Seasonal Home Ranges of Wild Turkeys in Central Mississippi

Darren A. Miller,[1] *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

Bruce D. Leopold, *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

George A. Hurst, *Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762*

Abstract: Home range size is an important component of wild turkey (*Meleagris gallopavo*) ecology. We estimated 95% convex polygon home ranges for gobblers and hens within biological seasons in central Mississippi. Mean home range size of gobblers (N = 97) varied from 607.1 ha (subadults during spring) to 809.9 ha (subadults during fall/winter). Mean home range size of hens (N = 127) varied from 97.2 ha (early brood) to 541.9 ha (fall/winter). Male home range size did not differ among seasons (P >0.05). However, gobblers tended to have larger home range sizes than hens, which likely reflected sexual dimorphism of turkeys and movements of gobblers to associate with hens during spring. Home ranges for hens were smallest during the early brood period (P <0.003). Home ranges on our area were larger than reported from other comparable Southeastern studies. We posit that these larger ranges resulted from the lack of interspersed opening (e.g., fields, pastures) on our area and exploitation of a variety of forested habitats by male and female wild turkeys.

Proc.Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 51:414–425

Burt (1943:351) described home range as "that area traversed by an individual in its normal activities of food gathering, mating, and caring for young." Home range estimation provides an assessment of areal requirements of a species within a given system. Generally, home ranges are calculated seasonally to examine movements of species within a landscape.

Different movement patterns among wild turkey sex and age groups may be important for management decisions (Smith et al. 1988, Godwin et al. 1990). Many

1. Present Address: Weyerhaeuser, Southern Forestry Research, P.O. Box 2288, Columbus, MS 39704-2288.

home range/movement studies exist for male (e.g. Barwick and Speake 1973, Fleming and Webb 1974, Wigley et al. 1986, Smith et al. 1988, Hurst et al. 1991, Godwin et al. 1996) and female (Hillestad and Speake 1970, Holbrook et al. 1985, Burk et al. 1990, Kurzejeski and Lewis 1990, Badyaev et al. 1996) eastern wild turkeys (*M. G. sylvestris*) in the Southeast. However, few studies have examined male and female seasonal home ranges simultaneously or compared home range size across season and sex. Only Badyaev et al. (1996) partitioned hens into reproductive classes (successful vs. unsuccessful nesters during pre-incubation) for home range assessment. Because home range sizes are variable and dependent on local habitat and environmental conditions, it is essential to determine the area needed by turkeys to acquire resources within specific management areas. Our objectives were to estimate home range sizes of wild turkeys within biological seasons, and to compare seasonal and sex-specific home ranges.

Funding was provided by the National Wild Turkey Federation (NWTF), the Mississippi Chapter of NWTF, the Mississippi Department of Wildlife, Fisheries and Parks (through Federal Aid in Wildlife Restoration Funds), and the U.S. Forest Service. This manuscript was a contribution of the Mississippi Cooperative Wild Turkey Research Project and the Forest and Wildlife Research Center. We operated under Mississippi State University Animal Care and Use Committee (IACUC) Protocol 93-030.

Methods

Study Area

Our study area was the 14,410-ha Tallahala Wildlife Management Area (TWMA) located within the Bienville National Forest in parts of Scott, Newton, Jasper, and Smith counties, Mississippi. It was located within the Lower Coastal Plain Province and the Blackland Prairie Resource Area (Pettry 1977). Most (95%) of TWMA was forested with 30% in mature bottomland hardwood forests, 37% in mature pine (*Pinus* spp.) forests, 17% in mixed pine-hardwood forests (30%–70% pine), and 11% in 0- to 14-year-old loblolly (*P. taeda*) pine plantations. The remaining 5% was composed of human habitations and odd areas.

Wild Turkey Capture and Monitoring

Wild turkeys were captured with cannon nets (Bailey 1976) or alpha-chloralose (Williams et al. 1966) from 7 January to 4 March 1984–1995 and 1 July to 25 August 1984–1994. We used cracked corn as bait for both capture procedures. Turkeys captured with cannon nets were removed from the net and placed into cardboard boxes sized for wild turkeys (76.2 × 35.6 × 61 cm). Turkeys were sexed, classified as adults or juveniles (Williams and Austin 1988, D. A Miller, unpubl. data), and marked with 2 patagial wing tags (Knowlton et al. 1964) and 2 metal triple-lock leg bands. Turkeys were fitted with a 108-g mortality-sensitive radio transmitter attached backpack-style. Hens were radio-tagged throughout the study; gobblers were radio-marked during 1985–1989. Cannon-netted turkeys were released within 10–45 minutes of capture depending on number caught; tranquilized turkeys were transported to study area headquarters for making and recovery and were released the next day. All turkeys were released at their capture site.

