

Level III and IV Ecoregion Descriptions for Washington

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The following ecoregion descriptions are derived from:

- Clarke, Sharon E., and Sandra A. Bryce, eds., 1997, Hierarchical subdivisions of the Columbia Plateau and Blue Mountains Ecoregions, Oregon and Washington. Portland: U.S. Department of Agriculture-Forest Service General Technical Report PNW-GTR-395, 114 p.
- McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2002. Ecoregions of Idaho. (2 sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,350,000.
- Pater, David. E., Sandra A. Bryce, Thor D. Thorson, Jimmy Kagan, Chris Chappell, James M. Omernik, Sandra H. Azevedo, and Alan J. Woods. 1998. Ecoregions of Western Washington and Oregon (2 sided color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, US Department of the Interior - Geological Survey (map scale: 1:1,350,000)*. ISBN 0-607-89571-3
- Thorson, T.D., S. A. Bryce, D. A. Lammers, A. J. Woods, J. M. Omernik, J. Kagan, D. E. Pater, and J. A. Comstock. 2003. Ecoregions of Oregon (2-sided color poster with map, descriptive text, summary tables, and photographs), U. S. Geological Survey, Reston, Virginia. Map scale 1:1,500,000).

1. COAST RANGE

The low mountains of Ecoregion 1 are covered by highly productive, rain-drenched coniferous forests. Sitka spruce forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar, western hemlock, and seral Douglas-fir blanketed inland areas. Today Douglas-fir plantations are prevalent on the intensively logged and managed landscape.

1a. Coastal Lowlands

The Coastal Lowlands ecoregion encompasses estuarine marshes, freshwater lakes, black-water streams, marine terraces, and sand dune areas. Elevations range from sea level to 300 feet. Channelization and diking have converted many of its wetlands into dairy pastures; associated stream quality degradation has occurred.

1b. Coastal Uplands

The Coastal Uplands ecoregion extends to an elevation of about 500 feet. The climate of Ecoregion 1b is marine-influenced and is characterized by an extended winter rainy season, sufficient fog during the summer dry season to reduce vegetal moisture stress, and a lack of seasonal temperature extremes. The ecoregion roughly corresponds with the historic distribution of Sitka spruce. The extent of the original forest has been greatly reduced by logging.

1c. Low Olympics

The Low Olympics ecoregion contains foothills and mountains and rises to an elevation of approximately 4000 feet. Copious precipitation (up to 200 inches/year) supports a lush, epiphyte-rich rainforest of western hemlock, western red cedar, and Douglas-fir. Much of the region is in the third rotation of logging. However, a portion of the region lies within the Olympic National Park and contains ancient forests.

1d. Volcanics

The Volcanics ecoregion varies in elevation from 1,000 to 4,000 feet and is disjunct. Columnar and pillow basalt outcrops occur. Its mountains may have been offshore seamounts engulfed by continental sediments

about 200 million years ago. The basaltic substrate preserves relatively stable summer stream flows that still support spring chinook salmon and summer steelhead. Its forests are intensively managed.

1e. Outwash

The Outwash ecoregion is a gently sloping fan of glacial outwash material that is dominated by industrial timber plantations. It lies outside the zone of marine influence and has lower stream flows than most other parts of the Coast Range (1).

1f. Willapa Hills

The Willapa Hills ecoregion has erodible silt and clay soils. Drainage density is lower than in other parts of the Coast Range (1) that are also underlain by sedimentary rock. Industrial timberland has almost completely replaced the historic forests of the ecoregion.

2. PUGET LOWLAND

Ecoregion 2 is a broad rolling lowland that is characterized by a mild maritime climate. It occupies a continental glacial trough and is composed of many islands, peninsulas, and bays in the Puget Sound area. Coniferous forest originally grew on the ecoregion's ground moraines, outwash plains, floodplains, and terraces. The distribution of forest species is affected by the rainshadow from the Olympic Mountains.

2a. Fraser Lowland

The Fraser Lowland ecoregion is composed of glacial drift plains, terraces, and some floodplains. Undulating terrain, a mild, wet climate, and productive pastureland are characteristic. This ecoregion has the highest dairy farm concentration in Washington.

2b. Eastern Puget Riverine Lowlands

The Eastern Puget Riverine Lowlands ecoregion is composed of floodplains and terraces. Western red cedar forest, western hemlock forest, and both riverine and wetland habitat were common before the 19th century. Subsequently, many of the wetlands were drained. Pastures, cropland, forests, and urban centers now dominate the landscape.

