PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
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TITLE: Wild Turkey Research/Management

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TITLE: Hen Turkey Fall Harvest Rates and Annual Survival Rates

PERIOD COVERED: 1 July 2012 to 30 June 2013

WORK LOCATIONS: Wildlife Management Units 2C, 2E, 2F, 2G, 2H, 4A, 4B and 4D

COOPERATING AGENCIES: U.S. Fish and Wildlife Service, Pittman-Robertson Research Grants Program; The Pennsylvania State University; U.S. Geological Survey, Pennsylvania Cooperative Fish and Wildlife Research Unit; National Wild Turkey Federation; Pennsylvania Chapter National Wild Turkey Federation

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ABSTRACT: The Pennsylvania Game Commission manages wild turkey populations by setting fall seasons, because fall harvest influences the number of hens that survive to reproduce the following spring. However, fall harvest rates of hen wild turkeys in Pennsylvania, and the effects on harvest rates of lengthening or shortening the fall hunting season or adding key harvest days, are unknown. This research was designed to determine female turkey harvest rates and survival rates by age and fall season structure, determine the relationship between fall mast crop and age-specific harvest rates, fall hunter participation and hunter harvest throughout the season and hunter satisfaction. These data will be used to build population models to allow us to successfully model the dynamics of the turkey population and help direct future management decisions. We are using a band-recovery study (with reward bands to ensure 100% reporting) to calculate annual survival and harvest rates by age and fall season structure in Study Area (SA) 1 where longer fall turkey seasons have a history of correlation with decreases in population trends (Wildlife Management Units [WMUs] 2C, 2E, 4A, 4B and 4D); and SA 2 where fall turkey seasons traditionally have been the longest we allow and population models suggest fall harvest rates are high (~10%), but actual harvest rates are unknown (WMUs 2F, 2G and 2H). Because trapping turkeys is difficult during late summer, most turkeys are being banded during winter. We are maintaining a sample of approximately 60 backpack style satellite transmittered hens to monitor survival from winter trapping to the fall hunting season. During the first 7 trapping periods (winter and fall 2010, 2011 and 2012 and winter 2013) 1,509 female wild turkeys were leg-banded, including 822 females in SA 1 (473 adults, 342 juveniles, 7 unknown age) and 687

in SA 2 (397 adults, 289 juveniles, 1 unknown age). Of these, 230 also were equipped with backpack style satellite transmitters (146 adults, 84 juveniles), 131 in SA 1 and 99 in SA 2. During the 2012 fall turkey season, 12 leg banded females were reported harvested (22 in 2011 and 11 in 2010). The majority of mortalities of transmittered hens occurred from spring dispersal through brood rearing (62%), with most occurring during nesting. Causes of mortality varied, but the majority of predation was mammalian (31% of all mortality) versus avian (20% of all mortality). The survival rate of transmittered turkeys from April-October 2012 was: adult 0.601; juvenile 0.562, with no differences between study areas. Survival rates varied by year, but not study area, and were lowest in 2010 and highest in 2012. Point estimates suggest fall 2012 harvest rates of all reported harvests were approximately 1.4% in SA 1 (shorter season) and 3.2% in SA 2 (longer season). Harvest rates are consistent with the fact that WMUs 2F and 2G (SA 2) have traditionally had longer fall hunting seasons and would be expected to consistently have higher harvest rates. Harvest rates were greatest in 2011 and lowest in 2012. The response rate of the 10,000 surveys mailed to the general hunting population after the fall 2012 turkey season was 56% compared to 50% in 2011 and 46% in 2010. The majority (51%) of those who hunted fall turkey have hunted the species each fall for the last 3 years. Of those who hunted fall turkeys at least 1 of the past 3 years, the proportion of respondents hunting only in 2012 (15%) was significantly higher than the proportion hunting 2011 only or 2010 only (7% and 9%, respectively). This year's increase in participation may be related to a new regulation which allowed mentored youth to participate in fall turkey hunting. Hunter satisfaction in 2012 (45%) was similar to 2011 (46%), both of which were lower than 2010 (57%). Harvest success also decreased from 2010 (9%) to 2012 (7%). However, satisfaction with the new Thanksgiving season remained similar for all 3 years, 55% in 2012, 57% in 2011 and 54% in 2010, demonstrating that hunter satisfaction may incorporate more than the number of hunting days and success. For the first 3 years it appears existing turkey hunters are satisfied with the additional recreational opportunity with the Thanksgiving holiday season segment, but non-turkey hunters may simply be too busy to take advantage of this opportunity. Of the 56 transmittered hens alive at the beginning of nest incubation, 86% incubated nests, 91% of adult hens and 60% of first-year hens. A fewer percentage of hens incubated in SA 2 than SA 1. Pennsylvania's 2013 spring turkey hunting season opened approximately 1 week prior to the peak of nest incubation.

OBJECTIVES

1. Determine female turkey harvest rates and survival rates by age and fall season length.

2. Determine the relationship between fall mast crop and age-specific harvest rates.

3. Determine fall hunter participation and hunter harvest throughout the season and hunter satisfaction.

4. Use these data to build population models to allow us to successfully model the dynamics of the turkey population and help direct future management decisions.

INTRODUCTION

The Pennsylvania Game Commission's (PGC's) Management Plan for Wild Turkeys in Pennsylvania, 2006 – 2015 (Casalena 2006) specifies that the strategic goal is to provide optimum wild turkey populations in suitable habitats throughout Pennsylvania for hunting and viewing recreation by current and future generations. The plan states that our primary form of population management is maintaining a conservative fall either-sex harvest, because harvesting more than 10% of the total fall population (females and males combined) can lead to a decrease in future turkey populations (Healy and Powell 1999). Currently we do not know fall harvest rates in Pennsylvania. An important strategy listed in the plan is to begin a study by 2010 to determine harvest and survival rates of hen wild turkeys to be used for population modeling and setting fall season lengths (Casalena 2006). Population indices show that turkey population trends vary considerably at the Wildlife Management Unit (WMU) level (Casalena 2007). Therefore, harvest and survival rates most likely vary according to WMU or physiographic region.

Wildlife Management Units 2C, 2E, 4A, 4B and 4D have a history of demonstrating decreases in wild turkey population trends (spring harvest per mile squared and summer turkey sighting index of turkeys seen per mile driven) when the fall season is 3 weeks (19 days, including 4 Saturdays and Veteran's Day holiday), suggesting that harvest rates in these units surpass 10% with this long season structure (Casalena 2007). From 2004–2009 season lengths in WMUs 2C, 2E, 4A and 4B were 2 weeks (13 days, including 3 Saturdays and Veteran's Day holiday). Wildlife Management Unit 4D had a 2-week season from 2004–2006 and 3-week season from 2007–2009. Wildlife Management Units 2F, 2G and 2H traditionally had 3-week seasons, but have lower spring harvest densities (harvest per mile squared) than the state average and after harsh winters in the 1970s populations recovered slowly. Population modeling suggests fall harvest rates are high (~10%), but actual harvest rates are unknown. The fall season in WMU 2F was decreased to 2 weeks from 2007-2009 to aid population recovery. This study provides data to determine if the fall hunting season structures may be limiting future turkey population growth in these WMUs.

In 2010, the Pennsylvania Board of Game Commissioners changed the fall turkey season framework, but due to substantial negative comments from sportsmen after the season, the Board returned the 2011 season framework to its original timeframe, except, as established in 2010, the 3-week season WMUs close on a Friday instead of a Saturday (to allow for opening day of rifle black bear season on Saturday without conflicts from wild turkey hunters) and the additional 3-day Thanksgiving holiday wild turkey season was maintained. The additional Thanksgiving segment was intended to increase hunter participation when most schools and many businesses were closed. All 3 days provide high harvest potential, however, because of opening day effects and high participation potential due to the season being opened on holidays and Saturday (G. Norman, Virginia Department of Game and Inland Fisheries, personal communication). The fall season opens the fourth Saturday prior to Thanksgiving, in WMUs with greater than 1 week seasons. Wildlife Management Units with 2-week seasons close on a Saturday (allowing 3 Saturdays) and WMUs with 3-week seasons close the following Friday. All WMUs with more than 1 week seasons have the additional Thanksgiving holiday season.

