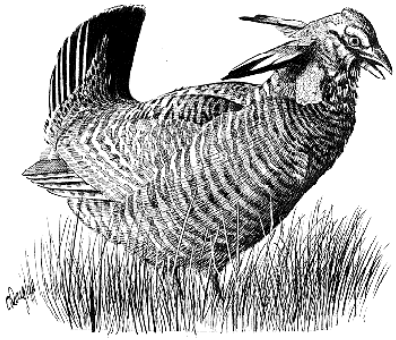
GAME REPORT

Spatial Ecology, Land Use, Harvest, and the Effect of Dog Training on Sympatric Greater Prairie-Chickens and Sharp-tailed Grouse on the Fort Pierre National Grasslands, South Dakota

Thomas R. Kirschenmann



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by

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Abstract

Spatial Ecology, Land Use, Harvest, and the Effect of Dog Training on Sympatric Greater Prairie-Chickens and Sharp-tailed Grouse on the Fort Pierre National Grasslands, South Dakota

Concern over the effects of dog training activities on prairie grouse survival and behavior on the Ft. Pierre National Grasslands has existed for many years. Heightened awareness, concerns, and the continued popularity of dog training on national grasslands in South Dakota have all escalated, resulting in a study to determine the impacts of these activities, and to provide recommendations for future recreational uses of these resources. Evaluating these activities also provided the opportunity to collect additional information on grouse ecology which will provide insight for future management recommendations on both public and private land. Sharp-tailed grouse (*Tympanuchus phasianellus*) and Greater Prairie Chicken (*Tympanuchus cupido*) hens and chicks were fitted with radio transmitters to gather demographic and behavioral information for grouse populations on the Fort Pierre National Grasslands in central South Dakota during the summer months of 2003-2005.

Hen home ranges (hens with broods) for Sharp-tailed grouse (ST) and Greater Prairie Chicken (PC) were similar ($P = 0.482$) during the three year study (ST – 184 ha; PC – 174 ha). A minimum home range of 77 ha and a maximum of 303 ha was found for PC hens, while ST minimum home range size was 99 ha and a maximum of 274 ha. Dispersal distances (straight line distance from lek capture to nest site) was also similar between species ($P = 0.988$; PC – 1,978 m, ST – 2,037 m). Maximum dispersal distance for PC was 7,113 m, however one ST hen initiated a nest 12,270 m from the lek site where captured. Prairie chickens and ST both dispersed in random directions from lek sites to nest sites ($P = 0.483$, $P = 0.088$ respectively). A strong relationship existed between brood age and home range size for PC ($r^2 = 0.998$) and ST ($r^2 = 0.995$), with the largest proportional changes occurring within the first six weeks.

Prairie chicken and ST hen home ranges exhibited selectivity for pastures where no grazing occurred the prior year or current year compared to pastures where grazing occurred the prior year. Considering pastures grazed the prior year, ST and PC selected those where grazing began after August 1 compared to pastures where grazing began before August 1. Comparison of the two species showed that ST were more selective of pastures not grazed than PC, however pastures where grazing began after August 1 the prior year was selected more by PC than ST ($P = 0.013$). Fifty-nine percent (40 of 69) of the total nest sites were found in pastures where no grazing occurred the prior year. Prairie chicken nest site selection was higher ($P < 0.05$) for pastures where no grazing occurred the prior year compared to pastures grazed, regardless of when grazing began. Pastures where grazing began after August 1 the prior year were not selected by ST ($P = 0.012$).

Prairie chicken and sharp-tailed grouse combined, twenty-one of 333 (6.3%) of all marked birds (males with leg bands, hens with necklace style radio transmitters, chicks fitted with back-pack radio transmitters) were reported to be harvested during the fall hunting seasons of 2003-2005. Over 85% (18 of 21) were harvested during Fall 1 (the fall of the year they were marked).

The impact of dog training activities on grouse survival and behavior appeared to be marginal. Our results indicate that under current levels of use and with current restrictions, this activity has minimal impacts on prairie grouse survival and distribution. Minimum chick survival rates were 92% during the month of August, regardless if found in open or closed dog training areas. Brood breakup was minimal for both ST and PC, however there were 4 more groups (group definition: hen with brood = 1 group; lone chick not associated with brood = 1 group) in the open dog training area for PC ($P > 0.05$) after training activities ceased. On the other hand, there was 1 more group counted for ST in both open and closed dog training areas. Avoidance characteristics indicated that multiple flushings from dog training pressure did not cause birds to exhibit "more wild" characteristics. No differences ($P > 0.05$) were detected for either PC or ST in respect to flush distances in open and closed training areas. Run effect results indicated the two grouse species responded oppositely, although no statistical differences ($P > 0.05$) were found. However, PC run effect distances were farther in closed areas, whereas ST run effect distances were longer in open dog training areas. In respect to age, hen ST run effect distances were farther ($P = 0.043$) than young of the year. When considering the difference in average daily movements between July and August, opposite results were determined for PC and ST. The difference in movements for ST was greater ($P = 0.017$) in areas open to dog training, however PC movements were less ($P > 0.05$). No differences ($P > 0.05$) were found for either PC or ST in the proportion of home range used prior to (July) and during (August) the dog training time frame comparing closed and open dog training areas, however PC home ranges overlapped by 58% during July and August on the area closed to dog training, while the overlap was only 38% on the open dog training area. Sharp-tailed grouse home range overlap was very similar in the open dog training area (31%) compared to the closed area (33%).

Spatial data obtained from this study provided supporting information that grouse populations are quite viable on a landscape managed for livestock, with wildlife management as a second priority. The management of Ft. Pierre National Grasslands provides an excellent model of grassland management that shows prairie grouse positively respond to grazing systems which include areas of annual rest, providing essential nesting and brood-rearing cover the following year. Although dog training from horseback has the potential of negatively impacting grouse, especially a distressed population with limited habitat, this study ascertained that these activities have minimal impacts where prairie grouse populations are relatively stable, habitat conditions are of higher quality, and where the number of trainers, dogs, and timing are restricted.

Preface

This report summarizes results of data collected by South Dakota Game, Fish, and Parks personnel from April 2003 through September 2005 on spatial ecology, land use, harvest, and the effects of dog training on Greater Prairie Chicken and Sharp-tailed Grouse on the Fort Pierre National Grasslands under Pittman-Robertson Project W-75-R, Study No. 75108.

This study was initiated to evaluate the potential effects of dog training activities with the use of horses, while also providing the opportunity to collect useful biological information on prairie grouse populations. These objectives were accomplished by tracking radio-marked prairie chicken and sharp-tailed grouse hens and chicks. Results from this study will be used to make recommendations and decisions on dog training activities on public land, as well as providing management recommendations to landowners interested in managing their property for prairie grouse.

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Spatial Ecology, Land Use, Harvest, and the Effect of Dog Training on Sympatric Greater Prairie-Chickens and Sharp-tailed Grouse on the Fort Pierre National Grasslands, South Dakota

Thomas R. Kirschenmann

The native range of Greater Prairie-Chicken (*Tympanuchus cupido*) (PC) and Sharp-tailed Grouse (*Tympanuchus phasianellus*) (ST) overlap in central South Dakota (Hillman and Jackson 1973). In the midst of this range overlap is the Fort Pierre National Grassland (hereafter, FPNG). The FPNG encompasses approximately 46,980 ha in central South Dakota and is managed for multiple uses that include livestock production, wildlife production and outdoor recreation. As such, the FPNG is a popular destination for both resident and nonresident grouse hunters. South Dakota annually hosts 7,500 – 13,000 resident and 4,000 – 6,000 nonresident grouse hunters statewide. These hunters have harvested as few as 40,000 (2004) and as many as 120,000 (2000) grouse per year (both species combined) over the past 10 years.

The FPNG is also a popular destination for bird dog enthusiasts to train hunting dogs, including the use of horses. At the onset of this study, use of horses while training dogs on the FPNG was allowed by obtaining a free permit (an unlimited number of permits available) from South Dakota Game, Fish, and Parks (GF&P). This permit allowed training with horses on Fridays, Saturdays and Sundays from the first Friday in August through the first Sunday in September. Despite these restrictions, many grouse hunters believe that this style of dog training impacts grouse hunting opportunities through reduced grouse survival, induced movements of grouse off the FPNG, and/or altering the flushing behavior of grouse. In 1999, SD Game, Fish and Parks (Giglotti 2000) conducted an opinion survey of grouse hunters that hunted the FPNG on opening weekend. Of those that had hunted the FPNG in past years, 45% believed the grouse flushing behavior was similar in 1999 to what it had been in past years. While only 6% of these hunters believed that grouse were "less wild" than past years, 46% perceived grouse to flush more wildly than past years. Hicks (1992a) reported that in Canada, dog trainers reduced grouse numbers by repeatedly flushing broods from preferred habitat, thus making them more susceptible to predation.

While ranges of prairie grouse have constricted over recent history, South Dakota is one of only a few states where PC and ST populations appear to be stable (Svedarsky et al. 2000), although populations can fluctuate appreciably between years. Aside from evaluating the potential conflict among recreational users of grouse on the FPNG, information on the spatial ecology and use of habitats by both grouse species was collected and examined for future management recommendations. Survival, reproduction and habitat use data was collected in conjunction with this study by South Dakota State University (Norton 2006). Data combined and simulated from the two reports will provide insight to important variables contributing to the dynamics of grouse populations and may also shed light on efforts to reestablish populations in restricted portions of the greater prairie-chicken range (Snyder et al. 1999).

OBJECTIVES

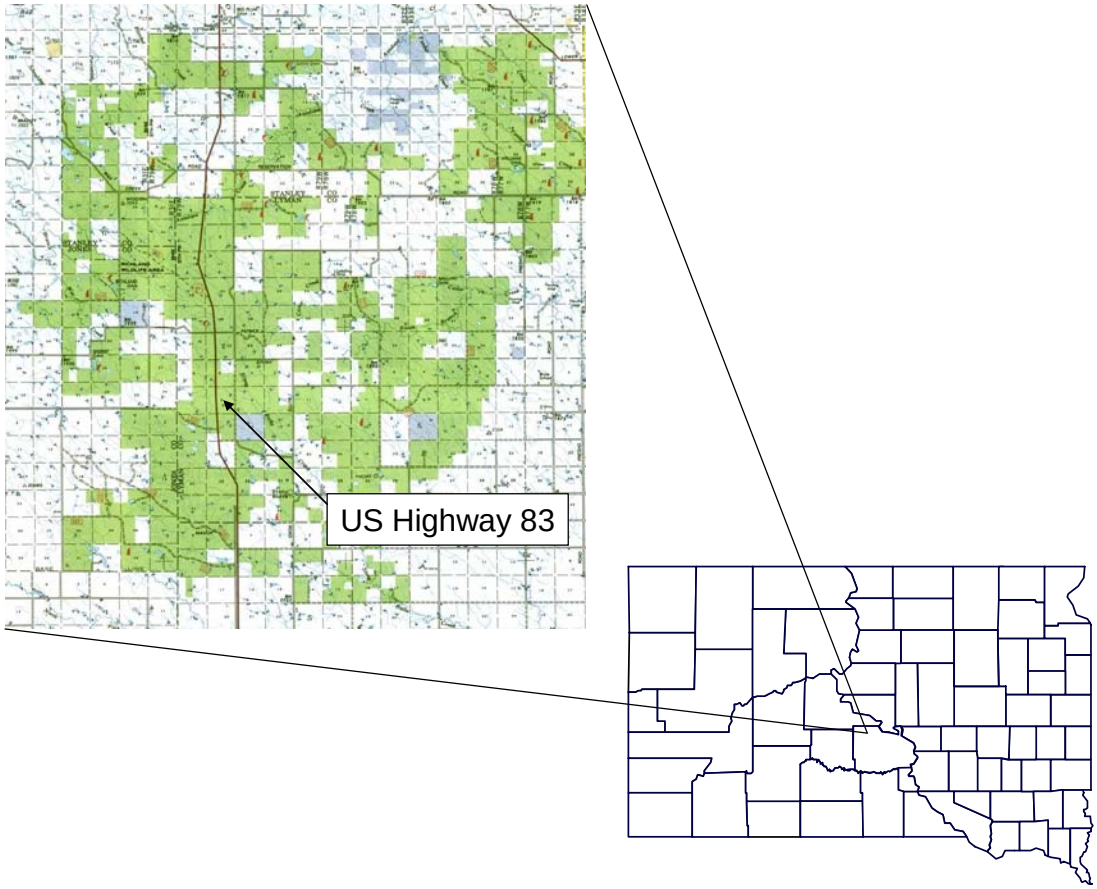
1. Estimate and evaluate spatial ecology characteristics (home range, dispersal, and brood home range based on age) for sharp-tailed grouse and greater prairie chickens.
2. Compare land-use composition of home ranges and nest site selection for sympatric female greater prairie-chicken and sharp-tailed grouse.
3. Estimate and compare harvest rates of sympatric greater prairie-chicken and sharp-tailed grouse from the FPNG.
4. Evaluate the effect of training hunting dogs from horseback on the survival, spatial ecology and avoidance behavior of sympatric greater prairie-chicken and sharp-tailed grouse on the FPNG.

STUDY AREA

This study took place on the FPNG located in central South Dakota, parts of which fall within the boundaries of Stanley, Jones, and Lyman County. More specifically, research efforts focused on the western half of the FPNG (approximately 19,500 ha), west of US Highway 83 (Figure 1). Amongst the FPNG, private land is intermixed, consisting of additional pastureland as well as some agricultural crops such as wheat (*Triticum aestivum*), sunflowers (*Helianthus annuus*), and alfalfa (*Medicago sativa*). Management of FPNG by the US Forest Service has a three pronged approach: livestock production, wildlife production, and outdoor recreation. In the early 1990's, drastic changes were implemented in the management of the FPNG where the new guidelines instituted that 8% be rested annually, and that grazing rotations be improved by using higher stocking rates for shorter durations for each pasture grazed (Moravek 2001). During our study, stocking rates were variable from pasture to pasture, year to year, however the rotational grazing system calls for no more than 1/3 of FPNG to have cattle on at any given time. During the 2003-2005 study period, a minimum of 10% of the FPNG was not grazed on an annual basis.

