

Influence of hunting on movements of female mule deer

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Abstract

Hunting is a fundamentally important tool for wildlife managers. We examined the null hypothesis that hunting does not influence deer movement and their use of habitat types. Seventeen radio-collared, adult, female Rocky Mountain mule deer (*Odocoileus hemionus hemionus*) were located 1 day before the 1983 first Colorado deer season, and during day 2 of the first and day 3 of the second deer seasons in the foothills west of Fort Collins, Colorado. Distance from the preseason location to each location during hunting seasons were calculated for each deer. There were no differences between mean distance from pre-hunting season location to hunting season location for 10 deer that had all 3 locations in the area closed to hunting, and 4 deer that had 3 locations in the area open to hunting ($P = 0.34$ and 0.52). All 17 deer had all 3 locations in the interior of their minimum convex polygon home ranges. Those home ranges had a mean size of 226 ha and range of 117 to 323 ha. However, deer in the section open to hunting generally moved to vegetation types with increasingly better escape cover as the hunting seasons progressed. We conclude that hunting pressure did not cause deer movement in terms of distance or cause them to leave their normal home ranges, but did cause deer to move into more adequate cover.

Key Words: *Odocoileus hemionus hemionus*, response to hunting, behavior, disturbances

Behavioral responses of deer to hunting pressure have important management implications. Wildlife habitat managers and live-

stock range managers need to understand how hunting pressure influences deer distribution and how they relate to vegetative cover when hunted so that deer habitat needs can be provided. If hunted deer move to areas closed to hunting (Zagata and Haugen 1973, Kemmermeyer and Marchinton 1975), resulting harvest could be less than desired. Conversely, where hunting pressure is high, such movement could prevent overharvest. Where deer are well adapted to their habitat and have learned to make maximum use of escape cover, they may become reluctant to leave their home ranges when hunted (Dasmann and Taber 1956, Van Etten et al. 1965, Robinette 1966, Behrend and Lubeck 1968, Marshall and Whittington 1968, Roseberry et al. 1969, Roseberry and Klimstra 1974, Grau and Grau 1980, Pilcher and Wampler 1981). Under these conditions, they can sustain higher levels of hunting pressure. Thus, more hunting may be needed to achieve a desired harvest.

Swenson (1982) found that mule deer on mixed grass prairie in eastern Montana increased ($P < 0.001$) their use of upland timbered cover types during the hunting season. Prairie mule deer appeared to be more vulnerable to hunting than those in forested habitats. We examined the null hypothesis that hunting does not influence distances moved and habitat types used by deer in relatively open to densely timbered foothills habitat west of Fort Collins, Colorado.

Study Area

The study area, approximately 14.5 km², is about 5 km west of Fort Collins, Colo., and lies mainly within the boundaries of Lory State Park. It is bounded on the east by Horsetooth Reservoir, on the west by the ridge extending north from Horsetooth Mountain, and on the south by the southern park boundary. Elevations range from 1,646 m at the reservoir shoreline to 2,138 m on Horsetooth Mountain over a linear distance of about 2.5 km. Steep, rugged, uplifted hogbacks capped by vertical rock outcrops occur along the western shore of the reservoir. These are covered by dense stands of true mountain mahogany (*Cercocarpus montanus* Raf.) interspersed with grassland (*Bromus secalinus* L. and *Stipa* spp.) openings and small patches of ponderosa pine (*Pinus ponderosa* Dougl.

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Ex P. & C. Laws.). West of the hogbacks lies an open valley about 0.6 km wide running north and south the length of the area. It is mainly grassland with very dense thickets of sumac (*Rhus aromatica* AIT.), hawthorn (*Crataegus erythropoda* Ashe) and wild plum (*Prunus americana* H. Marsh) along draws. Horsetooth Mountain is an area of rugged, mountainous terrain with numerous rock outcrops, ridges, and canyons. Lower portions and some south-facing slopes at higher elevations support dense mountain mahogany with patches of ponderosa pine and grass. Higher portions are covered by extensive stands of ponderosa pine interspersed with Douglas fir (*Pseudotsuga menziesii* [Mirb.] Franco), mountain meadows (*Poa* spp. and *Thermopsis divaricarpa* A. Nels.) and small grassland parks. Ponderosa pine canopy coverage has been placed in 3 categories: 10 to 39%, 40 to 69%, and 70 to 100%.

