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SPATIAL DISTRIBUTION OF FEMALE RIO GRANDE WILD TURKEYS DURING THE REPRODUCTIVE SEASON

Jody N. Schaap^{1,2}

2258 TAMU,

Department of Wildlife and Fisheries Sciences,
Texas A&M University,
College Station, TX 77843-2258, USA

Nova J. Silvy

2258 TAMU,

Department of Wildlife and Fisheries Sciences,
Texas A&M University,
College Station, TX 77843-2258, USA

Markus J. Peterson

2258 TAMU,

Department of Wildlife and Fisheries Sciences,
Texas A&M University,
College Station, TX 77843-2258, USA

Raymond Aguirre

Texas Parks and Wildlife Department,
Comfort, TX 78013, USA

Humberto L. Perotto Baldvieso

2126 TAMU, Department of Rangeland Ecology and Management,
Texas A&M University,
College Station, TX 77843-2126, USA

Abstract: Selection of suitable nesting habitat is commonly thought to be the catalyst for long-range movements of female Rio Grande wild turkeys (RGWT; *Meleagris gallopavo intermedia*) from their winter to reproductive ranges. However, distribution of female RGWTs across the landscape also could be an adaptation to avoid predation or competition for other resources. Thus, we hypothesized a priori that greater dispersion of female RGWTs across the landscape during the reproductive season should be linked to decreased population stability. We tested this hypothesis by comparing distances between reproductive-range centers (spatial distribution distance) for radio-marked female RGWTs on 2 study areas each in regions of declining and stable wild turkey abundance in the Edwards Plateau (EP) of Texas. During the first 2 years of the study, spatial distribution (km) in the stable region was significantly ($P < 0.001$) larger in the declining region. During the third year, one stable site had a larger ($P < 0.001$) spatial distribution than the declining sites as well as the other stable site. There was no significant ($P = 0.112$) difference between the 2 declining study sites. These data support the contention that the spatial distribution of suitable nesting sites may be as important to RGWT population stability as the mere presence of suitable nesting sites.

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Movement of female RGWT from their winter to reproductive ranges comprises the largest portion of annual movement for RGWTs; these movements typically are larger than for other subspecies of wild turkeys (Thomas et al. 1966, Schmutz and Braun 1989, Keegan and Crawford 2001). Those studying RGWTs generally follow the lead of eastern wild turkey (*M. g. silvestris*) biologists in assuming that limited resources

induce larger ranges and longer distance movements (Taylor 1949, Porter 1977, Exum et al. 1987, Godwin et al. 1996, Thogmartin 2001).

Badyaev et al. (1996) proposed that selection of

¹ Present address: SWCA Environmental Consultants, 4888 Langfield, Suite 300, Houston, Texas 77040, USA.

² E-mail: JSchaap@SWCA.com

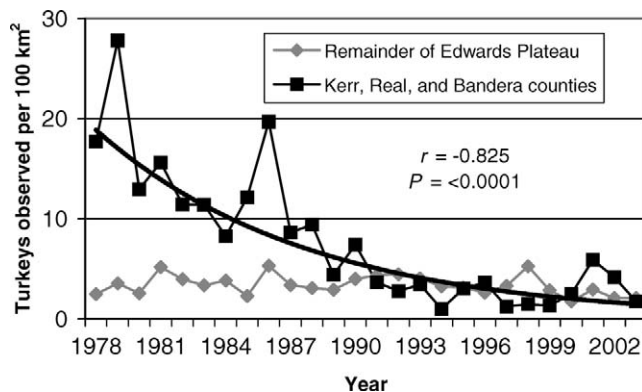


Fig. 1. Number of Rio Grande wild turkeys observed per 100 km² by Texas Parks and Wildlife Department biologists during August production surveys for Bandera, Kerr, and Real counties, Texas, and the remainder of the Edwards Plateau (EP), 1978–2004. Remainder of EP excludes counties with a mean value of <1 turkey observed per 100 km² (Taylor, Val Verde, Coke, Pecos, Kinney, Medina, Comal, Travis, Coleman, Burnet, Runnels, and Brewster counties).

suitable nesting habitat was the catalyst for long-distance movements of eastern wild turkeys. Numerous studies also have shown there is a tendency for female RGWTs to return to a given area to nest (Ellis and Lewis 1967, Hayden 1980, Keegan and Crawford 2001). Thus, it is possible that female RGWTs return to nesting areas because they found nesting habitat suitable previously. This fact alone, however, is inadequate to explain an individual hen's initial long-distance movement because, while suitable nesting habitat may be recognizable, it is not known what drives the initial long-distance movement or the nest-selection process. For these reasons, availability of suitable nesting sites cannot easily be quantified and subsequent preference/avoidance calculated. Consequently, while the hypothesis that long-distance movement to breeding areas is associated with selection of suitable nest sites seems plausible, it also is possible that this hypothesis is simply grounded in the expectation that because female RGWTs nest after long-distance movements, they must move a long distances to find a suitable nest site. This assumption has not been rigorously tested for wild turkeys, so it may have gained support primarily through repetition (Romesburg 1981).