Turkey locations were recorded using triangulation (Cochran and Lord 1963) from 2 fixed telemetry stations (*N* = 425). A hand-held, 3-element, directional Yagi antenna and either a Telonics (Mesa, Ariz.) or Wildlife Materials (Carbondale, Ill.) receiver were used for triangulation. Azimuths from 2 stations were used for triangulation if locations were ≥12 minutes apart and angles were between 60° and 120°. Transmitters were placed at a height and angle similar to that of hens to determine telemetry accuracy and precision. Average telemetry system error was 7.2° (SD = 6.3°; Palmer 1990).

All hens were located at least once/day beginning 14 March of each year. During the reproductive season (approximately 1 Apr–1 Jun), hens found in the same location for 2 consecutive days or hens with a transmitter emitting a mortality signal were considered incubating and incubation initiation date was recorded (Miller et al. 1995). During other seasons, hens were located ≥2 times/week; brood-rearing hens were located as often as 6 times/day, 3 times/week. Gobblers were located twice daily every other day from January to August and ≥1 time weekly during fall and early winter (Kelley 1987). Godwin (1991) monitored some gobblers intensively during half-day monitoring periods. During 10 March 1984–30 June 1995, 18,785 hen locations were recorded; 12,073 gobbler locations were recorded during 23 January 1986–22 February 1990.

Home Range Estimation and Statistical Analyses

All home range estimates were determined by the 95% convex polygon method using program CALHOME (Kie et al. 1994). Home range size was estimated by season and hen reproductive classifications (Table 1) for turkeys that had ≥29 locations/season and were monitored, via radio-telemetry, consecutively for at least 80% of the days with a given season. The only exception was that all 7 brood hens monitored during 60%–72% of the late brood season were included. Home range size was not estimated for nesting hens during the nesting season as a nesting hen represented a point location. Some turkeys were monitored during the same season in different years. Consequently, some statistical independence was potentially lost by including these birds for >1 season.

To determine if increased sample size was related to larger home range size (i.e., test for adequacy of sampling), simple linear regression was used, with home range size or mean distance moved between consecutive locations as the dependent variable and number of locations as the independent variable (Kenward 1982, Harris et al. 1990). The hypothesis tested was that there was no linear relationship between number of locations and seasonal home range size.

Due to low within-year sample sizes, seasonal home ranges were pooled across years. We tested the following null hypotheses regarding mean home range size: (1) males did not differ by age (adult and subadult) within seasons; (2) males did not differ among seasons; (3) successfully nesting, unsuccessfully nesting, and non-nesting

Table 1. Male and Female seasons and hen classifications within seasons used for home range analyses, Tallahala Wildlife Management Area, Mississippi, 1984–1995.

Season	Classification	Begin date	End date
Males			
Spring	—	1 Mar	13 May
Summer	—	14 May	1 Oct
Fall	—	2 Oct	28/29 Feb.
Females			
Pre-incubation	Successful nesters[a]	1 Mar	Begin incubation
	Unsuccessful nesters	1 Mar	Begin incubation
	Non-nesters	1 Mar	31 Mar
Nesting	Non-nesters	1 Apr	13 May
Renesting[b]	Successful	End incubation	Begin renest incubation
	Unsuccessful	End incubation	Begin renest incubation
Early Brood	—	End incubation	14 days post-incubation
Late Brood	—	15 days post-incubation	1 Oct
Non-reproductive	After nesting	End incubation	1 Oct
	After renesting	End incubation	1 Oct
	Non-nesting	14 May	1 Oct
Fall/winter	—	2 Oct	28/29 Feb

a. Indicates nest success for the subsequent nesting season.
b. Period between nesting attempt and subsequent renesting attempt.

hens did not differ within the pre-incubation season; (4) hens did not differ by age within 4 seasons: those hens during the fall/winter season, pre-incubation hens that subsequently nested unsuccessfully, hens during pre-incubation that did not subsequently attempt to nest, and non-nesting hens during the nesting season; (5) hens did not differ among seasons; (6) males and females did not differ within seasons.

