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ABSTRACT We evaluated pronghorn (*Antilocapra americana*) fawn bedding site characteristics on a prairie and ponderosa pine (*Pinus ponderosa*) landscape interface in Custer State Park, South Dakota. We radiomarked 16 adult female pronghorn and collected bed site information from their fawns during 2007–2008. We compared bed site selection with random sites (n = 74) during 2 periods; the early hiding phase when fawns were 1–28 days of age (n = 23 bed sites) and the later group phase when fawns were 29–60 days of age (n = 52 bed sites). During the hiding phase fawns selected dry prairie-seminatural mixed grassland at the course-scale level; group phase fawns selected prairie dog (*Cynomys ludoviciana*) dominated grasslands and dry prairie-seminatural mixed grassland at the course-scale. Evaluation at the fine-scale indicated fawns during the group phase period selected bed sites that had greater forb cover and overstory canopy cover of ponderosa pine trees compared to random sites. Management activities that promote a dynamic grassland ecosystem with patches of forb cover may enhance resources selected as bedding habitat by pronghorn fawns during the group phase period.

KEY WORDS *Antilocapra americana*, bed site, Black Hills, Custer State Park, resource selection, pronghorn, South Dakota

Pronghorn (*Antilocapra americana*) occupy a wide variety of habitats ranging from the Chihuahuan and Sonoran deserts of northern Mexico to the Plains of central Canada (O'Gara and Yoakum 2004). Understanding requirements of critical habitat, particularly during the early life stages is essential for sound management of the species (Yoakum 1972, 1974). Fawn recruitment may be the most important factor dictating pronghorn population dynamics (O'Gara and Yoakum 2004). Predation is the primary cause of fawn mortality among pronghorn, and perhaps the most important factor influencing fawn survival is habitat quality and characteristics of bedding sites (Von Gunten 1978, Tucker and Garner 1983, Byers 1997, Yoakum and O'Gara 2000).

Research in sagebrush-steppe habitats indicates pronghorn fawns select bed sites with greater visual obstruction provided by shrubs (Pyrah 1974, Autenrieth 1976); even though fawns select for greater shrub density, they may avoid the tallest and most dense shrub stands that are available (Alldredge et al. 1991). Information regarding habitat selection from short and mixed-grass prairie habitats is varied. In Texas, pronghorn fawns selected bed sites with less vegetation and increased mortality was associated with greater concealment cover (Canon and Bryant 1997). Where shrub cover is limited, selection of bed sites using small depressions or patches of bare ground provided horizontal and vertical cover (Bromley 1977, Barret 1981). Some researchers have hypothesized pronghorn fawns select for areas with greater visual detection of predators versus bed concealment (Bromley 1978, Smith and Beale 1980). A recent study in Wind Cave National Park indicated pronghorn fawns selected grasses as bed cover; grassland habitat was not limited in this area (Jacques et al. 2007).

Pronghorn in Custer State Park, South Dakota, share resources with several large ungulate species including bison (*Bos bison*), elk (*Cervus elaphus*), and deer (*Odocoileus virginianus, O. hemionus*). Coarse-scale resource selection and overlap of use among these species are currently being investigated (Barbara J. Keller, University of Missouri, unpublished data) and could have implications for management of pronghorn habitat in Custer State Park. However, little or no information is available on finer scale habitat needs, such as bed site selection by pronghorn fawns along a prairie and ponderosa pine (*Pinus ponderosa*) ecotone. Our objective was to assess bed site resource selection of pronghorn fawns at coarse (third-order) and fine-scale levels (fourth-order; Johnson 1980) in Custer State Park. Based on previous literature, we hypothesized that fawn bed sites would be greater in grass cover and visual obstruction than random sites (Bromley 1977, Canon and Bryant 1997, Jacques et al. 2007).

