

Sagebrush on Relict Ranges in the Snake River Plains and Northern Great Basin

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In 1936, McArdle, et al., estimated the acreage of sagebrush in the western United States at 96 million acres. Following extensive reconnaissance, Beetle (1960) suggested that this estimate was much too low and that approximately 422,275 square miles (over 270 million acres) within 11 western states supported one or more species of sagebrush. Whatever the true extent of sagebrush may be, it is evident that it grows on a vast acreage and is a most important constituent of western range vegetation.

The original or climax status of sagebrush has been debated for many years. Early explorers and historians often gave conflicting reports of the abundance and even the presence of sagebrush along their routes of travel. Most who argue that sagebrush was or was not originally a dominant over much of the range it now occupies would undoubtedly agree that it has made some extension within its original range and that it has materially increased on much of the area where it originally occurred.

The qualitative and quantitative evaluation of sagebrush as it occurs on undisturbed native rangeland relicts is no doubt the most reliable method of determining its place in the potential

plant community for sites represented by those relicts. Such relicts are unfortunately too few to provide such information for all rangelands.

Weaver and Clements (1938), referring to Palouse grasslands now dominated by sagebrush, stated that the study of relict and protected areas proves that the grasses are climax and that they again assume dominance when grazing is reduced or eliminated. Cooper (1953) showed that sagebrush in the Big Horn

Basin of Wyoming was greatly reduced following only 8 years of deferred and reduced grazing. Stoddart and Smith (1955) stated that burning will not keep sagebrush out of an area normally dominated by sagebrush, but proper grazing and burning will keep it out of an area of natural grassland. On the Snake River Plains of Idaho, Blaisdell (1953) found that sagebrush normally becomes re-established following burning regardless of the amount of grass before burning or management after burning.

These and other evidences suggest that areas which may have had some grazing or disturbance in the past but which have been protected from use for long periods of time are also satisfactory reference areas from which the

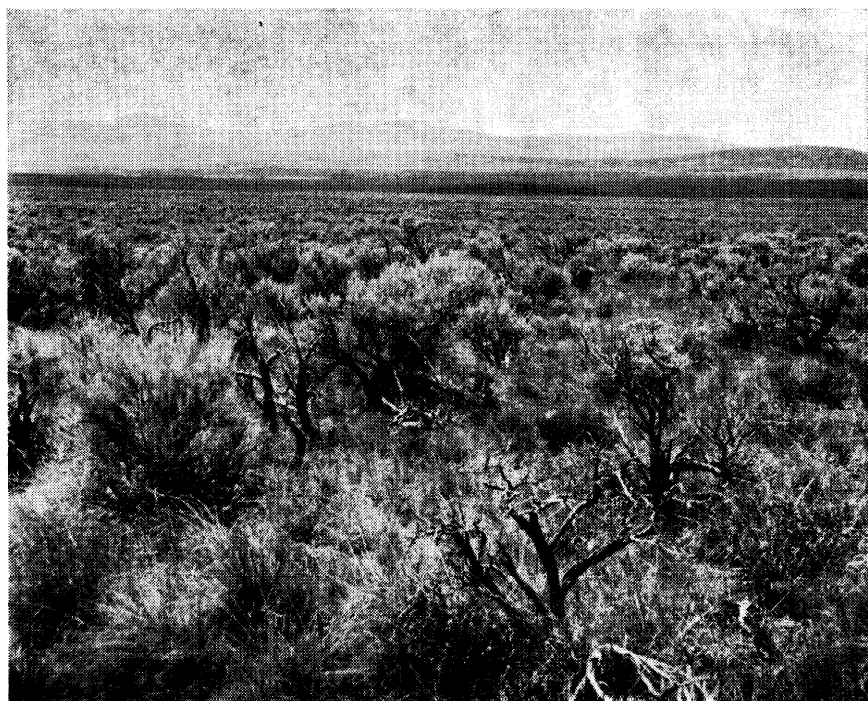


FIGURE 1. Big sagebrush savanna on Chestnut soil in northeastern Nevada.

Table 1. Presence and dominance of sagebrush species by great soil groups on relict range study locations.

