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## Home-range Size and Habitat Selection of Female Wild Turkeys (*Meleagris gallopavo*) in Arkansas

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**ABSTRACT.**—Eastern wild turkeys (*Meleagris gallopavo silvestris*) in the Ouachita Highland Province of westcentral Arkansas have some of the largest reported home ranges for this subspecies. Previous research on wild turkeys has generally attributed large home-range size to forage abundance or quality. However, limitations in reproduction by wild turkeys in the Ouachitas may influence home-range size and habitat selection. To discern factors governing home-range size, I examined habitat use by 54 female wild turkeys from 1993 to 1996. Short-leaf pine (*Pinus echinata*) and mixed pine-hardwood sawtimber were selected over other overstory cover types, whereas blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*) and white oak (*Quercus alba*) were favored in the understory. Mean fixed kernel home-range size during the breeding season was 18.9 km<sup>2</sup>, the largest reproductive period home range reported for the eastern subspecies. Home-range size varied as a function of age, body mass, reproductive status and the structure of selected habitats. Subadult females occupied larger home ranges ( $\bar{x} = 32.0$  km<sup>2</sup>,  $SE = 7.0$ ) than adult females ( $16.3 \pm 1.7$  km<sup>2</sup>) and moved greater distances between nest sites in subsequent years ( $8.9 \pm 1.8$  km vs.  $2.4 \pm 1.1$  km, respectively). After removing effects of age, heavier females occupied smaller home ranges than lighter females. Nesting individuals occupied less area than non-nesters, and female turkeys that occupied smaller areas avoided stands of seedlings and saplings in favor of mature poletimber. Taken together, effects of physiological condition and experience influenced home-range size in female wild turkeys in westcentral Arkansas.

### INTRODUCTION

Female eastern wild turkeys (*Meleagris gallopavo silvestris*) occupying pine forests of the southeastern U.S. (Speake and Metzler, 1985; Miller *et al.*, 1997), including the Ouachita Highland Province of westcentral Arkansas (Wigley *et al.*, 1986) and eastern Oklahoma (Bidwell *et al.*, 1989; Stewart *et al.*, 1998), have the largest observed home ranges. The reasons for this are unclear, but may be due to poor soils and low vegetative productivity (Wigley *et al.*, 1986) decreasing available forage resources which, in turn, necessitates a larger area to meet daily nutritional needs (Kurzejeski and Lewis, 1990).

In the Ouachita Highlands, poor reproduction in the late 1980s and early 1990s led to a decline in wild turkey abundance (Stewart *et al.*, 1998; Thogmartin and Johnson, 1999). In response to increased nest predation in stream bottoms, female turkeys nested in large upland pine patches away from riparian habitat and areas of high edge density (Thogmartin, 1999). These nest-site selection decisions should be reflected in the habitats selected by female turkeys during the reproductive period. I hypothesized that: (1) female turkeys in the Ouachita Mountains would primarily occupy pine habitat, the cover-type providing the largest available patches in the study area, as a means of locating suitable nesting locations (Thogmartin, 1999). Older females are dominant over younger females (Schorger, 1966; Hewitt, 1967), and thus should occupy more suitable habitat important for nesting

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and foraging. Consequently, despite greater energetic demands associated with larger size, I hypothesized (2) older females would have smaller home ranges. Finally, (3) I examined a hypothesis suggested by Badyaev and Faust (1996) that nesting female wild turkeys occupying areas of high rates of nest predation should range farther between successive nest sites to find more suitable nesting locations. Nesting success rates were among the lowest observed for wild turkeys (Thogmartin and Johnson, 1999) and, thus, turkeys in the study area should exhibit markedly less nest site fidelity than turkeys elsewhere. To examine these hypotheses, I quantified home-range size, mean daily movement and habitat selection in female wild turkeys during the reproductive period. I assessed fidelity to nest locations by comparing the distance moved between annual nesting locations to other studies of nesting wild turkeys.

#### METHODS

Muddy Creek Wildlife Management Area (34°35'N, 93°65'W; hereafter Muddy Creek) is a 390 km<sup>2</sup> area of the Ouachita National Forest, Arkansas, managed cooperatively by the U.S. Forest Service and the Arkansas Game and Fish Commission. East-west ridges and stream valleys dominated the topography, with shortleaf pine the major cover-type. Mean  $\pm$  SE overstory patch size was  $31.4 \pm 7.8$  ha, with pine patches being the most common and largest ( $67.5 \pm 35.8$  ha) habitats and oak (*Quercus* sp.)/hickory (*Carya* sp.) the smallest ( $8.5 \pm 1.0$  ha) and rarest (Thogmartin, 1998). Because of a preponderance of small patches, the landscape was fairly heterogeneous; few patches exceeded 500 ha. Two-thirds of habitat in the Muddy Creek landscape was edge (Thogmartin, 1999), defined as the outer 60 m of a cover type patch. Areas of recent timber harvest were dominated by blackberry (*Rubus* spp.), greenbriar (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), bluestem and panic grasses (*Andropogon* spp. and *Panicum* spp.), grape (*Vitis* spp.), pine and oak seedlings and sumac (*Rhus* spp.). The most obvious understory component of mature pine stands was flowering dogwood (*Cornus florida*).

