A MONTANE FOREST WINTER DEER HABITAT IN WESTERN MONTANA[1]

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Abstract: A study of a mule deer (*Odocoileus hemionus*) winter range was conducted on an area in western Montana, which had been burned in 1919 and where a shrub vegetation type developed. Estimates of present tree densities and of tree densities prior to the fire indicate that about as many trees are present now as in 1919, but the present stands are younger. Browse sampling reveals that four shrubs provide the major amount of browse; one of the most common shrubs, ninebark (*Physocarpus malvaceus*), is not used. Utilization data show that forage plants on the portions of the winter range with the greatest density of trees are less utilized by the mule deer than those on the more open portions of the range. A continued increase in the size and density of the tree vegetation is expected, with a resultant decrease of forage plants and amount of usable winter range.

An inverse relationship exists between shrub density and overstory density in forested areas (Halls and Crawford 1960, Brown 1961, Pengelly 1961). In the mountains of the west, this relationship is important because burning, logging, and overgrazing provided more deer range than was present prior to the advent of the white man (Leopold 1950, Brown 1961). This often resulted in large numbers of deer where previous herds had been small. In some areas, fire prevention, improved fire fighting methods, and better grazing practices are now preventing the maintenance of these ranges in a subclimax stage, and plant succession is reducing the amount of deer range. The need to maintain these subclimax ranges for deer habitat, however, is important to big game managers.

This paper gives an account of a study conducted during two winter seasons on a subclimax forest winter range of Rocky Mountain mule deer in western Montana. The study was established to describe the vegetation, to determine the amount of deer forage produced and utilized, and to determine the trend of the forest vegetation in order to obtain a basis from which to predict the future of this winter range.

This paper is a portion of a master's thesis completed under the guidance of Dr. R. D. Taber, Montana State University.

STUDY AREA

The study area is a 1,200-acre tract located in the Rattlesnake Creek drainage, a tributary of Clark's Fork River near Missoula. It is the main mule deer wintering area in the drainage, maintaining about 100–150 mule deer during January, February, and March. The owners, the Montana Power Company, granted permission to use the land for study.

The range is a ridge between 4,000 and 5,500 feet in elevation, which has a long southeast-facing slope and southern-facing end exposed to the sun in the winter with correspondingly lower snow depths than the surrounding areas. The northwest face, however, is usually heavily covered with snow. This is a successional range that was burned by wildfire in 1919. Before the fire, ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) were the predominant species on the area, but the fire eliminated most of the trees. The result was the development of a shrub type with

[1] Contribution from the Montana Cooperative Wildlife Research Unit: Montana State University, Montana State Department of Fish and Game, U. S. Fish and Wildlife Service, and The Wildlife Management Institute, cooperating.

snowbrush ceanothus and ninebark the two most common species. (Scientific names can be found in Tables 3 and 4.)

METHODS

The study began in the fall of 1960 with a visual reconnaissance survey. The range was divided into seven areas on the basis of tree composition and density. The open southeast aspect of the ridge was further subdivided into seven subtypes because of differences in shrub density. Thus, 13 areas were sampled. After the compilation of sampling results, locations with no differences were grouped, resulting in the five areas discussed in this paper. These areas were numbered in direct relation to the present tree density.

For gathering the field data, 10 points were located at random on each of the 13 areas. A grid placed on an aerial photograph and a table of random numbers provided the means of establishing each point. These points served as locations in the field for sample plots and transects.

The point-centered quarter method (Cottam and Curtis 1956) was used to measure abundance of tree vegetation. The species and age of each tree and the distance to the closest living tree in each quarter of the area surrounding each sample point were recorded, providing the number of trees present per acre, the average age of the various species, and the species composition. The age of each tree was determined by counting branch whorls or, for older trees, by increment borings.