STUDY AREA

Custer State Park (28,618 ha) was located in southwestern South Dakota, and within the Black Hills physiographic region (Johnson et al. 1995). Elevations ranged from 1,146 to 2,042 m above mean sea level. Northwest to southeast the Park has a marked gradation in topography and vegetation communities. The northwest was characterized by dense ponderosa pine/white spruce (*Picea glauca*) forest with steep topography, the central portion had rolling topography dominated by ponderosa

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pine forest, and the southeastern portion was slightly rolling and dominated by grasslands. The climate was semi-arid with mean annual precipitation of 50.6 cm at the northern end of the Park (National Climatic Data Center 1971–2000) and 46.8 cm at the southern end of the Park (Custer State Park Climate Data 1983–2007). Mean annual temperature was 6.6°C at the northern end of the Park (National Climatic Data Center 1971–2000). The study area was mostly coniferous forest dominated by ponderosa pine (55%). Meadows (22%) included dry native prairie and seminatural grasslands. Deciduous communities were rare (2%) and were primarily bur oak (*Quercus macrocarpa*), aspen (*Populus tremuloides*), green ash (*Fraxinus pennsylvanica*), and to a lesser extent cottonwood (*Populus deltoides*). Twenty percent of the study area was burned by wildfires in 1988, 1990, and 2007. Common woodland understory species in the southern end of the Park included bearberry (*Arctostaphylos uva-ursi*), swamp current (*Ribes lacustre*), and common juniper (*Juniperus communis*), while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) occurred less frequently (Larson and Johnson 1999). Common native grasses in the southern end of the Park included needle-and-thread (*Stipa comata*), western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), little bluestem (*Schizachyrium scoparium*), sideoats grama (*Bouteloua curtipendul*), and buffalograss (*Buchloe dactyloides*; Larson and Johnson 1999). Western snowberry (*Symphoricarpos occidentalis*) was a common shrub both in the pine forest and interspersed in meadow habitats.

METHODS

Capture and Radiotelemetry

We captured and radiocollared female pronghorn during fall (1–30 November, 2005–2007) using net guns (DelGiudice et al. 2001, Jacques et al. 2009). We captured pronghorns from a vehicle by deploying a 0.93 m^2 net from a modified 0.308 caliber net gun (Coda Enterprises Incorporated, Mesa, Arizona, USA). Following capture, pronghorn were aged based on incisor wear and replacement (Dow and Wright 1962). Radiocollars were placed around the neck of adult pronghorns and transmitters were equipped with activity and mortality signals (Advanced Telemetry Systems, Isanti, Minnesota, USA). Pronghorn were located systematically approximately every 48 hours throughout the sampling period by visual observation aided with a hand-held yagi antenna.

Fawn Monitoring and Bed Site Characteristics

When it became apparent each radiomarked female had localized movements due to parturition, we attempted to visually locate and count the number of fawns. We estimated the date of parturition for each female based on localized movements and visual observation of fawns. We confirmed the existence of each female's fawn by observing suckling behavior or observations of defensive behavior by the female when the fawn was approached by investigators. We determined diurnal locations of bed sites from fawns 2–60 days of age by visually observing fawns of radiomarked females in their beds from 1 June–15 August. Fawn behavior for the first 3 to 4 weeks of life is primarily laying and hiding in cover away from its dam; subsequent to this period, fawns typically group together with their dams and possibly other conspecifics (Autenrieth and Fichter 1975). Therefore, fawn resource selection was evaluated during 2 time periods; the early hiding phase (1–28 days of age) and the later group phase (29–60 days of age). To avoid temporal bias we stratified diurnal locations into morning (sunrise-1000), mid-day (1001–1400), and afternoon (1401–sunset) time periods. We recorded bed site locations with a Global Positioning System (Garmin Ltd., Olathe, Kansas, USA).

