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Eastern wild turkey reproductive ecology in longleaf pine forests

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Abstract

Longleaf pine (*Pinus palustris*) forests 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 forests, 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 (≥ 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 re-nested following loss to predation, fire, or other factors. Of these, 43% successfully hatched (≥ 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; SE = 44.7). 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. Management of longleaf pine ecosystems 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.

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1. Introduction

Longleaf pine (*Pinus palustris*) ecosystems historically occupied over 38 million ha in the southeastern United States (Brockway et al. 2005). However, land use change and reduction in use of prescribed fire have led to a decline in longleaf pine forests (Van Lear et al. 2005). Natural resource professionals recognize the diversity of flora and fauna in longleaf pine ecosystems (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 forests (Brockway et al. 2005). Longleaf pine restoration efforts have been underway during the past 30+ years, yet little research has focused on the population demographics of Eastern wild turkey (*Meleagris gallopavo silvestris;* hereafter, wild turkey) in this ecosystem. Therefore, we evaluated population demographics of wild turkeys to understand how longleaf pine management affects this species.

Longleaf pine ecosystems are primarily managed by prescribed 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). Traditionally, many fires within the longleaf pine ecosystem were ignited by lightning during the growing season (Komarek 1964, Pyne 1982, Robbins and Myers 1992). Therefore, 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. Concern over potentially excessive nest loss resulting from growing-season prescribed fire is particularly contentious among those interested in wild turkey ecology. 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. Therefore, reducing and/or isolating preferred habitat patches (e.g., hardwoods) in a longleaf pine matrix may have potential negative effects on wild turkey production.

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 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 ecosystem 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 3,900-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).

To successfully restore and maintain longleaf pine ecosystems at the Jones Center and Silver Lake WMA, land managers used prescribed fire and mechanical hardwood removal. Prescribed fire was typically conducted during the dormant and growing seasons (1 January – 31 July) and occurred in a mosaic fashion, which promoted landscape diversity. Average patch size burned at the Jones Center was 21.43 ha (SE = 0.84; range = 0.02 – 240.57 ha). Whereas, average patch size burned at Silver Lake WMA was 14.37 ha (SE = 0.58; range = 0.66 – 88.27 ha). Fire-return interval ranged from 1-3 years during the study. Hardwood trees that were too large to be controlled by fire were removed mechanically. Mechanical removal efforts were primarily focused in areas where fire was either historically suppressed or in fire shadows (i.e., structural features that caused fire to go around a particular area and allowed hardwoods to mature).

2.2 Field methods

We captured female wild turkeys using rocket nets baited with corn during December–March of 2011-2013 and June–August of 2011-2012. We fitted all captured females with serially numbered, butt-end (left leg) and riveted (right leg) aluminum leg bands (National Band and Tag Co., Newport, KY). We also affixed a backpack-style VHF radio-transmitter, weighing approximately 60-g, (Sirtrack, Havelock North, New Zealand; and Telenax, Playa del Carmen, México) to all females. All birds were released at the capture site immediately after processing. The Institutional Animal Care and Use Committee at the University of Georgia approved all turkey capture, handling, and marking procedures (Protocol #A2013 05-034-Y1-A0).

We used a hand-held, 3-element Yagi antenna and Wildlife Materials TRX 2000S receiver (Wildlife Materials, Murphysboro, Illinois) to locate radio-marked females ≥2 times per week from mid-July to mid-March and ≥ 1 time per day from mid-March to mid-July to evaluate nest and brood ecology. We triangulated each female and recorded the locations using a mobile phone containing Location Of A Signal-SD software (Ecological Software Solutions, LLC) and a Bluetooth-Global Positioning System unit. We determined that a female initiated incubation when she was found in the same location for 3 consecutive days. Once a female was determined to be incubating, we approached to within 25-m of the nest and recorded compass bearings toward the nest. After termination of incubation, we approached nest-sites to determine nest fate, clutch size, and possible brood size, and a GPS location was recorded for future analyses. If a nest could not be located, we used the point of triangulation as an estimate for the nest location. We categorized nests as successful (≥ 1 egg hatched) or unsuccessful (no eggs hatched). In addition, we considered nests as depredated if eggs were found destroyed, trampled, or moved away from the nest-site. We considered nests abandoned if the female left the nest and did not return.