Because of these significant fall turkey season changes, the Bureau of Wildlife Management took the opportunity, in 2010, to establish an annual fall survey of sportsmen and

women to determine hunter satisfaction, participation during the different season segments and hunter recruitment (in addition to documenting effects on turkey populations).

Steffen et al. (2002) showed that juvenile and adult hen harvest rates differ significantly during years of high mast yields, with juvenile harvest rates being significantly higher than that of adults because adult hens are more dispersed throughout the woods and are more difficult to locate and to call in to hunters. Acquiring harvest rate information by age within these 8 WMUs will enable us, for the first time, to accurately and confidently recommend fall turkey hunting seasons that reflect actual turkey population densities.

Future gains in Pennsylvania's wild turkey populations largely depend on wise fall harvest management. Little et al. (1990), and Vangilder and Kurzejeski (1995) have stated that, unless specifics of a turkey population are known, conservative approaches to both spring and fall harvests are warranted. Determining fall harvest rates by WMU region will improve decisions regarding harvest management, to ultimately provide recreational opportunity without jeopardizing the status of the turkey population.

This study also will provide annual survival rate information. Survival and harvest rates will be used to estimate the statewide turkey population size and population by region via the regional wild turkey population model (McGhee 2006), or a Pennsylvania-specific model. This study will allow us to achieve several population objective strategies specified in our turkey management plan; 1.1, 1.2, 1.4, 1.6, 1.7 and 1.9, our information and education objective strategy 3.1 of conducting surveys to determine satisfaction of hunters, as well as our hunting heritage and hunter safety objective strategy 4.2 of determining participation rates of the various age segments of turkey hunters (Casalena 2006). Additionally, from satellite telemetry data we will estimate the average nest incubation date and compare with our historic data (Rinell et al. 1965) to determine if the opening date of our spring turkey season is still appropriate.

METHODS

Eight of the state’s 23 WMUs have been selected for this study. Study Area 1 (SA 1) consists of WMUs where turkey populations appear to be sensitive to longer season lengths: 2C, 2E, 4A, 4B and 4D. Study Area 2 (SA 2) consists of WMUs 2F, 2G and 2H that traditionally have the longest fall seasons we allow, but have lower spring harvest densities (harvest per mile squared) than the state average.

The study plan has a cross-over design in which a shorter season length in SA 1 and a longer season length in SA 2 are maintained for 2 years, after which the season lengths are reversed (SA 1 to the longer season, and SA 2 to the shorter season) for the next 2 years. From a statistical standpoint, this allows detecting differences in harvest rates within study areas as well as any differences in the pattern of change between study areas. Due to the significant changes to the fall season framework in 2010, then the return, in 2011, to the traditional season timeframe, except the additional 3-day Thanksgiving holiday season was maintained, the study was extended 1 year, such that 2010 was an experimental year, then same season lengths were maintained from 2011-2012, and the cross-over of season lengths will occur in 2013 and continue in 2014.

In each of the 2 study areas, our goal is to trap 230 female wild turkeys per year for 4 years using rocket nets (Eriksen et al. undated) during the winter (January–March) and fall (August–September). Each female turkey is aged (juvenile or adult, Brenneman, undated) and leg-banded with a stainless steel locking type band (National Band and Tag Company, Louisville, Kentucky). Leg bands are stamped with "$100 reward" to ensure 100% reporting (Diefenbach et al. 2001, Nichols et al. 1991) along with a toll-free telephone number to report the band number. Also, 30 females per area are equipped with backpack style satellite platform transmitter terminal (PTT) transmitters (North Star Science and Technology, LLC, King George, Virginia) to monitor hen survival from trapping to fall hunting season. During late summer trapping seasons we place transmitters on a sample of juvenile hens > 2.04 kg (4.5 lbs) as well as adults, to obtain survival data by age-class. Sample size analyses indicate that 200 leg-banded females plus 30 radio-tagged per study area each year provides harvest rate estimates with adequate precision.

Any male turkeys incidentally trapped also are leg-banded with locking-style stainless steel bands stamped with the toll-free phone number for reporting, but do not have the "$100 reward" stamped (National Band and Tag Company, Louisville, Kentucky). If a spur is present, the band is placed between the spur and foot. During fall trapping periods, any juvenile that cannot be accurately sexed is banded with a non-reward band and recorded as juvenile of unknown sex.

Beginning with the winter 2012 trapping season we began placing 1 leg band on each leg to determine leg band retention rates of the stainless steel locking type bands, for males and females.

Four years of annual banding and deployment of transmitters and 4 years of fall harvests will provide the ability to determine harvest rates under various season scenarios. Also, 4 years provides better precision of population estimates. Band-recovery models require at least 3 years of banding (Brownie et al. 1985, Wilson et al. 1989) to estimate harvest and survival rates; however, precision of the estimates for the first and last years is poorest.

To report bands, a toll-free telephone number was established at the Pennsylvania Cooperative Fish and Wildlife Research Unit at Pennsylvania State University (PSU). Hunters who call to report the harvest of a banded bird are asked to leave a message with their name, address, phone number, and the best time to contact them. Wage employees at PSU contact hunters (via phone, email, or mail) to confirm the band number, date and location of kill, and to obtain information for payment of the reward. Hunters are also asked if they were aware of the study and if they saw the leg band(s) before harvesting the bird, to determine if hunters target harvesting leg banded turkeys. Use of a toll-free number results in greater reporting rates by hunters (compared to a mailing address) and is an effective means of collecting harvest information and paying rewards (Diefenbach et al. 2001).

Harvest and annual survival rates are estimated using a band-recovery type model (Brownie et al. 1985). The models are constructed using software SURVIV (White 1983) or MARK (White and Burnham 1999), similar to analyses performed by Diefenbach and Vreeland

(2010). By assuming hunters report all harvested birds, it is possible to estimate harvest rates (Diefenbach et al. 2001). Survival and harvest rates determined in this study will be compared with data from similar studies in other states (Kurzejeski et al. 1987, Little et al. 1990, Pack et al. 1999, Alpizar-Jara et al. 2001) to evaluate their importance to determining fall season lengths. Harvest and survival rates will be used to adapt the McGhee (2006) regional turkey population model to Pennsylvania or to independently develop a Pennsylvania-specific model.

Satellite telemetry data have provided enough location information to determine when a hen is incubating a nest. We used the Kaplan-Meier estimate to determine percentage of hens incubating, by study area and age, and the average nest incubation date (Kaplan and Meier 1958, Pollock et al. 1989).

Even though transmitters are set to transmit only every 3 days for 6 hours (to save battery life for the 5-year study), we are able to determine cause of death for the majority of mortalities using a standard protocol (Campa et al. 1987). Seasonal mortality also can be determined. Although this information is not part of the study objectives and was not included in previous annual reports, the public is very interested in this information and it will now be included in reports.

Fall mast crop is being monitored via the current statewide survey of wildlife food conditions (Ternent 2011), which categorizes the abundance of 28 plants that provide food for wildlife in Pennsylvania. Abundance is categorized as excellent, above average, average, below average or poor. These categories of fall food abundance can be incorporated into the model to estimate harvest rates. If mast abundance helps predict harvest rates, then mast abundance can be incorporated into the population model to better monitor and manage the turkey population.

To determine hunter satisfaction, turkey hunter recruitment, and reactivation of former fall turkey hunters with the new fall season structure, we have developed a fall turkey hunter survey, using standard mail survey protocols (Dillman 1978), by sending a postcard announcement one week in advance of the first mailing in early January, and a follow-up reminder postcard to non-respondents after the first mailing. The survey instrument was developed in-house in collaboration with our agency's Human Dimensions Specialist. A sample of 10,000 randomly selected hunting license buyers provides a sufficient cross-section sample of the hunting population to partition among youth and adult hunters, and those who have hunted turkeys in the past versus recruitment of new turkey hunters. In 2012, we began offering recipients the option to respond online (website address for survey completion provided in the postcard announcement), and subsequently sent paper surveys for return by postal mail to those not responding online. We expect to conduct this survey after the fall turkey hunting season during each year of the hen study using similar procedures and the same questions (where applicable) for comparable results among years.