Habitat availability was determined at the third-order (macrohabitat) scale (Johnson 1980) using resource maps within ArcGIS 9.2 (Environmental Systems Research Institute, Redland, California, USA). Available habitats for possible resource selection in Custer State Park were based on *a priori* information and consisted of grasslands and dry ponderosa pine forest (Bromley 1977, 1978, Jacques et al. 2007). Vegetation descriptions of these macrohabitats were based on the Black Hills Inventory which ground-truthed polygons using a physiognomic-floristic classification hierarchy (Marriot et al. 1999, Marriot and Faber-Langendoen 2000, Cogan et al. 2002). Each polygon in the spatial database was interpreted using 1:12,000 scale color infrared aerial photography. Land cover categories of macrohabitats included black-tailed prairie dog (*Cynomys ludoviciana*) grassland, dry prairie grassland, riparian shrubland, dry ponderosa pine forest, dry prairie-seminatural mixed grassland, montane grassland, and seminatural grassland (Cogan et al. 2002). The prairie dog grassland category represented areas occupied by black-tailed prairie dogs with a variety of grasses and forbs intermixed with bare ground patches. The dry prairie grassland category included upland grasslands dominated by a western wheatgrass-green needlegrass (*Stipa virudula*) association and little bluestem prairie. The riparian shrubland category was lowland watershed areas composed primarily of western snowberry shrubs. The dry ponderosa pine forest category was ponderosa pine forest composed of various structural stage and overstory canopy cover categories. The dry prairie-seminatural mixed grassland category was dominated by a mixture of native upland grasses and introduced graminoid species. The montane grassland category was post-fire grassland dominated by poverty oatgrass (*Danthonia spicata*). The seminatural grassland category was primarily composed of introduced graminoid species such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). This classification scheme resulted in 7 land cover categories (Table 1). Fawn bed locations were entered into a geographic information system (GIS; ArcGIS, Environmental Systems Research Institute) and overlaid with the Custer State Park Land Cover Database. To estimate microhabitats selected by fawns, we used proportional stratified random sampling (Cochran 1977) within our study area to identify available microhabitats. Strata for the random sampling included land cover categories described above. Using GIS, we identified all polygons of the same vegetation classification, and from these we randomly selected polygons without replacement. Within each of these polygons we selected one random point using the Hawth's tools extension in ArcGIS (Beyer 2004). We measured vegetation at random points and at observed bed sites from 1 June–15 August of each year. Random vegetation data was collected in a temporal manner during the sampling period so that conditions were similar to bed site data collection to avoid vegetation development bias.

We quantified fourth-order vegetation characteristics using transects centered at the bed or random site and data collected along transects were averaged for each variable of interest. Overstory canopy cover was estimated from 50 point measurements at 1-m intervals along 4 transects in the cardinal directions using a GRS densitometer (Stumpf 1993). Understory visual obstruction readings (VOR) of vegetation was estimated by placing a Robel pole with 2.54-cm increments (Robel et al. 1970, Benkobi et al. 2000) at the bed or random site and at an additional 12 points at 5-m increments in the 4 cardinal directions (n = 13). The lowest visible increment on the pole was recorded from a distance of 4 m. Investigators kneeled to a height of 1 m while recording VOR (Robel et al. 1970). We estimated percent canopy cover of total herbaceous cover, grass, forbs, shrubs, and dominant plant species using a 0.1 m^2 quadrat (Daubenmire 1959). We estimated percent canopy cover at the bed or random site and at 2-m intervals in the 4 cardinal directions for the outer 10 measurements (n = 41). Tree characteristics were measured in a single plot centered at the bed or random site. We recorded all trees ≥15.24 cm DBH in a variable-radius plot using a 10-factor prism (Sharpe et al. 1976). We recorded data for trees <15.24 cm DBH in a 5.03-m fixed radius plot. Aspect was recorded using a compass as the prevailing downhill direction from the site; percent slope was estimated along this same gradient with a clinometer. Distance (m) to nearest edge such as a meadow-ponderosa pine forest interface, or a change in meadow type was measured using GIS and the land cover database.

Table 1. Selection of land cover categories (macrohabitats) for bed sites by pronghorn fawns during the hiding phase period (1–28 days of age) in Custer State Park, South Dakota, 2007–2008.

Land Cover Categories[a]	Available proportion[b]	Use Counts	Selection ratio (C.I.)	Utilization[b]
Prairie dog grassland[c]	<0.01	1	–	0
Dry prairie grassland	0.07	7	4.24 (0.68–7.80)	0
Riparian shrubland	0.07	1	0.64 (–0.93–2.21)	0
Dry ponderosa pine forest	0.33	1	0.14 (–0.17–0.45)	–
Dry prairie-seminatural mixed grassland	0.30	12	1.84 (1.01–2.68)	+
Montane grassland	0.22	1	0.21 (–0.30–0.72)	–
Seminatural grassland	0.01	0	0 (0–0)	0

[a] Land cover categories were described using a physiognomic-floristic classification hierarchy for the Black Hills (Marriot et al. 1999, Marriot and Faber-Langendoen 2000, Cogan et al. 2002).

