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Habitat Use and Movement Patterns by Migrating Mule Deer in Southeastern Idaho

Abstract

Relocations of radiocollared mule deer (*Odocoileus hemionus*) captured on two winter ranges in southeastern Idaho indicated that deer associated with the winter ranges occupied summer ranges spread over a >6,000 km² area. Most marked animals summered on public lands in mountainous areas east and southeast of the winter ranges. Autumn migration occurred in October-November. Spring migration occurred in March-May. Most marked deer migrated along definable corridors and used the same corridors in spring and autumn. Migration corridors followed prominent geographic features, and deer selected open vegetation types within corridors. The observed habitat use and movement patterns showed that deer migrating from one of the largest winter concentration areas in southeastern Idaho were not exposed to excessive hunting pressure during migration nor were their migration corridors immediately threatened by human land use. Areas where deer concentrated in migration corridors were identified and these areas should be protected from overgrazing and excessive conversion of native vegetation to crop production.

Introduction

Long distance movements between seasonal ranges are common in mule deer populations in the northern Rocky Mountains (Wallmo and Regelin 1981). Migration allows animals to make optimal use of vegetation with pronounced seasonal changes in quality or availability and to minimize the negative energy balance deer in the Rocky Mountains face during winter (Geist 1981, Wallmo and Regelin 1981, Garrott *et al.* 1987). These benefits are gained at the expense of increased exposure to predation or accidents as animals move between widely separated seasonal ranges.

As the intensity of human land use has increased in the Northwest, so has the potential for animal mortality increased along migration routes. Deer must negotiate highways, intensive agriculture, subdivisions, urban areas, and changes in harvest regulations as they pass through different administrative jurisdictions on their journey from summer to winter ranges. Quantitative information on migration timing and routes is difficult to obtain in the northern Rocky Mountains because of the inclement weather and the restrictions to observer ground mobility enforced by the snow and/or mud common during migration periods.

Information on migration patterns is sparse for mule deer using winter concentration areas in southeastern Idaho. The Idaho Department of Fish and Game initiated a radiotelemetry study of mule deer on two winter ranges in southeastern Idaho in 1983 to determine movement patterns, habitat use, and vulnerability of these deer to impacts associated with human land uses. This paper addresses three questions relative to movement, habitat use, and vulnerability during migration:

1) What is the timing and spatial pattern of migration?
2) What vegetation and which physiographic features are important to deer during migration?
3) Are migrating deer threatened by hunting and human land use during migration?

Study Area

The Willow Creek Winter Range (Figure 1), a 155-km² canyon complex 20 km east of Idaho Falls, provides a wintering area for a minimum of 3,000 mule deer (Thomas 1987). Elevation ranges from 1550-1950 m, annual precipitation averages 43 cm, and average annual temperature is 5°C. The shrub steppe vegetation of the Willow Creek area is dominated by sage (*Artemesia tridentata* and *tripartita*)—wheatgrass (Agropyron)/needlegrass (*Stipa*) habitat types with scattered juniper (*Juniperus osteosperma* and *scopulorum*) and aspen (*Populus tremuloides*) stands in canyon breaks and willow (*Salix* spp.) thickets along streams. Three-quarters of the plateau area above the canyon complex had

