SHARP-TAILED GROUSE RESPONSE TO FALL PRESCRIBED FIRE AND MOWING

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SUMMARY OF FINDINGS

We began a 2-year pilot study in 2015 to examine sharp-tailed grouse (i.e., sharptail, *Tympanuchus phasianellus*) responses to habitat management in the fall (mid-August through November). Our study area included the northwest (NW) and east-central (EC) sharp-tailed grouse populations in Minnesota, but only one site was managed in the fall in the EC region during the pilot study. We studied responses to prescribed fire and mechanical treatment (i.e., mowing) using a Before-After-Control-Impact (BACI) design. In falls of 2015 and 2016, we measured sharp-tailed grouse use and vegetation at 15 managed and 14 control sites prior to and following management. Managed areas included 7 mowing treatments and 8 prescribed burns, ranging in size from 12 to 664 ac (4.9–269 ha) and totaling 1,812 ac (733.3 ha). We also conducted surveys of sharp-tailed grouse use and vegetation at an additional 18 control sites and 27 sites that were planned to be managed, but for which management could not be completed because of unfavorable weather and site conditions.

We conducted surveys of sharp-tailed grouse use 0–28 (mean 10.3) days before management (PRE), 1 week after (1WK), 1 month after (1MO), and 1 year after (1YR) management by conducting fecal pellet transects and documenting sharptails observed at the site. In the NW, we detected sharp-tailed grouse pellets at 2 of the 14 treatment sites and 3 of the 13 control sites prior to treatment. Following treatment, sharp-tailed grouse pellets were detected in ≥1 fall survey (1WK, 1MO) at 9 treatment sites and 3 control sites. Sharptails were observed at only 1 treatment site and at no control sites in PRE surveys, but in later fall surveys (1WK, 1MO), sharptails were observed at 4 treatment and 2 control sites. In 1YR surveys, which have yet to be completed for sites managed during fall 2016, naïve occupancy of sites treated in fall 2015 was higher than before management, but control sites remained unchanged from pretreatment values.

We have developed a proposal to continue the study for another 3 years but anticipate additional data collection may be necessary to understand the variables that influence sharp-tailed grouse responses to these types of management actions.

INTRODUCTION

Sharp-tailed grouse rely on early successional habitats of open grass and brushland. Historically, these habitats were created and maintained through periodic wildfire. More recently, fire suppression has played a role in reducing habitat for sharp-tailed grouse (Berg 1997). Prescribed fire has become an important management tool for maintaining open grass and brushlands habitats, but it can be difficult to implement effectively or safely under many conditions (e.g., too wet, windy, humid, dry) and can require considerable staff and resources to execute. Thus, wildlife managers supplement prescribed burning with mechanical habitat management tools (e.g., shearing, mowing) to maintain early successional habitats. Although mechanical treatments set succession back, they may not produce the same wildlife response as fire does. Wildlife managers have expressed concern that sharp-tailed grouse are not responding to management in the way they would expect if habitat were limiting.

Fall may be a particularly important season for management because juvenile sharptails disperse to surrounding habitat in the fall. Currently, most prescribed burns on state and other lands in the sharp-tailed grouse range occur in the spring (Roy and Shartell, unpubl. data from DNR Wildlife Managers). Region 1 (R1) regularly conducts fall burning, however Regions 2 and 3 (R2/3) have not been burning in the fall because of concerns about peat fires during drier conditions and challenges mobilizing a large number of fire-qualified staff on short notice during the fall (R1 has a Roving Crew to assist with prescribed fire treatments and R2 does not). This study aims to measure the response of sharptails to prescribed burning and mechanical treatments in the fall, as compared to untreated controls.

Historically, fires occurred throughout the year and maintained early successional habitats, such as open grass and brushland, on the landscape. Grassland fires were started by lightning during the growing season, and Native Americans set fires during both the spring and fall dormant seasons in both grasslands and forests to aid hunting (see review in Knapp et al. 2009). Stand replacing fires occurred at 0-10 year intervals in grass and shrub vegetation types, and in forest and woodland types, understory fires occurred at 0-10 year intervals, with more severe, stand-replacement fires occurring at less frequent intervals in Minnesota (Brown and Smith 2000).

