



Population dynamics, food habits, seasonal habitat use, and spatial relationships of bighorn sheep, mule deer, and feral horses in the Pryor Mountains, Montana/Wyoming
by Robert E. Kissell, Jr

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Biological Sciences
Montana State University
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Abstract:

Seasonal habitat use, seasonal food habits, interspecific behavior, and population dynamics of bighorn sheep (*Ovis canadensis*) mule deer (*Odocoileus hemionus*) and feral horses (*Equus Caballus*) in the Pryor Mountains, Montana, centered on the Pryor Mountain Wild Horse Range and adjacent rangelands, were examined during 1993-1995. Bighorn sheep used mountainmahogany, juniper, and mountainmahogany/juniper complexes most frequently at elevations < 2200 m on northeast and southeast aspects. Most slopes used were <45° and at distances > 100 m from escape terrain. Mule deer used juniper and mountainmahogany/juniper complexes on the winter range and sagebrush and conifer on the summer range. Elevations used on the winter range were < 1800 m and on the summer range varied from 1400 - 2200 m. Southeast and southwest aspects dominated use in winter and northeast in summer. Slopes <31° were commonly used on both summer and winter range. [Feral horses used juniper and grasslands most frequently, and use varied in elevation depending upon the season and portion of the herd. Winter was spent at elevations < 1800 m and summer elevation use included elevations > 2300 m and < 1800] All aspects were used equally, except northwest which was used least.

Bighorn sheep diets were dominated by browse (34.0% - 93.8%) in all seasons except spring, when grass was the dominant (58.6% - 66.0%) forage class. Mule deer diets showed winter to summer seasonal trends, with browse as the major winter, summer, and fall dietary component and forbs as the major spring dietary component. Feral horses consumed primarily grasses (66.95% - 96.35%) during all seasons and exhibited a high level (>20%) of browse use in the fall. Morista's similarity index suggested substantial dietary overlap between bighorn sheep and mule deer during fall and winter and substantial dietary overlap between bighorn sheep and feral horses during spring and summer.

Twenty-one interspecific interactions were observed during the study. If horses were involved in an encounter and there was a dominant species, horses were the dominant species; bighorn sheep and mule deer were not observed exhibiting dominant or subordinate actions towards one another during the study.

The bighorn sheep population peaked at an estimated 211 animals in 1994 and declined in 1996 to an estimated 125 animals. Lamb production by bighorn sheep was sufficient to increase the population size; however, mean recruitment of yearlings was only sufficient to maintain the population in each year except 1995, when recruitment fell below the maintenance level. The mule deer population peaked at an estimated 780 animals during 1995 and decreased to an estimated 143 animals in 1996. Mean mule deer recruitment increased each year from 1994-1996, from 37 fawns: 100 does to 44.8 fawns to 100 does. The feral horse-population peaked at a minimum of 177 animals during 1994. Removal of 51 feral horses yielded a minimum of 143 animals in 1995. Population growth rates for feral horses were estimated at a maximum of 16.5%, 23.8%, and 21.2%, during 1993, 1994,-and 1995, respectively. Population structure of bighorn sheep and mule deer indicated inadequate nutrition for lambs and

fawns, respectively. Feral horse population growth indicated adequate nutrition. -

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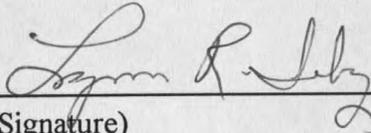
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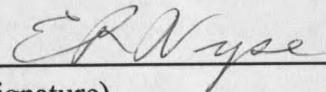


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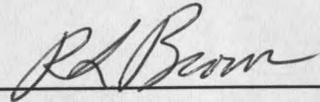


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ABSTRACT

Seasonal habitat use, seasonal food habits, interspecific behavior, and population dynamics of bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), and feral horses (*Equus caballus*) in the Pryor Mountains, Montana, centered on the Pryor Mountain Wild Horse Range and adjacent rangelands, were examined during 1993-1995. Bighorn sheep used mountainmahogany, juniper, and mountainmahogany/juniper complexes most frequently at elevations < 2200 m on northeast and southeast aspects. Most slopes used were < 45° and at distances > 100 m from escape terrain. Mule deer used juniper and mountainmahogany/juniper complexes on the winter range and sagebrush and conifer on the summer range. Elevations used on the winter range were < 1800 m and on the summer range varied from 1400 - 2200 m. Southeast and southwest aspects dominated use in winter and northeast in summer. Slopes < 31° were commonly used on both summer and winter range. Feral horses used juniper and grasslands most frequently, and use varied in elevation depending upon the season and portion of the herd. Winter was spent at elevations < 1800 m and summer elevation use included elevations > 2300 m and < 1800 m. All aspects were used equally, except northwest which was used least.