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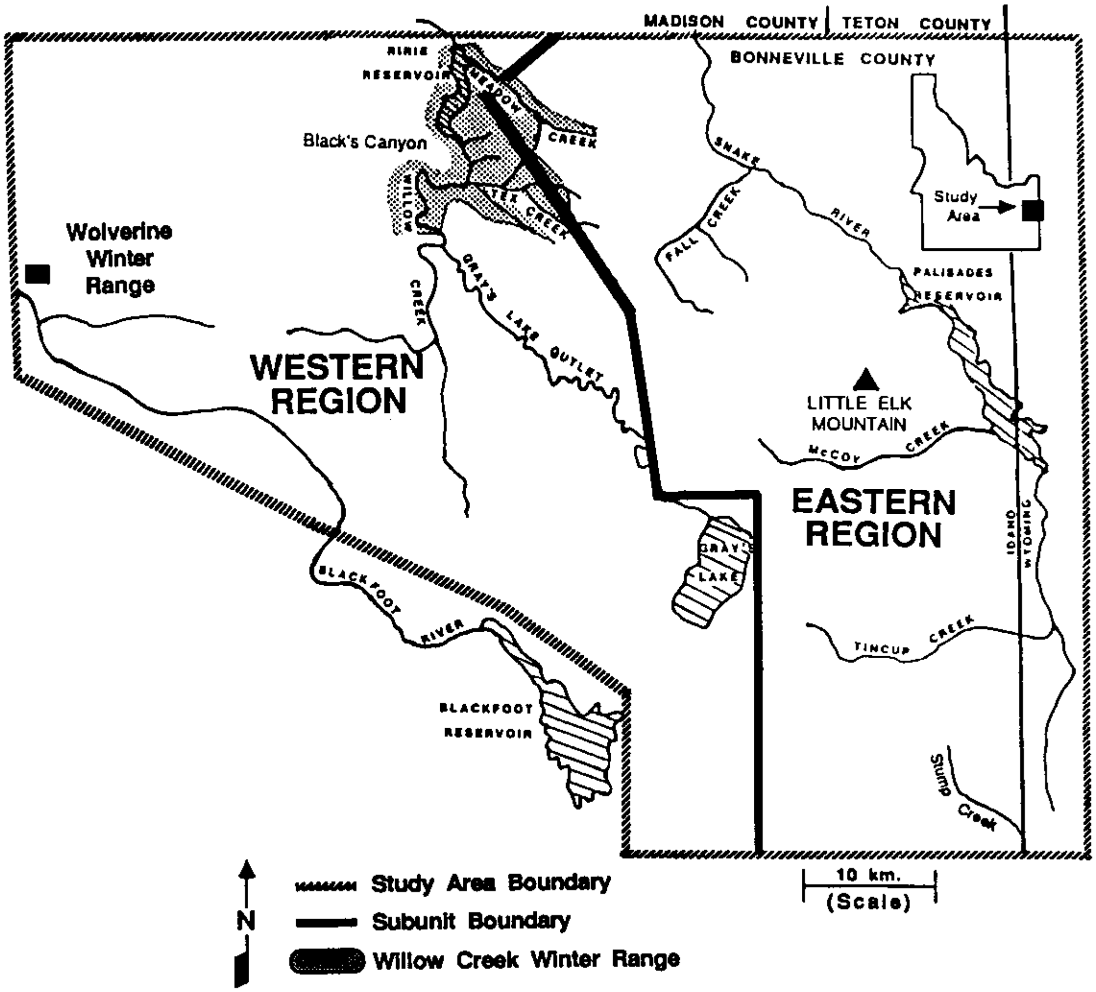

Figure 1. Map of the area occupied by mule deer associated with the Willow Creek and Wolverine winter ranges.

been converted to dryland wheat production at the time of this study. Movement information was supplemented by deer associated with wintering areas 30 km west of Willow Creek along Wolverine Creek. The 10-km^2 subunit in which deer were captured is similar in vegetation and land use to the Willow Creek area.

Land west of the winter ranges is similar in topography, vegetation, and land use to the shrub steppe surrounding the winter ranges. Land east of the winter ranges is dominated by foothills, mountains, and the Snake River Valley. Elevations range from 1,550-3,000 m. Vegetation varies from shrub steppe on dry (usually lower elevation) sites to aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*), and subalpine fir (*Abies lasiocarpa*) forests on wet (usually higher elevation) sites.

Methods

Eighty-eight mule deer were captured on the Willow Creek Winter Range and 66 on the Wolverine Winter Range (Figure 1) during 1983-86 using dropnets, helicopters and collapsible drive-nets, or Clover traps (Clover 1954, Ramsey 1968, Beasom *et al.* 1980). Thirty animals (26 from Willow Creek and 4 from Wolverine) were fitted with radio-transmitters (Telonics, Mesa, AZ), 51 with individually coded urethane collars (Ritchey Manufacturing, Brighton, CO), and 15 with colored plastic eartags. All animals were marked with numbered metal eartags.

