REPORT OF THE DEPARTMENT OF NATURAL RESOURCES ON

ACT 41 122nd SESSION OF THE SOUTH CAROLINA GENERAL ASSEMBLY (2015)

Wild Turkey Resources in South Carolina with Recommendations on Seasons and Bag Limits

November 1, 2018

Executive Summary

Act 41 temporarily sets a March 20 to May 5 statewide season for hunting wild turkey on private land by suspending until July 2019 Section 50-11-520 which historically prescribed the wild turkey season in South Carolina. This had the effect of opening the season 10 days earlier and increasing the number of days in the season by 50 percent for 34 of 46 counties in the state. In an effort to mitigate increased harvest rates associated with the increase in season length the Act reduced the bag limit in most of the state from 5 gobblers to 3.

Act 41 is controversial among some hunters and legislators. The controversy is due to concern for negative impacts on turkeys related to the earlier opening date and increased season length for most of the state. The Act required the South Carolina Dept of Natural Resources (SCDNR) to conduct an analysis of the turkey resources in the state and report to the legislature by November 1, 2018 recommending any changes to seasons and bag limits. SCDNR accomplished this during 2015-2018 by compiling turkey harvest and hunter effort data, turkey recruitment data, and by conducting a major 4 year field study to determine the timing of gobbling activity and nesting chronology.

Unlike other game birds, wild turkeys are hunted during spring, a timeframe coinciding with reproductive activities such as breeding and nesting. There is a delicate balance between the timing of spring gobbler season and the timing of nesting because hens must breed in order to successfully nest. Given this period's biological importance, wildlife managers and legislators are challenged to avoid negative population impacts due to harvest while simultaneously providing quality hunting opportunities.

Total turkey harvest under the new season framework (Act 41) increased in spite of a declining trend in harvest prior to the new season and poor turkey recruitment during the 3 years of the new season. The increase in harvest is likely due to the increase in season length afforded to most of the state and not increases in turkey abundance. This is supported by an increase in hunter effort and decrease in efficiency as demonstrated by increased time (effort) required to harvest a gobbler during the new season framework.

The attempt to mitigate increasing harvest associated with the season length increase by reducing the bag limit from 5 to 3 appears to have been unsuccessful because the percentage of hunters who harvested 3 birds nearly doubled under the new framework (94% increase). This essentially negated any net reductions in harvest gained by limiting the few hunters who killed 4 or 5 birds under the previous 5 bird bag limit. While the 3 bird limit is an important component to improve South Carolina's turkey population, in this case, season length appears more important. Finally, there has been little controversy associated with the bag limit reduction.

Gobbling activity exhibited significant daily variation across the turkey reproductive and hunting seasons. Compared to an unhunted study area, gobbling activity was immediately and negatively affected by the onset of hunting via a combination of gobblers being killed and disturbance from hunters. Based on the "natural" gobbling distribution documented on the unhunted study area and the chronology of gobbing activity on hunted areas, the hunting season could begin 2 weeks later with little effect on the amount of gobbling available to hunters through mid-May. Furthermore, our data indicates that gobbling activity at the beginning of a season with a later opening date would be substantially greater than it is on March 20, providing hunters with higher quality opportunity and giving turkeys more time for successful breeding.

The 4-year nesting study found an average nest initiation date (egg-laying) of April 9 and an average nest incubation start date of April 22. Nesting success was poor during the study with only 13 percent of hens successfully rearing a brood to 15 days. There should be concern that the current March 20 opening date for turkey season occurs 20 days prior to average nest initiation

and 33 days prior to average nest incubation start date. Based on these dates approximately 60 percent of the annual gobbler harvest occurs prior to average nest initiation under the March 20 opening date. Hunting activity not only immediately and negatively impacts gobbling through gobbler deaths, but additionally these males are lost from a reproductive standpoint which could affect successful reproduction by hens.

Male wild turkeys are dramatically different both physically and behaviorally than females. These differences are driven by sexual selection in which one sex, in this case the hen, chooses a mate based on characteristics that may improve her reproductive success and the fitness of her offspring. The removal of dominant males by hunting prior to breeding may disrupt the natural process of selection, with potential implications for reproductive fitness (genetics) in the population.

The decline in turkeys in South Carolina and other southeastern states has been well documented. Although causes of this decline remain uncertain, they may include changes in habitat and forestry management practices, fire suppression, predation, and potentially the timing and intensity of hunter harvest. However, the only factor that can be managed from a regulatory standpoint is hunter harvest activities, which are typically dictated by season framework and bag limits.

It is important to note that the study areas for the gobbling and nesting research are in the lower coastal plain and for that reason should represent the earliest gobbling and nesting activity in the state. Therefore, parts of the state farther north may have gobbling and nesting timing distributions that are somewhat later which could increase any negative effects of early season opening dates.

Recommendations on Spring Turkey Season and Bag Limits in South Carolina

The average start date for spring turkey season among the 15 southeast states is April 3 and the average closing date is May 7. Average season length is 36 days. Average bag limit is 2.8. Many southeastern states have concerns with their season opening date and a recent meta-analysis suggests most Southeastern states open spring turkey seasons an average of 15 days prior to the predicted average nest initiation date. Notably, several states have recently adjusted seasons to later start dates.

The white paper entitled "Establishing Opening Dates for Spring Wild Turkey Hunting Seasons" which was adopted by the Southeast Association of Fish and Wildlife Agencies (SEAFWA) Board of Directors in October 2016 recommends opening spring seasons concurrent with average date of nest initiation. Applying the data from this 4-year nesting study to the SEAFWA white paper would yield a recommended season opening date of April 9. Benefits of this recommendation include; reduced risk of illegal female harvest, diminished risk associated with early gobbler harvest, hunter exposure to quality gobbling activity, and increased responsiveness of gobblers to hunter calls. Similarly, this white paper indicates that conservative seasons should open concurrent with or following average date of nest incubation which would yield a conservative opening date of April 22. Benefits of this approach include minimized risk of illegal female harvest and elimination of risks associated with excessive early gobbler harvest.

Based on the SEAFWA recommendations on season timing, a 4-year field study recently completed in South Carolina documenting the timing of gobbling and nesting, as well as the average season length and bag limit among southeastern states, SCDNR offers the following.

SCDNR Recommended Wild Turkey Season Structure
Season Dates: April 10 to May 15 (36 days) ***Youth Day:*** Saturday prior to April 10
Bag Limit: 3 gobblers per season, no more than 2 per day
Rationale - April 10 start date is in keeping with the SEAFWA recommendation to begin the spring turkey season concurrent with average date of nest initiation (egg-laying) which reduces potential negative effects of early gobbler harvest on the reproductive success of hens. It also reduces the likelihood of inadvertent/illegal harvest of hens when hunters encounter and attempt to harvest gobblers because hens actively involved in the nesting process are less likely to associate with gobblers. Season length and bag limit are average among southeastern states.

Liberal Alternative Wild Turkey Season Structure
Season Dates: April 5 to May 10 (36 days) ***Youth Day:*** Saturday prior to April 5
Bag Limit: 3 gobblers per season, no more than 2 per day, no more than one (1) prior to April 10
Rationale - Early season bag limit adjustment is an effort to mitigate April 5 start date which is prior to average nest initiation (egg-laying). This should partially mitigate potential negative effects of early gobbler harvest on the reproductive success of hens. The likelihood of inadvertent/illegal harvest of hens increases because fewer hens are involved in nesting activities and still associating with gobblers. Season length and bag limit are average among southeastern states.

Introduction

Act 41 (2015) of the 121st Session of the South Carolina General Assembly adds SC Code Section 50-11-850 relating to the season and bag limits for hunting wild turkey and specifies details of a youth turkey hunting weekend. The Act suspended Section 50-11-520 which set the historic wild turkey seasons until November 7, 2018 at which time Act 41 is repealed. Act 227 of 2018 subsequently amended Act 41 by providing that Section 50-11-520 would remain suspended until July 1, 2019 and Act 41 would be repealed on the same date. This effectively extended the "sunset clause" on Act 41 by adding an additional year of the new season framework.

In summary, Act 41 temporarily sets a March 20 to May 5 statewide season for hunting wild turkey on private land. It suspends Section 50-11-520 which historically prescribed the wild turkey season as April 1 to May 1 in 34 counties and March 15 to May 1 in 12 counties. Without legislative action, the season prescribed by Act 41 will "sunset" following the 2019 season. The Act prescribes a daily bag limit of 2 gobblers (male turkeys) and season limit of 3, whereas bag limits had formerly been 2 per day and no more than 5 per season in 36 counties and no more than 2 per season in 10 counties. The Act also prescribed a youth turkey hunting weekend on the Saturday and Sunday before March 20. Finally, Act 41 requires the South Carolina Department of Natural Resources (SCDNR) to conduct an analysis of the wild turkey resources in South Carolina, and issue a report including recommendations for seasons and bag limits to the General Assembly within one hundred eighty days of the conclusion of the third turkey season following the effective date of the legislation.