Native Americans referred to the sharp-tailed grouse as the “fire grouse” or “fire bird” because of their association with habitats frequently burned, and kept open, by fire. Sharptails have been shown to respond to prescribed fire treatments. Kirsch and Kruse (1973) found that the numbers of broods hatched per 100 acres was higher in 2 burned areas compared to an unburned control 1 year after spring prescribed fires. Sexton and Gillespie (1979) reported that sharptails switched leks just 2 days after a spring burn, abandoning the former dancing ground in favor of the recently burned site 480 m to the north. Sharptails have also been observed returning to leks to dance the day after a burn (J. Provost, pers. comm.).

Burn season may have an effect on the response of sharptails to prescribed fire treatments. Burns conducted in the fall might attract dispersing juveniles searching for habitat. Numerous bird species are known to be attracted to fire, smoke, and recently burned areas (Smith 2000); smoke, flames, and dark burned ground could provide strong visual cues about habitat creation and its direction from a large distance. Young sharptails disperse during September and October (Gratson 1988), typically <6 km from brood rearing areas near nest sites. Sites burned in the fall are not followed by regrowth of vegetation during winter (Kruse and Higgins 1990) and could serve as lek sites the following spring. Sharp-tailed grouse also resume dancing at leks in the fall; Hamerstrom and Hamerstrom (1951) suggested that these fall dances, which include young males, might establish leks for the following spring.

Similar long-distance cues to habitat creation and maintenance are not provided by mechanical treatments. Thus, we might expect wildlife responses to management lacking these cues to be delayed or muted. In Florida shrub-grassland, burned plots were colonized by birds sooner than the mechanically treated plots, in which shrubs were chopped (Fitzgerald and Tanner 1992); birds were observed in burned plots the next day but not for months in chopped plots. Species richness and abundance remained lower in winter chop plots than in burned and control plots throughout this study. Fitzgerald and Tanner (1992) suggested that this was because burned plots provided more complex structure than mechanically treated plots.

Sharp-tailed grouse densities and responses to management treatments have been measured with numerous methods, but pellet counts are the simplest to execute. Pellet counts along transects have been shown to be indicative of the relative abundance of greater sage grouse

(*Centrocercus urophasianus*) (Hanser et al. 2011), density of red grouse (*Lagopus lagopus scoticus)* (Evans et al. 2007), and habitat use of red grouse (Savory 1978). Pellet counts along transects in plots have been used to compare sage-grouse responses to mechanical and chemical treatments (Dahlgren et al. 2006). Schroeder and Vander Haegen (2014) used pellet counts along circular transects to examine the effects of wind farms on sage-grouse.

OBJECTIVES

1. To compare sharp-tailed grouse use prior to and following fall management within burn, mow, and control treatments.
2. To relate vegetation metrics to differences in sharp-tailed grouse use of burn, mow, and control treatments.

Hypotheses

1. Sharp-tailed grouse use will increase following burning or mowing, with burned sites showing a greater increase in sharptail use than mowed sites, and both treatments having greater sharptail use than controls.
2. Vegetation composition and structure will influence the use of treatment and control sites by sharp-tailed grouse, with increased use in early successional habitats.

METHODS

Study Areas

Our pilot study included the northwest and east-central regions of Minnesota where sharp-tailed grouse occur. Treated study sites were mainly on state lands, however 1 site owned and managed by The Nature Conservancy (TNC) and 2 private land sites were included as well.

In 2015, we conducted pre-treatment surveys at 23 sites that were planned to be managed and 19 control sites. Of these, 10 sites (6 mows and 4 prescribed burns) were treated (Table 1) in the NW and management was not completed at any sites in the EC region. In 2016 we conducted pre-treatment surveys at 19 sites that were planned for management and 13 control sites. Of these, 4 sites (1 mow and 3 prescribed burns) were treated in the NW (2016 was an unusually wet year which restricted management opportunities) and 1 site was burned in the EC region.