For all hypotheses, homogeneity of variance was tested with Levene's test and the Shapiro-Wilks statistic was used to test for data normality. Violations of assumptions were rectified, if possible, using appropriate transformations (Steel and Torrie 1980) so that analysis of variance (ANOVA) could be used. If assumption violations were not correctable, non-parametric equivalents of ANOVA (i.e., Wilcoxon signed rank test, Kruskal-Wallis test) were used (Daniel 1990). All hypotheses were tested at $\alpha = 0.05$ and, because of unequal sample sizes among treatments, Type III sum of squares was used as the basis for F-tests. Least square means procedure was used for mean separation, and Dunn's multiple comparison was used for non-parametric multiple comparisons.The first hypothesis was tested using a 1-way ANOVA within seasons, with age as the independent variable. Hypotheses 2 and 5 were tested with a 1-way ANOVA with season as the independent variable.

Hypothesis 3 was tested using the Kruskal-Wallis test and hypothesis 4 was tested using the Wilcoxon signed rank test. Fall/winter hens, non-nesting hens during the nesting season, unsuccessful hens during pre-incubation, and non-nesting hens during pre-incubation were the only seasons when subadult hens had home ranges calculated. Due to disparity of sample sizes between subadults ($N \geq 5$) and adults ($N \geq 11$), we randomly chose an equal sample size of adult hens from each season to test against the subadults. If non-significant results were obtained, hens were pooled across ages (subadult and adult). Because only 2 non-nesting, subadults hens were available within the pre-incubation season, these hens were assumed to have similar home range sizes as adults and were pooled with adults for analyses. Additionally, we tested for significant differences with respect to home range size for the 3 classifications (non-nesting, unsuccessful nesters, and successful nesters) within the pre-incubation season for possible pooling. Finally, non-reproductive hens (unsuccessful renesters, unsuccessful nesters, and non-nesters; Table 1) during post-nesting seasons were pooled as non-reproductive hens.

Seasonal categories for male and female turkeys were defined by biological seasons so that seasons did not exactly coincide temporally (except fall/winter). Therefore, to examine hypothesis 6, comparisons were made between gobbler and hen home ranges when temporally commensurate. We used 1-way ANOVA, with sex as the classification variable, to test if mean home range size differed between spring gobblers and pre-incubation hens; spring gobblers and non-nesting hens during nesting season; summer gobblers and late brood hens; summer gobblers and non-reproductive hens; and fall/winter gobblers and fall/winter hens. Because of small sample sizes for late brood hens ($N = 7$), a randomly selected equal sample of gobblers was chosen for this comparison.

Results

Male Home Ranges

We used 97 seasonal home ranges from 54 individual gobblers (24 adults, 30 subadults) to estimate home ranges (Table 2). There was no significant linear relationship between home range size and number of telemetry locations during spring ($F = 0.69$, $P = 0.413$, $r^2 = 0.02$), summer ($F = 2.38$, $P = 0.1316$, $r^2 = 0.06$) nor fall/winter ($F < 0.01$, $P = 0.981$, $r^2 < 0.01$), indicating that 29 locations were adequate for home range estimation. Number of locations taken for gobblers used in analyses varied from 29–98 during spring ($\bar{x} = 55$), 37–107 during summer ($\bar{x} = 69$), and 29–129 during fall/winter ($\bar{x} = 53$).

Male home range sizes did not vary with age during any season ($P > 0.48$; Table

Table 2. Parameter estimates for home range sizes (ha) of male wild turkeys within age (adult and subadult) and season (spring, summer, fall/winter) classifications, Tallahala Wildlife Management Area, Mississippi, 1986–1990.