Great Soil Group	Number of Relict Study Locations	Big Sagebrush		Threetip Sagebrush		Black Sagebrush		Low Sagebrush		Alkali Sagebrush	
		Locations Where Present	Locations Where Dominant Shrub	Locations Where Present	Locations Where Dominant Shrub	Locations Where Present	Locations Where Dominant Shrub	Locations Where Present	Locations Where Dominant Shrub	Locations Where Present	Locations Where Dominant Shrub
Zonal Soils											
Sierozem	5	5	5	1	0	0	0	0	0	0	0
Brown	16	16	15	6	1	0	0	0	0	0	0
Chestnut	18	18	12	4	3	2	2	2	1	1	0
Prairie	2	0	0	0	0	0	0	0	0	0	0
Intrazonal Soils											
Calcisol	11	10	10	0	0	1	1	0	0	1	0
Planosol	6	4	1	1	0	1	1	0	0	4	4
Solodized Solonetz	2	2	2	1	0	0	0	0	0	0	0
Azonal Soils											
Lithosol	6	6	6	4	0	0	0	0	0	0	0

true status of sagebrush may be approximated.

The purpose of this paper is to describe the kind, amount and nature of sagebrush as it occurs on pristine or long-protected relicts of native rangeland and the relationship of sagebrush to kinds of soil. The data presented were collected during the course of soil survey investigations conducted by the Soil Conservation Service from 1958 through 1961.

The Study Area

Studies were conducted on relicts of sagebrush-grassland vegetation on foothills and plains of the Great Basin in northern Utah, southern Idaho and northeastern Nevada and within portions of the Snake River drainage of southern Idaho. Elevation of the relicts studied ranged from 3100 feet in west central Idaho to 6400 feet in Nevada. Annual precipitation ranged from approximately 8 inches in parts of the Snake River Plains to 20 inches in west central Idaho with most of the moisture falling during the winter and early spring months. Winters are cold and summers are hot and dry. Ranges within the area of study are normally

grazed during the spring and fall months.

Methods

Through repeated and extensive reconnaissance several hundred areas of relict native range vegetation were located, examined and evaluated. A total of 66 of the least disturbed tracts on which the present vegetation most nearly represented the potential plant community for the site were selected for this study. Some of the selected relicts apparently had never been grazed or otherwise disturbed by man and none had been grazed, burned or otherwise disturbed for many years prior to the studies.

The soil on each study location was examined and described in detail in accord with procedures outlined in the Soil Survey Manual (Soil Survey Staff, 1951). Soils were classified into great soil groups (Baldwin, Kellogg and Thorp, 1938). Among soils studied were 41 zonal soils (5 Sierozem, 16 Brown, 18 Chestnut and 2 Prairie) and 25 intrazonal and azonal soils (11 Calcisols, 6 Lithosols, 6 Planosols, and 2 Solodized Solonetz soils).

The dominant species of shrubby sagebrush on each study location were recorded. Five species, all within the section *Tridentatae* Rydb. of *Artemisia*, occurred within the study locations. These included big sagebrush (*A. tridentata* Nutt.), threetip sagebrush (*A. tripartita* Rydb.), black sagebrush (*A. nova* Nels.), low sagebrush (*A. arbuscula* Nutt.) and alkali sagebrush (*A. longiloba* (Osterhout) Beetle). Table 1 indicates the dominant sagebrush on each soil. When two species of sagebrush occurred on a single study area, the location was grouped according to the more abundant species. No sagebrush was found on the two Prairie soils.

Total herbage production, by species, for all plants on each study location was determined by clipping herbaceous species at ground level and by clipping the current year's growth of shrubs on 3 plots of 9.6-square-foot area. The weight of each species was estimated on 20 additional plots of the same size located at random on the study location. Production was expressed in pounds per acre of air-dry herbage by the method described by Frischknecht and Plummer (1949). Species composition was expressed by the percent of the total herbage weight contributed by each plant species.

Both living and dead sagebrush plants were counted on a 1000-square-foot belt transect 200 feet long and 5 feet wide on each location. Age of the oldest big sagebrush plants on each location was determined by counting annual growth rings. Age of threetip, black, low and alkali sagebrush was not determined.

Form and growth habit of sagebrush plants and evidences of insect, disease or injury damage were recorded.

