

Adequacy of Some Important Browse Species In Overwintering of Mule Deer

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Winter is a critical period for game animals in temperate climates. During this season food supplies are at or near their minimum; cold and inclement weather puts stresses on the bodily functions of animals and, at the same time, hampers the animals in their attempts to secure forage. Population levels are therefore, frequently, if not invariably, determined by the condition of the game habitat used during the winter months. Because of these facts, knowledge of the value of species utilized for food during winter months is of extreme importance to the game manager. Throughout the West, but especially in those portions where snowfall restricts the available range for big-game animals, winter food supplies are of especial concern. These considerations led to studies directed toward an evaluation of native browse plants as sources of forage during the winter months.

Digestion tests conducted previously provided valuable information regarding the nutritive content of individual plants (Smith, 1950b, 1952, and 1957). During these studies it was noted that oftentimes the amount of forage consumed was low for certain species. Sagebrush (*Artemisia tridentata*) and juniper (*Juniperus osteosperma*) particularly come in this category. Even though a plant has a high level of nutrients, if, for some reason or other, it is not eaten in sufficient quantity, it cannot adequately support an animal. It was, therefore, deemed advisable to conduct feeding tests in which

the response of the animal to specified diets could be observed.

In Utah three species of plants are most important in the overwintering of deer, sagebrush, juniper, and scrub oak (*Quercus gambelii*). Other plants are more attractive to deer than are these three, but because of natural abundance and the fact that the more desired plants have undergone reductions on most areas over the years of heavy use, the three species listed probably provide the bulk of the forage for deer on Utah ranges during the winter months. Of the three, oak is less widely distributed, but is often more abundant than either of the other two. In other areas sagebrush is the most important single plant; and in still others, juniper provides the major part of the forage.

Procedures

These facts suggested the plan of study in which these three species would be tested alone and in combinations. For comparison, a diet which included these three species in addition to other more palatable browse plants was included. Because of the great amount of work involved in hauling feed and making accurate records, the study was conducted during three winters, 1954-55, 1955-56, and 1956-57. Tests were begun toward the end of December or early January with the onset of cold weather. Whenever a test was discontinued, other animals and diets were started as pens were vacated. Most tests were terminated before the middle of

March. Unless the condition of the animals indicated that further testing would be unwise, tests were discontinued after 60 or 70 days. This period was judged to be the limit of the severe winter period except in extreme years. By early March, slopes become bare of snow and opportunity is afforded to supplement the straight browse diet with other plant materials, and tests of longer duration than this were judged to be unnaturally long. The animals were weighed each week as a guide in judging the duration of the tests.

The deer were held captive in individual pens near Logan, Utah, and fed prescribed diets. Browse material was cut from the adjacent winter range. The cut material was weighed daily after the browsed material from the previous day's feeding had been removed. The differences in the initial and final weights of the browse material was corrected to correspond with observed changes in weights of bundles of browse handled identically to the material provided the animals except that it was not within reach of the deer. The loss in weight attributed to deer consumption was corrected to air-dry weight by means of sample materials hand-clipped from the check bundles and dried. Sheds were available to provide protection to the materials and minimize errors due to snow accumulation on the forage.

Animals being fed on restricted diets were given small amounts of other species once each week. This was done in the belief that feeding but one plant was unnatural, for even on deteriorated ranges a small amount of better browse forage is usually available.

In order to provide a basis for evaluating the accuracy of the feeding method, "dummy" data were secured. Bundles of material not available to the deer were clipped by hand in order to



FIGURE 1. Oak brush bundled and anchored to racks in feeding shed.

simulate browsing. These clipped bundles were reweighed and the same calculations made as in the case of the materials fed to the deer. The computed removal was then compared to the actual weight of material removed by clipping.

Results and Discussion

Comparison of the hand-clipped materials with the computed removal indicate an acceptable degree of accuracy in the feeding method. Although occasionally there were substantial differences between the actual and calculated figures due to breakage of the plants or loss of material from a bundle in handling, the mean differences were not great. The calculated amounts differed from the actual by +2.6 percent, -1.5 percent, +0.5 percent, and +0.03 percent in the case of sagebrush, juniper, curleaf mahogany (*Cercocarpus ledifolius*), and oak respectively.

