Washington Shrub-Steppe Ecoregion

Van R. Kane
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Sources for cover photos

Hanford site - http://www.pnl.gov/ecology/Gallery/Landsc/mtns.htm


Big sagebrush - http://www.laspilitas.com/plants/97.htm


Cryptogamic crust - http://www.pnl.gov/pals/resource_cards/Cryptogamic_crust.stm

Sage grouse – unable to refund original web site


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Preface

Note on Sources

R. Daubenmire appears to have devoted his working career to studying the shrub-steppe ecosystems of Washington State; sources used for this paper refer to his published work as far back as 1940. His technical bulletins (Daubenmire 1970 and 1988) form the basis for almost every other author’s discussion of the ecoregion and its plants. This paper also depends on Daubenmire for the majority of its information. Rather than constantly cite his work, it should be assumed that the facts I present on the plant ecosystems, climate, and geology come from his bulletins unless otherwise noted.

Scientific Names

Appendix A provides the scientific names for all species discussed in this report.
Ecoregion Setting

Daubenmire (1988) defines the Washington shrub-steppe region as a 6 million hectare area of central-eastern Washington and north-central Oregon (Figure 1). It is a hot, dry region where a combination of shrubs, grasses, and herbs dominate the landscape. Several researchers consider the Washington region an extension of the shrub-steppe that extends through eastern Oregon and southern Idaho (for example, Primm 1999 and Ricketts et al 1999).

The Washington shrub-steppe lies in the Columbia basin. The Cascade Mountains bound the region on the west, the Okanogan plateau on the north, the Palouse Prairie on the east, and the Blue Mountains on the south. Numerous low mountains, hills, valleys, and canyons provide local vertical relief. (Figure 2) Three major rivers – the Columbia, the Snake, and the Yakima – flow through the basin.

Climate

The Washington shrub-steppe lies in the Cascade Mountains’ rain shadow. Winters are moderately cold, and the summers are warm to hot. Precipitation falls primarily in the winter in the form of snow and melts by the early spring. (Daubenmire 1988) (Figure 3) Precipitation and temperature varies considerably from year to year (Rickard 1988). Records at the Hanford Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve show an average annual rainfall at the site of 12.8cm, with a low of 4.7cm and a high of 22.7cm. Temperatures similarly vary considerably from year to year.

The lowest parts of the basin (in the central and western portions) lie at the lowest elevations and receive the least amount of rain. As elevations gradually rise (Figure 2) towards the east, northeast, and south, precipitation increases and temperatures cool. (Franklin and Dyrness 1973; Daubenmire 1988) Daubenmire finds that the differences in climate caused by the gentle rise of the basin account for the major changes in plant zones.
Local topography creates microclimates that can significantly differ from the climate of the general area. Researchers at the ALE reserve (Gee et al 1988), for example, mapped 7 different microclimates based on elevation, exposure to the sun, and exposure to the wind. Daubenmire found that the plant cover on south and north facing hills differed, presumably because of different microclimates. Sullivan (1986) reports that this pattern extends to north and south facing railroad track banks and sides of knobs and kettles.

Even individual plants create microclimates (Gee et al 1988). The plant structures direct rainfall to their stem and create areas of relative dryness immediately below their canopies. They also influence soil temperatures. Soil measured 3cm below the ground around shrubs show significant differences in temperature. Sunlight reflected from the sagebrush’s canopy heats the soil on the sunward side by 2° to 8°C compared to surrounding soil. Similarly, hopsage cools the soil in its shade by 10°C.

Studies (Daubenmire 1988) at one site traced the soil water availability following the snow melt. Early in the spring, the soils is dry to the 5cm level; by the end of April to the 20cm level; by the end of May to the 50cm level; and by the end of June to the 1m level.

Geology and Soils

Daubenmire (1988) summarizes the geology (Figure 4) and soils of the Washington shrub-steppe. Numerous flows of lava laid a basalt floor the basin that remains near the surface in much of the basin. Wind carried in layers of loess. During the ice age, the glaciers did not reach the basin. Floods released by the glaciers, on the other hand, carved numerous canyons and deep valleys into the loess; the floods carried outwash sediments into the newly carved valleys (Wildung and Garland 1988). Volcanic ash from the Cascades volcanoes has periodically covered portions of the basin.

Deep loams on gentle slopes cover most of the Columbia Basin. Because this soil type broadly covers the basin, differences in soils do not cause broad differences in the
vegetation zones. In places, though, the soil becomes unusually sandy, shallow, stony, or alkali, which creates local sites of different vegetation types.

A local area can have a variety of soils. The Hanford site (Soll et al. 1988), for example, has 15 soil types. Silt loams dominate the slopes and higher elevations and sandier soils dominate on the Columbia River plain. The smaller ALE Reserve at the Hanford site has the same dominant soil patterns, but has 8 other soils types at local sites (Figure 5). Depending on the area and soil types, soil depths typically range from 25cm to 150cm before bedrock at the ALE reserve (Wildung and Garland 1988).

**Ecosystem Diversity**

Species of sagebrush and perennial grasses -- which evolved to survive the limited winter precipitation and the hot, dry summers -- dominate the Washington shrub-steppe ecosystems (Ricketts et al. 1999). Just three species -- the big sagebrush, bluebunch wheatgrass, and Idaho fescue -- constitute either the primary canopy or under story plant across most of the region (Daubenmire 1988) (Figure 6). Which species prevails in any particular zone depends on its annual precipitation (Franklin and Dyrness 1973; Daubenmire 1988). The relationship between elevation and plant community holds when the elevation increase comes from local topography such as a mountain (Rickard 1988; O’Connor and Wieda 2001). (Figure 7)

The lowest portions of the Columbia basin (approximately two-thirds of the region) are dry enough to allow sagebrush to be the upper story with an under story of perennial bunchgrasses. Big sagebrush/bluebunch wheatgrass prevails in the driest areas. Idaho fescue becomes the defining under story as higher elevations increases precipitation. In the wettest sagebrush areas threetip sagebrush becomes the dominant shrub with Idaho fescue remaining the most common under story plant.
Once the precipitation increases beyond the tolerance of sagebrush, perennial grasses and herbs dominate the landscape. At the lower elevations, the bluebunch wheatgrass/Idaho fescue community replaces the sagebrush communities. Above that, at the eastern and southern extents of the basin, the Idaho fescue dominates the landscape with inclusions of shrubs such as common snowberry or Nootka rose.

While the zonal system works well to explain the broad distribution of plant communities, Daubenmire documents 33 additional specialized native communities:

- Smaller zonal communities exist on the southern margins of the basin and along the Snake and southwestern Columbia River canyons and as meadow-like parks within the lower forest zones that surround the basin.
- The edaphic communities respond to soils that are sandier, shallower, stonier, or more alkali than the norm.
- Several specialized communities grow on dunes, talus slopes or in crevices.
- A number of communities specialize in lands adjacent to or in springs, streams, rivers, and ponds.