Background

In 1970, the South Carolina Wildlife and Marine Resources Department (SCWMRD) developed a Wild Turkey Research Project and the "Turkey Project" remains today as one of several special program areas in the Wildlife Section of the South Carolina Department of Natural Resources (SCDNR). The original objectives of the Turkey Project were to develop census techniques to monitor rapidly expanding turkey populations in the piedmont and to ascertain distribution patterns relative to habitat management practices. Studies also were initiated to determine peak periods of gobbling and nest incubation in order to best determine when the spring turkey season should begin and end.

At that time, spring seasons were open only in areas of the state with adequate numbers of turkeys. Much of the state, particularly in the coastal plain, had no open season because there were few or no turkeys. In 1975, a comprehensive biological plan was developed by the Department for the restoration of turkeys in the coastal plain. This restoration plan was implemented between 1976 and 2005, resulting in the capture and translocation of approximately 3,542 turkeys on 205 restoration sites statewide. In 1993 a portion of all counties was open to spring gobbler hunting and in 1998 all counties were fully opened with the exception of recent restoration sites.

Prior to 1976, all spring gobbler seasons in South Carolina began on March 15 and ended on April 15, though seasons were open only in certain areas. Results of gobbling and nesting studies conducted in the piedmont and coastal plain led to changes in the spring turkey season dates in 1976. Based on results from these studies, the Department recommended a statewide season of April 1-May 1. This recommendation was accepted by the legislature in that it provided SCDNR regulatory authority to set seasons in 34 of the state's 46 counties. These counties currently comprise Game Zones 1, 2, and 4, as well as, 3 counties that are now in Game

Zone 3. Conversely, the General Assembly provided no authority for SCDNR to set seasons in the other 12 counties (lower coastal plain) and added the Department's recommendation for the new biologically based season to the old socio-political season (SC Code 50-11-560). This resulted in a March 15 to May 1 season in the 12 counties that currently make up the lower coastal portion of Game Zone 3. In 2006 as part of "Game Zone Consolidation" legislation, the General Assembly removed Department authority to set seasons in the 34 April 1 to May 1 counties, however, it prescribed these season dates in law as was customary.

This "split" season system remained in place for 40 years when Act 41 of 2015 set a single statewide spring turkey season of March 20 to May 5 on private land. This had the effect of opening the season 10 days earlier and increasing the number of days in the season by 50 percent for the majority of the state (34 of 46 counties). In the 12 lower coastal counties the new season begins 5 days later and has no effect on number of days in the season. Of note, this increase in opportunity for most of the state was put in place following a decade-long decline in turkey harvest, which by 2015 had decreased 40 percent from the record established in 2002.

The legislation also reduced the season bag limit from 5 gobblers to 3 in 36 counties and raised the limit from 2 to 3 in 10 counties. This reduction in bag limit was an effort to mitigate effects of the much longer season across most of the state.

Act 41 required 2 years to pass and was controversial among some hunters and legislators. The controversy was due to concern for negative impacts on turkeys related to the earlier opening date and increased season length for most of the state in light of the recent decline in turkeys. It appears that this controversy was the impetus for the sunset clause in the legislation, as well as for the requirement that SCDNR conduct an analysis of the turkey resources and report to the legislature recommending any changes to seasons and bag limits.

The issues and controversy associated with spring turkey season are not unique to South Carolina. The Southeast Association of Fish and Wildlife Agencies (SEAFWA) is an organization whose members are the state agencies with primary responsibility for management and protection of the fish and wildlife resources in the 15 southeast states. During the last decade many SEAFWA states have documented declining trends in indices of turkey abundance, productivity, and harvest.[1] 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, these declining turkey indices have generated concern among wildlife managers in the region about the potential effects of season timing on turkey population demographics.

In light of these concerns, the SEAFWA Wild Turkey Working Group reviewed literature on the biological and sociological considerations associated with the timing of spring turkey seasons. The objectives were to (1) summarize literature pertaining to factors which should be considered when setting the timing of spring turkey seasons, (2) examine potential undesirable consequences associated with inappropriately timed spring turkey season frameworks, and (3) provide recommendations for state wildlife agencies to consider when setting the timing of spring turkey seasons. The result of this effort was a white paper entitled "Establishing Opening Dates for Spring Wild Turkey Hunting Seasons" which was adopted by the SEAFWA Board of Directors in October 2016. This white paper may be found in Appendix A of this report and lends support for the discussion and recommendations that follow.

Methods

Turkey Harvest and Hunter Effort. -- Annually SCDNR conducts a post-season survey of randomly selected hunters. The primary objectives of this annual survey research are to obtain

valid estimates of: (1) the statewide spring gobbler harvest, (2) the harvest of gobblers in the constituent counties of the state, and (3) hunting effort related to turkeys. Information on hunters' opinions of the turkey resource and other aspects of turkey hunting are also captured.

The questionnaire for the survey is developed by Wildlife Section personnel. Mailing list databases are constructed by randomly selecting approximately 30,000 individuals who received a set of Turkey Transportation Tags which are required in order to hunt turkeys in South Carolina. Data entry is completed by Priority Data, Inc., Omaha, Nebraska.

Results from these mail surveys are corrected for nonresponse bias using data collected during 2007-2013 by Responsive Management of Harrisonburg, Virginia using a Computer Assisted Telephone Interview program (CATI).

Statistical analysis is conducted using Statistix 7 (Analytical Software, Tallahassee, FL).

Complete harvest reports for 2015-2018 are included in Appendix B and represent all years of the new season framework, as well as the last season (2015) of the historic framework.

Wild Turkey Productivity. -- Annually since 1982 SCDNR has conducted a Summer Wild Turkey Survey to estimate reproduction and recruitment of wild turkeys in South Carolina. The survey involves agency wildlife biologists, technicians, and conservation officers, as well as many volunteers from other natural resource agencies and the general public. The survey is passive in that it simply involves recording turkey sightings incidental to the observers' normal activities. It does not involve actively attempting to locate and record turkeys. The survey period is July 1 to August 29. Questions often arise as to why the survey is not conducted in early summer because there are typically large numbers of poults (young turkeys) seen at that time. However, given the low survival rate of young poults the late summer survey measures poults that have survived and are likely to enter the fall population. All southeastern states use some form of late summer observational survey for turkeys.

Summer surveys are designed to monitor annual nesting success of hens and survival of their young, which has the greatest influence on wild turkey population dynamics. The information allows biologists to calculate many factors essential for sound turkey management including: average brood size, percentage of hens with and without young, gobbler to hen ratio, and overall numbers of turkeys observed. Combined with harvest data, this allows SCDNR to make science based recommendations in order to manage the state's wild turkey population. Complete Summer Turkey Survey Reports for 2015-2018 are included in Appendix C and represent all years of the new season framework, as well as, the last season (2015) of the historic framework.

Gobbling Chronology. -- Gobbling chronology studies were conducted on 3 sites along the Savannah River in the lower coastal plain of South Carolina. Areas included the Savannah River Site (SRS), Crackerneck Wildlife Management Area and Ecological Reserve (Crackerneck), and the Webb Wildlife Management Area Complex (Webb WMA Complex).

The SRS is owned by the U.S Department of Energy and consists of approximately 193,000 acres in Aiken and Barnwell counties. No hunting has occurred since 1951 on the portions of SRS where this research was conducted.

Crackerneck is a 10,800 acres portion of SRS on the western border of SRS in Aiken County and is managed and operated by SCDNR. Public spring gobbler hunting has historically occurred on Crackerneck from April 1 to May 1 and did so during the first year of this study (2015). During 2016-18 the season was April 1 to May 5. Hunting is allowed on Fridays and Saturdays. There is a youth turkey hunting day the Saturday prior to April 1 and scouting prior to the season is allowed.

The Webb WMA Complex is a conglomerate of 3 contiguous Wildlife Management Areas (Webb, Palachucola, and Hamilton Ridge) owned and managed by the SCDNR. The Webb WMA Complex is 25,893 acres located in Hampton and Jasper counties. Public spring gobbler hunting has historically occurred on the Webb Complex from April 1 to May 1 and did so during the first year of this study (2015). During 2016-18 the season was April 1 to May 5. Hunting is allowed on the property Monday – Saturday. There is a youth turkey hunting day the Saturday prior to April 1 and scouting prior to the season is allowed.