2c. San Juan Islands

The glacial-scoured San Juan Islands ecoregion is underlain by sedimentary rock. Well-drained, shallow soils are typical. It is in the rainshadow of the Olympic Mountains. The driest vegetation types in the Puget Lowland (2) grow here and include Douglas-fir/grand fir forests, oak woodlands, and grasslands.

2d. Olympic Rainshadow

The Olympic Rainshadow ecoregion receives, on the average, only 10 to 40 inches of precipitation each year depending on location. Streams on the till plains have low discharge, and their drainage pattern is often deranged or internal. Its loamy soils tend to retain moisture better than the soils of the San Juan Islands (2c) and support pastureland, cropland, and woodland.

2e. Eastern Puget Uplands

The Eastern Puget Uplands ecoregion is made up of rolling moraines and foothills and is a zone of transition. Both Puget Lowland and Cascadian vegetation associations occur with the latter most common in areas of greatest elevation and precipitation. The relief and precipitation of Ecoregion 2e tend to be high for the Puget Lowland (2), but low compared to the Cascades (4) or the North Cascades (77).

2f. Central Puget Lowland

The Central Puget Lowland ecoregion is the heart of Puget Sound both in physical and human terms. Its undulating drift plains are heavily urbanized in the east and more rural and forested in the west. Well-

drained, gravelly soils are common and exhibit limited moisture holding capacity and rather low agricultural productivity.

2g. Southern Puget Uplands

The Southern Puget Prairies ecoregion is comprised of nearly level to rolling glacial outwash plains and ground moraines. Well-drained soils promote a land cover mosaic of Douglas-fir/western hemlock forests, prairies, oak woodlands, cropland, and pastureland.

2h. Cowlitz/Chehalis Foothills

The Cowlitz/Chehalis Foothills are rolling to steeply sloping. The potential natural vegetation, western hemlock and western red cedar forest, is similar to Ecoregions 2a, b, d, e, f, and i. However, in contrast to much of the Puget Lowland (2), Ecoregion 2h was unaffected by continental glaciation.

2i. Cowlitz/Newaukum Prairie Floodplains

The Cowlitz/Newaukum Prairie Floodplains ecoregion is a transitional zone between the Puget Lowland (2) and the Willamette Valley (3). Its vegetation, soil, and climate are similar to those of the Southern Puget Prairies (2g) and the Eastern Puget Riverine Lowlands (2b). However, unlike those areas, it did not experience continental glaciation.

3. WILLAMETTE VALLEY

Rolling prairies, deciduous/coniferous forests, and extensive wetlands characterized the pre-settlement landscape of this broad, lowland valley. Ecoregion 3 is distinguished from the adjacent Coast Range (1) and Cascades (4) by lower precipitation, less relief, and a different mosaic of vegetation. Landforms consist of terraces and floodplains that are interlaced and surrounded by rolling hills. Productive soils and a temperate climate make it one of the most important agricultural areas in Oregon.

3a. Portland/Vancouver Basin

The Portland/Vancouver Basin ecoregion is composed of undulating terraces and floodplains with numerous wetlands, oxbow lakes, and ponds. Historically, prairie and oak woodland grew on better drained sites while wetlands, Oregon ash, and Douglas-fir occurred elsewhere in the fault block basin. Today, Ecoregion 3a is dominated by urban and suburban development, pastures, and nurseries. Weather here is often affected by cold or warm easterly winds that blow through the Columbia River Gorge.

3d. Valley Foothills

The Valley Foothills ecoregion is a transitional zone between the Willamette Valley, the Cascade Range, and the Coast Range. It has less rainfall than adjacent, more mountainous ecoregions and, consequently, its potential natural vegetation is distinct. Oregon white oak and Douglas-fir were originally dominant but, today, rural residential development, woodland, pastureland, vineyards, tree farms, and orchards are common.

4. CASCADES

Ecoregion 4 is mountainous, underlain by Cenozoic volcanics, and has been affected by alpine glaciations. It is characterized by steep ridges and river valleys in the west, a high plateau in the east, and both active and dormant volcanoes. Elevations range upwards to 14,410 feet. Its moist, temperate climate supports an extensive and highly productive coniferous forest. Subalpine meadows and rocky alpine zones occur at high elevations.

4a. Western Cascades Lowlands and Valleys

The Western Cascades Lowlands and Valleys ecoregion is characterized by a network of steep ridges and narrow valleys. Elevations are generally less than 3,200 feet and are the lowest in Ecoregion 4. The wet,

mild climate promotes lush forests that are dominated by Douglas-fir and western hemlock. It is one of the most important timber producing areas in the Northwest.

