Distribution, habitat use, and food habits of reintroduced elk in Theodore Roosevelt National Park, North Dakota

by Mark Gerald Sullivan

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:
This study was initiated to determine distribution, habitat use, food habits and, potential effects of elk (Cervus elaphus) on flora and fauna in the South Unit (SU) of Theodore Roosevelt National Park (TRNP). Elk were reintroduced into TRNP in March 1985. In 2 years the population grew from 47 to 80 animals with no known mortality. The range of elk increased in the Park from 35 km2 the first year to 75 km2 the second year. As elk increased their range, they utilized a wider variety of habitats. Hardwood draws received heavy diurnal use during the first summer for cover and forage. Diurnal use shifted to Rocky Mountain juniper (Juniperus scopulorum) draws the second summer. Grassland habitats were primarily used during evening from late spring through early fall and throughout the day in winter when elk did not seek out wooded habitats for cover. Feeding peaked in the early morning and evening for all seasons while bedding was the dominant midday activity. Fecal samples were collected for elk, mule deer (Odocoileus heminionus), white-tailed deer (0. virginianus), and feral horses (Equuis caballus) for microscopic determination of diet composition. Elk used browse heavily in summer when it constituted 60% of the seasonal diet. Use of browse decreased in late fall corresponding to an increase in graminoid use. Graminoids were the major food item for elk in the fall, winter, and spring. Forbs were utilized most in summer when they accounted for 22.3% of the diet. Fecal analysis indicated an overlap of food habits between elk, mule deer, and white-tailed deer in summer, between elk and feral horses in fall, and between elk, bison (Bison bison), and feral horses in winter and spring. The greatest potential for competition exists between elk and mule deer due to close similarities in habitat use and the high use of browse in the summer diets for both ungulates.

DISTRIBUTION, HABITAT USE, AND FOOD HABITS OF REINTRODUCED ELK IN THEODORE ROOSEVELT NATIONAL PARK, NORTH DAKOTA

by

Mark Gerald Sullivan

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Fish and Wildlife Management

MONTANA STATE UNIVERSITY
Bozeman, Montana

February 1988

APPROVAL

of a thesis submitted by

Mark Gerald Sullivan

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.

25 February 1988
Date

Lynn P. Isley
Chairperson, Graduate Committee

Approved for the Major Department

February 25, 1988
Date

Peter F. Brussard
Head, Major Department

Approved for the College of Graduate Studies

3-4-88
Date

Graduate Dean

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the library. Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made.

Permission for extensive quotation from or reproduction of this thesis may be granted by my major professor, or in his absence, by the Dean of Libraries when, in the opinion of either, the proposed use of the material is for scholarly purposes. Any copying or use of the material in this thesis for financial gain shall not be allowed without my written permission.

Signature M L G. Sullivan

Date February 25, 1988

ACKNOWLEDGMENTS

I especially thank Dr. Lynn Irby, Montana State University, who supervised and assisted me during all phases of this study and my wife Barbara Ann Sullivan who provided assistance and patience. I thank Drs. Clayton Marlow, Harold Picton, Richard Mackie, and William Gould, Montana State University and Jeff Bradybough, National Park Service, for reviewing the manuscript. Dr. Marlow also provided guidance and assistance in establishing vegetation transects.

A special thanks goes to the personnel at Theodore Roosevelt National Park, especially Jeff Bradybaugh, Bob Powell, Jack Norland, Jim and Karla Zahradka, Jock Whitworth, and many other permanent and seasonal employees who provided assistance and encouragement throughout this study.

Thanks go to Bill Jenson, Ron Fox and Kirby Kruger for assistance with field work and to the North Dakota Game and Fish for providing a fixed-wing aircraft to relocate elk outside the Park. Michelle Girard, USFS, offered ideas on vegetation sampling and helped I. D. several plant specimens. John Toepfer, K. C. Jensen, John A. Mack and Dr. Allen Wood all generously provided assistance in data analysis.

This study was funded by the National Park Service.

