Seasonal variation of fecal nitrogen and forage succulence in relation to condition and movements of two southeastern Montana mule deer populations
by Thomas Joseph Olenicki

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
Seasonal variation in nutrition and habitat use are important in understanding the ecology of mule deer (Odocoileus hemionus) in eastern Montana. Consequently, I used fecal nitrogen (FN) to assess nutrition of mule deer during summer and winter in a prairie habitat (Boxelder study area) and a ponderosa pine habitat (Ashland study area). Forage succulence predicted summer FN values ($R2=O.93$, $P<0.01$) on the Boxelder area but not on the Ashland area. Winter values of FN were lower than summer values for both areas, with those on Boxelder lower than Ashland. There was a curvilinear relationship ($R2=O.82$, $P<0.001$) between FN and rumen forage nitrogen. Kidney fat index was related linearly ($R2=O.83$, $P<0.001$) to rumen forage nitrogen and curvilinearIy ($R2=O.59$, $P<0.05$) to FN. Fawn girth measurements were greater ($P<0.01$) at Ashland than Boxelder. Deer use of cover types differed (P

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APPROVAL

of a thesis submitted by

Thomas Joseph Olenicki

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

6 April 1993
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6 April 1993
Date

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Approved for the College of Graduate Studies

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Date 4/6/93

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ABSTRACT

Seasonal variation in nutrition and habitat use are important in understanding the ecology of mule deer (Odocoileus hemionus) in eastern Montana. Consequently, I used fecal nitrogen (FN) to assess nutrition of mule deer during summer and winter in a prairie habitat (Boxelder study area) and a ponderosa pine habitat (Ashland study area). Forage succulence predicted summer FN values (R^2=0.93, P<0.01) on the Boxelder area but not on the Ashland area. Winter values of FN were lower than summer values for both areas, with those on Boxelder lower than Ashland. There was a curvilinear relationship (R^2=0.82, P<0.001) between FN and rumen forage nitrogen. Kidney fat index was related linearly (R^2=0.83, P<0.001) to rumen forage nitrogen and curvilinearly (R^2=0.59, P<0.05) to FN. Fawn girth measurements were greater (P<0.01) at Ashland than Boxelder. Deer use of cover types differed (P<0.001) between winter and summer on both areas. Aerial observations indicated greater use by deer of pine dominated cover types than was indicated by ground observations for the Ashland area. Mesic sites appeared to be important on both areas. Telemetry relocations at Boxelder indicated movement of deer onto the main drainage for a short period during late summer and fall. Most deer at Ashland were yearlong residents of the same areas, with 7 of 58 marked deer using distinct summer and winter ranges. Population estimates indicated higher population growth rates and densities at Boxelder than Ashland since the mid-1980s. Weather data from the Broadus NOAA station provided a better prediction of winter conditions on the Boxelder area than NOAA stations at Albion and Ridgeway. Seasonal and yearly differences in FN may be useful in estimating physical condition of deer; thereby helpful in predicting population trends based on relative periods of energy gain and loss.

INTRODUCTION

Weather and climate may be the ultimate variables controlling year round energetics of rocky mountain mule deer (Odocoileus hemionus hemionus) by influencing forage quantity and quality in summer and rate and extent of energy loss during winter. This may be especially true in prairie habitats of eastern Montana where climatic conditions and deer population numbers both vary widely. The ability to predict changes in deer numbers based on climatic factors would be beneficial from a management standpoint to balance hunter opportunity with landowner tolerance to high population levels.

The New Mexico deer model (Green-Hammond 1986) and the Hobbs model (Hobbs 1989) are potential management tools that include weather as an input for predicting trends in deer population levels. The relationship between vegetation, rumen nitrogen, and fecal nitrogen are important in the New Mexico model. Griffiths (1990) found this model to offer potential application in southeastern Montana, although it needed to be modified to reflect specific deer-habitat relationships. Likewise, the Hobbs model predicts overwinter mortality based on winter weather limiting the availability and digestibility of forage.