4b. Western Cascades Montane Highlands

The Western Cascades Montane Highlands ecoregion is composed of steep, glaciated mountains that have been dissected by high-gradient streams. It has lower temperatures than Ecoregion 4a and is characterized by a deep annual snow pack. Soils are of the frigid and cryic temperature regimes and support forests dominated by Pacific silver fir, western hemlock, mountain hemlock, Douglas-fir, and noble fir.

4c. Cascade Crest Montane Forest

The Cascade Crest Montane Forest ecoregion consists of an undulating plateau punctuated by volcanic buttes and cones that reach a maximum elevation of about 6,500 feet. Its Pliocene and Pleistocene volcanics were glaciated and numerous lakes occur. The ecoregion is extensively forested with mountain hemlock and Pacific silver fir.

4d. Cascade Subalpine/Alpine

The Cascades Subalpine/Alpine ecoregion is an area of high, glaciated, volcanic peaks that rise above subalpine meadows. Elevations range from 5,600 to 12,000 feet. Active glaciation occurs on the highest volcanoes and decreases from north to south. The winters are very cold and the growing season is extremely short. Flora and fauna adapted to high elevations include herbaceous and shrubby subalpine meadow vegetation and scattered patches of mountain hemlock, subalpine fir, and whitebark pine.

9. EASTERN CASCADES SLOPES AND FOOTHILLS

Ecoregion 9 is in the rainshadow of the Cascade Range. Its climate exhibits greater temperature extremes and less precipitation than ecoregions to the west. Open forests of ponderosa pine and some lodgepole pine distinguish this region from the higher ecoregions to the west where fir and hemlock forests are common, and the lower, dryer ecoregions to the east where shrubs and grasslands are predominant. The vegetation is adapted to the prevailing dry, continental climate and is highly susceptible to wildfire. Volcanic cones and buttes are common in much of the region.

9a. Yakima Plateau and Slopes

The unglaciated Yakima Plateau and Slopes ecoregion is characterized by plateaus, buttes, and canyons, a dry continental climate, and open woodlands dominated by ponderosa pine. Fire is an integral part of its ecosystem.

9b. Grand Fir Mixed Forest

The Grand Fir Mixed Forest ecoregion is mostly outside the limit of maritime climatic influence. It is characterized by high, glaciated plateaus and mountains, frigid soils, and a snow-dominated, continental climate. The vegetation is a mix of grand fir, Douglas-fir, and ponderosa pine.

9c. Oak/Conifer Eastern Cascades-Columbia Foothills

The Oak/Conifer Eastern Cascades Columbia Foothills ecoregion is more diverse than any other within the Eastern Cascade Slopes and Foothills (9). Soil, climate, and landforms are all highly variable and contribute to a mosaic of vegetation types that includes grasslands, oak woodlands, Douglas-fir/ponderosa pine forests, and western hemlock/Douglas-fir forests. Maritime weather systems sometime enter Ecoregion 9c via the Columbia River Gorge and moderate its otherwise continental climate.

10. COLUMBIA PLATEAU

Ecoregion 10 is an arid sagebrush steppe and grassland, surrounded on all sides by moister, predominantly forested, mountainous ecological regions. The Columbia Plateau (10) is underlain by basalt up to two miles

thick. It is covered in some places by loess soils that have been extensively cultivated for wheat, particularly in the eastern portions of the region where precipitation amounts are greater. During the glaciation of the Pleistocene era, parts of the area were scoured to bedrock by huge floods from breached ice dams.

10a. Channeled Scablands

The Channeled Scablands were formed as immense floods periodically broke through ice dams blocking glacial Lake Missoula during the Pleistocene. The depth and high speed of the flood waters scoured away the thick loess soil covering the plateau as well as portions of the underlying basalt bedrock. Patterned ground covers the basalt plateaus bordering the main flood channels. The patterns or “scabs” are mounds of loess surrounded by rock fragments. The scablands are generally too dry to support trees. The most common native vegetation on the scabland channels is the stiff sage-Sandberg’s bluegrass association.

10b. Loess Islands

The Loess Islands are the remains of the once unbroken mantle of wind-deposited loess that covered the entire Columbia Plateau. They are surrounded by eroded Pleistocene flood channels (ecoregion 10a). Precipitation ranges from 7-18 inches per year from west to east across the ecoregion. The big sage-bluebunch wheatgrass association grades into bluebunch wheatgrass-Idaho fescue as precipitation increases. Three tip sage and Idaho fescue grow in a band around the northern perimeter of the plateau. Present-day land use has transformed the loess islands into wheat fields. Because of the limitations in moisture, crop rotations generally include a fallow period.