Rocket nets (Bailey *et al.*, 1980) were used to capture 134 female wild turkeys between January and March in 1993 to 1996. Wild turkeys in winter often flock in large aggregations of individuals that may be related (Healy, 1992). Efforts were made to trap unrelated animals, but administrative and logistical constraints as well as the social behavior of wild turkeys in winter may have precluded a truly random sample. When co-occurring radio-tagged females were present one of the pair was randomly excluded from all analyses. Sex was determined by breast coloration and age (adult or yearling) from shape and barring patterns on the ninth and tenth primary feathers (Petrides, 1942; Larson and Taber, 1980). Body mass was recorded to the nearest 0.1 kg. Backpack harnesses (Kurzejeski *et al.*, 1987) equipped with shock cord (Roberts and Porter, 1996) were used to attach 110-g ( $\leq 3\%$  of body mass) radio transmitters (Telonics, Mesa, AZ) equipped with a 4-h delay motion switch. Individually numbered aluminum leg bands were attached to the left tarsus. Turkeys were released at the capture site.

Female wild turkeys were monitored during the reproductive period to determine habitats selected and their frequency of use. The reproductive period covered prespring foraging (late Jan.–Feb.), courtship (Mar.–Apr.), initial egg-laying (Apr.–May), nesting (May–Jun.) and early brood-rearing (Jun.–Jul.). Instrumented turkeys were monitored with Yagi 3-element directional antennas attached to TRX 2000S (Wildlife Material, Carbondale, IL) and Telonics TR-2 and TR-4 (Telonics Inc., Mesa, AZ) receivers. Because turkeys are diurnal, radiolocations were collected at varying times between dawn and dusk (a small sample of night roost locations was taken in 1993 and used to supplement the home range analyses).

Locations were separated by  $\geq 48$  h and  $\leq 96$  h to reduce serial correlation (Badyaev, 1994; Swanson *et al.*, 1994).

Nesting status was assigned to females in one of two conditions: (1) observed incubation or (2) localized behavior and inactive telemetry signal (Thogmartin and Johnson, 1999). Predation was extremely high and failure to make the latter accommodation would have resulted in misclassifying reproductive status for a large portion of the sample.

To derive estimated locations of turkeys, azimuths of the loudest signal from known road locations were entered into LOCATE II (Pacer; P.O. Box 641, Truro, Nova Scotia B2N 5E5). Sightings of instrumented turkeys were also provided a Universal Transverse Mercator (UTM) location. Mean straight-line error, as estimated by 59 test transmitters, was  $233 \pm 38$  m ( $\bar{x} \pm SE$ , range = 27–1498 m); median error was 153 m (Thogmartin, 1998). Eighty percent of locations were  $< 250$  m from the true location and 90% were  $< 485$  m from the true location. Standard deviation of bearing error, a measure of azimuth precision, was estimated as  $4.8^\circ$  ( $n = 38$ ).

I calculated 95% fixed kernel (Worton, 1989) home ranges with KERNELHR (version 3.07[K2], Seaman *et al.*, 1998) for each female wild turkey with  $\geq 30$  locations. Fixed kernels were created with least-squares cross validation for selection of “h”, the smoothing parameter (Seaman and Powell, 1996). Grid coarseness was allowed to vary across individuals. The program PLOT CNTR (B. Griffith, University of Alaska, Fairbanks) was used to determine core use areas of home ranges by the “inflection point” method (Seaman *et al.*, 1998). Home range and core use area maps created with the ANIMAL MOVEMENTS extension (Hooge and Eichenlaub, 1998) for ARCVIEW 3.0a (Environmental Systems Research Institute Incorporated, Redlands, California) were created.

Proportion and amount of six overstory cover type habitats, seven understory habitats and nine stand condition classes used by individual females were assessed as measures of habitat use (Table 1). Open areas included clearcuts, food plots and pastures, overstory cover types that were unfortunately indistinguishable within the geographic information system but which differed substantially in their composition and potential importance to turkeys. Stand condition and understory composition were not available for all stands occupied by wild turkeys in Muddy Creek and, therefore, analyses of selection accounting for stand structure and understory composition were not attempted for individual females when  $> 5\%$  of their home range occupied areas missing data.

Log-ratio compositional analysis was used to determine whether individual females selected specific habitat classes in Muddy Creek (Aebischer *et al.*, 1993; Elston *et al.*, 1996). To perform compositional analysis, BYCOMP.SAS (ver. 1.0) was used (Ott and Hovey, 1997). Proportions were log-ratio transformed ( $y_i = \ln(x_i/x_j)$ , where  $x_i$  is habitat  $i$ ) before analysis to create linear independence in the proportions of used habitat. A multivariate analysis of variance, followed by a ranking matrix of  $t$ -tests, was conducted to test differences between used and available habitat proportions. For available but unused habitats I replaced missing used habitat proportions by a trivial amount (0.0001).

