THE SAGEBRUSH REGION IN IDAHO

a problem in range resource management

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Contents

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Sagebrush-grass vegetation makes up one of the largest range types in the western states. It is also a type that has been much altered since the time of first settlement by white man. Thirty years ago, 85 percent of the more than 96 million acres in the sagebrush-grass zone was classed as severely depleted, with only two percent in good condition (USDA, Forest Service, 1936). Some improvement has occurred since that time, but the fact remains that today the sagebrush region is producing far below its potential (Fig. 1). This deteriorated condition is primarily a result of heavy and uncontrolled grazing in early days, aided by widespread fires and by cultivation and abandonment of marginal crop lands.

These extensive and drastic changes in the sagebrush vegetation have created many problems in range resource management. The primary problem is low forage production caused by the reduction or elimination of palatable grasses and forbs. The removal of herbaceous species has been accompanied by an increase in size and vigor of sagebrush and other woody species of low forage value, producing a "sagebrush desert" type familiar to all who travel through the region (Fig. 2). Such stands often produce less than 100 pounds of air-dry forage per acre annually, compared to original yields of 400 to 800 pounds or more.

In other areas, the destruction of sagebrush by fire accompanied by heavy grazing of perennial forage species has converted extensive areas into annual grass ranges (Fig. 3). The principal plant in this altered type is cheatgrass **(Bromus tectorum)**. While ranges dominated by this introduced annual provide fair forage for spring use, they are inferior to perennial grass ranges because of much greater fluctuations in annual production. Two other undesirable features of cheatgrass ranges are their great susceptibility to fire and to invasion by unpalatable or poisonous plants. It is estimated that the fire hazard on ranges in the sagebrush region has been increased 500 times by their conversion to cheatgrass (Platt and Jackman, 1946).

Poisonous and noxious weed problems are common on depleted ranges of the sagebrush zone. The poisonous annual halogeton **(Halogeton glomeratus)** has invaded both this type and adjacent salt-desert shrub ranges. Russian thistle **(Salsola**

Fig. 1. The original sagebrush-grass vegetation had an understory composed primarily of perennial bunchgrasses with a sprinkling of showy forbs. The amount of sagebrush was not static but varied with the history of the area, e.g. occasional fires, insect infestations and natural replacements.

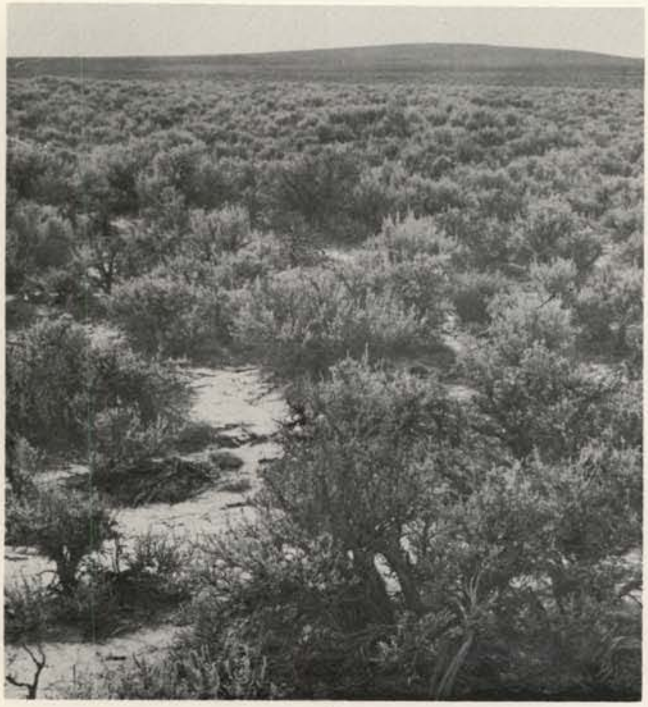

Fig. 2. The "sagebrush desert" of today is the result of loss of herbaceous understory by abusive grazing. The return of native understory species is slow because of the "closed community" effect produced by the sagebrush.

Fig. 3. Repeated burning accompanied by abusive grazing converted the original sagebrush-grass to an annual grass type. Re-establishment of sagebrush occurs if a seed source is available and the area is protected from fire.

pestifer) and tumble mustard **(Sisymbrium altissimum)** dominate the early stages of plant succession on abandoned fields and depleted ranges in the sagebrush region. These plants harbor an insect that is the carrier of curly leaf mosaic, a serious disease of crops in the irrigated areas of the sagebrush region (Piemeisel, 1945). On other ranges converted to annuals, the current major problem is the rapid increase of medusahead **(Taeniatherum asperum** syn. **Elymus caput-medusae).** This unpalatable annual grass is now abundant in California, Idaho, and Oregon. In Idaho alone it has replaced cheatgrass on nearly three-quarter million acres with a consequent marked reduction in grazing capacity (Hironaka, 1961).

Another problem arising from range depletion is that of soil erosion. While many sagebrush ranges show few signs of accelerated erosion, others have been seriously affected. On steeper slopes, serious floods have originated due to rapid runoff from depleted sagebrush ranges, especially those which have been converted to annuals and which are likely to be burned.

These problems of low forage production, increased noxious weed and insect pest populations, high fire hazard, soil erosion, and excessive runoff arise from poor range condition. The sagebrush ranges must be rehabilitated so that desirable species can utilize the resources of each site. This task will be a difficult one — not only because of the advanced stage of depletion of much of this range, but also because of its variability. The sagebrush region, once assumed to be relatively uniform, actually contains a large number of subdivisions or types, determined by differences in climate, soil, and topography. Many of these types are characterized by the dominance of a single species or subspecies of sagebrush, along with associated grasses and forbs. Effective improvement and management of sagebrush ranges require a thorough understanding of the natural and inherent productivity of these vegetation-soil complexes and their response to various management practices.