10d. Okanogan Drift Hills

The Okanogan Drift Hills ecoregion includes the rolling uplands bordering the Okanogan Valley (10m) to the north. The Okanogan lobe of the Wisconsin Glacier advanced far enough down the valley to dam the Columbia River, creating glacial Lake Columbia and rerouting the Columbia River through Grand Coulee. As the glacier melted, it retreated up the Okanogan valley, leaving behind a blanket of glacial till. The southern boundary of the ecoregion follows the Pleistocene glacier's terminal moraine. Precipitation levels are somewhat higher in ecoregion 10d than in the neighboring Okanogan Valley (10m). A common native plant association in this ecoregion is three-tip sage and Idaho fescue. Areas with enough loess soil support dryland wheat farming; otherwise, the major land use is grazing.

10e. Pleistocene Lake Basins

The Pleistocene Lake Basins ecoregion once contained vast temporary lakes that were created by flood waters from glacial Lake Missoula. Faint high water marks and shorelines, still visible between the 1,000 and 1,200 foot elevation contours, mark the margins of the former lakes. Today, Ecoregion 10e is the lowest and driest area on the Columbia Plateau (10) and receives an annual average precipitation of only 6 to 12 inches. Native vegetation consists of bluebunch wheatgrass and sagebrush. Major irrigation projects provide Columbia River water to Ecoregion 10e and have allowed the conversion of large areas of sagebrush to agriculture.

10f. Dissected Loess Uplands

The Dissected Loess Uplands ecoregion, located on the northeastern slopes of the Blue Mountains (11), comprises unforested, rolling loess hills, canyons, and flat plateau remnants isolated by the lower canyons of the Snake and Clearwater Rivers (10l). Pure grasslands without a sagebrush component dominate the lower elevations. Shrubs, such as rose and snowberry, appear with increasing moisture at higher elevations. Though grazing and farming have eliminated much of the original plant cover of Ecoregion 10f, the region is not as suited to agriculture as are neighboring Ecoregions 10h and 10i because of its dissected terrain and thinner soil. Sharp-tailed grouse, once abundant in shrub covered areas, have been recently reintroduced.

10g. Yakima Folds

The Yakima Fold belt is a series of unforested anticlinal ridges and synclinal valleys covering the western Columbia Plateau (10). Only the far eastern end of the ecoregion enters Oregon east of Wallula Gap on the Columbia River. The ridges are composed of layer upon layer of basalt up to 12,000 feet thick. Loess blankets the south-facing slopes and supports dryland wheat farming, while grazing occurs on steep, rocky north slopes. Located in the rain shadow of the Cascade Range, Ecoregion 10g receives little precipitation. Sagebrush and bunchgrass associations dominate plant communities outside of heavily farmed or grazed areas.

10h. Palouse Hills

The Palouse Hills are the western foothills of the Northern Rocky Mountains (15). The ecoregion boundaries define an unforested loess-covered area differing from other such areas in the Columbia Plateau by the increased moisture availability near the mountains. The soil has a higher organic matter and clay content and is highly productive. Original plant cover has been almost entirely supplanted by wheat farms. Water and wind erosion are major management issues. Perennial streams originate from the mountains to the east. Smaller, loess-bottomed streams rise within the ecoregion and are intermittent. Many of these streams are plowed through and tiled.

10i. Deep Loess Foothills

The Deep Loess Foothills ecoregion includes lower, northwest-facing slopes of the eastern Blue Mountains. Both Ecoregion 10i and the Palouse in Washington have highly-productive soil, equivalent average annual precipitation (16 to 23 inches), and similar land use capability. However, these areas differ in physiography and stream density. Instead of the dune-like ridges of the Palouse, the Deep Loess Foothills (10i) contain step-like terraced ridges that rise to the forested Blue Mountains. Ecoregion 10i also has more perennial streams than the Palouse; they are fed by the higher rainfall and snowpack that occurs in the Blue Mountains.

10l. Lower Snake and Clearwater Canyons

The Lower Snake and Clearwater Canyons ecoregion cuts deeply through the basalt layers of the Columbia Plateau (10) and has isolated plateau fragments of the Dissected Loess Uplands (10f). The depth of the canyons, up to 2,000 feet, create drier conditions than those in Ecoregion 10f and mean annual precipitation is about 10 inches. Outside of human population centers and transportation corridors, canyons provide wildlife habitat for bighorn sheep and game birds.