TABLE OF CONTENTS

TABLE OF CONTENTS-Continued

LIST OF TABLES

LIST OF TABLES - Continued

LIST OF TABLES - Continued

LIST OF TABLES - Continued

LIST OF FIGURES

ABSTRACT

This study was initiated to determine distribution, habitat use, food habits and potential effects of elk (Cervus elaphus) on flora and fauna in the South Unit (SU) of Theodore Roosevelt National Park (TRNP). Elk were reintroduced into TRNP in March 1985. In 2 years the population grew from 47 to 80 animals with no known mortality. The range of elk increased in the Park from 35 km^2 the first year to 75 km^2 the second year. As elk increased their range, they utilized a wider variety of habitats. Hardwood draws received heavy diurnal use during the first summer for cover and forage. Diurnal use shifted to Rocky Mountain juniper (Juniperus scopulorum) draws the second summer. Grassland habitats were primarily used during evening from late spring through early fall and throughout the day in winter when elk did not seek out wooded habitats for cover. Feeding peaked in the early morning and evening for all seasons while bedding was the dominant midday activity. Fecal samples were collected for elk, mule deer (Odocoileus heminionus), white-tailed deer (O. virginianus), and feral horses (Equuis caballus) for microscopic determination of diet composition. Elk used browse heavily in summer when it constituted 60% of the seasonal diet. Use of browse decreased in late fall corresponding to an increase in graminoid use. Graminoids were the major food item for elk in the fall, winter, and spring. Forbs were utilized most in summer when they accounted for 22.3% of the diet. Fecal analysis indicated an overlap of food habits between elk, mule deer, and white-tailed deer in summer, between elk and feral horses in fall, and between elk, bison (Bison bison), and feral horses in winter and spring. The greatest potential for competition exists between elk and mule deer due to close similarities in habitat use and the high use of browse in the summer diets for both ungulates.

INTRODUCTION

Elk were once one of the most widely distributed members of the deer family in North America (Boyd 1978). Early reports of explorers speak of vast herds of elk roaming the Great Plains. These elk, belonging to the subspecies Cervus elaphus manitobensis, were quickly extirpated when European man settled the Great Plains in the 1800's. In North Dakota, elk were relatively abundant until the 1870's. By 1881 elk were scarce and in 1883 the last official report of elk in North Dakota occurred when 6 elk were killed in Cavalier County (Kruckenberg 1973).

In 1942, 25 Rocky Mountain elk were released in western North Dakota in an unsuccessful attempt to reintroduce elk (Byrant and Maser 1982). No other attempts were made to reestablish elk; however, in 1979 a small herd of elk escaped from a holding pen on an Indian reservation into river breaks near the North Unit (NU) of Theodore Roosevelt National Park. Within several years elk numbers had increased enough to allow a limited hunt aimed at removing 25 - 30 animals a year.

In 1984, personnel at Theodore Roosevelt National Park began to formulate plans for reintroducing elk into the South Unit of the Park. The reintroduction was initiated to restore one of the major herbivores in the badlands

environment. A recent bison study in the South Unit determined that excess forage existed in the Park and elk might improve suboptimal range conditions due to underuse of some habitat types (Marlow et al. 1984). Forty-seven Rocky Mountain elk (C. elaphus nelsoni) captured and transported from Wind Cave National Park, South Dakota, were released in the South Unit in March 1985.

The objectives of this study, conducted from June 1985 to January 1988, were to determine: distribution, home range, population dynamics, activity and behavior patterns, habitat use, food habits, and the potential impacts of elk on Park resources. This study represents the first phase of a 4 year study with the primary objective of determining the carrying capacity of elk in TRNP. The second phase of the study is currently underway and is expected to be completed in August 1989.

STUDY AREA

The study was conducted in the South Unit of TRNP in western North Dakota (Fig. 1). Originally created as Theodore Roosevelt National Memorial Park in 1947, the name was changed to Theodore Roosevelt National Park in 1978. The Park consists of a SU, located in southwest North Dakota near Medora, and a NU, located 80 kilometers (km) north of Medora. The SU covers 18,756 hectares (ha) and is surrounded by Forest Service land intermixed with private holdings.

Geology

Geological features of TRNP have been described in detail by Laird (1950) and Hanson (1980). Both units of the Park are comprised of unglaciated badlands topography bisected by the Little Missouri River. The badlands were formed by the down cutting of the Little Missouri River and its tributaries into the soft sedimentary rock of the Great Plains upland prairie. Relics of the upland prairie still exist as grassland plateaus and buttes in the badlands. Small buttes and hills are often capped with scoria, a clinker formed from clay baked by burning coal veins.

