Movements and Habitat Selection of Male Rio Grande Wild Turkeys during Drought in South Texas

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Abstract: Wildlife managers rely on accurate information regarding wild turkey habitat selection and use to appropriately structure management activities. We used integrated VHF-GPS transmitters to evaluate fine scale movements and habitat selection of male Rio Grande wild turkeys (*Meleagris gallapavo intermedia*) in south Texas. As our study coincided with the regions second worst recorded drought, we evaluated the influence of supplemental resources (supplemental feeding and managed surface water) on turkey distribution and movements. We deployed eight GPS units on adult male Rio Grande wild turkeys captured in south Texas during spring 2009. We classified land cover into three vegetative categories: bare ground/herbaceous (26%), thorn scrub (69%), and woody riparian (5%). Based on recovered GPS units from five individuals, we found that adult male Rio Grande wild turkeys used bare ground/herbaceous (49%) and woody riparian (41%) habitat types in much greater proportion than availability on the landscape. Our results also suggest that turkey locations were significantly closer to supplemental resources than random locations generated within the study area. Our results suggest that bare ground/herbaceous and woody riparian habitat types may be important for wild turkey populations in the south Texas plains region and supplemental resources will be actively selected for during severe drought years.

Key words: habitat selection, movement ecology, Rio Grande wild turkey, *Meleagris gallapavo intermedia*, supplemental resources

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Telemetry-based monitoring has been the standard for research on movements and habitat selection for wildlife since the late 1950s (Rogers et al. 1996). Historically, research on wild turkey (*Meleagris gallapavo*) habitat use has used point locations, typically acquired daily via conventional VHF radio telemetry, to evaluate individual movements and range sizes, habitat selection (e.g., use/availability), and critical habitats for nesting and brooding (Miller et al. 1999, Chamberlain and Leopold 2000, Miller and Conner 2005, Hall et al. 2007). Telemetry techniques have provided a wide array of information on animal survival, movements, and habitat use among other population parameters. However, information acquired using telemetry often exhibits significant variance due to errors in triangulation angle definition, animal movements between bearings, signal strength, and tracking frequency (White and Garrott 1986, Saltz 1994, Millspaugh and Marzluff 2001, Thogmartin 2001). Due to reliance on radio telemetry, most early wild turkey movement studies were limited to home range descriptions (McMahon and Johnson 1980, Kelley et al. 1988) or movements of individuals or turkey flocks (Clark 1985, Lambert et al. 1990, Godwin et al. 1994). However, recent advances in the technology available for remote tracking (Guthrie et al. 2010) has increased researcher ability to identify fine scale movements of wild turkeys relative to external stimuli (Collier and Chamberlain 2011, Byrne et al. 2014, Gross et al. 2015). Information gleaned from recent movement ecology studies on wild turkeys has provided increased detail in evaluations of habitat selection and use (Byrne et al 2014, Byrne et al. 2015, Oetgen et al. 2015) and factors that impact demography (Byrne et al. 2015, Conley et al. 2015, Cohen et al. 2015).

Our goals were to identify fine scale movements and habitat use of Rio Grande wild turkeys (RGWT) during spring 2009, a time during which the second worst drought on record in Texas was occurring (Nielsen-Gammon and McRoberts 2009). Specifically, we 1) identified habitat selection and diurnal pattern of habitat use and 2) evaluated influence of supplemental resources on turkey distribution.

Study Area

We conducted our research on Temple Ranch located approximately 24 km NW of San Diego, Texas. The ranch covers 5,261 ha and was managed for white-tailed deer (*Odocoileus virginianus*) and bobwhite quail (*Colinus virginianus*) with limited seasonal cattle grazing. It is located in the eastern portion of the Central Rio Grande plain and has subtropical climates with warm winters and hot summers. Mean annual winter temperature is 14.4°C (minimum of 7.7°C) and mean summer temperature is 28.9°C (maximum of 35.6°C). Annual rainfall averages 680 mm with maxima in May and September (Archer 1990) but no rain occurred during our study period and for >3 months both before and after (Nielsen-Gammon and McRoberts 2009). Vegetation consisted of thorn-