10m. Okanogan Valley

The Okanogan Valley ecoregion is a glacial trough lying between the North Cascades Mountains and the Okanogan Highlands; it contains slopes, terraces, and alluvial flats surrounding the Okanogan and Methow Rivers at elevations below 3,000 feet. At 9-12 inches per year, annual precipitation in the ecoregion is sufficient for sagebrush and grasses. Increased precipitation at treeline denotes the upper boundary of the ecoregion. The porous glacial till has a thin veneer of loess; it supports irrigated agriculture and orchards in the alluvial areas and dryland wheat farming and grazing in the uplands.

11. BLUE MOUNTAINS

The Blue Mountains ecoregion is a complex of mountain ranges that are generally lower and more open than the neighboring Cascades (4), Northern Rockies (15), and the Idaho Batholith (16) ecoregions. Like the Cascades, but unlike the Northern Rockies, the region is mostly volcanic in origin. Only the few higher ranges, particularly the Wallowa and Elkhorn Mountains, consist of granitic intrusive and metamorphic rocks that rise above the dissected lava surface of the region. Unlike the bulk of the Cascades, Idaho Batholith, and Northern Rockies, much of this ecoregion is grazed by cattle.

11c. Maritime-Influenced Zone

The Maritime-Influenced Zone is that part of the Blue Mountains (11) that directly intercepts marine weather systems moving east through the break in the Cascades (4) at the Columbia River Gorge. Rain or snow events occur except in the summer. Loess soils are found at lower elevations near the Columbia Plateau (10) and have a moderately high water holding capacity. Moisture availability is sufficient to support forests at lower elevations than elsewhere in the Blue Mountains (11). A xeric forest of ponderosa pine and Douglas-fir occurs and has a dense and diverse shrub layer beneath it.

11f. Canyons and Dissected Highlands

The Canyons and Dissected Highlands ecoregion includes the eastern Blue Mountains, the eastern Wallawas, and isolated islands of uplifted Columbia Plateau that have been cut by the Snake River at Hells Canyon. Ecoregion 11f is on the lee side of the mountains and is drier than the marine-influenced Mesic Forest Zone (11i) that is found at similar elevations to the west. Its closed canopy forest is dominated by Douglas-fir that can withstand the difficult growing conditions and shifting colluvial soils of steep canyon slopes. Below about 4,500 feet elevation, the Douglas-fir forest of Ecoregion 11f changes abruptly to the grassland of the Canyons and Dissected Uplands (11g). Human activities are limited by the steep terrain of Ecoregion 11f.

11g. Canyons and Dissected Uplands

In the Canyons and Dissected Uplands ecoregion, deep river canyons divide the Blue Mountains from the Rocky Mountains. The Snake, Grande Ronde, Imnaha, and Salmon Rivers and their tributaries have cut the Columbia Plateau to depths of 2,000 to 5,000 feet. These canyons are cut through the same metasedimentary and metavolcanic rock that forms the Wallowa and Seven Devils; they differ from their lower stretches in Ecoregion 10i that are cut into basalt. The depth of the canyons and the exposed metamorphic rocks result in stony soils on canyon slopes that retain little moisture. Bluebunch wheatgrass, Sandberg's bluegrass, and spiny greenbush are adapted to grow under these hot, dry conditions. Land use includes grazing and recreation on National Forest land and in the Hells Canyon National Recreation Area.

11i. Mesic Forest Zone

The Mesic Forest Zone is found between 4,000-7,000 feet in the western Wallawas, the western Seven Devils Mountains, and the higher elevation Blue Mountains. These areas are influenced by marine air coming through the Columbia River Gorge to the west. Much of the ecoregion's precipitation falls as snow that persists late into the spring. The soil has a significant ash layer that is relatively rock free and that also helps to retain moisture during the dry season. The result of these factors is a highly productive and diverse forest community that includes true firs and Engelmann spruce.

11m. Subalpine-Alpine Zone

The Subalpine-Alpine Zone includes the highest areas of the Elkhorn, Wallowa, and Strawberry mountains or Oregon, the Seven Devils Mountains of Idaho, and a small sliver in the Blue Mountains of Washington, beginning near tree line at an elevation of 6,500 feet, where the forest cover becomes broken by alpine meadows, and continuing through alpine meadowland to include the exposed rock, snowfields, and glacial ice of the highest mountain peaks. These areas characteristically have cold soil, deep snowpack, and a very short growing season. Forest species adapted to such conditions are subalpine fir, Engelmann spruce and whitebark pine. Historically, green fescue and sedges covered the high alpine meadows, but, following intense grazing pressure by sheep early in the 20th Century, many high elevation plant associations reverted to seral or exotic species.