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INTRODUCTION

According to fossil records (Buechner 1960, Martin and Guilday 1967, Wallmo 1981, McFadden 1992), bighorn sheep (Ovis canadensis canadensis), mule deer (Odocoileus hemionus hemionus), and horses (Equus spp.) were all present on the North American continent prior to 8,000 years ago. Bighorn sheep evolved in Asia, apparently moved across the Bering land bridge during the Pliocene (Buechner 1960), and expanded southward throughout the Rocky Mountain range as far south as present day Mexico (Lawson and Johnson 1982). The evolution of mule deer on the continent is unclear and still debated; nonetheless, mule deer have been present in North America for at least 10,000 years and probably evolved from a cervid line that originated in Asia (Wallmo 1981, Mackie et al. 1982, Geist 1994). Equus evolved on the North American continent during the Pliocene (Simpson 1951, McFadden 1992), but along with many other large mammals (Simpson 1951, Martin 1967, Grayson 1989, McFadden 1992) became extinct on the North and South American continents between 8,000 and 13,000 years ago. Prior to that great megafaunal extinction all three genera had distributions encompassing the present day Pryor Mountains (Cowan 1940, Simpson 1951, Buechner 1960, McFadden 1992).

Bighorn sheep were numerous and widely distributed in western North America prior to European settlement (Buechner 1960), occurring in the Pryor Mountains and surrounding area before 1850 (Hamilton 1910). Distribution and numbers of bighorn

sheep in the Pryor Mountains declined from the early 1800's to about 1860, when sheep were extirpated (Gordon et al. 1974). The Montana Department of Fish, Wildlife & Parks (MDFWP) reintroduced a total of 77 bighorn sheep in 1971 and 1974 to the Pryor Mountains (Gordon et al. 1974). In 1973, the Wyoming Game and Fish Department (WGFD) transplanted 39 sheep to the Porcupine drainage (Helms 1973) of the Bighorn Mountains, which empties into the Bighorn River. Genetic profiles (FitzSimmons 1992) and visual observations (Simmons and Stewart 1977, Coates and Schemnitz 1989) indicated sheep from both reintroductions contributed to establishment of the present Pryor Mountain bighorn sheep herd.

Mule deer were a very common ungulate in Montana before European settlement of the area (Burroughs 1961). With growing numbers of settlers, collapse of the fur trade, expansion of the livestock industry, loss of habitat, and unlimited harvest, the mule deer population declined prior to 1900 and did not rebound until the 1940's (Egan 1971). Since the early 1960's, the Pryor Mountain mule deer herd has experienced periodic increases and decreases in harvests (Ellig 1960, Townsend 1964, Foss and Whitney 1966, Foss et al. 1969, Simmons and Stewart 1979) which are assumed to reflect population size (Wood et al. 1989).

Cortez, on March 13, 1519, unloaded 16 horses from his ships near Vera Cruz, Mexico and introduced the first horses to inhabit North America in at least 8,000 years (Wyman 1946, Martin and Guilday 1967, McFadden 1992). During the following 3 centuries numerous other horses were brought to the continent where trading by Native Americans, ranchers, and missions facilitated the expansion of horses throughout the United States

(Simpson 1951). "Wild" horses of today are descendants of horses that escaped or were released by ranchers, missions, or Native Americans to range freely.

The time of arrival of horses in the Pryor Mountains is uncertain. Hamilton (1910) did not mention the presence of free-ranging horses in the Bighorn Basin in 1848 or 1849. Others suggest that free-ranging horses may have occupied south-central Montana since the 1700's (Wyman 1946). Regardless, feral horses occurred in the Pryor Mountains and the surrounding area, apparently in great numbers (Wyman 1946), until the 1930's. In the early 1930's, because of potential competition with livestock, stockmen sponsored round-up efforts. By 1939, these efforts were sufficiently effective that few feral horses were still free-ranging in Montana (Wyman 1946). Feral horses became re-established in the Pryor Mountains (Thomas 1979) prior to or during the 1960's and numbered approximately 200 by 1968 (BLM 1984).