For each brood, , we conducted 3-4 brood-surveys approximately 30 minutes prior to dawn during the brood flightless period (≤ 14 days post-hatch) or until all poults were lost. The presence of poults was determined by an observer approaching to within 15 m of the brood-rearing female while she was ground-roosted, and recording 3-4 compass bearings in the direction of the female. In dense vegetation where it was difficult to determine whether the female was tree-roosted without poults or ground-roosted with poults, the observer flushed the female and counted the number of poults. We continued monitoring broods until 30 days post-hatch when brood mixing rendered broods indistinguishable from each other. In all cases, we recorded a GPS location at the brood location.

2.3 Habitat characteristics

At each nest-site we measured understory vegetation height, percent canopy cover, and percent ground cover. To evaluate understory vegetation height, we measured the average visual obstruction at each nest site using a Robel pole (Robel et al. 1970). The Robel pole was viewed from a distance of 15 m in each cardinal direction from the nest-site at a height of 1-m. We measured percent canopy cover using a spherical densiometer (Lemmon 1956) and percent ground cover using a 1-m^2 Daubenmire frame (Daubenmire 1959) at a distance of 15 m in each cardinal direction from the nest-site. Ground cover was partitioned into 6 cover types: debris, fern, forb, grass, vine, and woody. We then combined the 6 cover types into one variable (total ground cover).

To investigate the influence of patch-level metrics on wild turkey nest survival, we used a geographic information system (ArcGIS® 10.1, Environmental Systems Research Institute Inc., Redlands, CA, USA) to map anthropogenic and landscape features known to influence wild turkeys. We mapped 6 land cover types available on both study areas: mature pine (>20 years old), young pine (<20 years old), mature pine-hardwood, hardwood, shrub-scrub, and agriculture/food plot. We calculated the linear distance from each nest-site to each of the nearest land cover types. To evaluate whether roads as a form of travel corridors for mesopredators affected nest survival, we calculated the linear distance from each nest-site to the nearest road (paved, gravel, and dirt). We calculated the Julian day for the date of nest initiation because nest survival may be influenced by when a nest was initiated. We also calculated the number of days-since-last prescribed fire until the first day of incubation for each nest to describe nest site selection in a frequently burned landscape.

2.4 Statistical analysis

To evaluate nest success, we calculated initial nesting rate, initial nest success, re-nest rate, and re-nest success. We defined the beginning of the nesting season each year as the earliest nest initiation of all monitored females across both study sites (5 April, 2011; 27 March, 2012; 4 April, 2013). We calculated initial nesting rate as the percentage of females initiating incubation relative to all females entering the nesting season. We calculated initial nest success as the percentage of nests that successfully hatched ≥ 1 egg of those that initiated a nest. We calculated re-nest rate as the percentage of females that re-nested following failure of their first nest, early brood loss. We calculated re-nest success as the percentage of re-nests that successfully hatched ≥ 1 egg. We also evaluated nest success following exposure to growing-season prescribed fire.

To evaluate brood survival, we calculated the percent of broods that survived the flightless period (i.e., days 1-14 post-hatch). We then calculated the percent of broods that survived the following 2-week period (i.e., days 15-30). We also evaluated brood success following impact by growing-season prescribed fire.

We evaluated the influence of nest-site and patch-level habitat characteristics on nest survival using a Cox proportional hazards model (Cox 1972). We used the PHREG procedure in SAS 9.3® to evaluate risk of nest failure based on habitat characteristics. The Cox proportional hazards model provides hazard ratios for each covariate term included in the model. Hazard ratios >1.0 indicate increasing risk of an event (e.g., nest failure) with increasing values for the covariate, whereas hazard ratios <1.0 indicate decreasing risk of an event with increasing values for the covariate. Prior to data analysis, we assessed the proportional hazards assumption for our models. We removed any variables that were highly correlated ($r > 0.6$). We used Breslow's approximation for the likelihood calculation to partition deaths with equal failure times (Breslow 1974). We developed 16 models to evaluate nest survival as a function of nest-site, patch-level, and Julian day covariates. We used Akaike's Information Criteria adjusted for small sample size (AICc) to compare models (Akaike 1973, Burnham and Anderson 2002). The model with the lowest AIC*c* was considered to be the best model, and all models with AIC*c* < 2.0 units from the best model as the best set of approximating models. The Akaike weight (*wi*) for each model was calculated as an estimate of the probability of the model being the most parsimonious of the developed models.

