Shrub-Steppe Vegetation of the East Fork and the Middle Fork of the Salmon River Drainages

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Front Cover: Middle Fork Salmon River, January 1976.

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Abstract

Authors describe nineteen shrub-steppe communities in the Middle Fork and East Fork of the Salmon River, Idaho. Bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*) occur as dominants or major subdominants throughout the region. Big sagebrush (*Artemesia tridentata*), threetip sagebrush (*A. tripartita*), and low sagebrush (*A. arbuscula*) are dominants, especially in the East Fork and southern Middle Fork. Antelope bitterbrush (*Purshia tridentata*) communities exist throughout the region but are most abundant along the Middle Fork, where the species also occurs as a dominant in the understory of ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) stands on drier sites. Cliffy areas in all regions have curlleaf mountain mahogany (*Cercocarpus ledifolius*) and little greenbush (*Glossopetalon nevadense*) stands, reflecting the specialized habitats on which these communities occur. Shadscale saltbush (*Atriplex confertifolia*) communities occupy the driest sites in the lower East Fork. Common snowberry (*Symphoricarpos albus*), antelope bitterbrush, big sagebrush, threetip sagebrush, Idaho fescue, bluebunch wheatgrass, and needle-and-thread (*Hesperostipa comata*) are well represented in the plant communities. Bluebunch wheatgrass or Idaho fescue or both dominate grassland communities. Needle-and-thread dominates on some xeric, sandy sites. The presence of ponderosa pine or Douglas fir in shrub communities suggests these are successional stages of conifer-dominated community types. At least six conifer communities are represented in ten stands dominated by common snowberry, in thirteen dominated by ninebark (*Physocarpus malvaceus*), five dominated by Idaho fescue, and three dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Seven sites exclosed between 1915 and 1950 provide evidence of reduction in shrubs and expansion of grassland and herbaceous portions of these communities in the Middle Fork. A record of a stand photographed in 1925, 1968, and 1988 appears to corroborate these findings. Changes in species composition of these communities are attributed to changes in species of herbivores, including livestock, mule deer, and elk; to alterations in the natural fire regime; and to weather patterns that affected woody and herbaceous plants differently over the period. The major fire of 2000 in the Middle Fork drainage appears to have increased cheatgrass (*Bromus tectorum*) at least temporarily, and to have reduced nonresprouting shrubs including big sagebrush, curlleaf mountain mahogany, and antelope bitterbrush. Subsequent establishment of new plants from seeds has occurred on sites burned in the most recent fires. Productivity of bluebunch wheatgrass was reduced for one year following the 2000 fire.

Introduction

Central Idaho's mountain-canyon rangelands represent a signature portion of the unique complex of topography, climate, substrate, water, and vegetation that identifies the region. Initially carved by glaciers, and subsequently by cherished rivers and streams, the region contains a wealth of resources: mineral, animal, vegetable, and liquid, recognizable in its steep terrain, sandy soils, forests, and clear streams. However, if the rivers are its life blood, the rangelands or shrub steppe form the backbone of the system. Shrub-steppe vegetation provides important winter ranges for deer, elk, and mountain sheep, for which the region is famous. Other wildlife, such as blue grouse and meadowlark, depend on shrub-steppe vegetation for nesting cover and foraging. The major predators: mountain lion, gray wolf, golden eagle, and red-tailed hawk, in turn depend on the shrub steppe that sustains their prey.

Native Americans, who first inhabited the region, also depended on mule deer and mountain sheep. The biscuitroot (*Lomatium* spp.) and basin wildrye (*Elymus cinereus*) of the shrub steppe provided sustenance and weaving material. Early settlers, trappers, soldiers, and homesteaders depended on the mountain rangelands to sustain their livestock. The rangelands also provided forage for the pack stock that carried supplies to mines of the region. Today, ranchers, outfitters, recreationists, hunters, and fishermen depend on these rangelands in various ways, for forage, habitat, watershed, and for their austere, compelling esthetics. Humans and wildlife depend heavily on these rangelands.

The mountain canyon shrub-steppe lands of central Idaho are defined as those nonforested communities where shrubs, grasses, and forbs (herbs) dominate the landscape. In the driest southeast portion of the region, shrub steppe may occupy the entire elevation gradient, with forest confined to smaller areas. In the western portion along the Salmon River canyon and the South Fork tributary, forested communities predominate. There, shrub steppe is held to the driest and warmest sites. However, even as the familiar rangeland vegetation grades into forested communities, the drier forests often are underlain by many of those same shrub-steppe plants.

The rangeland complex consists of a number of different plant communities adapted to the changes in soil, topography, temperature, and precipitation occurring along the often steep elevation gradients of the region. Many plant communities that occupy dramatically different habitats and have different ecological attributes may not appear different to the observer at a distance. A person floating the Middle Fork, for instance, is able to observe a wide

variety of shrub-steppe complexes. However, each complex offers important contributions for sustaining the wildlife resource. Recognition of the different plant communities becomes a prerequisite to understanding the ecology of the entire system. We describe many of these different plant communities, consider their major plants, provide a dichotomous key to identify the communities using key plants, and report the values of each. We hope this work will stimulate a greater appreciation of this important vegetation complex.

Shrub-steppe plant communities in the East Fork and Middle Fork of the Salmon River (Figure 1) represent an intergrade between the shrub-steppe communities of the Snake River Plain and adjacent valleys, and the lower Salmon River and Snake River regions. Extant classifications of shrub-steppe communities in southern Idaho (Hironaka et al. 1983), western

Figure 1. Salmon River, Middle Fork of the Salmon River, East Fork of the Salmon River, and Big Creek drainages, sites of shrub-steppe communities examined in this study.

Montana (Mueggler and Stewart 1980), and the lower Salmon-Snake River grasslands (Tisdale 1986), demonstrated that plant communities vary across this region. Shrub steppe in the East Fork and Middle Fork is sufficiently unique to warrant a separate classification since existing classifications are not completely applicable. We offer a provisional description of these shrub-steppe plant communities.

Sufficient information was available from adjacent shrub-steppe communities to identify dominants likely to occur in this region. The early classifications by Daubenmire (1970) of the shrub steppe of eastern Washington and northern Idaho included the Snake River and lower Salmon River below Riggins, Idaho. Tisdale (1986) further clarified the canyon grasslands along the Snake River, Clearwater River, and lower Salmon River to 20 miles east of Riggins, immediately adjacent to our study area. Tisdale (1986) described eight grassland communities, of which five are dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), or both. Shrub dominated communities include common snowberry (*Symphoricarpos albus*) and curlleaf mountain mahogany (*Cercocarpus ledifolius*), but big sagebrush (*Artemisia tridentata*) is absent. These plant communities, within the Pacific Northwest Bunchgrass Region, are predominantly underlain by basalt with surface deposits of volcanic ash. This forms a fertile substrate when compared with the decomposed granites of the Idaho Batholith characterizing much of the shrub steppe in the study area.

The sagebrush-grassland communities reported by Hironaka et al. (1983) for southern Idaho extend into the mountain rangelands of this region. Of 32 communities identified, 18 are dominated by bluebunch wheatgrass, Idaho fescue, the various subspecies of big sagebrush, or by all of these. Antelope bitterbrush (*Purshia tridentata*), curlleaf mountain mahogany, threetip sagebrush (*Artemisia tripartita*), and black sagebrush (*A. nova*) are components of other communities.

Mueggler and Stewart (1980) described 29 communities for mountain rangelands of western Montana, including 22 dominated by Idaho fescue or bluebunch wheatgrass, or both. Again, big sagebrush, threetip sagebrush, antelope bitterbrush, black sagebrush, and curlleaf mountain mahogany are associated dominant species.

These investigations of vegetation adjacent to the central Idaho mountain rangelands have several attributes in common. First, bluebunch wheatgrass and Idaho fescue consistently occur as dominants on appropriate sites throughout the broader region of these investigations. Big sagebrush and

antelope bitterbrush also have broad distributions, though both are absent from the low elevations of the lower Salmon River and Snake River region. However, they reappear north of these low canyons and west of the Palouse Prairie region in Washington. Needle-and-thread (*Hesperostipa comata*) is well distributed throughout the region on drier sites, but may be best represented on disturbed sites dominated by other species.

The plant communities described here were examined in the 1970-2003 period, with most work occurring in the 1970s and 1980s. Even with complete protection, plant communities in sagebrush steppe change over long periods, depending on precipitation patterns, nature and intensity of the original disturbance (Anderson and Inouye 2001). Fire also affects the composition and appearance of these communities, as does invasion by exotic plants like cheatgrass (*Bromus tectorum*) and knapweeds (*Centaurea* spp.). Virtually all stands had been disturbed to some degree by livestock, native ungulates, and invasion of exotic species prior to examination. Many stands burned after we had examined them, and we report fire influence where we had observations.

Climate

Finklin (1988) described the climate of these mountain rangelands. Weather stations at Challis (1577 m above mean sea level), Middle Fork Lodge (1365 m), Taylor Ranch (1178 m), and Campbell's Ferry (704 m) provided an indication of the variation in temperature and precipitation in the vicinity of the study areas and across these canyon rangelands.