[b] Utilization of resources by pronghorn fawns were categorized as: selected (utilized more than available; +), random (equal utilization; 0), and avoided (utilized less than available; –).

[c] Prairie dog grassland habitats were not included in chi-square analyses because the expected values were <5 and there would be a confounding effect on other coefficients.

Table 2. Selection of land cover categories (macrohabitats) for bed sites by pronghorn fawns during the group phase period (29–60 days of age) in Custer State Park, South Dakota, 2007–2008.

Land Cover Categories [a]	Available proportion[b]	Use Counts	Selection ratio (C.I.)	Utilization[b]
Prairie dog grassland[c]	<0.01	10	–	+
Dry prairie grassland	0.07	7	2.22 (0.17–4.27)	0
Riparian shrubland	0.07	0	0 (0–0)	0
Dry ponderosa pine forest	0.33	3	0.22 (–0.05–0.49)	–
Dry prairie-seminatural mixed grassland	0.30	32	2.57 (2.01–3.14)	+
Montane grassland	0.22	0	0 (0–0)	–
Seminatural grassland	0.01	0	0 (0–0)	0

[a] Land cover categories were described using a physiognomic-floristic classification hierarchy for the Black Hills (Marriot et a 1999, Marriot and Faber-Langendoen 2000, Cogan et al. 2002).

[b] Utilization of resources by pronghorn fawns were categorized as: selected (utilized more than available; +), random (equa utilization; 0), and avoided (utilized less than available; –).

[c] Prairie dog grassland habitats were utilized more than available but were not included in chi-square analyses because the expected values were <5 and the effect that such a large selection ratio would have on other coefficients.

Statistical Analyses

We used the Design II approach (Manly et al. 1993) to estimate selection of macrohabitat categories by fawns for bed sites. Chi-square analysis was used to compare selected resources to available habitats within the study area during the early hiding and group phase observation periods. Significance was determined at $\alpha = 0.10$, and P-values for selection of macrohabitats were adjusted to maintain experiment-wide error rates at the predetermined α using the Bonferroni inequality (Miller 1981). The Bonferroni adjustment included $k = 6$ habitat categories.

We summarized microhabitat characteristics for random and fawn bed sites. For analyses of fine-scale resource selection by pronghorn fawns we included a weight factor to accommodate deviations from proportional sampling among random strata (Cochran 1977). Each random site was assigned a weight equaling $P_i{*}\ N_t/N_i$, where P_i was the proportion of the entire study area comprised of a particular stratum (i; vegetation classification), N_t was the total number of random samples, and N_i was the number of random samples in a particular stratum (i). Sites where we observed bedded fawns received a weight of 1.0.

Because of the large set of possible covariates that could be associated with bed site selection we reduced the number of covariates by fitting logistic regression models with individual continuous covariates (PROC LOGISTIC, SAS Institute Inc. Cary, North Carolina, USA) and chi-square contingency tables (PROC FREQ, SAS Institute Inc.) for categorical covariates at $P \leq 0.10$ (Hosmer and Lemeshow 2000, Steidl 2006). We selected a more liberal α-level because the 0.05 level can fail to identify variables known to be important (Hosmer and Lemeshow 2000).

Once a final set of covariates was determined relevant at the $P \leq 0.10$ level, we used stepwise logistic regression (forward at $P \leq 0.15$ for entry and $P \leq 0.10$ for removal; PROC LOGISTIC, SAS Institute Inc.) to compare bed and random sites. Resource selection was evaluated for hiding and group phase fawns. We calculated unit odds ratios and 95% confidence intervals to further evaluate importance of covariates (Hosmer and Lemeshow 2000). We used Receiver Operating Characteristic (ROC) curves (SAS Institute Inc.) as a predictive diagnostic to discriminate between use and random sites in logistic models; we considered ROC values between 0.7–0.8 acceptable discrimination and values between 0.8–1.0 excellent discrimination (Hosmer and Lemeshow 2000).

