



GOBBLING OF MERRIAM'S TURKEYS IN RELATION TO NESTING AND OCCURRENCE OF HUNTING IN THE BLACK HILLS, SOUTH DAKOTA

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Abstract: Timing of wild turkey (*Meleagris gallopavo*) nesting and peaks in gobbling activity are often used in setting spring hunting season dates. The relationship between gobbling activity, hunting pressure, and nesting chronology has not been studied using hunted and nonhunted turkey populations. We tabulated gobbling activity of Merriam's turkeys (*M. g. merriami*) in Wind Cave National Park (nonhunted) and Black Hills National Forest (hunted) during spring turkey hunting seasons from 2003–2004. We also monitored female nesting activity ($n = 72$) in relation to gobbling activity. Peak incubation of nests occurred between 8 and 15 May. During the hunting period gobbling activity during early morning surveys was lower ($P = 0.001$) in the hunted population ($\bar{x} = 4.56$, $SE = 0.45$) than the nonhunted population ($\bar{x} = 7.01$, $SE = 0.52$). We observed 2 peaks in gobbling activity: one following winter break-up of flocks, and the other just before or during peak incubation. Gobbling activity was poorly predicted by measured weather and nesting chronology variables ($R^2 = 0.08$). South Dakota's spring hunting season encapsulates the second peak of gobbling activity, with most gobblers harvested (57%) during the prelaying period. Illegal harvest of females was minimal even though females were not generally nesting during peak harvest. Gobbling activity was reduced during the hunting season presumably by the negative association between gobbling and subsequent disturbance by hunters.

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Information on wild turkey nesting chronology and gobbling activity is important in setting spring gobbler hunting season dates (Healy and Powell 1999). Hunting seasons should be set to coincide with the median date of nest incubation and second gobbling

peak after most breeding has taken place (Healy and

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Powell 1999). This is assumed to allow hunters to cue on gobbling turkeys while protecting females from illegal or inadvertent harvest (Bevill 1975, Hoffmann 1990, Kienzler et al. 1996). Factors suggested to influence gobbling by male turkeys include weather, hunting pressure, and nesting chronology (Bevill 1975, Hoffmann 1990, Kurzejeski and Vangilder 1992, Kienzler et al. 1996, Miller et al. 1997a, Miller et al. 1997b). Some investigators have reported only 1 peak in gobbling activity (Kienzler et al. 1996, Miller et al. 1997a), while others have reported 2 peaks (Bevill 1975, Porter and Ludwig 1980, Hoffman 1990).

Information on nesting chronology and gobbling activity is available within the native range of the Merriam's turkey subspecies (Scott and Boeker 1972, Lockwood and Sutcliffe 1985, Hoffmann 1990). In some states, lack of quantitative data on Merriam's turkey nesting chronology and peak gobbling activity has resulted in setting season dates based on tradition rather than scientific evidence (Kennamer 1986, Hoffmann 1990). For example, gobbling and nesting chronology information has not been quantified for Merriam's turkeys in northern latitudes such as the Black Hills. Our objectives were to (1) quantify and compare gobbling activity between simultaneously hunted and nonhunted Merriam's turkey populations, (2) determine spring gobbling activity in association with nesting chronology in an introduced Merriam's turkey population considerably north of their native range, and (3) evaluate nesting chronology and weather variables as predictors of gobbling activity.

STUDY AREA

Our study area was located within the southern Black Hills of southwestern South Dakota (Johnson et al. 1995). The southern Black Hills has a continental climate with mean annual precipitation of 44.02 cm and mean annual temperature of 7.78°C (National Climatic Data Center 1971–2000). Elevations range from 930 to 1627 m above mean sea level. Woodland habitats were predominantly ponderosa pine (*Pinus ponderosa*) with an understory component composed primarily of western snowberry (*Symphoricarpos occidentalis*) and common juniper (*Juniperus communis*) (Hoffman and Alexander 1987). Dominant grasses on the study area included two exotic species, Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*), and native species such as little bluestem (*Schizachyrium scoparium*), needle and thread (*Stipa comata*), sideoats grama (*Bouteloua curtipendula*), western wheatgrass (*Pascopyrum smithii*), and blue grama (*Bouteloua gracilis*) (Johnson and Larson 1999).

