

# Wild Turkey Use of Control-burned Loblolly Pine Plantations

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*Abstract:* Pine (*Pinus* spp.) plantations comprise a major habitat type in the Southeast, and burning is used for forest and wild turkey (*Meleagris gallopavo*) management. We studied turkey hen ( $N = 165$ ) use of control-burned loblolly pine (*P. taeda*) plantations, July 1986–March 1991, in Kemper County, Mississippi. Generally, hen use of plantations during summer (Jul–Sep), fall (Oct–Dec), and winter (Jan–Mar) was equal to or less than available for plantations  $<1$  year and  $\geq 7$  years since-burned. Use was equal to or greater than available for plantations 1–6 years since-burned. During spring (Apr–Jun), successful (hatched eggs) hens used most years since-burned classes equal to or greater than available for the preincubation and early brood (1–14 days post-hatch) periods. Most (90%) hens nested in plantations and success tended to be higher in those plantations not burned for approximately 5 years. A mixture of midrotation-aged (14–22 years old) plantations with different years since-burned, using a frequency of 3–6 years, would provide suitable turkey habitats.

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In the southeastern states industrial and non-industrial private landowners have established large acreages of pine plantations for wood production. In Mississippi there are approximately 1.2 million ha of plantations (Kelley 1990). Although there has been concern that wild turkeys are not compatible with even-aged, short rotation plantation management, several studies have reported turkey use of such plantations

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(Kenamer et al. 1980, Holbrook et al. 1985, Wigley et al. 1986, Bidwell et al. 1980, Smith et al. 1990, Burk et al. 1990).

Controlled-burning is conducted in pine stands for forest and wildlife management (Speake et al. 1975). Burning mature pine forests improved habitat conditions for wild turkeys (Stoddard 1963). However, there is little information on wild turkey use of burned, short rotation (e.g., 25–30 years) plantations, and turkey use of plantations with different burning regimes (years since-burned). We studied turkey hen use of burned loblolly pine plantations to provide guidelines for forest industry, private landowners, and others interested in wild turkey management.

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## Methods

The study was conducted in Kemper County, Mississippi. The core study area consisted of 9,700 ha of which about 70% was loblolly pine plantations. The total study area, including all areas used by transmitter-equipped hens, consisted of 20,250 ha of which 56% was plantations. Plantation size averaged 27 ha (1–129 ha), and most (58%) plantations in the core area were midrotation age (avg. 16 years, range 11–23 years old). Some (33%) plantations had been commercially thinned. In the core area, there were 276 stands (plantations) that contained 7,261 ha. Of the 276 stands, 147 (53%), with 4,255 ha, were burned between 1987 and 1991. Acreages burned averaged 509 ha and varied from 197–925 ha. On several occasions, adjacent and similar age plantations were burned at the same time.

Hens were captured by cannon net (Bailey et al. 1980) during winter (Jan–Mar) and summer (Jul–Aug) 1986–90 (Smith et al. 1990). Hens were aged (Williams 1981) and received black patagial wing tags (cattle ear tags) and a "back-pack" transmitter ( $\bar{X}$  = 108 g, Wildlife Materials, Inc., Carbondale, Ill.). Hen locations were determined by triangulation (Cochran and Lord 1963) using hand-held 3-element directional yagi antenna with either a Telonics, Inc. (Mesa, Ariz.) or a Wildlife Materials, Inc. (Carbondale, Ill.) receiver. Telemetry system accuracy tests produced a mean estimated error polygon of 0.26 ha (Burk 1989).

During 1986–88 hens were located 3 times/day, 3 days/week from December–August and 2 times/day, 3 days/week from September–November. During 1989–91 hens were located 2 times/day, 2 days/week from July–March. During April–June, focal hens, a random selection of available hens, were located 5 times/week, 3 times/day. Hens with broods were located daily, 3 times/day (1986–1988) and 6 times/day (1989–1990), during the first 2 weeks after hatching. Brood hens were located 3 times/day (1989–1990) during the third through eighth week post-hatch.

Time between consecutive azimuths was limited to 10 minutes and angles close to 90° were taken (Heezen and Tester 1967). However, angles between 25° and 155° were accepted because of an extensive road system that allowed us to get close to most turkeys (Burk et al. 1990).

The spring season (Apr–Jun) was divided into 7 periods based on hen reproductive status: nonreproductive (no indication of laying or incubating behavior by 30 Jun), pre-incubation of successful (hatched eggs) and unsuccessful hens, incubation, early-brood (poult 1–14 days old) and late-brood (poult 15–56 days old) of successful hens, and post-nest (after nest destruction) of unsuccessful hens.