15. NORTHERN ROCKIES

The high, rugged Northern Rockies (15) ecoregion is mountainous and lies east of the North Cascades (77). Despite its inland position, both climate and vegetation are typically, but not always, marine-influenced. Douglas fir, subalpine fir, Englemann spruce, and ponderosa pine and Pacific indicators such as western red cedar, western hemlock, and grand fir occur in Ecoregion 15. The vegetation mosaic is different from

that of the Idaho Batholith (16) and Middle Rockies (17) which are not dominated by maritime species. The Northern Rockies (15) ecoregion is not as high nor as extensively snow- and ice-covered as the Canadian Rockies (41), although alpine characteristics occur at highest elevations and include numerous glacial lakes. Granitic rocks and associated management problems are less extensive than in the Idaho Batholith (16). Thick volcanic ash deposits blanket large portions of Ecoregion 15 and are more widespread than in Ecoregion 16. Logging and mining are common and have caused stream water quality problems in the region.

15g. Western Okanagon Semiarid Foothills

The Western Okanagon Semiarid Foothills is typically covered with grasses, shrubs and scattered ponderosa pine and Douglas-fir. It includes savannas, near-savannas, and woodlands. Vegetation pattern is strongly driven by slope aspect. North-facing slopes have closed Douglas-fir and ponderosa pine forests and south-facing slopes are covered in open ponderosa pine woodland or shrubsteppe. Understories are generally dominated by bunchgrass steppe species, such as, Idaho fescue, rough fescue, bluebunch wheatgrass, or needlegrasses. Some stands have a short deciduous shrub layer of common snowberry. Ecoregion 15g contains antelope bitterbrush, an eastern Cascadian shrub that is absent from other parts of Ecoregion 15. Ecoregion 15g is more warmer, more xeric, and has more extensive woodlands and less extensive forests than the Okanogan-Colville Xeric Valleys and Foothills (15r). Rock outcrops are common. Land use is dominated by livestock grazing.

15h. High Northern Rockies

The wet, glaciated, mountainous High Alpine Zone begins at the upper limit of the closed canopied montane forest and includes non-commercial high altitude forests, subalpine parkland, and alpine meadows. Rockland, talus, glacial cirques, and mixed high elevation climax vegetation are characteristic and help to differentiate it from lower ecoregions. Ecoregion 15h is the highest ecoregion in the Northern Rockies (15) and elevations are usually sufficient to trap large amounts of Pacific moisture. Tree line varies according to wind exposure, frost and snow occurrence, droughtiness, and soil depth to the underlying rock substrate. Alpine vegetation grows on mountains above timberline whereas subalpine fir, whitebark pine, mountain hemlock, and alpine larch forests grow at slightly lower elevations. Krummholz vegetation occurs between the forest and alpine zones in windswept areas. Soils can contain volcanic ash and are usually thin and rocky. Ecoregion 15h is similar to the High Elevation Rockland Alpine Zone (17h) and the Crestal Alpine-Subalpine Zone (41b) that occur in different level III ecoregions.

15r. Okanogan-Colville Xeric Valleys and Foothills

The Okanogan-Colville Xeric Valleys and Foothills ecoregion consists of the major river valleys, such as the Columbia, Colville, and Kettle River valleys, and the lower slopes of the Okanogan Highlands. The ecoregion boundaries correspond to the distribution of glacial drift and till that fills the valleys and overtops lower slopes to roughly 3,500 feet elevation. As a result, the soils are gravelly, stony, and generally droughty; they support a dry forest cover of ponderosa pine, larch, and Douglas-fir. Vegetation pattern is strongly driven by soil pattern and the gentle elevational gradient in valleys. Deciduous shrubs including ninebark, oceanspray, and snowberry are common understory components than in the Western Okanagon Semiarid Foothills (15g). Historically, with a high fire frequency, forests were open-canopied and represented a transition from the treeless shrub and grassland of the Columbia Plateau (10). Today, large, old, fire-scarred larch and ponderosa pine may be surrounded by younger, more shade tolerant, but less fire-resistant, Douglas-fir. Ecoregion 15r is cooler, more mesic, and has more widespread forests and few woodlands than Ecoregion 15g. Woodland grazing and logging are more important land uses in Ecoregion 15r than in Ecoregion 15g.

15s. Spokane Valley Outwash Plains

The Spokane Valley Outwash Plain is a gently rolling expanse that includes the southern end of the Purcell Trench, Rathdrum Prairie, and the Spokane Valley. The Purcell Trench and the Spokane Valley served as the main outlet for the Pleistocene Missoula floods. The flood water and the glacial outwash entering from

the northern valleys left a coarse, gravelly soil base which becomes more arable in the southern Spokane valley where it was covered by glacial lake sediment. Potential natural vegetation includes dry open ponderosa pine and Douglas-fir woodland, unlike neighboring ecoregions 15o and 15u, that have a maritime-influence and a moist forest community.