Each female was treated as the statistical unit (Aebischer *et al.*, 1993). This was reasonable since only non-nesting females remained in flocks through the nesting season and only one (randomly chosen) radio-tagged female in any flock was included in analyses. Flocks were fluid through the nesting season (females together before nesting rarely flocked together after nesting), reducing the statistical bias of one radio-tagged female on another. Population-level relative differences in use and availability were summarized and graphed as geometric mean selection ratios ( $w_i = o_i/\pi_i$ , where  $i$  indicates the  $i$ th habitat,  $o_i$  is the used proportion and  $\pi_i$  is the available proportion in habitat  $i$ ). These selection indices do not account for the unit sum constraint and thus are not independent summaries of selection

TABLE 1.—Overstory, stand condition and understory habitat categories in Muddy Creek, Arkansas, 1993–1996

Class	Description	Mnemonic code
Overstory cover type		
Pine	>50% evergreen species, primarily <i>Pinus echinata</i>	PINE
Mixed pine-hardwood	Pine 25 to 49%	MPH
Upland hardwood	>50% deciduous species, except where pine $\geq 25\%$	UPHD
Riparian hardwood	Primarily gum species, typically in mesic areas	RPHD
Open areas	Food plots, clearcuts <10 years old and pasture	OPEN
Dry crops	Soybean, wheat	CROP
Stand condition <sup>1</sup>		
Regeneration	<50% in trees, with trees <12.7 cm dbh	RE
Seedling and sapling	$\geq 50\%$ in trees <12.7 cm dbh	SS
Sparse sawtimber	Inadequately stocked sawtimber ( $\geq 23$ cm dbh)	SP
Immature poletimber	Stand >50% pine poletimber (<23 cm dbh)	IP
Mature poletimber	Stand >50% pine poletimber (23 cm dbh); sawtimber ready for harvest	MP
Immature sawtimber	Stand >50% pine sawtimber	IS
Mature sawtimber	Stand >50% pine sawtimber; sawtimber ready for harvest	MS
Single tree cut	Individual mature sawtimber harvested	IT
Understory cover <sup>1</sup>		
Hickory and huckleberry	<i>Carya</i> spp. and <i>Gaylussacia</i> spp.	HK
Blackgum, red maple and white oak	<i>Nyssa sylvatica</i> , <i>Acer rubrum</i> and <i>Quercus alba</i>	BG
Southern red oak, black oak and sweetgum	<i>Q. falcata</i> , <i>Q. velutina</i> and <i>Liquidambar styraciflua</i> ; primarily in mesic creek bottoms	OG
Grass	<i>Andropogon</i> spp. and <i>Panicum</i> spp.	GR
Northern red oak, white oak and sugar maple	<i>Q. rubra</i> , <i>A. saccharum</i> ; primarily in upland areas	OM
Scrub oak	<i>Q. ilicifolia</i> ; primarily on dry north slopes	SC

<sup>1</sup> Categories defined by the US Forest Service; Other (OT) is an additional category comprised of a combination of rare habitat classes

for each habitat, however they do correspond well with compositional analysis rankings (Pendleton *et al.*, 1998).

Selection was analyzed at two scales, Johnson's (1980) second and third orders of habitat selection. Second-order selection was estimated by comparing proportion of habitat classes within home ranges to proportions of habitat classes available across the study area. The study area was delineated by a 100% minimum convex polygon of all locations of radio-tagged females. Third-order selection was identified by comparing habitat class proportions within core use areas to habitat classes available across the home range.

A Wilcoxon two-sample test was used to evaluate differences in home-range size, number of core use areas within the home range and selected habitat classes by age class and nesting status (Sokal and Rohlf, 1995). Mean daily distance traveled was calculated as the Euclidean distance between successive locations divided by number of days. I assumed the straight-line distance between consecutive locations was a good index to the total movement between locations; however, the strength of the correlation between straight-line distance and total distance is unknown. Normalized total amounts of each cover type and mean daily distance traveled were compared between age-class and nesting status with *t*-tests and analysis of variance.

In a previous study I described wild turkey nest site locations, in part, with principal component analysis (Thogmartin, 1999). The first two components from this analysis loaded on patch characteristics (PC1) and topographical position (PC2). Home-range size was regressed against these components to discern whether there was any association of nest location with home-range size.

Homogeneity of variances was assessed with Bartlett's and Levene's tests (Sokal and Rohlf, 1995). Normality of distributions was assessed with normal quantile plots and histograms, and corrected by  $\log_{10}$  and arcsine transformations. Statistics were conducted with JMP 3.2.1 (SAS Institute, Inc., 1995) and SAS 6.11 (SAS Institute, Inc., 1989). Variation around the mean is reported as  $\pm$ SE.

## RESULTS

Of 134 captured female wild turkeys, 54 ( $n = 44$  adults,  $n = 10$  subadults) were monitored sufficiently over the reproductive periods from February 1993 through July 1996 to test the hypotheses of this study. These 54 females were located 2030 times, with the number of locations used to estimate home ranges for each female ranging from 30 to 56 ( $\bar{x} = 37.6 \pm 8.5$ ). Mean fixed kernel home-range size was  $18.9 \pm 1.9$  km<sup>2</sup> and varied widely from 0.3 to 67.6 km<sup>2</sup>.

Variation in home-range size was largely attributed to differences in age and body mass of turkeys. Subadult female home ranges ( $32.0 \pm 7.0$  km<sup>2</sup>) were larger than adult home ranges ( $16.3 \pm 1.6$  km<sup>2</sup>;  $U_1 = 4.4$ ,  $P < 0.04$ ). With two outliers removed due to inaccurate estimates of home-range size, body mass and home-range size were negatively related. Heavier females had smaller home ranges than lighter females (Fig. 1; back-transformed  $y = 9.94(x)^{-1.73}$ ,  $F_{1,37} = 6.1$ ,  $n = 39$ , adj.  $R^2 = 0.12$ ,  $P < 0.02$ ).

