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# treeline

partnering for climate adapted  
forests

July 2023

**Missed the March Treeline Newsletter?** Click [here](#) to learn about how our partners are dealing with strains and stressors related to climate change.

**Interested in submitting an article?** Reach out to Kayla Seaforth [kseaforth@b-e-f.org](mailto:kseaforth@b-e-f.org)

*Photo Credit: Nisqually Land Trust*

**Treeline aims to:** Engage PNW restoration practitioners, nursery partners and researchers who work for or represent tribes, indigenous groups, non-profits, agencies, businesses and more. We gather, disseminate, and discuss information and knowledge across a broad region.

## The Disturbance Issue

This issue of Treeline focuses on the nexus of land management and disturbance caused by wildfire, drought, insects and more affecting federal, state, local and tribal agencies and NGO organizations.

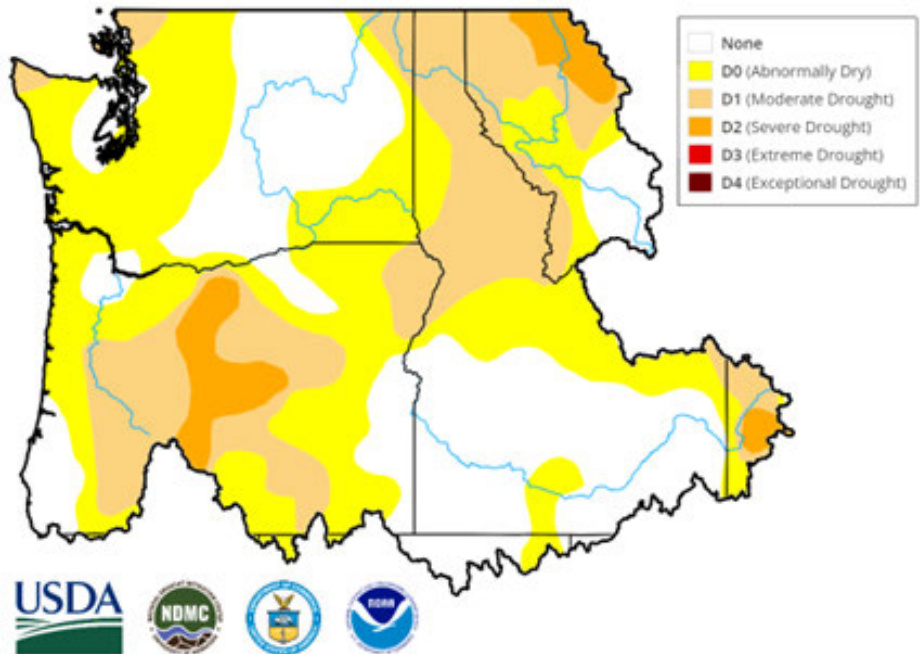
*Photo Credit: Luckiamute Watershed Council*

# Drought Status Update for the Pacific Northwest

## Stay up to date with the U.S. Drought Monitor

Drought conditions are likely to persist in the Pacific Northwest.

- In much of the Pacific Northwest, and in contrast to many other parts of the West, Water Year 2023 has been drier than normal. These dry conditions persisted despite the presence of La Niña, which often is associated with above-average precipitation in the Pacific Northwest. As a result, according to the U.S. Drought Monitor, there was sustained drought or minor drought development in parts of the region but some drought relief elsewhere.
- While **Oregon** has had the strongest snowpack in the Pacific Northwest this year compared with historical standards, it may not be enough to alleviate long-term precipitation and soil moisture deficits that have accumulated during the last several years in central Oregon. Since fall 2019, the precipitation deficit in parts of central Oregon has been equivalent to a full year. The south-central Oregon climate division is now facing its fourth consecutive summer with more than half its area in the severe drought (D2) category or worse as depicted by the U.S. Drought Monitor. At the same time, temperatures and evaporation in central Oregon have been much higher than normal.
- Above normal temperatures and below normal precipitation are predicted for June, July and August.



*The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.*

Information provided by [drought.gov](https://drought.gov)







# Complex Interactions Lead to Douglas-Fir Mortality in the Klamath Mountains



**Oregon State University**  
**Extension Service**

*In this interview, we dig into the work of Max Bennett, David Shaw and Laura Lowrey, who recently analyzed landscape scale Douglas-fir mortality in the Klamath Mountain ecoregion. Their published paper can be found in the [Journal of Forestry](#). Interview conducted by Kayla Seaforth, BEF.*

**Kayla:** Let's start by talking about what you found regarding the major die off of Douglas-fir in the Klamath Mountains.

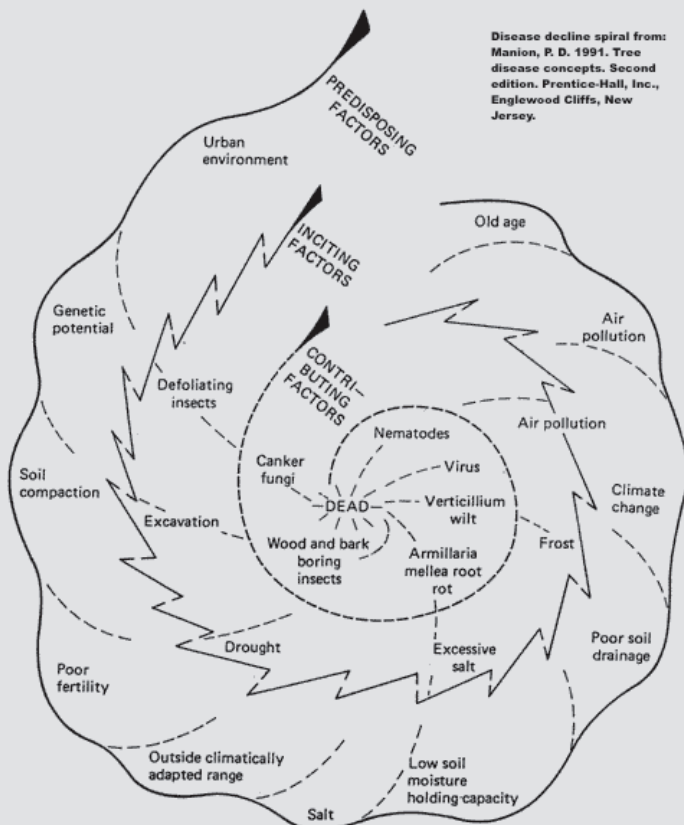
**Max Bennett:** This study looked at the Southwest Oregon portion of the Klamath mountains ecoregion. The main finding was confirmation of a decline spiral with Douglas-fir. This is primarily true in trees that are growing on sites that were already pretty marginal; hot and dry sites that likely didn't have as much Douglas-fir historically due to more frequent fire. As a result of fire exclusion, Douglas-fir has become more dense. Then, a hot drought came along.

We used the framework of Mannion's decline disease spiral, which suggests there are predisposing, inciting and contributing factors that lead to tree decline over time. It's pretty common sense, this idea that it's usually not just one thing that kills a tree. It's a complex interaction of biotic and abiotic factors. So, the combination of Klamath Douglas-fir existing on marginal sites, with conditions caused in part by fire exclusion and hotter drought in the past few years led to trees becoming extremely stressed and probably physiologically compromised. In that state, they're very vulnerable to various

diseases, insects and opportunistic pests, like flatheaded fir borer (FFB). It's a multiyear process where trees go down a spiral from stress to decline to death.