The pertinent data regarding the animals used and the duration of the tests are given in Table 1. An attempt was made to balance the several feeding tests by including animals of the different ages and sex classes in all diets. This was not precisely possible because of inadequate num-

bers of animals within each of these classes. However, this objective was approximately attained.

It will be noted that the juvenile animals could be held on the restricted diets a shorter period of time than could older animals. Exceptions to this occurred in the case of animal 1143 fed upon oak in 1954-55, and the two juveniles fed oak in combination with other forages in 1956-57, A418 and A405. However, because the duration of the tests was arbitrarily limited, these instances may not invalidate the conclusion that juveniles are less able to survive diets of restricted species composition even when the amount of feed available is not limited. It is possible that, had all tests been continued indefinitely, there may have been further confirmation of the inability of young animals to survive as well as older ones on these particular diets.

Only one animal was lost during the course of the studies. A juvenile fed upon oak died within 24 hours of being removed from the test after 41 days. It did not appear to have been in more serious condition than did other animals being fed other diets at the time of their removal. In

several instances animals were noticeably weakened at the close of the tests. The dead animal was examined by members of the veterinary department staff. The cause of death was not determined.

The shortest mean duration of the tests was recorded with sagebrush. Since the termination of the tests was based upon subjective criteria such as the general appearance of the animal and weight lost, no great precision could be attained, and too great significance cannot be attached to the small differences in the duration of the tests of sagebrush and juniper. Except for animal 1149, animals were able to subsist on oak alone as long as those on a varied diet.

The weights of the animals are shown in Table 1. Percentage losses as small as 2 percent and as large as 24 percent were recorded. The greatest average weight loss was observed in animals on sagebrush, although the superiority indicated for juniper on this score is very slight. Based upon the results secured herein, oak produced smaller weight losses than did either juniper or sagebrush. This is of particular interest in view of the low nutrient level found for this species in digestion trials (Smith, 1957).

Amounts Consumed

The ability of oak to support animals for appreciable periods in spite of low nutrient value is perhaps partially explained by the amounts ingested. It will be observed that the level of intake of oak is high, all animals consuming nearly two pounds per hundredweight (Table 2). By contrast, those fed sagebrush and juniper consumed considerably less than one pound per hundredweight on the average.

The animals fed on varied diets ate two and a quarter pounds per hundredweight. This figure is somewhat less than the average intake reported for two male deer in preference tests made

Table 1. Summary of deer used, duration of feeding tests, and weight changes of animals.

Diet	Deer number	Winter conducted	Age*	Sex	Dates	Duration (days)	Weights (lbs.)			Weight change	
							Initial	Final	Average	Pounds	Percent
Sagebrush	1135	1954-55	Y	M	8 Jan- 4 Feb	28	112	93	102	-19	-17
	1143	1955-56	Y	M	20 Dec- 3 Feb	46	110	90	97	-20	-18
	A419	1955-56	Y	M	4 Feb-16 Mar	42	127	97	113	-30	-24
	1144	1955-56	J	F	9 Feb-24 Feb	16	68	57	64	-11	-16
	Mean					36					-19
Juniper	A419	1954-55	J	M	8 Jan-26 Jan	19	52	45	51	- 7	-13
	2399	1955-56	M	F	20 Dec- 3 Feb	46	120	102	111	-18	-15
	A403	1955-56	Y	F	9 Feb-16 Mar	37	105	85	95	-20	-19
	1144	1956-57	Y	F	19 Dec-15 Feb	59	110	86	100	-24	-22
	Mean					41					-17
Oak	1143	1954-55	J	M	8 Jan-11 Mar	63	59	58	59	- 1	- 2
	1141	1955-56	M	F	8 Dec-28 Feb	71	119	116	119**	- 3	- 3
	1149	1955-56	J	F	20 Dec-29 Jan	41***	52	45	47	- 7	-13
	1132	1956-57	Y	F	20 Jan-15 Mar	63	103	83	90	-20	-19
	Mean				12	60					- 9
Sagebrush & juniper	2399	1956-57	M	F	5 Jan- 1 Mar	56	124	106	105	-18	-15
	1143	1956-57	M	M	18 Feb-29 Mar	40	135	110	124	-25	-19
	A410	1956-57	J	F	25 Feb-29 Mar	33	76	68	71	-10	-13
	Mean					42					-16
Sagebrush & oak	A418	1956-57	J	F	5 Jan- 8 Mar	63	88	76	83	-12	-14
Juniper & oak	A419	1956-57	M	M	5 Jan- 8 Mar	63	171	146	156	-25	-15
Juniper, oak, & sagebrush	A405	1956-57	J	F	5 Jan- 8 Mar	63	64	60	62	- 4	- 6
Mixed species	1142	1954-55	M	F	20 Dec-11 Mar	82	113	104	110	- 9	- 8
	1135	1955-56	M	M	20 Dec-28 Feb	71	143	110	126	-33	-23
	1132	1955-56	J	F	20 Dec-28 Feb	71	39	31	35	- 3	- 8
	1141	1956-57	M	F	19 Dec-22 Feb	66	124	104	111	-20	-16
	Mean					70					-14

