

# PACIFIC NORTHWEST WINE REGIONS AND CLIMATES

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## **Abstract**

This paper presents a review of wine regions in the Pacific Northwest (PNW) of North America. The PNW consists of the states of Oregon, Washington and Idaho and the province of British Columbia. There are currently 36 governmentally approved regions in the PNW with 30 American Viticultural Areas (AVAs) in the states and 6 Designated Viticultural Areas (DVAs) in British Columbia with more being developed. General wine region characteristics and the climate structure for viticulture and wine production are detailed.

**Keywords:** *Pacific Northwest, Oregon, Washington, Idaho, British Columbia, American Viticultural Areas, Designated Viticultural Areas, viticulture, wine production, climate, terroir*

## **1 INTRODUCTION**

The Pacific Northwest (PNW) of the United States and Canada has 36 approved wine regions across the states of Oregon, Washington, and Idaho and the province of British Columbia (Figure 1). Wine regions in the United States are approved by the government and called American Viticultural Areas (AVAs). Similarly, the Canadian government recognizes wine regions using Designated Viticultural Areas (DVAs) and is in the process of mapping out and approving four new DVAs (Figure 1). Winegrapes were planted in the 1800s when westward expansion brought Europeans with wine culture to many locations across the PNW. Across the region planted acreage remained quite small and isolated until the early 1900s when prohibition in both countries severely reduced plantings and production. Post prohibition winegrape industries developed slowly across the PNW with most of the growth occurring since the 1960s.

Today the wine regions of the PNW are found between 42°N (Oregon/California border) to 52°N in the proposed Shuswap DVA (Figure 1). The regions can be found near the coast in the inland sound areas of Washington (Puget Sound AVA) and British Columbia (Gulf Islands, Fraser Valley, and Vancouver Island DVAs) to approximately 1200 km inland in British Columbia (proposed Kootenays DVA) and Idaho (Snake River Valley AVA). The wine regions vary in size from small sub-regions such as the 650 ha Golden Mile Bench DVA, a sub-region of the Okanagan Valley DVA, to the 4.6 million ha two-state Columbia Valley AVA. While these regions encompass elevations from sea level to over 2000 m in elevation, most vineyards are planted below 1000 m.

## **OREGON**

Winegrapes have been planted in Oregon since the mid-1800s, but had a renaissance in the 1960s and has grown rapidly in the last 50 years. Oregon has 18 AVAs with three sharing borders with Washington (Columbia Gorge, Columbia Valley, and Walla Walla Valley AVAs) and one with Idaho (Snake River Valley AVA) (Figure 2). Oregon is the 4<sup>th</sup> largest winegrape producer in the United States behind only California, Washington, and New York (OWB, 2016). Today there are roughly 1100 vineyards planted to approximately 11500 ha that produce roughly 80000 tons of fruit, which is made into wine at nearly 700 wineries within the state. Due to a diverse geography and climate, Oregon has over 70 varieties planted with approximately 60% red and 40% white. Pinot Noir, Pinot Gris, and Chardonnay are the most widely planted, although the diversity of climates and grower interest in finding unique matches makes the ‘Other’ category roughly 12% of all planted acreage and production. The Willamette Valley AVA has approximately 70% of the planted acreage and production in the state, while the Southern Oregon AVA has 22% and eastern Oregon AVAs roughly 8% (SOURCE, 2016).

## **WASHINGTON**

The Hudson’s Bay Company planted the first winegrapes in Washington at Fort Vancouver in 1825. Further development of winegrape plantings followed the path of the early settlers through the Columbia River corridor. Development of large-scale irrigation, fueled by runoff from the melting snowcaps of the surrounding mountains, began in eastern Washington in 1903 allowing a very arid region to develop a large scale industry over time. Today Washington is the 2<sup>nd</sup> largest wine producer in the United States with acreage planted over 14 AVAs (Figure 3), three of which are shared with Oregon (Columbia Gorge, Columbia Valley, and Walla Walla Valley AVAs) and one with Idaho (Lewis-Clark Valley AVA). Throughout the Washington AVAs there are roughly 900 wineries processing nearly 225000 tons of fruit from 21000 ha of winegrapes planted at approximately 350 vineyards (WWC, 2016; WAWGG 2016; USDA, 2016). While it is estimated that 80 different varieties are planted, Cabernet Sauvignon, Riesling, Chardonnay, Merlot, and Syrah are the most common (USDA, 2016). The Yakima Valley AVA produces the most fruit in the state at roughly 40%.