Stumps of trees present when the fire occurred in 1919 are abundant throughout the area and in most cases are still erect. A measure of these stumps and boles provided a relatively accurate estimate of the trees present in 1919. The distance to the nearest stump in each quarter was recorded along with the species and age. The ages were easily determined as the weathering processes of 40 years facilitated counting the annual rings. When a living tree over 40 years old was closer to the point than a stump, the living tree was measured and its age estimated from increment borings. The number of trees per acre and the composition by age and species were calculated to provide an estimate of the tree vegetation in 1919.

It was later decided that more samples were needed in some areas, and five more random points were located and sampled on each of six areas. A species was not considered adequately represented unless the sample contained 25 or more trees.

The coverage of plant species was recorded by points located at 1-foot intervals along a 100-foot transect (Brown 1954, Larson 1959) using a plumb bob or wire pin to make the observations. Plant species, litter, bare soil, and rock were recorded. Any point inside the basal area of a plant or an actual hit on a part of the crown was recorded as a hit. Ten of these transects were installed per area on the same randomly located points used for the tree information. The transects were placed parallel to the slope with the upper end of the transect at the previously located point.

The amount of browse production and utilization was obtained by visual estimates of the current annual growth on the shrubs (Pechanec and Pickford 1937). It was difficult to determine the current growth on small plants and on snowbrush ceanothus, a plant with no indication of yearly growth visible outside the bark. The total plant was included in the samples of creeping hollygrape, kinnikinick, and spiraea. Portions of the snowbrush ceanothus plant stems less than 5 mm in diameter were considered to be the current annual growth. Estimates were made as soon as the ground was free of snow in April of both years. One hundred plots were established on each area by equally spacing 10 plots along 10 transects.

Table 1. The tree vegetation on the Rattlesnake Creek mule deer winter range at the time of the 1919 fire.

SPECIES	AREA 1		2		3		4		5	
	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age
Douglas fir	16(171)	72	12(109)	73	90(50)	74	34(29)	82	78(51)	80
Ponderosa pine	7(149)	92	12(71)	127	13(7)	91	9(8)	161	8(5)	138
Western larch							17(15)	159	6(4)	82
Grand fir							9(8)	59		
Lodgepole pine					5(3)	100				
Total	23		24		108		69		92	
Overall mean age		81		94		77		109		85

* Number of trees in the samples.

Each plot was a 9.6 square-foot circle. This plot size was chosen because of the simplicity of converting the plot weights in grams to pounds per acre.

The green weights were converted to dry weights using a factor that was determined by drying a series of browse samples at 130–140 F and computing the percent of water loss.

Additional data were obtained from 18 rumen samples collected between January 7 and April 2, 1958, by Dr. Taber and K. L. White, Montana Cooperative Wildlife Research Unit, Montana State University. The material was washed and separated by personnel of the Montana Fish and Game Food Habits Laboratory at Bozeman. Identification and volume determination were carried out by the author. Volumetric displacement of water in a graduated cylinder was used to determine the volume of food in the samples. The methods of analysis were developed and supervised by Kenneth Greer, Montana Department of Fish and Game.

RESULTS

Information gathered from the stumps and boles remaining from the fire indicates that the ridge had been covered with a stand of mature or nearly mature Douglas fir and ponderosa pine (Table 1).

The south- and southeast-facing slopes on this ridge (Areas 1, 2, and 4) had supported partly open stands with a higher proportion of ponderosa pine to Douglas fir than the more mesic northwest side of the ridge (Areas 3 and 5). Area 4 on the southeast face had a higher number of trees per acre than the other areas with the same exposure. Western larch (*Larix occidentalis*) had been

Table 2. The tree vegetation on the Rattlesnake Creek mule deer winter range, 1961.