scrub parklands with well-defined mosaic patterns of shrub clusters scattered throughout native grasslands (Northup et al. 2005). Closed-canopy woodlands were present in clay loam drainages and consisted primarily of honey mesquite (*Prosopis glandulosa*), hackberry (*Celtis occidentalis*), and Texas persimmon (*Diospyros texana*; Archer 1990). Herbaceous species on the study sites include thin paspalum (*Paspalum setaceum*), fringed signal grass (*Brachiaria ciliatissima*), red grama (*Bouteloua trifida*), and coastal sandbur (*Cenchrus incertus*; Archer 1990).

Methods

We captured adult males between 11 and 14 March 2009 using drop nets baited with milo and cracked corn. All turkeys were banded with size 12 aluminum leg bands provided by Texas Parks and Wildlife Department (TPWD), fitted with a GPS-VHF backpack style transmitter (SirTrack Ltd., Havelock North, New Zealand), and immediately released. Four of the GPS were programmed to alternate every other day between 60- and 120-minute sampling intervals while the remaining four GPS were programmed to acquire locations every 30 minutes. Additionally, 10-minute intervals were scheduled for the morning hours (0700–1100 hrs) and evening hours (1500–2000 hrs) from 24–29 March on all units to evaluate fine scale movement patterns during pre-planned hunting activities (Collier and Chamberlain 2011). All GPS recorded three locations between 2200–0500 while turkeys were roosted. As transmitters had to be recovered to download data (Guthrie et al. 2010), we attempted to re-trap GPS-tagged turkeys during May 2009 to retrieve GPS units to download movement data. We used drop nets baited with milo and cracked corn and released each individual at the trap size after removing the GPS unit. All animal handling protocols were conducted under Texas A&M University Institutional Animal Care and Use Committee Permit (2010–287).

We used 2008 National Agricultural Imagery Program (NAIP) imagery in 4-m resolution to classify cover types occurring on our study area. The study area was defined by a minimum convex polygon (MCP), created with Hawths Analysis Tools (Beyer 2004) in ArcGIS 9.3, based on point locations acquired for the wild turkeys. We then classified our study area into four classes using equal interval classification (bare ground, and three vegetation classes including herbaceous, woody riparian, and thorn scrub). We reclassified the image into two classes (vegetation or bare ground). We hand delineated woody riparian areas based on vegetation patches and distance from riparian corridors using a creek shapefile as a guide. We then masked the woody riparian area out of the vegetation/ bare ground raster to generate a vegetation/ bare ground raster for the riparian areas. We then combined the both rasters (study area vegetation/bare ground and riparian vegetation/bare ground) to depict bare ground/herbaceous, woody riparian, and thorn scrub vegetation types. We used Patch Analyst extension in ArcGIS to determine percent cover for each vegetation type. We classified supplemental resource (feeders [$n = 12$] and water [$n = 11$]) and generated 2,000 random locations within the study area to use for selection analysis. We intersected hourly turkey locations and random points with the classified image to evaluate selection differences in habitats used by turkey and used a chi-square test to evaluate whether we saw differences in selection relative to availability and to estimate the relative odds ratios of use/nonuse. We next created distance matrices for each supplemental resource location and intersected the matrix with turkey locations and random locations to evaluate whether turkeys were selecting for or against supplemental resources. We used analysis of variance to compare turkey and random point location distances from resources. We conducted our analysis in R v3.3.0 (R Development Core Team 2016) to describe hourly movements of wild turkeys in relation to habitat use, distance from resources, and diurnal movement patterns.

