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# Eastern wild turkey reproductive ecology in frequently-burned longleaf pine savannas

Andrew R. Little [a,*], Mary M. Streich [a,1], Michael J. Chamberlain [a], L. Mike Conner [b], Robert J. Warren [a]

[a] Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA
[b] Joseph W. Jones Ecological Research Center at Ichauway, Newton, GA 39870, USA

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ABSTRACT

Longleaf pine (*Pinus palustris*) savannas are economically and ecologically important throughout the southeastern United States; however, deforestation and other land use changes have led to their decline. Fortunately, natural resource professionals have recognized the importance of restoring these ecologically important forests that support a diversity of native flora and fauna. Although efforts are underway to restore longleaf pine savannas, little information exists on Eastern wild turkey (*Meleagris gallopavo silvestris*) reproductive ecology within these systems. Therefore, we used radio telemetry to investigate Eastern wild turkey reproductive ecology in 2 longleaf pine-dominated forests in southwestern Georgia during 2011–2013. Forty-two percent of nests ($n = 78$) were successful ($\geqslant 1$ egg hatched) with most nest loss resulting from predation. Five nests were exposed to prescribed fire events (2 were successful; 3 were unsuccessful). Thirty-seven percent of females renested following loss to predation, fire, or other factors. Of these, 43% successfully hatched ($\geqslant 1$ egg hatched). We monitored 34 broods post-hatch. Of the 34 broods, 11 (32%) survived the 14-day flightless period. Of the remaining 11 broods, 7 (64%) survived the following 2-week period (i.e., days 15–30). One of 34 broods was lost to growing-season prescribed fire during the study. Females frequently selected nest sites in areas at the end of their burn rotation (i.e., prior to the next scheduled burn; $\bar{x} = 613.7$ days since burn for all nests from nest initiation date; SE = 44.7 days). Habitat characteristics at the nest-site and patch-level had little influence on nest survival, suggesting that once a nest site is chosen, nest predation occurs randomly with respect to habitat characteristics. In addition, timing of nest initiation did not significantly improve nest survival. Management of longleaf pine savannas should focus on applying prescribed fire every 1–2 years to maintain native flora communities while enhancing nest and brood cover. Our results also indicate that growing-season prescribed fire has minimal impact on wild turkey production.



## 1. Introduction

Longleaf pine (*Pinus palustris*) savannas historically occupied over 30 million ha in the southeastern United States (Brockway et al., 2005; Van Lear et al., 2005). Historically, frequent fire ignited by lightning or humans maintained the early successional grassland community found in these pine savannas and prevented bottomland hardwood encroachment (Komarek, 1964; Pyne, 1982; Robbins and Myers, 1992; Kennamer et al., 1992). Likewise, longleaf pine savannas sustain a diversity of ecological communities (e.g., depressional wetlands, hammocks, and upland/wetland ecotones; Van Lear et al., 2005). An important upland game species found in longleaf pine savannas is the Eastern wild turkey (*Meleagris gallopavo silvestris;* hereafter, wild turkey). However, land use change (e.g., conversion from longleaf pine to faster growing loblolly pine (*Pinus taeda*) and slash pine (*Pinus elliottii*), and increase in agricultural practices and urban development) throughout the southeastern United States led to a decline in virgin forests (e.g., longleaf pine savannas; Frost, 1993; Alavalapati et al., 2002; Van Lear et al., 2005) and wild turkey populations (Kennamer et al., 1992). Likewise, over 30 plant and animal species that occur in this ecosystem are now threatened or endangered (Landers et al., 1995). Lack of reforestation efforts combined with government policies that encouraged landowners to exclude fire from their properties also contributed to the decline of longleaf pine savannas (Alavalapati et al., 2002). By the early-mid 1900's, longleaf pine savannas were reduced to 1/6 of the original acreage (Frost, 1993) and wild turkey populations were nearly extirpated

* Corresponding author. Address: Warnell School of Forestry and Natural Resources, University of Georgia, 180 E. Green St., Athens, GA 30602, USA. Tel.: +1 717 253 0558.
*E-mail address:* alittle@uga.edu (A.R. Little).
[1] Present address: 10620 U.S. 77, Sinton, TX 78387, USA.