**David Shaw:** We also found a connection with elevation, where this is primarily occurring at low to moderate elevations. It's also heavily skewed toward drier sites that receive under 40 inches of precipitation a year.

**Laura Lowrey:** This is occurring on a landscape level. It's pretty widespread across the Klamath ecoregion of Oregon and Western Cascadia. One of the other



Douglas-fir mortality overstory. Photo Credit: Chris Adlam, OSU



outcomes of the paper was to develop a hazard or risk rating for managers to use to prioritize management, perhaps on a landscape level, giving them a tool that they could use to focus work in areas experiencing Douglas-fir decline.

**MB:** There's a pretty clear relationship between the likelihood and the severity of Douglas-fir mortality and precipitation. Under 25 inches mean annual precipitation is pretty much too dry for coastal Douglas-fir. A lot of areas in Southwest Oregon fall into the 25-35 inch range, which is the highest risk zone for mortality. As you get to 35 to 45, there's still some risk, but as mean annual precipitation increases, mortality likelihood decreases. The other metric that we've been using is called climatic water deficit, which is the difference between potential evapotranspiration and actual evapotranspiration at a site. It's a really good measure of drought stress as experienced by plants. We're finding really good correlations with high deficit areas and tree mortality.

**KS:** I'm curious if you came to any conclusions that you think are applicable to folks outside of the Klamath region, especially in terms of thinking about how to manage decline in general, and how to prioritize management in areas that might be vulnerable going forward?

**LL:** We hope that the climate water deficit piece will be useful to other

land managers outside of Southwest Oregon, and they can start to see if similar correlations exist in their regions. The prevalence of flatheaded fir borer is something that came up as a part of the decline spiral that we are learning about in real time. We'd really like to dig in more on that side of things and see if there are any management recommendations we can develop around the fir borer, since it has had such an impact on Douglas-fir in the Klamath and attack dynamics seem to be different when populations are high.

**DS:** I think we can anticipate seeing this in the Willamette Valley at a much greater extent than we have historically. We're already seeing some Douglas-fir decline in the Willamette Valley, but not to the extent that they're seeing it in the southwest. We've been in an exceptional drought until very recently, and if that continues we may see this phenomenon moving on more of a continental scale. We're seeing this kind of thing happen with other species in other areas, all associated with hotter, longer drought, and increased vapor pressure deficit (VPD). I think this complex interaction of biotic and abiotic factors is an emerging theme all around the globe right now. There are many papers talking about how hotter drought is causing increased mortality in many different parts of the world. But it's not just hotter drought, it's the interaction of what some people might call secondary disturbance agents. It's all of these multiple factors

interacting. I think the decline spiral concept from Mannion does provide a nice context for predisposing factors, inciting factors and contributing factors. We would consider the flatheaded fir borer a contributing factor and the drought being the inciting factor and then the low elevation and marginal sites being a predisposing factor, all of which taken together are associated with mortality rather than any one of those alone.

**MB:** I think land managers can anticipate that there are going to be these trailing edge forest problems in many places. For example, the margins of the Willamette Valley are hot, dry sites that may become less hospitable to their current suite of species sooner. Similarly, the western red cedar decline in the Pacific Northwest is also manifesting in the same way. Trees on the edge of development in areas that tend to experience greater extremes are the ones in decline. Bigleaf maple in Washington, red alder in the valley bottom of the Willamette, juniper in Utah, we're seeing it in a number of species in a number of different places.

**DS:** Environmental aspects like hotter drought and increased VPD are really important, but the legacy of fire suppression can't be understated. It changed the density of the forest, and increased the conifer presence amongst the oak in some of these transitional areas. Having abundant conifers in the



*Thinned Douglas-fir stand in high risk zone with little mortality.*



*Fuels buildup in snag patch.*



oak zone actually stresses the system more, and increases susceptibility to drought, exacerbating the problem even further.

**LL:** This study and others like it provide tools for land managers to get ahead of what's to come in some of these trailing edge areas. It allows some degree of proactivity. It may help prioritize our work and provide some parameters around what is possible on the landscape. We hope the risk assessment tools will allow managers to find the stands at various mortality risk levels and develop management strategies accordingly. Often when insect outbreaks hit, or extreme drought sets in, it's too late to do anything about it. Hopefully, with more information we can start prioritizing actions that build additional resilience into these forests so they may have a better chance of dealing with potentially hotter or drier conditions.

**MB:** Land managers and agencies have a role to play in helping people understand that these forests are going to undergo a potentially rapid transition, and it's not a comfortable topic for a lot of people. In Oregon, we have a lot of Douglas-fir dominated forests, and some of them are pretty hammered. We didn't get ahead of the current situation, and now the trees are dying, and many of them are dead. There isn't always great social acceptance for a lot of management interventions, especially those that involve cutting down trees. But by letting the forests persist in their unnaturally dense states, we may have set them up for this die off.

**KS:** Could you paint a picture of what this shift implies for management, and what folks can be doing now to get ahead of this issue? What might this area look like in 50 years?

**DS:** One of the things that we're realizing is that the density of Douglas-fir is probably too great, and that we may want to lean on some more drought tolerant native species. A lot of people want to manage conifers because of their value, but we're suggesting things like madrone, oak, incense cedar, maybe, or pine might be better suited than Douglas-fir. That doesn't mean these sites will have no Douglas-fir, but it will likely be a smaller component of the forest than it has been.

**MB:** I couldn't agree more. I think that we're going to have to help these sites transition into a species composition that's more drought and heat tolerant. The other side of it is that some folks think we shouldn't have any Douglas-fir at all at lower elevations and it becomes a black and white thing. I think it requires nuanced management, but certainly the trend will be a shift to fewer Douglas-fir on the landscape.

### Further Reading

Interested in learning more about the shift of species composition to more heat tolerant plant communities? This phenomenon, referred to as thermophilization, is explored in the recently published paper "[Climate change, tree demography and thermophilization in western US Forests.](#)"