Classification	Dates	$\bar{x}$	SE	Range	N
Spring/adult	1 Mar–13 May	710.5	104.98	263–2155	18
Spring/subadult	1 Mar–13 May	607.1	106.5	256–2107	19
Summer/adult	14 May–1 Oct	611.8	67.0	262–1290	17
Summer/subadult	14 May–1 Oct	689.8	112.1	182–2427	20
Fall/adult	2 Oct–28/29 Feb	668.8	114.9	308–1727	14
Fall/subadult	2 Oct–28/29 Feb	809.8	168.1	233–1773	9

2). Therefore, ages were combined to test the hypothesis that home range sizes differed among seasons. Mean home range size of gobblers did not differ among seasons ($F = 0.24$, $P = 0.783$).

Hen Home Ranges

We calculated 127 seasonal home ranges for 81 individual hens (Table 3). Home range size was not associated with number of locations during pre-incubation, early brood, late brood, nesting, non-reproduction, nor fall/winter seasons ($r^2 < 0.21$, $P \geq 0.18$). Only 4 hens during the interval between nesting and renesting (2 successful and 2 unsuccessful) were sampled adequately to describe home range; subsequently, these home ranges were excluded from statistical analyses, but their sizes were reported (Table 3). Number of observations/hen ranged from 30–133 during pre-incubation ($\bar{x} = 54$), 30–73 ($\bar{x} = 39$) during nesting, 26–129 during early brood ($\bar{x} = 77$), 26–216 during late brood ($\bar{x} = 127$), 40–91 during fall/winter ($\bar{x} = 52$), and 29–199 for non-reproductive hens ($\bar{x} = 53$).

Four subadult hens were included in the fall/winter sample, 5 subadult hens were unsuccessful nesters during pre-incubation, and 5 subadult hens were non-nesters during the nesting season. Median home range sizes for subadult and adult hens were not different for unsuccessful nesters during pre-incubation ($P = 0.18$), non-nesting hens during nesting ($P = 0.69$), and fall/winter ($P = 1.00$). Additionally, within the pre-incubation season, unsuccessful nesters and successful nesters did not differ with respect to home range size ($P = 0.68$), nor did non-nesters during pre-incubation differ from these ($P = 0.12$). Therefore, we pooled age classes, successful and unsuccessful hens during pre-incubation, and non-nesting hens during pre-incubation for further comparisons. Seasons used for the ANOVA were pre-incubation, nesting (non-nesters only), early brood, late brood, non-reproductive and fall/winter (Table 3).

Table 3. Parameter estimates for home range sizes (ha) of female wild turkeys (adults and subadults) within seasons, Tallahala Wildlife Management Area, Mississippi, 1984–1995.

Classification	Dates	$\bar{x}$	SE	Range	N
Pre-incubation	a	401.0	35.6	94–1,124	51
Non-nesting	1 Apr–13 May	320.6	58.3	103–955	16
Early brood	b	97.2	26.6	20–314	10
Late brood	c	334.9	99.4	31–756	7
Non-reproductive	d	339.9	58.9	115–1,197	19
Fall/winter	2 Oct–28/29 Feb	541.9	96.6	141–1,789	20
UR	e	384.1	177.6	510–1,388	2
SR	f	209.6	162.7	116–920	2

a. Season was 1 March–31 March for non-nesters and 1 March—begin incubation for nesters.

b. Time between break-up of initial nests and beginning of renests for successful renesters.

c. Season was day of hatching + 14 days for nesters.

d. Includes unsuccessful nesters, renesters and hens that did not attempt nests after nest attempts; season dates variable based on hen nesting chronology, but began after 15 April and ended 1 October.

e. Time between break-up of initial nests and beginning of renests for unsuccessful renesters.

f. Time between break-up of initial nests and beginning of renests for successful renesters.

Table 4. Test statistics and critical values (in parentheses) for Dunn's multiple comparison procedure for home range size differences of wild turkey hens during pre-incubation (PI), early brood (EB), late brood (LB), non-nesting (NN), fall/winter (FW) and non-reproductive (NR) seasons, Tallahala Wildlife Management Area, Mississippi, 1984–1995. Values with (*) indicates significant comparison.

