Use Of Reclaimed Minelands By Pronghorn And Mule Deer

R. Scott Gamo[1], Wyoming Cooperative Research Unit, Department of Zoology and Physiology, University of Wyoming, Laramie, WY, 82070.
Stanley H. Anderson, Wyoming Cooperative Research Unit, Department of Zoology and Physiology, University of Wyoming, Laramie, WY, 82070.

Abstract

We examined use of reclaimed minelands by pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) in the Powder River Basin, Wyoming. Pronghorn selection of topography did not differ from availability and pronghorn were most commonly found on flat to gently sloped topography. We most often observed mule deer on sloped terrain; deer used base of slope more than expected during spring, summer, and fall. Alfalfa (*Medicago sativa*), sweetclover (*Melilotus officinalis*), and other forbs constituted important components of habitats used by pronghorn and mule deer. During summer, pronghorn also used areas with low overall vegetation height. Pronghorn use patterns reflected avoidance of human activity, whereas mule deer were more tolerant. Further enhancement of reclamation areas for these species might include increasing abundance of forbs, providing more cover, maintaining a mosaic of vegetation heights, and reducing fragmentation.

Key words: *Antilocapra americana*, habitat, mining, mule deer, *Odocoileus hemionus*, pronghorn, Powder River Basin, reclamation.

Introduction

Impacts of large-scale surface mining on pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) in the Powder River Basin of northeast Wyoming and southeast Montana are of concern to wildlife managers. Surface mining disturbs the original environment by removing topsoil and overburden to allow access to underlying coal. Disruption of the natural environment causes changes to which wildlife must adapt. Management concerns include elimination of habitat, interruption of migration, range partitioning, and increased human activity (Tessman 1985). To assure continued use of the land after mining, Congress enacted the Surface Mining Control and Reclamation Act (SMCRA) of 1977 to mitigate adverse impacts of coal development, protect public resources, and restore the capability of the mined land (Anderson et al. 1994). This act includes beneficial objectives for both fish and wildlife.

Both pronghorn and mule deer utilize reclaimed lands following mining (Segerstrom 1982, Medcraft and Clark 1986). Proper management of pronghorn and mule deer in the Powder River Basin requires an analysis of habitat needs and impacts of mining. Our objective was to determine which habitat features on reclaimed mining lands were important to pronghorn and mule deer. Goals were to compare sites used by each species seasonally to random sites and describe physical and vegetative components of habitats used by pronghorn and mule deer on reclaimed surface-mined lands.

Study Area

The study area encompassed mine-land areas on seven surface coal mines on the eastern portion of the Powder River Basin in northeastern Wyoming. Mean annual precipitation is approximately 40 cm at the Gillette Weather Station 15 km south of

[1]Current address: Idaho Department of Fish and Game, 868 Main Street, Jerome, ID 83338

Gillette most of which occurs during spring and early summer. Midsummer precipitation is usually light and drought is common (Thilenius et al. 1994). Summer temperature extremes may occasionally reach above 38 °C with winter extremes below -15 °C.

Once coal is extracted, mined lands consisting of open pits, are filled and re-contoured to resemble natural topography and are planted with a variety of plant species designed to produce a rangeland suitable for livestock grazing and capable of supporting wildlife (L. Vicklund, pers. comm.). Sterile wheat (*Agropyron domesticus*) or other easily established plants are initially planted for soil stabilization. Legumes such as alfalfa (*Medicago sativa*) and yellow sweetclover (*Melilotus officinalis*) are sometimes planted to augment soil nitrogen. Re-contoured areas are eventually seeded with native grass species such as wheatgrasses (*Agropyron* spp.), blue grama (*Bouteloua gracilis*), and needlegrasses (*Stipa* spp.). Grass seed mixtures are often complimented by forb species such as yellow sweetclover or alfalfa which contribute to the diversity of the planting. Final plantings also may include hand-planted shrub species such as big sagebrush (*Artemesia tridentata*), winterfat (*Ceratoides lanata*), and fourwing saltbush (*Atriplex canescens*).