Females occupied a fairly dispersed distribution within their home range as the mean isopleth for core use areas was  $69.3 \pm 3.9\%$ ; this mean core use area isopleth was greater than the 50% core assumed in most studies ( $\chi^2_1 = 742.5$ ,  $P < 0.001$ ). Nesting females occupied smaller home ranges than non-nesters ( $13.6 \pm 2.1$  vs.  $24.6 \pm 3.0$  km<sup>2</sup>;  $U_1 = 7.5$ ,  $P = 0.006$ ), whereas their activities were dispersed over a greater number of core use areas ( $7.8 \pm 1.6$  vs.  $3.2 \pm 0.7$ ;  $U_1 = 4.3$ ,  $P = 0.038$ ).

Mean daily movement for adults ( $\bar{x} = 438 \pm 22$  m day<sup>-1</sup>) was approximately 20% less than for subadults ( $\bar{x} = 552 \pm 40$  m day<sup>-1</sup>). April and June corresponded to the period of greatest daily movement for both age-classes, however, adults moved less than subadults in April ( $t_{51} = 2.0$ ,  $P < 0.05$ ) and June ( $t_{52} = 2.5$ ,  $P < 0.02$ ) and for the entire reproductive period ( $t_{52} = 2.3$ ,  $P < 0.03$ ) (Fig. 2). Mean daily movement (MDD) was a positive linear function of amount of mixed pine-hardwood (MPH) in the home range ( $\log[\text{MDD}] = -1.83 + 1.77 \times \log(\text{MPH})$ ;  $F_{1,48} = 57.57$ ,  $n = 50$ , adj.  $R^2 = 0.54$ ,  $P < 0.0001$ ).

Females that nested moved more in February ( $400 \pm 69$  m day<sup>-1</sup>) among more core use areas than non-nesting females ( $246 \pm 35$  m day<sup>-1</sup>;  $t_{18} = 2.0$ ,  $P = 0.06$ ). Females that nested moved less than non-nesting females during pre-incubation and egg-laying in April ( $t_{51} =$

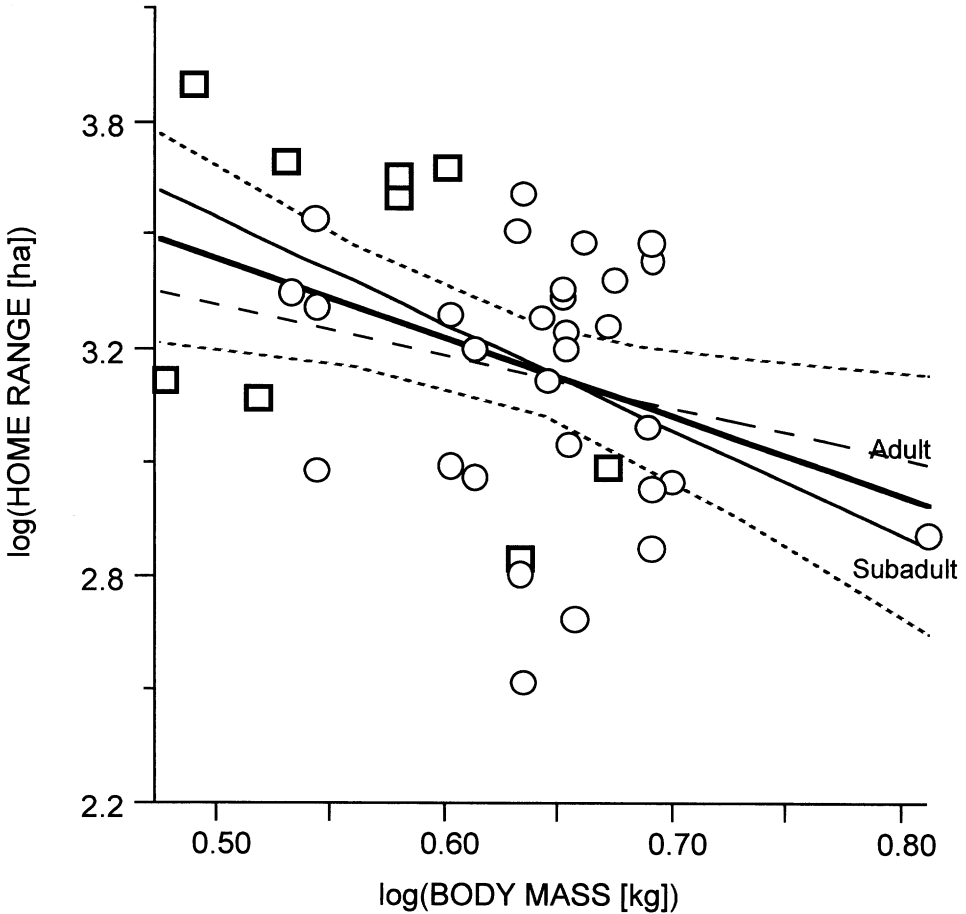


FIG. 1.—Home-range size as a linear function of female wild turkey body mass, 1993–1996. Both variables were common log-transformed to normalize residuals. Dashed line is regression fitted to adult body mass (individuals in circles), thin line is regression fitted to subadult body mass (squares). Curvilinear dashed lines are 95% confidence limits on the common regression line (thick line)

2.5,  $P < 0.02$ ), initial nesting in May ( $t_{52} = 2.7$ ,  $P = 0.01$ ), renesting and brood-rearing in June ( $t_{52} = 1.9$ ,  $P < 0.06$ ) and in the brood-rearing period in July ( $t_{43} = 2.7$ ,  $P = 0.01$ ). Movement between nest sites in subsequent years was greater for subadult females ( $8.9 \pm 1.8$  km) than for adult females ( $2.4 \pm 1.1$  km;  $n = 15$ ,  $U_1 = 2.9$ ,  $P = 0.09$ ).