*M = mature (over 2 years); Y = 1-2 years; J = under 1 year.

***Means are the averages of weekly weights. This animal increased in weight each week for four weeks.

***This animal died within 24 hours of completion of test.

earlier (Smith, 1950a) which was 2.65 pounds per hundred-weight. It is, moreover, less than the intake recorded for the animals being tested in 1954-55. In that winter all animals were fed a varied diet for a period of 18 days prior to the outset of the regular test diets. This was done to familiarize the student help with the technique and provide an opportunity for the animals to become accustomed to the species to be used. The average forage intake for four animals during this familiarization period was 2.7 pounds per hundred-weight of animal, varying from 2.1 to 3.4. In other years animals were supplied browse materials prior to the tests, but no records were kept of the amounts consumed.

The low intake of juniper and

sagebrush is of particular interest. The latter one especially has been found to be high in nutrients (Smith, 1950 and 1957). Moreover, it is held in high regard by many as a source of forage for deer. In previous tests, sagebrush appeared to be somewhat more palatable than did Utah juniper (Smith, 1950a; Smith and Hubbard, 1954). The data secured in the present feeding trials verify the approximate equality in palatability of these species, but tend to indicate slight superiority of juniper as a sustaining diet. This indication is contrary to conclusions drawn earlier from field observations.

Exclusive of those animals fed these two species alone or together, eight animals had access to sagebrush and juniper regularly as part of their daily ra-

tions. Of these, four ate larger quantities of sagebrush, and four ate more of juniper, thus verifying the approximate equality of these two species from a preference standpoint.

While these tests were being performed, it was noted that certain animals on a varied diet including the three major species as well as curleaf mahogany, bitterbush (*Purshia tridentata*), chokecherry (*Prunus virginiana* var. *melanocarpa*), birchleaf mahogany (*Cercocarpus montanus*), and cliffrose (*Cowania stansburiana*) ate fairly substantial amounts of sagebrush. Animal 1142 in 1954-55 consumed nearly a pound per hundred-weight (0.92) of sagebrush daily, nearly twice the average of those fed sagebrush alone. Animal 1132 in 1955-56 ate more sage-

brush (0.31 pounds per hundred-weight) than did two animals fed sagebrush alone. Furthermore, reference to Table 2 will show that when sagebrush and juniper were fed together, the average daily intake was almost identically the same as the sum of the average intakes of the two species when fed separately.

A similar situation exists in the case of juniper. In one instance the average intake per hundredweight of the species taken in combination with other forages compared favorably with consumption of juniper alone. Animal 1135, for example, while on a varied diet consumed 0.40 pounds of juniper per hundred-weight daily.

These data suggest the possibility that deer may have some limit for consumption of these species which is little affected by the other forage available. This point of view is given further weight by some observations of other deer which during 1956-57 were not being used in the feeding tests. These animals were being fed commercial livestock pellets and alfalfa hay as well as such browse material as was not consumed by the experimental animals. Invariably these animals left their hay and pellets to eat browse when it was placed in the pens, some animals preferring sagebrush to the artificial feeds. The same response was noted with juniper, but it was less pronounced.