The FPNG is characterized by rolling topography predominated by grass such as western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), big bluestem (*Andropogon gerardii*), side oats grama (*Bouteloua curtipendula*), and little blue stem (*Schizachyrium scoparium*). Temperatures can be of extreme nature, with average January temperatures as cold as -8 C and average July temperatures reaching 32 C (National Weather Service 2005). Average rainfall during the May-August time frame is 29cm.

Figure 1. State map indicating location of the FPNG (gray shaded area) in South Dakota. The focal area was the portion of the FPNG west of US Highway 83.



METHODS

Greater Prairie Chicken and Sharp-tailed Grouse were captured using walk-in traps on display grounds (Schroeder and Braun 1991) from mid-March through the end of April. All males were weighed, aged, and marked with leg bands, while females were weighed, aged, and fitted with a 11-g necklace style transmitter. To augment our sample size and equalize the distribution ratio between ST & PC, additional hens were located by nest dragging with ATV's (Higgins et al. 1969), then captured by using bow nets, and fitted with radio transmitters.

Approximately 2 weeks after hatch, broods were captured during the night by a system developed by T. Leif and G. Wolbrink (South Dakota Game, Fish, and Parks; *personal communication*). A brooding hen would be approached with a receiver and yagi antenna. Upon approaching the hen, the antenna was disconnected and circled using the receiver only to assure hen/brood location. The bird was then marked with 4 glow sticks at approximately 15 meters away in all four directions. Using a 15 x 15 m mesh net, a minimum of two people pulled the net over the hen using the glow sticks as a guide. After positioning the net, researchers turned on spot lights and walked in until spotting the hen with brood, surrounding them and capturing. All

captured chicks were weighed and a minimum of 3 chicks per brood were marked with a <2-g transmitter that was sutured on their backs (Burkpile et al. 2002).

Radio-marked birds were located using a vehicle mounted, null peak antenna system three times per week beginning in May and continuing through August. Birds with radio's emitting a mortality signal were walked in on and the cause of mortality was determined.

Spatial Ecology

Hen Home Range

Home range for sympatric PC and ST was calculated during the breeding season (day after hatch through the end of August) for all hens with broods, with a minimum requirement of 20 locations for each hen. Home range polygons were calculated like Gabbert et. al. (1999) using ARC GIS, with a 200m buffer on each radio-location. The 200m buffer was determined by looking at average daily movements of both PC and ST and adjusted for days during this same period. Locations with 200m buffers were overlaid in ARC GIS and merged to produce the home range polygon(s). Home ranges were evaluated by modeling year and species and comparing with analysis of variance.

Hen Dispersal

Hen dispersal was defined as the distance from trap location on display grounds to nest site. Only hens captured in walk-in traps were used in this evaluation. Species and year were variables used in the analysis of variance model to compare dispersal distances. Dispersal direction from capture leks to nest site was evaluated with Chi Square.

Brood Age and Home Range Relationship

Home range size for each brood was determined every two weeks using the same method (200m buffer per location) as described in calculating hen home range. Cumulative home range sizes and proportional change at two week intervals through 12 weeks of age or the end of August (telemetry locations ceased) were evaluated by linear regression.

Land-Use Composition

Home Range & Grazing

Land use evaluations focused on grazing regimes and home range. The US Forest Service provided grazing records of each pasture, as well as ARC GIS shape-files for each pasture. Pastures were categorized into 4 groups for analysis: 1) Previous Year No Grazing (NGPY), 2) Previous Year Grazing Beginning Prior August 1 (GPAPY), 3) Previous Year Grazing Beginning After August 1 (GAAPY), and 4) Current Year No Grazing (NGCY). The distinction of pastures where grazing began prior to August 1 and those where grazing began after August 1 were selected based on evaluating when individual pastures were grazed on the FPNG over the 3 year study. August 1 was the approximate mean turnout date, thus selected as the break for earlier and later grazing categories. Home range polygons for each hen with a brood were over-laid on the pasture shape-files, and analysis conducted to determine whether hens were selecting

or avoiding pastures based on grazing regimes. Using a compositional analysis (Aebischer et al. 1993), home ranges were examined against habitats available (grazing regimes) to generate habitat use scores. Compositional scores were analyzed by analysis of variance, and mean separation analyses conducted with Bonferroni paired t-test (compare grazing systems for PC and ST individually) and two sample t-test (compare grazing categories between species) in SYSTAT (SPSS 1998).

Nest Site & Grazing

Nest site selection was also examined based on the grazing history of individual pastures. Site selection was evaluated by overlaying nest locations (both first and second nest attempts) on grazing regime layers to determine whether nests occurred in pastures where no grazing took place the previous year (NGPY), where grazing began prior to August 1 the previous year (GPAPY), or whether nest sites were in pastures where grazing began after August 1 the previous year (GAAPY). The number of nests in each grazing regime for each species was analyzed with Chi Square.

Harvest Rates

In an attempt to determine hunter exploitation of prairie grouse on the FPNG, harvest rates (not adjusted for a Harvest Reporting Rate due to insufficient data) were calculated for PC and ST based on the number of marked birds (leg bands, necklace mounted transmitters, and sutured back-pack chick transmitters) reported to be harvested or returned to GF&P staff and offices. All known mortalities (predation, illness, accidental deaths, etc.) were removed before calculating harvest rates. Distribution of harvest by year was also determined.

Dog Training

The effects of dog training were evaluated by dividing the study area into a north and south half (Sheriff Dam Road), closing one half each year to all dog training activities, and rotating annually (Closures: North – 2003, South – 2004, North – 2005) (Appendix Figure 1). For evaluation purposes, five variables were examined to assess the impacts of dog training: 1) chick survival, 2) brood break-up, 3) avoidance characteristics, 4) average daily movements, and 5) home range overlap.

Chick Survival

Chick survival for radio-marked birds was estimated during the month of August on open and closed training areas using the Kaplan-Meier product-limit method modified for staggered entry (Kaplan and Meier 1958, Pollock et al. 1989) and compared with Chi-square analysis in Program CONTRAST (Sauer and Williams 1989).

Brood Break-Up

To determine whether dog training activities were causing brood break-up due to multiple flushings, we counted the number of groups (group definition: hen with brood = 1 group; lone chick not associated with brood = 1 group) before dog training activities began and compared to

the number of groups at the end of the dog training period on both open and closed dog training areas. The ratio of groups prior and after dog training activities was calculated for each species and compared using Chi Square.

Avoidance Characteristics

Avoidance characteristics were evaluated based on the distinction of a Flush Distance and Run Effect. In both cases, data was collected during the two week period after dog training activities ceased and before the grouse hunting season began. For utmost consistency in collecting this data, the same observer collected this information all three years. Radio-marked birds were located through telemetry triangulation, and then walked in on with receiver and hand held antenna. Flush Distance was defined as the distance between observer location and flush location. Run Effect was defined as the distance from the initial triangulated location to the actual flush location. Both characteristics were analyzed with analysis of variance using age and dog training area variables, and a group size covariate.

Average Daily Movements

Female grouse movements in both closed and open dog training areas were examined by using telemetry locations, calculating the distance moved between consecutive locations and adjusting for time intervals (both July and August locations), and calculating a difference in average daily movements between July (pre-dog training activities) and August (dog training period). The difference in average daily movements calculated for July and August were compared using analysis of variance, with year and dog training area as model variables. Data from 2003 was censored for these analyses because no data existed for ST in the open training areas, and no data for PC in the closed area.

Home Range Overlap

Using telemetry locations and the same 200m buffer used in the home range analysis, I determined the area used in July and August for each hen with a brood, constructed a polygon to represent each month, overlapped them, and calculated the proportional home range overlap for each species in open and closed dog training areas. Proportional data was ranked and then analyzed using analysis of variance.

RESULTS

Spatial Ecology

Hen Home Range

Thirty-five brooding hens (19 PC, 16 ST) were used for hen home range analysis. For all three years combined, average home range for PC was 174 ha, whereas ST was 183 ha (Table 1). Minimum home range size calculated for PC was 77 ha and a maximum of 303 ha. Sharp-tailed grouse minimum and maximum home ranges were similar, with 99 and 274 ha respectively (Appendix Table 1).

The interaction between year and species was found to be significant (F = 4.510, df = 2, 29, P = 0.020), however separately no significance was determined for either year (F = 1.192, df = 2, 29, P = 0.318) nor species (F = 0.507, df = 1, 29, P = 0.482) separately. Due to low sample sizes in 2003, and variation in range size between years, additional analysis was conducted to evaluate the year variable. This analysis determined PC average home range for 2003 (254 ha) was significantly higher than 2004 and 2005 (143 ha and 172 ha respectively) (F = 4.820, df = 2, 16, P = 0.023). Conversely, no difference was found for ST (2003 – 159 ha, 2004 – 196 ha, 2005 – 174 ha) (F = 0.875, df = 2, 13, P = 0.440).

Year	Species	n	Home Range (ha)	SE
2003	PC	3	254	25
	ST	2	159	60
2004	PC	7	143	19
	ST	8	196	15
2005	PC	9	172	19
	ST	6	174	10
ALL				
	PC	19	174	14
	ST	16	183	10

Table 1. Mean home range size for brooding hen PC and ST on the Ft. Pierre National Grasslands, 2003-2005.

Hen Dispersal

Thirty-seven PC and 30 ST were used in dispersal evaluations. Prairie chickens had an average dispersal distance of 1978 m (Table 2), with a maximum dispersal of 7113 m and a minimum of 338 m (Appendix Table 2). Although ST mean dispersal (2037 m) was similar in distance to PC, the maximum dispersal (12270 m) was almost twice the distance of the maximum PC dispersal and the minimum (172 m) was half the distance of the shortest PC dispersal. The model found no differences between species (F = 0.000, df = 1, 61, P = 0.988), year (F = .0475, df = 2, 61, P = 0.624), or species*year interaction (F = 0.047, df = 2, 61, P = 0.954).

Year	Species	n	Dispersal (m)	SE
2003	PC	11	1299	303
	ST	3	1618	764
2004	PC	11	2108	657
	ST	12	1946	988
2005	PC	15	2381	477
	ST	15	2193	625
ALL	PC	37	1978	291
	ST	30	2037	498

Table 2. Mean dispersal distance for hen PC and ST on the Ft. Pierre National Grasslands, 2003-2005.

The direction hens dispersed from respective capture leks to nest sites were random for both PC (χ^2 = 2.459, df = 3, P = 0.483) and ST (χ^2 = 6.533, df = 3, P = 0.088) (Table 3). Of the four cardinal directions, ST dispersal was most common (36.7%) in a west to north direction (270°-360°), whereas PC mainly dispersed (32.4%) in a north to east direction (0°-90°).

		Nest Dispersal Direction from Lek			
Year	Species	1 (0°-90°)	2 (90°-180°)	3 (180°-270°)	4 (270°-360°)
2003	PC	2	4	3	2
	ST	0	0	2	1
2004	PC	5	4	1	2
	ST	0	7	4	1
2005	PC	5	3	2	4
	ST	2	3	1	9
ALL					
	PC	12	11	6	8
	ST	2	10	7	11

Table 3. Dispersal direction from lek to nest site for PC and ST on Ft. Pierre National Grassalands, 2003-2005.

Brood Age and Home Range Relationship

The area used by PC and ST broods progressively increased over time, demonstrating a strong direct relationship between age and home range size (r^2=0.998, r^2=0.995, respectively) (Figure 2). Largest proportional change in home range size for PC and ST occurred within approximately the first six weeks, then gradually slowing with brood age (PC, r^2=0.734; ST, r^2=0.813) (Appendix Figure 8). Prairie chicken brood home range size increased between 89-120% from 2 weeks of age to six weeks, and ST home range changed between 128-134% (Appendix Table 3) within individual years. For the same week intervals and all years combined, PC home range increased by 102%, whereas ST had an increase of 132%. In contrast, the change in brood home range from 6 weeks of age to 12 weeks ranged from 64-92% (PC) and 71-83% (ST, data not available for 2003) for each year individually. When years were pooled, PC showed an increase of 77% in home range size, and ST only 68% (Appendix Table 3).

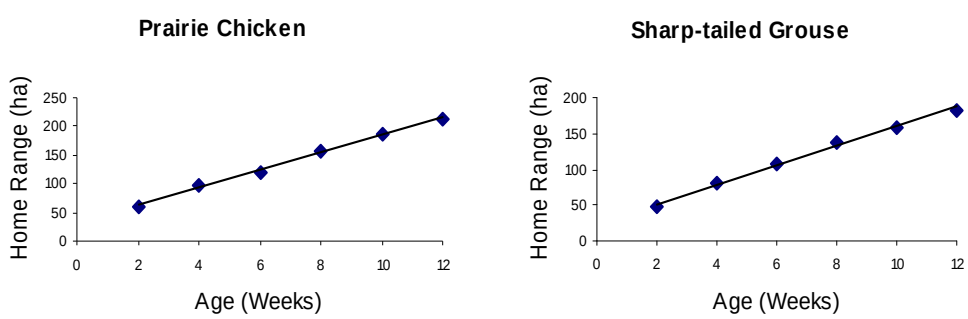


Figure 2 . Relationship of home range to brood age for PC and ST on the FPNG, 2003-2005.

Land Use Composition

Home Range & Grazing

Model analysis determined no differences for land use scores for the species-grazing interaction ($F = 1.518$, $df = 3, 124$, $P = 0.213$), year-grazing interaction ($F = 0.943$, $df = 6, 124$, $P = 0.467$), and species-year-grazing interaction ($F = 1.58$, $df = 6, 124$, $P = 0.158$). However, land use scores did differ for the grazing variable ($F = 2.724$, $df = 3, 124$, $P = 0.047$).