Data Collection & Experimental Design

Treatment sites varied in size, date of management, vegetative composition, surrounding landscape, and local sharptail density. We attempted to match treatments in each DNR work area or sub-work area (some work areas are very large) with a control site of similar size and successional stage (e.g., crude habitat classification, visual assessment of percent cover shrubs and herbaceous vegetation, and average shrub height) *a priori* as determined by inspection of aerial imagery, conversations with managers, and site visits. Control sites were identified ≤6 km from treatment sites when possible (based on dispersal distances of young males in the fall; Gratson 1988). Control sites helped account for changes related to seasonal progression (i.e., changes in habitat use, social behavior, and vegetation) not related to management. Dahlgren et al. (2006) implemented a similar design to account for temporal differences in the application of management treatments for sage grouse.

We surveyed treatment and control sites as close as possible in time, both before and after treatment (Smith 2002, also see Morrison et al. 2001:118-130). We walked systematically spaced parallel transects with a starting point placed on the site boundary and the transect traversing the treatment capturing both edge and interior portions. The sampling rate was standardized to 10 m of transect/ac (25 m/ha), with transects at least 150 m apart, based on placement of pellet transects in other studies (Evans et al. 2007, but half as dense as Dahlgren et al. 2006, Hanser et al. 2011). We counted sharptail pellet piles $\leq$0.5 m from the transect, removing all pellets encountered (Evans et al. 2007, Schroeder and Vander Haegen 2014). At each pellet pile we recorded pellet freshness and vegetation category (i.e., grass, shrub, forb, grass-shrub mix, grass-forb mix, etc.). We also recorded all sharp-tailed grouse observed (heard, flushed, tracks seen) at the site while walking transects.

We sampled transects 4 times at each site—once before treatment, targeting measurements within 2 weeks of treatment (PRE), and 3 times after treatment; one week after treatment (1WK), one month after treatment (1MO), and one year after treatment (1YR). Matched treatment and control sites were sampled within 14 days of each other. We also surveyed sites during the spring of 2016, but our early results indicated that sharptail use of managed sites in spring could be misleading at sites without a lek due to focused activity at lek sites in the spring. Thus, spring use of managed sites may have little relationship to fall habitat use, so we discontinued spring surveys in 2017.

To adjust naïve occupancy rates for detection differences among treatment groups, vegetation categories, and other sources, we conducted pellet detection assessments. We accomplished this by surveying transects with pellets placed in known locations (but unknown to observers) and estimated detection probabilities for each vegetation and management category. Dahlgren et al. (2006) reported detectability of pellets along transects to be very high and similar in different types of vegetative cover. However, their study was conducted on sage grouse in sage brush, and sharp-tailed grouse habitats in Minnesota differ considerably in vegetative composition and structure.

We sampled vegetation within treatments using point-intercept sampling (Levy and Madden 1933, Dahlgren et al. 2006) to determine percent cover and average height of broad vegetation classes (i.e., tree, shrub, forb, and graminoid) before and after treatment. We sampled vegetation along 20-m transects placed perpendicular to the pellet transect, with the number of transects based on the size of the site. We marked the start of each vegetation transect using ground staples with numbered aluminum tags and flagging, and we used Global Positioning System (GPS) coordinates to allow re-measurement following treatment. For each vegetation class we recorded maximum height every 0.5 m for a total of 40 points per transect. We used a pole with graduated measurements every dm to determine the type of vegetation intercepted (touching the pole) and the highest point at which each vegetation class touched the pole. We also recorded whether the vegetation was dead/dormant, combining those categories because it was unclear due to natural plant senescence whether vegetation was dormant or dead in late-fall surveys. Following treatment, we classified cut vegetation as dead/dormant, recorded height, and noted that the vegetation was cut. If no vegetation was present, the substrate type was recorded. For the purpose of this study, moss and lichen were considered a substrate type rather than vegetation. Vegetation metrics were determined for each study site. Proportion of cover in each class and average maximum height were compared among treatment types and between sites with and without sharptail use. In our preliminary analysis, we included both live and dead vegetation and used the maximum height of vegetation at each point. Significant differences were tested for using Tukey's Honest Significant Difference test.