## **IDAHO**

Idaho's grape growing and wine production history follows that of the neighboring states of Oregon and Washington with the arrival of German, Italian, and French immigrants to the PNW. Idaho's industry has been slower to grow than its neighbors largely due to state politics, climate risks (winter freezes), and the dominance of other horticulture and field crops (Jones and Duff, 2011). However, the industry has seen rapid growth in the last few decades. The region is home to three AVAs, the Snake River Valley AVA that crosses into Oregon (Figure 4), the Eagle Foothills AVA, and the Lewis-Clark Valley AVA that crosses into Washington. While still relatively small, the region has climbed to the 18<sup>th</sup> largest producer in the United States. Today there are roughly 50 wineries crushing over 3000 tons of fruit that is grown at approximately 200 vineyards with over 600 ha of planted vines (IWC, 2016). Idaho produces approximately 60% red varieties with Cabernet Sauvignon, Merlot, and Syrah the most planted and 40% white varieties (Riesling, Chardonnay, and Pinot Gris the most planted).

## **BRITISH COLUMBIA**

Similar to its neighbors to the south, winegrapes were planted in British Columbia in the mid-1800s, however much of the plantings at that time and even post prohibition were *Vitis labrusca* or French-American hybrids. Furthermore, much of the area in the region suitable for winegrapes was dominated by other fruit crops such as berries, apples, cherries, and apricots. In the late 1970s and early 1980s many fruit growers starting experimenting with *Vitis vinifera* with very good results and a rapid growth of the industry is seen today. There are six Designated Viticultural Areas currently in British Columbia with four more being developed (BCWA, 2016) (Figure 5). British Columbia is the 2<sup>nd</sup> largest wine producing province of Canada, behind only Ontario. Across the DVAs in British Columbia there are roughly 1000 vineyards, planted to nearly 4300 ha of winegrapes, which on average produce 35000 tons, which are ultimately crushed at 260 wineries (BCWA, 2016). The province produces 51% red and 49% white with Merlot, Pinot Noir and Cabernet Sauvignon the most common reds and Pinot Gris, Chardonnay, and Gewürztraminer the most common whites. The Okanagan Valley DVA is the largest producing region in the province.

## **GENERAL CLIMATE CHARACTERISTICS**

At the regional scale the weather and climate of the PNW is driven by its latitude and location in the westerly winds and the associated seasonality of storms coming off the Pacific. The region experiences strong seasonality with generally wet and cool to cold winters and very dry and mild to hot summers (Jones et al. 2012). Given the varied landscape, the strongest regional influences in PNW wine regions are the distance from the Pacific Ocean and the rain shadow effects of the Coastal Range, Olympic Mountains and Cascade Mountains to the west, which produces a moderately strong continentality effect (Jones and Duff, 2007; Jones and Duff, 2011).

Annual precipitation in the PNW ranges from what would be considered temperate rainforest conditions (>2500 mm annually) to desert conditions (<250 mm annually) (Figure 6). However, PNW wine regions are found mostly in rain shadows of the mountains, averaging 760 mm but varying strongly due to proximity to the coast (460 mm standard deviation). The wettest region is the McMinnville AVA, which gets on average 1525 mm per year, while the driest locations are found in eastern Washington with the Wahluke Slope AVA experiencing 180 mm on average. Reflecting the region's strong seasonality in rainfall, the growing season of April through October in the PNW sees moderate to severe dry conditions most everywhere (not shown). PNW wine regions average 28% of their annual rainfall during the growing season, with nearly all of it coming during April, early May, and October. The regions range from the driest at 60 mm during the growing season (Wahluke Slope AVA) to the wettest at 410 mm (Fraser Valley DVA).