Telemetry locations were entered into a single dBASE III+ (Ashton-Tate, Inc. 1986) file and converted to X,Y coordinates using the program TELEBASE (Wynn et al. 1990). A base map was digitized from stand maps set in Mississippi State Planer Coordinates. The map was transferred to PC Arc/Info (ESRI, Inc. 1989) using an AutoCad (AutoDesk, Inc. 1987) DXF interchange file. Plantations were assigned a unique identifier, and their stand treatment history (e.g., thinned, burned) was updated each year.

Data for individual hens by season and period monitored  $\geq 2.5$  months of a 3-month season were pooled. Telemetry locations were plotted and outermost locations were connected to simulate a minimum convex polygon (Hayne 1949). Availability of burned plantations was then determined by overlaying the polygon on the base map using the INTERSECT function of PC Arc/Info (ESRI, Inc. 1989). Plantations were classified by years since-burned into 5 types: <1, 1–2, 3–4, 5–6, and  $\geq 7$  (Palmer 1990). Only plantations >10 years old were considered because younger plantations were not burned.

Hen use (equal to, less than, or greater than available) of burned plantations was determined by comparing use to availability using chi-square analysis and simultaneous confidence intervals protected at  $\alpha = 0.10$  (Neu et al. 1974). Use of a plantation type (e.g., 3–4 years since-burned) was considered greater than available if the lower bound of the confidence interval was greater than the proportion of that type available, less than available if the upper bound of the confidence interval was less than the percent of that type available, and equal to available if the percent of that type available was within the confidence interval.

Turkey nests were located after clutch hatching or destruction had occurred. Characteristics (age, years since-burned, number of times burned) of plantations with nests were determined from stand files. Plantations used by successful hens (hatched eggs) were compared to those for unsuccessful hens using a Mann-Whitney U-Test (Leopold 1986).

## Results

A total of 165 turkey hens was transmitter-equipped and 15,343 telemetry locations were obtained during January 1987–March 1991. Average number of days a hen was monitored was 256 (1–747, SD = 155).

During summer (Jul-Sep), hen use of plantations <1 year since-burned was less than available during 3 of 4 years (Table 1). Availability was low: 5%, 3%, and 8% during these years. Use was generally equal to or greater than available in plantations 1-6 years since-burned but was less than available for plantations ≥7 years since-burned. Use during fall (Oct-Dec) was equal to or less than available for plantations <1 year since-burned, generally equal to or greater than available for plantations 1-6 years since-burned, and less than available for plantations ≥7 years since-burned. During winter (Jan-Mar), hen use was most often less than and equal to available for plantations <1 and 1-2 years since-burned. However, hens generally used plantations 3-≥7 years since-burned equal to available.

During the preincubation period, successful hens used plantations <1-≥7 years since-burned equal to available in most cases (years, seasons) (Table 2). Use of plantations during the early brood period (1-14 days post hatch) varied among all years since-burned classes. Plantations <1 year since-burned were only available in 1988 and were used greater than available. During the late brood period (15-56 days post-hatch) hens used plantations <1, 1-2, and ≥7 years since-burned, less than available, and those 3-6 years since-burned, equal to, or greater than available.

Use of plantations by unsuccessful hens during the preincubation period was equal to or greater than available for 13 of 18 cases for all years (Table 3). Unsuccessful hens used plantations <1 and 6 years since-burned, equal to, or greater than available 8 of 11 cases during the post-nest period. Plantations ≥7 years since-burned were used less than available in all years.

During the nonreproductive period for unsuccessful hens, use was mostly less than available for 3-4 and ≥7 years since-burned. Use of plantations <1, 1-2, and 5-6 years since-burned was equal to or greater than available in 9 of 12 cases.

**Table 1.** Use of control-burned loblolly pine plantations during winter, summer and fall seasons by wild turkey hens in Kemper County, Mississippi, 1987-1991<sup>a</sup>.

Year-since burn	N:	Year												
		1987			1988			1989			1990			1991
		WN <sup>b</sup> 4	SU <sup>c</sup> 4	FL <sup>d</sup> 22	WN	SU	FL	WN	SU	FL	WN	SU	FL	WN
<1		< <sup>e</sup>	<	= <sup>f</sup>	=	> <sup>g</sup>	=	=	<	<	<	<	<	<
1-2		<	=	<	<	<	=	>	>	=	<	>	>	=
3-4		=	>	>	>	>	=	=	>	>	>	<	<	=
5-6		>	=	=	<	<	=	>	>	>	=	>	>	=
≥7		=	<	<	=	<	<	<	<	<	=	<	<	=

<sup>a</sup>Data for 1987-1988 from Smith (1988) and Burk (1989).  
<sup>b</sup>WN = winter season (Jan-Mar).  
<sup>c</sup>SU = summer season (Jul-Sep).  
<sup>d</sup>FL = fall season (Oct-Dec).  
<sup>e</sup>Habitat use less than availability ( $P < 0.10$ ).  
<sup>f</sup>Habitat use equal to availability ( $P > 0.10$ ).  
<sup>g</sup>Habitat use greater than availability ( $P < 0.10$ ).