Generally, annual precipitation decreases from west to east in the canyonlands. Campbell's Ferry on the main Salmon River averaged 60 cm, Taylor Ranch 38 cm, Middle Fork Lodge 43 cm, and Challis 18 cm annually. The station having the lowest elevation, Campbell's Ferry, had the highest precipitation, while the highest station, Challis, had the least precipitation. The Salmon River and its South Fork lie within a 50-cm to 75-cm rainfall belt, the Middle Fork in a 25-cm to 50-cm belt, and the valleys containing the towns of Challis and Salmon lie in a rainfall belt of 25 cm or less (Finklin 1988). Riggins, Idaho, on the extreme western side of the region at 550 m msl, had 43 cm of annual precipitation. That portion of the Salmon River lies within a 38-cm to 50-cm rainfall belt, reflecting precipitation in the lower elevation and very deep canyon country of this area.

Approximately 50% of the precipitation came during November through March, with December and January being the wettest months, except in the eastern canyonlands, where May and June were the wettest. Total annual

snowfall at Challis averages 50 cm, at Middle Fork Lodge 135 cm, at Taylor Ranch 118 cm, and at Campbell's Ferry 182 cm.

Temperatures also show a gradient between the various portions of the study area, although they were not as pronounced as the moisture gradient. Challis had the lowest mean minimum temperature in January at -12°C, followed by Middle Fork Lodge (-11°C), Taylor Ranch (-10°C) and Campbell's Ferry (-7°C). Average maximum July temperatures at Challis were 30°C, at Middle Fork Lodge 30°C, at Taylor Ranch 31°C, and at Campbell's Ferry 33.5°C.

The pattern shows a slightly warmer, wetter climate on the northwest portion of the region and a slightly drier, cooler climate on the eastern side. Storms from the Pacific Ocean move up the Columbia River system into the Salmon River canyons. The eastern rangelands are located within a rain shadow and receive more influence from interior continental weather patterns.

Geology and Soils

Soils in the Middle Fork drainage primarily derive from granitic Idaho batholith parent material. This batholith formed during the Cretaceous period more than 55 million years ago. Shallow, coarse soils, interspersed with granitic outcroppings, characterize the ridges (Larson and Lovely 1972, Ross and Savage 1967).

In the East Fork and on some areas in the Middle Fork, Challis volcanics of tertiary age constitute the predominant formation (Ross and Savage 1967, Moye et al. 1988). The major portion of the area is composed of latite and andesite flows and flow breccia. The upper East Fork portions of the study area are underlain by Germer tuffaceous material, which is the result of explosive volcanic ash showers. Soils derived from the Challis volcanics are generally very fertile (Ralm and Larson 1972). A north to south gradient of a more moist climate but less fertile substrate on the northern portions trends to a less moist but more fertile substrate on the southern portions of the Salmon River Mountains.

Methods

Our data come from Herd Creek, a tributary of the East Fork of the Salmon River, the East Fork of the Salmon River, the Middle Fork of the Salmon, Big Creek (a tributary of the Middle Fork), and the main Salmon River from the Shepp Ranch to the Campbell's Ferry area. Field investigations involved establishing twenty $0.1m^2$ rectangular plots on randomly selected sites (Daubenmire 1959) to obtain canopy coverage and frequency of herbaceous

and low-growing plants. Canopy coverage of each species in each plot was estimated to be in one of six standard categories: 1) 0-5%; 2) 6-25%; 3) 26-50%; 4) 51-75%; 5) 76-95%; 6) 96-100%. Canopy coverage is defined as the vertical projection to ground level of the maximum aerial canopy of the species within the sample plot (Daubenmire 1959).

Productivity of grasses involved clipping study species to 1 cm above ground level in late June when plants were in full flower. Twenty 0.1m^2 plots were clipped at each site. Materials were placed in paper bags, oven-dried for at least 24 hours at 70^{0}C, and measured to the nearest 0.01 gm.

Density of shrubs was tabulated from six 9.2 m^2 circular plots established on each sample site. Presence or absence of each species and frequency were the common measurements for all study sites. Each site was inspected to ensure it represented the vegetation complex to be measured and that the sample area included no ecotones or other communities. Sites selected for this analysis did not show current evidence of disturbance, although evidence of past disturbance, primarily grazing, was apparent in some stands as revealed by examination of species composition.

The classification was guided by program TWINSPAN (Hill et al. 1979), which classifies stands and species according to affinities and produces an ordered two-way table that expresses species' synecological relationships. A Bray-Curtis ordination program (McCune and Mefford 1999) was used to identify relationships between individual species in the East Fork, where substrates were similar. McCune et al. (2002) provide information suggesting this method is a robust means of assessing species relationships. All annual species were omitted in both the classification and ordination. We use the analyses along with information from other vegetation classification investigations of nearby regions, plus observations of stand conditions to interpret our information. Common and scientific names of plants appear in Table 1. Nomenclature follows Hitchcock and Cronquist (1973) and the USDA Natural Resources Conservation Service National Plant Database (1998 website: plants.usda.gov).

Exclosure studies reported by Peek (2000) are expanded upon here because they illustrate changes in vegetation in the Middle Fork drainage. We randomly established a transect of twenty 0.1m^2 plots on representative sites inside exclosures and on similar adjacent sites. Plots were 1 m apart. When more than one vegetative type or topographical situation was present in an exclosure, we established paired plots inside and outside for each type where possible. We examined vegetation to determine if the fences appeared to influence composition and avoided locations immediately adjacent to

Table 1a. Scientific and common names of plant species named in this study.

Woody Plants

Amelanchier alnifolia	Serviceberry
Acer glabrum	Mountain maple
Artemisia tridentata ssp. *tridentata*	**Basin big sagebrush**
Artemisia tridentata	Big sagebrush
Artemisia tridentata ssp. *vaseyana*	Mountain big sagebrush
Artemisia tridentata ssp. *wyomingensis*	Wyoming big sagebrush
Artemisia tripartita	Threetip sagebrush
Artemisia arbuscula	Low sagebrush
Artemisia nova	Black sagebrush
Atriplex canescens	Fourwing saltbush
Atriplex confertifolia	Shadscale saltbush
Berberis repens	Oregon grape
Ceanothus sanguineus	Redstem ceanothus
Ceanothus velutinus	Shinyleaf ceanothus
Cercocarpus ledifolius	Curlleaf mountain mahogany
Chondrilla juncea	Skeletonweed
Chrysothamnus viscidiflorus	Green rabbitbrush
Ericameria nauseosa	Heath goldenrod
Eriogonum caespitosum	Mat buckwheat
Eriogonum heracleoides	Parsnip-flowered buckwheat, Wyeth buckwheat
Eriogonum microthecum	Slenderbush buckwheat
Eriogonum ovalifolium	Oval-leafed buckwheat
Glossopetalon nevadense	Little greenbush
Holodiscus discolor	Ocean-spray
Juniperus spp.	Juniper
Leptodactylon pungens	Granite prickly phlox
Lonicera utahensis	Utah honeysuckle
Opuntia polyacantha	Prickly pear
Philadelphus lewisii	Syringa
Phlox hoodii	Hood's phlox
Physocarpus malvaceus	Mallow ninebark
Pinus flexilis	Limber pine
Pinus ponderosa	Ponderosa pine
Potentilla fruticosa	Shrubby cinquefoil
Prunus virginiana	Chokecherry
Pseudotsuga menziesii	Douglas fir
Purshia tridentata	Antelope bitterbrush
Ribes aureum	Golden currant
Ribes cereum	Wax currant
Rosa spp.	Roses
Rosa gymnocarpa	Baldhip rose
Rubus parviflorus	Thimbleberry
Sambucus cerulea	Blueberry elder
Spiraea betulifolia	Birchleaf spirea
Symphoricarpos albus	Common snowberry
Symphoricarpos oreophilus	Mountain snowberry

Grasses

Achnatherum hymenoides	Indian ricegrass
Achnatherum lettermanii	Letterman's needlegrass
Achnatherum thurberianum	Thurber's needlegrass
Bromus tectorum	Cheatgrass
Calamagrostis rubescens	Pinegrass
Carex geyeri	Elk sedge
Danthonia spp.	Oatgrass
Elymus cinereus	Basin wildrye
Festuca idahoensis	Idaho fescue
Festuca octoflora	Six-week's fescue
Hesperostipa comata	Needle-and-thread
Koeleria cristata	Junegrass
Melica spp.	Oniongrass
Poa secunda	Sandberg bluegrass
Poa spp.	Bluegrasses
Pseudoroegneria spicata	Bluebunch wheatgrass
Sitanion hystrix	Bottlebrush squirreltail
Sporobolus cryptandrus	Sand dropseed