METHODS

Capture and Monitoring

We captured Merriam's turkeys during winter using cannon nets (Dill and Thornsberry 1950, Austin et al. 1972), rocket nets (Thompson and Delong 1967,

Wunz 1984), and drop nets (Glazener et al. 1964). We fitted captured turkeys with 98-g backpack-mounted radiotransmitters equipped with activity signals and a mercury switch mortality sensor set to activate after 8 hours of inactivity. We located radiomarked turkeys 6–7 days per week during spring (1 Apr–30 Jun) by triangulation and visual locations using hand-held yagi antennae.

Gobbling Activity

We followed sampling procedures outlined by previous investigators (e.g., Porter and Ludwig 1980, Kienzler et al. 1996, Healy and Powell 1999). We conducted counts of male calls, or gobbles, along 2 routes (one in the Black Hills National Forest that represented the hunted population and one in Wind Cave National Park that represented the nonhunted population) at least 2 days per week during 1 April–15 June. Each survey route (i.e., transect) included 13 listening stations at least 0.7 km apart, which were placed at the top of hills, mountains, or areas that maximized ability of researchers to count gobbles. Hunted and nonhunted stations were measured simultaneously by listening for gobbles at the same start times along transects. Gobbling per male or male group, herein referred to as gobbling activity, and number of males calling were estimated during a 4-minute period at each listening station. Transect days were the experimental units.

We did not conduct surveys on mornings with wind velocities ≥ 16 kmph or during rain or snow events as these conditions limit the ability to hear gobbles (Lint et al. 1995, Miller et al. 1997a). We monitored gobbling 40 minutes before sunrise to 65 minutes after sunrise. We alternated direction (i.e., starting point) of the route between days to negate any biases in gobbling activity associated with time of day. Additionally, we monitored a small sample ($n = 8$) of radiomarked males closely during spring to monitor movements near gobbling transects.

We partitioned gobbling activity post hoc into 3 periods based on nesting chronology for the hunted population (Black Hills National Forest Service stations): prelaying (1 April–day before initiation of first nest), laying–peak incubation (first day of nest initiation–median incubation date of first nests), and post-peak incubation (period following median incubation date of first nests–15 June). Gobbling data were collected in association to nesting chronology for 3 years on hunted transects (2001–2003).

We also partitioned gobbling activity into 3 periods post hoc based on the spring hunting season: pre-hunting (1 April–day before start of hunting season), hunting (first day of hunting season through last day), and posthunting (first day following end of hunting season–15 June). Gobbling data were simultaneously collected from hunted and non-hunted transects for 2 years (2003–2004).

Female Nesting Chronology

We monitored movements of radiomarked females closely during spring (1 Apr–30 Jun) to ascertain dates

of nest initiation, initiation of incubation, and nest hatching. When it became apparent a nest was initiated, based on inactivity from the radiotransmitter or localized movements (Lehman 2005, Lehman et al. 2005), we attempted to locate nests using hand-held yagi antennae. If found, we marked the nest with flags on 4 sides at a distance of 10–40 m depending on density of vegetation, topography, and signal strength. We obtained 6–7 daily locations per week and recorded the Universal Transverse Mercator (UTM) coordinates of each nest.

