Considerations for Timing of Spring Wild Turkey Hunting Seasons in the Southeastern United States

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Abstract: Eastern wild turkeys (*Meleagris gallopavo silvestris*; hereafter, turkeys) are widely recognized throughout the southeastern United States as a species of ecological, recreational, aesthetic, and economic importance. As a game species, male turkeys are most popularly hunted during spring, a timeframe coinciding with breeding and nesting activities. Given this period's biological importance, wildlife managers are challenged to avoid negative population effects from harvest while simultaneously providing quality hunting opportunities. Biological considerations associated with timing spring turkey seasons include potential effects on productivity from early and high male harvest and intentional or inadvertent illegal female harvest. Turkey hunters often request spring seasons timed to maximize exposure to gobbling activity, but these sociological considerations may conflict with biological objectives. Recent declining trends in indices of turkey abundance and productivity in several states in the southeastern United States have heightened the need to evaluate potential consequences of spring hunting season timing on turkey population demographics. Herein, we review literature about turkey gobbling and nesting chronology and summarize factors state wildlife agencies should consider when setting timing of spring turkey seasons. We suggest that spring turkey season opening dates which coincide with peak nest initiation (i.e., mean date of initial nest initiation; 9–22 April) reduce risk exposure to female turkeys. This framework also addresses concerns about potential effects of early male harvest on productivity while acknowledging hunter expectations of hearing vocal male turkeys. Furthermore, we suggest state wildlife agencies conduct research to reduce uncertainty about effects of spring season timing on turkey population demographics.

Key words: Eastern wild turkey, gobbling chronology, harvest frameworks, hunting, *Meleagris gallopavo silvestris*, nesting chronology, southeastern United States.

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Although historically abundant, eastern wild turkey (*Meleagris gallopavo silvestris*; hereafter, turkey) numbers in the southeastern United States declined precipitously during the late 1800s and early 1900s because of unregulated harvest and habitat loss (Kennamer et al. 1992). Due largely to restoration efforts by state wildlife agencies and their partners, turkeys now exist throughout the region. With an estimated population of about 2.6 million turkeys in the geography (Eriksen et al. 2015) of the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) and established spring turkey hunting seasons in all member states, turkeys are widely recognized as an important species from an ecological, recreational, aesthetic, and economic standpoint.

Unlike hunting seasons for other North American gallinaceous birds, spring turkey seasons coincide with breeding and nesting, challenging managers to provide hunter opportunity without negatively affecting turkey populations during this sensitive biological period (Kurzejeski and Vangilder 1992). Timing of spring turkey seasons is therefore a significant management consideration which must take into account turkey reproductive chronology and harvest susceptibility (Kurzejeski and Vangilder 1992). Managers must also acknowledge the relationship between season timing and hunter satisfaction (Taylor et al. 1996). Seeing (Little et al. 2001, Nicholson et al. 2001, Dingman et al. 2005), hearing (Vangilder et al. 1990, Thackston and Holbrook 1996, Isabelle and Reitz 2015), and harvesting turkeys (Swanson et al. 2005) are often cited as factors most positively affecting the spring hunting experience, and the behavioral tendencies of turkeys that dictate these interactions with hunters (e.g., gobbling propensity) can vary considerably throughout the breeding season (Bevill 1973, Miller et al. 1997b, Palumbo 2010).

Unsurprisingly, the philosophical balance between the biological and sociological considerations of spring season timing varies among states (Kurzejeski and Vangilder 1992; Table 1). In some states, spring turkey seasons are timed to occur after the first peak in gobbling, so the second peak (Bevill 1975, Hoffman 1990) will occur during the hunting season (Kurzejeski and Vangilder 1992). This approach aims to lessen hunter disruption to turkey breeding activities, diminish potential for inadvertent or intentional il-

legal female harvest, and increase responsiveness of male turkeys to hunters' calls. This framework yields relatively short seasons which limits hunting opportunity and increases the chance that extended periods of inclement weather reduce gobbling activity and hunter success (Norman et al. 2001a). Furthermore, in hunted populations, two peaks in gobbling may not always occur (Kienzler et al. 1996, Miller et al. 1997b, Norman et al. 2001a, Palumbo 2010, Colbert 2013), challenging the idea that spring seasons can be structured in such a manner. In other states, spring turkey seasons begin early in the reproductive period and nearly span the entire breadth of gobbling and breeding activity. This framework increases hunting opportunity, lessens the impact of inclement spring weather on hunting success by offering more potential days afield (Norman et al. 2001a), but ignores critical biological considerations which may dictate long-term turkey population viability. Given these differing approaches, spring season timing varies greatly throughout the southeastern United States as strategies have evolved to fit state-specific turkey management goals and hunter preferences.

Recently, many SEAFWA states have documented declining trends in indices of turkey abundance and productivity (Byrne et al. 2015) as have states in other portions of the United States (Casalena et al. 2015). In some cases, these trends have occurred concurrent with hunter requests for earlier spring season opening dates. Although the simultaneous occurrence of these developments does not necessarily imply a causative relationship, declining turkey indices have generated concern among wildlife managers about potential effects of season timing on turkey population demographics. In light of these concerns, we reviewed literature on the biological and sociological considerations associated with timing of spring turkey seasons. Our objectives were to 1) summarize literature pertaining to factors which should be considered when setting timing of spring turkey seasons, 2) examine potential undesirable consequences associated with timing of spring turkey season frameworks, and 3) provide recommendations for state wildlife agencies to consider when setting timing of spring turkey seasons.