When land use variables for ST and PC were combined the resulting analysis determined that grouse selected areas not grazed the current year over pastures grazed the prior year beginning before August (GPAPY) ($df = 36$, $P = 0.011$) as well as those pastures where grazing began after August 1 (GAAPY) ($df = 36$, $P = 0.017$). No difference ($P > 0.05$) was found comparing pastures where no grazing occurred the prior year (NGPY) to those that were grazed (GAAPY and GPAPY). Overall, grouse selected areas where no grazing took place whether during the current year or the previous year compared to pastures where grazing occurred the previous year (Figure 3).

Considering individual species (Figure 4), ST selection of pastures not grazed the current year (NGCY) or previous year (NGPY) was significantly higher ($t = 3.246$, $df = 15$, $P = 0.005$; $t = 2.431$, $df = 15$, $P = 0.028$, respectively) than pastures grazed prior to August 1 the previous year (GPAPY). Remaining grazing category comparisons for ST indicated no difference ($P > 0.05$). Prairie chicken analysis determined no differences in grazing category comparisons ($P > 0.05$).

The model did not indicate a difference between species, however additional comparisons were run to evaluate species selection of areas based on grazing. Only the GPAPY grazing category indicated a difference between species ($t = 2.625$, $df = 35$, $P = 0.013$), where PC was more selective compared to ST (Figure 4). All other comparisons between PC and ST found no differences ($P > 0.05$), although ST had higher compositional scores for the GAAPY, NGCY, and NGPY grazing categories.

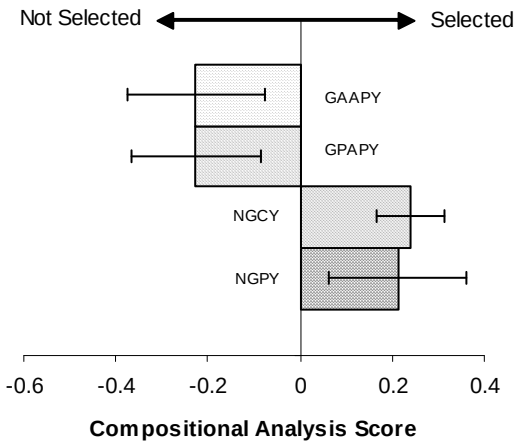
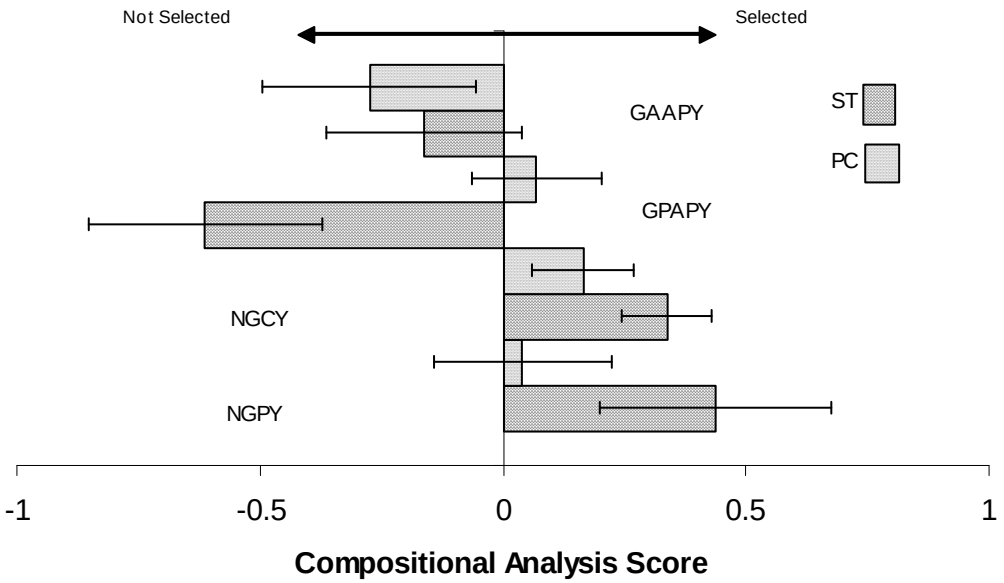


Figure 3. Mean compositional scores and standard error for pastures selected by grouse based on home range and habitat available in relation to grazing, 2003-2005.

Figure 4. Mean compositional scores and standard error for pastures selected by PC and ST based on home range and habitat available in relation to grazing, 2003-2005.



Nest Site & Grazing

Differences were also detected in nest site selection based on previous year grazing regimes for PC and ST ($P < 0.05$) (Table 4). Sixty-three percent of PC nest sites were located in pastures where no grazing occurred the previous year compared to pastures with grazing practices beginning prior to August 1 ($\chi^2 = 6.428$, df = 1, P = 0.011) or after August 1 ($\chi^2 = 13.33$, df = 1, P = 0.0002). However, no difference was found between pastures where grazing did take place (GPAPY vs. GAAPY) ($\chi^2 = 1.667$, df = 1, P = 0.197). Similar to PC, a majority of ST nests (52%) were found in pastures where no grazing occurred the previous year. No difference was found in the selection of pastures where no grazing occurred the previous year compared to pastures grazed beginning prior to August 1 ($\chi^2 = 1.00$, df = 1, P = 0.317), but pastures with grazing regimes beginning after August 1 were selected less compared to no grazing pastures ($\chi^2 = 6.368$, df = 1, P = 0.012). No difference was found for ST nest site selection between pastures where grazing began prior to August (GPAPY) and after August 1 (GAAPY) ($\chi^2 = 2.571$, df = 1, P = 0.11).

Grazing	PC		ST	
Regime	n	%	n	%
NGPY	25	63	15	52
GPAPY	10	25	10	34
GAAPY	5	12	4	14

Table 4. Nest site selection for PC and ST in respect to grazing regime on the Ft. Pierre National Grasslands, 2003-2005.

Harvest Rates

An overall known harvest of 6.3% (21 of 333) was calculated (Table 5) for marked grouse during the fall hunting seasons of 2003, 2004, and 2005. Individually, PC harvest rate was 7.2% (15 of 208) and ST 4.8% (6 of 125). Male prairie grouse marked with leg bands had a harvest rate of 7.6% (10 of 132) for PC and ST combined; with a harvest rate of 7.5% (7 of 94) for PC and 7.9% (3 of 38) for ST. Approximately 9.1% (7 of 77) of female grouse fitted with necklace mounted transmitters were harvested. Female PC harvest was 13.0 % (6 of 46) while female ST known harvest rates were 3.2% (1 of 31). Grouse fitted with the small sutured back-pack style transmitters, originally placed on chicks, were harvested at a rate of 3.23% (4 of 124); PC reported harvest of 2.9% (2 of 68) and a ST harvest of 3.6% (2 of 56) (Appendix Table 4).

Species	# Marked	# Harvested	% Harvested
PC	208	15	7.21
ST	125	6	4.80
Total	333	21	6.31

Table 5. Number of birds marked, known harvested, and known proportion harvested from the Ft. Pierre National Grasslands, 2003-2005.

Of the 21 known hunter-killed birds, 85.7% (18 of 21) were harvested in Fall 1 (the fall of the year they were marked), 4.8% (1 of 21) harvested in Fall 2 (the year after marked), and 9.5% (2 of 21) in Fall 3 (two years after marking) (Appendix Table 5). Similar harvest rates were observed regardless of the marking method (leg band, necklace transmitter, backpack transmitters), and most harvest occurred in Fall 1 (Appendix Table 5).

Dog Training

Chick Survival

When all years were combined, 8 of 105 (7.6%) radio-marked chicks had confirmed mortalities during the month of August. Fifty percent (4 of 8) of the mortalities occurred on areas open to dog training, all of which were PC. The 4 mortalities on closed dog training areas were split between PC and ST. Three mortalities were due to raptors, 1 mammalian mortality, and 4 unknown causes.

Chick survival was very high during the month of August (dog training period) for both ST and PC. Sharp-tailed grouse chick survival did not differ ($\chi^2 = 0.169$, df = 1, P = 0.680) and was 0.967 (SE = 0.033) in areas closed to dog training (n = 30), and 0.938 (SE = 0.063) in open dog training areas (n = 16). Prairie chicken chick survival was also similar ($\chi^2 = 0.169$, df = 1, P = 0.682) between dog training areas, with a 0.952 (SE = 0.519) survival rate in closed dog training areas (n = 21), and 0.925 (SE = 0.042) in open dog training areas (n = 38).

Brood Break-up

Brood break-up analysis detected no significant impacts from dog training activities. Chi square analysis comparing the number of groups at the beginning of August versus the end of August for both closed and open dog training areas, resulted in no differences for ST ($\chi^2 = 0.096$, df = 1, P = 0.756) or PC ($\chi^2 = 1.409$, df = 1, P = 0.235). At the end of the dog training period, ST had one more group in both open and closed areas compared to the beginning of the month. Prairie chickens had four more groups in the open area at the end of the month, however only one more group in the closed area.

Avoidance Characteristics

Flush Distance

Average flush distance for PC was slightly greater in the closed dog training areas compared to the open training area (Table 6), although no significant differences were detected between the dog training areas (F = 2.417, df = 1, 37, P = 0.129), nor did age influence flush distances (F = 0.303, df = 1, 37, P = 0.585). Group size also showed no effect on flush distances (F = 0.018, df = 1, 37, P = 0.894). Mean flush distances for ST were virtually identical between closed and open dog training areas (Table 6). Similar to PC, no significant differences were detected between training areas (F = 0.058, df = 1, 28, P = 0.812) and age (F = 0.188, df = 1, 28, P = 0.668), however the group size covariate for ST was significant (F = 4.725, df = 1, 28, P = 0.038).

			Flush Distance		Run Effect	
	Dog Training	n	(m)	SE	(m)	SE
PC	Open	26	11.7	1.2	32.1	4.5
	Closed	16	17.9	4.7	43.9	12.5
ST	Open	9	17.3	3.8	49.2	11.7
	Closed	24	17.2	2.5	37.6	7.2

Table 6. Avoidance characteristics (Flush Distance and Run Effect) average distances and standard errors for PC and ST in open and closed dog training areas on the Ft. Pierre National Grasslands, 2003-2005.

Run Effect

Prairie chicken and ST responses were opposite in respect to the Run Effect category of avoidance characteristics. Average Run Effect distance for PC in the closed training areas was over 11 meters greater than the open training area (Table 6). On the other hand, ST run effect distances in the closed area were more than 11 meters less than the open training area. The age-dog training area interaction showed no difference for PC (F = 0.230, df = 1, 34, P = 0.635) or ST (F = 0.086, df = 1, 27, P = 0.771), nor did group size (P = 0.321, P = 0.549; PC and ST respectively) impact grouse run responses. However, age appeared to be a factor in Run Effect for the ST (F = 4.522, df = 1,27, P = 0.043) as adult run responses were on average 30 meters farther than young of the year (adult – 52.7 m, SE = 8.5; young of the year – 22.7 m, SE = 5.7). On average, PC hens had a longer run effect distance than young of the year (42.9m vs. 27.1m) although not statistically different (F:0.854, df: 1, 34, P: 0.362).

Average Daily Movements

The difference in average daily movements for ST in closed areas was 23m less compared to open training areas (Table 7). Model analysis of the dog training and year interaction was not significant (F = 3.060, df = 1, 9, P = 0.114), however there was a difference between years (F = 12.954, df = 1, 9, P = 0.006) and dog training areas (F = 8.502, df = 1, 9, P = 0.017). Opposite results were detected for PC. The difference in average daily movements for closed areas was greater than the open areas (Table 7). As in the case of ST, the PC model indicated no significant difference for the dog training and year interaction (F = 0.145, df = 1, 10, P = 0.712), and no difference between years (F = 1.037, df = 1, 10, P = 0.333) or dog training areas (F = 0.160, df = 1, 10, P = 0.697).

			Difference In Movements	
	Dog Training	n	(m)	SE
PC	Open	8	0.7	15.6
	Closed	6	9.6	33.1
ST	Open	6	36.5	33.3
	Closed	7	13.3	18.3

Table 7. Difference in average daily movements between July and August for ST and PC in open and closed dog training areas on the Ft. Pierre National Grasslands, 2004-2005.

Home Range Overlap

The home range area used by PC during July (month preceding dog training activity) compared to August (dog training time frame) on the portion of the FPNG closed to dog training activities was twenty percentile points higher than it's respective overlap in the open dog training area (0.585 vs. 0.381), however no statistical difference for the ranked data was detected (F = 1.413, df = 4, 12, P = 0.288). No difference (F = 1.603, df = 4, 10, P = 0.248) was found in the area shared by ST comparing July to August, as the proportional overlap was very similar between the closed and open dog training areas (Table 8).

			Home Range Overlap	
	Dog Training	n	(proportional overlap)	SE
PC	Open	11	0.381	0.069
	Closed	6	0.585	0.115
ST	Open	6	0.316	0.050
	Closed	9	0.338	0.072

Table 8. Proportion of home range overlap between July and August for ST and PC on open and closed dog training areas on the Ft. Pierre National Grasslands, 2003-2005.

DISCUSSION

Home Range

Analyses were separate for ST and PC, however average ST home range size (183 ha) over the three year study was quite similar to PC (174 ha). However, moderate differences were observed between the two species over the three year period. Prairie chicken home range was almost twice the size of ST in 2003, however more than 50 ha less than ST in 2004. In 2003, PC average home range was over 100 ha larger than its respective size in 2004. Sharp-tailed and PC home range size was virtually identical in 2005. We can only speculate what caused PC to have such a difference in home range between 2003 and 2004; however the sample size in 2003 was small and could have skewed range sizes higher.

Although different techniques were used to calculate home range, range size during the reproductive period (nest hatch through the end of August) for ST and PC from this study was similar to home ranges of other studies. Female prairie chicken ranges on the FPNG from 1986-88 were 194 ha and on the Lower Brule area 122 ha (Fredrickson 1995). Almost identical to the 174 ha PC range size in this study, PC home range averaged 172 ha during the months of June, July, and August in Kansas (Robel et al. 1970). Prairie chicken home range on the FPNG was less than half the range size (488 ha vs. 174 ha) determined on the Sheyenne National Grasslands in North Dakota (Newell et al. 1988), however our study did not break down range sizes according to hen age. Multiple factors can determine range size (Newell et al. 1988), such as larger range sizes for young hens, the time of hatch, and habitat alteration. Burger (1988) found PC home range varied by habitat pattern, where home ranges in large block habitat areas were 240 ha, slightly larger than home range size determined in this study.

