Behavior and environmental selection by elk (Cervus canadensis nelsoni) during summer and fall in the first and second Yellow Mule drainages, Madison County, Montana
by Gayle Lynne Joslin

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Zoology
Montana State University

Abstract:
A study was conducted in the First and Second Yellow Mule drainages of southcentral Montana during the summer and early fall of 1973 and 1974 to investigate ecological aspects of elk (Cervus canadensis nelsoni). The study area was divided into park, broken park, and timber cover types covering 31, 13, and 56 percent of the area, respectively. Six habitat types were delineated on the timbered regions. Large mixed sex bull-cow groups observed in late July dispersed to form small single sex bull groups and cow groups which increased in size to late August. Environmental features recorded to compare areas selected by each elk group type were cover type, habitat type, timber type, distance to water, distance to the next closest cover type, downfall, sight distance, location, topography, elevation, aspect, and slope. Significant differences existed between preferences of group types for topography and aspect ($P<.05$) and location.($P<.01$). Selection of other environmental features were not statistically different. Bulls abandoned their environmental preferences in late summer to join cow groups in their preferred habitat.

Canopy cover of tree and shrub species, general ground cover, and the three dominant species in each of nine 2X5 decimeter frames were recorded at 21 feeding and 28 bedding sites. Ground cover at both types of sites was similar. Each group was observed in one of five basic activity patterns and in one of three response states. Elk in the restless response state were significantly more common during weather phase one (Landsberg, 1969). The "head jerk" and "humped back" postures and other dominant and subordinate gestures were observed. Rut-related activities began with velvet shedding, followed by herding, wallowing, bugling, and sparring.

Dry weight standing crops and percentage moisture contents were determined for forbs and grasses which were clipped every two weeks from elk feeding sites and from established timber and meadow plots at three elevations. Forbs at elk feeding sites had significantly greater moisture contents than forbs in all meadow and most timber sites; standing crops of forbs at feeding sites were also significantly greater than forbs at all timber and most meadow sites. Percentage moisture content of forbs fell below that of grasses during October, which was also the only time that moisture content of grasses at established plots exceeded that of grasses at feeding sites. However, elk moved into the timber in September, coincident with the rut, and reappeared in high open parks in October. Based on relative percentage moisture content, movement into the timber solely for succulent vegetation would not be founded; therefore, during this study it appeared that security requirements of elk were involved in this fall movement into the timber.

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151

BEHAVIOR AND ENVIRONMENTAL SELECTION BY ELK *(CERVUS CANADENSIS NELSONI)* DURING SUMMER AND FALL IN THE FIRST AND SECOND YELLOW MULE DRAINAGES, MADISON COUNTY, MONTANA

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF FIGURES

ABSTRACT

A study was conducted in the First and Second Yellow Mule drainages of southcentral Montana during the summer and early fall of 1973 and 1974 to investigate ecological aspects of elk *(Cervus canadensis nelsoni)*. The study area was divided into park, broken park, and timber cover types covering 31, 13, and 56 percent of the area, respectively. Six habitat types were delineated on the timbered regions. Large mixed sex bull-cow groups observed in late July dispersed to form small single sex bull groups and cow groups which increased in size to late August. Environmental features recorded to compare areas selected by each elk group type were cover type, habitat type, timber type, distance to water, distance to the next closest cover type, downfall, sight distance, location, topography, elevation, aspect, and slope. Significant differences existed between preferences of group types for topography and aspect ($P<.05$) and location ($P<.01$). Selection of other environmental features were not statistically different. Bulls abandoned their environmental preferences in late summer to join cow groups in their preferred habitat.

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INTRODUCTION

The Rocky Mountain elk *(Cervus canadensis nelsoni)* is an integral part of many Montana ecosystems, and because elk are valuable animals from the standpoint of economics, recreation and aesthetics, knowledge of the relationship of the species to the environment is essential. Elk consistently select certain aspects of various environmental features (Lonner, 1974) such as slope, aspect, topography, and cover type.