**Table 2.** Use of control-burned loblolly pine plantations by successful<sup>a</sup> wild turkey hens in Kemper County, Mississippi, 1987–1990<sup>b</sup>.

Year-since burn	N:	Year									
		1987		1988		1989			1990		
		PI <sup>c</sup> 5	EB <sup>d</sup> 5	PI 10	EB 9	PI 2	EB 3	LB <sup>d</sup> 2	PI 7	EB 7	LB 7
<1		=	=	= <sup>e</sup>	> <sup>f</sup>	=	<	< <sup>g</sup>	=	>	<
1–2		=	<	<	<	=	<	<	=	>	<
3–4		=	<	=	=	=	=	>	=	>	<
5–6		=	>	>	>	=	=	=	=	<	>
≥7		=	=	<	<	=	=	<	>	<	<

<sup>a</sup>Hen was successful if at least 1 egg hatched.  
<sup>b</sup>Data for 1987–1988 from Smith (1988) and Burk (1989).  
<sup>c</sup>PI = 1 April – incubation.  
<sup>d</sup>EB = early-brood (1–14 days post-hatch), LB = late-brood (15–56 days post-hatch).  
<sup>e</sup>Habitat use equal to availability ( $P > 0.10$ ).  
<sup>f</sup>Habitat use greater than availability ( $P < 0.10$ ).  
<sup>g</sup>Habitat use less than availability ( $P < 0.10$ ).

Most (92%–1987, 81%–1988, 89%–1989, 100%–1990) hens nested in burned plantations. In 1990, 7 hens nested in the same 22-year-old plantation which had been commercially thinned 9 years previously and burned 7 years previously. Age of burned plantations used for nesting varied from 15–22 years and there was no significant difference for age between successful and unsuccessful nests (Table 4). During 1987, 1989, and 1990, years since-burned was greater for successful nests, and was significantly different ( $P = 0.05$ ) in 1989. Number of times a plantation was burned was significantly greater ( $P = 0.05$ ) for unsuccessful nests in 1989 and 1990.

**Table 3.** Use of control-burned loblolly pine plantations by unsuccessful<sup>i</sup><sup>a</sup> and nonreproductive<sup>b</sup> wild turkey hens in Kemper County, Mississippi, 1987–1990<sup>c</sup>.

Year-since burn	N:	Year										
		1987			1988			1989			1990	
		PI <sup>d</sup> 7	PN <sup>d</sup>	NR <sup>b</sup> 2	PI 12	PN 13	NR 8	PI 8	PN 5	NR 11	PI 5	PN 3
<1		< <sup>e</sup>	> <sup>f</sup>	>	>	>	= <sup>g</sup>	<	<			<
1–2		=	=	<	<	<	>	>	>	>	>	>
3–4		=	<	=	>	<	<	<	<	<	=	<
5–6		=	=	=	=	>	=	=	>	=	=	>
≥7		=	=	=	<	<	<	<	<	<	<	<

<sup>a</sup>Hen was unsuccessful if killed while nesting or nest was depredated.  
<sup>b</sup>NR = Hens not showing any sign of reproduction 1 April–30 June.  
<sup>c</sup>Data for 1987–1988 from Smith (1988) and Burk (1989).  
<sup>d</sup>PI = 1 April – incubation, PN = time when hen's nest were broken up – 30 June.  
<sup>e</sup>Habitat use less than availability ( $P < 0.10$ ).  
<sup>f</sup>Habitat use greater than availability ( $P < 0.10$ ).  
<sup>g</sup>Habitat use equal to availability ( $P > 0.10$ ).

**Table 4.** Characteristics of control-burned pine plantations used for nesting by successful and unsuccessful wild turkey hens in Kemper County, Mississippi, 1987–1990.

Year	<i>N</i>		Stand age (yrs)		Years-since				<i>N</i> burns	
	S	U	S	U	Thinning		Burning		S	U
					S	U	S	U		
1987	5	6	17.8	17.7	5.0	4.0	5.2	4.0	1.0	1.7
1988	7	10	17.4	16.4	3.4	4.3	2.5	2.5	1.4	1.6
1989	3	13 <sup>e</sup>	21.0	17.9	8.0	5.6 <sup>d</sup>	7.3	2.9 <sup>d</sup>	1.0	2.0 <sup>d</sup>
1990	12 <sup>e</sup>	9 <sup>f</sup>	20.3	20.0	6.5	7.4	5.7	4.2	1.1	1.7 <sup>d</sup>

<sup>a</sup>CT = commercially thinned.

