GAME REPORT

Survival, Reproduction, Home Range, and Habitat Use of Translocated Eastern Wild Turkeys in the Wessington Hills, South Dakota.

Chad T. Switzer
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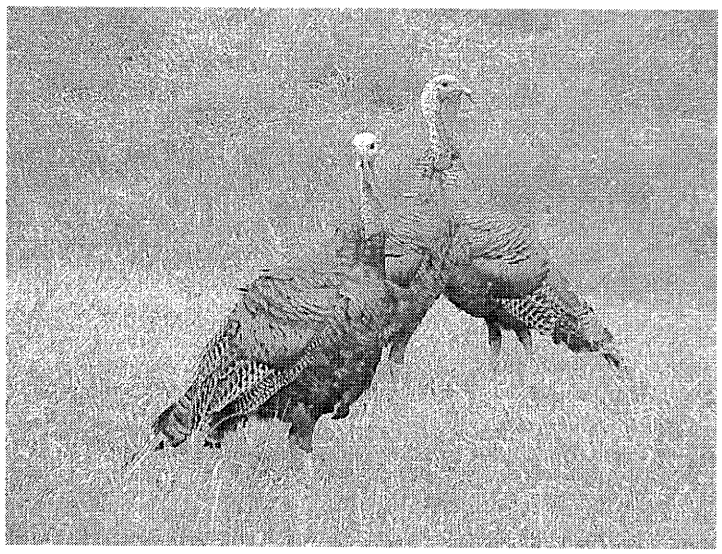

South Dakota
Department of
Game, Fish and Parks

Wildlife Division
Joe Foss Building
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by

Chad T. Switzer
Stephanie A. Tucker

Pittman-Robertson Project W-75-R-51

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Abstract

Survival, Reproduction, Home Range, and Habitat Use of Translocated Eastern Wild Turkeys in the Wessington Hills, South Dakota.

The reintroduction of wild turkeys (*Meleagris gallopavo*) to their original range across the nation is a great success story for wildlife management. Wild turkey populations are at or near record levels in many areas, including South Dakota. During this time, turkey hunting has become a popular recreational activity and now many have a sincere interest in the conservation and management of wild turkeys and their habitats. Outside of the Black Hills region, both the number of licenses and turkeys harvested has been steadily increasing for the past 10 years in South Dakota (Huxoll 2008). As a result, the South Dakota Department of Game, Fish and Parks continues to explore opportunities to use available landscapes which may provide suitable habitats for sustaining wild turkey populations.

To address questions and provide management implications for wildlife managers on less than desirable turkey habitat, we monitored translocated eastern wild turkeys released onto an isolated, minimally forested area in an agricultural landscape devoid of a river system in eastern South Dakota. We fitted 47 female turkeys with radio transmitters and collected 4,161 relocations to evaluate survival, reproduction, home range, and habitat use in the Wessington Hills, South Dakota.

We evaluated survival during the breeding, post-breeding, and winter seasons. Our estimates of annual female survival ranged from 0.45-0.55, with no significant difference among years. Predation was the probable cause of 82% of all mortalities. We found no significant difference in survival among seasons when comparing within years or among all years, though mortality of female turkeys was greatest during the breeding season. When we compared annual survival between female turkeys translocated from Grant County, South Dakota to those from Pennsylvania, we found survival was significantly lower for the Pennsylvania turkeys in both 2007 and 2008.

During the 2006-2008 breeding seasons, we documented 39 female turkeys initiating 49 nests, with 10 of those being second attempts. The majority of nests were located in pastures (31%), woodlands (24%), idle grasslands (16%), and haylands (14%). Specific vegetation types used included snowberry (33% [*Symphoricarpos albus*]), grasses (27%), and alfalfa (16% [*Medicago sativa*]). When we combined all years, 30% of first nest attempts and 60% of second nests attempts were successful in hatching ≥1 egg. Our observed clutch sizes ranged from 4-19 eggs ($\bar{x}$ = 10.2, n = 27, SE = 1.96) for first nest attempts and 6-11 eggs ($\bar{x}$ = 9.0, n = 5, SE = 4.02) for second nest attempts. Of the 32 nests where we were able to count the number of hatched eggs, 112 of 127 eggs hatched, for an average hatchability rate of 88% (range 50-100%). When we combined all nests and years, mean nest dispersal from release location was 3.60 km (range 0.4-19.6 km).

We used 2,597 daytime relocations to calculate 69 seasonal home ranges on 25 individual female turkeys. Home range sizes were significantly different between years and among biological seasons with averages ranging from 177-959 ha. For all years combined, breeding home ranges were 2.5 and 1.7 times larger than post-breeding and winter home ranges, respectively. We found no difference in home range size of turkeys transplanted from Grant County, South Dakota compared to those from Pennsylvania.

We used compositional analysis to determine habitat selection for 59 female turkeys. As expected, woodlands ranked significantly higher than all other habitat categories at both the landscape and local scales. In addition, we found that <1% of the total area within all buffered relocations was farmstead habitat.

Based upon the avoidance of farmsteads by turkeys in this study, we recommend wildlife managers to consider eastern wild turkeys for future transplants into marginal, unoccupied turkey habitat in South Dakota. Marginal habitat and predation may be limiting this population from reaching a density where range expansion is necessary. Potential translocation sites characterized by minimally forested sites in agricultural landscapes in eastern South Dakota should contain at least 20% woodland habitat, with as much connectivity among woodland habitats as possible. While these translocated turkeys were sustaining a local population, we observed no significant expansion in range or population density during our study.

Preface

This report summarizes results of data collected by South Dakota Department of Game, Fish and Parks personnel from March, 2006 through December, 2008 on the survival, reproduction, home range, and habitat use of translocated eastern wild turkeys in the Wessington Hills, South Dakota under Pittman-Robertson Project W-75-R-51.

This study was initiated to evaluate population parameters and habitat selection of translocated turkeys in minimally forested areas in an agricultural landscape devoid of a river system in South Dakota.

These objectives were accomplished by monitoring the locations and fates of radiomarked female turkeys. Results of this study will be used to assist wildlife managers and landowners in their decision making regarding the evaluation of marginal turkey habitat identified as potential sites for future wild turkey translocations.

 Copies of the report are available from the Department of Game, Fish and Parks, 523 East Capitol, Pierre, South Dakota 57501-3182.

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INTRODUCTION

In many states wild turkey (*Meleagris gallopavo*) populations are at record levels, resulting in a demand for more opportunities by hunters and the more challenging balance between landowner tolerance and optimum population levels. State wildlife agencies continue to explore opportunities to use the ever changing landscape and its habitat components for maximum wildlife benefits, including additional recreational opportunities. In particular, wild turkey hunting has seen tremendous growth and popularity, as holds true in South Dakota. In the prairie counties (i.e. outside the Black Hills region) of South Dakota, both the number of licenses and turkeys harvested has been steadily increasing for the past 10 years (Huxoll 2008).

Numerous efforts have taken place across the country to restore turkey populations in their original range; many with success. Studies have shown that eastern wild turkey (*M. g. silvestris*) populations can be successful in areas described to have minimally forested areas mixed within an agricultural landscape such as in Iowa (Little 1980, Little and Varland 1981), Indiana (Miller et. al. 1985), and Ohio (Clark 1985). Some of the most recent translocations in eastern South Dakota have successfully established populations of eastern wild turkeys (Leif 1997, Lehman 1998, Shields 2001), all of which have been in locations where landscapes are minimally forested and predominantly agriculture.

Although early studies suggested an evenly distributed ratio of mast-producing forest to agricultural fields to be optimum turkey habitat (Mosby and Handley 1943, Hurst and Dickson 1992), later studies have shown that this ratio can be much lower and that cropland, as a food source, can play a critical role in an annual life cycle (Little 1980, Kane et al. 2007,). Agricultural landscapes possess many positive attributes when considering locations for new turkey populations. Waste grain, particularly corn, can be an essential component in turkey survival and maintenance, where mast production is low, failed, or none existent, or when winter conditions are extreme and supplemental food sources could play a significant role in the success of a translocation effort (Porter 1977, Clark 1985, Kurzejeski and Lewis 1990, Paisley et al. 1995, Wright et al. 1996, Lehman 1998).

Farmstead avoidance characteristics make eastern wild turkeys a preferred subspecies for turkey reintroduction efforts in east-central South Dakota as well. Leif (1997) found that eastern wild turkeys typically avoided farmsteads and Lehman (1998) recommended eastern wild turkeys over Rio Grande turkeys (*M. g. intermedia*) for translocation efforts because they showed less dependence on farmsteads.

A common theme with many studies evaluating minimally forested areas and wild turkey reintroduction efforts is the association or proximity of a river or stream system (Porter 1977, Little and Varland 1981, Miller et al. 1985). In east-central South Dakota, minimally forested areas have been identified as potential wild turkey habitat and translocation sites (e.g. woody draws, shelterbelts, and riparian areas), although some are not connected, adjacent to, or part of a river system. Hence, there is a need to further evaluate the potential of isolated, minimally forested areas in an agricultural landscape devoid of a river system to wild turkeys.

OBJECTIVES

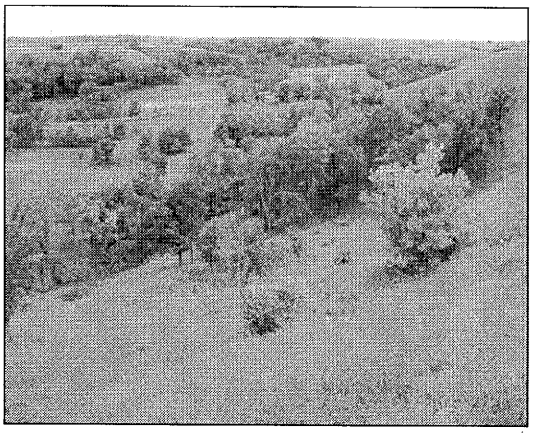
1. Monitor annual and seasonal survival of translocated eastern wild turkeys.
2. Estimate reproduction, including nest success and brood survival, of translocated eastern wild turkeys.
3. Determine home ranges of translocated eastern wild turkeys.
4. Estimate land-use composition and habitat types used by translocated eastern wild turkeys.
5. Compare population dynamics to other eastern turkey translocation efforts in South Dakota.

6. Monitor farmstead use and seasonal depredation of translocated eastern wild turkeys.

METHODS

Study Area

Our study area was a 208 km^2 area located in the Wessington Hills in southeastern Hand County (Appendix Fig. 1). Its boundaries were 200th Street and Highway 14 on the north, 374th Avenue on the east, 210th Street on the south, and 367th Avenue on the west. The study area was characterized by the Missouri Coteau and James River Lowland landform regions on the western and eastern sides, respectively. Elevation ranged from 427-573 m and slope ranged from 0-21 degrees. During our study, the area consisted primarily of pasture (41%), cropland (37%), comprised mostly of row crops such as corn and soybeans, and hayland (11%). Woodlands (3%), idle grasslands (2%), farmsteads (2%), water (2%), and roadways (2%) made up the remaining area. There were 36 occupied farmsteads and 130 residents within the study area equaling approximately 0.62 persons/km^2.



Wooded draw typical of the eastern edge of the Missouri Coteau landform found in the Wessington Hills, South Dakota.