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(Kennamer et al., 1992). Natural resource professionals recognized the diversity of flora and fauna in longleaf pine savannas (Barnett, 1999; Alavalapati et al., 2002). As a result, restoration efforts are often implemented in an attempt to convert altered landscapes back to longleaf pine savannas (Brockway et al., 2005). Likewise, wildlife biologists enacted restocking programs to reverse the drastic wild turkey population declines, which are today largely attributed to the population increase (Kennamer and Kennamer, 1990; Kennamer et al., 1992). Today, the economic benefits derived annually from wild turkey hunting are in excess of $500 million U.S. dollars (Baumann et al., 1990). With the restoration efforts of longleaf pine savannas underway during the past 30+ years and the substantial economic benefit of wild turkey hunting, research is needed to address the population demographics of wild turkeys in this ecosystem. Therefore, we evaluated population demographics of wild turkeys to understand how longleaf pine management affects this species.

Longleaf pine savannas are primarily managed by fire to reduce undesirable competing vegetation while stimulating growth and development of a diverse understory (Waldrop et al., 1992; Cain et al., 1998; Barnett, 1999; Steen et al., 2013). This practice promotes the availability of nesting and brood-rearing cover for ground-nesting birds (Dickson, 1981; Hurst, 1981; Landers, 1981). In addition, prescribed fire helps maintain early-successional understory habitat and herbaceous vegetation while increasing insect abundance for wild turkeys (McGlincy, 1985; Landers and Mueller, 1986; Exum, 1988; Provencher et al., 1998). Land managers frequently use growing-season prescribed fire to mimic lightning ignition in their efforts to control invading hardwoods and understory shrubs. Likewise, frequent prescribed fire (1–2 years) may provide adequate nesting cover while reducing the risk of predation due to a reduction in forage quality (e.g., reduction in soft mast for raccoons [*Procyon lotor*], Chamberlain et al., 2003; Jones et al., 2004; and gray fox [*Urocyon cinereoargenteus*], Johnson and Landers, 1978; Temple et al., 2010).

Despite the benefits of longleaf pine restoration efforts, consideration must also be given to their potential negative effects on wild turkey populations. Previous research has focused on the impacts of prescribed fire on wild turkey ecology in other pine systems (Stoddard, 1963; Miller et al., 2000; Jones et al., 2005; Miller and Conner, 2007; Martin et al., 2012); however, those interested in wild turkey ecology have raised concerns over potentially excessive nest loss from growing-season prescribed fire. Moore (2006) reported that 9% of turkey nests were destroyed by growing-season fire. In addition, Miller et al. (1999) recommended providing mature pine stands, burned every 3 years and juxtaposed to riparian areas and bottomland hardwoods to increase wild turkey nest success. However, hardwood patches have been shown to be important sources of refugia for bobcats (Godbois et al., 2003) and raccoons (Chamberlain et al., 2002) in pine forests; therefore, reducing and/or isolating hardwood patches shown to be important for wild turkey success may lead to increased risk of predation of nearby wild turkey nests.