From a temperature perspective, the PNW experiences stable year-round temperatures near the coast and strong fluctuations from relatively cold winters to very warm summers inland. For the growing season from April through October, the PNW wine regions range from quite cool suitability (hybrids or only early ripening *Vitis vinifera*) to moderately warm climate suitability (1950-2000 averages; Figure 7; Jones, 2006). Averaged over all PNW regions, growing season average temperatures (GST) have a median of 15.5°C, however this encompasses numerous higher elevation regions that are cooler and not planted. For example, the coolest region is the proposed Kootenays DVA in British Columbia at 13.3°C which includes isolated valleys that are climatically suitable. Most of the coolest regions range from 13-15°C and are found north and near the coast (Gulf Islands, Fraser Valley, and Vancouver Island DVAs and the Puget Sound AVA). Slightly warmer and more intermediate in GST (15-17°C) are the Willamette Valley AVA, the Okanagan Valley DVA, portions of the Umpqua, Rogue and Applegate Valley AVAs, and higher elevation valley extensions in eastern Oregon/Washington and Idaho regions (Figure 7). The warmest areas in the PNW during the growing season (17-19°C) include much of the regions in eastern Oregon/Washington (Wahluke Slope AVA is the warmest at 18.4°C on average), the Lewis-Clark Valley AVA, the Snake River Valley AVA, southern areas in the Umpqua Valley AVA, and portions of the Applegate Valley and Rogue Valley AVAs. The GST values seen in PNW wine regions is very similar to other regions worldwide (Jones et al. 2009) capturing conditions found in wine regions in Germany, France, Italy, Spain, and Portugal. The range of GST experienced in the PNW seen in

Figure 7 are equivalent to 950 to 2000 growing degree-days (GDD, C° units) or Regions Ia to lower Region IV on the Winkler Index (Jones et al. 2010). However, the last ten years (2006-2015) has seen GDD averaging 1300-2400 and GST averaging 15-20°C.

One climate characteristic that is prominent in the PNW is the diurnal temperature ranges (DTR) during ripening. Due to the region's dry summer climate, along with a ripening period that tends to coincide with changes in day length and a truncation of the season, the region experiences near ideal cool nights during maturation (Jones et al. 2009; Jones et al. 2012). Average August-September DTR values in PNW wine regions range from lower values near the coast and more to the north (10-15°C) where maximum temperatures are lower, to inland valleys where DTRs of 20-25°C are common. The lowest ripening DTR seen in the PNW wine regions is in the Gulf Islands DVA with 11.3°C on average, while the highest average DTR occurs in the Southern Oregon AVA with 22.4°C (not shown). An equivalent measure, the Cool Night Index (Jones et al. 2009), shows that the entire PNW is lower than the lowest class of the index, indicating that the PNW is unique globally in this regard.

Climate risks across the PNW include winter extreme cold that can impact vine productivity and/or survival, and is most common in eastern Oregon and Washington along with the Snake River Valley of Idaho and Oregon. Much of the PNW is also prone to spring frosts with the growth cycle for winegrapes starting in early to late April and the median frost dates in the inland valleys often overlapping vine growth and continuing into early May. Those areas closer to the coast and further north are also at risk from harvest rain. The onset of fall rains in the region varies, but can coincide with the final ripening stages in late September throughout October.

