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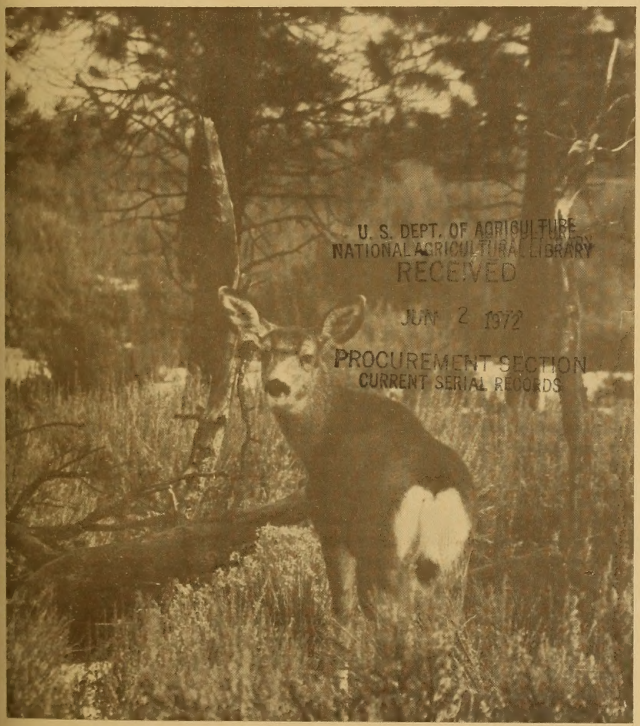

Habitat Characteristics of the Silver Lake Mule Deer Range

J. Edward Dealy

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Forest Service, U. S. Department of Agriculture
Portland, Oregon 1971

ABSTRACT

Twenty-one ecosystems of the Silver Lake mule deer range in northern Lake County, Oregon, are described by site, vegetation, and soil. Discussions are included on ecosystem interrelationships, habitat value for game, and habitat manipulation. A field key to ecosystems has been developed using vegetation characteristics easily identifiable on the ground.

Keywords: Ecosystem, habitat, mule deer, vegetation, soils, site class.

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Introduction

Mule deer *(Odocoileus hemionus hemionus)*[1] (Ingles 1965) in central Oregon are a migratory group of animals. They roam a vast mountainous summer range and crowd into a relatively small winter range when adverse climatic conditions dictate. Most of the deer ranges in central Oregon are grazed by livestock, either cattle or sheep or both together. Excessive populations of animals compete for food. Prolonged competition can produce changes in diet, nutrition, fecundity, and range conditions. To prevent or reduce this competition, a wide variety of facts must be gathered concerning the animals and their environment.

This paper presents an analysis of 21 habitats present on the Silver Lake deer range in northern Lake County, Oregon. Treatment includes analysis of site, vegetation, and soils on both the summer and transition (summer-winter range boundary) ranges and discussion of vegetation types for suitability as mule deer habitat. This descriptive work is one of the first steps in developing realistic management plans for maximum sustained and compatible mule deer-livestock production.

Information presented here is directly applicable to the Silver Lake deer herd range. Data can be used as guides for management of deer herd ranges in central and south central Oregon and elsewhere in the western United States under similar conditions.

Experience and personal judgment are critical ingredients which must be combined with the information presented here for each ecosystem. Remember, most of this area is deer summer range which, taken as a whole, is not generally a problem area for forage, though through careless disregard it could become such.

In general, suggested values and recommendations for game habitat development should be given secondary priority on high producing timber sites. However, I would expect timber specialists to be sensitive to compatible game habitat improvement suggestions. On low or marginal sites for tree growth, timber production may become secondary in management priorities.

Setting aside large summer range "scab flats" of low sagebrush for deer and antelope use may help make the difference between does being in good enough condition to carry twin fetuses through a bad winter to birth and beyond or being in poor condition and losing one or both young (Fichter 1962, Julander et al. 1961). Setting aside scattered small

[1] *Scientific and common names of animals and plants are listed in the appendix.*

meadow, spring, or aspen areas for game use may also help strengthen the general health of game populations as they prepare themselves for winter.

These suggestions are only examples of many such considerations which must be studied in relation to livestock needs and other priorities in order to maintain balance in a total management plan.

Ecological Studies Related to Central Oregon Vegetation

Daubenmire (1952) has done considerable work on forest vegetation in eastern Washington and northern Idaho. He developed a classification in which he included the following zones as those of primary importance: (1) *Pinus ponderosa*, (2) *Pseudotsuga menziesii*, (3) *Thuja plicata/Tsuga heterophylla*, and (4) *Picea engelmannii/Abies lasiocarpa*. Available soil moisture increased from (1) through (4). It was pointed out that *Populus tremuloides* came into *Pinus ponderosa* stands as a seral species where high water tables occurred.

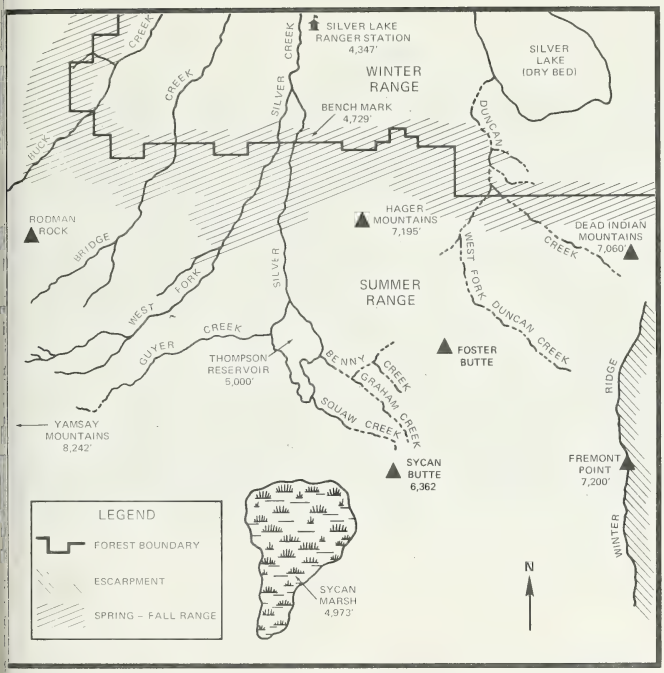
McMinn (1952), studying soil moisture in the northern Rocky Mountains, concluded that soil moisture is the most important factor influencing distribution of vegetation types.

Rummell (1951) compared two areas of *Pinus ponderosa* in central Washington. They were similar; but one had been grazed, and the other was protected by natural barriers. Density of herbaceous species in the ungrazed area was over twice that of species on the grazed site. However, pine saplings averaged 85 per acre under 4 inches d.b.h. on the ungrazed area and 3,291 per acre on the grazed site.

Dyrness (1960) studied vegetation and soil-site relationships near Silver Lake in a region of pumice soils. Six plant communities and their sites were sampled intensively in an area where basic information was lacking and where management felt a real need for understanding the productive capacity and management limitations of the resource. Of the six communities, five were dominated by *Pinus ponderosa* and one by *Abies concolor*. The dominant shrub species varied from *Purshia tridentata* under *Pinus ponderosa* in the driest of the communities to *Ceanothus velutinus* under *Abies concolor* which characterized the most moist site.

Dyrness effectively correlated serious bark beetle infestations and mistletoe occurrence with specific plant communities. He found that the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* association on Shanahan soil was accompanied by a high bark beetle hazard and *Pinus ponderosa/Ceanothus velutinus* community on the Lapine pumice soil was closely correlated with large-scale mistletoe infestations.

In describing and interpreting a seral stage of the *Abies concolor/Ceanothus velutinus* association, *Pinus ponderosa/Ceanothus velutinus*, Dyrness suggests that because the pine reaches a particularly high productivity on this site, cutting practices might well favor its maintenance for several rotations.



Map of the Silver Lake area of Oregon showing main topographic features and the division of summer, winter, and spring-fall ranges for mule deer.

Area Description

The Silver Lake deer herd range is located in northern Lake County, Oregon, and lies between Ranges 11 and 16 East, and Townships 27 and 33 South. It includes several hundred thousand acres, of which approximately one-fourth is winter range and the remainder summer range. The summer-winter range boundary (transition range) fluctuates yearly according to the depth and duration of winter snowpacks.

A major portion of the summer ranges lies within the timbered area of northern Lake County. From east to west it sweeps gently down the back

Silver Lake deer range, looking south. Mountains in the background illustrate the summer range and its topography.

of 7,000-foot Winter Ridge, an upthrust escarpment 20 miles long, to a low of 4,700 feet and then gradually climbs to 8,242-foot Yamsay Mountain 30 miles away. From north to south it follows the Winter Ridge-Yamsay Mountain trough from the timber's edge near Silver Lake south for approximately 15 miles, rising from 4,700 feet to 5,500 feet. Hager Mountain, a cone, rises to 7,000 feet out of the trough center near the north edge of the range.

Numerous seasonally ponded meadows, seasonal streams, and year-round springs are scattered throughout the area. Several year-round streams are present. Water is adequate (although probably not optimal) for big game needs throughout the summer range.

The general vegetation complex includes the forest types of *Pinus ponderosa*, *P. contorta*, *P. ponderosa-Abies concolor*, *A. concolor*, *Populus tremuloides*, and *Cercocarpus ledifolius* (Hitchcock et al. 1955), wet and dry meadows, high elevation burns grown primarily to dense *Artemisia tridentata*, and rocky *Artemisia arbuscula* flats.

A narrow transition area, where use is governed by weather, lies between the summer and winter range from approximately 4,700- to 5,000-foot elevation. During severe winters of deep snow, deer generally

move below 4,700 feet using the transition area primarily during the fall migration and again in the spring when moving back to the summer range. However, during most years the animals use it most of the winter. The vegetation complex includes the lower edge of the *Pinus ponderosa* communities, *Purshia tridentata*-bunchgrass, mixed *Artemisia tridentata-P. tridentata*, *Cercocarpus ledifolius*, *A. arbuscula*-bunchgrass, and the ecotone of *P. ponderosa-C. ledifolius-P. tridentata-Juniperus occidentalis-A. tridentata.*

The climate is typical of the intermountain West — — warm dry summers, crisp dry early falls, moderately severe winters with moderate snows generally occurring in January and February, and moderate, late spring rains. Annual precipitation at Silver Lake, in the middle of the winter range, averages 10 inches annually. Precipitation in the summer range varies from about 12 to 30 inches annually. Killing frosts may occur in any month of the year. However, they do not normally occur during July or August.

Day temperatures commonly reach 90° to 95° F. during July and August. The mean January and July temperatures at Silver Lake are approximately 28° and 64° F., respectively. Maximum and minimum temperatures have been recorded at 105° and −35° F. (U. S. Department of Agriculture 1941).

According to Knox (1968), soils in the study area include Grey-Brown Podzolic, Prairie (Brunizems), Chernozem, Chestnut, Regosol, Alluvial, and Humic Gley. Soils in the area are derived from residual parent material consisting primarily of flow basalt. There are localized areas of tuffs and tuff breccias overlying basalts in the lower elevation transition areas. Also, in the same lower areas there are localized occurrences of pumice deposits overlying basalts and tuff.

Methods

Vegetation was typed on the ground with the aid of aerial photographs. Type lines were placed as best as could be judged, in the center of ecotones. Then plots were located at random on photographs and finally on the ground. Plots were rejected if they landed in inclusions obviously not of the type, such as drainageways, another type, or in areas of geological change. These variants were accepted as small enough in area and minor enough in ecological impact to eliminate the need for sampling.

Vegetation sampling of most ecosystems included composition of all understory species from basal area cover, tree basal area, crown cover of shrubs and trees, shrub and tree density, and percent ground cover of moss, litter, rock, and bare soil. Frequency of species occurrence was recorded at each plot — — all data being used plus a careful search of the macroplot and an area within 100 feet in all directions.

Vegetation was measured by a nested plot sampling system. This system involved establishing large plots (macroplots) 100 feet long by 50 feet wide, restricted random location of four 50-foot transects within the plot, and systematic location of ten 1- by 2-foot observation plots (microplots) along each transect (Poulton and Tisdale 1961).

Basal cover for all species was estimated as a percent of the total 1- by 2-foot plot. This same information was used to calculate composition. Basal area of all trees within each 50- by 100-foot plot was taken from d.b.h. measurements. Crown cover of shrubs was estimated by using the line intercept method (Canfield 1941), and tree crown cover was estimated using the densiometer (Lemmon 1956). Crown intercept of *Cercocarpus ledifolius* was taken through an adaptation of the densiometer (Dealy 1960).

Due to time limitations, a few plant communities were sampled by a dominance rating rather than composition system for determining relative importance of various species within each vegetation layer: tree, shrub, grass, and forb. The rating consisted of five levels for each vegetation layer (Tansley and Chipp 1926) as follows:

5. **Very abundant** — dominant in its own vegetation layer.
4. **Abundant** — codominant with at least one other species in its own vegetation layer.
3. **Frequent** — common, can stand in one spot and see it wherever you turn.
2. **Occasional** — must walk around to observe it. Not readily noticeable.
1. **Rare** — must hunt through vegetation to find it.

Other vegetation, soil, and site data were taken as described for all plant communities.

Soils data were taken from pits dug next to each vegetation plot. Standard soil description procedures and nomenclature of the Soil Conservation Service Soil Survey Manual were followed (U. S. Department of Agriculture 1951). Complete profile descriptions were not taken on all communities. Some of the less important communities were sampled only for texture of the A and B horizons, solum depth, restrictive layers, drainage, surface and solum stoniness, pH, parent materials, and depth of root concentration.

The site characteristics recorded at each plot location were slope aspect, elevation, position on slope, and macrorelief. General use intensity by animals and geographical location were also recorded.

Key to Plant Communities

The Silver Lake deer's summer range ecosystems have been identified in a field key according to vegetation characteristics easily identifiable on the ground. The key is dichotomous in arrangement with ecosystems being separated first on the most broad and obvious vegetative characteristics as is necessary to separate similar ecosystems or phases within an ecosystem.

The first and most obvious separations are tree from nontree communities and shrub from nonshrub communities. The next most obvious separations are between tree species where the ecosystems exhibit single species overstories and between shrub species where there are single shrub communities. From this point, the key continues the separations through characteristics which are based primarily on plant species that should be easily identified by people working in this general area. The final confirmation of identification should be a close agreement between the keyed-out ecosystem label and the corresponding description.

There will be situations or sites which will not key out. These will include ecotones, localized and sharply divergent geological formations including most streamside areas, and a few vegetation complexes of minor extent and value. The latter could not be covered due to time and manpower limitations, but examples are *Abies concolor*, *Tsuga mertensiana*, and some *Pinus contorta* communities.

A. Communities with tree cover — Page

B. Cover dominated by broadleaf trees

C. Tree cover dominated by *Populus*

Shrub cover present, big sagebrush common to abundant —

10. *Populus tremuloides/Artemisia tridentata/Bromus carinatus* 48

Shrub cover sparse or absent —

11. *Populus tremuloides* colonies on meadows or streambanks 53

C. Tree cover dominated by *Cercocarpus*

Understory dominated by *Festuca idahoensis* —

13. *Cercocarpus ledifolius/Festuca idahoensis* 60

Understory has *Festuca idahoensis* codominant with *Agropyron spicatum*. Soil surface rocky —

12. *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum* .. 55

B. Cover dominated by coniferous trees — Page

D. Tree cover and reproduction of *Pinus ponderosa* only, or other species scarce

E. Shrub cover dominated by *Purshia tridentata*

F. *Purshia tridentata* a sparsely scattered stand, *Festuca idahoensis* the dominant understory species —

2. *Pinus ponderosa/Purshia tridentata/Festuca idahoensis: Festuca idahoensis* phase 15

F. *Purshia tridentata* common to abundant and the dominant understory species

Festuca idahoensis the dominant grass —

1. *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* 10

Carex rossii dominant —

3. *Pinus ponderosa/Purshia tridentata/Festuca idahoensis: Carex rossii* phase 19

E. Shrub cover not dominated by *Purshia tridentata*

Shrub cover dominated by *Artemisia tridentata.* Dominant grass is *Bromus carinatus* —

6. *Pinus ponderosa/Artemisia tridentata/Bromus carinatus* 30

Shrub cover dominated by *Arctostaphylos patula* or codominant with *Purshia tridentata* —

4. *Pinus ponderosa/Arctostaphylos patula/Festuca idahoensis* 23

D. Tree cover and reproduction not of "*Pinus ponderosa* only, or other species scarce"

G. Tree cover dominated by *Pinus contorta*

Festuca idahoensis common to abundant —

8. *Pinus contorta/Festuca idahoensis* 40

Festuca idahoensis absent to rare —

9. *Pinus contorta/Danthonia californica* 45

G. Tree cover mixed species

Pinus ponderosa and *Abies concolor* mixed overstory, sometimes *A. concolor* mostly as abundant to dominant reproduction under *P. ponderosa* —

7. *Pinus ponderosa-Abies concolor/Festuca idahoensis* 35

Pinus ponderosa and *Cercocarpus ledifolius* mixed —

5. *Pinus ponderosa-Cercocarpus ledifolius/Festuca idahoensis* 28

Ecosystems

1 *Pinus ponderosa / Purshia tridentata / Festuca idahoensis* Ecosystem

Physical Description

Site. — This is the largest single ecosystem on the summer range. It is characterized by gentle to rolling topography at elevations from 4,700 to 6,500 feet. Slopes range from 0 to 10 percent, and all aspects are represented.