If one makes the assumption that the search for suitable nesting habitat is indeed the catalyst for long-distance movements by female RGWTs, 2 logical conclusions can be drawn. One is that, in an area with abundant suitable nesting habitat, hens should not move as far as in areas with a lesser abundance of suitable nesting habitat. Another conclusion, assuming all other environmental variables are similar (e.g., habitat components, predation rates, etc.), is that if an area has more suitable nesting habitat, it should support a more stable population than regions with less suitable nesting habitat.

Data collected by Texas Parks and Wildlife Department (TPWD) biologists in cooperation with landowners and managers in the Edwards Plateau ecoregion of Texas (EP; Gould 1962) demonstrated that

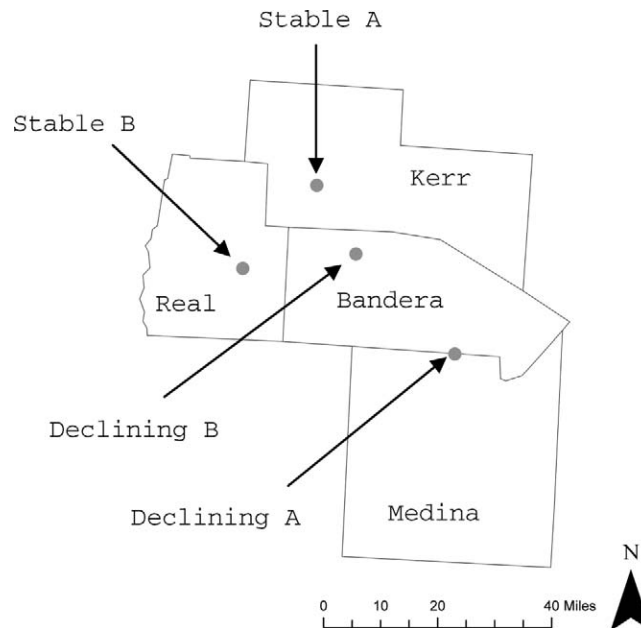


Fig. 2. Location of study sites for Rio Grande wild turkey project in the Edwards Plateau of Texas.

RGWT abundance has declined since the late 1970s in the southeastern portion of the plateau, particularly in Bandera, Kerr, and Real counties, while it remained relatively stable throughout the remainder of the EP (Figure 1). Moreover, D. A. Jones (Texas A&M University, unpublished data) demonstrated in 2001 that brood survival was significantly ($P = 0.019$) greater for a study site in the stable as compared to the declining region, while nest success was not different ($P = 0.807$).

Given this information, it follows that RGWT females in the region characterized by declining RGWT abundance should be expected to disperse a greater distance across the landscape in search of suitable nesting habitat than females in the region, which in turn should move shorter distances.

The objective of our study was to test the hypothesis that female RGWTs in the declining region disperse further during the breeding season than those in the stable region. We also addressed the alternative hypothesis that RGWT hens not only seek out a nest site meeting their requirements, but also attempt to separate themselves somewhat from other breeding females, possibly as an adaptation to avoid nest predation and competition for brood resources. Specifically, we determined whether distances between reproductive-range centers for female RGWTs in the EP differed between study areas in regions of declining and stable wild turkey abundances and the direction of such differences.

STUDY AREAS

Our study areas were located in the southeastern portion of the EP in Kerr, Real, Bandera, and northern Medina counties, Texas (Figure 2). This portion of the EP is predominately classified as rangeland and is

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Table 1. Mean distance (km) between arithmetic mean centers of breeding ranges for female Rio Grande wild turkeys in 2 study areas in regions characterized by stable (SA and SB) and declining (DA and DB) turkey abundance in the Edwards Plateau, Texas, 16.

Year	Region											
	Declining						Stable					
	DA			DB			SA			SB		
<i>n</i>	\bar{x}	SD	<i>n</i>	\bar{x}	SD	<i>n</i>	\bar{x}	SD	<i>n</i>	\bar{x}	SD	
2001	21	3.85	2.04		NA		23	7.49	5.62		NA	
2002	26	3.40	2.07	9	4.11	2.65	28	8.47	4.68	10	8.01	6.55
2003	22	3.73	2.30	11	4.15	2.09	26	5.23	4.09	10	3.48	2.25

characterized by rocky limestone outcroppings, flat-to-rolling divides with rocky, but fertile soils, and an average annual precipitation of 38–89 cm (Oakes et al. 1960). Gould (1962) identified the climax vegetation community as tall and mid-size grasses including various species of bluestems (*Andropogon* spp.), grammas (*Bouteloua* spp.), and panicum (*Panicum* spp.). Mid and over-story vegetation included Ashe juniper (*Juniperus ashei*), live oak (*Quercus virginiana fusiformes*), and shinnery oak (*Q. pungens vaseyana*). In addition, important turkey roosting trees found along river bottoms included bald cypress (*Taxodium distichum*), cottonwood (*Populus deltoides*), and pecan (*Carya illinoensis*) (Glazener 1967, Quinton et al. 1980, Reagan and Morgan 1980).