SPECIES	AREA 1		2		3		4		5	
	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age	Trees/Acre (Sample Size)*	Mean Age
Douglas fir	3(107)	27	13(86)	23	49(42)	23	46(28)	44	447(46)	21
Ponderosa pine	7(209)	20	16(93)	19	14(12)	12	8(5)	60	29(3)	207
Western larch	tr(3)	38			tr(1)	27	25(15)	37	58(6)	37
Grand fir							13(8)	41		
Lodgepole pine	tr(1)	28	tr(1)	9	6(5)	27	7(4)	30	49(5)	29
Total	10		29		69		99		583	
Overall mean age		23		21		21		42		33

* Number of trees in the samples.

Table 3. Percent canopy coverage on the Rattlesnake Creek mule deer winter range, 1961.

Species	Percent Canopy Coverage				
	Area 1	Area 2	Area 3	Area 4	Area 5
Preferred shrubs					
Serviceberry (*Amelanchier alnifolia*)	3	7	3	11	5
Snowbrush ceanothus (*Ceanothus velutinus*)	15	13	17	5	1
Creeping hollygrape (*Mahonia repens*)	1		2	3	1
Chokecherry (*Prunus virginiana*)	5	1			
Total preferred shrubs	24	21	22	19	7
Not preferred shrubs					
Oceanspray (*Holodiscus discolor*)		2			
Ninebark (*Physocarpus malvaceus*)	11	5	24	10	22
Bitter cherry (*Prunus emarginata*)		3			
Russet buffaloberry (*Shepherdia canadensis*)			1		1
Spiraea (*Spiraea betulifolia*)	3	1	4	6	5
Snowberry (*Symphoricarpos albus*)	4	1	4	1	
Total not preferred	18	12	33	17	28
Other shrubs	1	5	4	7	7
Total shrubs	43	38	59	43	42
Grasses and sedges	25	19	7	13	9
Herbaceous plants	10	5	6	2	6
Coniferous overstory			5	40	58
Litter	27	30	30	23	16
Total ground cover	105	92	107	121	131
Rock		6			
Bare soil	5	5	1	1	1

an important species on this area. Moderate slope and a slight shielding from the sun as a result of a bend in the ridge are probably the main reasons for the differences on this area.

The density of the present tree vegetation (Table 2) is more varied than before the burn, but species densities are ranked the same now as in 1919 except on Area 1. There, ponderosa pine is more common than the other species, whereas Douglas fir predominated in 1919. The present high number of young Douglas fir trees on Area 5, so dense a person can barely travel through, is the main difference in the tree distribution. Grand fir (*Abies grandis*) is present only on Area 4. Lodgepole pine (*Pinus contorta*), though found only on Area 3 in 1919, can now be found throughout the ridge.

A few trees which survived the fire are present on every area, but they are important only on Area 4.

A comparison of the overall mean ages reveals that in 60 years, barring another fire or similar setback, the present stand should be about where it was in 1919, except presumably Area 5 will be more dense and Areas 1 and 3 will be somewhat more open.

The data recorded from the line point transects indicate the predominance of shrubs over most of the winter range since, with one exception, the total percent shrub-canopy coverage is greater than the coverage of any other type of vegetation (Table 3). Even on Area 5 where the coniferous overstory covers 58 percent of the ground, the cover provided by the shrubs is not noticeably less than that on the other areas.

The totals of the preferred and not preferred shrubs show that on the overall winter range one class is about as common as the other (Table 3). On the areas of lowest tree densities, however, the preferred plants predominate. Shrubs classified as *Others* are present in small numbers and moderately utilized.

Table 4. Browse production on the Rattlesnake Creek mule deer winter range (mean of 2 years, 1960 and 1961).