RESULTS AND DISCUSSION

Sharp-tailed grouse pellets were detected on transects at 2 (14%) of the 14 treatment sites and 3 (23%) of the 13 control sites prior to treatment in the NW (Table 2). Following treatment, sharp-tailed grouse pellets were detected in ≥1 fall survey (1WK, 1MO) at 9 treatment sites (64%) and 3 control sites (23%). Sharptail observations on transects prior to treatment exhibited similar patterns, with detections at only 1 treatment site (7%) and no control sites (0%). In later fall surveys (1WK, 1MO), however, sharptails were observed at 4 treatment sites (29%) and 2 control sites (15%, Table 3). In 1YR surveys (completed for 2015 sites to date), we detected pellets on transects at 3 (30%) of 10 treatment sites and 2 (22%) of 9 control sites, and sharptails were observed on transects at 2 treatment sites (20%) and 1 control site (11%). Naïve occupancy of treated sites was higher 1YR later, but occupancy of control sites remained unchanged (Figure 1).

Our pellet survey results thus far suggest that our methods are capturing sharptail use of treatment and control sites. Naïve occupancy rates (i.e., site use) from data collected thus far suggest increases in sharptail use of sites following management (Figure 1). Although occupancy and detection are confounded in naïve estimates for the 1WK, 1MO, and spring (SP) surveys (due to treatment effects on screening cover), surveys conducted 1 year (1YR) following treatments should have similar detection rates to pre-treatment measurements due to regrowth of vegetation the next growing season, especially in burn sites. Thus, the PRE vs. 1YR comparison should be reasonably straightforward and informative (e.g., Figure 2), whereas results from other time comparisons are more tenuous to interpret from naïve occupancy rates. Nevertheless, demonstrating that managed sites are used after management directly addresses manager concerns.

General field observations of vegetation prior to treatment indicated that mowing might be applied to sites at a later successional stage than prescribed fire. However, there were no significant differences observed when averaging sites by treatment, possibly due to the low sample size and high variability of sites. Despite this, mow sites tended to have a lower mean proportion of grass cover, greater mean proportion of forb and shrub cover, and taller shrubs than burn sites (Table 4).

Control sites had lower graminoid height in 1MO surveys than PRE surveys, which was likely the result of vegetation senescence (Table 5). One year later, we did not detect differences in vegetation cover or height at control sites compared to pre-treatment measurements (Table 5). At sites that were mowed, shrub cover and graminoid, forb, and shrub height were lower in 1MO surveys, but in 1YR measurements only shrub height differed from PRE survey measurements. At sites that were burned, graminoid cover, forb cover, and graminoid height were lower in 1MO surveys, but in 1YR surveys no differences were detected (Table 5). Sites occupied by sharp-tailed grouse did not differ in vegetation cover or height from unoccupied sites during PRE or 1YR surveys (Table 6).

This report includes the fall surveys for the second year of data collection but not the 1YR surveys that will be conducted in fall 2017. Results presented in this report are preliminary and subject to revision. We anticipate that 5 years of data collection may be necessary to understand the complex responses of sharp-tailed grouse to fall management treatments and associated vegetation changes. This 2 year pilot study provided data to inform development of a proposal for continuing the study. Managers throughout sharptail range in Minnesota have expressed a need for this type of information to more effectively manage for sharptails. Given the current sharptail population concerns in the east-central region, information on the effectiveness of various management options would be helpful for decision-making with finite resources for management. Managers in the northwest region are also interested in this information to ensure that their management actions are as effective as possible.

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Table 1. Management activities completed for sharp-tailed grouse habitat during falls 2015 and 2016 and associated control sites, in order of treatment date.

