

Spatial Ecology and Survival of Male Wild Turkeys in a Bottomland Hardwood Forest

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Abstract: Eastern wild turkey (*Meleagris gallopavo silvestris*) ecology in bottomland hardwood forests remains poorly understood. Specifically, managers lack basic information on spatial ecology and survival of males in these forests. Space use is an important tool to determine areas of extensive or non-use, and these areas may provide insight to managing quality habitats for turkeys. Furthermore, no information is available on potential shifts in space use by males before and during the breeding season, yet such information could help managers better understand male behavior relative to habitat management scenarios. Likewise, little information is available on survival of males in Louisiana although estimates of survival help managers balance population and harvest management. We radio-monitored 29 male wild turkeys to evaluate spatial ecology during 2005–2007 in south-central Louisiana. We used 108 males (with and without radios) to assess seasonal survival rates during 1998–2007. Seasonal home ranges varied from 966 ha in fall/winter to 768 ha in spring. Males did not move about their home ranges differently during the weeks before and during the breeding season, nor did they shift space use at the core area scale before and during the breeding season. Survival was lowest in spring (0.43, SE = 0.09) and highest in fall/winter (0.74; SE = 0.05) and summer (0.74; SE=0.06). Mean annual survival was 0.64 (SE = 0.06) and $\leq 15\%$ of marked males were harvested. Factors such as habitat heterogeneity, dominance status, season, and age acted synergistically or on an individual level to influence spatial ecology. Our estimates of annual survival are among the highest ever reported, likely due to a conservative harvest strategy and restricted hunting season.

Key words: bottomland hardwood forests, Louisiana, space use, survival, eastern wild turkey

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Bottomland hardwood forests have long been considered high-quality habitat for Eastern wild turkey (*Meleagris gallopavo silvestris*; Dickson 1992). (Dickson 1992). Although space use and survival of wild turkeys in upland areas are well understood, little research has been conducted in bottomland systems (Cobb and Doerr 1997), and the only existing published literature detailing these parameters in the lower Mississippi Alluvial Valley is focused on females (Chamberlain et al. 1996, Wilson et al. 2005 a,b). Effectively managing wild turkey populations in the southeastern United States requires reliable information on space use and survival of males, as this information will improve understanding of wild turkey ecology and assist managers with maintaining appropriate harvest seasons for this popular game bird.

Spatial fidelity is the tendency of an animal to maintain similar space use patterns among periods of interest, and may be described in terms of differences in dispersion of locations (distance of individual locations from the geographic median location) and shifts in space use (Miller et al. 2001). Spatial fidelity of wild turkey males is poorly understood (Miller et al. 2001) and there is no published information on potential shifts in space use of males during spring. Knowledge of whether males shift areas of use pri-

or to or during breeding could assist managers with refining land management scenarios to improve habitat quality for turkeys. Because wild turkeys express resource defense polygyny (Eaton 1992), areas used by males during breeding should contain resources preferred by females, whereas areas used prior to breeding likely contain abundant and reliable food resources needed by males.

Our objectives were to estimate space use, determine seasonal and annual survival rates, and assess fidelity of space use for male wild turkeys in a bottomland hardwood forest of Louisiana. Because male wild turkeys may increase space use during breeding (Kelley et al. 1988, Godwin et al. 1995), presumably to increase the likelihood of encountering receptive females, we hypothesized that males in our study would maintain larger home ranges and core use areas during the breeding season. Likewise, we hypothesized that male survival would be reduced during breeding relative to other seasons (Godwin et al. 1991, Vangilder 1995, Stafford et al. 1997) because of mortalities attributed to sport hunting. Finally, we hypothesized that males would display a greater dispersion of locations during the pre-breeding season because during this season they spend considerable time searching for food and females (Eaton 1992). Furthermore, we predicted males would shift space

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use between pre-breeding and breeding because male movements during the breeding season may be influenced more by female location than food resources (Godwin et al. 1994).

Study Area

We conducted research on a 17,243-ha bottomland hardwood forest in Iberville, St. Martin, and Point Coupee parishes, Louisiana, located in the Atchafalaya floodway system (hereafter Sherburne). Sherburne included Sherburne Wildlife Management Area (4,767 ha) owned by the Louisiana Department of Wildlife and Fisheries, Bayou des Ourses (6,317 ha) owned by the U. S. Army Corps of Engineers, and the Atchafalaya National Wildlife Refuge (6,159 ha) owned by the U. S. Fish and Wildlife Service. Additionally, there were approximately 770 ha of private lands interspersed throughout the state and federal lands. Sherburne was bordered on the north by Highway 190, on the south by Interstate-10, on the west by the Atchafalaya River, and on the east by the East Protection Guide Levee.