Along the edge of the Missouri Coteau region, woodland habitat found in riparian areas consists primarily of green ash (*Fraxinus pennsylvanica*), bur oak (*Quercus macrocarpa)*, plains cottonwood (*Populus deltoides),* boxelder *(Acer negundo)*, peachleaf willow (*Salix amygdaloides*), and shrubs. Additional woodlands include farmstead shelterbelts and field windbreaks composed primarily of green ash, American elm (*Ulmus Americana)*, plains cottonwood, eastern red cedar (*Juniperus virginiana)*, and numerous shrub species.

Idle grasslands and pastures are primarily characterized by smooth bromegrass (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), western wheatgrass (*Pascopyrum smithii*), and sweetclover (*Melilotus*). In addition, managed rangeland and pastures include a climax composition of green needlegrass (*Stipa viridula*), sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracillis*), big bluestem (*Andropogon gerandii*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and prairie cordgrass (*Spartina pectinata*).

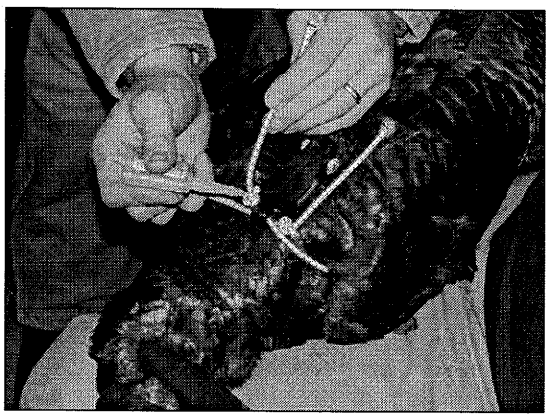
Release

In 2006, we received eastern wild turkeys (hereafter, turkeys) for transplantation from Grant County, South Dakota (SD). In 2007 and 2008, we released turkeys translocated from Pennsylvania (PA). The turkeys received from PA arrived within 5 days of their capture and were released within 24 hours following their arrival. Prior to release, we placed metal bands on 1 leg of each turkey for identification. Several months before translocating the turkeys, South Dakota Department of Game, Fish and Parks personnel located and removed any farm-reared turkeys within the study area that had previously been released by local landowners.

Radiotelemetry

We fitted female turkeys with backpack style radio-transmitters (Model No. 42409; Advanced Telemetry Systems, Isanti, MN), equipped with a 6-hour mortality switch, prior to their release. Following their release, we relocated the radio-marked turkeys 3 times per week using a vehicle mounted null-peak system (Samuel and Fuller 1996). We used Location of a Signal software (Ecological Software Solutions™, Sacramento, CA) and a Global Positioning System (GPS) to triangulate the location of the turkeys. Within the Location of a Signal software, a maximum likelihood estimator was used to calculate an error ellipse for relocations with ≥3 azimuths.

We divided our turkey relocations into 3 biological seasons (Flake et al. 2006, Leif 1997): 1) Breeding (1 April-31 July), 2) Post-breeding (1 August-30 November), and 3) Winter (1 December- 31 March).



Female turkeys were fitted with backpack style radio-transmitters to determine survival, reproduction, home range and habitat use.

Survival

We estimated annual and seasonal survival of female turkeys using the Kaplan-Meier product-limit method modified for staggered entry (Kaplan and Meier 1958, Pollock et al. 1989). Survival distributions were compared using Chi-square analysis in program CONTRAST (Sauer and Williams 1989). If there was a mortality, we recovered the radio transmitter and searched the immediate area for evidence of bird fate and predator type. We classified cause of death as mammalian predation, avian predation, unknown predation, trampled by livestock on nest, haying operation, vehicle collision, and unknown. We carefully evaluated mortalities related to predation for signs such as tracks, scat, hemorrhaging, puncture wounds, decapitation, and presence of dens or caches to identify predator type. All radio-marked female turkeys that survived ≤10 days after their date of release were censored from the analysis (Wilson and Norman 1996).

Reproduction

We determined that a female was incubating eggs if we located her in the same spot on ≥2 consecutive locations. We approached incubating females using a hand-held yagi antenna and marked the area for subsequent fate determination. Once the female had permanently left the nest location or was predated, we located the nest bowl and recorded the nest location. We also recorded the total number of hatched and unhatched eggs remaining in and near the nest, as well as the nesting cover. Nest initiation dates were estimated from our documented hatch dates. We classified a nest as successful if ≥1 egg hatched. For unsuccessful nests, the known cause of fate was recorded as female mortality, abandoned, destroyed by cattle, destroyed by machinery, depredated, flooded, or destroyed by researcher.

To determine female turkey use of the study site, we calculated dispersal distance from the release site to all known nests. Additionally, we calculated the distances between first nest attempts in subsequent years (hereafter, nest site fidelity). Differences in dispersal distance among years were compared using a mixed model (R Development Core Team, Vienna, Austria) to account for repeated measures on the same individual in multiple years. We compared differences in dispersal distance between first and second nesting attempts and SD and PA turkeys using standard *t*-tests.

We estimated brood survival at 1 week intervals after hatch until 4 weeks of age. We defined brood survival as those females with ≥1 surviving poults. Brood survival was monitored by visual observations, primarily with a hand-held yagi antenna to locate the female and her respective brood.

Habitat use

Home range size: We calculated seasonal home ranges for female turkeys using a fixed-kernel (Worton 1989, Seaman and Powell 1996) estimator with least squares cross validation and a 95% utilization distribution (Powell 2000). We used the Animal Movement extension (Hooge and Eichenlaub 1997) for ArcView to calculate home ranges. Relocations with an error ellipse >90th percentile (≤2.33 ha) were removed from the analysis (White and Garrot 1990). Only turkeys that had ≥30 locations for a season were included in the analysis (Seaman et al. 1999). Home range sizes were transformed logarithmically to approximate a normal distribution (Ramsey and Schafer 2002). We tested for differences between years and among seasons using a mixed model procedure to account for repeated measures on the same individuals in multiple years (SAS Institute Inc., Cary, NC). In addition, we tested for differences in home range size between turkeys translocated from SD and PA.

Habitat selection: We used the Common Land Unit (as defined by USDA Farm Service Agency) GIS data layer to delineate our land

cover. To take into account habitat changes that would have occurred annually, such as CRP conversion to cropland, we ground-truthed the entire study area each year. We condensed the data layer into 7 habitat categories that we determined would be functionally important to turkeys (Appendix Figures 5-7):

1. Woodland – Includes forested draws, tree rows and shelterbelts not adjacent to farmsteads, windbreaks, living snow fences, and wooded riparian areas.
2. Cropland – Includes row crops (corn, soybeans, sorghum, and sunflowers) and small grains (wheat). Food plots planted annually for wildlife were also included in this category.
3. Pasture – Includes grazed grasslands.
4. Hayland – Includes grasslands and alfalfa fields that were mowed annually.
5. Idle – Includes Conservation Reserve Program (CRP) lands and grasslands that were neither mowed nor grazed.
6. Farmstead – Includes occupied and unoccupied dwellings and associated outbuildings, feedlots, and adjacent shelterbelts. Rural cemeteries and a small section of the town of Wessington were also included in this category.
7. Roadway – Includes paved and gravel roads with their respective road right-of-ways. Road right-of-ways were determined by buffering road centerlines by 22.86 m and 10.06 m for paved and gravel roads, respectively, which is the standard size of road right-of-ways in South Dakota (Jason Humphrey, South Dakota Department of Transportation, personal communication).
8. Water – Includes streams, wetlands, dugouts, stock dams, and any other open water.

We were interested in determining not only where on the landscape females gravitated, but also what specific habitats the turkeys used once established in an area. Therefore, we examined habitat selection at both the Second (hereafter, landscape scale) and Third (hereafter, local scale) Order (Johnson 1980) using compositional analysis (Aitchison 1982, Aebischer et al. 1993). For the landscape habitat selection, habitats within the study area were considered available and the used habitat was that within the home range. For the local habitat selection, habitats within the home range were considered available and the used habitat was that where the females were relocated. To account for error in radiotelemetry relocations, we buffered each location with an area equivalent to the median error ellipse (0.14 ha) for all useable locations (Gosselink et al. 2003). We created rank matrices using *t*-tests (Aebischer et al. 1993) and examined the magnitude of selection using standardized selection ratios (Pendleton et al. 1998, Phillips et al. 2003). For the compositional analysis and *t*-tests, log-ratios were weighted by number of relocations collected for each turkey (Phillips et al. 2003).

RESULTS

Release

We released 26 turkeys (20 females, 6 males) captured in SD on 4 March 2006, 7 (4 females, 3 males) captured in PA on 23 February 2007, 8 (8 females) captured in PA on 5 March 2007, and 17 (15 females, 2 males) captured in PA on 8 February 2008, for a total of 65 turkeys (53 females, 5 males) being released.

Eastern wild turkey release in the Wessington Hills of Hand County, South Dakota, 2006.

Radiotelemetry

We fitted 20 (20 females), 14 (12 females, 2 males), and 11 (11 females) turkeys with radio transmitters in 2006, 2007, and 2008, respectively. Backpack radio transmitters weighed an average of 88 g, which is 1% and 2% of the body weight of adult male and female turkeys, respectively (Pelham and Dickson 1992). This is well within the recommendation of <5% of body weight prescribed by Caccarnise and Hedin (1985).

We collected 4,161 relocations on our radio-marked turkeys. Of these, 78% were collected using triangulation methods, 12% using homing techniques or from visuals of the turkeys, and 10% using only 2 azimuths, which did not produce an error ellipse. All locations were collected during daylight hours.

Survival

We censored 4 female turkeys from analyses, with 2 surviving ≤10 days after release, 1 slipping its radio transmitter, and 1 due to radio transmitter failure.

Annual female survival ranged from 0.45-0.55 (Figure 1, Appendix Table 1) for 2006-2008. We found no significant difference among all years (χ_1^2 = 0.46, P = 0.793) or between years (2006-2007, χ_1^2 = 0.26, P = 0.607; 2006-2008, χ_1^2 = 0.02, P = 0.898; 2007-2008, χ_1^2 = 0.41, P = 0.520). When we compared annual survival between female turkeys translocated from SD (0.70 in 2007, 0.71 in 2008) to those from PA (0.20 in 2007, 0.23 in 2008), we found a significant difference in both 2007 (χ_1^2 = 8.45, P = 0.004) and 2008 (χ_1^2 = 6.23, P = 0.013).

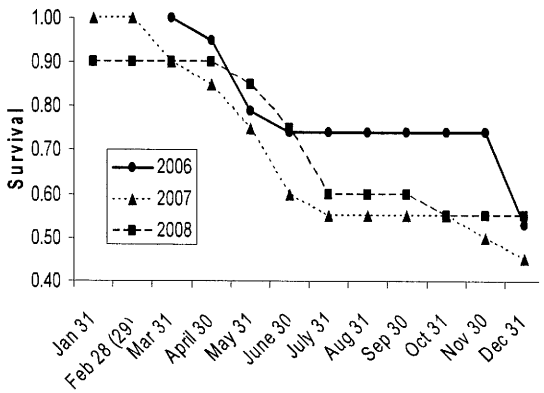
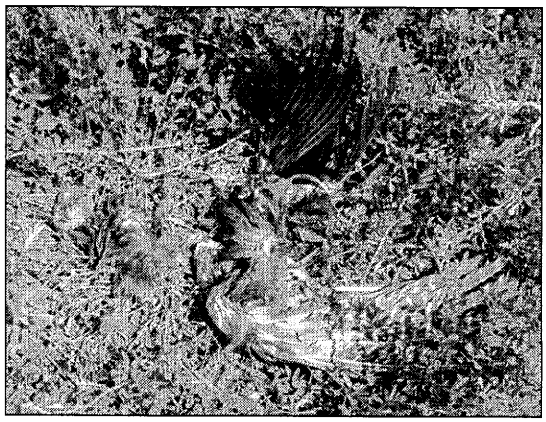


Figure 1. Annual survival distributions for translocated female turkeys in the Wessington Hills, South Dakota, 2006-2008.

