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WILDLIFE HABITATS IN MANAGED RANGELANDS-- THE GREAT BASIN OF SOUTHEASTERN OREGON

PLANT COMMUNITIES AND THEIR IMPORTANCE TO WILDLIFE

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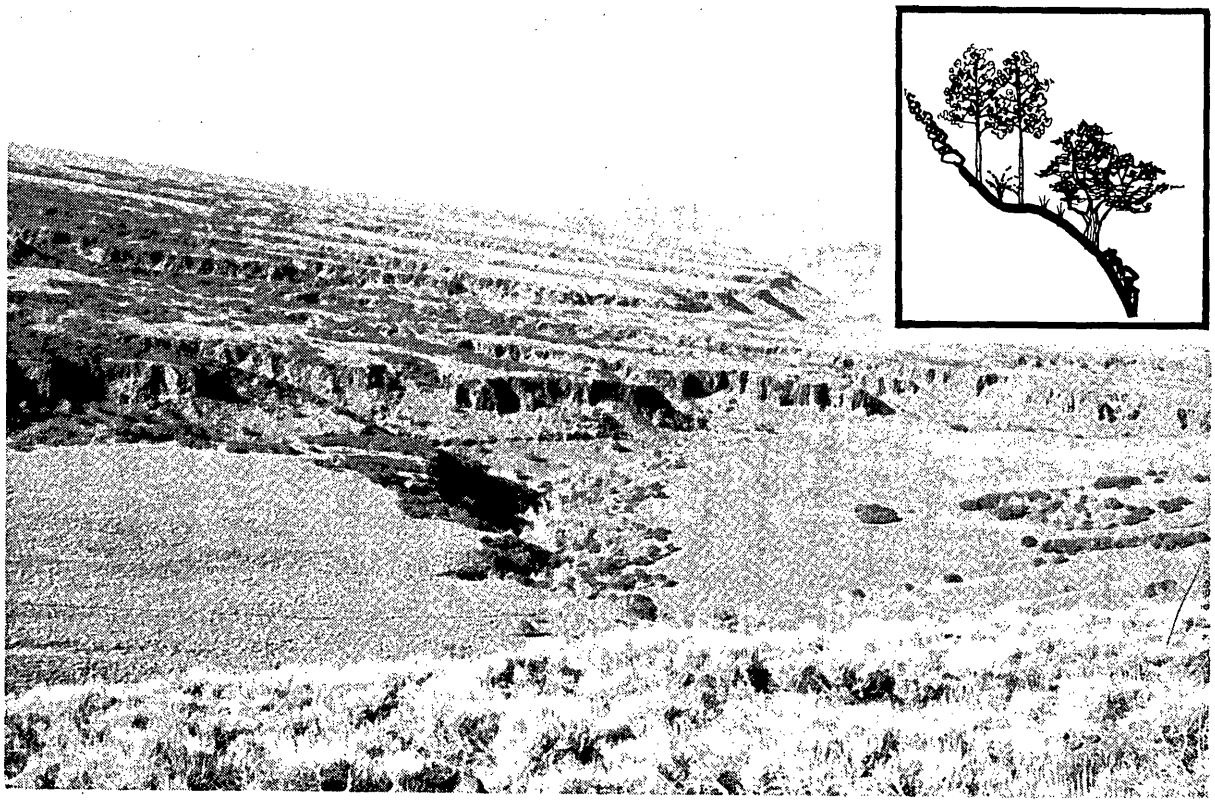

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE

ABSTRACT

Plant communities in the Great Basin of southeastern Oregon are described, and a field key is provided. The value of a plant community's vertical and horizontal structure and the seasonal availability of its forage are examined in relation to wildlife habitat in managed rangelands. Further, the importance of individual and combined plant communities to wildlife in managed rangelands is discussed, and management alternatives are presented.

KEYWORDS: Communities (plant), range management, wildlife habitat.

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This publication is part of the series **Wildlife Habitats** in **Managed Rangelands — The Great Basin of Southeastern Oregon.** The purpose of the series is to provide a range manager with the necessary information on wildlife and its relationship to habitat conditions in managed rangelands in order that the manager may make fully informed decisions.

The information in this series is specific to the Great Basin of southeastern Oregon and is generally applicable to the shrub-steppe areas of the Western United States. The principles and processes described, however, are generally applicable to all managed rangelands. The purpose of the series is to provide specific information for a particular area but in doing so to develop a process for considering the welfare of wildlife when range management decisions are made.

The series is composed of **14** separate publications designed to form a comprehensive whole. Although each part will be an independent treatment of a specific subject, when combined in sequence, the individual parts will be as chapters in a book.

Individual parts will be printed as they become available. In this way the information will be more quickly available to potential users. This means, however, that the sequence of printing will not be in the same order as the final organization of the separates into a comprehensive whole.

A list of the publications in the series, their current availability, and their final organization is shown on the inside back cover of this publication.

Wildlife Habitats in Managed Rangelands — The Great Basin of Southeastern Oregon is a cooperative effort of the USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, and United States Department of the Interior, Bureau of Land Management.

Introduction

Our purpose is to describe the major plant communities and examine the importance of their structure and species composition to wildlife. Plant communities here are directly related to the wildlife covered .in the other chapters and can be used in developing management plans based on characteristics and potential of the plant community. We did not cover some northern Great Basin rangeland communities because they are rare, small in total area, or information is not available.

Great Basin rangelands in southeastern Oregon support a wide variety of plant communities, dominated by grasses, shrubs, or trees ranging from conifers to deciduous and evergreen hardwoods. Predominant are big sagebrush communities.[1] Tree-dominated and true grassland communities constitute the least common types. True grasslands occur as meadows, relict stands of valley bottom bunchgrass, and subalpine bunchgrass types.

Tree-dominated communities occur primarily at elevations above the sagebrush steppe, except willow and cottonwood communities of low-elevation riparian zones. Quaking aspen is primarily restricted to mountain riparian zones, such as streams, seeps, springs, ponds, or lakes (fig. 1). With the exception of relict stands of ponderosa pine (Packard 1972) or white fir (Hansen 1956), curlleaf mountainmahogany requires the most moisture of the dry-land tree types in the high desert mountains. Western juniper grows just below curlleaf mountainmahogany and mixes with it in transition zones. These tree-dominated communities are adjacent to and above the shrub zone.

Big sagebrush, including several subspecies, is dominant among the shrub communities. Other significant tall shrub communities include black greasewood, squaw apple, Bolander silver sagebrush, and mountain silver sagebrush. Short shrub communities include shadscale saltbush, and stiff, low, early low, black, and cleftleaf sagebrushes.

[1] Common and scientific names and plant symbols are from Garrison et al. **(1976)** and are listed in the appendix.

The terms "stand" and "cornmunity" are used as suggested by international agreements on terminology (Kuchler 1964, Mueller-Dombois and Ellenberg 1974). The specific unit of vegetation observed in the field is called a vegetation stand or stand (coenosis). The generalized, abstract unit of vegetation analogous to an "average" of a group of similar stands is a plant community or vegetation type. **A** plant community with a "definite flora, uniform habitat, and physiognomy" is called an association (Mueller-Dombois and Ellenberg 1974, p. 174).

Plant communities presented here are compared with Kuchler's (1964) vegetation types in table 1. Kuchler has one major vegetation type for each listing, which represents the major physiognomy (general aspect and visual character) of a region. Kuchler omits other similar vegetation types less extensive in occurrence and less noticeable or refers to them as inclusions because his treatment of vegetation throughout the conterminous United States is so extensive. Table 1 shows., single vegetation types of Kuchler's related to a number of vegetation types used in this publication. The best example is Kuchler's (1964) "sagebrush steppe"—the big sagebrush-bearded bluebunch wheatgrass vegetation type. We recognize 11 vegetation types dominated by sagebrush within Kuchler's (1964) "sagebrush steppe." The Wyoming big sagebrush/bunchgrass vegetation type described here is probably the only one relating directly to it since it is considered the most common sagebrush of the high desert in Oregon (Winward 1980).

Subtle variations in an environment give rise to different subordinate plant species in communities. These "characteristic" and "differentiating" species (Mueller-Dombois and Ellenberg 1974) are useful indicators of site potential. For example, the mountain big sagebrush/bunchgrass community encompasses stands containing either Thurber needlegrass, western needlegrass, or needleandthread. These grasses are generally subordinate to bearded bluebunch wheatgrass and reflect an increasing sandiness of the soil profile. Recognition of these three variations

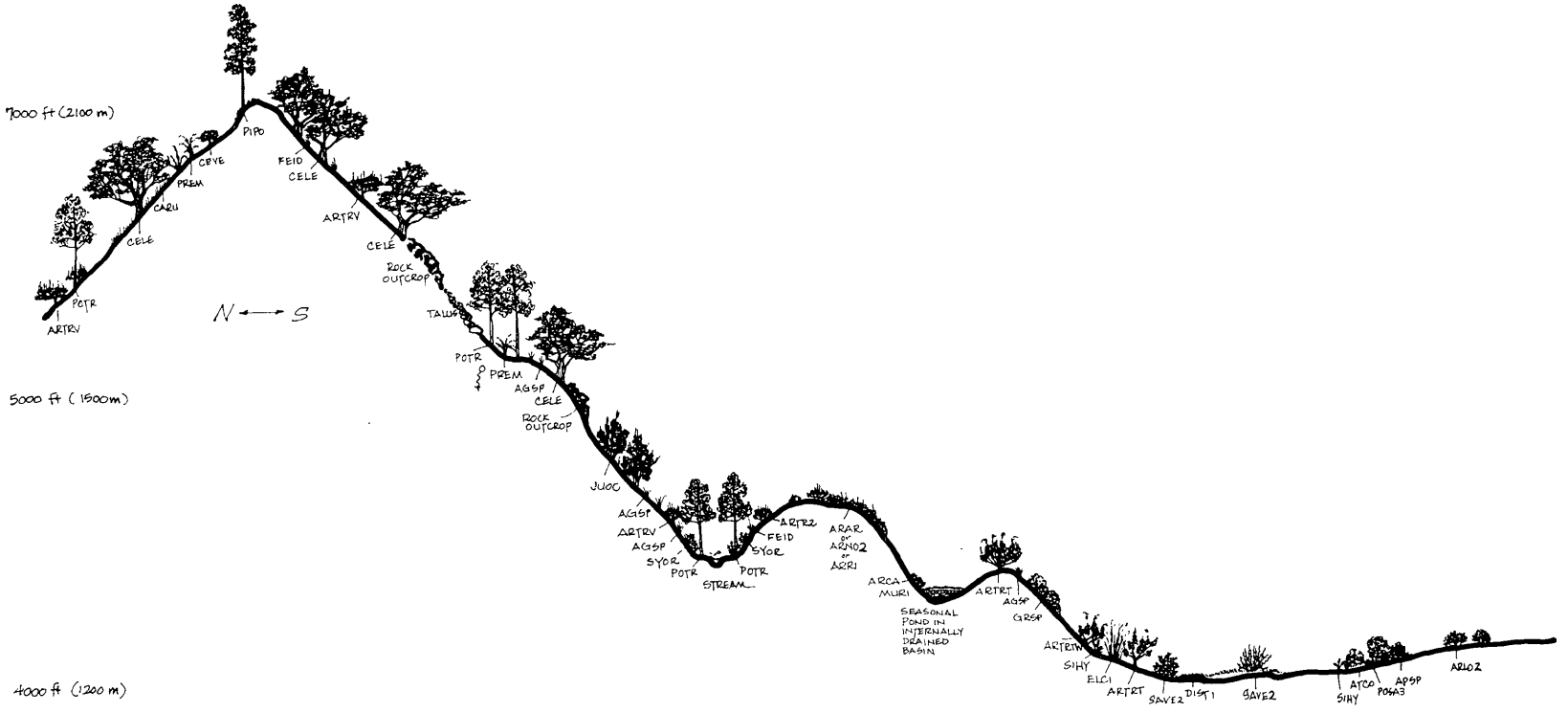

Figure 1.—Elevation and site relationships among dominant plant species in the Great Basin of southeastern Oregon. Plant symbols are from Garrison et al. (1976). AGSP = *Agropyron spicatum;* ARAR = *Artemisia arbuscula;* ARCA = *Artemisia* ***cana*****; ARL02** = *Artemisia longiloba;* **ARN02** = *Artemisia nova;* **ARRI** = *Artemisia rigida;* ARSP = *Artemisia spinescens;* **ARTR2** = *Artemisia tripartita;* ARTRT = *Artemisia tridentata* subsp. *tridentata;* ARTRV = *Artemisia tridentata* subsp. *vaseyana;* ATCO = *Atriplex confertifolia;* CARU = *Calamagrostis rubescens;* CELE = *Cercocarpus ledifolius;* CEVE = *Ceanothus velutinus;* **DISTI** = *Distichlis* sp.; **ELCI** = *Elymus cinereus;* **FEID** = *Festuca idahoensis;* GRSP = *Grayia spinosa;* JUOC = *Juniperus occidentalis;* **MURI** = *Muhlenbergia richardsonis;* **PIPO** = ***Pinus*** *ponderosa;* **POSA3** = *Poa sandbergii;* POTR = *Populus tremuloides;* PREM = ***Prunus*** *emarginata;* SAVE2 = *Sarcobatus vermiculatus;* SIHY = ***Sitanion hystrix*****;** SYOR = *Symphoricarpus oreophilus.*

Table l—Comparison of the plant communities with potential natural vegetation by Kuchler (1964)

Natural vegetation as described by Kuchler (1964)	Plant communities in this publication
37 mountainmahogany-oak scrub (similarposition—not equal)	Curlleaf mountainmahoganylmountain big sagebrushmunchgrass Curlleaf mountainmahoganylmountain snowberrylgrass Curlleaf mountainmahoganylpinegrass Curlleaf mountainmahogany/Idaho fescue Curlleaf mountainmahogany/bearded bluebunch wheatgrass-Idaho fescue
No provision	Squaw apple/bunchgrass
55 sagebrush steppe (withjuniper)	Western juniper/big sagebrushbearded bluebunch wheatgrass Western juniper/big sagebrush/Idaho fescue
55 sagebrush steppe	Basin big sagebrushhunchgrass Wyoming big sagebrush/bunchgrass Mountain big sagebrushmunchgrass Threetip sagebrush/bunchgrass Bolander silver sagebrushbunchgrass Mountain silver sagebrush/bunchgrass Stiff sagebrushmunchgrass Low sagebrushhunchgrass Cleftleaf sagebrush/bunchgrass Early low sagebrush/bunchgrass Black sagebrushbunchgrass
40 saltbush-greasewood	Black greasewoodlgrass Shadscale saltbush/bunchgrass
No provision	Riparian
No provision	Permanently wet meadows Seasonally wet meadows
No provision	Quaking aspenlmountain big sagebrush Quaking aspenlgrass
No provision	Subalpine big sagebrush/bunchgrass
52 alpine meadows and barren (similar—notequal)	Subalpine bunchgrass

,within the community should help managers of wildlife and livestock. The associated changes in soil texture[2] and plant phenology are important to programs designed to maintain suitable habitat for animals and to increase production of forage.

[2]Soil nomenclature and definitions are from "Soil Survey Manual" (SoilSurvey Staff 1951).

PLANT AND COMMUNITY STRUCTURE

Most animal species are more narrowly adapted to plant structure for thermal and hiding cover than they are to plant species for food. For example, mule deer and black-tailed jackrabbits use a wide variety of forage species (Hill 1956, Ingles 1967, Kufeld et al. 1973); but **a** specific structure of trees or shrubs (fig. **2)** is required to fulfill their thermal or hiding cover requirements (Anthony 1928, Thomas et al. 1979a). The sage sparrow has seed and insect food available in many plant communities, but a specific shrub structure is required to provide hiding cover and suitable nesting sites (Gabrielson and Jewett 1940, Miller 1968). The overhanging or umbrellalike structure of bunchgrass provides both hiding and thermal cover for birds, such as the lark sparrow in the open bunchgrass communities (fig. 3).

Figure 2.—Big sagebrush provides important thermal cover for small mammals (Robert R. Kindschy photograph).

Figure 3.—A, arrow at the base of a bunchgrass points to the nest of a lark sparrow. B, the nest is hidden from predators and is protected from sun and wind in an open stand of grass by the overhanging blades of grass (Chris Maser photograph).

Shrub structure is variously altered from browsing by different animals and at different intensities (fig. **4).** Antelope bitterbrush, for instance, when severely browsed produces a crown that appears to be structurally different, depending on type and intensity of use (Hormay **1943).** This species also occurs throughout its range in different structural forms because of what appear to be genetically distinct populations (Alderfer **1976,** Nord **1965).**

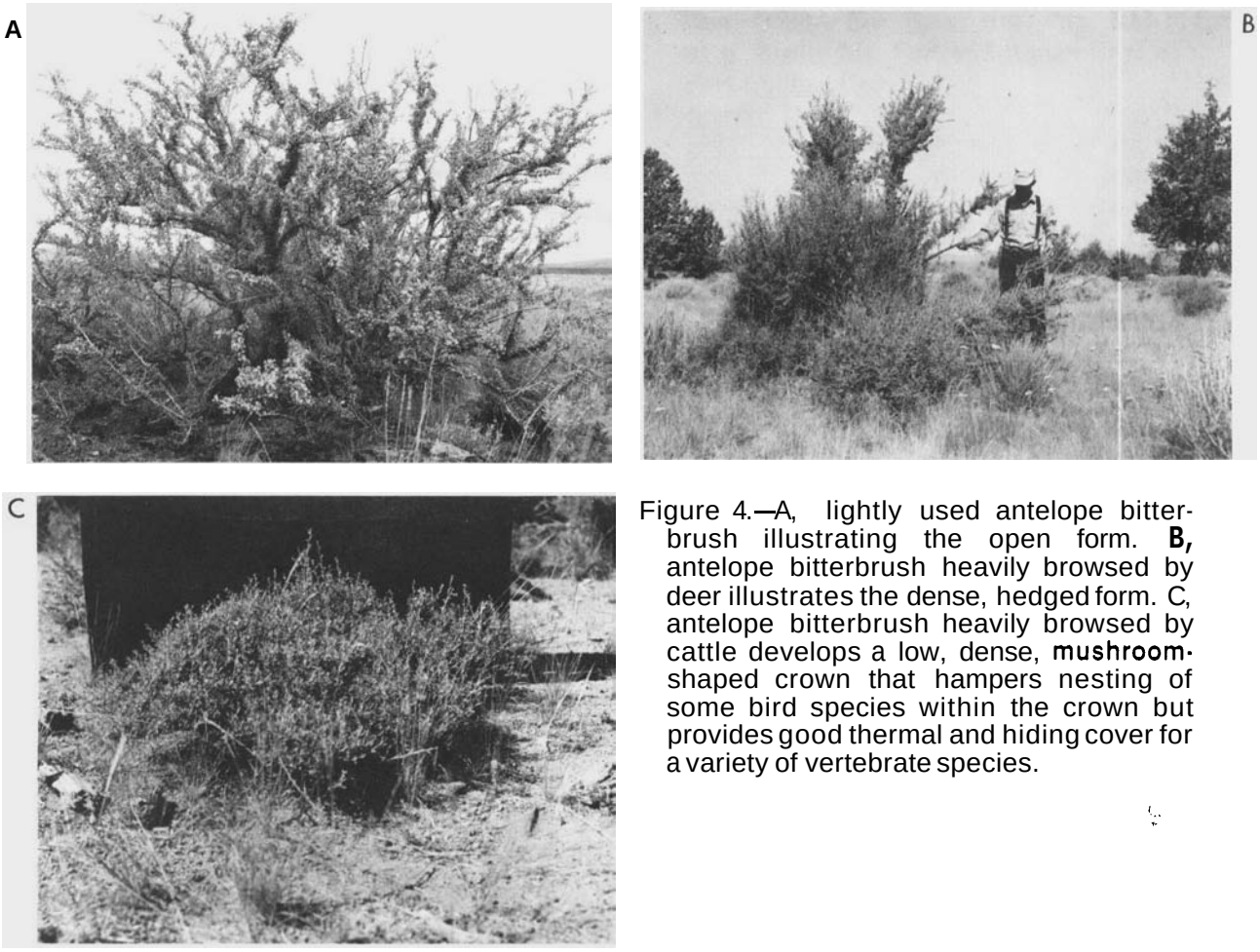

Figure 4.—A, lightly used antelope bitterbrush illustrating the open form. **B,** antelope bitterbrush heavily browsed by deer illustrates the dense, hedged form. C, antelope bitterbrush heavily browsed by cattle develops a low, dense, mushroom-shaped crown that hampers nesting of some bird species within the crown but provides good thermal and hiding cover for a variety of vertebrate species.

The structural diversity of rangeland communities relates directly to wildlife diversity: the greater the structural diversity, the greater the wildlife diversity (fig. **5).** Exceptions may occur where a mosaic of diverse stands is on a scale too small to meet the home range needs of a species that requires large blocks of uniform vegetation (Thomas et al. 1978,1979c).

Figure 5.—Cliffs, talus, sagebrush, juniper, seasonally and permanently wet meadows, and riparian vegetation provide habitat for a wide variety of wildlife in the western edge of the Great Basin.

Plant communities contain both vertical and horizontal structural elements. At least three vertical vegetative layers—herbaceous, shrub, and tree (fig. 6)—are provided by western juniper communities in high desert rangelands. MacArthur and MacArthur (1961) considered vertical layers of vegetation critical to diversity of avian species. Thomas et al. (1977) examined each 5-foot layer of vegetation from shrubs to the tops of trees and found that

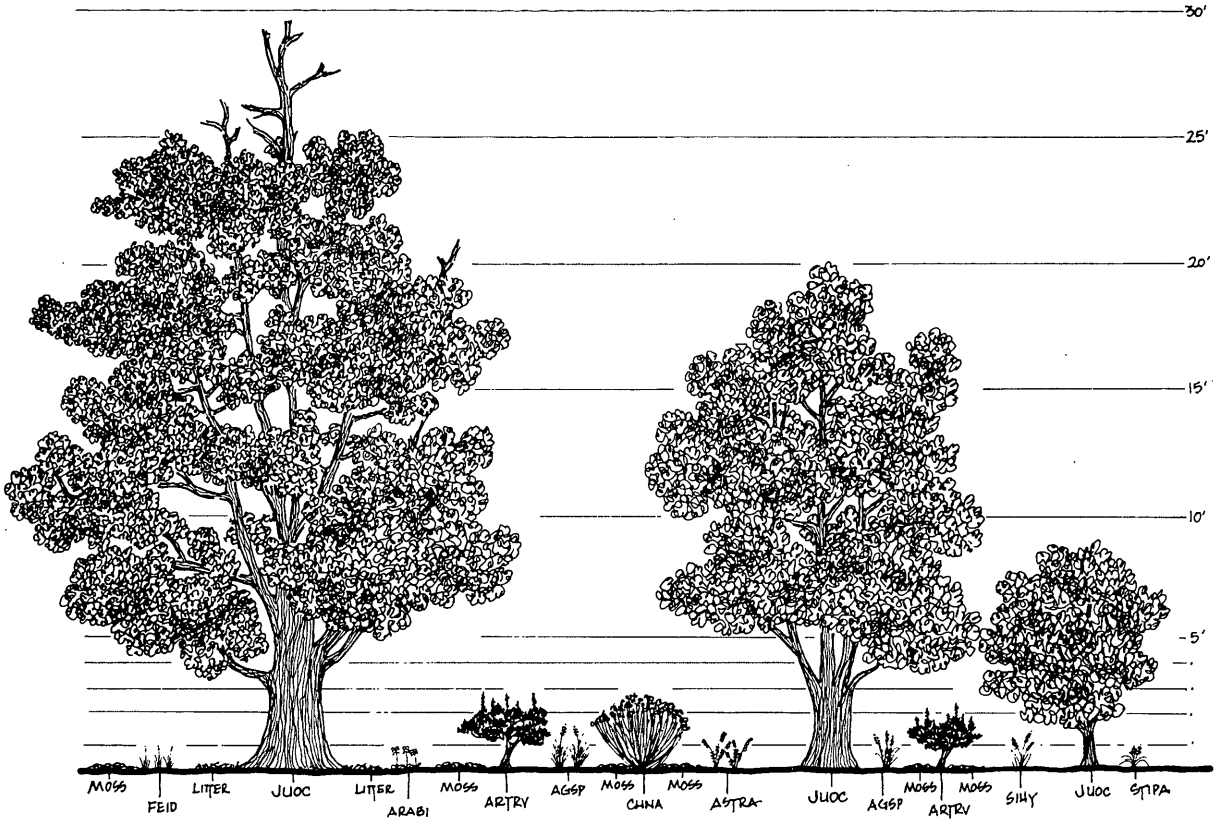

Figure 6.—This tree-shrub-grass community illustrates the structural variety present and the high vertical diversity in some communities of the high desert. Plant symbols are from Garrison et al. (1976). AGSP = *Agropyron spicatum;* ARABI = *Arabis* sp.; ARTRV = *Artemisia tridentata* subsp. *vaseyana;* ASTRA = *Astragalus* sp; CHNA = *Chrysothamnus nauseosus;* FEID = *Festuca idahoensis;* JUOC = *Juniperus occidentalis;* SIHY = *Sitanion hystrix;* STIPA = *Stipa* sp.

different species of birds were significantly correlated with different vertical layers in both coniferous and deciduous vegetation. Horizontal diversity, on the other hand, deals primarily with stands of different plant communities or different stages within plant communities that are close together (fig. 7). For example, optimum spacing between stands of big sagebrush and crested wheatgrass for black-tailed jackrabbits requires that the wheatgrass openings be no larger than 600 meters (1,900 ft) across (Westoby and Wagner 1973), because most use of wheatgrass occurs within 300 meters (985 ft) of the type edge. This illustrates how the size of two adjacent communities can result in optimum habitat for a particular animal species.