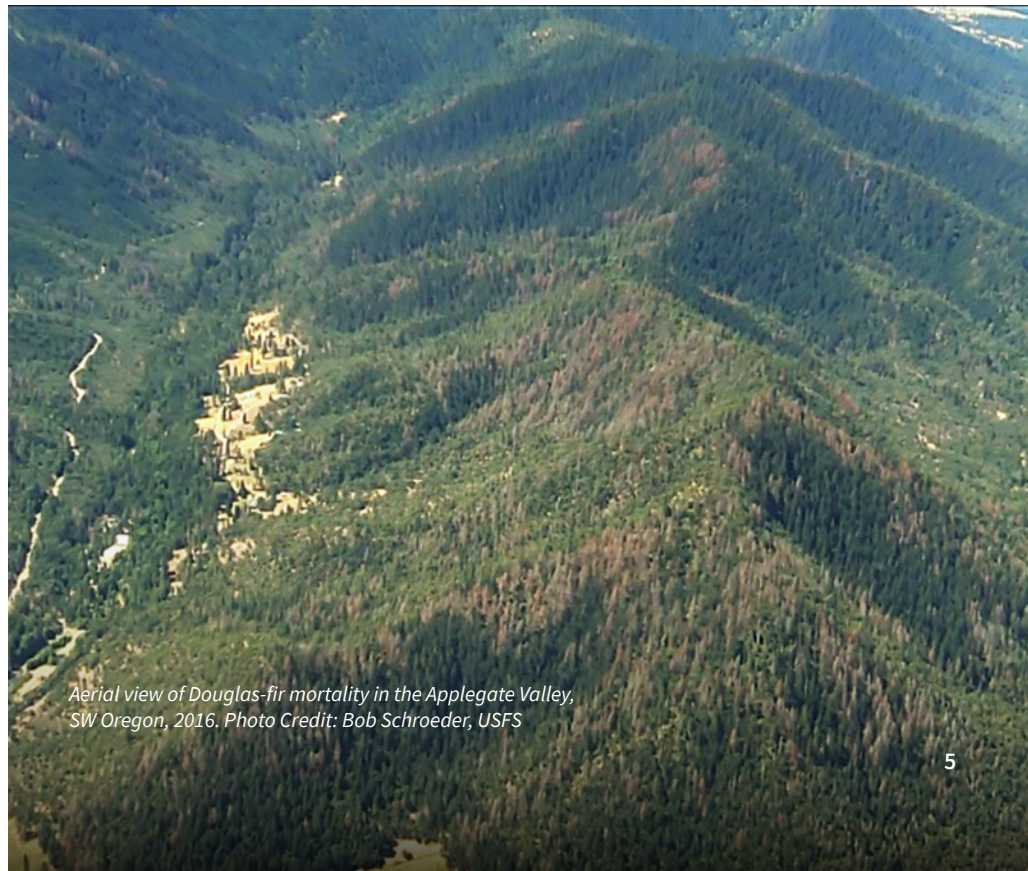
**LL:** The water deficit is an indicator of where we might have more problems with Douglas-fir dying. The amount of water that can be stored in the soil limits

how many trees a site can support, and that factor will be an even greater stress point as things get hotter and drier. We'll have fewer trees, which gets at the basic but very powerful point that we can't necessarily stop what's happening; the composition of these sites is changing. The hard part is imagining what that will look like.

**KS:** Are there any differences between coastal and interior Douglas-fir that play into the die-off we are seeing?

**DS:** The US Forest Service's 2022 aerial surveys showed 450,000 acres of Douglas-fir mortality across Oregon, with 378,000 acres associated with flatheaded fir borer and other secondary agents. Even though it was concentrated in the southwest, they're also seeing isolated mortality elsewhere. We do think that Douglas-fir is being influenced on the east side. If this drought persists, we're nervous that we may see elevated mortality of Douglas-fir on the east side, similar to what has occurred in the Klamath.

**LL:** Bark beetles and Douglas-fir beetles (DFB) have been important mortality agents in interior Douglas-fir historically. One of the factors that can determine who the mortality agents are is how



*Aerial view of Douglas-fir mortality in the Applegate Valley, SW Oregon, 2016. Photo Credit: Bob Schroeder, USFS*



much large, stressed Douglas-fir is on the landscape near insect populations following drought. For example, forests in the high and dry Intermountain West also push the boundaries of where Douglas-fir can grow and forests tend to be less diverse than in the coastal region. DFB hang out in these drought and water stressed forests, perhaps in root disease pockets, and outbreak when a pulse of habitat is created via fire-scorched and/or defoliated trees. This makes them prone to large landscape-scale bark beetle outbreaks, but DFB progeny need to have good phloem to eat under the bark. FFB larvae severely damage the phloem of the trees they have attacked and we are thinking that DFB can't compete well in those trees, or parts of the tree where FFB larvae are living. DFBs do attack quickly using pheromones, maybe faster than FFB at the landscape level in the short term. It will be interesting to see how dynamics of insect competition play out in low diversity forests versus the more diverse westside forests, and what will change as they dry out. We are still learning a lot about the current distribution of FFB.

**MB:** I'm thinking of the western red cedar work, and one thing I gleaned from that discussion was the interior western red cedar occurring on fairly dry sites were not as affected by the decline that's been seen on the west side of the Cascades. I do wonder if there are some parallels

between inner mountain Douglas-fir in the sense of genetic differences and how that might play into this.

When we say drought, we're often talking about a precipitation deficit. But, it's much more of an elevated heat issue than it is just drought. If you look at the elevated mortality in southwestern Oregon in the last seven or eight years, and then you look at drought patterns, what really stands out is the consistently higher summer temperatures versus the precipitation deficit, which is there, but by the historical standards, it's nothing extraordinary. It's up and down, but what really jumps out is the heat.

**LL:** With hot drought, we need to learn more about cavitation processes, embolisms and how those events can influence which insects are interested in affected trees. For example, will different levels and types of decline make trees more or less attractive to bark beetles versus wood boring insects versus other agents of insect and disease? There's still some work to do looking into mechanisms of cavitation as cues for FFB.

It's very important for us to work with our tree and plant physiologists to understand what's happening with Douglas-fir during hot droughts, and how they are coping with the strain. When do they shut down seasonally? Is it timed with hotter periods in the

summer? During the 2021 heat dome, for example, we saw damage to the foliage in northern Oregon, but we didn't see that same damage to foliage in southwest Oregon. However, a lot of us that work out here are of the opinion that the damage may have been far greater to the trees in the southwest because of potential starvation and hydraulic failure caused by that event. The tipping point was reached after they had experienced chronic drought stress for several years, then the heat dome was the event that pushed them over the edge. So really understanding the physiological processes happening within trees, and how extreme events and climate may be affecting those processes is going to be important for understanding which trees will be threatened in the future.