Forbs or Herbs

Achillea millefolium	Yarrow
Actaea rubra	Baneberry
Adenocaulon bicolor	Trail plant
Agoseris glauca	False dandelion
Arabis holboellii	Rockcress
Arenaria congesta	Ballhead sandwort
Antennaria dimorpha	Pussy-toes
Antennaria microphylla	Roseate pussy-toes
Apocynum androsaemifolium	Dogbane
Arnica cordifolia	Heartleaf arnica
Arnica sororia	Arnica
Aster spp.	Asters
Astragalus filipes	Threadstalk milkvetch
Astragalus spp.	Locoweeds
Balsamorhiza hookeri	Hooker's balsamroot
Balsamorhiza sagittata	Arrowleaf balsamroot
Castilleja inverta	Dwarf pale Indian paintbrush
Castilleja spp.	Paintbrushes
Centaurea spp.	Knapweeds
Cerastium arvense	Chickweed
Collinsia parviflora	Blue-eyed Mary
Cirsium utahense	Utah thistle
Crepis atrabarba	Hawksbeard
Epilobium angustifolium	Fireweed
Epilobium minutum	Small-flowered willow-herb
Erigeron spp.	Fleabane
Frasera albicaulis	Frasera
Fragaria vesca	Woods strawberry
Fragaria spp.	Strawberry
Galium spp.	Bedstraw
Geranium viscosissimum	Sticky geranium
Geum triflorum	Prairie smoke
Heuchera cylindrica	Alumroot
Hieracium albertinum	Hawkweed, Albert Hawkweed
Lewisia rediviva	Bitterroot
Lithophragma parviflora	Woodland star
Lithospermum ruderale	Gromwell
Lomatium foeniculaceum	Harryseed lomatium
Lomatium spp.	Biscuitroots
Lupinus spp.	Lupines
Mentzelia albicaulis	Whitestem mentzelia
Mertensia spp.	Bluebell
Montia spp.	Miner's lettuce
Myosotis spp.	Forget-me-not
Osmorhiza chilensis	Mountain sweet-cicely
Penstemon spp.	Penstemons
Phacelia linearis	Threadleaf phacelia
Phacelia spp.	Phacelia
Phlox longifolia	Longleaf phlox
Polygonum douglasii	Smartweed
Potentilla gracilis	Cinquefoil
Pyrola secunda	Wintergreen
Sedum stenopetalum	Stonecrop
Senecio integerrimus	Groundsel
Silene acaulis	Moss campion
Sisymbrium altissimum	Tumblemustard
Smilacina stellata	Starry false Solomon's seal
Solidago canadensis	Goldenrod
Thalictrum occidentale	Meadow rue
Tragopogon dubius	Salsify
Trifolium spp.	Clovers
Viola adunca	Hook violet

Mosses and Ferns

Selaginella densa	Lesser clubmoss
Woodsia oregana	Woods fern

Table 1b. Common and scientific names of plant species named in this study.

Woody Plants

Antelope bitterbrush	*Purshia tridentata*
Baldhip rose	*Rosa gymnocarpa*
Basin big sagebrush	*Artemisia tridentata* ssp. *tridentata*
Big sagebrush	*Artemisia tridentata*
Birchleaf spirea	*Spiraea betulifolia*
Black sagebrush	*Artemisia nova*
Blueberry elder	*Sambucus cerulea*
Chokecherry	*Prunus virginiana*
Common snowberry	*Symphoricarpos albus*
Curlleaf mountain mahogany	*Cercocarpus ledifolius*
Douglas fir	*Pseudotsuga menziesii*
Fourwing saltbush	*Atriplex canescens*
Golden currant	*Ribes aureum*
Granite prickly phlox	*Leptodactylon pungens*
Green rabbitbrush	*Chrysothamnus viscidiflorus*
Heath goldenrod	*Ericameria nauseosa*
Hood's phlox	*Phlox hoodii*
Juniper	*Juniperus* spp.
Limber pine	*Pinus flexilis*
Little greenbush	*Glossopetalon nevadense*
Low sagebrush	*Artemisia arbuscula*
Mallow ninebark	*Physocarpus malvaceus*
Mat buckwheat	*Eriogonum caespitosum*
Mountain big sagebrush	*Artemisia tridentata* ssp. *vaseyana*
Mountain maple	*Acer glabrum*
Mountain snowberry	*Symphoricarpos oreophilus*
Ocean-spray	*Holodiscus discolor*
Oregon grape	*Berberis repens*
Oval-leafed buckwheat	*Eriogonum ovalifolium*
Parsnip-flowered buckwheat	*Eriogonum heracleoides*
Ponderosa pine	*Pinus ponderosa*
Prickly pear	*Opuntia polyacantha*
Prickly phlox	*Leptodactylon pungens*
Redstem ceanothus	*Ceanothus sanguineus*
Roses	*Rosa* spp.
Serviceberry	*Amelanchier alnifolia*
Shadscale saltbush	*Atriplex confertifolia*
Shinyleaf ceanothus	*Ceanothus velutinus*
Shrubby cinquefoil	*Potentilla fruticosa*
Skeletonweed	*Chondrilla juncea*
Slenderbush buckwheat	*Eriogonum microthecum*
Syringa	*Philadelphus lewisii*
Thimbleberry	*Rubus parviflorus*
Threetip sagebrush	*Artemisia tripartita*
Utah honeysuckle	*Lonicera utahensis*
Wax currant	*Ribes cereum*
Wyeth buckwheat	*Eriogonum heracleoides*
Wyoming big sagebrush	*Artemisia tridentata* ssp. *wyomingensis*

Grasses

Basin wildrye	*Elymus cinereus*
Bluebunch wheatgrass	*Pseudoroegneria spicata*
Bluegrasses	*Poa* spp.
Bottlebrush squirreltail	*Sitanion hystrix*
Cheatgrass	*Bromus tectorum*
Elk sedge	*Carex geyeri*
Idaho fescue	*Festuca idahoensis*
Indian ricegrass	*Achnatherum hymenoides*
Junegrass	*Koeleria cristata*
Letterman's needlegrass	*Achnatherum lettermanii*
Needle-and-thread	*Hesperostipa comata*
Oatgrass	*Danthonia* spp.
Oniongrass	*Melica* spp.
Pinegrass	*Calamagrostis rubescens*
Sand dropseed	*Sporobolus cryptandrus*
Sandberg bluegrass	*Poa secunda*
Six-week's fescue	*Festuca octoflora*
Thurber's needlegrass	*Achnatherum thurberianum*

Forbs or Herbs

Albert hawkweed	*Hieracium albertinum*
Alumroot	*Heuchera cylindrica*
Arnica	*Arnica sororia*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Asters	*Aster* spp.
Ballhead sandwort	*Arenaria congesta*
Baneberry	*Actaea rubra*
Bedstraw	*Galium* spp.
Biscuitroots	*Lomatium* spp.
Bitterroot	*Lewisia rediviva*
Bluebell	*Mertensia* spp.
Blue-eyed Mary	*Collinsia parviflora*
Chickweed	*Cerastium arvense*
Cinquefoil	*Potentilla gracilis*
Clovers	*Trifolium* spp.
Dogbane	*Apocynum androsaemifolium*
Dwarf pale Indian paintbrush	*Castilleja inverta*
False dandelion	*Agoseris glauca*
Fireweed	*Epilobium angustifolium*
Fleabane	*Erigeron* spp.
Forget-me-not	*Myosotis* spp.
Frasera	*Frasera albicaulis*
Goldenrod	*Solidago canadensis*
Gromwell	*Lithospermum ruderale*
Groundsel	*Senecio integerrimus*
Harryseed lomatium	*Lomatium foeniculaceum*
Hawksbeard	*Crepis atrabarba*
Hawkweed	*Hieracium albertinum*
Heartleaf arnica	*Arnica cordifolia*
Hook violet	*Viola adunca*
Hooker's balsamroot	*Balsamorhiza hookeri*
Knapweeds	*Centaurea* spp.
Locoweeds	*Astragalus* spp.
Longleaf phlox	*Phlox longifolia*
Lupines	*Lupinus* spp.
Meadow rue	*Thalictrum occidentale*
Miner's lettuce	*Montia* spp.
Moss campion	*Silene acaulis*
Mountain sweet-cicely	*Osmorhiza chilensis*
Paintbrushes	*Castilleja* spp.
Penstemons	*Penstemon* spp.
Phacelia	*Phacelia* spp.
Prairie smoke	*Geum triflorum*
Pussy-toes	*Antennaria dimorpha*
Rockcress	*Arabis holboellii*
Roseate pussy-toes	*Antennaria microphylla*
Salsify	*Tragopogon dubius*
Small-flowered willow-herb	*Epilobium minutum*
Smartweed	*Polygonum douglasii*
Starry false Solomon's seal	*Smilacina stellata*
Sticky geranium	*Geranium viscosissimum*
Stonecrop	*Sedum stenopetalum*
Strawberry	*Fragaria* spp.
Threadleaf phacelia	*Phacelia linearis*
Threadstalk milkvetch	*Astragalus filipes*
Trail plant	*Adenocaulon bicolor*
Tumblemustard	*Sisymbrium altissimum*
Utah thistle	*Cirsium utahense*
Whitestem mentzelia	*Mentzelia albicaulis*
Wintergreen	*Pyrola secunda*
Woodland star	*Lithophragma parviflora*
Woods strawberry	*Fragaria vesca*
Yarrow	*Achillea millefolium*

Mosses and Ferns

Lesser clubmoss	*Selaginella densa*
Woods fern	*Woodsia oregana*

fences.