Rangelands of the desert basins, uplands, and mountains are limited in their complement and acreage of tree communities and true (climax)grasslands. The abundant shrub communities are predominantly big sagebrush. In the enhancement of both livestock range and wildlife habitat, a mixture of communities in proper juxtaposition and **of** optimum stand size provides a more suitable environment than large uniform areas of seeded grasslands or dense shrublands. Tree communities, such as western juniper and curlleaf mountain-mahogany, provide valuable thermal and hiding cover for wild ungulates (deer, pronghorn, bighorn sheep) and other species of wildlife, as well as important shading areas for livestock in the summer.

These communities with an open tree cover, besides being good wildlife habitat, produce an ideal opportunity for livestock to obtain much needed shade close to forage. McIlvain and Shoop (1971) studied the use of shade by cattle in the southern Great Plains and found that summer-long gains by yearling Hereford steers increased 9 kilograms (19 *lb*) per head when shade was available. They also found that shade was nearly as effective as the location of water and supplemental feed in distributing use by cattle. Advantages of shade for livestock, then, are threefold: increased weight gain, increased forage supply, and more uniform range conditions. These advantages also apply to ungulate wildlife.

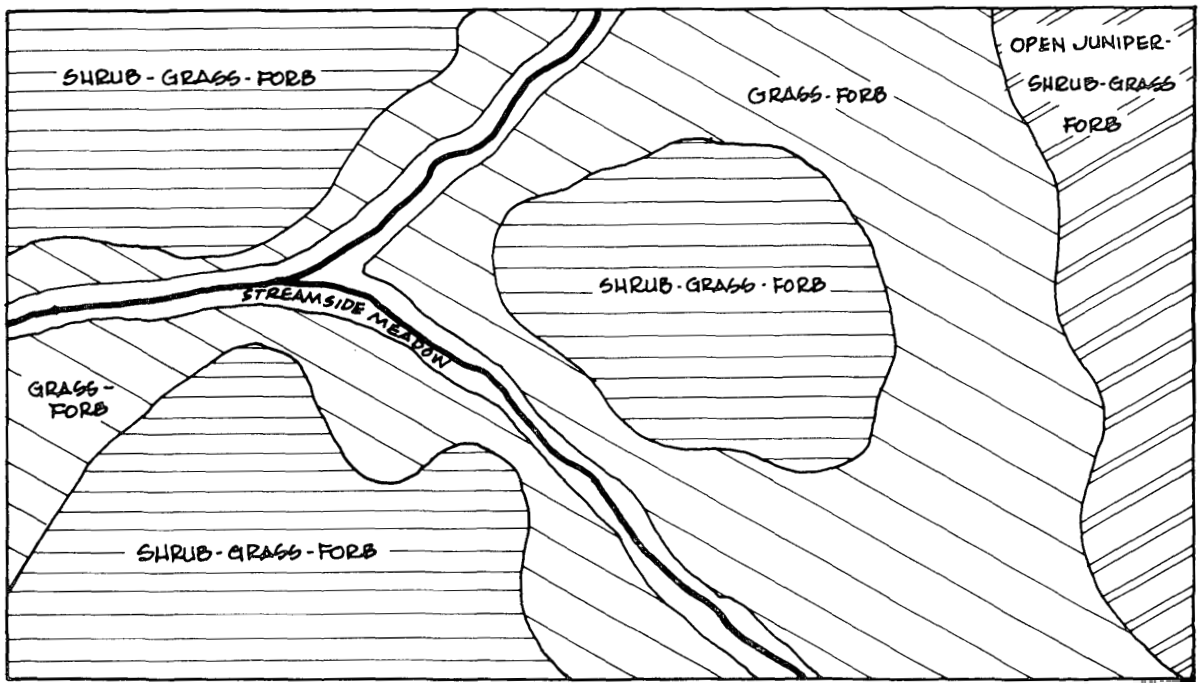

Figure 7.—A variety of habitats produces a variety of wildlife. A mosaic of plant communities of appropriate sizes and shapes maximizes edge and provides a wide selection of forage and cover species.

AVAILABILITY OF FORAGE

Forage availability of high desert plant communities varies annually and seasonally (fig. 8). Annual herbaceous species are available as green forage in early spring but dry rapidly and provide only dry material by late spring. Most perennial herbaceous species are generally available from midspring to midsummer, whereas deciduous shrub and tree species usually provide their most nutritious forage from midspring through late summer. Evergreen and deciduous shrub and tree forage is available throughout the year, although nutritional value peaks in the early growing season. Annual and perennial herbaceous species produce nutritious regrowth after fall rains. Although production varies among years, regrowth is usually available throughout the winter, particularly on south-facing exposures.

Controlled seasonal use is the key to coordinated use of the same range by livestock and wild ungulates. Controlled livestock use of perennial grasses can produce a stubble height of some plants short enough to allow wild ungulates to reach green regrowth that otherwise would be unavailable to them. Also, important winter foraging areas of wild ungulates can be enhanced by preventing livestock from grazing after fall rains have produced herbaceous regrowth.

PLANT COMMUNITY GROUPS

The array of plant communities listed in the following key and later described in detail can be dealt with individually in management. Depending on the user's objective, however, simplified groupings of these communities may be made (table 2). A criterion for grouping might be that the combined communities have equivalent values for livestock or for a featured wildlife species; or the communities in the group would react in an equivalent way to a specific management program (Leckenby 1978a). The rationale for grouping plant communities and examples of the relationships of terrestrial vertebrates to such groups will be presented in another chapter in this series, "The Relationship of Terrestrial Vertebrates to the Plant Communities.''

Figure 8.—Completely shaded blocks indicate the season of greatest productivity and nutritional value for forage plants. Partially shaded blocks with arrows indicate nutritious fall regrowth.

Table 2—Plant communities grouped by similarity of structure and selected structural and site characteristics[1]

Community number	Page number	Community	Structurally similar	Maximum number of vertical layers	Maximum height; meters (feet)	Ungulate thermal cover	Ungulate hiding cover	Ungulate forage	Small vertebrate thermal cover	Small vertebrate hiding cover	Small vertebrate forage	Elevational range; meters (feet)	General soil depth[2] and other notes
1	17	Riparian		4	25.0 (80)	X	X	X	X	X	X	All	Highly variable in soil depth and stoniness
2	17	Quaking aspen/grass		4	21.0 (70)	X	X	X	X	X	X	1 525- 2 134 (5,000- 7,000)	Moderately deep to deep
3	18	Quaking aspentmountain big sagebrush		4	12.0 (40)	X	X	X	X	X	X	1 525- 2 134 (5,000- 7,000)	Moderately deep to deep
4	20	Curlleaf mountainmahogany/ mountain big sagebrush		3	7.0 (23)	X	X	X	X	X	X	1 600- 1 950 (5,250- 6,400)	Shallow to moderately deep; stoniness variable
5	22	Curlleaf mountainmahoganyl mountain snowberry											
6	22	Curlleaf mountainrnahoganyl Idaho fescue		2	7.0 (23)	X	X	X	X	X	X	1 600- 1 700 (5,250- 5,575)	Moderately deep; stoniness variable
7	22	Curlleaf mountainmahoganyl bearded bluebunch wheatgrassl Idaho fescue											
8	24	Curlleaf mountainmahoganyl pinegrass										1 750- 1 920 (5,750- 6,300)	Moderately shallow; stoniness highly variable
9	25	Western juniper/big sagebrushl bearded bluebunch wheatgrass		4	10.0 (33)	X	X	X	X	X	X	777- 1 450 (2,550- 4,750)	Shallow to moderately deep; stoniness variable
10	25	Western juniper/big sagebrush1 Idaho fescue											
11	31	Basin big sagebrushlbunchgrass		3	2.4 (8)	X	X	X	X	X	X	Below 2 140 (7,000)	Moderately deep to deep; stoniness variable. Silver sagebrush flooded in spring
12	35	Mountain big sagebrushl bunchgrass										1 070- 2 900 (3,500- 9.500)	
13	35	Subalpine big sagebrush1 bunchgrass										1 070- 2 900 (3,500- 9,500)	
14	37	Wyoming big sagebrushl bunchgrass										Below 1 980 (6,500)	
15	38	Threetipped sagebrushl bunchgrass										915- 1 830 (3,000- 6,000)	
16	40	Bolander silver sagebrush1 bunchgrass										1 680- 2 440 (5,500- 8,000)	
17	40	Mountain silver sagebrush/ bunchgrass										1 680- 2 440 (5,500- 8,000)	

Table 2—Plant communities grouped by similarity of structure and selected structural and site characteristics[1] (Continued)

Community number	Page number	Community	Structurally similar	Maximum number of vertical layers	Maximum height; meters (feet)	Ungulate thermal cover	Ungulate hiding cover	Ungulate forage	Small vertebrate thermal cover	Small vertebrate hiding cover	Small vertebrate forage	Elevational range; meters (feet)	General soil depth[2] and other notes
18	42	Stiff sagebrushlbunchgrass		2	.4 (1.3)	—	—	X	X	X	X	915-2 134 (3,000-7,000)	Very shallow and mostly very stony over a layer restricting root growth; saturated in spring
19	44	Low sagebrushlbunchgrass										915-2 745 (3,000-9,000)	
20	44	Cleftleaf sagebrushlbunchgrass										1 525-2 745 (5,000-9,000)	
21	47	Black sagebrushlbunchgrass										1 220-2 745 (4,000-9,000)	
22	47	Early low sagebrush1 bunchgrass										1 830-2 440 (6,000-8,000)	
23	48	Squaw apple/bunchgrass		3	1.5 (5)	X	X	X	X	X	X	760-1 525 (2,500-5,000)	Moderately deep to deep
24	49	Black greasewoodlbunchgrass		2	1.5 (5)	X	X	X	X	X	X	600-1 525 (2,000-5,000)	Deep; flooded in spring
25	51	Shadscale saltbush/bunchgrass		2	.5 (1.6)	—	—	X	X	X	X	760-1 525 (2,500-5,000)	Moderately deep; no apparent layer restricting root growth
26	52	Meadow. seasonally wet		1		—	—	X	X	X	X	All	Deep; saturated to flooded in spring. dry in summer and fall
27	54	Meadow, permanently wet		1		—	—	X	X	X	X	All	Deep; saturated to flooded in spring; perennially wet
28	55	Subalpine bunchgrass		1	.3 (1.2)	—	—	X	X	X	X	2 439-2 900 (8,000-9,500)	Shallow to deep; stoniness variable

[1] X = present

[2] Very shallow—less than 25 centimeters (10 inches); shallow—26 to 50 centimeters (10 to 20 inches); moderately deep—51 to 125 centimeters (20-49 inches); and deep—more than 126 centimeters (49 inches).

Key to Plant Communities

CONSTRUCTION OF KEY

The plant communities are identified in a dichotomous key by descriptive vegetation and site characteristics easily recognized in the field. Groups of communities are separated on broad characteristics, such as trees vs. no trees, broadleaf trees vs. coniferous trees, shrubs vs. no shrubs, and so forth. Here we consider curlleaf mountainmahogany a tree. Site information, such as elevation or topography, is used as an aid in distinguishing communities or groups of communities. Separation within community groups may be based on vegetative differences among dominant species, such as anatomical variations in leaves alone or in combination with differences in form or height.

Some native communities are not covered. Some stands will not key to a community because of their early stage of succession. In stands where community identification is difficult, users should refer to the section, "successional vegetation.''

KEY

The general riparian zone will be identified here rather than within the structure of the key because there is insufficient information from which to develop a multiple community key section: It is a zone with communities immediately adjacent to wattr, that require large amounts of free or unbound water, that may be dominated by trees, shrubs, or grasses, and that may be multilayered — (RIPARIAN ZONE COMMUNITIES, page 17).

Page

1a Communities with tree cover (tree communities not in key; see "SUCCESSIONAL VEGETATION" page 55)
- 2a Cover dominated by broadleaf trees
  - 3a Tree cover dominated by quaking aspen
    - 4a Shrub cover of mountain big sagebrush common to abundant (QUAKING ASPEN/MOUNTAIN BIG SAGEBRUSH) 18
    - 4b Shrub cover sparse to absent (QUAKING ASPEN/GRASS) 17
  - 3b Tree cover dominated by curlleaf mountainmahogany
    - 5a Shrub cover common
      - 6a Shrubs primarily mountain big sagebrush (CURLLEAF MOUNTAIN MAHOGANY/MOUNTAIN BIG SAGEBRUSH/BUNCHGRASS) 20
      - 6b Shrubs primarily mountain snowberry (CURLLEAF MOUNTAIN MAHOGANY/MOUNTAIN SNOWBERRY/GRASS) 22
    - 5b Shrub cover sparse to absent
      - 7a Understory primarily bunchgrass
        - 8a Grass layer obviously dominated by Idaho fescue (CURLLEAF MOUNTAIN MAHOGANY/IDAHO FESCUE) 22
        - 8b Grass layer not obviously dominated by Idaho fescue; grass a codominant mixture of bearded bluebunch wheatgrass and Idaho fescue (CURLLEAF MOUNTAIN MAHOGANY/BEARDED BLUEBUNCH WHEATGRASS-IDAHO FESCUE) ... 22
      - 7b Understory not primarily bunchgrass; grass predominantly pinegrass (CURLLEAF MOUNTAIN MAHOGANY/PINEGRASS) ... 24
- 2b Cover dominated by coniferous trees; dominant tree western juniper with a shrub layer dominated by big sagebrush
  - 9a Grass cover dominantly bearded bluebunch wheatgrass (WESTERN JUNIPER/BIG SAGEBRUSH/BEARDED BLUEBUNCH WHEATGRASS) 25
  - 9b Grass cover dominantly Idaho fescue (WESTERN JUNIPER/BIG SAGEBRUSH/IDAHO FESCUE) 25

1b Communities without tree cover
- 10a Communities with shrub cover dominant; grasses and forbs mostly native (shrub communities not in key; see "SUCCESSIONAL VEGETATION" page 55)
  - 11a, Dominant mature[3] shrubs taller than 5 decimeters (20 inches)
    - 12a Dominant shrub a sagebrush species[4]
      - 13a Dominant shrub with persistent (overwintering), entire (leaf edges smooth), and lance-shaped leaves
        - 14a Leaves of dominant shrub silver-gray, plants in internally drained basins with seasonal flooding; associated herbaceous vegetation usually sparse; soil alkaline and extremely clayey (BOLANDER SILVER SAGEBRUSH/BUNCHGRASS) ... 40

[3] Mature sagebrush considered at least 20 years old by count of annual rings or xylem layers of main stem (Winward 1980). This should also be the guide for other shrub species.

[4] Sagebrush and attendant site characteristics from Winward (1980) and Winward and Tisdale (1977).

Page

14b Leaves of dominant shrub green-gray, plants along margins of streams or meadows; associated herbaceous vegetation floristically rich and highly productive; variable soils (MOUNTAIN SILVER SAGEBRUSH/BUNCHGRASS). . . . 40

13b Dominant shrubs with persistent lobed and wedge-shaped leaves

15a Dominant shrub uneven topped, with flowering shoots (inflorescences) arising throughout the crown (bottom to top); branches appear as upright feathery sprays

16a Mature shrubs greater than 100 centimeters (40 inches) tall; leaf margins straight, forming a tapered wedge; common big sagebrush community of valley bottoms and foothills on deep, well-drained soils (BASIN BIG SAGEBRUSH/BUNCHGRASS) 31

16b Mature shrubs less than 100 centimeters (40 inches) tall; leaf margins flare outward, forming a bell-shaped wedge; sagebrush on dry sites commonly below 1 830 meters (6,000 ft) and on moderately deep, well-drained soils (WYOMING BIG SAGEBRUSH/BUNCHGRASS) 37

15b Dominant shrubs even topped with flowering shoots (inflorescences) arising from the upper portion of the crown and extending above the foliage

17a Dominant shrub with leaf margins belled outward; flower stalks absent, flowers attached directly to main stem of flowering shoot (inflorescence spicate) or flower stalks present but unbranched (inflorescence racemose); widespread through the high desert steppe (LOW SAGEBRUSH/BUNCHGRASS) 44

17b Dominant shrub with leaf margins not belled outward, leaf margins straight; flower stalks branched (inflorescence paniculate)

18a On dominant shrub, four to six individual (very small) flowers per head; found on deep, well-drained soils throughout the upper foothill and mountain areas where soil moisture is available most of the summer (MOUNTAIN BIG SAGEBRUSH/BUNCHGRASS) 35

18b On dominant shrub, more than six individual (very small) flowers per head; often roots from branches in contact with soil (layering); found at high elevations (most commonly above 2 000 meters or 6,500 ft) (SUBALPINE BIG SAGEBRUSH/BUNCHGRASS) 35
(Treated briefly under mountain big sagebrush/bunchgrass community description)

12b Dominant shrub not a sagebrush species

19a Dominant shrub spiney, bark is whitish; usually found on alkaline soil where water table is shallow—flood plains, playas, and terraces (BLACK GREASEWOOD/GRASS). 49

Page

19b Dominant shrub not spiney, bark is dark; usually occurs on high moist hillsides in the northern edge of the high desert steppe; often near the ponderosa pine zone and often mixed with antelope bitterbrush (SQUAWAPPLE/BUNCHGRASS). 48

11b Dominant mature shrubs shorter than 5 decimeters (20 inches)

20a Dominant shrub with leaf edges smooth (leaves entire), spines present on branches; occurs primarily on alkaline soils in desert plains and foothills (SHADSCALE SALTBUSH/BUNCHGRASS) 51

20b Dominant shrub with leaves divided or lobed, lacking spines

21a Leaves of dominant shrub divided into lobes; lobe length more than three times lobe width

22a Dominant shrub with flowering shoot leaves divided; flower stalks absent, flowers attached directly to main stem of flowering shoot (inflorescence spicate); all leaves winter deciduous; most commonly found in the north and west edge of the Great Basin and beyond, in Oregon, on shallow rocky soils (STIFF SAGEBRUSH/BUNCHGRASS) 42

22b Dominant shrub with flowering shoot leaf edges smooth (entire)

23a Flower stalks branched (inflorescence paniculate); leaves on upper flowering shoots much longer than flower heads; found in the northern part of the Great Basin in Oregon and north; grows on moderate to deep, well-drained, loamy and sandy loam soils (THREE-TIP SAGEBRUSH/BUNCHGRASS). 38

23b Flowering shoots with flower stalks (pedicels) unbranched (racemose) or absent (spicate); flowering shoot leaves equal to or only slightly longer than flower head; most common to the north of the Great Basin in Oregon, occurring only at moderately high elevations of 1 500 to 2 700 meters (5,000 to 9,000 ft), and usually within the conifer zone (CLEFTLEAF SAGEBRUSH/BUNCHGRASS). 44
(Cleftleaf sagebrush treated briefly under low sagebrush/bunchgrass)

21b Leaves of dominant shrub divided into lobes; lobe length less than three times lobe width

24a Flowering shoots (inflorescences) of dominant shrub with flower stalks (pedicels) branched (paniculate); fruits mature after August; seed stalks brownish and persistent into following year; leaves very small; stands of plants appear dark in color compared with low sagebrush; occurs on droughty, stony, and often calcareous soils (BLACK SAGEBRUSHIBUNCHGRASS) 47

24b Flower shoots (inflorescences) of dominant shrub with flower stalks unbranched (racemose) or absent (spicate); seed stalks grayish and weakly persistent into following year

25a Fruits of dominant shrub mature in July or early August (EARLY LOW SAGEBRUSH/BUNCHGRASS). 47

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25b Fruits of dominant shrub mature from late August to October; widespread throughout the Great Basin of southeastern Oregon
(LOWSAGEBRUSH/BUNCHGRASS) 44

10b Communities without shrub cover, shrub cover sparse, or shrub cover sparse with introduced grass species (grass or forb communities not in key; see "SUCCESSIONAL VEGETATION," page *55)*

26a Communities reseeded with introduced grasses and with or without introduced forbs, or communities appearing as bunchgrass types below 2 440 meters (8,000 ft) with or without a sparse shrub cover; mostly sagebrush communities with the shrub component eliminated or reduced by fire, chemicals, or mechanical means

27a Rehabilitated with introduced species; old seedings may have big sagebrush or rabbitbrush, and native grasses and forbs mixed at various densities with crested wheatgrass; seedings sometimes include introduced forbs
(CRESTEDWHEATGRASS SEEDINGS—not discussed in text)

27b Rehabilitated without introduced species (shrub cover removed by fire, chemical, or mechanical means); residual native species used for natural reseeding of grass stand; often dominated by bearded bluebunch wheatgrass, with a mix of other species present
(SUCCESSIONAL VEGETATION). 55

26b Communities not reseeded

28a Sod-forming grasslands

29a Occurring in permanently wet situations along streams, ponds, or lake
(PERMANENTLYWET MEADOWS) 54

29b Occurring in places that are seasonally wet a significant part of the year; near streams or near other moist areas
(SEASONALLY WET MEADOWS) 52

28b Not sod-forming grasslands; bunchgrass communities in the subalpine zone above 2 **440** meters (8,000 ft)
(SUBALPINE BUNCHGRASS). 55

Riparian Zone Communities

Riparian zones are identified by the presence of vegetation that requires free or unbound water or conditions that are more moist than normal (Thomas et al. 1979b). Riparian plant communities within this zone are complex and highly variable in structure, number of species, species composition, productivity, and size. This variability is due, in part, to the interaction of water quality, hydraulics, hydroperiod, topography, soil, geology, elevation, animal use, and alterations by people (Odum 1971, 1979; Thomas et al. 1979b). They are disproportionately important among Great Basin plant communities, yet there is probably less known about them than any other major zone under management.

Because of the complexity of the riparian zone and a lack of information on riparian vegetation in the Great Basin of southeastern Oregon, this section is limited to a general discussion. The riparian zone in relation to management is discussed by Thomas et al. (1979b).

1—RIPARIAN

Riparian communities vary structurally from a low grass and grasslike layer to a tree layer reaching above 25 meters (80 ft) and include many combinations of grasses, forbs, shrubs, and trees in between. Density of vegetation varies markedly. Because most woody vegetation is deciduous, however, hiding and thermal cover is effective primarily during the growing season.

Concentrated and valuable forage resources characterize this community. Intensive grazing may alter vegetation, causing not only a loss of forage but a different community structure and reduced productivity for the site. Soil losses through erosion of streambanks and lowering of water tables through channelization may permanently reduce plant productivity or change the vegetation. For example, a streambed lowered by erosion can cause a lower water table in the adjacent meadow and convert the meadow to a shrub community.

Management decisions must be made on a case by case basis because of the high variability between communities in the zone. Many critical site factors that influence productivity change from one riparian community to another.

Quaking Aspen Communities

Quaking aspen communities are scattered through mountainous areas of the Great Basin, most commonly at elevations from 1 550 to 2 150 meters (5,000 to 7,000 ft). These communities are usually found on wet sites but occasionally occur in combination with mountain big sagebrush.

2—QUAKING ASPEN/GRASS (fig. 9)

Vegetation

Crown cover of quaking aspen in the quaking aspen/grass community varies from 25 to 75 percent. Some stands have a two-tiered tree canopy—a mature and a reproduction layer. Mature stands reach a mean height of 21 meters (70 ft) with a mean stem diameter

Figure 9.—Quaking aspen/grass community along an intermittent streambed. Note the lack of reproduction and close cropping of grass and forbs by livestock and mule deer.

(breasthigh) of 36 centimeters (14 inches) and a maximum diameter of 56 centimeters (22 inches). Basal area (area of tree trunks covering the ground surface) of one large mature stand was 28 square meters per hectare (120 ft^2 per acre).[5] When present, the shrub layer is sparse and consists of occasional plants of mountain big sagebrush, green rabbitbrush, or mountain snowberry averaging 40 centimeters (16 inches) in height.

Grass and forb species, plant composition, and plant density vary among stands, partially because of varying amounts of moisture and severity of livestock use. Common grasses include blue wildrye, wheatgrass, needlegrass, hairgrass, or bottlebrush squirreltail[6] (see footnote 5). Total crown cover of the grass-forb layer may vary from less than 5 to over 30 percent. Height of the grass layer averages about 40 centimeters (16 inches).

Stinging nettle, a forb, often dominates disturbed stands. Other common forbs include peavine, aster, dandelion, sorrel, cinquefoil, and bedstraw (see footnotes 5 and 6). False hellebore and thistle are occasionally found. Dominant forb species average 1 meter (3.28 ft) tall. Some stands, however, lack tall forbs, such as stinging nettle, sorrel, false hellebore, and thistle. Height of forbs in such stands averages 30 centimeters (12 inches).

Site

Elevation of this community ranges between 1 830 and 2 300 meters (6,000 and 7,500 ft) in southeastern Oregon. It may occur near the top of mountains or on the middle, lower, toe, and bottom slopes; it often occurs around springs, seeps, lakes, ponds, or along streams on slopes from 0 to 30 percent. Some stands are extensive, occurring adjacent to and parallel with streams in unbroken bands up to 150 meters (500 ft) wide and several hundred meters long. Other stands are small patches of less than 1 hectare (2.5 acres) in size.

[5] J. Edward Dealy, unpublished data on file at Range and Wildlife Habitat Laboratory, La Grande, Oregon.

[6] Personal communication from A. H. Winward, Oregon State University, Corvallis.

Soil

Soils are moderately deep to deep, gravelly silt loams and loams. Cobble and stone volume in the soil varies, and coarse fragments on the surface are scarce. These soils are well drained, runoff is medium, and erosion hazard is moderate.

Discussion

Most stands have been intensively grazed by livestock for nearly 100 years. Since these sites are highly productive and found near water, wild and domestic ungulates concentrate on them. Reproduction of aspen on streamsides is damaged by grazing, except in areas where access by livestock has been restricted.