METHODS

Twenty-five adult female pronghorn and 25 adult female mule deer were captured with a net-gun fired from a helicopter on or near reclaimed mine lands during November 1994 and radio-collared in accordance with guidelines approved by the American Society of Mammalogists. Radio-collared animals were located twice monthly from the ground using a handheld two-element directional antenna (Telonics Inc., Mesa, AZ) or from the air using a fixed-wing aircraft. Animal locations were recorded using Universal Transect Mercator (UTM) coordinates obtained from a portable Global Positioning System (GPS) unit. Data were recorded only on visually confirmed radio-collared animals.

Animal groups located from the ground were observed with a spotting scope or binoculars. We defined a group as one or more animals within close proximity (<50m) to each other. Date, time of day, UTM location, topographic position, aspect, slope, distance to man-made disturbance (roads, buildings, etc.), distance to water, and sex and age composition were recorded. Data collected during flights included date, time of day, location (UTM), and total number of individuals.

We categorized position of observed animals on reclaimed mine lands as ridge/hilltop, mid slope, base of slope, flat, or drainage/riparian. Slope was estimated as degrees from horizontal. General weather conditions including temperature, wind speed and direction, precipitation, and cloud cover also were recorded for each animal location but were not used in the analysis.

We measured habitat variables at microsites used by radio-collared animals (use sites) on reclaimed lands during the growing season. Because radio-collared animals often were associated with each other at use sites, only a single radio-marked animal was chosen to represent the site. To assure statistical independence, we chose use sites by systematically selecting every third recorded animal location with no individually collared animal sampled more than once/season. This restricted our sample on reclaimed areas to nine pronghorn use sites and 11 mule deer use sites measured each season.

We measured 29 random sites on reclaimed mine lands using a grid of XY coordinates overlaid on a map of reclaimed land. Random sites were randomly selected from XY coordinates by use of a random numbers table. We located at least one random site in areas reclaimed during 1976-1995 to assure representation of available habitat and then located sites in the field. We recorded the same physical data as on use sites.

On both animal use and random sites, the following vegetation variables were measured at the peak of the growing season: plant species frequency, average plant height, percent shrub cover, and number of different species. We estimated plant species frequency by determining presence or absence of plants in 30 (25x25 cm) frames placed at 1-m intervals on two perpendicular bisecting 15-m transects centered at each site. Transects were oriented in the four cardinal directions. We determined frame size adequacy a priori by ensuring that average frequencies of major species fell within 20 and 80 percent frequency for the sample site (Higgins et al. 1994). The line intercept technique estimated percent shrub cover on both transects. Average plant height was estimated using a Robel pole positioned at the center of the plot and observed from a distance of 4 m along each transect (Robel et al. 1970). We recorded four more readings from random placement of the pole within each quadrant created by the two transects.

Statistical Analysis

We tested hypotheses that observed occurrences of pronghorn and mule deer on topography types were similar to the proportional availability of topography types predicted by our random samples on reclaimed areas using a contingency table framework for studies with sampled availability of resources (Design I, Manley et al. 1993). The term expected use throughout this paper refers to the proportion of available habitat resulting from the random samples times the number of pronghorn or mule deer observations. We tested whether pronghorn or mule deer use differed from expected use of topography types during each season by applying a Bonferroni correction (to maintain experiment-wise error rates) to the probability of a 1df chi-square test that the estimated selection ratio was 1.0 (H_0: w = 1.0, Manley et al. 1993). Tests were considered significant at $\alpha \leq 0.10$.

We used independent sample *t*-tests to test for significant differences between microhabitat variables at use and random sites for three seasons on reclaimed areas: winter (1 Jan-15 Apr); spring (16 Apr-30 June); and summer (1 Jul-31 Aug). Microsite data were further analyzed with stepwise logistic regression to determine habitat variables that distinguish use sites from random sites. We estimated logistic regression parameters by the maximum likelihood method (Norusis 1994). Covariance of habitat components can confound interpretation of analysis (Yeo and Peek 1992), so we used only one of a pair of highly correlated ($r^2 > \pm 0.8$) variables in the model; we eliminated the least biologically important variable from the data set. SPSS for Windows version 6.1 was used for all statistical analyses.