Average herbage production of all sagebrush, average percent of total herbage production con-

tributed by sagebrush, average number of living sagebrush plants per 1000-square-foot transect, and the average age of the oldest big sagebrush plants on all study locations dominated by each species within each great soil group are shown in Table 2.

Results and Discussion

One or more species of sagebrush were present on each study location except the two with Prairie soils. Two species were present on 26 locations and only one was present on 40 locations. Not more than two species were found on any location.

Even within the same great soil group, sagebrush stands varied as to size, number, productivity and spacing of plants. Stands were typically uneven-aged although mature plants were always in the majority. Most stands contained sufficient young plants to about offset the number of plants dying of old age, disease or injury. Numerous dead sagebrush stems, many partly decayed, indicated a continual replacement of plants within stands.

Stands dominated by big sagebrush were more or less open and formed a sagebrush savanna as described by Clements (1949). Big sagebrush plants were not uniformly spaced and stands were composed of unevenly distributed small clusters, groups or single individuals interspersed with irregularly shaped openings. Sagebrush plants were not as uniformly distributed as were the more numerous grasses and forbs with which they were associated (Figure 1).

Threetip sagebrush stands were more uniform and plants were more closely spaced than were big sagebrush stands. Scattered colonies of 20 to 50 small, closely spaced plants sometimes occurred within threetip sagebrush stands.

Plants in stands of black, low and alkali sagebrush were more closely and uniformly spaced

and were more numerous than were big sagebrush plants in stands dominated by that species (Figure 2).

Big Sagebrush

Big sagebrush occurred on 61 locations, was the dominant shrub on 51, and was the only sagebrush species on 35. It was the most common and most abundant species and occurred on the greatest number of soils. It was the most abundant on the drier and stonier soils. It was absent only on 2 Prairie soils, 2 Planosols and one Calcisol.

Threetip Sagebrush

Threetip sagebrush occurred on 17 locations with a wide variety of great soil groups.

Black Sagebrush

Black sagebrush was dominant

Table 2. Average production, percent composition, number, and maximum age of sagebrush in relation to great soil groups and dominant sagebrush species.

Dominant Sagebrush Species	Great Soil Group	Number Relict Study Locations	Average Sagebrush Herbage lbs./Ac. ¹	Average % Comp. All Sagebrush ²	Average Sagebrush Plants/1000 Sq.Ft. ³	Average Age of Oldest Plants ⁴
Big Sagebrush	Zonal Soils					
	Sierozem	5	145	23	109	100
	Brown	15	110	14	47	66
	Chestnut	12	122	10	57	39
	Intrazonal Soils					
	Calcisol	10	111	12	78	49
	Planosol	1	47	9	28	27
Threetip Sagebrush	Solodized Solonetz	2	146	39	164	96
	Azonal Soils					
	Lithosol	6	103	16	29	100
	Zonal Soils					
	Brown	1	92	17	214	—
	Chestnut	3	112	14	74	66*
	Black Sagebrush					
Black Sagebrush	Zonal Soils					
	Chestnut	2	205	25	219	47*
	Intrazonal Soils					
	Calcisol	1	110	24	164	—
Low Sagebrush	Planosol	1	322	50	480	51*
	Zonal Soils					
	Chestnut	1	144	19	167	46*
	Alkali Sagebrush					
Alkali Sagebrush	Intrazonal Soils					
	Planosol	4	108	17	174	—

¹ Average dry-weight herbage of all sagebrush species.

² Average % of total herbage contributed by sagebrush.

³ Includes all species of sagebrush.

⁴ Age determined for big sagebrush only.

* Age of big sagebrush on or near study location.