Beavers inhabit this community where there is sufficient running water. Damage to aspen reproduction by livestock and wild ungulates and to older trees by beavers has eliminated some stands, thereby eliminating beaver habitat. In one area, for example, there was one active beaver pond, one being built in an aspen stand too small to support the beaver, and approximately 15 abandoned ponds where aspen stands have been eliminated. It did not appear that these destroyed stands would become reestablished (see footnote 5).

Aspen stands provide valuable thermal and hiding cover for many vertebrate species, and nesting sites for birds, including cavity nesters.

3—QUAKING ASPEN/MOUNTAIN BIG SAGEBRUSH (fig. 10)

Vegetation

A single species tree stand of quaking aspen is typical of this community. It usually occurs as an open stand with less than 50-percent crown cover. Height ranges from 6 to 12 meters (20 to 40 ft), and trees on these sites often appear stunted and broad crowned with heavy lateral branches (see footnote 5). Occasionally, all mature trees in this type are either dying or dead. Some stands have a dead (snag) overstory above live reproduction, but in other

Figure 10.—Quaking aspenlmountain big sagebrush community illustrating the common branched tree form. Note the hole in the trunk used by cavity nesters (Chris Maser photograph).

stands both layers are dead. The causes of such mortality are unknown. It does appear, however, that these sites are marginal, and fluctuation in underground moisture or winter snowpack may be important factors. Also, long-term concentrated use of these small areas for forage and shade by livestock and big game may have consistently destroyed reproduction and prevented replacement of the old, degenerating stand.

Crown cover of quaking aspen reproduction ranges from **25** to **75** percent, and all heights may be represented, from a few centimeters to mature height. It is common, however, to see the aspen reproduction, where present, dominated by a single age and height class.

Mountain big sagebrush is the dominant shrub, with crown cover ranging from **15** to **40** percent. Average height is approximately **1** meter **(3.28** ft). Gray rabbitbrush is the next most abundant shrub and may have crown cover as high as **20** percent. Green rabbitbrush is a consistent but sparse component; it increases in density, however, as moisture availability increases in severely grazed communities (see footnote 5).

Common perennial grasses and grasslike plants in disturbed stands of this type, in descending order of amounts of crown cover, are needlegrass, bottlebrush squirreltail, wheatgrass, and sedge. Annual cheatgrass is also common. Total crown cover of these species is less than **10** percent. Mean heights of needlegrass and wheatgrass are 50 and 60 centimeters **(20** and **24** inches), respectively. Bottlebrush squirreltail and cheatgrass both average **25** centimeters (10 inches) in height, whereas sedge averages 5 centimeters **(2** inches) (see footnote 5).

Forbs are sparse. Thistle and aster appear as occasional plants, and common dandelion is a rare component. Their total crown cover is generally less than **1** percent (see footnote 5).

Site

The quaking aspenlmountain big sagebrush community occurs most commonly on what appear to be dry sites between **1** 550 and **2 150** meters **(5,000** and **7,000** ft). It is present both in the Owyhee Uplands and Basin and Range Provinces (Franklin and Dyrness **1973).** Macrorelief is mountainous and microrelief smooth. Slope ranges from less than 5 to **25** percent, and the position on a slope may be upper, middle, or lower. Slope aspects are generally northerly—from north-northwest to east-northeast (see footnote 5).

Soil

Soils are moderately deep, gravelly loams to sandy loams overlying basalt or rhyolite. They are well drained, and erosion hazard is moderate. Cobble and stone volume in the soil ranges from 5 to **30** percent, and coarse fragments cover less than 5 percent of the soil surface (see footnote 5).

Discussion

This quaking aspen community indicates a high soil moisture level, possibly caused by the combination of an unusual underground source of water and an exceptionally heavy snowpack.

All observed sites occur near maximum elevations on aspects roughly 180° from prevailing winter storm winds. Snowpack is deep and persistent compared with surrounding sites.

Use by livestock is intense in this community because of its high production of forage and tree shade. These stands are small; relative to the overall livestock forage resource of the adjacent open range, they have little impact. They appear to be important, however, as islands that maintain habitat diversity for wildlife and, therefore, merit management.

Curlleaf Mountainmahogany Communities (figs. 11 and 12)

Curlleaf mountainmahogany has two recognized varieties in the intermountain west. Only ***Cercocarpus ledifolius*** var. ***ledifolius*** is commonly present in the Great Basin of southeastern Oregon, occurring within four broad community groups: tree-sagebrush-bunchgrass, tree-snowberry-grass, tree-bunchgrass, and tree-grass (Dealy 1971,1975).

Figure 11.—Extensive stands of curlleaf mountainmahogany blanket the tops and slopes of high desert mountains. Communities with open stands and understories of mountain big sagebrush differ from those with dense-canopied stands and a grass understory. Vegetation changes depend on changes in aspect and elevation which produce changes in available moisture.

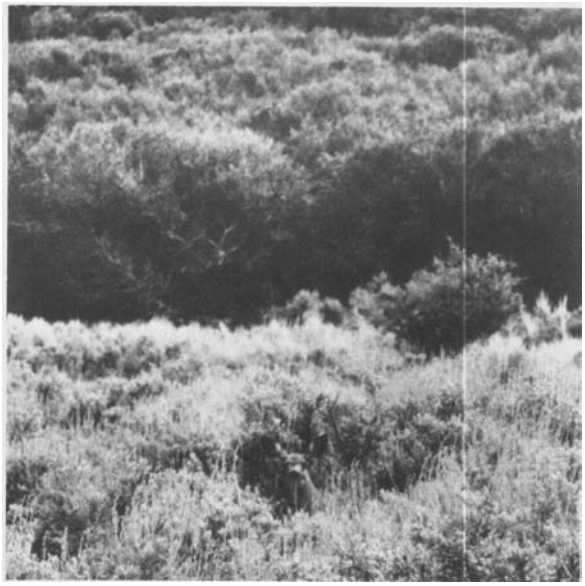

Figure 12.—Dense curlleaf mountainmahogany stand upslope from a vigorous mountain big sagebrush stand. These two high value habitats commonly occur adjacent to one another and, as a result, increase diversity fo? deer (in foreground) and other wildlife. Precipitation is above 50 centimeters (20 inches).

4—CURLLEAF MOUNTAINMAHOGANY/ MOUNTAIN BIG SAGEBRUSH/ BUNCHGRASS (fig. 13)

Vegetation

This community is characterized by a patchy distribution of curlleaf mountainmahogany with a crown cover ranging from 35 to 60 percent and averaging 50 percent. Tree density varies between 800 and 2,000 stems per hectare (300 and 800 per acre) and averages 1,250 per hectare (500 per acre) with an occasional interspersed western juniper. Occasionally, ponderosa pine may occur within the stands.

The shrubby understory usually consists of a mountain big sagebrush layer of less than 5-percent crown cover. Density and vigor of sagebrush increase noticeably in the spaces between trees. Gray rabbitbrush, green rabbitbrush, wax currant, and Wyeth eriogonum are less common in the shrub layer.

Figure 13.—Curlleaf mountainmahogany/mountain big sagebrushlbunchgrass community in the Great Basin of southeastern Oregon. Mountain big sagebrush grows densely and with high vigor under open tree canopies.

Dominant grasses are Idaho fescue, cutting wheatgrass, and big bluegrass. Other common grasses or grasslike species are California brome, bottlebrush squirreltail, Lemmon needlegrass, and Ross sedge.

Between **20** and **30** forbs occur in the understory. Lambstongue groundsel, arrowleaf balsamroot, western hawkweed, lupine, violet, and annual agoseris are most common.

Site

The curlleaf mountainmahogany/mountain big sagebrush/bunchgrass community occurs mostly on southerly facing slopes, ranging from 0 to **40** percent at elevations of 1 600 to 1950 meters **(5,250** to 6,400 ft). Mean elevation is 1 750 meters (5,750 ft). Macrorelief is mountainous and microrelief smooth. Since local topography in some areas is abruptly broken by ridges and hillocks, directional aspects may change within short distances.

Stands of this community occur on the driest sites suited to curlleaf mountainmahogany in the high desert mountains. When situated as narrow stringers on rimrock sites, the stands characteristically contain fewer species and some atypical species because of ecotonal influences within the narrow strip of the type.

Soil

The soil is well drained and varies from gravelly loam to gravelly sandy loam in the A horizon, and from gravelly clay loam to fine sandy loam in the B or AC horizon. Soil depth varies from **23** to 85 centimeters (9 to **33** inches) and averages 55 centimeters **(22** inches). Soil surface cover of coarse fragments ranges from 1 to 60 percent and averages **32** percent. Cobble and stone volume in the soil ranges from **25** to 90 percent and averages 68 percent. Parent material can be either residuum or colluvium. Underlying material is generally either basalt or rhyolite. The soil is often shallow in stringer sites adjacent to rimrock, and stoniness of these soils is generally pronounced (Dealy 1975).

Discussion

This community has had a long history of heavy use by livestock—sheep in the early days and cattle more recently. This has resulted in an increase of understory species, such as gray or green rabbitbrush, cheatgrass, bottlebrush squirreltail, Lemmon stipa, or thistle. Generally, stands occur in a mosaic with mountain big sagebrush where relatively dense clumps of curlleaf mountainmahogany are interspersed with openings dominated by sagebrush and bunchgrass.

Fire easily kills curlleaf mountainmahogany. In many instances, patterns of burning are indicated by old, large trees in rocky, fire-resistant sites adjacent to young (60-80 year) stands in less rocky sites more vulnerable to fire. The old trees appear to have been missed by fire and provided the seed to reestablish adjacent stands. Many curlleaf mountainmahogany stands appear to have increased in size since fire has been controlled (Dealy 1975). Such action has been an advantage to wildlife in general since these stands provide important hiding and thermal cover for deer and bighorn sheep, as well as nesting sites for birds and ground-dwelling mammals.

5—CURLLEAF MOUNTAINMAHOGANY/ MOUNTAIN SNOWBERRY/GRASS

Vegetation

Stands of the curlleaf mountainmahoganyl mountain snowberrylgrass community are characterized by a tree crown cover, ranging from 50 to 85 percent and averaging 70 percent. Such stands may vary in size from a few hectares to extensive areas with only small interspaces that may be dominated by grasses or shrubs (often mountain big sagebrush). Tree density varies from 900 to 3,200 stems per hectare (365 to 1,300 per acre) and averages 1,770 per hectare (720 per acre). An occasional western juniper may occur and, rarely, quaking aspen on moister sites (Dealy 1975).

The shrub understory commonly is a mixture of mountain snowberry and mountain big sagebrush. Dominance may change from one to the other in different stands. Crown cover is generally less than 5 percent. Other shrubs commonly found are green rabbitbrush, gray rabbitbrush, chokecherry, and creeping Oregon grape. Saskatoon serviceberry is present on about 50 percent of the area sampled. Other less commonly occurring shrubs are bittercherry and desert rockspirea.

Dominant grasses and grasslike species are big bluegrass or Idaho fescue in stands lightly used by livestock. Ross sedge and Sandberg bluegrass are common in most stands of the complex. In stands heavily used by livestock, there is an increase in bottlebrush squirreltail, cheatgrass, and Sandberg bluegrass.

Dominant forb species vary among sites in this community. Common species on dry sites are balsamroot, lupine, prairiesmoke avens, and varileaf phacelia; on moist sites—gray hawksbeard, heartleaf arnica, meadowrue, lambstongue groundsel, and Holboell rockcress.

Site

The driest stands of this community occupy south to southwest slopes at elevations averaging 1 770 meters (5,800 ft). Slopes average 30 percent.

Other stands are found on northerly aspects, varying from east-northeast to northwest at elevations between 1 800 and 1 900 meters (5,900 and 6,232 ft). Slopes range from 25 to 35 percent. Macrorelief is mountainous; microrelief generally rough. Topography is steep and abrupt in some stands and moderate in others.

Soil

Soils range from shallow to moderately deep and from a loam texture to gravelly loam. Cobble and stone cover of the soil surface ranges from 5 to 48 percent, and cobble and stone volume in the soil ranges from 27 to 81 percent. Parent material is generally colluvium or a mixture of colluvium and residuum material. Some soils overlay basalt; others occur over rhyolite (Dealy 1975).

Discussion

Density, vigor, and size of shrubs appear to be either a function of available moisture or an interaction of available moisture and tree crown cover (reduction of light) on the drier sites. Under dense tree canopies, shrubs are small, structurally weak, and scattered. In more open stands, however, shrubs are larger, more vigorous, and more dense. Increased available moisture within sites favors an increase in grasses and forbs rather than shrubs.

Stands of the community are habitat for mule deer and bighorn sheep. Livestock have also used these areas since the 1860's.

Fire control has permitted development, maintenance, and expansion of tree stands within the curlleaf mountainmahogany/mountain snowberrylgrass community (Dealy 1975).

6, 7—CURLLEAF MOUNTAINMAHOGANY/ IDAHO FESCUE (fig. 14) AND CURLLEAF MOUNTAINMAHOGANY/BEARDED BLUEBUNCH WHEATGRASS-IDAHO FESCUE (fig. 15)

Vegetation

Tree cover varies from an average 66 percent in stands on the moister sites to 36

Figure 14.—Curlleaf mountainmahoganyl Idaho fescue community commonly occurs adjacent to the ponderosa pine zone on moist northerly sites.

Figure 15.—Curlleaf mountainmahoganyl bearded bluebunch wheatgrass-Idaho fescue community commonly occurs below and adjacent to the lower edge of the ponderosa pine zone.

percent on drier sites. Curlleaf mountainmahogany is the dominant species, but ponderosa pine occurs as scattered trees where the community is adjacent to the pine zone. Western juniper occurs as a subordinate species in some stands. Density of curlleaf mountainmahogany ranges from 500 to 2,000 stems per hectare (200 to 800 per acre). Stands are either patchy in distribution or occur as narrow bands perpendicular to the slope below and adjacent to the ponderosa pine zone. They occasionally encircle scab flats as bands within a ponderosa pine forest.

The shrub layer consists of occasional big sagebrush plants and rare plants of wax currant, gray rabbitbrush, green rabbitbrush, or antelope bitterbrush.

Grasses and grasslike species on sites indicating highest soil moisture are Idaho fescue (a strong dominant), bearded bluebunch wheatgrass, bottlebrush squirreltail, prairie junegrass, Sandberg bluegrass, California brome, Ross sedge, and cheatgrass. On drier sites, understories are bearded bluebunch wheatgrass and Idaho fescue in a codominant relationship. Both Sandberg bluegrass and bottlebrush squirreltail are more abundant, and prairie junegrass and cheatgrass remain about the same as on moist sites.

Forbs are scarce in the understory. Western hawkweed and phlox are most common on moist sites, and arrowleaf balsamroot is most common on drier sites. Occasional forbs are yarrow and annual agoseris.

Site

The curlleaf mountainmahogany/Idaho fescue community is found on most aspects from 1 600- to 1 700-meter elevation (5,250 to 5,575 ft). Northerly slopes ranging from 5 to 15 percent contain a dominant understory of Idaho fescue, whereas on other aspects with slopes ranging from **25** to 60 percent, bearded bluebunch wheatgrass and Idaho fescue are codominant. Macrorelief is mountainous, and microrelief varies from smooth to rough.

Soil

Soils are generally moderately deep, well-drained loams. Cobble and stone volume in the A horizon ranges from 5 percent where Idaho fescue is dominant to 30 percent where bearded bluebunch wheatgrass is codominant with Idaho fescue. Cobble and stone volume in B horizons is about 65 percent. Soils are developed from colluvium or weathered basalt. Permeability is moderate,. runoff is estimated as medium, and erosion hazard is moderate (Dealy 1975).

Discussion

Use by cattle is minor in these stands because dense (70-percent crown cover), short stands of curlleaf mountainmahogany form a natural physical barrier. The trees commonly retain dead lateral branches below the live canopy. In a dense stand, these brittle but tough branches make penetration by cattle difficult. Domestic sheep travel through these thickets, however, as evidenced by wool hanging from low branches (Dealy 1971).

Tree crown cover averages 35 percent on sites having a high percentage of bearded bluebunch wheatgrass. Cattle move readily within these stands to graze the understory.

Mule deer use all sites for cover and forage; these sites, however, are more important to deer for cover than for forage (Dealy 1971).

8—CURLLEAF MOUNTAINMAHOGANYI PINEGRASS (fig. 16)

Vegetation

Curlleaf mountainmahoganylpinegrass stands contain only one other tree species—an occasional bittercherry. Crown cover ranges from 62 to 96 percent and averages 80 percent. Density ranges from 1,400 to 4,700 stems per hectare (570 to 1,900 per acre) and averages 2,000 stems per hectare (800per acre).

Shrubs are sparse; Saskatoon serviceberry and creeping Oregon grape are almost always present. Occasional shrubs are green rabbitbrush, gray rabbitbrush, and Wyeth eriogonum.

Pinegrass dominates the grass layer in light to moderately grazed stands. Big bluegrass is abundant, and Ross sedge, bottlebrush squirreltail, and cutting wheatgrass are common. Either Idaho fescue or Lemmon needlegrass is codominant with pinegrass in stands that have been heavily grazed by livestock. Other common grass and grasslike species in these heavily used stands are bottlebrush squirreltail, big bluegrass, and Ross sedge.

Western hawkweed is the dominant forb on relatively undisturbed sites. On disturbed sites, Nuttall violet dominates, western hawkweed is found consistently in low abundance, and thistle and common dandelion increase with disturbance. Common forbs on all sites are prairiesmoke avens, annual agoseris, and yarrow.

Figure 16.—The curlleaf mountainmahoganylpinegrass cornmunity has the highest potential for production of dry land species in the Great Basin of southeastern Oregon.

The Alaska habenaria (commonly called Alaska rein-orchid) grows in low abundance in stands showing no evidence of litter disturbance. This plant develops a fleshy tuber delicately attached just below the interface of litter and mineral soil. It appears in stands protected from livestock and wild ungulate trampling by a dense tree thicket but disappears from sites where the litter-soil interface is even slightly disturbed (Dealy 1975).

Site

The curlleaf mountainmahoganylpinegrass community has been identified in the Owyhee Uplands (Dealy 1975) at elevations ranging from 1 750 to 1 920 meters (5,750 to 6,300 ft). It consistently occupies slopes facing east-northeast to north. Slopes range from 10 to 40 percent and average 24 percent. Macrorelief is mountainous, microrelief smooth. These sites experience heavy snowpacks during most winters. Measurements over a period of years have established annual precipitation at 56 centimeters (22 inches) (Dealy 1975).

Soil

Soils are moderately deep (48 centimeters or 19 inches), varying from gravelly loams to gravelly sandy loams, overlying fractured rhyolitic bedrock. Parent material is residual. Cobble and stone cover of the soil surface ranges from 0 to 10 percent and averages 3 percent; cobble and stone volume in the soil profile ranges from 15 to 80 percent and averages 44 percent. Soils under this community are well drained and moderately permeable. Runoff is medium and erosion hazard moderate to high (Dealy 1975).

Discussion

Domestic sheep and cattle grazing in the Owyhee Uplands, where this community occurs, was moderate to heavy during the late 1800's and early 1900's (Griffiths 1902). Since 1934, cattle have been the primary domestic animals grazing in the area. Historically, bighorn sheep and mule deer inhabited the area. Bighorn sheep were eliminated, however, near the turn of the century and did not return until 1965, when the Oregon Department of Fish and Wildlife reestablished them in some mountainous areas. Mule deer have been present throughout recorded history.

The curlleaf **mountainmahoganylpinegrass** community exhibits what may be the highest potential for production of dry land species in the high desert mountains of the northern Great Basin. Stands of this community where the Alaska habenaria occurs appear to be closer to pristine conditions than any others. This community is particularly valuable to birds and small ground-dwelling vertebrates.

Western Juniper Communities

Western juniper is unique to the intermountain west. Its center of development is the large woodland of central Oregon. It also occurs throughout southeastern Oregon, southwestern Idaho, northwestern Nevada, and northeastern California in scattered, open stands, as single trees, and rarely in more dense, extensive stands (Dealy et al. 1978a, 1978b) (fig. 17).

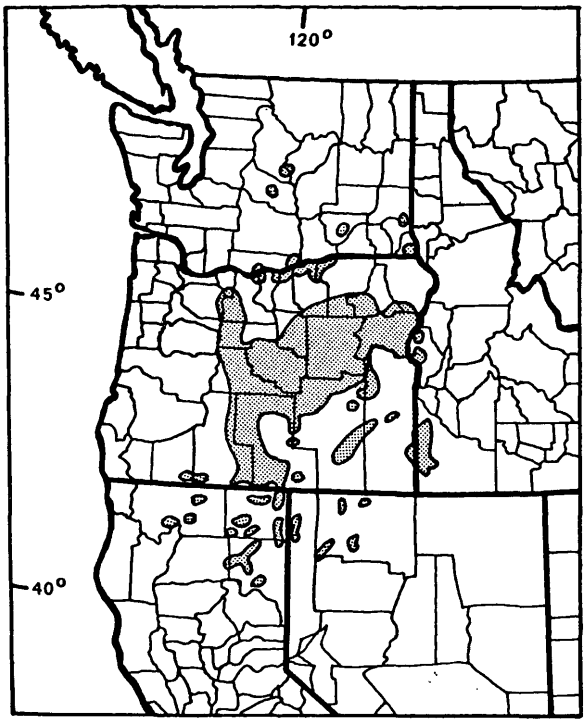

Figure 17.—Generalized distribution of western juniper (shaded portion) which occurs only in the Northwest (from Dealy et al. 1978a). Tree densities vary within and among the different localities.

9,IO—WESTERN JUNIPER/BIG SAGEBRUSH/BEARDED BLUEBUNCH WHEATGRASS (fig. 18) AND WESTERN JUNIPER/BIG SAGEBRUSH/IDAHO FESCUE

Vegetation

Western juniper in stands of these communities occurs primarily as a single overstory species with wide spacing. Some stands occur with a mature overstory, whereas others have recently developed with a young overstory on sites previously occupied by big sagebrush communities (fig. 19). Crown cover of western juniper is less than 35 percent in most stands.[7] Big sagebrush is the dominant shrub; gray rabbitbrush and green rabbitbrush are present in varying amounts. On moist sites, the shrub layer becomes less dominant and both western juniper and grass increase in importance. Occasionally, antelope bitterbrush and broom snakeweed are present (Driscoll 1964, Eckert 1957).

[7]Donavin A. Leckenby, Oregon Department of Fish and Wildlife, La Grande, Oregon, unpublished data.

Figure 18.—Western juniperlbig sagebrush/bearded bluebunch wheatgrass community illustrating a mature stand of open juniper. Value as protective cover is high for ungulates, small mammals, birds, and other wildlife in the juniper communities.

Figure 19.—Before fire control and livestock grazing, this area supported a mountain big sagebrushlbunchgrass community. All western juniper trees here have become established since fire control and grazing (reduces grass fuel) reduced the frequency of fires.

Dominant grasses are bearded bluebunch wheatgrass or Idaho fescue. On some sites these grasses appear as codominants. Common grasses are Thurber needlegrass, bottlebrush squirreltail, Sandberg bluegrass, and cheatgrass. Burkhardt and Tisdale (1969)also found these grasses in the western juniper type in southwest Idaho. Occasionally plants of prairie junegrass and needleandthread occur in Idaho and Oregon stands (Burkhardt and Tisdale 1969, Roberts 1975; also see footnote 7).

Forbs in the juniper community include the following: locoweed, phlox, biscuitroot, fleabane, buckwheat, pussytoes, hawksbeard, annual agoseris, rockcress, arrowleaf balsamroot, and lambstongue groundsel.

Driscoll (1964)made an intensive study of western juniper communities, describing vegetation, site, and soils of nine associations and two variants in central Oregon. Three of these associations—western juniper/Idaho fescue, western juniperlbearded bluebunch wheatgrass, and western juniperlbearded bluebunch wheatgrass-Idaho fescue—have understories dominated by grass. The other six have understories with prominent big sagebrush layers, and the two variants have prominent antelope bitterbrush layers. Tables **3** and **4** list Driscoll's (1964) associations and present selected information on vegetation, site, and soil. Similar communities have been studied in south-central Oregon (Adams 1975, Roberts 1975). Intensive studies on western juniper communities are lacking for southeastern Oregon. Vegetation-site relationships, including plant and community structure, can be applied from Driscoll's (1964) work where similar conditions are found.

Site

The western juniperlbig sagebrush/bearded bluebunch wheatgrass and western juniperlbig sagebrush/Idaho fescue communities occupy level to hilly sites and ridges and northerly slopes in mountainous areas where moisture levels are higher than in the sagebrush steppe. Western juniper, as a type, occurs just below and abuts the curlleaf mountainmahogany zone. Precipitation ranges from approximately **25** to 38 centimeters (10 to 15 inches) per year. Macrorelief is level to mountainous, and microrelief can be rough in rimrock situations or smooth in deeper soils. Idaho fescue dominates the understory on sites with highest moisture, and bearded bluebunch wheatgrass is dominant on the driest sites. A more varied mixture of these grasses is found on sites of intermediate moisture.

