Relations of moose, cattle, and willows in southwestern Montana
by Robert Donald Dorn

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Fish and Wildlife Management
Montana State University

Abstract:
The Shiras moose {Aloes aloes shirasi) was studied on Red Rock Lakes National Wildlife Refuge in southwest Montana from June 10, 1968 to March 17, 1969 to determine use of vegetation types, food habits, sex and age ratios, and the extent of moose-cattle competition. A means for checking the adequacy of a sample obtained by the feeding site method of food habits analysis was presented. Vegetation of the study area was analyzed quantitatively. The average height of a willow (Salix) species was related to its most common habitat. Observations of moose in the willow type accounted for 84 percent of the total in summer and 93 percent in winter. Food habits primarily determined the use of vegetation types. Browse accounted for 98.3 percent of all forage used by moose in summer with Salix myvtillifolia, Betula glandulosa, Salix geyeriana3 and Salix planifolia accounting for 58.1, 11.8, 9.6, and 6,7 percent, respectively. In winter browse accounted for 99.8 percent of the forage used by moose with S. myvtillifolia, S. planifolia, S. bebbiana, and S. geyeriana accounting for 25.0, 24.2, 15.4, and 10.5 percent, respectively. The factors determining the amount of various plant species in the diet of moose were availability, adaptation, palatability, and habit. It appeared that all species of willow present in this study were potentially important as forage for moose at some time during the year, especially in winter. Salix Wolfii, S, myrtillifolia, S. geyeriana, and S. bebbiana accounted for 50.2, 15.9, 11.2, and 10.9 percent, respectively, of all browse used by cattle in the willow and sedge types in summer. Forage competition between moose and cattle was not significant under conditions prevailing during this study. Competition would be expected under certain conditions. Forage competition between moose and beaver (Castor canadensis) was greater than competition between moose and cattle but was not significant. Observation data show that in summer bulls were more readily identified from the ground than cows and that many calves were not observed from the ground. The data also show that observed sex and age ratios were influenced by home range and migration patterns and differential use of vegetation types between sexes. September ratios obtained from aerial observations were probably most reliable for the composition of the breeding population. Only a small proportion of adult bulls wintered on the study area. Resident, summer, winter, and transient population segments appeared to be using the area. The importance to management of movements and twinning rates was discussed. The range appeared to be in satisfactory condition during the study except for one local area. Management recommendations were given.

RELATIONS OF MOOSE, CATTLE, AND WILLOWS IN SOUTHWESTERN MONTANA

by

ROBERT DONALD DORN

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Fish and Wildlife Management

Approved:

Head, Major Department

Chairman, Examining Committee

Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

June, 1969

ACKNOWLEDGMENT

Appreciation is extended to the following for their assistance or cooperation during the study: Dr. D. C. Quimby, Montana State University, for setting up the study and for guidance and suggestions in preparing the manuscript; Dr. R. J. Graham and Dr. R. L. Eng, Montana State University, for reading the manuscript and offering suggestions for its improvement; Dr. W. E. Booth, Montana State University, for many hours at verification of plant specimens; Dr. G. W. Argus, University of Saskatchewan, Saskatoon, for verification of willow specimens; Mr. Thomas Mussehl and Mr. Philip Schladweiler, Montana Fish and Game Department, for assistance in various phases of the study; Mr. Kenneth Greer and staff, Montana Fish and Game Department, for gross separation of rumen samples; other personnel of Montana Fish and Game Department for assistance and cooperation; U. S. Fish and Wildlife Service personnel and residents of Lakeview, Monida, and the Centennial Valley for assistance, cooperation, and hospitality; and Mr. George Kamps, Montana State University, for making available feeding site data for mule deer and white-tailed deer. The study was financed by the Montana Fish and Game Department under Federal Aid Projects W-98-R-9 and W-73-R-14.