In order to assess gobbling chronology and intensity, autonomous recording units (ARU; Song meter model SM2: Wildlife Acoustics Inc., Concord, Massachusetts) were deployed on each site to collect ambient acoustic recordings from March 1 through May 31 from 2015 to 2018. ARUs were placed in trees approximately 10 feet off the ground. A microphone was connected to the ARU and attached to the same tree at about 20 feet above the ARU, which allowed for a greater sampling range away from the recorder as microphones were above ground story vegetation.[2]

Each year 45 ARUs were deployed with 20 on SRS, 15 on the Webb WMA Complex, and 10 on Crackerneck. ARUs were placed at sites known to have turkey activity based on field observations and GPS locations of wild turkeys collected during previous research.[3] ARUs were programmed to continuously record from 30 minutes before sunrise until 2 hours and 30 minutes after sunrise for a total of 180 minutes a day. Programming in this manner was for the purpose of evaluating gobbling during a time frame consistent with previous gobbling research and to simulate a morning spring gobbler hunt with gobbling being monitored for 30 minutes while birds were on the roost and for approximately 2 hours after they flew to the ground.

ARUs were checked every 2 weeks to replace batteries and SD cards. Audio files were automatically searched for gobbles using Raven 1.4 (Cornell Laboratory of Ornithology, Ithaca, NY). A test identification set based on known gobble recordings was created and used to "train" the Raven software for gobble identification. Additionally, once the software selected potential gobbles each was audibly and visually verified by a researcher.

To evaluate impacts of hunting activity on gobbling activity, we summarized total daily hunters present which was collected via required check-in/out on the Webb WMA Complex and Crackerneck.

Nesting Chronology and Success. -- The Webb WMA Complex was the site where turkeys were captured and marked to assess nesting chronology and success. Turkeys were captured during January 1 to March 1 each year using rocket nets baited with corn and milo. All captured birds were aged and given a unique leg band. Certain individuals were outfitted with a backpack-style GPS-VHF transmitter produced by Biotrack Ltd. (Wareham, Dorset, UK). Each GPS transmitter was programmed to record a location every 30 or 60 minutes depending on the sex of the turkey and what part of the study the bird was involved in (general movements, nesting, etc.). GPS locational data was downloaded periodically (typically weekly) and analyzed using appropriate statistical software.

Results and Discussion

Considerations for Setting Spring Turkey Seasons. -- With approximately 50,000 hunters, wild turkeys are second only to white-tailed deer in popularity among hunters in South Carolina. Not only are turkeys important recreationally, they have ecological, aesthetic, and economic importance. Unlike other game birds, turkeys are hunted in the spring, a timeframe coinciding with reproductive activities such as breeding and nesting. Given this period's biological

importance, wildlife managers and legislators are challenged to avoid negative population impacts due to harvest while simultaneously providing quality hunting opportunities. Considerations associated with timing of spring turkey seasons include the potential effects of early and excessive gobbler harvest on productivity, effects on gobbling from gobbler deaths and disturbance from hunting, and the tendency for intentional or inadvertent illegal female harvest to occur earlier in the reproductive season when hens still accompany gobblers.

Turkey hunters often request spring seasons timed to maximize exposure to gobbling activity, but these sociological considerations regularly conflict with biological objectives. 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, the potential consequences of season timing are important to recognize. Recent declining trends in indices of turkey abundance, productivity, and harvest in South Carolina and other southeastern states have heightened the need to evaluate potential consequences of spring hunting season timing on turkey population demographics. These issues seemed to spark the controversy around Act 41 and the new turkey season in South Carolina.

Trends in Spring Gobbler Harvest and Hunter Effort in South Carolina. -- Spring gobbler harvest in South Carolina peaked around the turn of the century (Figure 1). Turkeys had expanded rapidly during restoration due to extremely high productivity in the 1980's that accompanied this colonization phase. However, by the early 2000's the turkey harvest began to decline due in large part to declining reproductive trends that began in the 1990's. As previously mentioned, this declining trend in reproduction followed by declines in harvest have been noted in many southeastern states during this time frame. By the year 2010 the term "southeast turkey decline" had been coined by turkey biologists across the region. Numerous research projects, including this South Carolina study, began attempting to identify causative factors for the regional turkey decline.

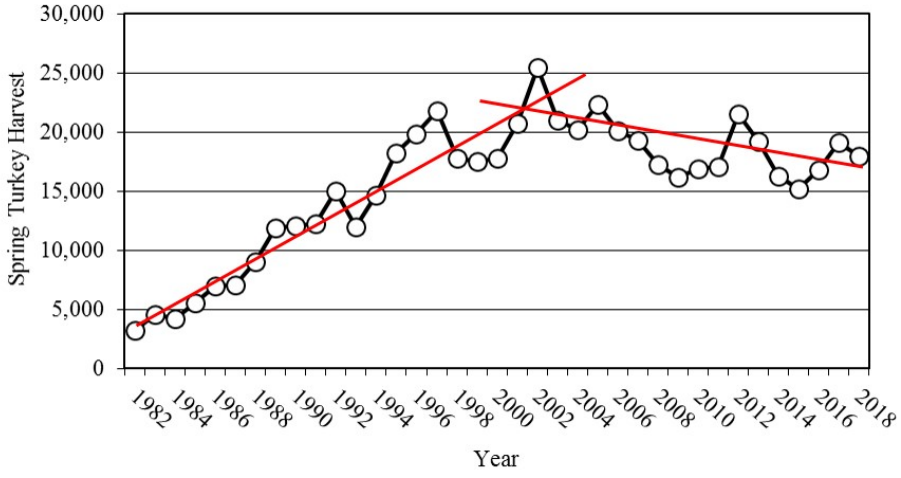

Figure 1. Spring wild turkey harvest in South Carolina 1982-2018. Harvest increased ($R^2 = 0.92$) between 1982 and 2002 as a result of increasing turkey population during restoration efforts. Since 2002 harvest has generally decreased, although harvest has been up an average of 18 percent during the 3 years of the new season framework.

As would be expected, the number of turkey hunters increased in South Carolina as the turkey population expanded across the state (Figure 2). In recent years the number of hunters has been approximately 50,000, substantially more than 25 years ago. Not only have hunter numbers increased but turkey hunting techniques have changed as well. Spring gobbler hunting traditionally involved locating and calling a gobbler from the roost at first light or shortly after fly-down. Hunting now can be an all-day event with hunters returning in the afternoon to roosting areas or hunting from a blind over food plots similar to "still hunting" for deer. Harvest data consistently shows that approximately 25 percent of gobblers are now killed in the afternoon. Sophisticated long-range shotgun chokes, ammunition shot type, optics, portable ground blinds and realistic decoys are now available and popular. These different styles of hunting and technological advances in equipment increase hunter efficiency and effectiveness.

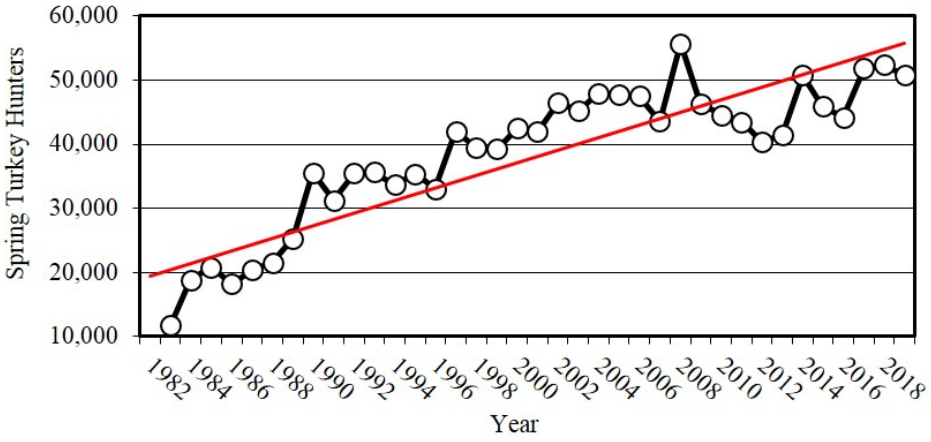

Figure 2. Number of spring turkey hunters in South Carolina 1982-2018 demonstrating increasing hunters over time ($R^2 = 0.75$).

As it relates to Act 41 and the new turkey season a number of points can be made. Act 41 was enacted in 2016 and provided an earlier starting date and increased number of days in the turkey season in 34 of 46 South Carolina counties. The effect of this season change was a 50 percent increase in opportunity (days) for the majority (74%) of the state. The harvest under the 3 years of the new season framework has consistently been higher (18%) than prior to the new season (Figure 1).