Table 1 summarizes Daubenmire’s plant communities.

The Hanford Site (Soll et al 2000) shows how the mix of zonal and specialized communities creates rich biodiversity at the local level. The site lies within the hottest and driest area of the big sagebrush/bluebunch wheatgrass zone. The area’s topography – tall hills in the north and south with a low-lying plain in between – creates a range of temperature and precipitation zones. Specialized soils permit the existence of edaphic communities. The southern hills contain numerous springs and streams that provide riparian habitat. And the free-flowing Columbia River creates a number of communities specialized to its shores, wetlands, sloughs, islands, riffles, and ponds. A inventory of the site found a total of 48 occurrences of 17 terrestrial plant communities and 8 riparian, 3
island, and 1 wetland communities along the Columbia River (Figure 8a-d). The inventory also found 1,509 taxa of invertebrates (including 368 taxa of butterflies and moths), 221 species of birds, 22 species of mammals, 9 species of reptiles, and 4 species of amphibians.

**Native and Zootic Communities**

**Plant Communities**

This section introduces the communities by focusing on three widespread zones. (Unless otherwise cited, all information comes from Daubenmire (1988).)

The most extensive community, dominated by big sagebrush/bluebunch wheatgrass, has four layers (Figure 9). Big sagebrushes, with a scattering of other sages such as rabbitbrush and threetip sagebrush, create the upper layer. Perennial grasses such as bluebunch wheatgrass constitute the second layer. Short vascular plants such as small fescue form the third layer. A cryptogamic crust composed of lichen and mosses constitutes the final layer. Primary production of this community is low, ranging from 105 to 166 grams/m².

While the big sagebrush/bluebunch wheatgrass community lies at the lowest and driest portion of the basin, the Idaho fescue/common snowberry lies at some of the highest and wettest portions of the basin. In this meadow-steppe, low winter temperatures limit primary production instead of summer drought. Perennial grasses such as the Idaho fescue provide the canopy with forbs providing an under story and a cryptogamic crust on the ground. (Figure 9) The wetter climate supports more species of plants than the shrub-steppe, and a large number of perennial forbs are found. Rhizome propagation is also more common than in the lower, hotter regions. The meadow-steppe produces 2-3 times more biomass (239 to 368 grams/m²) than does the shrub-steppe.
The plants in both of these native communities have adapted to the arid climate. Most plants confine their growth to the spring following the snowmelt and then become dormant over the summer. Mosses desiccate in late April; bluegrasses in May; and the largest grasses and forbs in June. The largest shrubs, however, have roots that tap into deep subsurface water and remain active throughout the summer. (Constrained water supplies, however, impact the big sagebrush. It typically covers just 5-26% of the surface. Experiments have shown that the use of near-surface water by other plants in the area prevents it from growing more densely.) With the return of rain in the autumn, the perennial grasses grow new leaves and grow sporadically through the winter. Most plants, however, remain dormant during the winter.

The cryptogamic crust appears to play a number of roles in the community (Soll et al. 2000): It helps preserve the soil against wind and water erosion; it enriches the soil by providing carbon and nitrogen; and it appears to assist water in infiltrating the soil. Some research also suggests that the crust provides favorable microhabitats for native seedlings while discouraging the establishment of exotic seedlings.

The exotic cheatgrass community differs from the two communities discussed above. It is found throughout the Columbia basin where the native community has been severely disturbed (primarily through farming or grazing). Once it becomes established, it apparently has never been dislodged by natural succession -- cheatgrass has become a widespread climax community in its own right. Native plants grow sporadically in this community; the cryptogamic crust is absent (Crawford and Kagan 2001).

Cheatgrass competes well against the native plants (Rickard and Vaughan 1988). An annual, cheatgrass sprouts at the beginning of the autumn rains. It resumes production as soon as warm spring weather permits and out competes native perennials for water and space. It produces copious seeds, overwhelming the comparatively paltry seed production
of the native perennials. After seeding, the cheatgrass dies. Cheatgrass produces 12g of biomass per centimeter of precipitation compared to 2.7g/cm in one native shrub-steppe community; total cheatgrass productivity is 225 grams/m² compared to 59 grams/m² in the native community.1

Animal Communities

The simple trophic structure of the pure shrub-steppe reflects its limited primary production (Rogers et al 1988). Insects consume over 80% of the biomass. Small mammals and birds consume almost equal amounts of the rest; large native animals consume relatively little. The sparseness of primary productivity ultimately limits the number and kinds of predators. For example, the shrub-steppe supports just 3 carnivorous mammals compared to 10 commonly found in Washington forests (Vander Haegen et al 2001). Predatory birds consume 38% of herbivore mass, mammals 43%, and insects 18%.

Several mammal and bird species have developed specialized adaptations for life in the arid shrub-steppe. (Vander Haegen et al 2001). The grasshopper mouse and sage sparrow, for example, get most of their water requirements from their food and can survive without free water for long periods. Many species avoid the heat by spending the day underground or in crevices and being active only at night. Some, such as ground squirrels and pocket mice, spend the dry, hot summer months underground in a torpor. Shrub-steppe small mammals and birds typically nest either underground or nest using the structure of shrubs and tall grasses. A number of species have become so adapted to the shrub-steppe that they have become obligates, including the Sage and Brewer’s sparrows, sage grouse, sage thrasher, and pygmy rabbit.

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1 The productivity numbers for the shrub-steppe from Daubenmire differ significantly from Rickard and Vaughn; the difference could come from different techniques, sample sites, or years.
The biodiversity of the shrub-steppe increases dramatically where springs or streams occur. The tree-and-shrub-lined riparian areas directly support a number of species found only in or near water such as several bird species (Rogers et al 1988), fish, reptiles, and amphibians (Johnson and O'Neil 2001). In addition, a number of species that primarily use the shrub-steppe also depend on riparian areas. Almost all bird species found at Hanford, for example, depend on riparian areas for water, habitat, or food during at least some part of the year (Soll et al 2000). Similarly, the mule deer and elk in Hanford’s southern hills use the riparian areas for drinking water (Rogers et al 1988).

A clear relationship exists between animal biodiversity and the three plant communities described above. Structural diversity creates more habitats and supports greater animal diversity: The shrub-steppe has more animal biodiversity than does the meadow-steppe; both have more diversity than does the cheatgrass community (49 closely associated species versus 34 versus 2) (Vander Haegen et al 1988). While cheatgrass produces significant plant biomass, many species cannot eat it once it dies or cannot effectively use its seeds. (Vander Haegen et al 1988). Abundance of animals also appears to be lower in cheatgrass communities (Rogers et al 1988). One experiment caught over 3 times (283 versus 89) as many small burrowing mammals in a native shrub-steppe community as in a nearby cheatgrass community.

