



An ecological study of creeping juniper (*Juniperus horizontalis* Moench.) in Montana
by John Gage Miller

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

Various ecological characteristics and relationships for creeping juniper (*Juniperus horizontalis* Moench.) in Montana were determined through intensive studies in 30 widely separated juniper stands. Supplementary data were obtained from an additional 21 study sites. Creeping juniper was associated primarily with the mountain foothills of north-central, central and southcentral Montana, and the open prairies of eastern Montana. Ridges, rimrocks, escarpments and hilltops adjacent to a river or mountain range were typical areas of occurrence. Stands occurred more frequently on northerly exposures, slopes with gradients less than 40 percent, and at elevations below 1500 meters (4900 ft). Creeping juniper was the most important plant species in all stands, with mean canopy coverage of 32 percent. Graminoids were the most prominent plant associates, with Idaho fescue being the most common species. Trees typically were lacking. Eight creeping juniper "associations" were defined through simple ordination. Soils associated with creeping juniper stands appeared to be poorly developed with thin topsoils, large quantities of stone and exposed rock parent material, and some degree of surface erosion. They tended to be clay loam in texture, slightly basic (pH = 7.2), low to medium in organic matter content (4.6%), very low in phosphorus (18 ppm), medium to high in potassium (280 ppm) and low in salt hazard (.08 meq/100 gms soil). Creeping juniper plants averaged 6.4 cm in height, with 3.5 percent of the crown area dead. Most growth occurred horizontally on the peripheral branches or leaders. Annual twig growth commenced in early April, coincident with a crown color change from brown to green, and continued into September and possibly early October. The overall average terminal and lateral twig growth was 34.5 and 9.0 cm, respectively, during 1978. Longest twigs were produced in stands with northerly exposures and 13-14 inches of annual precipitation. Shortest twigs were produced in stands having a tree overstory. The "greening" of plants in early April coincided with staminate cone maturation. Once pistillate buds formed, berries generally formed and matured. Berry production peaked in mid summer (late June to early July). Ripening apparently requires 1-2 years after berries turn purple in late summer. Germination of seeds in the laboratory was very low (approximately 0.1%). Reproduction from seed also appeared to be a rare occurrence in the field where plants apparently are maintained vegetatively by rooting along branches. Plants producing the highest numbers of reproductive parts were associated with soils having relatively high phosphorus, moderate calcium and sodium levels and low salt hazard. Wildlife usage of creeping juniper included mule deer, small mammals and birds. Utilization by deer occurred mainly during the late winter and appeared to be influenced more by the distribution of deer, the relative availability and/or abundance of creeping juniper and the occurrence of other more preferred forage plants than by protein content. Data indicated that creeping juniper is subject to some damage and destruction by fire, though these effects may be less severe than reported for other species of juniper.

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JOHN GAGE MILLER

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of

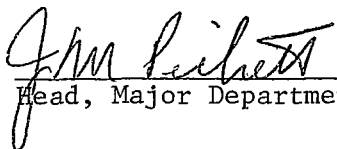
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ABSTRACT