This increase in harvest can be explained in 2 ways. First, perhaps turkey numbers have increased since the new season went into effect leading to an increase in harvest because more birds are available for harvest on the landscape. Alternatively, more hunter effort can clearly increase the harvest, to a point, regardless of the number of turkeys on the landscape.

Diving deeper into this issue we find that turkey production, as measured during the annual Summer Turkey Survey, has been poor since the new season began (Figure 3). In fact, recruitment during the last 5 years has been the lowest of any 5-year period since the survey began in 1982. Typically, low recruitment is followed by decreasing harvest and good recruitment is followed by increasing harvest. Based on this analysis the recent trend of higher harvest under the new season does not fit with the notion of a recent increase in turkey productivity or overall population.

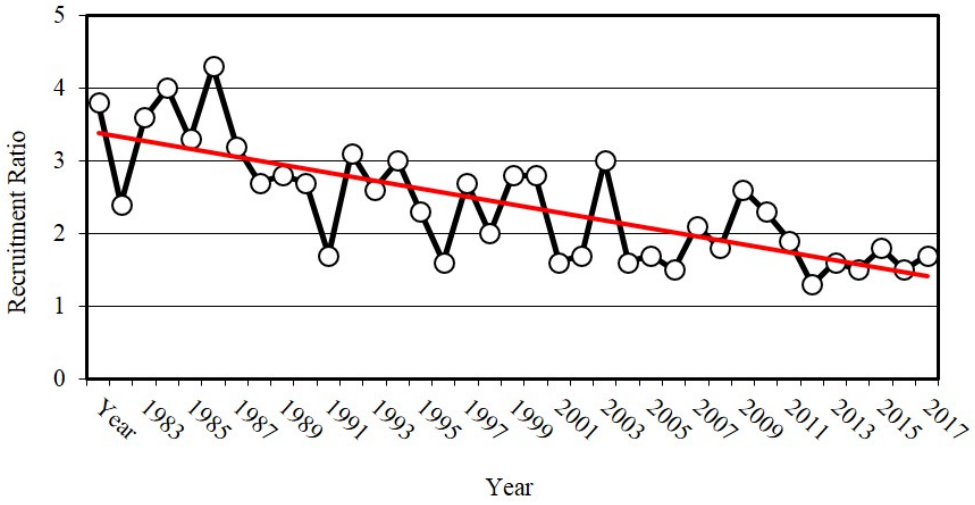

Figure 3. Summer wild turkey recruitment ratio in South Carolina 1982-2018. Note declining trend since 1988. Average recruitment prior to 1988 = 3.5. Average recruitment since 1988 = 2.1. This represents a 40 percent decrease in average recruitment. Of particular note, reproduction during the last 5 years has been the lowest since the survey began which is contrary to the consistently higher harvests that have accompanied the new season framework.

On the other hand, hunter effort (days hunted) increased an average of 23 percent under the new season framework compared to 2015, the last season prior to the new framework. Again, the new season increased opportunity for hunters in 34 of 46 counties by 50 percent and effort data clearly indicates that hunters have taken advantage of the additional opportunity provided. With recent turkey production being low recently, it appears that increased hunter effort rather than increased turkey numbers is more influential in the increase in harvest that has accompanied the new season.

An additional measure of the harvest versus effort issue is catch per unit effort (CPUE) which is the amount of effort (days) it takes to harvest a turkey. Statewide CPUE prior to the new season was 12.7 days per turkey harvested. It was virtually the same for the 34 counties (12.4 days/turkey) that received more days under the new season framework as the 12 counties (13.4 days/turkey) that received no more days. Under the new season framework the CPUE in the 34 counties receiving more days increased 36 percent to 16.9 days/turkey, whereas, it remained the same in the 12 counties (12.6 days/turkey) that received no additional days. This may be indicative of hunters in the 34 counties who received more days under the new season framework using the additional days to kill more total gobblers from a population that had no more birds than it previously did.

Spring Turkey Bag Limits in South Carolina. -- In addition to season structure, Act 41 changed the gobbler bag limits in the state. In 36 counties the season bag limit was reduced from 5 gobblers to 3, whereas the limit was raised from 2 to 3 in 10 counties. The statewide daily bag limit of 2 per day remained unchanged. The historic bag limit of 5 gobblers in South Carolina was somewhat of an anomaly in the southeast and across the county. The average season limit among the 15 southeast states is 2.8 gobblers meaning that states generally have either a 2 or 3 bird limit. In fact, in response to declining turkey reproductive indices and spring harvest rates, SCDNR began discussions seeking a reduction in the bag limit in 2008. Similarly, indications leading up to the reduction in bag limit were that most hunters questioned the appropriateness of a 5-bird limit and would support a reduced limit.

Although bag limits for game species are important, season length or hunting opportunity is often the most important factor in appropriately controlling harvest. For example, when

season length is very short bag limits can be irrelevant because few hunters have the opportunity to make multiple harvests or to reach the bag limit. On the other hand, as season length increases more hunters have time to reach the bag limit and even when limits are restrictive the net result of longer seasons can be overharvest due to the cumulative number of hunters who approach or reach the limit.

The reduction in bag limit brought about by Act 41 was based on concerns related to increasing season length by 50 percent in most of the state. However, this attempt at mitigation appears to have been unsuccessful because the percentage of hunters at each harvest level (1 gobbler, 2 gobblers, and 3 gobblers) was higher during the 3 years of the new framework (Figure 4). The percentage of hunters who harvested 3 birds nearly doubled under the new framework (94% increase). This was due to a shift in hunters who previously took 4 or 5 birds into the 3 bird per hunter category. However the percentage of hunters taking 1 or 2 birds under the new framework also increased 13 and 16 percent, respectively. Finally, under the new season framework successful hunters are just as likely to take 2 gobblers as they are one which is a departure from the past. These increases are likely related to increased opportunity due to the longer season and they may also be related to the fact that turkeys are still in winter flocks with the March 20 opening date which increases the likelihood of multiple kills during a hunt.

These findings essentially negate any net reduction in harvest gained by limiting the few hunters who killed 4 or 5 birds under the previous 5 bird bag limit. This reiterates the importance of season length in managing harvest. Finally, although the season structure change brought about by Act 41 remains controversial, there has been little controversy associated with the bag limit reduction and SCDNR believes the 3 bird limit is an important component to improve South Carolina's turkey population

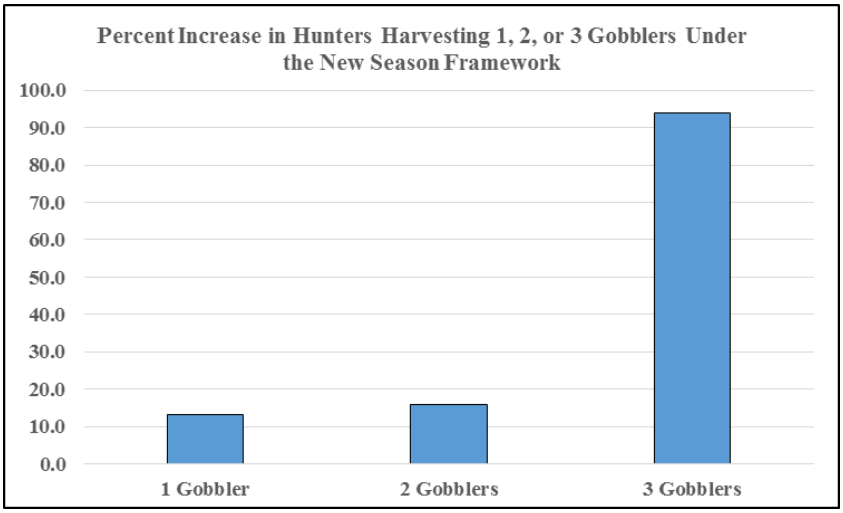

Figure 4. Percent increase in hunters harvesting 1, 2, or 3 gobblers under the new season framework in South Carolina. The percentage of hunters at each harvest level increased under the new season framework with the percentage of hunters who harvested 3 birds harvested increasing over 90 percent compared to the old season framework.