Placement of home ranges within the study area occurred nonrandomly (Overstory cover type: Wilks'  $\lambda = 0.26$ ,  $F_{5,50} = 28.3$ , Randomized  $P = 0.001$ ). Pine was selected over all cover types, followed by mixed pine–hardwood (Table 2; Fig. 3). Upland-associated hardwood and open areas (which included clearcuts, foodplots and pasture) were used randomly. Riparian-associated hardwoods and dry crop agriculture were avoided. Overstory cover types within core use areas were also selected nonrandomly (Wilks'  $\lambda = 0.58$ ,  $F_{5,50} = 7.4$ , Randomized  $P = 0.001$ ). Pine and mixed pine–hardwood cover types were selected over open areas, upland- and riparian-associated hardwoods and dry crop agriculture (Table 2).

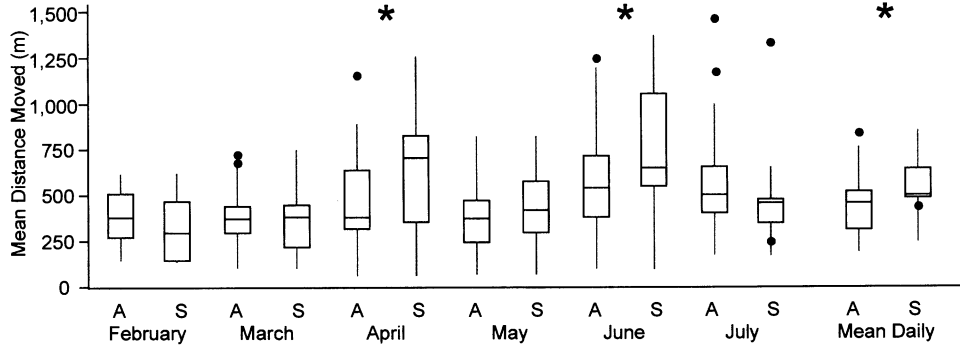


FIG. 2.—Whisker plots of daily movement (m), by age (A, adult; S, subadult) and month, for female wild turkeys, 1993–1996. Quartiles (25<sup>th</sup> and 75<sup>th</sup>) bound the median; lines represent 1.5× (interquartile range) whereas filled circles are outliers. Starred months indicate significant age-specific differences in mean daily movement

There was large variation in the proportion of pine in the home range (range = 0.35–0.76,  $\bar{x}$  = 0.54 ± 0.01) and core use area (0.20–0.78,  $\bar{x}$  = 0.55 ± 0.02). Only three female turkeys (6% of the sample) selected mixed pine–hardwood as the dominant cover-type in their home range, whereas the rest selected pine. However, five females (10%) with pine as the dominant cover-type in their home range centered their core activities in areas dominated by mixed pine–hardwood (Fisher’s Exact Test,  $P$  = 0.004). No females selected hardwood or open areas as the dominant cover type within their home range or core use areas.

Selection for stand condition was nonrandom at both second (home range vs. study area: Wilks’  $\lambda$  = 0.27,  $F_{8,36}$  = 12.35, Randomized  $P$  = 0.001) and third orders (core use area vs. home range: Wilks’  $\lambda$  = 0.38,  $F_{8,36}$  = 7.25, Randomized  $P$  = 0.001). Female turkeys favored mature (mean core composition, 21 ± 2%,  $n$  = 40) and immature sawtimber (36 ± 3%), whereas mature poletimber and newly harvested areas were avoided.

Selection of understory habitats was also nonrandom at both second (Wilks’  $\lambda$  = 0.37,  $F_{6,36}$  = 10.84, Randomized  $P$  = 0.001) and third orders (Wilks’  $\lambda$  = 0.53,  $F_{6,36}$  = 5.23,

TABLE 2.—Simplified ranks for habitat selection by female wild turkeys during the reproductive period, Muddy Creek, Arkansas, 1993–1996

Level of selection <sup>1</sup>	Habitat rankings <sup>2</sup>
<b>Overstory</b>	
Home range vs. Study area	PN MPH UPHD OPEN RPHD CROP
Core use vs. Home range	PN MPH OPEN RPHD UPHD CROP
<b>Stand condition</b>	
Home range vs. Study area	MS IS SS IP RE OT IT SP MP
Core use vs. Home range	IS IP MS SS IT RE SP MP OT
<b>Understory</b>	
Home range vs. Study area	BG HK GR SC OG OT OM
Core use vs. Home range	BG HK OT GR OM OG SC

<sup>1</sup> Ranks based on observed  $t$  statistics and randomized  $P$ -values