Woody plant density in and adjacent to exclosures was measured in twenty $4m^2$ circular plots (1.13 m radius) adjacent to the herbaceous transects. Counts of stems were made at ground level inside plots. Where individual plants had crowns with stems rising just below or at ground level and were obviously one plant, one plant was recorded. This occurred with antelope bitterbrush, curlleaf mountain mahogany, big sagebrush, currants (*Ribes* spp.), heath goldenrod (*Ericameria nauseosa*), green rabbitbrush (*Chrysothamnus viscidiflorus*), and mallow ninebark (*Physocarpus malvaceus*) in this area. Height of a representative plant of each species in the plot was recorded. Dead plants were recorded when present, and percentage of decadent growth on each shrub was estimated.

Twigs, representing current annual growth (CAG) over 1 cm long, were counted for each species inside each plot. The plot was envisioned as a cylinder; twigs within the cylinder were counted whether originating from stems that occurred inside or not. A twig density was calculated to serve as a partial measure of productivity. Lengths of 50 or more randomly selected twigs were measured, air-dried, and individually weighed. The entire collection was then weighed and oven-dried at 70° C for 24 hours and reweighed. The ratio of oven-dried weight to air-dried weight was multiplied for each twig weight to convert to the oven dried weight for each individual twig. Photographs were taken of all stands, and a description of the location of each transect was recorded.

Comparisons of exclosures and adjacent unprotected sites were made using midpoints of the coverage estimation classes, and standard descriptive statistics for each species on the site were obtained using SAS-PC or STATISTIX. Paired T-tests were used to determine significant differences (P=0.05) for selected vegetative parameters inside and outside of the exclosures. Coverage and density data were transformed using log (number+ 1) to account for nonnormal distributions. A Wilcoxon test also was used to compare with the t-tests, but no changes in conclusions resulted from the t-test comparisons.

Results

Species Relationships

A total of 35 perennial species in 63 stands in the East Fork were included in the Bray-Curtis ordination. Moisture and temperature gradients explained 81% of the variance in the analysis, with moisture explaining 61% of the variance and the temperature explaining approximately 20%. The moisture gradient is more extended than the temperature gradient, reflecting the typical

extremes for both attributes that occur on these steppe communities.

Eight grasses and sedges are positioned along the two gradients (Figure 2). As would be expected from its broad distribution in the intermountain west, bluebunch wheatgrass occupies the middle portions of both moisture and temperature gradients. This species is a major climax dominant as well as a major component of many sites where it is not the most dominant plant.

Idaho fescue, the other major climax dominant grass in this region, occupies cooler and moister habitats than bluebunch wheatgrass. Both species have a broad ecological amplitude, since they may occur as dominant understory plants in Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) forests in this region (Steele et al. 1981).

Indian ricegrass (*Achnatherum hymenoides*) occupies the hot, dry ends of the gradients. It appears to have a fairly narrowly defined habitat requirement in this region, and most commonly occurs in the East Fork.

Needle-and-thread occupies drier portions of the moisture gradient, and is common at low elevations in the bigger valley portions of the Middle Fork, for instance around Brush Creek and Warm Springs Creek.

Junegrass (*Koeleria cristata*) occupies a moister portion on the gradient

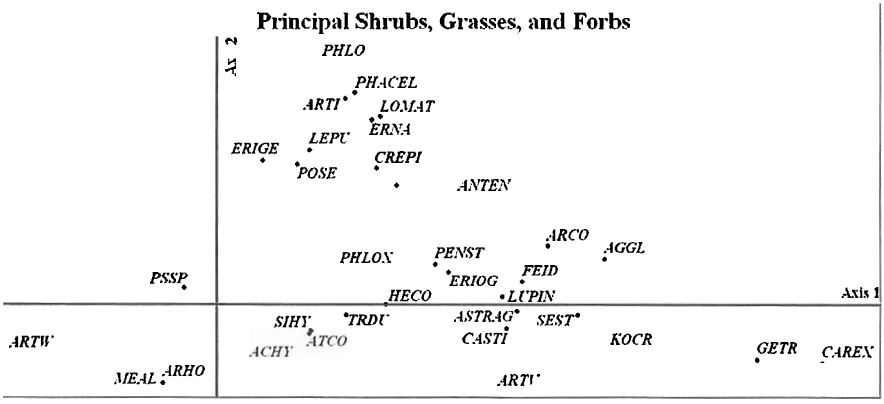

Figure 2. Ordination of principal grasses, shrubs and forbs found in stands examined in the East Fork drainage along moisture and temperature axes. ACHY= *Achnatherum hymenoides*, AGGL= *Agoseris glauca*, ANTEN= *Antennaria* spp., ARCO= *Arenaria congesta*, ARHO= *Arabis holboelli*, ARTV= *Artemisia tridentata vaseyana*, ARTW= *Artemisia tridentata wyomingensis*, ASTRAG= *Astragalus* spp., ATCO= *Atriplex confertifolia*, CAREX = *Carex* spp., CASTI= *Castilleja* spp., CREPI= *Crepis* sp., ERIGE= *Erigeron* spp., ERIOG= *Eriogonum* spp., ERNA= *Ericameria nauseosa*, FEID= *Festuca idahoensis*, GETR= *Galium triflorum*, HECO= *Hesperostipa comata*, HECY= *Heuchera cylindrica*, KOCR= *Koeleria cristata*, LEPU= *Leptodactylon pungens*, LOMAT= *Lomatium* spp., LUPIN= *Lupinus* spp., MEAL= *Mentzelia albicaulis*, PENST= *Penstemon* spp., PHACEL= *Phacelia* spp., PHLO= *Phlox longifolia*, PHLOX= *Phlox* spp., POSE= *Poa secunda*, POGR= *Potentilla gracilis*, PSSP= *Pseudoroegneria spicata*, SEST= *Sedum stenopetalum*, TRDU= *Tragopogon dubius*.

than Idaho fescue. Sandberg bluegrass (*Poa secunda*) is more closely associated with the drier side of the moisture gradient when using cover data rather than presence-absence data. These two species are the most common short grasses which occur as secondary plants beneath the more dominant, taller grasses in this region. Junegrass is more common at higher elevations and on the more mesic sites, while Sandberg bluegrass is more frequent at lower elevations and more xeric sites. Both species dry to a gray litter by mid- to late summer, but green growth starts in fall with the initial rains.

Cheatgrass is a ubiquitous annual most common on the drier sites. We chose not to consider it in the classification because of its exotic status, but it must be considered a permanent occupant of many plant communities in the region. Cheatgrass closely approximates the water requirements of bluebunch wheatgrass (Harris 1967), and coexists with the native species on many sites. In extreme cases of disturbance, caused by fire in some habitats, grazing in others, and extended camping and associated human use in still others, cheatgrass may dominate and replace the native species. Cheatgrass has become the dominant grass on many sites in the Middle Fork where the fires of 2000 occurred, but our photographs of the plant communities were taken before these fires and illustrate the appearance of the vegetation prior to this dominance.

The sagebrushes illustrate unique and rather subtle adaptations to different habitats in this region. The sagebrushes consist of three species, low sagebrush (*Artemisia arbuscula*), threetip sagebrush, and big sagebrush, with big sagebrush further separated into three subspecies: basin big sagebrush (*A. tridentata* ssp. *tridentata*), Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*), and mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), that occupy different habitats and are morphologically distinguishable by their leaves (Hironaka et al. 1983). Mountain big sagebrush occupies the higher elevation cold dry sites, while Wyoming big sagebrush occupies the driest and warmest sites. Basin big sagebrush occurs along streams and valleys, especially in the eastern portions of the region. Threetip sagebrush occupies a slightly moister and warmer habitat than does mountain big sagebrush. Low sagebrush occupies a specific habitat of poorly drained soils underlain by a clay pan and may be supersaturated into early summer (Hironaka et al. 1983). We found it in the East Fork on rocky benches at mid-elevations and ridgetops that exhibited these soil characteristics. Schultz (1986) classified the habitats occupied by the sagebrushes according to a moisture gradient, with basin big sagebrush occupying the most mesic sites, followed by mountain big sagebrush, threetip sagebrush, and low sagebrush. Wyoming big sagebrush

occupied the most xeric sites.

Antelope bitterbrush was not included in the ordination because it was scarce or absent in most of the areas examined in the East Fork drainage. It commonly occurs with mountain big sagebrush as a dominant, as a major understory species under ponderosa pine, and as a seral species in Douglas fir-common snowberry stands on the South Fork and the Middle Fork (Steele et al. 1981, Peek et al. 1978).

Curlleaf mountain mahogany and little greenbush (*Glossopetalon nevadense*) are Great Basin species that persist on the northern edges of their ranges in these canyon rangelands. They occupy unique habitat on cliffs along the river systems and the drier portions of the moisture gradient. Curlleaf mountain mahogany, the species with the broadest ecological amplitude of the two, occurs on slopes with Idaho fescue and antelope bitterbrush as well as on rocky river bars. Little greenbush is primarily confined to cliffs in this region.