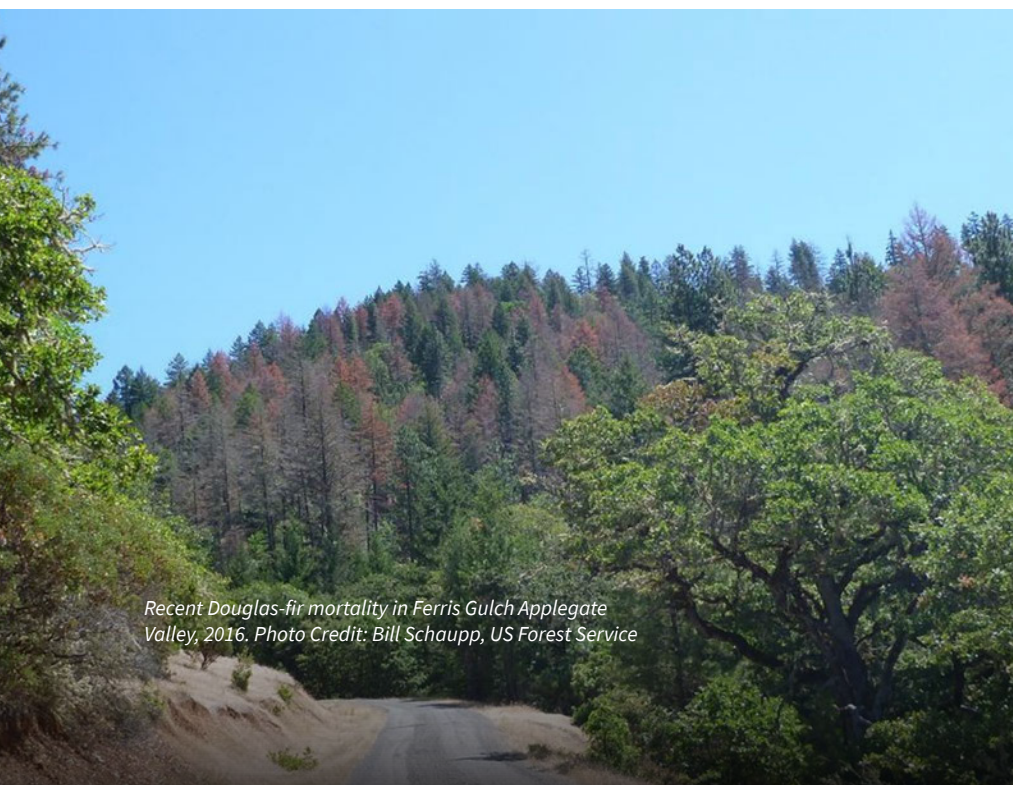
**KS:** How does the life cycle of these mortality agents line up with seasonal patterns and processes?

**LL:** We are observing flatheaded fir borer attacks throughout the year, which is more frequent than we previously thought. In the last two years we've seen new attacks in January and February, which surprised us. We still have a lot of work to do to fully understand the timing of the attacks, but it appears they may be active longer throughout the year, which could lead to more year-round mortality.

**DS:** The season for wood borer activity has increased, and therefore they're able to attack trees during more months of the year. That makes a lot of sense, really, especially for something like the flatheaded fir borer that doesn't necessarily follow a synchronous pattern.

**KS:** What kind of framework may be helpful for folks to really understand the decline cycle?

**MB:** One framework piece that I think is important is thinking about site and microsite level differences. In more hot, dry, moisture limited landscapes, a small change in the aspect, or slope, or soil depth, or some sort of physiographic feature can make a big difference in terms of the atmospheric demand and the soil moisture availability, and therefore, the vigor of the tree. I think people have to become more attuned to the finer scale differences. Especially with climate



*Recent Douglas-fir mortality in Ferris Gulch Applegate Valley, 2016. Photo Credit: Bill Schaupp, US Forest Service*



change in these dry landscapes, subtle differences can be the difference between survival and mortality.

**LL:** That's very true. When I was working in Idaho the landscape was so dramatic; a slight change in aspect was the difference between trees and scrub-shrub or grassland. Because that environment tends to host less diversity than westside forests, it was more apparent. On the west side, we're not used to thinking that microsites can be so important to conifer survival, but we may need to shift that thinking soon.

**DS:** One other thing I'd like to remind folks of is that it wasn't one of the big mortality agents that we normally think about that ultimately caused this event. We normally think Douglas-fir beetles are the big killer of Douglas-fir, in this kind of situation. But in this case, we found no Douglas-fir beetle in our sample trees. In many of the declines that we may see in the future, we may not see the expected

big mortality agent that everybody is familiar with. We may start seeing native insects and pathogens playing a lot bigger role in mortality than they have historically. Some forest health protection people are calling it "the rise of the secondaries." Basically, the insects and diseases we know are potentially pathogenic, but haven't been big players on the landscape. When site conditions shift, they become the biggest player on the landscape. I think we need to expect more of that in the future.

**KS:** Is there anything else you'd like to share?

**DS:** I think the concept of vapor pressure deficit (VPD) is really central to this conversation and important to understand. VPD is the difference between the amount of water in the air and the amount of water the air can hold. As temperature gets hotter, the air can hold more water. So if there was 2 inches of precipitation during the summer, and if the vapor pressure

deficit increases, the plants experience a drier summer. The vapor pressure deficit in the study was off the charts in some of these areas: 20%, 30%, 40% greater than the baseline. We think the higher temperature is not only affecting the trees themselves, but the increased vapor pressure deficit that comes with that, we think is really putting the squeeze on the trees. The study found that higher VPD was associated with greater landscape scale mortality. All of the climate change models are calling for higher VPD even if precipitation doesn't change.

It's important to recognize that in our response to this, it's not going to be a one size fits all management approach. It's nuanced, and associated with site specific factors, stand structures, stand history and all of that. It doesn't lend itself to easy solutions that can be easily described, it has to be more nuanced and informed by the site, and the timing of the outbreak.

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## Bios



**Max Bennett** has served as an Extension Forester for Oregon State University since 1999. Max covers Jackson and Josephine counties working with small woodland owners, natural resource professionals and collaborative groups to improve forest stewardship. In his work, Max utilizes the latest research and innovations from Oregon State University and other institutions to provide science-based education and expertise. His areas of interest include climate adaptive silviculture, forest health, and living with wildfire.



**David Shaw** is a Professor in the Department of Forest Engineering, Resources, and Management at Oregon State University, a Forest Health Specialist with Forestry and Natural Resources Extension, and Director of the Swiss Needle Cast Cooperative (a research cooperative focused on needle disease of Douglas-fir).



**Laura Lowrey** is a Forest Entomologist with the USDA Forest Service, Pacific Northwest Region, Forest Health Protection currently based out of the Rogue River-Siskiyou National Forest covering all federal lands in SW Oregon. She worked in vulnerable Douglas-fir Rocky Mountain forests of the Intermountain Region for 15 years, and has been working in Southwest Oregon since 2020.



# Small Woodland Owners can Help Prevent the Introduction of Invasive Phytophthoras

By Norma Kline and Daniel Stark, OSU Extension Service

Recent introductions of *Phytophthoras* into sensitive restoration sites in California have created an urgent need to spread the word on *Phytophthora* prevention in Oregon. *Phytophthoras* are microscopic organisms that cause root, stem and leaf diseases in crops, ornamentals and native plants (including forbs, shrubs and trees). A recent extension publication, [Preventing Phytophthora Infestations in Restoration Nurseries](#), highlights the importance of *Phytophthora* prevention in restoration nurseries and at restoration sites. The publication provides information on best management practices (BMPs) including purchasing healthy plants from nurseries with excellent phytosanitation practices, ensuring that plants are transported in clean vehicles and plants are stored off the ground in intermediate holding areas. Additionally, tools, footwear, and vehicles should be cleaned prior to entering a restoration site (Figure 1). Providing *Phytophthora* prevention education and outreach efforts to support restoration nurseries and restoration practitioners is an important first step. There are other key groups engaged in restoration planting efforts that would be well served to receive straightforward and practical techniques to prevent *Phytophthora* infestations. These include small woodland owners and contractors who help them implement land management objectives.

Our group of extension educators and plant pathologists developed a short brochure to ensure that small woodland owners and their contractors received straightforward *Phytophthora* prevention information to help them successfully achieve their management objectives. Small woodland owners are often engaged in a full spectrum of

land management activities including restoration planting projects. Small woodland owners collaborate with local watershed associations on fish habitat improvement projects and receive cost share funding for conservation projects from the Natural Resource Conservation Service and Soil and Water Conservation Districts.