Site name	Work area	Treatment	Treatment date	Treatment ac (ha)	Control ac (ha)
Roseau River	Roseau River	Mow	28 Aug–16 Sep 15	31 (12.5)	28 (11.3)
Skull Lake	Karlstad	Burn	1 Sep 2015	90 (36.4)	70 (28.3)
Halma	Karlstad	Mow	16–23 Sep 2015	41 (16.6)	39 (15.8)
Red Lake mow	Red Lake	Mow	22 Sep 2015	12 (4.9)	22 (8.9)
Spooner	Baudette	Mow	28 Sep 2015	22 (8.9)	26 (10.5)
Caribou	Karlstad	Burn	28 Sep 2015	664 (268.7)	No control
TL 2015 burn	Thief Lake	Burn	28 Sep 2015	58 (23.5)	31 (12.5)
Red Lake burn	Red Lake	Burn	19 Oct 2015	152 (61.5)	176 (71.2)
Prosper	Baudette	Mow	19–30 Oct 2015	63 (25.5)	201 (81.3)
TL mow	Thief Lake	Mow	30 Oct 2015	20 (8.1)	19 (7.7)
TL 2016 burn	Thief Lake	Burn	1 Sep 2016	31 (12.5)	37 (15.0)
Noracre	Roseau	Burn	14 Sep 2016	71 (28.7)	22 (8.9)
Roseau brush	Roseau	Mow	27 Sep – 7 Oct 16	23 (9.3)	29 (11.7)
Espelie	Thief River Falls	Burn	3 Oct 2016	443 (179.3)	460 (186.2)
Hasty Brook*	Cloquet	Burn	16 Nov 2016	91 (36.8)	90 (36.4)

* Hasty Brook was the only site where management was completed in the east-central sharptail region during the 2-year pilot study, and because of snowfall after treatment, post-treatment surveys were incomplete.

Table 2. Sharp-tailed grouse pellet detections at treatment and control sites in northwest Minnesota. Surveys were conducted before (PRE), 1 week (1WK), 1 month (1MO), the spring (SP), and 1 year (1YR) after treatment. The number of pellet detections on transect are indicated numerically, and pellets detected off-transect are indicated with an OT, indicative of site use not captured in sampling. An asterisk indicates that snow impeded detection of pellets, and T indicates that tracks were detected in snow. Surveys with confirmed sharptail use through any source of sign at the site during a survey are highlighted in gray. NS indicates that a survey has not yet been completed for sites managed during fall 2016.

Fecal pellets	Treatment					Control				
Site	PRE	1WK	1MO	SP	1YR	PRE	1WK	1MO	SP	1YR
Red Lake mow	0	0	0	0	2	0	0	0	0	1
Thief Lake mow	0	0	0*	0	0	0	0	0*	0	0
Spooner mow	0	0	2	3	0	0	0	0	0	0
Roseau 2015 mow	2 OT	1 OT	1	0	0	0	0	0	0	0
Halma mow	0	0	0	0	1 OT	1	1	2	0	0
TL 2015 burn	1 OT	0	1	0	1 OT	0	0	0	0	0
Skull Lake burn	0	1	0	0	1	0	0	0	4	0
Red Lake burn	0	0	0	0	0	0	0	0*	0	0
Prosper mow	0	1	0*	0	2	1	11	T*	11	5 4 OT
Caribou burn	1	2	1 OT	1	0	.	.	.	.	-
TL 2016 burn	0	1	4 7 OT	NS	NS	0	0	0	NS	NS
Noracre burn	0	9 3 OT	0	NS	NS	0	0	0	NS	NS
Espelie burn	1	6	18 31 OT	NS	NS	1 1 OT	1 3 OT	4 5 OT	NS	NS
Roseau 2016 mow	1 OT	0	0	NS	NS	0	0	0	NS	NS

Table 3. The number of sharp-tailed grouse observed at treatment and control sites in northwest Minnesota. Surveys were conducted before (PRE), 1 week (1WK), 1 month (1MO), the spring (SP), and 1 year (1YR) after treatment. Sharp-tailed grouse observed while off-transect are indicated with OT, indicating site use not captured in sampling. Surveys with confirmed sharptail use through observations of any birds at the site during a survey are highlighted in gray. NS indicates a survey has not been completed for sites managed in fall 2016.