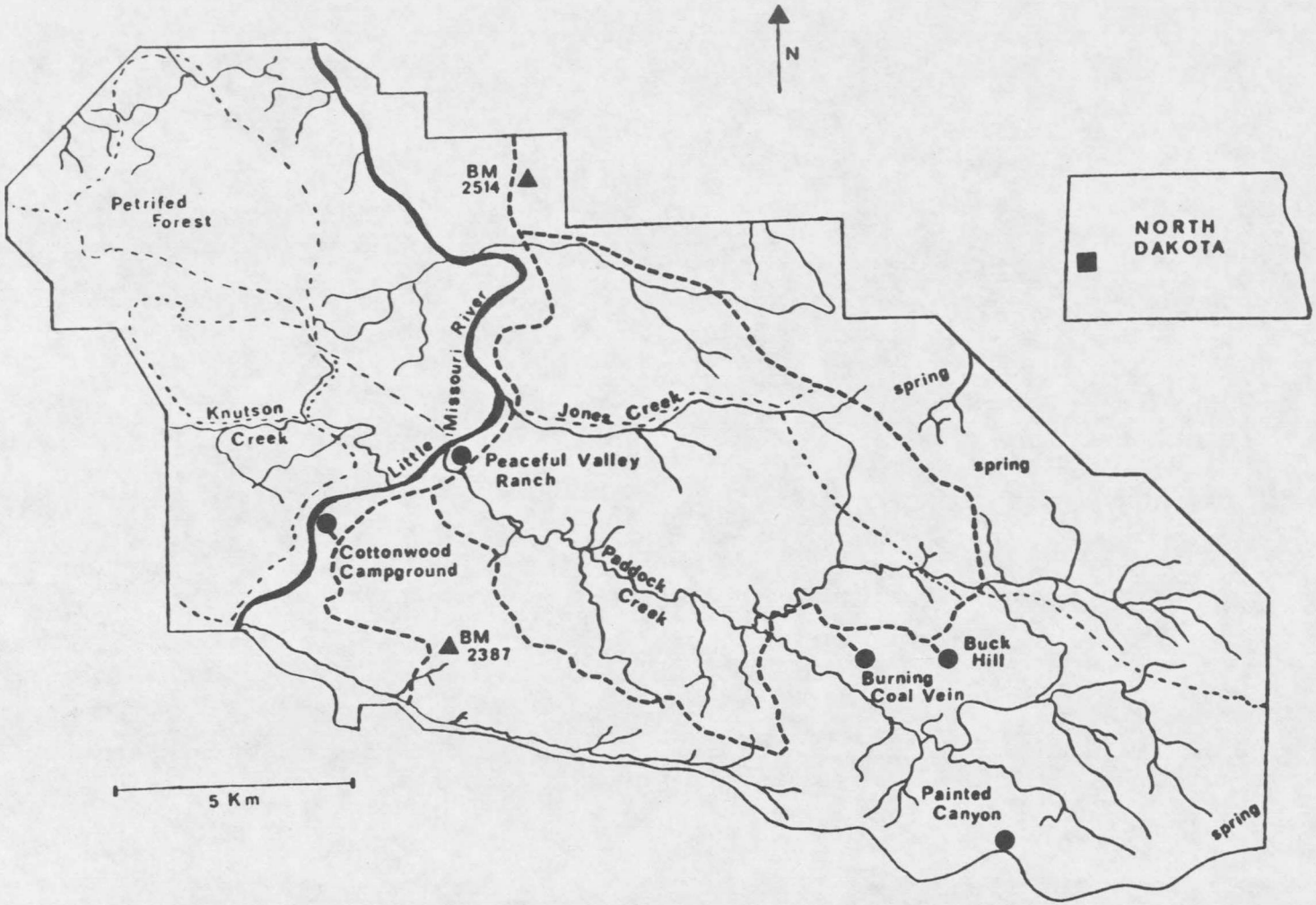

Figure 1. Map of South Unit, Theodore Roosevelt National Park.

Climate

Climate for Western North Dakota is Continental, characterized by short arid summers (mean July Temp.= 22 Celeus (C)) and long cold winters (mean Jan. Temp.= -11 C). Average annual rainfall is about 35.5 centimeters (cm) most of which occurs in spring and summer in the form of thunderstorms (TRNP Resource Management Plan and Environmental Assessment 1984).

Vegetation

Detailed descriptions of vegetation and habitat types in or adjacent to TRNP are given by Nelson (1961), Whitman (1978), Hanson (1980), Girard (1985), and Hirsch (1985). Vegetation in this area is considered to be mixed grass prairie. The combination of mixed grass prairie and the rugged topography of the badlands has resulted in a mosaic of habitat types in TRNP. Norland (1984) used 2 schemes (physiographic/vegetational types and habitat types) to describe vegetation in TRNP.