RESULTS

During the 7 turkey trapping seasons of winter and fall 2010, 2011 and 2012, and winter 2013, 1,509 female wild turkeys were leg-banded (870 adults, 631 juveniles, 8 unknown age; Table 1). This comprised of 822 females in SA 1 (473 adults, 342 juveniles, 7 unknown age) and

687 in SA 2 (397 adults, 289 juveniles, 1 unknown age). Of these, 230 also were equipped with satellite transmitters (146 adults, 84 juveniles). This comprised of 131 females in SA 1 (78 adults, 53 juveniles) and 99 in SA 2 (68 adults, 31 juveniles). As of 30 June 2013, 38 satellite transmittered hens were being monitored (19 in each SA).

Additionally, during the 7 trapping periods 317 male turkeys were incidentally trapped and leg-banded (50 adults and 267 juveniles), and 37 juveniles of unknown sex were trapped and leg-banded during fall periods (Table 2).

Mortality and Survival Analyses

From January through December 2012 the majority of mortalities of transmittered hens occurred from spring dispersal through brood rearing (62%), with most of this mortality occurring during nesting (43%), as is typical for ground nesting birds (Fig. 1). These were higher than 2011, which were 47% and 34%, respectively. Conversely, winter (3%) and hunting season mortality of transmittered hens (9%) were much lower in 2012 than 2011 (17% and 15%, respectively). Causes of mortality varied among 11 causes and varied between years. Predation accounted for 54% in 2012 and 45% in 2011 (Fig. 2). The majority of predation during both years was mammalian (31% of all mortality and 54% of predation mortality in 2012). Avian mortality accounted for 20% of all mortality and 37% of predation mortality. Illegal harvests (fall and spring seasons) accounted for 6% of mortalities (n=2) in 2012, similar to 2011, while no legal harvests of transmittered hens were reported in 2012 compared to 9% in 2011 (n=4). However, we did document 1 legal, unreported harvest (3%); the hunter stated he had not yet reported the harvest when researchers contacted him. Eleven percent of mortalities were censored out of the data set because the transmittered hens died within the 2-week adjustment period, compared to 15% in 2011.

Survival analyses are preliminary because the study involves two additional years of data collection. Therefore, results should not be considered conclusive. The following analyses were conducted by Duane Diefenbach, PhD, at the Pennsylvania Cooperative Fish and Wildlife Research Unit, PSU. Preliminary results do not include data from poults captured in late summer. These data are sparse such that analysis will not be conducted until completion of the study.

Analysis of the satellite transmitter data showed that tagging-harvest survival rates did not differ between study areas, but survival did differ between hens captured as juveniles versus adults and varied among years (Table 3). The data for juvenile hens analyzed by year was sparse (as few as 2 hens being monitored in some months) and suggested that juveniles had lower tagging-harvest survival rates than adults. However, a model in which data were pooled across years indicated that cumulative survival was greater for juveniles than adults (Table 4), which makes more biological sense because fewer juvenile hens are expected to nest and thus would be exposed to less risk of predation. Survival is lowest during nesting season.

Therefore, the data used to estimate the parameters in Table 4 were used in the joint known-fate and tagging-recovery data analysis to estimate harvest rates. These analyses suggest that 50% or more of hens captured in January-March die prior to the fall hunting season (Tables 3 and 4).

Harvest Rate Analysis

Harvest data from the experimental year of 2010 are not part of the analyses, but are presented in the tables for information. During the 2012 fall turkey season, 12 leg banded females were reported harvested (22 in 2011). In 2012, 3 were reported harvested from SA1 with the shorter turkey season (10 in 2011), and 9 from SA2 with the longer turkey season (13 in 2011). In 2012 during the first season segment before Thanksgiving 3 were harvested in SA1 (9 in 2011) and 5 were harvested in SA2 (12 in 2011). During the second season segment (Thanksgiving weekend) none were harvested in SA1 (1 in 2011) and 4 were harvested in SA2 (1 in 2011); 1 was harvested with a shotgun on Friday after Thanksgiving and 3 with rifles on Saturday after Thanksgiving. We did not ask hunters if they were scouting for deer. Interestingly, of the 15 hunters reporting fall harvests in 2012 (including 3 harvested males) 7 were aware of the study, but only 1 hunter saw the leg band on the turkey (shining in the sun) before harvesting the bird. In 2011 of 23 hunters reporting (including 8 harvested males) only 3 were aware of the study and none saw the leg band. Thus far only 1 of 38 hunters (3%) has targeted leg banded turkeys.

Similar to survival analyses, preliminary harvest rate analyses do not include data from poults captured in late summer. We assumed that although survival to the hunting season differed between birds captured as juveniles and adults, harvest rates did not differ between these 2 groups.

These harvest rates do not include the male component of the populations, so the appropriate rates for comparison to the 10% threshold (Healy and Powell 1999) would be higher. We will combine data from this study with male harvest rate data for population modeling and fall season setting criteria.

The best model of these data did not indicate differences in harvest rates by study area, but estimated a separate harvest rate for each year. However, harvest rates are presented by study area and year (Table 5) as well as for the best model (Table 6). Harvest rate point estimates presented by study area (1.4% in SA 1 and 3.2% in SA 2) are consistent with the fact that WMUs 2F, 2G and 2H (SA 2) have traditionally had longer fall hunting seasons and would be expected to consistently have higher harvest rates (Table 5).

The large standard errors relative to the harvest rate estimates make it difficult to identify differences in harvest rates among years with statistical confidence. However, there must be sufficient variability among years for the model selection process to identify the best model as having harvest rates that vary annually despite the overlap in confidence intervals. This is supported by the consistent pattern in harvest rates between study areas (Table 5) where harvest rates were greatest in 2011 and lowest in 2012.

The level of precision based on current data (Table 6) was not unexpected based on computer simulations conducted prior to the initiation of the study. However, because the study design includes a cross-over effect where fall hunting season regulations are switched between study areas after the 2012 hunting season, we believe there is reasonable likelihood of measuring the effect of this management action.

During the spring 2013 turkey season 2 leg-banded bearded hens were legally harvested and reported. During non-hunting periods of Fiscal Year 2012, 4 female turkey leg bands were reported, 3 from SA 1 (2 of which were road-killed, 1 was found dead and likely killed by an owl) and 1 from SA 2 (found dead and consumed by a predator).

Thirty-two non-reward, male, leg bands were reported harvested during the 2013 spring turkey season (31 in 2012). Twenty-one were harvested in SA 1 (16 adults, 5 juveniles) and 11 in SA 2 (9 adults, 2 juveniles). Age and sex composition were similar to other years, 21% juvenile males (jakes) and 74% adult gobblers (and 6% bearded females). Additionally, 1 leg banded male was found dead during non-hunting periods, SA 1.

Fall 2012 Turkey Hunter Survey Results

Of the 10,000 surveys mailed 5,600 usable returns were received (56% response rate versus 50% in 2011, 46% in 2010). The margin of error was $\pm$ 1% at the statewide level for all surveyed. Even with 2012 as the initial year of an internet based survey, 57% still responded via standard mail; 43% via internet.

Each year of the survey approximately one-third of the respondents have hunted fall turkey (Fig. 3). The majority of those who fall turkey hunt (51%) have hunted the species each fall for the last three years (Fig. 4). Of those who hunted fall turkeys at least 1 of the past 3 years, the proportion of respondents hunting only in 2012 (15%) was significantly higher than the proportion hunting 2011 only or 2010 only (7% and 9%, respectively, Fig. 4). The increase in participation this year may be related to a new regulation which allowed mentored youth to participate in fall turkey hunting.

Fall turkey hunting participation in 2012 (119,493), estimated from annual game-take hunter survey data, decreased 23% from the previous 3-year average (154,973; Johnson et al. 2012) even though 2012 was the third year of the Thanksgiving season segment, established to increase hunter participation. This decrease, however, may be more a function of the long-term decreasing trend in general hunting in Pennsylvania because the percent of hunters who fall turkey hunt has remained the same (Fig. 3).