The FPNG typically provides favorable habitat conditions due to the current grazing plan; however climatic conditions have the potential of drastically changing habitat conditions. Below normal precipitation in late 2002 and 2003 created marginal habitat conditions on the FPNG, and may have caused PC to cover larger areas in search of suitable brood-rearing habitat. Subsequent years (2004 and 2005) experienced more favorable precipitation and habitat conditions, especially with the boom of sweet clover in 2004 (Norton 2005), allowing PC hens with broods to remain in a smaller area. However, USFS policy on the FPNG is structured to adjust grazing allotments and stocking rates to grassland conditions, thereby allowing grassland managers the ability to reduce grazing pressure and maintain essential residual cover even during periods of drought.

Both ST and PC broods had a strong correlation between age and range size. Every two weeks range size proportionally increased, with the largest increases in range size occurring the first 6 weeks. The larger expansion of home ranges in the first month and half could be contributed to the hen searching for suitable brood-rearing cover (Svedarsky 1979), especially when habitat conditions are sub-par or poor. These dramatic movements occur the first few weeks of brooding because nesting cover is substantially different than brood rearing habitat (Svedarsky et al. 2003), characterized as more open for chick movement, providing protection from weather and predators, contain openings for sunning and dusting, and accessible from the nest.

Dispersal

Dispersal distance may be influenced by various factors, the foremost of which is the availability of suitable nesting cover. The literature recommends suitable habitat conditions must be in relatively close proximity to leks, in some cases suggesting less than 2 miles (Bernhoft 1969, Hillman and Jackson 1973, Svedarsky et al. 2003, Toepfer and Septon 2003) for ST and PC nest site selection. Like home range size, variation occurred within species, however average distances from lek to nest for ST and PC were quite similar (2037 m, 1978 m, respectively). Bernhoft (1969) found distances to be at 1430 m in SW North Dakota, and Kobriger (1980) found distances averaging 1288 m; both of which were substantially less than ST distances from this study (2037 m). The maximum distance measured by Kobriger (1980) was 3220 m, however the largest distance on this study was 12,270 m. In respect to PC, the largest distance was 7113m, similar to the 7700m distance measured by Robel et al. (1970). The distance from the lek captured to the nest is largely a function of available habitat within the 2-3 km radius of the display ground. By maintaining good residual cover for nesting prairie grouse, it will limit the distance needed to travel to find suitable cover, thereby increasing the chances of hen survival and improve overall fitness.

Sharp-tailed grouse and prairie chickens both demonstrated random direction selection from the lek of capture when choosing nest site locations. Although each species showed stronger tendencies for certain directions over others, habitat preference and availability are probably the determining factors dictating direction chosen for nest site selection.

Land-Use Composition

The one factor that can have a profound impact on grouse habitat, other than climatic conditions, is grassland condition in response to livestock grazing. Multiple studies over the past 30 years have evaluated numerous grazing regimes to determine which are the most productive for livestock and grouse alike, however consensus is lacking in terms of appropriate grazing strategies to optimize use of the grassland forage and still maintain adequate cover for prairie grouse. What does appear fairly consistent is that areas of undisturbed or minimal grazing pressure play a key role in providing both nesting and brooding habitat. Overall our study found brooding grouse hens selected areas not grazed the current year or the previous year compared to pastures grazed the prior year. These results reflect Newell et al. (1988) findings where hens with broods seldom used areas disturbed the current year and spent more time on areas that were undisturbed or minimally disturbed. In Grosz's (1988) study, sharp-tailed grouse brood use was seldom observed in grazed areas (23 of 216 sightings), whereas 91 of 216 brood observations occurred in idle areas. Rice and Carter (1982) found prairie chickens used pastures that consisted of the rest portion of a rest-rotation grazing system on the Ft. Pierre National Grasslands. Our findings would concur with these assessments as both PC and ST selected pastures that were not grazed, current year or prior year, compared to pastures grazed the prior year.

When compositional analysis scores were compared between the two species, both demonstrated a stronger selection of non-grazed pastures over grazed pastures. However, a closer look at

compositional scores suggests that ST demonstrated a much stronger selection for non-grazed pastures and non-selection for grazed pastures compared to PC. The only statistical difference found was in pastures with grazing beginning prior to August 1, where PC had a higher selectivity for these areas than did ST.

Similar to home range and grazing practices, both ST and PC hens tended to utilize pastures for nest site selection where grazing did not occur the prior year when compared to grazed pastures. Residual cover from the previous year is important for reproduction (Svedarsky et al. 2003), thus ungrazed habitat is frequently selected for nesting. These findings mirror results from previous work which indicated breeding hens chose non-grazed areas over grazed for nest site selection, including non-grazed portions of twice over and deferred rotations (Bernhoft 1969, Rice and Carter 1982, Grosz 1988, Sedivec et al. 1990, Prose et al. 2002). In the case of the FPNG, the current rest-rotation grazing regime works quite well to fulfill these requirements. Sixty-three percent of PC and 52% of ST nests were found in pastures that were not grazed the prior year, and although we did not attempt to calculate a nest density on this project, both Grosz (1988) and Rice and Carter (1982) found higher nest densities per unit of hectares in non-grazed pastures compared to those grazed. A stronger affinity for non-grazed areas for nest site selection by both ST and PC hens on the FPNG is assumed to be related to previous year residual cover; attracting breeding hens to nest in these areas. Our findings, as well as those from other studies, solidifies the necessity and importance of undisturbed areas and its associated residual cover for grouse populations, and further justifies the rest-rotation grazing regime of the FPNG.

Harvest Rates

Central SD is the stronghold of grouse numbers within the state; it also receives the highest hunting pressure for grouse within the state. Not only do grouse hunters find good numbers, but the opportunity to harvest both PC and ST in the same location makes the FPNG an attractive hunting destination. During the three year study, an average of 24% of the statewide grouse harvest (SD GFP, unpublished data) occurred in this three county area. An actual harvest rate could not be determined for this study as a reporting rate could not be calculated, however a handful of hunters (21) did report marked birds, giving a total known harvest of 6.3% of marked grouse. This appears very low as Robel et al. (1972) determined that hunters harvested approximately 20%-25% of marked birds from two study areas in south-central and south-western SD. Factors contributing to the small number of harvested birds being reported may have been 1) hunter reluctance, fearing they would not be able to retain the attached transmitter, 2) back-pack transmitters were extremely small and may have been overlooked while dressing birds, 3) transmitters may have dislodged from the bird before being harvested (especially suture type transmitters), or 4) hunters did not know who to contact. Although we had an extremely low sample size, it is noteworthy to mention that of the three marking methods, the small sutured back-pack transmitters, regardless of species, were the least reported (3.23%).

Similar to a previous study evaluating harvest and population parameters in south-central SD (Robel et al. 1972), the majority of marked birds were recovered the first fall after marking, substantially declining thereafter. Over 85% of reported harvests from our marked birds occurred in Fall 1; however a few were harvested in the second and third fall. Of the birds recovered in the second and third fall, all 3 were males.

Dog Training

Dog training with the use of horse on public lands has been and will continue to be a contentious issue. With the increased awareness and on-going discussions, it was important that the Division of Wildlife evaluate the potential impacts these activities may have on prairie grouse on the FPNG. The issues of highest concern regarding dog training activities centered around survival, especially of broods from re-nest attempts (Toepfer and Septon 2003), and whether these activities make grouse "more wild".

Young of the year grouse survival is probably the most diagnosed issue when discussing the potential impacts of dog training, especially broods from re-nest attempts and how young chicks (2-4 weeks) may be negatively effected. Juvenile survival is typically less than breeding age birds (Schroeder and Baydack 2001), especially during the first 2 weeks post-hatch. On the contrary, it is not uncommon for PC survival to reach levels as high as 75%-85% between 6 and 12 weeks of age (Toepfer and Septon 2003). Norton (2005) found young of the year survival from 19 days to fledge to be 0.57 (0.41-0.73) on the FPNG. However, Hicks (1992a, 1992b) found dog training activities displaced young birds, thus increasing mortality by forcing juvenile birds from preferred habitats. Our study did not find the same results, as juvenile survival was extremely high during the month of August, regardless if radiomarked birds were in an area open or closed to dog training activities. In fact, the lowest survival rate calculated during the month of August was PC survival on areas open to dog training at a rate of 0.925. Of the 105 chicks monitored during the dog training time period over the three years, only 8 mortalities occurred, half of which were found in areas open to dog training. Also, only 2 of the 8 chick mortalities were of less than 4 weeks of age when mortality took place, one in the closed dog training area and one in the open dog training area.

Another concern of dog training activities on grouse is the continued flushing of broods, and prematurely breaking-up the brood before normal brood break-up in late summer and early autumn. Bowman and Robel (1977) found prairie chicken broods typically break apart and disperse during late August and continue through September, which coincidentally overlaps the last 2-3 weeks of dog training activities in South Dakota. Hicks (1992a, 1992b) found that fewer juvenile birds returned to the areas where flushed from, at times with a maximum loss of 2-3 birds per brood. In our analysis, no statistical differences were found in the number of groups after dog training ceased for either ST or PC, regardless if dog training activities were allowed or not. However, 4 more PC groups were counted at the end of the dog training period in the area open to training compared to the closed area. The increase in group numbers may have been the result of normal brood break-up, and not necessarily the result of dog training, however neither could be confirmed.

The most common theme expressed by hunters was the fact that grouse seem "more wild" due to dog training activities, thus lowering the opportunities and success of harvesting prairie grouse. In response, extensive effort was given each year to evaluate and determine if differences could be detected in avoidance characteristics (flush distances and running effect) of ST and PC. Hicks (1982a) found that flush distances increased over time and after multiple flushes. Although our

study only flushed radio-marked birds once, our analysis concluded that there was no difference in flush distances for either species when comparing closed dog training areas to those open to dog training. Also, neither group size nor age of bird made a difference in flush distances. Run effect (distance from first telemetry location to the point of flush) results of the avoidance characteristics revealed different results for the two species, although none were statistically significant. Prairie chickens had a smaller run effect distance in areas open to dog training, on average 11 meters shorter. Conversely, ST had an average distance of 11 meters longer for run effect distances in areas open to dog training. Group size did not influence run effect distances, however the bird's age could be a critical component as hens had on average a run effect distance greater than 30 meters when compared to young of the year. This factor alone may help explain why hunters suggest grouse appear to be "more wild". During years of low production and recruitment, prairie grouse may appear to be "more wild" because populations consist primarily of adults, especially for sharp-tailed grouse.

Robel et. al (1970) found that female greater prairie chicken movements during the breeding season (May-August) ranged between 417 yards (381m) in July to 465 yards (425m) in August. Females with broods in this study had much smaller average daily movements in both months. Adjusted average daily movements for PC in July were 203 m and ST 178 m. Movements were not much different for August, but both species had slightly larger movements in August (PC – 213 m; ST – 206 m). In respect to evaluating open and closed dog training areas, it was decided that a more meaningful evaluation was to compare the difference in average daily movements for the month preceding (July) and during (August) dog training to determine whether these activities altered brooding female movements. No change occurred for PC movements in open dog training areas, and only a difference of 10 m greater in August on the closed dog training areas. On the other hand, differences in movements for ST did occur on open training areas, with a 36 m increase. Areas closed to dog training only had an increase of 13 m in movements. Small sample sizes may contribute to the differences detected for ST as only one hen was available for analysis in the open training area in 2005. Both species did show some increases in movements between the two months, however in respect to home range size and movements, these distances are of little significance. It was inconclusive whether dog training activities caused the increase in movements, as increases also occurred on areas closed to training activities.

Another concern of dog training activities is the possibility of pushing hens with broods out of preferred habitat areas, causing undo stress and negatively effecting survival (Hicks 1982a). To address that concern, the overlap of areas used between July and August were examined. Although PC hens had a 58% proportional overlap in the closed training area, only 38% of the area was shared on the open dog training areas. Sharp-tailed grouse used virtually the same amount of area (31%-33%) regardless if dog training occurred or not. These findings revealed no statistical differences, and although PC hens used a larger proportion of its home range in the closed training area, other factors may have contributed to both species using different areas during July and August. Habitat conditions, whether caused by drought-related climatic or grazing practices, may have forced hens to use other areas which provided suitable cover for brood rearing.

Valuable information was gathered from the dog training portion of this study, however we could not ascertain any single factor that would conclude dog training activities were having a significant negative impact on prairie grouse. Major conclusions derived are as follows.

(1) Prairie chickens and ST appeared to respond differently to dog training activities. Prairie chicken responses through avoidance "run effect" and differences in average daily movements indicate they tend to "sit tight" or "hunker down" from the increased activity, whereas sharp-tailed grouse responded oppositely and showed signs of "more wild" characteristics, especially among adult birds.
(2) Because dog training began on August 1, its impact on broods seemed to be minimal due to chick age at the time of the initiation of dog training activity. Including renests, the average brood age at the beginning of dog training activities was just under 8 weeks (average age = 55 days).
(3) Concern over lower chick survival caused by flushing activities and early brood break-up were essentially dismissed as survival rates were extremely high (≥ 92%) during dog training activities over the three year period. Furthermore, we could find no evidence to support or suggest that brood associations were terminated earlier as a result of disturbance from activities related to dog-training.
(4) No definitive effect stood out from the data indicating that dog training, at its current level and under the current restrictions, is having a significant negative impact.
(5) If the number of permits issued, and dog training activities continually increased, negative impacts may become more prominent and adversely affect grouse populations on the Ft. Pierre National Grasslands.

