Habitat Use by Eastern Wild Turkey Broods in Tennessee

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Abstract: Habitat use of eastern wild turkey (*Meleagris gallopavo silvestris*) broods (1993: $N = 7$; 1994: $N = 9$) in western Tennessee were monitored for up to 2 months following hatching to determine preferred habitats during this critical period. Based on availability within their home ranges, hens and their broods selected bottomland hardwoods over other habitat types during weeks 1–4 ($P < 0.001$). Older broods (4–6 weeks) selected upland hardwood, upland pine, bottomland hardwood, and open habitats in that order over other habitat types ($P < 0.001$). Intensive monitoring of 6 broods in 1995 verified that telemetry data accurately reflected habitat use. Invertebrate biomass was lower in bottomland forests than in open habitats ($P = 0.02$), but apparently was adequate to meet the needs of developing poults.

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Historically, managers concentrated on providing food for turkeys during the winter months to increase populations (Hillestad and Speake 1970, Vander Haegen et al. 1989). Recent studies have suggested that reproductive success is positively related to brood habitat availability (Everett et al. 1985, Healy 1985), supporting the concept of Hillestad and Speake (1970) that a lack of brood habitat may be limiting

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to some wild turkey populations. Ultimately, the density of many wild turkey populations may be determined by poult survival during the first 4 weeks after hatching because most turkey mortality occurs during this time (Williams and Austin 1988). Quality brood habitat has been described as permanent herbaceous openings interspersed in a forested matrix (Hurst and Stringer 1975, Porter 1992, Wunz and Pack 1992). These openings are presumed to attract abundant insects, the major source of food for poults (Hurst 1992), and to provide cover when foraging (Hamrick and Davis 1971, Healy 1985).

Eastern wild turkeys were released at Natchez Trace State Park, Forest, and Wildlife Management Area (NTWMA) from 1952 to 1989 as part of the turkey restoration program of the Tennessee Wildlife Resources Agency (TWRA). These releases resulted in a self-sustaining flock, but the population failed to reach desired densities possibly due to limited brood habitat (Benner 1989, Gunn 1993). In 1991, a linear wildlife opening (LWO) was established at NTWMA to provide additional nesting and foraging habitat for turkeys and other upland game species. Our study was conducted to determine the types of habitats preferred by turkey broods and to assess the value of creating additional open habitat in a largely forested landscape. A secondary objective was to quantify invertebrate abundance in 2 major habitat types.

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Methods

Study Area

The study was conducted primarily at NTWMA, a 19,440-ha block of mostly forested (>97%) land in Benton, Carroll, and Henderson counties of western Tennessee. Topography at NTWMA was rolling, with numerous ravines and gullies due to past mismanagement of erodible soils. Forests consisted of approximately 60% hardwood and 40% pine. Except for regeneration areas, most stands were in the large-pole or sawtimber stages. Our study area in the Scarce Creek drainage totaled 9,623 ha. Most of the study area was within the NTWMA boundary, but some adjoining private land, mostly fallow fields and pastures, was included.

We identified 7 distinct habitat types within the study area: bottomland hardwood (BLH; 1,403 ha), upland hardwood (ULH; 3,050 ha), upland pine (*Pinus* spp.; ULP; 3,274 ha), bottomland pine (BLP; 128 ha), bottomland regeneration (BLR; 26

ha), upland regeneration (ULR; 129 ha), and fields and other openings (OPN; 1,613 ha). Most area in the OPN category was on private land outside the WMA. Dominant overstory species in ULH included scarlet oak (*Quercus coccinea*), southern red oak (*Q. falcata*), and hickory (*Carya* spp.). Loblolly pine (*P. taeda*) predominated in ULPs. Understory species in ULH and ULP included greenbrier (*Smilax* spp.), Virginia creeper (*Parthenocissus quinquefolia*), Japanese honeysuckle (*Lonicera japonica*), and poison ivy (*Rhus radicans*). Some ULP stands were completely overgrown with kudzu (*Pueraria lobata*). Tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), and sweetgum (*Liquidambar styraciflua*) dominated BLH sites. Bottomland hardwoods typically had a dense herbaceous layer that included Japan grass (*Microstegium vimineum*), sensitive fern (*Onoclea sensibilis*), Christmas fern (*Polystichum acrostichoides*), Virginia creeper, poison ivy, and greenbrier. Regeneration areas (ULR and BLR) varied, but most were composed of saplings and seedlings from the above groups. Bottomland pine stands primarily were composed of loblolly pine.