Table 3—Number of macroplots and generalized characteristics of vegetation-soil units in the central Oregon juniper zone; reproduced from Driscoll (table 2, 1964)

Unit	Sample units	Aspect	Associated great soil group	Elevational range
		Number		Feet
Juniperus/Artemisia/Festuca	5	NW. to NE.	Chestnut	4,250-4,500
Juniperus/Artemisia/Festuca-Lupinus	4	N. to NE.	Regosol in Brown zone	4,400-4,550
Juniperus/Festuca (*Purshia* variant)	5 (2)	NW. (SE. to E.)	Brown	4,100-4,300
Juniperus/Artemisia/Agropyron-Chaenactis	5	NW. to NE.	Regosol in Brown zone	3,900-4,400
Juniperus/Artemisia/Agropyron	5	Level	Brown	2,550-2,650
Juniperus/Agropyron (*Purshia* variant)	6 (2)	E. to NE. (SE.)	Brown	4,150-4,450
Juniperus/Artemisia-Purshia	5	N. to NE.	Regosol in Brown zone	4,100-4,400
Juniperus/Agropyron-Festuca	5	E.	Regosol in Brown zone	4,250-4,750
Juniperus/Artemisia/Agropyron-Astragalus	6	S. to sw.	Brown	4,000-4,400

Table 4—Average values of selected surface and subsoil characteristics attendant to nine associations. in the central Oregon juniper zone; reproduced from Driscoll (table 3, 1964)

Association	Basal area perennial herbs	Bare soil surface	Available SMS[1] capacity, 2- to 14-inch zone	Organic matter, A horizon	Total nitrogen, A horizon	Horizon texture[2]	
						A	B or AC
Juniperus/Artemisia/Festuca-Lupinus	7.4	22.1	1.41	4.78	0.21	l	c
Juniperus/Artemisia/Festuca-Lupinus	6.5	30.9	1.98	1.74	.10	sl	sl
Juniperus/Festuca (*Purshia* variant)	4.4	33.3 (46.8)	1.81 (2.14)	3.91 (2.33)	.17 (.10)	l (1)	sil, c (c)
Juniperus/Artemisia/Agropyron-Chaenactis	5.2	52.3	.87	1.53	.08	sl	sl
Juniperus/Artemisia/Agropyron	6.6	41.3	2.31	1.50	.08	l	c, cl
Juniperus/Agropyron (*Purshia* variant)	3.2	51.1	1.34	2.12	.10	scl (1)	c, cl
Juniperus/Artemisia-Purshia	3.1	55.0	1.54	1.05	.06	sl	sl
Juniperus/Agropyron-Festuca	4.1	54.7	.97	1.32	.07	sl	sl
Juniperus/Artemisia/Agropyron-Astragalus	3.5	45.7	1.21	1.63	.06	l	c

[1] SMS, soil moisture storage.

[2] The AC horizon is immediately below the A horizon in Regosols. B horizon textures were taken for the finest part of that horizon. Textural classes: cl, clay loam; l, loam; scl, sandy clay loam; sil, silt loam; c, clay; and sl, sandy loam.

Soil

Soils are highly variable in western juniper communities. Relatively young stands (100 years old or younger) have been reported on deep sandy loam soils in areas supporting the big sagebrush type before advent of fire control (Burkhardt and Tisdale 1969, 1976). Old-growth stands (more than 100 years) have been found on rocky rims having shallow soils. Eckert (1957), working in southeastern Oregon, found soils supporting western juniper to be in the Brown and Chestnut great soil groups that were derived primarily from residuum or colluvium of basalt and rhyolite origin. Some, however, developed on alluvial fans. Soil profiles were similar in many respects to those described by Dealy et al. (1978a, 1978b) and Driscoll (1964).

Discussion

Some authors have described western juniper as an "invader" in certain big sagebrush communities (Anderson 1956; Burkhardt and Tisdale 1969, 1976). Western juniper appears to be a strongly dominant native species but historically has been kept in a subordinate role on some sites because of natural fires (Dealy et al. 1978a, 1978b). Since fire control has been in effect and since severe livestock grazing began in the late 1800's, resulting in reduced grass-forb fuel for carrying fires, western juniper has increased its range and density in some areas

(fig. 19). Whether the increase of western juniper communities is an "invasion" or an "expansion" is important semantically because "invasion" has a negative connotation. It is more important that managers objectively recognize values of western juniper communities and retain them, if desired; this is consistent with the strategy of preserved diversity (Bellaand Overton 1972).

The western juniper community is important for livestock production because of available shade, wildlife habitat (Leckenby 1977, 1978b; Maser and Gashwiler 1978), recreational activities, and erosion protection, to name a few values. A provisional list of 83 species of birds and 23 species of mammals that use western juniper communities was developed by Maser and Gashwiler (1978). The importance of thermal qualities of western juniper communities for mule deer has been documented by Leckenby (1977). Old-growth stands of western juniper provide a special habitat for cavity dwellers, such as the bushy-tailed woodrat (fig. 20).

Figure 20.—Nests of bushy-tailed wosdrats in a hollow western juniper stem illustrate one of the many values of old growth for wildlife habitat (Chris Maser photograph).

Sagebrush Communities

Woody sagebrushes dominate the aspect (physiognomy) of the high desert shrub-steppe plant communities. These shrubs are distributed from Canada to Mexico and from the Pacific Northwest States to the Great Plains (Beetle 1960).

Aromatic gray sagebrushes appear as at least 13 distinctive taxa in Oregon. Among other characteristics, habitat, height, branching form, leaf shape, chromosome number, chromatographic response, and fluorescence in ultraviolet light help to identify the various important taxa (Beetle 1960; Hanks et al. 1971, 1973; Stevens and McArthur 1974; Winward 1980; Winward and Tisdale 1977). The above characteristics except chromosome number and chromatographic response, can be used in the field for identification of taxon. Heights of sagebrushes vary between extremes of the tall basin big sagebrush and the small bud sagebrush. Height of other species and subspecies declines between those extremes in about the following order: (1) subalpine big sagebrush, (2) mountain big sagebrush, (3) Wyoming big sagebrush, (4) mountain silver sagebrush, (5) Bolander silver sagebrush, (6) threetip sagebrush, (7) stiff sagebrush, (8) early low sagebrush, (9) low sagebrush, and (10) black sagebrush (see footnote 6, p. 18). Branching appears feathery and upright in basin big sagebrush and silver sagebrushes, tabular and compact in mountain big sagebrush, and globelike or flattened in black sagebrush (fig. 21). Leaves are predominantly wedge shaped, with three lobes (occasionally five or more) at the wide tip; silver sagebrush leaves are tapered to one tip, like lance points. Alcohol or water extracts of the leaves and other parts fluoresce characteristic shades of creamish-blue or brownish-red (table 5) in long-wave ultraviolet light (Stevens and McArthur 1974, Winward 1980, Winward and Tisdale 1977).

The various sagebrushes readily cross (genetic plasticity), as evidenced by similarities among their morphological characteristics (Beetle 1960).

At least four, and probably more, sagebrush taxa reach the same growth stages

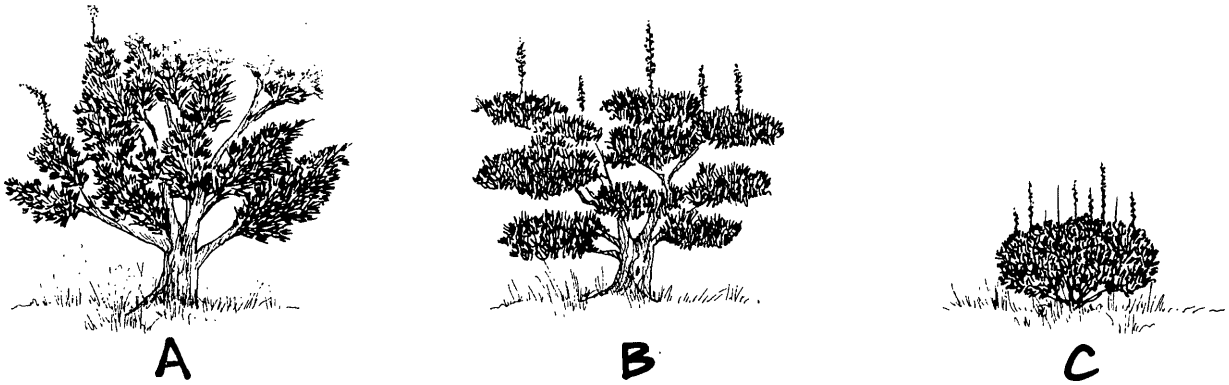

Figure 21.—Three major growth forms of sagebrushes: A, feathery and upright; B, tabular and compact; and C, globular or flattened.

Table 5—Characteristic color shades of alcohol extracts of persistent leaves of 12 sagebrushes during exposure to long-wave ultraviolet light (after Winward 1980)

Sagebrush taxa	Shade of fluorescence	
	Creamish-blue	Brownish-red
Basin big sagebrush		X
Wyoming big sagebrush		X
Stiff sagebrush		X
Black sagebrush		X
Mountain big sagebrush	X	
Subalpine big sagebrush	X	
Threetip sagebrush	X	
Bolander silver sagebrush	X	
Mountain silver sagebrush	X	
Low sagebrush	X	
Cleftleaf sagebrush	X	
Early low sagebrush	X	

(phenology) at different times. For example, mountain big sagebrush initiates growth 2 weeks later and ripens seed 2 weeks earlier than basin or Wyoming big sagebrush; subalpine big sagebrush initiates growth later and seed development earlier than any other taxon; differences between basin and Wyoming big sagebrushes are not consistent (Winward and Tisdale 1977).

Winward and Tisdale (1977) discussed several management reasons for identifying sagebrushes to subspecies. Briefly, the various taxa of sagebrush provide indicators for (1) recognition of the plant environment or site (climate, soil, and other factors); (2) estimation of productive potential; (3) prediction of reaction to disturbance (changes in plant composition or stand structure); (4) determination of

range condition; (5)evaluation of forage preferences among stands; (6)applications of grazing systems; and (7)selection of treatment methods and schedules appropriate to accomplishment of management goals.

Sagebrushes can be separated conveniently into tall and short groups based on species, subspecies, and form. Each group requires different manipulations to meet management objectives for forage or cover. The tall sagebrush group is comprised of basin big sagebrush, mountain big sagebrush, Wyoming big sagebrush, subalpine big sagebrush, threetip sagebrush, mountain silver sagebrush, Bolander silver sagebrush, and other as yet undefined taxa. The short sagebrush group is comprised of low sagebrush, cleftleaf sagebrush, early low sagebrush, black sagebrush, stiff sagebrush, bud sagebrush, and other as yet undefined or unidentified taxa.

The recognition of species, subspecies, and forms of sagebrush supplies much information about a stand or a community—much that would take years to measure by other means; for example, weather stations. Variation in composition of plants among stands may identify differences in environments (Fosberg and Hironaka 1964); for example, stands of silver sagebrush, low sagebrush, and big sagebrush are usually separated by sharp ecotones because these species greatly differ in tolerance to soil moisture saturation. Silver sagebrush survives flooding and soil saturation longer than low sagebrush, and both silver and low sagebrush survive soil saturation better than big sagebrush. Tolerances for given environmental conditions vary even within species: Bolander silver sagebrush is more tolerant of alkalinity than is mountain silver sagebrush and occurs in closed basins; Wyoming big sagebrush is more tolerant of finer textured, alkaline soils than is basin big sagebrush and therefore dominates it on such sites.

The effect of climate on broad patterns of plant distribution is well accepted, and this effect is usually described and predicted by single factor relationships. For example, "Mean annual precipitation is never more than 363 mm in the *Artemisia* zone and never less than 408 mm in the *Pinus* forest" (Daubenmire 1956, p. 142);these moisture levels defined the sagebrush-forest ecotone in portions of Washington and Idaho. In another example, the threetip sagebrush-fescue zone is separated from a big sagebrush-wheatgrass zone and is associated with cooler temperatures from October through April and with higher precipitation and water balances in September, November, December, January, and March (Daubenmire 1970).

Microclimate is closely reflected by many plant species, and most of these are probably *not* dominants in the stand.

Grazing management has a marked influence on densities and crown cover of sagebrushes and cheatgrass.

Unusual and prolonged increases in soil moisture (i.e., water spreading as a management tool) drastically alter the relative dominance of western juniper, sagebrushes, and grasses. If flooding is of sufficient duration, pygmy woodlands and shrub steppes are converted to meadows or marshlike plant communities. Again, the characteristic species within the stand reflect the management. Not all interactions are obvious. There is still much to learn about a site from composition of plant species and how best to manage the site for specific goals (Daubenmire 1968, Pechanec et al. 1965).

Community composition reflects quality of forage, and community structure reflects quality of cover. Foraging animals preferentially browse some sagebrush species and subspecies more than others (Sheehy 1975; Smith 1950, 1952);cattle, domestic sheep, and pronghorns favor black sagebrush more than big sagebrush (Dayton 1931). In another study, mule deer and domestic sheep preferred mountain big sagebrush, Bolander silver sagebrush, and low sagebrush; the mule deer ate but did not prefer Wyoming and basin big sagebrush and showed the least preference for black sagebrush (Sheehy 1975). Chemical composition may influence the palatability of sagebrushes (Short et al. 1972). Sage grouse, horned larks, and pronghorns prefer low sagebrush stands

over big sagebrush stands of the high desert steppe. The taller big sagebrushes provide considerable shelter from the elements for cattle, domestic sheep, mule deer, and sage grouse and nesting sites for many animals. Few mammals and birds are small enough to effectively use the short sagebrush species for cover—thermal or hiding. Since many plant species of the shrub-steppe often comprise both forage and cover, composition of plant species as well as crown cover of stands are measures of site dominance and forage production. Height of vegetation cover and depth of crown, and layering (adventitious rooting from branches in contact with the soil) are attributes that directly create thermal and hiding cover.

Useful information is thus available from identification of the community; its identification is accomplished by means of characteristic plant species. This information can be applied in evaluation, selection, and application of program alternatives for management of that stand (Daubenmire **1968,** Kuchler **1957).**

Sagebrush/bunchgrass communities are broadly distributed as a shrub-steppe type from Canada south through **11** Western States into Mexico (Beetle **1960,** Garrison et al. **1977).** Extensive areas of the type are found in Washington **(5.9** million ha or **14.7** million acres), Oregon **(10.9** million ha or **26.9** million acres), Idaho **(15.0** million ha or **37.1** million acres), Nevada **(13.7** million ha or **33.9** million acres), and California **(7.3** million ha or **18.1** million acres) (Beetle **1960).**

Stands vary from austere expanses dominated by single species to multihued mosaics rich in species.

Sagebrushes dominate arid, cold desert plains beginning at 30-meter (100-ft) elevation, but similar stands also mingle with moist, subalpine parklands up to **3** 050 meters **(10,000** ft) in elevation. The stands are distributed down drainages, within basins, up slopes, across plateaus, and along ridge crests.

Associated soils usually fall within either the Brown or Chestnut Great Soil Groups. Some sagebrush stands also occur on Chernozem or Sierozem soils (Fosberg and Hironaka **1964,** Tisdale et al. **1969).** Species distributions are generally correlated with soil depth and seasonal wetness. Franklin and Dyrness **(1973).** compiled information published by several authors and compared soils of four major sagebrush species: big sagebrush on deeper soils, low sagebrush on shallow stony soils, stiff sagebrush on very shallow stony soils (lithosols), and silver sagebrush in moister habitats.

Sagebrush communities of the Great Basin are valuable range habitats that help protect as well as produce multiple resources. Sagebrushes comprise a protective cover that minimizes wind and water erosion on many sites. Grazing of livestock is the primary measured economic use of the Great Basin sagebrush zone. Free-ranging big game and other wildlife provide many secondary benefits to society as well as an unmeasured but real economic flow within the region. Because of these values, results from manipulating sagebrush vegetation are important to the short-term and the long-range economic goals of Western States. Every management strategy in manipulating cover and forage qualities of the sagebrush range involves trade-offs in benefits to livestock and wildlife.

11—BASIN BIG SAGEBRUSH/ BUNCHGRASS (fig. 22)

Beetle **(1960)** described the range of basin big sagebrush in Oregon as extending from the southern end of the Blue Mountains, northeastern Oregon, throughout the central and southeastern portions of the State. Although he also recorded the basin form for every county east of the Cascade Range, Winward **(1980)** considered its range more restricted than that of other big sagebrush forms. The land area occupied by basin big sagebrush constitutes a minor portion of the sagebrush complex in Oregon; much of its former range is now cultivated land. Over recent history, the distribution has changed little, but various uses have considerably altered the density of stands (Winward and Tisdale **1977).**

This tallest of big sagebrush forms is usually upright with erect spreading branches and a definite trunk (fig. **21);** occasionally it may be either dwarf or treelike (Beetle **1960,**

Figure 22.—A basin big sagebrush/bunchgrass stand illustrating the typical structure of this sagebrush subspecies and an understory that has been intensively grazed for a long time, resulting in reduced density of bunchgrass and an increase of annuals.

Winward and Tisdale 1977). The flower stalks are scattered throughout the irregular top. The persistent leaves are long and relatively narrow, shallow lobed, straight margined, and widest at the lobe tips. Alcohol extracts of the leaves fluoresce brownish-red in' long-wave ultraviolet light (Winward 1980).

Vegetation

Diversity of species in some stands creates a rich composition, whereas other stands appear to be almost monotypes. Associated plants that are common enough to be used in naming big sagebrush communities and that also occur with basin big sagebrush are: Sandberg bluegrass, needleandthread, Idaho fescue, bearded bluebunch wheatgrass, giant wildrye, and Thurber needlegrass (Daubenmire 1970, Tisdale et al. 1965, Winward 1980). Franklin and Dyrness (1973, p. 235) compiled information from several workers and demonstrated the variety of plant species associated with big sagebrushes as well as the wide distribution of plants that identify the named communities (table 6). Detailed species lists for big sagebrush/bunchgrass communities where the big sagebrush form is unspecified are available in Concannon (1978), Culver (1964), Dealy (1971), Dean (1960), Eckert (1957, 1958), Hansen (1956), Segura-Bustamante (1970), Urness (1966), and Volland (1976).

Structure varies considerably among big sagebrush stands, and that variability influences their cover and forage qualities. Shrub height, crown cover, and plant density are commonly reported measures of structure of big sagebrush stands (table 7). Other important measures of structure seldom reported are the number and height of layers (vegetation strata) as well as hiding cover quality and crown depth. Many references contain structural measures, but most of these are concerned with big sagebrush in general—not a specific form, such as basin big sagebrush (table 7).

Site

In Oregon, basin big sagebrush is found primarily along valley bottoms and in lower foothill regions between **30** and 2 140 meters (100 and 7,000 ft) in elevation. This subspecies is also common to many sites with dry, shallow soils, southerly to westerly aspects, and at talus perimeters (Beetle 1960, Tisdale et al. 1965, Winward 1980). Basin big sagebrush is also found in valley bottoms and lower foothills from 700 to 2 140 meters (2,500 to 7,000 ft) in Idaho (Winward and Tisdale 1977).

Soil

Soil descriptions for many big sagebrush stands are readily available, but none were found that specified the subspecies of big sagebrush that was present. Winward and Tisdale (1977), however, describe basin big sagebrush in Idaho as "growing in deep, well-drained soils." Our observations indicate the tallest stands of basin big sagebrush (to over 2.4 m or 8 ft in height) grow in deep, well-drained soils alongside rivers and streams in southeastern Oregon. Big sagebrush/bunchgrass communities are common on shallow, moderate, and deep soils. Textures include silty clay loams through fine sandy loam and loamy sands to well-drained pumice sands (Culver 1964, Daubenmire 1970, Dealy 1971, Fosberg and Hironaka 1964, Hall 1973, Tisdale et al. 1965, Urness 1966, Volland 1976). The soil profiles generally show well-developed

Table 6—Characteristic species for *Artemisia* associations[1]

Association	Species group	High Lava Plains	Owyhee Upland	Southern Blue Mountains
Artemisia tridentata/ Agropyron spicatum	**Shrubs**	*Artemisia tridentata*	*Artemisia tridentata*	
	Grasses	*Agropyron spicatum*	*Agropyron spicatum*	
		Poa sandbergii	*Poa sandbergii*	
	Herbs	*Phlox diffusa*	*Lupinus sericeus*	
		Aster scopulorum	*Lomatium triternatum*	
		Aster canescens	*Lomatium macrocarpum*	
		Chaenactis douglasii	*Zigadenus paniculatus*	
		Collinsia parviflora	*Microseris troximoides*	
		Phlox gmcilis	*Astragalus filipes*	
		Lappula redowskii	*Astragalus lentiginosus*	
		Gayophytum ramosissimum		
Artemisia tridentata/ Festuca idahoensis	**Shrubs**	*Artemisia tridentata*	*Artemisia tridentata*	
		Chrysothamnus viscidiflorus	*Chrysothamnus viscidiflorus*	
		Symphoricarpos rotundifolius		
		Ribes cereum		
		Juniperus occidentalis		
	Grasses	*Festuca idahoensis*	*Festuca idahoensis*	
		Agropyron spicatum	*Agropyron spicatum*	
		Poa sandbergii	*Poa sandbergii*	
		Koeleria cristata	*Sitanwn hystrix*	
			Bromus tectorum	
			Elymus cinereus	
	Herbs	*Phlox diffusa*	*Balsamorhua sagittata*	
		Antennaria corymbosa		
		Calochortus nitidus		
Artemisia tridentata/ Elymus cinereus	**Shrubs**		*Artemisia tridentata*	
	Grasses	*(mentioned but not described)*	*Elymus cinereus*	
			Poa sandbergii	
			Agropyron spicatum	
			Bromus tectorum	
	Herbs		*Penstemon speciosus*	
			Penstemon cusickii	
			Thlaspi amense	
			Eriogonum umbellatum	
Artemisia arbuscula/ Agropyron spicatum	**Shrubs**	*Artemisia arbuscula*	*Artemisia arbuscula*	*Artemisia arbuscula*
		Eriogonum sphaerocephalum		*Purshia tridentata*
		Juniperus occidentalis		
	Grasses	*Agropyron spicatum*	*Agropyron spicatum*	*Agropyron spicatum*
		Poa sandbergii	*Poa sandbergii*	*Poa sandbergii*
		Festuca idahoensis	*Sitanwn hystrix*	*Sitanwn hystrix*
			Bromus tectorum	
	Herbs	*Phlox diffusa*	*Penstemon aridus*	*Trifolium macrocephalum*
		Erigeron linearis	*Lagophylla ramosissima*	
		Collinsia parviflora		
Artemisia arbuscula/ Festuca idahoensis	**Shrubs**	*Artemisia arbuscula*	*Artemisia arbuscula*	*Artemisia arbuscula*
		Juniperus occidentalis		
	Grasses	*Festuca idahoensis*	*Festuca idahoensis*	*Festuca idahoensis*
		Agropyron spicatum	*Agropyron spicatum*	*Agropyron spicatum*
		Poa sandbergii	*Poa sandbergii*	*Poa sandbergii*
	Herbs	*Phlox diffusa*	*Ambis holboellii*	*Phlox douglasii*
		Phlox hoodii	*Phlox diffusa*	*Balsamorhua serrata*
		Phlox longifolia	*Erigeron linearis*	
		Microseris troximoides	*Astragalus miser*	
		Antennaria dimorpha	*Balsamorhiza hookeri*	
		Astragalus stenophyllus	*Agoseris heterophylla*	
		Lupinus saxosus	*Achillea millefolium*	
		Trifolium gymnocarpon	*Haplopappus stenophyllus*	
		Trifolium macrocephalum		
Artemisia rigida/ Poa sandbergii	**Shrubs**		*Artemisia rigida*	*Artemisia rigida*
	Grasses		*Poa sandbergii*	*Poa sandbergii*
			Bromus tectorum	*Sitanion hystrix*
			Festuca microstachys	
			Agropyron spicatum	
			Sitanwn hystrix	
	Herbs		*Mimulus nanus*	*Phlox douglasii*
			Zigadenus paniculatus	

[1] Adapted from Franklin and Dyrness (1973, p. 235).

Table 7—Structural measurements reported for tall sagebrush stands

Taxon	Shrub height		Crown cover[1]	Density			Reference
				Plants	Area		
	Meters	Feet	Percent	Number	Square meters	Square feet	
Big sagebrush	0.4-2.0	1.2-6.6	—	—	—	—	Hitchcock et al. (1955)
	1.1	3.5	13	3-7	9.29	100	Tisdale et al. (1965)
	1.o-2.0	3.3-6.6	13-75	33	1076.00	100	Daubenmire (1970)
	.7	2.2	20-27	—	—	—	Culver (1964)
	.5-.6	1.7-1.9	7-12	11-15	18.58	200	Eckert (1957)
	.3-.7	1-2	7-27	—	—	—	Segura-Bustamante (1970)
	.4-.5	1.2-1.7	16-29	103-147	74.00	800	Urness (1966)
	.2-1.0	.6-3.3	9.8-16.6	.3-4.7	10.76	1	Kornet (1978)
	—	—	15-16	—	—	—	Volland (1976)
	—	—	4-15	—	—	—	Hall (1973)
Basin big sagebrush	.3-2.4	1-8	—	—	—	—	Brunner (1972)
	1.0-5.0	3.3-16.0	—	—	—	—	Beetle (1960)
	—	—	13.2	.057	.09	1	Sheehy (1975)
	1.2-2.4	3.9-7.9	—	—	—	—	Winward and Tisdale (1977)
Mountain big sagebrush	—	—	12	.088	.09	1	Sheehy (1975)
	.3-1.2	1.O-4.0	—	—	—	—	Brunner (1972)
	1.0	3.3	—	—	—	—	Beetle (1960)
Wyoming big sagebrush	.3-.9	1.O-3.0	—	—	—	—	Brunner (1972)
	—	—	8-23	—	—	—	Winward (1980)
	—	—	9.7	.078	.09	1	Sheehy (1975)
	.4-1.0	1.5-3.3	—	—	—	—	Winward and Tisdale (1977)
Threetip sagebrush	.5	1.7	10	14	9.29	100	Tisdale et al. (1965)
	1.0-2.0	3.3-6.6	—	—	—	—	Beetle (1960)
	.2-.6	.6-2.0	—	—	—	—	Hitchcock et al. (1955)
Silver sagebrush	1.5	4.9	—	—	—	—	Beetle (1960)
	.5-1.2	1.6-3.9	—	—	—	—	Peck (1961)
Bolander silver sagebrush	.3-0.6	1.O-3.0	—	—	—	—	Beetle (1960)
	—	—	27.8	.33	.09	1	Sheehy (1975)
Mountain silver sagebrush	1.0	3.3	—	—	—	—	Beetle (1960)

[1]Same as crown canopy, canopy closure, or crown density — the proportion of ground surface covered by shrub crowns as vertically projected, like a shadow.

horizons and often include a very fine-textured B horizon. Brown and Chestnut soils are most commonly associated with big sagebrush communities, but some stands have been found on other soils.