<sup>b</sup>CB = control-burned.

<sup>c</sup>Includes nests of 2 hens that were not transmitter-equipped.

<sup>d</sup>Significantly different ( $P < 0.05$ ).

<sup>e</sup>Includes nests of 4 hens that were not transmitter-equipped.

<sup>f</sup>Includes a nest of a hen that was not transmitter-equipped.

## Discussion

Sample sizes varied but were considered adequate ( $>10$ ) in most summer, fall, and winter seasons. Predation reduced the sample size of successful hens.

Most plantations had been commercially thinned, and some were burned before and some after thinning. Vegetation (i.e., hardwood brush, vines, forbs, grasses) regrows rapidly following a fire and flourishes after commercial thinning in this area. Vegetative response to thinning and/or thinning and burning was a confounding factor. However, most vegetative responses (e.g., regrowth of hardwood brush) occurred during the first and second growing seasons after thinning or burning (Hurst and Warren 1982).

Hens used plantations 1–6 years since-burned, equal to, or greater than available in 30 of 39 cases in summer, fall, and winter and 21 of 28 cases for successful hens in spring. The fact that hens used plantations with various burning regimes indicates there is a wide “window” of acceptable conditions regarding time since burning. This result is important because burning and smoke management regulations have become restrictive.

Burning of mature (i.e.,  $>30$  years old) pine forests has been promoted to improve food and/or cover conditions for turkeys (Speake et al. 1975). Davis (1976) thought that burning reduced dense woody brush and opened the ground level stratum, thus improving vision and mobility for turkeys. Perhaps, plantations burned in February and March may be too open right after the fire and do not provide adequate cover for hens. However, Palmer (1990) found that prior to nesting, hens used mature pine forests burned the previous winter equal to or greater than available in central Mississippi. Plantations not burned for  $\geq 7$  years were probably too dense or had less food (e.g., green forage, seeds) and were not used as available by hens.

Most hens nested in plantations, and there was no difference in plantation age regarding fate of the nest. However, hens that nested in plantations with fewer

burns, or more years since-burned, tended to be more successful. Predation of turkey eggs by the raccoon (*Procyon lotor*) was the main factor limiting turkey reproduction (Burk et al. 1990) in our plantations. Perhaps, in plantations less frequently burned and not recently, ground vegetation density affected predator movements and search efforts, resulting in fewer nests found. The relationship between vegetative conditions and nest destruction by predators deserves further research.

Stoddard (1963) found that hens preferred to nest in brushy clumps in spots that escaped fire for 2–5 years. In slash pine (*P. elliottii*) plantations in southern Alabama, hens nested in plantations that had not been burned for several years (Exum et al. 1987). Most (74%) nests were in 1–3 year “roughs” (not burned 1–3 years) in pine forests in Florida (Sisson et al. 1990). No reference or avoidance was detected for nesting in mature pine forests up to 6 years since-burned in central Mississippi (Seiss et al. 1990). Although a wide “window” regarding years since-burned and nesting appears to exist, the relationship between burning and nest success should be further evaluated.

Successful hen use of plantations during the preincubation period was not often equal to available for all years since-burned. During the early brood period, when the highest poult mortality rates have been reported (Speake 1980), hen use of plantations on our study area varied, but 10 of 16 cases were equal to or greater than available for all years since-burned. Three of the less than available cases were for plantations  $\geq 7$  years since-burned. It appears that hens with young poults were not selective (i.e., hens used plantations  $< 1-6$  years since-burned). This result is different than for hens with broods  $< 9$  weeks old in slash pine plantations in southern Alabama (Exum et al. 1987). Brood hens in that study used plantations burned within 1–2 years and almost entirely avoided plantations not burned for more than 2 years. The plantations in Alabama had not been thinned, and canopy and ground-story conditions in slash pine plantations differed from our thinned and burned loblolly plantations.

Hen use of plantations during the late brood period was limited, but hens tended to use those 3–6 years since-burned. Apparently, brood hens sought the denser cover of plantations not recently burned, but plantations not burned for  $\geq 7$  years were unacceptable. The relationship between poult survival rate/predation and burning regimes needs to be determined.

Burning pine forest on a 2- or 3- to 5-year rotation has been recommended for enhancing turkey foods (forage, seeds, fruits, insects) and cover (Speake et al. 1975, Hurst 1981). Our results, particularly for nest success and brood habitat, suggest a burning regime of 5–7 years would suffice in plantations.

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