MANAGEMENT IMPLICATIONS

Grouse Ecology and Grazing

Prairie grouse populations on the FPNG and throughout South Dakota have remained at a relatively stable level, even with continual changes in land management practices and recent periods of drought. Grassland existence will be the ultimate determinant of grouse numbers; however the management of existing acres, in particular grazing management, will be a critical component in sustaining grouse numbers at current levels. In many areas within the sharp-tailed grouse and prairie chicken range, grazing has been identified as one of the main reasons for prairie grouse declines (Giesen and Kobriger 1997) and as grazing pressure increases, avian species richness tends to decline (Kantrud 1981). Associated with grazing, management for prairie grouse should incorporate the development and maintenance of healthy grasslands consisting of a grass-forb community (Kirsch et al. 1973).

Probably the most critical habitat component to prairie grouse is residual cover for nesting (Grosz 1988, Niemuth 2000, Prose et al. 2002). Although precipitation will affect vegetation growth, grazing is the main land management practice on grasslands which dictates the amount of residual cover available the following year, and one of the only vegetation management tools available to wildlife and land managers. In many cases, residual cover is lacking on rangelands that have been grazed (Prose et al. 2002), and areas with more and higher residual cover had high success rates for initial nest attempts compared to attempts with minimal residual cover (Eng et

al. 1988). Sixty-three percent of prairie chickens and 52% of sharp-tailed grouse selected pastures not grazed the prior year on the FPNG for nesting, suggesting a strong affinity to pastures with residual cover. Pastures constituting the rest portion of the rest-rotation grazing system on the FPNG appear to be essential to nesting grouse, providing critical nesting and brood-rearing habitat.

Not only is adequate vegetation required for nesting, but cover for brood-rearing is just as essential. Several studies have suggested minimum residual cover heights for nesting, most falling somewhere between 15 and 50 cm (Kirsch 1974, Eng et al. 1988, Fredrickson 1995, Manzer and Hannon 2005); however this cover will also provide the habitat needed for brood-rearing activities. Throughout the literature, discrepancies exist when discussing which grazing system is more beneficial to prairie grouse. Kobriger (1980) determined broods utilized pastures managed under a deferred rotation or early spring grazing, however Manske and Barker (1988) and Mattise (1978) found prairie grouse to select against deferred grazing treatments. Mattise (1988) also found season-long grazing provided better overall habitat as uniform grazing was less likely. Rice and Carter (1984) evaluated grazing on the FPNG and determined that a rest-rotation grazing system would produce over four times as many grouse as a deferred-rotation system, coincidentally urging an immediate switch to a rest-rotational grazing system, including light livestock use pastures. To date, this is the grazing system used across the entire FPNG complex. Evaluation of hen home range (hens with broods) indicated that pastures not grazed the prior year or current year were selected for brood-rearing areas compared to pastures grazed the prior year. Although both species of prairie grouse selected non-grazed pastures, our data suggests that sharp-tailed grouse have a stronger affinity to non-grazed pastures than do prairie chicken. This may be a significant factor when considering sharp-tailed grouse management statewide, due to their wider distribution. This selection also indicates the rest portion of the rest-rotation system is providing habitat specifically targeted by brooding hens, and may be vital areas needed by both sharp-tailed grouse and prairie chickens to maintain stable population levels.

With continued agricultural changes, and the pressure to farm more acres, undisturbed grassland cover and grassland establishment will be top priorities for grouse management. Very little, if any, rangeland is left ungrazed, and conversion, not establishment, of grasslands seems to be the norm within prairie grouse's range. However, existing conservation programs through the Federal Farm Bill do provide opportunities to manage and restore grassland habitats. Because of the financial incentives provided, the Conservation Reserve Program (CRP) has established thousands of grassland acres (Svedarsky et al. 2000) and is probably the one program to which prairie grouse have positively responded and benefited from (Riley 2004). Sharp-tailed grouse numbers are at some of the highest levels in portions of eastern South Dakota than they have been for quite some time (W. Morlock, South Dakota Game, Fish, and Parks; personal communication) and can be attributed to favorable weather conditions and CRP acres mixed within cropland, pastures, alfalfa, and other idle areas such as Waterfowl Production Areas (WPA) and Game Production Areas (GPA). In northeastern South Dakota, sharp-tailed grouse are intricably associated with CRP plantings that are interspersed within a framework of cultivated croplands (T. Runia, SDSU, personal communication). Because grouse selected non-grazed areas in our study, it would be beneficial to focus new CRP plantings in areas where

known sharp-tailed grouse dancing grounds and prairie chicken booming grounds exist so they could serve as nesting and brooding areas.

Because dancing grounds and booming grounds are the geographical focal point of prairie grouse reproduction, it would be note-worthy to focus grazing management and CRP acres within close proximity to these areas. At a landscape level, Niemuth (2000) found prairie chicken leks had a positive correlation to the proportion of pasture, grass, and shrubs, however a negative correlation to the distance to the nearest booming ground. Other prairie chicken research findings suggest approximately 30% of grassland habitat be within 1.6 km of known booming grounds, providing nesting cover and access to brood cover (Svedarsky et al. 2000). Our study found the average dispersal distance from lek to nesting site for both sharp-tailed grouse and prairie chickens was around 2.0 km. These findings, coupled with the selection of non-grazed portions for nesting and home range, results in the recommendation of intensively managing grassland habitat with undisturbed areas within 2 km of a lek. In areas of the state where grassland habitat is scattered throughout agricultural crops, undisturbed grassland habitat are probably important up to 3 km from known leks.

Home range size during the brood-rearing period was quite similar between ST and PC (approximately 180 ha) over the three year study. This, coupled with the importance of idle and ungrazed portions of a grazing system to breeding grouse, suggests that grassland management should incorporate a rest area of at least 175 ha. Size being considered, CRP fields should be similar sized as well, although most CRP will be smaller than 175ha. However, tracts of undisturbed grassland that possess the required habitat components for nesting and brood-rearing (Svedarsky et al. 2003) may be of smaller size and still provide conditions suitable for a successful hatch and brood-rearing.

Based on current grouse numbers, grouse trends over the past 10 years, findings from this study, and reproductive statistics from Norton (2005), it is suggested that current grazing management practices be retained on the FPNG. The rest-rotation grazing regime appears to be providing the necessary grassland habitat needed by both sharp-tailed grouse and prairie chickens to maintain current population levels. Most importantly, the rest portion is being highly selected by both species for reproductive efforts; the most critical component for maintaining prairie grouse populations. Management of private grasslands can incorporate aspects of the FPNG grazing regime, with a rest portion being of a highly significant value. Outside the FPNG, this rest portion criterion can be partially fulfilled through CRP land on private ground and state or federally owned land managed for wildlife.

Land-Use Recommendations:

1. Utilize a rest-rotation grazing system which provides an undisturbed area on an annual basis for nesting and brood-rearing cover.
2. Position undisturbed grassland habitat within 2 km of known leks. Undisturbed grassland cover can be fulfilled by CRP land, ungrazed pastures, GPA's, and WPA's.
3. Idle or rested portions of a grazing system should be managed with target sizes of at least 175 ha, however could be smaller providing the area has the habitat components/structure needed for nesting and brood-rearing.

4. The FPNG should continue using the rest-rotation grazing regime currently in place as it provides the necessary habitat conditions for nesting and brood-rearing of both sharp-tailed grouse and prairie chickens.

Dog Training

Overall, we found no evidence to suggest that dog training had negative impacts on either sharp-tailed grouse or prairie chickens on the FPNG. Hicks (1982a, 1982b) found that chick survival was lowered due to these activities in Canada; however chick survival in our study was very high, never dropping below a 0.92 survival rate during the dog training time period. The main reason for no impact on chick survival can probably be attributed to the fact that average chick age at the beginning of dog training was 55 days. At this point, young of the year birds are more apt to withstand numerous flushings from training activities without having a negative impact on survival.

Although some sportsmen felt prairie grouse on the FPNG were more wild (Gigliotti 2000), our data did not support these assertions, as analysis of avoidance characteristics (flushing and running) did not reveal any differences between birds on areas open to dog training compared to those on closed dog training areas. Findings within the data did suggest adult birds responded much quicker than young of the year, thus a population with a higher adult ratio may show signs of being "more wild"; potentially lowering hunter success.

Evaluation of 5 different criteria on areas open and closed to training activities (chick survival, brood break-up, avoidance characteristics, movements, proportional area shared) indicated that dog training by horseback was not having a significant negative impact on sharp-tailed grouse and prairie chickens on the FPNG, although a few differences were found between the two species. However, the one variable that was not measurable was the actual training pressure (number of trainers per day, per weekend, per area) during the study. In 2004 and 2005, aerial surveys were conducted over the open training area on days when weather conditions permitted, plain availability, and staff availability. Overall, aerial surveys estimated that training pressure by horseback was 2.18-2.54 horse trainers/flight days. These are more than likely conservative estimates as some training may have been concluded by the time flights were conducted, especially on extremely hot days. Anecdotal observations indicate that many trainers concentrated on specific areas because of access trails, camp sites, and known concentration of birds. Prairie grouse in these areas may have been affected to a greater extent than birds found in more isolated areas amongst the FPNG. It would be recommended that further evaluations determine the true training pressure and the potential impacts on grouse in these popular areas, or consider dividing the FPNG into smaller units and designate a specific number of training permits for each unit to effectively distribute the training pressure within the FPNG.

Since the conclusion of field work, results were provided to the South Dakota Game, Fish, and Parks Commission to help in the decision making process of whether to continue the allocation of dog training permits on the three national grasslands in South Dakota. Multiple testimonies, both for and against, were given at a public hearing in April of 2006. A decision was rendered to allow a maximum of 30 free "dog training by horseback" permits per year; recipients determined

by submitting an application and selected through a random drawing process. The other added change to these specific permits was training activities would cease at noon.

Dog Training Recommendations:

1. At minimum, maintain the current restrictions in respect to horseback training activities (maximum of 30 permits, halt training activities at 12p.m., train on Fridays, Saturdays, and Sundays only for the allotted training time frame, and no more than 4 dogs trained in any one day).
2. Our study found no impact on chick survival, however it would be justifiable to consider a later start date (August 15) for the years when environmental conditions create the situation where re-nesting is at higher than normal rates.
3. Although sharp-tailed grouse and prairie chicken populations are relatively stable, any substantial decline in prairie grouse numbers should be considered when allocating future horseback training permits.

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LITERATURE CITED

Aebischer, N. J., P. A. Robertson and R. E. Kenward. 1993. Compositional analysis of habitat use from animal radio-tracking data. Ecology 74: 1313-1325.

Bernhoft, L. S. 1969. Habitat preferences of sharp-tailed grouse. ND State Game and Fish Dept. Report No. a-362. 37pp.

Bowman, T. J., and R. J. Robel. 1977. Brood break-up, dispersal, mobility, and mortality of juvenile prairie chickens. J. Wildl. Manage. 41(1):27-34.

Burger, L. W. 1988. Movements, home range, and survival of female Greater Prairie-Chickens in relation to habitat pattern. M.S. Thesis. Univ. of Missouri, Columbia.

Eng, R. L., J. E. Toepfer, and J. A. Newell. 1988. Management of livestock to improve and maintain Prairie-Chicken habitat on the Sheyenne National Grasslands. Pp. 55-57. In Prairie-Chickens on the Sheyenne National Grasslands (A.J. Bjugstad, ed.) US Dep. Agric., For. Serv., Gen. Tech. Rep. RM-159.

Fredrickson, L.F. 1995. Prairie chicken range expansion and movements study, 1985-89. SD Dept. Game, Fish, and Parks. Completion Report No. 96-11. 125pp.

Giesen, K.M. and G.D. Kobriger. 1997. Status and management of Sharp-tailed grouse *Tympanuchus phasianellus* in North America. Wildl. Biol. 3:286. Abstract only.

Gigliotti, L. M. 2000. Ft. Pierre National Grasslands 1999 Opening Weekend Grouse Hunter Survey. South Dakota Game, Fish, and Parks. HD-6-99.SAM. 12pp.

Grosz, K. L. 1988. Sharp-tailed grouse nesting and brood rearing habitat in grazed and nongrazed treatments in south-central North Dakota. M. S. Thesis. North Dakota State University., Fargo, ND. 72pp.

Hicks, D. L. 1992a. Dog training impacts native grouse. The Outdoor Edge 1(6): 39.

Hicks, D. L. 1992b. The effects of dog training on sharp-tailed grouse in Manitoba. M.S. Thesis. Natural Resource Institute, University of Manitoba, Canada. 144 pages.

Hillman, C. N., and W. W. Jackson. 1973. The Sharp-tailed Grouse in South Dakota. S. Dakota Dep. Game, Fish, Parks. Tech. Bull. 3. 63pp.

Kantrud, H. A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. Can. Field Nat. 95(4): 404-417.

Kirsch, L. M. 1974. Habitat management considerations for prairie chickens. Wildl. Soc. Bull. 2:124-129.

Kirsch, L. M., A. T. Klett, and H. W. Miller. 1973. Land use and prairie grouse population relations in North Dakota. J. Wildl. Manage. 37:449-453.

Kobriger, G. D. 1980. Habitat use and brooding Sharp-tailed Grouse in southwestern North Dakota. North Dakota Outdoors. 43(1):2-7.

Manske, L. L., and W. T. Barker. 1988. Effects of grazing management on grassland plant communities and prairie grouse habitat. Pp. 8-20. In Prairie-Chickens on the Sheyenne National Grasslands (A.J. Bjugstad, ed.) US Dep. Agric., For. Serv., Gen. Tech. Rep. RM-159.

Manzer, D. L., and S. J. Hannon. 2005. Relating grouse nest success and corvid density to habitat:a multi-scale approach. J. Wildl. Manage. 69:110-123.

Mattise, S. N. 1978. Effects of grazing systems on Sharp-tailed Grouse habitat. MS Thesis, S. Dakota State Univ., Brookings. 46pp.

Newell, J. A., J. E. Toepfer, and M. A. Rumble. 1988. Summer brood-rearing ecology of the Greater Prairie-Chicken on the Sheyenne National Grasslands. Pp.24-31 in Prairie-chickens on the Sheyenne National Grasslands (A. J. Bjugstad, ed.). US Dep. Agric., For. Serv., Gen. Tech. Rep. RM-159.

Niemuth, N. D. 2000. Land use and vegetation associated with Greater Prairie-Chicken leks in an agricultural landscape. J. Wildl. Manage. 64:278-286.