Discussion

The forage value of big sagebrush has been related to the quantity and quality of other browse species within the same or adjacent stands (Dietz and Yeager 1959; Short et al. 1972; Smith 1950, 1952). Use by wildlife varies among taxa of big sagebrush. For example, mule deer and domestic sheep preferred other subspecies to basin big sagebrush (Sheehy 1975, Winward 1980); basin big sagebrush was never grazed in Nevada (Brunner 1972).

Recognition of basin big sagebrush stands can aid the range manager in planning for maintenance or enhancement of cover and forage. Crown cover may increase dramatically because of crown enlargement after disturbance, and in such communities there is a greater potential for herbaceous production, native as well as introduced, than in some other big sagebrush communities (Winward 1980).

Burning of various big sagebrush/bunchgrass stands produces different responses among plant communities; different responses among basin big sagebrush communities should also be expected. Perennial grass cover is increased by burning of big sagebrush/bearded bluebunch wheatgrass stands, but fescue plants are damaged by fire (Daubenmire 1970, Concannon 1978). Fires eliminate big sagebrush and initiate plant successions during which perennial grass dominates the sites for long periods.

The influence of grazing in big sagebrush/bunchgrass stands may vary relative to the dominant form of big sagebrush. Daubenmire (1970) suggested that a big sagebrush/Sandberg bluegrass community did not result from overgrazing or burning of big sagebrushlbearded bluebunch wheatgrass stands. In Oregon, the quantity of Sandberg bluegrass increases as Idaho fescue declines, and this relationship is suggested as a measure of range condition (Tueller 1962). Sandberg bluegrass, along with bottlebrush squirreltail and longleaf phlox, increases as bearded bluebunch wheatgrass declines in burned stands of the big sagebrushlbearded bluebunch wheatgrass community (Concannon 1978). Tisdale et al. (1969) found that big sagebrush/Thurber needlegrass stands changed to big sagebrush/Sandberg bluegrass stands during heavy grazing.

Soils associated with big sagebrush communities influence the use of stands by burrowing mammals, the rooting depth of plants, the patterns of soil moisture through the seasons, and the responses of plants after disturbance. Stone-free soils of big sagebrush/fescue stands were favorable to voles, ground squirrels, and badgers (Daubenmire 1970). Rooting depths were greater or effective moisture was better in big sagebrush/giant wildrye stands compared with adjacent stands of other communities (Culver 1964). Cooler and moister sites were indicated by big sagebrushlfescue stands, but soil moisture was depleted earlier in the needlegrass phase of the big sagebrushlbearded bluebunch wheatgrass community (Eckert 1957). On pumice soils, manipulation of big sagebrush and other disturbances increased undesirable species, such as rabbitbrush, horsebrush, goldenweed, and bottlebrush squirreltail; burning produced grasslands that were slowly reinvaded by big sagebrush (Volland 1976).

Thorough identification of a plant community depends on the identification of its species—an important step in determining its potential for management toward various goals. This is often difficult to accomplish in one visit to a stand because of differences in timing of plant development among species. Dean (1960) presented an account of peak flowering times for species within big sagebrush types that illustrates this point.

12, 13—MOUNTAIN BIG SAGEBRUSH/BUNCHGRASS (fig. 23) AND SUBALPINE BIG SAGEBRUSHIBUNCHGRASS

The mountain big sagebrush subspecies is common in uplands from Oregon to the Rocky Mountains (Beetle 1960, Winward and Tisdale 1977). At higher elevations, mountain big sagebrush is replaced by subalpine big sagebrush, and an unnamed variant **of** mountain big sagebrush extends from the lower edge of the western juniper zone into the steppe communities in northeastern and central Oregon (Winward 1980). Mountain big sagebrush is found in all Oregon counties east of the Cascade Range, from below Anthony

Figure 23.—Mountain big sagebrushlbunchgrass communities are species rich, have high forage production, and provide dense cover for many wildlife species.

Lakes in Baker County southwest to the Siskiyou Mountains in Josephine County (Beetle 1960, Winward 1980).

Mountain and subalpine subspecies of big sagebrush are moderately tall, flat-topped shrubs (fig. 21B); the flower stalks come from only the upper part of the branches and extend above the foliage (Beetle 1960, Winward and Tisdale 1977). The persistent leaves are wider relative to their length compared with basin big sagebrush, and they are broadest below the leaf lobes (Winward and Tisdale 1977). Alcohol extracts of the leaves of both the mountain and subalpine taxa fluoresce creamish-blue under long-wave ultraviolet light (Winward 1980).

Vegetation

Mountain big sagebrush/bunchgrass stands have a rich diversity of species; **40** plant associates are common (Winward 1980; also see footnote 7, p. 25). Some of the usual associates are the same as those found with other big sagebrush taxa (table 6). Bearded bluebunch wheatgrass, Idaho fescue, needleandthread, giant wildrye, bottlebrush squirreltail, and Sandberg bluegrass are usual dominants in the grass-forb layer. Prairie junegrass and Kentucky bluegrass are more usual with the subalpine form than with mountain big sagebrush. Rabbitbrushes are usually present, and their densities are greater in disturbed stands. California brome, slender wheatgrass, onion-grass, and sedges are common associates of subalpine big sagebrush (Winward 1980).

Mountain big sagebrush and the subalpine form have structurally dense stands (table 7); they have the potential for attaining greater crown cover than the other sagebrush species, subspecies, or form. Crown cover increases after disturbance and as range condition deteriorates (Winward 1980, Winward and Tisdale 1977).

Sits

Many upper foothill and mountain sites from 1070 to **3** 050 meters **(3,500** to 10,000 ft) in elevation are occupied by mountain big sagebrush (Beetle 1960, Winward 1980, Winward and Tisdale 1977). Schumaker and Hanson (1977) found the mountain form of big sagebrush on sites where annual precipitation varied from 0.5 meter (20 inches) to 1.1 meter **(43** inches), slope varied from 6 to **33** percent, and aspects included east through northeast to north. Where both occur in high elevation areas, mountain big sagebrush is found on drier sites, subalpine big sagebrush on moister sites (Winward 1980).

Soil

Mountain big sagebrush occurs on deep, well-drained soils where moisture is available throughout most of the summer (Winward and Tisdale 1977). Schumaker and Hanson (1977) found this subspecies on mixed coarse and fine loamy soils from rhyolite and basalt as well as granite.

Discussion

The greater preference of ruminants for mountain big sagebrush forage may be related to phenological development, nutrient content, or essential oils. Mule deer have shown equal preference for mountain big sagebrush and its unnamed variant,[8] both being more preferred than basin or subalpine big sagebrush.[9] Sheehy (1975) found that mule deer and domestic sheep preferred Wyoming big sagebrush over mountain and basin big sagebrush. Brunner (1972) found that mountain big sagebrush was seldom grazed in Nevada. Growth of mountain big sagebrush is initiated later than that of basin and Wyoming big sagebrushes by about 2 weeks, but seed ripening of the mountain subspecies precedes that of the other two subspecies by about 2 weeks (Winward and Tisdale 1977). Cattle and domestic sheep grazed sagebrush principally in spring and fall according to Garrison et al. (1977), but Pechanec et al. (1965) found that sheep also depended on sagebrush for winter browse. Mountain big sagebrush shows the least variation in chemical content and also has the most persistent leaves among sagebrush taxa (Beetle 1960). The chemical value of different

[8] **Personal communication from A. H. Winward, Oregon State University, Corvallis.**

[9] **Personal communication from** D. **P. Sheehy, Oregon Department of Fish and Wildlife, Burns.**

sagebrushes compares favorably with other forages, although pure diets of sagebrush appear inadequate for maintenance of animals (Beetle **1960,** Cook **1972,** Dietz and Yeager **1959,** Dietz et al. **1962).** Consumption of sagebrush foliage may be limited by antimicrobial substances, such as essential oils, but inhibitory effects on the rumen microflora demonstrated in the laboratory (Nagy and Tengerdy **1968)** are not likely to be attained in nature because of insufficient rates of release in the acid environment of the rumen (Short et al. **1972).** Perhaps the varying consumption of sagebrush forms by grazers, however, is related to differences in consumption and content of essential oils among the sagebrushes (Sheehy **1975).**

The dense structure of mountain and subalpine big sagebrush stands and their capacity for increases in plant density and crown cover after disturbance make these communities valuable cover habitats for wildlife. Managers should plan periodic control of parts of some stands to develop openings for mule deer, thus producing more diversity and greater edge length. In fawning and fawn-rearing areas dominated by mountain big sagebrush or subalpine big sagebrush, some dense stands of either form may be best left alone (Winward **1980).** The mountain subspecies is readily controlled by flooding (Beetle 1960), as are other forms of big sagebrush (see footnote 8).

Seeding managed stands of mountain big sagebrush with crested **or** intermediate wheatgrass and seeding stands of subalpine big sagebrush with intermediate wheatgrass, California brome, or smooth brome are usually successful. Seeding, however, is infrequently required because the understory is usually in good condition (Winward **1980).** Large populations of gophers in some dense stands of subalpine big sagebrush sufficiently disturb the soil to increase the annual forb component.

14—WYOMING BIG SAGEBRUSH/ BUNCHGRASS (fig. 24)

Wyoming big sagebrush is the most common sagebrush throughout the high desert in Oregon (Winward **1980).** It is **a** low growing

Figure 24.—Wyoming big sagebrush/bunchgrass communities occur on relatively dry sites and are the most common of the sagebrush-dominated communities in the Great Basin of southeastern Oregon (Chris Maser photograph).

shrub, **0.4** to **1** meter (1.5 to 3.3 ft) tall, with an irregular and rounded top (fig. **21A)** and with the flower stalks scattered throughout the crown—like small shrubs of basin big sagebrush. The main stem is not trunklike, however, but is comprised of two or three twisted portions at ground level. The persistent leaves are relatively short and wide, more deeply lobed. than in other big sagebrush taxa, and their margins curve outward from the base to form bell-shaped blades. Alcohol extracts from the leaves fluoresce shades of brownish-red in long-wave ultraviolet light (Winward **1980,** Winward and Tisdale **1977).**

Vegetation

Many plant species commonly occurring with Wyoming big sagebrush are also found with other taxa, such as basin or mountain big sagebrush. Major associated species include: bearded bluebunch wheatgrass, needleandthread, Thurber needlegrass, bottlebrush squirreltail, Sandberg bluegrass, and cheatgrass. Idaho fescue occurs occasionally with Wyoming big sagebrush (Schumaker and Hanson **1977,** Winward **1980).** Many stands have a sparse grass-forb layer because of heavy use by livestock and wildlife; some stands and the understory have been altered by natural,

periodic burning (Winward 1980). These disturbances and loss of understory are associated with increased density of sagebrush or other shrubs. There are few perennial forbs, antelope bitterbrush is not a natural component, and cryptogams may fill much of the bare areas in undisturbed stands. The lateral rooting of this subspecies may compete more with herbaceous species than that of other big sagebrush taxa (Winward and Tisdale 1977). A correlation between crown cover or crown diameter and production has been determined for this subspecies (Rittenhouse and Sneva 1977). The stands are not structurally dense (table 7), yet they may totally occupy the site.

Site

Wyoming big sagebrushlbunchgrass is most common at elevations of less than 1 830 meters (6,000 ft) and on more xeric mountain sites than other big sagebrush communities (Winward 1980). Schumaker and Hanson (1977) described stands on northeast aspects of 8-percent slope in an area with 33 centimeters (13 inches) of annual precipitation. The subspecies is common on slopes of major drainages in hot and dry areas from 700 to 1 980 meters (2,500 to 6,500 ft) in Idaho (Winward and Tisdale 1977). In Nevada, this subspecies is found within the terrace sagebrush complex (Brunner 1972).

Soil

Relatively shallow to moderately deep soils are present under stands of Wyoming big sagebrush/bunchgrass; often the soil is slightly calcareous in the surface layer (Winward 1980, Winward and Tisdale 1977). Fine, loamy soils from basalt were associated with the community in Idaho (Schumaker and Hanson 1977); the community is also found on ''red-rock surfaces" over deep soils in Nevada (Brunner 1972).

Discussion

Wyoming big sagebrush was of low to intermediate palatability for mule deer and domestic sheep in Oregon compared with six other sagebrush taxa (Sheehy 1975, Winward 1980). Conversely, this subspecies was as palatable as antelope bitterbrush and often severely grazed in parts of Nevada (Brunner 1972). Sparse grass-forb layers are common in Wyoming big sagebrush/bunchgrass stands, and they offer little forage from associated plant species.

Dense, low cover for small animals is offered by some stands of Wyoming big sagebrush. Often, however, the shrubs are too small or scattered to provide much protection, especially not for large mammals and birds. Disturbances of the grass-forb layer causes only moderate increases in density of this subspecies.

15—THREETIP SAGEBRUSH/ BUNCHGRASS (fig. 25)

Threetip sagebrush is distributed in Washington, Idaho, and Oregon (Beetle 1960, Daubenmire 1970). Within Oregon, the species occurs in Baker and northern Harney counties and occasionally in Malheur County (Beetle 1960, Winward 1980; also see footnote 8, **p.** 36).

Figure 25.—Threetip sagebrushlbunchgrass stand in a usual topographic location. The elevation of this stand, 865 meters (2,837 ft), in northern Malheur County, Oregon, is lower than reported in the literature (see footnote 5, p. 18).

Threetip sagebrush is an erect shrub (fig. 21A) that freely and profusely branches to form a moderately large crown, 0.4-0.8 meter (1.3-2.6 ft) in diameter (Beetle 1960). This species does not normally root from its branches (layering) because of its upright form;

it readily does so when the branches touch the soil, and it sprouts readily from burned crowns (Beetle **1960).** Dwarf threetip sagebrush is a low subspecies in some stands, is rarely taller than **0.2** meter **(0.7** ft), has a crown from **0.3** to **0.4** meter **(1.0** to **1.3** ft) wide, and readily layers from its naturally decumbent branches (Beetle **1960).** This subspecies is usually found adjacent to mountain big sagebrush but not mingled with it; dwarf threetip sagebrush occupies shallow soils along ridges rather than the deeper soils at the base of foothills (Beetle **1960).**

The leaves of threetip sagebrush are relatively long, **3** centimeters **(1.2** inches), and deeply three cleft into linear lobes which may also be divided (Beetle **1960).** Alcohol extracts of the persistent leaves fluoresce creamish-blue under long-wave ultraviolet light (Winward **1980).**

Vegetation

Many plant species found with big sagebrushes in general, occur with threetip sagebrush in its fescue and wheatgrass communities (Daubenmire **1970,** Tisdale et al. **1965,** Winward **1980).** Plant species composition for the threetip sagebrushlfescue and threetip sagebrush/wheatgrass communities were similar except for the occurrence of fescue. Extensive species included the following: rabbitbrush, big sagebrush, antelope bitterbrush, squaw apple, Sandberg bluegrass, bearded bluebunch wheatgrass, prairie junegrass, needleandthread, Thurber needlegrass, Kentucky bluegrass, threadleaf sedge, arrowleaf balsamroot, dwarf hesperochiron, longleaf phlox, nineleaf biscuitroot, and tapertip hawksbeard.

Canopy cover measurements are high where plants are dense (table **7),** since individual crowns are of large diameter, **0.4** to 0.8 meter **(1.3** to **2.6** ft), and freely branched (fig. 21A). Threetip sagebrush may form stands sufficiently dense to crowd out herbaceous species (Winward **1980).**

Site

Threetip sagebrush/fescue stands occur on moist and cool sites, such as north and east slopes and in depressions, whereas threetip sagebrushlbearded bluebunch wheatgrass stands are found on dry, warm sites where exposure to sun and wind is too severe for fescue; for example, on east slopes curving to the north there are abrupt ecotones between the communities (Daubenmire **1970,** Tisdale et al. **1965).** In Oregon, this species is reported at elevations of **1 160** meters **(3,800** ft) or higher by Winward **(1980).** Dealy (see footnote ***5,*** p. 18) reports a low elevation of **865** meters **(2,837** ft) for this species in northern Malheur County, Oregon. Beetle **(1960)** reported that threetip sagebrush occurred between **914** and **1 830** meters **(3,000** and **6,000** ft).

Soil

Threetip sagebrush is the only resprouting sagebrush species associated with loam to sandy-loam soils in Oregon (Winward **1980).** Daubenmire **(1970)** found stands of the threetip sagebrushlbunchgrass community on Brown, Chestnut, Chernozem, Planosol, and Prairie soils in Washington and Idaho. Threetip sagebrush communities were associated with silty clay loams containing a B horizon at 0.2-0.3 meter **(0.7-0.8** ft) and a lime zone below **0.9** meter **(2.9** ft) in Idaho (Tisdale et al. **1965).** In general, threetip sagebrush communities are associated with deep, well-drained soils (Beetle **1960).**

Discussion

Apparently the intensity of browsing of threetip sagebrush varies by subspecies and areas. Winward **(1980)** considered that grazing by native and domestic animals contributed to the density of present threetip sagebrush/bunchgrass stands. Brunner **(1972)** observed that threetip sagebrush was never grazed, but he reported that dwarf threetip sagebrush was usually severely grazed.

The structure of threetip sagebrushlbunchgrass stands should provide considerable cover, but the shorter dwarf threetip sagebrush can protect only smaller animals. The resprouting ability and growth form can produce very dense brush fields that vigorously compete with herbaceous species (Winward **1980).** Stable shrub densities cannot be maintained with proper grazing or even no use;

periodic thinnings are necessary to attain some management goals. Sandberg and Kentucky bluegrasses are common in threetip sagebrush/bunchgrass stands, and crested wheatgrass can be established on these sites (Winward 1980).

The stone-free mound soils associated with some threetip sagebrush communities provide a favorable substrate for burrowing rodents and badgers (Daubenmire 1970).

16, 17—BOLANDER SILVER SAGEBRUSH/BUNCHGRASS (fig. 26) AND MOUNTAIN SILVER SAGEBRUSH/BUNCHGRASS (figs. 27 and 28)

Silver sagebrushes are found in seasonally moist areas from central and eastern Oregon eastward across the Rocky Mountains to Nebraska and the Dakotas. Two subspecies are associated with two distinct habitats, closed basins and streamside or pond-edge meadows, that are scattered throughout the Pacific Northwest and intermountain regions (Beetle 1960). The basin subspecies, Bolander silver sagebrush, is distributed within the desert areas of Oregon from Prineville throughout the southeastern third of the State; the streamside-meadow subspecies, mountain silver sagebrush, is most common in east-central and southeastern Oregon where there are seasonally high water tables adjacent to streams and meadows (Dealy 1971, Winward 1980).

These two silver sagebrush subspecies differ morphologically, chemically, and ecologically. Bolander subspecies is a low rounded shrub with erect or spreading dense branches, but mountain silver sagebrush can be taller and more erect (Beetle 1960). Branching of both subspecies creates an irregular crown (fig. 21A). Branches of both subspecies readily form roots when they touch the soil, and the plants resprout from the root crown. The leaves are tapered toward both ends, are usually not lobed, are very silky with white hairs, and smell pungent (like turpentine) when crushed (Beetle 1960). Alcohol extracts of leaves from either subspecies fluoresce creamish-blue shades under long-wave ultraviolet light (Winward 1980). The unlobed leaves and tolerance

Figure 26.—This stand of Bolander silver sagebrush/bunchgrass on an internally drained basin site illustrates the usual bare soil interspaces and sparse understory.

Figure 27.—Mountain silver sagebrush/bunchgrass stand adjacent to a mountain meadow.

Figure 28.—This detailed view of a mountain silver sagebrush/bunchgrass stand illustrates the usually dense understory.

of soil saturation and seasonal flooding clearly set both silver sagebrushes apart from all other shrubby, tall sagebrushes. Leaves of the other tall species are cleft three or more times, and those shrubs are easily killed by even brief periods of flooding or soil saturation.

Vegetation

Moist sites dominated by silver sagebrushes support rich herbaceous understories in spring, but these understories are usually maintained through the grazing season only in mountain silver sagebrush stands. The sagebrushes are usually the only shrubs present, but muhly, spike rush, rushes, sedges, and a few forb species are associated (Dealy **1971,** Winward **1980;** also see footnote **7,** p. **25).** Other plants commonly observed in Bolander silver sagebrush stands include: Douglas sedge, Baltic rush, Newberry cinquefoil, bottlebrush squirreltail, showy downingia, combleaf, tiny mousetail, and cheatgrass (Leckenby and Toweill **1979,** Sheehy **1975).** Herbaceous species are more abundant in the floristically rich mountain silver sagebrush stands and include some species not present in Bolander silver sagebrush communities, such as: slender wheatgrass, California brome, Nevada bluegrass, sedges, timothy, and Kentucky bluegrass[10] (Winward **1980).**

Structural attributes of free branching, layering, and crown sprouting can create considerable cover, but silver sagebrushes are seldom sufficiently tall (table **7)** to provide cover for animals larger than swans, geese, rabbits, and coyotes.

Site

Subspecies of silver sagebrush are closely associated with sites that are seasonally very moist to saturated or even temporarily flooded (usually late winter and spring) (Beetle **1960,** Cornelius and Talbot **1955,** Dealy **1971,** Winward **1980;** also see footnote **7,** p. **25).** This single environmental condition' eliminates most other plants common to shrub-steppe communities. The internally drained, alkaline basins dominated by Bolander silver sagebrush are frequently ponded to depths of **0.3-0.6** meter **(1-2** ft) for at least a month each spring when the snowpack melts. There have been years—1965, for example—when flooding persisted even beyond the tolerance of silver sagebrushes and aerial portions of the shrubs died. The dead branches were replaced within **3** years by new or resprouted individuals, after the basins passed through a structural condition dominated by Newberry cinquefoil and annual forbs (see footnote **7,** p. **25).** Sites containing the mountain subspecies usually are saturated in spring and early summer, but normally they are covered only briefly with standing water. The exception is found in wet meadows that form ponds (Dealy **1971).** Both subspecies occur at midelevation to high elevation: Bolander silver sagebrush, **1 000-1** 800 meters **(3,500-6,000** ft); mountain silver sagebrush, **1 680-2 240** meters **(5,500-8,000** ft) (Beetle **1960,** Winward **1980;** also see footnote 8, p. **36).**

[10]**Schallig, W. H. C., unpublished data on file at Oregon State University, Corvallis.**

Soil

Silver sagebrush communities are associated with deep soils of variable surface texture (sand to clay) (Beetle **1960,** Cornelius and Talbot **1955).** Within Oregon, however, these subspecies are dominant on deep clay and alkaline soils (Leckenby and Toweill **1979,** Urness **1966,** Winward **1980).** Clay soils found with mountain silver sagebrush develop wide deep cracks as they dry over the summer, and the flaking surface layers readily slough into deep fissures (Cornelius and Talbot **1955;** also see footnote **10).**

Discussion

Use of silver sagebrush/bunchgrass stands varies among seasonal ranges. Bolander silver sagebrush foliage is highly preferred by mule deer and domestic sheep (Sheehy **1975;** also see footnote **7, p. 25).** These basin communities are occupied by mule deer more than expected from their availability on the Silver Lake-Fort Rock winter range (Leckenby 1978a, Urness **1966).** On summer range in the same area, Dealy **(1971)** considered silver sagebrush/muhly stands of low value because they constituted a small area and thus provided limited forage compared with that in adjacent communities. Dealy (1971), however, found that

competition between livestock and deer appeared high for the limited herbaceous forage available. All silver sagebrush communities should be considered important foraging habitats for mule deer, pronghorns, and sage grouse.

Depth and density of vegetation may provide good cover in some mountain silver sagebrush stands, but cover is sparse in the severely grazed alkaline basins dominated by Bolander silver sagebrush. Pronghorns frequently use these "flats" as resting and bedding areas throughout the summer.

The heavy soils and seasonal ponding make forage improvement in most silver sagebrush sites risky at best; introduced species have rarely survived well (Cornelius and Talbot 1955, Leckenby and Toweill 1979, Winward 1980).These communities are best left untilled and unsprayed because of their wildlife value and because the native plants are difficult to replace with other forage species that do as well.

Waterholes are often developed in silver sagebrush basins. Frequently, ditches are dug across the basin floor to drain a shallow pond rapidly into a deep reservoir which maintains a reliable water source longer through the livestock grazing season. The improved drainage produces a shorter period of flooding; new, drier, plant habitats are created that favor big sagebrush and rabbitbrushes over silver sagebrush. In smaller basins, silver sagebrush stands are being slowly replaced by big sagebrush-rabbitbrush communities (Leckenby 1978a). Thus, some trade-offs among multiple resource goals are illustrated in the case of silver sagebrush basins altered for enhancement of water sources for livestock.

18—STIFF SAGEBRUSHIBUNCHGRASS (fig. 29)

Stiff sagebrush (also called scabland sagebrush) communities occur from the Cascade Range and Blue Mountains of Washington through central and southeast Oregon into Idaho (Daubenmire 1970). This short sagebrush species is found regularly at the northern end of the Great Basin within eastern

Figure 29.—The site on which this sparse stand of stiff sagebrushlbunchgrass occurs illustrates the severe conditions under which the species can grow in the Great Basin of southeastern Oregon.

Oregon. It is common in the following Oregon counties: Wasco, Wheeler, Crook, Gilliam, Jefferson, Umatilla, Union, Wallowa, and Harney (Beetle 1960). Winward (1980) found stiff sagebrush stands distributed primarily in northern and northeastern Oregon, but stiff sagebrush was also located from northern Harney County east through Malheur County into Idaho.