Vegetation. — It is characterized by an overstory of *Pinus ponderosa* with reproduction occurring in patches. Basal area averages 166 square feet per acre, including reproduction above 5.5 feet, and average density of stems under 10-inch d.b.h. is 2,932 per acre.

The shrub layer is dominated by *Purshia tridentata* with 16-percent composition and 100-percent frequency of occurrence. *Chrysothamnus viscidiflorus*, *Haplopappus bloomeri*, and *Mahonia repens* also occur commonly.

Grasses are dominated by *Festuca idahoensis*, with *Carex rossii* and *Stipa occidentalis* major components of this layer. These species and *Sitanion hystrix* occurred on every macroplot. The only forbs occurring with 100-percent frequency were *Achillea millefolium*, *Fragaria virginiana*, and *Microsteris gracilis*. In the table are average vegetative characteristics for all species. *Abies concolor* moves in at high elevations and on north-facing slopes. *Pinus contorta* becomes established because of disturbance or other localized site influences, *Populus tremuloides* and meadows appear in moist sites, and *Artemisia arbuscula* appears on rocky, shallow-soil openings. Inclusions of *Cercocarpus ledifolius* and *Juniperus occidentalis* occur on shallow rocky soils and at the dry edge of the type.

Soil. — The soil occurring in this ecosystem has been tentatively classified as a Tournquist loam.[2] It commonly contains basalt stones and boulders throughout the solum, which averages 30 inches in depth with A

[2] *C. T. Youngberg, unpublished field notes. Soils Dep., Oreg. State Univ., Corvallis.*

and B horizons averaging 10 and 20 inches, respectively. Drainage is good and roots are abundant to 12 inches and common to 20 inches.

Soil texture varies from loam in the A1 to light clay loam in the A3 and from loam to clay in the B horizon. The pH in the A1 and A3 horizons averages 5.9 and 6.1, respectively.

Discussion

Ecosystem. — Evidence indicates that this ecosystem is in a high good to excellent condition and can be considered relatively stable. *Pinus ponderosa*, the only major overstory species, occurs in all age classes, and there is no indication of other species moving into the stand.

The composition levels at which *Purshia tridentata* and *Festuca idahoensis* occur have very likely been influenced by deer and livestock use, both cattle and sheep. *Festuca idahoensis* in this ecosystem is the least preferred of the forage species we normally consider important. Conversely, *P. tridentata* is probably the species most preferred by deer, sheep, and cattle. It is suspected that percent composition of *P. tridentata* is low due to the long history of heavy use in combination with soil moisture stresses in a site apparently fully occupied.

In this ecosystem, the ability of *Purshia tridentata* to recover after disturbance is open to question. Since *P. tridentata* is relatively fire intolerant, it is possible that before the advent of effective fire control, the understory physiognomy was *Festuca idahoensis* (such as in the fescue phase of this ecosystem). This might have been considered a "fire climax" or something similar in the past but might now more reasonably be thought of as a successional stage which, without further disturbance, can be expected to progress toward the "*P. tridentata-F. idahoensis*" physiognomy. The premise that fire control allowed *P. tridentata* to increase in this ecosystem, in the face of an *F. idahoensis* dominated understory, must necessarily include the idea that *P. tridentata* can compete successfully with *F. idahoensis*. If the premise is true one can conclude, perhaps with some danger, that natural *P. tridentata* reestablishment after logging is to be expected. Even though this conclusion is probably valid, the long period of time evolved in the reestablishment would be unacceptable to land and game managers. This process will most likely involve an increase of *Chrysothamnus viscidiflorus* and *Haplopappus bloomeri* before *P. tridentata* can reestablish itself.

Habitat value. — Food and cover value is considered high. The *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* association is the single most important plant community for deer on the summer range. In addition to being the largest and one of the most widespread communities, it is also a high forage producer. Forbs and grasses provide a moderate variety of early season food, and *P. tridentata* provides the bulk of summer and fall forage. *P. ponderosa* reproduction of 2,932 stems per acre commonly occurs in a clumped pattern and provides good hiding cover and fair protection from heat and insects.

Average site-vegetation characteristics of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem[1]

Number of plots: 8 Condition class: high good to excellent

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 1 percent surface area	--	100
Rock, 3 percent surface area	--	100
Litter, 94 percent surface area	--	100
Moss, 0.5 percent surface area	--	100
Total vegetation, 1.5 percent surface area	--	100
Purshia tridentata, 7 percent crown cover	16	100
Chrysothamnus viscidiflorus	.7	63
Mahonia repens	.4	25
Haplopappus bloomeri	.1	25
Ceanothus prostratus	T	13
Festuca idahoensis	49	100
Carex rossii	13	100
Stipa occidentalis	5	100
Sitanion hystrix	4	100
Poa nervosa	4	100
Poa sandbergii	.4	25
Koeleria cristata	T	13
Achillea millefolium	2	100
Fragaria virginiana	1	100
Microsteris gracilis	1	100
Hieracium cynoglossoides	.7	75
Lupinus caudatus	.6	75
Lomatium triternatum	.5	50
Antennaria geyeri	.5	37
Balsamorhiza sagittata	.4	63
Viola purpurea	.1	37
Paeonia brownii	.1	25
Arnica cordifolia	.1	25
Senecio integerrimus	T	13

(— Continued)

Number of plots: 8 Condition class: high good to excellent

Site and vegetation	Understory composition	Frequency
	Percent	
Castilleja sp.	T	13
Sidalcea oregana	T	13
Collinsia parviflora[2]	.2	25
Cryptantha ambigua[2]	.2	13

T = trace.

[1] Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	166	2,932	100	60
Cercocarpus ledifolius	T	9	50	T
Juniperus occidentalis	T	3	50	T

[2] Annuals.

Habitat manipulation. — Overstory removal on a selective basis with minimal disturbance of *Purshia tridentata* would not materially reduce the protection values and would probably increase forage values only in the form of early season grasses and forbs. *P. tridentata* would be expected to show a short- rather than long-term increase in production. This is based on two reasons. First, game and livestock demands on this shrub come during the growing season, demands which take part of the reserve strength which might otherwise be used for crown expansion. Second, the remaining overstory and pine reproduction will expand to reoccupy the site and reestablish the light and soil moisture competition present before logging. Any management practice or treatment which will favor use of *Festuca idahoensis* is desirable in this association, and any rehabilitation after fire or logging should favor *P. tridentata* unless a way is found to use *F. idahoensis* properly.

As was mentioned under ecosystem discussion, natural reestablishment of *Purshia tridentata* after logging is expected to be slow and therefore unacceptable on areas important for deer or livestock. After severe understory disturbances, rehabilitation of *P. tridentata* will require some type of site preparation.

A general view of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem. Note the scattered clumping of *P. ponderosa* reproduction.

A closeup view of the *P. ponderosa/P. tridentata/F. idahoensis* ecosystem.

2 *Pinus ponderosa / Purshia tridentata / Festuca idahoensis* Ecosystem: *Festuca idahoensis* Phase

Physical Description

Site. — This ecosystem has the same gross site characteristics as the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem which we will name the parent ecosystem.

Vegetation. — The vegetation is similar to that in the parent ecosystem, differing primarily in amounts of *Purshia tridentata* and *Festuca idahoensis*. The understory aspect is grass rather than shrub. *Pinus ponderosa* has a crown cover of 53 percent, compared with 60 percent in the parent. This species has 100-percent frequency of occurrence. *P. tridentata* has a composition of 0.9 percent and a frequency of 100 percent. The only other shrub occurring on sample plots was *Haplopappus bloomeri*. *F. idahoensis* is the dominant grass, having 62-percent composition and 100-percent frequency. *Carex rossii*, *Stipa occidentalis*, *Sitanion hystrix*, *Poa nervosa*, and *Bromus carinatus* are all common components of the understory.

There are four forbs which occur with 100-percent frequency, *Lupinus caudatus*, *Microsteris gracilis*, *Fragaria virginiana*, and *Hieracium cynoglossoides*.

Soil. — This is a well-drained, moderately deep loam. It varies from a loam in the A horizon to clay loam in the B2. The A horizon averages 10 inches deep and the B averages 24 inches. The $B2D_r$ horizon is a clay mixed with weathered basalt fragments. The zone of root concentration is 0 to 19 inches. Large basalt boulders may be present in the solum and may be visible on the surface.

Discussion

Ecosystem. — There is no readily apparent answer to the scarcity of *Purshia tridentata* in this phase of the community. The soil moisture-holding capacity appears, due to a textural difference, to be slightly less here than in the parent ecosystem. Here the A horizon is a loam and the B

Average site-vegetation characteristics for the *Festuca idahoensis* phase of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem[1]

Number of plots: 6 Condition class: poor

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 0.2 percent surface area	--	100
Rock, 3.6 percent surface area	--	100
Litter, 94.9 percent surface area	--	100
Moss, 0.1 percent surface area	--	83
Total vegetation, 1.2 percent surface area	--	100
Purshia tridentata, 2 percent crown cover	.9	100
Haplopappus bloomeri	.1	17
Festuca idahoensis	62	100
Carex rossii	17	100
Stipa occidentalis	5	100
Sitanion hystrix	2	100
Poa nervosa	1	100
Bromus carinatus	.1	33
Lupinus caudatus	4	100
Microsteris gracilis	4	100
Fragaria virginiana	1	100
Achillea millefolium	.8	67
Hieraceum cynoglossoides	.7	100
Silene sp.	.7	83
Balsamorhiza sagittata	.3	17
Antennaria geyeri	.1	33

[1] Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	180	1,940	100	53

horizon ranges to clay loam. In the parent ecosystem the A ranges from loam to clay loam and to clay in the B. Less available moisture is also indicated by the reduction of total vegetation basal area from 1.5 percent in the parent ecosystem to 1.2 percent in this phase. Tree and shrub crown cover reduction followed the same trend, varying respectively from 60 and 7 percent for the parent to 53 and 2 percent in the phase. The trend was followed in percent composition. Respective shrub composition percentages for the parent and phase were 16 and 1. Forbs showed no change in composition. Grass composition percentages showed a reverse trend, 75 percent for the parent and 87 percent for the phase.

Although there are no obvious indications that animal use has caused the reduction in shrub cover and increase in grass, it cannot be discounted without more intensive study. Fire may have produced the grass physiognomy. This is extremely difficult to determine since fire scars are common in both this and the parent ecosystem. In any case, rapid natural improvement of the shrub stand will be doubtful.

Habitat value. — Food and cover value is considered poor. In comparing this phase with the parent ecosystem, the two principal differences are effective hiding cover and forage production. Hiding cover is thinner here as indicated by 1,940 *Pinus ponderosa* seedling and sapling stems per acre compared with 2,932 for the parent ecosystem. Forb production is approximately the same, but *Purshia tridentata* production is reduced more than 70 percent from that indicated in the parent ecosystem. Production of grass and grasslike species increased in this phase, but the bulk of it, *Festuca idahoensis* and *Carex rossii*, has little importance as deer forage except as new green growth in late spring and early fall.

Habitat manipulation. — See parent ecosystem. If understory reseeding is desired and if the overstory cut is sufficient to make expansion of the understory feasible, then *P. tridentata* should be considered the priority species to be reseeded for wildlife.

General view of the *Festuca* phase of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem. Note the paucity of *P. tridentata.*

Closeup of the *Festuca* phase of the *P. ponderosa/P. tridentata/F. idahoensis* ecosystem.

3 *Pinus ponderosa / Purshia tridentata / Festuca idahoensis* Ecosystem: *Carex rossii* Phase

Physical Description

Site. — This ecosystem has the same gross site characteristics as the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem which will be referred to as the parent ecosystem.

Vegetation. — The vegetation differs from that of the parent primarily by exhibiting only half as many *P. ponderosa* stems per acre, less crown cover and basal area of the same species, more *P. tridentata*, and a decided dominance of *Carex rossii* in the grass-forb layer.

The tall shrub *Arctostaphylos patula* is present in trace amounts here but is absent in the parent, and the mat-forming shrub *Ceanothus prostratus* is present as a trace in the parent but absent here. Changes in the forb complement were primarily in composition with one exception, the addition of the perennial *Apocynum androsaemifolium* in this phase.

Soil. — The soil in this phase, like that in the parent, is tentatively classified as a Tournquist loam. However, it is shallow (22 inches) compared with the parent (30 inches). Textural differences of the B horizon are small, tending to be heavier in the phase and with more stone and gravels throughout the profile than that of the parent. A representative profile is:

01 1-0. Pine litter.

A1 0-2 inches. Brown (7.5 YR 5/4) dry, dark reddish brown (5 YR 3/2) moist; loam; weak, very fine granular; loose; very friable, slightly sticky, slightly plastic; pH 6.3; roots abundant.

A3 2-11 inches. Dark reddish brown (5 YR 5/4) dry, dark reddish brown (5 YR 3/4) moist; light clay loam; weak, fine granular; slightly hard; friable, slightly sticky, slightly plastic; pH 6.3; roots abundant.

B1 11-15 inches. Dark reddish brown (5 YR 3.4/4) moist; clay loam; weak, fine subangular blocky; firm, sticky, plastic with thin patchy clay flows on the ped surfaces; pH 6.3; roots common.

B3 15-22 inches. Dark reddish brown (4 YR 3/4) moist; clay; moderate fine subangular blocky; extremely hard; extremely firm, very

sticky, very plastic with thick continuous clay flows on the ped surfaces; pH 6.2; roots few.

CD2 22-24 inches +. Weathered basalt. There are numerous basalt stones throughout the full solum.

Discussion

Ecosystem. — This appears to be a variant of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem due to subtle environmental changes, probably moisture, primarily. There is evidence of past fires in this stand of vegetation. Charred remains of trees and a partial stand of mature timber with a patchy understory of sapling and pole size timber indicate disturbance.

Habitat value. — Value is moderate for both forage and cover. Although density of quality browse (*Purshia tridentata*) is very high, acreage is small. Cover is below average for *Pinus ponderosa* with stems per acre being 1,435 here, compared with 2,932 in the parent, and 1,940 in the *Festuca* phase.

Habitat manipulation. — Suggestions for habitat manipulation and rehabilitation follow those for the parent ecosystem. However, the density of *Purshia tridentata* is so great (3,834 stems per acre) that with some care in logging, the residual stand may be adequate for deer and livestock requirements.

The *Carex rossii* phase of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem has a denser stand of *P. tridentata* than any other ecosystem discussed.

Pinus ponderosa/Purshia tridentata/Festuca idahoensis ecosystem; *Carex rossii phase*[1]

Number of plots: 6 **Condition class: good**

Site and vegetation	Understory composition	Frequency
	- - - - - - - - *Percent* - - - - - - - -	
Bare soil, 4.2 percent surface area	--	100
Rock, 1.4 percent surface area	--	100
Litter, 93 percent surface area	--	100
Moss, 0.2 percent surface area	--	67
Total vegetation, 1.2 percent surface area	--	100
Purshia tridentata, 11 percent crown cover; 3,834 stems per acre	37	100
Mahonia repens, 108 stems per acre	.1	33
Chrysothamnus viscidiflorus, 9 stems per acre	.1	17
Haplopappus bloomeri, 18 stems per acre	T	50
Arctostaphylos patula, 38 stems per acre	T	33
Carex rossii	46	100
Stipa occidentalis	8	100
Festuca idahoensis	7	100
Sitanion hystrix	4	100
Poa nervosa	3	100
Koeleria cristata	T	17
Achillea millefolium	2	100
Castilleja sp.	.6	50
Microsteris gracilis	.4	83
Senecio integerrimus	.4	83
Viola purpurea	.4	67
Balsamorhiza sagittata	.4	50
Fragaria virginiana	.3	83
Lomatium triternatum	.3	50
Lupinus caudatus	.1	83
Hieracium cynoglossoides	.1	50
Antennaria geyeri	.1	33
Arnica cordifolia	.1	33

(— Continued)

Number of plots: 6 Condition class: good

Site and vegetation	Understory composition	Frequency
	Percent	
Apocynum androsaemifolium	.1	17
Pterospora andromeda	T	17
Sidalcea oregana	T	17
Cryptantha ambigua[2]	1	100
Collomia tenella[2]	1	50
Collinsia parviflora[2]	.3	100
Lithospermum sp.[2]	.3	17
Gayophytum nutallii[2]	.1	83

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	120	1,435	100	45
Juniperus occidentalis	.3	11	100	T
Cercocarpus ledifolius	1	9	50	.2
Abies concolor	T	1	17	T

[2]Annuals.

4 *Pinus ponderosa / Arctostaphylos patula / Festuca idahoensis* Ecosystem

Physical Description

Site. — This ecosystem occupies approximately 10,000 acres within the study area, primarily on the slopes of 7,000-foot Hager Mountain but with a small amount occurring on Dead Indian Mountain which is near the north end of Winter Ridge. The typical ecosystem occurs at elevations from 4,900 to 6,500 feet and on slopes from 5 to 25 percent. At the higher elevations and steep slopes it occurs on northwest to east aspects, whereas it may be found on others at lower elevations and on moderate slopes.