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

LIST OF TABLES
(continued)

LIST OF FIGURES

ABSTRACT

The Shiras moose (*Alces alces shirasi*) was studied on Red Rock Lakes National Wildlife Refuge in southwest Montana from June 10, 1968 to March 17, 1969 to determine use of vegetation types, food habits, sex and age ratios, and the extent of moose-cattle competition. A means for checking the adequacy of a sample obtained by the feeding site method of food habits analysis was presented. Vegetation of the study area was analyzed quantitatively. The average height of a willow (*Salix*) species was related to its most common habitat. Observations of moose in the willow type accounted for 84 percent of the total in summer and 93 percent in winter. Food habits primarily determined the use of vegetation types. Browse accounted for 98.3 percent of all forage used by moose in summer with *Salix myrtillifolia*, *Betula glandulosa*, *Salix geyeriana*, and *Salix planifolia* accounting for 58.1, 11.8, 9.6, and 6.7 percent, respectively. In winter browse accounted for 99.8 percent of the forage used by moose with *S. myrtillifolia*, *S. planifolia*, *S. bebbiana*, and *S. geyeriana* accounting for 25.0, 24.2, 15.4, and 10.5 percent, respectively. The factors determining the amount of various plant species in the diet of moose were availability, adaptation, palatability, and habit. It appeared that all species of willow present in this study were potentially important as forage for moose at some time during the year, especially in winter. *Salix wolfii*, *S. myrtillifolia*, *S. geyeriana*, and *S. bebbiana* accounted for 50.2, 15.9, 11.2, and 10.9 percent, respectively, of all browse used by cattle in the willow and sedge types in summer. Forage competition between moose and cattle was not significant under conditions prevailing during this study. Competition would be expected under certain conditions. Forage competition between moose and beaver (*Castor canadensis*) was greater than competition between moose and cattle but was not significant. Observation data show that in summer bulls were more readily identified from the ground than cows and that many calves were not observed from the ground. The data also show that observed sex and age ratios were influenced by home range and migration patterns and differential use of vegetation types between sexes. September ratios obtained from aerial observations were probably most reliable for the composition of the breeding population. Only a small proportion of adult bulls wintered on the study area. Resident, summer, winter, and transient population segments appeared to be using the area. The importance to management of movements and twinning rates was discussed. The range appeared to be in satisfactory condition during the study except for one local area. Management recommendations were given.

INTRODUCTION

This investigation was another segment of the ecological studies of the Shiras moose in southwestern Montana. Field work was conducted full-time in summer and winter and part-time in fall from June 10, 1968 to March 17, 1969. The main objectives were to determine use of vegetation types, food habits, sex and age ratios, and the extent of moose-cattle competition in a predominantly willow-sedge area. Previous studies in southwestern Montana were by Knowlton (1960), Peek (1962), Stevens (1965), and Stevens (1967). McMillan (1953), in Yellowstone National Park, and Denniston (1956), Harry (1957), and Houston (1968), in Jackson Hole, Wyoming, also studied the Shiras moose.

AREA DESCRIPTION

The study area, about 22 square miles, was mainly on the Red Rock Lakes National Wildlife Refuge in the Centennial Valley, Beaverhead County, Montana (Figure 1). The Red Rock Lakes lie in a down-dropped basin at 6,600 feet elevation (Banko 1960:40-41). The Centennial Mountains rise abruptly to nearly 10,000 feet immediately to the south and the foothills of the Gravelly Range lie to the north. Alden (1953) discussed area geology and Nielson and Farnsworth (1965) classified area soils.

The area has long, cold winters and short, cool summers. Climatological data for Lakeview, on the study area, are presented in Table I. Snow cover is variable from extensive drifting.

TABLE I. CLIMATOLOGICAL DATA FOR LAKEVIEW, MONTANA (U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU 1965, FARNES 1969).

Average annual precipitation	19.96 inches
Average annual snowfall	142.1 inches
Mean temperature	
Annual	34.6°F
January	10.3°F
July	58.9°F
Temperature extremes	
Maximum	91° F
Minimum	-44° F
Snow cover[1/]	
January 2, 1969	26 inches
January 31, 1969	71 inches
March 3, 1969	78 inches

1/ Data from Farnes (1969) for snow survey course in Douglas-fir--spruce-fir ecotone at 6,930 feet elevation.