Methods

We conducted a review of scientific literature by examining proceedings from the National Wild Turkey Symposium series and the annual SEAFWA conference, along with relevant keyword searches of peer-reviewed publications using Google Scholar to 1) characterize turkey gobbling and nesting chronology, 2) determine factors affecting illegal female turkey harvest during spring turkey seasons, and 3) determine potential of male turkey harvest to impact reproduction and long-term population fitness. We attempted

Table 1. Opening dates, season lengths, and bag limits for 2017 spring wild turkey hunting seasons, and fall wild turkey hunting information for states located in the southeastern United States.

State	Zone	Youth season opening date	Regular season opening date	Total days in season (youth and regular)	Bag limit	Fall hunting[a]
Alabama	1[b]	11 Mar	15 Mar	49	5[c]	NS
	2[d]	25 Mar	1 Apr	32	5[c]	NS
	3[e]	15 Apr	22 Apr	7	5[c]	NS
	4[f]	11 Mar	15 Mar	49	5[c]	MO
Arkansas	1, 2, 3, 4B, 5, 5B, 6, 7, 7A, 8, 9, 10, 17[b]	8 Apr	10 Apr	18	2[g]	NS
	1A, 4, 4A, 5A, 9A[h]	8 Apr	10 Apr	11	1[g]	NS
Florida	A[i]	25 Feb	4 Mar	39	2[j]	MO
	B[k]	11 Mar	18 Mar	39	2[j]	MO
	C[l]	11 Mar	18 Mar	18	1[j]	MO
Georgia		18 Mar	25 Mar	54	3	NS
Kentucky		1 Apr	15 Apr	25	2	ES
Louisiana	A[m]	18 Mar	25 Mar	32	2[j]	NS
	B[n]	18 Mar	25 Mar	25	2[j]	NS
	C[o]	18 Mar	25 Mar	18	2[j]	NS
Mississippi		8 Mar	15 Mar	55	3[p]	ES[q]
Missouri		8 Apr	17 Apr	23	2	ES
North Carolina		1 Apr	8 Apr	36	2	NS
Oklahoma[r]		15 Apr	17 Apr	22	2[s]	ES[t]
South Carolina		18 Mar	20 Mar	49	3	NS
Tennessee		25 Mar	1 Apr	46	4	ES
Texas[r]			15 Apr	30	1	NS
Virginia		1 Apr	8 Apr	38	3	ES
West Virginia		15 Apr	17 Apr	25[u]	2	ES

a. NS = no season, ES = either-sex harvest allowed, MO = male-only harvest allowed.
b. Included majority of state.
c. Statewide bag limit was five.
d. Included all or portions of seven counties.
e. Included all or portions of four counties.
f. Included all or portions of six counties.
g. Statewide bag limit was two. Adult male turkeys only, except youth hunters could harvest one juvenile male.
h. Limited to western portion of state and along Mississippi River.
i. Portions of state south of State Highway 70.
j. Statewide bag limit was two.
k. Portions of state north of State Highway 70, excluding Holmes County.
l. Holmes County only.
m. Included most of state that was open to spring turkey hunting.
n. Included all or portions of nine parishes.
o. Included all or portions of six parishes.
p. Hunters over the age of 16 could not harvest juvenile males.
q. Limited to private lands in 24 counties in which landowners needed to apply for permits.
r. Included range of Eastern subspecies only.
s. Only one turkey could be harvested in the southeast region.
t. Either-sex archery season in all counties. Bearded birds could be taken in some counties during shotgun season.
u. Most counties. For counties where hunting on Sundays was permitted, season length was 28 days.

to include all relevant literature published from 1970 to present from the SEAFWA geography that addressed these areas of focus. We also incorporated relevant literature from other geographic areas, but restricted temporal estimates of gobbling and nesting chronology to studies conducted within the southeastern United States.

Results

We reviewed 44 publications that reported findings of turkey gobbling and nesting chronology, illegal female turkey harvest, and male turkey harvest as related to potential impacts to reproduction and long-term population fitness. These included seven publications that documented timing of peak gobbling or nesting chronology within the SEAFWA geography (Table 2). We reviewed 10 studies conducted within the SEAFWA geography that estimated rates of illegal female turkey harvest during spring turkey seasons.

