

PRESCRIBED BURNING EFFECTS ON WILD TURKEY HENS DURING PREINCUBATION

William E. Palmer¹

Department of Zoology, North Carolina State University, Raleigh, NC 27695

George A. Hurst

Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS 39762

ABSTRACT

We studied temporal and spatial relations of wild turkey hen (*Meleagris gallopavo*) habitat use during the preincubation period and U.S. Forest Service (USFS) prescribed burning programs on Tallahala Wildlife Management Area (TWMA), Mississippi, 1984–1989. Mature pine (*Pinus taeda*) stands in USFS planning compartments were burned according to prescriptions during February and March. Compartments averaged 416 hectares, 37% of which was in mature pine stands. Frequency of prescribed burning within compartments ranged from 3 to 10 years. Overtime, different-aged burned areas were distributed across TWMA, as a shifting mosaic of similar-aged burns. Burning temporarily improved ground cover conditions for wild turkey hens in pine stands by reducing woody ground cover and ground cover height, and by increasing sighting distance ($P = 0.001$). However, ground cover conditions became dominated with woody vegetation within 2 years after burning. Wild turkey hen use of prescribed burned areas declined with time since burning ($P = 0.02$). Ratios of proportional use to availability for individual hens during preincubation were greater for 0- to 1-year after burning than 2- to 5-years after burning ($P = 0.009$). On average, only 30% of radio-tagged hens had 0- to 1-year postfire habitat patches available to them each year (range 0 to 66.7%). Proportion of hens with 0- to 1-year prescribed burned pine forests available to them was positively correlated with the number of compartments burned and the number of creek drainage systems with at least one burned compartment. We emphasize the need to understand how prescribed burning programs affect wild turkeys at multiple spatial and temporal scales. Based on our data, it appears that increasing the frequency and distribution of burned habitats on U.S. Forest Service lands would benefit wild turkey hens.

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INTRODUCTION

Despite the fact that prescribed burning occurs on a large scale in the South, little published information on how burning directly affects wildlife exists (Hurst 1981). For instance, the USFS manages more than one million hectares of forests in Mississippi. Prescribed fire is used extensively for hardwood and fuel control. However, few data have been collected on how USFS prescribed burning practices impact wild turkeys. To effectively manage wild turkeys, more information is needed on how they respond to prescribed burning at local and landscape scales. Most studies on wild turkey response to burning have focused on local scales, usually proportionate habitat use (Exum et al. 1987, Sisson et al. 1990, Stys et al. 1992) or changes to habitat structure and composition (Stys et al. 1992). Little information has been published that relates wild turkey distribution and habitat use to prescribed burning at a landscape scale. How wild turkeys respond to landscape features would affect availability of habitat management activities operating at smaller scales. For example, on our study area in Mississippi, annual home ranges of wild turkey hens were largely contained within major creek drainages (Palmer and Hurst 1996)

which may limit the availability of prescribed burned pine forests to a subset of the wild turkey population.

Wild turkeys select habitats based, at least partially, on ground cover vegetation (Healy 1985, Palmer 1990). Burning improves ground cover conditions in pine forests for wild turkey hens by reducing woody vegetation, increasing herbaceous vegetation, and generally modifying vegetation structure to facilitate feeding and travel (Hurst 1981, Sisson et al. 1990). While prescribed burning improves ground cover conditions for wild turkeys, understanding how fire affects wild turkey populations requires information at multiple spatial and temporal scales. In this paper, we document temporal changes in ground cover vegetation conditions after prescribed burning, determine selection of pine forests by hens during preincubation over a 6-year period, by hens during preincubation and determine how distribution of wild turkeys at a landscape scale is related to prescribed fire practices.

METHODS

Study Area

The study area consisted of 14,410 hectares of the TWMA, Strong River District, Beinville National Forest, and adjacent private lands. The area was 95% forested and was composed of bottomland hardwood (30%), pine (37%), mixed pine-hardwood (17%) for-

¹ Present address: Tall Timbers Research Station, Route 1, Box 678, Tallahassee, FL 32312-9712.

ests, and pine regeneration areas (11%). Age of most pine and hardwood stands exceeded 55 and 75 years, respectively. Nonforested areas occurred on private lands and were composed of old field (4%), agriculture (1%), and residential areas (<1%). Hardwood forests were located in four broad alluvial creek drainages.

During February and March, pine stands in USFS planning compartments ($n = 17$) were burned by prescription. Only mature pine stands within a compartment were burned. Compartments averaged 416 hectares ($SD = 79$) with an average of 37% in mature pine. Burning frequency of compartments ranged from 3 to 10 years. Therefore, different-aged burns existed across TWMA from one year to the next as a shifting mosaic of large blocks of similarly aged burns.

