

Preference Ratings for Winter Deer Forages from Northern Utah Ranges Based on Browsing Time and Forage Consumed

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THE increase of human habitation has resulted in a restriction of winter deer range throughout the West. This problem is particularly acute in northern Utah. Deer numbers have in many places increased concurrently with the decrease in available range, resulting in damage to urban as well as rural property, and high death loss among the animals. A knowledge of the preferences shown for the plants present on these ranges is desirable in the solution of these problems, and this need gave rise to the studies reported here.

Deer were held in captivity and fed browse plants during the winter of 1947-48 (Smith 1950). The preference ratings assigned in this study were based upon the comparative consumption of the species involved. This method is suitable only where animals may be held in captivity. Moreover, some question exists as to the validity of consumption data, as a basis for rating plants, for presumably these data integrate the ease with which forage may be secured with the preference of animals for the plant.

Forage preferences of game animals have been determined by field observations of the time spent in browsing (Dixon 1934, Robinson 1937, Snyder 1937, and Deen 1938). In an effort to relate time spent in browsing to the amount of herbage actually secured, both of these methods were tested under controlled conditions.

Methods of Study

Deer were held captive in pens and given free choice of several forage species. Four deer, two yearling does, a three-year-old doe, and a three-year-old buck were used during the first winter (1950-51). Four different deer were used the second winter (1951-52), a yearling buck and three yearling does.

The browse material was collected in the vicinity of Logan, Utah, as needed. Each species of browse was tied into three bundles. An attempt was made to include similar sized material in each of the three bundles. Each bundle was then weighed. One bundle was placed in the feeding pen for the deer to browse. The remaining two bundles served as checks to correct for losses or gains of weight due to factors other than browsing by deer, including transpiration and evaporation.

Bundles of several species were placed in feeding pens at the same time. Species were randomized as to their position in the feeding rack. If one species was completely consumed, it was replaced by another bundle of the same species. Every effort was made to have all species being studied available during the entire period of the feeding trial.

The deer were let into the feeding pens twice each day and allowed to feed as long as they chose. Only one deer was allowed in a feeding pen at a time. This procedure was continued for several feeding periods until fairly heavy utilization had

been obtained. The bundles were then removed and another trial begun.

An observer watched whenever the deer were in the feeding pens to record the time spent on each species and other pertinent observations.

During the first winter, four feeding trials were completed in late December and four during the latter half of March. Fifteen of the major winter browse species present in the vicinity of Logan were fed in each of the eight trials. It became apparent that accurate preference ratings could be determined for only those few species which were eaten in quantity. The remainder were so lightly browsed as to make comparative ratings hazardous. Moreover, the number of species handled complicated the problem of securing accurate records.

During the second winter the number of species fed was reduced to six. Four species which had been browsed upon 81 percent of the total feeding time during the first winter were believed to be reasonably well rated, and so were excluded from the second-year trials. These were: bitter-brush (*Purshia tridentata*), curlleaf mahogany (*Cercocarpus ledifolius*), a hybrid mountain mahogany (*C. ledifolius* x *C. montanus*), and cliffrose (*Cowania stansburiana*). The other exclusions were plants of uncommon occurrence, or plants which had not been grazed upon the first winter.

By reducing the number of species fed to six, it was possible to use a feeding design which gave a more precise measure of preference than could otherwise have been obtained. This plan is a balanced, incomplete block and has ten replications within each of two blocks, making a total of twenty trials. Three of the species studied were fed at a time. Each species was offered ten times in different combinations. (See Cochran and Cox 1950, p. 329, plan 11.5)

Table 1. Summary of feeding activity of deer during the winter of 1950-51 and consumption per minute during both winters