The size, composition, and habitat preferences of elk groups change with time and environmental conditions (Knight, 1970). Large early summer migratory groups become smaller dispersal groups of mid summer which become larger bull-cow groups once again with the onset of rut (Martinka, 1965). Behavioral patterns and hierarchical systems change with the season and hormonal development (Struhsaker, 1967). Matriarchal group control is the rule throughout the summer (Cole, 1969), but aggressive mature males join already formed large cow groups during the rut and assert their dominance in the new association (Altmann, 1952). According to Darling (1937), red deer stags move from their summering areas to join hind groups in their preferred habitat in the late summer, but similar movements have not been noted for elk. Seasonal movements of elk have been attributed to the phenological development of vegetation (Brazda, 1953; Picton,

1959; Kirsch, 1962; Martinka, 1965; Stevens, 1966; Knight, 1970; Coop, 1971; Day, 1973), but though this may be a cause of such seasonal movements, it may not be the only cause (Cole, 1969; Ream *et al.*, 1972).

During the summer and fall of 1973 and 1974, elk were studied in the Yellow Mule drainages of southcentral Montana. The purpose of the study was to describe some of the environmental features of the elk's summer habitat and various daily and seasonal social interactions and group changes. This information may help to shed additional light on the ecological requirements of elk and provide some baseline data for future monitoring of the elk in the Yellow Mule area.

The National Science Foundation RANN Program provided support for the Gallatin Canyon Case Study team to assess the impact of the Big Sky development on the Gallatin Canyon region. My project was an offshoot of this endeavor and was funded in part by the NSF RANN Program grant numbers GI-29908x and GI-29908x1.

METHODS

Field work was conducted from July 24 to October 5, 1973, and from July 6 to October 15, 1974. Travel within the area was unrestricted in 1973, but in 1974 the area was closed to all but two wheeled motorized vehicles which were restricted to authorized trails. Travel to and from the area was by motorcycle, and travel within the area was on foot.

Elk observed with the aid of a 32X spotting scope and 7 X 35 binoculars were classified into one of three elk group types. Bull groups consisted of bulls and spikes, alone or in association with each other. Cow groups included cows, calves and spikes, alone or in association with each other, but lone spikes were classified as bulls. Bull-cow groups always included at least a bull and cow, but might also include calves and spikes. The size, composition, activity, response state and behavior of groups were recorded. Aerial observations in 1973 and 1974 were made over the area during 12 flights in a light plane.

Environmental characteristics recorded for each group were cover type, habitat type, timber type, distance to water, distance to next closest cover type, downfall, sight distance, location, topography, elevation, aspect, slope and weather conditions. Relative tree densities and distribution ascertained from aerial photos and

topographic maps were used to determine the park, broken park and timber cover types. Forest areas were classified and mapped by habitat type according to Pfister *et al.* (1974). Points along systematically traveled routes were habitat-typed and plotted on topographic maps. Habitat type boundaries were mapped by delineating areas of similarly habitat-typed points. Notes were made at each point on understory and overstory vegetation composition. Associations of five tree species comprise four timber types present in the overstory. Identification and distribution of each timber type was determined from ground reconnaissance, aerial photos, and U.S.D.A. Forest Service timber inventory maps. Measurements of distance to free surface water and next closest cover type were grouped in categories of less than 100 meters, less than 500 meters, and more than 500 meters. Downfall in the nearest timber stand was recorded as none, light (scattered fallen trees which do not appear to deter elk movement), moderate (fallen trees which retard movement), and heavy (thick downfall in which movement is extremely difficult). Sight distance in the timber stand where elk were observed, or with which elk were most closely associated, was recorded as less than 20 meters, less than 50 meters, and more than 50 meters. Location was noted by drainage. The topography of the immediate area where a group was observed was recorded as ridge, upper slope, mid slope, lower slope, bench or flat, or stream bottom. Elevation was recorded

to the nearest 30.5 meter interval using a U.S. Geological Survey 15 minute topographic map. Aspect of each site was categorized as north, northeast, east, southeast, south, southwest, west, and northwest. Slope categories included 0-15 percent, 16-25 percent, 26-35 percent, 36-45 percent, and over 45 percent. Aspect and slope were measured with a Brunton transet. Wind direction and velocity, cloud cover, and temperature were estimated in the field for each observation. Barometric pressure for each day was later derived from records kept in Bozeman by Harold D. Picton. Various combinations of wind velocity, cloud cover, temperature and barometric pressure comprise six weather phases as described by Landsberg (1969) (Appendix Table 12). One of the six weather phases was ascribed to each observation of elk.

