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BIRTH AND FAWN BED SITE SELECTION BY PRONGHORNS IN A SAGEBRUSH-STEPPE COMMUNITY

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Abstract: In a sagebrush-steppe community in southcentral Wyoming, we measured shrub canopy cover and height at 13 pronghorn (*Antilocapra americana*) fawn birth sites and 50 fawn bedding sites and compared them to measurements we made at 47 random points in areas infrequently used by parturient pronghorn. Birth sites and bed sites were similar ($P = 0.96$) in shrub cover but differed from random points ($P = 0.015$ and $P = 0.002$, respectively). Plant height was not significantly different between birth sites, bedding sites, or random points measured in low use areas. In a second study, we fitted 7 pronghorn fawns (3–5 days old) with solar-powered radio transmitters and relocated them daily for 3 weeks. We measured shrub height and canopy cover at 72 bed sites and 228 random points, located within fawn home ranges. Percent canopy cover and plant heights were similar at fawn bed sites but differed ($P < 0.05$) from measurements made at random points. Shrubs at bed sites were taller than those measured at random locations. Parturient pronghorns and fawns selected more dense shrub cover, but the tallest, most dense cover in the study area was avoided.

Two distinct forms of maternal–infant, integrated behavior occur in ungulates, "hiding"

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and "following" (Walther 1964, Lent 1974); predation is a powerful force often credited with influencing the evolution of these behaviors. Lent (1974) considered hider species to include cervids that generally use forested habitats, or smaller species like pronghorn antelope and gazelle (*Gazella* spp.), which are able to utilize low cover in relatively open habitats. In hider

species, mother and infant enter into a postpartum phase in which the two are separated for long periods of time. Hider neonates appear to act independently in their selection of hiding or bedding sites, but they are dependent upon their mothers to initiate activity periods.

During their first 3 weeks of life, pronghorns spend up to 90% of their time lying in seclusion (Fichter 1974, Byers and Byers 1983) and are thus termed a hider-type species. We believe success of this strategy depends on 4 intrinsic features of the neonate: lack of early scent gland development (Carl and Robbins 1988), cryptic coloration, the ability to lie motionless for long periods of time, and the ability to select proper concealment. The last 3 of these characteristics are largely influenced by habitat.

Much of the previous literature on pronghorn fawns has focused on social behavior (Kitchen 1974, Autenreith and Fichter 1975) and fawn mortality (Barrett 1978, Beale 1978, Bodie 1978, Von Gunten 1978); few studies have discussed cover characteristics of birth and fawn bedding sites (Autenreith and Fichter 1975, Deblinger 1988). Earlier work in our study area (Boyle 1981, Boyle and Alldredge 1984) reported that areas with highest concentrations of pronghorns during summer were partially characterized by availability of free water and a large forb component in the vegetation community.

We sought to ascertain characteristics of vegetation at pronghorn birth and fawn bedding sites and to compare those characteristics to measurements made in nearby habitats not selected by parturient females or fawns. The null hypotheses tested were that shrub height and canopy cover measured at (1) sites selected by pronghorns for parturition did not differ from those measured at random sites where few parturient females resided; (2) pronghorn birth sites did not differ from those measured at fawn bed sites; and (3) fawn bed sites did not differ from those measured at sites randomly located within each fawn's home range.

STUDY AREA

The study area, located in the Great Divide Basin of southcentral Wyoming, varied in topography from flat basins and grasslands to gently rolling, shrub-dominated hills. Elevation ranged from 1,940 to 2,442 m. The climate has been described as semiarid; mean annual precipitation ranges from 14.7 to 24.2 cm (U.S. Dep. Inter. 1978).

The area is classified as a cold, shrub-steppe community. Major plant species include the following: big sagebrush (*Artemisia tridentata*), bud sagebrush (*A. spinescens*), birdfoot sagewort (*A. pedatifida*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush (*C. nauseosus*), saltbush (*Atriplex canescens*), winterfat (*Eurotia lanata*), spiny prickly phlox (*Leptodactylon pungens*), western wheatgrass (*Agropyron smithii*), Indian ricegrass (*Oryzopsis hymenoides*), and bluegrass (*Poa* spp.) (U.S. Dep. Inter. 1978).