Radiocollared deer were relocated at 3-14 day intervals during January 1984-November 1986 from a fixed wing aircraft. Sights of collared, eartagged, and radiocollared animals by hunters and resources agency personnel were used to supplement radio relocations. Aerial relocations were recorded to 0.01 minutes of latitude and longitude using LORAN C navigational receivers interfaced to an onboard computer (F. Reed, Western Air Research, Driggs, ID). Small scale corrections were made when the pilot's description (notes on terrain form, vegetation growth form, and aspect entered in the onboard computer at the time the LORAN location was entered) and/or 35 mm photographs taken at locations did not agree with LORAN locations. Coordinates of all locations were plotted on 7.5-minute USGS topographical maps.

Seasonal home range boundaries were delineated using the minimum polygon method (Mohr 1947, Lonner and Burkhalter 1986). Migration routes were plotted using relocations during autumn and spring migration periods. Migration periods for individual animals were defined as beginning with the first location more than 3 km outside a seasonal homr range without a return movement to the home range and ending with the first relocation on the new seasonal home range. Distances between seasonal ranges were calculated based on distances between summer and winter geographical activity centers (GAC = mean x and y coordinates obtained from all locations within a seasonal home range).

Availability of ground cover types (closed conifer, open conifer, closed aspen, open aspen, open grass/shrubland, agriculture, riparian, other (bare ground, rock, road, buildings, etc.)) in areas used by migrating deer was determined from 46 35-mm transparencies taken at intervals of 2.5 minutes of longitude and latitude from an altitude of 4,930 m a.s.l. These photographs provided a coverage of 95 km^2 or 18 percent of the 527 km^2 area associated with the two major migration corridors we identified. The proportion of each cover type on each slide was determined by projecting slides onto a sheet of white cardboard marked with 80 randomly distributed dots. Summed results of counts on all slides were assumed to be representative of the proportions of cover types available. Availability of aspect classes within migration corridors was determined from 80 randomly distributed points within 19 circles, each covering 4 km^2 on 7.5-minute topographic maps.

Ground cover characteristics of areas used by deer were described, based on the projection of 35-mm transparencies taken at elevations of 100-500 m above ground (coverage of 0.2-3.8 ha per photograph) onto a cardboard sheet with 80 randomly distributed dots. Aspect class and position on slope at deer locations were determined from 7.5-minute topographic maps.

Selection for ground cover type and aspect was determined using a method described by Marcum and Loftsgaarden (1980). Since both habitat availability and deer habitat use were calculated based on clumped subsamples taken at different scales (2 ha per deer location versus 200 ha per habitat location), the null hypothesis tested was: there is no difference between the proportionate distribution of vegetation cover types within a sample of small areas immediately surrounding a deer and the proportionate distribution of cover types sampled in an area roughly half the size of the average seasonal home range of a deer (Thomas 1987) at a series of points selected without regard to deer use. This approach was adopted to minimize biases associated with small scale movements that deer might have made in response to disturbance by the airplane (Jensen 1988) and errors associated with locations in which deer could not be seen. Mean elevation and slope at deer locations were tested against mean values for the study area using Student's t-tests (Steel and Torrie 1982).

Results

Movement patterns

With one exception, a yearling male, all deer followed for more than one year did not shift summer or winter home ranges between years. Radiocollared animals followed similar routes between seasonal ranges in spring and autumn and in different years.

We were unable to identify common migration routes for five of the seven radiocollared animals that summered near or west of winter ranges. Two radiocollared animals that summered near winter ranges and 23 that moved more than 30 km eastward from winter ranges traveled in broad corridors following prominent topographical features (ridges, canyons) oriented toward summer ranges (Figure 2). Corridors

