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MES Analytical Essay

Benefits of *Alnus Rubra* (Red Alder) in Riparian Restoration in the Pacific Northwest

Riparian ecosystems, while making up less than 1% of land area in the western United States, support the most diverse abundance of plants and animals of any other type of habitat in the region (*Riparian*, n.d., *Riparian Zones*, n.d.). According to the Washington Department of Fish and Wildlife (WDFW), 77 species of fish inhabit freshwater in Washington state, and 85% of the wildlife uses riparian habitat for "essential life activities" (WDFW, n.d.). Since the early 1800's it is estimated that 23 million acres of riparian area in Washington state have been either completely lost to urbanization or heavily modified for purposes such as farming, ranching, and logging (Kauffman, B., n.d., WDFW, n.d.). Recently, a greater appreciation for the benefits of riparian ecosystems has sparked many efforts in restoring these vital habitats. Restoring these lands to their ideal arboreal riparian communities with a mix of conifers and hardwoods will take time and require all stages of succession to reach their greatest ecological potential (Kauffman, B., n.d.). *Alnus rubra*, commonly known as Red Alder, serves as an essential pioneer in obtaining this goal.

The early succession period is the perfect time for light loving opportunistic plants to begin shooting up. These pioneers will set the stage for communities in later successional stages by creating ideal growth conditions. As they spread their roots they provide stability for the soil and create beneficial connections with various bacterial and fungal associates. These partnerships provide benefits such as fixed nitrogen and accelerated breakdown and availability of rock-derived nutrients (Perakis, S. S., & Pett-Ridge, J., 2019). A number of plants form an association with the bacteria *Frankia* which develops nodules on the roots in order to provide the plant with fixed nitrogen, a chemical nutrient vital to all plants and trees. Without nitrogen, they could not make up the chlorophyll that they need to perform photosynthesis (Crop

Nutrition, 2023). While a number of plants have the ability to create this association, there is only one tree in the Pacific Northwest that will partner up with *Frankia*. That tree is the Red Alder (*Alnus rubra*), a strong pioneer species that continues on, aiding in the transition from primary to secondary succession.

A. rubra, has long been considered a "weed species", particularly by foresters whose primary goal is to produce the maximum timber yield per crop. Only recently has this tree started to be recognized for its plethora of benefits, from both an ecological and economical standpoint. As climate change and environmental conservation have come to a head, researchers have begun to reconsider the benefits of *A. rubra*, particularly in the area of riparian restoration. *A. rubra* is a relatively short lived tree, mainly known for rapidly invading regularly disturbed environments such as flood plains, burned areas, and clearcuts. The latter is likely behind the "weed" stereotype due to prioritization of the growth of new crops. However, this opinion has begun to change due to the more recently recognized benefits of letting *A. rubra* run its course. These benefits include improving soil fertility and stability, supporting local wildlife, providing timber resources for lightweight applications such as furniture and paper production, and more. Overall, *A. rubra* can be a vivacious path of revival for many disturbed riparian areas as well as provide many economic and commercial values.

A. rubra is the largest and fastest growing alder in North America, growing from 70 - 120 ft. tall and rarely living past 100 years (Pacheo, n.d.). It is found from southeast Alaska to southern California, with a few isolated communities in Idaho (Habitatdana, 2014). It is typically introduced through disturbance and is equally likely to occur in both wetland and non-wetland ecosystems (Habitatdana, 2014). It sports large, wavy, toothed leaves with revolute margins and is monoecious, producing separate male and female flowers on the same tree (Pacheo, n.d.). Blooming from February to April, the male flowers present themselves as long, pollen-producing catkins, while the female flowers present themselves as small, cone-like strobiles, typically staying on the tree over winter. These strobiles shed winged nutlets from

September to December, typically becoming food for local wildlife, particularly in winter months when food is scarce. For the male flowers, wind is the strongest dissemination method for natural regeneration (Habitatdana, n.d.). With propagation requiring a simple combination of sunlight and water, it's no wonder these trees seem to shoot up so quickly.

This species exists in highly dynamic systems that go through a multi-stage growth process and can experience destruction at any time due to environmental factors such as flooding, fire, disease, and more. After this destruction happens, *A. rubra* is quick to move in alongside several associates such as Fireweed (*Chamaenerion angustifolium*), Black Cottonwood (*Populus trichocarpa*), and Salmonberry (*Rubus spectabilis*). Over the next 70 - 100 years, *A. rubra* will give way to secondary succession species such as Western Hemlock (*Tsuga heterophylla*), Douglas Fir (*Psuedotsuga menziesii*), and Big-Leaf Maple (*Acer macropohyllum*). Many foresters would prefer to skip the primary succession and move straight to secondary where their ideal timber (i.e. Western Hemlock, Douglas Fir, etc.) can begin growth straight away. The downsides of this approach however, can ultimately be detrimental to the overall health of the final crop and its surrounding ecosystem. Pioneer species are particularly important because they quickly reestablish masses of roots that help to secure the soil from excessive erosion immediately after a significant disturbance (Clausen, 2019).