Results

Four males were recaptured during May 2009 using walk-in traps and released after the GPS unit was removed. We recovered an additional unit during April 2010 after the male was legally harvested. We used only diurnal data collected from 1 March–31 May 2009 for analysis of movement patterns and habitat use during the drought period. Individuals traveled on average 4.1 km day^{-1} moving longer distances during morning hours (2.9 km) than afternoon (1.2 km; range 0.5 to 11 km). Thorn scrub vegetation covered 69% of the study area followed by bare ground/herbaceous (26%) and woody riparian (5%; Figure 1). Based on an average of 2,011 locations individual^{-1}, turkeys selected primarily bare ground/herbaceous (48%) and woody riparian (40%) habitat and selected against thorn scrub (12%; $X^2 = 12.3$, df = 5, $P = 0.032$, Table 1). Random point locations were located in thorn scrub habitat types 2.56 times more frequently ($X^2 = 18.1$, df = 5, $P = 0.002$) than known turkey locations (Figure 2). Hourly habitat use throughout the day was a mix of bare ground/herbaceous (~55%) and woody riparian (~35%), however early morning and late evenings were typically spent in woody riparian areas (>50% of locations) around roost sites (Figure 3).

Table 1. Percent cover of bare ground/ herbaceous, thorn scrub, and woody riparian habitat types and proportion of habitat types used by tagged wild turkeys on Temple Ranch in south Texas from March–May 2009.

Habitat type	% cover	% use
Bare ground/herbaceous	26	48
Thorn scrub	69	12
Woody riparian	5	40