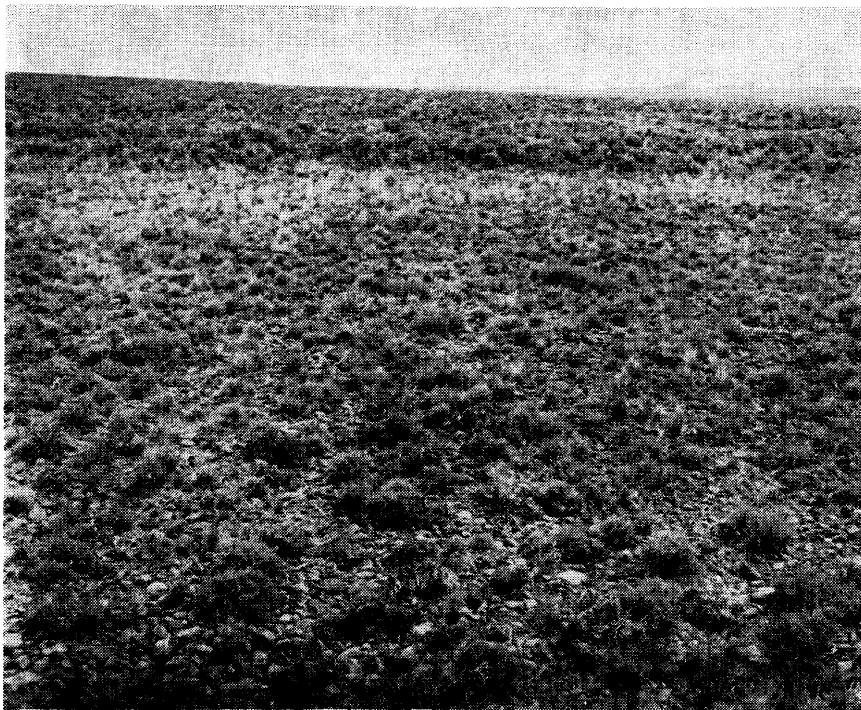


FIGURE 2. Alkali sagebrush on planosolic soil in southern Idaho with big sagebrush growing on Brown soil in background.

on each of the 4 locations where it occurred but was associated with big sagebrush on 3 of these. It was the dominant sagebrush on 2 Chestnut soils, one Calcisol and one Planosol.

This species is commonly associated with shallow, stony, dry soils (Kearney and Peebles 1951, Davis 1952, Thatcher 1959, Beetle 1960). All soils on which it occurred in these studies were at least moderately deep and only two were gravelly or stony. It was common on a very deep Chestnut silt loam soil and formed a dense stand on a Planosol with a very slowly permeable silty clay horizon at 11 inches. These occurrences point to the probability that this species is adapted to a much wider range of soil conditions than is commonly believed.

Low Sagebrush

Low sagebrush occurred on only two study locations, both on stony Chestnut soils where it was associated with big sagebrush. It was the dominant shrub on only one of these locations.

Alkali Sagebrush

Alkali sagebrush was the dominant shrubby species on 4 Planosols and was the only sagebrush species on two of these locations. It was also present in small amount on a Calcisol and on a Chestnut soil.

Although Beetle (1960) associated this species with "poorly drained or tight, and highly alkaline soils", the present studies do not bear out this relationship. On the contrary, the 4 Planosols on which the species dominated were classed as slightly acid to only slightly alkaline in reaction. The pH of surface horizons of these soils (as determined by field methods) ranged from 6.3 to 6.8 and the highest pH rating of any horizon of these soils was only 7.9. These Planosols do have imperfect drainage and could be classed as "tight" because of their fine textured B horizons but they are certainly not "highly alkaline".

Herbage Production and Composition

Sagebrush produced from 47 to

322 pounds of air-dry herbage per acre and from 9 to 50 percent of the composition on the locations studied. (Table 2). Both production and composition varied considerably among great soil groups and among stands dominated by different species of sagebrush.

Lowest production (47 pounds) and lowest percent composition (9 percent) was on a Planosol dominated by big sagebrush. Highest production (322 pounds) and highest percent composition (50 percent) was on a Planosol dominated by black sagebrush.

Number of Plants

Numbers of sagebrush plants per 1000-square-foot transect varied with species, age and size of plants as well as with soils. The average number of live sagebrush plants per transect on locations dominated by big sagebrush was 164 on Solodized Solonetz, 109 on Sierozem, 78 on Calcisols, 57 on Chestnut, 47 on Brown, 29 on Lithosols and 28 on Planosols.

On soils dominated by threetip sagebrush, there was an average of 74 plants per transect on Chestnut and 214 on Brown soils.