<sup>2</sup> From most favored to least favored; See Table 1 for habitat codes



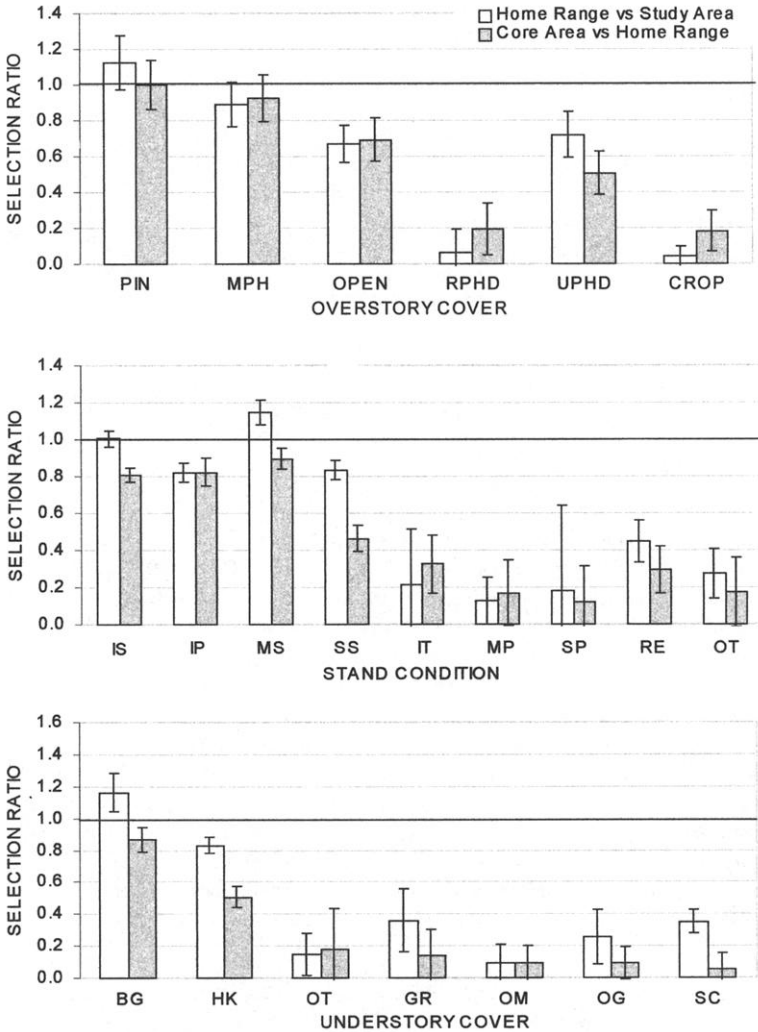


FIG. 3.—Selection ratios (used proportion/available proportion) summed over sample of female wild turkeys. Variation around mean is one standard error

Randomized  $P = 0.002$ ). Female turkeys selected understory habitat areas dominated by blackgum, red maple and white oak, comprising  $45 \pm 5\%$  of core use areas ( $n = 39$ ). Hickory and tree huckleberry were next most favored ( $0.37 \pm 0.04$ ). Understories with a large oak component were avoided.

Non-nesting females did not occupy more riparian hardwoods than nesting females ( $\chi^2 = 0.36, P < 0.5$ ). However, within a home range, amount of hardwood, a cover type associated with mesic northern slopes, was a function of nesting status and age-class (Fig. 4;  $F_{3,47} = 5.1, n = 51, P < 0.01$ ). Non-nesting adult and subadult females occupied comparatively larger amounts of hardwood than nesters. Selection ratios indicated that non-nesting

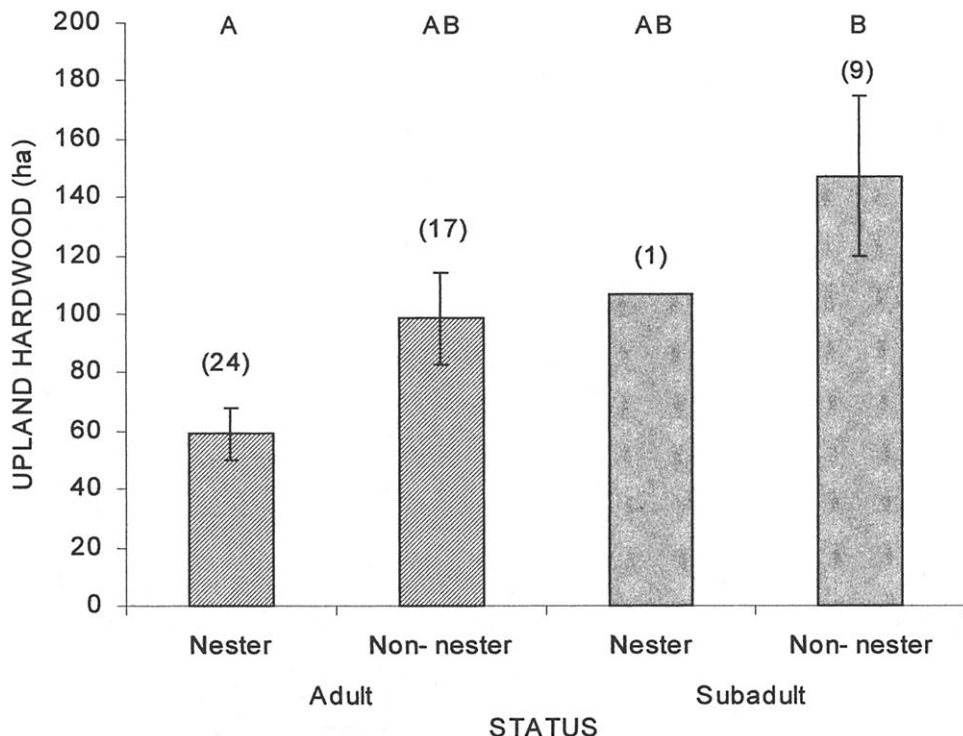


FIG. 4.—Amount of hardwood (ha) in female wild turkey home ranges as a function of nesting status (nester vs. non-nester) and age-class (adult vs. subadult), 1993–1996. Letters indicate means discriminated at  $\alpha = 0.05$  by Tukey-Kramer HSD; sample size provided parenthetically above error bars

females occupied regeneration ( $0.99 \pm 0.18$  vs.  $0.52 \pm 0.10$ ) and scrub oak ( $0.80 \pm 0.09$  vs.  $0.47 \pm 0.09$ ) habitats more than nesting females.