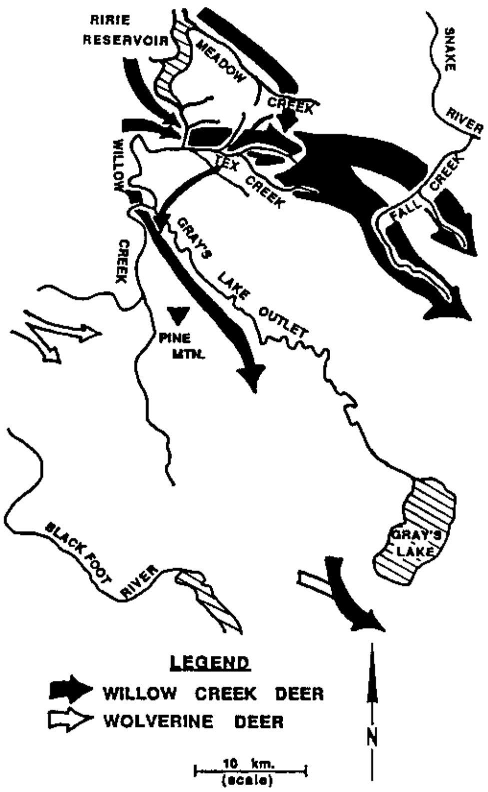

Figure 2. Spring movement patterns observed for mule deer using the Tex Creek-Fall Creek and Gray's Lake Outlet migration corridors.

became increasingly indistinct as distance from the winter range increased. Twenty-four of the 25 radiocollared deer that used defined corridors moved towards summer range through the corridor closest to their winter range. Individuals with adjacent winter home ranges tended to use the same corridors (10 of 14 adjacent pairs). During 1984-86, 112 radio relocations (83 in spring, 29 in autumn) and 12 sightings of neckbanded deer were obtained along definable migration corridors.

Distance between summer and winter GAC's varied from 11 to 115 km for the 29 radiocollared animals that did not shift ranges between years (mean = 54 km, SD = 23). We were unable to identify significant differences in distances between summer and winter GAC's for males (n = 7, mean = 46 km, SD = 34) and females (n = 22, mean = 56 km, SD = 19) ($t = 0.66$, $P > 0.50$).

Movement from winter to summer range was characteristically composed of rapid movement of 5-20 km with breaks of 1-10 days between movements. Deer apparently had favored areas, transitional ranges, in which they remained between movements. These areas were used in spring and autumn migrations. We identified four probable transitional ranges in the Tex Creek-Fall Creek migration corridor and one in the Gray's Lake Outlet corridor. These five areas accounted for 71 percent of the 83 spring locations of deer within migration corridors but comprised less than 20 percent of the area traversed during migration. Deer remained on transition areas as late as 8 December during autumn migration.

Individuals varied widely in timing and length of time spent in migration (Figure 3). Mean dates of initiation of spring migration during 1984-86 were 22 May (SD = 9 days), 22 April (SD = 12 days), and 29 March (SD = 15 days), respectively. Time spent in spring migration by individuals averaged 21 days (SD = 9) in 1984, 26 days (SD = 14) in 1985, and 51 days (SD = 24) in 1986. We were unable to detect significant differences in dates of departure between deer that moved more than 60 km between winter and summer range (n = 22) and deer that moved less than 40 km (n = 7, t = 0.72, P = 0.50).

Mean dates of initiation of autumn migration were 18 November (SD = 20 days) and 11 November (SD = 20 days) for 1984 and 1985, respectively. By 27 December 1984 and 26 November 1985, all deer had begun to move towards winter range. Mean dates of arrival on winter range for 1984 and 1985 were 27 December (SD = 20 days) and 5 December (SD = 15 days), respectively. Deer moving more than 60 km between seasonal ranges (n = 11) apparently did not vacate summer ranges earlier than deer whose seasonal ranges were separated by less than 40 km (n = 7, t = 0.50, P > 0.50).

Habitat Use During Migration

Habitat use during migration was similar during spring and autumn; therefore, habitat use data for the two seasons were combined. Of 112 relocations within definable migration corridors, only 4 percent were on ridge tops or stream bottoms. The remainder were nearly evenly divided between the upper third (31%), middle third (29%), and the lower third (35%) of slopes.