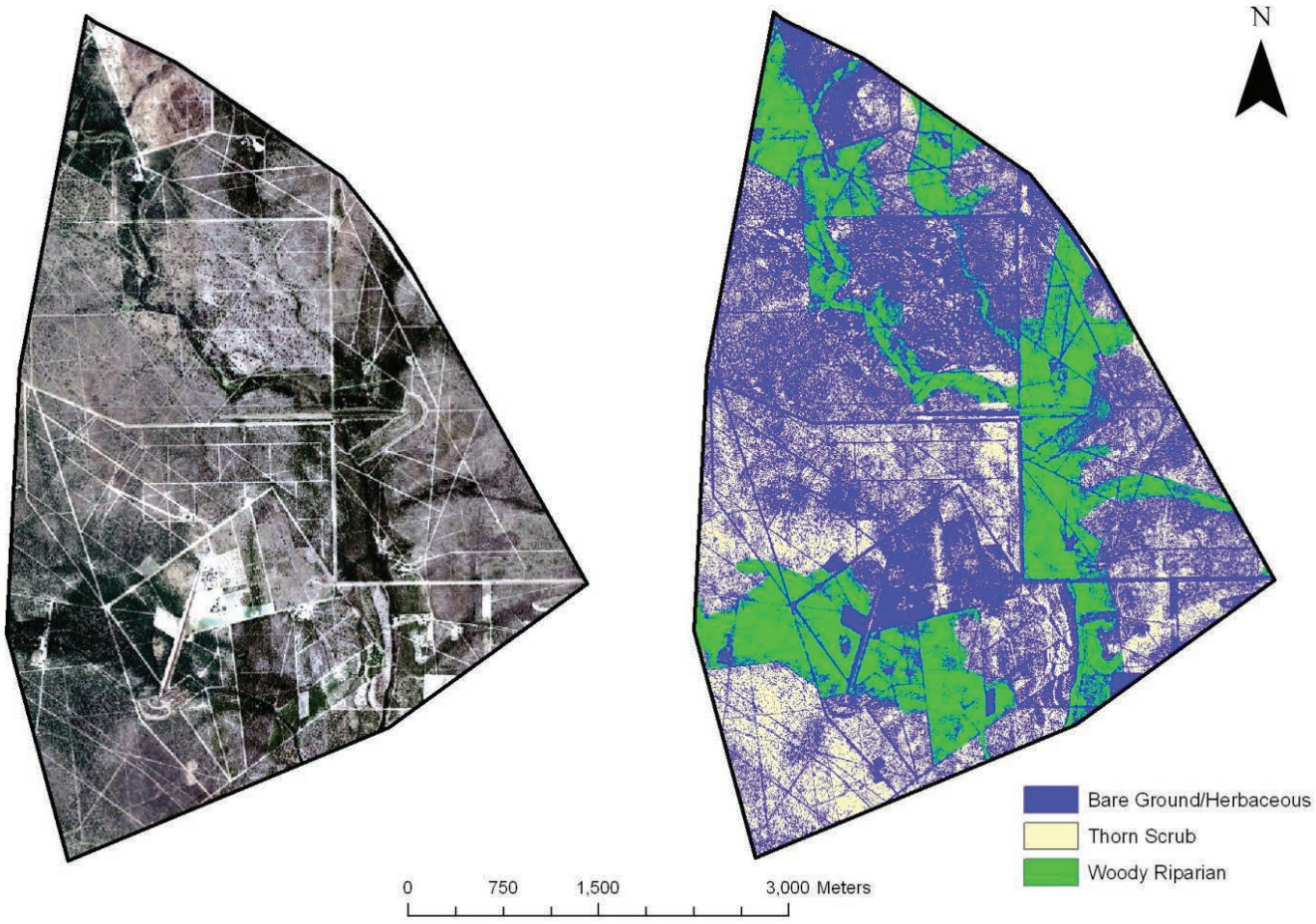

Figure 1. 2008 National Agricultural Imagery Program (NAIP) imagery in 1-m resolution (left) and classified image (right) showing bare ground/ herbaceous vegetation (blue), thorn scrub vegetation (yellow), and woody riparian vegetation (green).

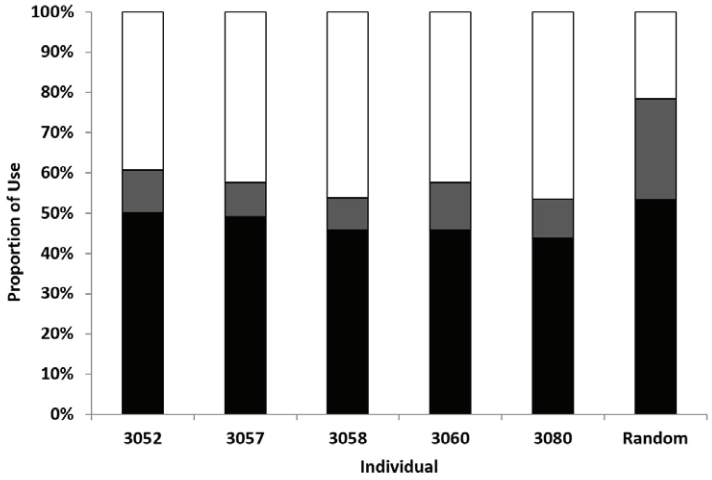

Figure 2. Individual habitat selected by GPS tagged males from March–May 2009 on Temple Ranch in South Texas compared to the distribution of random points in bare ground/herbaceous (black), thorn scrub (gray), and woody riparian (white).

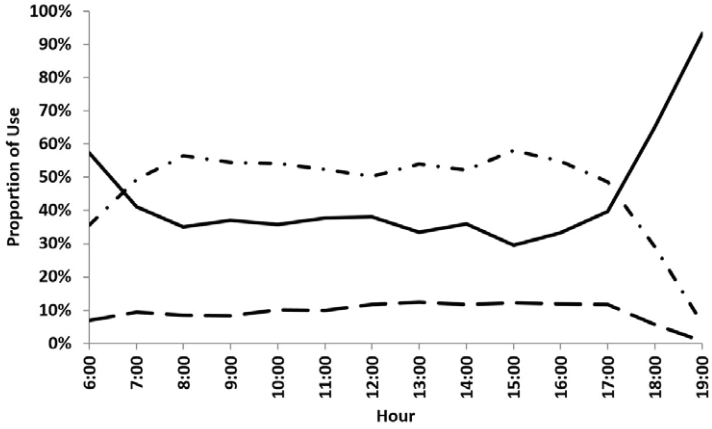

Figure 3. Hourly use of bare ground/herbaceous (dash-dot line), thorn scrub (dash line) and woody riparian (solid line) vegetation types of GPS tagged males from March–May 2009 on Temple Ranch in South Texas.