Participation in the season segments differed somewhat from last year (Fig. 5), but may be a factor of available time and weather during the season. In many parts of Pennsylvania the weather was nicer in 2012 than 2011 (2 hurricanes prior to the season), and the acorn mast crop was better in 2012 versus 2011. Fall harvest, from annual game-take hunter survey data, was approximately 12% higher in 2010 than in 2012 and 10% higher than in 2011 (Johnson et al. 2012). More importantly, hunters continue utilizing both season segments.

Hunter satisfaction in 2012 (45%) was similar to 2011 (46%), both were lower than 2010 (57%; Fig. 6). Harvest success also decreased from 2010 (9%) to 2012 (7%), suggesting a slight correlation between success and satisfaction. We will investigate this relationship further for the final report for this project.

When asked their level of satisfaction with different aspects of the fall 2012 season, there were no general consensuses among current fall turkey hunters, similar to 2011 and 2010. There was general satisfaction with the 3-day Thanksgiving season in that 61% were satisfied with the Thanksgiving Day hunt (60% in both 2011 and 2010), 66% were satisfied with the Friday after Thanksgiving (69% and 68%, respectively in 2011 and 2010) and 66% were satisfied with the Saturday after Thanksgiving (66% and 68%, respectively in 2011 and 2010). When asked their level of satisfaction if the seasons were returned to the former structure with no Thanksgiving segment, most desired to maintain the Thanksgiving season, similar to last year, but a significant change in opinion from 2010 (Fig. 7). In 2012 only 11% would be satisfied if the season was returned to the former format. However, satisfaction with the new Thanksgiving season remained similar for all 3 years, 56% in 2012, 57% in 2011 and 54% in 2010. This again demonstrates that hunter satisfaction incorporates more than just season structure.

Non-turkey hunters were asked how 10 factors (4 of which were related to length and timing of fall turkey season) likely would influence their interest in starting to participate annually in fall turkey hunting. The top 3 reasons remained the same all three years; more free time to hunt, higher turkey populations and having a place to hunt and were not related to season structure (Fig. 8). The top reason mimicked that of nationwide surveys for the need of more free time to hunt.

For the first 3 years it appears existing turkey hunters are satisfied with the additional recreational opportunity with the Thanksgiving holiday season segment, but non-turkey hunters may simply be too busy to take advantage of this opportunity. Hunter satisfaction and harvest success were lower in both 2012 and 2011 than in 2010 even though the traditional season structure was reinstated in 2011 and the Thanksgiving season was maintained, both of which provided more hunting days than in 2010. This suggests success, and possibly satisfaction, may not be directly correlated with season structure, but other factors such as recruitment (i.e., fall flock size), natural food sources and weather during the hunting season may also influence success and satisfaction. During all 3 years, and similar to trends observed nationally, available time, higher turkey populations and a place to hunt had more of an influence than season structure on influencing participation by non-turkey hunters.

2013 Nesting Analysis

Fifty-six satellite transmittered hens (46 adults and 10 juveniles) were alive during the onset of nest incubation in 2013 (Table 7). Of these, 86% incubated nests, 91% of adult hens and 60% of first-year, juvenile, hens. Incubation rates were similar to other studies (Vangilder 1992). A fewer percentage of hens incubated in SA 2 than SA 1 (Table 7).

Date of first incubation detection, 29 March $\pm$3 days, was similar to 2012 and 2011 (26 March $\pm$3 days both years), but earlier than 2010 (6 April $\pm$3 days), an unusually cold spring (Fig. 9). The median date of nest incubation for all nests in 2013 was the same as in 2011 (4 May) and similar to 2012 (3 May), but was earlier in 2010 (24 April) even though that year's first date of incubation was later than other years. The average date of nest incubation for all 4 years combined was 1 May, (Fig. 9) similar to Pennsylvania data from 1958-1963 (Rinell et al. 1965) demonstrating that the timing of nest incubation hasn't changed due to climatic changes, but is influenced more by photoperiod. During 3 of the last 4 years the spring wild turkey season

has opened only a few days prior to the median nest incubation. Our management goal is to open the season in conjunction with median nest incubation to minimize disturbance of hens as hens are less prone to accidental harvest and disturbance once they have begun incubation. The season opens the Saturday closest to 1 May; thus the season opening date continues to be well-timed. Median date of incubation in 2013 was similar between study areas, 4 May in SA 1 and 2 May in SA 2 (Fig. 10 and Fig. 11). Therefore, maintaining a statewide rather than a geographically staggered season structure is appropriate.

A summary of the study is posted on the agency's website http://www.portal.state.pa.us/portal/server.pt/community/wild_turkey/14517, under Research, Hen Research Study.

RECOMMENDATIONS

1. I recommend continuing this project to determine annual survival rates of female wild turkeys and fall harvest rates under different fall season structures and varying mast crops to help guide fall season recommendations.

2. I recommend incorporating the harvest and survival rate data from this research into our turkey population model and into a structured decision making process for guiding fall season recommendations.

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Table 1. Trapping location, age, and marker type for female wild turkeys captured in Pennsylvania, winter 2010 through winter 2013.

Trapping Period	Study Area	Adults			Juveniles			Unknown Age		Total
		B + T[a]	B[b]	Total	B + T	B	Total	B	Total	
Winter 2010	SA1[c]	24	86	110	3	39	42	5	5	157
	SA2[d]	31	76	107	3	35	38	0	0	145
	Total	55	162	217	6	74	80	5	5	302
Fall 2010	SA1	4	13	17	8	33	41			58
	SA2	2	6	8	10	27	37			45
	Total	6	19	25	18	60	78			103
Winter 2011	SA1	13	100	113	8	40	48			161
	SA2	7	64	71	4	87	91			162
	Total	20	164	184	12	127	139			323
Fall 2011	SA1	7	4	11	11	27	38			49
	SA2	4	2	6	1	17	18	1	1	25
	Total	11	6	17	12	44	56	1	1	74
Winter 2012	SA1	11	82	93	10	92	102			195
	SA2	13	83	96	6	20	26			122
	Total	24	165	189	16	112	128			317
Fall 2012	SA1	2	3	5	9	15	24			29
	SA2	0	7	7	4	15	19			26
	Total	2	10	12	13	30	43			55
Winter 2013	SA1	17	107	124	4	43	47	2	2	173
	SA2	11	91	102	3	57	60			162
	Total	28	198	226	7	100	107	2	2	335
Total		146	724	870	84	547	631	8	8	1,509

[a] B + T = Leg band plus satellite transmitter
[b] B = Leg band only
[c] SA1 = Study Area 1 (WMUs 2C, 2E, 4A, 4B, 4D)
[d] SA2 = Study Area 2 (WMUs 2F, 2G and 2H)

Table 2. Trapping location and age of male and unknown-sex wild turkeys incidentally captured in Pennsylvania, winter 2010 through winter 2013.

Trapping Period	Trapping Location	Males		Unknown Sex	Total
		Adults	Juveniles		
Winter 2010	SA1[a]	8	15		23
	SA2[b]	11	14		25
	Total	19	29		48
Fall 2010	SA1		7	13	20
	SA2		7	7	14
	Total		14	20	34
Winter 2011	SA1	7	55		62
	SA2	5	37		42
	Total	12	92		104
Fall 2011	SA1		18	9	27
	SA2		13		13
	Total		31	9	40
Winter 2012	SA1	6	19		25
	SA2	2	4		6
	Total	8	23		31
Fall 2012	SA1		16	1	17
	SA2		7	7	14
	Total		23	8	31
Winter 2013	SA1	9	30		39
	SA2	2	25		27
	Total	11	55		66
Total		50	267	37	354

[a] SA1 = Study Area 1 (WMUs 2C, 2E, 4A, 4B, 4D)
[b] SA2 = Study Area 2 (WMUs 2F, 2G and 2H)

Table 3. Cumulative survival rates ($\hat{S}$) between capture (February-March) and the month prior to the fall hunting season (October) for hen wild turkeys in Pennsylvania, 2010-2012.