The [How to Prevent Phytophthoras in Restoration Plantings on Your Woodland](#) brochure is available online in the OSU extension catalog in English and Spanish. A quarter-fold brochure will also be available in both English and Spanish. The topics covered in the brochure include:

- A background on *Phytophthoras* and why these invasive pathogens are so damaging to our native ecosystems
- Why we need to focus on prevention
- Best practices for restoration planting
- How to keep planting projects clean
- A handy planting checklist with practical steps small woodland owners and their contractors can take to help prevent invasive pathogens from hitching a ride into a restoration site

The importance placed on *Phytophthora* prevention is highlighted by the diverse array of expertise represented by our authors. Marianne Elliott is a Washington State University research associate in the Department of Plant Pathology at the Puyallup Research and Extension Center. Jennifer Park is a courtesy faculty with the Department of Crop and Soil Science at Oregon State University (OSU). Aaron Groth is an OSU regional fire specialist. Beatriz Botello Solgado is an OSU family and

community health program coordinator. Norma Kline and Dan Stark are OSU extension foresters who work with small woodland owners. Both Beatriz and Aaron were instrumental in adapting the brochure for a Spanish speaking audience. This project was funded by the Oregon Forest Resources Institute.

If you would like copies of the brochure to help get the word out about this important topic please contact Norma Kline at [Norma.Kline@Oregonstate.edu](mailto:Norma.Kline@Oregonstate.edu).

## References

*Preventing Phytophthora Infestations in Restoration Nurseries*. <https://catalog.extension.oregonstate.edu/em9330>

*How to Prevent Phytophthoras in Restoration Plantings on Your Woodland*, <https://extension.oregonstate.edu/pub/em-9398>

*Prevención de las Especies de Phytophthoras en Plantaciones de Restauración en su Tierra*. <https://extension.oregonstate.edu/es/pub/em-9398>



Figure 1.



## Watch: People, Lamprey & Cultural Ecology

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This film focuses on the cultural geography of the lower Willamette River, and how First Foods teachings inform environmental programs at Tryon Creek State Natural Area. All of this work is interconnected, we are hoping to inform every youth who resides here now, of the authentic cultural narrative of the landscape.

- Gabe Sheoships, Executive Director of Friends of Tryon Creek



Photo Credit: Jeremy Monroe

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The film, produced by the team at [Freshwaters Illustrated](#), is available to view [here](#).



# Understanding Connections Between Fuels Management, Fire Disturbance, and Streams

*In this interview, Natalie Collar shares ways in which waterways experience fire and the effects of adjacent fuels management on stream systems.*

**Kayla:** Can you start by sharing how you got started working in fire-affected watersheds?

**Natalie:** I am from a small town in the foothills of northern California's Sierra Nevada called Paradise. I grew up with parents that were very aware we lived in a very fire-prone area. They were always aware of fuels and maintaining defensible space around their house to the extent they could. I also had a lot of neighbors that weren't or who didn't have the resources to. The entire town of Paradise was destroyed in 2018 in California's costliest and most fatal wildfire to date. Ninety-five percent of the 30,000 people that lived there lost their homes and businesses in one day. That's about 14,000 structures. Eighty-five people died.

It was a tragedy and I wish the November 2018 Camp Fire had never happened, but I am thankful for the unique, very personal perspective it provided me

about the wildfire victim's experience. I think it helped me to become a better fire scientist; most people working in wildfire engineering and science are not directly affected by the hazard they deal with professionally. Yes, wildfire is a natural phenomenon, but it can still have devastating consequences for life and property. We were evacuated a few times growing up but fire never really came into town until after I left. I went to undergrad in Santa Barbara where fire activity was pervasive as well. A lot of my professional work involves post-fire debris flows and other hydrogeomorphic hazards, including how to predict their likelihood of occurrence in a pre-fire context. I feel privileged to have gained a deeper understanding of some of the conflicting perspectives that come with management decisions.

**KS:** Can you speak to some things resource managers might consider when they're planning multi-objective fuels reduction projects in and around riparian areas?

**NC:** I think the important thing to know about fuel or forest management actions in riparian areas is that they're typically being conducted because the riparian area itself has been substantially altered, either through intentional land management or natural or anthropogenic disturbances, and that has triggered the need for proactive fuels management and often concurrently habitat restoration. Some of those management or disturbance pressures might be wildfire itself—maybe it's more wildfire-prone because of fuel densification after a century of fire suppression, and that's actually kicked that riparian area and abutting upland area into a different fire regime where now we have plants that are not adapted to higher burn severities or more frequent fire activity. Maybe this area has been infested by exotic species. Prescribed burns and mechanical thinning and other management actions are often used to suppress those non-endemic species. Maybe there's been



## Natalie Collar

*Senior Hydrologist for Wright Water Engineers, Inc.*

Natalie Collar is a Senior Hydrologist for Wright Water Engineers, Inc. where she focuses on disturbance hydrology, H&H modeling, statistics, and big data analysis. She holds B.S. (biology) and M.S. degrees (watershed science) from U.C. Santa Barbara and a Ph.D. in civil engineering from Colorado School of Mines. Her dissertation focused on how to characterize hydrologic response patterns of disturbed ecosystems from burn scar to continental scales. Natalie is a Lincoln Institute of Land Policy Babbitt Dissertation Fellow and won the Remote Sensing Technical Committee Outstanding Presentation Award at AGU's 2020 conference. She is from Paradise, California, which was destroyed on November 8, 2018 in California's deadliest and most destructive wildfire to date.



timber harvesting or grazing in the area. There are a lot of reasons why you might get to the point where you're conducting fuel treatment activities in riparian areas and I think it's important to think about what your objectives are. It is also important to acknowledge that some objectives may compete with one another, requiring managers to think about which objective(s) to prioritize over others. Resource managers often start by identifying which resources in the management area are most critical to humans or sensitive species. Is this a high-yield source water area? Are there any threatened or endangered species present? That's going to trigger different types of management questions. One of the most common reasons fuel management campaigns are conducted in riparian areas is to reduce the likelihood of moderate to high burn severity. But oftentimes, managers try to layer riparian habitat restoration and

ecosystem restoration on top of fuel management objectives. Sometimes those objectives compete, sometimes they harmonize.

**KS:** What are some of the potential downsides and constraints of fuel management in and around riparian areas?

**NC:** Managers need to be cognizant of any potential trade-offs between how their management activities might impact landscape processes and ecosystem function versus how wildfire itself could. A lot of impacts from management fully overlap with the impacts that fire itself can have in riparian and upland areas.