Various ecological characteristics and relationships for creeping juniper (*Juniperus horizontalis* Moench.) in Montana were determined through intensive studies in 30 widely separated juniper stands. Supplementary data were obtained from an additional 21 study sites. Creeping juniper was associated primarily with the mountain foothills of north-central, central and southcentral Montana, and the open prairies of eastern Montana. Ridges, rimrocks, escarpments and hilltops adjacent to a river or mountain range were typical areas of occurrence. Stands occurred more frequently on northerly exposures, slopes with gradients less than 40 percent, and at elevations below 1500 meters (4900 ft). Creeping juniper was the most important plant species in all stands, with mean canopy coverage of 32 percent. Graminoids were the most prominent plant associates, with Idaho fescue being the most common species. Trees typically were lacking. Eight creeping juniper "associations" were defined through simple ordination. Soils associated with creeping juniper stands appeared to be poorly developed with thin topsoils, large quantities of stone and exposed rock parent material, and some degree of surface erosion. They tended to be clay loam in texture, slightly basic (pH=7.2), low to medium in organic matter content (4.6%), very low in phosphorus (18 ppm), medium to high in potassium (280 ppm) and low in salt hazard (.08 meq/100 gms soil). Creeping juniper plants averaged 6.4 cm in height, with 3.5 percent of the crown area dead. Most growth occurred horizontally on the peripheral branches or leaders. Annual twig growth commenced in early April, coincident with a crown color change from brown to green, and continued into September and possibly early October. The overall average terminal and lateral twig growth was 34.5 and 9.0 cm, respectively, during 1978. Longest twigs were produced in stands with northerly exposures and 13-14 inches of annual precipitation. Shortest twigs were produced in stands having a tree overstory. The "greening" of plants in early April coincided with staminate cone maturation. Once pistillate buds formed, berries generally formed and matured. Berry production peaked in mid summer (late June to early July). Ripening apparently requires 1-2 years after berries turn purple in late summer. Germination of seeds in the laboratory was very low (approximately 0.1%). Reproduction from seed also appeared to be a rare occurrence in the field where plants apparently are maintained vegetatively by rooting along branches. Plants producing the highest numbers of reproductive parts were associated with soils having relatively high phosphorus, moderate calcium and sodium levels and low salt hazard. Wildlife usage of creeping juniper included mule deer, small mammals and birds. Utilization by deer occurred mainly during the late winter and appeared to be influenced more by the distribution of deer, the relative availability and/or abundance of creeping juniper and the occurrence of other more preferred forage plants than by protein content. Data indicated that creeping juniper is subject to some damage and destruction by fire, though these effects may be less severe than reported for other species of juniper.

INTRODUCTION

Creeping juniper, *Juniperus horizontalis* Moench., occurs extensively on mountain foothill and prairie-plains habitat in Montana east of the Continental Divide. In many areas, it serves as an important source of forage for mule deer, especially during winter (Lovaas 1957, Kamps 1969, Eustace 1971, Dusek 1971, Hamlin 1976). Coverage measurements for creeping juniper on 12 condition-trend transects, established by the Montana Department of Fish and Game on foothill winter ranges along the eastern fringe of the Rocky Mountains, show a general decline in the occurrence of mature juniper during the past 20 years (Fig. 1).

Little is known as yet about the ecology of creeping juniper. Previous studies have been concerned mainly with diseases (Brener et al. 1974, Nemec 1968), chromosomal biology (Evans 1971, Evans and Rasmussen 1972, 1974), ornamental value (Lamphear 1966), chemistry (Couchman 1965), morphology (Bifoss 1947), associated insects (Bradley 1963, Nemec 1972), and hybridization (Fassett 1944a, 1944b, 1945a, 1945b, 1945c, Ross 1949). The lack of ecological information has hampered interpretation of possible interrelationships between the occurrence of creeping juniper and mule deer.

This study was established in the spring of 1975 to obtain basic ecological data for creeping juniper in Montana. Specific objectives include: (1) to determine the natural distribution and associated