Chokecherry (*Prunus virginiana*) tends to occupy warmer habitats than serviceberry (*Amelanchier alnifolia*). Common snowberry occurs on warmer habitats than does mountain snowberry (*Symphoricarpos oreophilus*).

Forbs generally are more abundant on the more mesic, cooler habitats (Figure 2). The more succulent forbs, such as the cinquefoils (*Potentilla gracilis*), fleabanes (*Erigeron* spp.), locoweeds (*Astragalus* spp.), hawkweeds (*Hieracium albertinum*) and balsamroots (*Balsamorhiza* spp.), tend to occupy the wetter portions of the moisture gradients. Bitterroot (*Lewisia rediviva*), phacelia (*Phacelia* spp.), pussy-toes (*Antennaria dimorpha*), and sandworts (*Arenaria* spp.) occupy more xeric portions of the moisture gradient. Whitestem mentzelia (*Mentzelia albicaulis*) and rockcress (*Arabis holboellii*) are present on the drier ends of the moisture gradient in the ordination.

The forb complex best expresses itself on the northern and western portions of the study area, where the climate is more moist and warm. The drier sites along the East Fork support fewer species, but even here, sites at higher elevations where more moisture falls appear to have as many species as do comparable sites farther north and west. This shrub steppe produces a relatively high number of annual forbs, which grow and flower in spring and early summer.

Plant Communities

Three attributes of the vegetation pattern stand out for the region, coinciding with the moisture gradient. First, sagebrush communities are common and well developed on the southern portions of the area, and

become scarce and less well developed along the main Salmon River and in the South Fork. Second, the more mesic shrub-steppe communities tend to occur as understories in Douglas fir or ponderosa pine communities. Thus, an Idaho fescue/Bluebunch wheatgrass community may be positioned next to a Douglas fir stand, where the herbaceous union appears much the same as it would without the conifer component. Third, an increasingly larger component of forbs occurs in the communities along the southeast to northwest gradient. Table 2 lists constancy and frequency of species in the following shrub-steppe communities. Table 3 provides a key to the nonforested shrub-steppe communities.

Bluebunch wheatgrass/Sandberg bluegrass Community

On dry sites, a community dominated by bluebunch wheatgrass occurs without the presence of a large, dominant forb (Figure 3). Sandberg bluegrass typically is present but may be absent on the most xeric sites. We examined five stands, including two in the Middle Fork and three in Big Creek. Cheatgrass invades all the stands, which also are susceptible to invasion by noxious weeds such as knapweed and skeletonweed (*Chondrilla juncea*).

Tisdale (1986) classified these communities as being in the Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community in spite of the absence of arrowleaf balsamroot (*Balsamorhiza sagittata*). However, he

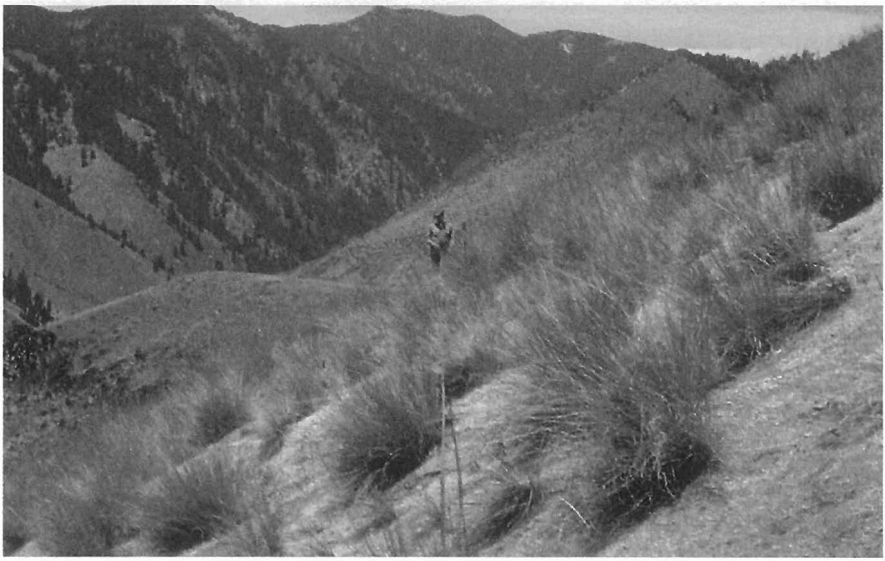

Figure 3. A Bluebunch wheatgrass/Sandberg bluegrass community in the Pole Creek area, Middle Fork Salmon River, June 1973.

Table 2. Constancy and frequency of plant species found in shrub-steppe communities in the East Fork and Middle Fork of the Salmon River, Idaho. Constancy is the percentage of stands in which the species occurred. Frequency is the percentage of plots in each stand in which the species occurred, averaged over all stands for the community.

SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Amelanchier alnifolia																			17/1.
Artemisia arbuscula												+/90	+/90						
Artemisia nova														50/1					
Artemisia spinescens														100/1	67/8				
Artemisia tridentata t.					100/45														
Artemisia t. vaseyana								100/72	100/53			+/90				20/1	43/1		17/9.
Artemisia t. wyomingensis						100/42	100/46								67/5				
Artemisia tripartita										100/59	100/67	+/5							
Atriplex canescens															33/1				
Atriplex confertifolia														100/8	100/30				
Cercocarpus ledifolius																			100/20
Chrysothamnus viscidflorus					50/1	50/1.	22/1.	27/2	40/2.			+/5							
Ericameria nauseosa								45/1	30/1.		55/6			100/1	33/1	40/1	29/1		1/1.
Eriogonum caespitosum						100/10	11/1.	18/1	20/2.										
E. heracleoides	25/10							18/1	10/4.			+/65							33/2.
E. microthecum			11/2.			28/1.	55/1.			14/2							29/1		

Table 2 (continued). Constancy and frequency of plant species found in shrub-steppe communities, East Fork and Middle Fork of the Salmon River, Idaho.

SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
E. ovalifolium	33/1	6/1.	67/5	42/1.			18/1.		40/3		55/10					100/5		30/1	50/2
E. umbellatum										43/5									
Glossopetalon nevadense								9/1.									14/1	100/27	
Leptodactylon pungens			6/1.			7/1.	27/1.	18/2		43/20	11/7.								
Penstemon deustus	66/7	20/1	17/1.							14/2	11/1.						14/1.		
Philadelphus lewisii																		20/1.	67/1.
Phlox hendersonii										14/4	22/6.								
Phlox hoodii						33/2.	64/2.	27/5	10/1.	28/3	44/17	+/80	+/5						
Phlox longifolia	33/3		22/5	46/28				73/16	20/8	14/1	11/2.								83/11
Prunus virginiana								9/1.									14/2		
Purshia tridentata								36/1								100/12	100/12	20/1.	17/2.
Ribes cereum	25/1				50/1	17/1.													34/1
Ribes velutinum								18/1									14/1	20/1.	55/2
Sambucus cerulea																		10/1.	
Symphoricarpos albus	33/3																		
Symphoricarpos oreophilus									30/4.										
Achnatherum hymenoides														100/23	100/37				

SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Achnatherum thurberianum							9/2.												
Bromus tectorum	100/30	20/19	94/62	83/3	50/13			45/27	20/80	14/13.	11/4.					100/52	100/59	100/54	100/55
Calamagrostis rubescens+A85				8/2.															
Carex petasata			6/2.	8/2.					60/11		11/1.	/5							
Elymus cinereus					50/10														
Festuca idahoensis				100/37					100/66		100/44		/80			100/24		40/2	95/20
Festuca octoflora			11/1.	13/9.				27/4.											
Hesperostipa comata		100/58		4/1.	50/17							/10		100/18			28/9	10/2.	30/4
Poa nevadensis														100/8					
Poa secunda	66/11																		
Pseudoroegneria spicata	100/41	100/65	100/62	100/72	100/38	100/69	100/75	100/72	80/16	100/85	100/54	/40	/50		66/30	100/64	100/43	100/44	100/62
Sitanion hystrix					50/25		9/4.					/55		100/32	66/3				
Sporobolus cryptandrus														10u/8					
Achillea millefolium	66/14	40/1	72/7	83/22				27/1.	20/5.	14/4.	11/1.					60/10	57/7	20/1	34/3
Agoseris glauca	33/2		11/1.	42/8				27/1	20/7	14/1.								10/1.	17/12
Allium spp.			17/1.				9/1.							50/3					
Amsinckia lycopsoides			28/2	4/1.				9/1.								60/3			
Anaphalus margaritacea									10/8.										
Antennaria dimorpha	25/2			29/5				9/2.											

Table 2 (continued). Constancy and frequency of plant species found in shrub-steppe communities, East Fork and Middle Fork of the Salmon River, Idaho.

SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Antennaria microphylla						17/1	18/1	18/1.	70/42	86/30	88/40	/50	/5						
Apocynum androsaemifolium	33/4	20/7	11/1.	8/3.													14/2		
Arabis holboellii		40/1	6/1.	38/6	50/3		18/1	42/4	30/2								28/1	20/3	
Arabis californica			6/1.	17/1.															
Aralia californica			6/1.						10/1.	14/2.						20/2	28/2		
Aralia nudicaulis	33/3										11/1.								
Arenaria congesta				8/3.			9/1.		30/16	43/16	11/2.	/80	/65						
Arnica cordifolia				4/1.															
Arnica sororia				13/3.															
Aster spp.		40/1	6/1.	4/1.					10/1.								43/1		
Aster scopulorum							27/9					+/80	+/60						
Aster purshii								29/1											
Astragalus filipes								36/7	60/31	29/4		+/60	+/75						17/6
Astragalus purshii	33/2	20/1	6/1.			3/1.	36/1		10/1.							20/2			
Astragalus stenophyllus		20/1	28/3	33/12					10/1.		44/4								
Balsamorhiza hookeri				17/6															
Balsamorhiza incana				13/1.															17/1

Balsamorhiza sagittata			61/11	63/19				36/2	20/1.							60/7	57/1	10/1.	83/8
SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Castilleja inverta	25/+			29/5.				18/2	70/7		22/7								17/2
Castilleja spp.			6/1.		50/3		27/1		10/4.				+/20						
Chaenactis douglasii		80/1	17/2	4/1.													28/1	20/1	
Chenopodium album						5/1.													
Cirsium utahense		20/1	44/2	8/1.			1/1.	27/1								40/6	57/1		
Clarkia pulchella																	14/11	10/2.	
Collinsia parviflora	25/12	20/1	28/7	50/27				18/6	50/8								43/6	10/10	17/14
Collomia linearis			33/1	29/10				9/1.											
Coryphantha vivipara								18/5											
Crepis acuminata						28/1	18/1	18/1	10/1.			+/10	+/60						
Crepis atrabarba	25/12			33/3				9/1.		43/9									34/1
Cryptantha pulchella			6/1.																
Cryptantha scoparia																		10/1.	
Cryptantha watsonii				4/1.															
Cymopterus bipinnatus													+/70						
Delphinium bicolor				4/1.															
Descurainia pinnata	33/11	100/10	33/8	29/6	100/5			36/3	10/1.					100/30	33/2		43/2	70/12	
Dodecatheon conjugens				8/3.															
Epilobium paniculatum		80/3	50/6	13/1.				27/2										30/3	

Table 2 (continued). Constancy and frequency of plant species found in shrub-steppe communities, East Fork and Middle Fork of the Salmon River, Idaho.

Erigeron compositus	33/1						18/1				11/2.								10/1.
SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Erigeron pumilus		40/1	11/1.	21/2			9/3.	36/8	10/2.										
Erysimum asperum				4/1.															
Frasera albicaulis			6/1.	4/1.															17/1
Frasera atropurpurea				4/1.															
Frasera speciosa									10/1.										
Fritillaria pudica	25/1			25/2.				18/1											
Galium triflorum			28/5							14/1								10/2.	17/2
Geum triflorum	25/1			25/5					50/7		11/1.								
Gilia aggregata								18/1	10/1.								14/1		34/4
Gilia tenerrima			11/2.	4/1.				9/1.										10/1.	
Hackelia cinerea		20/1.	28/3					10/1.									14/4		
Haplopappus acaulis							18/6												
Heuchera cylindrica				8/10.					50/5	28/3	22/2.								
Hieracium albertinum				21/1.														10/1.	34/1
Hymenopappus filifolius													+/5						
Hypericum perforatum	33/2																		
Lappula redowskii					100/13														

Lepidium spp.														50/3					
SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Lewisia rediviva			11/1.	8/1.				27/2					+/5					10/1.	
Lithophragma parviflora			6/1.	33/11														10/1.	17/1
Lithospermum ruderale	66/2		22/1	46/2					20/1							60/2	14/2	30/4	34/1
Lomatium spp.			50/14	13/4.			9/1.												17/1
Lomatium foeniculaceum	33/1	40/1.	6/1.					9/1.	10/1.		44/14							30/	
Lomatium triternatum				46/10				9/1.											
Lupinus sericeus	33/1	20/1.	56/4	58/9		45/1	54/2	9/1.	70/29	43/5	67/21					20/3	14/1		17/1
Machaeranthera canescens														50/1	33/1				
Mentzelia albicaulis		100/6	39/9	8/2.	50/10			27/2									57/7	40/3	
Mentzelia laevicaulis				4/1.															
Mertensia longiflora				4/1.															
Mertensia viridis									50/4		22/2								
Mimulus nanus		40/1	6/1.														14/1	40/1	
Montia siberica	25/1			4/1.															
Myosotis spp.				8/1.															
Opuntia polyacantha														50/7	66/1				
Pedicularis contorta										14/2									

Table 2 (continued). Constancy and frequency of plant species found in shrub-steppe communities, East Fork and Middle Fork of the Salmon River, Idaho.

Penstemon glandulosus				4/1.															
SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Penstemon spp.			28/2.		50/3		36/6							100/5		20/4	28/3	40/1	17/1
Penstemon procerus								9/2.	40/9	28/14	33/7		+/45						
Phacelia hastata		60/1															28/1	10/1.	17/1
Phacelia linearis	66/9	60/5	72/13	42/8				18/1	10/1.								57/5	80/15	17/2
Physaria geyeri			33/7	4/1.				18/1									28/2		
Polygonum douglasii	66/12		39/14	46/11						14/1						40/1	14/1	10/3.	17/2
Potentilla gracilis									20/8										
Ranunculus glaberrimus				4/1.															
Saxifraga spp.	25/2			25/5.					10/2.										17/4
Scutellaria antirrhinoides			11/2.					18/1											
Sedum lanceolatum									20/8	42/7	22/2	/15	+/45						
Sedum stenopetalum				13/4.															
Senecio integerrimus									40/4		11/6.		+/5					10/1.	
Silene acaulis			6/1.						10/2.										
Silene oregana	25/2	20/1		6/1.				9/1.											
Sisymbrium altissimum			6/1.															10/1.	
Stephanomeria exigua						3/1.												20/3	

Taraxacum officinale				17/2.	100/5								+/5						
SPECIES	PSSP	PSSP	PSSP	FEID	ARTRT	ARTRW	ARTRW	ARTRV	ARTRV	ARTR4	ARTR4	ARAR	ARAR	ATCO	ATCO	PUTR	PUTR	GLNE	CELE
	POSE	POSE	POSE	PSSP	PSSP	PSSP	PSSP	PSSP	FEID	PSSP	FEID	PSSP	FEID	SPCR	ACHY	FEID	PSSP		
		HECO	BASA				POSE												
Tragopogon dubius		60/2	39/1.	42/3	50/3			27/2	10/1.					100/10		20/1	42/1	10/1.	
Trifolium spp.		20/1	6/1.					9/1.										10/1.	
Valeriana acutiloba									10/4.										
Viola nuttallii											11/1.								
Woodsia oregana			11/1.	33/9													14/1	10/1.	17/1
Zygadenus venenosus																20/1			

[1]Species codes: ACHY= *Achnatherum hymenoides;* ARTRT= *Artemisia tridentata tridentata;* ARTRV= *Artemisia t. vaseyana;* ARTRW= *Artemisia t. wyomingensis;* ARTR4= *Artemisia tripartita;* ARAR= *Artemisia arbuscula;* ATCO= *Atriplex confertifolia;* BASA= *Balsamorhiza sagittata;* CELE= *Cercocarpus ledifolius;* FEID= *Festuca idahoensis;* GLNE= *Glossopetalon nevadense;* HECO= *Hesperostipa comata;* POSE= *Poa secunda;* PSSP= *Pseudoroegneria spicata;* PUTR= *Purshia tridentata;* SPCR= *Sporobolus cryptandrus.*

Table 3. Key to nonforested shrub-steppe communities, Salmon River Mountains, including the East Fork of the Salmon River, the Middle Fork of the Salmon, Big Creek (a tributary of the Middle Fork), and the main Salmon River from the Shepp Ranch to the Campbell's Ferry area.