While there was no significant difference among mean seasonal survival for all years combined (χ_1^2 = 5.14, P = 0.076; Appendix Table1), overall breeding season survival (0.66) was considerably less than the post-breeding survival (0.94). However, when we compared survival between female turkeys translocated from SD and those from PA, we found that females from SD (1.00) had nearly 2 times higher survival during the winter season versus those from PA (0.56) in 2008 (χ_1^2 = 13.44, P = 0.0002; Appendix Table 2; Appendix Figures 2-3).

We determined probable causes of mortalities to be mammalian predation (n = 9), unknown predation (n = 8), avian predation (n = 6), trampled by livestock on nest (n = 2), haying operation (n = 1), vehicle collision (n = 1), and unknown (n = 1).



The number one cause of death to adult turkeys was predation, especially by coyotes (Canis latrans).

Reproduction

For the 2006-2008 breeding seasons, 39 female turkeys initiated 49 nests, with 10 of these being second attempts. Nesting rates for all hens available during the breeding season was 0.72, 0.76, and 0.87 for 2006, 2007, and 2008, respectively. In cases where we were confident we got an accurate count of the number of eggs, 8 of the 27 (30%) first nest attempts and 3 of the 5 (60%) second nest attempts were successful in hatching ≥1 egg. Clutch size of these nests ranged from 4-19 eggs ($\bar{x}$ = 10.2, n = 27, SE = 1.96) for first nest attempts and 6-11 eggs ($\bar{x}$ = 9.0, n = 5, SE = 4.02) for second nest attempts. Of the 32 nests with countable hatched eggs, 112 of 127 eggs hatched for an average hatchability rate of 88% (range 50%-100%).

We found no significant difference for nest dispersal from release location among years ($F_{2,25}$ = 1.84, P = 0.184) or between first and second nest attempts (t_{21} = 0.43, P = 0.674). Therefore, for all nest attempts (n = 49) and years combined, the mean dispersal from release location to nest site was 3.6 km (Appendix Table 3). In addition, we found no

difference in nest dispersal between female turkeys translocated from SD to those from PA ($t_{2,14}$ = -0.91, P = 0.369).

We found no significant difference in nest site fidelity ($F_{2,14}$ = 0.09, P = 0.918) among years. Therefore, nest site fidelity distance for all years combined was 2.8 km (range 0.2-7.8 km [Appendix Table 4]).

A variety of habitats were used for nest sites during the 2006-2008 nesting seasons (Appendix Figure 4). General habitat classes used included pastures (31%), woodlands (24%), idle grasslands (16%), haylands (14%), roadways (10%), and croplands (4%). Specific types of nesting cover included snowberry (33% [*Symphoricarpos albus*]), grasses (27%), and alfalfa (16% [*Medicago sativa*]). Additionally, 12% of nests were located in Conservation Reserve Program lands and 8% were in roadside ditches.

Successful turkey nest located underneath downed tree limbs and characterized by eggs with their end caps removed and detached membranes.

We estimated brood survival up to 4 weeks age as 0.75 (n = 3, SE = 0.22), 0.00 (n = 1), and 0.40 (n = 5, SE = 0.22) in 2006, 2007, and 2008, respectively. Predation was the only known cause of mortality for females and broods, occurring from 1-11 days after hatch.

Habitat use

Home range size: We used 2,597 daytime relocations to calculate 69 seasonal home ranges on 25 individual female turkeys (Appendix Table 5). The number of relocations available for each female ranged from 30-47 (median = 37). Error ellipse size for the

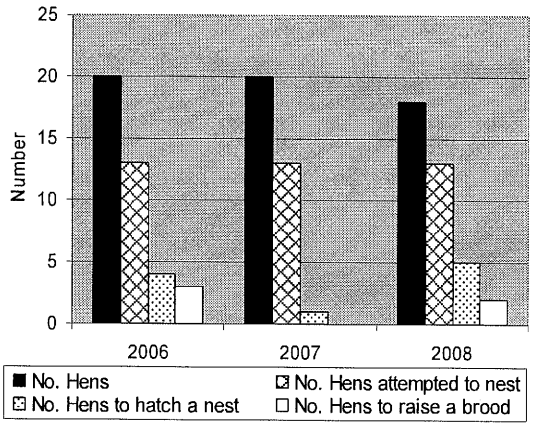


Figure 2. Reproduction of translocated female turkeys by nest attempts, successful nests, and rearing of brood to 4 weeks of age in the Wessington Hills, South Dakota, 2006-2008.

relocations used averaged 0.34 ha (range = 0.00-2.32 ha). We collected relocations >24 hours after the previous relocation. We found a significant difference in home range size among years ($F_{2,18}$ = 3.94, P = 0.038), where home ranges in 2007 were 44% smaller than those in 2006 (t_{18} = 2.24, P = 0.038) and 53% smaller than those in 2008 (t_{18} = -2.36, P = 0.030). In addition, we found a significant difference in home range size among seasons ($F_{2,46}$ = 3.88, P = 0.028), where post-breeding home ranges were less than half the size of breeding home ranges (t_{46} = 2.71, P = 0.01) and 34% smaller than winter home ranges (t_{46} = -1.03, P = 0.31). We found no difference in home range size of turkeys translocated from SD compared to those from PA (t_{19} = -0.46, P = 0.65)

Habitat selection: We used 59 female turkey home ranges (Appendix Figures 8-14) to conduct compositional analysis and determine whether or not habitat selection was occurring. We did not use 10 other home ranges because all or part of the home range was outside the study area boundary. We determined that habitat selection was occurring at both landscape (Wilks' Λ < 0.001) and local (Wilks' Λ < 0.001) scales. As expected, woodlands ranked significantly higher in importance than all other habitat categories at both landscape and local scales. Standardized selection ratios revealed that woodlands were used 4.4 and 3.1 times more than random selection would predict at the landscape and local scales, respectively (Fig. 3). At the landscape scale, pastures and farmsteads ranked as the second and third

most important habitat categories to female turkeys. Water and pastures ranked as the second and third most important habitat categories at the local scale.

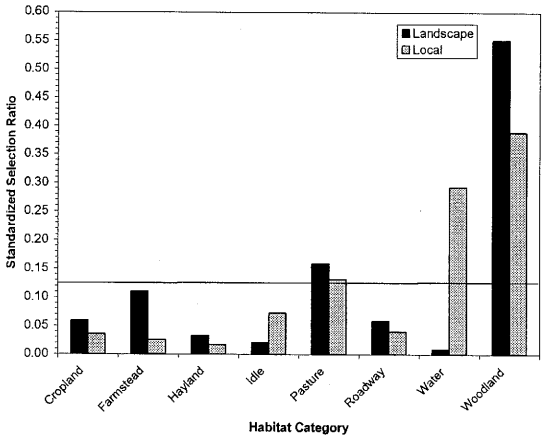


Figure 3. Standardized selection ratios illustrating the magnitude of habitat selection of female wild turkeys in the Wessington Hills, South Dakota, 2006-2008. The horizontal line indicates random selection (Krebs 1999).

Farmstead Use: Standardized selection ratios (Fig. 3) revealed that female turkeys used farmstead habitat 12% and 80% less than random selection would predict at the landscape and local scales, respectively. There were 36 occupied and 14 unoccupied farmsteads within our study area, equaling 0.25 farmsteads/km^2. Farmsteads made up <2% of the total land cover within our study area. Of all the female turkey home ranges that fell within the study area, 95% contained at least 1 farmstead. On average, farmsteads made up 2% of the total home range area. When we examined turkey relocations buffered by the median error ellipse, we found that <1% of the total area within all buffered relocations was farmstead habitat. We interpret these results as avoidance of turkeys to farmsteads, even though most farmsteads contained wooded habitat in the form of adjacent shelterbelts and windbreaks.

DISCUSSION

Female eastern wild turkeys translocated into the Wessington Hills exhibited a much lower annual survival rate (0.50) when compared to those translocated into the riparian woodlands of the James River in eastern South Dakota (0.78 [Leif 1997]) and in northeastern South Dakota (0.67 [Lehman 1998], 0.67 [Shields 2001]). However, our annual survival was similar to other research on eastern wild turkeys from Iowa (Little and Varland 1981; Kurzejeski et al. 1987), Ohio (Clark 1985), and Wisconsin (Wright et al. 1996). Similar to Leif (1997) and in contrast to Lehman (1998), we found no female mortalities to be the direct result of winter weather or starvation.

In comparing annual survival between the two sources of turkeys for this project, the assumption can be made that female turkeys translocated from SD were more accustomed to minimally forested habitats like those found within our study area, and perhaps to the extreme winter weather conditions found in Northern Great Plains, than those females translocated from PA.

Mortality for female turkeys was greatest during the breeding season as found in similar studies (Leif 1997, Lehman 1998). Selecting nest locations, incubating nests, and caring for young poults make female turkeys more vulnerable to predators during this time of year.

During our study, nest success and brood survival were noticeably less than desired for expansion of the population. Predation upon nests and females with poults were significant factors relating to the poor reproduction we observed.

Breeding home ranges during our study were among the largest reported for the eastern subspecies, with only those from Mississippi having been documented as larger (Goodwin et al. 1995). Other research on eastern wild turkeys from Alabama (Hillestad 1973, Speake et al. 1975), Minnesota (Porter 1980), Georgia (Eichholz and Marchinton 1975), Iowa (Little and Varland 1981), and West Virginia (Pack et al. 1980) all reported considerably smaller home ranges. The large home ranges we observed may be the result of poor habitat quality within our study area (Flake et al. 2006) or low population density, or a combination of the two. Compared to other studies evaluating translocated eastern turkey populations in South Dakota, we found larger home ranges for breeding, post-breeding and winter seasons than were reported by Leif (1997), Lehman (1999) and Shields (2001).

We observed the largest home ranges of female turkeys during the breeding season, when females would likely be dispersing to find males

and nesting locations (Porter 1977). Home ranges decreased in size following the hatching of poults, and then further decreased in size during the winter when turkeys flock together in large groups.

As expected, our radio-marked turkeys selected for woodlands more than any other habitat, which is similar to results found in other Midwestern states (Clark 1985, McCabe and Flake 1985, Kurzejeski and Lewis 1990, and Flake et al. 2006). On average, female home ranges were comprised of 56% pastures, 20% croplands, and 14% woodlands. At the landscape scale, our results indicate female turkeys centered their home ranges around large wooded draws located along the eastern edge of the Missouri Coteau landform region (Appendix Figure 1). Standardized selection ratios at the landscape scale also indicated that female turkeys used pasture habitats greater than random selection would have predicted. However, as most of the large wooded draws are surrounded by pasture, the turkeys' use of pasture habitats may be the result of its juxtaposition to woodlands and not the turkeys' actual preference for pastures.