Stiff sagebrush is a winter deciduous, low, spreading, and dense shrub (fig. 21C) that consists of short, rigid, decumbent, and brittle branches (Hitchcock et al. 1955, Peck 1961, Winward 1980). Alcohol extracts of the narrow-based and tridentlike lobed leaves fluoresce brownish-red under long-wave ultraviolet light (Winward 1980).

Vegetation

Stiff sagebrushibunchgrass plant communities are often floristically rich but may appear impoverished because of spacing between plants and sparse ground cover (Daubenmire 1970). Common associated plant species include several mosses (*Tortula, Bryum, C'eratodon, Grimmia*), woodlandstar, biscuitroot, spring draba, autumn willowweed, pink microsteris, dwarf monkeyflower, Sandberg bluegrass, cheatgrass, Pacific fescue, bearded bluebunch wheatgrass, and bottlebrush squirreltail (Culver 1964, Daubenmire

1970, Winward **1980).** Hall **(1973)** found dwarf squirreltail, false agoseris, a biscuitroot, and bighead clover common to stiff sagebrush stands in the Blue Mountains. Other common associated species are listed in table **6.**

Although many species provide diversity of forage, the small shrubs and open stands provide little cover for other than the smallest animals (table 8).

Site

Stiff sagebrush in the Great Basin of Oregon is found exclusively on various aspects of rocky scablands that have undulating or rolling relief. Stiff sagebrush/bunchgrass stands are found from **914** to **2 134** meters **(3,000** to 7,000 ft) in elevation. They are usually on gentle slopes or benches of 0- to 20-percent slope and occasionally on steeper slopes of up to **40** percent (Beetle **1960,** Culver **1964,** Hall **1973,** Winward **1980).**

Soil

Stiff sagebrush communities are associated with very shallow to shallow **10-** to 28-centimeter **(4-** to 11-inch), stony soils that have been developed from basalt and rhyolite (Culver **1964,** Daubenmire **1970,** Hall **1973,** Winward **1980).** Soil textures vary from loams to fine clay loams. The profiles usually become saturated with water in winter and spring and are regularly subjected to frost heaving or frost boils.

Discussion

Big game and livestock use stiff sagebrush as browse (Daubenmire **1970,** Hall **1973,** Winward **1980;** also see footnote **7,** p. **25).** Many commonly associated species are valuable forage for grazing animals.

The low stature and dispersion of stiff sagebrush shrubs does not provide cover of any consequence for animals larger than

Table 8—Structural measurements of short sagebrushes

Sagebrush species	Shrub height		Crown cover[1]	Density			Reference
				Plants	Area		
	Meters	Feet	Percent	Number	Square meters	Square feet	
Stiff	0.2-0.4	0.6-1.3	—	—	—	—	**Peck** (1961)
	—	—	20	—	—	—	**Culver** (1964)
	—	—	10-34	—	—	—	**Daubenmire** (1970)
	—	—	5-20	—	—	—	**Hall** (1973)
Low	.1-.4	.3-1.3	13-16	55-56	18-58	200	**Eckert** (1957)
	—	—	26	—	—	—	**Culver** (1964)
	.1-.2	.4-.5	4-22	1.2-8.3	—	—	**Kornet** (1978)
	—	—	10.8	.18	—	—	**Sheehy** (1975)
	—	—	10	—	—	—	**Volland** (1976)
	.2-.3	.7-.9	6-20	—	—	—	**Segura-Bustamante** (1970)
	.2	.7	8-26	—	—	—	**Dealy** (1971)
Black	—	—	11.8	.28	—	—	**Sheehy** (1975)
	.1-.3	.3-1.0	—	—	—	—	**Beetle** (1960)
	.1-.4	.3-1.3	—	—	—	—	**Hitchcock and Cronquist** (1973)
	.3	1.0	—	—	—	—	**Brunner** (1972)
	.1-.3	.3-1.0	—	—	—	—	**Dayton** (1931)
Early low	.2	.8	1.5	25	9.29	100	**Tisdale et al.** (1965)
	.3	1.0	—	—	—	—	**Beetle** (1960)

[1] Same as crown canopy, canopy closure, or crown density—the proportion of ground surface covered by shrub crowns as vertically projected, like a shadow.

horned larks or ground squirrels. The lack of leaves (this is the only deciduous shrubby sagebrush in the area) in winter severely reduces the little cover this species offers on the scablands during periods of thermal stress. Even in winter, however, the shrubs do provide some protection from erosion by wind (Hall 1973).

Stressful environmental conditions for plant growth, such as waterlogging and consistent frost heaving of very shallow soils, make successful seedings of domestic grasses highly improbable (Hall 1973, Winward 1980). Removal or control of the stiff sagebrush cover would increase thermal stress for small animals, reduce the forage available for both large and small animals, and increase erosion by wind.

19, 20—LOW SAGEBRUSH/BUNCHGRASS (fig. 30) AND CLEFTLEAF SAGEBRUSH/ BUNCHGRASS (figs. 31 and 32)

Low sagebrush/bunchgrass communities typically occur adjacent to or intermixed with big sagebrush communities but are distinctly separate stands of an edaphic (soil-related) climax vegetation associated with shallow, stony soils (Dealy 1971, Dealy and Geist 1978, Franklin and Dyrness 1973).Low sagebrush is common in most counties east of the Cascade Range in Oregon. Beetle (1960)listed the counties where low sagebrush occurs (Baker,Grant, Crook, Jefferson, Wheeler, Harney, Malheur, Lake, Klamath, and Jackson.

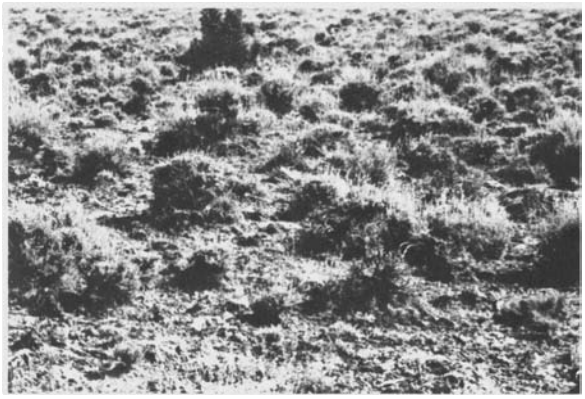

Figure 30.—Low sagebrushlbunchgrass communities are common on shallow, stony soils (photo, courtesy Oregon Department of Fish and Wildlife).

Figure 31.—This stand of cleftleaf sagebrushlbunchgrass occurs at 1524 meters (5,000 ft) in east-central Malheur County, Oregon, adjacent to curlleaf mountainmahogany. This is a new location in Oregon for the subspecies (see footnote 5, p. 18).

Figure 32.—Closeup of a cleftleaf sagebrushlbunchgrass stand illustrating the habit (general appearance) of this subspecies of sagebrush and the gravelly, shallow soil of sites on which it grows in the Great Basin of southeastern Oregon.

Low sagebrush is a gray to green dwarf shrub formed of irregular, short, and stiff branches (fig. 21C). It produces a small crown between 0.4 and 0.8 meter (1.3 and 2.6 ft) wide (Beetle 1960, Brunner 1972). The species infrequently forms roots from branches touching the soil. Both the small, narrow, wedge-shaped, and deeply three-toothed leaves of low sagebrush, as well as the much thinner lobed leaves of the subspecies cleftleaf sagebrush, fluoresce

creamish-blue in alcohol solutions exposed to long-wave ultraviolet light (Winward 1980). A taller variant (as yet unnamed) associated with pumice soils requires more research (Winward 1980.)

Vegetation

Stands vary from small—2 hectares (5 acres)—to wide "flats" 1.6 kilometers (1 mi) or more across. The usual associated plants create a rich diversity of species within these stands of vegetation. Common associates are: bearded bluebunch wheatgrass, Idaho fescue, Thurber needlegrass, Sandberg bluegrass, prairie junegrass, one-spike oatgrass, bottlebrush squirreltail, cheatgrass, western needlegrass, woolly eriophyllum, Bloomer fleabane, low pussytoes, yarrow, gay penstemon, Nevada biscuitroot, Holboell rockcress, starved milkvetch, obscure milkvetch, spreading phlox, longleaf phlox, Hooker balsamroot, annual agoseris, daggerpod, granite gilia, bighead clover, and nineleaf biscuitroot (Culver 1964; Dealy 1971; Dean 1960; Eckert 1957, 1958; Hall 1973; Segura-Bustamante 1970; Volland 1976; Winward 1980; also see footnote 7, p. 25).

As with other structurally short sagebrushes, low sagebrush shrubs are too small and too scattered to provide cover for large animals (table 8), but the dense crowns do shelter small animals, such as lizards, snakes, birds, and mice. The evergreen low sagebrush does, however, maintain its minimal cover qualities through winter better than does the deciduous stiff sagebrush.

Site

Low sagebrushlbunchgrass communities are regularly found on dry, relatively sterile, often alkaline sites (Beetle 1960). Although Beetle (1960) reported low sagebrush often occurring on alkaline sites, Brunner (1972), presenting data on the sagebrush genus in Nevada, and Dealy (1971), studying low sagebrush in Oregon, report low sagebrush only on acid to neutral sites. Occurrences are between 914- and 2 743-meter (3,000- and 9,000-ft) elevation. The stands are on most aspects, but commonly they are found on gentle slopes (2-15 percent) in rolling to undulating or flat uplands, top-of-rim edges, level and sloping plateaus, and crests and slopes of ridges (Culver 1964; Dealy 1971; Dean 1960; Eckert 1957, 1958; Hall 1973; Segura-Bustamante 1970; Volland 1976; Winward 1980).

Soil

Low sagebrush thrives on shallow, stony, fine-textured soils derived from basaltic, andesitic, or rhyolitic parent materials. These soils may have basic, neutral, or acidic reactions. They generally are less than 0.6 meter (2 ft) deep, may contain an impermeable (or at least restrictive) clay B horizon, become saturated with water in late winter and spring, and are extremely droughty in summer (Brunner 1972, Culver 1964, Dealy 1971, Dealy and Geist 1978, Eckert 1957, Fosberg and Hironaka 1964, Hall 1973, Segura-Bustamante 1970, Volland 1976, Winward 1980; also see footnote 7, **p.** 25). Lack of physical support during spring periods of soil saturation can result in damage from trampling (Hall 1973). Extremes of saturation, frost heaving, and drying in these soils make plant survival tenuous at best. Though the species are well adapted, even the low sagebrush and Sandberg bluegrass roots are pedestaled and broken during seasonal cycles of frost heaving and soil drying. Often, cracks in the underlying base rock, or interrupted restrictive layers in the solum produce dispersed soil microsites that are deeper and better drained than surrounding soil. This permits establishment and survival of a few scattered ponderosa pine, western juniper, curlleaf mountainmahogany, antelope bitterbrush, or other shrubs (Dealy and Geist 1978, Segura-Bustamante 1970).

Discussion

Low sagebrush stands are intensively used by wildlife and are particularly important to large ruminants, including livestock. Mule deer regularly and preferentially occupied these communities during mild weather in winter and spring (Leckenby 1978a). Use by pronghorn and sage grouse is also high, though less seasonal. Indigenous species of wildlife intensively graze the associated forbs and grasses. Browsing of low sagebrush by insects, mice, rabbits, hares, sage grouse, and ruminants is also extensive.

Forage species develop as much as 2 weeks earlier in low sagebrush stands than in the adjacent antelope bitterbrush, tall sagebrush, rabbitbrush, western juniper, curlleaf mountainmahogany, or ponderosa pine communities. Grazing animals follow the sequence of forage development which is induced by differences in site factors among these communities. Similar grazing patterns exist elsewhere and appear to be an expression of resource partitioning related to rates of plant growth which in turn are correlated with different plant habitats. In a shortgrass zone, deBoer (1974) found that herds of grazing wildlife preferred plant communities produced by a shallow soil overlying a restrictive hardpan (a soil environment similar to that of short sagebrush stands). Low total herbaceous production and low rates of growth on these sites apparently permitted earlier season grazing that was nonselective for plant species and that maintained growth of vegetative parts that were highly digestible. Two other vegetational zones, both characterized by more precipitation, deeper soils, and lack of a restrictive layer, produced higher rates of plant growth (soil environments similar to those of tall sagebrushes and other steppe communities). There, the grazing animals exhibited marked selectivity of forage species and grazed these stands much later and less intensively than those of the shortgrass zone.

Low sagebrush was one of the most preferred sagebrushes offered to mule deer and domestic sheep (Sheehy 1975). Some subspecies of low sagebrush are grazed more extensively than others by mule deer and other wildlife (Brunner 1972, Dealy 1971, Leckenby 1978a, Volland 1976, Winward 1980). In addition, the plant composition of many stands offers a rich diversity of seasonal forages.

Height, crown cover, and plant density of low sagebrush/bunchgrass stands provide little structure to create hiding or thermal cover for animals larger than ground squirrels, mice, and small birds; these communities are primarily habitats for production of forage. Total crown cover of all vegetation was less where low sagebrush/bunchgrass stands were compared with adjacent big sagebrush communities of similar composition (Segura-Bustamante 1970): western juniper/antelope bitterbrush-big sagebrush, 39-percent total cover; western juniper/antelope bitterbrush-low sagebrush, 38 percent; antelope bitterbrush-big sagebrush, 36 percent; antelope bitterbrush-low sagebrush, 34 percent; big sagebrush, 35 percent; and low sagebrush, 23 percent. Crown cover of western juniper, however, was similar among stands dominated by either sagebrush. Abundance of forbs increased steadily, whereas total crown cover decreased in those stands. Densities of bearded bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and Idaho fescue were greater where these grasses occurred with low sagebrush compared with big sagebrush/bunchgrass stands (Segura-Bustamante 1970).

Management designed to harvest or improve production of forage from low sagebrush/bunchgrass stands should be planned after careful evaluation of the goals, trade-offs, and risks. These sites are fragile, generally will not produce much more forage after treatment, are not suitable for cultivation, and occur on soils that are too shallow for crested wheatgrass or other readily available introduced species (Dealy 1971, Hall 1973, Volland 1976, Winward 1980). Abundance of remnant forbs and grasses may improve with changes in grazing management (Dealy 1971, Winward 1980), but some stands in poor condition have apparently not changed even where they were completely protected for 30 years or more.

Identification of specific low sagebrush plant communities requires data from more than one season (Leckenby 1978a). Dean (1960) described plant species appearance (especially phenology of flowering) in spring, summer, and autumn. The marked differences in time of plant species appearance, recognition, or prominence in the physiognomy (outward feature) of a stand produce quite different impressions of low sagebrush communities. In spring when obscure milkvetch is prominently flowering, the foliage easily contrasts with the wet soils; in summer when the colorful ashy penstemon is in full bloom, the obscure milkvetch has all but disappeared.

21—BLACK SAGEBRUSH/BUNCHGRASS

Black sagebrush is more common in that portion of the Great Basin east of Oregon (Hitchcock et al. 1955), but Beetle (1960) reported it scattered in Oregon's Harney and Lake Counties. Winward (1980) found that the relatively few areas of this sagebrush occurred primarily in the southern portions of Malheur, Harney, and Lake Counties. West et al. (1978) observed black sagebrush in many stands throughout Nevada and in Utah.

The shrub is low to dwarf (fig. 21C); its branches are decumbent; the flower stalks are brown and persistent (Beetle 1960). Although some authors consider black sagebrush a variety of low sagebrush (Hitchcock and Cronquist 1973), there are important differences (Winward 1980). There may be subspecies of black sagebrush that are also important to recognize, for at least a glossy-green form appears to be grazed less than a gray-green form (Brunner 1972). Beetle (1960) also described these color phases. The broadly wedge-shaped (flabelliform), three- to five-lobed leaves produce alcohol solutions that fluoresce brownish-red during exposure to long-wave ultraviolet light (Winward 1980).

Vegetation

Plant species associated with black sagebrush communities are often the same as those found with stiff and low sagebrush communities. Species lists from black sagebrush/bunchgrass stands regularly include one or more of the following: bearded bluebunch wheatgrass, Indian ricegrass, bottlebrush squirreltail, and Sandberg bluegrass; occasionally, needleandthread may be present (Winward 1980).

Short stature and wide spacing of shrubs throughout the stands create sufficient cover for hiding or thermally protecting only the smallest animals (table 8).

Site

Vegetation stands of black sagebrush/bunchgrass occur between 1 200 and 2 740 meters (4,000 and 9,000 ft) on drier, shallow sites (Beetle 1960, Dayton 1931, Winward 1980). The species is common to level plains and slopes in foothills and mountains and is reported to occur with ponderosa pine, aspen, and woodland types—even into the spruce-fir zone (Dayton 1931).

Soil

The black sagebrush/bunchgrass community, like other short sagebrushes, is associated with shallow, stony soils (Beetle 1960). This species, however, has particular affinity for calcareous soils (Brunner 1972, Winward 1980). Either lime hardpans or a concentration of lime is present in most soils supporting this sagebrush species. Such a relationship contrasts with that of the neutral to acid volcanic soils common to low sagebrush stands (Brunner 1972, Dealy 1971).

Discussion

Six other sagebrush species were more palatable than was black sagebrush to mule deer and domestic sheep (Sheehy 1975). Pronghorns (Winward 1980), domestic sheep, and domestic goats (Dayton 1931) were reported to intensively graze black sagebrush. Use may depend on the variety, form, or subspecies present (Brunner 1972). Cultural treatment and seeding of forage or cover plants are not likely to improve composition and structural qualities of black sagebrush stands. Disturbance of these stands initiates long succession from Sandberg bluegrass dominance back to other bunchgrasses. Often, stands in poor condition have not recovered although they were protected from grazing (Winward 1980).

22—EARLY LOW SAGEBRUSH/ BUNCHGRASS

Early low sagebrush has also been called alkali sagebrush (Beetle 1960, Tisdale et al. 1969) and early sagebrush (Winward 1980). This species is also found primarily east of Oregon, but limited local stands exist in Deschutes, Crook, Lake, and Harney Counties (Beetle 1960, Brunner 1972, Tisdale et al. 1965, Winward 1980). Eckert (1957) reported a large-headed form of low sagebrush that flowered

from mid-July until mid-August in northern Lake and Harney Counties; the phenology of the form he observed matches that of this uniquely early-flowering species of short sagebrush.

The form and stature of early low sagebrush and the sites it is common to in many ways resemble those of low sagebrush. It is a dwarf shrub (fig. 21C) with lax and spreading branches that frequently layer (Beetle 1960). These two short sagebrushes, early low and low, form adjacent pure stands; but they may also occur mixed together (Eckert 1957, Winward 1980). These species cannot be readily separated on the basis of leaf form or fluorescence. Alcohol extract solutions fluoresce creamish-blue from exposure to long-wave ultraviolet light (Winward 1980). Difference in phenology is the most suitable diagnostic characteristic to separate early low and low sagebrush (see footnote 8, p 36).

Vegetation

Plants associated with early low sagebrush are commonly found in stands of other short sagebrushes. Typical lists include pussytoes, wild buckwheat, phlox, violet, Idaho fescue, Thurber needlegrass, Sandberg bluegrass, and bottlebrush squirreltail (Tisdale et al. 1965).

Early low sagebrush stands offer little structural cover because of plant density (table 8). Stands rich in species may serve as valuable forage areas, but only small animals find much shelter in typical stands.

Site

Early low sagebrush stands are found at elevations from 1 830 to 2 440 meters (6,000 to 8,000 ft) on poorly drained, hot, and dry sites; the ecological situation is similar to sites dominated by low sagebrush (Beetle 1960, Winward 1980.)

Soil

Brunner (1972) found early low sagebrush in pure stands on shallow stony soils, but the species also occurred in mixed stands with other sagebrushes on deeper soils. The name "alkali sagebrush" came from plants found on fine textured and highly alkaline soils (Beetle 1960). In Idaho, Tisdale et al. (1965) associated this species with a silty clay loam subsoil at 0.1 meter (0.3 ft) and a strongly developed B horizon at 0.3-0.4 meter (1-2 ft).

Discussion

Early low sagebrush, except for its earlier flowering, may be best considered a form of low sagebrush (Winward 1980). Its preference as forage by mule deer has not been evaluated. This species was not grazed in Nevada and was seldom eaten by sage grouse (Brunner 1972). Management of early low sagebrush stands should enhance or preserve the diversity of native forage species and adjust the grazing season to accomplish that goal. Crested wheatgrass is not adapted to the sites because of the shallow, heavy, and seasonally saturated soils.

Other Communities Dominated by Shrubs

23—SQUAW APPLE/BUNCHGRASS (fig. 33)

Squaw apple is an intricately and rigidly branched, deciduous shrub that may attain heights of 2 meters (6.5 ft) (Hitchcock and Cronquist 1973). Subspecies or varieties have not been identified.

Figure 33.—Squaw apple/bunchgrass community illustrating the large, robust form of the species and other species that commonly occur with it, such as mountain big sagebrush and bearded bluebunch wheatgrass (Chris Maser photograph).

Vegetation

Although squaw apple is seldom the dominant (measured by canopy cover) shrub of broad expanses, it may occasionally assume dominance in some stands. Squaw apple constitutes the tallest shrub layer except where antelope bitterbrush is present. A variety of other shrub species comprise the shorter shrub layer. Squaw apple also occurs in eastern Oregon in association with scattered ponderosa pine and western juniper.

Squaw apple communities may have as many as four major strata, the tallest at a height of 1.5 meters (5 ft). Mountain big sagebrush may average 0.8 meter (2.5 ft) and is usually the dominant shrub of the middle shrub layer with green and gray rabbitbrush occasionally present. The subshrub granite gilia and the shrublike slenderbush eriogonum comprise a sparse, low shrub layer 0.5 meter (1.5 ft) tall. The herbaceous layer averages 0.2 meter (0.5 ft) tall and consists primarily of wild buckwheat, fleabane, rockcress, low pussytoes, Thurber needlegrass, bearded bluebunch wheatgrass, Sandberg bluegrass, and cheatgrass.

Communities are characterized by a shrub cover of approximately 10-15 percent.

Often two to five squaw apple bushes may be found growing close together so that their branches intertwine, giving the illusion of one huge shrub, 2.0-2.5 meters (6.5-8 ft) in diameter.

Threetip sagebrush, averaging 0.6 meter (2 ft) tall, occasionally dominates the intermediate shrub layer. Also included in this layer are a few scattered big sagebrush, gray rabbitbrush, and green rabbitbrush. Threetip sagebrush and the rabbitbrushes are rounded shrubs that branch from near the base. The basal leaves of wild buckwheat and low pussytoes may form small islandlike mats on the otherwise stony and bare surface.

Site

The range of squaw apple is restricted to high, moist hillsides in the northern portion of southeastern Oregon. The topography is generally characterized by rolling hills and prominent drainages.

Soil

Squaw apple commonly occurs on moderately deep, well-drained soils. Texture generally varies from loam to sandy loam. The percent of soil surface covered by cobbles and stones and cobble and stone volume in the soil profile are highly variable.

Squaw apple also occurs on very shallow, medium-textured soils derived from weakly consolidated, occasionally fractured tuff and diatomaceous deposits. Plant density is likely controlled, in part, by fracturing frequency of the soil parent material. Plant crowns act as a protective influence on these highly erodible soils.[11]

Discussion

Hayes and Garrison (1960) described squaw apple as fair browse for domestic sheep and cattle in spring and for deer in the winter. Beneath the canopy of squaw apple is a well-concealed haven for small animals. Stem density is high in the interior of squaw apple crowns, providing small birds excellent protection from predators.

24—BLACK GREASEWOOD/GRASS (fig. 34)

Black greasewood is a spiny, freely branched shrub that may grow nearly 2.5 meters (8 ft) high (Hitchcock and Cronquist 1973). The succulent leaves of this deciduous species give a luxuriant appearance to the plant (Shantz and Piemeisel 1940). The bright yellow green of communities dominated by black greasewood contrasts with the gray green of sagebrush communities during the summer. The species is not relished by livestock, but severe grazing may produce smaller plants with compact canopies. Black greasewood will resprout from the root crown after fire (Daubenmire 1970).

[11] J. Michael Geist, unpublished data on file at Range and Wildlife Habitat Laboratory, La Grande, Oregon

Figure 34.—The black greasewoodlgrass community is one of the tallest of the shrub types and provides excellent protective cover for nesting birds and small mammals and thermal cover for all species.

Vegetation

Generally, black greasewood communities have shrub and herbaceous layers, but community structure varies, depending on species composition or age class.

Some black greasewood areas contain few other shrubs, and in pure stands the plants are widely spaced with large interspaces of bare soil (Shantz and Piemeisel 1940). On some sites with almost pure stands, the shrub cover ranges from 10 to 20 percent and averages between 0.9 meter and 1.2 meters (3 and 4 ft) tall. The interspaces are mainly barren but are occasionally occupied by cheatgrass and bottlebrush squirreltail. Russianthistle is present but restricted to disturbed areas near roads.

Black greasewood comprises 90-95 percent of the shrubs in stands of the valley bottoms; the remainder consists of very large shadscale saltbush plants (reaching heights of 1 meter—**3.28** ft), green rabbitbrush, and basin big sagebrush. Cheatgrass, which usually dominates the herbaceous layer, is confined beneath shrub canopies.

Patches of the strongly rhizomatous desert saltgrass occur in areas of greater moisture. Desert saltgrass swards occur in some dense black greasewood communities where the shrub cover may reach almost 30 percent. Black greasewood dominates the shrub layer, both in percent composition and height—1.3 meters (4.3 ft). Big sagebrush and green rabbitbrush also occur. In some communities, giant wildrye attains the greatest height of any species but is present only in small amounts; however, this grass may have been more prevalent before grazing. **A** layer of cheatgrass is common between and beneath the shrubs, and the amount of bare ground varies according to fluctuations in the density of this species.