Season	PI	EB	LB	NN	FW	NR
PI	—	54.90 (33.63)*	11.40 (39.20)	10.80 (27.87)	8.20 (25.66)	10.70 (26.14)
EB		—	43.50 (47.92)	44.33 (39.20)*	63.17 (37.66)*	44.12 (37.99)*
LB			—	2.20 (44.07)	19.60 (42.71)	0.60 42.99)
NN				—	21.90 (32.62)	2.80 32.99)
FW					—	19.07 (31.15)
NR						—

Mean home range size differed ($P = 0.004$) for hens among seasons. Dunn's multiple comparison procedure was used and adjusted for experimentwise error rate (15 comparisons) resulting in $\alpha = 0.003$ for each comparison. Early brood home ranges were smaller than pre-incubation, non-reproductive, non-nesting, and fall/winter home ranges (Table 4).

Comparisons of Male and Female Seasonal Home Ranges

Home ranges of males during spring were larger than females during pre-incubation and during non-nesting ($F = 19.0$, $P < 0.001$).Home ranges of males during summer were larger than females during late breeding ($F = 6.3$, $P = 0.028$) and than non-reproductive hens ($F = 19.7$, $P < 0.001$). Finally, mean home range size for gobblers during fall/winter tended to be larger ($F = 3.75$, $P = 0.060$) than for hens.

Discussion

Comparing home range sizes in this study to other studies is difficult. Home range size can be calculated several ways and may vary within methods. For example, program CALHOME calculates the 95% minimum convex polygon by constructing a 100% polygon, excluding border points one at a time, recalculating the 100% polygon to determine which excluded point produces the smallest area, and repeating this procedure until 5% of the points have been excluded (Kie et al. 1994:13). Program HOMERANGE, another often-used package, calculates a 95% minimum convex polygon by removing the point farthest from the arithmetic center, recalculating a new arithmetic center with the remaining points, and repeating this until 5% of the points have been removed (Ackerman et al. 1990:10).

Comparisons among home range methods are subject to methodological (Larkin and Halkin 1994) and sample size variation (Boulanger and White 1990). This lack of consistency, in addition to biological phenomena, adds variability to home range estimates, further hampering comparison of home range estimates among studies. Larkin and Halkin (1990) recommended reporting ≥1 home range estimator. However, this is not an effective solution for among-study comparisons as home ranges calculated by the same method can vary considerably, especially for statistically-based estimators (harmonic mean, kernel estimator) that require a subjective selection of certain parameters. Differences in definition of biological seasons adds variability among studies. Because of these difficulties, we have restricted comparisons primarily to studies within the Southeast using similar techniques and have relied on trends rather than actual reported sizes.

In our study, home range size displayed wide variation among individuals in all seasons, as has been reported elsewhere (Barwick and Speake 1973, Brown 1980, Kelley et al. 1988). This large variance decreased power. Large variation in individual home ranges may be due to localized differences in habitat quality (Porter 1977, Exum et al. 1987, Godwin et al. 1996) or individual behavior. Smaller home range size for early brood hens was expected as this season was half as long as the next shortest season. Hens during early brood season may restrict their movements because young poults cannot travel long distances (Porter 1977). Additionally, the specialized habitat needs of turkey broods (Speake et al. 1975, Healy 1992:59, Hurst 1992) may limit hen movements. These 3 factors likely interacted to produce smaller home ranges during the early brood season.

Home range sizes of gobblers were commensurate with other studies conducted in predominantly forested landscapes (Everett et al. 1979, Hurst et al. 1991). Research conducted where a large portion of the area was open/pasture lands reported smaller home ranges for gobblers (Barwick and Speake 1973, Fleming and Webb 1974, Smith et al. 1988). Previous authors have noted a possible relationship between amount of open areas and home range size for gobblers, possibly reflective of habitat quality (Porter 1977, Everett et al. 1979, Wigley et al. 1986, Exum et al. 1987, Godwin et al. 1996). This relation was consistent with our results.

Successfully nesting and unsuccessfully nesting hens had similar pre-incubation home range sizes. Miller (1997) determined that unsuccessful and successful hens had different habitat use patterns during pre-incubation. He attributed this difference to successful hens spending more time in potential upland nesting habitats and facilitating location of "better" nest sites. A similar conclusion was reached by Badyaev et al. (1996) in central Arkansas. Because home range sizes were similar, hen classes in our study did not differ in area used during pre-incubation as described by Badyaev et al. (1996). This result indicates successful hens used the area within their home range differently than unsuccessful hens, e.g., they spent more time within potential nesting habitat than unsuccessful hens.