Results

Flats and mid slope areas accounted for the greatest use of topography types by pronghorn on reclaimed lands during each season (Table 1). Overall pronghorn use of topography types during spring did not differ with expected use as determined by the proportional availability ($\chi^2 = 5.16$, P = 0.271). Pronghorn made the greatest use of flats, which was similar to the expected use ($P = 1.0$). The second most used topographic type was mid slope terrain which also did not differ from expected use ($P = 1.0$). Pronghorn exhibited a similar pattern during summer and fall. An exception to this pattern occurred during winter. Mid slope areas accounted for the highest use by pronghorn, which did not differ from expected use ($P = 0.527$), with no use observed on flats.

Mule deer use mostly occurred on flats and midslope areas (Table 2). During spring, overall mule deer use of topography types differed with expected use as determined by the proportional availability ($\chi^2 = 7.81$, $P = 0.099$). Mule deer made greater ($P = 0.011$) use of base of slope than expected during spring. Overall use of topography types during summer did not differ from expected use ($\chi^2 = 6.66$, $P = 0.155$). However, within topographic categories, mule deer used base of slope ($P = 0.076$) and drainage areas ($P = 0.076$) more than expected. Overall use of

Table 1. Pronghorn use compared with expected use of topographic categories on reclaimed minelands, 1995-1996.

Season Topographic category	Availability (%)	Observed (%)	Expected (%)	Selection (%)	Bonferroni adjusted *P*-value (H0: w=1.00)
Spring (χ^2 = 5.16, P = 0.271)					
Ridge/hill top	3.4	6.7	5.3	1.933	1.0
Midslope	41.4	28.9	33.8	0.698	1.0
Base of slope	3.4	13.3	9.6	3.867	0.115
Flat	48.3	51.1	50.0	1.059	1.0
Drainage	3.4	0.0	1.3	0.000	1.0
Summer (χ^2 = 3.69, P = 0.449)					
Ridge/hill top	3.4	8.5	7.3	2.468	0.958
Midslope	41.4	30.9	33.3	0.746	1.0
Base of slope	3.4	11.7	9.8	3.394	0.166
Flat	48.3	46.8	47.1	0.970	1.0
Drainage	3.4	2.1	2.5	0.617	1.0
Fall (χ^2 = 2.33, P = 0.675)					
Ridge/hill top	3.4	12.5	6.8	3.625	0.556
Midslope	41.4	37.5	40.0	0.906	1.0
Base of slope	3.4	6.3	4.2	1.813	1.0
Flat	48.3	43.8	46.8	0.906	1.0
Drainage	3.4	0.0	2.2	0.000	1.0
Winter (χ^2 = 7.63. P = 0.106)					
Ridge/hilltop	3.4	0.0	2.0	0.000	1.0
Midslope	41.4	80.0	48.0	1.930	0.527
Base of slope	3.4	20.0	6.0	5.800	0.305
Flat	48.3	0.0	42.0	0.000	0.23
Drainage	3.4	0.0	2.0	0.000	1.0

topography categories during fall also did not differ from the expected use ($c^2 = 3.35$, $P = 0.501$). Within topographic categories, use of base of slope was higher ($P = 0.098$) than expected. Mule deer use of topography did not differ from the expected use ($c^2 = 2.97$, $P = 0.563$) during winter and no differences were observed within categories ($P = 1.0$).

Spring Use

Microsite habitat data were analyzed by season. Frequency of graminoids on random sites was higher ($P = 0.001$) than on mule deer use sites (Table 3). Random sites had more ($P = 0.04$) green needlegrass (*Stipa viridula*) than estimated at pronghorn use sites (Table 4) but less ($P = 0.02$) than deer use sites. Both pronghorn and deer use sites had more ($P = 0.01$) yellow sweetclover than random sites. False flax (*Camelina microcarpa*) and mustard (*Descurainia* spp.) also were more common on pronghorn ($P = 0.02$) and mule deer ($P = 0.001$) use sites than random sites. Alfalfa was more common ($P = 0.001$) on pronghorn use sites than random sites. Spring pronghorn sites had no shrubs while random sites had < 1 percent. Shrubs were more common ($P = 0.01$) on mule deer use sites than random sites primarily because of greater ($P = 0.01$) occurrence of Gardner's saltbush (*Atriplex gardneri*). The number of plant species on pronghorn use sites was greater ($P = 0.03$) than at random sites. Deer use sites had greater ($P = 0.001$) plant height and shrub cover ($P = 0.001$) than random sites during spring.