A system of physiographic/vegetational types was developed based on terrain form and vegetational structural characteristics (Norland 1984). Eleven types are present in the SU: 1) Breaks consist of steep slopes which are often devoid of vegetation; 2) Cottonwood forests are found along the Little Missouri River and are dominated by

plains cottonwood (Populus deltoides); 3) Woody draws are deciduous tree stringers along slopes and are dominated by green ash (Fraxinus pennsylvanica) and chokecherry (Prunus virginiana); 4) Upland grasslands are level to rolling grasslands found on the plains above the river valley; 5) Old river terraces are level grasslands 61 to 152 m above the river situated on terraces; 6) Grassland flats are grassed alluvial deposits found 30 to 61 m above the river valley; 7) Bottom grasslands are grassed alluvial deposits found on higher floodplains of the Little Missouri River and its tributaries 8) Ridge and Ravine types are lands highly dissected by ephemeral water courses and covered by a wide variety of grasses, shrubs, and trees; 9) Scoria hills are rugged varied topography covered by grasses and shrubs; 10) Sagebrush bottoms are floodplains dominated by silver sagebrush (Artemisia cana) with a grass understory; 11) Prairie dog towns are lands influenced by black-tailed prairie dogs (Cynomys ludovicianus) where vegetation is absent or dominated by unpalatable plant species.

Norland (1984) also classified the vegetation types in TRNP by habitat types. The habitat type system followed Whitman (1978), Hanson et al. (1980), Hirsch (1985), and Girard (1985). Disturbed areas or early stages of succession were classified as mapping units.

The 7 grassland habitat types and mapping units in the SU are: Agropyron smithii - Stipa viridula, A. smithii -

S. comata, S. comata - Bouteloua gracilis, Schizachyrium scoparius, Andropogon gerardii, A. smithii - B. gracilis - Distichlis spicata, and Grassed floodplain (dominated by needle-and-thread grass (S. comata) and prairie sandreed (Calamovilfa longifolia)), habitat types. Two mapping units dominated by grasses are also present: Introduced grass (dominated by crested wheatgrass (A. cristatum) or smooth brome (Bromus inermis)) and Prairie dog towns (areas where vegetation has been modified by prairie dogs).

Shrubby habitat types and mapping units include: Artemisia cana, A. tridentata - Atriplex confertifolia, and A. tridentata - B. gracilis habitat types and the Brush (dominated by snowberry (Symphoricarpos occidentalis or chockcherry) and Willow mapping units. Wooded habitat types include: Juniperus scopulorum - Oryzopsis micrantha, Populus deltoides - J. scopulorum, P. tremuloides - Betula occidentalis and Hardwood draws (dominated by green ash and chokecherry).

Areas having very small intermixed habitat types or mapping units were classified as complexes (Norland 1984). The rolling scoria complex was comprised of Schizachyrium scoparium, Agropryon smithii - Stipa viridula, S. comata - Bouteloua gracilis, A. smithii - S. comata, S. scoparium - Juniperus horizontalis, and the A. smithii - B. gracilis - Distichlis stricta habitat types. The steep scoria complex was comprised of S. scoparium, S. comata - Bouteloua

gracilis, A. smithii - S. viridula, S. scoparium - Juniperus horizontalis, and the A. smithii - B. gracilis - Distichlis stricta habitat types. The proportion of each habitat type within theses two complexes is given in Norland (1984).

Large Herbivores

Bison were reintroduced into the SU in 1956. The Park Service currently manages the population at a level of approximately 200 animals. Feral horses in the SU are descendents of escaped local horses and 5 stallions donated by the BLM (TRNP Resource Management Plan and Environmental Assesment 1984). Horses are managed at a level of approximately 40 animals and are primarily restricted to the eastern portion of the SU. Mule deer are common throughout TRNP and the estimated population in the SU is 600 - 700 animals (TRNP Resource Management Plan and Environmental Assesment 1984). White-tailed deer are found primarily in the bottom lands of the Little Missouri River and the estimated population in the SU is 150 - 225 animals (TRNP Resource Management Plan and Environmental Assesment 1984).