Home-range size was significantly associated with topographical position of the first nesting attempt (Fig. 5). Females with larger home ranges placed their first nests in low elevation, shallow slope areas typical of stream valleys and creek bottoms ( $F_{1,23} = 7.37$ ,  $n = 25$ , adj.  $R^2 = 0.21$ ,  $P = 0.012$ ). However, the regression model best explaining variation in home-range size included female body mass, whether the female nested and two stand condition variables, the selection ratios for mature poletimber and seedling and sapling (Table 3;  $F_{4,27} = 8.55$ ,  $n = 32$ , adj.  $R^2 = 0.49$ ,  $P < 0.0001$ ).

#### DISCUSSION

Wild turkey home-range size varies more in spring than at other times of the year (Badyaev *et al.*, 1996): In Muddy Creek reproductive period home-range size varied by three orders of magnitude. This wide variation in home-range size is typical of wild turkeys (Brown, 1980; Miller *et al.*, 1997) and is thought to be a response to local habitat quality (Porter, 1977; Godwin *et al.*, 1996). In Muddy Creek home-range size was a function of age, body mass, reproductive decision and the habitats selected, supporting my research hypotheses. Female turkeys favored pine over other cover-types, in agreement with hypothesis

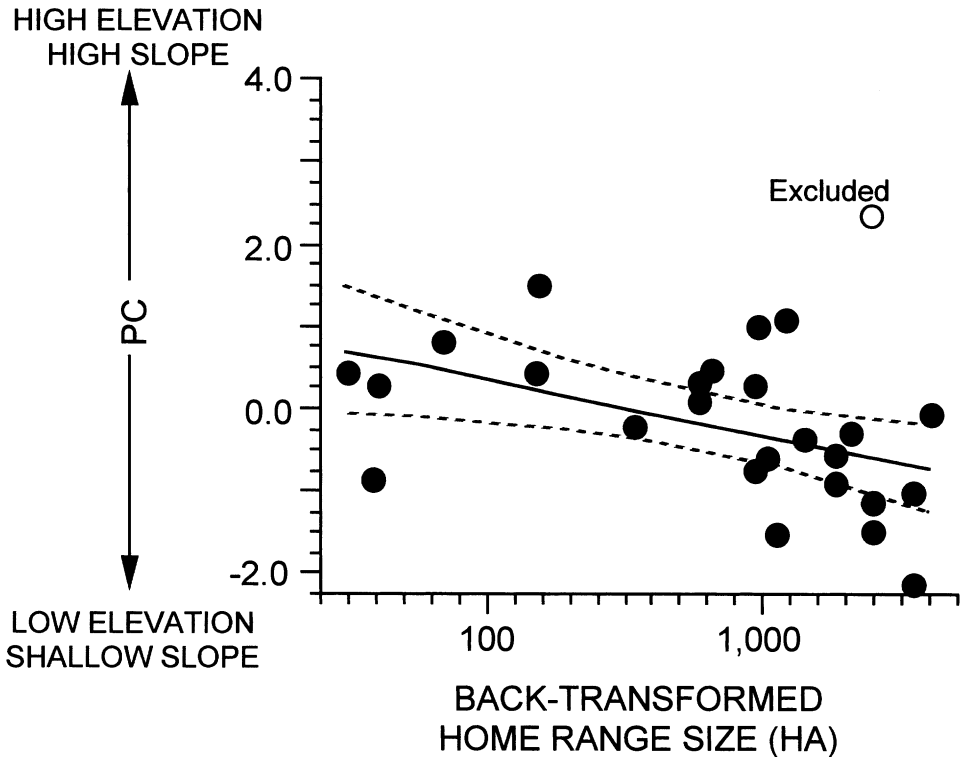


FIG. 5.—Linear relationship between nest site characteristics (as summarized by principal component score [PC]) and home-range size in the reproductive season for female wild turkeys, 1993–1996. Dashed lines are 95% confidence limits

(1). Hypothesis (2) was supported as heavier females occupied smaller home ranges than lighter females.