Norton, M. 2005. Reproductive success and brood habitat use of greater prairie chickens and sharp-tailed grouse on the Fort Pierre National Grassland of central South Dakota. M. S. Thesis. South Dakota State University, Brookings, SD. 64pp.

Prose, B. L. 2002. Selection of nesting habitat by Sharp-tailed Grouse in the Nebraska Sandhills. Prairie Naturalist. 34:85-106.

Rice, L. A., and A. V. Carter. 1984. Evaluation of South Dakota grassland management practices as they affect prairie chicken populations, 1974-78. SD Dep. Game, Fish, and Parks. Completion Report No. 84-11. 25pp.

Riley, T. Z. 2004. Private-land habitat opportunities for prairie grouse through federal conservation programs. Wildl. Soc. Bull. 32:83-91.

Robel, R. J., F. R. Henderson, and W. Jackson. 1972. Some Sharp-tailed Grouse population statistics from South Dakota. J. Wildl. Manage. 36:87-98.

Robel, R.J., J. N. Briggs, J.J. Cebula, N. J. Silvy, C. E. Viers, and P. G. Watt. 1970. Greater Prairie Chicken ranges, movements, and habitat usage in Kansas. J. Wildl. Manage. 34:286-306.

Schroeder, M. A., and R. K. Baydack. 2001. Predation and the management of prairie grouse. Wildl. Soc. Bull. 29:24-32.

Sedivec, K. K., T. A. Messner, W. T. Barker, K. F. Higgins, and D. R. Hertel. 1990. Nesting success of upland nesting waterfowl and Sharp-tailed Grouse in specialized grazing systems in south-central North Dakota. USDA For. Serv. Gen. Tech. Rep. RM-194, Ft. Collins, CO.

SPSS Inc. 1998. SYSTAT 8. Standard version 8.0.

Svedarsky, W. D. 1979. Spring and summer ecology of female greater prairie chickens in northwestern Minnesota. Ph. D. Dissertation. University of North Dakota, Grand Forks. 166pp.

Svedarsky, W. D., J. E. Toepfer, R. L. Westemeier, and R. J. Robel. 2003. Effects of management practices on grassland birds: Greater Prairie-Chicken. Northern Prairie Wildlife Research Center, Jamestown, ND.

Svedarsky, W. D., R. L. Westemeier, R. J. Robel, S. Gough, and J. E. Toepher. 2000. Status and management of the greater prairie-chicken *Tympanuchus cupido pinnatus* in North America. Wildl. Biol. 6:277-284.

Toepfer, J. E., and G. Septon. 2003. Prairie Chickens and grasslands: 2000 and beyond. A report to the Council of Chiefs. Society of Tympanuchus Cupido Pinnatus, Ltd. 69pp.

APPENDIX

Appendix Table 1. Home range for radiomarked PC and ST hens with broods on the Ft. Pierre National Grasslands, 2003-2005.

Bird ID	Species	Year	Home Range (ha)
688	PC	2003	226
711	PC	2003	234
721	PC	2003	303
798	PC	2004	119
410	PC	2004	223
540	PC	2004	77
948	PC	2004	108
930	PC	2004	121
920	PC	2004	173
778	PC	2004	177
410	PC	2005	126
1530	PC	2005	130
1630	PC	2005	97
1553	PC	2005	172
519	PC	2005	200
1442	PC	2005	273
730	PC	2005	135
720	PC	2005	187
1577	PC	2005	226
798	ST	2003	219
899	ST	2003	99
490	ST	2004	185
79	ST	2004	155
591	ST	2004	183
49	ST	2004	185
345	ST	2004	229
224	ST	2004	144
964	ST	2004	211
40	ST	2004	274
1411	ST	2005	152
1368	ST	2005	151
1692	ST	2005	164
1670	ST	2005	174
1731	ST	2005	186
1132	ST	2005	213

Appendix Table 2. Dispersal distance (straight line distance from capture location to nest site) and direction of radiomarked PC and ST hens on the Ft. Pierre National Grasslands, 2003-2005. Dispersal direction quantified as 0°-90° (1), 90°-180° (2), 180°-270° (3), and 270°-360° (4).

Bird ID	Species	Year	Dispersal (m)	Dispersal direction
640	PC	2003	4008	4
688	PC	2003	1889	2
711	PC	2003	727	3
721	PC	2003	545	2
730	PC	2003	1358	3
740	PC	2003	699	2
759	PC	2003	400	3
791	PC	2003	785	4
829	PC	2003	1330	1
920	PC	2003	1486	1
965	PC	2003	1063	2
193	PC	2004	833	3
283	PC	2004	1935	1
396	PC	2004	2788	4
468	PC	2004	1510	1
501	PC	2004	451	1
540	PC	2004	1314	1
568	PC	2004	7113	2
778	PC	2004	5276	2
908	PC	2004	902	2
930	PC	2004	338	1
948	PC	2004	723	4
1041	PC	2005	4653	2
1160	PC	2005	1868	4
1180	PC	2005	999	2
1442	PC	2005	3206	3
1468	PC	2005	4378	1
1530	PC	2005	1544	1
1553	PC	2005	509	4
1630	PC	2005	1323	2
1649	PC	2005	965	3
217	PC	2005	348	1
411	PC	2005	5134	4
519	PC	2005	638	4
720	PC	2005	5276	1
730	PC	2005	4073	1
678	ST	2003	2946	4
798	ST	2003	1607	3
900	ST	2003	301	3
039	ST	2004	927	2
049	ST	2004	443	2
069	ST	2004	4073	2
079	ST	2004	172	2

Appendix Table 2. Continued.

Bird ID	Species	Year	Dispersal (m)	Dispersal direction
217	ST	2004	236	2
224	ST	2004	290	4
309	ST	2004	1697	3
345	ST	2004	495	3
373	ST	2004	675	3
479	ST	2004	12270	2
591	ST	2004	746	2
964	ST	2004	1331	3
110	ST	2005	1122	3
1132	ST	2005	251	4
1242	ST	2005	4532	4
1261	ST	2005	7934	4
1368	ST	2005	329	4
1411	ST	2005	6468	1
1491	ST	2005	669	2
1612	ST	2005	1389	1
1671	ST	2005	820	2
1692	ST	2005	447	4
1731	ST	2005	440	4
240	ST	2005	968	4
346	ST	2005	4169	4
373	ST	2005	1819	4
759	ST	2005	1539	2

Appendix Table 3. Brood home range size at 2 week intervals and % change in home range size between 2-6 weeks of age and 6-12 weeks of age for PC and ST on the Ft. Pierre National Grasslands, 2003-2005.

			Home Range (ha)						Change (%)	
	Year	N	2wk	4wk	6wk	8wk	10wk	12wk	2-6 Week	6-12 Week
PC	2003	5	92	140	180	242	290	346	96	92
	2004	7	55	84	104	120	162	171	89	64
	2005	9	46	79	101	133	157	184	120	82
	2003-2005	21	60	96	121	157	185	214	102	77
ST	2003	2	46	91	105	126	140	NA	128	NA
	2004	8	51	88	119	148	179	203	133	71
	2005	6	41	68	96	123	146	176	134	83
	2003-2005	16	47	81	109	136	160	183	132	68

Appendix Table 4. Number of PC and ST marked (leg bands, necklace style radios, back-pack style) and harvested on the Ft. Pierre National Grasslands, 2003-2005.

Species	Marker	# Marked	# Harvested	% Harvested
PC	Leg Band	94	7	7.45
	Necklace	46	6	13.04
	Chick Trans.	68	2	2.94
ST	Leg Band	38	3	7.89
	Necklace	31	1	3.23
	Chick Trans.	56	2	3.57
Total	Leg Band	132	10	7.58
	Necklace	77	7	9.09
	Chick Trans.	124	4	3.23

Appendix Table 5. Prairie chicken and ST harvest distribution for grouse marked with leg bands, necklace transmitters, and back-pack transmitters on the Ft. Pierre National Grasslands, 2003-2005.

		Fall 1	Fall 2	Fall 3
Leg Bands (Males)				
	#	7	1	2
	%	70	10	20
Necklace Trans. (Hens)				
	#	7	0	0
	%	100	0	0
Back-Pack Trans. (Chicks)				
	#	4	0	0
	%	100	0	0
All Markers				
	#	18	1	2
	%	85.7	4.8	9.5

Appendix Table 6. Flush and Run Effect distances of PC and ST used in the avoidance aspect of evaluating the effects of dog training on the Ft. Pierre National Grasslands, 2003-2005.

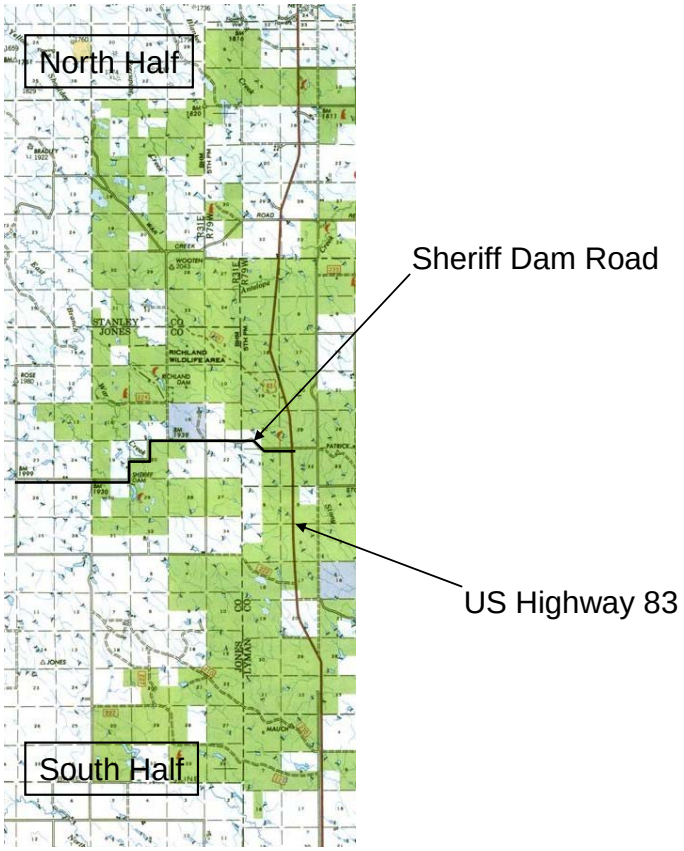
Bird ID	Year	Species	Age	Dog Training Area	Group Size	Flush Distance (m)	Run Effect Distance (m)
759	2003	PC	H	C	2	9	19
798	2003	ST	H	C	12	22	20
770	2003	ST	H	C	7	26	96
698	2003	PC	H	O	1	8	10
688	2003	PC	H	O	1	5	25
1064	2003	PC	C	O	1	5	21
1113	2003	PC	C	O	8	17	26
1261	2003	PC	C	O	5	12	5
1250	2003	PC	C	O	1	6	11
640	2003	PC	H	O	1	5	14
1379	2003	PC	C	O	3	11	76
1410	2003	PC	C	O	2	6	21
721	2003	PC	H	O	1	9	15
791	2003	PC	H	C	1	5	112
540	2004	PC	H	C	1	3	128
699	2004	PC	C	C	5	26	.
819	2004	PC	H	C	4	40	12
1669	2004	PC	C	C	1	19	16
539	2004	PC	C	C	4	17	21
798	2004	PC	H	C	1	8	11
1872	2004	ST	C	C	6	18	24
568	2004	PC	H	C	1	11	45
079	2004	ST	H	C	5	27	20
1969	2004	ST	C	C	5	23	12
040	2004	ST	H	C	1	18	68
1610	2004	ST	C	C	4	15	19
1832	2004	ST	C	C	1	5	7
1884	2004	ST	C	C	2	8	9
048	2004	ST	H	C	1	12	12
948	2004	PC	H	O	7	15	21
1850	2004	ST	C	O	1	5	5
411	2004	PC	H	O	1	10	84
859	2004	PC	C	O	9	25	15
1113	2004	ST	C	O	3	14	43
490	2004	ST	H	O	13	27	62
1903	2004	ST	C	O	1	18	.
224	2004	ST	H	O	11	16	28
930	2004	PC	H	O	3	11	44
964	2004	ST	H	O	5	14	116
283	2004	PC	H	O	1	11	55
373	2004	ST	H	C	2	7	19
443	2004	PC	H	C	2	14	18

Appendix Table 6. Continued.