At the local scale, standardized selection ratios indicated female turkeys were selecting for water and wetlands, which is likely due to the presence of trees and shrubs near intermittent streams and ponds. In addition, we anticipated a larger proportional use of croplands at the local scale because most of our relocations were collected during the daytime when turkeys would be foraging (Flake et al. 2006). However, out of 8 habitat classes cropland was ranked fifth, indicating that the females were spending a considerable amount of time foraging in habitats other than croplands. Shields (2001) found a similar result in northeastern South Dakota, where eastern wild turkeys used croplands less than anticipated. However, most of our relocations during the winter were associated with an area that included a 4.0 ha corn food plot adjacent to a field windbreak. This particular windbreak was comprised of large cottonwood trees providing desirable roosting habitat. The close proximity of food and roosting habitats could have under represented the use of cropland as a selected habitat type during the winter season.

Our findings support the suggestions by Leif (1997) and Lehman (1999) that eastern wild turkeys are less likely to cause farmstead depredation than the Merriam subspecies. Our standardized selection ratios at the landscape scale indicated that turkeys were selecting farmsteads near to what random selection would predict. Although, at the local scale, turkeys selected farmsteads 4 times less, suggesting that even though farmsteads and their adjacent shelterbelts were being included in turkey home ranges, the turkeys were not spending a significant amount of time within these habitats. None of our radio-collared females nested in a farmstead. Additionally, during our study we received no turkey depredation complaints from farmers within the study area. However, depredation complaints typically manifest themselves in areas with high turkey densities (Tefft et al. 2005), whereas our study area had a relatively low turkey density of approximately 4/km^2.

In comparing the 2 sources of turkeys for this study (i.e. SD and PA), we found no significant differences in dispersal distance from release location to nest sites, nest site fidelity, or home range size. However, female turkeys from SD did appear to have higher seasonal survival rates, in particular during the winter seasons. This may be attributed to the similarity between the landscapes and winter conditions of this study area and northeastern South Dakota. Therefore, we assume that females from PA had to adjust to new habitat types and may not have experienced similar winter weather conditions.

When we compared this population of eastern turkeys in the Wessington Hills to other eastern turkey populations studied in South Dakota, we observed lower seasonal and annual survival. Lehman (1999) and Shields (2001) reported higher survival rates in a similar landscape in northeastern South Dakota. However, the availability of suitable habitat along the portion of the Coteau des Prairie landform region in northeastern South Dakota is much larger than found on or adjacent to our study area, and may have led to increased survival rates. In addition, Leif (1997) found higher survival rates for eastern turkeys translocated into the lower James River Valley, which provides greater woodland habitat associated with the river system and adjacent woody draws. At least during the first 3 years following the translocation, minimally forested habitat surrounded by an agricultural landscape, along with high rates of predation, may have restricted this turkey population from attaining the higher

levels of survival and reproduction reported in similar studies.

MANAGEMENT IMPLICATIONS

Our results indicate that these translocated eastern wild turkeys were sustaining a population; however, there was no significant expansion in range or population density during our study. This may be the result of a lag time after translocating turkeys, during which the turkeys are becoming familiar to a new landscape and making fitness adjustments. Alternatively, less than ideal habitat conditions and predation pressure may limit this population, thus preventing it from reaching a density where range expansion is necessary. It will be important to monitor this population to determine if they begin to expand and fill in adjacent habitats, as this will provide valuable information into the suitability of using areas void of major riparian corridors as translocation sites.

Woodland habitat comprised only 3% of the total land cover in our study area which was void of a major river corridor. Leif (1997) reported that river corridors in eastern South Dakota containing at least 15% woodland habitat should be able to support a wild turkey population. Though our study area provided woodland drainages and field windbreaks, the absence of a river system and such a small percentage of available woodland habitat, may have been below the threshold needed for this population to reach a level of survival and reproduction necessary to increase and expand their range. Home ranges within our study area included 14% woodland habitat. To increase the success of future wild turkey translocations into marginal habitat void of a river corridor in eastern South Dakota, we recommend sites should contain at least 20% woodland habitat, with as much connectivity among woodland habitats as possible.

Wildlife managers should also take into consideration grassland habitat, with a significant portion comprised of CRP or other grassland managed by deferred or rotational grazing systems located adjacent or in close proximity to woodland habitat. The inclusion of perennial streams and wooded tributaries associated with major river systems in eastern South Dakota could enhance the success of future wild turkey translocation projects. Other important considerations include interested landowners and the absence of domestic turkeys, riparian areas and seasonal streams that provide under story cover, wide field windbreaks and shelterbelts comprised of tree species capable of providing roosting habitat, and properly placed food plots to increase winter survival in marginal habitats.

Based upon their avoidance of farmsteads, eastern wild turkeys should be considered for release in eastern South Dakota and other similar landscapes to reduce nuisance activities, such as damage to stored crops. To increase the success of future translocation projects, we recommend the use of eastern wild turkeys from South Dakota or adjacent states.

Winter flock counts conducted during the winter of 2008-2009 indicated a population of approximately 60 turkeys, with approximately 12 mature male turkeys. Therefore, the South Dakota Game, Fish and Parks Commission approved the inclusion of Hand County for the 2009 spring archery turkey season. Since our study area included no public hunting lands, this season was approved to provide recreational hunting opportunities on private land where hunting was allowed. We recommend the use of winter flock and landowner surveys in the future to monitor the population. These surveys will provide population estimates, any indication of expansion to their current range, and to determine if landowners begin to report turkey depredation associated with farmstead habitats. This will provide wildlife managers with information needed to make season recommendations for proper management and to provide for recreational opportunities.

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APPENDIX

Appendix Table 1. Estimates of seasonal and annual survival rates of translocated female wild turkeys in the Wessington Hills, South Dakota, 2006-2008.

	2006			2007			2008		
Time Period[a]	*n*	*S*	SE	*n*	*S*	SE	*n*	*S*	SE
Breeding	20	0.74	0.10	18	0.61	0.11	17	0.65	0.12
Post Breeding	14	1.00	0.00	11	0.91	0.09	11	0.91	0.09
Winter	20	1.00	0.00	24	0.64	0.09	20	0.76	0.09
Annual	20	0.53	0.11	22	0.45	0.11	21	0.55	0.11

[a] Breeding (1 April-31July), Post-Breeding (1 August-30 November), Winter (1 December-31 March), Annual (1 January-31 December).

Appendix Table 2. Comparison of seasonal and annual survival rate estimates between female wild turkeys translocated from SD and PA in the Wessington Hills, South Dakota (2006-2008).

	SD			PA		
Time Period[a]	*n*	*S*	SE	*n*	*S*	SE
2006						
Breeding	20	0.74	0.10			
Post-Breeding	14	1.00	0.00			
Winter	20	1.00	0.00			
Annual	20	0.53	0.11			
2007						
Breeding	10	0.70	0.14	8	0.50	0.18
Post-Breeding	7	1.00	0.00	4	0.75	0.22
Winter	14	0.71	0.12	12	0.81	0.13
Annual	10	0.70	0.14	12	0.20	0.10
2008						
Breeding	7	0.71	0.16	10	0.60	0.15
Post-Breeding	5	1.00	0.00	6	0.83	0.15
Winter	7	1.00	0.00	14	0.56	0.12
Annual	7	0.71	0.17	13	0.23	0.09

[a]Breeding (1 April-31 July), Post-Breeding (1 August-30 November), Winter (1 December-31 March), Annual (1 January-31 December).

Appendix Table 3. Mean ± SE dispersal distances (km) of nests for female wild turkeys in the Wessington Hills, South Dakota, 2006-2008.

Year	*n*	$\bar{x}$ ± SE	Range
2006	15	3.8 ± 4.2	0.6-15.4
2007	16	2.8 ± 3.9	0.4-16.8
2008	18	4.1 ± 4.9	0.4-19.6
All Yrs. Combined	49	3.6 ± 4.4	0.4-19.6

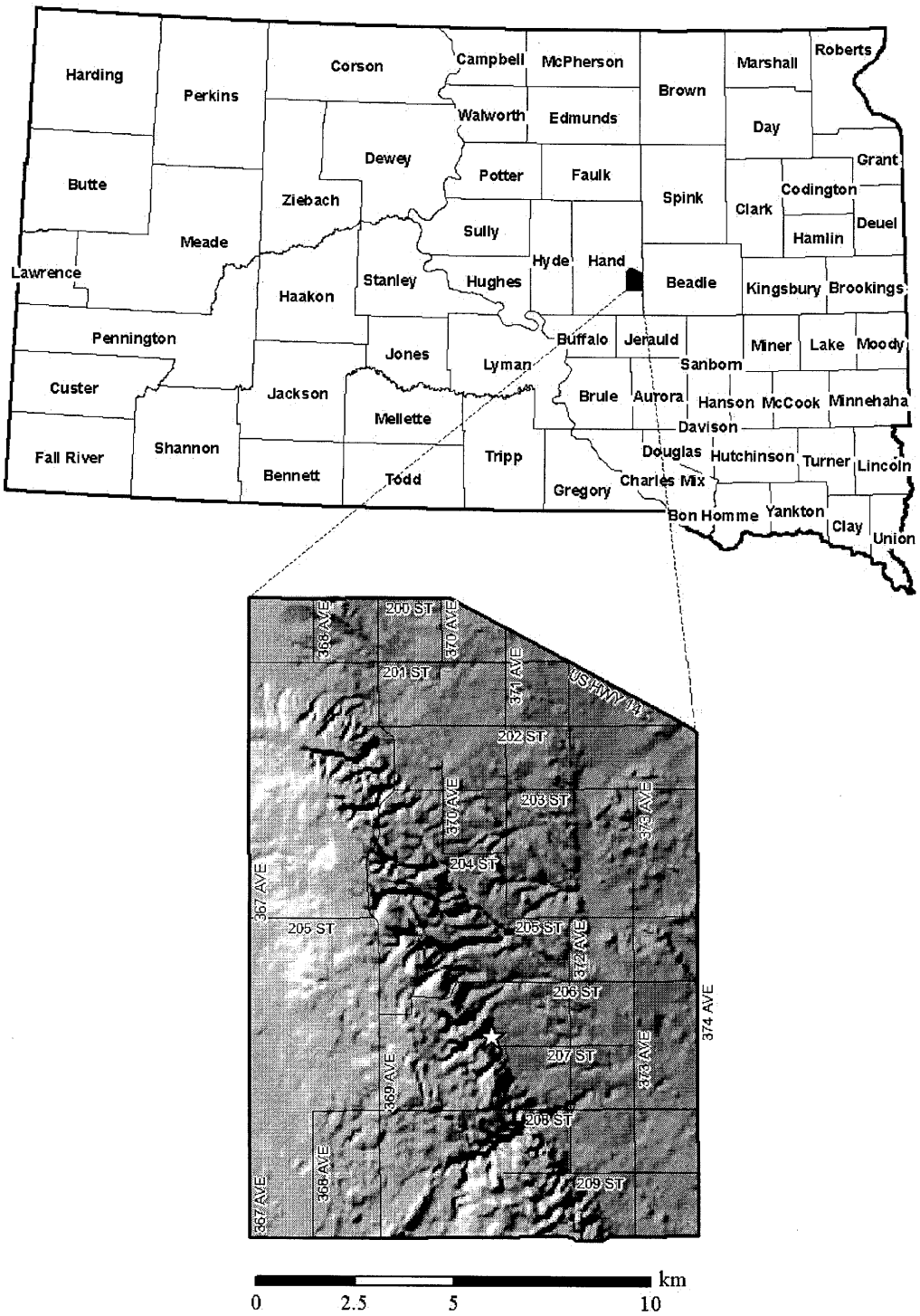
Appendix Table 4. Mean ± SE nest site fidelity (km) for female wild turkeys in the Wessington Hills, South Dakota, 2006-2008.