The stable and declining regions were delineated by Texas A&M University (TAMU) and TPWD personnel. Study sites were selected based on their function as winter roosting sites for RGWTs and willingness of landowners–managers to participate. We selected 2 study sites each from both the stable and declining regions (Figure 2). Stable site A (SA) was a 4,880-ha site located in the stable region in northern Kerr County, approximately 20.9 km west of Hunt, Texas. Stable site B (SB) was an 845-ha site located in Real County, approximately 9.4 km north of Leakey, Texas. Declining site A (DA) was a 4,922-ha site in the declining region of Bandera County, approximately 18.8 km west of Medina, Texas. Declining site B (DB) was a 6,100-ha site located in northern Medina County, approximately 17.0 km southwest of Bandera, Texas. Sites SA and DA were the same sites where D. A. Jones (Texas A&M University, unpublished data) conducted his study in 2001.

These study sites were in close proximity to each other (Figure 2), resulting in similar precipitation patterns, vegetation types, and topography. No vegetative differences at or near nest sites were detected between stable and declining sites (Randel 2003). The relative abundance of potential nest predators was similar on all study sites (Willsey 2003). No turkey hunting occurred on any of the study areas, but neighboring ranchers allowed turkey hunting during both the spring and fall hunting seasons (Randel 2003).

METHODS

We trapped RGWTs using modified walk-in traps (Davis 1994, Peterson et al. 2003) during winter when

turkeys were gathered in flocks. During 2001, only 2 sites (1 stable and 1 declining; D. A. Jones, Texas A&M University, unpublished data) were trapped. Birds were equipped with battery-powered mortality-sensitive radio transmitters (64.2–95.0 g; Advanced Telemetry Systems, Isanti, Minnesota, USA) and aluminum leg bands unique to each individual. Each bird was aged, sexed, weighed, and had blood taken via jugular puncture for related disease and genetic studies. Radiomarked turkeys were located by homing and triangulation from ≥ 3 fixed (Global Positioning System) telemetry stations (Silvy 1975, White and Garrott 1990) at random intervals and ≥ 3 times weekly (Swihart and Slade 1985). Locations and error polygons were estimated using LOAS software (Location of a Signal; Ecological Software Solutions, Sacramento, California, USA). Telemetry error was controlled by eliminating estimated locations with error ellipses > 5 ha (Miller 1993) or estimated locations $> 4,827$ m from the farthest telemetry station.

We focused on females during the reproductive season (16 Mar–15 Aug) to test our hypothesis. Sample size was the number of females with > 10 locations for the season (Jenrich and Turner 1969, Hoffman 1991, Badyaev et al. 1996). Ranges were calculated in hectares as 95% kernels (Worton 1989), and the arithmetic mean center of each individual turkey range was found using ArcView Spatial Analyst software (Version 2.0, Environmental Systems Research Institute, Redlands, California, USA) and Animal Movement Extension (Hooge and Eichenlaub 1997).

The distances between the arithmetic centers of all radiomarked females in each population were calculated to find spatial distribution distances. Because spatial distribution distances were normally distributed, we analyzed data for each year and for each region (stable and declining) using *t*-tests (first year), and ANOVA and LSD tests (subsequent years) to determine if there were significant ($P < 0.05$) differences between regions and years.

RESULTS

During the first year of the study (2001), spatial distribution (km) in SA was significantly ($P < 0.001$) larger than in DA (Table 1). A similar pattern was found the second year (2002), with stable-site spatial distribution distances being roughly twice as large as those in the declining sites ($P < 0.001$, Table 1). There



were no significant differences between sites in the same region, but both DA and DB had significantly ($P < 0.001$) smaller spatial distribution distances than did the stable sites. During the third year (2003), mean distribution distance in SA was again significantly ($P < 0.001$) larger than the declining sites, but also significantly ($P < 0.001$) larger than SB (Table 1). There was no significant ($P = 0.112$) differences in mean distribution distance between the 2 declining study areas or DA and SB in year 3 ($P = 0.373$), but DB was significantly ($P = 0.043$) larger than SB in that year.