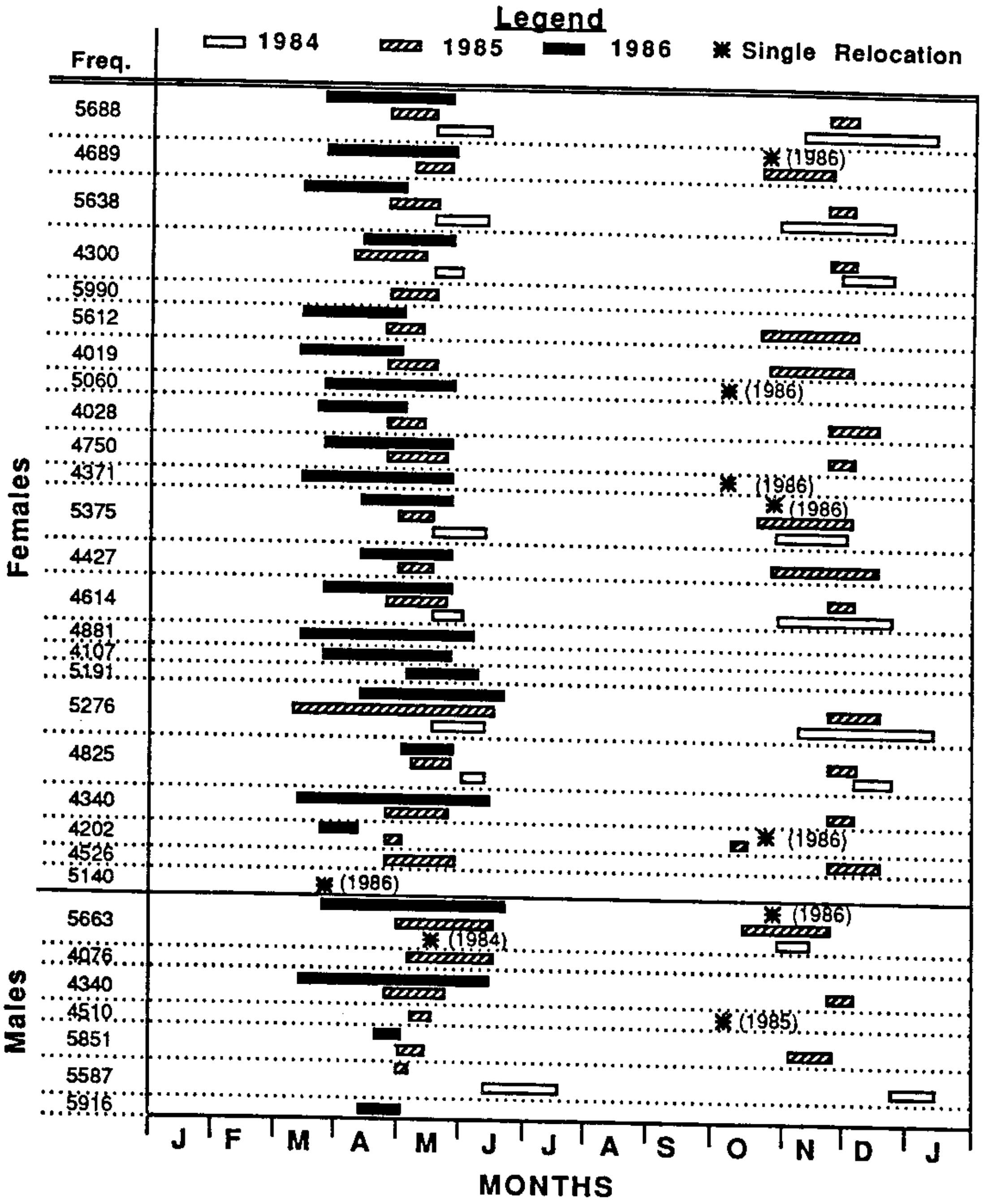

Figure 3. Chronology of spring and autumn migration for 30 radiocollared mule deer marked on the Willow Creek (n = 26) and Wolverine Creek (n = 4) winter ranges, 1984-86. Identification numbers (I.D. #) within sex classes are arranged by distance between winter and summer ranges with animals moving the greatest distances between ranges listed first.