Open habitat (OPN) included abandoned pastures dominated by fescue (*Festuca arundinacea*) and invading brushy species, scattered small (< 0.5 ha) corn fields, weedy fields, and the LWO. The 54-ha LWO was 9.0 km long, and 50–150 m in width. It was constructed mostly in ULH and ULP habitats, but portions were in BLH. The plant communities in the LWO were diverse because of differing edaphic conditions and management throughout its length. Following timber removal in 1991, portions were allowed to revegetate naturally while others were planted to mixtures of cool- and warm-season grasses, clover (*Trifolium repens*), and both shrub and prostrate *Lespedeza* spp. In 1994, milo strips were planted extensively. Mowing was used to control woody vegetation.

Brood Monitoring

Hens were captured during January to March, 1993–1994, with rocket nets (Bailey et al. 1980) and fitted with motion-sensitive transmitters, patagial tags, and leg bands (Cochran and Lord 1963). In 1993, 120-g, Telonics model LB-400 transmitters were placed on hens in a backpack configuration. In 1994, 90-g AVM transmitters were used. Successfully reproducing hens and their broods were monitored from May to August, 1993–1995 (birds monitored in 1995 were from the 1994 capture group). Locations were determined by triangulations (Cochran and Lord 1963) supplemented by visual observations. Triangulations consisted of a minimum of 3 bearings taken from predetermined stations during a 30-minute period (White and Garrott 1990). Angles of <30 degrees or >155 degrees were not used (Burk et al. 1990, Smith et al. 1990). Prenest monitoring consisted of locating each hen daily to determine if incubation had begun. It was assumed hens were incubating when a mortality signal was received or hens were located at the same location on 3 consecutive days (Day et al. 1991). After hatching in 1993 and 1994, hens with poults were located daily for 14 consecutive days post-hatch (Smith et al. 1990) and every other day thereafter until 15 August.

All compass bearings were recorded on standardized data sheets, corrected for

1° east declination, and plotted on U.S. Geological Survey 7.5-minute topographic maps (scale = 1:15,580). Bearings that intersected to form triangles were entered into TELEM88, a home range and triangulation program that generates UTM coordinates (Coleman and Jones 1988). Home range coverages were generated by ARC/INFO (ESRI 1994) with the UTM coordinates using the minimum convex polygon method (Burk et al. 1990). Using ARC/INFO, home range polygons were intersected with a habitat cover map developed by the Tennessee Division of Forestry from aerial photographs.

In 1995, we concentrated on broods that were located in close proximity to permanent openings. This effort was conducted to determine if broods were foraging in open habitats for brief periods of time. We were concerned that if such activity did occur, it would not be indicated by the monitoring routine employed the previous 2 years. Individual hens and their broods were monitored intensively—as frequently as 1 location/hour if birds were moving regularly. Hens and broods that consistently were found in the same location and that were not near open habitats were monitored less often. Intensive monitoring continued until poults were 4 weeks old. At that time, relocations were made infrequently (1–2 times/week). Three broods were monitored into their 6th week of life.

Throughout the study, care was taken not to influence movements of broods. On the few occasions when turkeys observed the investigator and flushed, poults were counted and not approached for the remainder of the day.

Invertebrate Sampling

Invertebrates were sampled using a standard sweep net (hoop diameter of 40 cm) from 3 June to 13 July 1995 to determine food availability for poults throughout the period that animal material is most important in the diet (Hurst 1992). Habitats sampled were OPN and BLH. Four locations within each habitat type were randomly selected and 9 samples (50 sweeps each) were taken at each point (Sisson et al. 1991). All sampling was done on dry days between 1000 and 1600 hours (Healy 1985, Sisson et al. 1991). Invertebrates were separated from vegetation and debris, ovendried at 50 C for 30 hours, and weighed to the nearest g.

