Ecology of skunkbush sumac (Rhus trilobata Nutt.) in Montana with special reference to use by mule deer
by Peter Raymond Martin

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:
This study determined various ecological characteristics and relationships for skunkbush sumac (Rhus trilobata Nutt.) within its range in Montana east of the Continental Divide. Intensive investigations were conducted in 25 skunkbush stands on 5 widely separated study areas.

Highest skunkbush densities were associated with areas of extensive rough "breaks" and uplands adjacent to major rivers and frost-free or growing seasons longer than 120 days. Skunkbush stands occurred significantly more often (P=.0l) on south exposures, slopes with gradients between 40 and 80 percent, and at altitudes below 5,000 feet. Soils associated with the stands tended to be sandy clay loams, low in organic matter (3.09 percent), mildly alkaline (pH=7.44), very low in phosphorus (22.4 ppm), and high in potassium (377.4 ppm). The stands were typically "open" with a distinct tree overstory either lacking or only poorly developed and a generally sparse ground cover. Ponderosa pine, Rocky Mountain juniper, bluebunch wheatgrass, and fringed sagewort were the most important plant associates. Skunkbush was the dominant shrub in most stands with a mean stand density of 549 plants/ha. and an overall importance rating of 1.61. It attained highest importance in stands on southwest exposures, slopes less than 40 percent, and at elevations below 5,500 feet. Skunkbush plants tended to be rather low growing with dense rounded crowns comprised of many leaders, a growth form resulting from natural "hedging" and predominantly lateral, twig growth. Upon completion of annual growth, twigs either developed flower buds terminally or died back to the first lateral vegetative bud. Average measurements for 500 plants were. 2.35 meters diameter, .079 meters height, 3.5m^2 live crown area, and 26 percent of total crown dead. Plant size and growth form varied among stands and study areas in response to local weather and site conditions. Annual growth of skunkbush plants commenced with flowering in late April and early May. Twig growth began about mid-May and was essentially com-' pleted by mid-June. The longest annual growth twigs were produced on open sites, dominated by skunkbush, of south and east exposure, and at lowest elevations' with relatively long growing seasons. An average of 1.34' annual growth twigs developed from each year-old twig. Of the 1.2 flower buds which developed on each "fruiting" twig, only'10'percent produced mature fruits and seeds. Reproduction .from seed was extremely rare, while the potential for vegetative reproduction through resprouting was extremely high.' Skunkbush was important as forage only for mule deer. In eastern Montana utilization occurred primarily during summer and fall while on foothill ranges in west and south central Montana use occurred primarily during winter. Total utilization varied from 3.4 to 27.0 percent among the study areas. Broad variation between areas and years seemed related to the seasonal use patterns and the relative availability of other higher quality and more preferred forage plant's. Correlation coefficients between counted- and estimated twig use were very high, r =.94 and .93 for spring and fall, respectively.

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Date January 3, 1973

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by

PETER RAYMOND MARTIN

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

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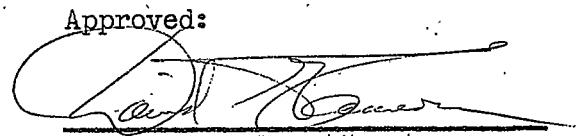
Approved:



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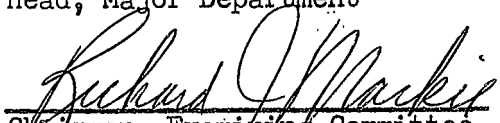

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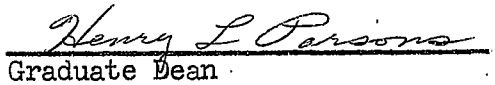

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Bozeman, Montana

March, 1973

ACKNOWLEDGEMENT

To the following, among others, I wish to extend sincere appreciation for their contribution to this study: Dr. Richard J. Mackie, Montana State University, for project planning, invaluable advice and aid in preparation of the manuscript, and for permission to use unpublished data from a growth and production study of key browse plants inside and outside of exclosures on big game ranges in Montana; Dr. Don C. Quimby, Montana State University, for critical reading of the manuscript and personal encouragement; Dr. Gene F. Payne, for critical reading of the manuscript; Dr. W. E. Booth, Montana State University, for aid in identification of plant species; Mr. Thomas W. Mussehl and Mr. Kenneth R. Greer, Montana Fish and Game Department, for providing facilities; Mr. Charles D. Eustace and Mr. Floyd A. Gordon, Montana Fish and Game Department, for field assistance; Mr. Ernest Kehrberg, District Forest Ranger, Fort Howes, Custer National Forest and Hubert Ellwein, Beartooth Game Range Manager, for use of facilities; Dr. Martin A. Hamilton, Montana State University, for consultation on statistical analysis; Mrs. Joyce Hanson for typing the manuscript; all the private individuals who allowed me to establish sites on their land; and most of all to my wife, Susan, for encouragement, patience and assistance. I was employed by the Montana Fish and Game Department under Federal Aid Project No. W-120-R-3 and W-120-R-4.