Work by Griffiths (1990) was the start of an effort to develop predictive capability of mule deer populations in southeastern Montana. My study was a continuation of this effort, undertaken as an exploratory study to better define fecal nitrogen (FN) patterns and its usefulness as an indicator of nutrition. Specific objectives were to: 1)examine the accuracy of FN as a measure of consumed protein 2)determine the relationship of forage succulence (as a general indicator of forage quality) to FN 3)evaluate seasonal variation in nutrition of deer and relate their movements and use of cover types in response to declining forage quality during the year.

I conducted field work full time during the summer of 1990 and winter of 1990-91. Additional field work was done part time between these periods and after the winter season.

DESCRIPTION OF STUDY AREAS

Two separate study areas approximately 140 km apart in southeastern Montana were used for this study. Topography and habitat types were distinct for each area. Boundaries were identical to those used by Griffiths (1990).

Boxelder Study Area

The 142 km^2 Boxelder study area was located approximately 10 km northeast of Hammond, Montana in Carter county. Bounded areas were the Boxelder Creek road to the northwest, Alzada Ridge to the southeast, the divide between T.L. Creek and Cow Creek to the northeast, and the divide between Steep Creek and Groat Creek to the southwest (Fig. 1). Population trends on this area have been monitored by MDFWP since 1979.

Elevations range from 1,045 m along Boxelder Creek to 1,235 m on Alzada Ridge. Buttes are present throughout the rolling terrain.

The study area is characterized by highly eroded ephemeral streams. In some areas, stream width is only 1 m, with vertical sides reaching a depth greater than 2 m. In other areas, undercutting and slumping have increased stream width to >15 m with terraced sides. Branching and sinuosity have greatly increased stream length throughout