Statistical Analysis

We used the Shapiro-Wilks statistic to test the assumption of normality, and the O'Brien statistic was used to test for equal variance. If assumption of normality was violated, we log-transformed the data (Steel et al. 1997). Before our analysis of gobbling activity data, we tested the hypothesis that number of males heard did not differ between hunted and non-hunted populations. We used two-factor analysis of variance (ANOVA) (PROC MEANS, PROC UNIVARIATE, SAS Institute 2000) to test the hypothesis that mean gobbling activity did not differ between hunted and non-hunted populations and among periods (prehunting, hunting, posthunting). Our main effects were hunted or non-hunted and hunting period. In the event of a significant main effect interaction, we compared gobbling activity between hunted and nonhunted populations within periods using paired *t*-tests (SAS Institute 2000). We used one-way ANOVA to test the hypothesis that mean gobbling activity did not differ among periods (main effect) based on nesting chronology for the hunted population. We used Tukey-Kramer HSD pairwise comparisons to test whether gobbling activity differed among periods.

We used mean number of days from 1 April to initiation of incubation for radiomarked females to evaluate timing of nesting among years. We used one-way ANOVA and Tukey-Kramer HSD pairwise comparisons to test the null hypothesis that timing of nesting did not differ among years. We set our initial significance level at $\alpha = 0.10$ and used Bonferroni corrections to control the Type I experimentwise error rate for multiple comparisons.

Factors Influencing Gobbling

We developed a model to predict gobbling activity using variables reported to influence gobbling in previous studies (Bevill 1975, Hoffmann 1990, Kurzejeski and Vangilder 1992, Kienzler et al. 1996, Miller et al. 1997b). We also included some additional variables (see below) that warranted evaluation. We used univariate tests (PROC UNIVARIATE, SAS Institute 2000) to determine if relationships existed between explanatory variables and gobbling activity. We considered variables with univariate tests $P < 0.30$ in forward stepwise regression (PROC REG, SAS Institute 2000) with $P = 0.15$ for variables to enter and $P = 0.20$ for variables to be removed. We evaluated resid-

ual plots for normality and tested for homogeneity of variance.

Explanatory variables we considered included: (1) number of days from 1 April to median nest incubation, (2) minimum morning temperature ($^{\circ}\text{C}$) on date of gobbling activity count, (3) precipitation (cm) during the previous 24 hrs, and (4) change in barometric pressure the previous 16 hrs. We based median nest incubation dates on nesting data from radiomarked females. We used temperature and precipitation data collected at the field research station in Pringle, South Dakota, 2001–2004. We used barometric pressure data (mm Hg) that was collected with a micro-barograph at Jewel Cave National Park (United States Department of the Interior, Jewel Cave National Monument, Custer, South Dakota 2001–2004). The Pringle field research station was located in the center of the study area, and Jewel Cave National Park was located on the northern end of the study area.

RESULTS

Gobbling Activity

Gobbling Activity in Relation to Nesting Chronology

Gobbling activity did not differ among periods across years ($F \leq 2.30$, $df = 2$, $P \geq 0.12$), so we pooled annual data. Gobbling activity differed among periods ($F = 6.39$, $df = 2$, $P = 0.003$). Pairwise comparisons indicated that gobbling activity during post-peak incubation ($\bar{x} = 3.32$, $SE = 0.42$) was lower than prelaying ($\bar{x} = 5.19$, $SE = 0.47$) and laying-peak incubation ($\bar{x} = 5.08$, $SE = 0.36$) periods. Gobbling activity data were normally distributed and there was no indication of heterogeneous variance.

Two peaks of gobbling activity occurred in our study area (Figure 1). Typically, the primary gobbling activity peak occurred immediately following winter break-up of flocks in early to mid-April, and the secondary peak occurred when most females were laying or during the laying-peak incubation period (Figure 1).

Gobbling Activity and Occurrence of Hunting

Number of males heard differed ($F = 8.97$, $df = 1$, $P = 0.005$) between years for the nonhunted population and therefore we compared number of males heard between populations within each year. In 2003, number of males heard did not differ ($F = 1.18$, $df = 1$, $P = 0.28$) between hunted and nonhunted populations. In 2004, number of males heard did not differ ($F = 0.28$, $df = 1$, $P = 0.60$) between hunted and nonhunted populations.