	Captured as adult			Captured as juvenile		
Year	$\hat{S}$	SE($\hat{S}$)	95% CI	$\hat{S}$	SE($\hat{S}$)	95% CI
2010	0.358	0.0715	0.23–0.51	0.315	0.1220	0.13–0.58
2011	0.487	0.0836	0.33–0.65	0.444	0.1119	0.25–0.66
2012	0.601	0.0846	0.43–0.75	0.562	0.1053	0.36–0.75

Table 4. Monthly and cumulative survival rates ($\hat{S}$) between capture (February-March) and the month prior to the fall hunting season (October) for hen wild turkeys in Pennsylvania, 2010-2012, where data are pooled across years.

	Captured as adult			Captured as juvenile		
Month	**$\hat{S}$**	**SE($\hat{S}$)**	**LCL**	**$\hat{S}$**	**SE($\hat{S}$)**	**LCL**
Feb	0.900	0.0536	0.80–1.00	1.000	0.3351	0.53–1.00
Mar	0.965	0.0246	0.92–1.00	1.000	0.2024	0.68–1.00
Apr	0.915	0.0267	0.86–0.97	0.904	0.0516	0.81–1.00
May	0.813	0.0391	0.74–0.89	0.744	0.0805	0.60–0.92
Jun	0.921	0.0304	0.86–0.98	0.951	0.0469	0.86–1.00
Jul	0.866	0.0407	0.79–0.95	0.897	0.0673	0.77–1.00
Aug	0.963	0.0251	0.92–1.00	0.943	0.0545	0.84–1.00
Sep	0.910	0.0378	0.84–0.99	1.000	0.2145	0.66–1.00
Oct	0.982	0.0179	0.95–1.00	0.931	0.0650	0.81–1.00
Feb-Oct	0.444	0.0514	0.35–0.56	0.504	0.2418	0.21–1.00

Table 5. Estimated harvest rates ($\hat{H}$) for hen wild turkeys captured as juveniles or adults during January-March in Pennsylvania, by study area and year, 2010-2012. Study Area 1 includes WMUs 2C, 2E, 4A, 4B, and 4D and Study Area 2 includes WMUs 2F, 2G, and 2H.

	Study Area 1			Study Area 2		
Year	**$\hat{H}$**	**SE($\hat{H}$)**	**95% CI**	**$\hat{H}$**	**SE($\hat{H}$)**	**95% CI**
2010	0.049	0.0284	0.02–0.14	0.053	0.0304	0.02–0.15
2011	0.079	0.0312	0.04–0.17	0.098	0.0373	0.05–0.20
2012	0.014	0.0107	0.00–0.05	0.032	0.0226	0.01–0.11

Table 6. Estimated harvest rates ($\hat{H}$) for hen wild turkeys captured as juveniles or adults during January-March in Pennsylvania, 2010-2012.

Year	**$\hat{H}$**	**SE($\hat{H}$)**	**95% CI**
2010	0.05	0.021	0.02–0.11
2011	0.088	0.0251	0.05–0.15
2012	0.022	0.0109	0.01–0.05

Table 7. The number of female wild turkeys alive at the onset of incubation, 29 March 2013, the number that incubated a nest and the percent nest incubation by Study Area in Pennsylvania, 2013. Study Area 1 contains WMUs 2C, 2E, 4A, 4B, and 4D and Study Area 2 contains WMUs 2F, 2G and 2H.

Study Area	Age	Alive	Incubated	% Incubation
1	Adults	24	24	100%
	Juveniles	4	3	75%
	Total	28	27	96%
2	Adults	22	18	82%
	Juveniles	6	3	50%
	Total	28	21	75%
Both Study Areas	Adults	46	42	91%
	Juveniles	10	6	60%
	Total	56	48	86%

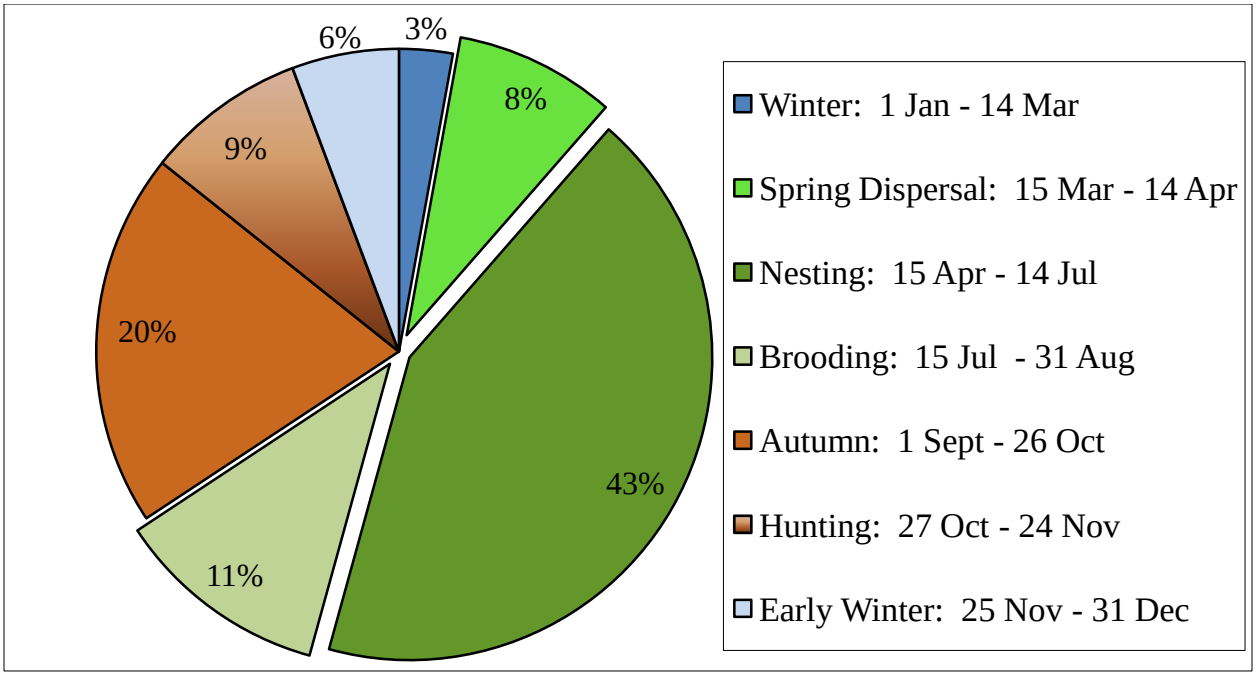

Figure 1. Seasonal mortality of satellite transmittered wild turkey hens across both study areas in Pennsylvania, January – December 2012, n = 35.