Factors Considered when Setting Timing of Spring Turkey Seasons

Gobbling Chronology.—Although chronology of turkey gobbling can be influenced by weather (Kienzler et al. 1996, Miller et al. 1997a, Norman et al. 2001a), the reproductive period is primarily triggered by photoperiod (Healy 1992). As such, latitude can be used to predict broad regional variation in gobbling activity (Whitaker et al. 2005, Palumbo 2010). For turkey populations experiencing little to no hunting pressure, researchers have documented one (Colbert 2013) or two (Bevill 1975) gobbling peaks, which may coincide with breakup of winter flocks (Bevill 1973), initiation of laying behavior (Miller et al. 1997b), peak nest initiation (Colbert 2013), or peak nest incubation (Bailey and Rinell 1967, Bevill 1975, Norman et al. 2001a). Hunting can reduce gobbling activity (Kienzler et al. 1996) and obscure its chronology (Bevill 1975, Norman et al. 2001a) by removing males from the population or through disturbance of turkeys by hunters (Kienzler et al. 1996, Norman et al. 2001a, Lehman et al. 2005). As a result, only one gobbling peak may exist in hunted populations (Kienzler et al. 1996, Miller et al. 1997b, Norman et al. 2001a, Colbert 2013). While acknowledging that some variation in gobbling chronology can be attributed to latitudinal differences (Whitaker et al. 2005), gobbling activity generally peaks from late April (28 April; Bevill 1975) to early May (7 May; Norman et al. 2001a) in unhunted turkey populations in the southeastern United States. By comparison, gobbling peaks can occur from early (2 April; Miller et al. 1997b) to mid-April (12 April; Norman et al. 2001a) in hunted populations. As such, managers should acknowledge the chronology and variability in turkey gobbling and view them in concert with other factors when setting timing of spring turkey seasons.

Table 2. Timing of wild turkey gobbling peaks and first nest incubation initiation dates in the Southeastern United States.

Literature citation	State	Gobbling peak	Incubation initiation	Annual incubation initiation range
Bevill 1975	SC	28 Apr[a]		
Miller et al. 1997b	MS	2 Apr[b]		
Miller et al. 1998b	MS		22 Apr[c]	12 Apr–3 May[c]
Norman et al. 2001a	VA, WV	7 May[a]		
Norman et al. 2001a		12 Apr[b]		
Norman et al. 2001b	VA, WV		5 May[d]	29 Apr–10 May[d]
Thogmartin and Johnson 1999	AR		7 May[c]	26 Apr–20 May[c]
Vangilder and Kurzejeski 1995	MO		5 May[e]	28 Apr–26 May[e]

a. Unhunted population.
b. Hunted population.
c. Median date of incubation initiation of adult females.
d. Mean date of incubation initiation.
e. Median date of incubation initiation.

Nesting Chronology.—Despite their generally gregarious nature, female turkeys become secretive during the nesting period (Healy 1992). Although they may interact with other turkeys during feeding, these activities and mating behaviors occur away from the nest (Williams et al. 1974). It takes female turkeys approximately two weeks to lay a clutch of eggs (Healy 1992), and early in the egg-laying period they spend about one hour each day on the nest (Williams and Austin 1988). Continuous incubation lasts about 26 days (Williams et al. 1971). During this time period, females leave the nest on average about three times every four days to feed, drink, and defecate, with average recesses lasting about one hour (Martin et al. 2015). During incubation recesses, average distance traveled from the nest site is less than 100 m (Conley et al. 2015). As such, female turkeys are generally solitary during the incubation period and do not often associate with male turkeys.

Photoperiod triggers nesting in turkeys (Healy 1992). As with gobbling chronology, broad regional variation in nesting chronology is relatively predictable based on latitude (Whitaker et al. 2005), although weather can cause considerable annual variability (Vangilder and Kurzejeski 1995, Norman et al. 2001b). In the southeastern United States, median dates of initial nest incubation generally occur from late April to early May. In Mississippi, Arkansas, Missouri, Virginia, and West Virginia, mean or median dates of first nest incubation initiation ranged from 22 April–5 May (Vangilder and Kurzejeski 1995, Miller et al. 1998b, Thogmartin and Johnson 1999, Norman et al. 2001b). Given the two weeks needed to lay a clutch of eggs (Healy 1992), average nest initiation dates in the southeastern United States based on these studies are approximately 9–22 April.

Although average dates of nest initiation are generally similar across the southeastern United States, annual variability can be considerable. For example, during a five-year period in Virginia and West Virginia, annual mean incubation initiation dates for

first nests ranged 12 days (29 April–10 May; Norman et al. 2001b). During a 13-year period in Mississippi, annual median dates of initial incubation initiation ranged 22 days (12 April–3 May; Miller et al. 1998b). Median annual date of first-nest incubation in Arkansas showed even greater variation, ranging 25 days in four years (26 April–20 May; Thogmartin and Johnson 1999), and in Missouri, annual median dates of incubation initiation ranged 29 days in seven years (28 April–26 May; Vangilder and Kurzejeski 1995). Researchers have related this variability to weather (Vangilder and Kurzejeski 1995, Norman et al. 2001a) and female body condition (Thogmartin and Johnson 1999). In Missouri, colder March temperatures appeared to be associated with a delay in incubation initiation (Vangilder and Kurzejeski 1995). In Virginia, Norman et al. (2001a) reported that incubation initiation dates were negatively correlated with March temperatures and positively correlated with snow depth. In Arkansas, nesting was delayed for some female turkeys in poor body condition (Thogmartin and Johnson 1999). Therefore, as with gobbling activity, managers must acknowledge annual variability in nesting chronology when establishing timing of spring turkey seasons.