**Disturbances and Succession**

The native shrubs and bunchgrasses evolved in a regime with modest natural disturbance (Daubenmire 1988). Few large native ungulates existed, and they tended to cluster near the basins borders or near streams. Their numbers were low enough that they put little pressure on the native plants. Similarly, fire occurred at a modest frequency of once every 25 years (Crawford and Kagan 2001). When a large disturbance such as fire did sweep through an area, the initial recovery was swift for the perennial grasses, forbs,
and some shrubs. These species rapidly regenerated from roots that survived below ground. A few shrubs, such as the big sagebrush, would be killed outright, and their return to the area would take up to 10 years (Crawford and Kagan 2001).

European settlers dramatically changed the disturbance and succession regime. Farming and building directly disturbed a number of communities. Cattle grazed native grasses and forbs with an intensity that reduced these plants' numbers to a shadow of their former selves. The repeated trampling of the cattle also destroyed the cryptogamic crusts that were essential to retaining soil and water in the natural community.

Cheatgrass and Kentucky bluegrass brought by the settlers enhanced the damage to native communities. These annual grasses evolved in areas with heavy grazing and frequent fires. They rapidly take over areas disturbed by grazing, fire, or human activities. Once established, they out compete native seedlings by appropriating the water supply, more efficiently converting water to growth, and producing an overwhelming quantity of seeds. Fire sweeps through exotic grass communities every 3-5 years; native communities cannot cope with this frequency (Johnson and O’Neil 2001).

**Human Impacts and Management**

Europeans settled the Columbia Basin in the second half of the 1800s and radically remade the landscape. Daubenmire (1970) had to reconstruct the original ecosystem map through a “diligent search spanning three decades to find scraps of apparently virgin vegetation in fence-corners, road right-of-ways, old cemeteries, and in places simply too remote from water to be grazed.” A federal survey (Quigley et al 1996) found the ecological integrity of the region low across the basin. (Figure 10) Almost 60% of the land (preferentially in the moister uplands and river valleys) has been converted to agriculture; much of the rest is used for grazing (O’Connor and Wieda 2001). (Table 2) Of Daubenmire’s zonal communities, only the big sagebrush and bluebunch wheatgrass
communities survive in large expanses and these suffer extensive incursions of exotic grass communities (Daubenmire 1988; O’Connor and Wieda 2001). (Table 2 and Figure 11) Several species – such as the pygmy rabbit and the sage grouse -- dependent on healthy shrub-steppe are threatened with extinction in the region (Soll et al 2000).

Ownership of the land divides among several entities (Figure 12) with the majority of privately held. The Bureaus of Reclamation Land Management have numerous small holdings in the central portion of the basin. Two large, nearly intact expanses of the native shrub-steppe community exist at the Hanford National Monument and the Yakima Training Center (Ricketts et al 1999). The Federal government is drawing up plans to manage Hanford to preserve biological diversity (much of it has been managed as an ecology reserve or wildlife area for many years) (Federal Register 2002). The Army has undertaken extensive surveys of its training center and attempts to preserve the ecosystem while still carrying out its training mission (Environment and Natural Resource Division 2002).

Put together, farming, grazing, fragmented ownership, and invasion of exotic communities have left the Washington shrub-steppe in poor condition. On the positive side, the situation apparently has not worsened dramatically in the last 50 years (Quigley 1999) and may have improved since the early decades of the 20th century (Daubenmire 1988). On the negative side, the ecoregion enters the period of global warming in poor shape. The results of the climate change on weakened ecosystems are likely to be unpredictable. In a cautionary study, for example, researchers studying an arid shrub-grassland in Arizona found that increased rain caused increased desertification (Brown et al 1997). What our descendents receive of the Washington shrub-steppe 200-400 years hence may bear little resemblance to what our forefathers found just 150 years ago.
Appendix A: Plants and Animals of the Columbia Basin Shrub-Steppe

The following list combines the plants that define the plant communities identified by Daubenmire (1988) (listed in bold type) with common plants and animals from O’Connor and Wieda (2001).

Plants and animals common to the terrestrial shrub-steppe are listed first followed by those common to riparian and aquatic habitats within the shrub-stepped. O’Connor and Wieda focus on the Hanford site, so the list of plants and animals may be biased toward those found in the hotter and drier regions of the basin typified by the Hanford site.

(a) = introduced species

**Terrestrial Shrub-steppe species**

<table>
<thead>
<tr>
<th>Shrub-steppe Species</th>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shrubs</strong></td>
<td></td>
</tr>
<tr>
<td>Big sagebrush</td>
<td>Artemisia tridentata</td>
</tr>
<tr>
<td>Bitterbrush</td>
<td>Purshia tridentata</td>
</tr>
<tr>
<td>Common snowberry</td>
<td>Symphoricarpos albus</td>
</tr>
<tr>
<td>Gray rabbitbrush</td>
<td>Ericamerica nauseosa</td>
</tr>
<tr>
<td>Hackberry</td>
<td>Celtis douglasii</td>
</tr>
<tr>
<td>Nootka rose</td>
<td>Rosa nutkana</td>
</tr>
<tr>
<td>Parsnipflower</td>
<td>Eriogonum heracleoides</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>Salvia dorii</td>
</tr>
<tr>
<td>Purple sage</td>
<td>Eriogonum spaerocephalum</td>
</tr>
<tr>
<td>Rock buckwheat</td>
<td></td>
</tr>
<tr>
<td>Smooth sumac</td>
<td>Rhus glabra</td>
</tr>
<tr>
<td>Snow buckwheat</td>
<td>Eriogonum niveum</td>
</tr>
<tr>
<td>Spiny hopsage</td>
<td>Grayia spinosa</td>
</tr>
<tr>
<td>Stiff sagebrush</td>
<td>Artemisia rigida</td>
</tr>
<tr>
<td>Threetip sagebrush</td>
<td>Artemisia tripartita</td>
</tr>
<tr>
<td>Thyme buckwheat</td>
<td>Eriogonum thymoides</td>
</tr>
<tr>
<td>Winterfat</td>
<td>Eurotia lanata</td>
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</table>