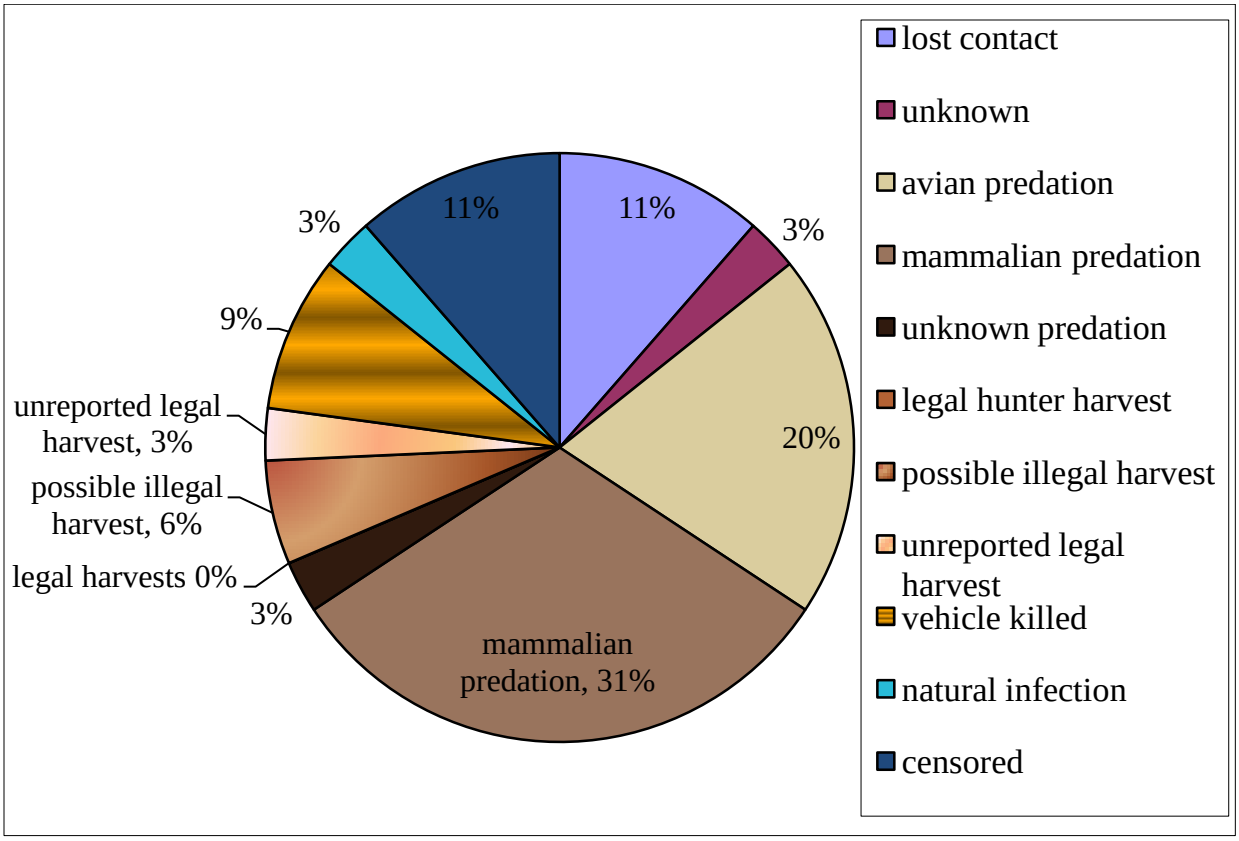

Figure 2. Causes of mortality of satellite transmittered wild turkey hens across both study areas in Pennsylvania, January – December 2012, as determined by researchers upon recovery of each bird, n = 35.

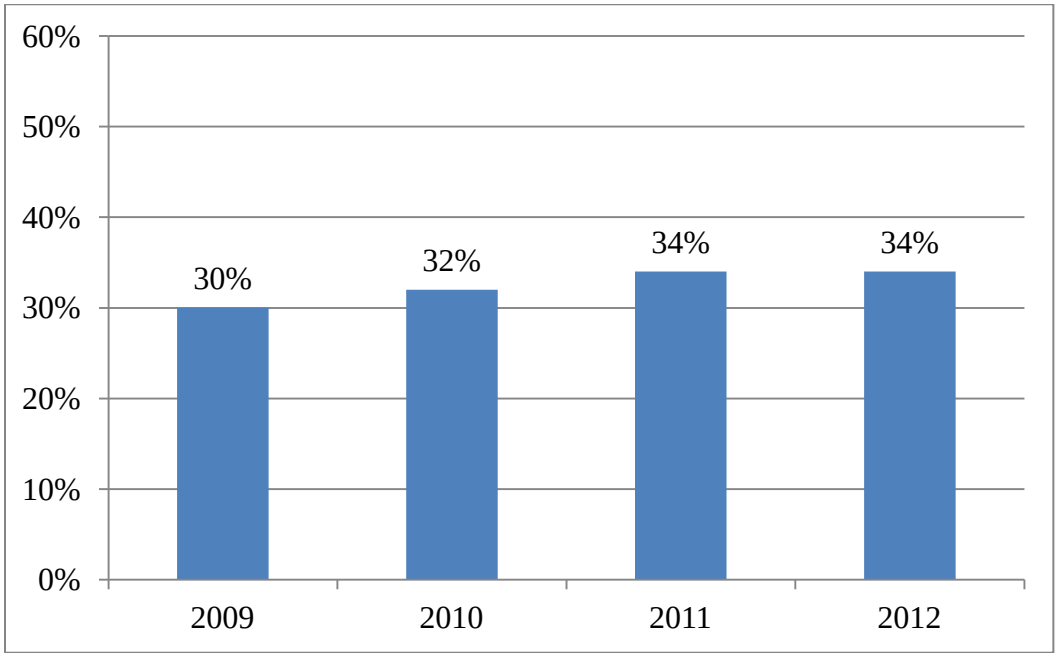

Figure 3. Annual participation in fall wild turkey hunting for survey respondents who hunt the fall wild turkey season in Pennsylvania.

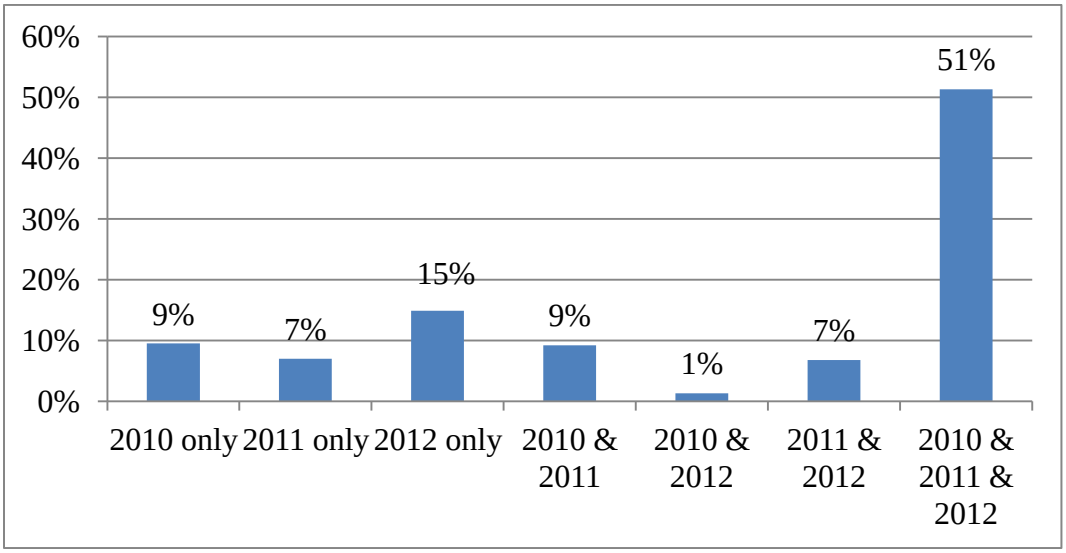

Figure 4. Pennsylvania fall turkey hunting participation by those survey respondents who participated in at least 1 fall turkey season, 2010 - 2012.

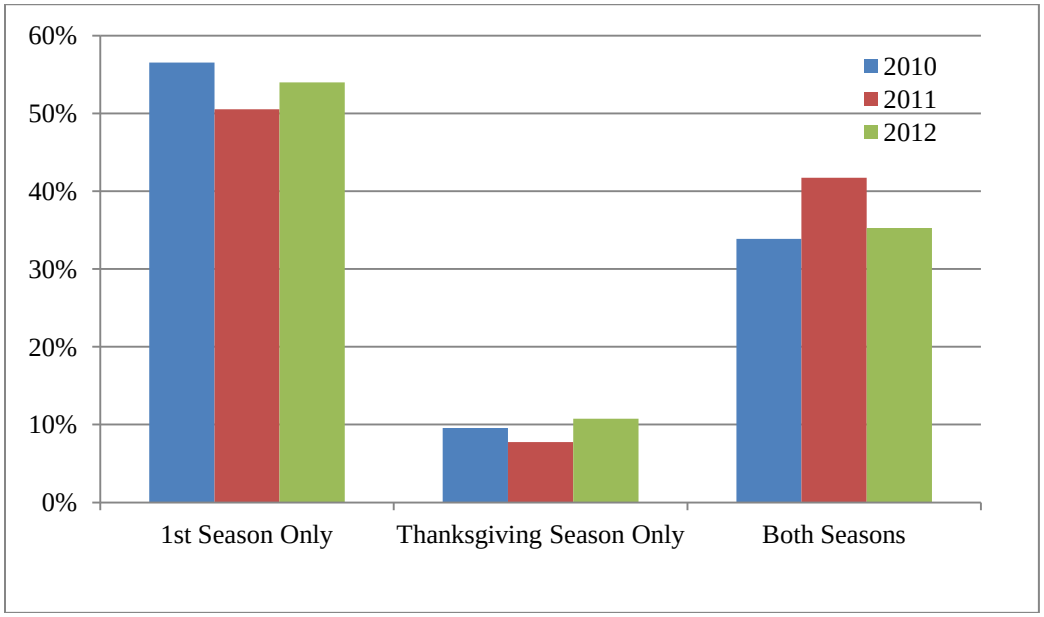

Figure 5. Pennsylvania fall wild turkey hunter participation by survey respondents for each season segment during 2010, 2011 and 2012. The first season was the traditional season in early November prior to black bear season (2 – 3 weeks depending on Wildlife Management Unit). The Thanksgiving season, which began in 2010, is Thanksgiving Day and the following Friday – Saturday.