Materials and Methods

Part of Lory State Park was open to deer hunting, and part was closed. These sections were separated by a road. Hunters were checked in and out of the park each day during the first and second Colorado deer seasons (late October to early November, 1983) by State Parks personnel, and detailed records on hunter numbers and harvest were maintained. The first season lasted 5 days, and the second one began 3 days after the first season ended.

Seventeen radio-collared adult does living in Lory State Park were located 1 day before the first deer season and during day 2 of the first season (after deer in the area open to hunting had been hunted for 2 days) and day 3 of the second deer season (after deer in the area open to hunting had been through the first season and hunted for 3 days during the second season). Deer were located through triangulation with 2 large, precision-null antennas mounted on pickup campers. Directional accuracy of the precision-null antenna system on this study area and a description of procedures used in locating transmitters with this antenna are described by Kufeld et al. (1987). Triangulation to locate instrumented deer was accomplished from 2 sites (receiver points) on the east side of Horsetooth Reservoir. Antenna attitude was positioned and calibrated at the start of each monitoring session by orienting the antenna toward a fixed beacon transmitter located atop Horsetooth Mountain. A compass rose on the mast of each antenna was then set to coincide with the surveyed bearing from its receiver point to the beacon. Operators communicated via 2-way radios to facilitate simultaneous directional bearings on each instrumented deer.

Distance between pre-season location and each hunting season location was calculated for each deer. Mean distance comparisons were made between deer which were located each time in the area closed to hunting and deer which were located each time in the area open to hunting by use of a 2 sample-*t* test. Vegetation type for each deer location was determined using habitat-type maps.

A minimum convex polygon was constructed for each deer using locations obtained by tracking individuals from November through March beginning November 1982, through March 1985, or until their demise. Sample sizes for minimum convex polygons ranged from 101 to 317 locations per deer.

Results and Discussion

Ten instrumented deer (group 1) were located all 3 times in the portion of Lory State Park that was closed to hunting while 4 deer (group 2) were located all 3 times in the area open to hunting. On day 2 of the first season, deer in group 2 were located an average (\bar{x}) of 150 m farther from their pre-season locations than were group 1 deer. By day 3 of the second season, mean distance from pre-season locations for group 2 deer exceeded that for group 1 deer by 82 m (Table 1). These differences were not significant ($P = 0.34$ and 0.52 , respectively). Three deer (group 3) were in the closed area during pre-season but had moved to the open area by the day 2 of the first season. They were located back in the closed section on day 3 of the second season. All locations of the 17 deer, for each of the 3 times

Table 1. Comparison of distances moved by hunted deer during 2 deer hunting seasons.

No. of deer	Location	Mean \pm t.05 se distance (m) from pre-season location on day 2 of first and day 3 of second deer season	
		1st season	2nd season
10	Closed to hunting	317 \pm 167	325 \pm 133
4	Open to hunting	467 \pm 95	407 \pm 158
	Difference	150	82
3	Closed-Open-Closed	1,334 \pm 627	342 \pm 397

(pre-season and 2 hunting seasons) were in the interior of their minimum convex polygon home ranges. Mean sizes of these home ranges was 226 ha and they ranged from 117 to 323 ha. The home range of each of the 17 deer contained both areas open and closed to hunting.

Much of the area, both hunted and unhunted, was relatively open. Grassland and mountain mahogany vegetation types comprised a mean of 68% of the area within home ranges of all 17 instrumented deer (Table 2). Major vegetation types (Table 2) ranked in order of those providing least adequate escape cover for deer to those providing most, based on general estimates of the relative degree to which human visibility was obstructed by vegetation within each type, were: grassland, mountain mahogany, ponderosa pine 10–39% canopy coverage, sumac-hawthorn-*Prunus* (SU-HA-PRU), ponderosa pine 49–69% canopy coverage, and ponderosa pine 70–100% canopy coverage. Instrumented deer that remained in the unhunted section of the park, were mostly located in the mountain mahogany vegetation type pre-season and during both hunting seasons (Table 3). Those deer that stayed in the hunted section generally moved to vegetation types with increasingly better escape cover as the hunting seasons progressed (Table 3). Most deer that were located in the unhunted area pre-season, in the hunted section during first season, and back in the unhunted section during second season also used higher density escape cover while in the hunted area (Table 3). Since 3 of 7 deer in the hunted area during the first season were located in the mountain mahogany type, that type apparently provides suitable escape cover for deer, even though a human observer might consider it less than adequate.