Data Collection

Capture of Wild Turkeys and Telemetry

Wild turkey hens were captured by cannon-net during January–February and July–August, 1984–1989, following Bailey et al. (1980). Wild turkeys were equipped with a 107-g battery-powered, “back-pack-style” transmitter (Wildlife Materials, Inc., Carbondale, Illinois.) with a mortality or motion switch, leg bands, and numbered black patagial wing tags.

We determined wild turkey location by triangulation (Cochran and Lord 1963, Heezen and Tester 1967) from two telemetry stations ($n = 275$) using a handheld, three-element yagi antenna and a Telonics (Mesa, Arizona.) TR-2 receiver. Absolute error of test azimuths averaged 7.2 degrees ($SD = 6.3$).

Vegetation Conditions in Different-Aged Burns

To determine postfire vegetation conditions at different ages, three to five sampling plots were placed along random azimuths through pine stands delineated by the USFS. Sampling points were at least 100 meters apart and spread equidistantly across transects. We measured vegetation using six ground cover boards (GCB) placed systematically around and above the sampling point. Each GCB was composed of 50, 5×10 centimeter rectangles. Rectangles occupied by vegetation (>50% obstruction) were counted and assigned to grass/sedge, forb, woody or vine vegetation classes. Height of vegetation was measured at the center of each GCB. Ground cover structure, defined as degree of obstruction to horizontal vision through vegetation (Gysel and Lyon 1980) was measured indirectly using a vertical sighting board (20×90 centimeters with each 30 centimeter section alternately painted orange or white) placed at the sampling point. At each of the cardinal directions, an observer recorded the distance when each section became 100% occluded by vegetation. All vegetation measurements were completed within 3 weeks of the latest initiation of incubation (i.e., end of preincubation) (Palmer 1990).

To avoid pseudoreplication, data from transects within each USFS pine stand that we measured were averaged prior to applying statistical analyses. We used the Kolmogorov-Smirnov one-sample test to assess

normality of variables (SPSS Inc. 1995). Variables which followed the normal distribution were tested for equality of variances using the Bartlett-Box F test. When assumptions of ANOVA were met (with raw or log-transformed data) we used one-way ANOVA to determine statistical differences in variables between prescribed burns 0- to 3-years old. Multiple comparisons were performed using Duncan's Multiple Range Test. Significance of tests was assessed at $P < 0.05$.

Monitoring Habitat Use

Radio-collared hens were located daily between 1 March and 30 June, 1984–1989. This period encompassed flock dispersal, searching for nesting range, incubation of nests and some brood rearing. In this paper, we concentrated on habitat use of hens during the preincubation period. We defined preincubation from disbanding of winter flocks (late March) to incubation of nests (May). During this period, wild turkey hens disperse across the landscape searching for nesting ranges. Because use of pine forests was greatest during preincubation (Palmer 1990) changes to habitat from different fire-return intervals might be notable.

Wild Turkey Hen Use of Different-Aged Burns

Wild Turkey hen use of different-aged burns was determined in 1988 and 1989 when these areas were available to most of the radio-collared hens. Proportional availability of prescribed burns in classes (i.e., pine stands prescribed burned 0- to 4-years prior) was determined from an overall minimum convex use polygon for hens as the ratio of area in each burn class to total prescribed burned area within the hen use polygon. Proportional use was the ratio of locations within a burn class to total locations within pine forests, or areas that were burned. Ratios of proportional use to proportional availability were determined for pine forests burned 0- to 3-years prior to provide an indication of habitat use in relation to availability.

During 1989, data were available for use and availability of prescribed burned stands in relation to individual birds. Therefore, we compared selection of pine forests burned 0- to 1-year and 2- to 5-years prior by individual wild turkey hens using Wilcoxon's Matched-Paired Signed Rank test ($P < 0.05$). For individual wild turkey hens, different-age prescribed burns were considered available if they were located within their minimum convex use polygon. The denominator for proportion use was number of telemetry locations in pine forests burned within the previous 6 years.