Comparing size of hen home ranges to other studies is difficult because most previous work has not examined hens by reproductive status Mean home range size during late brood season (335 ha) was much larger than home range size (112 ha) reported for broods by Speake et al. (1975). However, these authors did not clearly define seasonal boundaries, although it is implied that their brood season encompassed late spring through late summer. As with gobbler home range studies, areas studied by Speake et al. (1975) contained many openings/pastures (up to 24% of the area) with a subsequent reduction in home range size. On TWMA, brood hens used bottomland hardwood forests early (poults, 1- to 4-weeks-old) and began to use upland habitats more extensively as their dietary needs changed (Phalen et al. 1986, Miller 1997). Thus, larger home ranges on TWMA may result from larger movements associated with exploitation of a variety of habitats as late broods used bottomland hardwood forests and upland forests. Hens associated with openings, as in Speake et al. (1975), have the needs of older broods (insects, soft mast) highly juxtaposed and may concentrate their movements around these patches.

Hillestad (1973) reported a mean spring/summer home range size for non-nesting hens of 78.5 ha, which is much lower than non-reproductive hens in this study. Approximately one-third of the Hillestad (1973) area was in grazed pasture. Again, wild turkey home range size may be larger in mostly forested areas due to a lack of openings, fields and/or pastures, possibly reflective of lower habitat quality.

Gobbler home ranges were larger than hen home ranges for pre-incubation hens, non-nesting hens during nesting season, large brood hens, and non-reproductive hens. They also tended to be larger during fall/winter. These differences were likely related to larger gobblers exploiting a larger area to meet physiological and nutritional requirements. Additionally, during pre-incubation, winter hen flocks on TWMA began to break up (Palmer 1990) while gobblers were still actively breeding. Godwin (1991) noted gobbler movements may be affected by hen movements. Dispersal of hens during this time period may have caused gobblers to move farther to associate with smaller groups of hens. Smith et al. (1988) determined hen and gobbler space use to differ in southeastern Louisiana. However, they determined gobbler home range sizes were smaller than hen home ranges during summer. Otherwise, their results were consistent with ours. Gobblers on TWMA moved from upland habitats to bottomland forests during spring to associate with hens (Godwin et al. 1992, Miller 1997). This movement may have increased home range sizes of gobblers during this time.

Management Implications

Throughout the Southeast, hens and gobblers display different home range sizes. This variability implies that managers and researchers wishing to determine areal requirements of wild turkey must explicitly address movement patterns for each sex. Also, because hens in different reproductive states have potentially different movement patterns, examining space use patterns should partition hens into reproductive classes. Determining home range size may be important for managers responsible for relatively small (<10,000 ha) management areas, as large movements may influence the probability of wild turkey using associated private lands, thus affecting management decisions (Godwin et al. 1990)

Managers may be interested in management options to decrease wild turkey home range size. This is likely not a viable option for gobblers, which can cover large distances in short time periods and exploit a diversity of habitats (Miller 1997). Home ranges of hens may be reducible on TWMA by providing recently (<3 years) burned mature pine stands adjacent to riparian areas and bottomland hardwood stands. Previous research on TWMA has indicated hens use riparian areas to travel between upland nesting sites, preferably in mature pine, and bottomland hardwoods, which was the most preferred habitat type on TWMA (Palmer and Hurst 1996, Miller 1997). With recently burned mature pine and bottomland hardwood habitats in close juxtaposition, hens may be able to select nesting sites without extensive travel (Palmer and Hurst 1996, Miller 1997).

Home range analyses will remain a descriptive tool until analyses incorporating variables important to species allow insights into ecological mechanisms of space utilization (Waldschmidt 1979). For our study, extensive knowledge of habitat use patterns by gobblers and hens (Miller 1997) allowed interpretation of observed areal movements. Without these data, home range size provides limited information. As habitat quantity decreases, it will become increasingly important for managers to provide for needs of wild turkeys within management area boundaries. Knowledge of movement patterns in association with habitat needs would provide a much clearer image of management needs.

Literature Cited

Ackerman, B.B., F. A. Leban, M.D. Samuel, and E. O. Garton. 1990. User's manual for program Home Range, 2nd ed. For. Wildl. and Range Exp. Sta. Tech. Rep. 15, Univ. Idaho, Moscow. 80pp.