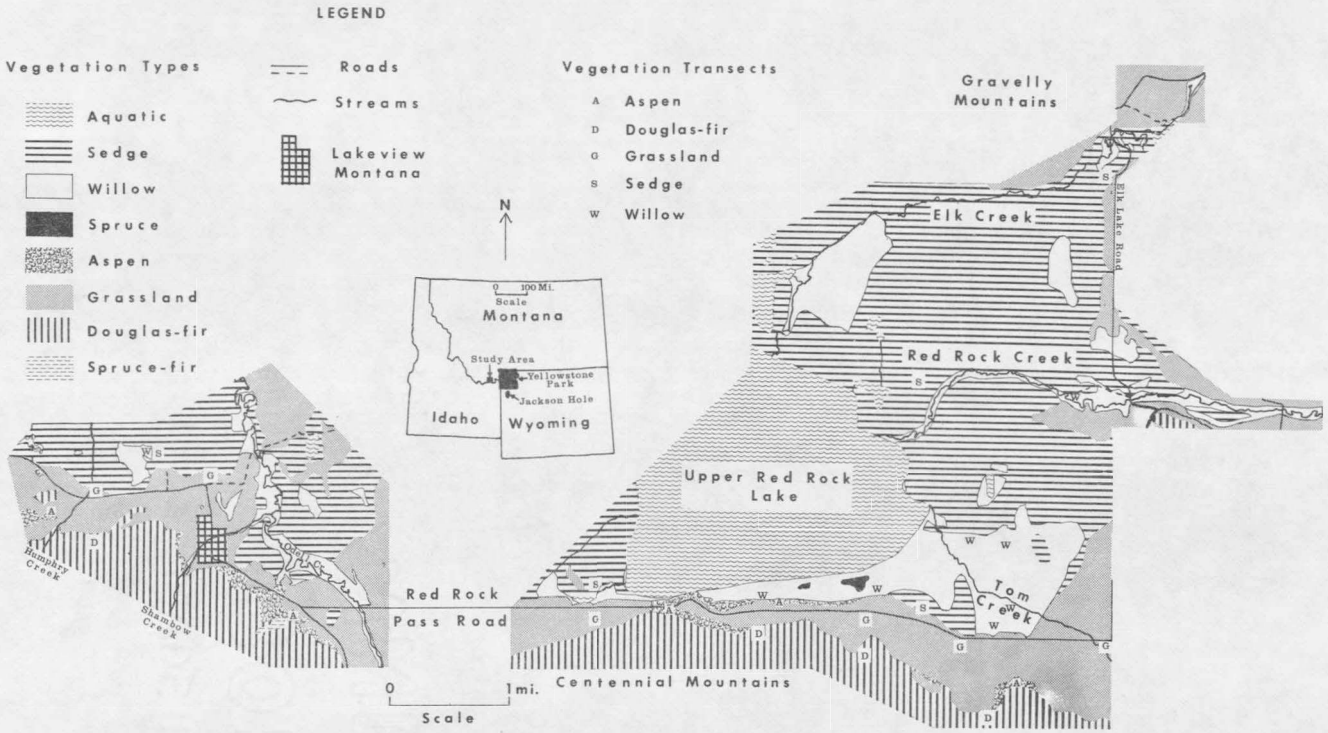

Figure 1. Location of the study area, vegetation types, and vegetation transects.

Red Rock Lakes Refuge, now about 40,000 acres, was established in 1935 to preserve the trumpeter swan (*Olor buccinator*). The primary land uses in non-swan habitat are cattle grazing and haying. Recreational use is heavy in some areas.

Moose were observed in the Centennial Valley shortly after 1900 but were not numerous until after 1940. A conspicuous increase occurred about 1950 (Banko 1951:1). Houston (1968:16-17) described this same pattern for Jackson Hole, Wyoming. Houston (1968:13, 35) also reported a progressive increase in mean annual snowfall in Jackson Hole from 122 inches in the 1912-1930 period to 179 inches in the 1951-1966 period. Data for Lakeview (U. S. Department of Commerce, Weather Bureau 1955:40, 1965:42) show a similar increase from 132 inches in the 1943-1952 period to 159 inches in the 1951-1960 period. This may have resulted in conditions which increased favorable habitat for moose at the same time that the grizzly bear (*Ursus horribilis*) and timber wolf (*Canis lupus*), the primary predators of moose (Houston 1968:79, Mech 1966:114), were being reduced. Changes in land use may also have influenced the increase.

Over-utilization of browse resulted from the population increase on the refuge around 1950 (Banko 1951:2). A die-off of willows occurred shortly after from unknown causes. The refuge was opened to moose hunting by permit in 1952 when the moose population at peak use was about 60 animals. A total of 128 moose was killed over eight successive seasons. A closure of 5 years followed. Five permits were issued annually from 1965 to 1968 and 19 moose were killed (Refuge records). The population at peak use in 1968-69 was about 55 animals.

METHODS

Vegetation

The canopy-coverage method (Daubenmire 1959), line-intercept method (Gates 1949:36-38), point-centered quarter method (Cottam and Curtis 1956), and habitat inventory technique (Webster 1965) were used to sample vegetation types. Sampling dates, sample size, and methods for each vegetation type are presented in Table II. Sample transects were mostly selected in areas frequented by moose and near section lines or landmarks (Figure 1). Transects were 300 feet long with 33 feet 4 inches between plots or points. Upper Red Rock Lake, randomly sampled by the refuge biologist, represented the aquatic type. Vegetation types were mapped from ground observations and aerial photos.