#### 4 CONCLUSION

The Pacific Northwest has 36 governmentally approved wine regions across Oregon, Washington and Idaho in the United States (AVAs) and British Columbia, Canada (DVAs) with more being developed. These regions all saw their first winegrape plantings occur in the early to middle 1800s, then languished through the early 1900s due to prohibition, but have all seen rapid growth since the 1960s. The regions span from 42 to 52°N latitude, from the coast to nearly 1200 km inland, encompassing areas from 650 ha to over 4.6 million ha, with vineyards planted to just over 1000 m in elevation. All together the regions represent roughly 2700 vineyards, growing 38000 ha of winegrapes, producing 350000 tons of fruit that is being crushed at approximately 2000 wineries.

Wine regions in the PNW grow over 80 different varieties in climates that range from quite cool to moderately warm. These regions experience strong seasonality in rainfall, which is further enhanced by rain shadow effects, and generally see less than 25% of annual rainfall in the growing season. The dry growing seasons have warm days and cool nights that create some of the largest diurnal temperature ranges during the maturation period in the wine world.

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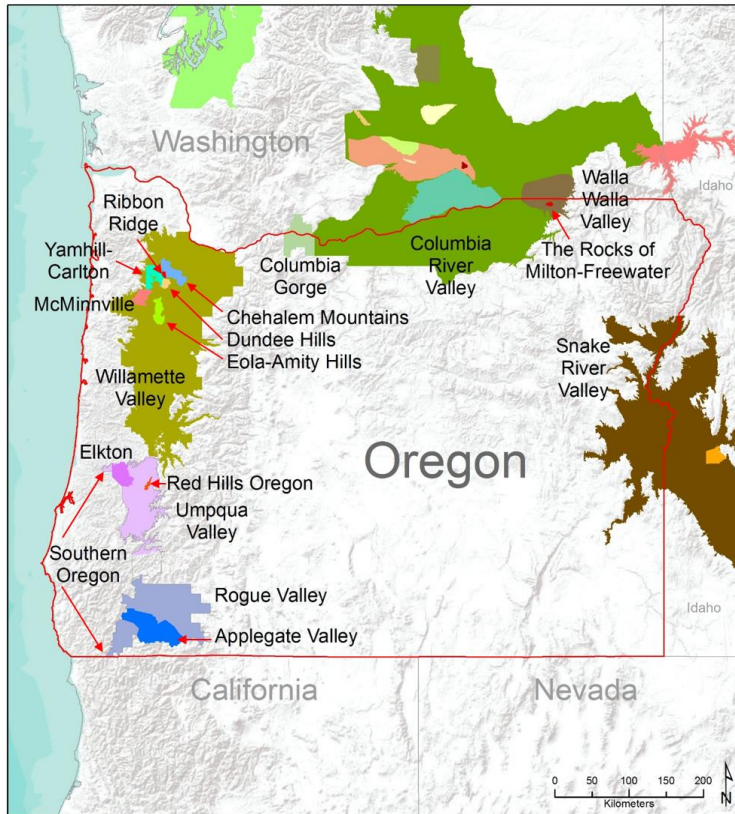
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**Figure 1: Pacific Northwest wine regions (American Viticultural Areas in the US and Designated Viticultural Areas in Canada).**



**Figure 2: Oregon American Viticultural Areas. A total of 18 AVAs are in the state with three shared with Washington and one with Idaho.**