With this in mind, a coordinated program was started in 1954 by representatives of the land grant universities of Idaho, Oregon, and Washington as a contributing project to Western Regional Project W-25*, "The Ecology and Improvement of Shrub-Infested Ranges." Objectives of this tri-state effort are:

1. To describe the major ecosystems of the sagebrush region and determine the factors responsible for their differences.
2. To determine the changes produced in these ecosystems by fire, grazing, or other biotic factors and by climatic fluctuations.
3. To evaluate the present and potential productivity of the ecosystems recognized.

*Project W-25 was terminated in 1966 and replaced by Project W-89, "Characterization of Habitat-types of Sagebrush Ranges.'

Characteristics of the Sagebrush Region

Sagebrush vegetation extends over much of eastern Oregon, southern Idaho, Utah, and Nevada, western portions of Montana, Wyoming, and Colorado, and smaller areas in southwestern Canada, Washington, California, Arizona, and New Mexico. "Sagebrush" includes the species, all woody, which compose the section **Tridentatae** Rydb. of the genus **Artemisia.** The terms "sagebrush zone" and "sagebrush vegetation" designate those communities in which a sagebrush species is one of the dominants on relatively undisturbed areas.

The total area of sagebrush vegetation has been estimated at 96.5 million acres (USDA, Forest Service, 1936). While this appears too low, the estimate of 270 million acres by Beetle (1960) seems high. Beetle's estimate apparently includes all areas which support even a modicum of sagebrush, regardless of its relative importance in the community. Under this concept many adjacent communities, including the pinyon-juniper zone and some salt-desert shrub types, could be included as "acreage of sagebrush." While this method is useful in describing the total range of sagebrush, it does not define the region of sagebrush dominance.

Sagebrush vegetation or seral types derived from it currently occupies about 17 million acres in Idaho. In addition, some 8 million acres of the sagebrush type have been brought under cultivation for dryland or irrigated crop production. Thus, the area of climax sagebrush vegetation in the State was approximately 25 million acres. Before white settlement, sagebrush vegetation occupied most of Idaho south of the central mountainous region of coniferous forests (Fig. 4). It is still the largest grazing region in Idaho, and the major source for spring, fall and often summer range.

Physiography and Geology

Physical features of the geomorphic provinces of Idaho (Fig. 5) are described in detail by Ross and Savage (1967). The dominant physical feature is the arc-shaped Snake River Plain (4A and 4B, Fig. 5), 360 miles long and 50 to 80 miles wide. It is dominantly a basalt lava plain gradually rising from less than 2,300 feet in elevation at the Idaho-Oregon border to 6,600 feet at the Wyoming border. The Malheur Section (4B, Fig. 5) is composed of sedimentary deposits with some basalt lava flows. The dominating sedimentary deposits are found in smooth, broad terraces and fans. The eastern section of the plain (4A, Fig. 5) is almost completely covered by late Pleistocene and Recent basalts.

The Owyhee Upland Section (4C, Fig. 5) borders the plain on the southwest and is a plateau 4,000 to 6,000 feet in elevation interrupted by mountain masses of granitic origin rising to 8,000 feet. The plateau rock formations are dominantly Idavada silicic volcanics made up of welded tuffs and rhyolites, intermixed with basalt flows older than those of the Snake River Plain.

East of the Owyhee Upland Section lies the northern end of the Basin and Range Province (3, Fig. 5), characterized by mountains separated by open valleys oriented in a north-south direction. These mountain ranges are composed of old Cretaceous sedimentary rocks.

The Snake River Plain is bordered on the east by the Middle Rocky Mountain Province (2, Fig. 5). The northern part of this Province comprises the Yellowstone Plateau, which is formed of silicic rhyolites and welded tuffs. The southern part consists of mountain ranges composed of Paleozoic and Mesozoic sedimentary rocks. These mountains are similar in many respects to those of the Basin and Range Province.

Most of the area that lies to the north of the Plain is classified as the Northern Rocky Mountain Province (1, Fig. 5). The southeastern portion of this Province is characterized by parallel mountain ranges composed of Paleozoic sedimentary rocks, intermingled with silicic volcanics of the Challis and Idavada formations. The outstanding feature of the broad intervening valleys is the extensive glacial outwash fans. The southwestern parts of this Province are composed predominantly of granitic rocks of the rugged Idaho Batholith.

Along the northwest side of the Snake River Plain is the Seven Devils Section (4D, Fig. 5) of the Columbia Plateau Province. The plateau portion of this Section is composed of tilted basalts related to the Columbia River basalts but older and more strongly weathered than most of those that occur in the Snake River Plain.

Climate

The sagebrush-grass region in Idaho receives between 8 and 20 inches of precipitation annually, with most of the precipitation occurring during the winter months (Stevlingson, 1959). Mean annual temperatures range between 37 and 52°F.