Availability of Selected Age Burns to Hens

Spatial arrangements of burned habitats were determined from USFS fire management records. Spatial burning data were entered into a GIS system (ESRI 1989) and overlaid onto the creek drainage map to determine area and proportion of each drainage in the 0- to 1-year-old prescribed burn class. Availability of pine stands burned 0- to 1-year prior was determined

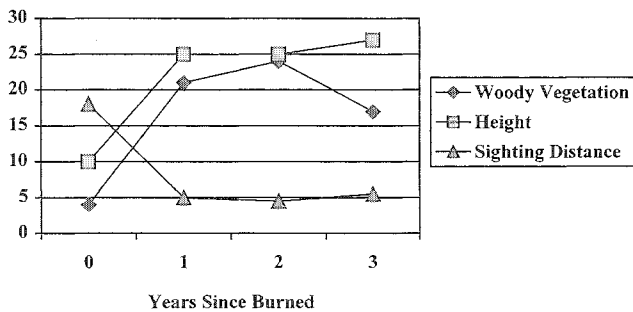


Figure 1. Percent woody ground cover, height of ground cover vegetation (decimeters), and sighting distance (decameters) in pine forests prescribed burned zero-, one-, two-, and three-years prior on Tallahala Wildlife Management Area, Mississippi, May 1989.

for hens monitored between 1984 and 1989 (excluding 1987 due to small sample size). To be conservative, a burned pine stand was considered available to a wild turkey hen if a hen used the same compartment where the burn was located. There were five to seven different compartments within each drainage system. We used Spearman's Rank Correlation (SRC) to evaluate the relationships between number of compartments with a burn, and the availability of prescribed burns to hens. We also used SRC to evaluate the number of drainages with one or more prescribed burned compartments, and the availability of burned habitats to wild turkey hens.

RESULTS

Vegetation Conditions in Burned Pine Stands

Thirty-seven transects were placed in an equal number of pine stands burned 0- to 4-years prior to the study. These stands were located in 13 different USFS planning compartments. While transects were randomly placed in pine stands, burning treatments were not randomly assigned to pine forests.

Sighting distance was greater, cover of woody vegetation lower, vegetation height lower and percent ground cover lower for 0-year burns ($P < 0.05$) (Figure 1). Vegetation conditions quickly reverted to a woody or vine dominated ground cover vegetation. Differences in forb ground cover or grass ground cover between burns were not significant.

Hen Use and Selection of Different-Aged Burns

One hundred nineteen hens were monitored between 1984 and 1989 during the preincubation period. Sample size varied by year; 8, 29, 20, 42 and 20 hens were monitored 1984–1986 and 1988–1989, respectively. Total number of telemetry locations was 229, 938, 459, 1227 and 1267 for the study years, respectively.

Proportions of upland pine forests within the hen use polygon that were in different-aged burn classes (i.e., 0 to 1, 2, and 3) ranged from 0.12 to 0.40 in 1984–89. Proportion of different-aged burned pine forests available to wild turkey hens was not related to

years since burning ($P = 0.98$). Therefore, there was no trend to increase or decrease prescribed burning over the course of the study. However, use of different-aged prescribed burns was related to age of burn ($P = 0.02$). Ratios of proportional use of burned pine stands to their proportional availability averaged 2.0 (range 0.9,3.0; $n = 5$), 1.1 (range 1.0,1.2; $n = 5$), 0.5 (range 0.5,0.5; $n = 5$) and 0.6 (range 0.5,0.7; $n = 5$) for pine stands burned 0-, 1-, 2- and 3-years prior, respectively.

In the 1989 preincubation period, 13 wild turkey hens were monitored intensively ($n = 53$ to 73 locations per hen) to better evaluate habitat use. Ratios of use of burned pine stands to their availability for individual wild turkey hens were greater in areas prescribed burned 0- to 1-year prior ($x = 1.3$; $SE = 0.15$) than areas burned 2- to 5-years prior ($x = 0.5$; $SE = 0.15$) ($P = 0.009$; $df = 10$). Ratios for wild turkey hens using 0- to 1-year-old burns varied, ranging from 0 to 3.1. Some of this variance among hens in use of 0- to 1-year-old burns was explained by an inverse relationship between use of these burned areas and use of hardwood stands along drainages ($r = -0.54$; $P = 0.03$). Proportion of locations in prescribed burns was related to age of prescribed burns; with use/availability ratios declining from 2.5 to 1.2, 0.5, 0.6 and 0.5 for burns aged 0- to 4-years, respectively.

Availability of Burned Pine Forests to Wild Turkey Hens

Number of compartments burned each year varied from one in 1983 and 1985, three in 1984, 1986, 1988 and 1989, and six in 1987. Of four drainage systems on TWMA, the number of systems with at least one prescribed burned compartment ranged from one in 1983 and 1985, two in 1988 and 1989, and three in 1986 and 1987.