Vegetation. — Dominant species which typify this ecosystem are *Pinus ponderosa*, *Arctostaphylos patula*, and *Festuca idahoensis*. In some areas *Ceanothus velutinus* becomes an important shrub component. In the tree layer, *Abies concolor* varies from a codominant position with *P. ponderosa* to a minor component.

Basal area of all vegetation averages 1.2 percent for the ecosystem. Grasses make up a much smaller part (34 percent) of the composition here than in any other ecosystem. Due to a small sample size, data in the table should be used cautiously.

Soil. — The soil is a well-drained loam varying from 25 to 30 inches in depth with an A horizon averaging 11 inches and a B horizon averaging 15 inches. Texture is loam for the A horizon, and the B horizon ranges from silty clay loam to clay loam. The pH ranges from 5.0 to 6.0 in the A horizon and from 5.5 to 6.0 in the B. Root concentration is in the upper 14 inches. Percentage of rock on the solum surface and in the solum averages less than 5 percent. Litter cover and bare ground average 95 and 3 percent, respectively.

Discussion

Ecosystem. — The occurrence of *Abies concolor* in the *Pinus ponderosa* stand identifies this community as a successional stage of the *P. ponderosa-A. concolor/Festuca idahoensis* ecosystem. Another indication

Average vegetation-site characteristics of the *Pinus ponderosa/Arctostaphylos patula/Festuca idahoensis* ecosystem[1]

Number of plots: 3 Condition class: high good

Site and vegetation	Dominance rating	Understory composition	Frequency
			Percent
Bare soil, 3 percent surface area	--	--	100
Rock, 0.1 percent surface area	--	--	100
Litter, 95.6 percent surface area	--	--	100
Moss, 0.1 percent surface area	--	--	100
Total vegetation, 1.2 percent surface area	--	--	100
Arctostaphylos patula, 10 percent crown cover	5	22	100
Ceanothus prostratus, 8 percent crown cover	3	13	66
Haplopappus bloomeri	3	.7	100
Purshia tridentata	3	T	100
Ceanothus velutinus, 0.3 percent crown cover	2	T	66
Amelanchier alnifolia	1	T	33
Chimaphila umbellata	1	T	33
Symphoricarpos albus	1	T	33
Festuca idahoensis	5	22	100
Sitanion hystrix	3	10	100
Poa nervosa	2	1	66
Carex rossii	3	.9	100
Stipa occidentalis	2	T	100
Balsamorhiza sagittata	3	11	66
Hieracium cynoglossoides	4	8	100

(— Continued)

Number of plots: 3 Condition class: high good

Site and vegetation	Dominance rating	Understory composition	Frequency
		- - - - - - - - *Percent* - - - - - -	
Achillea millefolium	3	4	66
Fragaria virginiana	4	2	100
Castilleja sp.	3	1	66
Eriophyllum lanatum	3	.9	100
Apocynum androsaemifolium	3	.9	66
Lupinus sp.	3	.9	66
Agoseris sp.	2	T	66
Anaphalis margaritacea	1	T	33
Delphinium sp.	1	T	33
Lilium colombianum	1	T	33
Pterospora andromeda	1	T	33
Sidalcea oregana	1	T	33

T = trace.

[1] Averages for trees are:

	Dominance rating	*Basal area in square feet per acre*	*Stems per acre < 10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	5	157	917	100	48
Abies concolor	3	2	69	100	2
Cercocarpus ledifolius	3	1	78	66	T
Pinus contorta	2	T	T	33	T
Juniperus occidentalis	1	T	T	33	T
Prunus emarginata	1	T	T	33	T

Pinus ponderosa/Arctostaphylos patula/Festuca idahoensis **ecosystem.**

of their relationship is the occurrence in the parent ecosystem of dead remnants of *Arctostaphylos patula* which were crowded out by dense patches of tree reproduction.

This successional community varies widely in both species and composition; particularly noticeable is the variation in shrubs and forbs.

Habitat value. — This ecosystem is of moderate value as deer habitat. It provides only a small portion of the summer deer range because of its restricted location and limited acreage. Total summer forage is not so great as in the habitats where *Purshia tridentata* is more prominent. However, forbs comprise a greater proportion of the forage here than in the *Pinus ponderosa/P. tridentata/Festuca idahoensis* association.

Hiding cover is high due to the patchy but dense *Abies concolor* and *Pinus ponderosa* reproduction.

Habitat manipulation. — Selective logging would probably produce a

Ground cover closeup of the *P. ponderosa/A. patula/F. idahoensis* ecosystem.

temporary increase in herbaceous forage, but the long-range value would be small.

Logging with severe site disturbance would precipitate a substantial increase in most understory species, probably with a resultant increase in deer concentrations. We might expect *P. tridentata* to suffer in relation to other shrubs. Where *Festuca idahoensis* is dominant we can expect it to hold its own in relation to *Carex*, *Stipa*, and *Sitanion*. Where other species are codominant, it will probably be outproduced. It is doubtful that pine plantings or seedings would be seriously disturbed in this situation as the summer range is not normally the range of short food supply. However, if animal damage did occur, then consideration should be given to large clearcuts in order to more easily absorb the deer numbers or to a selective cutting with reliance on natural regeneration and a less attractive situation for deer concentrations.

5 *Pinus ponderosa-Cercocarpus ledifolius / Festuca idahoensis* Ecosystem

This is an ecosystem which may occur anywhere in the drier portions of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem. Soil is normally a shallow phase of that under the adjacent *P. ponderosa/ Purshia tridentata/Festuca idahoensis* ecosystem. In this study area, it would be the Tournquist loam; although near the lower edge of the forest, it may occur on other soils derived from pumice and volcanic ash.

Pinus ponderosa is dominant, with *Cercocarpus ledifolius* an important but secondary species. *Juniperus occidentalis*, *Purshia tridentata*, *Artemisia tridentata*, and *Chrysothamnus viscidiflorus* are minor components of the stand. *Festuca idahoensis* is the strong dominant in the grass-forb layer with *Carex rossii*, *Sitanion hystrix*, *Agropyron spicatum*, and *Stipa occidentalis* other less important species. Commonly occurring forbs are *Achillea millefolium* and *Eriophyllum lanatum*.

Habitat value is low due to limited acreage and low browse availability. Primary value of the ecosystem is cover.

Pinus ponderosa-Cercocarpus ledifolius/Festuca idahoensis ecosystem. Note the paucity of shrubs.

A close view of the ground cover in the *P. ponderosa-C. ledifolius/F. idahoensis* ecosystem illustrating *F. idahoensis* dominance.

6 Pinus ponderosa / Artemisia tridentata / Bromus carinatus Ecosystem

Physical Description

Site. — This ecosystem occupies several thousand acres at elevations between 6,000 and 7,200 feet with a slight westerly aspect. This is an area where the runoff from heavy snowpacks appears to produce numerous intermittent drainageways or seasonal streambeds.

Vegetation. — *Pinus ponderosa* dominates the overstory and is mixed with very small numbers of *Pinus contorta* and *Abies concolor*. Tree reproduction, although sparse, includes all three species with *P. ponderosa* outnumbering the others tenfold. The shrub layer is characterized by a dominant stand of *Artemisia tridentata* with *Symphoricarpos albus* and *Eriogonum microthecum* commonly distributed throughout.

Bromus carinatus and *Poa nervosa* are about equally abundant and together account for about 31 percent of the total composition. Lesser amounts of *Sitanion hystrix*, *Stipa occidentalis*, and *Carex rossii* complete the grass and sedge component of this ecosystem.

Forbs are less prominent than grasses. About 15 species combine to make 10 percent or less of the vegetal composition. *Collinsia parviflora*, an annual, makes up nearly half of the forb component, and the other half is composed primarily of *Achillea millefolium*, *Lathyrus* sp., and *Fragaria virginiana*.

Soil. — The soil is a moderately deep, well-drained loam with gravels common throughout the solum. Depth averages 24 inches and roots are concentrated in the upper 8 inches but common to 20 inches. Stones account for 1 percent of the soil surface and vary from less than 5 percent to 60 percent of the solum volume.

The A horizon has a loam texture, a pH of 5.8, and averages 12 inches in depth. The B horizon is a clay loam, 12 inches deep, and the pH is 5.8 to 6.0. The typical profile description is as follows:

A11 0-3 inches. Dark brown (7.5 YR 3/2)[3]; brown (7.3 YR 4/4 crushed) loam; dark reddish brown (5 YR 3/2) moist; loam; weak

[3] *In this profile, colors will be dry unless otherwise noted.*

fine granular structure; very friable, slightly sticky and slightly plastic; abundant very fine and fine roots; slightly acid reaction (pH 5.8); abrupt, smooth boundary. (2 to 4 inches thick.)

A12 3-7 inches. Dark brown (7.5 YR 3/2); brown (7.5 YR 4/4 crushed) loam; dark reddish brown (5 YR 2/2) moist; loam; weak fine subangular blocky structure; very friable; slightly sticky, slightly plastic; common very fine, fine and medium roots; slightly acid reaction (pH 5.8); clear, smooth boundary. (3 to 5 inches thick.)

A3 7-12 inches. Brown (7.5 YR 4/2) dark reddish brown (5 YR 3/3) moist; loam; strong, medium subangular blocky structure; firm; sticky, plastic; common, very fine, fine, and medium roots; slightly acid reaction (pH 5.8); abrupt, smooth boundary. (4 to 6 inches thick.)

B1 12-18 inches. Brown (7.5 YR 4/4) dark reddish brown (5 YR 2/2) moist; clay loam; strong, medium subangular blocky structure; firm; sticky, plastic; common fine and medium roots; slightly acid reaction (pH 5.8); clear, smooth boundary. (5 to 7 inches thick.)

B2 18-24 inches. Dark brown (7.5 YR 3/2) moist; pinkish grey (7.5 YR 7/2) on dry surfaces broken across peds; thin clay films on ped surfaces; clay; strong, medium angular blocky structure; extremely firm; very sticky, very plastic; uncommon fine, medium and large roots; neutral reation (pH 6.0); clear, smooth boundary.

C 24-28 inches +. Light brown (7.5 YR 6/4); strong brown (7.5 YR 5/6) moist; abundant partly decomposed igneous materials; few medium roots.

Permeability is estimated as moderate and runoff as slow to medium. Erosion hazard is low to medium. Effective rooting depth includes the full horizon under natural vegetation.

Discussion

Ecosystem. — We think of *Artemisia tridentata* as occurring primarily in the low rainfall, high desert areas rather than the high elevation, high precipitation area of this ecosystem. However, *A. tridentata* is the dominant shrub in the general area of upper Winter Ridge. This ecosystem seems to be a relatively stable one. Reproduction varies from pure *Pinus ponderosa* to a mixture of *P. ponderosa*, *P. contorta*, and very sparse *Abies concolor*. Ecotones occur between this plant community and *A. concolor*, *P. contorta*, *Populus tremuloides*, and *Artemisia arbuscula* in the same general elevation range, and *P. ponderosa/Purshia tridentata/Festuca idahoensis* community at the lower elevation perimeter.

Habitat value. — Value is moderate to high for deer and livestock due to the wide variety of summer forbs which are available. Tree reproduction is very sparse and provides little protective cover.

Habitat manipulation. — Clearcutting does not seem desirable for this ecosystem. Observations in the general area indicate that fire results in a successional stage of dense *Artemisia tridentata* and forbs, making success-

ful reforestation difficult. Reforestation should always be accomplished as rapidly as possible after a burn. In addition, following burns or selective logging, consideration should be given to seeding forbs, native and introduced, for game and livestock use rather than grass and browse. Forbs are probably better competitors than browse with the vigorous and dense *A. tridentata* stands observable on all burns in the area and may also be more desirable as summer forage.

Average vegetation-site characteristics of the *Pinus ponderosa/Artemisia tridentata/Bromus carinatus* ecosystem[1]

Number of plots: 5 **Condition class: good**

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 14 percent surface area	--	100
Rock, 1 percent surface area	--	80
Litter, 83 percent surface area	--	100
Moss, zero percent surface area	--	0
Total vegetation, 2 percent surface area	--	100
Artemisia tridentata	45	100
Eriogonum microthecum	2	60
Symphoricarpos albus	1	80
Ribes cereum	.1	20
Bromus carinatus	17	100
Poa nervosa	14	80
Sitanion hystrix	6	100
Stipa occidentalis	1	80
Carex rossii	1	60
Achillea millefolium	2	80
Lathyrus sp.	1	80

(— Continued)

Number of Plots: 5 **Condition class: good**

Site and vegetation	Understory composition	Frequency
		Percent
Fragaria virginiana	1	40
Aster sp.	.6	40
Lupinus sp.	.6	40
Hieraceum cynoglossoides	.1	60
Agoseris sp.	.1	20
Arnica cordifolia	.1	20
Balsamorhiza sagittata	.1	20
Eriophyllum lanatum	.1	20
Penstemon sp.	.1	20
Sidalcea oregana	.1	20
Silene sp.	T	20
Collinsia parviflora[2]	5	100
Polygonum douglasii[2]	.6	60
Collomia grandiflora[2]	.1	40

T = trace.

[1] Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	139	97	100	47
Pinus contorta	2	10	60	T
Abies concolor	T	4	20	T
Juniperus occidentalis	T	T	20	T

[2] Annuals.

Dense *Artemisia tridentata* is serious competition to other species of the open canopied *Pinus ponderosa/A. tridentata/Bromus carinatus* ecosystem.

Grasses are well used by cattle in the *P. ponderosa/A. tridentata/B. carinatus* ecosystem.

7 *Pinus ponderosa-Abies concolor / Festuca idahoensis* Ecosystem

Physical Description

Site. — This ecosystem ranges in elevation from approximately 5,000 to 7,000 feet and includes moderate slopes of a northerly aspect averaging 7 percent. This includes the upper three-quarters of the *Pinus ponderosa* communities where slope aspect and/or elevation provide conditions which are suitable.

Vegetation. — Overstory is a mixture of *Pinus ponderosa* and *Abies concolor* in varying proportions but is generally dominated by mature pine. *A. concolor* dominates tree reproduction on all plots sampled, and *Pinus contorta* occurs on about 25 percent of the plots.

The shrub layer, which is characterized by *Mahonia repens* and *Purshia tridentata*, is a minor component from the standpoint of composition; however, frequencies of both these species are above 50 percent.

Principal forbs (100-percent frequency) are *Hieracium cynoglossoides*, *Fragaria virginiana*, and *Arnica cordifolia*.

Grasses and sedges are second only to trees in basal area composition, with *Festuca idahoensis* dominant. Other species that occurred with 100-percent frequency are *Carex rossii*, *Stipa occidentalis*, *Sitanion hystrix*, and *Poa nervosa*.

Soil. — The soil is a Tournquist loam (tentative) which is over 30 inches deep. The A1 of 2 inches and A3 of 7 inches are dark reddish brown loams, the B1 of 8 inches is a dark red gritty heavy loam, the B21 of 9 inches is a dark clay loam, and the B22 of 4 inches is a dark red stony clay. The B31, beginning at 30 inches, contains well-weathered basalt fragments.

This is a well-drained soil with roots concentrated in the upper 17 inches and common to 26 inches. Surface rock makes up only one-half of 1 percent of the soil surface area and less than 5 percent of the solum volume. Permeability is estimated as good and runoff is slow. Erosion hazard is low. Effective rooting depth is the full horizon under natural vegetation.

Average vegetation-site characteristics of the *Pinus ponderosa-Abies concolor/Festuca idahoensis* ecosystem[1]

Number of plots: 7 Condition class: high good

Site and vegetation	Understory composition	Frequency
		- - - - - - - - *Percent* - - - - - - - -
Bare soil, 1.7 percent surface area	--	100
Rock, 0.3 percent surface area	--	100
Litter, 96.4 percent surface area	--	100
Moss, 0.1 percent surface area	--	100
Total vegetation, 1.5 percent surface area	--	100
Mahonia repens	2	57
Purshia tridentata	1	86
Arctostaphylos patula	.3	29
Festuca idahoensis	39	100
Carex rossii	21	100
Stipa occidentalis	6	100
Poa nervosa	4	100
Sitanion hystrix	4	100
Bromus carinatus	1	43
Danthonia californica	.6	14
Fragaria virginiana	4	100
Arnica cordifolia	4	100
Hieraceum cynoglossoides	1	100
Achillea millefolium	1	71
Lupinus caudatus	1	71
Paeonia brownii	1	71

(— Continued)

Number of plots: 7 **Condition class: high good**

Site and vegetation	Understory composition	Frequency
		Percent
Senecio integerrimus	1	71
Sidalcea oregana	1	57
Lomatium triternatum	.8	29
Microsteris gracilis	.8	29
Phacelia sp.	.8	29
Balsamorhiza sagittata	.7	43
Antennaria geyeri	.4	14
Collinsia parviflora[2]	2	57
Cryptantha ambigua[2]	.8	43
Epilobium minutum[2]	.4	43
Lithospermum sp.[2]	.4	14

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Abies concolor	54	2,941	100	
Pinus ponderosa	151	458	100	66
Pinus contorta	3	130	29	
Juniperus occidentalis	T	T	14	T

[2]Annuals.