Factors that influence climate within the State are latitude, location with respect to the Pacific Ocean, mountain barriers, prevailing winds, and variation in elevation. Atmospheric high pressure systems frequently extend outward from Nevada and Utah into Idaho during winter. These highs often form a barrier to eastward-moving, low-pressure systems from the Pacific and storms are

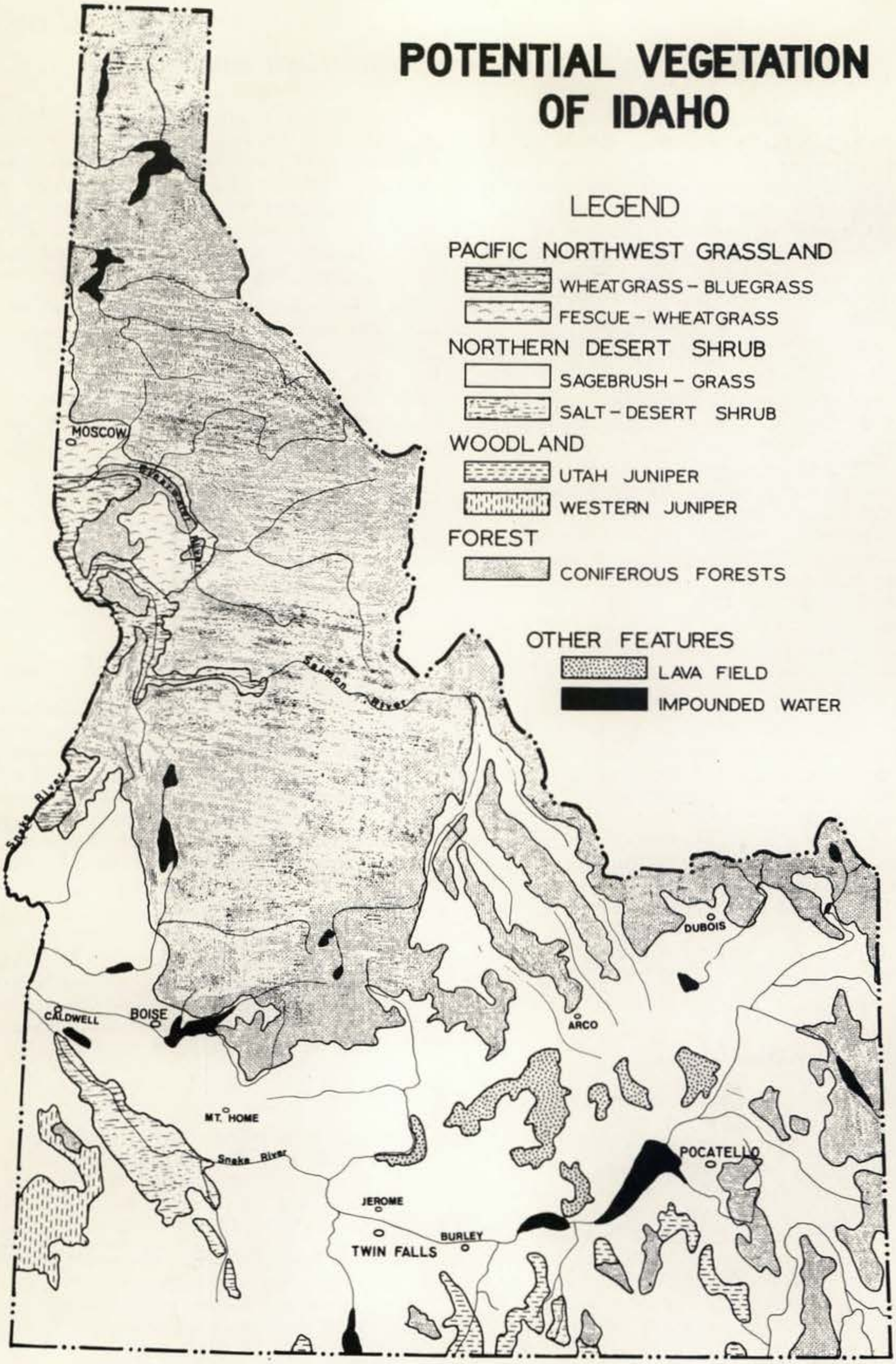

Fig. 4. Sketch map showing major potential vegetation types of Idaho. Revised from Kuchler (1964).