Biotic and abiotic processes operate and interact at multiple spatial scales on the landscape (Turner, 1989); no one spatial scale likely exists for multiple landscape metrics that may influence avian nest success and/or survival (Stephens et al., 2005; Webb et al., 2012). Wild turkey populations are strongly influenced by reproductive success (Palmer et al., 1993; Roberts and Porter, 1996; Miller et al., 1999) with the primary cause of reproductive loss due to predation from mesocarnivores (Speake, 1980; Still and Baumann, 1990; Miller and Leopold, 1992; Lovell et al., 1997). Therefore, reproductive success may be influenced by nest-site and patch-level habitat metrics. Greater understory vegetation cover has been shown to increase the probability of wild turkey nest survival (Badyaev, 1995; Badyaev and Faust, 1996; Fuller et al., 2013). Conversely, patch-level metrics have been shown to have little effect on nest survival (Thogmartin, 1999; Fuller et al., 2013). Roads have also been shown to be a detrimental influence on wild turkey nest survival (Thogmartin, 1999), likely due to the high probability of use of roads as travel corridors by mesocarnivores (e.g., raccoon; Frey and Conover, 2006). Likewise, timing of nest initiation has been found to affect nest survival of multiple avian taxa (e.g., lesser prairie-chicken [*Tympanuchusp allidicinctus*] and greater prairie-chicken [*Tympanuchusc upido*], Fields et al., 2006; willow ptarmigan [*Lagopus lagopus*], Wilson et al., 2007; greater sage-grouse [*Centrocercus urophasianus*], Webb et al., 2012). Similarly, Thogmartin and Johnson (1999) found heavier females (i.e., better body condition) laid larger clutches and initiated nests earlier in the nesting season presumably due to healthier body conditions relative to females in poor body condition.

To address the effects of longleaf pine savanna restoration efforts on wild turkey production, we addressed the following objectives: (1) estimate nest and brood survival, (2) evaluate the effect of growing-season prescribed fire on nest and brood survival, and (3) evaluate whether habitat characteristics and time of nest initiation affect nest survival. We hypothesized that nest and brood survival would be greater in a longleaf pine savannas relative to other forested ecosystems in the southeastern United States because management (e.g., prescribed fire) of this ecosystem maintains the availability of early successional cover. We hypothesized that growing-season prescribed fire would not significantly affect nest and brood survival because the scale of fires is relatively small across a large landscape. We hypothesized that nest site vegetation would be a strong predictor of nest survival relative to metrics quantified at the patch-level because females would likely select for security cover adjacent to the nest site compared to habitat types at larger spatial scales. Lastly, we hypothesized that nests initiated early in the nesting season would have a greater probability of survival because females entering the nesting season may be in healthier condition relative to other females that initiate a nest later in the nesting season.

## 2. Materials and methods

### 2.1. Study area

The study was conducted on the 11,735-ha Joseph W. Jones Ecological Research Center at Ichauway (hereafter, Jones Center) located in Baker County, Georgia and the 3900-ha Silver Lake Wildlife Management Area owned by the Georgia Department of Natural Resources located in Decatur County, Georgia (hereafter, Silver Lake WMA). The Jones Center was comprised of approximately 39% mature pine (>20 years old), 24% mixed-pine hardwood, 11% agriculture/food plot, 8% young pine (<20 years old), 7% hardwoods, 4% scrub-shrub, 3% wetland, 3% open water, and 1% urban/barren. Silver Lake WMA was comprised of approximately 56% mature pine (>20 years old), 22% young pine (<20 years old), 10% open water, 9% mature pine-hardwood, 1% shrub-scrub, 1% hardwood, and 1% urban/barren. Paved, gravel, and dirt road densities were 5.48 km/km$^2$ and 6.59 km/km$^2$ on the Jones Center and Silver Lake WMA, respectively. Total rainfall during the nest and brood-rearing season (1 April–31 July) at the Jones Center was 28.32 cm in 2011, 36.35 cm in 2012, and 52.02 cm in 2013. Similarly, total rainfall at Silver Lake WMA was 25.48 cm in 2011 and 36.55 cm in 2012. Average daily temperature at the Jones Center was 25.09 °C in 2011, 24.56 °C in 2012, and 23.62 °C in 2013 (Jones Center; Georgia Automated Environmental Monitoring Network; http://georgiaweather.net). Likewise, average daily temperature at Silver Lake WMA was 25.77 °C in 2011 and 25.24 °C in 2012 (Lake Seminole; Georgia Automated Environmental Monitoring Network; http://georgiaweather.net).