Potential Biological Consequences of Spring Turkey Season Timing

Illegal Female Harvest.—Survival of adult female turkeys is one of the most important factors determining annual changes in turkey abundance (Vangilder and Kurzejeski 1995, Alpizar-Jara et al. 2001). Therefore, hunting regulations that protect female turkeys from being killed during the reproductive period represent a safeguard on population viability. As such, most spring hunting regulations in the southeastern United States prohibit or greatly restrict harvest of female turkeys. Although some states within the region permit harvest of bearded female turkeys during spring hunting seasons, these turkeys generally represent ≤1% of the total spring harvest (Waymire 2013, Isabelle 2015) and are therefore not likely to impact viability of these populations.

Despite regulations designed to protect female turkeys, research in some areas of the southeastern United States has documented considerable inadvertent or intentional illegal harvest of female turkeys during spring seasons (Wright and Speake 1975, Kimmel and Kurzejeski 1985, Williams and Austin 1988, Davis et al. 1995, Norman et al. 2001a). Conversely, other regional studies suggest illegal female harvest during spring seasons is minimal (Everett et al. 1980, Palmer et al. 1993, Vangilder 1996, Miller et al. 1998a, Wilson et al. 2005). Numerous factors likely influence the degree to which illegal female harvest occurs, including hunter density (Williams and Austin 1988, Vangilder and Kurzejeski 1995) and hunting pressure (Kurzejeski et al. 1987), habitat fragmentation (Norman et al. 2001a), gobbling activity (Williams and Austin 1988), male turkey density (Williams and Austin 1988), and hunter experience (Vangilder 1996). Despite complexities associated with these factors, female reproductive status is one of the most direct determinants of susceptibility to illegal harvest (Miller et al. 1998a). Females actively involved in the nesting process are less likely to associate with male turkeys, which minimizes inadvertent harvest when hunters encounter and attempt to harvest males. Incubating females also remain solitary and concealed, which reduces their chances of being killed illegally (Williams and Austin 1988, Vangilder and Kurzejeski 1995). Higher rates of illegal female harvest have been documented in some areas of the southeastern United States when spring hunting seasons occur before the onset of nesting, suggesting hunting seasons that occur prior to this timeframe place females at greater risk (Norman et al. 2001a). Such risk could be significant to population viability, as modeling studies suggest population growth rates may drop linearly with increases in female harvest (Alpizar-Jara et al. 2001), and population declines likely occur as female harvest rates approach 10% (Vangilder and Kurzejeski 1995, McGhee et al. 2008).

Early or High Male Harvest.—Due to turkeys' polygamous breeding system, an underlying assumption of spring hunting seasons is that harvest of males does not impact population growth if it does not disrupt or impede breeding activities (Allen 1956, Healy and Powell 2000). Nonetheless, potential effects of spring season timing on male harvest and its relationship to population vigor are important considerations, especially in areas of low turkey densities, intense hunting pressure, high harvest rates, and fragmented landscapes (Vangilder 1992, Kurzejeski and Vangilder 1992, Stafford et al. 1997, Chamberlain et al. 2012). These concerns are based on observations that suggest insufficient availability of adult male turkeys can detrimentally impact localized population productivity (Exum et al. 1987, Isabelle et al. 2016). Annual adult male survival can be relatively high in unhunted populations (Moore et al. 2008), yet most male mortality occurs during spring as a result of harvest with some additional mortality due to crippling loss during, or shortly after, the hunting season (Godwin et al. 1991, Wright and Vangilder 2000). Furthermore, most male harvest may be concentrated early in the hunting season under frameworks in which hunter access or opportunity is unrestricted (Miller et al. 1997b, Lehman et al. 2005). It is therefore important for managers to consider the timing of hunting seasons and harvest within the progression of the turkey breeding season. A relatively recent meta-analysis suggests most SEAFWA member states open spring turkey seasons early in the breeding season, prior to the predicted mean nest incubation initiation date ($\bar{x}$ = 29.5 days prior; range 9–47 days prior; Whitaker et al. 2005). If male turkey abundance is greatly reduced due to high harvest rates, the combination of additive harvest concentrated ear-

ly in the breeding season could result in an insufficient number of males remaining for copulation with females, thereby violating the assumption that spring turkey seasons do not impact reproduction. Though this situation is theoretically possible, it is largely uninvestigated. Confounding this issue is that a single breeding may be able to fertilize eggs for an initial and second nesting attempt (Grigg 1957) which could lessen concern about high harvests of male turkeys early in the breeding season. Clearly, the impact of spring turkey harvests on turkey reproduction remains a considerable knowledge gap in the management of turkey populations.

Long-term Fitness of Turkey Populations.—Removal of males prior to breeding activities could also cause long-term detrimental consequences to populations if individuals of greater fitness are removed prior to their reproductive contribution (Harris et al. 2002, Milner et al. 2007). While this potential has not been explored in turkeys, correlates of fitness have been shown to determine participation in the species' breeding season (Bevill 1973, Badyaev et al. 1998), with more dominant turkeys engaging in reproductive activities earlier than subdominants (Badyaev et al. 1996a, Badyaev et al. 1996b). Hunting seasons that occur before completion of breeding activities could therefore expose these early-engaging dominant individuals to increased risk of harvest, potentially impacting long-term population vigor (Milner et al. 2007).