Discussion

Ecosystem. — The dominance of *Abies concolor* reproduction in the understory of this ecosystem indicates the future dominance of the species in the mature stand, assuming no major disturbance. Past management practices have favored *Pinus ponderosa* dominance by selective logging of the *A. concolor* whenever feasible.

This ecosystem illustrates clearly the influence of moisture and temperature changes on vegetation. Subtle changes of elevation, aspect, and slope result in obvious changes in composition of conifer regeneration throughout the study area. Wherever these influences produce better moisture and temperature conditions, the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* community gives way to the mixed conifer of the one under discussion. *P. tridentata* decreases, *Mahonia repens* becomes more prominent, and forbs change both in species and in composition.

Habitat value. — Value is considered high, primarily due to the excellent protective cover and the summer forage supplied by forbs. This

Pinus ponderosa-Abies concolor/Festuca idahoensis **ecosystem. Note the dense conifer reproduction, primarily of** *A. concolor.*

ecosystem exhibits the highest density in conifer stems per acre under 10 inches d.b.h. of any described in this study, amounting to 3,530. Forage supplied by forbs, although not significantly greater here than in other ecosystems, is palatable over a longer period of time because of the cooler temperatures and higher moisture conditions prevailing on these sites.

Habitat manipulation. — After logging or burning, we can expect an increase in *Arctostaphylos patula.* In rehabilitating these sites, there is a great opportunity for experimentation with legumes and other forbs. It may be desirable to convert the native forb components, some of which are used very little if any, to introduced species both suitable to the site and highly palatable to deer. Additional benefits that might accrue from forb development — as compared with shrub development — are reduced competition with tree regeneration and improvement of the habitat for ruffed grouse *(Bonasa umbellus sabini)* (Gabrielson and Jewett 1940).

If a rehabilitation program is considered and grasses, particularly fescue, are dominating the site, scarification may be necessary.

Understory view of *P. ponderosa-A. concolor/F. idahoensis.*

8 *Pinus contorta / Festuca idahoensis* Ecosystem

Physical Description

Site. — This is a relatively small ecosystem which occurs from 5,000 to 6,000 feet in elevation with moderate to level topography, slopes averaging 3 percent and aspects ranging from north to northeast. It can occur in a meadow edge situation. Downed logs with evidence of fire are common throughout.

Vegetation. — *Pinus contorta* is dominant in both overstory and reproduction. *Pinus ponderosa* and *Abies concolor* are common in very small numbers. *P. ponderosa* was present in all the macroplots but was not recorded in any microplots, whereas *A. concolor*, with four times as many stems per acre, was more widely distributed.

The shrub layer consisting of *Purshia tridentata* and *Chrysothamnus viscidiflorus* is very sparse.

Festuca idahoensis is dominant in the grass stratum, making up over half of the total understory. The next three most prominent species in order of abundance are *Carex rossii*, *Sitanion hystrix*, and *Stipa occidentalis*. Other grasses include *Poa nervosa*, *Danthonia californica*, and *Bromus carinatus*.

The primary forbs in order of abundance are *Microsteris gracilis*, *Fragaria virginiana*, *Lupinus* sp., *Viola purpurea*, *Lomatium triternatum*, *Achillea millefolium*, and *Arnica cordifolia*. Among others of equal forage value but much less common are *Sidalcea oregana*, *Hieraceum cynoglossoides*, *Penstemon* sp., and *Trifolium* sp.

Soil. — This is a well-drained loamy soil with root concentrations in the upper 15 inches and roots common to 28 inches. Surface rock makes up 0.2 percent of the soil surface and less than 5 percent of the solum volume. The A horizon is a dark reddish brown loam approximately 10 inches deep. The B horizon is 18 inches thick and ranges from a dark reddish brown heavy loam to a clay loam.

Discussion

Ecosystem. — The community appears to be a fire-produced seral stage which is progressing to an overstory of *Abies concolor*. The trend is indi-

Pinus contorta/Festuca idahoensis ecosystem illustrating logs from old burn and good hiding cover for game. Note absence of shrub cover.

Pinus contorta/Festuca idahoensis ecosystem ground cover illustrating the strong dominance of *F. idahoensis*.

Average vegetation-site characteristics of the *Pinus contorta/Festuca idahoensis* ecosystem[1]

Number of plots: 6 Condition class: good

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 1.8 percent surface area	--	100
Rock, 0.2 percent surface area	--	83
Litter, 96.8 percent surface area	--	100
Moss, 0.1 percent surface area	--	33
Total vegetation, 1.1 percent surface area	--	100
Purshia tridentata	.3	83
Chrysothamnus viscidiflorus	.3	17
Festuca idahoensis	55	100
Carex rossii	7	100
Sitanion hystrix	5	83
Stipa occidentalis	4	100
Poa nervosa	2	67
Danthonia californica	.9	50
Bromus carinatus	.5	33
Microsteris gracilis	9	100
Fragaria virginiana	4	100
Lupinus sp.	2	83
Viola purpurea	2	67
Achillea millefolium	1	83
Lomatium triternatum	1	83
Arnica cordifolia	1	67
Sidalcea oregana	.8	67
Hieraceum cynoglossoides	.5	33
Thalictrum sp.	.4	17

(— Continued)

Number of plots: 6 Condition class: good

Site and vegetation	Understory composition	Frequency
	Percent	
Trifolium sp.	.4	17
Silene sp.	.3	33
Penstemon sp.	.2	33
Potentilla sp.	.2	33
Zigadenus sp.	.2	33
Antennaria rosea	.2	17
Geum ciliatum	.2	17
Geum sp.	.2	17
Paeonia brownii	.2	17
Potentilla glomerata	.2	17
Gayophytum nutallii[2]	.4	33
Collomia tenella[2]	.2	17
Epilobium minutum[2]	.2	17
Lithophragma sp.[2]	.2	17

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus contorta	144	1,653	100	77
Pinus ponderosa	5	87	100	T
Abies concolor	.2	322	100	T
Juniperus occidentalis	T	2	17	T

[2]Annuals.

cated first by the young stand of shade-tolerant *A. concolor* which averages 322 stems per acre and second by the evidence of fire history. The trend is further indicated by the occurrence of *Bromus carinatus* and *Danthonia californica*, which are not found in the drier *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* association but occur within the more mesic *P. ponderosa-A. concolor/F. idahoensis* association.

There may be an interaction of cold air drainage in situations of low or "pocket" topography. However, with both *Abies concolor* and *Pinus ponderosa* reproduction present, it would have to be minor enough for *P. contorta* to ameliorate temperatures sufficiently in the spring to allow the other conifers to establish themselves.

Habitat value. — Value to game is fair due to low acreage. It is valuable primarily in the area of protection and secondarily in forage in the form of a high variety of forbs. A dense stand of over 2,000 young trees per acre provides game with good protection from heat, insects, and all other sources of harassment during the late spring, summer, and fall seasons. In that respect, this community compares quite closely with the *Pinus ponderosa/Abies concolor/Festuca idahoensis* community.

Habitat manipulation. — Overstory removal would reduce protection values for game but increase forage values for both game and livestock. With severe ground disturbance favoring a dominance of grasses and *Pinus contorta*, it would be necessary to scarify the soil before *P. ponderosa* or forbs could be planted.

When this ecosystem occurs in a meadow edge situation with an interaction of cold temperature, it may be best to log, forgo rehabilitation, and allow a natural succession to follow, gambling that intensified management of the future will allow us to thin at the proper time to produce a valuable crop of *P. contorta.* If rehabilitation is desirable in this situation, advice should be sought in order to plan what may be a difficult program. In any case, from a game standpoint, this ecosystem presents a better opportunity for grass and forb rehabilitation than for shrubs. Forbs, particularly, would supply needed succulents for both deer and grouse.

9 *Pinus contorta / Danthonia californica* Ecosystem

Physical Description

Site. — This ecosystem is characterized by a low site which we might describe as one step above a meadow. It is a typically moist site, possibly with a cold air drainage pattern. This situation may occur at any elevation range within the study area.

Vegetation. — It is characterized by an overstory of *Pinus contorta* with sparse and scattered reproduction. Basal area averages 128 square feet per acre, including reproduction above 5.5 feet, and average density of stems under 10-inch d.b.h. is 620 per acre.

There is no shrubby understory.

The grass layer is dominated by *Danthonia californica*, with five other grasses and grasslike species of a total of 13 being major components of the stand.

The forb dominant is *Antennaria corymbosa*. Other important forbs are *Aster* sp., *Trifolium* sp., *Achillea millefolium*, and *Fragaria virginiana*. Forbs of minor but consistent occurrence include *Sidalcea oregana*, *Geum macrophylum*, and *Potentilla gracilis*. Due to a small sample size, data in the table should be used with caution.

Soil. — The soil is a moderately deep and moderately well-drained clay loam. There is less than 5 percent of the soil surface covered with stone, and stone comprises less than 15 percent of the solum volume. Roots are concentrated in the upper 12 inches.

Discussion

Ecosystem. — This is a small, highly variable ecosystem that is obviously responsive to moisture gradients which account for its irregular vegetation patterns. It is very possibly a result of invasion of *Pinus contorta* into a dry meadow type. A relatively high moisture table and/or a

Pinus contorta/Danthonia californica ecosystem[1]

Number of plots: 2 Condition class: good

Site and vegetation	Dominance rating	Frequency
		Percent
Bare soil, 5 percent surface area	--	100
Rock, <5 percent surface area	--	100
Litter, 85 percent surface area	--	100
Moss, 5 percent surface area	--	100
Total vegetation, <5 percent surface area	--	100
Danthonia californica	5	100
Carex sp.	3	100
Deschampsia elongata	3	100
Juncus sp.	3	100
Koeleria cristata	3	100
Muhlenbergia filiformis	3	100
Poa sp.	2	100
Scirpus sp.	2	100
Sitanion hystrix	1	100
Stipa occidentalis	1	100
Danthonia unispicata	1	50
Deschampsia danthonioides	1	50
Festuca idahoensis	1	50
Antennaria corymbosa	5	100
Achillea millefolium	3	100
Aster sp.	3	100
Fragaria virginiana	3	100
Trifolium sp.	3	100
Agoseris sp.	2	100
Geum macrophyllum	2	100
Potentilla gracilis	2	100
Sidalcea oregana	2	100

(— Continued)

Number of plots: 2 **Condition class: good**

Site and vegetation	Dominance rating	Frequency
		Percent
Penstemon sp.	2	50
Arnica cordifolia	1	50
Circium sp.	1	50
Geum sp.	1	50
Phacelia sp.	1	50
Potentilla glandulosa	1	50
Linanthus harknessii[2]	1	50

[1]Averages for trees are:

	Dominance rating	*Basal area in square feet per acre*	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Pinus contorta	5	128	620	100	50

[2]Annual.

cold drainage appear to be why this ecosystem is characterized by *P. contorta* rather than *P. ponderosa*, the typical species in adjacent but higher and drier ecosystems.

Habitat value. — The value of this ecosystem is low, primarily due to the relatively small acreage available to game in this summer range. However, wherever it occurs, both deer and grouse find succulent mid- and late summer forbs available.

Habitat manipulation. — If a market were to develop in the area for *Pinus contorta*, then clearcutting, maintenance as a meadow, and managing for livestock grazing would be desirable, particularly considering the scarcity of meadow acreage in this area. It may be desirable in some locations to fence small portions of the ecosystem as game areas to encourage both deer and grouse development.

10 *Populus tremuloides / Artemisia tridentata / Bromus carinatus* Ecosystem

Physical Description

Site. — This ecosystem occurs between 6,000- and 7,100-foot elevation with level terrain or west-facing slopes of less than 5 percent in areas with numerous intermittent drainageways and heavy winter snowpacks. Topography is smooth to rolling, and the ground surface is moderately rough.

Vegetation. — The overstory crown cover is unmistakably *Populus tremuloides* (24 percent) with an occasional, scattered *Pinus ponderosa*. *Artemisia tridentata* is the most abundant species in the shrub stratum. Other shrubs with wide ecosystem distribution but much less prominence are *Eriogonum microthecum* and *Symphoricarpos albus*. *Ribes cereum* and *Haplopappus bloomeri* complete the shrub list.

Grasses are dominated by *Bromus carinatus* (18-percent composition), followed by *Sitanion hystrix* and *Poa nervosa*. Perennial forbs occurring on all plots are *Aster* sp. and *Lathyrus* sp. Also common are *Agoseris* sp., *Thalictrum* sp., and *Eriophyllum lanatum*. The only annual which occurs with 100-percent frequency is *Collinsia parviflora*.

As this community is heavily used by livestock during the summer, the understory appears ragged and trampled. Obviously, species composition represents something less than pristeen conditions.

Soil. — This is a deep, well-drained, medium-textured soil developed in basalt residuum. The surface horizon (8-10 inches thick) ranges from brown to dark brown and from silt loam to loam.

The solum is 28 inches plus with roots concentrated in the upper 10 inches but common throughout the profile. Permeability is estimated as moderately rapid and runoff as slow to medium. Erosion hazard is medium. The following soil profile description is representative of the soil under this vegetation community:

O1 1-0 inch. *Populus tremuloides* and *Artemisia tridentata* litter.

A1 0-2 inches. Dark brown (7.5 YR 3/2) moist; loam; moderate fine granular structure; very friable; slightly sticky, slightly plastic; many very fine, fine, medium, and large roots; slightly acid (pH 6.2); many stones and boulders (50 percent horizon volume); clear, smooth boundary. (1 to 3 inches thick.)

A3 2-9 inches. Dark brown (7.5 YR 3/2) moist; loam; moderate medium subangular blocky structure; very friable; slightly sticky, slightly plastic; many very fine, fine, medium, and large roots;

slightly acid reaction (pH 6.0); many stones and boulders (50 percent horizon volume); clear, smooth boundary. (6 to 9 inches thick.)

B1 9-20 inches. Very dark brown (10 YR 2/2) moist; clay loam; moderate medium subangular blocky structure; friable; sticky, plastic; common fine, medium, and large roots; slightly acid reaction (pH 6.0); many boulders (50 percent of horizon); clear wavy boundary; this horizon has inclusions from the A3 as a result of rodent activity and/or old root channels. (9 to 12 inches thick.)

B2 20-28 inches +. Strong brown (7.5 YR 5/6) moist; clay loam; moderate medium subangular blocky structure; friable; sticky, plastic; common fine, medium, and large roots; slightly acid reaction (pH 6.0); many boulders (50 percent of the horizon).

Discussion

Ecosystem. — This ecosystem occurs in areas within the conifer communities where soil-site conditions have been naturally altered to provide localized mesic conditions which meet the requirements of *Populus tremuloides*. Both game and livestock use are heavy, resulting in serious abuse to understory species. Because the environment is localized and transitional with concentrated shade and succulent forage, animals of all kinds tend to congregate here as they do in the even more moist *P. tremuloides* groves on streambanks and at spring locations. There is more bare soil here than in any other ecosystem sampled.

Habitat value. — The value of this habitat for deer is limited due to the small area involved but varies with proximity of conifer types. Where it occurs in association with the open *Pinus ponderosa/Artemisia tridentata/Bromus carinatus* association but remote from other cover, its value is moderate due to both the cover provided by *P. tremuloides* and succulent forage provided. Where it is near *P. contorta* thickets or *Abies concolor* communities, the protective cover advantage is less important as is the difference in forage types.

A potential value which is generally ignored is that for grouse and other small animal species. This is high due to the excellent variety of forage and cover which could be developed with proper management.

Habitat manipulation. — The variety and quality in forage and cover which is available to game should put this ecosystem in a low multiple use category for logging the occasional *Pinus ponderosa* which might occur in the overstory. Opportunity exists for deer and grouse habitat improvement by fencing some of the more strategically located areas, probably scarifying the soil, and seeding the understory, if necessary, to legumes and other desirable forbs. This would eliminate severe livestock damage in fenced areas, allow deer use, and provide habitat which would encourage the increase of grouse and other small animals. Consideration should also be given to water development in the form of guzzlers for both deer and grouse.