Black sagebrush stands contained an average of 219 plants per transect on Chestnut soils, 164 on Calcisols and 480 on Planosols.

A total of 167 sagebrush plants per 1000 square feet was recorded on the Chestnut soil on which low sagebrush was the dominant shrub.

An average of 174 plants per transect was counted on the 4 Planosols dominated by alkali sagebrush.

As a rule, threetip, black, low and alkali sagebrush plants were much smaller than big sagebrush plants and, where dominant, they were comparatively more numerous.

Age of Plants

Big sagebrush plants with 90 or more annual growth rings

were recorded on 9 study locations. The oldest plant observed had 120 rings and was growing on a Sierozem soil. The average age of the oldest big sagebrush plants on locations within each great soil group was greatest on the Sierozem (100), Solodized Solonetz (96), Lithosols (73), and Brown soils (66). Average maximum ages were lowest on Planosols (27), Chestnut soils (39) and Calcisols (49).

The oldest big sagebrush plants occurred on the drier soils. The present studies agree with the observations of Beetle (1962) that age and size of big sagebrush are unrelated. Most of the largest plants were relatively young, had soft wood with widely spaced rings and had long, slender branches. The oldest plants were short and broad, had very dense wood with closely spaced growth rings and had short, stout branches and twigs.

Changes in Stands

Sporadic infestations of larvae of the sagebrush moth (*Aroga websteri* Clarke) were observed to kill or seriously weaken many mature big sagebrush plants on local areas. An example of the effect of these insects is illustrated by results of a study on a Brown soil in northern Utah. Big sagebrush produced 143 pounds of herbage per acre and 14 percent of the total herbage yield on this location in 1958, but only 46 pounds of herbage and 6 percent of the total yield in 1960 following a moth infestation. The decline in productivity was due to death of some plants and to lowered vigor of surviving plants.

The presence of dead big sagebrush plants of mature form but which were not old enough to have become naturally decadent suggests that the sagebrush moth is a factor influencing temporary fluctuations in the number and production of big sagebrush plants.

Sagebrush populations on specific soils apparently are not static but may be expected to fluctuate as they are affected by insects, disease, fire or climatic factors even on areas undisturbed by man.

Summary and Conclusions

Vegetation and soils were studied on 66 pristine or long-protected areas of relict native rangeland on foothills and plains of southern Idaho, northern Utah and northeastern Nevada. Qualitative and quantitative values of five species of sagebrush on these locations and their relationship to great soil groups were reported.

One or more species of sagebrush occurred on 64 of the 66 study locations. Sagebrush was present on all zonal Sierozem, Brown and Chestnut soils, on all intrazonal Calcisols, Planosols and Solodized Solonetz, and on all azonal Lithosols but did not occur on either of the zonal Prairie soils included in the studies. Species dominance, number, age, herbage production and percent of total herbage production of sagebrush varied within and between great soil groups.

Sagebrush stands were uneven-aged but were dominated by mature plants. Stands dominated by big sagebrush were open and plants were unevenly distributed to form sagebrush savannas. Plants were more closely and more uniformly spaced in stands dominated by threetip, black, low and alkali sagebrush than on stands dominated by big sagebrush.

Big sagebrush occurred more frequently and on a greater variety of soils than did any other sagebrush species. Alkali sagebrush appeared to be the most specific of any species in soil requirements and occurred in dominance only on slightly acid to slightly alkaline Planosols.

Sagebrush produced from 47

to 322 pounds of air-dry herbage and contributed from 9 to 50 percent of total herbage production on those soils where it occurred. The number of sagebrush plants per 1000 square feet of area ranged from 28 to 480.

The oldest big sagebrush plants grew on the driest soils. Size and age of big sagebrush were unrelated.

Even on lands protected from grazing use, the amount and species of sagebrush within a stand may fluctuate because of the influence of insects, disease, fire or climatic factors.

The studies indicated that sagebrush may be a component of the climax or potential native plant community on many of the soils within the area of study.

The data presented will be useful in the technical description of range sites represented by the relicts and, through interpolation and extrapolation of these data, the place of sagebrush in potential native plant communities may be approximated for range sites not represented by suitable relict areas. These data also have value as a basis for planning sagebrush control measures on rangelands.

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