Percent frequency of alfalfa and

Table 2. Mule deer use compared with expected use of topographic categories on reclaimed minelands, 1995-1996.

Season Topographic category	Availability (%)	Observed (%)	Expected (%)	Selection (%)	Bonferroni adjusted *P*-value (H0: w=1.00)
Spring (χ^2 = 7.81, P = 0.099)					
Ridge/hill top	3.4	5.2	4.7	1.506	1.0
Midslope	41.4	40.3	40.5	0.973	1.0
Base of slope	3.4	15.6	12.2	3.867	0.011
Flat	48.3	27.3	33.0	4.519	0.269
Drainage	3.4	11.6	9.6	3.390	0.191
Summer (χ^2 = 6.66, P = 0.155)					
Ridge/hill top	3.4	4.4	4.3	1.279	1.0
Midslope	41.4	39.7	40.0	0.960	1.0
Base of slope	3.4	12.5	10.9	3.625	0.076
Flat	48.3	30.9	33.9	0.640	0.444
Drainage	3.4	12.5	10.9	3.625	0.076
Fall (χ^2 = 3.35, P = 0.501)					
Ridge/hill top	3.4	5.7	5.2	1.657	1.0
Midslope	41.4	42.9	42.6	1.036	1.0
Base of slope	3.4	12.4	10.5	3.590	0.098
Flat	48.3	37.1	39.4	0.769	1.0
Drainage	3.4	1.9	2.3	0.552	1.0
Winter (χ^2 = 2.97, P = 0.563)					
Ridge/hill top	3.4	0.0	1.7	0.000	1.0
Midslope	41.4	55.2	48.3	1.333	1.0
Base of slope	3.4	6.9	5.2	2.000	1.0
Flat	48.3	34.5	41.4	0.714	1.0
Drainage	3.4	3.4	3.4	1.000	1.0

mustard contributed significantly to predicting pronghorn use. Both species were more likely to occur at sites selected by pronghorn than random. The logistic model correctly classified 84 percent of the sites (use and random) overall. However, only 44 percent of pronghorn use sites were correctly classified. Frequencies of alfalfa, downy brome, mustard species, and common dandelion (*Taraxacum officinale*) and average distance to human disturbance contributed to a site being utilized by mule deer. All these same variables except human disturbance were positively associated with increased probability that mule deer selected sites. The logistic model correctly classified 98 percent of the sites overall, and 91 percent of mule deer use sites were correctly classified.

Summer Use

Occurrence of graminoids on random sites was higher than both pronghorn (P = 0.004) and mule deer (P = 0.001) use sites. Downy brome (P = 0.003) was more common on random sites than on pronghorn use sites. Crested wheatgrass (P = 0.03) and other wheatgrasses (P = 0.01) were more common on random sites than on mule deer use sites. Alfalfa was more common (P = 0.001) on both pronghorn and deer use sites than on random sites. Random sites had greater (P = 0.02) frequencies of vetch species (*Astragulus* spp.) than did pronghorn use sites. Mule deer use sites had more (P = 0.001) mustard than did random sites. We found no shrubs on pronghorn or deer use sites. More (P = 0.008) plant species occurred on random

Table 3. Percent frequency (± SE) of common plant species and other variable on mule deer reclaimed use and random habitat sites, 1995-1996.