California bighorn sheep (Ovis canadensis california), introduced into the SU in the 1950's, suffered a population crash in the mid 1970's (TRNP Resource Management Plan and Environmental Assesment 1984). Only 5

- 6 animals were present at the time of this study. These sheep were kept in an enclosed area within the southwest corner of TRNP as Park personnel attempted to rebuild the population. A small population of pronghorn antelope (Antilocapra americana) are found in the northeastern region of the SU. Seventy five antelope were released into the SU in 1956 and the herd size has fluctuated around this number as seasonally migratory herds move in and out of the Park (TRNP Resource Management Plan and Environmental Assesment 1984).

Land Use

Domestic livestock grazing and mineral development (oil and gas) are principle land uses in the badlands surrounding TRNP. This country was originally homesteaded in the late 1800's, but the federal government reacquired much of the land following the 'dust bowl' years of the 1930's (J. Bradybaugh pers. comm. 1987). TRNP is situated mostly on reacquired land set aside for a state park and recreation demonstration area before the establishment of a national park in 1947 (J. Bradybaugh pers. comm. 1987).

METHODS

Distribution and Movements

Four elk, 2 males and 2 females, were equipped with radio-collars prior to the release of elk into TRNP in March 1985. Two of these elk were recaptured and fitted with new radio-collars in March 1986, using a net gun fired from a helicopter (Barrett et al. 1982). A yearling bull was also radio-collared at this time. All radio-collars were color coded for individual recognition.

Each radio-collared animal was relocated from the ground during summer and fall 1985 and spring and summer 1986 using a 2-element pack antenna or a 3-element Yagi antenna. The locations and daily movements of all elk observed were plotted on 1:24,000 topographic maps. In June 1985, a fixed winged aircraft equipped with a 3-element Yagi antenna was used to locate 2 elk which had moved out of the Park. Attempts were made to relocate these elk during subsequent flights in summer and fall 1985 by a researcher working on a mule deer study south of the Park using the same aircraft and equipment. (B. Jensen pers. comm.).

Nocturnal movement patterns of elk were investigated during 5 12-hr night radio relocation periods in summer

1985, 3 in fall 1985, and 5 24-hr radio relocation periods in summer 1986. Two to 3 5-m towers, each equipped with 2 3-element Yagi antennas, were used during these periods. Radio-collared elk were located at 1/2-hr intervals by an observer at each tower. Radio relocation bearings from each tower were plotted on a 1:24,000 topographic map and the location for each radio-collared elk was determined by triangulation. Correction factors were determined from visual sightings of radio-collared elk during relocation periods.

A survey of pellet groups on trails was conducted in August 1986 to aid in determining yearlong distribution of elk in TRNP. The Park was divided into 9 sections and all pellet groups were noted on 8 to 14 km of trails walked in each section.

Seasonal and annual home range sizes were determined using the Telday computer program (Montana Department of Fish, Wildlife and Parks 1985). Telday determines home range size by forming a minimum convex polygon (Mohr 1947) using animal relocations on the perimeter of all relocations. Total home range sizes were calculated by using all the relocations for each radio collared animal during this study.

Population Dynamics

Complete or near complete ground counts of elk in the Park were obtained in September 1985, March and August 1986, and January 1987. At these times the elk had either coalesced into one large group or into separate bull and cow/calf groups. Age and sex composition was noted during these observations.

Habitat Use

Habitat use was determined by observation of elk during 1 to 6-hr diurnal observation periods. Elk were observed with 7x35 mm binoculars or a 15-60X spotting scope at distances of 200-4000 m.

The following information was collected at 5-minute intervals during the observation period: 1) the location of elk (plotted on 1:24000 topographic maps); 2) the number of cows, bulls, and calves observed; and 3) the activity and habitat use of animals in each sex and age class. Activity was classified as feeding, bedding, moving, standing, other, or unknown. Other included grooming, nursing, mating activity, and other social behavior.

In many instances the habitat type being utilized by elk was identified in the field during the observation period. If this was not possible, the habitat type was determined by overlaying a habitat type map (Norland 1984)

over a topographic map of the Park on which the location had been marked.

Although observations were made throughout the day, the tendency of elk to occupy dense cover during midday hours resulted in low numbers of observed elk in wooded habitat types during midday hours. To minimize this bias against woodland habitat use, wooded draws were observed during periods when elk were not visible but had been observed moving into the draw. If elk could not leave the draw without being observed, elk activity within the draw was classified as unknown and notes were included in habitat use analysis.