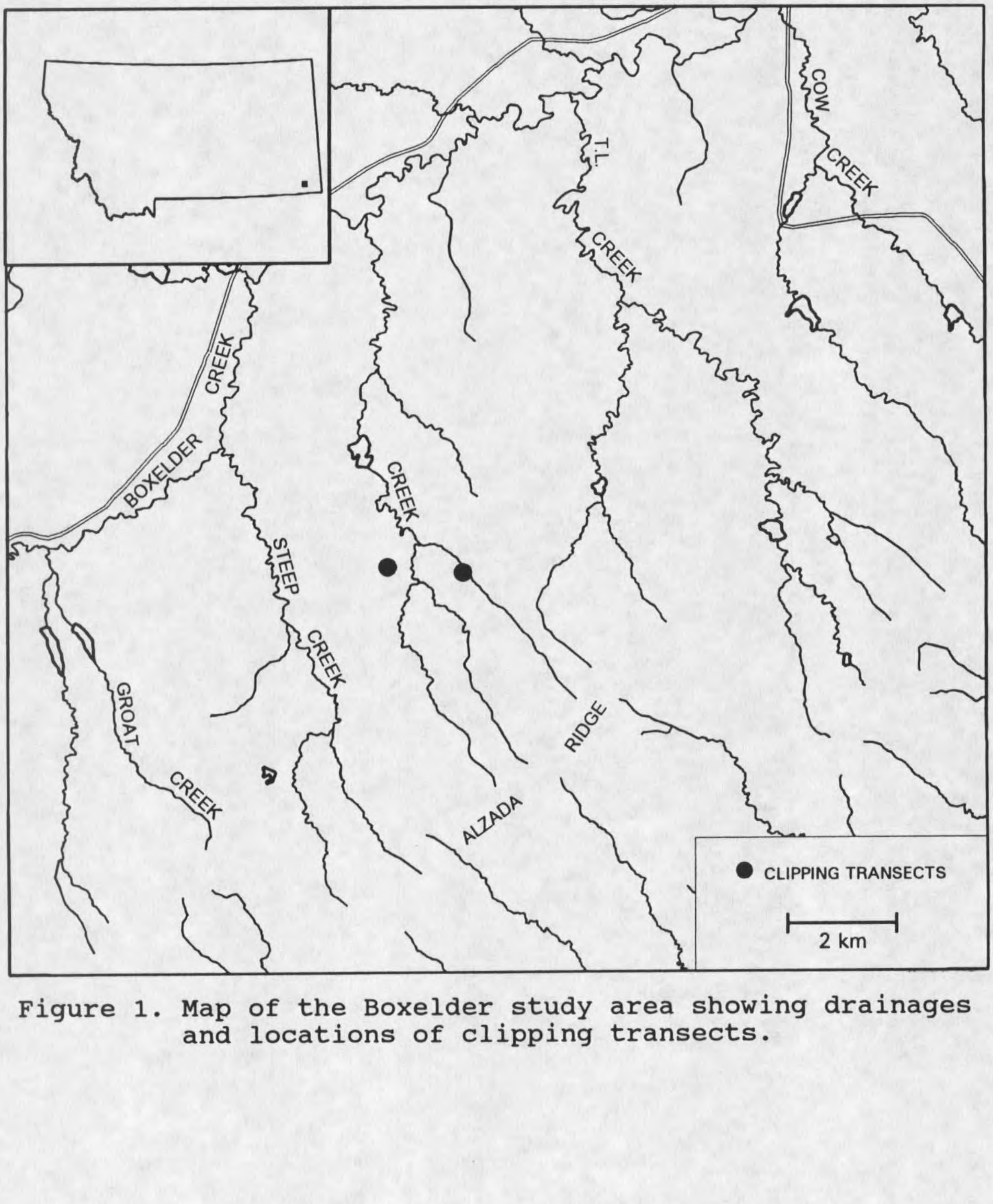

Figure 1. Map of the Boxelder study area showing drainages and locations of clipping transects.

the study area. Water flow generally occurs only in spring or after heavy rainfalls.

During summer, temperatures were often cooler in the bottoms of ephemeral streams. On 1 occasion, I measured a temperature of 27°C in a creek bottom compared to 57°C in the sun on the adjacent bank.

Boxelder Creek flows northeast through the study area into the Little Missouri River. Flows were yearlong from at least 1950 to the early 1980's, but have been only seasonal since the early 1980's (Ralph Brownfield, pers. comm.).

Vegetation on the study area is predominantly a sagebrush-grassland community. Climax grass species include western and thickspike wheatgrass (Agropyron spp.), green needlegrass (Stipa viridula), little bluestem (Andropogon scoparius), bluebunch wheatgrass (Agropyron spicatum), and prairie junegrass (Koeleria macrantha) (Ross and Hunter 1976). Big sagebrush (Artemesia tridentata) is present throughout the study area.

Saltbush (Atriplex gardneri) dominates ridges and the sides of many buttes. The occurrence of greasewood (Sarcobatus vermiculatus) increases in the southeast portion of the study area. Various shrubs and hardwood trees are common along Boxelder Creek but occur only in scattered areas along side creeks. Important species include snowberry (Symphoricarpos spp.), rose (Rosa woodsii), cottonwood (Populus deltoides), and boxelder maple (Acer negundo). Fragrant sumac (Rhus aromatica) [fragrant sumac (Rhus aromatica)=skunkbush (Rhus trilobata)] occasionally occurs in draws on the sides of some buttes. Big sagebrush reaches a height of over 75 cm along creeks, with reduced height farther away. Yellow sweetclover (Melilotus officinalis), a biennial of widely varying occurrence, was common on the study area during the summer of 1990. Plant nomenclature follows Dorn (1984).

Land ownership consists of approximately 51% private land, 43% public land administered by the Bureau of Land Management (BLM), and 5% state-owned land. Cattle and sheep ranching is the major land use. Livestock are wintered along Boxelder Creek. The current grazing management allows grazing over virtually the entire area at some point during the year. Roughly 30 stock ponds are located on the study area.

Pronghorn antelope (Antilocapra americana) and red fox (Vulpes vulpes) were commonly seen, and limited numbers of white-tailed deer (Odocoileus virginianus) were present. Coyote (Canis latrans) populations are rigorously controlled by landowners and I observed only 1 individual during the study.

Deer hunting on private land within the study area is controlled by landowners, with over half receiving some form of pay hunting. Hunting on BLM land is probably minimal due to limited access.