Analysis

We evaluated habitat selection at the second order (selection of home range) and third order (selection of habitats within the home range) levels identified by Johnson (1980). Available habitat for second-order selection was defined as the area within the outermost telemetry locations of all home ranges combined (Sisson et al. 1991). Used habitat was the proportion of habitats within home ranges. Available habitat at the third order level was defined as the home range of each individual bird. Use was measured by the proportion of telemetry locations within each habitat type. Compositional analysis (Aebischer et al. 1993) was used to determine if habitats were selected preferentially at either level in 1993 and 1994. We further examined selection at the third-order level by delineating 2 age classes of broods (0–4 weeks and >4 weeks) to determine if preferences changed as poults matured. Data from

the intensive radio-tracking conducted in 1995 could not be examined using compositional analysis because of the small number of broods monitored.

Multiple analysis of variance (MANOVA) was used to test for differences between habitat availability and habitat use. If differences existed, a matrix of pairwise *t*-tests was constructed using differences of log ratios between habitats to rank habitats in order of preferences and to determine where differences occurred (Miller 1997). Analysis of variance for repeated measures (Maceina et al. 1994) was used to determine if differences in invertebrate biomass existed between forested and open habitats. All statistical tests were conducted using SAS (SAS 1989) and Mystat (Hale 1992). Significance was accepted at $\alpha = 0.05$.

Results

During 1993–1994, 31 eastern wild turkey hens were captured and fitted with radio transmitters. An additional 10 hens that had been captured previously had functioning transmitters and also were monitored in 1993–1995. Because of radio failures, nest losses, and hen and poult mortality, not all of these birds were tracked long enough to provide useful data. Data on 7 and 9 hens with broods were used for 1993 and 1994, respectively. The intensive monitoring conducted in 1995 involved 6 broods. The mean number of locations per brood in 1993 was 22.8 and in 1994 was 42.2. In 1995, monitoring varied with activity, but most broods were located from 4–8 times/day.

Brood Habitat Use 1993–1994

Selection of habitats composing the home range differed slightly between years, but BLH, ULH, and ULP were important during both years (Fig. 1). In 1993, BLR ranked highest in order of preference, although no habitat differed significantly from another ($F = 87.74$; 6,1 *df*; $P = 0.082$). In 1994, BLH and ULP ranked first and second respectively, and both were preferred over the other types ($F = 36.44$; 6,3 *df*; $P = 0.007$).

Selection within the home range showed similar patterns each year with ULH, BLH, ULP, and OPN ranked highest (1993: F = 22.63; 6,15 *df*; $P < 0.001$; 1994: F = 164:39; 6,18 *df*; $P < 0.001$; Fig. 2). Other habitat types were less preferred in 1994, while there was overlap between OPN and BLP in 1993. The order of the 4 primary types varied slightly, although none differed ($P > 0.05$) from each other during either year. Because of this lack of difference, data were pooled across years to increase the discriminating power of the analysis.

Using data combined from both years, hens and their broods exhibited a preference for BLH during the first 4 weeks following hatching ($F = 16.41$; 6,9 *df*; $P < 0.001$; Fig. 3). Upland hardwoods, OPN, and ULP were ranked next, with BLR, ULR, and BLP least preferred. When broods were >4 weeks old, habitat preferences shifted. Upland hardwoods became the highest-ranked habitat type ($F = 810.73$; 6,9 *df*; $P < 0.001$; Fig. 3), although its use relative to abundance did not differ ($P > 0.05$) from ULP, BLH, and OPN. These 4 types were different ($P < 0.05$) from the remaining habitats except for OPN, which overlapped with BLP.