Turkey Productivity Trends in South Carolina. -- Wild turkey productivity is assessed by observations of reproduction and associated survival of offspring being recruited into the population. This measure of young entering the population based on the number of hens in the

population is the Total Recruitment Ratio (TRR). This annual index is the most practical measure of productivity because it considers successful hens, unsuccessful hens and poult survival. Recruitment of 4 or more poults per hen is considered excellent, 3 is good, 2 is fair and considered a break-even point, and less than 2 poults per hen is poor. The goal is to optimize conditions through management applications to promote optimal reproductive success and turkey populations that provide sustainable, quality turkey hunting opportunities into the future. Unlike deer, wild turkeys are much more susceptible to significant fluctuations in reproduction and recruitment. Lack of reproductive success is often associated with bad weather (cold and wet) during nesting and brood rearing season. However, there are a host of predators that take advantage of turkey nests and broods including: raccoons, opossums, skunks, armadillos, snakes, foxes, coyotes, bobcats, feral hogs and numerous avian predators.

South Carolina has experienced declines in turkey productivity since 1988. Average recruitment prior to 1988 was 3.5 poults per hen. Average recruitment since 1988 has been 2.1, representing a 40 percent decrease in average recruitment (Figure 3). This has been a slow and steady decline with TRR figures in the 1990's generally between 2 and 3, but since 2000 numbers below 2.0 have been the norm with levels staying under 2.0 since 2010. Of particular note, reproduction and recruitment during the last 5 years with a TRR averaging 1.6 has been the lowest since the survey began. For hens that successfully raise a brood, average brood sizes of 3.5 to 4 poults have remained consistent over time. However, the driving factor in the low productivity is the high percentage of hens that have no poults at all by late summer. Hens with no poults has averaged 56% the last five years (Table 1). Hens without poults are considered unsuccessful and either did not attempt to nest, abandoned their nest, lost their nest to predation or human disturbance or had no poults survive due to predation, exposure, starvation, disease or flooding.

Table 1. Statewide Summer Turkey Survey reproductive data 2014-2018.

Year	Gobbler Hen Ratio	# Hens w/Poults	# Hens w/o Poults (%)	# Poults	Avg. Brood Size	Total Recruitment Ratio
2014	0.60	983	1,403 (59)	3,834	3.9	1.6
2015	0.50	1,077	1,543 (59)	3,829	3.6	1.5
2016	0.48	893	1,003 (53)	3,370	3.8	1.8
2017	0.58	1,409	1,737 (55)	4,832	3.4	1.5
2018	0.62	1,076	1,206 (53)	3,948	3.7	1.7
Average	**0.56**	**1,088**	**1,378 (56)**	**3,963**	**3.6**	**1.6**

These figures consistently below 2.0 can be indicative of a declining population which does not pair well with increasing hunter opportunity and harvest. It is also worth noting that turkeys have high reproductive potential and are normally able to maintain populations in spite of predation and other mortality factors when conditions and habitat are favorable. Predators and periodic poor weather conditions existed prior to the year 2000 so this more recent and prolonged poor success may be tied to other factors possibly including the high number of hens that do not attempt to nest. Our research at the Webb WMA Complex demonstrated 33 percent of hens did not attempt to nest during the 4-year study period. While some of those hens were juveniles which in some cases are not sexually mature, many were adults which raises the question why they did not attempt to nest and could early and excessive removal of gobblers be a factor.

Gobbling Chronology. -- The reproductive period in turkeys is primarily triggered by length of day or photoperiod and as such, latitude can be used to predict broad regional variation in gobbling activity.[4] It is important to note that the study areas for this research are in the lower coastal plain and for that reason should represent the earliest gobbling activity in the state. Therefore, parts of the state further north may have gobbling timing distributions that are somewhat later, particularly in the mountains as elevation can also shift gobbling later.

Various research has documented one or two gobbling peaks which may coincide with breakup of winter flocks, initiation of laying behavior, peak nest initiation, or peak nest incubation.[5] However, in order to accurately assess gobbling, studies must be conducted on unhunted areas because hunting can reduce gobbling activity and obscure its chronology by removing males from the population or through disturbance of turkeys by hunters.[6] Contemporary gobbling studies on unhunted areas are generally lacking in the southeast, including South Carolina.

To document the effects of hunting and to determine a "natural" distribution of gobbling timing in South Carolina, our study monitored the unhunted SRS along with Crackerneck and the Webb WMA Complex both of which are hunted. The findings suggest that gobbling activity exhibits significant daily variation during the turkey reproductive and hunting seasons and that statistically defined peaks were not occurring on any of the areas (Figure 6).

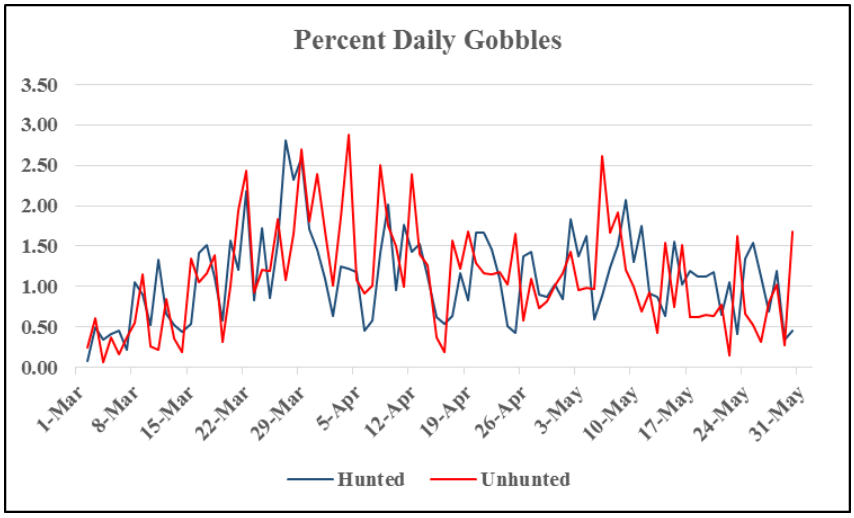

Figure 6. Percent of total gobbles by day for unhunted and hunted sites in South Carolina during 2015-2018. Total number of gobbles heard was 91,102. Note extreme variation in daily gobbling activity during the turkey reproductive and hunting seasons and decrease in gobbling activity on the hunted sites from early to mid-April.

On the other hand, peaks in gobbling activity were discernable only when data was aggregated by time, e.g. weekly (Figure 6). Additionally, the notion among some hunters that gobbling varies significantly from year to year based on "early spring or late spring" was not apparent in spite of at least one "earliest spring on record" during the study.

With respect to the effects of hunting, reduced gobbling activity was observed on hunted sites compared to the unhunted site (SRS) with 27% less gobbling on Crackerneck and 45% less gobbling on the Webb WMA Complex compared to SRS.[7] Recall that Crackerneck is only open to hunting 2 days per week, whereas the Webb WMA Complex is open 6 days a week. Interestingly, the Webb WMA Complex averaged over 3 times as many hunter days as

Crackerneck and had the lowest amount of gobbling activity compared to the moderately hunted Crackerneck and unhunted SRS.

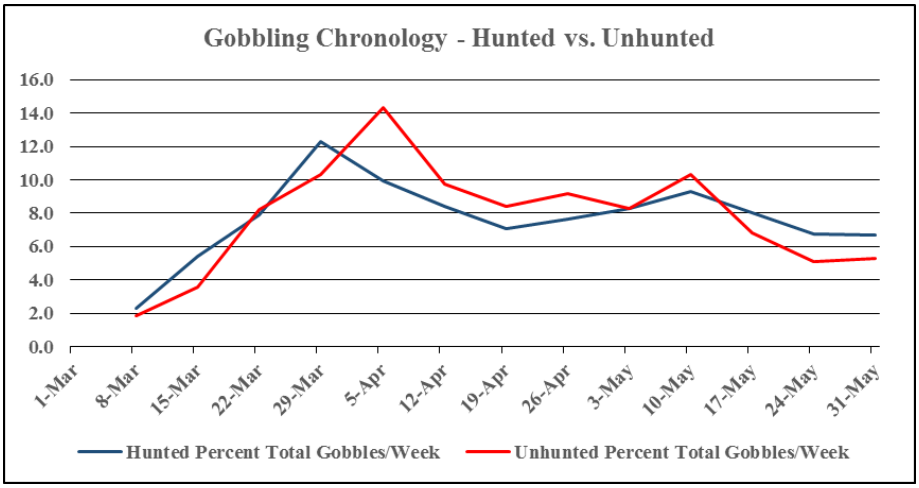

Figure 7. Comparison of the timing and distribution of gobbling between hunted and unhunted study areas in South Carolina. Gobbling is immediately and negatively affected by the onset of hunting through a combination of gobblers being killed and disturbance from hunters.