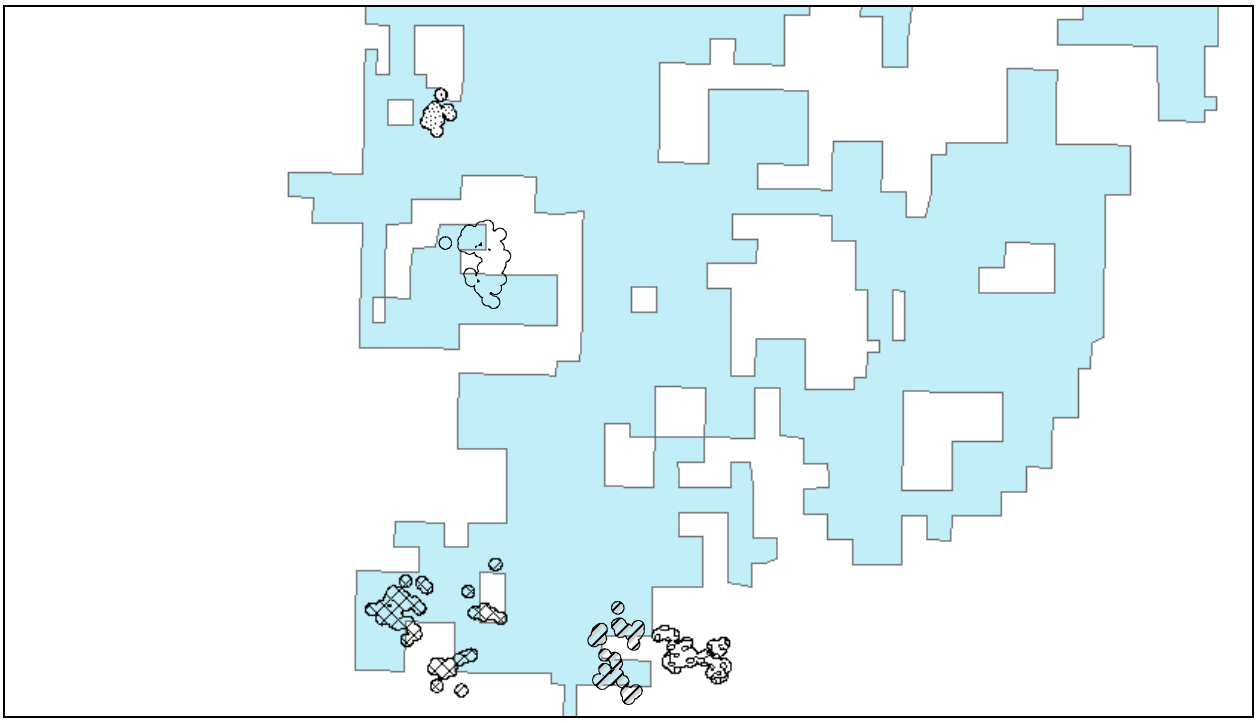
Bird ID	Year	Species	Age	Dog Training Area	Group Size	Flush Distance (m)	Run Effect Distance (m)
069	2004	ST	H	C	1	5	143
1940	2004	ST	C	C	3	16	77
1588	2004	ST	C	C	4	7	13
720	2005	PC	H	C	1	74	.
691	2005	PC	C	C	5	38	52
1691	2005	ST	H	C	8	16	35
1670	2005	ST	H	C	2	8	36
1710	2005	PC	H	C	1	1	.
1490	2005	ST	H	O	1	9	48
346	2005	ST	H	O	4	10	28
1160	2005	PC	H	O	4	30	30
848	2005	ST	C	C	1	5	5
730	2005	PC	H	C	3	7	7
1132	2005	ST	H	C	12	48	51
1410	2005	ST	H	C	1	45	100
1368	2005	ST	H	C	1	7	30
130	2005	ST	C	C	3	34	36
180	2005	ST	C	C	1	24	31
198	2005	PC	C	O	1	14	15
340	2005	PC	C	O	2	8	54
373	2005	PC	C	O	2	16	10
1630	2005	PC	H	O	3	2	32
651	2005	PC	C	C	19	5	11
879	2005	PC	H	C	1	10	118
1612	2005	ST	H	C	1	3	26
612	2005	ST	H	O	4	43	63
518	2005	PC	H	O	1	13	82
1442	2005	PC	H	O	2	10	35
69	2005	PC	C	O	4	14	61
676	2005	PC	C	O	5	17	24
1530	2005	PC	H	O	1	13	27
828	2005	ST	C	C	9	13	14
1440	2005	PC	C	O	3	12	20

Appendix Table 7. Area used by PC and ST hens during July and August, as well as the proportional overlap of the two months on the Ft. Pierre National Grasslands, 2003-2005.

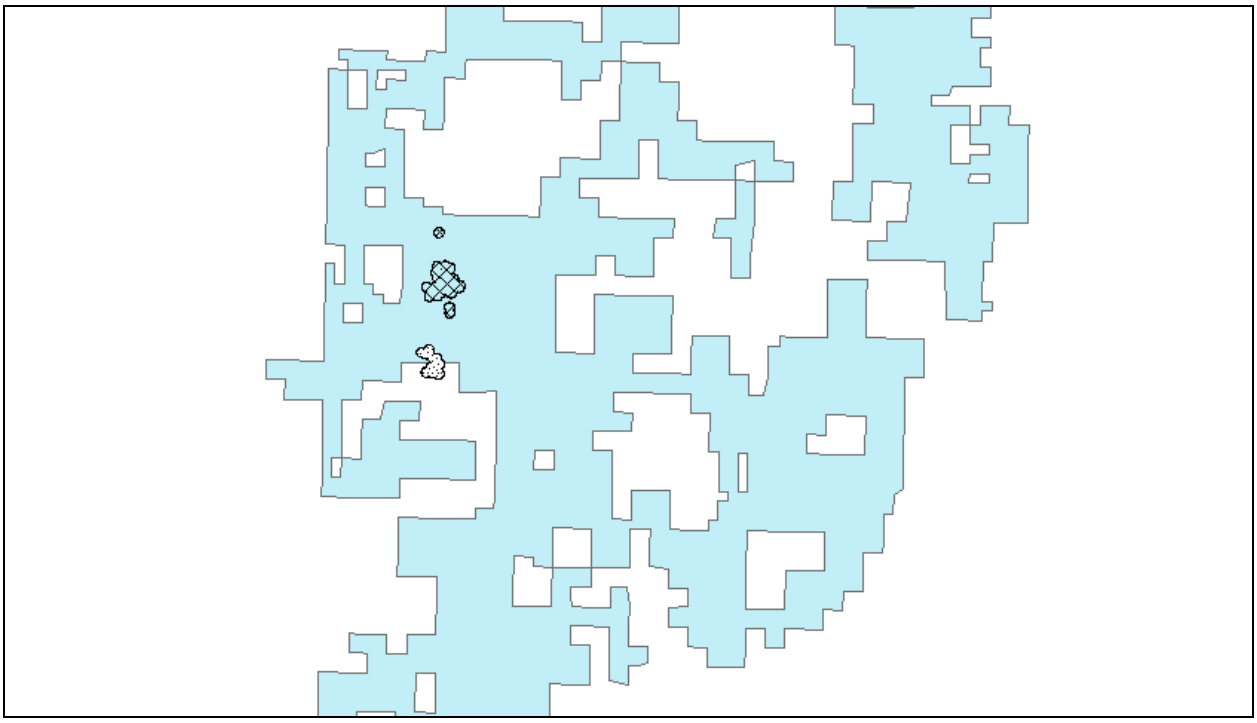
Bird-Id	Year	Species	Dog Training Area	Area Used July (ha)	Area Used August (ha)	Proportion Overlap
640	2003	PC	O	161	151	0.27
688	2003	PC	O	126	66	0.55
721	2003	PC	O	163	147	0.49
798	2003	ST	C	137	145	0.52
899	2003	ST	C	57	45	0.68
540	2004	PC	C	49	64	0.42
778	2004	PC	C	52	63	1.00
798	2004	PC	C	61	41	0.88
930	2004	PC	O	68	93	0.43
948	2004	PC	O	107	53	0.80
49	2004	ST	C	95	71	0.37
79	2004	ST	C	78	43	0.00
224	2004	ST	O	97	72	0.30
345	2004	ST	O	90	83	0.51
410	2004	ST	O	108	78	0.30
490	2004	ST	O	80	33	0.39
964	2004	ST	O	102	90	0.14
410	2005	PC	C	80	49	0.47
720	2005	PC	C	92	96	0.44
730	2005	PC	C	76	73	0.31
519	2005	PC	O	90	97	0.44
1442	2005	PC	O	101	134	0.14
1530	2005	PC	O	68	50	0.58
1553	2005	PC	O	72	96	0.17
1577	2005	PC	O	70	69	0.00
1630	2005	PC	O	37	89	0.33
1132	2005	ST	C	87	110	0.08
1368	2005	ST	C	89	72	0.32
1411	2005	ST	C	101	65	0.51
1670	2005	ST	C	84	74	0.24
1692	2005	ST	C	62	94	0.34
1731	2005	ST	O	62	120	0.26



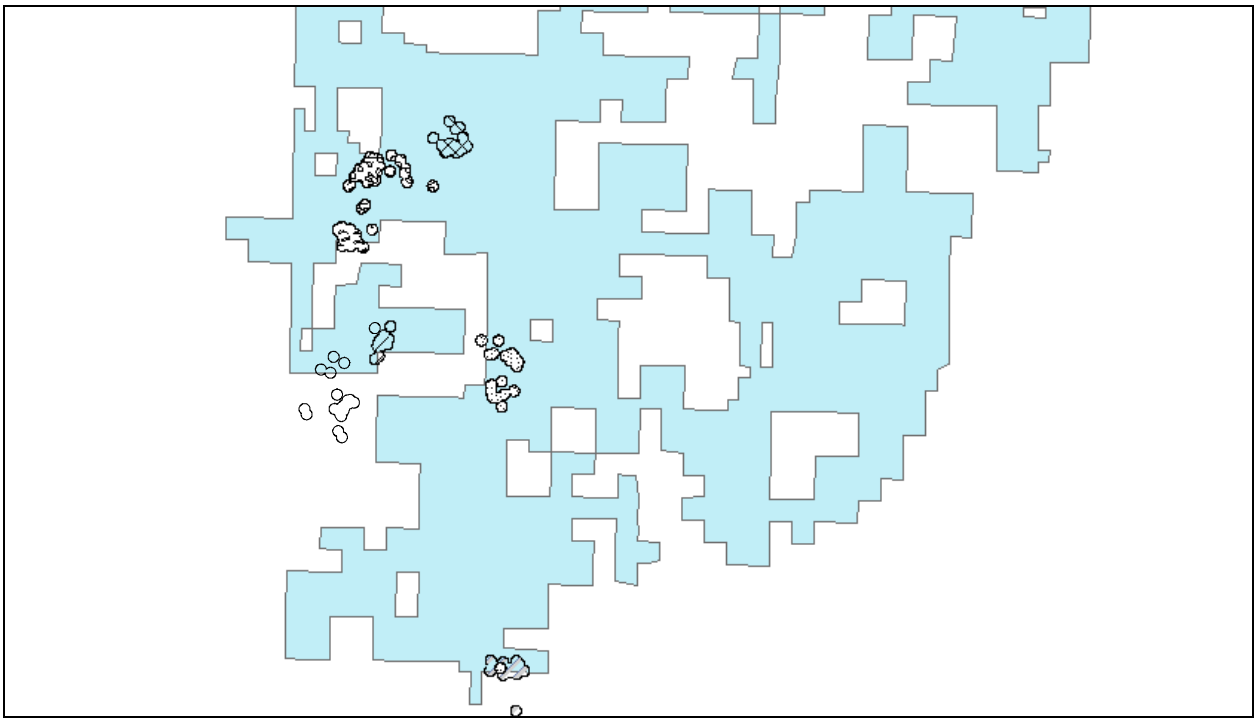
Appendix Figure 1. Focal area of the Ft. Pierre National Grasslands (west of US Highway 83) divided in half by Sheriff Dam Road. This divider provided the boundary between open and closed dog training areas on the Ft. Pierre National Grasslands, 2003-2005.



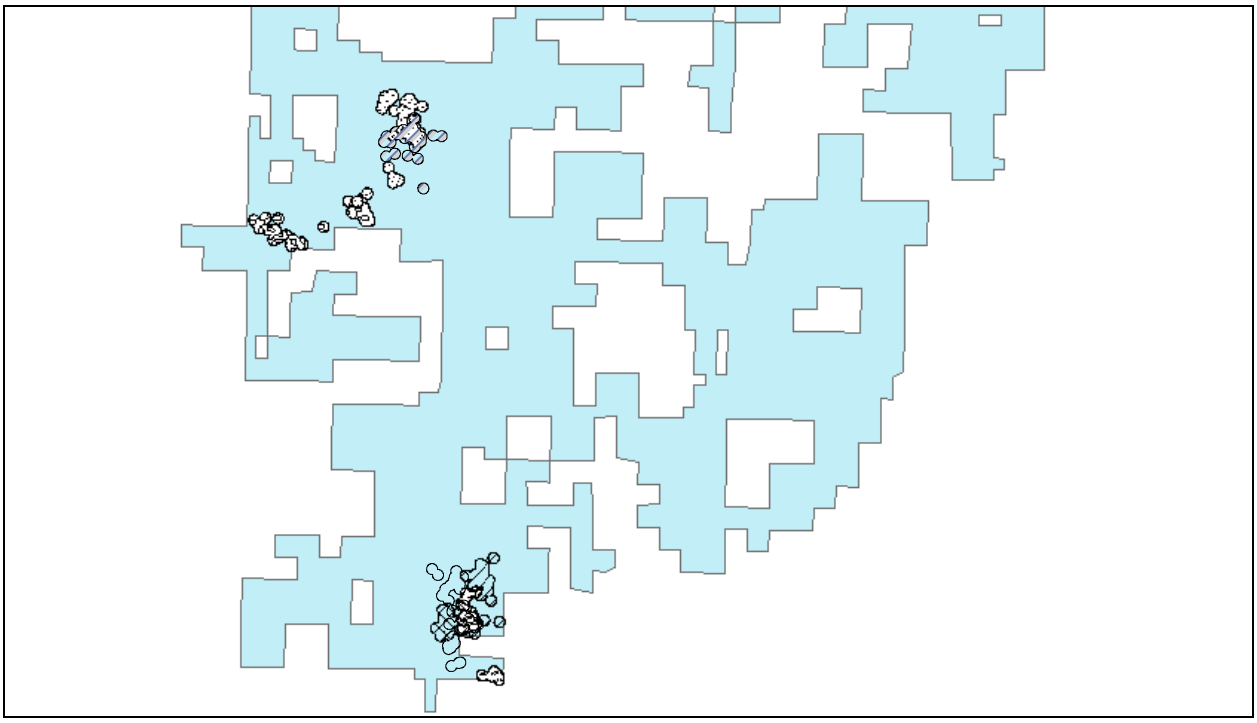
Appendix Figure 2. Home ranges of PC hens on the Ft. Pierre National Grasslands in 2003. Polygon patterns indicate individual radiomarked hens.