Year	*n*	$\bar{x}$ ± SE	Range
2006-2007	7	3.0 ± 3.0	0.2-7.8
2006-2008	4	2.6 ± 1.6	0.3-4.2
2007-2008	6	2.5 ± 2.1	0.4-5.8
All Yrs. Combined	17	2.8 ± 2.3	0.2-7.8

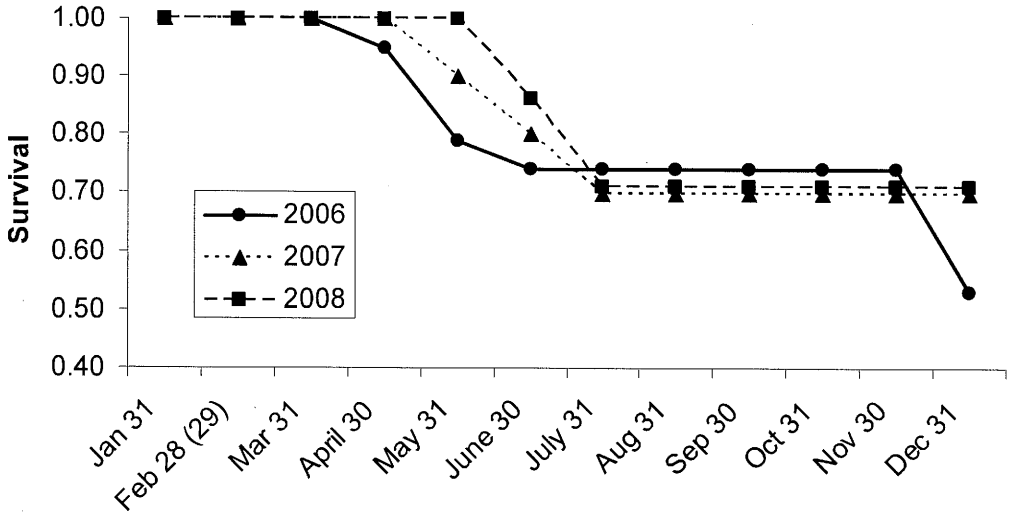
Appendix Table 5. Mean home range size (ha) of female wild turkeys in the Wessington Hills, South Dakota (2006-2008).

	2006			2007			2008			All years			
	n	$\bar{x}$	95% CI	*n*	$\bar{x}$	95% CI	*n*	$\bar{x}$	95% CI	*n*	No. individuals[a]	$\bar{x}$	95% CI
Breeding	11	748.1	391.6-1429.1	13	555.9	305.4-1011.8	14	805.3	450.6-1439.1	38	25	695.3	471.4-1025.7
Post breeding	4	958.7	320.2-2870.1	11	177.1	90.5-346.6				15	14	274.7	155.3-485.9
Winter	10	452.4	223.9-914.4	6	358.0	148.2-865.2				16	11	416.8	232.2-748.2

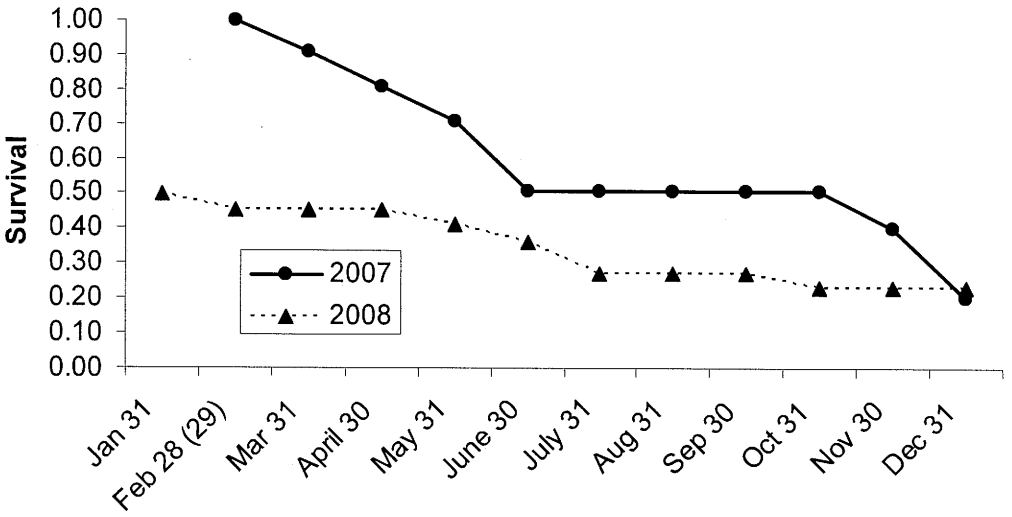
[a]Some home ranges were calculated on the same individual for in more than one year.



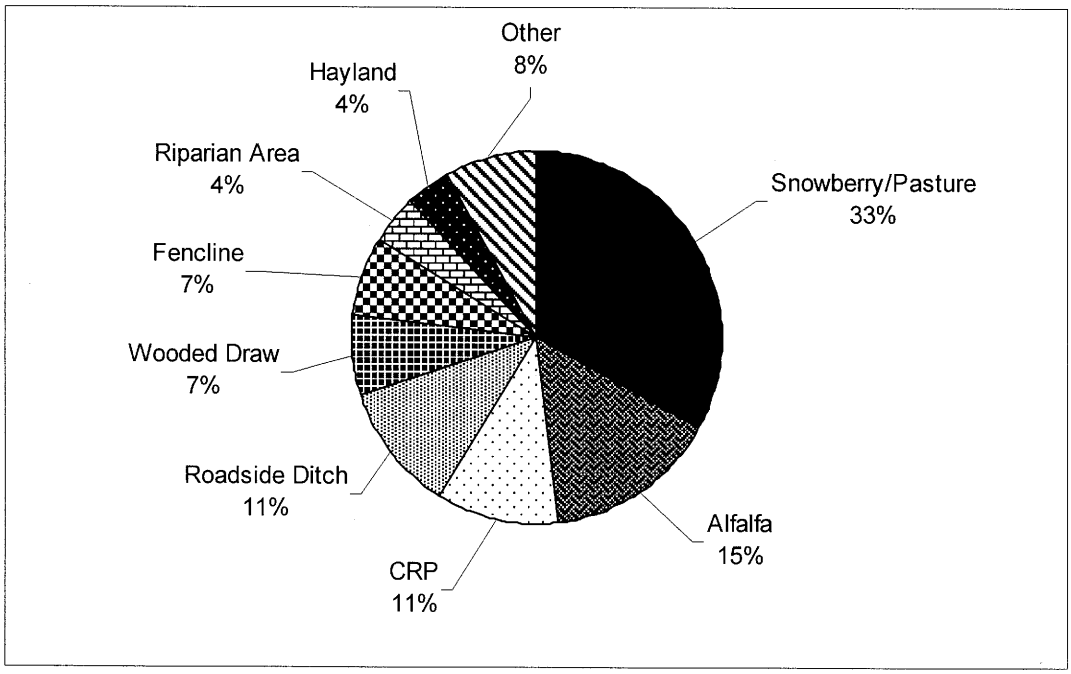
Appendix Figure 1. Location of study area in eastern Hand County, South Dakota, 2006-2008. The star indicates the release location of the eastern wild turkeys.



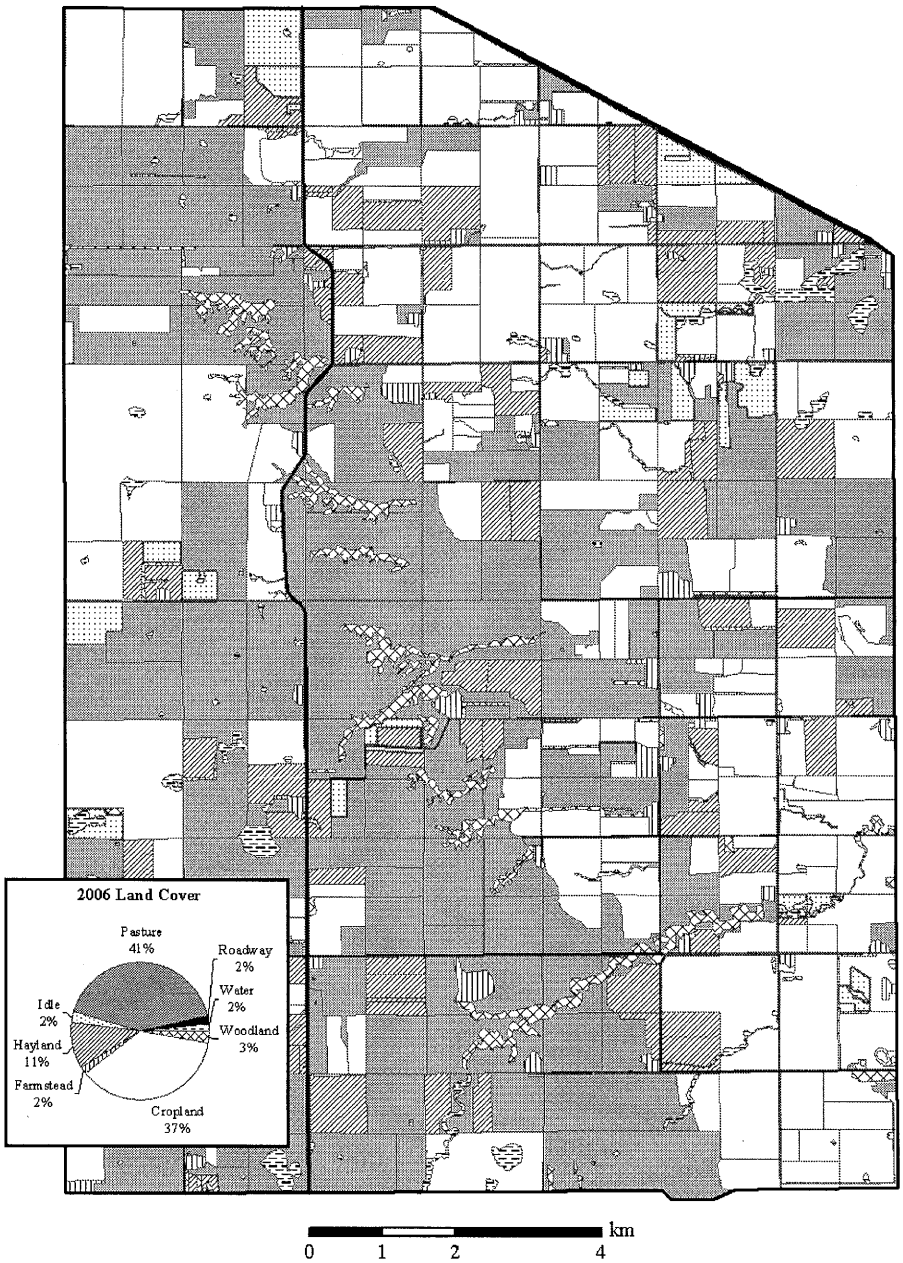
Appendix Figure 2. Annual survival distributions for female wild turkeys translocated from Grant County, South Dakota to the Wessington Hills, South Dakota, 2006-2008.