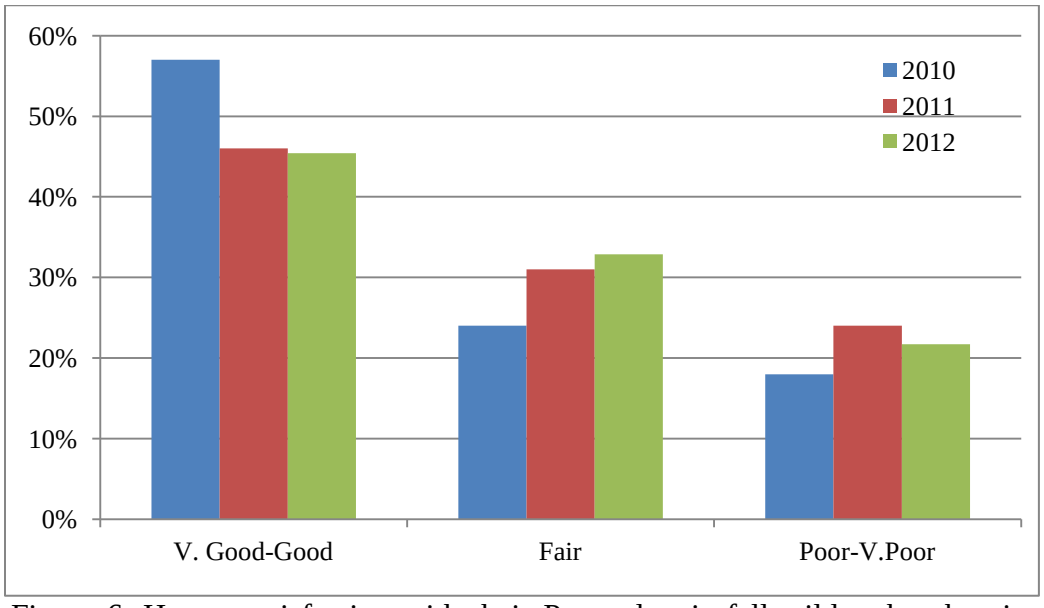

Figure 6. Hunter satisfaction with their Pennsylvania fall wild turkey hunting experience, by year, as determined by survey respondents.

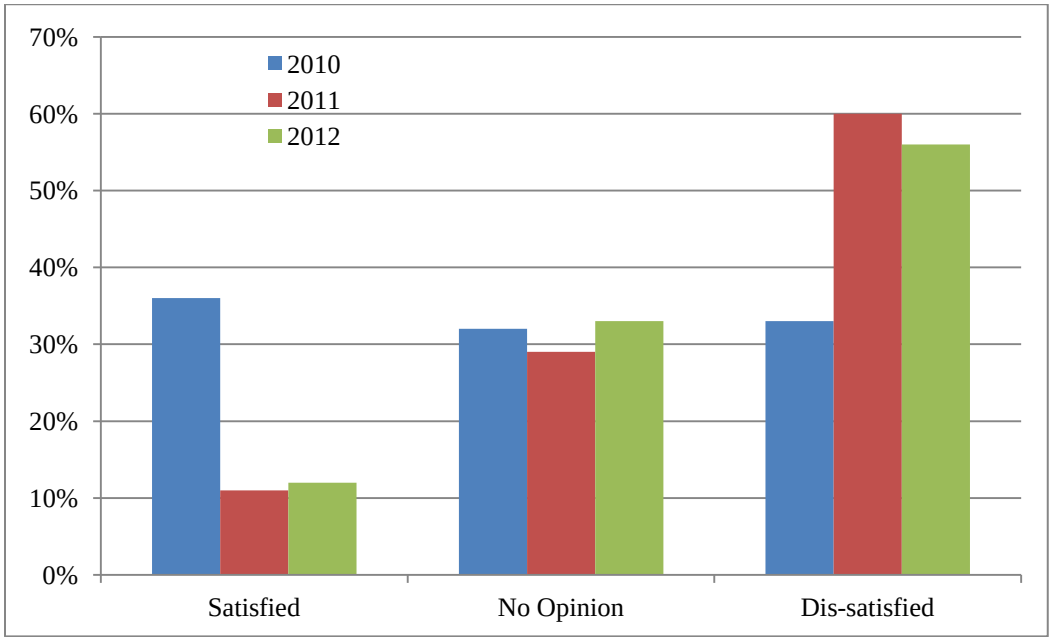

Figure 7. Pennsylvania fall wild turkey hunter satisfaction if the fall wild turkey hunting seasons were returned to the former structure with no Thanksgiving season segment, as determined by survey respondents. The 3-day Thanksgiving season segment was added in 2010.

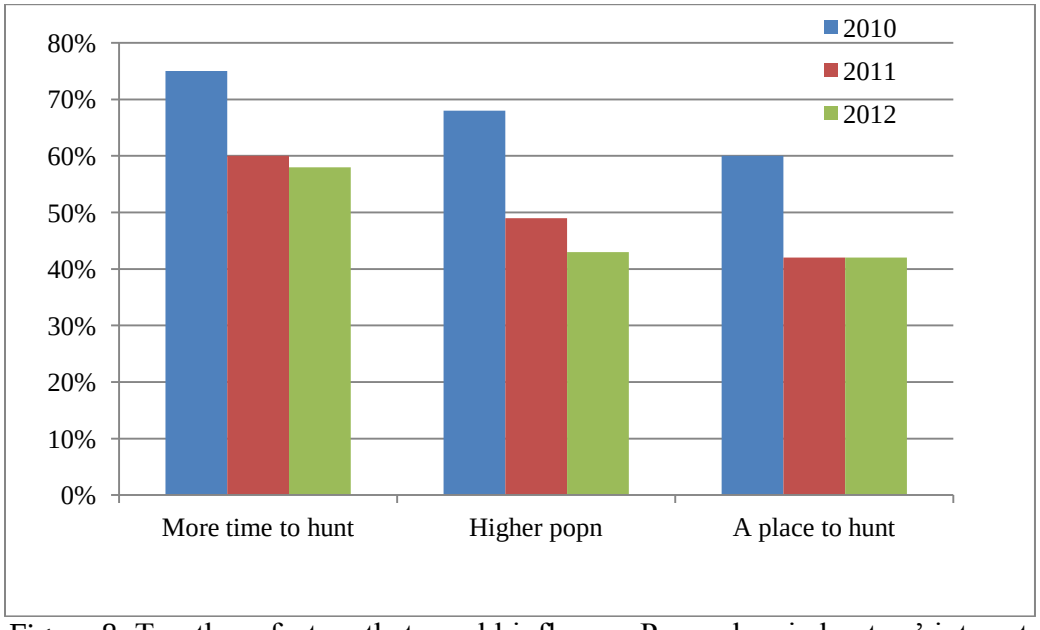

Figure 8. Top three factors that would influence Pennsylvania hunters' interest in starting fall wild turkey hunting, 2010 - 2012.