TABLE 1. The distribution of 89 deer locations in the Tex-Fall Creek and 22 locations in the Gray's Lake Outlet migration corridors (% USE) in southeastern Idaho among aspect classes compared with availability of aspects (% AVAIL). Availability was determined from 80 points at each of 19 (13 in the Tex-Fall Creek and 6 in Gray's Lake Outlet corridors) randomly selected locations on topographic maps covering 76 km^2 within corridors.

	Tex-Fall Creek		Gray's Lake	
Aspect class	% USE	% AVAIL	% USE	% AVAIL
North	9	6	0	9
Northeast	16	23	4	18
East	2	7	46	2
Southeast	9	15	0	3
South	36 *	6	14	7
Southwest	17	10	18	7
West	7	16	0	18
Northwest	3	10	4	8
< 3% slope—riparian and flats	1	6	0	23
< 3% slope—ridgetop	0	1	14	6

* USE differs significantly from AVAIL ($P < 0.05$, Bonferroni simultaneous comparisons). Gray's Lake locations were not tested.

Deer in the Tex-Fall Creek Corridor were located on south aspects in greater than expected frequencies (Table 1). The sample size was too small for statistical analysis by aspect for the Gray's Lake Outlet Corridor, but 10 of 22 locations were on east aspects.

Forty-one usable photographs of deer locations (including 3,279 points at which vegetation cover could be identified) were available for analysis of cover type preferences in the Tex-Fall Creek corridor and 13 (1,031 usable points) in the Gray's Lake Corridor. Areas immediately surrounding radiocollared deer located in the Tex-Fall Creek corridor had higher proportions of open native cover types and lower proportions of closed conifer forests, riparian thickets, and agricultural lands than the high elevation photographs (Table 2). Deer in the Gray's Lake corridor used closed canopy forests and agricultural areas more and open shrub/grassland less than proportionate availability would suggest.

Human Impacts on Migrating Deer

Twenty-six of 29 deer followed during the general hunting season were on their summer home ranges at the opening of the season. In six cases (one male and three females during a single year and one female during two years), deer effectively shortened the time they were vulnerable to harvest by migrating from a hunting unit with a 26-day season to a unit with a 10-day season. In all other instances, deer migrating during hunting season either remained in the hunting unit in which they summered or moved into a unit with a similar season length.

At the time of this study, more than 90 percent of identified migration corridors, 70 percent of lands within 5 km of winter range, and 20 percent of the areas west of winter range used by marked migrating deer (Figure 1) were controlled by state or federal land management agencies. Private lands and human settlements were concentrated in areas west of winter range and along the Snake River and its major tributaries. Approximately 50 percent of land through which deer migrated near winter ranges and west of winter range was used to produce wheat and hay on unirrigated lands. Sheep and cattle were grazed throughout the migration area, with summer grazing dominant on Forest Service lands south and east of the winter ranges and winter or yearlong grazing on low elevation private lands east and west of the winter ranges. Logging and mining were carried out on a small scale within the study area, but no active operations were located in migration corridors.

TABLE 2. Cover type percentages in 41 transparencies taken at mule deer locations (% USE) in the Tex-Fall Creek migration corridor and 13 in the Gray's Lake Outlet migration corridor in southeastern Idaho compared with percentages of cover types in 31 (Tex-Fall Creek) and 15 (Gray's Lake Outlet) transparencies covering 18% of the 527 km^2 area surrounding the migration corridors (% AVAIL). Percentages are based on the cover types recorded at 80 points per transparency.

Cover type	Tex-Fall Creek			Gray's Lake		
	% USE		% AVAIL	% USE		% AVAIL
Closed canopy conifer	10	*	22	1	*	3
Open canopy conifer	9		8	0		tr[a]
Closed canopy aspen	9		10	8	*	18
Open canopy aspen	3	*	1	0		tr
Open shrub/grass	69	*	52	91	*	66
Riparian	tr	*	1	1		2
Agricultural	0	*	6	0	*	11
Other[b]	1	*	2	tr		1

* USE differs from AVAIL ($P < 0.05$, Bonferroni simultaneous confidence intervals). Cover types with less than 1% availability were not tested.