We also note that gobbling activity essentially ceased on parts of the hunted sites after hunting began.[8] Obviously, local cessation of gobbling after the onset of hunting could result from death of gobblers. However, interactions with predators such as hunters can negatively affect gobbling and may prompt gobblers to shift their core use areas away from hunting activity.[9] The collective result would be notable reductions in gobbling activity on hunted areas and declines in gobbling activity as hunting seasons progressed, trends obvious in the data set.[10]

The timing of gobbling activity, or more often, hunter perception of gobbling activity and the socio-politics that accompany it, has historically driven the timing of spring seasons. It is clear that gobbling can immediately and negatively be affected by the onset of hunting via a combination of gobblers being killed and disturbance from hunters. That being the case, what do these findings mean for spring season recommendations in South Carolina?

When gobbling data are aggregated by week to expose a "peak" week of gobbling we see that the "natural" peak in gobbling is later and greater on the unhunted SRS than on the hunted sites (Figure 7). Additionally, average weekly gobbling activity on the unhunted site remained approximately 15 percent greater through mid-May than on the hunted sites. In essence, turkey season could begin 2 weeks later with little effect on the amount of gobbling available to hunters through mid-May and gobbling intensity at the beginning of the season would be substantially greater than it is on March 20. Beginning the season closer to the average date of nest initiation should also improve the responsiveness of gobblers to calling by hunters because more hens will be involved in nesting activities, i.e. gobblers will be less "henned-up." This point is recognized by many hunters who express frustration with early season hunting.

It must be reiterated that the gobbling activity documented in this study was from sites which are geographically in the southern part of the state. Based on latitude the timing of gobbling determined in this study should be the earliest in the state, therefore gobbling activity may be later in more northern reaches of the state.

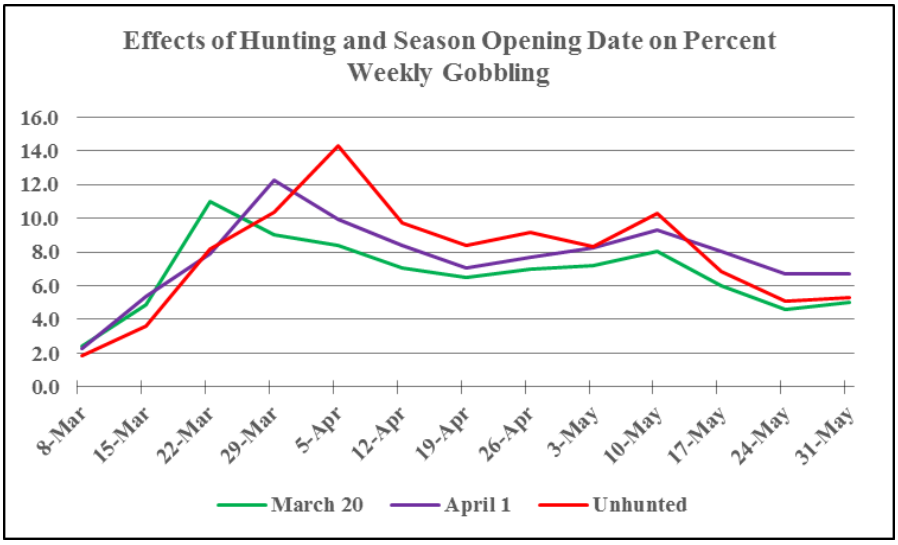

Figure 8. Effects of hunting and season opening date on percent weekly gobbling in South Carolina. Compared to the "natural" gobbling distribution documented on the unhunted study area the onset of hunting immediately and negatively affects gobbling. Data for the March 20 opening date was predicted based on the relationship between gobbling data collected on the unhunted study area compared to 2 areas where hunting began the Saturday before April 1 (youth turkey day).

Nesting Chronology. -- As with gobbling, day length or photoperiod triggers nesting in turkeys and as such, latitude can be used to predict broad regional variation in the timing of nesting activity.[11] It is important to note that the study areas for this research were in the lower coastal plain and for this reason should represent the earliest nesting activity in the state. On the other hand, parts of the state further north may have nesting chronology distributions that are somewhat later, particularly in the mountains as elevation also tends to shift nesting later.

Despite their generally gregarious nature, female turkeys become secretive during the nesting period.[12] Although they may interact with other turkeys during feeding or mating behaviors, these activities occur away from the nest.[13] It takes hen turkeys approximately two weeks to lay a clutch of eggs, and early in the egg-laying period they spend about one hour each day on the nest.[14] During the egg-laying period hens continue to roost in trees and associate with male turkeys. Following completion of the clutch, a hen begins continuous incubation which lasts about 26 days and during this time the hen only leaves the nest briefly each day or every other day to feed, drink, and defecate, with average recesses varying from about one to two hours.[15] As such, female turkeys are generally solitary during the incubation period and do not often associate with gobblers.

Two terms related to nesting activity are often cited, average nest initiation date and average nest incubation date. Average nest initiation date refers to the date on which the average hen begins egg-laying and average nest incubation date refers to the date on which the average hen begins continuous incubation of a nest. In each case for our purposes, the term refers to the first nesting attempt for all hens sampled because nests often fail which can lead to subsequent attempts later in the nesting season.

Average date of nest initiation in this 4-year study was April 9 **(**Figure 9). There was little annual variation in average date of nest initiation with the earliest being April 7 in 2016 and the latest being April 14 in 2015. Average date of nest incubation during the study was April 22 (Figure 9). As with nest initiation, there was little annual variation in average date of nest incubation with the earliest being April 20 in 2017 and the latest being April 27 in 2015.

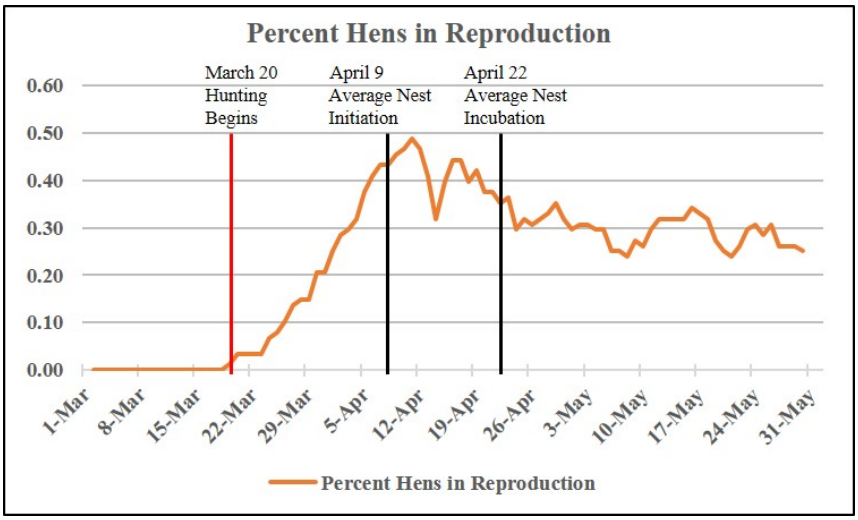

Figure 9. Percent of hen turkeys in reproduction in South Carolina 2015-2018. In reproduction refers to egg-laying, incubating, and brooding. The current March 20 season opening date is 20 days prior to the April 9 date of average nest initiation (egg-laying) and 33 days prior to the April 22 date of average nest incubation.

It is important to note that the white paper entitled "Establishing Opening Dates for Spring Wild Turkey Hunting Seasons" which was adopted by the SEAFWA Board of Directors in October 2016 recommends opening spring seasons concurrent with average date of nest initiation. Benefits of this recommendation include; reduced risk of illegal female harvest, diminished risk associated with early gobbler harvest, hunter exposure to quality gobbling activity, and increased responsiveness of gobblers to hunter calls. Similarly, this white paper indicates that conservative seasons should open concurrent with or following average date of nest incubation. Benefits of this approach include minimized risk of illegal female harvest and elimination of risks associated with excessive early gobbler harvest. Applying the data from this 4-year nesting study to the SEAFWA white paper would yield a recommended season opening date of April 9 and a conservative opening date of April 22.

Finally, it must be reiterated that the Webb WMA Complex where nesting studies were conducted is located in Hampton and Jasper counties which are geographically in the southern part of the state. Based on latitude the nest initiation dates determined in this study should be the earliest in the state, therefore, nesting activity may be later in more northern reaches of the state.

Nesting Success. -- Although 156 hens were outfitted with GPS units during this study, due to mortality prior to the nesting season or malfunctioning transmitters 88 hens were monitored entering the nesting season. A total of 59 (67%) hens attempted a nest with 11 (19%) of these hens attempting to renest due to failure of their first nest (Figure 10). Of the 70 nest attempts, 28 (40%) were successful in hatching a brood and 42 (60%) were unsuccessful with 34 (81%) of the unsuccessful nests being attributed to predation. Only 11 (40%) of the 28 broods that successfully hatched survived to 15 days, a time at which poults should begin roosting off the ground which improves survival. Results in this study indicate that only 13 percent of hens

entering the nesting season successfully hatched and reared a brood to 15 days. These findings easily explain the declining trend in the annual Summer Turkey Survey that has been apparent for a number of years.