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ABSTRACT

This study determined various ecological characteristics and relationships for skunkbush sumac (Rhus trilobata Nutt.) within its range in Montana east of the Continental Divide. Intensive investigations were conducted in 25 skunkbush stands on 5 widely separated study areas. Highest skunkbush densities were associated with areas of extensive rough "breaks" and uplands adjacent to major rivers and frost-free or growing seasons longer than 120 days. Skunkbush stands occurred significantly more often (P=.01) on south exposures, slopes with gradients between 40 and 80 percent, and at altitudes below 5,000 feet. Soils associated with the stands tended to be sandy clay loams, low in organic matter (3.09 percent), mildly alkaline (pH=7.44), very low in phosphorus (22.4 ppm), and high in potassium (377.4 ppm). The stands were typically "open" with a distinct tree overstory either lacking or only poorly developed and a generally sparse ground cover. Ponderosa pine, Rocky Mountain juniper, bluebunch wheatgrass, and fringed sagewort were the most important plant associates. Skunkbush was the dominant shrub in most stands with a mean stand density of 540 plants/ha. and an overall importance rating of 1.61. It attained highest importance in stands on southwest exposures, slopes less than 40 percent, and at elevations below 5,500 feet. Skunkbush plants tended to be rather low growing with dense rounded crowns comprised of many leaders, a growth form resulting from natural "hedging" and predominantly lateral twig growth. Upon completion of annual growth, twigs either developed flower buds terminally or died back to the first lateral vegetative bud. Average measurements for 500 plants were 2.35 meters diameter, .079 meters height, 3.5m^2 live crown area, and 26 percent of total crown dead. Plant size and growth form varied among stands and study areas in response to local weather and site conditions. Annual growth of skunkbush plants commenced with flowering in late April and early May. Twig growth began about mid-May and was essentially completed by mid-June. The longest annual growth twigs were produced on open sites, dominated by skunkbush, of south and east exposure, and at lowest elevations with relatively long growing seasons. An average of 1.34 annual growth twigs developed from each year-old twig. Of the 1.2 flower buds which developed on each "fruiting" twig, only 10 percent produced mature fruits and seeds. Reproduction from seed was extremely rare, while the potential for vegetative reproduction through resprouting was extremely high. Skunkbush was important as forage only for mule deer. In eastern Montana utilization occurred primarily during summer and fall while on foothill ranges in west and south central Montana use occurred primarily during winter. Total utilization varied from 3.4 to 27.0 percent among the study areas. Broad variation between areas and years seemed related to the seasonal use patterns and the relative availability of other higher quality and more preferred forage plants. Correlation coefficients between counted and estimated twig use were very high, r =.94 and .93 for spring and fall, respectively.

INTRODUCTION

Skunkbush sumac, Rhus trilobata Nutt., occurs extensively on rangelands throughout Montana east of the Continental Divide. It has been reported to be a major browse plant, at least locally, for mule deer (Trueblood 1960, Mackie 1970, Dusek 1971, Eustace 1971a, Knapp 1972). The Montana Fish and Game Department recognizes skunkbush as a key browse species in eastern Montana where about 110 permanent transects have been established on important mule deer ranges to annually measure utilization and plant condition trends.

Like most other browse plants, little ecological information has been available for skunkbush sumac on Montana's rangelands. This lack of knowledge has hindered the interpretation of range survey data and has precluded consideration of the biological and ecological attributes of the species in the formulation of big game and land management programs in eastern Montana. The only previous study of skunkbush, conducted by Sanford (1970) in the badlands of western North Dakota, helped fill this void but further studies are needed.

The present study was established in the spring of 1971 to obtain basic ecological information for skunkbush sumac in eastern Montana. Specific objectives were: (1) to determine general distributional, edaphic, climatic and synecological characteristics; (2) to determine and describe certain autecological characteristics such as reproduction, growth and development, and forage production; and (3) to evaluate the essential relationship between skunkbush and deer throughout its range in Montana.