Species	1950-51 Feeding Activity ¹				Consumption Per Minute of Feeding (grams, air-dry)
	Number of periods fed upon	Average feeding time (minutes)	Maximum feeding time (minutes)	Number of times fed upon	
<i>Cercocarpus ledifolius</i> x <i>C. montanus</i> (hybrid mahogany)	14	2.9	19.0	152	6.6
<i>C. ledifolius</i> (curlleaf mahogany)	14	2.3	19.5	72	6.0
<i>Cowania stansburiana</i> (cliffrose)	13	1.1	9.5	86	4.5
<i>Purshia tridentata</i> (bitterbrush)	13	1.2	6.0	49	3.5
<i>Quercus utahensis</i> (oak)	13	0.7	4.0	47	3.1
<i>Cercocarpus montanus</i> (mountain mahogany)	12	1.5	7.0	19	3.3
<i>Salix exigua</i> (willow)	12	0.8	3.5	41	3.1
<i>Prunus virginiana</i> (chokecherry)	13	1.0	8.0	33	3.2
<i>Amelanchier alnifolia</i> (serviceberry)	12	0.4	2.0	21	2.3
<i>Juniperus scopulorum</i> (Rocky Mountain juniper)	9	0.4	1.3	32	5.8
<i>Chrysothamnus nauseosus</i> (rabbit brush)	2	1.0	4.5	20	4.1
<i>Artemisia tridentata</i> (sagebrush)	0	0	0	0	4.9 ²
<i>Acer grandidentatum</i> (maple)	5	0.2	0.5	5	—
<i>Sambucus coerulea</i> (elderberry)	5	0.6	2.5	6	—
<i>Juniperus utahensis</i> (Utah juniper)	3	0.2	0.7	5	—

¹ Fourteen feeding periods during 10 calendar days.

² Data available for 1951-52 only.

Results and Discussion

Feeding Behavior of Animals

While the notes made on feeding activity were intended primarily to discover the time spent feeding upon each species, it was possible to secure other data from them. Such data from the first year's observation are shown in Table 1. The data were based upon 14 feeding periods during 10 calendar days, two deer being observed at each period. The number of times fed upon is the number of visits to each species during which some browsing took place.

A considerable agreement exists between the different rankings, in

that for the more desired species the individual feeding period was long and the number of visits was large. However, ranking the plants according to any one column would give different results. Willow (*Salix exigua*), for example, would rate higher on the basis of the number of times it was visited than it would upon the average time it was fed upon. It is of interest to note that the average time spent foraging was less than a minute for 8 of the 15 species.

The data suggest problems that exist in evaluating species based upon limited observation. Sagebrush (*Artemisia tridentata*) was

not eaten during the tests made the first winter. Only once was it approached. During the second winter more time was spent upon it than upon juniper (*Juniperus scopulorum*). Rabbit brush (*Chrysothamnus nauseosus*) appears, from the data in Table 1, to be fairly attractive. However, on only one day was it browsed upon and except for a fraction of a minute, by only one of the animals. No satisfactory basis for objectively integrating such observations as this into the final rating suggests itself. Obviously, use of a plant essentially by one deer on one day, though fairly heavy, requires modification of the rating attained either on the basis of time or forage consumption. From our observations, it is not possible to know how often such sporadic occasions of heavy use of certain plant species occur.

Comparison of Feeding Minutes and Weight Consumed as Methods of Preference Ranking

Each of the species fed during the first winter's trials was ranked numerically both on the basis of total time spent and total weight consumed. The species tested during the second year of this study were ranked on the basis of adjusted means both for feeding minutes and weight eaten (Table 2).¹

The correlation between the two methods of ranking was determined for each year's data. The correlation was significant at a probability level of 1 percent for the first year's data and at 5 percent for the second year's data. Thus the two methods gave approximately the same preference ranking for the species tested.

In order to test the relative efficiency of the two methods of preference determination, the coefficients of variation of the individual species were computed for

¹ Adjusted means used because of the small number of degrees of freedom as outlined by Cochran and Cox, 1950, p. 324.