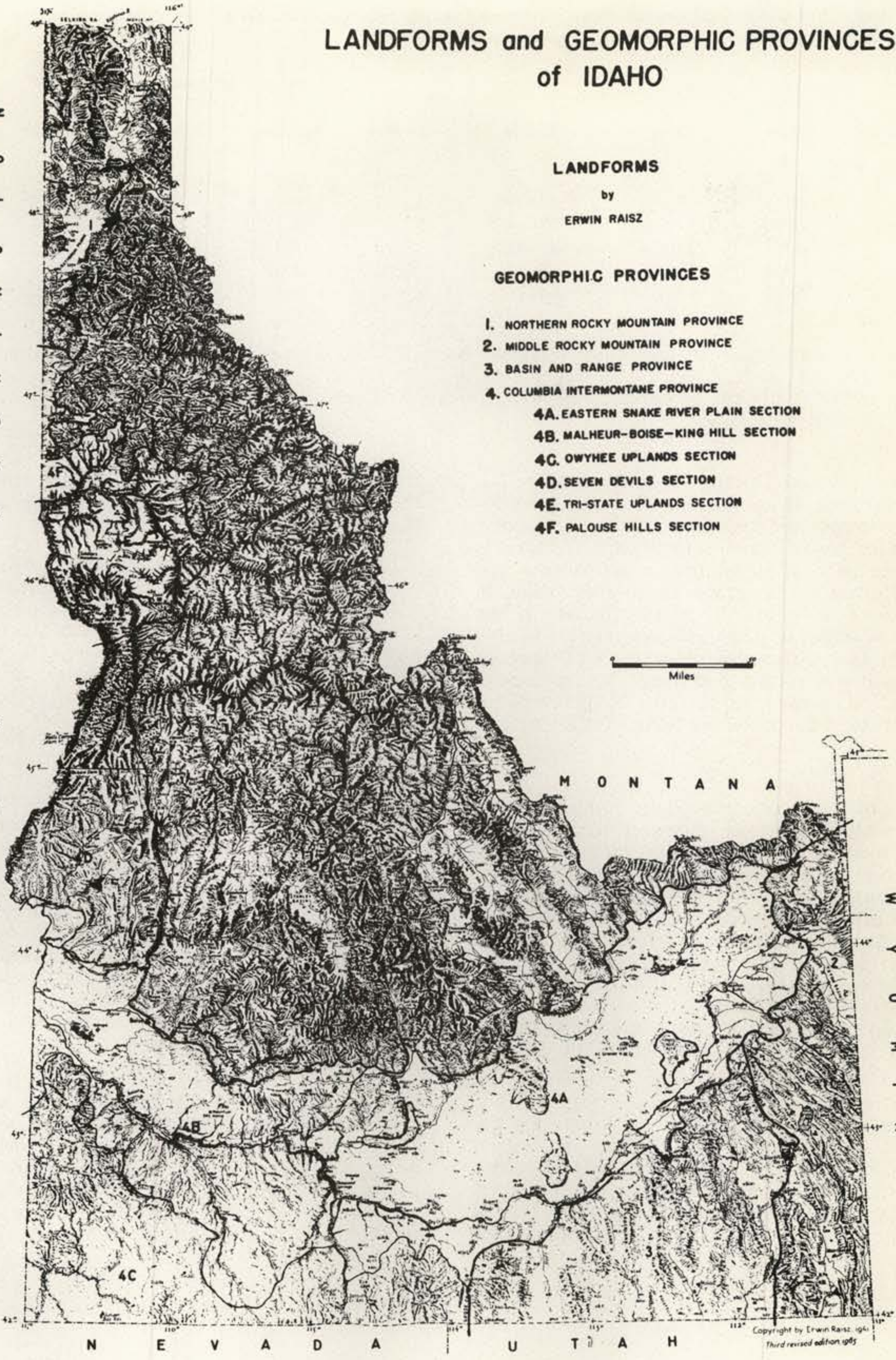

Fig. 5. Landforms and geomorphic provinces of Idaho. From Ross and Savage (1967).

Table 1. Distribution pattern of precipitation expressed as percentage of mean annual precipitation for six weather stations at different longitudes in southern Idaho.[1]

Location	Elev	Long W	Lat N	Percent of annual precipitation: Jan-Mar	Apr-June	July-Sept	Oct-Dec	Mean annual precipitation
	(ft)							(in.)
Caldwell	2370	116°41′	43°40′	35.06	27.05	7.16	30.72	10.61
Mt. Home	3180	115°41′	43°07′	34.28	29.49	7.85	28.35	8.78
Jerome	3785	114°31′	42°44′	35.85	26.15	8.34	29.65	8.80
Burley	4180	113°47′	42°32′	33.33	27.64	10.91	28.10	8.61
Arco[2]	5320	113°19′	43°38′	25.58	32.87	19.38	23.98	9.34
Dubois E. S.	5462	112°12′	44°15′	21.66	36.56	19.56	22.21	10.94

[1]Source: U. S. Department of Commerce. Weather Bureau. Idaho climatological data — annual summary 1965. Vol. 68, No. 13.

[2]Source: U. S. Department of Agriculture. 1941. Climate and man, the yearbook of agriculture. Government Printing Office, Washington.

deflected northward. During summer, penetration of storm systems from the Pacific is at a minimum and summer precipitation occurs principally from thunderstorms. The eastern part of Idaho is often in the path of moist upper air masses and summer storms occur more frequently than in other parts of the state. This is reflected in the difference in seasonal precipitation pattern (Table 1). Eastern Idaho receives more than 50 percent of its annual precipitation during the April-September period, compared to only 35 percent for the same period in other portions of the state.

Soils

The soils of the sagebrush-grass region in Idaho exhibit greatly different characteristics in response to a number of formative factors. Differences in topography result in well-marked zonation of climate, vegetation, and soils. Variation in parent material due to extensive loessial and alluvial deposits and weathering of local rock formations contributes further to soil differences. Superimposed on these influences is the great variability in age of these soils and the striking effects of local solifluction and erosion during periods of periglacial climate. The distribution of Idaho's zonal soil groups is outlined in Fig. 6.

Soils in the Malheur Section of the Snake River Plain are developed mainly from sedimentary deposits that are mixed with a shallow deposition of loess. Sierozems are extensive. Soil development is strongly influenced by varying amounts of exchangeable sodium and soluble salts. Solodized Solonetz or slick-spot soils are widely distributed in this zone and are easily identified by their lack of vegetation due to high concentrations of sodium and soluble salts.

In the eastern section of the Snake River Plain, most soils are developed in moderate to deep silty, calcareous loess. Sierozem and Brown soils predominate but some Chestnut soils occur. In the dry southeastern valleys adjacent to the Plain, soils are similar except that many have lime to the surface and show influence of salts.