Site

The black greasewoodlgrass community reaches its best development on lowlands in the Great Basin of southeastern Oregon, occurring primarily on saline-sodic flood plains, playas, and terraces. On middle slopes of about 10 percent, spiny hopsage, as well as giant wildrye and green rabbitbrush, is conspicuous in the black greasewood community. On the lower slopes, spiny hopsage and shadscale saltbush become prominent. The low growing bud sagebrush occurs sparingly, and cheatgrass dominates the herbaceous layer.

Soil

The black greasewoodlgrass community generally occurs on soils exhibiting high alkalinity and high water tables (Potter 1957); however, Shantz and Piemeisel (1940) reported alkali is not necessary for the presence of black greasewood, but a high moisture content of the soil is.

Discussion

The black greasewoodlgrass community provides thermal cover for all species of wildlife and excellent protective cover for nesting birds and small mammals. This excellent cover is primarily due to the tall growth form of black greasewood combined with its spines and coarse structure:

Rickard (1964) reported sagebrush was replaced by black greasewood in an area that had been excessively grazed. The attendant loss of a relatively nonsaline surface layer produced a saline-sodic environment where water was available only to the halophytic black greasewood. This indicates the limited options

available for management of stands that occur on marginal sites.

25—SHADSCALE SALTBUSH/ BUNCHGRASS (fig. 35)

Vegetation

Shadscale saltbush/bunchgrass is the dominant community on large expanses of the high desert in southeastern Oregon (see footnote 5, p. 18). Crown cover in most stands averages 15 percent and ranges from **10** to **35** percent. Heights average **37** centimeters **(15** inches) and range from **30** to **45** centimeters **(12** to **18** inches). Spiny hopsage is a common species, generally with a crown cover of less than 5 percent; height averages **62** centimeters **(24** inches) and ranges from 50 to **70** centimeters **(20** to **28** inches) between sites. Big sagebrush is. a sparse component in most areas, with an average crown cover of less than 5 percent and an average height of **56** centimeters **(22** inches), ranging from 50 to **70** centimeters **(20** to **28** inches). Big sagebrush generally appears as small patches within the type, indicating a possible variation in 'soil. Bud sagebrush is common on most sites, with a crown cover averaging less than 5 percent but ranging up to 10 percent in some areas; average height is 15 centimeters **(6** inches), ranging from 10 to **20** centimeters **(4** to 8 inches). The only other shrubs commonly present are gray and green rabbitbrushes, normally with less than 1-percent crown cover. Heights of gray and green rabbitbrushes average **48** and **30** Centimeters (19 and **12** inches), respectively.

Figure 35.—Shadscale saltbush/bunchgrass community occurs on large expanses of the high deserts (Chris Maser photograph).

Average height of the grass-forb layer in this community is **14** centimeters **(6** inches), ranging from **5** to **25** centimeters **(2** to **10** inches). In most cases, total crown cover for the forb component is less than **1** percent (see footnote **5,** p. **18).** Dominance of the herbaceous layer varies between Sandberg bluegrass and bottlebrush squirreltail; average crown cover of each species is generally less than **5** percent. Sandberg bluegrass occurs in shrub interspaces and under shrub crowns; bottlebrush squirreltail, however, is found primarily under shrubs. The average height of Sandberg bluegrass, including seedstalks, is **10** centimeters **(4** inches); that of bottlebrush squirreltail, **15** centimeters **(6** inches). Cheatgrass, the only other grass present, has an average crown cover of less than **1** percent,

Forbs are sparse in this type. Only clasping pepperweed and Russianthistle are common. Crown cover is generally less than 5 percent and rarely exceeds **15** percent. Rare species are halogeton, wild buckwheat, and milkvetch.

Site

Most stands of this community occur on relatively level, lowland sites, but some are present on rolling topography. Slope varies from 0 to **30** percent among sites, directional aspect from north-northwest to south; the community is found on all slope positions. Macrorelief is level to moderately rolling hills, and microrelief is moderately smooth to moderately rough (see footnote 5, p. **18).**

Soil

Soils are moderately deep, varying from silt loams to coarse gravelly and stony silt loams. Cobble and stone cover of the soil surface varies from **5** to **40** percent, with erosion pavement made up of coarse gravels that occupy small, low areas in shrub interspaces. In some lowland flats, dry soil surfaces in depression spots exhibit cracked and plated, polygonal patterns. Soil in all areas is strongly alkaline. In most areas, edges and bottoms **of** surface stone are encrusted with **a** thin calcareous layer (see footnote **5,** p. **18).**

Discussion

Vegetation in all stands appears to have had a long period of heavy use by livestock. Most perennial bunchgrass plants are present only under the protection of shrub crowns. The most common forbs are annual species (Russianthistle and clasping pepperweed) on abused ranges. Rodent burrows, mostly of kangaroo rats, are present in most sites but concentrated in areas of rolling, hilly relief. Mounds in these areas are large, 2 to 5 meters (7 to 16 ft) in diameter, and occur on ridges and slopes at a density up to 25 per hectare (10 per acre). Fewer and smaller mounds are found in bottoms and on flat topography. Small mounds of burrowing rodents are present on level areas with a density up to 12 per hectare (5 per acre). Large mounds vary from **4.5** to 6 meters (15 to 20 ft) in diameter and occur on flats at a density of approximately 10 per hectare **(4** per acre).

The primary dispersal pattern of halogeton into the shadscale saltbush type in the Great Basin of Oregon is from highway shoulders and barrow pits to rodent mounds and other disturbed areas. From a survey of two 300-meter (985-ft) by 10-meter (33-ft) transects, beginning 10 meters from a highway shoulder and moving at a right angle to the road, only 2 halogeton plants were discovered in vegetation undisturbed by rodents, and 12 plants or small groups of plants were counted on rodent mounds. Frequency of halogeton fell off with distance from the highway.

Holmgren and Hutchings (1972) described shadscale saltbush as being palatable to livestock, but because of its spiny stems, use was limited to 15 to 20 percent of the previous season's growth. Bud sagebrush was generally palatable only in late winter, but it may be consumed all winter on occasion. It is considered more palatable for domestic sheep than for cattle. Russianthistle and cheatgrass are often abundant on heavily grazed shadscale saltbush ranges. These species are considered both palatable and nutritious by Holmgren and Hutchings (1972) but are undependable sources of forage because they are annuals.

Grassland Communities

The following natural communities dominated by grass and grasslike plants include seasonally wet and wet meadows, as well as subalpine grasslands. Shrubs and trees are either minor components or are absent from these communities.

26—SEASONALLY WET MEADOWS (figs. 36 and 37)

Vegetation

At low elevations, seasonally wet meadow vegetation is comprised primarily of grasses and sedges. Shrubs, such as willow, may occur in riparian situations adjacent to the type, or dry site shrubs may be present in stands on high ground or upslope at the dry edge of the type. Grasses include Kentucky bluegrass, Sandberg bluegrass, skyline bluegrass, Wheeler bluegrass, northern meadow barley, and spike trisetum. Sedges that may be present are smallwing, epapiilous, Douglas, Liddon, slenderbeak, and Raynolds. Rushes generally occur as minor species; the most common in southeastern Oregon may be Drummond and swordleaf (Hansen 1956).

Hansen (1956) described shrubs in subalpine seasonally wet meadows on Steens Mountain as low weatherbeaten forms typical of windswept high mountain vegetation. Common shrubs (willows listed in appendix under "TREES") are Drummond willow, coyote willow, snow willow, bush cinquefoil, cartha-moid goldenweed, and dwarf blueberry. Only four grass and grasslike species were reported—false-scirpus sedge, subnigricans sedge, winter bentgrass, and spreading woodrush. Forbs were more abundant: crag aster, elkslip marshmarigold, alpine shootingstar, Sierra willowweed, Watson willowweed, white bogorchid, oblongleaf bluebells, Rocky Mountain parnassia, lousewort, American bistort, Kellogg's knotweed, short-leaved cinquefoil, plainleaf buttercup, modest buttercup, roseroot stonecrop, and crisped starwort.

Figure 36.—Extensive seasonally wet meadows are shown with lesser amounts of permanently wet meadows along streams and around ponds.

Figure 37.—Seasonally ponded sumps at the western edge of the Great Basin generally dry up by mid-season. These areas are severely limited in production of forage.

Site

Seasonally wet meadows can occur in any vegetation zone in the high desert, from bottomlands of low elevation to subalpine ranges. Communities are present as either seasonally ponded or wet swales with no external drainage or as transitional stands between wet meadows and dryland shrub types (Dealy 1971). Where streams have been channeled because of erosion, wet meadows often have been permanently converted to either seasonally wet meadows or dryland shrub communities. In high precipitation zones or on sites where a subsurface lateral drainage emerges at valley edges (toe slopes), the seasonally wet grassland community often becomes prominent. Seasonal seeps, springs, and streams in any slope position often provide small stands of the community.

Soil

Seasonally wet meadows generally occur on moderately deep to deep clay or clay loam soils. Soils under meadows in good condition are high in organic matter and moisture-holding capacity. Wide cracks occur in the dry clay soils, producing a churning action (surface soil falls into cracks when the soil is dry and is incorporated at a lower level when soils become wet and cracks close) which mixes the upper horizons. Trampling of meadows by livestock during wet periods can result in soil damage and thus damage forage plants.

Discussion

Seasonally wet meadows are highly attractive to domestic and wild ungulates, and heavy grazing for more than 100 years has depleted vegetation of these stands. Sites large enough to provide substantial forage may be practical for intensive management of livestock. Small sites, however, such as near seasonal seeps and springs, may be best developed for wildlife but with water piped outside the protected habitat. Young tender forbs and grasses available into late spring contribute to optimum habitat for young grouse (Bump et al. 1947) and probably other gallinaceous birds. An oasis such as this is used by many wildlife species for food and cover.

27—PERMANENTLY WET MEADOWS (fig. 38)

Vegetation

Plant species composition of stands varies considerably among permanently wet sites on rangelands of the high desert. Grasses and sedges are typically dominant in meadows in good condition, and the forbs may also be abundant. At elevations below the subalpine zone, Hansen (1956) stated that whiplash willow was the most abundant shrub in meadows. Common grass and grasslike species were creeping bentgrass, northern meadow barley, mountain hairgrass, and ovalhead sedge. Columbia monkshood, primrose monkeyflower, and Scouler St. Johnswort were the most common forbs.

Figure 38.—Small areas of permanently wet meadows around seeps and springs are typical of the high desert mountains.

Site

Other than the large meadowlands on private holdings, wet meadow communities are found primarily as belts adjacent to riparian zones and as patches around perennial springs and seeps. They can be found on any aspect and most slopes, but those around springs and seeps may be more common on northerly aspects.

Discussion

Heavy grazing of most wet meadows for over 100 years has had a marked effect on the composition and productivity of these communities. Through recently developed manage-

ment practices, some riparian zones and adjacent wet meadows are being improved.[12] Small areas of meadow around springs and seeps within expanses of drier range may appear to be uneconomical for management planning, yet they are stands where livestock and wildlife concentrate. Because of their special values for wildlife, it may be desirable to protect them to enhance the production of grasses, forbs, and shrubs and thus improve cover and forage for a wide variety of small animals and birds.

28—SUBALPINE BUNCHGRASS (figs. 39 and 40)

Vegetation

Grassland communities of the subalpine zone are characterized by a dominant stand of fescue, primarily sheep fescue (Maser and Strickler 1978). Other grasses and grasslike species are rough fescue, prairie junegrass, Cusick bluegrass, longtongue mutton bluegrass, Sandberg bluegrass, and Dunhead sedge (Hansen 1956). Areas with disturbed soil contain small amounts of forbs (Hansen 1956).

Site

Hansen (1956) found the subalpine zone above 2 439-meter (8,000-ft) elevation predominantly grassland interspersed with large areas of bare windswept ground and the lower 244 meters (800 ft) overgrown to short sagebrush.

Discussion

Communities in subalpine regions are fragile and can be severely damaged by livestock grazing and trampling. High winds and unstable soils combined with severe grazing can produce rapid erosion of the surface layer of grassland soils. Large, bare windswept areas are probably a product of severe use by domestic sheep during the late 1800's and early 1900's. Griffiths (1902) toured through southeastern Oregon and referred to domestic sheep use as extremely heavy. Vegetation was severely damaged. Griffiths (1902) noted large clouds of dust caused by bands of domestic sheep during the peak of the grazing season. Mule deer, pronghorns, bighorn sheep, and occasionally Rocky Mountain elk also use these high elevation areas.

[12] Personal communication, 1979, from Robert Kindschy, Bureau of Land Management, Vale, Oregon.

Figure 39.—Subalpine grassland of the high desert mountains; sheep fescue dominates the site (Chris Maser photograph).

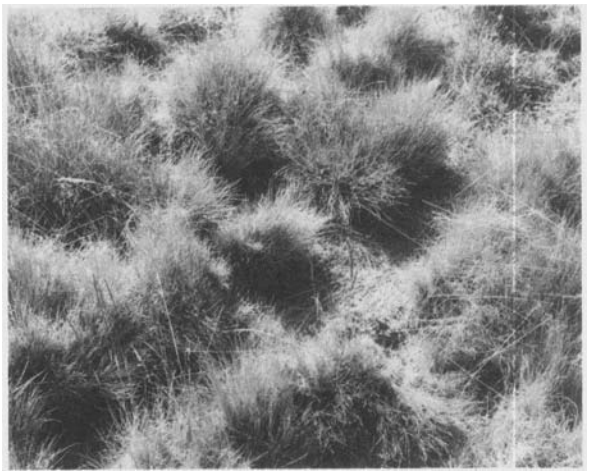

Figure 40.—Detailed view of a subalpine grassland; sheep fescue dominates the site (Chris Maser photograph).

Successional Vegetation

Successional patterns are highly complex in the communities of the northern Great Basin. Current composition of plant species can be misleading when site potential and suitable management alternatives are determined for various stands. Because of alterations by natural fire patterns and a long

history of heavy use by livestock, there are relatively few communities or local stands in the desert rangelands that can be considered at or near climax condition. In other words, few stands are in a natural balance with the environment. The stands most difficult to identify are those that have been most severely altered.

Much work has been done to identify subspecies of big sagebrush (Beetle 1960, Beetle and Young 1965, Winward 1970, Winward and Tisdale 1977). Some of this work includes identification of typical soils and sites on which various subspecies are found. For example, Winward and Tisdale (1977), besides giving a taxonomic description of the subspecies, describe basin big sagebrush as growing "in deep, well drained soils of valley bottoms and lower foothill regions." They describe the occurrence of the subspecies in terms of elevation and response to disturbance. Recognition of subspecies and information on sites, along with soils and identification of remnant species that are characteristic of climax or advanced successional communities, can often help managers determine potential for a community.

The relationship between dominance of sagebrush and that of bunchgrass in climax shrub steppe communities is not understood. An excellent stand of grass dominated by bearded bluebunch wheatgrass or Idaho fescue and bearded bluebunch wheatgrass, either devoid of big sagebrush or having a small component of this shrub, may appear on the surface as a climax grassland community. That premise is usually not the case in the shrub steppe. Central and southeastern Oregon steppe communities devoid of a major shrub component are uncommon, and those that do appear as grasslands may have resulted from burning (Franklin and Dyrness 1973).

A brief examination of sites in question should help observers to correctly classify the stands. If topography, elevation, and soils in areas of question are similar to adjacent types with stands of shrubland communities, there is a greater than 90-percent chance that the questionable type is a shrub-grass climax in some stage of succession. Nearly complete destruction of the grass-forb layer under a shrub or tree-shrub-dominated stand can also make identification of plant communities difficult. Here, discovery of remnants of grass species and an analysis of site factors can help identify the original plant community.

An important key to developing a management outlook is recognizing ecological potential of the site—the potential of a community to support vegetation of interest. For example, Burkhardt and Tisdale (1969) presented strong evidence that with management and fire control in southwestern Idaho, western juniper has the potential to occupy the entire mountain big sagebrush/bunchgrass community. Given a site with this potential, a seed source, and barring fire or other repression of the trees and shrubs, the inevitable conclusion will be a western juniperlbig sagebrushlbunchgrass stand. Similarly, given a potential sagebrush/bunchgrass community in a bunchgrass successional stage, the inevitable conclusion, barring inhibition of developing sagebrush, will be a shrublgrass community. With such knowledge built into management plans, managers will be spared the frustration of seeing "invasions" of shrubs or trees into communities considered stable "grass" types or "shrub/grass" types. The managers can then plan management strategies of stocking rates, season of use, manipulation of vegetation, and "preserved diversity" to suit established priorities based on the ecological realities of each site's potential.

The rate of successional advancement can vary greatly within any community. Experienced managers generally recognize and have a feel for this. A light fire that leaves scattered shrubs in a sagebrush type provides a ready seed source for reoccupancy by shrubs. **A** hot extensive fire, on the other hand, may virtually eliminate seed sources of shrubs over a great distance. Burning a south exposure shrub/grass community can produce microclimate conditions that may prevent reestablishment of shrubs for a long time. Such effects can be assessed and the information used in projecting future management alternatives.

Literature Cited

Adams, A. W.
1975. A brief history of juniper and shrub populations in southern Oregon. Oreg. Wildl. Comm., Wildl. Res. Rep. **6, 33** p. Corvallis.

Alderfer, J. M.
1976. A taxonomic study of bitterbrush ***(Purshia tridentata*** (Pursh) DC.) in Oregon. M.S. thesis. Oreg. State Univ., Corvallis. **197** p.

Anderson, E. W.
1956. Some soil-plant relationships in eastern Oregon. J. Range Manage. 9(4):**171-175.**

Anthony, H. E.
1928. Field book of North American mammals. **674** p. G. P. Putnam's Sons, New York.

Beetle, A. A.
1960. A study of sagebrush, the section Tridentatae of ***Artemisia.*** Agric. Exp. Stn. Bull. 368, 83 p. Univ. Wyo., Laramie.

Beetle, A. A., and A. Young.
1965. A third subspecies in the ***Artemisia tridentata*** complex. Rhodora 67:405-406.

Bella, D. **A.,** and W. S. Overton.
1972. Environmental planning and ecological possibilities. J. Sanitation Eng. Div., Proc. Am. Soc. Civ. Eng. 98(SA3).

Brunner, J. R.
1972. Observations on ***Artemisia*** in Nevada. J. Range Manage. 25(3):205-208.

Bump, G., R. W. Darrow, F. C. Edminster, and W. F. Crissey.
1947. The ruffed grouse — life history, propagation, and management. **915** p. N. ***Y.*** State Conserv. Dep., Buffalo.

Burkhardt, J. W., and E. W. Tisdale.
1969. Nature and successional status of western juniper vegetation in Idaho. J. Range Manage. 22(4):264-270.

Burkhardt, J. W., and E. W. Tisdale.
1976. Causes **of** juniper invasion in southwestern Idaho. Ecology 57(3):472-484.

Concannon, D. M.
1978. Plant succession on burned areas of the ***Artemisia tridentata/Agropyron spicatum*** habitat type in southeastern Oregon. M.S. thesis. Humboldt State Univ., Arcata, Calif. **101** p.

Cook, C. W.
1972. Comparative nutritive values of forbs, grasses, and shrubs. *In* Wildland shrubs: their biology and utilization. C. M. McKell, J. P. Blaisdell, and **J.** R. Goodin, eds. USDA For. Serv. Gen. Tech. Rep. INT-1, p. **303-310.** Intermt. For. and Range Exp. Stn., Ogden, Utah.

Cornelius, D. R., and M. W. Talbot.
1955. Rangeland improvement through seeding and weed control on east slope Sierra Nevada and on southern Cascade Mountains. U.S. Dep. Agric. Agric. Handb. 88, 51 p.

Culver, R. N.
1964. An ecological reconnaissance of the ***Artemisia*** steppe on the east central Owyhee uplands of Oregon. M.S. thesis. Oreg. State Univ., Corvallis. **99** p.

Daubenmire, R.
1956. Climate as a determinant of vegetation distribution in eastern Washington and northern Idaho. Ecol. Monogr. 26(2):**131-154.**

Daubenmire, R.
1968. Plant communities, a textbook of plant synecology. **300** p. Harper and Row, Publ., New York.

Daubenmire, R.
1970. Steppe vegetation of Washington. Wash. Agric. Exp. Stn. Tech. Bull. **62, 135** p. Wash. State Univ., Pullman.

Dayton, W. A.
1931. Important western browse plants. U.S. Dep. Agric. Misc. Publ. **101, 214** p. Washington, D.C.

Dealy, J. E.
1971. Habitat characteristics of the Silver Lake mule deer range. USDA For. Serv. Res. Pap. PNW-125, **99** p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Dealy, J. E.
1975. Ecology of curlleaf mountain-mahogany in Oregon and adjacent areas. Ph. D. thesis. Oreg. State Univ., Corvallis. **162** p.

Dealy, J. E., and J. M. Geist.
1978. Conflicting vegetational indicators on some central Oregon scablands. J. Range Manage. 31(1):56-59.

Dealy, J. E., J. M. Geist, and R. S. Driscoll.
1978a. Communities of western juniper in the intermountain Northwest. *In* Proceedings of the western juniper ecology and management workshop. R. E. Martin, J. E. Dealy, and D. L. Caraher, eds. USDA For. Serv. Gen. Tech. Rep. PNW-74, p. 11-29. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Dealy, J. E., J. M. Geist, and R. S. Driscoll.
1978b. Western juniper communities on rangelands of the Pacific Northwest. Proc. 1st Int. Rangeland Congr., p. 201-204. D. N. Hyder, ed. Soc. Range Manage., Denver, Colo.

Dean, M. L.
1960. A taxonomic and ecologic study of the vascular plants of a section of the Owyhee River Canyon in Oregon. M.S. thesis. Oreg. State Univ., Corvallis. 147 p.

deBoer, T. A.
1974. [The contribution of vegetation science to the management of wildlife reserves.] Misc. Pap. 5, p. 63-78. Landbouwhogesch. Wageningen, The Netherlands. [In Dutch.]

Dietz, D. R., R. H. Udall, and L. E. Yeager.
1962. Chemical composition and digestibility by mule deer of selected forage species, Cache La Poudre Range, Colorado. Colo. Game and Fish Dep. Tech. Publ. 14, 89 p.

Dietz, D. R., and L. E. Yeager.
1959. The apparent role of sagebrush in the management of mule deer winter range. Proc. West. Assoc. State Game and Fish Comm. 39:151-158.

Driscoll, R. S.
1964. Vegetation-soil units in the central Oregon juniper zone. USDA For. Serv. Res. Pap. PNW-19, 60 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Eckert, R. E., Jr.
1957. Vegetation-soil relationships in some *Artemisia* types in northern Harney and Lake Counties, Oregon. Ph. D. thesis. Oreg. State Univ., Corvallis. 208 p.

Eckert, R. E.
1958. Vegetation-soil relationships in some *Artemisia* types in Harney and Lake Counties, Oregon. J. Range Manage. 11(1):50.

Fosberg, M. A., and M. Hironaka.
1964. Soil properties affecting the distribution of big and low sagebrush communities in southern Idaho. Am. Soc. Agron. Spec. Publ. 5:230-236.

Franklin, J. F., and C. T. Dyrness.
1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8, 417 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Gabrielson, I. N., and S. G. Jewett.
1940. Birds of Oregon. 650 p. Oreg. State Coll. [Univ.]Publ., Corvallis.

Garrison, G. A., A. J. Bjugstad, D. A. Duncan, M. E. Lewis, and D. R. Smith.
1977. Vegetation and environmental features of forest and range ecosystems. U.S. Dep. Agric. Agric. Handb. 475, 68 p. Washington, D.C.

Garrison, G. A., J. M. Skovlin, C. E. Poulton, and A. H. Winward.
1976. Northwest plant names and symbols for ecosystem inventory and analysis. USDA For. Serv. Gen. Tech. Rep. PNW-46, 263 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Griffiths, D.
1902. Forage conditions on the northern border of the Great Basin. USDA Bur. Plant Ind. Bull. 15, 60 p. Gov. Print. Off., Washington, D.C.

Hall, F. C.
1973. Plant communities of the Blue Mountains in eastern Oregon and eastern Washington. USDA For. Serv. R6 Area Guide 3-1, 62 p. Pac. Northwest Reg., Portland, Oreg.

Hanks, D. L., J. R. Brunner, D. R. Christensen, and A. P. Plummer.
1971. Paper chromatography for determining palatability differences in various strains of big sagebrush. USDA For. Serv. Res. Pap. INT-101, 9 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Hanks, D. L., E. D. McArthur, R. Stevens, and A. P. Plummer.
1973. Chromatographic characteristics and phylogenetic relationships of *Artemisia tridentata*. USDA For. Serv. Res. Pap. INT-141, 24 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Hansen, C. G.
1956. An ecological survey of the vertebrate animals on Steen's Mountain, Harney County, Oregon. Ph. D. thesis. Oreg. State Univ., Corvallis. 200 p.

Hayes, D. W., and G. A. Garrison.
1960. Key to important woody plants of eastern Oregon and Washington. U.S. Dep. Agric. Agric. Handb. 148, 227 p. U.S. Gov. Print. Off., Washington, D.C.

Hill, R. R.
1956. Forage, food habits, and range management of the mule deer. *In* The deer of North America, p. 393-414. W. P. Taylor, ed. Stackpole Co., Harrisburg, Pa.

Hitchcock, C. L., and A. Cronquist.
1973. Flora of the Pacific Northwest, an illustrated manual. 730 p. Univ. Wash. Press, Seattle.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson.
1955. Vascular plants of the Pacific Northwest. Part 5: Compositae. 343 p. Univ. Wash. Press, Seattle.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson.
1977. Vascular plants of the Pacific Northwest (5 parts). Part 3, Saxifragaceae to Ericaceae. 614 p. Univ. Wash. Press, Seattle and London.