Use of the terms significant and highly significant indicate statistical significance at the five and one percent levels, respectively.

Selected feeding and bedding sites from each two week period in 1974 were sampled with a 141.5 square meter circular plot centered on the spot of most intense elk activity. In it a species list was compiled; scientific and common names follow Booth (1950) and Booth and Wright (1959). General ground cover including grass, forbs, litter, rock and bare ground was recorded by the canopy coverage method (Daubenmire, 1959) in nine 2 X 5 decimeter frames. Frames

were arranged in three concentric circles within the circular plot. The outer circle of four frames circumscribed the perimeter of the plot: the inner circle of four frames located half way between the edge and center alternate with those in the outer circle; a single frame was placed in the center. The three low growing species with the greatest aerial coverage per frame were recorded as dominant species. Overall dominance values were assigned to each dominant species to indicate the percentage of frames it occurred as a dominant species in 189 and 252, 2 X 5 decimeter frames analyzed at feeding and at bedding sites, respectively. Data recorded for each site indicated whether a species was present, and if it was a dominant, in what percentage of nine frames it occurred as a dominant. Shrub cover was measured with the line intercept method of Canfield (1950), along two perpendicular lines each bisecting the plot. Tree species, size classes in four centimeter increments (dbh), and canopy coverage classes as described by Daubenmire (1959) were recorded for each site plot.

In 1974, six 10.5 square meter permanent plots were established east of the study area boundaries, near the Doe Creek road, to monitor the phenological development of vegetation. Pairs of plots were located at each of three elevations: 2200, 2500, and 2800 meters. One of each pair of plots was located in a meadow and the other was located in the timber. Ten 2 X 5 decimeter frames were clipped in

each plot every two weeks from mid July to mid October, 1974. Vegetation from each plot was separated into grasses and forbs, put in plastic bags, labeled, weighed in the laboratory on a Mettler balance scale to the nearest 0.25 gram, transferred to paper bags, labeled, dried for at least 24 hours at 90 C, and reweighed. Percentage moisture content was calculated for grasses and forbs from each plot according to the formula, $\frac{\text{Wet Weight-Dry Weight}}{\text{Dry Weight}} \times 100$.

Vegetation from five of nine 2 X 5 decimeter frames at each of 21 elk feeding sites was clipped and separated into grasses and forbs and similarly weighed, dried and reweighed. A maximum of four feeding sites was clipped each two week period.

THE STUDY AREA

The Yellow Mule study area (Figure 1) is located about 4.8 kilometers south of Meadow Village of Big Sky, Montana, in the Madison Mountain Range of the Gallatin National Forest. The 24.1 square kilometer area is bisected from north to south by the Madison-Gallatin County line and encompasses the First and Second Yellow Mule Creeks and the bordering ridges from the Buck Creek ridge at 2865 meters to the 2195 meter level near the South Fork of the West Fork of the Gallatin River. In 1973 the area boundaries were not well defined, and observation trips were also made to Buck Creek, Beaver Creek, McAtee Basin, Muddy Creek and Third Yellow Mule Creek.

The large amphitheater basins of Muddy Creek, the First, Second, and Third Yellow Mule Creeks are indicative of possible glacial action during the Bull Lake glacial stade. There are no interlocking spur creeks between drainages, and the valleys are wide straight troughs providing evidence of glacial activity, although mass gravity action in the region has largely obscured glacial evidence. Extensive alluvial deposits occur in the basins at the heads of these drainages. They are derived from sedimentary parent material of sandstone, shale and limestone (Walsh, 1971).

