMENT IMPLICATIONS

Our results indicate that hen movements post-nest failure were fairly short with hens choosing similar habitats for all nesting attempts. Across 2 semi-arid regions of Texas, female Rio Grande wild turkeys preferred to nest in open areas with low edge-to-area ratios and moderate woody cover. Managers should focus on optimizing landscape conditions such that suitable nesting cover, defined based on our nest

locations as early successional habitats with patchy moderate (30–60%) woody cover, is readily available.

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## LITERATURE CITED

- Angelstam, P. 1986. Predation on ground-nesting bird's nests in relation to predator densities and habitat edge. *Oikos* 47:365–373.
- Archer, S. 1995. Tree-grass dynamics in a *Prosopis*-thornscrub savannah parkland: reconstructing the past and predicting the future. *Ecoscience* 2:83–99.
- Badyaev, A. V. 1995. Nesting habitat and nesting success of eastern wild turkeys in the Arkansas Ozark Highlands. *Condor* 97:221–232.
- Badyaev, A. V., and J. D. Faust. 1996. Nest site fidelity in female wild turkey: potential causes and reproductive consequences. *Condor* 98:589–594.
- Badyaev, A. V., T. E. Martin, and W. J. Etges. 1996. Habitat sampling and habitat selection by female wild turkeys: ecological correlates and reproductive consequences. *Auk* 113:636–646.
- Collier, B. A., and M. J. Chamberlain. 2011. Redirecting research for wild turkeys using global positioning system transmitters. *Proceedings of the National Wild Turkey Symposium* 10:81–92.
- Collier, B. A., K. B. Melton, J. B. Hardin, N. J. Silvy, and M. J. Peterson. 2009. Impact of reproductive effort on survival of Rio Grande wild turkey *Meleagris gallopavo intermedia* hens in Texas. *Wildlife Biology* 15:370–379.
- Cook, R. L. 1972. A study of nesting turkeys in the Edwards Plateau of Texas. *Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners* 26:236–244.
- Davis, B. D. 1994. A funnel trap for Rio Grande turkey. *Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Agencies* 48:109–116.
- Dreibelbis, J. Z., J. D. Guthrie, R. J. Caveny, J. B. Hardin, N. J. Silvy, M. J. Peterson, and B. A. Collier. 2011. Predator community and researcher-induced impacts on nest success of Rio Grande wild turkeys in Texas. *Proceedings of the National Wild Turkey Symposium* 10:235–242.
- Faaborg, J., M. Brittingham, T. M. Donovan, and J. Blake. 1995. Habitat fragmentation in the temperate zone. Pages 357–380 in T. E. Martin and D. M. Finch, editors. *Ecology and management of neotropical migratory birds*. Oxford University Press, United Kingdom.
- Flake, L. D., and K. S. Day. 1996. Wild turkey reproduction in a prairie woodland complex in South Dakota. *Proceedings of the National Wild Turkey Symposium* 7:153–158.
- Glazener, W. C., A. S. Jackson, and M. L. Cox. 1964. The Texas drop-net turkey trap. *Journal of Wildlife Management* 28:280–287.
- Gould, F. W. 1962. Texas plants—a checklist and ecological summary. MP-585. Texas Agricultural Experimental Station, College Station, USA.
- Greenwood, P. J., and P. H. Harvey. 1982. The natal and breeding dispersal of birds. *Annual Review of Ecology and Systematics* 13:1–21.
- Hopkins, C. R., J. J. Campo, W. G. Swank, and D. J. Martin. 1982. Dispersal of restocked eastern wild turkeys in East Texas. *Proceedings Annual Conference of Southeastern Association of Fish and Wildlife Agencies* 36:578–585.
- Huffman, R. T., M. C. Wallace, W. B. Ballard, G. Hall, R. Houchin, R. Applegate, S. J. DeMaso, and P. S. Gipson. 2006. Nesting habitat of Rio Grande wild turkeys. Pages 103–111 in J. W. Cain III and P. R. Krausman, editors. *Managing wildlife in the southwest: new challenges for the 21st century*. The Southwest Section of the Wildlife Society, Alpine, Texas, USA.
- Kenward, R. E. 1987. *Wildlife radio tagging*. Academic Press, London, United Kingdom.
- Larkin, T. J., and G. W. Bomar. 1983. *Climatic atlas of Texas*. Texas Department of Water Resources, Publication LP-192, Austin, USA.