Common overstory species on Sherburne included American sycamore (*Platanus occidentalis*), water oak (*Q. nigra*), overcup oak (*Q. lyrata*), American elm (*Ulmus americana*), sweetgum (*Liquidambar styraciflua*), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanicus*), black willow (*Salix nigra*), and baldcypress (*Taxodium distichum*). Midstory was composed primarily of boxelder (*Acer negundo*), Drummond red maple (*A. rubra* var. *drummondii*), and rough-leaf dogwood (*Cornus drummondii*), with regeneration of the canopy species also present. Understory species included yellowtop (*Senecio glabellus*), greenbrier (*Smilax* spp.), bedstraw (*Gallium* spp.), horsetail (*Equisetum hyemale*), Virginia creeper (*Parthenocissus quinquefolia*), stinging nettle (*Urtica chamaedryoides*), poison ivy (*Toxicodendron radicans*) and southern shield fern (*Thelypteris kunthii*). Wildlife food plots were planted in various forest openings and remaining openings consisted of rights-of-way, levees, or natural regeneration from timber harvests (Wilson et al 2005a).

Male harvest was allowed on Sherburne, beginning with a two-day youth lottery hunt on the third Saturday in March of each year. One week after the youth hunt, a five-day lottery season opened on Sherburne, with 150 hunters allowed per day. Following the five-day lottery hunt, a four-day hunt was open to the public. Hunters selected for the lottery hunt were allowed to harvest one male during the lottery hunt and one male during the public hunt. If no male was harvested during the lottery hunt, the hunter was allowed to harvest two males (bag limit one per day) during the public hunt. Hunters not selected for the lottery hunt were allowed to harvest two males (bag limit one per day) during the public hunt.

Methods

Capture Methods

We captured male wild turkeys in winter (February-March) and summer (June-August) 2005–2007 with rocket nets at permanent bait sites. We banded captured birds with an aluminum butt-end leg band (provided by U. S. Geological Survey with contact information for Louisiana Department of Wildlife and Fisheries), aged them (juvenile or adult) based on feather characteristics of the ninth and tenth primaries (Pelham and Dickson 1992), and fitted males with 75-g mortality-sensitive backpack radiotransmitters (Advanced Telemetry Systems, Isanti, Minnesota). We captured females with broods opportunistically during late summer with rocket nets, which allowed us to determine sex of the poult because 56 days after hatching the leg length, body mass, and molt sequence differ by sex (Eaton 1992). We banded male poults with aluminum leg bands. We released all birds at the capture site. We conducted research under Louisiana State University Agricultural Center Institutional Animal Care and Use Protocol Numbers A-03-04 and A2007-01.

We estimated locations of radio-marked males using triangulation from 2–6 fixed telemetry stations ($n=157$) using a hand-held three-element Yagi antenna and a Telonics T-2 receiver (Telonics, Inc., Mesa, Arizona). We located males three times weekly from September–December, and one time daily throughout the rest of the year. During the spring harvest season, we used focal telemetry to determine locations of males at three-hour intervals, with one location recorded each hour (these data were used to assess spatial fidelity, see below). We used a 20-minute interval for triangulation of each male to minimize error from movement. If mortality was suspected, we used homing to locate the bird to verify the cause of death. We used Locate III (Pacer Computing, Tatamagouche, Nova Scotia, Canada) to obtain Universal Transverse Mercator (UTM) coordinates for each triangulated location.

We estimated telemetry error during the leaf-on (spring, summer, and fall) and leaf-off (winter) periods using dummy radios ($n=45$). We placed dummy radios at similar height of a male to minimize error and observers did not know the true location of the dummy radio. Average angle error for leaf-on season was $\pm 6.9^\circ$ and $\pm 6.0^\circ$ during the leaf-off season.

Space Use Analysis

We divided the calendar year into three biological seasons: spring (1 March–31 May), summer (1 June–30 September), and fall/winter (1 October–28 February; Godwin et al. 1995). We pooled fall and winter because of the warm climate in south Louisiana and similarities in food availability (succulent vegetation) and male behavior (winter flocking; Healy 1992a) during this period.