Riparian areas tend to be less flammable than upland areas because of their higher soil moisture and vegetative water content—the water table is

typically closer to the ground surface and there are more phreatophytes. This means it requires a lot more heat energy to make potential fuel sources combustible and to sustain an ignition source. Riparian areas are often used as natural fuel breaks in fire management, along with other natural landforms like ridge lines and rocky outcrops. Fire typically gets into the riparian area when an ignition source successfully ignites a fire in drier upland fuels and then travels down into the riparian area through gullies and steep ravines, oftentimes during extreme fire weather. If fuel treatments have been conducted in the upland area but not in the adjacent riparian corridor, that creates a break in the continuity of the fuel treatment; you don't want your riparian area to be the fuel source that bumps the fire activity into a more extreme state. Again, there are some competing pressures there, so managers have to determine which objectives are most important when planning a fuels management campaign.



Another potential downside for fuel management in riparian areas is a reduction in shading of the stream corridor. Shading is important because stream temperature plays important roles in nutrient cycling, behavioral patterns of aquatic biota, fish distribution in the stream channel, and more. For example, if a fuels management project reduced cover by mechanically thinning the canopy or removing ladder fuels, or if prescribed burning is implemented to reduce herbaceous material and/or new woody growth along the waterway, all of that is going to reduce shade, which can increase stream temperature in the summer. In the winter, interestingly, the opposite effect can occur where stream temperatures decrease because you permit radiant cooling that would otherwise potentially be moderated or buffered by overhanging riparian vegetation. Another potential downside could be altering organic matter inputs to the aquatic food web. If a food source is coming from within your study area, we call that autochthonous. If it's being transported from outside of your project area into it, we call that allochthonous. Because most stream reaches are directly and indirectly connected to processes upstream, upslope, and even vertically into the canopy, allochthonous carbon and organic matter inputs



tend to dominate in systems that are in equilibrium. When you reduce the amount of woody vegetation being delivered to the stream, you are removing a potentially very important allochthonous carbon input. Greater reliance on autochthonous sources may be required for months to years to come. Streamside management can be considered a disturbance to that food web since fish rely on the invertebrates that thrive in habitat created by large woody debris. This can create trickle-up effects to the higher chains in the food web depending on what is happening with primary food sources. Another potential downside related to large woody debris is the potential habitat complexity reduction that occurs when large woody debris inputs are suppressed. Habitat complexity is important for aquatic ecosystem form and function, such as when in-channel debris creates lower-velocity refugia habitat for fish during high flows.

Another thing to consider is how management actions can alter the soil hydraulic properties that control how water moves through the subsurface. For example, heavy machinery can decrease porosity and saturated hydraulic conductivity by compacting soils, thereby changing local hydrology and soil biogeochemical processes which can affect stream water quality. Riparian areas often have finer textured soils with higher water-holding capacity than non-riparian areas, which can render them more vulnerable to compaction or even to alteration of what's happening with microbes in the soil column. Management activities in and of themselves can also rearrange the amount, size and orientation of surface woody materials. One example of this is

what happens in mechanical chipping and mastication operations. We use mulch to increase soil water holding capacity and to buffer soils from erosive raindrop impact, but these changes need to be accounted for when thinking about landscape processes. Mulch cover can change the rates and types of chemical reactions occurring in the soil if it alters soil temperature, for example.

Constraints also affect which management options are available. Some examples include:

- Potential presence of threatened endangered or sensitive species
- Old-growth habitat
- Cultural resources in the area
- Lack of agreement among resource specialists
- Funding sources
- Landscape and ownership continuity
- Limited scientific information on effects of fuels treatment on aquatic and riparian areas
- Aesthetic and recreational impacts

**KS:** What kind of things should folks be taking stock of before a fire, or when they're planning fuel treatments?

**NC:** Oftentimes the vegetation in riparian zones remains intact after fire, either because fire didn't actually burn close to the stream or because severities

were lower there. So the acute impacts of the fire are not present or not as obvious by waterways. But, it's really important to recognize that it's often the riparian areas that get hit by the post-fire hydrogeomorphic response. When it rains after a fire and runoff response is amplified, all that water is heading towards your stream network. That can have devastating consequences.

The first thing I think about is what's happening with the region's fire regime, how often and at what intensity do you expect to experience fire in a given area? It is also worth thinking through whether the historic fire frequency is consistent with present-day conditions. Fuels in North America are denser now than they were a century ago due to the Forest Service's 20th-century 10 am fire suppression policy, which can create conditions that deviate from the historic fire return interval. Given aridification trends, some areas will likely experience more extreme and/or frequent fire behavior in the future, so planning for that becomes a part of the equation. Unfortunately, an increasingly non-stationary climate can make it really hard to use the past as a blueprint for how to move forward. The next thing I'd suggest is taking stock of what is happening in your watershed and in your management zone specifically. The world is extremely heterogeneous, meaning wildfire resiliency planning has to be site-specific. One plan does not fit all. Looking at how vegetation communities are distributed throughout your watershed, topographic shape, and other characteristics that influence how fire moves across and interacts

Landsat aerial image of the November 8, 2018 Camp Fire that destroyed Paradise, CA.



Painting by Natalie's twin sister, Noelle Phares, a professional artist in Denver, CO ([www.noellephares.com](http://www.noellephares.com)), depicting a plume of smoke. Painting title: "Plume." Painted in 2022.



The street Natalie grew up on in Paradise, CA, shortly after the 2018 Camp Fire. Photo taken by Natalie Collar.







*At the 2022 Hermit's Peak-Calf Canyon burn scar (New Mexico) in October 2022. Photo taken by Natalie Collar.*

with your landscape is a good place to start. Luckily, there is a lot of information out there on how various species do and do not tolerate fire. Understanding how the different parts of your watershed will respond to fire disturbance is fundamental to upping your pyrology game.

My colleagues and I are frequently hired to conduct pre-fire hazard assessments, requiring us to catalog or inventory what is at risk in a given area. The scope of this depends a lot on the setting and can get more complex where development mixes with large fuel loads, such as in the wildland-urban interface and intermix. Understanding what your potential values at risk are is really important. I work in an industry that is often focused on the built landscape, which is so important, but I do try to be a voice for the natural environment too (like many others do also). I hope that the protection of environmental resources when feasible, not just because of what they provide us but because they are important and worthy in and of their own right, is always part of the conversation one day soon.

I think understanding potential recovery pathways for vegetation within a watershed is really important. Vegetation can respond in so many different ways to fire. Some evolutionary adaptations that facilitate survival are recolonization success includes epicormic or coppice sprouting, root

suckers, basal sprouting, and thick bark. Certain species rely on tissues/plant organs underground to survive the fire and to continue growing, like Aspen. Aspens often live along waterways and they spread via rhizomes. In postburn environments, I've seen so many tiny Aspens growing up in and around streambeds because what was there before has been wiped out. Fire created a gap that the most competitive colonizers exploit. That is part of natural succession. On the other side of that might be lodgepole pine, whose post-fire recolonization success hinges on their serotinous cones that open up during fire. The parent tree itself might not survive, but her seeds get spread and enjoy the post-fire carbon-rich soil. Wind and water can also disperse propagules. Fire triggers flowering and fruit production of certain species. If the fire doesn't burn very hot or its residence time is short, the seed bank may be preserved and with vegetation removed, the light limitations for germination and shade-intolerant species in general are reduced or removed.

**KS:** Can you speak to the physical, chemical, and biological effects of fire on watershed landscape processes and how that relates to stream structure and function?