3. Results

We monitored 79 nests initiated by 45 individual females resulting in 34 broods. Average onset of incubation for initial nests was 18 April (range: 27 March–12 June; Table 1). One nest survived to 39 days likely due to infertility. We removed this nest from subsequent analyses since it was an outlier and not representative of the other nests. Three individual females each initiated 3 nests in a given nesting season. Average length of incubation for successful nests was 28 days ($n = 33$, range 24–30 days). Of 78 nests, 33 (42.3%) were successful, including 2 (6.1%)

nests exposed to growing-season prescribed fire. Of the unsuccessful nests, 32 (71.1%) were depredated, 10 (22.2%) were abandoned due to observer error, and 3 (6.7%) were exposed to growing-season prescribed fire.

Females frequently selected nest sites in areas towards the end of their burn rotation (i.e., prior to the next scheduled burn; $\bar{x}$ = 613.7 days; SE = 44.7). Thirty-seven percent of females re-nested following nest loss. Of these, 43% hatched (Table 2). Eleven of 34 broods (32%) survived the entire flightless period (Table 3); 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 prescribed fire during the study.

To evaluate nest-site, patch-level, and Julian day models of nest survival, we first excluded 17 nests from the analysis because they were abandoned due to observer error (n=10) and vegetation was altered by prescribed fire and/or mowing (n=7). We removed one outlier nest from the analysis since the distance to patch-level types were not similar to other nests. Distance to mature-pine hardwoods was highly correlated with distance to agriculture (r =0.79); therefore, we retained distance to agriculture in the survival analysis. Nest-site, patch-level, and Julian day covariates had little influence on nest survival (Table 4). The null model was the most parsimonious model, but there were several models within 2 ΔAICc units of the null model suggesting great model uncertainty and providing evidence that nest predation is a random event relative to habitat characteristics used in our models

4. Discussion

Our findings indicate that longleaf pine forests and associated management using frequent prescribed fire (≤ 2 year fire-return interval) is compatible with wild turkey reproduction. As hypothesized, growing-season prescribed fire had minimal impact on wild turkey production. Contrary to our hypothesis, nest-site and patch-level habitat metrics, and Julian day had little influence on nest survival.

The initial nesting rate we observed was comparable to previous studies in the southeastern United States (Palmer et al. 1993, Miller et al. 1998, Thogmartin and Johnson 1999, Wilson et al. 2005, Byrne and Chamberlain 2013). We observed a higher initial nest success relative to other published studies in the region (Palmer et al. 1993, Miller et al. 1998, Thogmartin and Johnson 1999, Wilson et al. 2005, Byrne and Chamberlain 2013). We also observed a higher re-nest rate and re-nest success relative to other published studies in the region (Palmer et al. 1993, Miller et al. 1998, Thogmartin and Johnson 1999, Wilson et al. 2005, Byrne and Chamberlain 2013) with the re-nest success rate being ≥2.3 times that of other published studies (Palmer et al. 1993, Miller et al. 1998, Thogmartin and Johnson 1999, Wilson et al. 2005, Byrne and Chamberlain 2013). These findings suggest that although overall nest success on initial nesting attempts is comparable to other landscapes in the Southeast, females in the systems we studied are more likely to re-nest after nest loss.

The first 2-weeks post-hatch is the greatest period of vulnerability to wild turkey poults (Barwick et al. 1971, Glidden and Austin 1975, Speake et al. 1985, Peoples et al. 1995, Spears et al. 2007). Similarly, we found the majority of poult loss occurred during the first 2-weeks post-hatch (Glidden and Austin 1975, Speake et al. 1985, Lehman et al. 2001, Spears et al. 2007). After 2-weeks of age, brood survival increases because poults can roost in trees to avoid risk of terrestrial predators (Barwick et al. 1971). We observed that survival rate to 30 days (22%) was greater than reported in other studies in coastal plain pine forests (9%, Peoples et al. 1995; 13%, Exum et al. 1987; 10%, Sisson et al. 1991). Our findings are likely a function of broad expanses of longleaf pine and associated herbaceous understory that are structurally similar to habitats (forest with dense herbaceous understory) known to provide quality brooding areas (Sisson et al. 1991, Porter 1992, Sisson and Speake 1994, Spears et al. 2007). Alternatively, risk of predation may be less in longleaf systems due to the interactions between habitat and predation risk. Additional research is needed to address interactions between habitat and predation risk in a longleaf pine ecosystem.