Adjacent to the Snake River Plain, the soils are generally darker due to higher organic matter content, the effect of greater productivity resulting from more favorable growing conditions. Most of the soils in the Middle Rocky Mountain Province and in the valleys of the Basin and Range Province are weakly developed from deep silty loess. The soils in the hills and mountains throughout the remaining area are extremely variable. They generally range in depth from 20 to 40 inches and vary in texture from clay to loamy sand in the B horizon, depending on the geologic origin of the parent material, age of development, and the effects of Pleistocene periglacial climates (Malde, 1946; Fosberg, 1965).

Preserved in the soil is a record from which may be interpreted (1) the influence soil has on the distribution of species of importance, such as sagebrush (Fosberg and Hironaka, 1964), (2) the geographic distribution of native vegetation prior to its alteration and destruction by man's intervention, (3) relative productivity, and (4) an interpretation of present day climates.

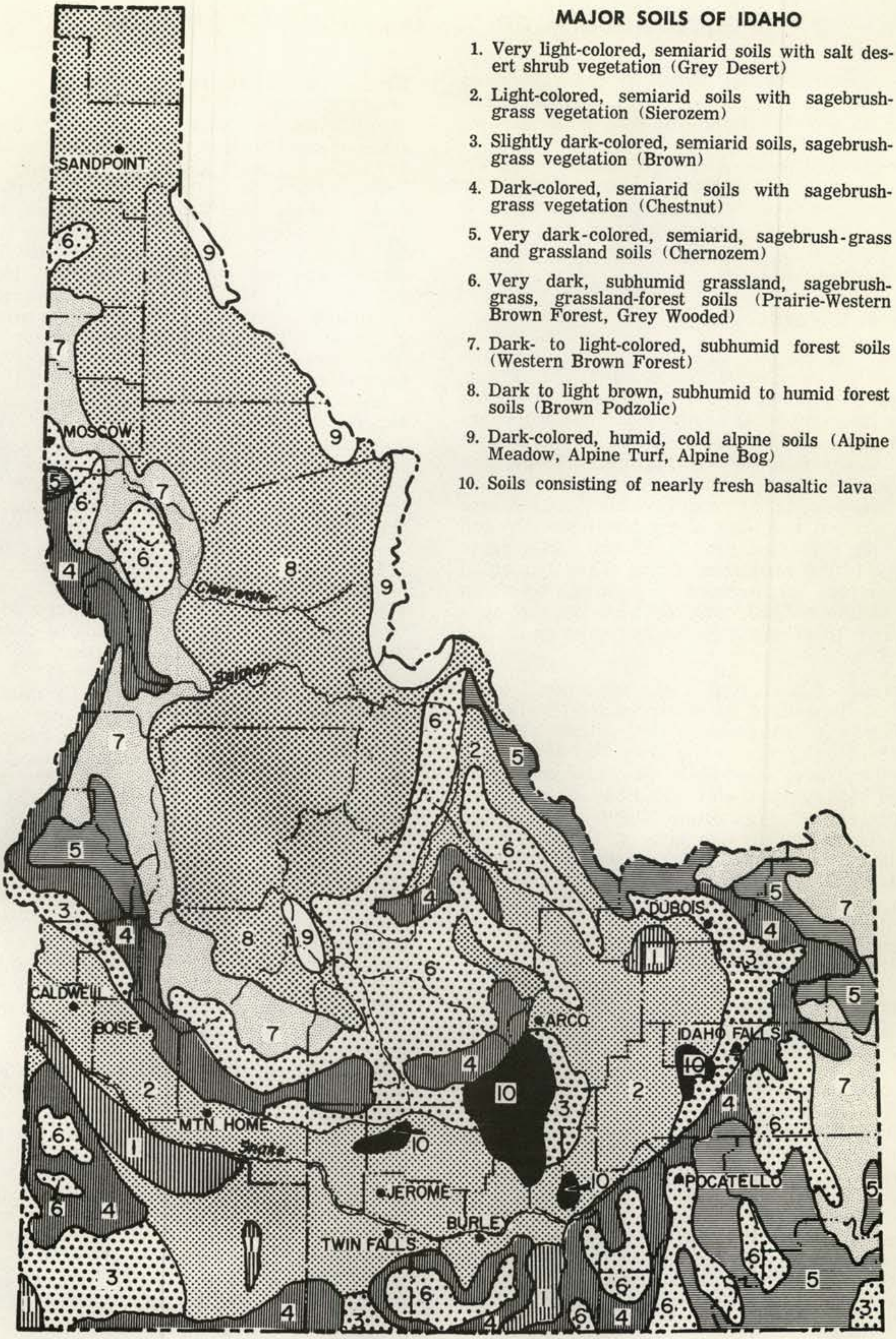

Fig. 6. Distribution map of major kinds of soils in Idaho. Revised from Ross and Savage (1967).

Vegetational Composition and Use History

To understand the potential of the sagebrush zone for multiple use management, we must learn as much as possible about the nature of the native plant cover and soils under relatively undisturbed conditions. Although this vegetation has been greatly altered since the beginning of settlement, two sources of information are available — the records of early explorers and travelers and study of "relict" areas which have escaped major disturbance.

Historical Records

Publications by early travelers in the sagebrush region differ greatly in the amount of information they give about native vegetation. The most detailed records of the northern part of the sagebrush region are in the journals of Townsend (1834), Wislizenus (1839), Fremont (1845), the U. S. War Department (1855), Hayden Expedition (1879), Merriam (1890), and Russell (1902). These parties crossed the area along the main Oregon Trail or its branches, and in several cases made side trips to the north and south. They traversed large portions of western Wyoming, southern Idaho, northern Utah, and eastern Oregon at a time when little disturbance by white man had occurred.