Table 3. Means, SE, and comparisons of covariates measured for pronghorn fawn bed sites ($n = 23$) and random sites ($n = 74$) during the hiding phase period (1–28 days of age) in Custer State Park, South Dakota, 2007–2008.

	Bed site		Random site		Comparison[b]	
Covariate	$\bar{x}$	SE	$\bar{x}$	SE	χ^2	P-value
North aspect (316–45°)[a]	1.0		17.0			
West aspect (226–315°)[a]	3.0		4.0			
South aspect (136–225°)[a]	14.0		29.0			
East aspect (46–135°)[a]	5.0		24.0			
		Overall χ^2 test for aspect =			6.3	0.10
Overstory canopy cover	10.8	4.8	5.4	1.4	1.2	0.27
Basal area (m^2/ha)	9.1	3.9	8.8	2.2	<0.01	0.95
Large tree (≥15.23 cm) dbh (cm)	17.7	5.0	10.8	2.2	1.4	0.25
Small tree (<15.23 cm) density (trees/ha)	9.2	6.5	3.1	1.8	0.9	0.35
Small tree dbh (cm)	0.7	0.5	0.3	0.2	0.7	0.41
Total herbaceous cover (%)	61.8	4.8	74.2	2.0	4.9	0.03
Grass cover (%)	49.9	5.3	64.4	2.4	4.9	0.03
Forb cover (%)	15.8	2.3	16.9	1.3	0.1	0.72
Shrub cover (%)	12.7	2.7	11.1	1.6	0.1	0.72
Visual obstruction (cm)	7.0	1.2	6.4	0.6	0.2	0.66
Slope (%)	13.4	2.8	15.1	2.4	0.1	0.74
Edge (m)	12.2	1.9	21.0	3.6	2.4	0.12

[a] Total no. instead of means (SE) for bed sites and random sites in each categorical variable.

[b] We fit single-variable logistic regression models for continuous covariates and we used contingency ables for categorical covariates. Blank cells equal no data.

RESULTS

apture and Radiotelemetry

We captured and radiomarked 16 adult pronghorn emales during fall 2006–2008. Over the study period, adiomarked females produced 44 fawns. Range of dates bserved for parturition of fawns from radiomarked females vas 27 May through 10 June, 2007–2008.

Fawn Bed Site Metrics

Over the two-year study period, 16 female pronghorn with fawns were included in our analyses, resulting in 75 bed sites (23 hiding phase observations, 52 group phase observations); bed sites were compared with 74 random sites.

Table 4. Logistic regression model which fit several covariates for the comparison of bed and random sites during the hiding phase period (fawns 1–28 days of age) in Custer State Park, South Dakota. Odds ratios and 95% confidence intervals are presented for covariates used in the final model[a].

Covariate	Odds ratio[b]	Confidence interval
Grass cover (%)	0.97	0.94 – 1.00
East aspect	0.96	0.30 – 3.01
North aspect	0.20	0.04 – 1.11
South aspect	1.41	0.51 – 3.92

[a] Regression model: u = 1.31 — 0.03 (grass cover [%]) — 0.04 (aspect [east]) — 1.59 (aspect [north]) + 0.34 (aspect [south]).

[b] Unit odds ratios >1 indicate a positive relationship and <1 indicate a negative relationship with the response variable.

Course-scale Resource Selection—During the hiding phase there were no differences (χ^2_{75} = 39.8, P = 1.00) in use of habitats by fawns among individual radiomarked pronghorn. However, resource use was not proportional to availability (χ^2_5= 26.9, P < 0.001) at the course-scale level. Dry prairie-seminatural mixed-grassland was selected and dry ponderosa pine forest and montane grassland vegetation communities were avoided (Table 1). Prairie dog grasslands were not included in chi-square analysis due to small sample size of availability (<1% of samples), but did not appear to be selected with only 1 observed bed site during the early hiding phase.