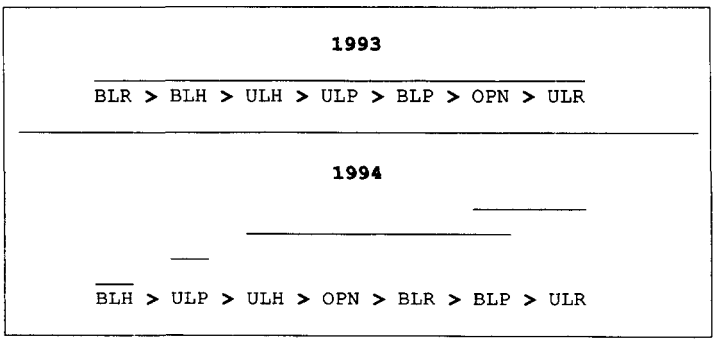

Figure 1. Habitat preferences of eastern wild turkey hens (second-order selection) in May-August, 1993 ($N = 7$) and 1994 ($N = 9$) at Natchez Trace State Park and Wildlife Management area in western Tennessee. Habitat types were bottomland hardwoods (BLH), bottomland pine (BLP), bottomland regeneration (BLR), open (OPN), upland hardwoods (UPH), upland pine (ULP), and upland regeneration (ULR). Preference decreases left to right. Habitats bounded by the same line do not differ ($P > 0.05$).

Brood Habitat Use 1995

Intensive monitoring of young broods led us to conclude that hens did not routinely lead their poults into open areas to feed for brief periods. Therefore, our findings from the previous 2 years accurately reflected actual habitat use. The 1995 study also corroborated our initial findings regarding habitat use patterns. We confirmed that hens and their broods foraged primarily in BLH during the first 2 weeks of life (58 of

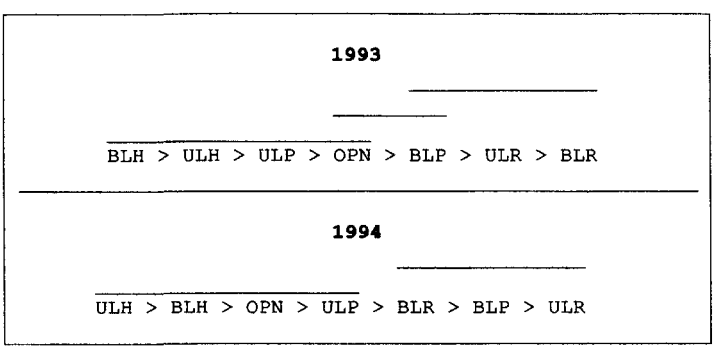

Figure 2. Habitat preferences of eastern wild turkey hens (third-order selection) in May–August, 1993 ($N = 7$) and 1994 ($N = 9$) at Natchez Trace State Park and Wildlife Management area in western Tennessee. Habitat types were bottomland hardwoods (BLH), bottomland pine (BLP), bottomland regeneration (BLR), open (OPN), upland hardwoods, (ULH), upland pine (ULP), and upland regeneration (ULR). Preference decreases left to right. Habitats bounded by the same line do not differ ($P > 0.05$).

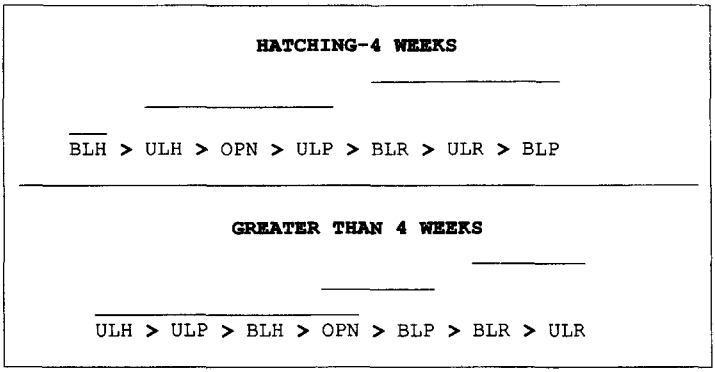

Figure 3. Habitat preferences of eastern wild turkey hens with broods (third-order selection) for 2 periods: hatching-4 weeks of age ($N = 16$) and >4 weeks of age ($N = 16$) at Natchez Trace State Park and Wildlife Management area in western Tennessee in 1993–1994. Habitat types were bottomland hardwoods (BLH), bottomland pine (BLP), bottomland regeneration (BLR), open (OPN), upland hardwoods (ULH), upland pine (ULP), and upland regeneration (ULR). Preference decreases left to right. Habitats bounded by the same line do not differ ($P > 0.05$).