Appraisal of this region varied among these observers, depending on their backgrounds, the particular area traversed, and the time of year. All agree on one major feature: the abundance of sagebrush over essentially the same area now occupied by this type of vegetation or its successional derivatives. Wislizenus (1839) mentions the change, near the present site of Casper, Wyo., from plains vegetation to a type characterized by "the constant presence of wild sage, **Artemisia columbiana**" (an early name for **A. tridentata**). Fremont (1845) described sagebrush as abundant beginning at a point just west of Fort Laramie and continuing west across Wyoming and southern Idaho. At several places he mentions the difficulty of wagon travel through the dense sagebrush, and describes the Snake River Plains west of Fort Hall as a "great sage plain."

Less reference is made to the herbaceous understory of the sagebrush vegetation. These travelers came from the eastern part of the country and were impressed by the drier climate and sparser growth found west of the Great Plains. Also the normal timing of these expeditions brought them to the sagebrush region in mid-summer when most herbaceous plants were mature and dried up. As a result, their descriptions of the sagebrush area stress the "barren" or "desert" aspect of the region, and the "sandy" or "sterile" nature of the soils. On the other hand, Russell (1902, pg. 23), who saw the area earlier in the year, states that "Beneath the sagebrush in a state of nature nutritious bunchgrass grows abundantly."

Undisturbed Areas

A continuing search for relatively undisturbed areas of sagebrush vegetation has revealed a number of such stands which range in size from 1 to 200 acres and occur under a wide variety of climatic and soil conditions. These areas, because of difficulty of access, lack of water, or other factors, have escaped serious disturbance. Their vegetation and soil conditions may not be pristine, but they display a condition of stability and of maximum development under the prevailing climatic conditions. All of these stands possess a woody species of sagebrush as one of the dominant elements of the plant cover, and an understory dominated by perennial grasses, along with varying amounts of perennial forbs. The nature and amount of understory vary from climatic and soil conditions, but in all cases there appears to be a natural balance between sagebrush and herbaceous perennials. Introduced annuals such as cheatgrass, medusahead, halogeton, or other weedy species are unimportant, in some cases not present at all.

The evidence from historical records and current study of relatively undisturbed sites supports this view of the sagebrush region:

1. The geographic area currently dominated by woody species of sagebrush or successional types derived from this kind of cover is essentially the same today as in presettlement times. The data do not support the idea of large-scale invasion of grassland areas by sagebrush, although local spread appears to have occurred on meadows where the water table has been lowered (Cottam and Stewart, 1940) and on some upland areas (Cooper, 1953).

2. Since sagebrush is a natural part of the vegetation of this region, it is not likely to disappear under normal grazing practices or even total protection, although it may be reduced by special treatments such as heavy fall grazing of sheep (Mueggler, 1950; Laycock, 1961).

3. Sagebrush will tend to return on areas from which it has been removed by fire, herbicides, cultivation, or other means. This recovery may be very slow on sites where no readily available seed source remains.

4. Because of its ecological position as a dominant, sagebrush competes strongly with herbaceous understory plants. Sites from which herbaceous vegetation has been almost or wholly eliminated develop vigorous stands of sagebrush which may delay indefinitely the recovery of an understory, particularly that of perennial species of high forage value. This kind of vegetation has shown negligible improvement even after 20-25 years of protection from grazing.

Kinds of Information Needed

Sound classification of the natural vegetation is critically needed for wiser management of sagebrush-grass ranges. An inventory of present vegetational resources alone is inadequate for long range planning. What is needed is a classification based on the potential productivity of the landscape and an understanding of the dynamics of this important range vegetation. A classification system based on the habitat-type concept seems most useful in providing this tool for better management. The habitat-type is defined as ". . . the collective area which one association occupies, or will come to occupy as succession advances" (Daubenmire, 1952). This implies that if the landscape is properly classified on the basis of its potential climax vegetation, response to management could be expected to be predictable on all areas of the same climax potential.

Vegetation is used to identify and characterize the habitat-type because it is the component of ecosystem that is most easily observed and measured. It is also the resource that is being managed directly. Vegetation-soil correlation based on climax potential is an essential part of the program. Knowedge of soil relations is particularly important when we deal with seral vegetation. Research is badly needed in identifying habitat-types on the basis of seral vegetation. Depleted stands usually contain some remnant perennials to help identify the habitat-type, but as more of the original vegetation is altered greater dependence on soils is required. Soil characteristics are not as easily destroyed and may be the only remaining identifying evidence of the habitat-type.

Sagebrush species generally grow in pure stands and each tells us something about the ecosystem. Nine woody species and subspecies of sagebrush occur on sufficient acreage to be important for management purposes. Three subspecies of the **Artemisia tridentata** complex occur on more than two-thirds of the total sagebrush area in the State. These subspecies are not always readily distinguishable from one another. Mountain big sagebrush **(A. tridentata** subsp. **vaseyana)** is found in areas of higher elevation and precipitation than the other two. Basin big sagebrush **(A. tridentata** subsp. **tridentata)** and Wyoming big sagebrush **(A. tridentata** subsp. **wyomingensis)** occupy lower elevation ranges. Wyoming big sagebrush was only recently recognized (Beetle and Young, 1965). Preliminary work suggests that Wyoming big sagebrush tolerates conditions that are drier than basin big sagebrush. All of the subspecies occupy sites of deep, well-drained soils.