**NC:** Hydrology is the science of how water moves through the environment. There are many things that influence how much precipitation you get and

how much of that precipitation input is lost to evapotranspiration or becomes groundwater or runoff. For example, evapotranspiration rates are influenced by what we call atmospheric demand, or your vapor pressure deficit, how much water is available in the soil for plants to use, and how much solar radiation is hitting the vegetation surface.

In a water budget, the biggest input is typically precipitation as rain or snow. Your biggest loss is not how much water runs off into streams or percolates down to the water table, it's how much water evaporates back up in the atmosphere via evaporation from open water surfaces, including water on vegetation that has been intercepted, and of course, from water being taken into plants via root structures and then lost to the air surrounding the plant via evapotranspiration through leaf stomata. In more arid locations, upwards of 80% of the water that falls on a watershed might be evaporated back into the atmosphere.

In some areas, one of the biggest changes we've seen in climate recently is higher air surface temperatures. There's a relationship between how much water the atmosphere can hold and temperature called the Clausius-Clapeyron relationship. It describes why warmer air requires more water to saturate and reach 100% relative humidity. What we call "temperature" is simply a measure of how fast molecules are moving in a given space. With higher temperatures, water molecules are simply moving faster be they in solid, liquid, or vapor phase. As temperatures increase, the molecules move faster and are more likely to escape the liquid phase and transform into the vapor phase. That's why higher air temperatures hold more water on average, there are just more molecules that manage to escape the liquid phase into the vapor. Because of that, we have higher atmospheric water vapor demand when temperatures get higher—it takes more water to saturate hotter air, and more terrestrial water gets lost to the atmosphere via evapotranspiration.

That all matters because fire can alter evapotranspiration rates (among other relevant hydrologic processes) where it changes vegetation structure and function. Suddenly, some of that



water that would have otherwise been lost back to the atmosphere via evapotranspiration might now be available to run off downstream because vegetation isn't using it. I published a series of articles about this topic in the [Journal of Hydrology](#) over the last three years.

The second change to note is how modifying vegetation changes the way that a landscape responds to a storm event. When you remove vegetation, you remove some of the material that buffers the erosive impact of raindrops as they fall onto the soil surface. Canopy foliage is no longer there to intercept raindrops, and reduced grass and herbaceous vegetation cover also increases the amount of erosion that rainfall can cause.

Fire itself can really alter soil structure. The ash that's generated during fire can clog soil pores and reduce infiltration. Hydrophobicity is another effect, although it occurs in a much more heterogeneous way than is often acknowledged. Hydrophobic soil lenses can develop when waxy compounds on plant leaves, which are typically a water loss prevention strategy for intact vegetation, get vaporized by the hot temperatures of the fire. Those vaporized hydrophobic waxy compounds follow the thermal gradient down into the soil column and then

re-coalesce to coat soil particles when the temperature is low enough for the vaporized molecules to move back into a more solid phase. That hydrophobic soil layer can now impede water infiltration until it breaks down. A couple of caveats: if fire burns hot enough and/or sticks around long enough, that material can re-vaporize and the hydrophobic soil layer can get annihilated before the fire is even over. It is also important to recognize that many areas have naturally occurring water-repellent soil layers even without fires, including parts of the Pacific Northwest. All these things can increase runoff which in turn increases stream power and subsequently, the sediment carrying capacity of that runoff. The amount of discharge has a direct relationship with the amount of sediment it can move, and those are always in what geomorphologists call Lane's balance. More discharge means that water will pick up and carry more sediment. That has huge consequences for potential debris flow production and nuisance erosion. You don't have to get devastating debris flow to be highly impactful to a waterway; sediment itself is considered a pollutant in certain contexts.

Another big deal with hydrology and fire is surface energy balances. A tree with dark needles, say an Engelmann spruce, will absorb a fairly high fraction of the shortwave solar radiation that hits it

and then will re-emit some of the energy it absorbed as longwave radiation. In contrast, grains of snow reflect most of the light that hits them meaning they have high albedos. Fire itself can shift the surface energy balance of a local environment. If that spruce burns and its needles are removed, now that solar radiation penetrates all the way down to the lighter soil surface because less of it is getting absorbed preemptively by the needles. The relatively lighter soil surface reflects more of the radiation than the darker needles would have because of the differences in their optical properties, so you're changing the energy balance mechanics in numerous ways. When you remove or kill evergreen species, newly-exposed mineral soils tend to be exploited by deciduous trees in the boreal forests of Canada, for example, which typically have lighter-colored leaves than the conifers that dominated the landscape before the fire in this conceptual example. Again, that can lower the total albedo because of that shift in the optical properties of the ground cover. Maybe the ash from the fire commingles with and gets incorporated into the snowpack, darkening it. The pack will now absorb more solar radiation and melt off faster. That's one reason why we tend to see earlier melt times after a fire, which can shift the timing of peak flows, leading to greater asynchrony between snowpack accumulation and peak water



*At the 2020 Echo Mountain burn scar (Oregon) in January 2021. Photo taken by Natalie Collar.*





demand which typically occurs later in the summer during the growing season in the northern hemisphere.

**KS:** How do all of the changes brought on by fire affect stream structure?

**NC:** Changes in sediment inputs can certainly alter the dimension, plan, and profile of a stream. Streams are always trying to find their most probable state; they're trying to find this perfect balance of discharge and sediment transport. If discharge increases, you'll see a corresponding uptick in sediment carrying capacity. Not just from upstream inputs, like hillslopes, but in the channel itself. More lateral migration might start to occur at outer stream bends because the water in the stream is now hungrier for sediment—it will start to pluck sediment grains from the channel bank. Because of this, I think allowing waterways enough space to move around and do their thing after fire is important, although not always possible due to development constraints.

On the biogeochemical side, there is such a shift in what is coming in, for months to potentially years after a fire. In terms of potential chemical compounds, polycyclic aromatic hydrocarbons are oftentimes produced from partially combusted organic matter, like logs and trees. Greater

nutrient export is often observed, and that has big water treatment implications. I talk a lot about this and important post-fire considerations in an [article](#) I recently published in the *Journal of Environmental Management*.

As far as stream function and structure and how it relates to food chains, it's really typical to see high algae growth, which has important implications for dissolved oxygen concentration, solar penetration into the water column, and so on.

**KS:** Following fire in source water collection areas, what can managers do to preserve or enhance hydrologic function? Are there any proactive or responsive steps people can be thinking about to make the best out of the situation that they're in?

**NC:** Incorporating fire resiliency planning into your forest management plan is critical. Managing potential fuel densities and patterns and potential ignition sources can reduce the changes of high severity fire. Another thing is not putting potential values at risk in harm's way. Humans like to put structures in fire-prone areas because it's nice to live among trees, but it behooves us to think smartly about where and how we're allowing development. There are a lot of good resources for fire-aware zoning and

building codes that local communities can model their own policies after.

We typically prescribe erosion reduction best management practices after the fire occurs—you're not going to be hydro-mulching a vegetated hillslope. But you can plan for the things you might need in place before a fire happens. It's easier to respond to an emergency when you have a plan in place. Who is on your must-call list? Where are you going to get your funding from? Working out what the phone tree ahead of time can be really useful. Pre-event agreements with contractors and supply procurement can reduce the amount of time and effort spent when you're actually experiencing the emergency.