Category	Percent Frequency of Occurrence (± SE)			
Species	Spring	Summer	Winter	Random
Total Graminoids	97.0 ± 0.0	93.3 ± 3.8	96.1 ± 2.0	99.3 ± 0.4
Crested wheatgrass *(Agropyron cristatum)*	16.7 ± 8.3	3.0 ± 1.9	52.4 ± 14.1	14.3 ± 5.9
Other wheatgrasses (*Agropyron* spp.)	17.8 ± 7.9	7.0 ± 3.8	10.6 ± 4.9	25.3 ± 4.8
Green needle-grass (*Stipa viridula*)	16.4 ± 8.4	12.7 ± 5.7	4.3 ± 1.7	10.5 ± 2.4
Total Forbs	68.2 ± 10.9	57.6 ± 8.5	43.9 ± 7.8	44.8 ± 6.2
Yellow sweetclover (*Melilotus officianalis*)	30.3 ± 12.6	22.4 ± 8.5	12.1 ± 4.9	12.4 ± 4.5
False flax (*Camelina microcarpa*)	10.6 ± 7.5	6.1 ± 3.0	1.2 ± 0.7	6.7 ± 2.7
Mustard spp. (*Descurainia* spp.)	11.2 ± 6.6	10.9 ± 5.3	5.2 ± 2.3	1.1 ± 0.8
Alfalfa (*Medicago sativa*)	7.3 ± 4.7	11.8 ± 6.6	15.8 ± 8.6	0.6 ± 0.4
Total Shrubs	3.3 ± 3.0	0.0 ± 0.0	0.6 ± 0.6	0.5 ± 0.3
Gardner's saltbush (*Atriplex gardneri*)	3.0 ± 3.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Big sagebrush (*Artemisia tridentata*)	0.3 ± 0.3	0.0 ± 0.0	0.0 ± 0.0	0.3 ± 0.0
Silver sagebrush (*Artemisia cana*)	0.0 ± 0.0	0.0 ± 0.0	0.6 ± 0.6	0.0 ± 0.0
Category	**Average (± SE)**			
Other Habitat Variables	**Spring**	**Summer**	**Winter**	**Random**
Number of plant species	9.4 ± 1.1	9.9 ± 0.7	8.2 ± 1.1	9.8 ± 0.8
Percent shrub cover	1.1 ± 1.0	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1
Plant Height (cm)	20.4 ± 3.2	18.1 ± 2.0	17.4 ± 1.1	15.7 ± 0.8
Slope (^{0})	16.8 ± 4.9	11.8 ± 4.5	10.5 ± 4.2	12.4 ± 2.4
Distance to man-made disturbance (m)	137.7 ± 27.7	108.2 ± 30.2	163.2 ± 42.7	211.2 ± 27.3

sites than on pronghorn use sites during summer.

Among primary vegetative characteristics, frequency of alfalfa and average plant height distinguished pronghorn use sites from random habitat sites. As frequency of occurrence of alfalfa increased, probability of the site being utilized by pronghorn increased. As average plant height decreased, probability of pronghorn use increased. The logistic model correctly classified 84 percent of the sites overall. However, as during spring, the model correctly classified only 44 percent of pronghorn use sites. Frequency of mustard species and wheatgrass species, and average distance to water were significant variables distinguishing sites used by mule deer from random sites. Increasing the frequency of mustard species increased the probability of mule deer selecting a site. Increasing the frequency of wheatgrass species and increasing the distance to water decreased the probability of mule deer selecting a site. The model correctly classified 88 percent of the sites overall and 64 percent of mule deer use sites.

Winter Use

Graminoids more commonly occurred ($P = 0.001$) on random sites than on either pronghorn or mule deer use sites. However, green needlegrass was more common ($P = 0.04$) on pronghorn use sites than on random sites. Crested wheatgrass was more common ($P = 0.01$) on deer use sites than on random sites. Other wheatgrasses were more common on random sites than mule deer sites ($P = 0.05$). Both pronghorn ($P = 0.02$) and deer ($P = 0.001$) use sites

Table 4. Percent frequency (± SE) of plant species and other variables on pronghorn reclaimed use and random habitat sites, 1995-1996.