15u. Inland Maritime Foothills and Valleys

The Inland Maritime Foothills and Valleys ecoregion includes the moist, lower valleys of the Pend Oreille and Priest rivers which are wide, glaciated, and contain broad floodplains that are interspersed with areas of low hills. These river valleys contrast with the dry Columbia, Kettle, and San Poil valleys of the Okanogan-Colville Xeric Valleys and Foothills (15r) to the west. Ecoregion 15u has higher precipitation, more ash in its soils, more water holding capacity in its soils, and a more maritime-influenced climate than Ecoregion 15r. Vegetation is western hemlock, western redcedar, and white pine with paper birch, quaking aspen, and black cottonwood in floodplains and along shorelines. It contrasts with the dry forest communities of Ecoregion 15r.

15v. Northern Idaho Hills and Low Relief Mountains

The Northern Idaho Hills and Low Relief Mountains ecoregion is exposed to marine influence, mantled by a mixture of volcanic ash and loess, and has rich, forest-type soils that contrast with the grassland-type soils of the Columbia Plateau (10). Frigid Andisols and Inceptisols are common and support mixed coniferous forests dominated by grand fir, Douglas-fir, and western redcedar and also containing ponderosa pine, western larch, lodgepole pine, and western white pine. Mid-elevations and north-facing stream slopes support mixed grand fir and western redcedar stands. South-facing slopes along major streams are dominated by ponderosa pine and Douglas-fir forests and have open canopies. Higher elevations and cold drainage ways are dominated by Engelmann spruce and subalpine fir. Hemlock is less common than in Ecoregions 15o and 15p and is never abundant. Annual precipitation ranges from 30 to 50 inches and is well distributed throughout the year. Ecoregion 15v is not as rugged nor as high as the Coeur d'Alene Metasedimentary Zone (15o) and St. Joe Schist-Gneiss Zone (15p) to the east. Its relatively gentle terrain makes timber harvesting easier and cheaper than in neighboring mountainous ecoregions and its productive forests are extensively logged.

15w. Western Selkirk Maritime Forest

The Western Selkirk Maritime Forest ecoregion includes the mountainous areas of the Okanogan Highlands west of the Columbia River as well as the narrow valley of the upper Pend Oreille River. Geologically, a significant portion of the region is underlain by the metasediments of the Kootenay Arc and Old Belt deposits. This ecoregion is wetter than the Okanogan Highland Dry Forest (15x) ecoregion to the west because it is influenced by marine air entering the region via the Columbia River Valley. The distribution of trees of dry habitats, such as ponderosa pine and subalpine fir, declines eastward as they are replaced by grand fir and western hemlock. An ash layer aids in soil water retention, increasing forest productivity.

15x. Okanogan Highland Dry Forest

The Okanogan Highland Dry Forest ecoregion covers the mid-elevation Okanogan Highlands between the Okanogan River Valley and the Columbia River Valley. It lies at lower elevations than the High Northern Rockies (15h) and at higher elevations than the Okanogan-Colville Xeric Valleys and Foothills (15r) and Western Okanagon Semiarid Foothills (15g). Mountains and hills in Ecoregion 15x have broad rounded profiles caused by the scouring action of continental ice flows during the Pleistocene. Bedrock often lies close to the surface, which controls topographic expression and vegetation patterns. Loess and volcanic ash deposits are widespread. Soils have a xeric moisture regime. Ecoregion 15x lies in the rain shadow of the Cascade Mountains; dry conditions result in a forest low in species diversity with Douglas-fir and subalpine fir dominating. Land uses include woodland grazing and timber production.

15y. Selkirk Mountains

The dissected, partly glaciated Selkirk Mountains ecoregion is rugged, covered in mixed coniferous forest, and mantled by volcanic ash that increases forest productivity. Both Pacific species (grand fir, western redcedar, and western hemlock) and Rocky Mountain species (western larch, western white pine, and lodgepole pine) are common. Ecoregion 15y is wetter and has more maritime influence than Ecoregion 15w. A combination of weather patterns, high relief, and very narrow valleys result in more summer precipitation, fog, and relative humidity at low and mid-elevations than elsewhere in northern Idaho. Boreal influence is stronger, subalpine fir–spruce forests are lower, and whitebark pine forests are more extensive than in the rest of the Northern Rockies (15). Boreal influence increases toward the north and some north-facing valleys have extensive peatlands. Ecoregion 15y includes the largest contiguous old growth cedar–hemlock forest in the interior U.S., extensive peatlands, and important lynx and grizzly bear habitat. It supports the only woodland caribou herd in the conterminous U.S. Erosion hazards can be high where road beds intercept perched water tables above subsurface compacted tills. Avalanche chutes are common.