Willow heights were measured with an 11-foot pole marked in feet. Heights over 20 feet were estimated. The closest plant sampling technique (Cole 1963:7) was used for common species. Less common species were merely sought out. Heights were first measured within about 50 yards of the transects in the willow type. Insufficient samples were then completed in areas at least one-quarter mile from any transect. The degree of difficulty in locating plants of a species to measure was proportional to the relative abundance of that species. Frequency indices for each species could then be determined. If at least ten plants of a species were found within about 50 yards of each of the ten transects in the willow type, the frequency index was 100. The obtainable sample was also considered for rare species. Only ten plants of one species were found, but all were near a transect for a frequency

TABLE II. SAMPLING DATES, SAMPLE SIZE, AND METHODS USED FOR VEGETATION TYPE ANALYSES.

Vegetation Type	Sampling Dates	No. of Transects	No. of Plots or Points	METHOD[1/]		
				Tree Group	Shrub Group	Herb Group
Aquatic	8/24		50			Habitat inventory
Sedge	8/27-28	5	50		Line-intercept	Canopy-coverage
Willow	7/3-7	10	100	Line-intercept	Line-intercept	Canopy-coverage
Spruce	7/23-25	3	30	Line-intercept Point-quarter	Line-intercept	Canopy-coverage
Grassland	6/25-7/2	6	60		Canopy-coverage	Canopy-coverage
Aspen	7/15-18	5	50	Line-intercept Point-quarter	Line-intercept	Canopy-coverage
Douglas-fir	7/19-20	4	40	Line-intercept Point-quarter	Line-intercept	Canopy-coverage
Spruce-fir	7/19	1	10	Line-intercept Point-quarter	Line-intercept	Canopy-coverage

1/ See text, page 5, for citation.

index of 10. For another species 35 plants were found, but only 5 were near a transect for a frequency index of 5. The larger number of plants found of the latter species indicated a higher abundance than for the former despite the frequency index figures.

Representatives of most plant species were collected and are filed in my personal collection, in the herbarium at Montana State University, and/or at Red Rock Lakes Refuge. Plant nomenclature follows Porter (1967) for the genus *Salix* and Booth (1950) and Booth and Wright (1966), with some unpublished corrections, for other plants unless otherwise noted.

Ninety-one willows identified in summer were tagged to facilitate identification of willows in winter. General distribution of willow species was determined from field observations.

Vegetation Type Use

Observations of moose in summer, June 10 to September 30, were mostly from roads and were aided by a 7 x 50 binocular and a 25X spotting scope. A regular route was traversed nearly every day shortly after sunrise. Observed moose were recorded by vegetation type and location. Few evening observations were made. Observations in winter, December 20 to March 17, were incidental to the study of food habits except for an intensive survey twice each month by snowmobile. Nearly all animals present were probably observed during these surveys except in December and January. A feeding site examined while snow tracking without observing the animal was considered an observation.

Food Habits

Food habits of moose and cattle in summer and of moose in winter were determined from feeding site observations (Knowlton 1960:162-163). An instance of use on browse was utilization of one leaf or one leader in summer and one leader in winter and on forbs, grass, and grass-like plants was utilization of one leaf or one stem. An instance of use on bark was utilization of a volume estimated to be equivalent to an average leader. Food habits data of cattle included only browse use in the willow and sedge types. Food habits of moose in fall were determined from rumen samples from hunter-killed moose. Rumen analysis was as described by Knowlton (1960:163) except measurements were to the nearest 0.5 cc. In winter each vegetation type was surveyed for feeding sites in approximate proportion to its occurrence on the study area. Winter data from the spruce-fir and Douglas-fir types were partly from areas immediately adjacent to the study area. Data from feeding sites and rumen samples were compiled by the aggregate volume method (Martin, *et al.* 1946).

The adequacy of a sample obtained by the feeding site method can be determined with a plotted curve similar to the species:area curve used by plant ecologists (Oosting 1956:44-47). The accumulated total of instances of use on all plant species is plotted on the x axis. The percent of the accumulated total of instances of use that is accounted for by an important species is plotted on the y axis (Figure 2). The three plant species with the most use should each be used for plotting