SPECIES	PRODUCTION (POUNDS PER ACRE)				
	Area 1	Area 2	Area 3	Area 4	Area 5
Preferred shrubs					
Serviceberry (*Amelanchier alnifolia*)	11	17	7	8	6
Snowbrush ceanothus (*Ceanothus velutinus*)	607	600	411	78	56
Creeping hollygrape (*Mahonia repens*)	11	11	11	25	11
Chokecherry (*Prunus virginiana*)	10	3			
Total	639	631	429	111	73
Intermediately preferred shrubs					
Mountain maple (*Acer glabrum*)		1	2	3	1
Kinnikinick (*Arctostaphylos uva-ursi*)	14	39	69	22	92
Woods rose (*Rosa woodsii*)	2	1			
Big whortleberry (*Vaccinium membranaceum*)				3	
Others		1	1	8	1
Total	16	42	72	36	94
Not preferred shrubs					
Ninebark (*Physocarpus malvaceus*)	37	10	30	13	18
Bitter cherry (*Prunus emarginata*)		2			
Spiraea (*Spiraea betulifolia*)	1		2	2	2
Snowberry (*Symphoricarpos albus*)	3	1	1		1
Others		1			1
Total	41	14	33	15	22

The total amount of ground cover provided by the vegetation and litter is sufficient to provide soil protection with little chance of range deterioration due to soil erosion. The high total ground cover values in Table 3 represent overlap in the canopy.

Snowbrush ceanothus is the principal forage producer (Table 4). It is evergreen and seldom grows over 3 feet tall, thus being practically all available to deer. Snow sometimes covers this plant which limits utilization, but the deer paw away the snow to get at the forage. Kinnikinick is another high-producing forage plant, but it grows in scattered patches that are lightly utilized. Ninebark is the third highest producer, but it is not utilized, even on areas where forage plants are heavily browsed.

The utilization samples indicate that serviceberry, chokecherry, snowbrush ceanothus, and creeping hollygrape are the four primary browse species (Table 5). The amount of forage taken from shrubs other than these four species is very low; consequently, they have been omitted from the table. Serviceberry and chokecherry, where present, are the most preferred species, but snowbrush ceanothus is extensively used. When the percent use of snowbrush ceanothus is compared with the amount of forage that this plant produces, it becomes obvious that this is the staple forage plant of the mule deer in this area. The rumen analyses support this conclusion.

As tree density increases, browse production and utilization decrease. The results of a survey made of the form class of serviceberry correlate with the utilization data given in Table 5 (Klebenow 1962). On Areas 1 and 2 where there are few trees, the majority of the serviceberry plants are in a severely hedged condition. On Area 3 where the tree density is somewhat greater, more shrubs are in a moderately hedged condition, and on the remaining two areas the majority are slightly hedged.

Fig. 1 illustrates the results of the rumen analyses. Every rumen sample had snow-

Table 5. The percent utilization of the four preferred browse species on the Rattlesnake Creek mule deer winter range (mean of 2 years, 1960–61 and 1961–62).

SPECIES	PERCENT UTILIZATION BY AREA				
	1	2	3	4	5
Serviceberry	16	10	16	2	2
Snowbrush ceanothus	10	4	5	2	9
Creeping hollygrape	2	2	1	tr	tr
Chokecherry	21	8	No plants present		

brush ceanothus present as the bulk of the contents. The high frequency of occurence of serviceberry and chokecherry indicates that although they are desirable species, the volume eaten is low. The high occurrence of grasses and sedges and herbaceous plants indicates the desirability of these winter foods, but they were not included in the field production and utilization measurements. Except for elk sedge (*Carex geyeri*), the only forage of this nature available during the winter months is the dried material from the previous growing season. Elk sedge remains green at the base of the clumps and is the most common of the grasses and sedges. Miscellaneous items included kinnikinick, mountain maple, willow (*Salix* sp.), russet buffaloberry, and conifer needles.