Mean monthly temperature on the Boxelder area is estimated to range from -8.3° C in January to 20.6° C in July. Mean annual precipitation is 356-406 mm with 60% of it occurring between April and July (Fig 2). The frost-free season lasts approximately 110-120 days, although most plant growth is normally completed by mid summer (July). All weather data are extrapolated values from the Montana State University MAPS (Montana Agricultural Potential System) computer program.

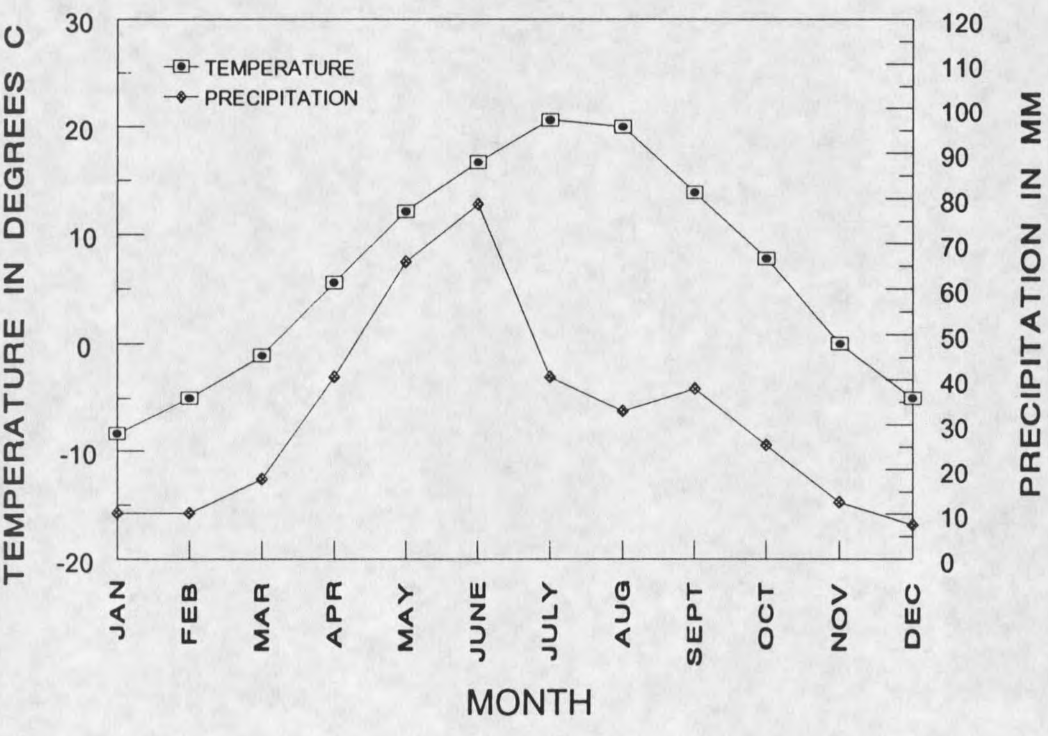

Figure 2. Mean monthly temperature and precipitation on the Boxelder study area (MAPS).

Snowfall during the winter averages 127-245 cm (MAPS). Maximum monthly snowfall during 1952-1989 at 3 nearby weather stations (Broadus, Ridgeway, and Albion, Montana) has never exceeded 76cm. Mean monthly snowfall values are all below 22 cm, with highest readings occurring in March or April (NOAA 1952-89).

Ashland Study Area

The 357 km^2 Ashland study area is located northwest of the Boxelder study area, near Ashland, in Rosebud and Powder River counties, Montana. Boundaries consist of State Highway 212 on the north, Otter Creek road on the east, and Cow Creek road to the south. The western boundary includes portions of the Tongue River, O'Dell Creek, and Stocker Branch road (Fig. 3). Deer populations have been monitored by MDFWP on a portion of this area (Otter Creek trend area) since 1979 (Fig. 3).

Topography varies throughout the study area. A distinct north-south ridge reaching an elevation of 1,265 m runs through the middle of the study area. This becomes a high plateau along the southern boundary, with rolling terrain over the rest of the area. A low point of 890 m is reached along the Tongue River to the west.

Steeply-eroded ephemeral streams similar to those on the Boxelder area are present throughout the rolling