[a] trace = less than 1%.

[b] Includes bare rock, roads, houses, lakes.

Discussion

The distances moved between seasonal ranges by mule deer in our study area (15-115 km) were characteristic of herds associated with interior mountain-plains complexes in which snowfall limits access to forage at higher elevations (Leopold *et al.* 1951, Robinette 1966, Mackie *et al.* 1982, Ihsle Pac *et al.* 1988). Migration patterns (direction, initiation, duration, and termination) varied among individual animals and between the years of our study, but most animals moved to mountain or foothill summer ranges through restricted migration corridors. The pattern we observed could be interpreted as avoidance of deep snows (Richens 1967, Gilbert *et al.* 1970, Wallmo and Regelin 1981), population optimization of year-round forage quality (Garrott *et al.* 1987), or a series of individual animals responding to changes in conditions on their seasonal ranges modified by tradition, local weather/microclimatic patterns, disturbance, and knowledge of alternate sites to which they could move (Hamlin 1978, Mackie *et al.* 1982, Ihsle Pac *et al.* 1988).

Migration corridors were associated with prominent geographical features, and were pronounced only where terrain channelized deer movement, tending to become less distinct as distance from winter range increased. The extent to which deer used transitional ranges within migration corridors varied among years. Radio-collared deer apparently did not stop at some transitional ranges when migration coincided with severe autumn weather in 1984 but lingered for 2-4 weeks under the mild weather conditions during the 1985 autumn migration.

The extent of transition range use in spring depended on how early the deer left their winter range. During the three years of this study, deer left winter range latest in 1984, the most severe of the three winters, and earliest in 1986, the mildest of the three winters (Thomas 1987). Use of transition range on Tex Creek was lowest in 1984, moderate in 1985, and heaviest in 1986 (Thomas 1987). This pattern corresponds more closely with that described by Mackie *et al.* (1978) and Ihsle Pac *et al.* (1988) for mule deer in the eastern Rocky Mountains of Montana than with that described by Garrott *et al.* (1987) for the western slope of the Rockies in Colorado.

While in migration corridors, deer apparently selected open, nonagricultural cover types. Preferred aspects supported open vegetation. Position on slopes did not appear to be important since sightings were distributed approximately in proportion to availability of slope classes.

Areas used by migrating deer contained no large cities, and human land use was largely restricted to agriculture. Deer moving to summer ranges near or west of the winter ranges were evidently not concentrated into narrow corridors during migration. Migration corridors to the east of winter ranges were on public land and accessed only by secondary roads which were generally closed by snow or mud during migration periods.

Hunting was timed so that the general deer season occurred when most deer were on summer range thereby reducing the vulnerability of migrating deer to harvest. The high frequency of sightings on open sidehills during autumn migration may have been partially due to the minimal amount of hunting disturbance in the study area during the migration period. Nyberg (1980) determined that closed canopy cover types were important when migration took place during the hunting season. Bertram and Rempel (1977) suggested that hiding cover was important on transition ranges largely because of hunting activity.

Transition areas along migration corridors provide the last opportunity for deer to gain or maintain weight during autumn and one of the earliest opportunities to regain weight in spring (Wallmo and Regelin 1981, Garrott *et al.* 1987). Agricultural practices along migration routes could negatively impact migrating deer through overgrazing by domestic livestock and, possibly, through the conversion of native vegetation to croplands. Although our analysis indicated that deer were infrequently located in closed forest cover types, aspen patches in predominantly agricultural lands were used during migration, and loss of these patches could deprive deer of cover and/or nutritious forage during migration periods.

Overall, mule deer using the Willow Creek and Wolverine winter ranges do not appear to be threatened by current land uses. Deterioration of habitat used in migration could be minimized by conventional agricultural conservation practices. Land owners (public and private) should be encouraged to protect patches of woody vegetation that are used as diurnal resting sites by migrating deer, to avoid over-grazing pastures, and to maintain a mosaic of crop and grazing lands in areas where crops are grown.

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