**Annual grasses**

<table>
<thead>
<tr>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluebunch wheatgrass</td>
</tr>
<tr>
<td>Alkali saltgrass</td>
</tr>
<tr>
<td>Bottlebrush</td>
</tr>
<tr>
<td>Squirreltail</td>
</tr>
<tr>
<td>Cusick's bluegrass</td>
</tr>
<tr>
<td>Giant wildrye</td>
</tr>
<tr>
<td>Idahoe fescue</td>
</tr>
<tr>
<td>Indian rice grass</td>
</tr>
<tr>
<td>Needle and thread</td>
</tr>
<tr>
<td>Prairie junegrass</td>
</tr>
<tr>
<td>Red threeawn</td>
</tr>
<tr>
<td>Sand dropseed</td>
</tr>
<tr>
<td>Sandberg's bluegrass</td>
</tr>
</tbody>
</table>

**Perennial Herbs**

<table>
<thead>
<tr>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common cowparsnip</td>
</tr>
<tr>
<td>Douglas' buckwheat</td>
</tr>
<tr>
<td>Hood's phlox</td>
</tr>
</tbody>
</table>
Shrub-Steppe Ecoregion

<table>
<thead>
<tr>
<th>Hounds-tongue hawkweed</th>
<th><strong>Hieraceum cynoglossoides</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lance-Leaved Psoralea</td>
<td><strong>Psoralea lanceolata</strong></td>
</tr>
<tr>
<td>Longleaf phlox</td>
<td>Phlox longifolia</td>
</tr>
<tr>
<td>Lupine</td>
<td>Lupinus spp.</td>
</tr>
<tr>
<td>Munro's globemallow</td>
<td><em>Sphaeralcea munroana</em></td>
</tr>
<tr>
<td>Narrowleaf goldenweed</td>
<td>Eriogonum compositum</td>
</tr>
<tr>
<td>Northern buckwheat</td>
<td><em>Eriogonum microthecum</em></td>
</tr>
<tr>
<td>Oregon cliff fern</td>
<td><em>Woodsia oregana</em></td>
</tr>
<tr>
<td>Oregon double bladderpod</td>
<td><em>Physaria oregana</em></td>
</tr>
<tr>
<td>Pale evening primrose</td>
<td>Oenothera pallida</td>
</tr>
<tr>
<td>Penstemon</td>
<td><em>Penstemon triphyllus</em></td>
</tr>
<tr>
<td>Piper’s daisy</td>
<td><em>Erigeron piperianus</em></td>
</tr>
<tr>
<td>Rosy halsamroot</td>
<td><em>Balsamorhiza rosea</em></td>
</tr>
<tr>
<td>Sand beardtongue</td>
<td>Penstemon acuminatus</td>
</tr>
<tr>
<td>Sand dock</td>
<td><em>Rumex venosus</em></td>
</tr>
<tr>
<td>Slenderbush buckwheat</td>
<td><em>Eriogonum microthecum</em></td>
</tr>
<tr>
<td>T. Moore slender lipfern</td>
<td><em>Cheilanthes feei</em></td>
</tr>
<tr>
<td>Threadleaf fleabane</td>
<td><em>Erigeron filifolius</em></td>
</tr>
<tr>
<td>Turpentine springparsley</td>
<td><em>Pteryxia terebinthina</em></td>
</tr>
<tr>
<td>Yarrow</td>
<td><em>Achillea millefolium</em></td>
</tr>
<tr>
<td>Yellow hell</td>
<td><em>Fritillaria pudica</em></td>
</tr>
</tbody>
</table>

**Annual Herbs**

<table>
<thead>
<tr>
<th>Clasping pepperweed</th>
<th>Lepidium perfoliatum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian wheat</td>
<td><em>Plantago patagonica</em></td>
</tr>
<tr>
<td>Jacob’s ladder</td>
<td><em>Polemonium micranthum</em></td>
</tr>
<tr>
<td>Jagged chickweed</td>
<td><em>Holosteu umbellatum</em></td>
</tr>
<tr>
<td>Jimrn Hill’s turnblemustard</td>
<td><em>Sisymbrium altissimum</em></td>
</tr>
<tr>
<td>Matted cryptantha</td>
<td>Crypttheta circumscissa</td>
</tr>
<tr>
<td>Pink microsteris</td>
<td><em>Microsteris gracilis</em></td>
</tr>
<tr>
<td>Prickly lettuce</td>
<td><em>Lactuca seriola</em></td>
</tr>
<tr>
<td>Rough wallflower</td>
<td><em>Erysimum asperum</em></td>
</tr>
<tr>
<td>Russian thistle</td>
<td><em>Salsola kali(a)</em></td>
</tr>
<tr>
<td>(turnhleweed)</td>
<td></td>
</tr>
<tr>
<td>Slender hawksbeard</td>
<td><em>Crepis atrarbara</em></td>
</tr>
<tr>
<td>Spring whitlowgrass</td>
<td><em>Draba verna(a)</em></td>
</tr>
<tr>
<td>Storksbill</td>
<td><em>Erodium cicutarioum(a)</em></td>
</tr>
<tr>
<td>Tall willowherb</td>
<td><em>Epilobium paniculatum</em></td>
</tr>
<tr>
<td>Tarweed fiddleneck</td>
<td><em>Amsinckia lycopsoides</em></td>
</tr>
<tr>
<td>Threadleaf scorpion weed</td>
<td><em>Phacelia linearis</em></td>
</tr>
<tr>
<td>Western tansymustard</td>
<td><em>Descuraninia pinnata</em></td>
</tr>
<tr>
<td>White cupseed</td>
<td><em>Plectritis macroecera</em></td>
</tr>
<tr>
<td>Whitestem stickleaf</td>
<td><em>Mentzelia albicaulis</em></td>
</tr>
<tr>
<td>Winged cryptantha</td>
<td><em>Cryptantha pteroecarya</em></td>
</tr>
<tr>
<td>Yellow salsify</td>
<td><em>Tragopogon dubius(a)</em></td>
</tr>
</tbody>
</table>