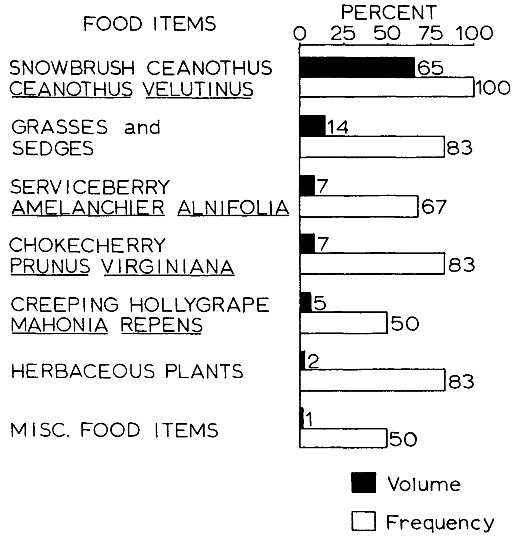

Fig. 1. Principal foods in the diet of the deer on the Rattlesnake winter range, January–April, 1958, determined by analyses of 18 rumen samples.

DISCUSSION

Measurements indicate that in 60 years, barring further disturbance, the stand on the Rattlesnake Creek mule deer winter range should appear similar to the one of 1919. Even with no further increase in tree density, competition will become greater between the trees and shrubs because of an increase in tree size. Less browse can be expected, but the amount of forage decrease is unknown. Production of available forage is already low on Areas 4 and 5, and further decrease there is possible. Tree density should increase on Area 3. From all appearances, this area lacked a good seed source after the fire, and trees did not reestablish themselves as quickly as on Area 5, located on the same side of the ridge and adjoining Area 3. The south and southeast aspects (Areas 1 and 2) will probably remain an open stand of Douglas fir and ponderosa pine and the decrease in the abundance of browse should be less than on any other portion of the winter range.

Utilization information indicates that browse is not as heavily used on areas of high tree densities as on the more open areas although forage is present. The deer are kept out of the wooded areas by deep snow, which is protected from the sun by the trees. A continued increase in tree size and density on the winter range will increase the size and abundance of the deep snow areas, and the amount of usable winter range will decrease. Areas 4 and 5, wooded areas lightly used by wintering deer, comprise about 20 percent of the total winter range. As the trees become reestablished on Area 3, this portion is expected to become poor winter range, and then over one-third of the area will be of little use to wintering deer. Field observations of probable tree sites indicate that eventually only 30 or 35 percent of the whole ridge may be suitable for wintering mule deer. If this occurs, the area will adequately support a mule deer herd only a fraction of the present size with fewer deer available for hunter harvest.

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COMPARISON OF STRONTIUM-90 LEVELS BETWEEN ANTLER AND MANDIBLE OF WHITE-TAILED DEER

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Abstract: Strontium-90 concentrations of antlers and mandibles (plus teeth) collected from 18 white-tailed deer (*Odocoileus virginianus*) were compared to evaluate the feasibility of utilizing antlers to establish strontium-90 fallout levels during the period of antler development. As there was a significant correlation (computed $r = 0.74$; $r_{.01}$ (16 df) $= 0.59$) between antler and mandible level it was concluded that the strontium-90 content of an antler is influenced by bone level; therefore, not a reliable indicator of amount of radionuclide consumed during the antler growth period. The overall average strontium-90 content of mandibles was not significantly different from that of antlers. Further, differences between mandibles and antlers were independent of age of deer.

During the past few years, it has been postulated that antlers afford a convenient and reliable source of information on yearly deposition of strontium-90 in the environs because antlers are produced annually and the strontium-90 consumed during the period of antler growth would presumably be reflected in this structure. Notes to this effect appeared in the nation's newspapers (*Washington Post*, November 27, 1959, Section C-7),

> Outgrown and shed by the deer they once decorated, these antlers make a towering pile at Jackson Hole, Wyo. Once good only for hatracks, the horns are now studied by scientists measuring radioactive strontium fallout, which is deposited in the calcium of the bones. The quick-growing antlers which bud each spring and drop off each winter, give yearly measurements not obtainable from slow-growing skeletons.

An article in *Time* magazine (November 17, 1958) went so far as to state that "If enough antlers can be accumulated and analyzed, British and U. S. scientists will be