Growing-season prescribed fire is an important factor in maintaining quality 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). Our findings suggest that prescribed fire, specifically growing-season prescribed fire, had little impact on wild turkey reproductive success. Our results are consistent with previous studies that found little impacts of prescribed fire on wild turkey nest and brood survival (Carlisle 2003, Jones et al. 2005, Moore 2006). For example, Jones et al. (2005) reported 3% (n=2) of 64 nests were destroyed by growing-season fire. However, the population-level impacts due to loss of a few nests to growing-season prescribed fire are further mitigated by re-nesting. Longer fire-return intervals (3-7 years) in pine stands have previously been recommended to manage for wild turkeys (Stoddard 1963, Miller et al. 2000, Miller and Conner 2007). However, to balance management objectives of wild turkey habitat management with those of threatened and endangered species (e.g., red-cockaded woodpecker [*Picoides borealis*]); frequent fire-return intervals ($\leq$ 2 years) are recommended in pine savanna ecosystems (Martin et al. 2012).

Nest-site and patch-level metrics, and Julian day were not important predictors of nest survival in a longleaf pine ecosystem. Habitat characteristics have previously been shown to be important to wild turkey during nest site selection (Schmutz et al. 1989, Day et al. 1991, Thogmartin 1999, Williams 2012). On our study site, Williams (2012) found that females selected nest sites with reduced canopy cover, greater woody ground cover, and greater vegetation height relative to random sites on our study areas. Likewise, areas with ≥ 1.5 years of vegetative growth post-fire on our study areas were highly preferred by females for nest site selection, which suggests these locations provide some level of visual obscurity. Although females selected nest sites with greater cover (Williams 2012), our findings suggest that doing so did not lead to increased nest survival. Patch-level metrics were not important predictors of nest survival. This finding is consistent with previous studies that have found little support for the influence of patch-level habitat characteristics on wild turkey nest survival (Thogmartin 1999, Fuller et al. 2013). Likewise, Julian day was not an important predictor of nest survival. Despite previous studies that found the timing of nest initiation affects avian nest survival (Thogmartin and Johnson 1999, Fields et al. 2006, Wilson et al. 2007, Webb et al. 2012), we suggest that body condition may not be an important factor affecting timing of nest initiation primarily due to the abundance of early successional habitat and food resources from a frequently burned landscape (McGlincy 1985, Landers and Mueller 1986, Exum 1988, Provencher et al. 1998).

Prescribed fire is an important management tool in longleaf pine ecosystems (Barnett 1999). With frequent fire-return intervals (≤ 2 years), herbaceous plant communities do not shift to dense hardwood understory communities (Glitzenstein et al. 2012). In addition, frequent use of prescribed fire in longleaf pine forests increases understory plant species richness, diversity, and evenness (Brockway and Lewis 1997). These impacts on understory plants contribute to providing suitable nesting habitat for wild turkeys. Likewise, frequent fire-return intervals (≤ 2 years), have been shown to decrease predator use of early successional stands (Chamberlain et al. 2003, Jones et al. 2004). Jones et al. (2004) found that raccoon use of longleaf pine stands during avian nesting season was reduced by 62% if the stand had been burned since the last growing season. Furthermore, Byrne and Chamberlain (2012) did not find area restricted search behavior (foraging) by raccoons in openings and dry areas with sparse ground-level vegetation. Additional research to address predator – wild turkey dynamics relative to season and frequency of prescribed fire would enhance our understanding of wild turkey nesting ecology within longleaf pine ecosystems.

4. Conclusions

Longleaf pine restoration efforts necessitate a need to address the impact of longleaf pine management on wild turkey ecology. Longleaf pine management with frequent fire-return intervals (≤ 2 years) is compatible with wild turkey production. We observed greater initial nest success relative to other studies in the southeastern United States. Likewise, we observed greater re-nesting rates, re-nest success, and brood survival than in previous studies. Our results suggest that small-scale (12-22 ha) and frequent fire-return intervals (≤ 2 years) will have little impacts on wild turkey production. We suggest land managers focus on small-scale and frequent burns in longleaf pine ecosystems to manage for wildlife diversity while maintaining suitable nesting conditions for wild turkeys.