**Shrub-steppe mammals**

<p>| Badgers                | Taxidea taxus                |
| Black-tailed jackrabbit| Lepus californicus           |
| Bushy-tailed woodrat   | <em>Neotoma cinerea</em>            |
| Coyotes                | Canis latrans                |
| Deer mouse             | <em>Peromyscus maniculatus</em>     |
| Grayish-brown montaine vole | <em>Microtus montanus</em> |
| Great basin pocket mouse | <em>Perognathus parvus</em>      |
| Least chipmunk         | <em>Eutamias minimus</em>           |
| Merriam’s shrew        | <em>Sorex merriami</em>             |
| Mule deer              | <em>Odocoileus hemionus</em>        |
| Northern grasshopper mouse | <em>Onychomys leucogaster</em>   |
| Northern pocket gopher  | <em>Thomomys talpoides</em>         |
| Nuttall's cottontail   | <em>Sylvilagus nuttallii</em>       |
| Porcupine              | <em>Erethizon doratum</em>          |
| Pygmy rabbit           | <em>Sylvilagus idahoensis</em>      |
| Rocky Mountain elk     | <em>Cervus elaphus</em>             |
| Sagebrush vole         | <em>Lagurus curtatus</em>           |
| Skunk                  | <em>Mephitis mephitis</em>          |</p>
<table>
<thead>
<tr>
<th>Shrub-Steppe Ecoregion</th>
<th>Kane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Townsend's ground squirrel</td>
<td>Spermophilus townsendii</td>
</tr>
<tr>
<td>Vagrant shrew</td>
<td>Sorex Vagrans</td>
</tr>
<tr>
<td>Washington ground squirrel</td>
<td>Spermophilus washingtonii</td>
</tr>
<tr>
<td>White-tailed jackrabbit</td>
<td>Lepus townsendi</td>
</tr>
<tr>
<td>Yellow-bellied marmot</td>
<td>Marmota flaviventris</td>
</tr>
<tr>
<td><strong>Shrub-steppe bats</strong></td>
<td></td>
</tr>
<tr>
<td>Big brown bat</td>
<td>Eptesicus fuscus</td>
</tr>
<tr>
<td>California myotis</td>
<td>Myotis californicus</td>
</tr>
<tr>
<td>Hoary bat</td>
<td>Lasiurus cinereus</td>
</tr>
<tr>
<td>Little brown myotis</td>
<td>Myotis lucifugus</td>
</tr>
<tr>
<td>Pallid bat</td>
<td>Antrozous pallidius</td>
</tr>
<tr>
<td>Western pipistrel</td>
<td>Pipistrellus hesperus</td>
</tr>
<tr>
<td>Western small-footed myotis</td>
<td>Myotis cilioabrum</td>
</tr>
<tr>
<td>Yuma myotis</td>
<td>Myotis yumanensis</td>
</tr>
<tr>
<td><strong>Shrub-steppe birds</strong></td>
<td></td>
</tr>
<tr>
<td>American crow</td>
<td>Corvus brachyhynchos</td>
</tr>
<tr>
<td>American kestrel</td>
<td>Falco sparverius</td>
</tr>
<tr>
<td>Bald eagle</td>
<td>Haliaeetus leucocephalus</td>
</tr>
<tr>
<td>Barn swallow</td>
<td>Hirundo rustica</td>
</tr>
<tr>
<td>Black-billed magpie</td>
<td>Pica pica</td>
</tr>
<tr>
<td>Brewer's blackbird</td>
<td>Euphagus cyanopehalus</td>
</tr>
<tr>
<td>Brewer's sparrow</td>
<td>Spizella brevirostris</td>
</tr>
<tr>
<td>Burrowing owl</td>
<td>Athene cunicularia</td>
</tr>
<tr>
<td>California quail</td>
<td>Callipepla californica</td>
</tr>
<tr>
<td>Chukar</td>
<td>Alectoris chukar</td>
</tr>
<tr>
<td>Cliff swallow</td>
<td>Hirundo pyrrhoinota</td>
</tr>
<tr>
<td>Common raven</td>
<td>Corvus corax</td>
</tr>
<tr>
<td>Ferruginous hawk</td>
<td>Buteo regalis</td>
</tr>
<tr>
<td>Golden eagle</td>
<td>Aquila chrysaetos</td>
</tr>
<tr>
<td>Gray partridge</td>
<td>Perdix perdix</td>
</tr>
<tr>
<td>Great horned owl</td>
<td>Bubo virginianus</td>
</tr>
<tr>
<td>Greater sage grouse</td>
<td>Centrocercus urophasianus</td>
</tr>
<tr>
<td>Horned lark</td>
<td>Eremophila alpestris</td>
</tr>
<tr>
<td>Lark sparrow</td>
<td>Chondestes grammacus</td>
</tr>
<tr>
<td>Loggerhead shrike</td>
<td>Lanius ludovicianus</td>
</tr>
<tr>
<td>Long-billed curlow</td>
<td>Numenius americanus</td>
</tr>
<tr>
<td>Mourning dove</td>
<td>Zenaida macroura</td>
</tr>
<tr>
<td>Northern harrier</td>
<td>Circus cyaneus</td>
</tr>
<tr>
<td>Northern flicker</td>
<td>Colaptes auratus</td>
</tr>
<tr>
<td>Prairie falcon</td>
<td>Falco mexicanus</td>
</tr>
<tr>
<td>Red-tailed hawk</td>
<td>Buteo jamaicensis</td>
</tr>
<tr>
<td>Ring-nicked pheasant</td>
<td>Phasianus colchicus</td>
</tr>
<tr>
<td>Rock wren</td>
<td>Salpinctes obsoletus</td>
</tr>
<tr>
<td>Rough-legged hawk</td>
<td>Ruteo lagopus</td>
</tr>
<tr>
<td>Sage sparrow</td>
<td>Amphispiza belli</td>
</tr>
<tr>
<td>Sage thrasher</td>
<td>Oreoscoptes montanus</td>
</tr>
<tr>
<td>Say's phoebe</td>
<td>Sayornis saya</td>
</tr>
<tr>
<td>Sharp-tailed grouse</td>
<td>Tympanuchis phasianellus</td>
</tr>
<tr>
<td>Swainson's hawk</td>
<td>Buteo swainsoni</td>
</tr>
<tr>
<td>Western kingbird</td>
<td>Tyrannus verticalis</td>
</tr>
<tr>
<td>Western meadowlark</td>
<td>Surnella neglecta</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
</tr>
<tr>
<td>Side-botched lizard</td>
<td>Uta stansburiana</td>
</tr>
<tr>
<td>Sagebrush lizard</td>
<td>Sceloporus gracioso</td>
</tr>
<tr>
<td>Short-horned lizard</td>
<td>Phrynosoma douglasi</td>
</tr>
<tr>
<td>Night snake</td>
<td>Hypsiscina torquata</td>
</tr>
<tr>
<td>Striped whipsnake</td>
<td>Masticophis taeniatus</td>
</tr>
<tr>
<td>Western terrestrial garter snake</td>
<td>Thamnophis elegans</td>
</tr>
<tr>
<td>Western rattlesnake</td>
<td>Crotalus viridus</td>
</tr>
</tbody>
</table>
Riparian and Aquatic Species