Grouse observations`		Treatment					Control			
Site	PRE	1WK	1MO	SP	1YR	PRE	1WK	1MO	SP	1YR
Red Lake mow	0	0	0	0	0	0	0	0	0	0
Thief Lake mow	0	0	0	0	0	0	0	0	0	0
Spooner mow	0	0	11	3	3 OT	0	0	0	0	0
Roseau 2015 mow	2 OT	5OT	2OT	1 OT	0	0	0	0	0	0
Halma mow	0	0	1	0	0	0	2	0	0	0
TL 2015 burn	4	0	0	0	0	0	0	0	0	0
Skull Lake burn	0	0	0	0	0	0	0	0	0	0
Red Lake burn	0	0	0	0	0	0	0	0	0	0
Prosper mow	0	0	0	0	1	0	0	0	4	12-20
Caribou burn	0	5	13	0	2	-	-	-	-	-
TL 2016 burn	0	0	0	NS	NS	0	0	0	NS	NS
Noracre burn	0	0	0	NS	NS	0	0	0	NS	NS
Espelie burn	0	1	2 OT	NS	NS	5 OT	1	7 OT	NS	NS
Roseau 2016 mow	6 OT	0	0	NS	NS	0	0	0	NS	NS

Table 4. Mean pre-treatment vegetation cover and height for 4 vegetation classes at control (*n* = 13), mow (*n* = 7), and burn (*n* = 7) sites sampled for sharp-tailed grouse use in northwestern Minnesota during 2015 and 2016.

	Control	Mow	Burn
Cover (proportion)			
Graminoid	0.92	0.88	0.96
Forb	0.33	0.46	0.24
Shrub	0.34	0.36	0.21
Tree	0.05	0.04	0.09
Height (m)			
Graminoid	0.52	0.51	0.56
Forb	0.34	0.37	0.33
Shrub	1.09	1.30	0.74
Tree	2.50	1.63	1.98

Table 5. Change in mean vegetation cover and height from PRE treatment to 1MO (control *n* = 13, mow *n* = 7, and burn *n* = 7) and 1YR (control *n* = 9, mow *n* = 6, and burn *n* = 4) surveys in northwest Minnesota. Comparisons to 1YR surveys exclude sites managed in 2016, thus results are preliminary and subject to change with additional data collection. Significant differences (P < 0.05) between pre and post measurements are indicated with an asterisk.

	Control 1MO	Control 1YR	Mow 1MO	Mow 1YR	Burn 1MO	Burn 1YR
Cover (proportion)						
Graminoid	-0.01	0.02	-0.32	-0.03	-0.38	-0.03
Forb	-0.14	-0.02	-0.35	0.01	-0.18*	0.13
Shrub	-0.06	0.01	-0.30*	-0.07	-0.06	-0.05
Tree	-0.01	0.02	-0.04	-0.04	-0.03	-0.03
Height (m)						
Graminoid	-0.11*	-0.01	-0.37*	-0.08	-0.19*	0.04
Forb	-0.04	-0.03	-0.18*	-0.09	0.10	-0.09
Shrub	0.11	-0.10	-1.05*	-0.77*	0.02	-0.04
Tree	-0.32	0.01	-0.25	-1.03	-0.02	-0.21

Table 6. Mean cover and height at sites occupied and unoccupied by sharp-tailed grouse during PRE (occupied n = 8, unoccupied n = 19) and 1YR (occupied n = 9, unoccupied n = 10) surveys in northwest Minnesota. 1YR surveys exclude sites managed in 2016, thus results are preliminary and subject to change with additional data collection. No significant differences ($P < 0.05$) between occupied and unoccupied sites were observed.

Sharptail occupancy	PRE unoccupied	PRE occupied	1YR unoccupied	1YR occupied
Cover (proportion)				
Graminoid	0.92	0.92	0.90	0.90
Forb	0.36	0.30	0.33	0.41
Shrub	0.34	0.27	0.37	0.29
Tree	0.04	0.09	0.04	0.02
Height (m)				
Graminoid	0.51	0.58	0.54	0.49
Forb	0.35	0.33	0.33	0.28
Shrub	0.97	1.24	0.90	0.72
Tree	1.71	3.32	1.93	1.41