90 observations) and continued to use this type of habitat extensively throughout weeks 3 and 4. In weeks 3 and 4, progressively more use was made of other habitats, particularly ULP and OPN. The 3 broods that were monitored until 6 weeks of age used OPN, including the LWO, more than they had previously, but continued to forage in ULH and BLH as well.

Invertebrate Analysis

Invertebrate biomass (g) in OPN ($\bar{x} = 0.49$; SE = 0.05) was greater than in BLH ($\bar{x} = 0.27$, SE = 0.02; $F = 9.77$; 1,42 *df*; $P = 0.02$). This difference resulted in part from an increase in the size of individual invertebrates (primarily grasshoppers) in OPN later in the field season. Although the average mass of grasshoppers in June ($\bar{x} = 0.36$; SE = 0.02) did not differ from the average mass in July ($\bar{x} = 0.63$; SE = 0.08) ($F = 3.35$; 1,18 *df*; $P = 0.16$), the July values were substantially higher.

Discussion

We found that turkey hens and their broods selected certain habitats during the pre- and post-nesting periods. Hens favored BLH when selecting their home ranges; although interestingly, 88% of the 41 hens that we outfitted with radios moved from BLH to upland areas to nest. Within a few days following hatching, hens moved their broods back to BLH, which they used more than any other type of habitat during the first month. Sample sizes were insufficient to examine selection over a shorter time interval than 1 month; however, it appeared that BLH were especially important for the first 3 weeks. While OPN were used occasionally by a few broods during their

first weeks, most broods restricted their activities to BLH and did not use OPN or upland habitats until the 3rd or 4th week after hatching.

The selective use of hardwood bottoms by broods during the time when most poult mortality occurs (Williams and Austin 1988) suggests that this type of habitat may be more important in some areas than previously thought. In each year of our study, hens had the opportunity to move their broods to fields or the LWO immediately after hatching, but selected BLH. We speculate that invertebrate biomass in BLH, although lower than in OPN, was adequate to meet the needs of poults during their initial weeks of life. It is noteworthy that spiders, which were reported by Hurst and Poe (1985) to be extremely high in protein (76%), were common in samples from BLH. This quality food source, coupled with the security of overhead cover, presumably was why these areas were preferred by hens with very young broods. Although we did not have reliable information on brood survival, there is some evidence that broods using forested bottoms may experience improved survival. For example, Everett et al. (1985) noted that in northeastern Alabama unsuccessful hens (hens that failed to raise a brood to 14 days) used creekbottom hardwood habitat in proportion to its availability, while successful hens used the same habitat more than would be expected based on availability.

Our study was consistent with Phalen (1986), Ross and Wunz (1990), and Miller (1997), adding to the body of evidence that the proper type of forested habitat may be more important than openings during the first critical weeks of poult growth and development. We suggest that managers carefully evaluate their existing forests prior to establishing clearings in what might already be excellent brood habitat. Avian and mammalian predation may increase in open areas, especially large, linear ones such as a LWO. Therefore, managers should consider whether the benefits created by openings would offset the loss of existing forest habitat especially habitats with characteristics favored by broods (i.e., low-growing herbaceous vegetation for insect production and overhead cover for thermal regulation; Porter 1992).

We recommend that managers in areas similar to NTWMA maintain key BLH areas for hard mast production in fall/winter and for brood habitat. The canopy should be maintained open enough to promote development of herbaceous plants for cover and invertebrate production.

Openings were used regularly by broods ≥4 weeks of age and still must be viewed as an important component of turkey habitat, especially because clearings provide many of the foods eaten by juveniles and adults (e.g., grass seeds, fruits, and green forage; Hurst 1992). Everett et al. (1985) thought that 12%–25% of an area should be in openings for optimum conditions for turkeys. Openings at NTWMA and similar areas should be planted in large-seeded grasses such as *Paspalum* spp. and *Digitaria* spp. These grasses, clovers (*Trifolium* spp.), and lespedezas (*Lespedeza* spp.) provide green forage and attract insects for excellent foraging opportunities for all age classes of turkeys. Healy and Nenno (1983) recommended that such areas be mowed late in the growing season every 1–2 years to maintain favorable conditions. Ideally, openings should be established in upland forest habitat that currently provides few benefits to turkeys, but is close to areas that are used extensively.

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