It is interesting to note that although the amount of oak consumed was much greater than was the case either with juniper or sagebrush when fed alone, when these three were fed along with better forage plants this superiority is not evident. Thus, animal 1142 ate a relatively large amount of sagebrush, 457 grams daily, and but small amounts of either oak or juniper. Another, number 1135, consumed 225 grams daily of juniper and small amounts of oak and sagebrush. The other two animals on the

Table 2. Daily forage consumption by deer during course of feeding tests and nutritive content of diets

Diet	Winter conducted	Deer number	Daily consumption lbs./cwt. (air-dry)	Pounds TDN per cwt. of animal	Ratio
Sagebrush	1954-55	1135	0.48	.40	
	1955-56	1143	0.63	.52	
	1955-56	A419	0.27	.22	
	1955-56	1144	0.30	.23	
Juniper	Mean		0.42	.34	.24
	1954-55	A419	0.71	.45	
	1955-56	2399	1.40	.95	
	1955-56	A403	0.73	.48	
Oak	Mean	1144	0.26	.15	
			0.78	.51	.35
	1954-55	1143	3.56	1.24	
	1955-56	1141	1.74	.72	
Sagebrush & Juniper	Mean		1.82	.73	
		1132	1.96	.76	
			2.25	.86	.60
	1956-57	2399	1.10	.77	
Sagebrush & oak	Mean		1.07	.72	
		1143	1.46	.95	
		A410	1.23	.81	.56
	1956-57	A418	2.20	.79	
Juniper & oak	Mean		1.44	.55	
		A419	2.73	.99	
				.78	.54
	1956-57	A405	2.39	1.62	
Mixed species	Mean		1.80	1.38	
		1135	3.11	1.75	
		1132	1.79	1.02	
	Mean		2.25		1.00

varied diet ate more oak than either of the other species, but the amounts consumed were small and the differences not marked. These data further suggest that not preference, but a differential in the tolerance of deer for these three species, accounts for the difference in consumption when these species are fed alone.

Both sagebrush and juniper are known to exhibit great individual differences in palatability, for animals eat of some plants of either species but avoid others. In juniper, and presumably in sagebrush, this varied palatability appears to be related to the essential oil content of the individual plants (Smith, 1950c). In the case of juniper the evidence of selective foraging is obvious in the high-lined effect that

is produced on the selected plants, but this is not true with sagebrush. This factor may be expected to influence the results secured when these two species are compared under the conditions of this experiment, for it is not possible to be certain of supplying representative material of these variable species.

This inherent variability may account for the fact that the consumption of these two species in this study was much less than has been noted in previously conducted tests. Prior to the initial digestion trials in 1948, consumption of sagebrush in excess of two pounds per hundredweight were noted (Smith, 1950b). Similarly, one animal was observed to eat more than two pounds of juniper per hundred-weight (Smith, 1952). The pe-

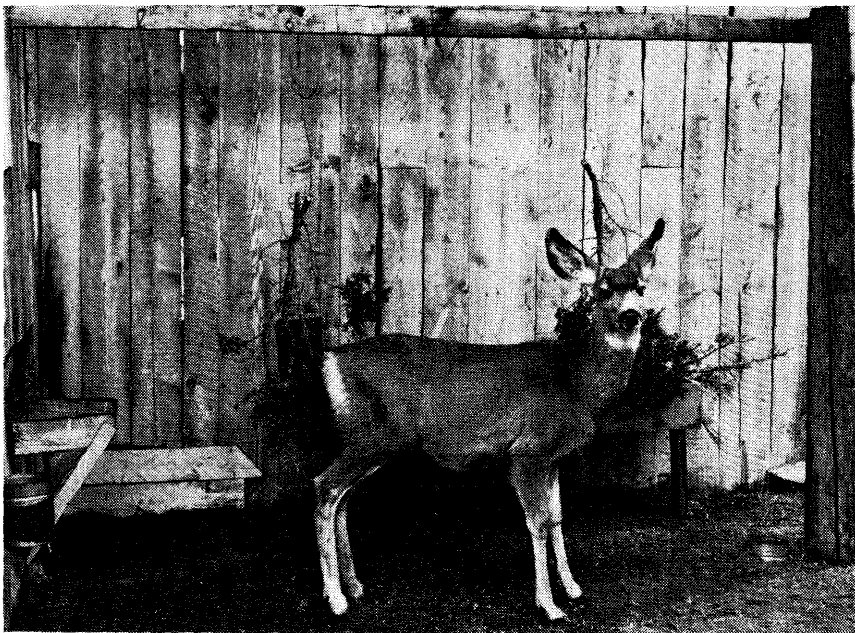


FIGURE 2. Yearling doe being fed juniper and showing signs of poor nutrition, 1956-57.

riods during which these consumption figures were noted were short, however. The possibility thus exists of selecting superior strains of these two species if we could learn to identify them in the field. This possibility takes on added significance as revegetation programs are undertaken on deteriorated ranges.