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Table 1. Mean and date ranges of the onset of incubation of initial nesting attempts of Eastern wild turkeys (*Meleagris gallopavo silvestris)* at the Joseph W. Jones Ecological Research Center (JC) and Silver Lake Wildlife Management Area (SL), southwestern Georgia, USA, 2011-2013.

Year	Site	*n*	Mean Date	Range
2011	JC	6	13-April	5 April – 26 April
	SL	5	22-April	5 April – 9 May
2012	JC	14	19-April	27 March – 12 June
	SL	16	21-April	1 April – 2 June
2013	JC	16	19-April	4 April – 7 May

Table 2. Nesting ecology of Eastern wild turkeys (*Meleagris gallopavo silvestris)* at the Joseph W. Jones Ecological Research Center (JC) and Silver Lake Wildlife Management Area (SL), southwestern Georgia, USA, 2011-2013. Numbers in parentheses correspond to the number of nesting attempts or successful nesting attempts of all females monitored from the earliest known nesting attempt (2011: 5 April; 2012: 27 March; and 2013: 4 April).

Year	Site	*n*[a]	% Initial Nesting (*n*)	% Initial Nest Success (*n*)	% Re-nest (*n*)	% Re-nest Success (*n*)
2011	JC	7	85.7 (6)	83.3 (5)	33.3 (2)	50.0 (1)
	SL	8	62.5 (5)	60.0 (3)	N/A	N/A
2012	JC	19	73.7 (14)	35.7 (5)	57.1 (8)	50.0 (4)
	SL	25	64.0 (16)	25.0 (4)	31.3 (5)	20.0 (1)
2013	JC	23	69.6 (16)	43.8 (7)	37.5 (6)	50.0 (3)
Pooled Sites and Years		82	70.0 (57)	42.1 (24)	36.8 (21)	42.9 (9)

[a]Number of female wild turkeys entering the nesting season.

Table 3. Poult survival of Eastern wild turkey (*Meleagris gallopavo silvestris)* broods at the Joseph W. Jones Ecological Research Center and Silver Lake Wildlife Management Area, southwestern Georgia, USA, 2011-2013. Numbers in parentheses correspond to the number of broods (≥ 1 poult) that survived during the time period.

Year	Site	*n (broods)*	Day 1-14 (% survived)	Day 15-30 (% survived)
2011	JC	6	16.7 (1)	0
	SL	3	66.7 (2)	33.3 (1)
2012	JC	9	22.2 (2)	11.1 (1)
	SL	5	60.0 (3)	40 (2)
2013	JC	11	27.3 (3)	100.0 (3)
Pooled Sites and Years		34	32.4 (11)	20.6 (7)

Table 4. Nest-site[a], patch-level[b], and Julian day[c] models associated to Eastern wild turkey (*Meleagris gallopavo silvestris*) nest survival at the Joseph W. Jones Ecological Research Center and Silver Lake Wildlife Management Area, southwestern Georgia, USA, 2011-2013.

Model	*K*	AICc	Δ AICc	Relative Likelihood	w_i
Null	1	160.51	0.0	1.00	0.20
Julian day	2	161.92	1.42	0.49	0.10
Canopy cover	2	161.93	1.42	0.49	0.10
Distance to young pines	2	162.10	1.59	0.45	0.09
Total ground cover	2	162.35	1.84	0.40	0.08
Distance to nearest road	2	162.40	1.89	0.39	0.08
Distance to hardwoods	2	162.51	2.00	0.37	0.07
Distance to agriculture	2	162.54	2.03	0.36	0.07
Distance to shrub/scrub	2	162.54	2.03	0.36	0.07
Mean visual obstruction	2	162.62	2.11	0.35	0.07
Distance to mature pines	2	162.64	2.13	0.34	0.07
Nest-site	4	166.02	5.52	0.06	0.01
Nest-site+Temporal	5	167.85	7.35	0.03	0.01
Patch-level	7	172.82	12.31	0.00	0.00
Patch-level+Temporal	8	173.28	12.77	0.00	0.00
Nest-site+patch-level	10	179.51	19.00	0.00	0.00
Nest-site+patch-level+temporal	11	180.89	20.38	0.00	0.00

[a]Nest-site: total ground cover, canopy cover, and mean visual obstruction.
[b]Patch-level: distance to mature pines, hardwoods, agriculture, shrub/scrub, young pines, and nearest road.