Table 2. Rankings of species based upon browsing time and forage consumption

Species	Numerical Rank Based On	
	Time spent	Weight of forage consumed
Winter 1950-51		
Hybrid mahogany	1	1
Curlleaf mahogany	2	2
Cliffrose	3	3
Bitterbrush	4	5
Oak	7	4
Mountain mahogany	8	9
Willow	6	6
Chokecherry	5	14
Serviceberry	11	10
Rocky Mtn. juniper	10	8
Rabbit brush	9	7
Sagebrush	15	13
Maple	13	12
Elderberry	12	11
Utah Juniper	14	15
Winter 1951-52		
Oak	1	1
Mountain mahogany	2	2
Chokecherry	3	3
Serviceberry	4	5
Rocky Mtn. Juniper	6	4
Sagebrush	5	6

both time spent and weight consumed. These coefficients were determined for the four species upon which the deer spent the greatest amount of time during the first year and for five species of the six tested during the second winter. Rocky Mountain juniper was not included in these calculations because there was some question regarding the accuracy of the weight record. Temperatures were sufficiently low to cause it to become brittle and shatter with handling. It is possible that part of the foliage was lost between weighings as a result.

Statistical analysis showed no difference between the efficiency of the two methods of preference rankings. Similarly the quantity of material consumed from the various species cannot be accurately esti-

mated by observation of feeding minutes, for deer consume forage from different species with varying degrees of efficiency (Table 1).

Probably neither feeding time nor forage consumed may be said to be entirely satisfactory as a basis for evaluating forage species. Under controlled conditions such as here existed, determination of feeding time is the simpler. It is doubtful, however, that accurate observations can be made in the field. Moreover, only if plants were equally rewarding for foraging effort would it be justified to consider time spent as a satisfactory rating index.

While forage consumption may not represent desirability of forage, within the limits of availability it probably comes nearer to evaluating the significance of the individual species. It must be recognized, however, that under the conditions existing in this study, determining forage consumption is laborious and few animals can be handled. Moreover, shattering of vegetation during handling may introduce some errors.

Unquestionably, the results secured during short feeding periods may be affected by conditions existing at the time of the test and may not be consistent with tests conducted over a long period of time. It will be noted that sagebrush was not observed to be eaten during the first winter. It was of considerable importance during the second winter as it was during the 1947-48 tests (Smith 1950a). Such behavior may relate to external factors or to seasonal changes in the desirability of the forage. During the course of feeding browse species there appeared to be some relationship between temperatures and consumption of sagebrush. Upon analysis, however, no correlation between the daily level of consumption of sagebrush and minimum or mean temperatures was found. It may

however, be significant that during the prolonged feeding period during 1947-48 consumption remained low until late in January rising after a period of sub-zero temperatures. Thereafter daily consumption remained high with few exceptions irrespective of the temperature until early in March. It would thus appear more likely that seasonal differences, perhaps in essential oil levels influenced by temperatures, may explain the erratic preference shown for this species.

Because of the shortcomings of either time-spent or consumption methods, the results of the present study were combined with the rankings as determined by the former study (Smith 1950). The following classification is proposed; which follows the numerical ratings secured except for rabbit brush:

Class I. Plants which are both preferred and productive of grazing effort

hybrid mahogany, curlleaf mahogany, cliffrose, bitterbrush

Class II. Plants either well liked but unrewarding or moderately palatable and productive of grazing effort

oak, mountain mahogany, willow, chokecherry, serviceberry

Class III. Plants of low palatability, acceptable in moderate amounts

Rocky Mountain juniper, sagebrush

Class IV. Plants lightly eaten or not at all except in the absence of other forages

rabbitbrush, Utah juniper, elderberry, maple

Summary

Feeding tests of captive deer were conducted during the winter of 1950-51 and 1951-52 in an effort to determine relative preferences of browse plants common to northern Utah. Data were secured on two bases, the time spent browsing each species and the amount of forage consumed. There was no relation between time spent feeding on a

species and the amount of feed obtained from it.

Neither basis is a completely reliable index to forage preference. However, volume consumed more closely relates to the diet and the importance of a plant as a source of forage under a particular set of conditions. Time spent browsing is not indicative of diet.

A proposed rating classification for winter browse is present which

is felt to be more meaningful than to attempt numerical ratings or to list plants in definite order of preference.

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