Riparian Trees and Shrubs

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black cottonwood</td>
<td><em>Populus trichocarpa</em></td>
</tr>
<tr>
<td>Black greasewood</td>
<td><em>Sarcobatus vermiculatus</em></td>
</tr>
<tr>
<td>Black hawkthorne</td>
<td><em>Crataegus douglasii</em></td>
</tr>
<tr>
<td>Blue elderberry</td>
<td><em>Sambucus cerulea</em></td>
</tr>
<tr>
<td>Chokecherry</td>
<td><em>Prunus virginiana</em></td>
</tr>
<tr>
<td>Coyote willow</td>
<td><em>Salix exigua</em></td>
</tr>
<tr>
<td>Golden currant</td>
<td><em>Philadelphus lewissii</em></td>
</tr>
<tr>
<td>Mock orange</td>
<td><em>Salix amygdaloides</em></td>
</tr>
<tr>
<td>Peachleaf willow</td>
<td><em>Cornus stolonifera</em></td>
</tr>
<tr>
<td>Red osier dogwood</td>
<td><em>Elaeagnus angustifolia(a)</em></td>
</tr>
<tr>
<td>Russian olive</td>
<td><em>Amelanchier alnifolia</em></td>
</tr>
<tr>
<td>Siberian elm</td>
<td><em>Ulmus pumila(a)</em></td>
</tr>
<tr>
<td>White mulberry</td>
<td><em>Morus alba(a)</em></td>
</tr>
<tr>
<td>White poplar</td>
<td><em>Populus alba(a)</em></td>
</tr>
<tr>
<td>Willow</td>
<td><em>Salix spp.</em></td>
</tr>
<tr>
<td>Wood’s rose</td>
<td><em>Rosa woodsii</em></td>
</tr>
</tbody>
</table>

Riparian Perennial Grasses and Flowering Plants

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbous bluegrass</td>
<td><em>Poa bulbosa(a)</em></td>
</tr>
<tr>
<td>Bulrush</td>
<td><em>Scirpus spp.</em></td>
</tr>
<tr>
<td>Cattail</td>
<td><em>Typha latifolia</em></td>
</tr>
<tr>
<td>Columbia River mugwort</td>
<td><em>Artemisia lindleyana</em></td>
</tr>
<tr>
<td>Columbia tickseed</td>
<td><em>Coreopsis atkinsoniana</em></td>
</tr>
<tr>
<td>Horsetail</td>
<td><em>Equisetum spp.</em></td>
</tr>
<tr>
<td>Lovegrass</td>
<td><em>Eragrostis spp.</em></td>
</tr>
<tr>
<td>Purple loosestrife</td>
<td><em>Lythrum salicaria</em></td>
</tr>
<tr>
<td>Reed canarygrass</td>
<td><em>Phalaris arundinacea(a)</em></td>
</tr>
<tr>
<td>Rushes</td>
<td><em>Juncus spp.</em></td>
</tr>
<tr>
<td>Sedges</td>
<td><em>Carex spp.</em></td>
</tr>
<tr>
<td>Water Speedwell</td>
<td><em>Veronica anagallis-aquatica</em></td>
</tr>
<tr>
<td>Western marsh aster</td>
<td><em>Aster hesperius</em></td>
</tr>
<tr>
<td>Western water hemlock</td>
<td><em>Cicuta douglasii</em></td>
</tr>
<tr>
<td>Whild chives</td>
<td><em>Allium schoenoprasum</em></td>
</tr>
<tr>
<td>Wiregrass spikerush</td>
<td><em>Eleocharis spp.</em></td>
</tr>
<tr>
<td>Wormwood</td>
<td><em>Artemisia campestris</em></td>
</tr>
</tbody>
</table>

Aquatic Plants

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duckweed</td>
<td><em>Lemna minor</em></td>
</tr>
<tr>
<td>Pondweed</td>
<td><em>Potamogeton spp.</em></td>
</tr>
<tr>
<td>Columbia yellowcress</td>
<td><em>Rorippa columbiana</em></td>
</tr>
<tr>
<td>Spiked water milfoil</td>
<td><em>Myriophyllum spicatum</em></td>
</tr>
<tr>
<td>Watercress</td>
<td><em>Rorippa nasturtium-aquatica(a)</em></td>
</tr>
</tbody>
</table>

Fish species

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>American shad</td>
<td><em>Alosa sapidissima</em></td>
</tr>
<tr>
<td>Black bullhead</td>
<td><em>Ameiurus melas</em></td>
</tr>
<tr>
<td>Black crappie</td>
<td><em>Pomoxis nigromaculatus</em></td>
</tr>
<tr>
<td>Bluegill</td>
<td><em>Lopomis macrochirus</em></td>
</tr>
<tr>
<td>Bridgelip sucker</td>
<td><em>Castostomus columbianus</em></td>
</tr>
<tr>
<td>Brown bullhead</td>
<td><em>Ictalurus nebulosus</em></td>
</tr>
<tr>
<td>Burbot</td>
<td><em>Lota lota</em></td>
</tr>
<tr>
<td>Carp</td>
<td><em>Cyprinus carpio</em></td>
</tr>
<tr>
<td>Channel catfish</td>
<td><em>Ictalurus punctatus</em></td>
</tr>
<tr>
<td>Chinook salmon</td>
<td><em>Oncorhynchus tshawytscha</em></td>
</tr>
<tr>
<td>Chiselmouth</td>
<td><em>Acrocheilus alutaceus</em></td>
</tr>
<tr>
<td>Coho salmon</td>
<td><em>Oncorhynchus kisutch</em></td>
</tr>
<tr>
<td>Cutthroat trout</td>
<td><em>Oncorhynchus clarki</em></td>
</tr>
<tr>
<td>Dolly Varden</td>
<td><em>Salvelinus malma</em></td>
</tr>
<tr>
<td>Lake whitefish</td>
<td><em>Coregonus clupeaformis</em></td>
</tr>
<tr>
<td>Largemouth bass</td>
<td><em>Micropterus salmoides</em></td>
</tr>
<tr>
<td>Largescale sucker</td>
<td><em>Catostomus macrocheilus</em></td>
</tr>
</tbody>
</table>
Shrub-Steppe Ecoregion

Leopard dace  
Longnose dace  
Mottled sculpin  
Mountain sucker  
Mountain whitefish  
Northern pike minnow (squawfish)  
Pacific lamprey  
Peamouth  
Paite sculpin  
Prickly sculpin  
Pumpkinseed  
Rainbow trout (steelhead)  
Redside shiner  
Reticulate sculpin  
River lamprey  
Sandroller  
Smallmouth bass  
Sockeye salmon  
Speckled dace  
Tench  
Threespine stickleback  
Torrent sculpin  
Walley  
White crappie  
White sturgeon  
Yellow perch  
Yellow bullhead

Riparian and Riverine Bird Species

American coot  Fulica americana
American white pelican  Pelecanus erythrorhynchos
Bank swallow  Riparia riparia
Black-crowned night-heron  Nycticorax nycticorax
Blue-winged teal  Anas discors
Bufflehead  Bucephala albeo
Canada goose  Branta canadensis
California gull  Larus californicus
Caspian tern  Sterna caspia
Common goldeneye  Bucephala clangula
Common loon  Gavia immer
Common merganser  Mergus merganser
Forster’s tern  Sterna forsteri
Great blue heron  Ardea herodias
Horned grebe  Podiceps auritus
Mallard  Anas platyrhynchos
Ring-billed gull  Larus delawarensis
Western grebe  Aechmorhous occidentalis
Western sandpiper  Calidris mauri

Riparian Mammals

Muskrat  Castor canadensis
Beavers  Castor canadensis
River otters  Lutra canadensis
Raccoon  Procyon lotor
White-tailed deer  Odocoileus virginianus

Amphibians & Riparian Reptiles

Painted turtle  Chrysemys picta
Great Basin spadefoot toad  Scaphiopus intermontanus
Woodhouses toad  Bafo woodhousei
Pacific tree frog  Hyla regilla
Bullfrog  Cates beiana
Shrub-Steppe Ecoregion

References


Quigley TM, Haynes RW, Graham RT editors. 1996. Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath
Shrub-Steppe Ecoregion

United States Department of Agriculture. Portland, Oregon.