We imported male locations into ArcMap 9.1 (ESRI, Redlands, California) as point themes. We conducted area observation curves (Odum and Kuenzler 1955) on 10 randomly selected males to assess the minimum number of locations needed to accurately estimate a home range. Based on the area observation curves, we only used males with ≥ 23 locations per season for analysis. We constructed 95 (home range) and 50% (core area) adaptive-kernel density estimators (Seaman and Powell 1996) using Home Range Tools for ArcGIS 9.1 (Rodgers et al. 2005) in ArcMap 9.1. After verifying that data met assumptions of normality and homogeneity of variance, we used a factorial analysis of variance to test for season by age interactions in home range and core area size using SAS V9 (SAS 1996). If interactions did not occur, we used a one-way analysis of variance to test for effects of season and age on home range and core area size.

Spatial Fidelity

We were interested in evaluating potential shifts in space use prior to and during the breeding season (coinciding with spring harvest seasons). For this analysis, we defined the pre-breeding season as 15 February–14 March. The pre-breeding season occurred within the first peak of gobbling (Larry Savage, Louisiana Department of Wildlife and Fisheries, personal communication), a time associated with flock breakup on Sherburne (Wilson 2005). We defined the breeding season as 15 March–14 April; this period encompassed the second peak of gobbling and is associated with peak breeding. We arbitrarily selected 14 April as an end date for the analysis to ensure equal season lengths. We grouped males into one age category for this analysis because of limited sample size.

We used ArcMap 9.1 (ESRI, Redlands, California) to estimate the geographic center (bivariate median) for each male's set of telemetry locations and determined dispersion of locations as the distance (m) of each location from the bivariate median. We used Van Valen's test to determine if dispersion of locations differed between seasons (Van Valen 1978, see Miller et al. 2001). There is no straightforward way to determine shift in space use, therefore, we used the equation $Weightedmean = ((DISP_1)(n_1) + (DISP_2)(n_2)) / (n_1 + n_2)$ to determine if shifts occurred (Miller et al. 2001). $DISP_1$ was dispersion of locations for an individual male during pre-breeding, n_1 was number of locations of that individual during pre-breeding, $DISP_2$ was dispersion of points for an individual male during breeding, and n_2 was number of locations of that individual during breeding. We defined that a shift occurred if the distance between the bivariate median centers between seasons (i.e., distance between pre-breeding bivariate median and breeding bivariate median) exceeded the weighted mean in the formula. We used a paired *t*-test to determine if dispersion of points and

shifts in space use differed at the population level (across sample of birds); individual males were the experimental unit.

Survival Analysis

During 1998–2004, males were captured opportunistically as part of previous research (see Wilson et al. 2005a,b) using the same capture and handling procedures outlined above. To estimate annual and seasonal survival rates, we used banded and radio-marked birds captured during 1998–2007. Sherburne had a nine-day hunt for males annually. All males harvested during this time were required to be checked by Louisiana Department of Wildlife and Fisheries personnel. Some hunters have been unaware that radio-equipped turkeys were legal game, and may have not reported these harvested birds (Godwin et al. 1991). To alleviate this problem, we placed signs throughout the study area encouraging hunters to check in harvested birds with radio-transmitters. We combined age classes to assess seasonal and annual survival. Although it is important to assess juvenile and adult survival, low sample size for juveniles prevented us from accurately assessing their survival rates. Several previous studies at similar latitudes have reported that survival was similar between adults and juveniles (Godwin et al. 1991, Lint et al. 1995).

We used Barker's joint live-recapture, live-resight, and tag-recovery model (Barker 1997) to model survival and tag recovery rates using Program MARK (White and Burnham 1999). We used Akaike's information criterion (AIC_c), changes in AIC_c and ΔAIC_c values, and Akaike weights (AIC_w) to evaluate model performance and select the best approximating model (Anderson et al. 2000). We used Barker's model because live resightings provide more accurate estimates of desired parameters (Burnham and Anderson 2002). Model parameters included:

S_i —the probability an animal alive at i is alive at $i + 1$

p_i —the probability an animal at risk of capture at i is captured at $i + 1$

r_i —the probability an animal that survives from i , $i + 1$ is found dead and the band reported

R_i —the probability an animal that survives from i to $i + 1$ is resighted some time between i and $i + 1$

R'_i —the probability an animal that dies in i , $i + 1$ without being found dead is resighted alive in i , $i + 1$ before it died

F_i —the probability an animal at risk of capture at i is at risk of capture at $i + 1$

F'_i —the probability an animal not at risk of capture at i is at risk of capture $i + 1$. Parameters were either constant (.) or time dependent (t).