Average vegetation-site characteristics of the *Populus tremuloides/Artemisia tridentata/Bromus carinatus* ecosystem[1]

Number of plots: 5 Condition class: fair

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 30 percent surface area	--	100
Rock, 1 percent surface area	--	100
Litter, 67 percent surface area	--	100
Moss, zero percent surface area	--	0
Total vegetation, 2 percent surface area	--	100
Artemisia tridentata, 20 percent crown cover	39	100
Eriogonum microthecum	9	80
Symphoricarpos albus, 3 percent crown cover	3	80
Ribes cereum	1	40
Haplopappus bloomeri	T	20
Bromus carinatus	18	100
Sitanion hystrix	6	100
Poa nervosa	5	60
Stipa occidentalis	4	20
Deschampsia elongata	1	40
Melica bulbosa	.1	20
Aster sp.	3	100
Agoseris sp.	1	60
Thalictrum sp.	1	60
Lathyrus sp.	.7	100
Lupinus caudatus	.4	40

(— Continued)

Number of plots: 5 **Condition class: fair**

Site and vegetation	Understory composition	Frequency
	- - - - - - - - *Percent* - - - - - - - -	
Potentilla glomerata	.4	40
Achillea millefolium	.2	40
Castilleja sp.	.2	20
Eriophyllum lanatum	.2	60
Lomatium triternatum	.2	20
Hieracium cynoglossoides	.1	40
Delphinium sp.	.1	20
Hydrophyllum capitatum	.1	20
Sidalcea oregana	.1	20
Collinsia parviflora[2]	5	100
Polygonum douglasii[2]	1	80
Collomia grandiflora[2]	.1	40
Linanthus harknessii[2]	.1	20

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Stems per acre <10 inches d.b.h.*	*Percent frequency*	*Percent crown cover*
Populus tremuloides	34	435	100	24
Pinus ponderosa	1	10	80	.1
Abies concolor	T	2	20	T

[2]Annuals.

Populus tremuloides/Artemisia tridentata/Bromus carinatus ecosystem.

Understory illustration of *P. tremuloides/A. tridentata/B. carinatus* ecosystem.

11 *Populus tremuloides* Colonies

The *Populus tremuloides* colonies in the mule deer's summer and transition range characteristically occur on stream banks, around springs, or on moisture seeps and comprise a very small acreage. Because water is more available, these colonies are even more attractive to grazing animals than the ecosystem discussed above and subject to the same abuse. Possibilities for improving them are also the same.

Habitat Value

Habitat potential is similar to that in the *Populus tremuloides/ Artemisia tridentata/Bromus carinatus* community. However, in these colonies there is little if any shrub cover. It appears that protection from livestock can result in an increase of cover due to aspen suckering. Thus, hiding cover for deer can approach that which can be attained in the *P. tremuloides/A. tridentata/B. carinatus* community through fencing.

Overall view of a *Populus tremuloides* colony. Note the understory vegetation cropped short by deer and cattle.

A close view of ground vegetation under a *P. tremuloides* canopy.

12 *Cercocarpus ledifolius / Festuca idahoensis-Agropyron spicatum* Ecosystem

Physical Description

Site. — This ecosystem occurs at the lower edge of the *Pinus ponderosa/Purshia tridentata/Festuca idahoensis* ecosystem and is characterized by topography at elevations from 4,700 to 5,600 feet and by slopes ranging from less than 5 to 40 percent. Exposure aspects are northeast and northwest in the Silver Lake study area. As topography is cut abruptly by ridges and hillocks, aspects change within very short horizontal distances.

Most of the *Cercocarpus ledifolius* occurs in a transition area between the lower edge of the *Pinus ponderosa* forest and the upper edge of the high desert shrub steppe. It also occurs, but in smaller amounts, as inclusions in the pine type, sometimes as belts around scab or *Artemisia arbuscula* flats, and as a dominant on various sites throughout the high desert of eastern Oregon.

Mean annual precipitation is approximately 12 inches with two-thirds falling as snow and rain during the winter and the rest as rain in the fall and spring, except for 5 percent which falls during the 3 summer months.

Vegetation. — This ecosystem is characterized by a dense, patchy cover of *Cercocarpus ledifolius* averaging 36 percent, with an occasional *Juniperus occidentalis* and *Pinus ponderosa*. The understory is primarily *Festuca idahoensis* and *Agropyron spicatum* with *Artemisia tridentata* and other shrubs increasing where *C. ledifolius* crown cover is absent. Other shrubs include *Chrysothamnus viscidiflorus*, *C. nauseosus*, *Ribes cereum*, and *Purshia tridentata*.

Balsamorhiza sagittata and *Achillea millefolium* are the principal forbs. The annual, *Bromus tectorum*, was 11 percent of the composition, more than any of the forbs or perennial grasses except the codominants *Festuca idahoensis* and *Agropyron spicatum*.

Soil. — The soil is a well-drained, moderately deep stony loam on rolling to steep topography. Surface area of bare soil and rock averaged 5 and

Average vegetation-site characteristics of the *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum* ecosystem[1]

Number of plots: 5 Condition class: good to high good

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 5 percent surface area	--	100
Rock, 26 percent surface area	--	100
Litter, 63.5 percent surface area	--	100
Moss, 2 percent surface area	--	100
Total vegetation, 3.5 percent surface area	--	100
Artemisia tridentata, 3 percent crown cover	4	100
Chrysothamnus viscidiflorus	1	80
Chrysothamnus nauseosus	T	60
Ribes cereum	T	20
Purshia tridentata	T	20
Festuca idahoensis	37	100
Agropyron spicatum	24	100
Sitanion hystrix	9	100
Poa sandbergii	8	100
Koeleria cristata	2	80
Bromus carinatus	.5	40
Bromus tectorum[2]	11	80
Balsamorhiza sagittata	3	80
Achillea millefolium	.1	60
Microsteris gracilis	.1	40
Astragalus stenophyllus	.1	20
Erigeron sp.	.1	20
Lupinus caudatua	.1	20
Collinsia parviflora[2]	T	20

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Percent frequency*	*Percent crown cover*
Cercocarpus ledifolius	--	100	36
Juniperus occidentalis	T	80	.5
Pinus ponderosa	T	80	.1

[2]Annual.

26 percent, respectively. Stone in the solum averages 60 percent of the volume. Solum development is in mixed colluvium and weathered basalt. A representative profile is:

A11 0-3 inches. Dark reddish brown (5 YR 2/2) moist; gravelly loam; weak fine granular structure; very friable; slightly sticky and slightly plastic; abundant very fine and fine roots and common medium to large roots; medium acid reaction (pH 6.0); angular cobbles 30 percent of the volume; clear, wavy boundary. (2 to 5 inches thick.)

A12 3-9 inches. Dark reddish brown (5 YR 2/2) moist; gravelly loam; weak fine granular structure; very friable, slightly sticky, slightly plastic; abundant very fine, fine, and medium roots and common large roots; medium acid reaction (pH 6.0); angular cobbles 30 percent of the volume; clear, wavy boundary. (5 to 8 inches thick.)

B21 9-14 inches. Dark reddish brown (5 YR 3/2) moist; heavy gravelly loam; moderate, fine granular structure; very friable; slightly sticky and slightly plastic; common very fine, fine, medium and large roots; slightly acid reaction (pH 6.5); angular cobbles 60 percent of the volume; clear, wavy boundary. (4 to 7 inches thick.)

B22 14-21 inches. Reddish brown (5 YR 4/4) moist; clay loam; moderate fine subangular blocky structure; sticky and plastic; uncommon fine, medium and large roots; slightly acid reaction (pH 6.5); angular cobbles 60 percent of the volume; clear, wavy boundary. (5 to 9 inches thick.)

IIC 21 inches +. Gravelly clay, mixes with weathered basalt fragments and cracked basalt rock.

This is a well-drained soil with moderate permeability. Runoff is estimated as medium, and erosion hazard is moderate to high. Effective rooting depth includes the entire profile under natural vegetation.

Discussion

Ecosystem. — This is an ecosystem in good to very good condition with little evidence of abuse by livestock. Deer have highlined the mature *Cercocarpus ledifolius*, and both deer and sheep have kept the few young plants severely hedged. Grass appears almost untouched; however, green regrowth is used readily by deer during the fall, winter and spring periods and should be considered an important part of their diet. The shrub layer has been relatively undisturbed except for *Purshia tridentata* which amounts to only a trace of total composition.

The greatest pressure animals have on this ecosystem seems to be that of continued extreme use of *Cercocarpus ledifolius* with two results: (1) the highlining of mature plants which probably has little adverse effect

Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum **ecosystem. Note the relatively open canopy.**

on the maintenance or survival of the species and (2) the suppression of young plants by producing a low-hedged or "pincushion" growth form. This heavy utilization does not suppress germination or establishment of young plants. They escape detection in the tall bunchgrass and winter snows until they are 6 to 12 inches tall and have a strong competitive root system and well-branched top.

Because this community lies between the conifer forest and high desert steppe, it might be considered more a part of an ecotone than a separate ecosystem. However, the consistency and reliability with which it occurs in the position described, and the marked and abrupt change that is exhibited at its upper and lower edge, make it a very real and unique ecosystem.

Habitat value. — Although this is of relatively small acreage, it is in a position contiguous with the other *Cercocarpus ledifolius* ecosystems and, therefore, in combination they become a very valuable habitat for deer particularly during the fall, winter, and spring periods. The greatest value

Understory view of *C. ledifolius/F. idahoensis-A. spicatum* ecosystem. Note the prominence of *A. spicatum*.

is hiding cover, followed by forage. This relationship might be reversed with rehabilitation.

Habitat manipulation. — When a *Cercocarpus ledifolius* plant attains the stature of a tree and is highlined, it no longer provides forage but does continue to be a valuable source of seed. Attempts have been made to push these trees over so that deer can utilize the forage in their tops, but the trees usually die. Studies are underway to determine if pruning the tops will stimulate sprouting on the lower part of the main stem, within reach of deer.

When rehabilitation is necessary after fire, *Cercocarpus ledifolius* should be seeded exclusively until more information is gathered concerning its ability to compete with other species. Reseeding on most sites will probably be limited to hand or aerial methods due to steepness and rockiness. Until more information is available on seed stratification, seeding should be done in late fall. Overstory removal should not be deliberate on steep sites due to erodable soils.

13 *Cercocarpus ledifolius / Festuca idahoensis* Ecosystem

Physical Description

Site. — This ecosystem is characterized by mountainous terrain on northeast to north-northwest exposures with slopes from less than 5 to 25 percent and at elevations from 4,700 to 5,400 feet.

Vegetation. — This vegetation, although similar in many respects to that of the *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum* ecosystem, differs mainly in its much denser stand of *C. ledifolius* (66-percent crown cover), fewer shrubs, and the large amount of *F. idahoensis* in the composition (80 percent). The shrubs, represented mainly by *Artemisia tridentata* and *Chrysothamnus viscidiflorus*, are largely restricted to openings in the dense *C. ledifolius*.

The following grasses combined comprise 14 percent of the composition: *Agropyron spicatum*, *Sitanion hystrix*, *Koeleria cristata*, and *Poa sandbergii*. Forbs that are frequently encountered include *Hieraceum cynoglossoides* and *Microsteris gracilis*.

Soil. — Because this and the *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum* eocsystems are contiguous, they are subjected to very similar climatic conditions and are derived from the same parent material (mixed colluvium and weathered basalt). They appear to be only slight variations of the same soil. The primary difference is the much smaller volume of cobbles in the A horizon of this unit (5 percent as compared with 30 percent). A representative profile is:

A11 0-4 inches. Very dark brown (10 YR 2/2) moist; loam; weak, fine granular structure; slightly sticky and slightly plastic; common large, medium, and many fine and very fine roots; few fine and very fine tubular and interstitial pores; medium acid reaction (pH 6.0); cobbles 5 percent of the volume; clear, smooth boundary. (3 to 5 inches thick.)

A12 4-10 inches. Very dark brown (10 YR 2/2) moist; loam; weak, fine granular structure; slightly sticky, slightly plastic; common large

Average vegetation-site characteristics of the *Cercocarpus ledifolius/Festuca idahoensis* ecosystem[1]

Number of plots: 5 Condition class: good to high good

Site and vegetation	Understory composition	Frequency
	- - - - - - - - *Percent* - - - - - - - -	
Bare soil, 3 percent surface area	--	100
Rock, 3 percent surface area	--	100
Litter, 73.5 percent surface area	--	100
Moss, 17 percent surface area	--	100
Total vegetation, 3.5 percent surface area	--	100
Artemisia tridentata, 3 percent crown cover	2	80
Chrysothamnus viscidiflorus	T	40
Amelanchier alnifolia	T	20
Ribes cereum	T	20
Tetradymia canescens	T	20
Festuca idahoensis	80	100
Sitanion hystrix	6	80
Agropyron spicatum	5	100
Koeleria cristata	2	80
Poa sandbergii	1	100
Bromus carinatus	.6	40
Carex rossii	T	20
Bromus tectorum[2]	.6	40
Hieraceum cynoglossoides	1	100
Microsteris gracilis	1	80
Agoseris sp.	.2	60
Eriophyllum lanatum	.2	60
Achillea millefolium	T	20
Balsamorhiza sagittata	T	20
Erigeron sp.	T	20
Collinsia parviflora[2]	.2	60
Cryptantha ambigua[2]	.2	40
Montia perfoliata[2]	T	20

T = trace.

[1] Averages for trees are:

	Basal area in square feet per acre	*Percent frequency*	*Percent crown cover*
Pinus ponderosa	T	100	T
Cercocarpus ledifolius	--	100	66
Juniperus occidentalis	T	60	1

[2] Annuals.

Cercocarpus ledifolius/Festuca idahoensis ecosystem. Note surprisingly dense stand of *F. idahoensis* under this heavy canopy.

Understory of *C. ledifolius/F. idahoensis.*

and medium and many fine roots; few fine and very fine tubular and interstitial pores; medium acid reaction (pH 6.0); cobbles 5 percent of the volume; clear, wavy boundary. (4 to 7 inches thick.)

B21 10-16 inches. Dark brown (7.5 YR 3/2) moist; clay loam; moderate, fine, subangular blocky structure; sticky and plastic; common large, medium and fine roots; common fine and very fine pores; medium acid reaction (pH 6.0); stone 65 percent of the volume; clear, wavy, boundary.(4 to 8 inches thick.)

B22 16-24 inches. Dark brown (7.5 YR 3/2) moist; clay loam; sticky and plastic; moderate, fine, subangular blocky structure; common large and medium roots; few fine and very fine pores; medium acid reaction (pH 6.0); stone 65 percent of the volume; clear, smooth boundary. (7 to 9 inches thick.)

IIC 24 inches +. Weathered basalt gravels and slightly weathered, cracked basalt rock.

This soil is well drained. Permeability is estimated as medium, runoff is medium, and erosion hazard is moderate. Effective rooting depth includes the entire profile under natural vegetation.

Discussion

Ecosystem. — This community is in good to high good condition with no evidence of abuse by livestock and only moderate abuse by deer. Sheep are trailed through this area, but use is light, and only a minor amount of *Cercocarpus ledifolius* is available. Deer have highlined the *C. ledifolius* stand which was tall enough that very little damage resulted. This stand is relatively even-aged, and young plants are few. Lack of regeneration is not believed to be a result of heavy deer use but of lack of openings in an almost closed community.

Habitat value. — Although acreage is relatively small, its contiguous occurrence with other *Cercocarpus ledifolius* ecosystems in the winter-summer range transition zone, its potential production of highly preferred deer browse, and its value as cover make it an important habitat.

Habitat manipulation. — The same comments concerning manipulation of the *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum* ecosystem apply to this one.

14 Purshia tridentata / Festuca idahoensis Ecosystem

Physical Description

Site. — This eocsystem occurs on the deer's transition range between the summer and winter ranges. It is characterized by gentle to rolling benchland which rims a portion of the Silver Lake Valley. Slopes range from 0 to 5 percent.

Vegetation. — It is characterized by a dominant aspect of *Purshia tridentata* with *Artemisia tridentata* and *A. arbuscula* commonly occurring throughout the stand. Other shrub species occurring consistently are *Chrysothamnus viscidiflorus* and *C. nauseosus.*

There is an occasional *Juniperus occidentalis* and *Cercocarpus ledifolius* occurring in this ecosystem; however, composition, basal area, and crown cover data indicate that these species are of minor importance.

The strong dominant in the grass layer is *Festuca idahoensis. Poa sandbergii*, *Stipa thurberiana*, *Sitanion hystrix*, and *Agropyron spicatum* are other grasses which occur consistently and prominently.

Antennaria rosea, *Erigeron* sp., *Astragalus purshii*, and *Arabis* sp. are forbs which occur consistently throughout the stand. Others which are common but irregular are *Eriophyllum lanatum* and *Crepis* sp.

Soil. — This is a well-drained, moderately deep loam. The A horizon averages 6 inches in depth and is slightly acid. The B1 is a stony clay loam, the B2 is a stony clay, and both are slightly acid. Stones in the solum average 35 percent by volume, and the zone of root concentration is 0 to 12 inches. Inclusion of approximately 10 percent of the shallow soil under the *Purshia tridentata-Artemisia arbuscula/Stipa thurberiana* ecosystem occurs here.

Discussion

Ecosystem. — This is the relatively narrow transition belt between the high desert steppe and the forest. Here variability is high, and it might seem that successful ecosystem definition would be unreasonable. However, in unraveling vegetation, soils, and sites, there seems to be enough uniformity to justify the effort, especially since this is a very critical area for deer management.