Gobbling activity did not differ among periods across years ($F \leq 3.04$, $df = 1$, $P \geq 0.13$), so we pooled annual data. Two-factor analysis for gobbling activity indicated a significant population treatment by period interaction ($F = 2.58$, $df = 2$, $P = 0.08$). Therefore, gobbling activity was compared between hunted and nonhunted within each period. During the pre-hunting period, gobbling activity was similar (*t*-ratio = 0.26, $df = 14$, $P = 0.801$) between hunted ($\bar{x} =$

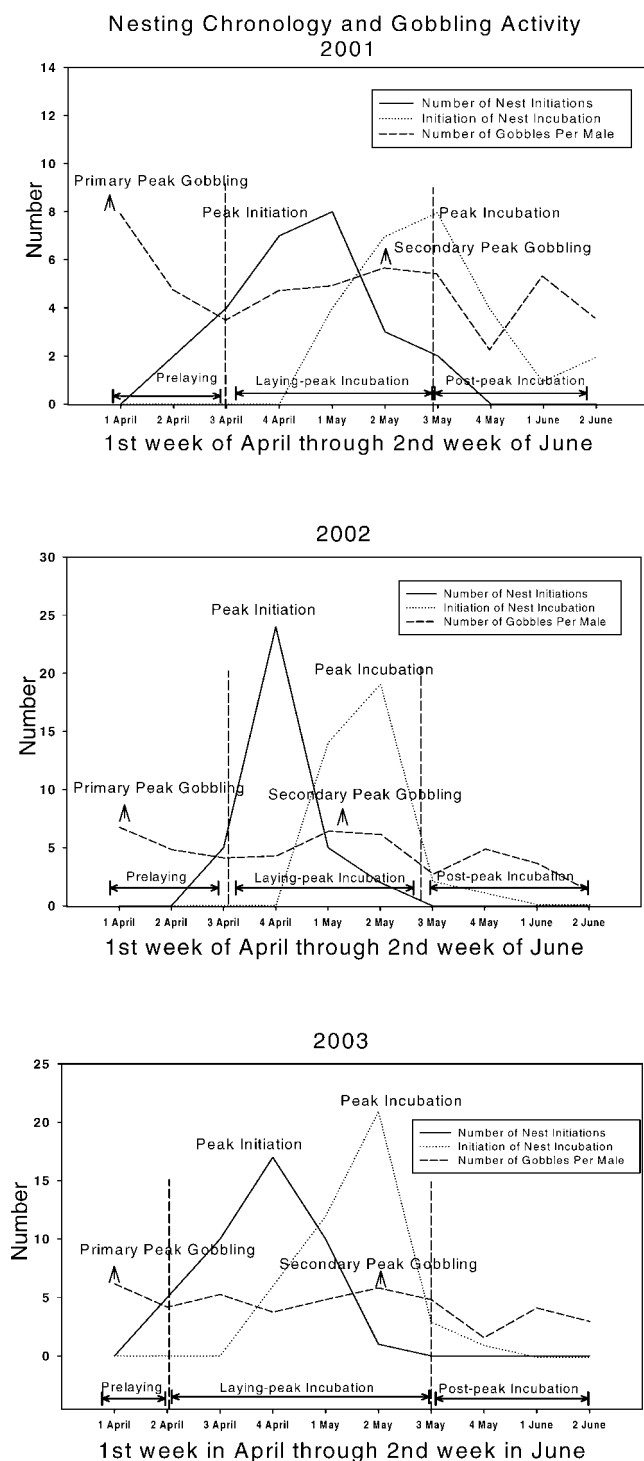


Fig. 1. Relationship of female nesting chronology and gobbling activity for a hunted population of Merriam's turkeys in the southern Black Hills, South Dakota, 2001–2003.