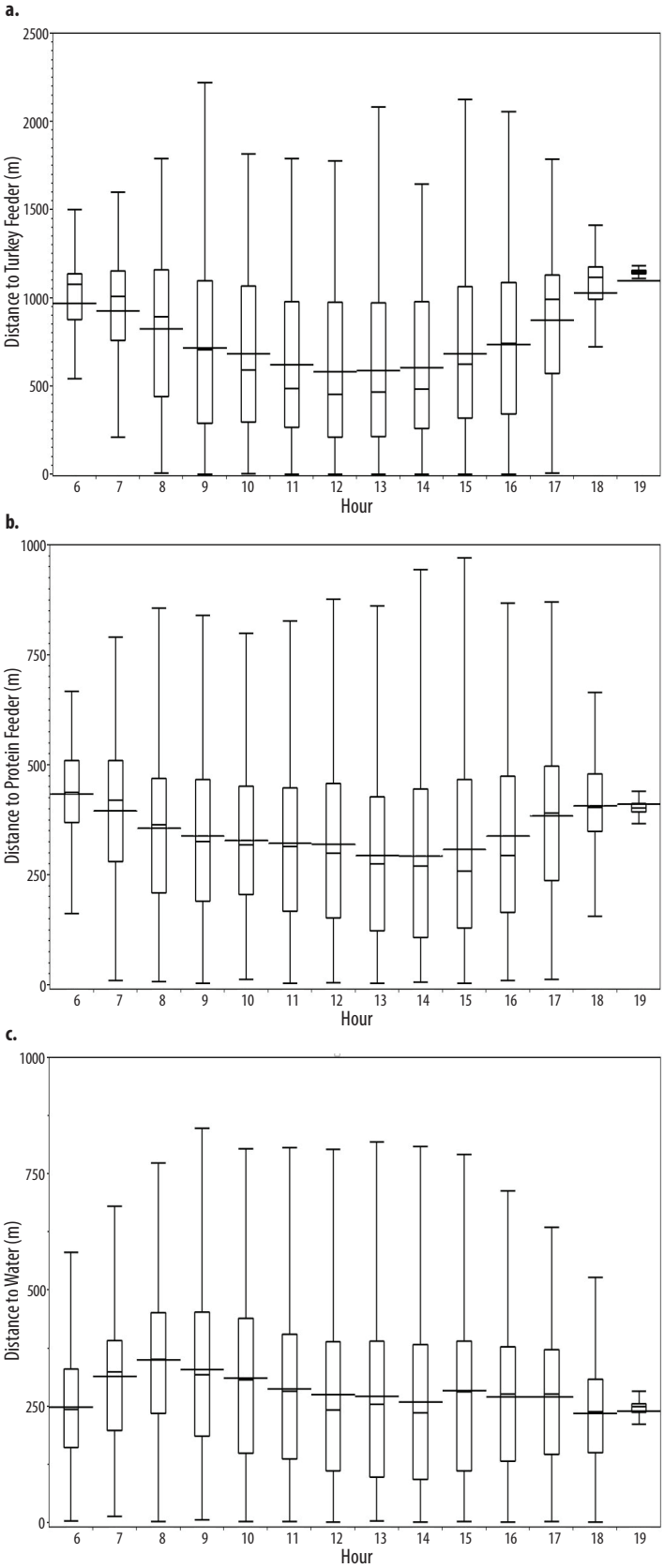

Figure 4. Hourly distances from turkey feeders (a), protein feeders (b), and water locations (c) of GPS tagged males from March–May 2009 on Temple Ranch in South Texas. Hours highlighted in red represent time periods where turkey locations were significantly closer to resources during the day.

Table 2. Mean distance from turkey locations by band number and random locations to turkey feeders, water, and protein feeders from March–May 2009 in south Texas.