Breeding season home ranges (18.9 km<sup>2</sup>) and mean daily movement were larger for female wild turkeys in Muddy Creek than for females elsewhere in their range. Miller *et al.* (1997) in Mississippi reported one of the largest mean home ranges in the reproductive period ( $\bar{x}$  = 10.7 km<sup>2</sup>, range = 5.7–17.6 km<sup>2</sup>). Swanson *et al.* (1994) reported a mean spring home range in West Virginia of 5.3 km<sup>2</sup>. However, only Wigley *et al.* (1985) in the

TABLE 3.—Home-range size of female wild turkeys as a linear function of body mass, nesting status, and stand condition in Muddy Creek, Arkansas, from 1993–1996

Variable	Estimate	SE	F	P
Intercept	3.95	0.42		<0.0001
log(body mass)	-1.65	0.65	6.49	0.0169
Nesting status	0.19	0.05	15.68	0.0005
Mature pole	-0.09	0.05	3.30	0.0806
Seedling and sapling	0.32	0.14	5.07	0.0327

Muddy Creek area (15.9 km<sup>2</sup>) and Stewart *et al.* (1998) in the Ouachita Highland Province of southeastern Oklahoma (13.7 ± 9.2 km<sup>2</sup>) reported home-range sizes similar to those reported here. Whereas some of these differences in range size are likely due to home range calculation methodology (Larkin and Halkin, 1994), given the consistency of home-range sizes reported for the Ouachitas, calculated with various methods, the geographical differences appear real. For instance, in Louisiana where spring home ranges were typically <1.3 km<sup>2</sup>, mean daily movements by female adult and subadult turkeys were 307 m and 378 m, respectively (Smith *et al.*, 1989). Movement rates that were nearly 50% greater in Muddy Creek helped produce home ranges that were ten times larger.

Movement by nesters within the reproductive period was likely a combination of the search for nesting locations with a lowered risk of nest predation and greater or higher quality foraging resources. Trade-offs in foraging and nesting resources within small patches may have required females to range farther, enlarging their home range (Dunning *et al.*, 1992; Badyaev, 1994; Godwin *et al.*, 1994). Because nest sites are limited in Muddy Creek (Thogmartin, 1999), these trade-offs may have favored securing suitable nesting habitat over optimal foraging habitat.

This limitation in nesting habitat and its influence on movement is supported by additional data regarding nest-site fidelity. Nest-site fidelity (2.4–8.9 km) was less for female wild turkeys in the Ouachita Mountains than for females elsewhere in their range (supporting hypothesis 3) probably due to the very high rate of nest predation. Flake and Day (1996) reported a mean distance between successive nest sites of 0.9 ± 0.3 km for Merriam's turkeys (*Meleagris g. merriamii*) in South Dakota, whereas subadult and adult females in the Arkansas Ozarks moved 1.8 ± 1.3 km and 5.7 ± 3.4 km, respectively (Badyaev and Faust, 1996).

Female turkeys used greater amounts of pine and mixed pine–hardwood than expected by chance. However, individual turkeys exhibited large plasticity in their selection of cover types. In a previous study of habitat use by turkeys in Muddy Creek, pine plantations were avoided by adult females whereas stands of natural pine >40 y old were selected (Wigley *et al.*, 1985). Wigley *et al.* (1985), in concordance with this study, reported avoidance of hardwood by female turkeys. These patterns of selection in the mid-1980s were largely the same as those exhibited in the mid-1990s despite nearly a magnitude higher turkey density in the mid-1980s (Thogmartin, 1998). Conversely, in the nearby Oklahoma portion of the Ouachita Highland Province, female turkeys avoided mature pine and mixed pine–hardwood stands and favored widely dispersed, early-successional openings (Stewart *et al.*, 1998). Such geographical differences in habitat selection within the Ouachita Highlands may be the product of a functional response by female turkeys responding to the relative availability of cover-types (Myserud and Ims, 1998). As the proportion of early successional openings in the landscape increases, female turkeys may alter their selection to account for the increased availability of open areas.

Selection by female turkeys for pine and mixed pine–hardwood appears associated with reproduction. Many females with large home ranges, including most subadults, placed nests in stream valleys, which were unfavorable for successful nesting (Thogmartin, 1999). They did so after three extra weeks of nest-searching. Scarcity of suitable nest sites in upland pine areas (Thogmartin, 1999) may have required subdominant females to search for nest sites in stream valleys, increasing distances moved and, ultimately, home-range size. In Mississippi preferential nesting in upland pine (Seiss *et al.*, 1990; Miller *et al.*, 1999a) occurred as a means of avoiding predator-rich hardwood bottoms (Phalen, 1986). This appeared to be the case in Muddy Creek as well, as predators were abundant in every year of the study (Thogmartin, 1998; Thogmartin and Schaeffer, 2000).

Older dominant (*i.e.*, heavier) females occupying areas providing suitable foraging re-

sources were likely able to pre-empt occupation of nesting locations by subdominant or younger females, requiring these subdominant females to range farther in their search for suitable places for nesting. Badyaev and Faust (1996) suggested individual experience with past predation at nest sites influenced females to move greater distances in the search for higher quality, unoccupied breeding habitats. Older females found moving over large areas in Muddy Creek were likely individuals with less historical success in nesting.

The notion of home-range size as a function of nest-site availability is counter to the prevailing dogma on factors influencing wild turkey home-range size. Usually, relatively large home ranges have been attributed to poor quality of foraging habitat (*e.g.*, Wigley *et al.*, 1986, Swanson *et al.*, 1994; Godwin *et al.*, 1996; Stewart *et al.*, 1998). In Missouri, for instance, Kurzejeski and Lewis (1990) suggested food availability determined home-range size. Increased territory size in response to reduced availability of high quality foraging habitat has also been reported for capercaillies (*Tetrao urogallus*), another large-bodied galliform (Wegge and Rolstad, 1986). The differential influence of reproductive decisions and forage availability on habitat use and home-range size deserves greater attention (Miller *et al.*, 1999b; Miller *et al.*, 2000), but at Muddy Creek at least reproductive decision appears more important.

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