Holmgren, R. C., and S. S. Hutchings.
1972. Salt desert shrub response to grazing use. *In* Wildland shrubs: Their biology and utilization. C. M. McKell, J. P. Blaisdell, and J. R. Goodin, eds. USDA For. Serv. Gen. Tech. Rep. INT-1, p. 153-164. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Hormay, A. L.
1943. Bitterbrush in California. USDA For. Serv., Calif. For. and Range Exp. Stn. Res. Note 34, 13 p.

Ingles, L. G.
1967. Mammals of the Pacific States. 506 p. Stanford Univ. Press., Stanford, Calif.

Kornet, C. A.
1978. Status and habitat use of California bighorn sheep on Hart Mountain, Oregon. M.S. thesis. Oreg. State Univ., Corvallis. 49 p.

Kuchler, A. W.
1957. Applied phytosociology. Ecology 38(3):541-542.

Kuchler, A. W.
1964. The potential natural vegetation of the conterminous United States. Am. Geogr. Soc. Spec. Pubi. 36, 160 p.

Kufeld, R. C., O. C. Wallmo, and C. Feddema.
1973. Foods of the Rocky Mountain mule deer. USDA For. Serv. Res. Pap. RM-111, 31 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Leckenby, D. A.
1977. Management of mule deer and their habitat: Applying concepts of behavior, physiology, and microclimate. Proc. West. Assoc. State Game and Fish Comm. 57:206-217.

Leckenby, D. A.
1978a. Mule deer occupancy of plant communities on a south-central Oregon winter range. Spec. Rep., Oreg. Dep. Fish and Wildl. Final Rep. Proj. W-53-R and W-70-R-Sub. B. SIJ5. 77 p.

Leckenby, D. A.
1978b. Western juniper management for mule deer. *In* Proceedings of the western juniper ecology and management workshop. R. E. Martin, J. E. Dealy, and D. L. Caraher, eds. USDA For. Serv. Gen. Tech. Rep. PNW-74, p. 137-161. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Leckenby, D. A., and D. E. Toweill.
1979. Mule deer winter range ecology and management: Seeding response of selected plant species on a mule deer winter range in south-central Oregon. Oreg. Dep. Fish and Wildl. Final Rep. W-53-R-12 and W-70-R-1 through 8, Sub. B. SII/J2. 22 p.

MacArthur, R. H., and J. W. MacArthur.
1961. On bird species diversity. Ecology 42(3):594-598.

McIlvain, E. H., and M. C. Shoop.
1971. Shade for improving cattle gains and rangeland use. J. Range Manage. 24(3):181-184.

Maser, C., and J. S. Gashwiler.
1978. Interrelationships of wildlife and western juniper. *In* Proceedings of the western juniper ecology and management workshop. R. E. Martin, J. E. Dealy, and D. L. Caraher, eds. USDA For. Serv. Gen. Tech. Rep. PNW-74, p. 37-82. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Maser, C., and G. S. Strickler.
1978. The sage vole, *Lagurus curtatus*, as an inhabitant of subalpine sheep fescue, *Festuca ouina,* communities on Steens Mountain: An observation and interpretation. Northwest Sci. 52(3):276-284.

Miller, A. H.
1968. *Amphispiza belli Nevadensis* (Ridgeway) northern sage sparrow. *In* Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies, part 2, p. **1004-1013.** A. C. Bent and O. L. Austin, Jr., eds. Dover Publ., Inc., New York.

Mueller-Dombois, D., and H. Ellenberg.
1974. Aims and methods of vegetation ecology. **547** p. John Wiley and Sons, New York.

Nagy, J. G., and R. P. Tengerdy.
1968. Antibacterial action of essential oils of *Artemisia* as an ecological factor. Appl. Microbiol. 16(3):441-444.

Nord, E. C.
1965. Autecology of bitterbrush in California. Ecol. Monogr. 35(3):307-334.

Odum, E. P.
1971. Fundamentals of ecology. 3d ed. **574** p. W. B. Saunders Co., Philadelphia, Pa.

Odum, E. P.
1979. Ecological importance of the riparian zone. *In* Strategies for protection and management of floodplain wetlands and other riparian ecosystems. R. R. Johnson and J. F. McCormick, tech. coords. USDA For. Serv. Gen. Tech. Rep. WO-12, p. **2-4.** Washington, D.C.

Packard, P. L.
1972. *Pinus ponderosa* in Malheur County, Oregon. Madrono 21(5):298.

Pechanec, J. F., A. P. Plummer, J. H. Robertson, and A. C. Hull, Jr.
1965. Sagebrush control on rangelands. U.S. Dep. Agric. Agric. Handb. **277, 40** p. U.S. Gov. Print. Off., Washington, D.C.

Peck, M. E.
1961. A manual of the higher plants of Oregon. 2d ed. **936** p. Binfords and Mort, Publ., Portland, Oreg.

Potter, L. D.
1957. Phytosociological study of San Augustin Plains, New Mexico. Ecol. Monogr. 27(1):113-136.

Rickard, W. H.
1964. Demise of sagebrush through soil changes. Bioscience 14(1):43-44.

Rittenhouse, L. R., and F. A. Sneva.
1977. A technique for estimating big sagebrush production. J. Range Manage. 30(1):68-70.

Roberts, R. W.
1975. Evaluating the impact of range treatment on vegetation. Oreg. Wildl. Comm., Wildl. Res. Rep. 7, 30 p. Corvallis.

Schumaker, G. A., and C. L. Hanson.
1977. Herbage response after mechanical and herbicide treatment of big sagebrush in southwest Idaho. U.S. Dep. Agric. Agric. Res. Serv. **W-46,** 15p.

Segura-Bustamante, M.
1970. Ecology of bitterbrush *(Purshia tridentata* (Pursh) DC.) in the Silver Lake deer winter range, Oregon. Ph. D. thesis. Oreg. State Univ., Corvallis. **342** p.

Shantz, H. L., and R. L. Piemeisel.
1940. Types of vegetation in the Escalante Valley, Utah, as indicators of soil conditions. U.S. Dep. Agric. Tech. Bull. **713, 46** p. U.S. Gov. Print. Off., Washington, D.C.

Sheehy, D. P.
1975. Relative palatability of seven *Artemisia* taxa to mule deer and sheep. M.S. thesis. Oreg. State Univ., Corvallis. **147** p.

Short, H. L., R. M. Blair, and L. Burkart.
1972. Factors affecting nutritive values. *In* Wildland shrubs: Their biology and utilization. C. M. McKell, J. P. Blaisdell, and J. R. Goodin, eds. USDA For. Serv. Gen. Tech. Rep. INT-1, p. **311-318.** Intermt. For. and Range Exp. Stn., Ogden, Utah.

Smith, A. D.
1950. Sagebrush as a winter feed for deer. J. Wildl. Manage. 14(3):285-289.

Smith, A. D.
1952. Digestibility of some native forages for mule deer. J. Wildl. Manage. 16(3):309-312.

Soil Survey Staff.
1951. Soil survey manual. U.S. Dep. Agric. Agric. Handb. 18, **503** p. U.S. Gov. Print. Off., Washington, D.C.

Stevens, R., and E. D. McArthur.
1974. A simple field technique for identification of some sagebrush taxa. J. Range Manage. 27(4):325-326.

Thomas, J. W., R. M. DeGraaf, and J. C. Mawson.
1977. Determination of habitat requirements for birds in suburban areas. USDA For. Serv. Res, Pap. NE-357, 15 p. Northeast. For. Exp. Stn., Upper Darby, Pa.

Thomas, J. W., C. Maser, and J. E. Rodiek.
1978. Edges—their interspersion, resulting diversity and its measurement. *In* Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the Western United States. USDA For. Serv. Gen. Tech. Rep. PNW-64, p. 91-100. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Thomas, J. W., H. C. Black, Jr., R. J. Scherzinger, and R. J. Pedersen.
1979a. Deer and elk. *In* Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. J. W. Thomas, ed. U.S. Dep. Agric. Agric. Handb. 553, p. 104-127. U.S. Gov. Print. Off., Washington, D.C.

Thomas, J. W., C. Maser, and J. E. Rodiek.
1979b. Riparian zones. *In* Wildlife habitats in managed rangelands: The Great Basin of southeastern Oregon. USDA For. Serv. Gen. Tech. Rep. PNW-80, 18 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Thomas, J. W., C. Maser, and J. E. Rodiek.
1979c. Edges. *In* Wildlife habitats in managed rangelands: The Great Basin of southeastern Oregon. USDA For. Serv. Gen. Tech. Rep. PNW-85, 17 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Tisdale, E. W., M. Hironaka, and M. A. Fosberg.
1965. An area of pristine vegetation in Craters of the Moon National Monument, Idaho. Ecology 46(3):349-352.

Tisdale, E. W., M. Hironaka, and M. A. Fosberg.
1969. The sagebrush region in Idaho, a problem in range resource management. Agric. Exp. Stn. Bull. 512, 15 p. Univ. Idaho, Moscow.

Tueller, P. T.
1962. Plant succession on two *Artemisia* habitat types in southeastern Oregon. Ph. D. thesis. Oreg. State Univ., Corvallis. 249 p.

Urness, P. J.
1966. Influence of range improvement practices on composition, production, and utilization of *Artemisia* deer winter range in central Oregon. Ph. D. thesis. Oreg. State Univ., Corvallis. 183p.

Volland, L. A.
1976. Plant communities of the central Oregon pumice zone. USDA For. Serv. R6 Area Guide 4-2, 110 p. Pac. Northwest Reg., Portland, Oreg.

West, N. E., R. J. Tausch, K. H. Rea, and P. T. Tueller.
1978. Taxonomic determination, distribution, and ecological indicator values of sagebrush within the pinyon-juniper woodlands of the Great Basin. J. Range Manage. 31(2):87-92.

Westoby, M., and F. H. Wagner.
1973. Use of a crested wheatgrass seeding by black-tailed jackrabbits. J. Range Manage. 26(5)349-352.

Winward, A. H.
1970. Taxonomic and ecological relationships of the big sagebrush complex in Idaho. Ph. D. thesis. Univ. Idaho, Moscow. 80 p.

Winward, A. H.
1980. Taxonomy and ecology of sagebrush in Oregon. Agric. Exp. Stn. Stn. Bull. 642, 15 p. Oreg. State Univ., Corvallis.

Winward, A. H., and E. W. Tisdale.
1977. Taxonomy of the *Artemisia tridentata* complex in Idaho. For., Wildl., and Range Exp. Stn. Bull. 19, 15 p. Univ. Idaho, Moscow.

Appendix

Common and Scientific Names of Animals

Common name	Scientific name	Symbol[1]
	MAMMALS	
Badger	*Taxidea taxus*	
Beaver	*Castor canadensis*	
Bighorn sheep	*Ovis canadensis*	
Black-tailed jackrabbit	*Lepus californicus*	
Bushy-tailed woodrat	*Neotoma cinerea*	
Cattle	*Bos taurus*	
Coyote	*Canis latrans*	
Deer	*Odocoileus* sp.	
Domestic sheep	*Ovis aries*	
Domestic goat	*Capra* sp.	
Gophers	*Thomomys* sp.	
Ground squirrel	*Spermophilus* sp.	
Hare	*Lepus* sp.	
Kangaroo rat	*Dipodomys* sp.	
Mule deer	*Odocoileus hemionus*	
Pronghorn	*Antilocapra americana*	
Rabbit	*Sylvilagus* sp.	
Rocky Mountain elk	*Cervus elaphus*	
Vole	*Lagurus* sp.	
	BIRDS	
Geese	*Branta* sp.	
Horned lark	*Eremophila alpestris*	
Lark sparrow	*Chondestes grammacus strigatus*	
Sage grouse	*Centrocercus urophasianus*	
Sage sparrow	*Amphispiza belli*	
Swan	*Olor* sp.	

Common and Scientific Names and Symbols of Plants

	TREES	
Bittercherry	*Prunus emarginata*	PREM
Chokecherry	*Prunus virginiana*	PRVI
Cottonwood	*Populus* sp.	POPUL
Drummond willow	*Salix drummondiana*	SADR
Fir	*Abies* sp.	ABIES
Juniper	*Juniperus* sp.	JUNIP
Ponderosa pine	*Pinus ponderosa*	PIPO
Quaking aspen	*Populus tremuloides*	POTR
Spruce	*Picea* sp.	PICEA
Western juniper	*Juniperus occidentalis*	JUOC
White fir	*Abies concolor*	ABCO

[1] After Garrison et al. (1976).

Appendix (continued)

Common name	Scientific name	Symbol[1]
	SHRUBS	
Antelope bitterbrush	*Purshia tridentata*	PUTR
Basin big sagebrush	*Artemisia tridentata* subsp. *tridentata*	ARTRT
Big sagebrush	*Artemisia tridentata*	ARTR
Black greasewood	*Sarcobatus vermiculatus*	SAVE2
Black sagebrush	*Artemisia nova*	ARNO2
Bolander silver sagebrush	*Artemisia cana* subsp. *bolunderi*	ARCAB
Broom snakeweed	*Gutierrezia sarothrae*	GUSA
Bud sagebrush	*Artemisia spinescens*	ARSP
Bush cinquefoil	*Potentilla fruticosa*	POFR
Carthamoid goldenweed	*Haplopappus carthamoides*	HACA
Cleftleaf sagebrush	*Artemisia arbuscula* subsp. *thermopola*	ARART
Coyote willow	*Salix exigua*	SAEX,
Creeping Oregon grape	*Berberis repens*	BERE
Curlleaf mountainmahogany	*Cercocarpus ledifolius ledifolius*	CELEL
Desert rockspirea	*Holodiscus dumosus*	HODU
Dwarf blueberry	*Vaccinium caespitosum*	VACA
Dwarf threetip sagebrush	*Artemisia tripartita* subsp. *rupicola*	ARTRR
Early low sagebrush	*Artemisia longiloba*	ARLO2
Goldenweed	*Haplopappus* sp.	HAPLO2
Granite gilia	*Leptodactylon pungens*	LEPU
Gray horsebrush	*Tetradymia canescens*	TECA
Gray rabbitbrush	*Chrysothamnus nauseosus*	CHNA
Green rabbitbrush	*Chrysothamnus viscidiflorus*	CHVI
Hopsage	*Grayia*	GRAYI
Horsebrush	*Tetradymia sp.*	TETRA
Low sagebrush	*Artemisia arbuscula* subsp. *arbuscula*	ARARA
Mountain big sagebrush	*Artemisia tridentata* subsp. *vaseyana*	ARTRV
Mountain silver sagebrush	*Artemisia cana* subsp. *viscidula*	ARCAV
Mountain snowberry	*Symphoriocarpus oreophilus*	SYOR
Rabbitbrush	*Chrysothamnus* sp.	CHRYS3
Sagebrush	*Artemisia* sp.	ARTEM
Saskatoon serviceberry	*Amelunchier alnifolia*	AMAL
Shadscale saltbush	*Atriplex confertifolia*	ATCO
Silver sagebrush	*Artemisia cana*	ARCA
Snow willow	*Salix nivalis*	SANI
Spiny hopsage	*Grayia spinosa*	GRSP
Squaw apple	*Pemphyllum ramosissimum*	PERA3
Stiff sagebrush	*Artemisia ngida*	ARRI
Subalpine big sagebrush	*Artemisia tridentata* form *spiciformis*	ARTRS
Threetip sagebrush	*Artemisia tripartita*	ARTR2
Wax currant	*Ribes cereum*	RICE
Whiplash willow	*Salix caudata*	SACA
Willow	*Salix* sp.	SALIX
Wyoming big sagebrush	*Artemisia tridentata* subsp. *wyomingensis*	ARTRW

[1]After Garrison et al. (1976).

Appendix (continued)

Common name	Scientific name	Symbol[1]
	GRASS AND GRASSLIKE PLANTS	
Baltic rush	*Juncus balticus*	JUBA
Bearded bluebunch wheatgrass	*Agropyron spicatum*	AGSP
Big bluegrass	*Poa ampla*	POAM
Blue wildrye	*Elymus glaucus*	ELGL
Bottlebrush squirreltail	*Sitanion hystrix*	SIHY
California brome	*Bromus carinatus*	BRCA
Cheatgrass	*Bromus tectorum*	BRTE
Creeping bentgrass	*Agrostis palustris*	AGPA
Crested wheatgrass	*Agropyron desertorum*	AGDE
Cusick bluegrass	*Poa cusickii*	POCU
Cutting wheatgrass	*Agropyron caninum*	AGCA
Desert saltgrass	*Distichlis stricta*	DIST
Douglas sedge	*Carex douglasii*	CADO
Drummond rush	*Juncus drummondii*	JUDR
Dunhead sedge	*Carex phaeocephala*	CAPH
Dwarf squirreltail	*Sitanion hystrix* var. *hordeoides*	SIHYH
Epapillous sedge	*Carex epapillosa*	CAEP
False-scirpus sedge	*Carex scirpoidea* var. *pseudoscirpoidea*	CASCP
Fescue	*Festuca* sp.	FESTU
Giant wildrye	*Elymus cinereus*	ELCI
Green fescue	*Festuca viridula*	FEVI
Hairgrass	*Deschampsia* sp.	DESCH
Idaho fescue	*Festuca idahoensis*	FEID
Indian ricegrass	*Oryzopsis hymenoides*	ORHY
Intermediate wheatgrass	*Agropyron intermedium*	AGIN2
Kentucky bluegrass	*Poa pratensis*	POPR
Lemmon needlegrass	*Stipa lemmonii*	STLEZ
Liddon sedge	*Carex petasata*	CAPE
Longtongue mutton bluegrass	*Poa longiligula*	POLO
Medusahead wildrye	*Elymus caput-medusae*	ELCA2
Mountain hairgrass	*Deschampsia atropurpurea*	DEAT
Muhly	*Muhlenbergia richardsonis*	MURI
Needleandthread	*Stipa comata*	STCO2
Needlegrass	*Stipa* sp.	STIPA
Nevada bluegrass	*Poa nevadensis*	PONE2
Northern meadow barley	*Hordeum brachyantherum*	HOBR
One-spike oatgrass	*Danthonia unispicata*	DAUN
Oniongrass	*Melica* sp.	MELIC
Ovalhead sedge	*Carex festivella*	CAFE
Pacific fescue	*Festuca pacifica*	FEPA
Pinegrass	*Calamagrostis rubescens*	CARU
Prairie junegrass	*Koeleria cristata*	KOCR
Raynolds sedge	*Carex raynoldsii*	CARA
Ross sedge	*Carex rossii*	CARO
Rough fescue	*Festuca scabrella*	FESC
Rush	*Juncus* sp.	JUNCU
Sandberg bluegrass	*Poa sandbergii*	POSA3
Sedge	*Carex* sp.	CAREX
Sheep fescue	*Festuca ovina*	FEOV
Skyline bluegrass	*Poa epilis*	POEP
Slenderbeak sedge	*Carex athrostachya*	CAAT
Slender wheatgrass	*Agropyron trachycaulum*	AGTR

[1]After Garrison et al. (1976).

Appendix (continued)

Common name	Scientific name	Symbol[1]
Smallwing sedge	*Carex microptera*	CAMI
Smooth brome	*Bromus inermis*	BRIN
Spike rush	*Eleocharis* sp.	ELEOC
Spike trisetum	*Trisetum spicatum*	TRSP
Spreading woodrush	*Luzula divaricata*	LUDI
Subnigricans sedge	*Carex subnigncans*	CASU5
Swordleaf rush	*Juncus ensifolius*	JUEN
Threadleaf sedge	*Carex filifolia*	CAFI
Thurber needlegrass	*Stipa thurberiana*	STTH
Timothy	*Phleum pratense*	PHPR
Western needlegrass	*Stipa occidentalis*	STOC
Wheatgrass	*Agropyron* sp.	AGROP
Wheeler bluegrass	*Poa nervosa*	PONE
Winter bentgrass	*Agrostis scabra*	AGSC
	FORBS	
Alaska habenaria	*Habenaria unalascensis*	HAUN
Alpine shootingstar	*Dodecatheon alpinum*	DOAL
American bistort	*Polygonum bistortoides*	POBI
Annual agoseris	*Agoseris heterophylla*	AGHE
Arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA
Ashy penstemon	*Penstemon humilis*	PEHU
Aster	*Aster* sp.	ASTER
Autum willowweed	*Epilobium paniculatum*	EPPA
Balsamroot	*Balsamorhiza* sp.	BALSA
Beckwith violet	*Viola beckwithii*	VIBE
Bedstraw	*Galium* sp.	GALIU
Beethistle	*Eryngium articulatum*	ERAR
Bighead clover	*Trifolium macrocephalum*	TRMA
Biscuitroot	*Lomatium* sp.	LOMAT
Bloomer fleabane	*Erigeron bloomeri*	ERBL
Bog-orchid	*Habenaria* sp.	HABEN
Buckwheat	*Eriogonum caespitosum*	ERCA
Cinquefoil	*Potentilla* sp.	POTEN
Clasping pepperweed	*Lepidium perfoliatum*	LEPE
Columbia monkshood	*Aconitum columbianum*	ACCO
Combleaf	*Polyctenium fremontii*	POFR2
Common dandelion	*Taraxicum officianale*	TAOF
Crag aster	*Aster scopulorum*	ASSC
Crisped starwort	*Stellaria crispa*	STCR
Daggerpod	*Phoenicaulis cheiranthoides*	PHCH
Dandelion	*Taraxicum* sp.	TARAX
Dwarf hesperochiron	*Hesperochiron pumilis*	HEPU
Dwarf monkeyflower	*Mimulus nanus*	MINA
Elkslip marshmarigold	*Caltha leptosepala*	CALE2
False agoseris	*Microseris tmximoides*	MITR
False hellebore	*Veratrum* sp.	VERAT
Fleabane	*Erigeron* sp.	ERIGE
Gay penstemon	*Penstemon laetus*	PELA
Gray hawksbeard	*Crepis intermedia*	CRIN
Gray's biscuitroot	*Lomatium grayi*	LOGR
Halogeton	*Halogeton glomemtus*	HAGL
Hawksbeard	*Crepis* sp.	CREPI
Heartleaf arnica	***Arnica*** *cordifolia*	ARCO

[1]After Garrison et al. **(1976).**

Appendix (continued)

Common name	Scientific name	Symbol[1]
Holboell rockcress	*Ambis hoelboellii*	ARHO
Hood's phlox	*Phlox hoodii*	PHHO
Hooker balsamroot	*Balsamorhiza hookeri*	BAHO
Kellogg's knotweed	*Polygonum kelloggii*	POKE
Lambstongue groundsel	*Senecio integerrimus*	SEIN
Locoweed	*Astragalus* sp.	ASTRA
Longleaf phlox	*Phlox longifolia*	PHLO
Lousewort	*Pedicularis attollens*	PEAT
Low pussytoes	*Antennaria dimorpha*	ANDI
Lupine	*Lupinus* sp.	LUPIN
Meadowrue	*Thalictrum* sp.	THALI
Milkvetch	*Astragalus sp.*	ASTRA
Modest buttercup	*Ranunculus verecundus*	RAVE
Nevada biscuitroot	*Lomatium nevadenses*	LONE
Newberry cinquefoil	*Potentilla newberryi*	PONE3
Nineleaf biscuitroot	*Lomatium triternatum*	LOTR
Nuttall violet	*Viola nuttallii*	VINU
Oblongleaf bluebells	*Mertensia obligifolia*	MEOB
Obscure milkvetch	*Astragalus obscurus*	ASOB
Peavine	*Lathyrus* sp.	LATHY
Phlox	*Phlox sp.*	PHLOX
Pink microsteris	*Microsteris gracilis*	MIGR
Plainleaf buttercup	*Ranunculus alismaefolius*	RAAL
Prairiesmoke avens	*Geum triflorum*	GETR
Primrose monkeyflower	*Mimulus primuloides*	MIPR
Pussytoes	*Antennaria* sp.	ANTEN
Rockcress	*Arabis* sp.	ARABI
Rocky Mountain parnassia	*Parnassia fimbriata*	PAFI
Roseroot stonecrop	*Sedum roseum*	SERO
Russianthistle	*Salsola kali*	SAKA
Scouler St. Johnswort	*Hypericum scouleri*	HYSC
Short-leaved cinquefoil	*Potentilla brevifolia*	POBR
Showy downingia	*Downingia elegans*	DOEL
Sierra willowweed	*Epilobium brevistylum*	EPBR
Skyrocket gilia	*Gilia aggregata*	GIAG
Slenderbush eriogonum	*Eriogonum microthecum*	ERMI
Sorrel	*Rumex* sp.	RUMEX
Spreading phlox	*Phlox diffusa*	PHDI
Spring draba	*Draba vema*	DRVE2
Spur lupine	*Lupinus laxiflorus*	LULA2
Starved milkvetch	*Astragalus miser*	ASMI
Stenophyllus pussytoes	*Antennaria stenophylla*	ANST
Stinging nettle	*Urtica dioica*	URDI
Tapertip hawksbeard	*Crepis acuminata*	CRAC
Thistle	*Cirsium* sp.	CIRSI
Tiny mousetail	*Myosurus minimus*	MYMI2
Varileaf phacelia	*Phacelia heterophylla*	PHHE
Violet	*Viola* sp.	VIOLA
Watson willowweed	*Epilobium watsonii*	EPWA
Western hawkweed	*Hiemceum albertinum*	HIAL2
White bogorchid	*Habenaria dilatata*	HADI2
Wild buckwheat	*Eriogonum* sp.	ERIOG
Woodlandstar	*Lithophragma bulbifera*	LIBU
Woolly eriophyllum	*Eriophyllum lanatum*	ERLA
Wyeth eriogonum	*Eriogonum hemcleoides*	ERHE
Yarrow	*Achillea millefolium*	ACMI

[1]After Garrison et al. **(1976).**

WILDLIFE HABITATS IN MANAGED RANGELANDS — THE GREAT BASIN OF SOUTHEASTERN OREGON

Technical Editors

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