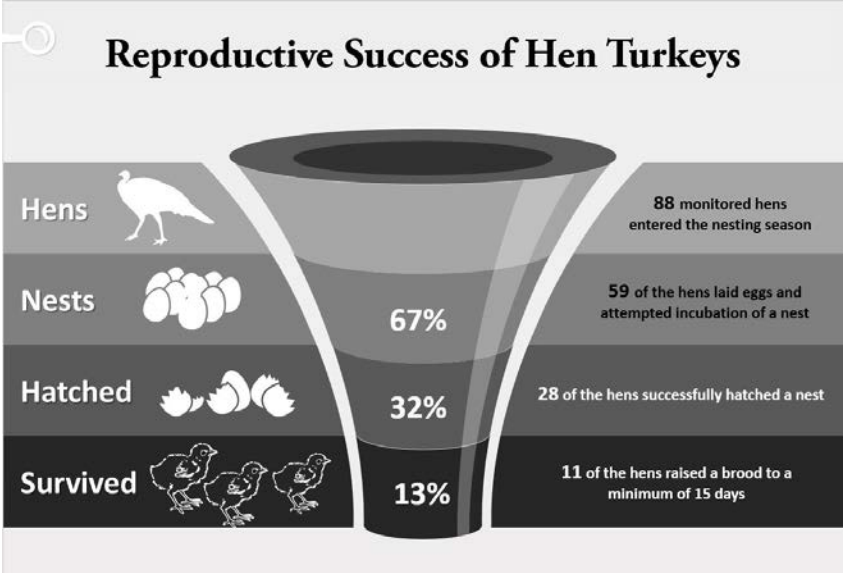

Figure 10. Nesting success for female wild turkeys on Webb WMA Complex in South Carolina 2015-2018.

Inadvertent Illegal Female Harvest. -- Survival of adult female turkeys is one of the most important factors determining annual changes in turkey abundance.[16] Therefore, hunting regulations that protect female turkeys from being killed during the reproductive period represent a safeguard on population viability. With the exception of a few states that allow the harvest of bearded hens which are rare, all southeastern states prohibit the harvest of hens during the spring season. Despite regulations designed to protect female turkeys, research in some areas of the southeast has documented considerable inadvertent or intentional illegal harvest of hens during spring seasons.[17]

Hen reproductive status is one of the most direct determinants of susceptibility to illegal spring harvest.[18] Hens actively involved in the nesting process are less likely to associate with gobblers which minimizes inadvertent harvest when hunters encounter and attempt to harvest males. Incubating hens also remain solitary and concealed, which reduces their chances of being killed inadvertently.[19] Higher rates of illegal female harvest have been documented in some areas of the southeast when spring hunting seasons occur before the onset of nesting, suggesting hunting seasons that occur prior to this timeframe place hens at greater risk.[20]

Early or Excessive Gobbler Harvest. -- There is a delicate balance between the timing of spring gobbler season and the timing of nesting because hens must breed in order to successfully nest. An underlying assumption of spring hunting seasons is that harvest of males does not impact population growth as long as it does not disrupt or impede breeding activities.[21] However, early or excessive gobbler mortality may lead to insufficient availability of adult gobblers which can detrimentally impact localized population productivity.[22] In essence, if gobbler abundance is severely reduced due to high harvest rates, particularly harvest concentrated early in the breeding season, it could result in an insufficient number of gobblers remaining for breeding with hens,

thereby violating the assumption that spring turkey seasons do not impact reproduction. Although gobbler harvest rates in South Carolina have not been verified by field studies, it is estimated that approximately 39 percent of males are harvested annually from the population. This harvest rate is based on long-term average disparity in hen to gobbler ratio observed during the Summer Turkey Survey which can only be explained by differential mortality between the sexes, in this case attributed to hunter harvest.

Paramount to the discussion of season timing and potential negative effects of early gobbler removal on reproduction is the April 9 average nest initiation date. Based on the recent nesting study, we now know that the turkey season opening date of March 20 provided by Act 41 is 20 days prior to average nest initiation date. Furthermore, the March 20 opening date is 33 days prior to the average nest incubation start date of April 22.

South Carolina harvest data consistently shows that 35-40 percent of the annual gobbler harvest occurs during the first 7-10 days of the season. This is the case under the current March 20 opening date and this was the case in areas that opened on March 15 and April 1 in years past. Additionally, in comparing harvest data associated with the March 20 opening date with the April 9 date of average nest initiation we find that consistently approximately 60 percent of the annual gobbler harvest occurs prior to average nest initiation (Figure 9). The importance of this point cannot be overemphasized. Not only is gobbling immediately and negatively affected by gobbler deaths, these males are lost from a reproductive standpoint which could affect successful reproduction by hens as sexual selection activities are primarily female driven in wild turkeys. This may explain why 33 percent of hens in the study did not attempt a nest and why only 19 percent of hens that lost a nest attempted to renest.

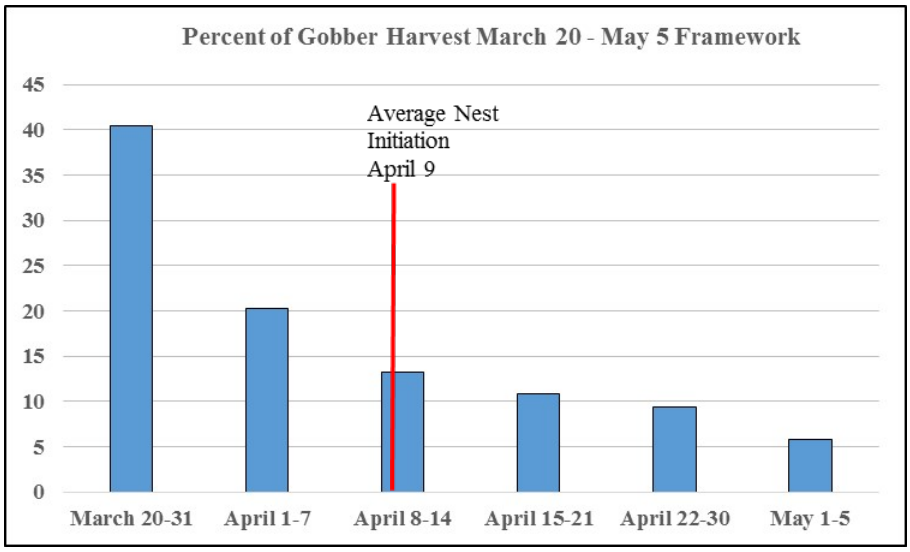

Figure 9. Percent gobbler harvest by week in South Carolina 2016-2018. Under the current March 20 opening date in South Carolina, approximately 60 percent of the annual gobbler harvest occurs prior to average date of nest initiation (egg-laying) by hens. These gobblers are immediately lost from a reproductive standpoint which could affect successful reproduction by hens.

Sexual Selection and Long-term Turkey Population Fitness. -- Male turkeys are dramatically different than female turkeys. This is not only related to body size and coloration but to behaviors including elaborate courtship displays, fighting, and vocalizations (gobbling, spitting, drumming).[23] These differences between males and females are driven by sexual selection in which one sex, in this case the female, chooses a mate based on characteristics that may improve her reproductive success and the fitness of her offspring.

Hunting and removal of males prior to breeding can alter sex ratios affecting competition among males and mate selection by females.[24] Most hunters are familiar with gobbler groups and the concept of one gobbler being dominant in the group (pecking orders). In many cases, the gobbler perceived to be dominant is chosen by the hunter. Either way, hunting can disrupt gobbler groups by degrading dominance hierarchies affecting selection by hens and subsequent genetics of her offspring.[25] Conversely, in the absence of hunting hens should be able to select gobblers based on potential fitness of his offspring, hence the removal of dominant gobblers by hunting prior to breeding may disrupt the natural process of selection, with potential implications for reproductive fitness (genetics) in the population.[26] Once again, this highlights the importance of season timing to the demographics of wild turkey populations.

Summary

Act 41 temporarily sets a March 20 to May 5 statewide season for hunting wild turkey on private land by suspending until July 2019 Section 50-11-520 which historically prescribed the wild turkey season in South Carolina. This had the effect of opening the season 10 days earlier and increasing the number of days in the season by 50 percent for the majority of the state. In an effort to mitigate increased harvest rates associated with the increase in season length the Act reduced the bag limit in most of the state from 5 gobblers to 3.