A potential downside to encouraging alder growth in riparian areas is the possibility of encroachment on timber crops. This could potentially lead to disagreements involving private landowners and government agencies. A collaborative solution to this might be to work with relevant agencies and affected parties to bring *A. rubra* into the game, so to speak. While *A. rubra* has long been dismissed by foresters, it has many commercial uses that make it a viable product. With countless applications in woodworking such as furniture, utensils, cabinets and more, *A. rubra* is also able to be used for paper production. It is even used for planks for grilling salmon in restaurants, a technique acquired from indigenous peoples who have practiced this for hundreds of years (Habitatdana, 2014). It also might surprise some to know that in 2018, the value per thousand board feet (mbf) of *A. rubra* was $720, compared to *P. menziesii* (Douglas Fir) which was valued at $745/mbf (Notes, 2019). This makes *A. rubra* timber just as valuable as *P. menziesii*. In addition to this commercial value, having *A. rubra* in a stand will increase habitat diversity within the conifers which will support wildlife and improve the soil conditions (Cascade Hardwood, n.d.). These improvements can have beneficial effects on the growth of a stand of *P. menziesii* or *T. heterophylla* (Western Hemlock).

Another important benefit of *A. rubra* is its ability to store large amounts of carbon, particularly in the first decades of their life. Their "large leaves and wide crowns enable maximum photosynthesis" (Cascade Hardwood, n.d.), allowing *A. rubra* to soak up more carbon than some of its coniferous neighbors. The use of *A. rubra* in commercial products will prolong that carbon storage for the life of the item (Cascade Hardwood, n.d.). Naturally fallen logs will release some carbon into the atmosphere, but much of it will become locked up in the soil as a carbon layer. These logs will leech nutrients into the soil for other growing plants and trees to take advantage of, in addition to providing food and shelter for many animals. With *A. rubra* being a go-to hardwood for beavers to use in building their dams and homes, it contributes to an increased diversity of habitat types, providing greater opportunity for complex plant and wildlife communities. Cooled pools created by fallen logs and canopy cover are perfect refuges for fish seeking shelter or a spawning ground. The leaf litter that falls into streams can be eaten by insects, which in turn attracts fish, birds, and small mammals. These will attract larger animals such as eagles and coyotes and ultimately support upwards of 300 species of wildlife (WDFW, 2021). In addition to this wildlife potential, *A. rubra* helps to slow flood waters and filters pollutants from the runoff. This allows excess water to soak into the soil instead of washing it away. Controlled flood waters have the added economical benefit of reducing potential property damage costs to downstream residents.

A successful example of using *A. rubra* to restore a riparian ecosystem is the North Creek Wetland project, a collaborative project that focused on reconnecting North Creek's "historical floodplain through creation of a new primary and secondary channel and restoration of approximately 58 acres of riverine and floodplain ecosystem" (History & Restoration, 2023). Located on the UW/Bothell campus, this project focused on planting early successional species such as *A. rubra* and *P. trichocarpa* (Black Cottonwood) which created a continuous canopy over most of the area that could be observed in as little as ten years, with as many as 20 general types of plant communities. Within seven more years of monitoring, the site successfully met the project goals and was released from any further requirements (History & Restoration, 2023). The success of this project serves as a testimony to how quickly an urbanized riparian area can be returned to a healthy state through the planting of *A. rubra*.

Overall, *A. rubra* has countless benefits to being planted in riparian restoration. Its nitrogen-fixing capabilities and acceleration of release of rock-based nutrients create ideal soil conditions for all other plants. Its deciduous canopy provides plenty of shelter for birds and mammals while still letting in enough light for the young conifers taking root. It provides shade and downed timber to create pools perfect for fish to rest and spawn. As for the wood itself, beavers make great use of it while building their dams. The benefits to people and the economy are also plentiful. From building furniture to using it for firewood to making grilling planks for salmon, the applications are many. By controlling flood waters *A. rubra* helps reduce overall economic impacts and saves us from the enormous costs of repairing flood damage. Once *A. rubra* has reached the end of its life it can be harvested for commercial use or left to maximize ecosystem health. When it comes to restoring riparian areas anywhere in the Pacific Northwest, *A. rubra* should be a top contender when considering which species to include in planted communities.

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