METHODS
Fawn Bed and Birth Sites Compared to Low Use Sites

During June 1982 and 1983, we sampled 13 parturition sites, 50 fawn bedding sites, and 47 random sites in areas of low use. Low use areas, also located in the shrub-steppe community, were 10–30 km from birth and bedding sites; they were used during spring, summer, and fall by territorial pronghorn males but contained few parturient females (Deblinger 1988). Because there were no unused habitats in our study area, we chose areas of low use for comparison of cover differences to habitats selected more frequently by parturient pronghorns.

Within low use areas, we located random points by randomly choosing a compass bearing and pacing a random distance along the bearing to the random point. A minimum distance of 40 m was maintained between random points. We used the line intercept method (modified from Hayes et al. 1981) to measure shrub canopy cover. At each site, linear distance and height were measured for every shrub and shrub-like plant intercepting each of 5 10-m lines. All lines originated from the actual birth or bedding site or random point and were 72° apart. Because fawns were unmarked, we do not know if we measured repeated bed sites for fawns or if we measured birth sites for fawns whose bedding sites were measured. One-way ANOVA's were

performed on canopy cover measurements collected for the first 5-m line segment and the entire 10-m line originating from the birth or bedding site or random point. We also tested for differences in canopy cover across all sites for 3 shrub species—big sagebrush, Douglas rabbitbrush, and winterfat.

Fawn Bed Sites Compared to Random Sites within Fawn Home Ranges

In June 1984, we used a hand-held net to capture 7 neonatal fawns (4 M and 3 F; 2 were siblings), and fitted each with a solar-powered radio transmitter affixed to an ear tag. Each transmitter package weighed 32 g. None of the fawns captured died during the study. Fawns were visually located each day, if possible, for 3 weeks following their capture, after which they joined nursery herds. Because we did not want to influence bed site selection, we avoided flushing fawns. One to 5 days after locating a bedded fawn, we relocated the exact bed site from marked locations, compass bearings, and depressions in the sandy soil, and we made vegetation measurements.

We measured shrub height and canopy cover for 72 bed sites for 7 fawns and 228 random points within fawn home ranges. Mean number of bed sites measured per fawn was 10 ± 1 (SE), and mean number of random points measured per fawn home range was 109 ± 26. Some fawn home ranges overlapped, thus more than 1 fawn was compared to a single set of random points. Percent shrub cover was measured along 4 5-m transects radiating outward from the actual bed or random site along cardinal compass directions (modified from Hayes et al. 1981). Individual fawn home ranges were defined as the maximum convex polygon formed by relocation points observed during the 3-week study period. Random points were within the bounds of respective fawn home ranges and were located by the procedure described above.

Because our objective was to ascertain differences in distributions between data sets for fawn bed sites and random points within fawn home ranges, the Multi-Response Permutation Procedure (Mielke 1986) was the appropriate statistical test. We divided our data into categories consisting of all canopy cover, and that >10 cm tall. A height of 10 cm was selected because this was our estimate for the average height of a bedded fawn. These 2 data sets were further subdivided into 1-m horizontal increments be-

ginning at the actual bed site and progressing outward. This approach allowed comparison of total canopy cover and canopy cover for the strata above 10 cm for each horizontal increment from 1 to 5 m from the fawn's selected bed site.

RESULTS

Fawn Bed and Birth Sites Compared to Low Use Sites.—Pronghorn birth sites and fawn bedding sites were similar in shrub canopy cover ($P = 0.96$), but random points in low use areas contained less cover than birth or bedding sites (Table 1). At birth and bedding sites, big sagebrush comprised significantly ($P < 0.05$) more of the canopy cover than it did at random points for both 5- and 10-m line segments. There were no differences between sites in shrub cover for the other 2 species (Table 1). There were no significant differences in plant heights between birth sites, bedding sites, or random points, and big sagebrush was the tallest plant measured at all sites ($\bar{x} = 14.1 \pm 0.23$ cm).

Fawn Bed Sites Compared to Random Sites Within Fawn Home Ranges.—Significantly more shrub cover existed within the first meter from fawn bed sites compared to random sites located within fawn home ranges for 6 of the 7 fawns examined (Fig. 1, Table 2). All fawns selected similar canopy cover (Table 2) at distances between 0 and 1 m from the bed site; however, canopy cover at distances beyond 1 m differed between fawns (1–2 m, $P = 0.009$; 2–3 m, $P = 0.002$; 3–4 m, $P = 0.003$; 4–5 m, $P = 0.001$). Differences beyond 1 m may reflect variation in the vegetation community rather than actual differences in canopy cover at bed sites. Canopy cover for the 0- to 1-m segment of line transects differed between fawn bed sites and random points (Table 2).