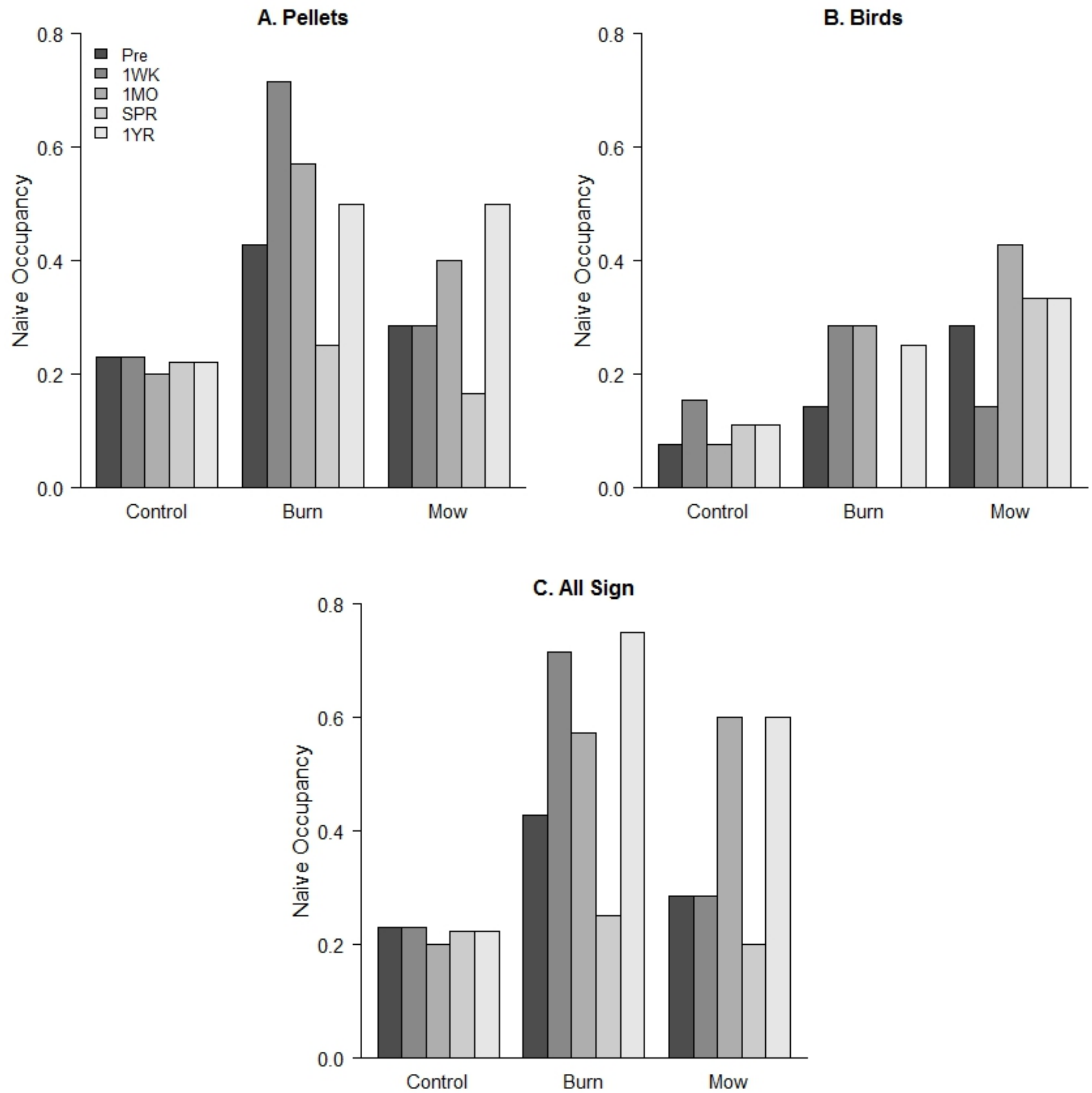

Figure 1. Naïve occupancy for sharptail pellets (A), sharptail observations (B), and all sign (includes off-transect detections), C) during surveys conducted before (PRE), 1 week (1WK), 1 month (1MO), the spring (SP), and 1 year (1YR) after treatment during 2015 in the northwest study area of Minnesota to assess the effects of prescribed burning and mowing.