As public support for protection of feral horses grew in the western United States, both national and local pleas for preservation increased. The Pryor Mountain Wild Horse Range (PMWHR) was established in 1968 by the Department of Interior (Federal Register Document 68-11056). Subsequent passage of the Wild Free-Roaming Horses and Burros Act (Public Law 92-195) in 1971 ended commercial exploitation of feral horse herds on public lands in the United States.

Condition of rangeland across the majority of the PMWHR and adjacent areas during the last half of this century has been described as poor or very poor (Firebaugh 1969, Gordon and Coop 1973, Hall 1973, BLM 1984, BLM 1992) with high potential for soil loss (Cleary and MacIntyre 1973). This, together with a steady increase in the bighorn

sheep herd (Coates and Schemnitz 1989), fluctuating mule deer numbers as indicated by highly variable harvests (MDFWP, unpubl. data), and consistent high levels of reproduction of feral horses (Garrott and Taylor 1990), provided impetus for this study.

The study was designed to address the following objectives and hypotheses [given in brackets] on and around the PMWHR: 1) determine seasonal habitat use for bighorn sheep, mule deer, and feral horses [H_0 : there is no significant overlap in habitat use among ungulates by season]; 2) determine seasonal diets for bighorn sheep, mule deer, and feral horses [H_0 : there is no significant overlap in diets of ungulates by season]; 3) determine if population structure of bighorn sheep, mule deer, or feral horses indicated adequate nutrition [H_0 : there is no difference between population structure of healthy populations and population structures of ungulates in the Pryor Mountain Study Area]; 4) estimate the population size trends for bighorn sheep, mule deer, and feral horses during 1993-1995; and, 5) determine if behavioral interactions among bighorn sheep, mule deer, and feral horses influence distribution or habitat use patterns [H_0 : there is no difference in distribution given the presence or absence of another species].

STUDY AREA

The Pryor Mountain Study Area (PMSA) is located approximately 75 km south of Billings in Bighorn county, Wyoming, and Bighorn and Carbon counties, Montana ($45^{\circ} 00'$ N latitude, $108^{\circ} 15'$ W longitude). The study area (Figure 1) encompassed approximately 700 km² that included the PMWHR and adjacent lands managed by the Bureau of Land Management (BLM), portions of the Bighorn Canyon National Recreation Area (BCNRA), the Custer National Forest (CNF), the Crow Tribe Indian Reservation (CTIR), and privately owned properties.

Topoedaphic Features

Topographic features (Figure 1) consisted of vertical canyon walls, steep talus slopes, and gently rolling hills and meadows intersected by canyons. Elevation varied from 1109 m to 2660 m. Steep slopes ($> 45^{\circ}$) were primarily located along the Bighorn and Crooked Creek Canyons. Many creeks traversed the area, but perennial streams were rare and most water courses were intermittent (Figure 2). Soils were composed of sandstone, limestone, shale, dolomite, and alluvial deposits (Richards 1955, Blackstone 1975). Soil depth varied but has been described as severely depleted (Cleary and MacIntyre 1973).

Vegetation

Vegetation (Figure 3) was classified into 9 principal types (Knight et al. 1987, McCarthy 1996). Juniper woodlands were dominated by Utah juniper (Juniperus osteosperma). Mountainmahogany woodlands were dominated by curlleaf mountainmahogany (Cercocarpus ledifolius). Juniper/mountainmahogany woodlands were composed of a mixture of both Utah juniper and curlleaf mountainmahogany. Riparian habitat was dominated by cottonwoods (Populus spp.) and fragrant sumac (Rhus aromatica). Desert shrubland was characterized by saltbush (Atriplex canescens, A. confertifolia), black greasewood (Sarcobatus vermiculatus), rubber rabbitbrush (Chrysothamnus nauseosus), big sagebrush (Artemisia tridentata), broom snakeweed (Gutierrezia sarothrae), bluebunch wheatgrass (Agropyron spicatum), threeawn (Aristida fendleriana and A. longiseta), and needle-and-thread (Stipa comata). Sagebrush steppe included both big sagebrush and black sagebrush (Artemisia nova) communities, the latter on limestone derived soils. Grasslands were dominated by bluebunch wheatgrass, blue grama (Bouteloua gracilis), needle-and-thread, broom snakeweed, Hooker sandwort (Arenaria hookeri), fringed sagebrush (Artemisia frigida), and Hood phlox (Phlox hoodii), alpine bluegrass (Poa alpinum), alpine timothy (Phleum alpinum), Ross sedge (Carex rossii), bluebunch wheatgrass, annual fescue (Festuca octoflora), silky lupine (Lupinus sericeus), grouse whortleberry (Vaccinium scoparium), paintbrush (Castilleja pulchellum), tufted fleabane (Erigeron caespitosus), tufted phlox (Phlox caespitosa), and goldenrod (Solidago radiata). Coniferous woodlands were characterized by limber pine (Pinus