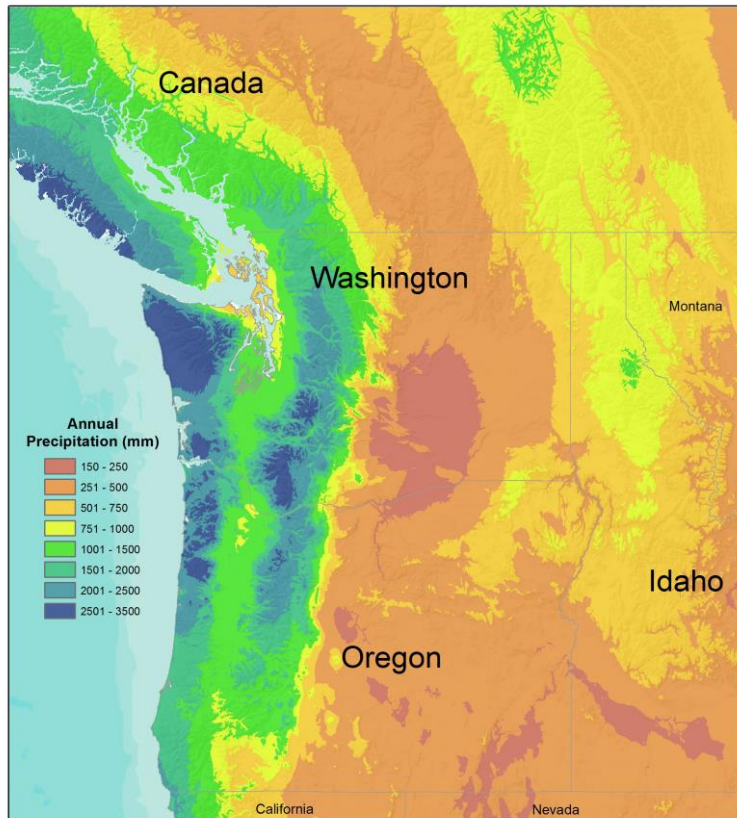
**Figure 3: Washington American Viticultural Areas. A total of 14 AVAs are in the state with three shared with Oregon and one with Idaho.**



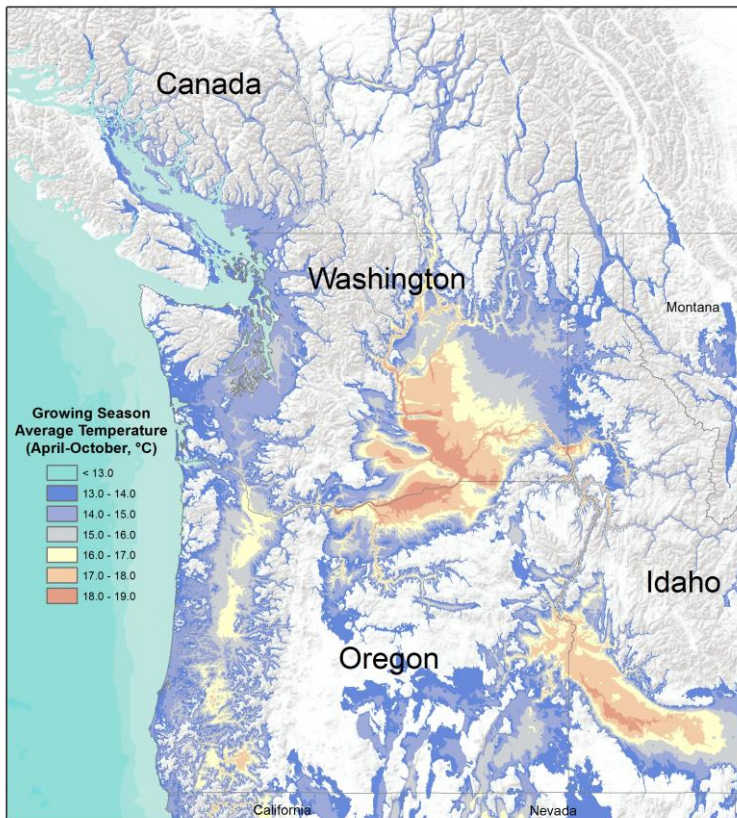
**Figure 4: Idaho American Viticultural Areas. A total of 3 AVAs are in the state with one shared with Oregon and one with Washington.**



**Figure 5: British Columbia Designated Viticultural Areas. A total of 6 approved DVAs are in the province (solid colors) with an additional 4 being proposed.**



**Figure 6: Annual precipitation (mm) for the PNW region. Data Source: WorldClim 1950-2000 (Hijmans et al. 2005).**



**Figure 7: Growing season average temperatures (April through October, °C) for the PNW region. Data Source: WorldClim 1950-2000 2000 (Hijmans et al. 2005).**