This ecosystem has a long history of both heavy livestock use and moderately heavy to heavy deer use. Livestock use has been primarily from late spring through summer and deer use during the late fall, winter, and

Purshia tridentata/Festuca idahoensis ecosystem[1]

Number of plots: 3 Condition class: fair to good

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 37 percent surface area	--	100
Rock, 1 percent surface area	--	100
Litter, 43 percent surface area	--	100
Moss, 17 percent surface area	--	100
Total vegetation, 2 percent surface area	--	100
Purshia tridentata, 3 percent crown cover	29	100
Artemisia tridentata	13	100
Artemisia arbuscula	9	100
Chrysothamnus nauseosus	4	100
Chrysothamnus viscidiflorus	4	100
Festuca idahoensis	13	100
Poa sandbergii	7	100
Stipa thurberiana	6	100
Sitanion hystrix	4	100
Agropyron spicatum	2	100
Carex rossii	.9	100
Koeleria cristata	.5	66
Melica bulbosa	.4	66
Stipa occidentalis	.2	66
Bromus tectorum[2]	5	100
Antennaria rosea	.6	100
Erigeron sp.	.4	100
Arabis sp.	.2	100
Astragalus purshii	.2	100
Crepis sp.	.1	66
Eriophyllum lanatum	.1	66
Penstemon sp.	.1	33
Achillea millefolium	.1	33
Eriogonum sp.	.1	33
Lomatium triternatum	.1	33

T = trace.

[1] Averages for trees are:

	Basal area in square feet per acre	*Percent crown cover*	*Percent frequency*
Juniperus occidentalis	T	66	T
Cercocarpus ledifolius	T	66	T

[2] Annual.

spring periods. The combination of these uses has resulted in *Purshia tridentata's* exhibiting a sculptured crown. Also the native grasses have been overused to the point where *Bromus tectorum* composition has climbed to 5 percent, a figure higher than those of 67 percent of the native grasses present.

In analyzing the use history and composition, it seems reasonable to conclude that this ecosystem is in a successional stage. Enough soil does not appear to have been lost through erosion to change the potential of the site.

Habitat value. — The value of this ecosystem is high due to both its position in a critical deer range and its productivity for deer forage. Available in this one ecosystem is a variety of four usable shrub species. Two of these species are very desirable *(Purshia tridentata* and *Artemisia arbuscula)*, and two provide variety during times of plenty and emergency forage when times are hard *(A. tridentata* and *C. viscidiflorus). A. arbuscula* is particularly valuable during the spring period after it puts out new leaders.

There are two grass species which provide excellent forage during the fall and spring periods and even some green regrowth during the winter periods when snow cover is lacking *(Poa sandbergii* and *Bromus tectorum).*

Habitat manipulation. — This and other ecosystems in the deer's transition range should be given high priority for deer management when manipulation becomes necessary. Any livestock use or rehabilitation plans should hold to the objective of providing a combination of shrub and herbaceous forage. *Purshia tridentata* and *Artemisia arbuscula* could both be reseeded since it is suspected that this ecosystem as well as *P. tridentata-A. arbuscula/Stipa thurberiana* have specific soil microsites for each species. Site preparation will probably be necessary in many situations before seeding. It may be more reasonable to encourage *Bromus tectorum* and *Poa sandbergii* or similar responsive grass species for this situation rather than *Festuca idahoensis*, *S. thurberiana*, and *Agropyron cristatum*, etc. The latter commonly produce forage later in the spring than deer prefer and/or have more old standing litter hiding the fresh growth than deer are willing to chew through. This litter can be dealt with in sites where management is for grass only by manipulation with livestock; however, on shrub ranges it becomes very difficult to use livestock (although not unreasonable in some situations) where both they and deer prefer the same shrub species.

Unless fire or some other disaster disturbs this ecosystem, it may be necessary to use cattle to remove standing litter from perennial grasses in the spring **before** new growth begins on shrub species. Then any shrub forage used by cattle will be last year's (that which deer did not use during the preceding winter), and new growth will be reserved for next winter's needs. Soil compaction must be watched carefully as this soil is susceptible.

15 *Purshia tridentata-Artemisia arbuscula / Stipa thurberiana* Ecosystem

This ecosystem occurs on the upper portion of the deer's winter range near the lower edge of the pine forest. Slope is less than 5 percent. The soil is shallow, stony, and heavy and only moderately well drained.

Purshia tridentata and *Artemisia arbuscula* are strong shrub dominants with *Chrysothamnus viscidiflorus* and *C. nauseosus* occurring as minor components, increasing in importance with a reduction in condition class. The dominant grass is *Stipa thurberiana* with *Sitanion hystrix* and *Poa sandbergii* being major competitors. Other grasses include *Koeleria cristata*, *Agropyron spicatum*, and *Bromus tectorum*. The dominant forb is *Antennaria rosea*. Other important forbs are *Astragalus* sp., *Erigeron* sp., and *Lomatium triternatum*. This vegetation seems to be only in fair condition due to a long history of heavy use by livestock.

Normally in central Oregon, *Purshia tridentata* and *Artemisia arbuscula* are strange companions since *P. tridentata* requires a considerably deeper and better drained soil than does *A. arbuscula*. Here they grow together in apparent harmony. Preliminary tests indicate that these two species are growing on two distinct microsites. *A. arbuscula* occurs on those which have a layer restrictive to roots at approximately 15 to 20 inches, and *P. tridentata* occurs on sites where this restrictive layer has failed to form. Thus, what appears to be an *A. arbuscula* stand with *P. tridentata* randomly scattered throughout may rather be a vegetation mosaic where the species are growing on distinctly different soil sites. The major cementing agent which seems to be restricting drainage and root penetration has been identified as silica.

This ecosystem is an important component of the deer's transition range and during most years provides valuable grass regrowth in the fall and grass regrowth and shrub forage in both the winter and spring periods.

Purshia tridentata-Artemisia arbuscula/Stipa thurberiana ecosystem. Note the *A. arbuscula* plants in the interspaces.

16 *Artemisia tridentata-Purshia tridentata / Festuca idahoensis* Ecosystem

Physical Description

Site. — This is a large ecosystem situated in the mule deer's summer-winter range transition belt just below the *Pinus ponderosa* and *Cercocarpus ledifolius* forest edges at an elevation range from 4,500 to 4,700 feet. During the greater number of years, this ecosystem provides winter habitat for the deer. Slopes range from level benches to those of 15 percent and exposures may be east, north, or west.

Vegetation. — It is characterized by an aspect of *Artemisia tridentata* peppered with *Purshia tridentata* in a crown cover ratio of approximately 2 to 1. There is a small but consistent amount of *Chrysothamnus viscidiflorus* throughout the stand, and *C. nauseosus* and *Tetradymia canescens* occur only sporadically.

Perennial grasses are dominated by *Festuca idahoensis* and *Sitanion hystrix*, with the annual *Bromus tectorum* having as high a place in composition as either perennial. All three grasses occur with 100-percent frequency. Other important perennials in the grass layer which occur consistently are *Carex rossii*, *Stipa occidentalis*, and *Agropyron spicatum*.

Forbs are of relatively minor importance, occurring with less than 1-percent composition in total. The most consistently occurring perennials are *Lupinus* sp. and *Astragalus* sp.

Soil. — The soil is a deep, well-drained sandy loam derived primarily from pumice. Fine pumice gravels are common in the upper 2 feet, and pumice gravels and stones up to 8 centimeters in diameter are common from 21 inches to 4 feet. There is some colluvium in the profile, with basalt gravels and stones common in the upper 12 inches.

The A horizon has a sandy loam texture, a pH of 6.0 to 6.4, and averages 12 inches in depth. The AC horizon is also a sandy loam, has a pH of 6.4, and is 17 inches deep. The typical description is as follows:

A11 0-3 inches. Gray brown (10 YR 5/2)[4] ; dark reddish brown (5 YR 3/2) moist; sandy loam; moderate, medium platy structure; soft;

[4] *In this profile colors will be dry unless otherwise noted.*

Artemisia tridentata-Purshia tridentata/Festuca idahoensis ecosystem

Number of plots: 4 Condition class: low good

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 21 percent surface area	--	100
Rock, 1 percent surface area	--	100
Litter, 61 percent surface area	--	100
Moss, 12 percent surface area	--	100
Total vegetation, 5 percent surface area	--	100
Artemisia tridentata, 12 percent crown cover	10	100
Purshia tridentata, 7 percent crown cover	4	100
Chrysothamnus viscidiflorus	1	100
Chrysothamnus nauseosus	.5	25
Tetradymia canescens	.5	25
Sitanion hystrix	23	100
Festuca idahoensis	19	100
Carex rossii	7	100
Stipa occidentalis	4	100
Agropyron spicatum	2	100
Poa sandbergii	2	100
Stipa thurberiana	2	75
Koeleria cristata	1	75
Bromus tectorum[1]	23	100
Astragalus sp.	.2	100
Lupinus sp.	.2	100
Eriogonum sp.	.1	50
Chaenactis douglasii	T	50
Collinsia parviflora[1]	.1	100
Cryptantha ambigua[1]	.1	100
Epilobium minutum[1]	T	100
Polygonum douglasii[1]	T	75

T = trace.

[1]Annuals.

nonsticky; nonplastic; abundant very fine and fine roots; slightly acid reaction (pH 6.0); clear, sharp boundary.

A12 3-12 inches. Dark reddish brown (5 YR 3/3) moist; sandy loam; weak, medium subangular blocky structure; very friable; nonsticky, nonplastic; common fine and medium roots; abundant fine gravels of pumice and few of basalt; slightly acid reaction (pH 6.4); clear gradual boundary.

AC11 12-21 inches. Light brown (7.5 YR 6/4); dark reddish brown (5 YR 3/4) moist; sandy loam; weak, medium, subangular blocky structure; very friable; nonsticky, nonplastic; common fine and medium roots; common fine to medium pumice gravels; very slightly acid reaction (pH 6.4); clear gradual boundary.

AC12 21-29 inches. Light brown (7.5 YR 6/4); yellowish red (5 YR 4/6) moist; sandy loam; weak, medium, subangular blocky structure; very friable; nonsticky, nonplastic; common fine and medium roots; common fine to medium pumice gravels; very slightly acid reaction (pH 6.4); clear gradual boundary.

C1 29-39 inches. Pink (5 YR 7/4); yellowish red (5 YR 4/6) moist; sandy loam; weak, medium subangular blocky, breaking to single grain structure; very friable, nonsticky, nonplastic; common fine roots; common medium to large pumice gravels to 6 cm. in diameter; very slightly acid reaction (pH 6.4); clear gradual boundary.

C2 39-45+ inches. Yellowish red (5 YR 4/6) moist; sandy loam; hard; nonsticky, nonplastic; common large pumice gravels and stones to 8 cm. in diameter; very slightly acid reaction (pH 6.4).

Discussion

Ecosystem. — The composition relationship among species is primarily a result of heavy past use by both livestock and deer. We might expect *Purshia tridentata* to have a higher composition figure and *Artemisia tridentata* a lower one under better conditions or less past use, since *P. tridentata* is highly preferred for forage over *A. tridentata*. The high figures for *Bromus tectorum* and *Sitanion hystrix* as compared with *Festuca idahoensis* and *Agropyron spicatum* also indicate a history of past overuse by foraging animals. Here, too, reverse trends in composition might be expected under better use management. Also the climate and soil indicate that this ecosystem has a higher potential for *P. tridentata*, *F. idahoensis*, and *A. spicatum* than is indicated by present composition figures.

This ecosystem grades into an ecotonal mixture of *Juniperus occidentalis*, *Cercocarpus ledifolius*, and *Pinus ponderosa* with a varying but continual mixture of present shrubs under a more favorable moisture regime, but it grades out of *P. tridentata* and into a dominant stand of *A. tridentata* with a decrease of moisture.

Habitat value. — Value is considered high, primarily due to available shrub forage during the winter period. This ecosystem is positioned in

Ground vegetation of the *A. tridentata-P. tridentata/F. idahoensis* ecosystem. Note the disturbed appearance of the ground surface and the high incidence of broken and trampled shrub stems.

what is generally considered the "transition range," i.e., the spring-fall range. However, in the past 12 years, this area has been accessible for the greater part of most winters and during that time has never been unavailable during an entire winter.

An added value provided by this ecosystem is the cover protection from winter winds. Shrubs are tall enough to provide considerable wind protection during daily feeding forays and provide adequately protected daybeds for rest except during severe storms.

Habitat manipulation. — Since this, along with adjacent transition and winter range ecosystems, provides highly critical forage and cover for deer, any deliberate vegetation manipulation should be based on plans carefully developed by both land and game management agencies.

Studies in progress indicate that rehabilitation of the shrub stand

General view of the *Artemisia tridentata-Purshia tridentata/Festuca idahoensis* ecosystem.

should favor *Purshia tridentata.* A study of *P. tridentata* seeded after a burn, being conducted in this immediate area (Dealy 1970), found that after 2 years of treatment the shrub response was greater from browsing protection than from elimination of vegetation competition. Any shrub rehabilitation project may need site preparation and should provide some type of protection from animal use for from 3 to 5 years. This protection could be accomplished either physically by fencing or by a large enough acreage of rehabilitation to absorb the intense use with minimal damage. Protective fencing costs per acre are not unreasonable when considering 1,000-acre blocks or larger.

Rehabilitation after wildfire is difficult primarily due to a limited availability of *Purshia tridentata* seed on short notice. In this case it would be desirable to seed with a mixture of seed from any available species which are suitable for the area and for deer forage.

17 *Artemisia tridentata / Stipa occidentalis-Lathyrus* Ecosystem

Physical Description

Site. — This ecosystem is characterized by a narrow range in elevation from 6,500 to 7,000 feet and by gentle slopes of 5 percent or less. It includes portions of the upper slopes of Winter Ridge and aspects ranging generally from south through west. Microrelief is broken only by intermittent waterways which are shallow, narrow, and apparently the result of spring melt from typically heavy winter snowpacks.

Vegetation. — *Pinus contorta* occurs erratically in patches throughout this community. *Pinus ponderosa* was not recorded on or near any sample plots but occurs as rare, overmature individuals which are significant to the ecological interpretation of the community.

Artemisia tridentata is the dominant shrub with 57-percent composition and 100-percent frequency of occurrence. All other shrubs are minor in importance and occurrence. They include *Chrysothamnus viscidiflorus*, *Symphoricarpos albus*, *Eriogonum microthecum*, and *Ribes cereum*.

The grass and sedge component (19-percent composition) is the smallest sampled with the exception of the *Pinus ponderosa/Arctostaphylos patula/Festuca idahoensis* ecosystem. *Stipa occidentalis* is dominant (6-percent composition) and *Carex rossii* is a close second (5 percent). Other important grasses include *Poa nervosa*, *Sitanion hystrix*, *Bromus carinatus*, and *Melica bulbosa*.

Perennial forbs are represented by a greater number of species here than in any other community described. They also comprise a larger part of the composition (16 percent) than in any community except the *Artemisia arbuscula/Danthonia unispicata*. *Lathyrus* sp., *Achillea millefolium*, and *Senecio* sp. are most prominent. Annuals make up 40 percent of the total forb component. Those most commonly found are *Collinsia parviflora*, *Linanthus harknessii*, *Epilobium minutum*, and *Polygonum douglasii*.

Soil. — The soil is a moderately deep, well-drained loam over a residuum of weathered basalt. Depth of the solum averages over 30 inches. Surface area of bare soil and area of surface stone average 25 and 3 per-

A tall, dense stand of *Artemisia tridentata* indicates high moisture in the *A. tridentata/ Stipa occidentalis-Lathyrus* ecosystem.

A. tridentata/S. occidentalis-Lathyrus ecosystem showing grass stand in shrub interspaces. Note young *A. tridentata* in openings.

Average vegetation-site characteristics of the *Artemisia tridentata/Stipa occidentalis-Lathyrus* ecosystem[1]

Number of plots: 5 Condition class: fair

Site and vegetation	Understory composition	Frequency
		Percent
Bare soil, 25 percent surface area	--	100
Rock, 3 percent surface area	--	100
Litter, 69 percent surface area	--	100
Moss, trace of surface area	--	60
Total vegetation, 3 percent surface area	--	100
Artemisia tridentata, 32 percent crown cover	57	100
Eriogonum microthecum	T	60
Ribes cereum	T	40
Symphoricarpos albus	T	40
Chrysothamnus viscidiflorus	T	20
Stipa occidentalis	6	100
Carex rossii	5	100
Poa nervosa	3	100
Sitanion hystrix	2	100
Bromus carinatus	2	80
Melica bulbosa	1	80
Agropyron sp.	.1	20
Lathyrus sp.	5	100
Achillea millefolium	3	100
Senecio sp.	2	100
Viola purpurea	1	100
Agoseris sp.	1	80
Delphinium sp.	1	80
Hydrophyllum capitatum	1	80
Trifolium sp.	1	20
Phacelia hastata	.1	100
Arabis sp.	.1	60
Thalictrum sp.	.1	60

(— Continued)

Number of plots: 5 **Condition class: fair**

Site and vegetation	Understory composition	Frequency
	Percent	
Brodiaea sp.	.1	40
Castilleja sp.	.1	40
Geranium sp.	.1	40
Hieracium cynoglossoides	.1	40
Eriophyllum lanatum	.1	20
Fragaria virginiana	.1	20
Lomatium sp.	.1	20
Lupinus sp.	.1	20
Microsteris gracilis	.1	20
Potentilla sp.	.1	20
Ranunculus sp.	.1	20
Lewisia rediviva	T	20
Collinsia parviflora[2]	3	100
Linanthus harknessii[2]	1	100
Epilobium minutum[2]	1	100
Polygonum douglasii[2]	1	100
Cryptantha ambigua[2]	1	60
Collomia grandiflora[2]	1	60
Navarretia tagetina[2]	.2	60
Galium sp.[2]	.2	40

T = trace.