Act 41 was controversial among some hunters, legislators, and SCDNR staff. The controversy is due to concern for negative impacts on turkeys related to the earlier opening date and increased season length for most of the state. The Act required SCDNR to conduct an analysis of the turkey resources and report to the legislature by November 1, 2018 recommending any changes to seasons and bag limits. SCDNR accomplished this during 2015-2018 by compiling turkey harvest and hunter effort data, turkey recruitment data, and by conducting a major 4-year field study to determine the timing of gobbling activity and nesting chronology.

Unlike other game birds, wild turkeys are hunted during spring, a timeframe coinciding with reproductive activities such as breeding and nesting. There is a delicate balance between the timing of spring gobbler season and the timing of nesting because hens must breed in order to successfully nest. Given this period's biological importance, wildlife managers and legislators are challenged to avoid negative population impacts due to harvest while simultaneously providing quality hunting opportunities.

Total turkey harvest under the new season framework (Act 41) increased in spite of a declining trend in harvest prior to the new season and poor turkey recruitment during the 3 years of the new season. The increase in harvest is likely due to the increase in season length afforded to most of the state and not increases in turkey abundance. This is supported by an increase in hunter effort and decrease in efficiency as demonstrated by increased time (effort) required to harvest a gobbler during the new season framework.

The attempt to mitigate increasing harvest associated with the season length increase by reducing the bag limit from 5 to 3 appears to have been unsuccessful because the percentage of hunters who harvested 3 birds nearly doubled under the new framework (94% increase). This essentially negated any net reductions in harvest gained by limiting the few hunters who killed 4 or 5 birds under the previous 5 bird bag limit. While the 3 bird limit is an important component to improve South Carolina's turkey population, in this case, season length appears more important. Finally, there has been little controversy associated with the bag limit reduction.

Gobbling activity exhibited significant daily variation across the turkey reproductive and hunting seasons. Compared to an unhunted study area, gobbling activity was immediately and negatively affected by the onset of hunting via a combination of gobblers being killed and disturbance from hunters. Based on the "natural" gobbling distribution documented on the unhunted study area and the chronology of gobbing activity on hunted areas, the hunting season could begin 2 weeks later with little effect on the amount of gobbling available to hunters through mid-May. Furthermore, our data indicates that gobbling activity at the beginning of a season with a later opening date would be substantially greater than it is on March 20, providing hunters with higher quality opportunity and giving turkeys more time for successful breeding.

The 4-year nesting study found an average nest initiation date (egg-laying) of April 9 and an average nest incubation start date of April 22. Nesting success was poor during the study with only 13 percent of hens successfully rearing a brood to 15 days. There should be concern that the current March 20 opening date for turkey season occurs 20 days prior to average nest initiation and 33 days prior to average nest incubation start date. Based on these dates approximately 60 percent of the annual gobbler harvest occurs prior to average nest initiation under the March 20 opening date. Hunting activity not only immediately and negatively impacts gobbling through gobbler deaths, but additionally these males are lost from a reproductive standpoint which could affect successful reproduction by hens.

Male wild turkeys are dramatically different both physically and behaviorally than females. These differences are driven by sexual selection in which one sex, in this case the hen, chooses a mate based on characteristics that may improve her reproductive success and the fitness of her offspring. The removal of dominant males by hunting prior to breeding may disrupt the natural process of selection, with potential implications for reproductive fitness (genetics) in the population.

The decline in turkeys in South Carolina and other southeastern states has been well documented. Although causes of this decline remain uncertain, they may include changes in habitat and forestry management practices, fire suppression, predation, and potentially the timing and intensity of hunter harvest. However, the only factor that can be managed from a regulatory standpoint is hunter harvest activities, which are typically dictated by season framework and bag limits.

It is important to note that the study areas for the gobbling and nesting research are in the lower coastal plain and for that reason should represent the earliest gobbling and nesting activity in the state. Therefore, parts of the state farther north may have gobbling and nesting timing distributions that are somewhat later which could increase any negative effects of early season opening dates.

Recommendations on Spring Turkey Season and Bag Limits in South Carolina

The average start date for spring turkey season among the 15 southeast states is April 3 and the average closing date is May 7. Average season length is 36 days. Average bag limit is 2.8. Many southeast states have concern with their season opening date and a recent meta-analysis suggests most Southeastern states open spring turkey seasons an average of 15 days prior to the predicted average nest initiation date.[27] Notably, several states have recently adjusted seasons to later start dates.

The white paper entitled "Establishing Opening Dates for Spring Wild Turkey Hunting Seasons" which was adopted by the Southeast Association of Fish and Wildlife Agencies (SEAFWA) Board of Directors in October 2016 recommends opening spring seasons concurrent with average date of nest initiation. Applying the data from this 4-year nesting study to the SEAFWA white paper would yield a recommended season opening date of April 9. Benefits of this recommendation include; reduced risk of illegal female harvest, diminished risk associated with early gobbler harvest, hunter exposure to quality gobbling activity, and increased responsiveness of gobblers to hunter calls. Similarly, this white paper indicates that conservative seasons should open concurrent with or following average date of nest incubation which would yield a conservative opening date of April 22. Benefits of this approach include minimized risk of illegal female harvest and elimination of risks associated with excessive early gobbler harvest.

Based on the SEAFWA recommendations on season timing, a 4-year field study recently completed in South Carolina documenting the timing of gobbling and nesting, as well as the average season length and bag limit among southeastern states, SCDNR offers the following.

SCDNR Recommended Wild Turkey Season Structure
Season Dates: April 10 to May 15 (36 days) ***Youth Day:*** Saturday prior to April 10
Bag Limit: 3 gobblers per season, no more than 2 per day
Rationale - April 10 start date is in keeping with the SEAFWA recommendation to begin the spring turkey season concurrent with average date of nest initiation (egg-laying) which reduces potential negative effects of early gobbler harvest on the reproductive success of hens. It also reduces the likelihood of inadvertent/illegal harvest of hens when hunters encounter and attempt to harvest gobblers because hens actively involved in the nesting process are less likely to associate with gobblers. Season length and bag limit are average among southeastern states.

Liberal Alternative Wild Turkey Season Structure
Season Dates: April 5 to May 10 (36 days) ***Youth Day:*** Saturday prior to April 5
Bag Limit: 3 gobblers per season, no more than 2 per day, no more than one (1) prior to April 10
Rationale - Early season bag limit adjustment is an effort to mitigate April 5 start date which is prior to average nest initiation (egg-laying). This should partially mitigate potential negative effects of early gobbler harvest on the reproductive success of hens. The likelihood of inadvertent/illegal harvest of hens increases because fewer hens are involved in nesting activities and still associating with gobblers. Season length and bag limit are average among southeastern states.

Acknowledgements

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Endnotes

1 *See* Byrne et al. 2015.

2 *See* Colbert et al. 2015.

3 *See* Collier et al. 2017, Wightman et al. 2018.

4 *See* Healy 1992, Whitaker et al. 2005, Palumbo 2010.

5 *See* Colbert 2013, Bevill 1973, Bevill 1975, Miller et al. 1997b, Bailey and Rinell 1967, Norman et al. 2001.

6 *See* Kienzler et al. 1996, Bevill 1975, Norman et al. 2001, Lehman et al. 2007.

7 *See* Wightman et al. 2018.

8 *See* Wightman et al. 2018 Figure 4, Appendix B

9 *See* Norman et al. 2001, Gross et al. 2015.

10 *See* Wightman et al. 2018.

11 *See* Healy 1992, Whitaker et al. 2005.

12 *See* Healy 1992.

13 *See* Williams et al. 1974.

14 *See* Healy 1992, Williams and Austin 1988.

15 *See* Williams et al. 1971, Green 1982.

16 *See* Vangilder and Kurzejeski 1995, Alpizar-Jara et al. 2001.

17 *See* Wright and Speake 1975, Kimmel and Kurzejeski 1985, Williams and Austin 1988, Davis et al. 1995, Norman et al. 2001.

18 *See* Miller et al. 1998a.

19 *See* Williams and Austin 1988, Vangilder and Kurzejeski 1995.

20 *See* Norman et al. 2001.

21 *See* Allen 1956, Healy and Powell 2000.

22 *See* Exum et al. 1987, Isabelle et al. 2016.

23 *See* Pelham and Dickson 1992.

24 *See* Emlen and Oring 1977, Weir et al. 2011.

25 *See* Krakauer 2008.

26 *See* Chamberlain et al. 2018.

27 *See* Whitaker et al. 2005.

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