CROW RESERVATION

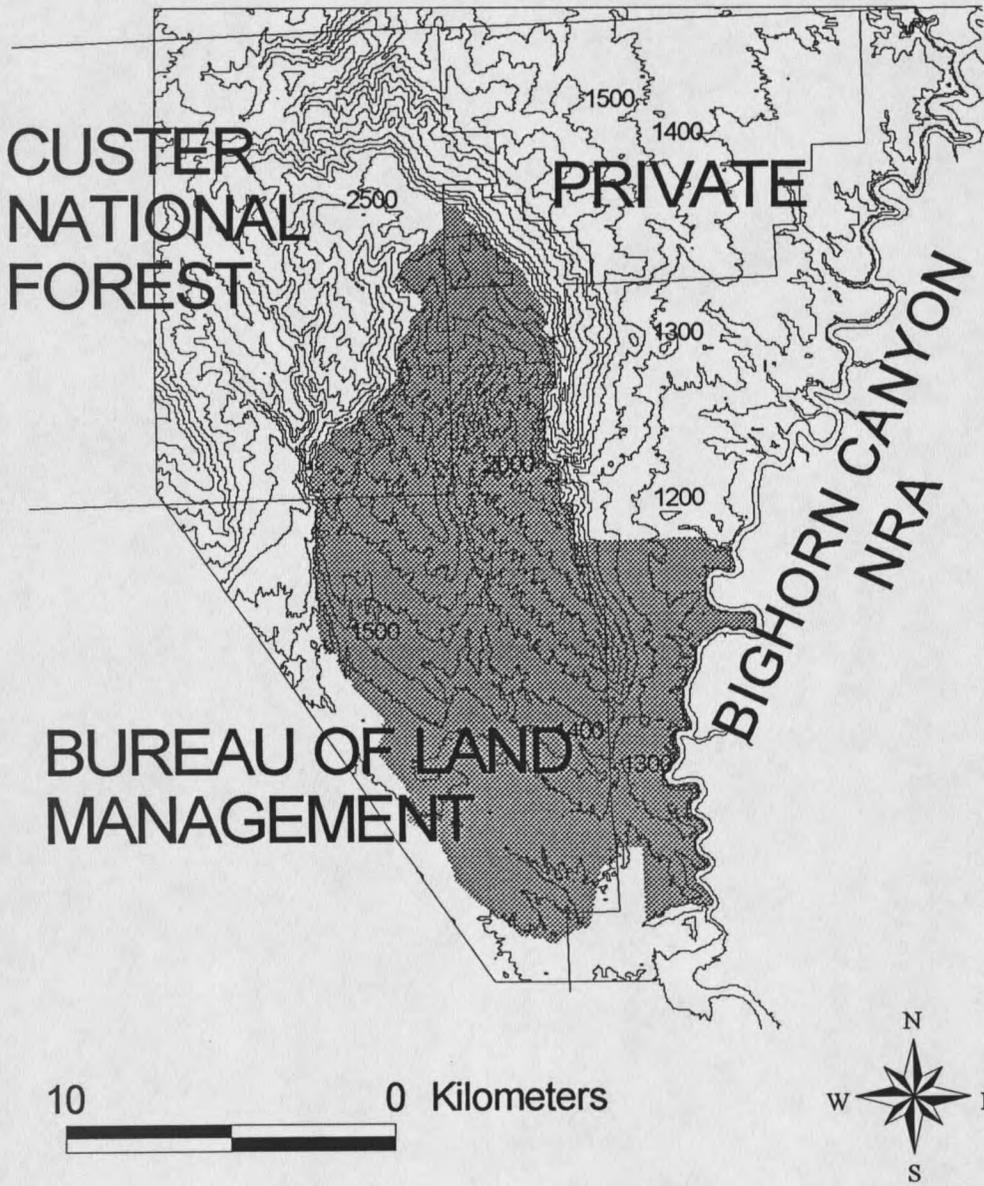


Figure 1. Pryor Mountain Study Area, associated ownership, and topography. The Pryor Mountain Wild Horse Range (shaded area) represents an approximate boundary.