DISCUSSION

The larger spatial distribution distances found in both study sites in the stable region during the first and second years, and in SA in the third year, do not support the hypothesis that female RGWTs in areas characterized by declining turkey abundance disperse further than those in areas not characterized by declining trends in abundance. Similarly, D. A. Jones (Texas A&M University, unpublished data) established that while nest success was not significantly ($P = 0.807$) different, brood rearing success was greater ($P < 0.019$) in SA than DA. Taken together, these data are consistent with the alternative hypothesis that, regardless of resource availability, there is some degree of spatial distribution required by female RGWTs during the reproductive season for there to be a stable population.

The smaller spatial arrangement of females during the reproductive season in SB appears counter to the findings in the first 2 years. It is important to note, however, the existence of a confounding factor associated with SB in the third year. This reproductive season was characterized by drought, with few females leaving hen flocks to even attempt nesting (Randel 2003).

The anomaly in year 3 for SB prompted a retrospective evaluation of the sample sizes for all study sites for that year. We calculated the percentage of females located sufficient times to create a breeding range. For DA, DB, and SA, the results were 95.65, 78.57, and 92.86%, respectively. For SB, only 34.48% of females had sufficient locations to create a breeding range. This lack of comparable sample sizes for SB in year 3 probably influenced the statistical analysis for that year.

Based on our results, we suggest that the driving force behind dispersion during the breeding season is not simply the availability of suitable nest sites (Badyaev et al. 1996). We contend that spatial distribution of females across the landscape during the reproductive season also may be an important component of population stability. Specifically, RGWT hens may not only seek out a nest site meeting their requirements, but also attempt to separate themselves from other breeding females, possibly as an adaptation to avoid nest or brood predation and/or avoid potential competition for brood resources.

Further research at a landscape level should be

conducted to compare habitat characteristics between breeding ranges used by females in both regions characterized by stable and declining RGWT numbers. If these habitat characteristics are found similar, it would lend further support to the spacing hypothesis. Further, ranges that were unused by reproductive females could be analyzed for these same habitat characteristics, thereby creating a baseline habitat suitability index that could be used in future management practices.

MANAGEMENT IMPLICATIONS

Research to date suggests that RGWTs range much further than other subspecies of wild turkeys (Taylor 1949, Thomas et al. 1966, Porter 1977, Schmutz and Braun 1989, Keegan and Crawford 2001). For this reason, the traditional approach that directs management recommendations to individual landowners and managers may be misguided, at least for RGWTs. To render management recommendations relevant to landowner cooperatives operating at a landscape level, wildlife managers must better understand the habitat characteristics consistently associated with female RGWTs during the reproductive season. Currently, more accurate, reliable, and efficient geospatial analyses are available, enabling these habitat characteristics to be accurately analyzed at a landscape scale. Unoccupied areas not possessing these characteristics could be manipulated to create them, thereby increasing the area females could use during the reproductive season. The framework required to complete this task can be laid now by establishing landowner cooperatives where habitat management can be completed at a scale relevant to RGWTs.

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- Jody Schaap** graduated from Texas A&M University in December 2000 with a B.S. in Wildlife and Fisheries Management with an emphasis in Wildlife Ecology. He earned his Master of Science from Texas A&M University in August of 2005. His research focused on population dynamics of Rio Grande wild turkeys in the Edwards Plateau of Texas. He currently works as an environmental specialist/wildlife biologist for SWCA Environmental Consultants in Houston, Texas. **Nova J. Silvy** is a Regents Professor with the Department of Wildlife and Fisheries Sciences at Texas A&M University. He received his B.S. and M.S. from Kansas State University and his Ph.D. from Southern Illinois University-Carbondale. Nova served as President of The Wildlife Society in 2000–2001 and received the Aldo Leopold Award in 2003. His research focus is upland game ecology. **Markus J. Peterson** is an Associate Professor in the Department of Wildlife and Fisheries Sciences at Texas A&M University. He received his B.S. from University of Idaho, D.V.M. from Washington State University, and M.S. and Ph.D. from Texas A&M University. Markus has a wide array of research interests ranging from ecology and management of terrestrial wildlife populations to the formation and implementation of environmental policy. **Raymond Aguirre** is a regulatory wildlife technician for the Texas Parks and Wildlife Department in the Edwards Plateau District. He works on a wide variety of research projects and programs associated with a diversity of wildlife species. He has worked with the Texas Parks and Wildlife Department for 29 years. **Humberto L. Perotto-Baldivieso** is an assistant professor in landscape ecology at the Texas Agricultural and Experiment Station in Uvalde, Texas. He received his B.S. from Universidad Mayor de San Simon (Bolivia), his M.S. and Ph.D. from Texas A&M University. His research is focused on multiple-scale analysis of ecological patterns and related processes. At the time of the research, Humberto was a graduate student in the Department of Rangeland Ecology and Management at Texas A&M University.