Other species of economic importance are low sagebrush **(A. arbuscula)**, three-tip sagebrush **(A. tripartita)**, black sagebrush **(A. nova)**, silver sagebrush **(A. cana** subsp. **viscidula)**, alkali sagebrush **(A. longiloba)**, and scabland sagebrush **(A. rigida)**, listed in order of decreasing acreages.

Sagebrush species and subspecies are generally so well adapted to the sites they occupy that mixing of species is limited. Sagebrush communities can be further classified by the dominant understory species such as bluebunch wheatgrass **(Agropyron spicatum)**, Idaho fescue **(Festuca idahoensis)** or Sandberg bluegrass **(Poa secunda)**, for example.

The ultimate classification unit of vegetation is the habitat-type which is determined by all of the component species and not by only a few dominants. The level of classification based on dominant species often results in grouping of communities that are noticeably different except for the dominant species. This is due to the broad ecological tolerance of dominant species that are as widely distributed as big sagebrush, bluebunch wheatgrass, and Idaho fescue, for example. Ecotypic variation is indicated for these species (Daubenmire, 1960; Tisdale, 1962; Passey and Hugie, 1963), but their magnitudes of variability have not been investigated in any comprehensive manner.

However, even at the level of classification based on dominant species, considerable order is made in understanding the distribution and behavior of the complex sagebrush-grass vegetation. More than 15 major sagebrush-grass types have been already recognized at this level of classification in Idaho. Subdivision into habitat-types and recognition of other major types are being made as new information becomes available through our research.

Table 2. Dry matter yields from two adjacent habitat-types on Carey Kipuka, Blaine County, Idaho, 1959.[1]

Species	Habitat-types	
	Alkali sagebrush Idaho fescue Gooding loam	Three-tip sagebrush Idaho fescue Tetonia silt loam
	(lb./acre)	(lb./acre)
Idaho fescue **(Festuca idahoensis)**	38	295
Bluebunch wheatgrass **(Agropyron spicatum)**	4	93
Sandberg bluegrass **(Poa secunda)**	44	46
Prairie junegrass **(Koeleria cristata)**	4	55
Squirreltail **(Sitanion hystrix)**	24	—
Thurber needlegrass **(Stipa thurberiana)**	43	—
Tapertip hawksbeard **(Crepis acuminata)**	—	41
Arrowleaf balsamroot **(Balsamorhiza sagittata)**	—	34
Milk vetch **(Astragalus stenophyllus)**	—	30
Longleaf & Hood's phlox **(Phlox spp.)**	40	12
Anderson's buttercup **(Ranunculus andersonii)**	14	—
Pussytoes **(Antennaria stenophylla)**	106	—
Mat eriogonum **(Eriogonum caespitosum)**	33	—
Other forbs	28	37
Annuals	—	7
Three-tip sagebrush **(Artemisia tripartita)**	—	135
Alkali sagebrush **(Artemisia longiloba)**	64	—
Douglas rabbitbrush **(Chrysothamnus viscidiflorus)**	—	5
Total (lb./acre)	442	790

[1]Source: Hugie, V. K., H. B. Passey, and E. W. Williams. 1964. Soil taxonomic units and potential plant community relationships in a pristine range area of southern Idaho. Amer. Soc. Agron. Spec. Publ. 5:190-205.

Differences in Habitat-types

The variability of effective environment is generally less from stand to stand within habitat-types than between stands of different habitat-types. At times the understory species may be more sensitive than sagebrush to some environmental factor. The repeated occurrence of needle-and-thread grass **(Stipa comata)** on sandy soils is an example. In other instances, sagebrush is more sensitive (Figs. 7 and 8) as indicated by the abrupt change from big sagebrush to low sagebrush with corresponding changes in the nature of the B horizon in the two communities (Fosberg and Hironaka, 1964).

From the management viewpoint, recognition of different habitat-types is important. They often differ greatly in productivity potential and floristic composition. Analysis of two adjacent habitat-types is shown in Table 2. The two stands were separated by a distance of only a few hundred feet. Vegetation in both stands was in pristine condition since the entire area was isolated by a buffer of rough lava at least three-fourths mile wide (Tisdale, Hironaka, and Fosberg, 1965). Difference in yield was nearly 350 pounds per acre, a sizeable amount when total yields are less than 1,000 pounds per acre. There was a marked difference in soils between the two sites. Response of the vegetation to a particular management practice would probably be greatly different on the two sites.

Fig. 7. Big sagebrush distribution is associated with soils that are deep and well drained. Productiveness of soil supporting big sagebrush is greater than those with low sagebrush in the same area.

Fig. 8. Low sagebrush occurs on soils that are shallow or possess a restrictive B horizon near the soil surface as noted by dashed line. Distribution of low sagebrush is confined primarily to the Chestnut and Chestnut-Prairie soil zones.

Secondary Succession

As range deteriorates, changes in the amount and distribution of the original species occur. Behavior of perennial grasses in three stages of depletion in the big sagebrush/Thurber needlegrass habitat-type is illustrated in Table 3. Data were obtained from stands located on the same soil series and phase with only a few miles separating any two stands. With greater degree of deterioration, the once-dominant Thurber needlegrass becomes less abundant. If depletion is not severe, vigor and size of individual plants decrease but the individuals remain well distributed. With continued deterioration, a change in distribution (frequency percent) occurs due to loss of individuals. With complete loss of Thurber needlegrass, the only important perennial herb remaining is Sandberg bluegrass.