The model parameters listed above differ from Barker (1997) because Program MARK enforces certain internal constraints that arise in joint probability (Burnham and Anderson 2002). We developed five *a priori* candidate models (Table 1) and selected the most parsimonious model using Akaike's information criterion as indicated above (Burnham and Anderson 2002). We developed candidate models based on knowledge of wild turkey behavior. Survival rates of males are known to vary through time because of spring harvest season (Godwin et al. 1991, Lint et al. 1995, Paisley et al. 1995). Recapture rates also can vary by time because of potential for captured individuals to become wary of bait sites. We considered resightings (relocations) time dependent because of our radio-telemetry protocol. Stated differently, relocations of individual birds depended on our telemetry schedule as we monitored males throughout the diurnal period. Models with large numbers of parameters often find little support (Anderson et al. 2001) and it is important to compare residual variance between reduced models [S(.) p(.) r(.) R(.) R'(.) F(.) F'(.)] and the global model [S(t) p(t) r(t) R(t) R'(t) F(t) F'(t)]. We used the c-hat value (\hat{c}) to determine if data fit Barker's model (Anderson and Burnham 2001, Cooch and White 2005).

Table 1. *A priori* list of candidate models to estimate survival and tag return rates of male wild turkeys on Sherburne Wildlife Management Area, Atchafalaya National Wildlife Refuge and Bayou des Ourses, Louisiana, from 1998–2007.

Model	Description
S(t) p(t) r(t) R(t) R'(t) F(t) F'(t)	Global model—all parameters vary with time
S(t) p(.) r(t) R(.) R'(.) F(.) F'(.)	Survival, recapture probability, and recovery rate varies through time, other parameters constant
S(t) p(.) r(t) R(.) R'(.) F(.) F'(.)	Survival and recovery rate vary with time, other parameters constant
S(.) p(.) r(.) R(.) R'(.) F(.) F'(.)	All parameters held constant in time
S(t) p(.) r(.) R(.) R'(.) F(.) F'(.)	Survival varies with time, other parameters constant

Table 2. Mean seasonal home range (HR) and core area (CA) size (ha) of adult and juvenile radio-marked male wild turkeys on Sherburne Wildlife Management Area, Atchafalaya National Wildlife Refuge and Bayou des Ourses, Louisiana, from 2005–2007.

Season	Age	HR Size ^a	HR S.E.	CA Size	CA S.E.
Summer	Adult	805.9	126.4	110.4	15.2
	Juvenile	732.6	155.2	112.9	15.7
Fall/winter	Adult	1018.1	71.4	176.3	9.6
	Juvenile	924.9	52.8	155.6	13.2
Spring	Adult	663.6	109.1	116.4	21.2
	Juvenile	975.9	114.9	178.0	23.7

a. n=23 (9 adults, 14 juveniles) during summer, 20 (10 adults, 10 juveniles) during fall, and 30 (20 adults, 10 juveniles) during spring

Results

Space Use

We excluded seasonal home ranges and core areas for three males because of an insufficient number of locations and used 69 home ranges and core areas from 29 males in analyses. Home range ($F_{2/66} = 0.12, P = 0.889$) and core area ($F_{2/66} = 0.45, P = 0.637$) size did not differ among years, so we pooled years for further analysis. Mean home range size was 880 ha (SE = 90) in 2005, 818 ha (SE = 98) in 2006, and 794 ha (SE = 76) in 2007, whereas mean core area size was 151 ha (SE = 15) in 2005, 130 ha (SE = 16) in 2006, and 144 ha (SE = 13) in 2007. Season and age did not interact to affect home range size ($F_{5/63} = 1.49, P = 0.207$), but did for core area sizes ($F_{5/63} = 2.35, P = 0.051$; Table 2). Home range size did not differ by season ($F_{2/66} = 1.56, P = 0.219$) or age ($F_{1/67} = 0.87, P = 0.355$). Adults maintained larger core areas in fall/winter than spring ($t_{63} = 2.10, P = 0.039$) and summer ($t_{63} = -1.99, P = 0.051$). Juvenile core area size was larger in spring than summer ($t_{63} = -2.23, P = 0.029$). Juveniles maintained larger core areas in spring than adults ($t_{63} = -2.34, P = 0.023$; Table 2).