1a. Douglas fir, Ponderosa pine, or other conifer species present 2
1b. Conifers not present 3a
2. Not shrub steppe: refer to Steele et al. (1981) for identification of forested communities, see discussion on page 45.
3a. Little greenbush present as more than occasional component; cliff sites. Curlleaf mountain mahogany/Little greenbush/Bluebunch wheatgrass community, page 41.
3b. Little greenbush absent or scarce; cliffs or other sites 4a
4a. Curlleaf mountain mahogany present as more than occasional component 5a
4b. Curlleaf mountain mahogany absent or scarce 6a
5a. Idaho fescue present–Curlleaf mountain mahogany/Idaho fescue community, page 43.
5b. Idaho fescue absent–Curlleaf mountain mahogany/Bluebunch wheatgrass community, page 44.
6a. Antelope bitterbrush present more than occasional component 7a
6b. Antelope bitterbrush absent or scarce 8a
7a. Idaho fescue present: Antelope bitterbrush/Idaho fescue community, page 40.
7b. Idaho fescue absent: Antelope bitterbrush/Bluebunch wheatgrass community, page 38.
8a. Mountain big sagebrush present as more than occasional component 9a
8b. Mountain Big sagebrush absent or scarce 10a
9a. Idaho fescue present: Mountain big sagebrush/Idaho fescue community, page 35.
9b. Idaho fescue absent: Mountain big sagebrush/Bluebunch wheatgrass community, page 34.
10a. Threetip sagebrush present, more than occasional component 11a
10b. Threetip sagebrush absent or scarce 12a
11a. Idaho fescue present: Threetip sagebrush/Idaho fescue community, page 36.
11b. Idaho fescue absent: Threetip sagebrush/Bluebunch wheatgrass community, page 35.
12a. Low sagebrush present as more than occasional component 13a
12b. Low sagebrush absent or scarce 14a
13a. Idaho fescue present: Low sagebrush/Idaho fescue community, page 37.
13b. Idaho fescue absent: Low sagebrush/Bluebunch wheatgrass community, page 37.
14a. Basin big sagebrush present as more than occasional: Basin big sagebrush/Bluebunch wheatgrass community, page 31.
14b. Basin big sagebrush absent or scarce. 15a
15a. Wyoming big sagebrush present as more than occasional component 16a
15b. Wyoming big sagebrush absent or scarce 17a
16a. Wyoming big sagebrush/Bluebunch wheatgrass community, page 33.
17a. Shadscale saltbush present as more than occasional component. 18a
18a. Sand dropseed abundant: Shadscale saltbush/Sand dropseed community, page 30.
18b. Sand dropseed absent: Indian ricegrass abundant, page 30.
17b. Shadscale saltbush occasionally present but not abundant 19a

19a. Idaho fescue present as more than occasional: Idaho fescue/Bluebunch wheatgrass community, page 30.
19b. Idaho fescue absent, Bluebunch wheatgrass common 20a
20a. Needle-and-threadgrass present, abundant. Bluebunch wheatgrass/Sandberg bluegrass/ Needle-and-thread community, page 27.
20b. Needle-and-threadgrass absent or scarce. 21a
21a. Arrowleaf balsamroot present as more than occasional component: Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community, page 28.
21b. Arrowleaf balsamroot not present, Bluebunch wheatgrass dominant: Bluebunch wheatgrass/ Sandberg bluegrass community, page 16.

recognized the community existed, identified by the absence of conspicuous perennial forbs. This community is present in western Montana (Mueggler and Stewart 1980). Higher frequencies of Sandberg bluegrass, junegrass, and lupines (*Lupinus* spp.) occur in the Montana stands than in those we examined. Daubenmire (1970) considered these communities a Bluebunch wheatgrass/Sandberg bluegrass community. Again, arrowleaf balsamroot had relatively low frequency and cover. The Washington-northern Idaho stands all contain cheatgrass, similar to our stands.

We consider five stands in the Middle Fork a needle-and-thread phase of the Bluebunch wheatgrass/Sandberg bluegrass community. These communities contain equivalent frequencies of needle-and-thread and bluebunch wheatgrass. They occur on southerly exposed, lower slopes, and do not appear to have been subject to recent disturbance, based on the absence of cheatgrass in four of the five stands when we examined them. Arrowleaf balsamroot is absent, and other large forbs including biscuitroots and locoweeds are scarce. These stands primarily consist of the two bunchgrass species, but were extensively invaded by cheatgrass following the 2000 fires.

This community was not recorded by Tisdale (1986) or Daubenmire (1970) farther north and west. Tisdale (1986) did not report needle-and-thread in the Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community. Hironaka et al. (1983) reported needle-and-thread occurred in the Wyoming big sagebrush/Bluebunch wheatgrass community on sandy, coarse textured, or calcareous soils. The community with a needle-and-thread phase was recorded in western Montana (Mueggler and Stewart 1980), where many of the same species were common but more showy forbs were present. The phase we describe may reflect a slightly moister climate that excludes big sagebrush but does not favor the expression of the forb complex. It is also possible that this phase is a long-lived late seral stage of the Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community, which could eventually evolve towards more forbs and less needle-and-thread, in the absence of fire. Fire also will reduce big sagebrush and antelope bitterbrush in stands, which then will appear as a grass-dominated community until reestablishment of shrubs.

Productivity and composition of a bluebunch wheatgrass/Sandberg bluegrass stand was evaluated over the 1988-2003 period, including three years following the 2000 fire (Figure 4). Production of bluebunch wheatgrass averaged 55.64 gm/m^2 (11.32 to 98.36 gm/m^2) over the period. Production estimates for 2000 were taken in late June; the fire occurred in August. The year following the fire, production was the second lowest over the 16-year

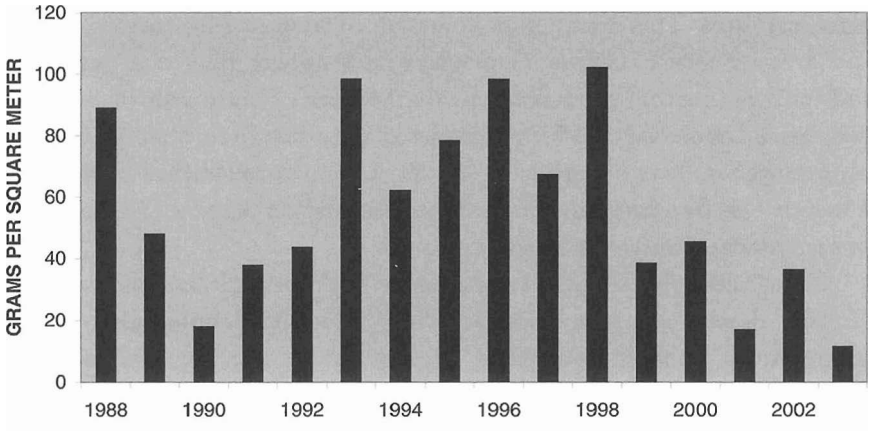

Figure 4. Bluebunch wheatgrass production in a Bluebunch wheatgrass/Sandberg bluegrass community near the Taylor Ranch, Big Creek drainage, from 1988-2003.

period. Productivity of bluebunch wheatgrass on this site is highly correlated with April-May-June precipitation (adjusted correlation coefficient = .723). April-June precipitation at the Taylor Ranch station averaged 13.8 centimeters over the period, when 2001 precipitation of 10.25 cm became the fourth lowest for the 16-year period. This suggests the fire suppressed productivity for one growing season, exacerbated by a lower rainfall pattern for that year. The following year (2002) production again was closer to the predicted level based on the amount of precipitation. We noted no changes in vegetative composition following the fire on this site.

Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass Community

Fifteen stands, including eight in the Middle Fork, two in Big Creek, and five on the main Salmon River are dominated by bluebunch wheatgrass and arrowleaf balsamroot (Figure 5). Occasional shrubs are present but Idaho fescue is absent. We designate these communities as a Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community. Bluebunch wheatgrass and arrowleaf balsamroot characterize the appearance of this community, being present in all stands at relatively high frequency.

Substantial variation occurs in the least-disturbed stands within this community. One stand on the Middle Fork with very low frequency of bluebunch wheatgrass contains high coverage of biscuitroot species, and did not have any cheatgrass prior to the 2000 fires. Two other stands of relatively

low frequency of bluebunch wheatgrass have high amounts of cheatgrass and arrowleaf balsamroot. Stands with high frequencies of Sandberg bluegrass also have high frequencies of bluebunch wheatgrass, cheatgrass, and annual forbs. Other stands have high frequencies of biscuitroots, equaling the frequencies for bluebunch wheatgrass and arrowleaf balsamroot.

Annual forbs are common in most stands. Seedstalks of the bluebunch wheatgrass may grow to 120 cm or more in height in some stands. This community is the most common grassland community in the region, and serves as both a major forage producer for big game, and a cover provider for nesting blue grouse and associated species. The community appears to withstand wildfire without undergoing much change in composition except for the invasion of cheatgrass.

We evaluated production and composition of one site within this community type from 1989 to 2003. The site burned completely during the 2000 fire. Productivity of bluebunch wheatgrass in 2001 was 30.1 gm/m^2, or 65.8% of the mean productivity of 45.83 gm/m^2 over the period, recovering to 58.5 gm/m^2 or 127.6% of the mean in 2002. April-June precipitation was approximately 73% of the mean over that period at the Taylor Ranch weather station. No changes in species composition were apparent.

Figure 5. A Bluebunch wheatgrass/Arrowleaf balsamroot/Sandberg bluegrass community at Waterfall Creek, Middle Fork Salmon River, May 1975.

Idaho fescue/Bluebunch wheatgrass Community

We studied and identified twenty-four stands as an Idaho fescue/Bluebunch wheatgrass community. Thirteen of these were in the Middle Fork, eight in Big Creek, and three on the main Salmon River. Observations apart from study of individual stands indicate this community is best represented in the Middle Fork drainage, including Big Creek, within the study area. These stands occur on all aspects, at elevations ranging from 1000 m to 1900 m. Bluebunch wheatgrass has the highest frequencies in plots in all three areas, followed by Idaho fescue and Sandberg bluegrass. Cheatgrass also occurs in high frequency in all stands.