Discussion

Tradition and hunter opinions vary across the southeastern United States and are important considerations for wildlife managers when establishing timing of spring turkey seasons. Beyond biological and sociological considerations, differences in hunter densities, turkey densities, turkey habitat, and management goals are all factors state wildlife agencies must consider (Norman et al. 2001a). It is widely accepted that spring turkey hunting seasons should be timed to ensure sustainable harvests while affording quality opportunities for hunters in regards to gobbling frequency and responsiveness to calling. Nonetheless, potential consequences of season timing are important to recognize. Inadvertent or intentional illegal harvest of female turkeys has been documented as a significant issue in portions of the southeastern United States (Wright and Speake 1975, Williams and Austin 1988, Davis et al. 1995, Vangilder and Kurzejeski 1995, Norman et al. 2001a). Research suggests the likelihood of illegal female harvest is greatest prior to onset of incubation (Miller et al. 1998a, Norman et al. 2001a). Therefore, in areas where substantial illegal female harvest occurs, the relationship between season timing and female mortality is a paramount consideration when establishing timing of spring seasons. This is particularly important in states that allow either-sex harvest during fall turkey hunting seasons because high levels of female harvest can result in declines in abundance (Vangilder and Kurzejeski 1995, Alpizar-Jara et al. 2001).

Effect of male harvest on turkey production remains a considerable knowledge gap. Yet, it is imprudent to ignore evidence which suggests high, early spring harvest (Exum et al. 1987) or insufficient adult male abundance (Isabelle et al. 2016) may locally suppress turkey productivity. In fact, many authors (Vangilder 1992, Kurzejeski and Vangilder 1992, Healy and Powell 2000) have warned about potential implications of high male turkey mortality on population productivity when it occurs early in the breeding season. While unquantified in turkeys, high, selective, or inappropriately-timed male harvest has been suggested to negatively impact other commercially or recreationally harvested taxa from cervids to crustaceans (Saether et al. 2003, Sato and Goshima 2006, Milner et al. 2007) suggesting this theory is not unfounded. The long-term genotypic or phenotypic consequences of removing dominant males prior to their reproductive contribution are also unknown, but should be a concern of wise management (Fenberg and Roy 2008).

Evaluation of the biological considerations associated with spring turkey season timing suggests hunting seasons delayed until peak nest initiation, defined as the mean date of initial nest initiation, should reduce illegal female harvest where it occurs (Norman et al. 2001a), while minimizing concerns about the potential effects of male harvest on productivity and sustainability of the resource (Table 3). This approach would also satisfy sociological considerations by offering the opportunity for hunters to experience high gobbling activity (Norman et al. 2001a), which is an important component of hunter satisfaction (Vangilder et al. 1990, Thackston and Holbrook 1996, Isabelle and Reitz 2015). Managers should recognize that spring turkey seasons beginning during peak nest initiation (9–22 April; Vangilder and Kurzejeski 1995, Miller et al. 1998b, Thogmartin and Johnson 1999, Norman et al. 2001b) may not overlap with early gobbling peaks (Miller et al. 1997b), which, on average, occur one week earlier (2–12 April; Miller et al. 1997b, Norman et al. 2001a). As such, managers should consider nesting and gobbling chronology, in conjunction with other factors, when establishing starting dates for spring turkey seasons.

A more conservative approach to establishing timing of spring turkey seasons is opening seasons during the peak of incubation initiation, defined as the mean date of initial nest incubation (Kurzejeski and Vangilder 1992, Healy and Powell 2000). Although more biologically conservative than opening during peak nest initiation, this framework may lead to dissatisfaction among hunters (Cartwright and Smith 1990, Taylor et al. 1996), especially in the southern latitudes where warmer temperatures and vegetative growth may detract from the hunting experience.

Although spring season timing has the potential to affect tur-

Table 3. Representative options for opening dates of spring wild turkey hunting seasons and potential positive, negative, and unknown biological and sociological consequences. Framework descriptions are theoretical and would vary in calendar date based upon state-specific differences in wild turkey reproductive chronology. Liberal framework: Opening prior to peak nest initiation; Recommended framework: Opening concurrent with peak nest initiation; Most conservative framework: Opening concurrent or following peak nest incubation initiation.

	Potential positive factors	Potential negative factors	Uncertainties and research needs
Liberal framework	Acknowledges requests of some hunters for early spring hunting seasons Allows for longer seasons which encompass all gobbling peaks, maximizes hunting opportunity, and reduces chances that inclement weather will reduce hunter success and satisfaction	Increased risk of illegal female harvest High or selective male harvest could impact population vigor	Risk of illegal female harvest varies and should be assessed at state-level Impact of early male mortality likely variable and currently unquantified
Recommended framework	Reduced risk of illegal female harvest Diminished risk associated with early male harvest Allows for exposure to secondary peak in gobbling activity Increased responsiveness of male turkeys to hunter calls compared to conservative framework	Hunters may miss first peak in gobbling Requires shorter, more precisely timed frameworks Some females may still be at risk of illegal harvest	Same as above, plus: Uncertain effects on hunter satisfaction Requires knowledge of local nesting and gobbling chronology
Most conservative framework	Minimized risk of illegal female harvest Eliminates risks associated with high, early male harvest	Occurs late in breeding season resulting in shortest season frameworks Hunters may miss all gobbling peaks in some years Warmer temperatures and advanced vegetation problematic	Uncertain effects on hunter satisfaction

key populations, its true effect remains uncertain. Butler et al. (2015) demonstrated that a framework change that moved Mississippi's opening date earlier resulted in a subsequent decline in harvest per unit effort for a group of avid hunters. However, the causative mechanism behind the relationship was unclear. In Arkansas, a long-term decline in spring harvest reversed following a framework alteration that moved the spring season's opening date until after peak nest initiation, but the causative mechanisms for the harvest increase were likewise uncertain (J. Honey, Arkansas Game and Fish Commission, unpublished data). While these case studies raise interesting questions, linkages between season timing and declining trends in turkey abundance or productivity have not been clearly documented or quantified.

