

## **The Impacts of Drought on Western Redcedars (*Thuja plicata*) in Portland Parks and Pacific Northwest Forests**

### **BACKGROUND**

Climate change is a topic that can be controversial. Whereas many people agree that our climate is changing such that temperatures are generally warmer and there are more frequent extreme temperatures, along with less precipitation that is less predictable, there are many perspectives about the cause of this phenomenon. However, the majority of scientists today agree that human activities are one of the primary factors influencing the Earth's changing climate (Raven, p. 140). Whether or not one agrees that humans are affecting our climate, it cannot be denied that the state of Oregon has been experiencing drought conditions for a prolonged period. According to the Oregon Department of Forestry (April 2019), drought is an indicator of climate change, and is defined by "high temperatures that are frequent or continuous, combined with low and inconsistent precipitation... Since 2012, these scenarios have been frequent and most of Oregon has been in a drought" (USDA, 2019, p. 5).

Oregon has approximately 30 million acres of forests, dominated by conifers, such as the native western redcedar (USDA, 2019, p. 2). These trees offer many benefits in day-to-day life, including social, communal, environmental, and economic (International Society of Arboriculture, 2011). Trees create shade and cover from the elements, improve air quality, reduce stormwater runoff, provide privacy, as well as, create space for community building, along with many other proven values. Yet they also require an investment, and in this paper I aim to demonstrate how the native tree, western redcedar (*Thuja plicata*) is being affected by drought, and how we can best set these trees up for success in our climate that is changing their living conditions.

### **OBSERVATIONS & RESEARCH**

In the City of Portland, the urban tree canopy covers almost 30% of the city (Portland Parks & Recreation, 2019). According to the Portland Parks & Recreation Park Tree Inventory Findings (2019), western redcedars consist of 4% of the total park tree inventory, and is the most prevalent young tree within the parks, at 4.9%. Furthermore, western redcedar is the top tree species categorized as young trees that are in poor condition, at 10.9% of all of this species within the parks. Why are western redcedars suffering and dying young? The cause is not completely obvious, but is "possibly a combination of factors including climate change" (Oregon Department of Forestry, April 2019). According to Oregon Department of Forestry's Entomologist, Christine Buhl, (2019) western redcedars are declining from Oregon to western Canada. The symptoms include yellowing needles, thinning canopy, flagging, crown dieback, and eventually whole-tree mortality. Similarly, Urban Forestry Staff at Seattle Parks, have

documented “reports of an increasing amount of dying western red cedars in our park system (Rippey, 2018, p. 1). Rippey notes additional symptoms, including abnormal branch collar swelling and epicormic shoots near these swollen branch collars. Additionally, secondary pests, such as redcedar borers and bark beetles attack trees suffering from drought and are able to infest them to greater degrees than normal (Oregon Department of Forestry, April 2019).

One Board Certified Master Arborist, who has been working with trees in the region for the past 20 years observes that hot dry summers that are longer are affecting trees that are on the edge of their “happy zone” (D. Schrosk, personal communication, November 21, 2019). Western redcedars thrive best in sites with shady exposure, high water tables or abundant precipitation, and in bottomland locations that tend to gather and hold cool air and moisture at night. Yet current drought conditions are damaging due to series of hot and dry days during spring and summer growing periods, and/or when winters are warmer than usual with little rain or snowpack to recharge waterways and water storage areas (USDA, 2019).

## **APPLIED PLANT SCIENCE**

With lower annual precipitation rates, the groundwater table is lower, and there is simply less moisture in the air and ground for trees to uptake. Western redcedars have fibrous roots which results in more surface area to volume, exposing the plant to more air pockets in the soil environment when there is not sufficient water and causing desiccation to happen more quickly and more often (D. Schrosk, personal communication, November 21, 2019). Water and carbon dioxide are both essential reactants in the process of photosynthesis (Raven, 2013). However, with less available water, arid conditions, and higher temperatures, stomata close more frequently to reduce moisture loss, which prevents carbon dioxide from diffusing into the xylem, and lowers the rate of photosynthesis. When water vapor is released through open stomata, a gradient of water potential is created in the vascular tissues of trees, acting as straws that pull water from the soil through the roots and up to the leaves. Yet when transpiration slows or stops, the lower water potential in the needles of western red cedars is disrupted, and the driving force for movement of water along the soil-plant-atmosphere continuum does not function. Without this process, roots cannot uptake water and needles cannot diffuse carbon dioxide or water in order to produce energy. “Xylem dysfunction induced by drought is a serious problem to plants” (Raven, 2013, p. 715).

When trees cannot photosynthesize, they cannot create energy, and their defense mechanisms are weakened. Furthermore, during warmer nights, trees are continuing to respire, which depletes their carbon reserves (Rippey, 2018) even further. Moreover, trees’ ability to uptake minerals is dependent on energy. Without this phloem loading, trees may start to show symptoms of decline, such as those mentioned above... yellowing needles, thinning canopy, flagging, crown

dieback, and eventual tree mortality.

## **MITIGATION GUIDANCE**

In order to preserve the existing western redcedars from succumbing to drought there are a number of mitigation techniques:

- Install more drought-tolerant plants near western redcedars which will provide more shade in the critical root zone, as well as, more opportunities and awareness for irrigating this zone (D. Schrosk, personal communication, November 21, 2019).
- Irrigate the critical root zone deep.
- Control vegetation of invasive species or grasses that outcompete trees for soil moisture (Oregon Department of Forestry, February 2019).
- Place mulch on top of the soil within the critical root zone to cool the soil, mitigate water loss, and encourage beneficial mycorrhizae to establish, increasing the root's water and nutrient uptake.
- Remove freshly dead or dying trees nearby to prevent secondary pest infestations (Oregon Department of Forestry, February 2019).
- Install western redcedars in appropriate sites, "limited to lowland areas where the night temperatures are coolest" (Rippey, 2018, p. 3), and in shady areas where there is ample water; do not plant this species in the open with full sun exposure, in windy sites, or in lawn areas, unless there is adequate supplemental irrigation directed to the tree's critical root zone.
- Thin stands to ensure adequate root space and penetration (Buhl, 2019).

In addition to investing in support for existing western redcedars, another option is to plant a different species of tree that is more resilient to drought. The Planting Program Coordinator for Portland Parks Urban Forestry noted that in the fall of 2019 she only procured one western redcedar out of 240 trees for planting in the park system. Instead, she procured many more ponderosa pine, which are much more adaptable to drought conditions. Leanne stated that "western redcedars are number one" in her mind when she thinks about how climate change is affecting the urban canopy (L.Wells personal communication, November 18, 2019).

## **CONCLUSION**

As the climate continues to change, and drought persists, we must adapt how we manage our urban canopy and forests, providing more support for susceptible trees and choosing more resilient species for our future parks and forests.

## References

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