Spatial Fidelity

We used 19 individual males that were able to be monitored intensively during spring to assess fidelity of space use; one male was monitored in 2006 and 2007 and appeared twice in this analysis for a sample size of 20 males. Eight males had greater dispersion of locations during pre-breeding, whereas 11 displayed greater dispersion during breeding. Although 9 of 20 (45%) males in our analysis qualitatively appeared to shift space use (i.e., area of use shifted geographically to some extent) between pre-breeding and breeding, we failed to detect a shift in space use at the population level between the two seasons ($t_{20} = -0.92, P = 0.367$). The weighted mean distance between bivariate medians from pre-breeding to breeding was 927 m (SE 73). Males did not travel more widely ($t_{20} = 1.11, P = 0.282$) during pre-breeding (weighted mean dispersion = 1011 m [SE = 92]) than during the breeding (weighted mean dispersion = 855 m [SE = 101]) during breeding.

Survival

Mandatory check-in of all harvested males on Sherburne resulted in recovery of all radio-marked turkeys harvested by hunters. We evaluated survival rates using 108 males (78 adults, 30 juveniles), including 32 radio-marked males (14 adults, 18 juveniles) and 76 (64 adults, 12 juveniles) banded males. Ten males were recaptured during our study. Causes of death for radio-marked birds included legal harvest ($n = 3$; 9% of radio-marked sample), predation by bobcat ($n = 1$), illegal harvest ($n = 1$), and unknown factors ($n = 4$). Birds classified as dying from unknown causes were

Table 3. Output from five *a priori* candidate models used to estimate survival rates for wild turkey males from banding and radiotelemetry data obtained on Sherburne Wildlife Management Area, Atchafalaya National Wildlife Refuge, and Bayou des Ourses, Louisiana, from 1998–2007.

Model	AIC _c	ΔAIC _c	AIC _w	K	Deviance
S(t) p(.) r(t) R(.) R'(.) F(.) F'(.)	599.50	0.00	0.95	52	273.63
S(t) p(.) r(.) R(.) R'(.) F(.) F'(.)	605.73	6.23	0.04	35	350.67
S(.) p(.) r(.) R(.) R'(.) F(.) F'(.)	631.07	31.57	0	6	456.56
S(t) p(t) r(t) R(.) R'(.) F(.) F'(.)	755.03	155.53	0	76	268.97
S(t) p(t) r(t) R(t) R'(t) F(t) F'(t)	1086.41	486.91	0	107	85.81

Table 4. Mean annual survival rates and associated standard errors for wild turkey males on Sherburne Wildlife Management Area, Atchafalaya National Wildlife Refuge, and Bayou des Ourses, Louisiana, from 1998–2007.

Year	Survival	Standard error	Year	Survival	Standard error
1998	0.58	0.11	2003	0.42	0.08
1999	0.46	0.09	2004	0.67	0.00
2000	0.39	0.03	2005	0.44	0.00
2001	0.86	0.06	2006	0.79	0.12
2002	0.84	0.12	2007	0.92	0.04
Mean	0.64	0.06			

recovered during late summer (August) and excessive decomposition prevented us from assigning cause of death accurately.

Of 108 marked males, 16 (15%) were harvested (15 adults, 1 juvenile) and as expected tag returns were highest in spring (0.81, SE = 0.04). The global model produced a \hat{c} value of 0.00, indicating that the underlying data fit Barker's model. According to the AIC_c, ΔAIC_c, and AIC_w values, the most parsimonious model had survival and recovery rates varying through time, while holding other parameters constant (Table 3). Based on this model, survival was lowest in spring (0.43, SE = 0.09), and averaged 0.74 (SE = 0.05–0.06) during fall/winter and summer. Mean annual survival was 0.64 (SE = 0.06) with highest survival in 2007 and lowest in 2000 (Table 4).

Discussion

Home range size may reflect habitat quality, and presumably, when habitat quality is low, turkeys must range over a larger area to meet basic requirements for survival (Everett et al. 1979). We failed to detect differences in seasonal space use, which we attribute to relatively stable and consistent habitat conditions throughout the year. Previous studies have noted that space use of males increased in winter and spring. Increasing space use in winter is driven by the need to locate adequate foraging resources, whereas increased space use during spring is typically associated with breeding ecology (Exum et al. 1987, Kelley et al. 1988, Godwin et al. 1995). The warm climate in southern Louisiana allows succulent vegetation to grow year round (Wilson et al. 2005b); therefore,

males likely do not have to alter patterns of seasonal space use to exploit quality foraging areas. Likewise, in spring male movements are influenced by female locations and food resources (Godwin et al. 1991). Space use of female wild turkeys on Sherburne is greatest during late winter and early spring, and least during spring and summer (Wilson et al. 2005b). We offer that male wild turkeys on Sherburne can maintain similar home range sizes across seasons because they are not required to increase space use in search of foraging resources or to secure breeding opportunities.