Cheatgrass and other annuals did not respond to the condition of continued depletion because the moisture that was made available due to reduction in number and vigor of perennial grasses was utilized by sagebrush. Had the sagebrush cover been destroyed or damaged with this degree of depletion of the understory perennials, cheatgrass undoubtedly would have taken over.

It is important to realize that this sequence in species composition change is specific to the big sagebrush/Thurber needlegrass and not bluebunch wheatgrass or Idaho fescue. These species never occurred naturally in this habitat-type. Knowledge of the habitat-type provides a basis for management and an estimate of expected returns.

To reverse a downward trend situation, the frequent recommendation is reduce livestock numbers. This may not always be necessary. Reduction in sagebrush cover is often needed along with manipulation of livestock numbers or change in the use pattern to permit marked improvement in the vegetation. As the understory is destroyed, the sagebrush component of the stand responds by growing more vigorously. Often the shrub canopy

Table 3. Vegetation characteristics of stands in three stages of depletion in the big sagebrush/Thurber needlegrass habitat-type with sagebrush cover intact.

	Range condition		
Species	**Good**	**Fair**	**Poor**
		Basal area percent	
Thurber needlegrass **(Stipa thurberiana)**	2.4	0.6	0.2
Sandberg bluegrass **(Poa secunda)**	4.8	5.2	2.3
Squirreltail **(Sitanion hystrix)**	0.3	0.2	0.3
Cheatgrass **(Bromus tectorum)**	T	T	0.1
		Frequency percent (1 x 2′ plot)	
Thurber needlegrass **(Stipa thurberiana)**	95	61	22
Sandberg bluegrass **(Poa secunda)**	100	100	100
Squirreltail **(Sitanion hystrix)**	42	30	43
Cheatgrass **(Bromus tectorum)**	5	5	30
Sum freq. perennial forbs	40	31	15
Sum freq. annual forbs	150	35	13
		Shrub characteristics	
Sagebrush canopy cover (%)	12	15	21
Mature sagebrush plants per 200 sq ft	21	18	22
Young sagebrush per 200 sq ft	1	14	4

cover increases without an accompanying increase in plant numbers (Table 3). In other situations, the changes in shrub cover and density are not as one would expect as ranges deteriorate from good to poor condition (Tueller, 1962).

Removal or reduction of sagebrush cover greatly influences the rate of understory recovery. This was demonstrated by a sagebrush thinning study in an exclosure in the big sagebrush/Thurber needlegrass habitat-type. The exclosure was constructed in 1932 and rabbit-proofed in 1938 (Piemeisel, 1938). Even after years of protection, the understory was not impressive, yielding less than 200 pounds per acre in 1963. Shrub-thinning treatments were made in 1960 on plots one-fourth acre in size. The desired amount of cover was obtained by randomly removing individual sagebrush plants. Yields obtained in 1963 showed that the amount of herbage was related to the amount of sagebrush remaining (Table 4).

The rapid establishment of squirreltail (**Sitanion hystrix**), a perennial grass, was impressive. Less than 200 feet on the windward side of the treated plots, both cheatgrass and squirreltail were plentiful. The probable explanation for the success of squirreltail over cheatgrass is that squirreltail plants were already present and additional seed was deposited from an outside source. Cheatgrass, on the other hand, had already dispersed its seed before the thinning took place. The natural dispersal of cheatgrass is only a few yards except in cases where it is swept over bare ground by gusty winds (Hulbert, 1955; Klemmedson and Smith, 1964).

Table 4. Response of understory to sagebrush thinning treatments. Treated in 1960 and sampled in 1963.

Sagebrush cover	Understory dry matter yield	Sum frequency-nested plot (1/100 & 1/25m²)		
		Squirrel-tail	Sandberg bluegrass	Thurber needlegrass
%	lb./acre	%	%	%
0 (clearcut)	830	97	166	2
2-3	594	56	153	11
7-8	253	37	163	2
15 (control)	194	25	174	11

Thurber needlegrass, the climax dominant of this habitat-type, did not increase. Several established seedlings were observed in 1963, however. The only marked change in the Sandberg bluegrass population was improved vigor on the treatments where sagebrush cover was reduced.

To obtain the desired change to more perennial forage in the understory, reduction in the sagebrush cover is not enough. An adequate seed source of desirable grasses must be made available if new plants are to be expected. Without this precaution, the understory will be invaded by weedy species, particularly cheatgrass or a noxious weed species.

Conclusion

The sagebrush-grass vegetation type is an important economic asset in Idaho. Its low productivity on a per acre basis is offset by the large acreage involved. Seventeen million acres of Idaho's rangeland are derived from this type. Primary uses of this land are spring and fall range for livestock and winter range for big-game animals.

The original sagebrush-grass vegetation was not a homogeneous type. At least nine sagebrush species and subspecies occurred over extensive areas, each so well adapted to the sites they occupied that intermixing of sagebrush species was minimal. The diversity of sites on which sagebrush grows is the result of the wide variability of climate, soil and relief that occurs in this broad vegetation type.

Much of the original vegetation has been altered because of abusive grazing and fire. The balance between sagebrush and perennial grasses and forbs has been upset over vast areas. Affected areas now support either dense stands of sagebrush with scant understories or, where unrestricted grazing has been accompanied by repeated fires, vegetation composed primarily of annual species.

In most cases, the productivity of today's sagebrush ranges is far below their potential. There is great need to recognize and classify these ranges on the basis of their potential productivity. Classification of the landscape at the habitat-type level and integration of this classification with soil-vegetation studies are essential if significant progress is to be expected in the management of sagebrush ranges of Idaho.

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