Band number	*n*	Mean distance	Standard Deviation	SE mean	Lower 95% CI	Upper 95% CI
Distance to turkey feeder						
3052	744	866.72	408.305	14.969	837.3	896.1
3057	2605	690.56	438.804	8.597	673.7	707.4
3058	2145	715.24	447.192	9.656	696.3	734.2
3060	2288	897.20	404.711	8.461	880.6	913.8
3080	2014	755.78	446.028	9.939	736.3	775.3
Random	2000	1171.24	695.852	15.560	1140.7	1201.8
Distance to water						
3052	744	302.259	171.917	6.3028	289.89	314.63
3057	2605	268.055	185.018	3.6250	260.95	275.16
3058	2145	263.321	168.478	3.6377	256.19	270.45
3060	2288	307.391	166.755	3.4862	300.55	314.23
3080	2014	269.414	160.882	3.5849	262.38	276.44
Random	2000	627.623	320.365	7.1636	613.57	641.67
Distance to protein feeder						
3052	744	344.75	184.181	6.752	331.50	358.0
3057	2605	352.79	194.448	3.810	345.32	360.3
3058	2145	336.57	173.510	3.746	329.22	343.9
3060	2288	337.38	175.823	3.676	330.17	344.6
3080	2014	366.52	264.758	5.900	354.95	378.1
Random	2000	1020.74	746.711	16.697	987.99	1053.5

Supplemental feeders ($n = 12$) were all located in bare ground herbaceous habitat. Water sources were located in bare ground herbaceous ($n = 6$), woody riparian ($n = 4$), and thorn scrub ($n = 1$). Turkey locations relative to supplemental resources were closer across all resources than random locations (Table 2). Turkeys were significantly ($t = 5.1$, df = 6, $P = 0.016$) closer to feeders during the period 1100–1500 compared to other periods of the day (Figure 4a, b). Turkeys were typically closer to water resources during 0600–0700 and from 1100–1900 hours relative to other times of the day (Figure 4c).

Discussion

Understanding the scale at which turkey select habitat can help determine optimal management techniques and also aid land managers in targeting high use areas to enhance habitat for wild turkeys (Collier and Chamberlain 2011). Rio Grande wild turkey ranges have been described as open, riparian savannahs and open bare ground/ herbaceous areas adjacent to brushy cover (Baker et al. 1980). Holdstock (2003) found that during the spring, male Rio Grande wild turkeys in north Texas avoided areas dominated by riparian trees and used them less than available. However, male Rio Grande wild turkeys in our study used areas dominated by woody riparian habitat in significantly greater proportion to

their availability and used thorn scrub/brushy habitat types much less than availability. Temporal variation in vegetation selection was fairly constant from late morning to early evening with bare ground/herbaceous and riparian habitat types primarily selected for, likely using bare ground/ herbaceous for feeding (Speake et al. 1975, Clark 1985, Ielmini et al. 1992) and riparian areas for thermal regulation during the heat of the day (Hafez 2005). However, we must temper any generalization of our conclusions with the fact that although we were dealing with a significant number of spatial locations (>10,000), the sample size was only five individuals.

Severe drought during our study likely impacted forage availability (Collier, unpublished data) which may have caused Rio Grande wild turkeys to rely more heavily on supplemental resources (Pattee and Beasom 1979). Quinton et al. (1980) reported spring diets of Rio Grande wild turkeys consisted of 47% insects, 37% grasses (seeds and leaves), 13% brush (seeds and fruits), 2% forbs, and 1% other. The decrease in available metabolic and preformed water during drought years increases turkey dependence on free water (Beasom and Wilson 1992), which may explain why turkey locations in our study selected areas near water sources as shown by Byrne et al. (2014). We speculate that turkey locations may not be as aggregated around supplemental food and water during normal years of precipitation (Oetgen et al. 2015).

Bare ground/herbaceous and woody riparian habitat types were used in much greater proportion to their abundance in our study and thorn scrub/ brushy habitat were rarely used. As such, habitat management for Rio Grande wild turkeys in the south Texas plains should focus on protecting riparian areas and hence roosting and loafing areas and also on brush management to increase herbaceous habitats. Habitat improvement methods including mechanical brush control and prescribed burning could provide sufficient openings in brush dominated areas and should be implemented if open areas are absent or uncommon. Management strategies should be implemented across the landscape to provide adequate habitat for wild turkey populations not just at small scales (individual properties), but perhaps at the watershed scale. Areas adjacent to supplemental resources were repeatedly used and may be very important for turkey populations during years of extreme drought. Therefore, supplemental resources can be important for Rio Grande wild turkeys during drought years; however, their use during years of normal precipitation remains unclear.

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