Badyaev, A. V., T. E. Martin, and W. J. Etges. 1996. Habitat sampling and habitat selection by female wild turkeys: ecological correlates and reproductive consequences. Auk 113: 636–646.

Bailey, R.W. 1976. Live-trapping wild turkeys in North Carolina. N.C. Wildl. Resour. Comm. Publ. Raleigh. 21pp.

Barwick, L.H. and D. W. Speake. 1973. Seasonal movements and activities of wild turkey gobblers in Alabama. Proc. Natl. Wild Turkey Symp. 2:125–134.

Boulanger, J. G. and G. C. White. 1990. A comparison of home-range estimators using Monte Carlo simulation. J. Wildl. Manage. 54:310–315.

Brown, E. K. 1980. Home range and movements of wild turkeys—a review. Proc. Natl. Wild Turkey Symp. 4:251–261.

Burk, J.D., G. A. Hurst, D.R. Smith, B.D. Leopold, and J. G. Dickson. 1990. Wild Turkey use of streamside management zones in loblolly pine plantations. Proc. Natl. Wild Turkey Symp. 6:84–89.

Burt, W.H. 1943. Territoriality and home range concepts as applies to mammals. J. Mammal. 24:346–352.

Cochran, W. W. and R. D. Lord. 1963. A radio-tracking system for wild animals. J. Wildl. Manage. 27:9–24.

Daniel, W. W. 1990. Applied nonparametric statistics. 2nd ed. PWS-KENT Publ. Co., Boston, Mass. 635pp.

Everett, D. D., Jr., D. W. Speake, and W. K. Maddox. 1979. Wild turkey ranges in Alabama mountain habitat. Proc. Annu. Conf. Southeast,. Assoc. Fish and Wildl. Agencies 33: 233–238.

Exum J. H., Jr., J. A. McGlincy, D. W. Speake, J. L. Buckner, and F. M. Stanley. 1987. Ecology of the eastern wild turkey in an intensively managed pine forest in southern Alabama. Tall Timbers Res. Sta. Bull. 23. Tallahassee, Fla. 70pp.

Fleming, W.H. and L. G. Webb, 1974. Home range, dispersal, and habitat utilization of eastern wild turkey gobblers during the breeding season. Proc. Annu. Conf. Southeast. Fish and Wildl. Agencies 30:377–385.

Godwin, K. D. 1991. Habitat use, home range size, and survival rates of wild turkey gobblers on Tallahala Wildlife Management Area. M.S. Thesis, Miss. State Univ., Mississippi State. 125pp.

———, G. A. Hurst, and B. D. Leopold. 1996. Size and percent overlap of gobbler home ranges and core-use areas in central Mississippi. Proc. Natl. Wild Turkey Symp. 7:45–52.

———, ———, ———, and R. L. Kelley. 1992. Habitat use of wild turkey gobblers on Tallahala Wildlife Management Area, Mississippi. Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 46:249–259.

———,W. E. Palmer, G. A. Hurst, and R. L. Kelly. 1990. Relationship of wild turkey gobbler movements and harvest rates to management area boundaries. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 44:260–267.

Harris, S., W. J. Cresswell, P. G. Forde, W. J. Trewhella, T. Woollard, and S. Wray. 1990. Home-range analysis using radio-tracking data—a review of problems and techniques particularly as applied to the study of mammals. Mammal Rev. 20:97–123.

Healy, W. M. 1992. Behavior. Pages 46–65 *in* J. G. Dickson, ed. The wild turkey, biology and management. Stackpole Books, Harrisburg, Pa.

Hillestad, H. O. 1973. Movements, behavior, and nesting ecology of the wild turkey in eastern Alabama. Proc. Natl. Wild Turkey Symp. 2:109–124.

——— and D. W. Speake. 1970. Activities of wild turkey hens and poults as influenced by habitat. Proc. Annu. Conf. Southeast. Fish and Wildl. Agencies 24:244–251.

Holbrook, H. T., M. R. Vaughan, and P. T. Bromley. 1985. Wild turkey management on domesticated pine forests. Proc. Natl. Wild Turkey Symp. 5:253–258.

Hurst, G. A. 1992. Foods and feeding. Pages 66–83 *in* J. G. Dickson, ed. The wild turkey, biology and management. Stackpole Books, Harisburg, Pa.