Projected 24-hr habitat use was estimated from data obtained during night radio-relocation of elk and from daytime observations taken during the first hour of light in the morning and the last hour of light in the evening. Habitat use during the first and last hour of light was assumed to be similar to the 4 hrs prior to dawn and the first 4 hrs after dusk, respectively.

Spearman's Rank Correlation test (Snedecor and Cochran 1980) was used to test differences in availability and habitat use. Differences in availability and habitat use of individual habitat types and physiographic classes were tested using Bonferroni's inequality test (Byers and Steinhorst 1984).

Food Habits

Fecal samples were collected from elk, mule deer, white-tailed deer, and feral horses. Samples consisted of 1-gram (g) subsamples from 10 different fecal piles. Two samples were collected each season (fall 1985, winter 1985-1986, spring 1986, and summer 1986) from a variety of habitat types used by each species. Samples were frozen, oven-dried, and shipped to the Wildlife Habitat Lab at Washington State University for microscopic determination of diet composition. Reference samples from 104 plant species collected at TRNP were also shipped to aid in identifying plant fragments in the fecal samples.

Elk Impacts On Vegetation and Other Herbivores

Vegetation

Twelve permanent vegetation transects were placed in hardwood and in Rocky Mountain juniper (*Juniperus scopulorum*) draws in summer 1985. Half of the transects were placed in or near regions heavily utilized by elk. The rest of the transects were placed in regions of the Park which the elk were not expected to reach by summer 1986. These transects were measured in summer 1985 and 1986 to determine changes attributable to elk.

Transects placed in hardwood and juniper draws were 20 m long and marked with metal stakes. Canopy coverages of

all grasses, forbs, and shrubs less than 50 cm in height were estimated at 1-m intervals along each transect using 2x5 decimeter (dm) plots (Daubenmire 1959). Canopy coverage was estimated only for plants growing within the plot. Because canopy coverage was estimated for plant strata up to 1-m in height, total canopy coverage may exceed 100% within a plot. Canopy coverage classes were: class 0 = 0%; class 1 = >0-1%; class 2 = >1-5%; class 3 = >5-25%; class 4 = >25-50%; class 5 = >50-75%; class 6 = >75-95%; and class 7 = >95-100%.

Canopy coverage for hardwood draws within and outside elk use areas (Appendix B) was calculated by averaging the mean canopy coverage for individual transects located within or outside the range of elk in the Park, respectively.

Shrub (woody vegetation <2 m in height) density was measured in 7 1-m^2 plots spaced 3 m apart along the transect. The number of individual shrubs by species in 3 height classes were counted within each 1-m^2 plot. Height classes were: 1 = 0-50 cm; 2 = >50-100 cm; and 3 = >100-200 cm.

Utilization of annual growth in individual shrubs was classified as: light = <10% browsed; moderate = 10-50% browsed; and heavy = >50% browsed. The percent utilization of each plot was calculated by averaging the midpoints of the utilization classes for individual shrubs of each plant

species. Summing the percent utilization of each species for all plots within a transect and dividing by 7, the number of plots within a transect, gave percent utilization for individual species within a transect. Total utilization for each species within and outside elk use areas (Appendix B) was calculated by averaging the mean utilization values for individual transects within and outside the range of elk in TRNP.

Sapling and tree densities were measured in a 60-m^2 plot parallel to the transect base line. Saplings were classified as woody species >2 m in height, but having a diameter at breast height (dbh) <10 cm. Woody species >2 m having a dbh >10 cm were classified as trees. The total numbers of individual sapling or trees by species within the 60-m^2 plot were recorded. I also noted whether the sapling or tree had vegetation available for elk or deer use (leaves and stems less than 2-m from the ground) and if this material had been utilized. I did not classify the percent of utilization. Means for transects in areas used by elk and areas not used by elk were calculated in the same manner as that described for shrubs.

Scientific plant names used are from the USDA 1982 National List of Scientific Plant Names. The Chi-square test for independence was used to test differences in utilization of saplings and shrubs between transects and years.

Other Herbivores

Locations of mule deer, bison, feral horses, and white-tailed deer sighted while observing or searching for elk were plotted on 1:24,000 topographic maps. Additional locations were made by driving through the Park in the evenings 2-4 times per month and recording all sightings of animals. Age and sex of these animals were noted when possible. In many cases the physiographic class in which the animals were sighted was noted at the time of the sighting. If this was not possible, the physiographic class was later determined using an overlay of physiographic classes on the Park map.

Spearman's rank correlation test was used to compare similarities in habitat use and diet between large herbivores in TRNP.