According to check station records, deer hunting pressure at Lory State Park was relatively heavy during the first season and lighter during second season (10.6 and 7.6 hunters/km² during day 1 and 2 of the first season, and 1.6, 1.9, and 1.8 hunters/km² during day 1, 2, and 3 of the second season). Neither the heavy nor light hunting pressure level caused a movement of deer from their home ranges nor even a significant movement within their home ranges. On day 1 of the first season, hunters interviewed at the check

Table 2. Mean \pm t.05 se percent composition of vegetation types within minimum convex polygon home ranges of 17 instrumented deer.

Vegetation type ¹	$\bar{x} \pm$ t.05 se
Grassland	37.1% \pm 3.8%
Mt. mahogany	30.4 \pm 4.7
SU-HA-PRU	9.4 \pm 0.9
Pond. pine 10–39	1.4 \pm 0.5
Pond. pine 40–69	11.4 \pm 3.1
Pond. pine 70–100	7.9 \pm 3.5
Other ²	2.4 \pm 1.6
Total	100.0%

¹Pine 10–39, 40–69, and 70–100 represent percent canopy coverage. SU-HA-PRU is the sumac-hawthorn-*Prunus* type.

²Includes mountain meadow and riparian types and rock outcrops.

Table 3. Vegetation types where 17 instrumented deer were located preseason, on day 2 of the first season, and day 3 of second deer season.

Hunting status where deer in category were located	Deer no.	Vegetation type where deer was located ¹		
		Preseason	Day 2 first season	Day 3 second season
Closed area preseason and during both seasons	1	Mt. mahogany	Mt. mahogany	Mt. mahogany
	2	Mt. mahogany	Mt. mahogany	Mt. mahogany
	3	Grassland	Mt. mahogany	Mt. mahogany
	4	Mt. mahogany	Mt. mahogany	Mt. mahogany
	5	Mt. mahogany	Mt. mahogany	Mt. mahogany
	6	Mt. mahogany	Mt. mahogany	Mt. mahogany
	7	Mt. mahogany	Mt. mahogany	Mt. mahogany
	8	Mt. mahogany	Mt. mahogany	Mt. mahogany
	9	Mt. mahogany	Mt. mahogany	Mt. mahogany
	10	Mt. mahogany	Mt. mahogany	Grassland
Open area preseason and during both seasons	11	Grassland	Mt. mahogany	SU-HA-PRU
	12	Pond. pine 40-69	Pond. pine 40-69	Pond. pine 70-100
	13	Mt. mahogany	Mt. mahogany	SU-HA-PRU
	14	Pond. pine 40-69	Pond. pine 70-100	Pond. pine 70-100
Closed-preseason to open-1st season to closed-2nd season	15	Mt. mahogany	Mt. mahogany	Mt. mahogany
	16	Mt. mahogany	SU-HA-PRU	Mt. mahogany
	17	Mt. mahogany	Pond. pine 70-100	Mt. mahogany

¹Deer escape cover suitability ranking from least to most: grassland, mt. mahogany, ponderosa pine 10-39% canopy density, sumac-hawthorn-*Prunus* (SU-HA-PRU), ponderosa pine 40-69% canopy density, ponderosa pine 70-100% canopy density.

station frequently mentioned seeing many deer. On day 2, they often complained about not seeing deer. Since the deer did not leave the area, they apparently adapted quickly to hunting pressure by moving into nearby patches of heavier escape cover.

We concluded that hunting pressure did not cause deer movement in terms of distance or cause them to leave their normal home ranges, but did cause deer to move into more adequate cover.

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