Field studies were conducted full time during the summer of 1971 and the spring and summer of 1972. Additional data were collected irregularly during the fall and spring of 1971 and the winter of 1972. Intensive investigations were conducted at five widely separated locations in the southwestern, southeastern, southcentral, northcentral and westcentral portions of Montana. Extensive surveys in intervening areas and other portions of eastern Montana provided supplementary data.

Skunkbush sumac is a member of the Sapindales order and the Anacardiaceae (cashew) family which includes about 60 genera and 600 species found mainly in tropical regions (Porter 1967). The genus Rhus, studied primarily by Fred A. Barkley (1937, 1938 and 1940), has been recognized from Greek times when some species were used for preparation of dye, medicine, seasoning and tanning of hides. It contains approximately 120 species with about half of these in the United States. Barkley (1937) lists Rhus trilobata and seven varieties as occurring in the western and midwestern United States and Mexico with a small extension into Canada above Montana and western North Dakota. Skunkbush was referred to as "Ho at to o nuts" by the Cheyenne Indians near the Bighorn Mountains who used it in a smoking mixture (Barkley 1940).

Booth and Wright (1959) refer to skunkbush as a "low branching, erect shrub, rather strongly aromatic; the young brachlets hairy; leaves 3-foilate, deciduous, more or less hairy on both surfaces; terminal leaflet 2.5 to 5.0 centimeters long, 3-lobed and coarsely toothed, the lateral leaflets smaller, round-ovate, scarcely lobed; flowers yellowish,

appearing before the leaves in short spike-like clusters; sepals 5, petals 5; stamens 5; ovary 1-celled; occurring on dry hillsides and plains." While several authors (Hitchcock, et al. 1961, Barkley 1937, St. John 1956 and Porter 1967) list Rhus with polygamous or dioecious flowers and make no reference to skunkbush, McKean (1956) indicates male catkins and persistent fruits occur simultaneously on skunkbush plants.

PROCEDURES

The geographical range and distribution of skunkbush sumac in Montana were determined by aerial survey, vehicle reconnaissance, examination of State Fish and Game Department browse survey records, review of ecological literature concerning Montana rangelands, and discussions with game management personnel. During aerial and ground surveys, skunkbush stands were arbitrarily rated as of low, moderate or high density.

Intensive studies were conducted in five locations, selected to represent broadly different geographic areas, habitat types and histories of skunkbush utilization by deer. Five individual skunkbush stands were studied at each location. These were representative of stands occurring on the various exposures and slope gradients, at various elevations and/or within various vegetational communities characterizing the distribution of skunkbush in each area. A 100 foot x 60 foot plot, including at least 20 representative skunkbush plants, marked the study site in each stand.

For each site, exposure was estimated from two azimuth readings with a Silva type 1 compass oriented downslope. Slope was estimated to the nearest 5 percent as the mean of two readings with a K & E pocket transit. Elevation was determined with a simple altimeter and verified from U.S.G.S. topographic maps for most sites. Soil characteristics, including pH, organic matter content, salt hazard and five important elements, were determined from a composite of 10 soil subsamples obtained from a

depth of 4 inches to 8 inches at each site and analyzed by the Montana State University Soils Testing Laboratory. Precipitation and temperature data were taken from climatological records for the U.S. Department of Commerce weather station nearest each major study area.

Synecological data for each stand studied were obtained as follows: Low growing species, grasses, forbs and shrubs less than two feet tall were quantitatively sampled by the canopy coverage technique (Daubenmire 1959). Ten 2 x 5 decimeter frames were placed at 10-foot intervals along each of three or four 100-foot lines, spaced 20 feet apart, which followed the contour of each slope. Coverage of each species, as well as bareground, rock and litter, were recorded by class in each plot. Classes were: (1) less than 5 percent; (2) 6-25 percent; (3) 26-50 percent; (4) 51-75 percent; (5) 76-95 percent; and (6) 96-100 percent. An additional measure of ground cover was provided by recording whether each leg of the Daubenmire frame touched a living plant, litter, bareground or rock. A total of 919 frames were analyzed. Trees and shrubs were quantitatively sampled using a modification of the point-center-quarter method (Cottam and Curtis 1959) as employed on skunkbush by Sanford (1970). Seven points were situated at 50-foot intervals along each of 3 lines; one near the top of the slope containing the skunkbush stand, one near the base of the slope and one through the study site. Data recorded for the nearest tree or shrub in each quadrant of each point included: (1) distance to the plant center, to the nearest 0.1 meter; (2) species;