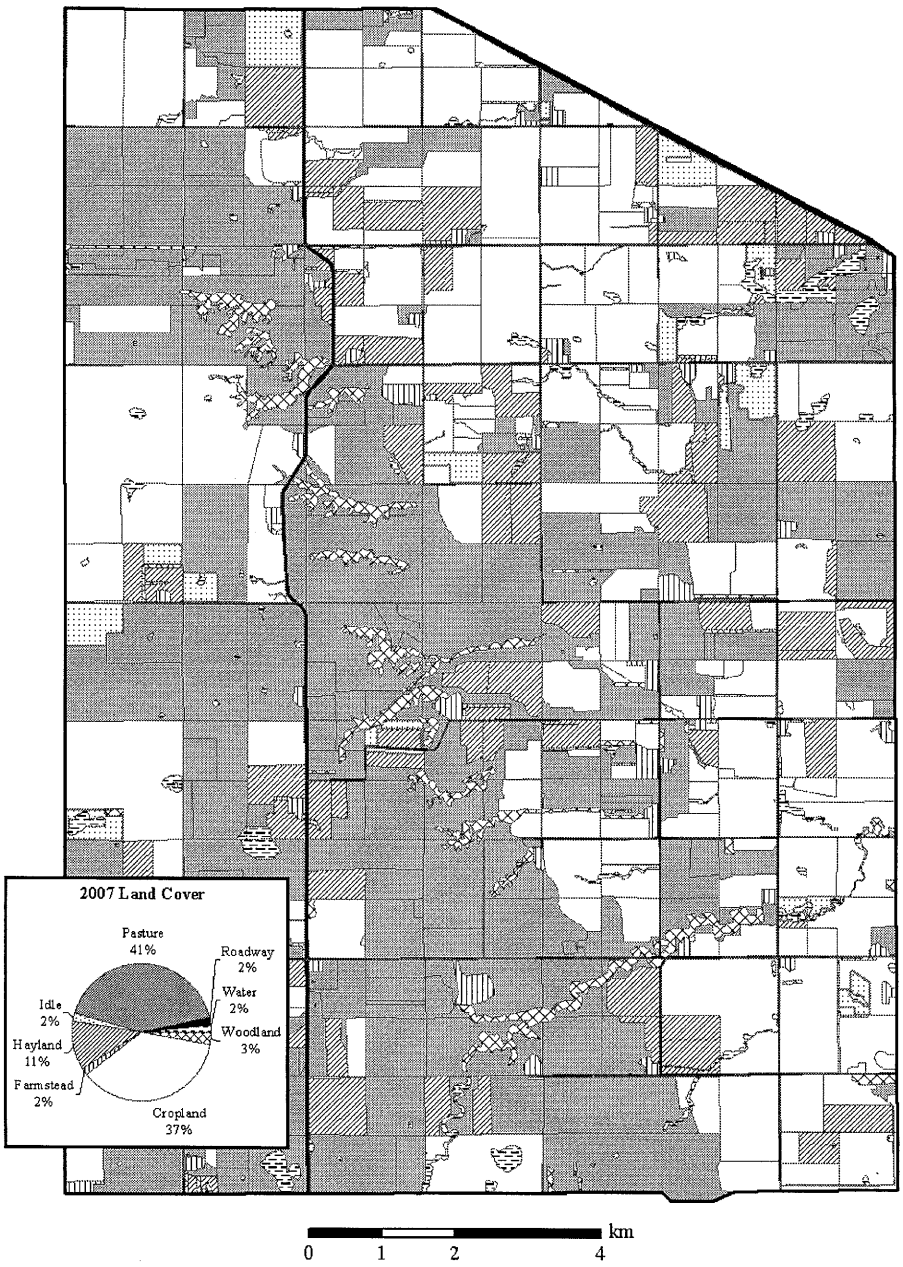
Appendix Figure 3. Annual survival distributions for female wild turkeys translocated from Pennsylvania to the Wessington Hills, South Dakota, 2007-2008.



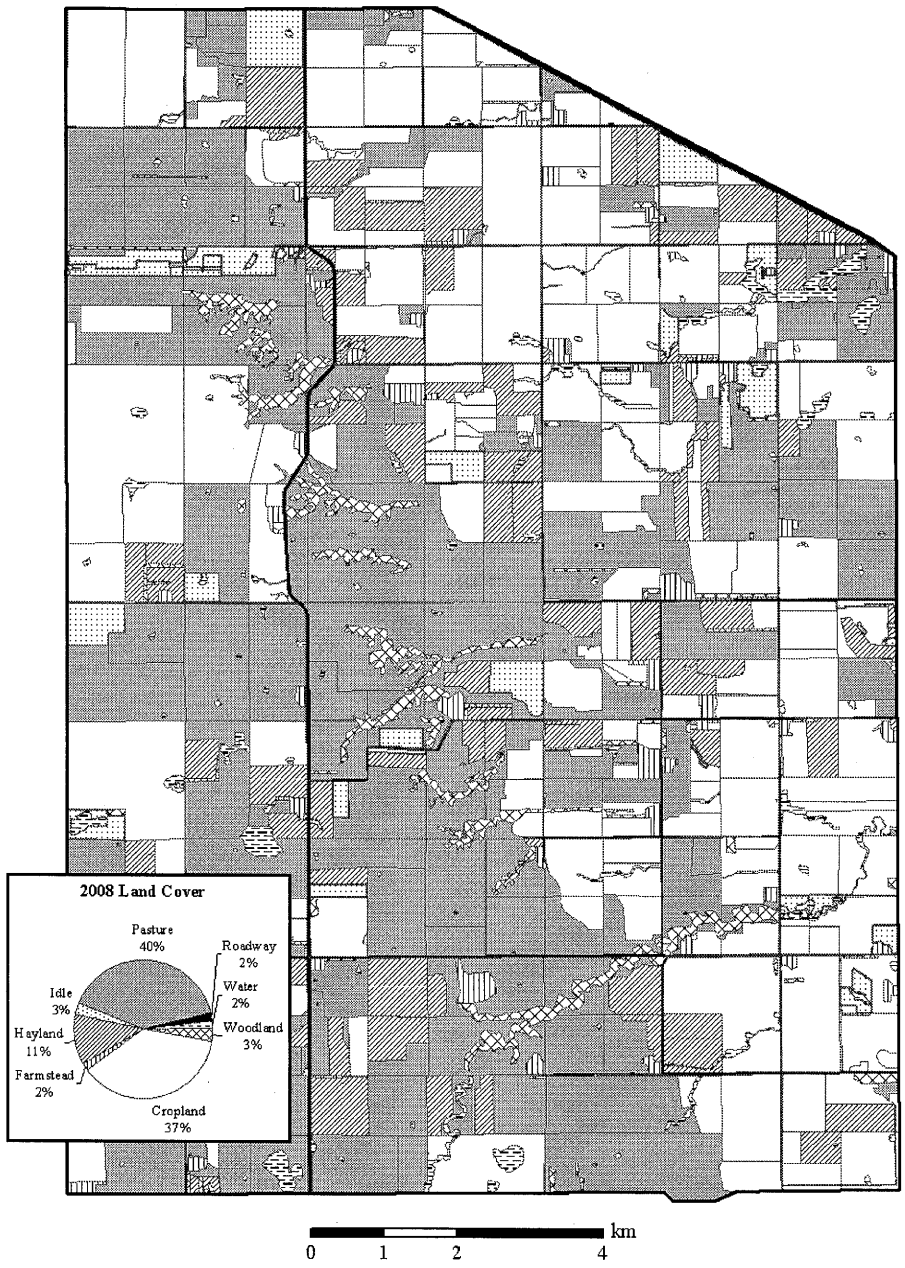
Appendix Figure 4. Nesting habitat cover selected by translocated female wild turkeys in the Wessington Hills, South Dakota, 2006-2008.



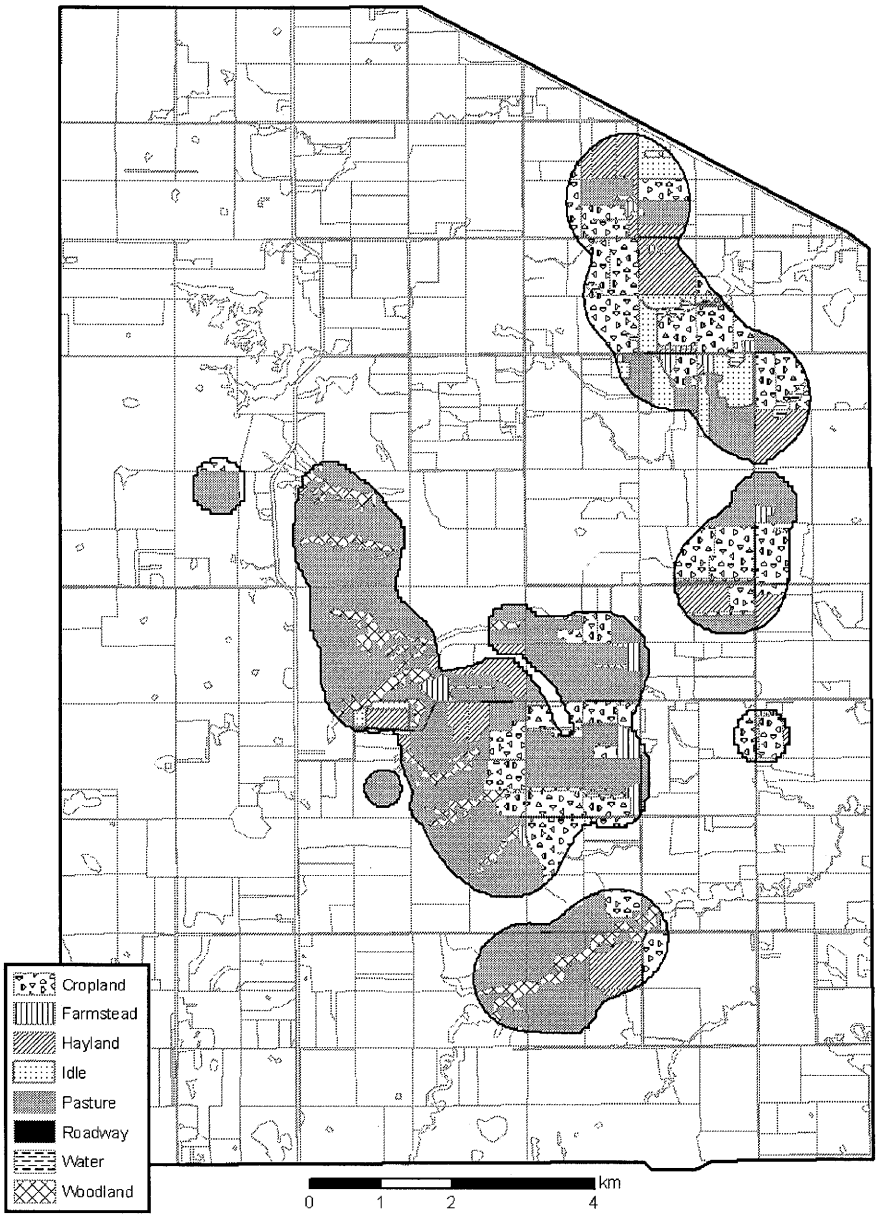
Appendix Figure 5. Study area land cover in 2006. Field boundaries were delineated on the basis of common land units by the Farm Service Agency, United States Department of Agriculture. Land cover classifications were ground-thruthed for the entire study area.