Canopy cover in the strata above 10 cm for all fawn bed sites was similar, as it was among all random points within 1 m of the origin (Table 3). Cover above 10 cm differed for all fawn bed sites combined compared to all random points combined. Additionally, cover values differed for individual fawns and their comparative random points (Table 3).

DISCUSSION

Shrub canopy cover was greater at birth sites selected by pronghorns compared to random sites in low use areas. It seems prudent that a parturient pronghorn, dependent on sight and

Table 1. Mean percent shrub cover from line intercept analysis at pronghorn birth and fawn bedding sites and random points in low use areas in the Great Divide Basin, Wyoming, 1982–83.

Line segment	P^a	Sites		Random points (low use site)
		Birth	Bedding	
All shrubs				
10-m line	0.015	12.4	13.1	9.8
5-m line	0.002	13.2	14.4	9.9
Artemisia tridentata				
10-m line	0.049	9.4	10.7	8.2
5-m line	0.008	10.6	11.9	8.2
Chrysothamnus viscidiflorus				
10-m line	0.180	0.9	1.0	1.3
5-m line	0.061	1.1	1.4	1.9
Eurotia lanata				
10-m line	0.102	<1.0	<1.0	1.1
5-m line	0.210	<1.0	<1.0	<1.0

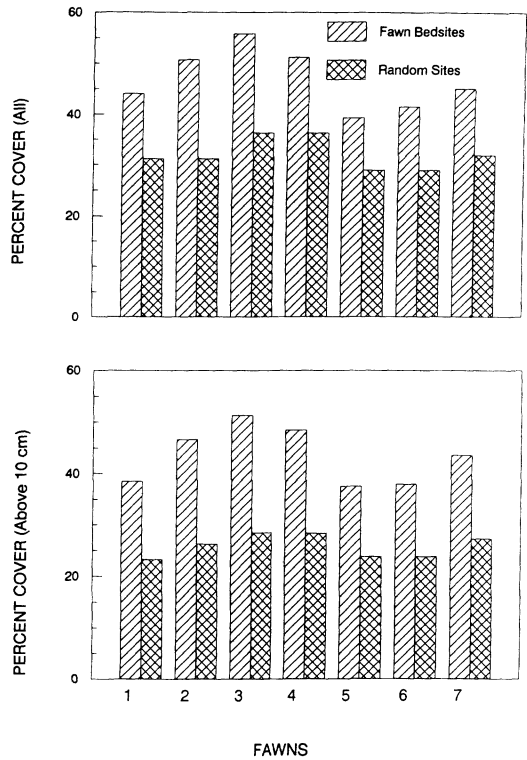[a] P value from ANOVA for comparison of birth and bed sites to random points.

Fig. 1. Comparison of canopy cover from 0 to 1 m for shrubs at pronghorn fawn bed sites and random points within respective fawn home ranges in the Great Divide Basin, Wyoming, 1984. Top figure includes all cover, whereas bottom figure includes only cover >10 cm.

speed for predator defense, would select a birth site where cover afforded some concealment, yet did not obstruct vision. Pronghorns we watched during parturition were almost always alert, and, although there were patches of dense, tall (>1.5 m) big sagebrush and rubber rabbitbrush, parturient does were never observed using these patches. Stands of taller sage and rabbitbrush were generally associated with draws and washes, and, as pointed out by Beale and Smith (1973), such areas are frequented by predators.

There are several explanations for the similarity in canopy cover between birth sites and fawn bedding sites. Fawns may "imprint" on vegetation at the sites where they were born and subsequently seek such cover, or their dams may directly influence site selection. It is not likely that all sites within fawn home ranges are so similar that any location is adequate because characteristics of vegetation at fawn bedding sites were significantly different from those of random points within respective fawn home ranges (our third hypothesis).

Although fawns in our study chose bed sites where shrub canopy cover was greater than that measured at random points within their home ranges they, too, avoided dense, taller shrub stands. The importance of shrub cover for pronghorn fawns has been reported by Pyrah (1974), Autenreith and Fichter (1975), Tucker and Garner (1983), and Barrett (1984). Proper concealment for the neonate is essential to its survival, especially in the presence of predators such as the golden eagle (*Aquila chrysaetos*) and coyote (*Canis latrans*). Bromley (1977) suggested that, for pronghorn fawns, bed site selection is largely a behavioral response to predation.