Turkeys are a valuable public trust resource which deserves a cautious, prudent, and conservative management approach. Targeted research to reduce uncertainty associated with potential biological effects of spring season timing is warranted and should be a priority for state wildlife agencies. Additionally, contemporary estimates of illegal female harvest during spring turkey seasons are needed, as most studies that documented these rates occurred ≥20 years ago (e.g., Wright and Speake 1975, Kimmel and Kurzejeski 1985, Williams and Austin 1988). Nevertheless, our review of existing literature suggests state wildlife agencies should thoroughly evaluate their current spring season timing and adjust frameworks if deemed appropriate. An assessment of both the biological and sociological underpinnings of spring season timing advocates for spring seasons which are timed in conjunction with or after peak nest initiation.

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Literature Cited

Allen, Jr., R. H. 1956. Is a spring gobbling season biologically sound? Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 10:124–126.

Alpizar-Jara, R., E. N. Brooks, K. H. Pollock, D. E. Steffen, J. C. Pack, and G. W. Norman. 2001. An eastern wild turkey population dynamics model for Virginia and West Virginia. Journal of Wildlife Management 65:415–424.

Badyaev, A. V., W. J. Etges, and T. E. Martin. 1996a. Age-biased spring dispersal in male wild turkeys. The Auk 113:240–242.

———, ———, and ———. 1996b. Ecological and behavioral correlates of variation in seasonal home ranges of wild turkeys. Journal of Wildlife Management 60:154–164.

———, ———, J. D. Faust, and T. E. Martin. 1998. Fitness correlates of spur length and spur asymmetry in male wild turkeys. Journal of Animal Ecology 67:845–852.

Bailey, R. W. and K. T. Rinell. 1967. Events in the turkey year. Pages 73–91 in O. H. Hewitt, editor. The wild turkey and its management. The Wildlife Society, Washington, D.C.

Bevill, W. V., Jr. 1973. Some factors influencing gobbling activity among wild

turkeys. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 27:62–73.

———. 1975. Setting spring gobbler season by timing peak gobbling. Proceedings of the National Wild Turkey Symposium 3:198–204.

Butler, A. B., G. Wang, and K. D. Godwin. 2015. Using avid hunter and brood surveys to predict hunter success and assess regulatory changes in spring gobbler seasons. Proceedings of the National Wild Turkey Symposium 11:225–235.

Byrne, M. E., M. J. Chamberlain, and B. A. Collier. 2015. Potential density dependence in wild turkey productivity in the southeastern United States. Proceedings of the National Wild Turkey Symposium 11:329–351.

Cartwright, M. E. and R. A. Smith. 1990. Attitudes, opinions, and characteristics of a select group of Arkansas spring turkey hunters. Proceedings of the National Wild Turkey Symposium 6:177–187.

Casalena, M. J., M. V. Schiavone, A. C. Bowling, I. D. Gregg, and J. Brown. 2015. Understanding the new normal: wild turkeys in a changing northeastern landscape. Proceedings of the National Wild Turkey Symposium 11:45–57.

Chamberlain, M. J., B. A. Grisham, J. L. Norris, N. J. Stafford, III, F. G. Kimmel, and M. W. Olinde. 2012. Effects of variable spring harvest regimes on annual survival and recovery rates of male wild turkeys in southeast Louisiana. Journal of Wildlife Management 76:907–910.

Colbert, D. S. 2013. Breeding season gobbling chronology in hunted and non-hunted populations of eastern wild turkey (*Meleagris gallopavo silvestris*) in southwestern Georgia. Thesis. University of Georgia, Athens.

Conley, M. D., J. Barrow, K. L. Skow, J. G. Oetgen, M. J. Chamberlain, and B. A. Collier. 2015. Habitat selection, incubation, and incubation recess ranges of nesting female Rio Grande wild turkeys in Texas. Proceedings of the National Wild Turkey Symposium 11:117–126.

Davis, J. R., H. R. Barnhill, D. C. Guynn, Jr., R. E. Larkin, and W. M. Baughman. 1995. Wild turkey nesting ecology in the Lower Coastal Plain of South Carolina. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 49:454–465.

Dingman, K. L., R. O. Kimmel, J. D. Krenz, and B. R. McMillan. 2005. Factors affecting wild turkey spring hunt quality in Minnesota. Proceedings of the National Wild Turkey Symposium 9:319–324.