[1]Averages for trees are:

	Basal area in square feet per acre	*Percent frequency*	*Percent crown cover*
Pinus contorta	T	40	T

[2]Annuals.

cent, respectively. Stone in the soil averages 70 percent of the volume. Topography is gently sloping. Mean annual precipitation is over 20 inches with two-thirds falling as snow and rain during the winter and the rest as rain in the fall and spring except for approximately 5 percent which falls during the 3 summer months. A representative profile is:

A1 0-3 inches. Brown (10 YR 5/3) dry; dark brown (10 YR 4/3) moist; loam; weak, fine granular structure; very friable; slightly sticky, slightly plastic; many very fine, fine, and medium roots; slightly acid reaction (pH 6.0); many stones and boulders (70 percent of horizon volume); clear, smooth boundary. (2 to 4 inches thick.)

A3 3-14 inches. Brown (10 YR 5/3) dry, dark brown (10 YR 4/3) moist; loam; weak, fine, subangular blocky structure; very friable; slightly sticky, slightly plastic; many fine and medium roots; medium acid reaction (pH 5.8); many stones and boulders (70 percent of horizon volume); clear, wavy boundary. (8 to 14 inches thick.)

B1 14-20 inches. Dark brown (7.5 YR 4/4) moist; clay loam; moderate, medium subangular blocky structure; friable; sticky and plastic; few fine and common medium roots; medium acid reaction (pH 5.8); many stones and boulders (70 percent of horizon volume); clear smooth boundary. (5 to 8 inches thick.)

B2 20-30 inches +. Dark brown (7.5 YR 4/4) moist; clay loam; strong, medium subangular blocky structure; firm; sticky and plastic; few fine, common medium roots; medium acid reaction (pH 5.8); many stones and boulders (70 percent of horizon volume).

Discussion

Ecosystem. — It is fairly obvious that this is a successional stage of an ecosystem similar to, if not the same as, that illustrated by the *Pinus ponderosa/Artemisia tridentata/Bromus carinatus* community. It occurs in the same general elevation range, has the same slope aspects, and has similar soils. It also exhibits remnants of a *Pinus ponderosa* stand in the form of occasional large, old individual trees still growing. In addition, there are scattered stands of *Pinus contorta*, a subordinate species in the *P. ponderosa/A. tridentata/B. carinatus* ecosystem. Charred tree remnants suggest that this seral stage is a result of fire.

In comparing the two communities with respect to composition relationships between species and the incidence of common occurrence of species, we find that in this seral shrub community all tree species except *Abies concolor* are present which are present in the *P. ponderosa* community. Likewise, all shrubs are present, most grasses are present, and the major forbs are present, particularly *Lathyrus* sp. and *Achillea millefolium*. *Artemisia tridentata* is easily the dominant shrub in both communities. Perennial grass-types dominant here are *Stipa occidentalis* and

Carex rossii instead of *Bromus carinatus* and *Poa nervosa*, the two principal species in the pine ecosystem.

When a tree community of 53-percent crown cover is reduced by fire to bare soil on a southwesterly exposure, insolation becomes a critical factor in changing the microsite. It, in combination with a lack of seed source, reduces to remote, the possibility of a reasonably fast recovery to a conifer stand. Apparently *Artemisia tridentata* seed sources survived sufficiently to allow a domination of the site by this species. Since a *Pinus ponderosa* seed source is lacking, and the site is totally occupied by successional vegetation, it appears that unless the site is artificially manipulated the *Artemisia tridentata/Stipa occidentalis-Lathyrus* community will remain dominant for some time. The scattered stand of *P. contorta* suggests that it will, in time, achieve dominance in the ultimate succession to *P. ponderosa* and *Abies concolor*.

Habitat value. — Value of this habitat is medium because it is limited to the upper Winter Ridge area and is small (less than 5,000 acres) in relation to the total study area. Its value lies principally in the availability of abundant perennial forbs during the late spring and early to middle summer. The significance of this forb forage supply is that this community has 16 percent of its vegetal composition in perennial forbs, whereas the *Pinus ponderosa/Artemisia tridentata/Bromus carinatus* ecosystem has only 5 percent.

Habitat manipulation. — Since this ecosystem is part of the mule deer's summer range that in total seems to supply adequate amounts of forage during most years, it should be considered primarily for timber production and secondarily for game production. The convenient rehabilitation of this ecosystem to a *Pinus ponderosa* stand is hampered by the dense and vigorous *Artemisia tridentata* which occupies the site. It is further hampered by the problem of exposure and severe insolation of a south- and west-facing slope devoid of even a thin tree canopy. Any attempt to plant pine will have to be preceded by at least a partial kill of *A. tridentata*, utilizing shrub shade for protection during establishment. A total kill of *A. tridentata* may produce such a severe site that planted tree seedlings cannot survive. Whether any of the species of legumes present has nitrogen-fixing capabilities is not known. However, it is probable that among *Lupinus* sp., *Trifolium* sp., and *Lathyrus* sp. one or more have provided this soil with a supplement of nitrogen which should benefit any conifer planting.

18 *Artemisia arbuscula / Festuca idahoensis* Ecosystem

Physical Description

Site. — This community is one of three dominated by *Artemisia arbuscula.* All occur on rocky openings from the transition range throughout all but the highest parts of the summer range, from elevations of 4,700 to 6,500 feet. These openings vary in size from approximately 5 acres to extended plains over 1 mile across.

Slopes are moderate, seldom exceeding 5 percent. Slope aspects are generally westerly but occasionally northerly, particularly in the transition range.

Vegetation. — Three communities that commonly occur in varying combinations with the one being described here are (1) *Artemisia arbuscula/Koeleria cristata,* (2) *A. arbuscula/Danthonia unispicata,* which will be discussed later, and (3) *Cercocarpus ledifolius/Festuca idahoensis-Agropyron spicatum,* which has been described. The latter commonly occurs around scab flat edges, between *A. arbuscula* and conifer types. The first two and the one under discussion here are treeless communities characterized by a low-growing shrub and an understory of mixed herbaceous species. The only shrub recorded in any of the three is *A. arbuscula.* In this ecosystem it averages 8 inches in height and 26 percent of the composition.

There are fewer forbs here than in any other ecosystem sampled except the two *Cercocarpus ledifolius* ecosystems previously described. *Lomatium triternatum* is the most widely distributed perennial (86-percent frequency), and *Eriophyllum lanatum* has the largest share of the composition (3 percent). Annual forbs, as a group, occur more frequently than perennials.

Soil. — This is a stony loam soil about 18 inches deep. Drainage, although not good, is less restricted than in the other *Artemisia arbuscula* ecosystems.

The A horizon is 6 to 7 inches deep, is a loam, and has a pH of 6.5. The B horizon is 12 to 15 inches, is a clay, and has a pH of 7.0. Root con-

Average vegetation-site characteristics of the *Artemisia arbuscula/Festuca idahoensis* ecosystem

Number of plots: 7 Condition class: good

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 18 percent surface area	--	100
Rock, 38 percent surface area	--	100
Litter, 37 percent surface area	--	100
Moss, 2 percent surface area	--	100
Total vegetation, 5 percent surface area	--	100
Artemisia arbuscula, 14 percent crown cover	26	100
Festuca idahoensis	32	100
Danthonia unispicata	16	100
Poa sandbergii	13	100
Sitanion hystrix	4	100
Koeleria cristata	2	86
Eriophyllum lanatum	3	57
Arenaria congesta	.9	29
Lomatium triternatum	.5	86
Erigeron bloomeri	.4	43
Agoseris sp.	.2	43
Microsteris gracilis	.2	29
Arabis sp.	.1	14
Calochortus macrocarpus	.1	14
Geum ciliatum	.1	14
Lomatium nudicaule	.1	14
Penstemon sp.	.1	14
Polygonum douglasii[1]	.4	86
Collinsia parviflora[1]	.2	71
Gayophytum nuttallii[1]	.2	29
Navarretia tagetina[1]	.2	100
Linanthus harknessii[1]	.1	86
Epilobium minutum[1]	.1	43
Plagiobothrys hispidus[1]	.1	29

[1]Annuals.

centration is in the upper 6 inches. Soil surface coverage by stones ranges from 26 to 75 percent, averaging 38 percent, and volume of stone in the soil mantle ranges from 37 to 63 percent with an average of 50 percent.

There is little obvious difference between this soil and the soil under the *Artemisia arbuscula/Koeleria cristata* ecosystem. Two differences and probably two reasons why this soil supports *Festuca idahoensis* while the other doesn't are the typically deeper A horizon (6 inches instead of 4) and less restrictive B horizon. The *A. arbuscula/Danthonia unispicata* ecosystem has no *F. idahoensis*, but it does have an A horizon depth and B horizon texture equal to this ecosystem. However, *D. unispicatum* replaces *F. idahoensis* in areas of higher moisture.

Discussion

Ecosystem. — The ecosystems which include the rocky or "scab" flat openings create an interesting and complex situation. It is common to have more than one *Artemisia arbuscula* community on a single scab flat. In fact, it is not uncommon to find *A. arbuscula/Festuca idahoensis*, *A. arbuscula/Koeleria cristata*, and *A. arbuscula/Danthonia unispicata* communities all on the same scab flat. Each appears to be an edaphic community. Soil-site factors typical of these scab flat ecosystems are shown below:

Ecosystem	A-horizon depth (Inches)	Depth to restrictive layer (Inches)	B-horizon texture	Stoniness in soil (Percent)	Drainage
Artemisia arbuscula/ Festuca idahoensis	6	18	Clay loam	50	Moderately well drained
A. arbuscula/ Danthonia unispicata	7	18	Clay loam	60	Imperfectly or somewhat poorly drained
A. arbuscula/ Koeleria cristata	4	15	Clay	5	Imperfectly or somewhat poorly drained

The most significant difference between the soil that supports *Festuca idahoensis* and the one supporting *Danthonia unispicata* appears to be in their drainage characteristics. *D. unispicata* generally grows in the lower parts of the flats where surface runoff is channeled or where it collects to form temporary pools. The very low percentage of solum stones, the clay, and the shallow A horizon under *Koeleria cristata* combine to restrict both water and root penetration.

A. arbuscula appears hedged from animal use in the *A. arbuscula/Festuca idahoensis* ecosystem.

Note the grass-shrub competition in the *A. arbuscula/F. idahoensis* ecosystem.

Habitat value. — Habitat value of all the *Artemisia arbuscula* communities is estimated to be high. There is no hiding cover so value is primarily for food. Value for food is high during the spring and early summer where these habitats extend into summer range, because of a good selection of forbs and grasses. Where the ecosystems occur in the transition area between summer and winter range, the food value is derived from *A. arbuscula*, as well as forbs and grasses. *A. arbuscula* is used heavily in central Oregon during the spring as soon as leader growth is sufficient to provide tender forage — about 1 to 2 inches long. New grass is used extensively during late winter and early spring but is relegated to second place when *A. arbuscula* becomes available. By the time deer move up into the summer range many forbs are available, as well as new growth on most shrubs, so that *A. arbuscula* is less important.

A high percentage of scab flat acreage in the Silver Lake mule deer's summer range is also the summer range for a small population of pronghorns *(Antilocapra americana).* They inhabit *A. arbuscula* openings as far as 17 miles inside the lower edge of the *Pinus ponderosa* zone measured from the closest point of access from the high desert.

Habitat manipulation. — The potential for total forage production on these sites is relatively low due to their rockiness and shallow soil both of which drastically reduce the soil moisture holding capacity and eliminate site preparation as a possibility. Also, soil compaction is a potential hazard because of the combination of soil texture and late spring moisture. These ecosystems should be maintained with as little manmade disturbance as possible, recognizing that there will be a combination of livestock, mule deer, and pronghorn use on these each year. Livestock use should be delayed until the soil is dry enough to prevent significant compaction. Where acreages of scab flats are small in comparison with higher producing conifer types, the flats may suffer abuse.

19 *Artemisia arbuscula / Danthonia unispicata* Ecosystem

Physical Description

Site. — Site characteristics for this community are described under the *Artemisia arbuscula/Festuca idahoensis* unit.

Vegetation. — *Artemisia arbuscula* averages 13 percent of the composition here, half as much as in the preceding unit.

Five grasses occur in this community, two of which make up more than half the composition, and three of which occur frequently but in small amounts. *Danthonia unispicata* is dominant with 28-percent composition and 100-percent frequency, and *Poa sandbergii* is a close second with 23-percent composition and 100-percent frequency. Site conditions vary so that occasionally these two species do change places with each other in dominance. *Sitanion hystrix*, *Koeleria cristata*, and *Stipa thurberiana* complete the list of grasses.

Perennial forbs account for a much larger part of the composition here (25 percent) than in any other community sampled. *Antennaria dimorpha*, with 17 percent, exceeds all other forbs combined. *Erigeron bloomeri*, *Lomatium triternatum*, *L. nudicaule*, and *Sedum stenopetalum* are widely distributed. *Polimonium micranthum* and *Gayophytum lanatum* are the most common annuals.

Soils. — This is a poorly drained, shallow, stony loam with 36 percent of the surface covered by rock and 27 percent bare. The solum contains approximately 60-percent stone by volume. Root concentration is in the upper 7 inches with roots common to 11 inches. Solum development is in mixed aeolian and illuvial material derived primarily from basalt. A representative profile is:

A11 0-3 inches. Dark brown (7.5 YR 3/2) moist; pinkish gray (7.5 YR 6/2) dry; loam; strong fine platy structure, slightly hard; slightly sticky and slightly plastic; abundant very fine and fine roots; medium acid reaction (pH 6.0); angular cobbles 60 percent of the volume; clear, smooth boundary.

Average vegetation-site characteristics of the *Artemisia arbuscula/Danthonia unispicata* ecosystem

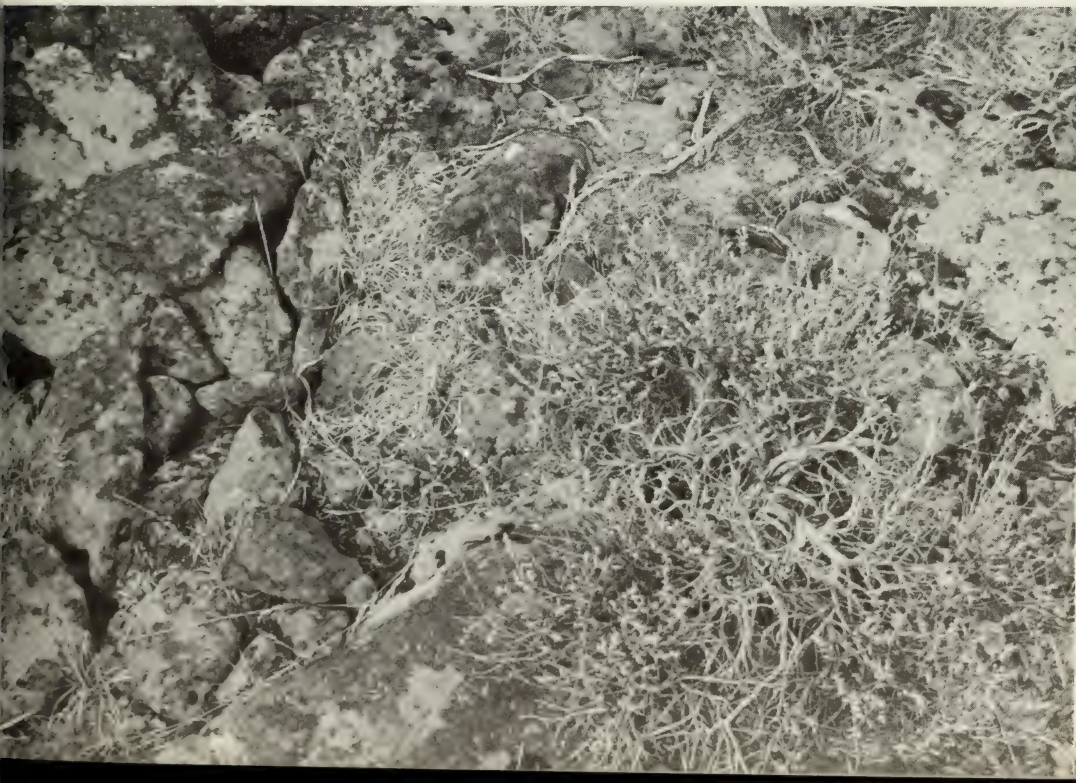
Number of plots: 5 Condition class: fair

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 27 percent surface area	--	100
Rock, 36 percent surface area	--	100
Litter, 33 percent surface area	--	100
Moss, 0.5 percent surface area	--	100
Total vegetation, 3.5 percent surface area	--	100
Artemisia arbuscula, 8 percent crown cover	13	100
Danthonia unispicata	28	100
Poa sandbergii	23	100
Sitanion hystrix	4	100
Koeleria cristata	2	80
Stipa thurberiana	1	60
Antennaria dimorpha	17	100
Microsteris gracilis	3	60
Erigeron bloomeri	1	100
Lomatium triternatum	1	100
Lomatium nudicaule	1	80
Agoseris sp.	.8	60
Sedum stenopetalum	.5	80
Castilleja sp.	.1	60
Achillea millefolium	.1	20
Allium sp.	.1	20
Astragalus sp.	.1	20
Geum ciliatum	.1	20
Trifolium sp.	.1	20
Polemonium micranthum[1]	2	100
Gayophytum lanatum[1]	1	100
Linanthus harknessii[1]	.5	60
Polygonum douglasii[1]	.4	80
Navarretia tagetina[1]	.1	40
Madia glomerata[1]	.1	20

[1] Annuals.