Proportion of radio-marked wild turkey hens using compartments containing pine stands prescribed burned 0- to 1-year prior (i.e., assumed to be available to the hen), averaged 30% ($SE = 7\%$) and ranged from 0% to 67%. Availability of prescribed burns to wild turkey hens was correlated to number of compartments burned ($r = 0.87$; $P = 0.001$) and number of drainage systems with burned compartments ($r = 0.70$; $P = 0.02$).

DISCUSSION

Wild turkey hens on TWMA used habitats based on ground cover conditions (Palmer 1990). Areas used by wild turkey hens had lower ground cover height, less woody vegetation, greater herbaceous (i.e., forbs and grasses) vegetation and longer sighting distances. Wild turkeys forage on green vegetation, insects, and mast during spring (Hurst 1992). Ground cover structural changes and resurgence of herbaceous growth following burning may increase abundance and availability of foods for wild turkeys in pine forests (Stoddard 1963, Hurst 1981).

Prescribed burning reduced woody ground cover and increased sighting distance, thus benefitting wild

turkeys. The 6-year burning rotation and reliance on cool season burns may explain relatively short-term changes in vegetation conditions. Rapid growth of top-killed hardwood brush occurs within 2 years of burning in Mississippi pine forests (Hurst and Warren 1982).

Preincubating wild turkey hens selected 0- to 1-year-old, dormant season (February or March) prescribed burns but used \geq 2-year dormant season burns less than their availability. These changes in use of burned pine stands over time paralleled the increase in woody vegetation on areas not burned for 2 or more years. In Georgia, Sisson et al. (1990) found that wild turkeys used pine forests burned the previous winter extensively and avoided uplands left unburned for 1 to 3 years, except for nesting sites. Similarly, Exum et al. (1987), found that wild turkeys generally preferred pine forests burned within 1 to 2 years. Stoddard (1963) and others (Hurst 1981, Exum et al. 1987, Sisson et al. 1990) recommended a 2- to 4-year burning rotation for wild turkey management. Our data, and that of Sisson et al. (1990), indicate that same year dormant season fires in pine forests are an important habitat component for wild turkey hens during spring.

Movements and habitat use of hens on TWMA were closely associated with bottomland hardwood forests and streamside zones in upland forests (Burk et al. 1990, Palmer and Hurst 1996). For instance, during 1989, wild turkey hen locations during preincubation were closer to creeks than random locations within their home ranges (Palmer and Hurst 1996). Bottomland hardwood forests and streamside zones had ground cover composition and structure suitable to wild turkey hens during spring (Palmer 1990). However, when 0- to 2-year-old prescribed burns were present within hen home ranges, hens used areas farther away from creeks (Palmer 1990). This shift in habitat use may benefit wild turkeys by increasing the useable amount of habitat area. This may also reduce predation pressure on nesting hens. Streamside zones and bottomland hardwood forests are relatively predator-dense habitats (McKeever 1959, Verts 1963, Leberg and Kennedy 1987). This hypothesis was supported by the fact that unsuccessful hens had significantly more bottomland hardwood forests within their nesting ranges than hens with successful nests (Palmer 1990).

The long burning rotation on TWMA resulted in most upland habitats being unsuitable to wild turkey hens during spring. Therefore, the birds relied on bottomland habitats and streamside zones for habitat use (Phalen 1986, Palmer 1990, Palmer and Hurst 1996). A pattern of hen distribution across the landscape emerged that was closely related to drainage systems. Wild turkey hens moved from bottomland hardwood forests to upland forests following streamside zones to nest each spring. Following nesting, wild turkey hens returned to bottomland hardwood forests from summer through winter. This pattern of habitat use resulted in hens being segregated into separate creek drainage systems. For instance, 92% of locations for wild turkey hens monitored 1 to 4 years were within one drainage system (Palmer and Hurst 1996). Prescribed burning

during the 1980's on Tallahala WMA was not frequent enough to benefit more than a third, on average, of the wild turkey hens on our study area each year. To increase availability of 0- and 1-year-old burned forests to wild turkeys greater frequency of burning would suffice only if burns were distributed evenly across landscapes in a similar pattern to hen distribution. Therefore, prescribed burns need to be distributed among drainage systems.

There is a critical need for long-term research on experimental manipulation of prescribed burning programs on a landscape scales. Beginning in 1992, prescribed burning increased on TWMA for red-cockaded woodpecker (*Picoides borealis*) management. The number of compartments burned each year increased from one to three per year during the 1980's to four to six per year during the 1990's with some compartments receiving annual burning and growing season fire. Such a burning program may benefit wild turkeys by improving brooding and nesting range, increasing useable habitat area during the nesting season, and possibly, increasing nesting success. It also demonstrates how an ecosystem approach may benefit multiple species.

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