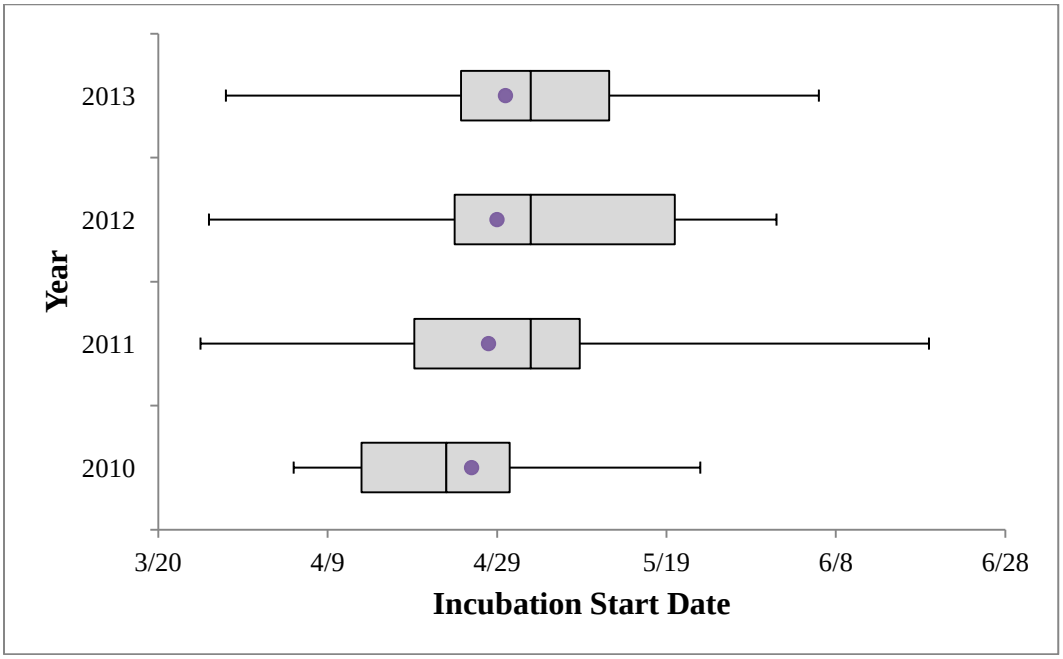

Figure 9. Median incubation start dates (vertical line inside the first quartile box) of satellite transmittered hens across both study areas in Pennsylvania, 2010 – 2013, n = 160, with minimum/maximum date whiskers. Circles represent spring season opening date.

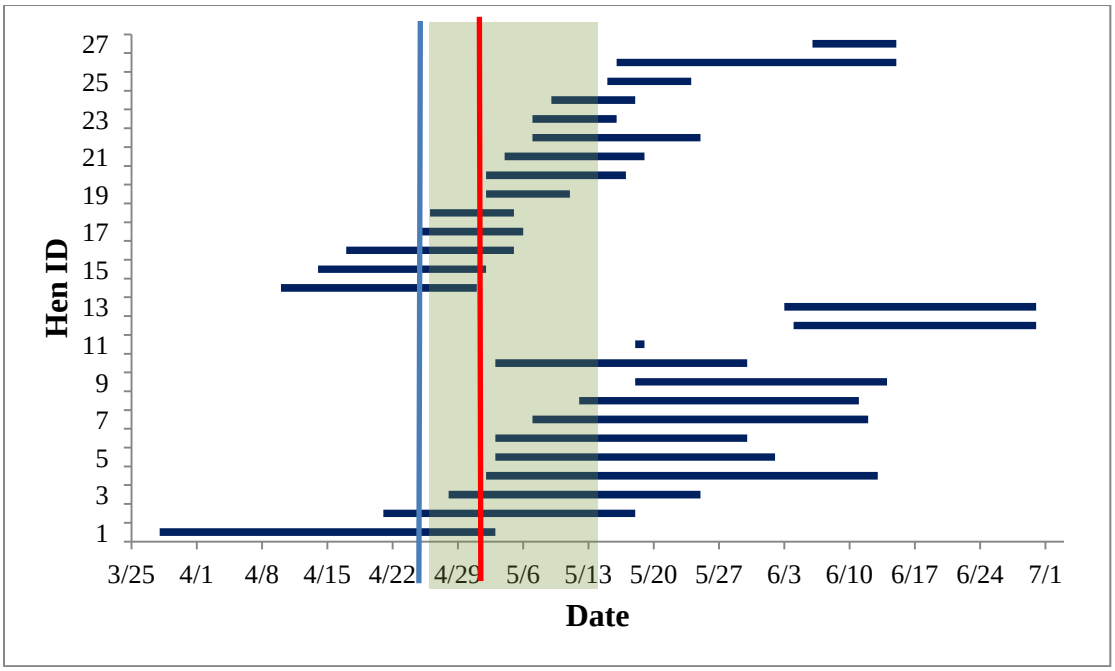

Figure 10. Timeline of incubation for nesting hens in Pennsylvania Study Area 1 (WMUs 2C, 2E, 4A, 4B, and 4D) for first nests in 2013, based on transmitter activity. Median date of incubation initiation (red line) was 4 May. Shaded area indicates the interquartile range. Opening date of regular spring turkey hunting season was 27 April (blue line).

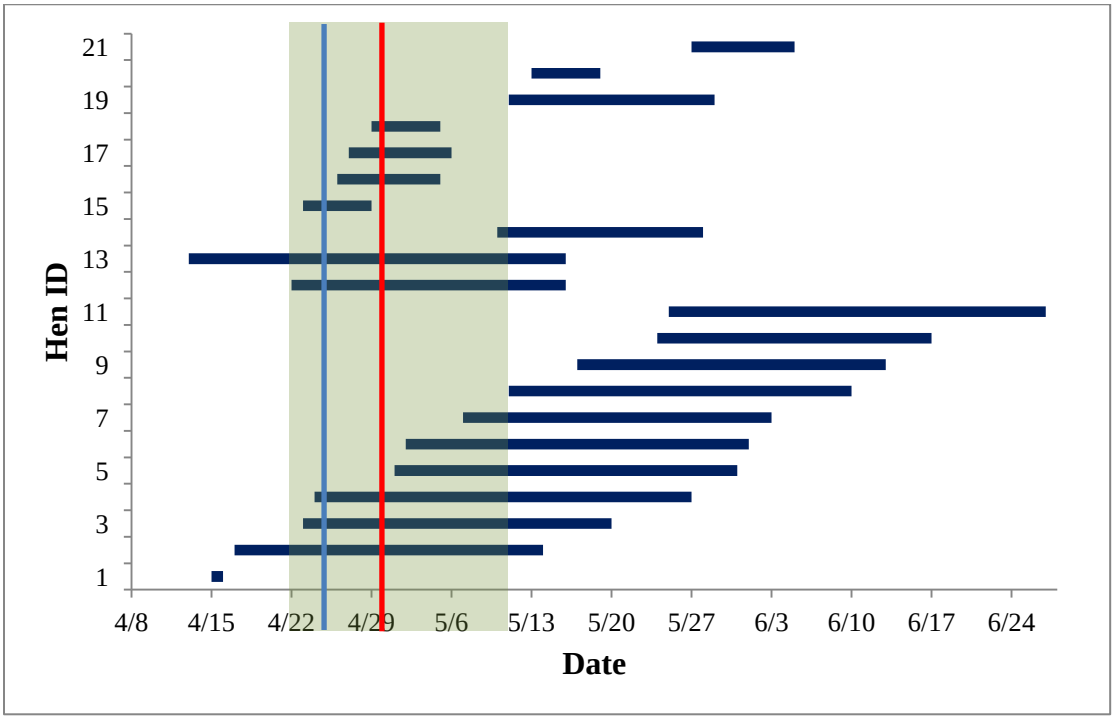

Figure 11. Timeline of incubation for nesting hens in Pennsylvania Study Area 2 (WMUs 2F, 2G, and 2H) for first nests in 2013, based on transmitter activity. Median date of incubation initiation (red line) was 2 May. Shaded area indicates the interquartile range. Opening date of regular spring turkey hunting season was 27 April (blue line).