5.25, $SE = 0.72$) and nonhunted populations ($\bar{x} = 5.01$, $SE = 0.58$) (Figure 2). During the hunting period, gobbling activity was lower (t -ratio = 3.55, $df = 38$, $P = 0.001$) for hunted turkeys ($\bar{x} = 3.55$, $SE = 0.45$) compared to nonhunted turkeys ($\bar{x} = 7.01$, $SE = 0.52$) (Figure 2). During the posthunting period, gobbling activity did not statistically differ (t -ratio = 1.43, $df = 22$, $P = 0.17$) between hunted turkeys ($\bar{x} = 2.88$,

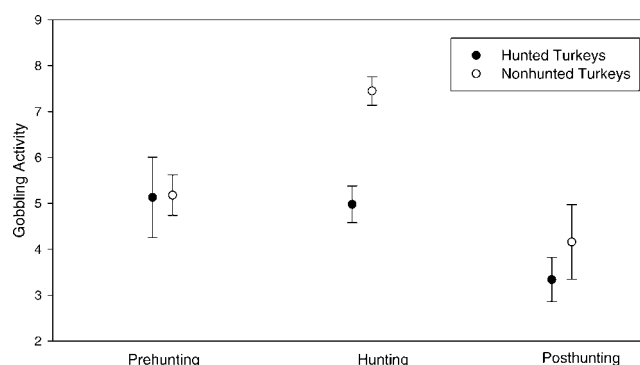


Fig. 2. Comparison of gobbling activity among pre-hunting, hunting, and posthunting time periods between hunted (Black Hills National Forest) and nonhunted (Wind Cave National Park) Merriam's turkeys in the southern Black Hills, South Dakota, 2003–2004.

$SE = 0.48$) and nonhunted turkeys ($\bar{x} = 4.02$, $SE = 0.64$) (Figure 2). Gobbling activity data were normally distributed and there was no indication of heterogeneous variance.

Nesting Chronology

From 2001–2003, we captured, radiomarked, and collected nesting chronology data on 72 female Merriam's turkeys (67 adults and 5 juveniles). Nest initiation dates for first nests ranged from 11 April to 18 May. Median dates for nest initiation, incubation, and hatching for first nests were similar between years (Table 1). However, timing of nesting chronology through initiation of nest incubation differed among years ($F = 5.37$, $df = 2$, $P = 0.006$). Pairwise comparisons indicated that females initiated nests earlier in 2003 than in 2001 and initiation of incubation for 2002 did not differ from either 2001 or 2003. Nesting chronology data were normally distributed and there was no indication of heterogeneous variance.

Factors Influencing Gobbling

The best model contained 2 variables with number of days to median nest incubation date being entered first ($F = 3.76$, $df = 1$, $P = 0.06$) followed by minimum temperature second ($F = 3.32$, $df = 1$, $P = 0.07$). Change in barometric pressure and previous 24-hour precipitation were not entered into the model. Gobbling activity could not be modeled easily with the measured variables, and the 2-variable model accounted for less than 10% of the variance in gobbling (R^2

Table 1. Nesting chronology of female Merriam's turkeys in the southern Black Hills, South Dakota, 2001–2003.

Year	N ^a	Days–inc ^b	SE	Median initiation date	Median incubation date	Median hatch date
2001	32	42.4	1.1	30 Apr	11 May	6 Jun
2002	36	39.1	0.8	27 Apr	9 May	5 Jun
2003	43	38.0	1.0	27 Apr	9 May	5 Jun

^a Number of females radiomarked.

^b Mean number of days from 1 Apr to incubation.

= 0.08). We did not have adequate information on hunter density to include in the model. Residuals from the model were normal and there was no indication of heterogeneous variance.

DISCUSSION

Kienzler et al. (1996) observed a decrease in gobbling activity once hunting season started, and their data suggested that hunting determined gobbling activity more than nesting status of females. Our results indicate that males in a nonhunted population gobble more during the hunting period than hunted males when measured simultaneously, supporting results of Kienzler et al. (1996). Gobbling activity was reduced during the hunting season presumably by the negative association between gobbling and subsequent disturbance of birds by hunters. Harvest data collected by South Dakota Department of Game, Fish, and Parks for 2002 and 2003 (Huxoll 2002, 2003) indicated about 22% of hunters harvested their birds on opening weekend. Also, harvest data indicated most harvest occurred during the prelaying period (57%). As the hunting season progresses, harvest decreases from the laying-peak incubation period (25%) to the post-peak incubation period (18%).