### Zonal Series

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Dominant Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Festuca idahoensis</em></td>
<td><strong>Agropyron spicatum</strong></td>
<td>Most extensive; widely distributed outside of state. Includes Hanford site. Species diversity low. Low water holding capacity and few nutrients in sandy soils influence composition. Hottest and driest areas. Range fires.</td>
</tr>
<tr>
<td><em>Agropyron spicatum</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Eastern areas with slightly higher precipitation and lower temperatures. Represented outside of state. Greater</td>
</tr>
<tr>
<td><em>Poa secunda</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Occurs in Snake River drainage and Columbia Gorge. Wheatgrass and bluegrass dominate to near exclusion of other species. Scattered gray rabbitbrush, but other shrubs are non-existent.</td>
</tr>
<tr>
<td><em>Symphoricarpos albus</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Region divided by Snake River Valley. Shrubs and perennial herbs rare. Moderate moisture.</td>
</tr>
<tr>
<td><em>Rosa nutkana</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Central position on eastern margin of Columbia Basin. Most common on dry southwesterly exposures. Low winter temperatures more limiting than summer drought. Recovery from fire rapid.</td>
</tr>
<tr>
<td><em>Hieracium cynoglossoides</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>North of Clearwater and Snake Rivers. Meadow-like community. Dwarf forms of rose represent the few shrubs. Wetter in winter but drier in summer.</td>
</tr>
<tr>
<td><em>Festuca tripartita</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Sagebrush barely rises above a continuous herb layer. Shrub layers discontinuous.</td>
</tr>
<tr>
<td><em>Poa pratensis</em></td>
<td><strong>Festuca idahoensis</strong></td>
<td>Abundance of forbs but lacks shrubs.</td>
</tr>
</tbody>
</table>

### Zootic Climaxes

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bromus tectorum</em></td>
<td>Replaces native communities in drier/hotter areas.</td>
</tr>
<tr>
<td><em>Poa pratensis</em></td>
<td>Replaces native communities in wetter/cooler areas.</td>
</tr>
</tbody>
</table>

### Other Communities

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Festuca idahoensis</em></td>
<td><em>Eriogonum heracleoides</em></td>
</tr>
<tr>
<td><em>Dune vegetation</em></td>
<td>Small dunes occur infrequently along Columbia River or in areas where glacier deposits are found. Plants like Chelone glomerata, Woodsia oreana, and Penstemon</td>
</tr>
<tr>
<td><em>Rock crevices</em></td>
<td>Cliffs found in river and dry canyon walls. Plants like Chelone glomerata, Woodsia oreana, and Penstemon</td>
</tr>
<tr>
<td><em>Talus slopes</em></td>
<td>Bases of cliffs. Usually bare except for mosses and lichens. Some shrubs can become established.</td>
</tr>
<tr>
<td><em>Pond vegetation</em></td>
<td>Multiplier of ponds in areas that were covered by glaciers or fell their runoff. Distinctive family of water plants</td>
</tr>
<tr>
<td><em>Artemisia tridentata spp. Vaseyana</em></td>
<td>Cold adapted population found in parks high up in eastern Washington mountains.</td>
</tr>
<tr>
<td><em>Camassia marshes</em></td>
<td>Found in remaining remnants of marshes throughout the region.</td>
</tr>
</tbody>
</table>