- Liebezeit, J. R., and T. L. George. 2002. Nest predators, nest-site selection, and nesting success of the dusky flycatcher in a managed ponderosa pine forest. *Condor* 104:507–517.
- Manolis, J. C., D. E. Andersen, and F. J. Cuthbert. 2002. Edge effects on nesting success of ground nesting birds near regenerating clearcuts in a forest-dominated landscape. *Auk* 119:955–970.
- McGuinness, J. H., J. M. Benner, and W. P. Smith. 1990. Survival and nesting success of late winter wild turkey introductions. Proceedings Annual Conference of Southeastern Association of Fish and Wildlife Agencies 44:171–181.
- Melton, K. B., J. Z. Dreibelbis, R. Aguirre, J. B. Hardin, N. J. Silvy, M. J. Peterson, and B. A. Collier. 2011. Reproductive parameters of Rio Grande wild turkeys on the Edwards Plateau, Texas. Proceedings of the National Wild Turkey Symposium 10:227–233.
- Northup, B. K., S. F. Zitzer, S. Archer, C. R. McMurtry, and T. W. Boutton. 2005. Above-ground biomass and carbon and nitrogen content of woody species in a subtropical thornscrub parkland. *Journal of Arid Environments* 62:23–43.
- Patton, P. 1994. The effects of edge on avian nest success: how strong is the evidence? *Conservation Biology* 8:17–26.
- Pelham, P. H., and J. G. Dickson. 1992. Physical characteristics. Pages 32–45 in J. G. Dickson, editor. *The wild turkey: biology and management*. Stackpole Books, Mechanicsburg, Pennsylvania, USA.
- Peterson, M. N., R. Aguirre, T. A. Lawyer, D. A. Jones, J. N. Schaap, M. J. Peterson, and N. J. Silvy. 2003. Animal welfare-based modification of the Rio Grande wild turkey funnel trap. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 57:208–212.
- R Core Development Team. 2012. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
- Randel, C. J., R. Aguirre, D. A. Jones, J. N. Schaap, B. J. Willsey, M. J. Peterson, and N. J. Silvy. 2007. Nesting ecology of Rio Grande wild turkey in the Edwards Plateau of Texas. Proceedings of the National Wild Turkey Symposium 9:237–243.
- Ransom, D. Jr., O. J. Rongstad, and D. H. Rusch. 1987. Nesting ecology of Rio Grande turkeys. *Journal of Wildlife Management* 51:435–439.
- Rumble, M. A., and R. A. Hodorff. 1993. Nesting ecology of Merriam's turkeys in the Black Hills. South Dakota. *Journal of Wildlife Management* 57:789–801.
- Scifres, C. J., and B. H. Koerth. 1987. Climate, soils and vegetation of the La Copita Research Area. Texas Agricultural Experiment Station Bulletin MP 1626, College Station, USA.
- Taylor, C. A. 2008. Ecological consequences of using prescribed fire and herbivory to manage Juniperus encroachment. Pages 239–252 in O. W. Van Auken, editor. *Western North American Juniperus communities: a dynamic vegetation type*. Springer, New York, New York, USA.
- Thogmartin, W. E. 1999. Landscape attributes and nest-site selection in wild turkeys of Arkansas. *Auk* 116:912–923.
- Thogmartin, W. E. 2001. Home-range size and habitat selection of female wild turkeys (*Meleagris gallopavo*) in Arkansas. *American Midland Naturalist* 145:247–260.
- Toomey, R. S. III, M. D. Blum, and S. Valastro, Jr. 1993. Late Quaternary climates and environments of the Edwards Plateau, Texas. *Global and Planetary Change* 7:299–320.
- Venables, W. N., and B. D. Ripley. 2002. *Modern applied statistics with S*. Fourth edition. Springer-Verlag, New York, New York, USA.
- White, G. C., and R. A. Garrott. 1990. *Analysis of wildlife radio-tracking data*. Academic Press, San Diego, California, USA.
- Wilkins, R. N., and W. G. Swank. 1992. Bobwhite habitat use under short duration and deferred-rotation grazing. *Journal of Range Management* 45:549–553.
- Wu, X. B., E. J. Redeker, and T. L. Thurow. 2001. Vegetation and water yield dynamics in an Edwards Plateau watershed. *Journal of Range Management* 54:98–105.

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