Although the general habitat type surrounding the bed site is thought to be influenced by interactions with the dam in hider-type ungulates, the actual bed site is chosen by the fawn (Fichter 1974, Autenreith and Fichter 1975, Huegel et al. 1986). We did not observe a doe selecting a bed site for her fawn. Following nursing bouts, fawns would move away from their dams and independently select a bed site. These observations concur with Fichter's (1974) description of the "relocation move." Telemetered fawns in our study never used the same bed twice, and Autenreith and Fichter (1975) report that pronghorn fawns may change bed sites as often as 10 times daily. Pronghorn dams likely

Table 2.   Percent canopy cover for shrubs measured within 1 m of pronghorn fawn bed sites and random points within respective fawn home ranges in the Great Divide Basin, Wyoming, 1984.

Comparison	P^a
All fawn bed sites to each other ($n = 72$)	0.0713
All random sites to each other ($n = 228$)	0.1197
All fawn bed sites ($n = 72$) to all random sites ($n = 228$)	0.0000
Fawn 1 ($n = 7$) and 7 ($n = 11$) to random sites in their home range ($n = 50$)	0.0141
Fawn 2 ($n = 14$) and 3 ($n = 13$) to random sites in their home range ($n = 153$)	0.0286
Fawn 4 ($n = 8$) to random sites in its home range ($n = 113$)	0.1709
Fawn 5 ($n = 12$) to random sites in its home range ($n = 50$)	0.0042
Fawn 6 ($n = 7$) to random sites in its home range ($n = 178$)	0.0256

^{a} Analysis using Multi-Response Permutation Procedure (Mielke 1986).

Table 3.   Percent canopy cover >10 cm tall for shrubs measured within 1 m of pronghorn fawn bed sites and at random points within respective fawn home ranges in the Great Divide Basin, Wyoming, 1984.

Comparison	P^a
All fawn bed sites to each other ($n = 72$)	0.1032
All random sites to each other ($n = 228$)	0.1504
All fawn bed sites ($n = 72$) to all random sites ($n = 228$)	0.0000
Fawn 1 ($n = 7$) and 7 ($n = 11$) to random sites in their home range ($n = 50$)	0.0061
Fawn 2 ($n = 14$) and 3 ($n = 13$) to random sites in their home range ($n = 153$)	0.0044
Fawn 4 ($n = 8$) to random sites in its home range ($n = 113$)	0.0475
Fawn 5 ($n = 12$) to random sites in its home range ($n = 50$)	0.0108
Fawn 6 ($n = 7$) to random sites in its home range ($n = 178$)	0.0204

^{a} Analysis using Multi-Response Permutation Procedure (Mielke 1986).

influence their fawn's bed site selection only by the general location where mother–infant contacts terminate. The fawn's bed selection may reflect "imprinting" on vegetation cover characteristics at its birth site, or it may reflect an innate desire for concealment and thermal cover, while allowing visibility of the surrounding area. Fichter (1974), Autenreith (1976), and Barrett (1981) suggested that until pronghorn fawns are about 3 weeks old, they tend to seek seclusion in vegetation resembling that in which they were born.

Small ungulates, like pronghorns, living in relatively open habitats, successfully use the hider strategy by taking advantage of cover. Although pronghorns are small ungulates, their neonates are relatively large in relation to the size of adult females (15.5% of maternal mass) (Robbins and Robbins 1979). Neonatal body size is advantageous in terms of temperature regulation and energy requirements (Robbins and Robbins 1979). Furthermore, because ungulates are most vulnerable to predation during their first few months of life (Lent 1974), a large neonatal body size would seem to be advantageous in attaining an adequate size as soon as possible for effective flight from predators (Carl and Robbins 1988). Constraints of concealment are likely severe for pronghorn neonates which must successfully hide to evade predators during their first 3 weeks of life, yet quickly attain a large enough body size to flee from predators. Vegetation height and canopy cover appear to

be important factors in the fawn's selection of a bed site. This selective process enhances survival for pronghorns in an environment where thermal stress and predation at least partially influence neonatal body size.

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