Eriksen, R. E., T. W. Hughes, T. A. Brown, M. D. Akridge, K. B. Scott, and C. S. Penner. 2015. Status and distribution of wild turkeys in the United States: 2014 status. Proceedings of the National Wild Turkey Symposium 11:7–18.

Everett, D. D., D. W. Speake, and W. K. Maddox. 1980. Natality and mortality of a north Alabama wild turkey population. Proceedings of the National Wild Turkey Symposium 4:117–126.

Exum, J. H., J. A. McGlincy, D. W. Speake, J. L. Buckner, and F. M. Stanley. 1987. Ecology of the eastern wild turkey in an intensively managed pine forest in southern Alabama. Bulletin of the Tall Timbers Research Station 23:1–70.

Fenberg, P. B. and K. Roy. 2008. Ecological and evolutionary consequences of size-selective harvesting: how much do we know? Molecular Ecology 17:209–220.

Godwin, K. D., G. A. Hurst, and R. L. Kelley. 1991. Survival rates of radio-equipped wild turkey gobblers in east-central Mississippi. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 45:218–226.

Grigg, G. W. 1957. The structure of stored sperm in the hen and the nature of the release mechanism. Poultry Science 36:450–451.

Harris, R. B., W. A. Wall, and F. W. Allendorf. 2002. Genetic consequences of hunting: what do we know and what should we do? Wildlife Society Bulletin 30:634–643.

Healy, W. M. 1992. Behavior. Pages 46–65 in J. G. Dickson, editor. Wild turkey biology and management. Stackpole Books, Harrisburg, Pennsylvania.

——— and S. M. Powell. 2000. Wild turkey harvest management: biology, strategies, and techniques. U. S. Fish and Wildlife Service, Biological Technical Publication BTP-R5001-1999.

Hoffman, R. W. 1990. Chronology of gobbling and nesting activities of Merriam's wild turkeys. Proceedings of the National Wild Turkey Symposium 6:25–31.

Isabelle, J. L. 2015. Missouri wildlife harvest and population status report—wild turkey. Missouri Department of Conservation, Columbia.

———, W. C. Conway, C. E. Comer, G. E. Calkins, and J. B. Hardin. 2016. Reproductive ecology and nest-site selection of eastern wild turkeys translocated to east Texas. Wildlife Society Bulletin 40:88–96.

——— and R. A. Reitz. 2015. Characteristics, attitudes, and preferences of spring wild turkey hunters in Missouri. Proceedings of the National Wild Turkey Symposium 11:249–258.

Kennamer, J. E., M. Kennamer, and R. Brenneman. 1992. History. Pages 6–17 in J. G. Dickson, editor. The wild turkey biology and management. Stackpole Books, Harrisburg, Pennsylvania.

Kienzler, J. M., T. W. Little, and W. A. Fuller. 1996. Effects of weather, incubation, and hunting on gobbling activity in wild turkeys. Proceedings of the National Wild Turkey Symposium 7:61–67.

Kimmel, V. L. and E. W. Kurzejeski. 1985. Illegal hen kill—a major turkey mortality factor. Proceedings of the National Wild Turkey Symposium 5:55–66.

Kurzejeski, E. W. and L. D. Vangilder. 1992. Population management. Pages 165–185 in J. G. Dickson, editor. Wild turkey biology and management. Stackpole Books, Harrisburg, Pennsylvania.

———, ———, and J. B. Lewis. 1987. Survival of wild turkey hens in north Missouri. Journal of Wildlife Management 51:188–193.

Lehman, C. P., L. D. Flake, M. A. Rumble, and D. J. Thompson. 2005. Gobbling of Merriam's turkeys in relation to nesting and occurrence of hunting in the Black Hills, South Dakota. Proceedings of the National Wild Turkey Symposium 9:343–349.

Little, D. A., J. L. Bowman, G. A. Hurst, R. S. Seiss, and D. L. Minnis. 2001. Evaluating turkey hunter attitudes on wildlife management areas in Mississippi. Proceedings of the National Wild Turkey Symposium 8:223–231.

Martin, J. A., W. E. Palmer, S. M. Juhan, Jr., and J. P. Carroll. 2015. Incubation and predation ecology of wild turkey nests: a cautionary case study regarding video camera surveillance. Proceedings of the National Wild Turkey Symposium 11:295–301.

McGhee, J. D., J. Berkson, D. Steffen, and G. W. Norman. 2008. Density-dependent harvest modeling for the eastern wild turkey. Journal of Wildlife Management 72:196–203.

Miller, D. A., L. W. Burger, B. D. Leopold, and G. A. Hurst. 1998a. Survival and cause-specific mortality of wild turkey hens in central Mississippi. Journal of Wildlife Management 62:306–313.

———, G. A. Hurst, and B. D. Leopold. 1997a. Factors affecting gobbling activity of wild turkeys in central Mississippi. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 51:352–361.

———, ———, and ———. 1997b. Chronology of wild turkey nesting, gobbling, and hunting in Mississippi. Journal of Wildlife Management 61:840–845.

———, B. D. Leopold, and G. A. Hurst. 1998b. Reproductive characteristics of a wild turkey population in central Mississippi. Journal of Wildlife Management 62:903–910.

Milner, J. M., E. B. Nilsen, and H. P. Andreassen. 2007. Demographic side effects of selective hunting in ungulates and carnivores. Conservation Biology 21:36–47.