### Table 1a: Daubenmire Plant Communities

Data from Daubenmire 1988

Page 20
<table>
<thead>
<tr>
<th>Edaphic Series</th>
<th>Deep soils</th>
<th>Shallow soils to bedrock (lithosols)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deep soils dominated by gravel, sand, or strongly weathered volcanic ash</td>
<td>Stony and extremely shallow to bedrock. Carpet of Sandberg’s bluegrass and crust of lichens and</td>
</tr>
<tr>
<td></td>
<td>Gravel and sand soils have low moisture holding capability. Volcanic ash</td>
<td>mosses typifies this zone. Almost all have some shrub.</td>
</tr>
<tr>
<td></td>
<td>has high moisture content but are ecological equivalents. Lower soil fertility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>appears key in supporting needle and thread.</td>
<td></td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Stipa comata</td>
<td>Appears throughout big sagebrush zones.</td>
</tr>
<tr>
<td>Purshia tridentata</td>
<td>Stipa comata</td>
<td>Restricted to big sagebrush/bluebunch wheatgrass.</td>
</tr>
<tr>
<td>Stipa comata</td>
<td>Poa secunda</td>
<td>Occurs in bluebunch wheatgrass/Sandberg’s bluegrass zones.</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Stipa comata</td>
<td></td>
</tr>
<tr>
<td>Shallow soils to bedrock (lithosols)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artemisia rigida</td>
<td>Poa secunda</td>
<td>Most widespread.</td>
</tr>
<tr>
<td>Eriogonum niveum</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Eriogonum nupharalum</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Eriogonum douglassi</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Eriogonum compositum</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Eriogonum thymoides</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Eriogonum microthecum</td>
<td>Physaria oregana</td>
<td></td>
</tr>
<tr>
<td>Aropyron spicatum</td>
<td>Poa secunda</td>
<td></td>
</tr>
<tr>
<td>Saline-alkali soils</td>
<td></td>
<td>Found throughout Washington steppe and commonly occur on poorly drained valley fill. All have Alkali saltgrass.</td>
</tr>
<tr>
<td>Distichlis stricta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elymus caninus</td>
<td>Distichlis stricta</td>
<td></td>
</tr>
<tr>
<td>Sacobalus vermiculatus</td>
<td>Distichlis stricta</td>
<td></td>
</tr>
<tr>
<td>Nonsaline soils that are more moist than zonal soils</td>
<td></td>
<td>Deciduous forest and woodland or tall scrub within the steppe region. More abundant moisture leads to a higher variety of vegetation.</td>
</tr>
<tr>
<td>Crataegus douglassi</td>
<td>Symphoricarpus albus</td>
<td>Confined to Idaho fescue/snowberry and Idaho fescue/rose zones. Includes a phase with quaking aspen.</td>
</tr>
<tr>
<td>Crataegus douglassi</td>
<td>Heracleum lanatum</td>
<td>Confined to wetter parts of these zones on valley floors.</td>
</tr>
<tr>
<td>Populus trichocarpa</td>
<td>Cicutta douglassi</td>
<td></td>
</tr>
<tr>
<td>Other special soils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purshia tridentata</td>
<td>Agropyron spicatum</td>
<td>Very stoney loam along eastern base of the Cascade Mountains.</td>
</tr>
<tr>
<td>Artemisia tripartita</td>
<td>Agropyron spicatum</td>
<td>Present in threetip sagebrush/Idahoe fescue areas with too much wind and sun exposure to support Idaho fescue</td>
</tr>
<tr>
<td>Artemisia tridentata</td>
<td>Poa secunda</td>
<td>Confined to the hottest and driest part of the big sagebrush/bluebunch wheatgrass zone.</td>
</tr>
<tr>
<td>Grayia spinosa</td>
<td>Poa secunda</td>
<td>Located in the lowest and driest portion of big sagebrush/bluebunch wheatgrass zone.</td>
</tr>
<tr>
<td>Eurotia lanata</td>
<td>Poa secunda</td>
<td>Highly calcareous reosols on the flanks of mountains.</td>
</tr>
<tr>
<td>Sporobolus cryptandrus</td>
<td>Poa secunda</td>
<td>Sandy or gravelly soils in bluebunch wheatgrass/Sandberg’s bluegrass.</td>
</tr>
<tr>
<td>Aristida longiseta</td>
<td>Poa secunda</td>
<td>Snake, lower Grand Ronde, and lower Palouse River valleys.</td>
</tr>
<tr>
<td>Rhus glabra</td>
<td>Agropyron spicatum</td>
<td>Colluvial and sandy alluvial soils in canyons.</td>
</tr>
<tr>
<td>Rhus glabra</td>
<td>Agropyron spicatum</td>
<td>Colluvial and sandy alluvial soils in canyons.</td>
</tr>
<tr>
<td>Rhus glabra</td>
<td>Sporobolus cryptandrus</td>
<td>Colluvial and sandy alluvial soils in canyons.</td>
</tr>
<tr>
<td>Celtis douglassi</td>
<td>Bromus tectorum</td>
<td>Zootic climax on colluvial clee and aprongs along major canyon walls.</td>
</tr>
</tbody>
</table>

**Table 1b: Daubenmire Plant Communities**

**Data from Daubenmire 1988**

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## Pre-1800s Plant Communities

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Pre-1800s*</th>
<th>1996*</th>
<th>Change**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluebunch wheatgrass steppe</td>
<td>13.8%</td>
<td>5.8%</td>
<td>-58%</td>
</tr>
<tr>
<td>Idaho fescue steppe</td>
<td>5.6%</td>
<td>1.6%</td>
<td>-72%</td>
</tr>
<tr>
<td>Bitterbrush steppe</td>
<td>1.6%</td>
<td>1.0%</td>
<td>-35%</td>
</tr>
<tr>
<td>Big sagebrush steppe</td>
<td>54.8%</td>
<td>22.2%</td>
<td>-59%</td>
</tr>
<tr>
<td>Juniper/sagebrush</td>
<td>1.5%</td>
<td>1.5%</td>
<td>-1%</td>
</tr>
<tr>
<td>Three-tip sagebrush</td>
<td>10.0%</td>
<td>0.0%</td>
<td>-100%</td>
</tr>
<tr>
<td>Blackgreasewood</td>
<td>1.8%</td>
<td>0.0%</td>
<td>-100%</td>
</tr>
<tr>
<td>Conifers/Idaho fescue</td>
<td>3.0%</td>
<td>0.0%</td>
<td>-100%</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>4.1%</td>
<td>4.5%</td>
<td>11%</td>
</tr>
<tr>
<td>Water</td>
<td>1.0%</td>
<td>1.0%</td>
<td>0%</td>
</tr>
<tr>
<td>Urban</td>
<td>0.0%</td>
<td>0.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Crop/hay/pasture</td>
<td>0.0%</td>
<td>59.4%</td>
<td>100%</td>
</tr>
<tr>
<td>Other</td>
<td>2.8%</td>
<td>2.7%</td>
<td>-2%</td>
</tr>
</tbody>
</table>

*% of land covered by the plant type or use
**Change in land covered by this plant type or use

### Table 2: Comparison of Historic and Current Plant Communities and Land Use

Data from O'Connor and Wieda 2001
Figure 1: Location of the Washington Shrub-steppe Ecoregion
Figure 2: Elevation Profiles of the Columbia Basin
Figure 3: Climate of the Washington Shrub-steppe Ecoregion

Data from Western Regional Climate Center
http://www-k12.atmos.washington.edu/k12/grayskies/eastern/index.html
Figure 4: Geology of the Washington Shrub-steppe Ecoregion
From O’Connor and Wieda 2001
From Wildung and Garland 1988

Figure 5: Soils of the ALE Reserve

From O'Connor and Wieda 2001

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Figure 6: Location of Shrub-steppe Plant Communities
From Daubenmire 1988
Bitterbrush/Sagebrush/Sandberg's Bluegrass

Figure 7: Plant Communities and Topography
From O'Connor and Wieda 1991
Figure 8b: Community Diversity at Hanford Site

From Soll et al 2000
Figure 8c: Community Diversity at Hanford Site
From Soll et al. 2000
Figure 2.4: Plant Community Cover Type of the Hanford Reach

Legend Plant Community Cover Types:
- Upland shrub
- Wetland
- Forebay
- River
- Channel
- Open Water

Map Information
- Federal Data: 1984
- USGS Topographic Map
- Map prepared by K.P. Kane
- Map scale: 1:24,000

Figure 8d: Community Diversity at Hanford Site
From Soll et al. 2000
Shrub-Steppe Ecoregion

Simplified shrub-steppe profiles
From O'Connor and Wieda 2001

Simplified riparian-aquatic profile
From O'Connor and Wieda 2001

Detailed shrub-steppe & meadow-steppe profiles
From Daubenmire 1988

Figure 9: Plant Communities Profiles
Figure 10: Ecological Integrity
From Quigley et al 1996

WA shrub-steppe ecoregion
Figure 11: Vegetative Cover and Land Use
From O'Connor and Wieda 2001
Figure 12: Land Ownership
From Quigley et al 1996

WA shrub-steppe ecoregion