(3) width of minor and major axis, to the nearest 0.1 decimeter; (4) height, to the nearest 0.1 decimeter; (5) percentage of crown dead; and (6) crown density (percentage of crown canopy cover within a line circumscribing the outer edge of the plant). Decadence and crown density were recorded by class as used in canopy coverage estimates. Importance values were obtained by adding relative dominance (percentage of total corrected crown area comprised by a species), relative density (percentage of total possible plants sampled, 84), and relative frequency (percentage of times an individual species occurred among 21 points).

Twenty representative skunkbush plants in each stand were selected for autecological studies of growth and reproductive characteristics. During the summer of 1971, the height and major and minor diameters, to the nearest 0.1 decimeter, and the percentage of dead crown of each plant were measured. Age and form classes (Cole 1958) were noted. Crown density and percentage of crown dead were also recorded for each plant in 1972.

Prior to the onset of growth in 1972, the following data were recorded for each of four branches on two randomly selected plants per site: numbers of last year's leaders; last year's terminal leaders; flower buds; and terminal leaders with flower buds. After growth began, the first 10 leaders on each branch were measured to the nearest 0.1 centimeter at approximately two-week intervals until it became apparent that growth had ceased. After growth was complete and seeds had ripened, I recorded

total numbers of current annual growth twigs, new terminal twigs or leaders, buds flowering, and buds producing fruits and/or seeds.

Dates of important phenological events, including opening of flower buds, peak of flowering, emergence of leaves, commencement of leader growth, termination of leader growth, formation of fruits and ripening of seeds were noted or calculated during the course of six or more visits to each stand.

Seed production was recorded for each plant in both 1971 and 1972. In 1972, the percentage of twigs bearing flowers and buds flowering and producing fruits and/or seeds were calculated. Numbers of resprouts of two plants on each stand were counted to determine the extent of vegetative reproduction.

Utilization of skunkbush by deer was determined in the fall (late September and early October) of 1971 and in the spring (early April) of 1972, for each stand using a modification of the Key Browse Survey Method (Cole 1958). Percentages of current annual growth twigs utilized were estimated by class, as for canopy coverage. Additional indication of browsing intensity was obtained by counting the number of leaders browsed for four marked branches on each of five plants in each stand during the fall of 1971 and the spring of 1972. Total numbers of twigs available per branch and numbers of leaves per twig were counted in the summer of 1971.

Methods of statistical analyses followed Snedecor and Cochran (1967).

They included one and two way analyses of variance in combination with least significant difference analysis where warranted, 95 percent confidence intervals, and linear regression. A computer program prepared by Dr. Martin A. Hamilton, Department of Mathematics, Montana State University, was used for comparing means of independent samples with unequal variances. Most calculations were performed using the Monroe Programmable Calculator, Model 1785 W1.

Common and scientific names of plants followed Booth (1950) and Booth and Wright (1959).

DESCRIPTION OF STUDY AREAS

Five major study areas were located in the Fort Howes area in southeast Montana, in the Missouri River Breaks of northcentral Montana, on the Beartooth Game Range in westcentral Montana, in the vicinity of Big Timber in southcentral Montana and along the Madison River in southwest Montana (Figure 1). Cadastral descriptions, exposures, slope gradients and elevations for the five representative stands in each area are listed in the Appendix, Tables 15 and 16.

Fort Howes

This area was located on the Custer National Forest in southern Rosebud and southwestern Powder River Counties approximately 20 miles south of Ashland. Knapp (1972) described the area as a ponderosa pine (Pinus ponderosa) woodland interspersed with a mixed grass prairie. Brown (1965) listed Artemisia-Atriplex-Agropyron and Rhus-Agropyron community types (Figure 2) as predominant, comprising 30 and 17 percent, respectively, of the vegetation in the area. Skunkbush stands selected for study ranged in elevation from 3,450 to 3,980 feet, in slope from 60 to 90 percent, included ENE, SSE, WSW, WNW and NNW exposures and were dominated variously by Rocky Mountain juniper (Juniperus scopulorum) and Indian ricegrass (Oryzopsis hymenoides), ponderosa pine and bluebunch wheatgrass (Agropyron spicatum), and skunkbush and bluebunch wheatgrass (Figure 3) or Japanese chess (Bromus japonicus). According to Knapp (1972), skunkbush was the most important browse species used by mule deer in summer and fall, comprising 40 and 41 percent, respectively,