Moore, W. F., J. C. Kilgo, and D. C. Guynn, Jr. 2008. Is spring wild turkey gob-

bler harvest additive or compensatory? Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 62:77–81.

Nicholson, D. S., L. S. Perrin, and E. R. Welsh, Jr. 2001. Florida's special-opportunity turkey hunts: providing a unique hunting opportunity in the new millennium. Proceedings of the National Wild Turkey Symposium 8:75–81.

Norman, G. W., J. C. Pack, C. I. Taylor, D. E. Steffen, and K. H. Pollock. 2001b. Reproduction of eastern wild turkeys in Virginia and West Virginia. Journal of Wildlife Management 65:1–9.

———, D. E. Steffen, C. I. Taylor, J. C. Pack, K. H. Pollock, and K. Tsai. 2001a. Reproductive chronology, spring hunting, and illegal kill of female wild turkeys. Proceedings of the National Wild Turkey Symposium 8:269–280.

Palmer, W. E., G. A. Hurst, and J. R. Lint. 1990. Effort, success, and characteristics of spring turkey hunters on Tallahala Wildlife Management Area, Mississippi. Proceedings of the National Wild Turkey Symposium 6:208–213.

———, ———, J. E. Stys, D. R. Smith, and J. D. Burk. 1993. Survival rates of wild turkey hens in loblolly pine plantations in Mississippi. Journal of Wildlife Management 57:783–789.

Palumbo, M. D. 2010. Influence of latitudinal and climatic variation and field observations on spring gobbling phenology of wild turkeys in Mississippi. Thesis. Mississippi State University, Starkville.

Saether, B. E., E. J. Solberg, and M. Heim. 2003. Effects of altering sex ratio structure on the demography of an isolated moose population. Journal of Wildlife Management 67:455–466.

Sato, T. and S. Goshima. 2006. Impacts of male-only fishing and sperm limitation in manipulated populations of an unfished crab, *Hapalogaster dentate*. Marine Ecology Progress Series 313:193–204.

Stafford, N. J., III., R. M. Pace, III, and M. W. Olinde. 1997. Eastern wild turkey gobbler harvest and physical characteristics in southeastern Louisiana. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 51:381–388.

Swanson, D. A., R. J. Stoll, Jr., and W. L. Culbertson. 2005. Attitudes, preferences, and characteristics of Ohio's spring turkey hunters, 1985–2001. Proceedings of the National Wild Turkey Symposium 9:325–330.

Taylor, C. I., J. C. Pack, W. K. Igo, J. E. Evans, P. R. Johansen, and G. H. Sharp. 1996. West Virginia spring turkey hunters and hunting. Proceedings of the National Wild Turkey Symposium 7:259–268.

Thackston, R. E. and H. T. Holbrook. 1996. Responsive management survey of turkey hunting on Georgia wildlife management areas. Proceedings of the National Wild Turkey Symposium 7:253–257.

Thogmartin, W. E. and J. E. Johnson. 1999. Reproduction in a declining population of wild turkeys in Arkansas. Journal of Wildlife Management 63:1281–1290.

Vangilder, L. D. 1992. Population dynamics. Pages 144–164 in J. G. Dickson, editor. Wild turkey biology and management. Stackpole Books, Harrisburg, Pennsylvania.

———. 1996. Survival and cause-specific mortality of wild turkeys in the Missouri Ozarks. Proceedings of the National Wild Turkey Symposium 7:21–31.

——— and E. W. Kurzejeski. 1995. Population ecology of the eastern wild turkey in northern Missouri. Wildlife Monographs 130.

———, S. L. Sheriff, and G. S. Olson. 1990. Characteristics, attitudes, and preferences of Missouri's spring turkey hunters. Proceedings of the National Wild Turkey Symposium 6:167–176.

Waymire, J. 2013. Oklahoma wild turkey status report. Proceedings of the 39th Annual Meeting of the Southeast Wild Turkey Working Group, Kingsville, Texas.

Whitaker, D. M., J. C. Pack, G. W. Norman, D. F. Stauffer, and S. D. Klopfer. 2005. A range-wide meta-analysis of wild turkey nesting phenology and spring season opening dates. Proceedings of the National Wild Turkey Symposium 9:351–360.

Williams, L. E., Jr. and D. H. Austin. 1988. Studies of the wild turkey in Florida. Florida Game and Fresh Water Fish Commission Technical Bulletin 10.

———, ———, and T. E. Peoples. 1974. Movement of wild turkey hens in relation to their nests. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 28:602–622.

———, ———, ———, and R. W. Phillips. 1971. Laying data and nesting behavior of wild turkeys. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 25:90–106.

Wilson, W. B., M. J. Chamberlain, and F. G. Kimmel. 2005. Survival and nest success of female wild turkeys in a Louisiana bottomland hardwood forest. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 59:126–134.

Wright, G. A. and D. W. Speake. 1975. Compatibility of the eastern wild turkey with recreational activities at Land Between the Lakes, Kentucky. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 29:578–584.

——— and L. D. Vangilder. 2000. Survival of eastern wild turkey males in western Kentucky. Proceedings of the National Wild Turkey Symposium 8:187–194.