During the group phase there were no differences (χ^2_{75}, = 29.5, P = 1.00) in use of habitats by fawns among individual radiomarked pronghorn. However, resource use was not proportional to availability (χ^2_5 = 62.6, P < 0.001) at the coarse-scale. Prairie dog towns were selected by pronghorn fawns (Table 2). Prairie dog grasslands were not included in chi-square analysis due to small sample size of availability (<1% of samples) and large sample size of use sites and sensitivity of the analysis to such extreme sample sizes. Dry prairie-seminatural mixed grassland also was selected but dry ponderosa pine forest and montane grassland vegetation communities were avoided during the group phase period (Table 2).

Fine-scale Resource Selection—During the hiding phase, some metrics differed between bed sites and random sites at the fine scale (Table 3). Fawns avoided bedding on north facing aspects compared to random sites. Also, total understory cover of herbaceous vegetation and grass cover were greater at random sites (Table 3).

Total herbaceous cover and grass cover were correlated (r = 0.93) and only grass cover was used in the final hiding phase resource model. The final hiding phase model included grass cover and aspect (Table 4). Odds ratios indicated grass cover and aspect had little association with bed site selection. Discriminatory capability of the final model was marginally adequate as the ROC value = 0.74. During, the group phase fawns bedded under greater overstory canopy cover of ponderosa pine compared to random sites (Table 5). Also, fawns selected sites with less grass and shrub cover but greater forb cover compared to random sites. Fawns selected for less visual obstruction and sites occurred on more gentle slopes.

The final group phase resource model included forb cover, overstory canopy cover, visual obstruction, and slope (Table 6). Forb cover and overstory pine canopy cover were positively associated with selection of bed sites (odds ratios >1.06). Confidence intervals indicated visual obstruction and slope had little association with bed sites (Table 6). Discriminatory capability of the final model was adequate as the ROC value = 0.81.

DISCUSSION

Coarse-scale bed site selection of pronghorn fawns in Custer State Park included prairie dog dominated grasslands and mixed grasslands composed of upland native species and seminatural graminoids. Similar to our study, doe and fawn groups used primarily native grass uplands and prairie dog towns during spring and summer in Wind Cave National Park (Wydeven and Dahlgren 1985). Meadows only comprise 22% of Custer State Park, yet selection of bed sites for a diversity of grasses and forbs was evident. Bromley (1978) hypothesized bed site selection was based on a behavioral response to predation and that sites were selected to increase visual detection of predators. Perhaps patches of adequate forb cover within a matrix of diverse grasslands are attractive for bedding fawns because it may allow them to visually detect approaching predators while still providing enough cover for hiding.

Previous investigations of fawn bed site selection at the fine-scale level indicated fawns selected for greater visual obstruction from increased grass cover at the northeastern

Table 5. Means, SE, and comparisons of covariates measured for pronghorn fawn bed sites (n = 52) and random sites (n = 74) during the group phase period (29–60 days of age) in Custer State Park, South Dakota, 2007–2008.

	Bed site		Random site		Comparison[b]	
Covariate	$\bar{x}$	SE	$\bar{x}$	SE	χ^2	*P*-value
North aspect (316–45°)[a]	5.0		17.0			
West aspect (226–315°)[a]	8.0		4.0			
South aspect (136–225°)[a]	27.0		29.0			
East aspect (46–135°)[a]	12.0		24.0			
	Overall χ^2 test for aspect =				5.4	0.15
Overstory canopy cover	13.0	3.1	5.4	1.4	3.2	0.07
Basal area (m^2/ha)	10.8	2.9	8.8	2.2	0.2	0.67
Large tree (≥15.23 cm) dbh (cm)	16.5	3.3	10.8	2.2	1.3	0.26
Small tree (<15.23 cm) density (trees/ha)	9.0	6.9	3.1	1.8	0.5	0.50
Small tree dbh (cm)	0.4	0.3	0.3	0.2	0.1	0.82
Total herbaceous cover (%)	71.5	2.7	74.2	2.0	0.4	0.52
Grass cover (%)	53.6	3.3	64.4	2.4	4.4	0.04
Forb cover (%)	26.9	2.4	16.9	1.3	8.4	<0.01
Shrub cover (%)	6.5	1.3	11.1	1.6	3.1	0.08
Visual obstruction (cm)	4.4	0.5	6.4	0.6	3.8	0.05
Slope (%)	9.5	1.0	15.1	2.4	3.2	0.07
Edge (m)	20.0	4.0	21.0	3.6	0.01	0.88

[a] Total no. instead of means (SE) for bed sites and random sites in each categorical variable.