The greatest variety of forbs occurs in the Middle Fork stands, probably reflecting in part the larger number of stands sampled across a broader stretch of that river. However, a wider variation occurs in aspect and elevation of stands sampled in this drainage than in the other two. Also, more disturbance appears in some stands, as reflected by the higher constancy and frequency of annuals. Arrowleaf balsamroot, yarrow (*Achillea millefolium*), lupines, and biscuitroots are the most conspicuous and common forbs.

This community is broadly distributed throughout the intermountain region. Daubenmire (1970) described this community in the Palouse region as consisting predominantly of the two dominant bunchgrasses and Sandberg bluegrass; shrubs and perennial forbs were inconspicuous.

On the Snake River and lower Salmon River areas, perennial forbs are well represented, suggesting a more mesic community than in eastern Washington (Tisdale 1986). Junegrass is not well represented in this community in either the lower Salmon River or on this study area, and as expected when compared with contiguous areas, species composition is similar. Mueggler and Stewart (1980) considered this community the most common type in western Montana mountain rangelands. In all regions, bluebunch wheatgrass is the most common species. Shrubs are scarce in the lower Salmon River stands, but are more frequent in the western Montana stands and in our study region.

Shadscale saltbush Communities

Salt desert shrublands dominated by shadscale saltbush (*Atriplex confertifolia*) are present on the most xeric sites we examined. Shadscale saltbush is present in all sites, while big sagebrush, heath goldenrod, and prickly pear (*Opuntia polyacantha*) were common (Figure 6). Fourwing saltbush (*Atriplex canescens*) and Wyoming big sagebrush are well represented. Indian

ricegrass is the dominant grass in all stands, followed by bottlebrush squirreltail (*Sitanion hystrix*). Sand dropseed (*Sporobolus cryptandrus*) grows in Malm Gulch near the confluence of the East Fork with the main Salmon River, and is more common farther north on foothills near Challis. Stands with Sand dropseed have greater species diversity than stands lacking that species and are considered a separate commmunity from the Shadscale saltbush/Indian ricegrass community.

Figure 6. A Shadscale saltbush/Indian ricegrass community in Malm Gulch, East Fork Salmon River, June 2000.

Hironaka et al. (1983) found shadscale saltbush on xeric or saline soils on the Snake River Plain, but did not describe communities dominated by this species. Tisdale (1986) and Mueggler and Stewart (1980) did not mention either of the saltbush species.

Basin big sagebrush/Bluebunch wheatgrass Community

In the lower, drier creek bottoms, especially on the southern and eastern portions of the region, a Basin big sagebrush/ Bluebunch wheatgrass community ex s (Figure 7). We examined two stands considered representative for the East Fork. Basin wildrye is common in some stands. Its presence indicates disturbance, most likely from grazing or ground squirrel activity. Basin big sagebrush may grow to more than 3 m tall, and dominates the appearance of these stands. Very often the understories are sparse, because the shrubs are so dense. The two stands we measured were disturbed, but indicate the species composition that may persist.

plants in eastern Idaho. Wyoming big sagebrush also grows up to 75 cm tall in our study area. This was considered the most xeric community dominated by sagebrushes in our samples.

Mountain big sagebrush/Bluebunch wheatgrass Community

Ten stands are classified as a Mountain big sagebrush/Bluebunch wheatgrass community, including three in the East Fork and seven along the Middle Fork (Figure 9). Elevations ranged from 1050 m to 2200 m, on all aspects. The type occurs on all slopes from flat to 80%. This is a highly variable, and very common plant community in this region.

Mountain big sagebrush, heath goldenrod and green rabbitbrush are common woody plants in the type. Heath goldenrod and green rabbitbrush have low frequencies but relatively high constancies, while longleaf phlox (*Phlox longifolia*) and mountain big sagebrush have higher frequencies. Antelope bitterbrush, mat buckwheat, parsnip-flowered buckwheat (*Eriogonum heracleoides*), longleaf phlox, Hood's phlox, and prickly phlox are relatively frequent as well.

Bluebunch wheatgrass and Sandberg bluegrass exhibit high frequencies in our stands. Needle-and-thread occurs on the lower, drier portions of this type. Threadstalk milkvetch (*Astragalus filipes*), roseate pussy-toes (*Antennaria*

Figure 9. A Mountain big sagebrush/Bluebunch wheatgrass community, Herd Creek drainage, June 1985.

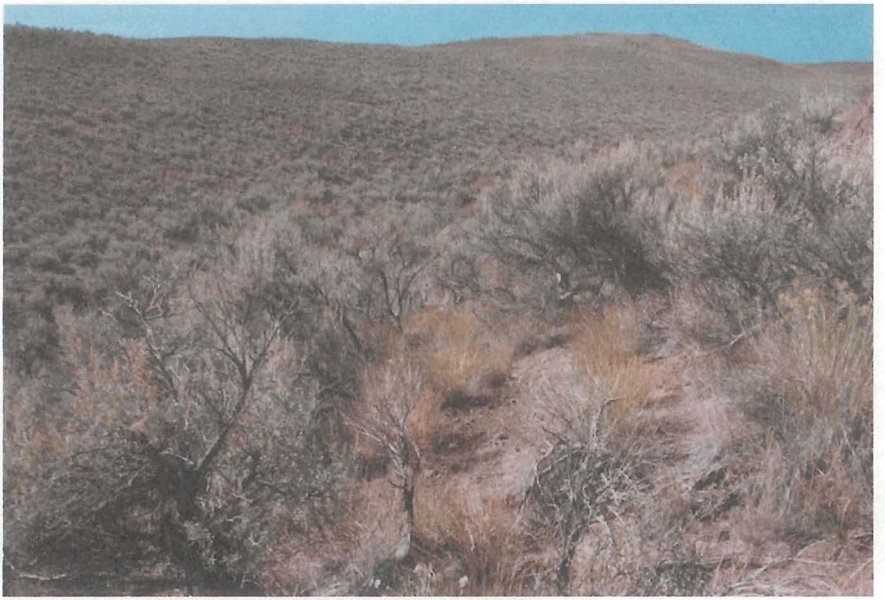

Figure 7. A Basin big sagebrush/Bluebunch wheatgrass stand, Herd Creek, East Fork Salmon River, June 1985.

Bluebunch wheatgrass is the predominant grass, with bottlebrush squirreltail, bluegrasses (*Poa* spp.), and needle-and-thread common. Heath goldenrod, prickly phlox (*Leptodactylon pungens*), and wax currant (*Ribes cereum*) are associated shrubs. Forb composition is depauperate, but our sparse information undoubtedly underestimates the potential for forb production on the sites.

Hironaka et al. (1983) described this type farther south, stating that all areas they examined had been altered. The soils were generally more fertile than adjacent uplands that often support Wyoming big sagebrush in the region. This community probably occupied most of the flood plains of the major streams of our study area adjacent to deciduous woody plants typical of the riparian complex. Representatives we observed may not reflect the development of this community where it was originally best expressed. The community could be considered the dry end of the riparian zone complex that occurs in this region.

Daubenmire (1970) classified a Basin big sagebrush/Bluebunch wheatgrass community farther north, where antelope bitterbrush was absent. Hironaka et al. (1983) reported this type contained antelope bitterbrush. Mueggler and Stewart (1980) did not find antelope bitterbrush present in this community in Montana.

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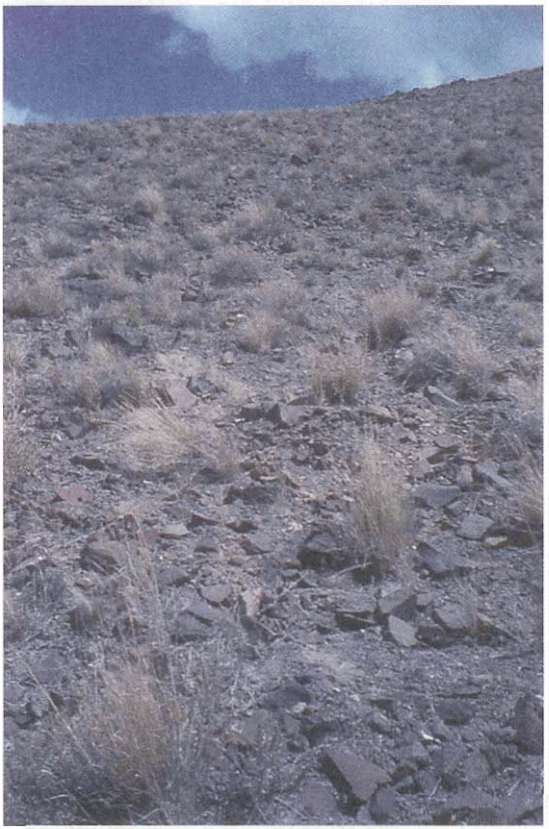

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