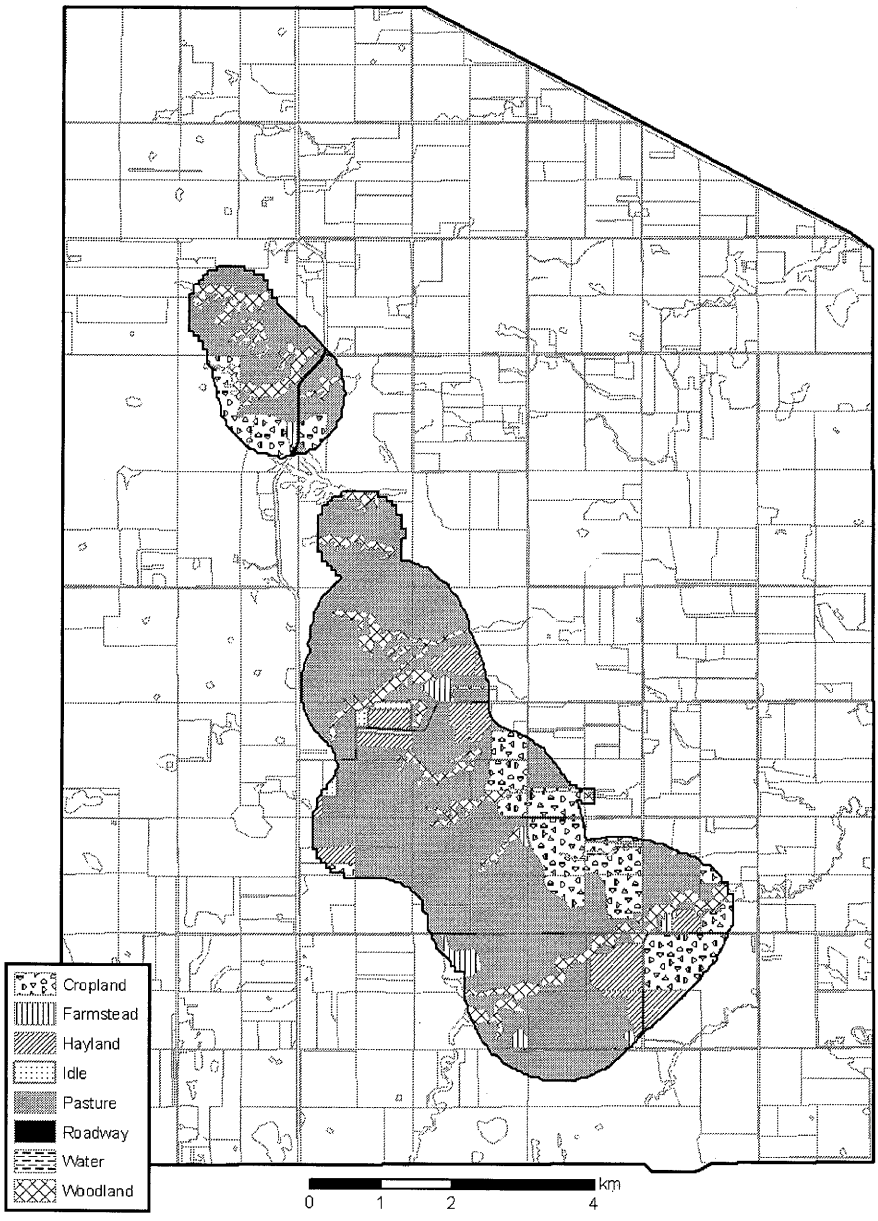
Appendix Figure 6. Study area land cover in 2007. Field boundaries were delineated on the basis of common land units by the Farm Service Agency, United States Department of Agriculture. Land cover classifications were ground-thruthed for the entire study area.



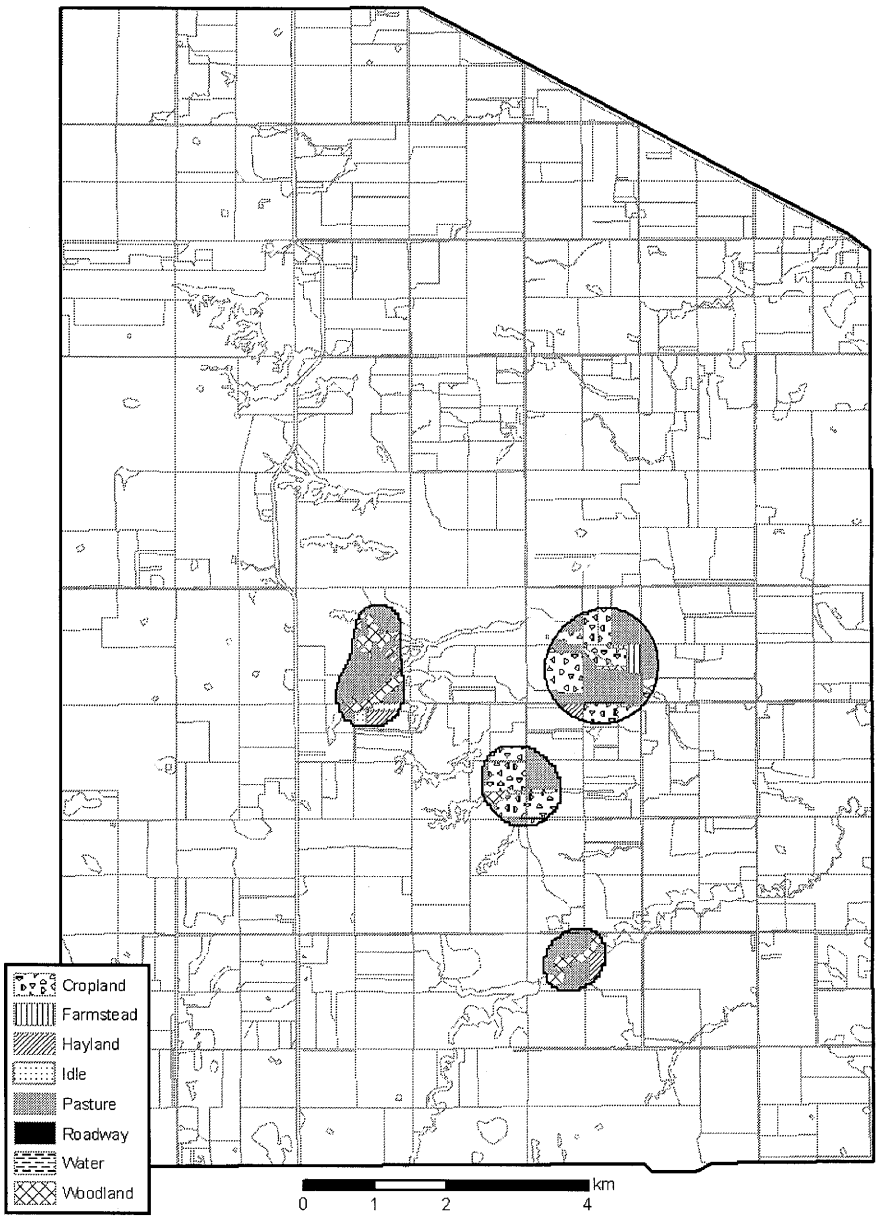
Appendix Figure 7. Study area land cover in 2008. Field boundaries were delineated on the basis of common land units by the Farm Service Agency, United States Department of Agriculture. Land cover classifications were ground-thruthed for the entire study area.



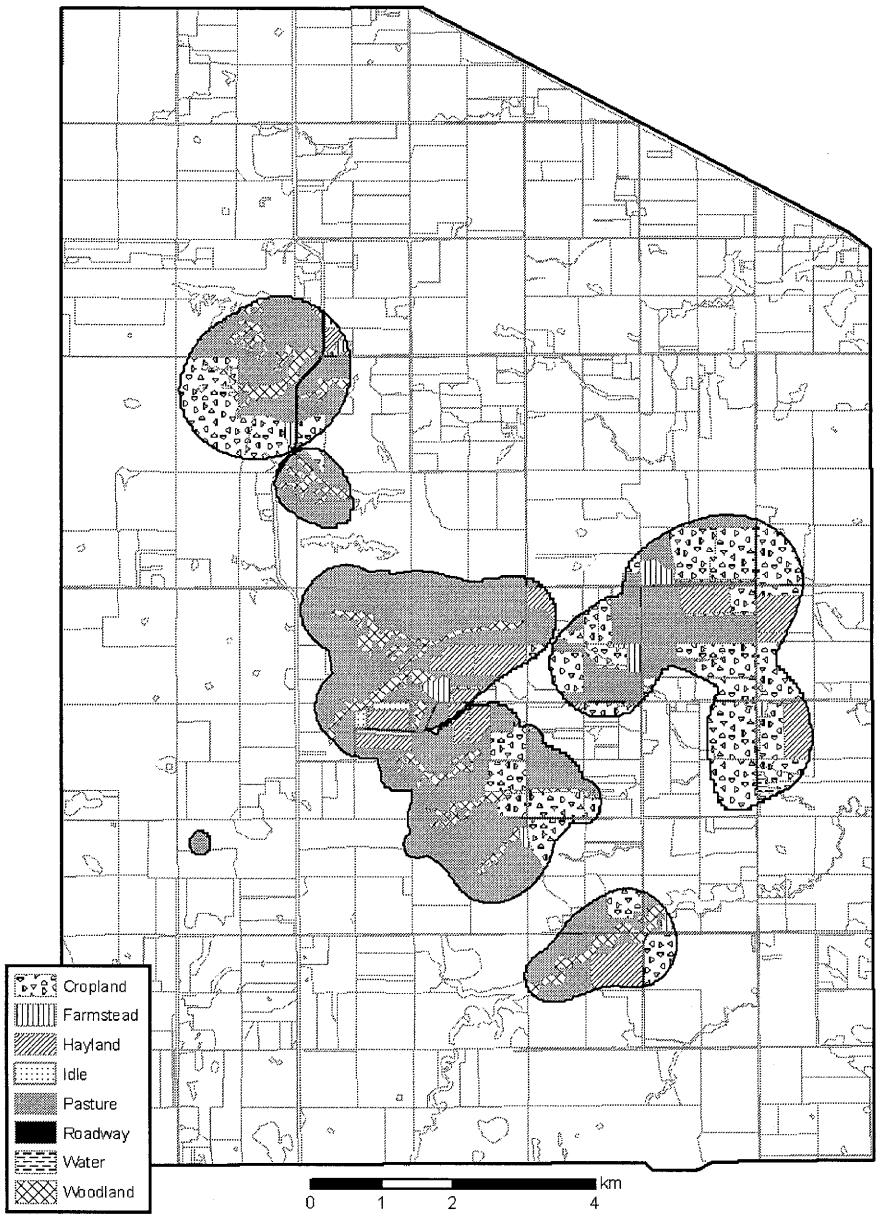
Appendix Figure 8. Aggregate home range of female wild turkeys in Hand county, South Dakota during the breeding season (1 April-31 July) of 2006. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