77. NORTH CASCADES

The terrain of the North Cascades is composed of high, rugged mountains. It contains the greatest concentration of active alpine glaciers in the conterminous United States and has a variety of climatic zones. A dry continental climate occurs in the east and mild, maritime, rainforest conditions are found in the west. It is underlain by sedimentary and metamorphic rock in contrast to the adjoining Cascades (4) which are composed of volcanics.

77a. North Cascades Lowland Forests

The North Cascades Lowland Forests ecoregion is composed of low mountains, broad glaciated valleys, and glacial-fed rivers that receive, on average, 60 to 90 inches of precipitation per year. Extensive, productive rainforests have developed under the mild maritime climate and are dominated by western hemlock, Douglas-fir, and western red cedar. Pastures occur in the valleys.

77b. North Cascades Highland Forests

The landscape of the North Cascades Highland Forests ecoregion consists of steep, glaciated ridges, high-gradient streams, and tarns. Colder climatic conditions, deeper snow pack, and Pacific silver fir/mountain hemlock forests distinguish it from Ecoregion 77a.

77c. North Cascades Subalpine/Alpine

The North Cascades Subalpine/Alpine ecoregion is characterized by high mountain peaks, bare rock, glaciers, many tarns, plentiful precipitation, and sediment-laden glacial meltwater streams. Subalpine meadows occur around the taller peaks; their flora and fauna is adapted to the prevailing subarctic climate.

77d. Pasayten/Sawtooth Highlands

The Pasayten/Sawtooth Highlands has colder winter temperatures than elsewhere in Ecoregion 77 and has experienced both continental and alpine glaciation. Its landscape of high ridges, plateaus, and trough valleys is dominated by subalpine fir. In addition, lodgepole pine grows in the northeast, Douglas-fir is found at lower elevations, and many wetlands occur. Mean precipitation is from 25 to 65 inches per year and varies according to elevation and slope aspect; it is less than that received by Ecoregions 77a, b, c, and i which occur to the west.

77e. Okanogan Pine/Fir Hills

The glaciated Okanogan Pine/Fir Hills ecoregion has rounded mountains and broad, U-shaped valleys. Elevations are lower and slope angles are gentler than further west in the jagged, mountainous areas of the North Cascades (77). Precipitation ranges from 10 to 35 inches per year, falling mostly as snow. It is lower than elsewhere in Ecoregion 77 and droughty conditions prevail. Precipitation and temperature both vary according to elevation, microtopography, and slope aspect and affect the distribution of vegetation.

Ponderosa pine grows in lower, drier areas and Douglas-fir is found at higher elevations. Bluebunch wheatgrass is common in the understory of the south and Idaho fescue grows in the north.

77f. Chelan Tephra Hills

The steep, glaciated Chelan Tephra Hills ecoregion is dominated by deep deposits of coarse, volcanic ejecta which contribute to the character of this dry, east-side region. Elevations range from 1200 to 5700 feet. Ponderosa pine grows in lower areas, Douglas-fir occurs in the mid-elevations, and subalpine fir is found above 5000 feet in elevation.

77g Wenatchee/Chelan Highlands

The glaciated Wenatchee/Chelan Highlands ecoregion is characterized by mountains and ridges, tarns, U-shaped valleys, and dissected high-gradient streams. Leeward climatic conditions prevail. Douglas-fir, grand fir, and subalpine fir are common; lodgepole pine and Englemann spruce also occur. Average precipitation ranges from only 15 to about 40 inches per year.

77h Chiwaukum Hills and Lowlands

The Chiwaukum Hills and Lowlands are composed of feldspar-rich sandstone and are unlike neighboring ecoregions which are underlain by metamorphic and igneous rock. Its low mountains, hills, and cuervas can be highly erodible and unstable. Streams have high sediment yields and run in V-shaped valleys; their network forms a trellis pattern.

77i. High Olympics

The High Olympics ecoregion contains steep, glaciated mountains that reach an elevation of 8000 feet. It is characterized by rock outcrops, tarns, persistent snow pack, alpine glaciers, and high-gradient, glacial-fed streams. Its vegetation includes subalpine mountain hemlock and Pacific silver fir forests as well as alpine meadows. Subalpine fir occurs on the xeric soils of northeastern rainshadow areas.