The Gallatin Gateway 26 SSW weather station is located 4.8 kilometers northeast of the study area in Beaver Creek at 2012 meters and provides the nearest record of climatological data. The seven year

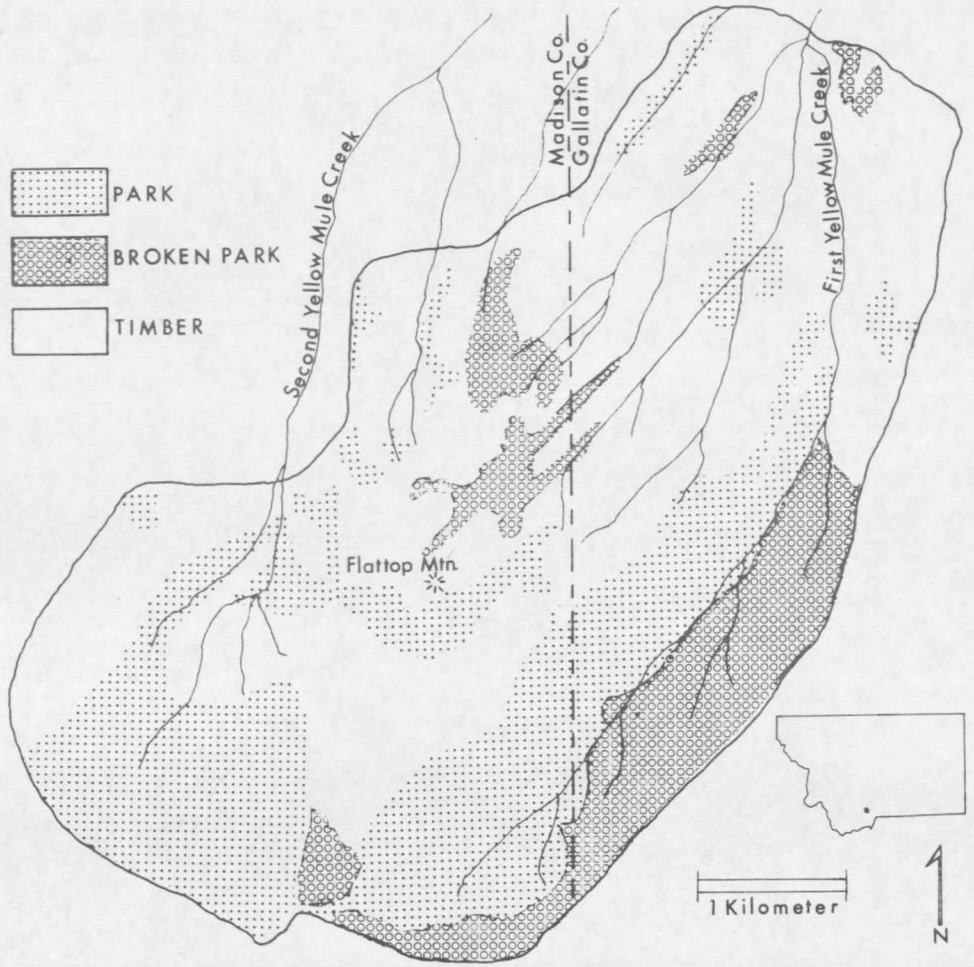

Figure 1. Map of study area showing cover types.

record (U.S. Weather Bureau, 1973 and 1974) indicates an average annual temperature of 2.6 C and an average annual precipitation of 56.95 centimeters. The study area is from 240 meters to 850 meters above the weather station and receives substantially more precipitation and experiences colder temperatures. According to the U.S.D.A. - S.C.S. (1974) precipitation map, from 76.2 to 127.0 centimeters of moisture falls annually, and Caprio (1965) indicates that less than thirty frost free days occur per year on the study area.

The area is part of a cattle grazing allotment leased by the Forest Service from July 1 to October 15. Cattle did not arrive on the area until September 9, 1973, but they were present at high elevations within the area from July 11 until after October 15, 1974.

The study area was divided into three general cover types as seen in Figure 1. The park cover type covers 31.0 percent (7.5 square kilometers) of the area. It consists of terraced benches with long bands and island-like clumps of subalpine fir *(Abies lasiocarpa)*, Engelmann spruce *(Picea engelmannii)*, and whitebark pine *(Pinus albicaulis)* (Figure 2). The large basins of both the First and Second Yellow Mule Creeks contain 67 percent of the park cover type and have a highly heterogeneous nature with interspersed creeks, willow flats, tree islands, meadows, rock piles and bare ground.

The broken park type is composed of small meadows separated by interconnecting tree stands (Figure 3). It covers 13.3 percent (3.2