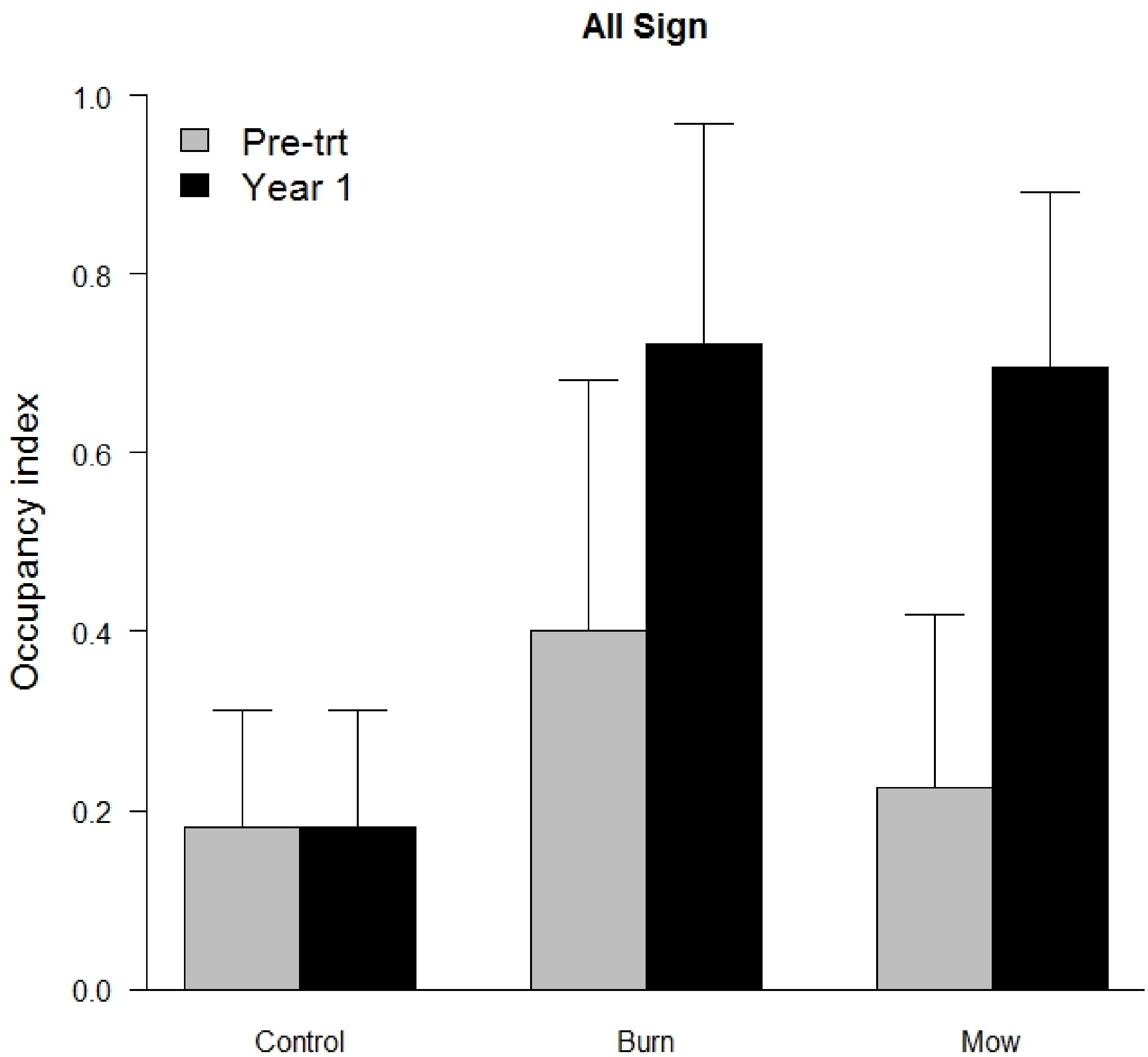

Figure 2. Mean naïve occupancy index at 10 sites managed for sharp-tailed grouse in northwestern Minnesota during 2015 based on a logistic regression model with an offset for transect length.