Nutritive Intake

Forage intake figures show a wide variation between the different diets. It is known, however, that wide differences exist between the digestible nutrients of the species used (Smith, 1957). Accordingly, the amounts of digestible nutrients actually consumed were calculated for the various diets (Table 2).

Sagebrush, for example, has a high level of TDN. On the basis of nutrient content, its value with reference to the other diets is improved somewhat. It produces about 40 percent of the total nutrients provided by oak, although the mean level of consumption between the two species differs by almost six times.

Neither sagebrush nor juniper provided a great amount of nutrients, but together they ap-

proached the level of nutrient intake of oak.

Because it was not possible to provide a balance of age classes of animals in sufficient numbers to provide adequate basis for determining mean values for these age classes, it is difficult to compare these nutrient levels with those recommended for domestic animals. Comparison of the data secured with those recommended for sheep (Pope, A. L. *et al.*, 1957) indicates that only two animals secured adequate nutrients. These were deer 1142 and 1135, mature animals fed on a varied diet. The other mature animal on this diet secured but 1.02 TDN per hundredweight of animal which is about 20 percent less than that required for a ewe of comparable weight. The fourth animal which secured more than one pound of nutrient per hundredweight was a juvenile fed oak, number 1143. Based upon the recommended amounts for lambs of comparable size, even the 1.24 pounds daily intake by this animal is only about half enough. Yet two of the animals fed oak lost but little weight (Table 1), in spite of the apparent inadequacy of the diets.

The findings suggest the impropriety of attempting final evaluations of range plants from the standpoint of content alone. Chemical analyses frequently have been used to rate forage plants. Without doubt considerable error is inherent in such a procedure. In the first place, gross analyses do not at all indicate the availability of the various chemical fractions to the animals. Moreover, as is shown in the data herein reported, even nutrient values provide incomplete pictures of the place of an individual species in support of a range or game animal.

Although sagebrush and juniper contribute heavily to the support of deer herds, neither appears to be satisfactory when it constitutes the sole item in the diet. Each would appear to be most valuable when other forage species are available to be taken in conjunction with them. Approximately one-fourth of the nutrient intake of the animals fed on a varied diet was supplied by sagebrush and juniper. Nearly one-sixth of the nutrients came from sagebrush alone. As better forage plants become limited it seems probable that these species can assume an even greater importance without ill effects to the animals.

Summary

During three winters mule deer were fed on prescribed diets of browse species common to Utah ranges. From the standpoints of distribution and abundance, sagebrush, juniper, and oak are the most important, although not the most preferred, browse species. These three species were fed singly and in combination. They were also included in diets which included all the more preferred browse forages.

The average daily consumption was lowest among the group fed sagebrush alone. Juniper was eaten in greater amounts. When

fed together, the mean level of consumption of these two species was equal to the sum of the amounts consumed when they were fed singly. No entirely satisfactory explanation can be found for the lower consumption of sagebrush and juniper in these as compared to earlier data.

Oak was eaten in quantity whether fed alone or together with sagebrush or juniper. However, it was not eaten well in comparison with the more preferred species making up the varied diets. Some animals on varied diets ate more sagebrush or juniper than they did oak.

The duration of feeding trials was least for sagebrush, second for juniper, and third for sagebrush and juniper together.

None of the diets appeared to be adequate in digestible nutri-

ents when compared to recommended allowances for domestic sheep. It may be improper, however, to expect to attain the levels of nutrition desired for domestic animals with game animals in the wild.

Neither chemical content nor digestible nutrients is an adequate measure of a plant's value as forage. Only when the reaction of an animal toward the plant is observed in comparison to other forages can its importance be assessed. Plants may have high value in a mixed diet, but may be inadequate as the sole source of forage.

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