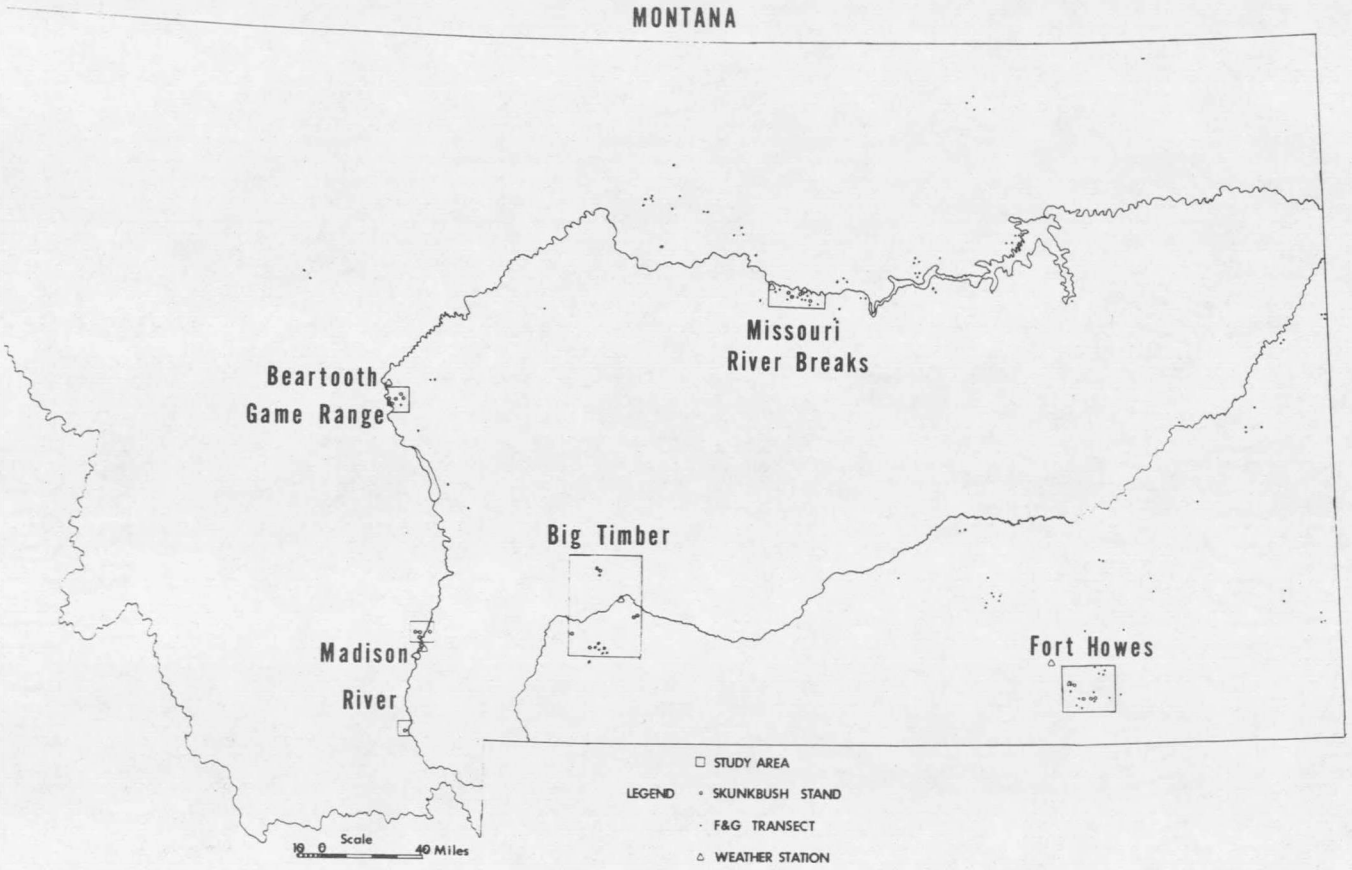

Figure 1. Five major study areas (FH–Fort Howes; MB–Missouri River Breaks; BG–Beartooth Game Range; BT–Big Timber and MR–Madison River) showing approximate location of study sites along with Fish and Game skunkbush transects and weather stations.