Artemisia arbuscula/Danthonia unispicata ecosystem. These stony, shallow soil ecosystems are fragile and recover very slowly.

Note the limited microsites available for establishment in the *A. arbuscula/D. unispicata* ecosystem.



A12 3-7 inches. Dark brown (7.5 YR 3/2) moist; loam; strong, medium; platy structure; friable; slightly sticky, slightly plastic; abundant very fine and fine roots, and common medium roots; medium acid reaction (pH 6.0); angular cobbles 60 percent of the volume; clear, wavy boundary.

B 7-15 inches. Dark brown (7.5 YR 3/2) moist; clay loam; moderate fine subangular blocky structure; friable; sticky, plastic; common fine and medium roots; medium acid reaction (pH 6.0); angular cobbles 60 percent of the volume.

Discussion

Ecosystem. — See discussion under *Artemisia arbuscula/Festuca idahoensis* community.

Habitat value. — This ecosystem is of moderate value for mule deer habitat. It is relatively small in acreage, has no hiding cover, and has considerably less *Artemisia arbuscula*, a valuable spring food for deer, than other *A. arbuscula* communities but has a high composition of forbs which provide valuable spring and early summer forage.

Habitat manipulation. — See discussion under *Artemisia arbuscula/ Festuca idahoensis* community.

20 *Artemisia arbuscula / Koeleria cristata* Ecosystem

Physical Description

Site. — Site characteristics for this community are described under the *Artemisia arbuscula/Festuca idahoensis* unit.

Vegetation. — The shrub component, composed entirely of *Artemisia arbuscula* (59-percent composition), is more than twice as large as either of the two *A. arbuscula* units previously described and exceeds all other units sampled. The mature plants average 8.5 inches in height.

On the other hand, the grass component is less than half as large (25-percent composition) as it is in the other two *Artemisia arbuscula* units. *Poa sandbergii* is dominant (13 percent), and *Koeleria cristata* (7 percent) and *Sitanion hystrix* (5 percent) follow.

Perennial forbs are a smaller part of the composition (6 percent) than annuals (9 percent). *Lomatium triternatum*, *Antennaria dimorpha*, and *Erigeron bloomeri* account for most of the perennial composition. *Polygonum douglasii*, *Collomia tenella*, and *Navarretia tagetina* are prominent annuals. Since only two plots were sampled for this ecosystem, composition and frequency averages have limited reliability.

Soil. — The soil is a poorly drained, shallow heavy loam or clay loam. Stone on the soil surface averages 34 percent and varies from 5 to 95 percent; stone in the soil averages 5 percent of the volume. Soil development is in basalt residuum with the probable influence of localized loess deposits. It occurs on level to gently sloping topography. A representative profile is:

A11 0-1 inch. Loam; moderate fine platy structure; friable; slightly sticky and slightly plastic; abundant very fine and fine roots and common medium roots; slightly acid (pH 6.2); cobbles 5 percent of the solum; clear, smooth boundary.

A12 1-4 inches. Clay loam; moderate medium platy structure; friable; sticky and plastic; abundant very fine and fine roots and common medium roots; slightly acid (pH 6.2); cobbles 5 percent of the solum; clear, smooth boundary.

Average vegetation-site characteristics of the *Artemisia arbuscula/Koeleria cristata* ecosystem

Number of plots: 2 Condition class: fair

Site and vegetation	Understory composition	Frequency
	Percent	
Bare soil, 15 percent surface area	--	100
Rock, 34 percent surface area	--	100
Litter, 48 percent surface area	--	100
Moss, 1 percent surface area	--	100
Total vegetation, 2 percent surface area	--	100
Artemisia arbuscula, 26 percent crown cover	59	100
Poa sandbergii	13	100
Koeleria cristata	7	100
Sitanion hystrix	5	100
Carex rossii	.2	50
Juncus sp.	.2	50
Antennaria dimorpha	2	100
Lomatium triternatum	2	100
Erigeron bloomeri	1	100
Achillea millefolium	.3	50
Lomatium nudicaule	.2	100
Agoseris sp.	.2	50
Geum ciliatum	.2	50
Trifolium sp.	.2	50
Polygonum douglasii[1]	4	100
Collomia tenella[1]	3	100
Navarretia tagetina[1]	2	100
Madia glomerata[1]	.3	100
Linanthus harknessii[1]	.2	100

[1]Annuals.

Surface stone in the *A. arbuscula/Koeleria cristata* ecosystem is highly variable.

Severe frost heave hampers the development of plants in the *Artemisia arbuscula/ Koeleria cristata* ecosystem.

B 4-18 inches. Clay; strong, medium subangular blocky structure; very sticky and very plastic; clay skins on ped surfaces, and clay skins on stones; uncommon very fine, fine and medium roots; medium acid reaction (pH 6.0); cobbles 10 percent of the solum; clear, smooth boundary.

C 18-20+ inches. Weathered basalt fragments in a clay matrix; mildly alkaline reaction (pH 7.5).

Permeability of this soil is estimated as slow and runoff, as slow to medium. Erosion hazard is moderate. Extreme pedestaling of both grasses and *Artemisia arbuscula* is evident in many areas. Frost crystals 3 inches high have been observed, and *A. arbuscula* shrubs commonly have 4 to 6 inches of roots exposed.

Discussion

Ecosystem. — This is the third "scab flat" ecosystem dominated by *Artemisia arbuscula.* It should be noted that there is a significantly larger percent composition of *Poa sandbergii* than *Koeleria cristata. P. sandbergii* is a species that seems to be in a position between perennial and annual grasses although it is actually a perennial. It begins growth early in the spring before most other perennial grasses and then normally matures and enters the summer with cured forage of no value to game and limited value to livestock. Yearly production on an equal cover basis is less, and varies to a greater degree, than species such as *K. cristata* or *Sitanion hystrix.* Being in this position of a quasiannual, *P. sandbergii* is not considered on a par ecologically with the typical perennial bunchgrasses. Therefore, even though its place in the composition indicates an apparent dominance in the grass layer, it is not considered as such here.

This ecosystem is probably most typical of the flat, stony, shallow soiled "scab flats" of this area — not particularly in species composition, but in the heavy soil and the prominence of *P. sandbergii.* Most scab flats have been severely overused by cattle in this area; therefore this ecosystem exhibits only one of many condition classes which may be encountered. *K. cristata* may commonly be replaced by *Sitanion hystrix*, *Stipa thurberiana*, or any codominant combination.

Habitat value. — The value of this ecosystem is high in combination with other scab flat ecosystems. Value is further discussed in the *Artemisia arbuscula/Festuca idahoensis* ecosystem.

Habitat manipulation. — As has been recommended for the other scab flat ecosystems, no deliberate manipulation (other than reduction of livestock use) of these sites should be attempted. If there are any areas which are large enough in acreage to be managed as separate game allotments (possibly near Sycan Marsh and Murphy Windmill) for mule deer and the pronghorn, then an elimination of livestock use would be an important step towards developing a wide selection of high quality summer range habitats for game.

21 *Artemisia cana/ Muhlenbergia richardsonis* Ecosystem

This ecosystem generally occurs as a ring surrounding seasonally ponded areas, expanding and receding as the water line moves back and forth with long-term changes in the moisture cycle.

Artemisia cana is the only shrub which occurs commonly. Trees and shrubs occurring at the type edge or as inclusions are *Salix* sp., *Populus tremuloides*, *Pinus contorta*, *Artemisia arbuscula*, and *A. tridentata*.

Muhlenbergia richardsonis, *Eleocharis* sp., and *Juncus* sp. form a fairly heavy stand under *Artemisia cana*, with forbs very scarce. There is extreme competition between livestock and deer for the few forbs which do occur.

Acreage as well as game forage in this ecosystem is limited, and therefore the value is low.

Artemisia cana **commonly rings seasonally ponded meadows in the Silver Lake deer range.**

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Appendix

Scientific Names, Authors, and Common Names of Species Mentioned in the Text

SCIENTIFIC NAMES & AUTHOR	COMMON NAME
Mammals	
Odocoileus hemionus hemionus Raf.	mule deer
Antilocapra americana Ord	pronghorn
Birds	
Bonasa umbellus sabini Douglas	Oregon ruffed grouse
Plants	
Abies concolor (Gord. & Glend.) Lindl. ex Hildebr.	white fir
Abies lasiocarpa (Hook.) Nutt.	subalpine fir
Achillea millefolium L.	yarrow
Agoseris Raf.	agoseris
Agropyron Gaertn.	wheatgrass
Agropyron cristatum (L.) Gaertn.	fairway crested wheatgrass
Agropyron spicatum (Pursh) Scribn. & Sm.	bluebunch wheatgrass
Allium L.	onion
Amelanchier alnifolia Nutt.	Saskatoon serviceberry
Anaphalis margaritacea (L.) B. & H.	common pearleverlasting
Antennaria corymbosa E. Nels.	flattop pussytoes
Antennaria dimorpha (Nutt.) T. & G.	low pussytoes
Antennaria geyeri Gray	pinewoods pussytoes
Antennaria rosea Greene	rose pussytoes
Apocynum androsaemifolium L.	spreading dogbane
Arabis L.	rockcress
Arctostaphylos patula Greene	greenleaf manzanita
Arenaria congesta Nutt.	ballhead sandwort
Arnica cordifolia Hook.	heartleaf arnica
Artemisia L.	sagebrush
Artemisia arbuscula Nutt.	low sagebrush
Artemisia cana Pursh	silver sagebrush
Artemisia tridentata Nutt.	big sagebrush

SCIENTIFIC NAMES & AUTHOR	COMMON NAME
Aster L.	aster
Astragalus L.	milkvetch loco
Astragalus purshii Dougl. ex Hook.	woollypod milkvetch
Astragalus stenophyllus T. & G.	hangingpod milkvetch
Balsamorhiza sagittata (Pursh) Nutt.	arrowleaf balsamroot
Berberis repens Lindl.	low oregongrape
Brodiaea Sm.	brodiea
Bromus carinatus Hook. & Arn.	California brome
Bromus tectorum L.	cheatgrass brome
Calochortus macrocarpus Dougl.	sagebrush mariposa
Carex L.	sedge
Carex athrostachya Olney	slenderbeak sedge
Carex rossii Boott	Ross sedge
Castilleja Mutis ex L.	paintbrush
Ceanothus prostratus Benth.	squawcarpet
Ceanothus velutinus var. *velutinus* Dougl. ex Hook.	snowbrush
Cercocarpus H. B. K.	mountain-mahogany
Cercocarpus ledifolius Nutt.	curlleaf mountain-mahogany
Chaenactis douglasii (Hook.) H. & A.	falseyarrow
Chimaphila umbellata (L.) Bart.	common pipsissewa
Chrysothamnus nauseosus (Pall.) Britt.	tall gray rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	tall green rabbitbrush
Cirsium Mill.	thistle
Collinsia parviflora Lindl.	littleflower collinsia
Collomia grandiflora Doug. ex Lindl.	largeflower collomia
Collomia tenella Gray	diffuse collomia
Crepis L.	hawksbeard
Cryptantha ambigua (Gray) Greene	obscure cryptantha
Danthonia californica Boland.	California danthonia
Danthonia unispicata (Thurb.) Munro ex Macoun	onespike danthonia
Delphinium L.	larkspur
Deschampsia danthonioides (Trin.) Munro ex Benth.	annual hairgrass
Deschampsia elongata (Hook.) Munro ex Benth.	slender hairgrass
Eleocharis R. Br.	spikesedge
Epilobium minutum Lindl. ex Hook.	smallflower willowweed
Erigeron L.	fleabane
Erigeron bloomeri Gray	scabland fleabane
Eriogonum Michx.	buckwheat
Eriogonum microthecum Nutt.	slenderbush buckwheat
Eriophyllum lanatum (Pursh) Forbes	woolly eriophyllum

SCIENTIFIC NAMES & AUTHOR	COMMON NAME
Festuca idahoensis Elm	Idaho fescue
Fragaria virginiana Duchesne	blueleaf strawberry
Galium L.	bedstraw
Gayophytum nuttallii T. & G.	nuttall groundsmoke
Geranium L.	geranium
Geum L.	avens
Geum macrophyllum Willd.	largeleaf avens
Geum triflorum Pursh	prairiesmoke avens
Haplopappus bloomeri Gray	rabbitbrush goldenweed
Hieracium cynoglossoides Arv.-Touv.	houndstongue hawkweed
Hydrophyllum capitatum Dougl. ex Benth.	ballhead waterleaf
Juncus L.	rush
Juniperus occidentalis Hook.	western juniper
Koeleria cristata Pers.	prairie junegrass
Lathyrus L.	peavine
Lewisia rediviva Pursh	bitterroot lewisia
Lilium columbianum Hanson	columbia lily
Linanthus harknessii (Curran) Greene	Harkness linanthus
Lithophragma Nutt.	woodlandstar
Lithospermum L.	gromwell
Lomatium Raf.	biscuitroot
Lomatium nudicaule (Pursh) Coult. & Rose	barestem lomatium
Lomatium triternatum (Pursh) Coult. & Rose	nineleaf lomatium
Lupinus L.	lupine
Lupinus caudatus Kell.	tailcup lupine
Madia glomerata Hook.	cluster tarweed
Melica bulbosa Geyer ex Porter & Coult.	oniongrass
Microsteris gracilis (Hook.) Greene	pink microsteris
Montia perfoliata (Donn) Howell	minerslettuce
Muhlenbergia Schreb.	muhly
Muhlenbergia filiformis (Thurb.) Rydb.	pullup muhly
Muhlenbergia richardsonis (Trin.) Rydb.	Richardsons muhly
Navarretia tagetina Greene	northern navarretia
Paeonia brownii Dougl. ex Hook.	Browns peony
Penstemon Mitch.	penstemon
Phacelia Juss.	phacelia

SCIENTIFIC NAMES & AUTHOR	COMMON NAME
Phacelia hastata Dougl. ex Lehm.	whiteleaf phacelia
Picea engelmannii Parry	Engelmann spruce
Pinus contorta Dougl.	lodgepole pine
Pinus ponderosa Laws.	ponderosa pine
Plagiobothrys hispidus Gray	popcornflower
Plagiobothrys scouleri (H. & A.) Johnst.	Scouler popcornflower
Poa L.	bluegrass
Poa nervosa (Hook.) Vasey	Wheeler bluegrass
Poa sandbergii Vasey	Sandberg bluegrass
Polemonium micranthum Benth.	littlebells polemonium
Polygonum douglasii Greene	Douglas knotweed
Populus L.	cottonwood
Populus tremuloides Michx.	quaking aspen
Potentilla L.	cinquefoil
Potentilla glandulosa Lindl.	gland cinquefoil
Potentilla gracilis Dougl. ex Hook.	beauty cinquefoil
Prunus emarginata (Dougl.) Walpers	bitter cherry
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Pterospora andromedea Nutt.	woodland pinedrops
Purshia tridentata (Pursh) DC.	antelope bitterbrush
Ranunculus L.	buttercup
Ribes cereum Dougl.	wax currant
Salix L.	willow
Scirpus L.	bullrush
Sedum stenopetalum Pursh	wormleaf stonecrop
Senecio L.	groundsel
Senecio integerrimus Nutt.	western groundsel
Sidalcea oregana (Nutt.) Gray	Oregon checkermallow
Silene L.	silene
Sitanion hystrix (Nutt.) J. G. Smith	bottlebrush squirreltail
Stipa occidentalis Thurb. ex Wats.	western needlegrass
Stipa thurberiana Piper	Thurber needlegrass
Symphoricarpos albus (L.) Blake	common snowberry
Tetradymia canescens DC.	gray horsebrush
Thalictrum L.	meadowrue
Thuja plicata Donn	western redcedar
Trifolium L.	clover
Tsuga heterophylla (Raf.) Sarg.	western hemlock
Tsuga mertensiana (Bong.) Carr.	mountain hemlock
Viola purpurea Kell.	goosefoot violet
Zigadenus Michx.	deathcamas

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Twenty-one ecosystems of the Silver Lake mule deer range in northern Lake County, Oregon, are described. Discussions are included on ecosystem interrelationships and value and management for game. A field key to ecosystems has been developed.

Keywords: Ecosystem, habitat, mule deer, vegetation, soils, site class.

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The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.

2. Development and evaluation of alterantive methods and levels of resource management.

3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

College, Alaska
Juneau, Alaska
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La Grande, Oregon
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The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.