Badyaev et al. (1996) predicted that breeding season movements of older, dominant males should center on suitable breeding sites, displacing subordinate males to other areas, requiring subordinate (e.g., juvenile) males to increase movements. Our findings support this prediction, as we observed juvenile males to maintain larger core use areas during spring relative to adults. Furthermore, increasing core area sizes for juveniles during breeding periods is consistent with expectations of resource-defense polygyny, where males establish and defend areas with resources preferred by females (Emlen and Oring 1977). Likewise, increased sizes of juvenile core areas could be a consequence of older, more dominant males displacing juveniles from their established core use area.

Our findings failed to support our prediction that males would display an increase in dispersion of locations during the pre-breeding season. Furthermore, we found no support for our prediction that males would shift space use between the pre-breeding and breeding season. In Mississippi, Miller et al. (2001) suggested that individual males vary widely in their patterns of spatial fidelity; males in our study also displayed highly variable patterns of fidelity as evidenced by nearly half of males shifting space use but no detectable patterns at the population level. We suggest that the lack of consistency among individuals indicates that factors such as habitat heterogeneity, dominance status, season, and age are acting synergistically or on an individual level to influence spatial fidelity of male wild turkeys.

Godwin et al. (1991) reported that 91% of male mortalities occurred during spring harvest seasons on public lands in Mississippi and survival rates of males during spring are inextricably tied to harvest susceptibility (Vangilder 1995). We observed survival rates of males during spring similar to what was expected based on previous studies at other latitudes and in other forested systems (Godwin et al. 1991, Stafford et al. 1997, Hubbard and Vangilder 2005, Wright and Vangilder 2005). Although annual survival rates were highly variable, the mean annual survival rate we observed was greater than what was reported in most previous studies. We attribute relatively high annual survival rates to correspondingly low (9%–15%) harvest rates, resulting from a conservative hunting season.

We observed relatively high survival rates of males during fall/

winter periods, likely a result of relatively consistent habitat conditions (see discussion above) and a lack of illegal harvest. On the other hand, observed survival rates during summer were lower than in previous studies. For instance, Vangilder (1995) reported a 0.82 survival rate during summer in the Missouri Ozarks and Godwin et al. (1991) consistently reported survival rates during summer exceeding 0.90 for males in Mississippi.

The reasons for reduced survival of males during summer on Sherburne are unclear, but may be related to extreme weather and consistent outbreaks of avian pox throughout our study. Extreme weather at northern latitudes directly reduces survival of turkeys in years of excessive snowfall and cold weather (Healy 1992b). The mean temperature for southern Louisiana in summer is 33.1 C with average relative humidity of 72% (<http://www.weather.gov/climate/index.php?wfo=lix>; accessed 1 August 2007). Wild turkeys have high metabolism (Eaton 1992), and additional stresses placed on males (i.e., predation attempt) during periods of extreme heat may negatively influence survival rates. Likewise, outbreaks of avian pox occurred sporadically throughout our study and were responsible for deaths of females and poults (Wilson 2005). Avian pox outbreaks increase during periods of greatest mosquito activity, and mosquito activity was high on our study area throughout spring summer and early fall. Hunters harvested marked males that showed clinical signs (i.e., evidence of lesions on head) of avian pox, and males showing these same clinical signs were observed during summer at bait sites. We observed unexplained deaths of several males during late summer, and suggest that it is plausible that avian pox negatively influenced survival rates of males during summer.

Management Implications

We observed a mean annual survival rate among the highest ever reported for a hunted population of wild turkeys. Vangilder and Kurzejeski (1995) suggested that harvest rates beyond 30%–35% would begin to negatively affect the proportion of adult males in the population, presumably through reduced survival of adults. Likewise, Hubbard and Vangilder (2005) recommended a spring harvest rate of no more than 40% of the male population, which translated to a 30% harvest rate for juvenile males and a 60% harvest rate for adult males. Furthermore, it is believed that if the proportion of juveniles in the harvest is <30% that exploitation rates are sustainable (Hubbard and Vangilder 2005, Wright and Vangilder 2005). Our findings suggest that the relatively conservative hunting season and observed harvest rates of males on our study area are sustainable through time. We recommend that harvest rates continue to be monitored to make appropriate decisions regarding season length and quality of hunting.

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