———, D. R. Smith, J. D. Burk, and B. D.Leopold. 1991. Wild turkey gobbler habitat use and home range in loblolly pine plantations. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 45:115–123.

Kelley, R. L., 1987. Temporary emigration, area of capture influence, and home range size for wild turkey gobblers on Tallahala Wildlife Management Area. M.S. Thesis, Miss. State Univ., Mississippi State. 44pp.

———, G. A. Hurst, and D. E. Steffen. 1988. Home ranges of wild turkey gobblers in central Mississippi. Proc. Annu. Conf. Southeast. Fish and Wildl. Agencies 42:470–475.

Kenward, R. E. 1982. Techniques for monitoring the behavior of grey squirrels by radio. Symp. Zool. Soc. London 49:175–196.

Kie, J. G., J. A. Baldwin, and C. J. Evans. 1994. CALHOME: Home range analysis program, electronic user's manual. U.S. Dep. Agric., For. Serv. Pacific Southwest Res. Sta., Fresno, Calif. 19pp.

Knowlton, F. F., E. D. Michael, and W. C. Glazener. 1964. A marking technique for the field recognition of individual turkeys and deer. J. Wildl. Manage. 28:167–170.

Kurzejeski, E. W. and J. B. Lewis. 1990. Home ranges, movements, and habitat use of wild turkey hens in northern Missouri. Proc. Natl. Wild Turkey Symp. 6:67–71.

Larkin, R. P. and D. Halkin. 1994. A review of software packages for estimating animal home ranges. Wildl. So. Bull. 22:274–287.

Miller, D. A. 1997. Habitat relationships and demographic parameters for an eastern wild turkey population in central Mississippi. Ph.D. Diss., Miss. State Univ., Mississippi State. 307 pp.

———, M. D. Weinstein, B. D. Leopold, and G.A. Hurst. 1995. Wild turkey reproductive parameters from two different forest ecosystems in central Mississippi. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 49:468–477.

Palmer, W. E. 1990. Relationships of wild turkey hens and their habitat on Tallahalla Wildlife Management Area. M.S. Thesis, Miss. State Univ., Mississippi State. 117pp.

——— and G. A. Hurst. 1996. Drainage systems as mimimum habitat management units for wild turkey hens. Proc. Natl. Wild Turkey Symp. 7:97–104.

Pettry, D. E. 1977. Soil resource areas of Mississippi. Miss. Agric. and For. Exp. Stat. Info. Sheet 1278, Mississippi State 4pp.

Phalen, P. S., G. A. Hurst, and W. J. Hamrick. 1986. Brood habitat use and preference by wild turkeys in central Mississippi. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 40:397–404.

Porter, W. F. 1977. Utilization of agricultural habitats by wild turkeys in southeastern Minnesota. Internatl. Congress Game Biol. 13:319–323.

Smith, W. P., E. P. Lambert, and R. D. Teitelbaum. 1988. Seasonal movement and home range differences among age and sex groups of eastern wild turkeys within southeastern Louisiana. Proc. Internatl. Symp. on Biotelemetry 10:151–158.

Speake, D. W., T. E. Lynch, W. J. Fleming, G. A. Wright and W. J. Hamrick. 1975. Habitat use and seasonal movements of wild turkeys in the Southeast. Proc. Natl. Wild Turkey Symp. 3:122–130.

Steel, G. D. and J. H. Torrie. 1980. Principles and procedures of statistics, a biometrical approach. 2nd ed. McGraw-Hill Publ., New York, N.Y. 633pp.

Waldschmidt, S. R. 1979. The effect of statistically based models on home range size estimate in *Uta stansburiana*. Am. Nat. 101:236–240.

Wigley, T. B., J. M. Sweeney, M. E. Garner, and M. A. Melchiors. 1986. Wild turkey home ranges in the Ouachita Mountains. J. Wildl. Manage. 50:540–544.

Williams, L. E., Jr. and D. H. Austin. 1988. Studies of the wild turkey in Florida. Fla. Game and Freshwater Fish Comm. Tech. Bull. 10, Gainesville. 232pp.

———, ———, and J. Peoples. 1966. Progress in capturing turkeys with drugs applied to bait. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 20:219–226.