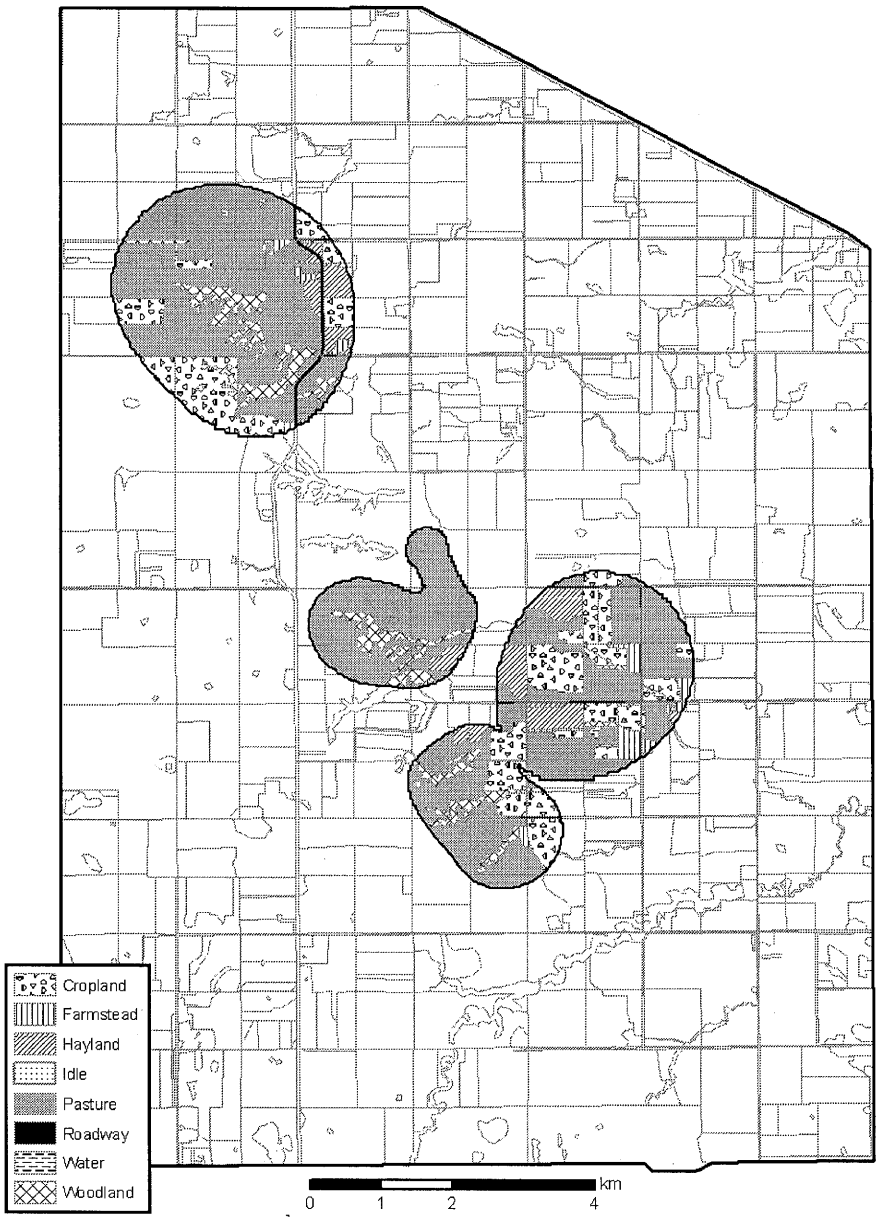
Appendix Figure 9. Aggregate home range of female wild turkeys in Hand county, South Dakota during the post-breeding season (1 August-30 November) of 2006. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



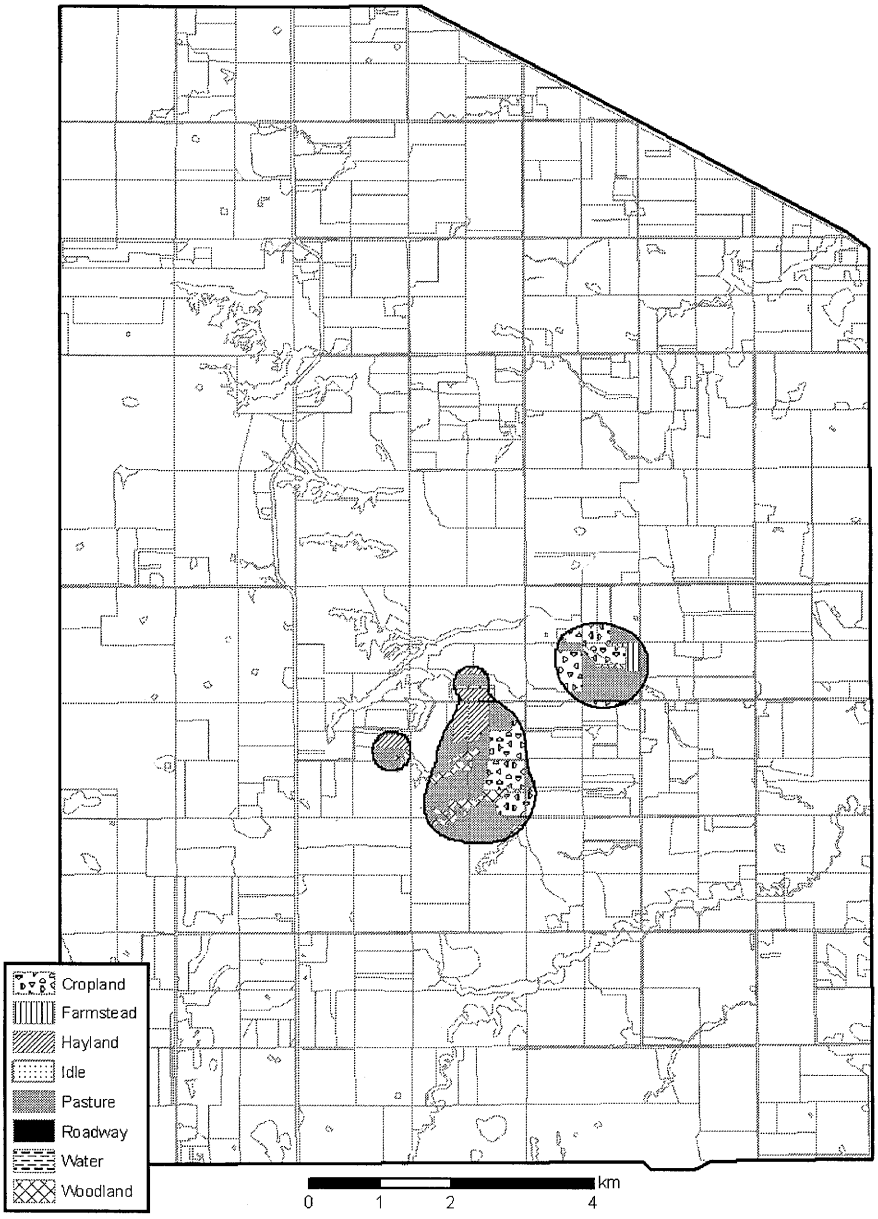
Appendix Figure 10. Aggregate home range of female wild turkeys in Hand county, South Dakota during the winter season (1 December-31 March) of 2006 and 2007. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



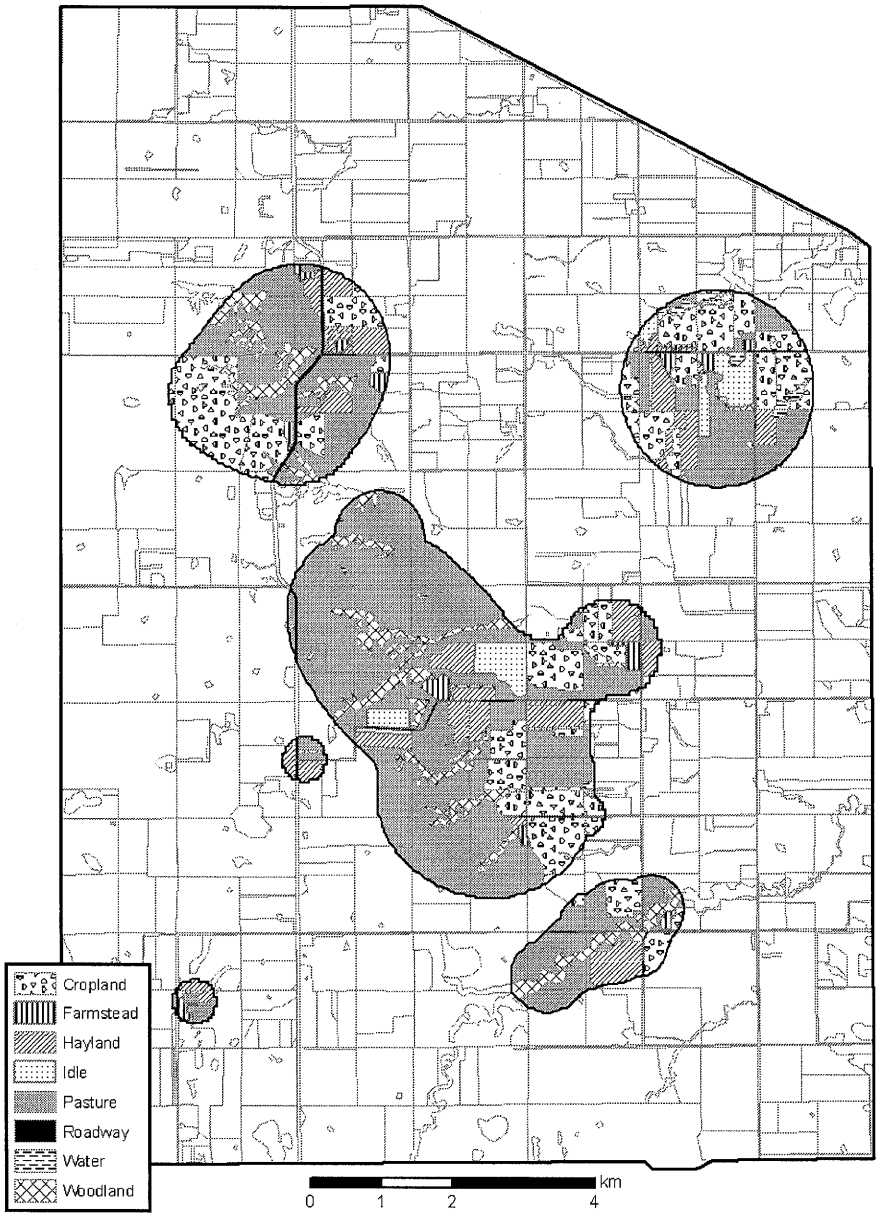
Appendix Figure 11. Aggregate home range of female wild turkeys in Hand county, South Dakota during the breeding season (1 April-31 July) of 2007. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



Appendix Figure 12. Aggregate home range of female wild turkeys in Hand county, South Dakota during the post-breeding season (1 August-30 November) of 2007. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



Appendix Figure 13. Aggregate home range of female wild turkeys in Hand county, South Dakota during the winter season (1 December-31 March) of 2007 and 2008. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).



Appendix Figure 14. Aggregate home range of female wild turkeys in Hand county, South Dakota during the breeding season (1 April-31 July) of 2008. Home ranges were calculated using a fixed-kernel estimator (Worton 1989).