[b] We fit single-variable logistic regression models for continuous covariates and we used contingency tables for categorical covariates. Blank cells equal no data.

fringe of their range (Bromley 1977, Jacques et al. 2007). Our logistic models failed to discriminate resource use at the fine-scale during the hiding phase perhaps because of the small sample size of observations during that period. However, another confounding factor may include the vast availability of adequate resources such as grass cover. Grass was the predominant form of cover, but percent of grass cover at bed sites was less than available. During the group phase there was some discrimination of bed sites as fawns selected for greater overstory canopy cover of pine trees and greater forb cover. Many of our bed site observations were taken at the periphery of prairie dog towns, or along the edges of high density forb cover within a matrix of grassland habitat. Within the center of prairie dog towns much of the visual obstruction of grass cover had been removed and forbs were the dominant vegetation type.

Table 6. Logistic regression model which fit several covariates for the comparison of bed and random sites during the grou phase period (fawns 29–60 days of age) in Custer State Park, South Dakota. Odds ratios and 95% confidence intervals are presented for covariates used in the final model[a].

Covariate	Odds ratio[b]	Confidence interval
Forb cover (%)	1.09	1.03 – 1.14
Overstory canopy cover (%)	1.06	1.02 – 1.10
Visual obstruction (cm)	0.89	0.78 – 1.02
Slope (%)	0.98	0.93 – 1.02

[a] Regression model: $u = -0.78 + 0.09$ (forb cover [%]) + 0.06 (overstory canopy cover [%]) — 0.11 (visual obstruction[cm]) — 0.02 (slope[%]).

[b] Unit odds ratios >1 indicate a positive relationship and <1 indicate a negative relationship with the response variable.

All of our bed site observations were collected during diurnal periods and pronghorn were most likely using ponderosa pine trees as shade to remain cool during hot periods of the day. Use of trees by pronghorn for shade is scarcely documented in the literature. Yoakum (1980) observed use of shade trees in Oregon and California but did not quantify use versus availability. It is important to note that most pronghorn research projects have been conducted in prairie or sagebrush-steppe landscapes and not in areas with trees. Therefore, we hypothesize in these fringe environments that pronghorn will take advantage of favorable microclimate conditions provided by overstory cover, provided other needs are met. Although such shading might not offer any energetic benefits, shading provides cooler and more comfortable conditions (Cook et al. 1998). Nevertheless, dry ponderosa pine forests were avoided at the coarse-scale, and ponderosa pine trees used as shade were primarily small patches or single trees found in prairie dog dominated grasslands and mixed grasslands.

Bromley (1978) and Smith and Beale (1980) found fawns selected for bed sites with less concealment, and they surmised this allowed for greater visual detection of predators. Alldredge et al. (1991) found that fawns selected bed sites where cover was sufficient but still allowed for visual detection of predators. In our study, fawns during the group phase often would bed on the periphery of prairie dog towns characterized by greater forb cover with less grass cover. Perhaps such resource selection in Custer State Park allowed fawns to better detect approaching predators.

MANAGEMENT IMPLICATIONS

Pronghorn fawns selected bed sites on the periphery of prairie dog towns and in diverse grasslands composed of upland native species and seminatural graminoids. Diversity of grasses and forbs was greatest on the edges of prairie dog towns and upland native prairie. The peripher of prairie dog towns typically is lower in prairie dog densit than in the center, and experiences less foraging activity b prairie dogs allowing relatively taller vegetation on th periphery versus the center of the prairie dog town. Thi may support the maintenance of towns to be dynamic, or o relatively young age and smaller size for a greater edge t area ratio and avoiding management for stagnant prairie do colonies. Additionally, management activities should provide for a diversity of grassland habitats and areas of grassland habitat that are dominated by a single species such as smooth brome (*Bromus inermis*) should be avoided.

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