Category	Percent Frequency of Occurrence (± SE)			
Species	Spring	Summer	Winter	Random
Total Graminoids	99.6 ± 0.4	97.0 ± 3.0	93.4 ± 3.1	99.3 ± 0.4
Crested wheatgrass (*Agropyron cristata*)	17.4 ± 10.9	7.0 ± 5.6	7.0 ± 5.6	14.3 ± 5.9
Other wheatgrasses (*Agropyron* spp.)	17.8 ± 7.9	7.0 ± 3.8	10.6 ± 4.9	25.3 ± 4.8
Downy brome (*Bromus tectorum*)	15.6 ± 6.5	1.1 ± 0.8	12.2 ± 6.2	18.3 ± 4.8
Green needle-grass (*Stipa viridula*)	3.7 ± 1.2	2.6 ± 1.6	16.3 ± 7.2	10.5 ± 2.4
Total Forbs	70.7 ± 10.9	42.6 ± 9.3	32.6 ± 11.4	44.8 ± 6.2
Yellow sweetclover (*Melilotus officinalis*)	27.8 ± 13.1	7.0 ± 6.2	0.0 ± 0.0	12.4 ± 4.5
False flax (*Camelina microcarpa*)	24.4 ± 11.5	1.9 ± 1.9	1.9 ± 1.3	6.7 ± 2.7
Mustard spp. (*Descurainia* spp.)	7.8 ± 3.2	1.5 ± 1.5	10.7 ± 6.0	1.1 ± 0.8
Vetch spp. (*Astragulus* spp.)	7.8 ± 3.8	0.7 ± 0.5	0.4 ± 0.4	8.7 ± 2.8
Alfalfa (*Medicago sativa*)	6.7 ± 4.4	5.6 ± 3.9	5.9 ± 5.9	0.6 ± 0.4
Total Shrubs	0.0 ± 0.0	0.0 ± 0.0	0.7 ± 0.5	0.5 ± 0.3
Big sagebrush (*Artemisia tridentata*)	0.0 ± 0.0	0.0 ± 0.0	0.7 ± 0.5	0.3 ± 0.3
Category	**Average (± SE)**			
Other Habitat Variables	**Spring**	**Summer**	**Winter**	**Random**
Number of plant species	11.6 ± 0.9	7.9 ± 0.6	7.4 ± 0.9	9.8 ± 0.8
Percent shrub cover	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1
Plant height (cm)	16.9 ± 2.4	11.3 ± 1.5	14.1 ± 1.0	15.7 ± 0.8
Slope (°)	12.2 ± 5.9	18.9 ± 5.4	18.3 ± 5.5	12.4 ± 2.4
Distance to man-made disturbance (m)	192.8 ± 50.8	132.2 ± 31.5	165.6 ± 36.2	211.2 ± 27.3
Distance to water (m)	350.0 ± 40.8	245.6 ± 43.1	361.1 ± 55.1	355.5 ± 30.1

included more alfalfa than did random sites. False flax was more common ($P = 0.04$) on random sites than mule deer sites, while other mustard species were more common ($P = 0.01$) on mule deer use sites.

Percent frequency of alfalfa, total forb frequency, and total graminoid frequency contributed significantly in distinguishing pronghorn use sites from random sites. As the frequency of alfalfa increased, the probability of the site being utilized by pronghorn increased. As the frequency of total forbs and graminoids decreased, the probability of pronghorn use increased. The model correctly classified 86 percent of the sites overall and 56 percent of the pronghorn use sites. Among significant variables, frequency of alfalfa and crested wheatgrass distinguished mule deer use sites from random sites, and as the occurrence of both species increased, probability of the site being utilized by mule deer increased. The model correctly classified 85 percent of the sites overall and 64 percent of mule deer use sites.

Discussion

As expected, pronghorn most often used reclaimed areas with gentle slopes as evidenced by their preference for flats. We did observe pronghorn using steeper terrain, such as ridges and hill tops, although less frequently. Pronghorn have adapted to open terrain using their keen eyesight to locate and identify potential dangers (Byers 1997). The relatively gentle terrain on reclaimed land provided pronghorn with an unobstructed view of the landscape enabling them to locate predators or other potential dangers. Pronghorn summer use sites on reclamation areas were characterized by shorter vegetation, and we often observed pronghorn bedded on areas void of vegetation. Our data showed that pronghorn selection of topographical features did not differ from availability on reclaimed lands. This was not surprising since much of the reclaimed land is contoured to resemble pre-mine conditions, which included extensive flats and gently sloped terrain (L. Vicklund, personal communication). Pronghorn selection of topography was consistent with others (Yoakum 1978, Wood 1989) suggesting that pronghorns often selected areas that allowed high visibility.