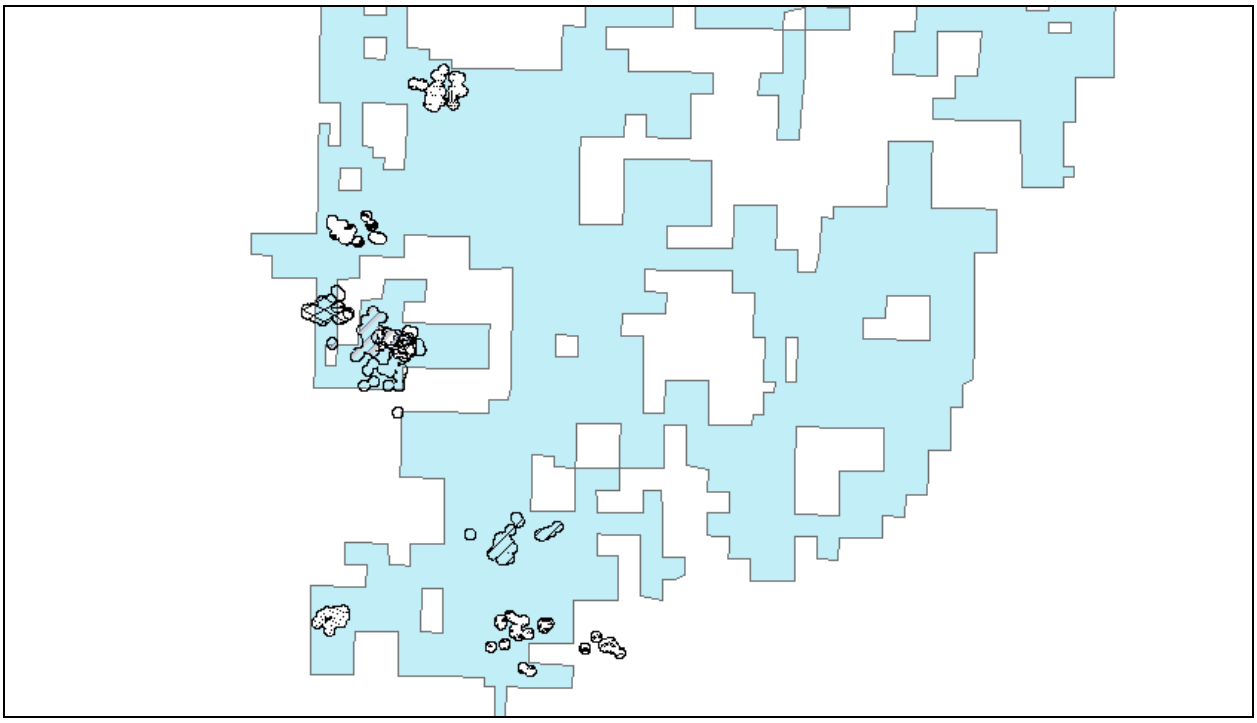
Appendix Figure 3. Home ranges of ST hens on the Ft. Pierre National Grasslands in 2003. Polygon patterns indicate individual radiomarked hens.



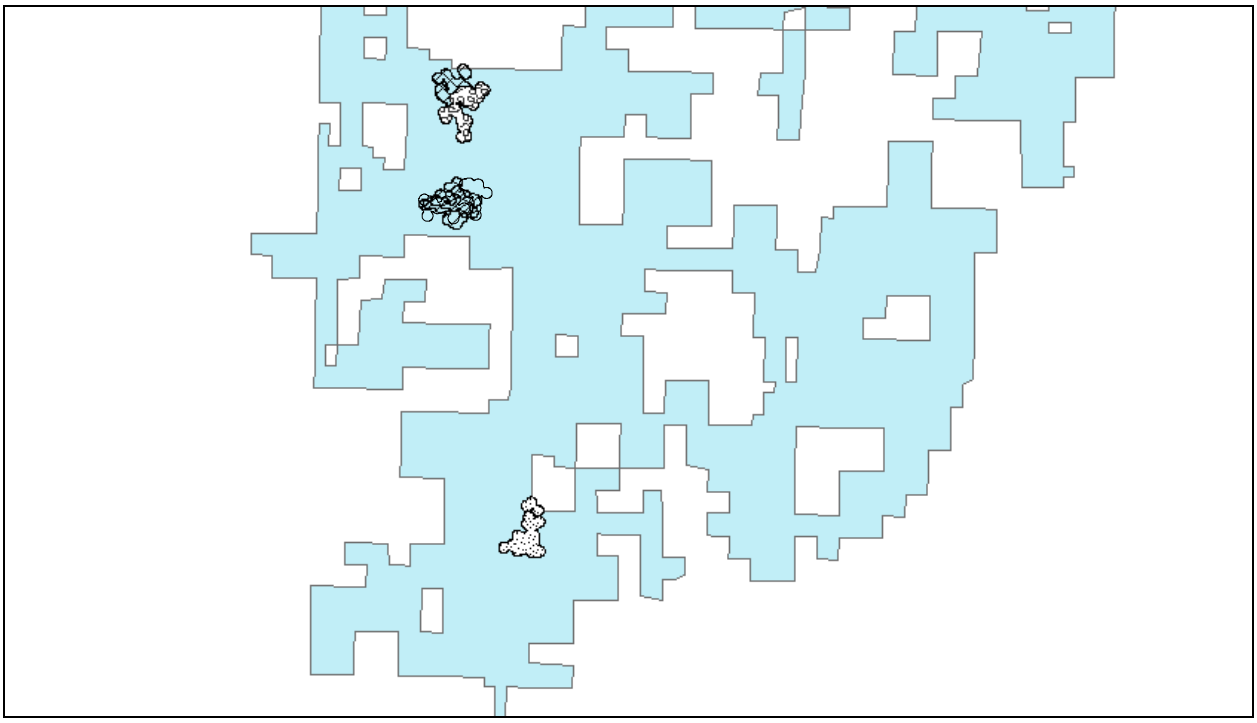
Appendix Figure 4. Home ranges of PC hens on the Ft. Pierre National Grasslands in 2004. Polygon patterns indicate individual radiomarked hens.



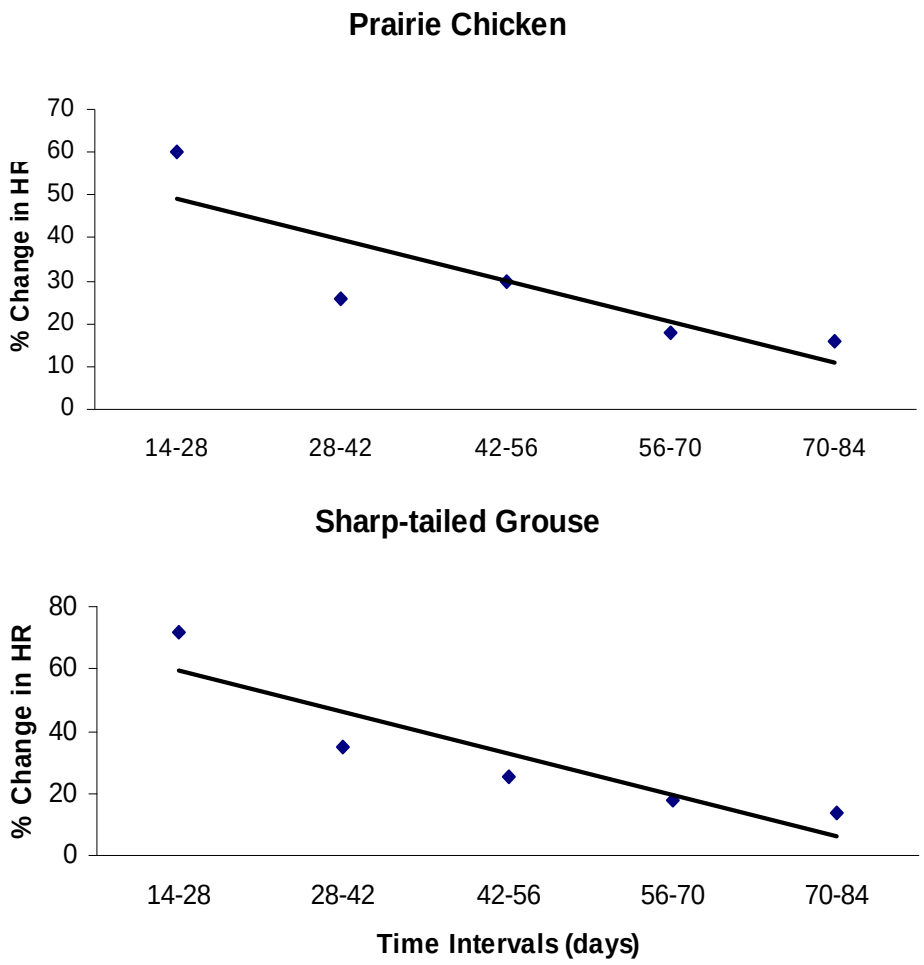
Appendix Figure 5. Home ranges of ST hens on the Ft. Pierre National Grasslands in 2004. Polygon patterns indicate individual radiomarked hens.



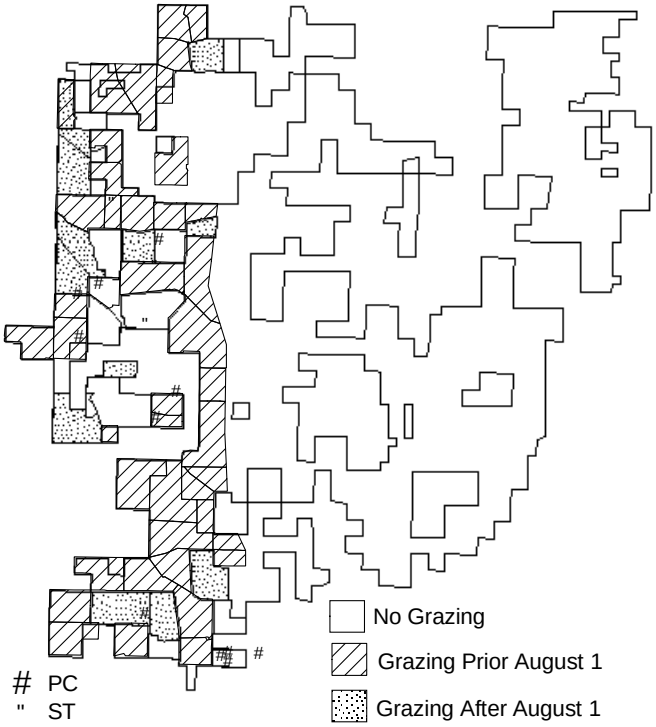
Appendix Figure 6. Home ranges of PC hens on the Ft. Pierre National Grasslands in 2005. Polygon patterns indicate individual radiomarked hens.



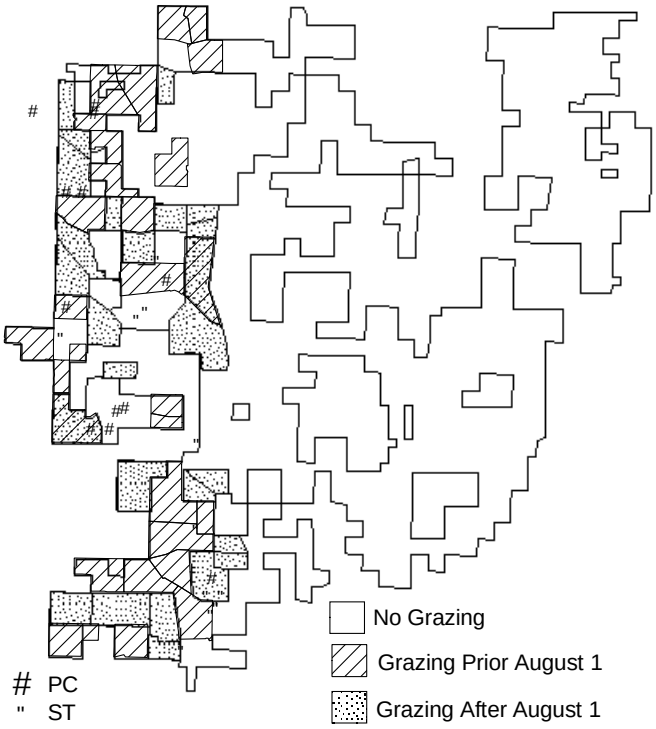
Appendix Figure 7. Home ranges of ST hens on the Ft. Pierre National Grasslands in 2005. Polygon patterns indicate individual radiomarked hens.



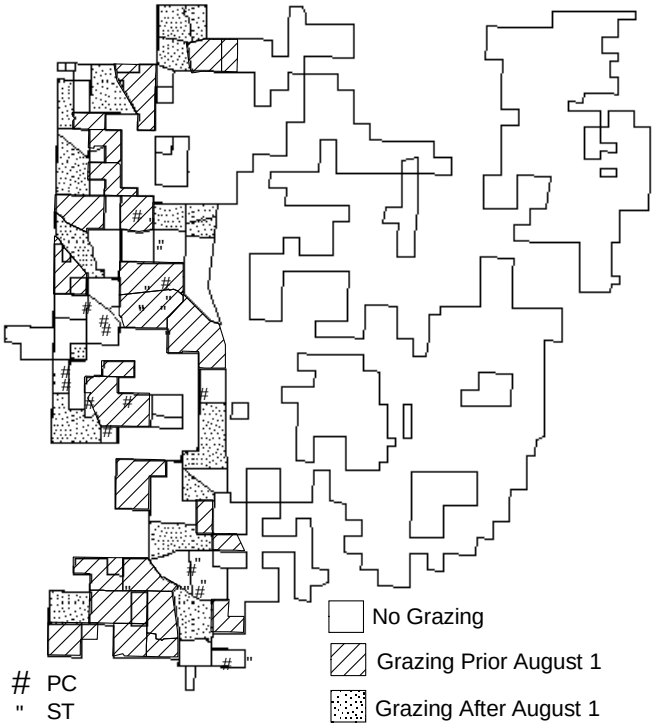
Appendix Figure 8. Relationship between the percentage change in brood size and time for PC and ST on the Ft. Pierre National Grasslands, 2003-2005.



Appendix Figure 9. Prairie chicken and ST nest locations for 2003 in relation to the type of grazing regime used on individual pastures in 2002.



Appendix Figure 10. Prairie chicken and ST nest locations for 2004 in relation to the type of grazing regime used on individual pastures in 2003.



Appendix Figure 11. Prairie chicken and ST nest locations for 2005 in relation to the type of grazing regime used on individual pastures in 2004.