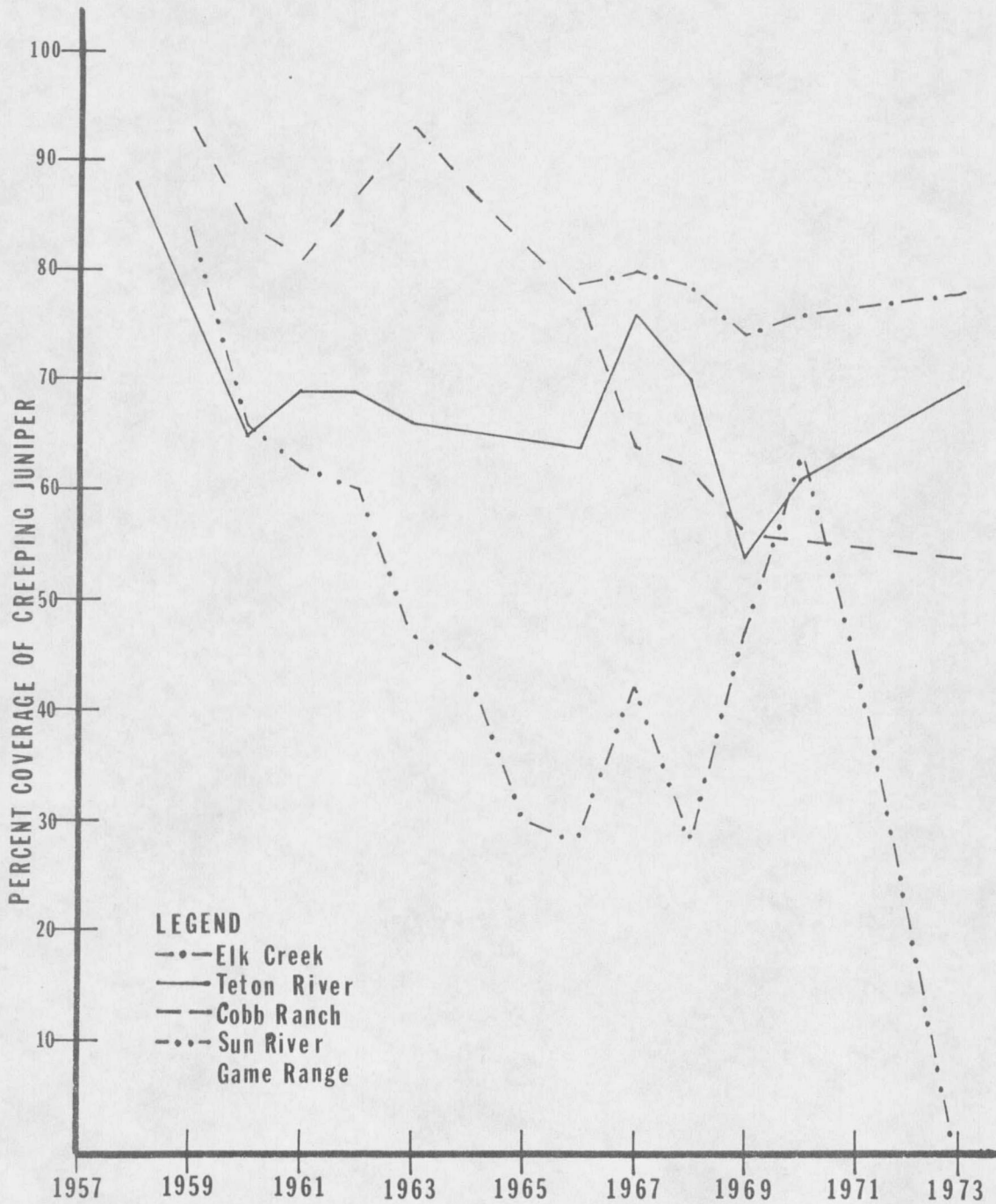


Figure 1. Population trends of creeping juniper on 12 condition trend transects established by the Montana Department of Fish and Game along the east slope of the Continental Divide.

edaphic and climatological characteristics; (2) to determine community relationships, phytosociology, and animal use relationships; and (3) to determine plant characteristics such as reproduction, growth and development, forage biomass, production indices, fire influences, and nutritional aspects and, to relate these to environmental conditions.

Field investigations were conducted primarily during the summers of 1975 and 1976 and in the spring and summer of 1977. Supplemental data were obtained in periodic field studies during the autumn and winter of 1976 and 1977.

METHODS

The natural distribution of creeping juniper in Montana was ascertained by ground reconnaissance throughout the State. Montana Department of Fish and Game range survey records and personal contacts with Department of Fish and Game and U. S. Forest Service personnel along with general publications as Little (1971) provided additional information.

Following the general distributional surveys, 30 sites representing an array of plant communities and physiographic situations (slopes, exposures, elevation, etc.) in which creeping juniper was observed to occur were selected for intensive investigation (Fig. 2). Additional basis for site selection were (1) a general and relative lack of major disturbance and (2) a history of importance for use by mule deer during winter. An additional 21 similarly selected sites were visited during the study to obtain supplementary data on edaphic and physiographic characteristics of creeping juniper stands. Locations of all sites are presented in Appendix Tables 13 and 14.

Generally, all study sites were located in northcentral, east-central and southcentral Montana. A majority (39 or 76 percent) were in areas currently grazed by domestic livestock. Two (4 percent) were situated in game exclosures on previously grazed sites. Two others were located in recreation areas and three (6 percent) were on big game winter range from which livestock grazing had been removed for at least