Pronghorn occurred most prevalently on mine sites with large tracts of contiguous reclaimed grassland. In contrast, fewer pronghorn used mine sites consisting of small reclaimed areas fragmented by roadways or other human-related structures (Gamo 1997). Segerstrom (1982) found that pronghorn better tolerated human activity when it was within their field of view. A combination of short plant structure, greater unobstructed viewing distance, and terrain that allows good visibility enabled pronghorn to view human activity and thus increased the likelihood that pronghorn would use reclaimed lands.

Thermoregulation is an important factor in the survival of mule deer (Parker and Gillingham 1990). Carson and Peek (1987) found that mule deer selected rugged landforms during winter. The random use of topography types exhibited by mule deer during winter suggests that re-contouring efforts on reclaimed lands provided some relief from winter winds for mule deer minimizing the effects of wind chill (Wood 1988). Sloped areas in general were most frequented by mule deer. Man-made rock placements positioned on flats and ridges and other topographic features provided cover for small mammals and birds (Rumble 1989, Parrish and Anderson 1994). These structures along with naturally eroded areas (drainages) were used by mule deer particularly during inclement weather. These same features also offered shade during summer.

During spring, both pronghorn and mule deer selected sites with higher frequencies of forbs, particularly alfalfa. Additional moisture, which may result in more lush plant growth, may have influenced mule deer selection of base of slope areas. Our data support those of Medcraft and Clark (1986), who found that mule deer diets were dominated by forbs, including legumes, during spring on reclaimed lands in the Powder River Basin. Others (Kufeld et al. 1973, Medcraft and Clark 1986, and Yoakum et al. 1996) have shown that pronghorn and mule deer prefer forbs such as alfalfa. Alfalfa and other legumes provide a high source of protein for mule deer, pronghorn, and other ruminants. Protein is important for proper fetal development (Minson 1990, Robbins 1993), which is nearing completion during spring.

Forbs also were an important factor in classifying pronghorn and mule deer use sites during summer. The importance of a quality diet is important for lactation during the summer months for both pronghorn and mule deer (Short 1981, Robbins et al. 1987, Robbins 1993). We also observed that animals remained near water sources during summer such as ponds or diversions created by reclamation efforts. Demands of lactation increases water use by females, and in late summer, water facilitates digestion of drier plant materials (Short 1982, Minson 1990).

Winter often is a season of stress for ungulates and measuring exactly what attracts animals to particular sites is difficult. We noted a relative consistency of plant species during the two years of this study. Thus, we attempted to provide some insight by measuring vegetation at winter sites the following fall assuming that late season plant species would be available depending upon snow cover and palatability of plants. We found that during winter, pronghorn and mule deer selected sites containing residual alfalfa. Forbs are a major source of forage for pronghorn from early spring through late fall (Medcraft and Clark 1986). Mule deer also were attracted to areas with resurgent cool season grasses such as crested wheatgrass, which often produce new growth during fall and early spring (Willms and McLean 1978, Willms et al. 1979, Austin et al. 1983). During our study, snow cover did not approach 100 percent ground cover. Therefore, forage was generally available for consumption by pronghorn and mule deer.

Management Recommendations

Impacts of large-scale surface mining on pronghorn and mule deer concern wildlife managers. However, as evidenced by our study and others (Segerstrom 1982, Medcraft and Clark 1986), pronghorn and mule deer successfully utilized reclaimed mine lands in the Powder River Basin. Additionally, game surveys conducted on reclaimed mine lands reflected numbers and production found on native range in adjacent hunt management units (Oedekoven 1993, Gamo 1997). A unique aspect of reclaiming mined land is the opportunity to re-establish wildlife habitat if managers choose to do so. To benefit pronghorn and mule deer, we recommend increasing efforts to establish forbs, continue providing topographical relief for cover (i.e. steeper slopes, cliffs, drainages, rock outcrops), maintain a mosaic of vegetation heights, and reduce fragmentation by assimilating small tracts of reclamation into larger contiguous areas.

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