We observed 2 primary peaks of gobbling activity and the spring hunting season encapsulated the second peak. Similar to our findings, other studies have observed 2 peaks in gobbling activity concurrent with spring dispersal and peak initiation of incubation (Bevill 1975, Porter and Ludwig 1980, Hoffman 1990). Some studies observed only 1 peak in gobbling during the laying period or at peak incubation (Kienzler et al. 1996, Miller et al. 1997a). The first gobbling peak for males in the southern Black Hills occurred when radiomarked males and females were dispersing from wintering areas to breeding areas between late March and early April. This peak in gobbling may have been higher in late March as our data collection started 1 April. The second peak coincided with peak incubation or occurred the week before peak incubation. We found peak incubation in the southern Black Hills to be 8–10 days earlier than in Colorado as most females initiated incubation 8–15 May. In Colorado, the peak period for onset of incubation was 16–25 May (Hoffman 1990).

In our study, females had earlier initiation of incubation in 2003 than in 2001. Other studies have observed variation in nesting chronology among years (Vangilder et al. 1987, Hoffman 1990, Flake and Day 1996, Lehman et al. 2000). Nest initiation was the most influential variable in our model prediction of gobbling activity. However, very little of the variability in gobbling activity could be explained by our regression model. Patterns of gobbling activity indicated fluctuating gobbling activity throughout spring. We agree with Miller et al. (1997b) that gobbling activity appears to be influenced by a complex interaction of population and environmental conditions that may not be easily modeled. Factors that influence gobbling ac-

tivity include break up of winter flocks, initiation of egg-laying, mating opportunities (Miller et al. 1997a), presence or absence of hens (Hoffman 1990), weather influences (Bevill 1973, Kienzler et al. 1996), hunting effects (Kienzler et al. 1996), and gobbler condition (Lint et al. 1995).

MANAGEMENT IMPLICATIONS

Two important goals of most wild turkey management plans are to maximize hunter opportunity for harvesting a gobbler during spring and to minimize the risk of females being illegally or accidentally harvested (Healy and Powell 1999). Gobbling is a behavioral cue that hunters use to locate turkeys during spring hunting. The current spring turkey hunting season in South Dakota encapsulates the second gobbling peak, which allows hunters to participate when males are gobbling at a higher level. Females are also nesting during the second gobbling peak and this may provide an excellent opportunity for hunters to call in and harvest males that are separated from females in early May. However, the current spring turkey hunting season in South Dakota opens the second Saturday in April, which usually occurs before most females have initiated nests. The highest proportion of harvest occurs during the prelaying period when males are courting females, and typically when Merriam's turkeys are found in large flocks. This may allow increased accidental female kill. However, illegal harvest of females during the spring turkey season accounted for only 1.9% of cause-specific mortality in the southern Black Hills (Lehman 2005). Miller et al. (1997a) suggested illegal kill was more a function of hunter density than timing of incubation. Illegal female kill in relation to hunting season dates should continue to be monitored as hunter densities increase in the Black Hills.

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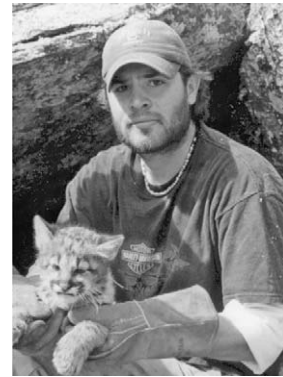
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Dan Thompson received his M.S. in Wildlife Science in 2003 and is currently pursuing a Ph.D. at South Dakota State University. He has worked on various projects addressing wild turkey population dynamics. His research interests include large carnivore ecology and expansion, along with carnivore/human/prey interactions.