**KS:** Do you see a lot of that pre-fire planning happening or are most agencies still in a responsive mode?

**NC:** I'm seeing more and more pre-fire planning. Private and public clients are hiring us to conduct flood and debris flow hazard modeling before fires occur, and to help them understand where their infrastructure may be vulnerable to post-fire hydrogeomorphic hazards.

My company does a lot of water supply planning, and I just wrote a paper that was published in the *Journal of Environmental Management* about what water utilities can do to think about



*At the 2020 Archie Creek burn scar (Oregon) in January 2021. Photo taken by Wright Water Engineers, Inc.*



*At the 2022 Hermit's Peak-Calf Canyon burn scar (New Mexico) in October 2022. Photo taken by Natalie Collar.*



this. Those facilities can be retrofitted to deal with the variable source water quality that you're going to get after a fire to deal with increased amounts of sludge and backwash water. On the water supply side, utilities with relatively small, homogeneous, local water supply portfolios tend to be more vulnerable to fire-related water supply disruptions because the chances of their entire source water area burning in a single fire event are higher. Utilities in that position can reduce their risk exposure by diversifying their supply portfolios, such as with standing, flexible agreements with other water utilities that guarantee an alternative water supply should theirs be compromised. Colorado has a lot of funding set aside for grants under, for example, the state-led Wildfire Ready Watersheds program. Wright Water Engineers was part of a technical team that conducted a statewide susceptibility of post-fire hazards under that program. The program also prepared guidance for how communities can write their own Wildfire Ready Action Plan and provides funding support for communities to do so.

**KS:** What are some of the regional nuances and factors that can affect the ways different ecological and human communities respond to wildfire?

**NC:** Landslides are a prominent post-fire hazard in the Pacific Northwest because of the high infiltration rates of your volcanic soils. Among other things, soils on steep slopes are stabilized by the tensile strength of tree roots. After a fire it could take many years for a fire-damaged tree to fall, but once it does, the shear strength provided by the reinforcing roots is diminished, escalating landslide hazard. During your long, drizzling storm events, that rain will infiltrate into soils and eventually increase pore water pressures. With the shear strength of the soils reduced, it now takes less rain and lower soil water pore pressures for a slope to fail.

One other site-specific nuance is what is controlling the success outcome of an ignition. In the southwestern US, fires are typically fuel-limited. Let's take Arizona as an example. The fuels in arid Arizona are almost always dry enough to burn, so what is driving or constraining fire frequency is the amount of time it takes for the fuel source to build up sufficiently to sustain and carry fire. By contrast, the

Pacific Northwest is climate-limited. The wetter parts of the PNW always have enough fuel to burn, but that potential fuel source isn't combustible until it has dried out enough to carry an ignition source. That scenario requires a severe seasonal or multi-year drought. It seems to me that the recent increases in aridification may have more dire impacts on fire-related losses in climate-limited areas because they have the fuel. That fuel is just waiting to dry out enough to be flammable.

**KS:** Is there anything else that you wanted to cover that we didn't get to?

**NC:** I'd like to acknowledge how many different hats everyone is expected to wear in 2023 and the difficulties associated with that. I am currently a full-time consultant at an engineering firm and a part-time researcher. In order to be productive and competitive I have to be a data scientist, I have to have working knowledge of multiple coding languages, big data management and cloud computing skills, awareness of

the ever-shifting landscape of artificial intelligence and machine learning, and so much more. I have to be a statistician; anyone conducting publishable research does. It requires scientists to be ever adaptive, especially as the pace of technological advancement increases exponentially. I must be an expert graphic and content creator—I have to be my own little brand. I am supposed to have a social media presence online (I don't, but it's so heavily pushed in this industry). I'm supposed to be an excellent technical writer; writing a peer-reviewed manuscript for a good journal is very humbling. I am constantly out there at conferences and meetings, sharing my latest research. Not to mention the required expertise in one's own discipline, hydrology in my case. Every day, I spend half an hour looking at the publications that came out the day before to stay on top of the newest literature. That is a commitment that I've made, but it takes a lot of time. It's a big commitment to be willing to talk about these topics that really matter to people and that potentially influence public health and welfare and safety.



*At Detroit Lake in the 2020 Beachie Creek burn scar (Oregon) in January 2021. Photo taken by Natalie Collar.*



# Oregon Fire Resilience Network Kicked Off in March

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By BEF Staff

The Oregon Fire Resilience Network (OR FRN) kicked off in March with an all-day workshop and participation from a diverse group of wildfire practitioners, planners and agency representatives. OR FRN supports knowledge sharing and connections for action focused community-based capacity to accelerate fire resilience and recovery in Oregon. The workshop consisted of a series of talks on a variety of wildfire and cultural fire topics, mixed in with lively group breakout sessions that allowed participants to introduce each other to their wildfire work, the barriers they face, and potential opportunities to catapult their work forward. The workshop culminated in a full group discussion on strategies

to harness the energy of the day and continue the collaborative momentum in future exchanges. The convening was the result of several months of planning by BEF staff and a temporary advisory team of wildfire partners. The willingness of the workshop participants to explore the realm of possible solutions to a range of complex wildfire related problems, no matter how farfetched, and to hold open and respectful discussions amongst groups that may not normally work in collaboration left me feeling hopeful and energized that together we can make significant strides in restoring healthy relationships with wildfire that are better adapted to the current and future wildfire landscape in Oregon.

Fire, whether started intentionally, accidentally, or naturally, or whether it is suppressed unnaturally, shapes Oregon's landscapes. Before naturally occurring wildfire and Native American use of fire were suppressed, people used fire in sophisticated ways for socio-ecological resilience.

Areas like the Willamette Basin that have not experienced widespread fire during the last 100 years of suppression-dominant wildfire management are facing increasing risk from wildfires due to climate change and forest conditions. These impacts include air quality impairment from local and regional fires, decreased resource availability during



Photo Credit: Confederated Tribes of Grand Ronde

wildfires, and other multiple community stressors. A contemporary example of this was the multiple wildfires impacting Oregon and surrounding states during the Labor Day Fires of 2020.

Communities in wildfire-prone areas face a constant need to pivot through the before, during, and after continuum of preparation, response, and recovery. No single agency or organization can sustain coordination and financial capacity around this cycle season after season. Federal and state agencies work with strong intentions to develop programs and funding to support better fire outcomes, but do so within established systems that may leave community needs unmet. Communities often struggle to keep up with programmatic changes, and have to re-learn which program is right for them after every institutional or situational change. Fire adaptation networks can accelerate connections between community needs and agency intentions. Rather than independent and separated disaster response actions or existing programming such as Firewise USA, which is limited in its focus, a networked approach can generate connections among practitioners that lead to a more holistic approach to addressing complex wildfire problems. These connections have the potential to accelerate local development and use of practices that will increase overall resilience and address where communities and the landscapes they live in exist on the fire and capacity continuum.

The National Fire Adapted Communities Learning Network and the Washington Fire Adapted Communities Learning Network serve as excellent examples of networks that accelerate progress on landscape and community resilience by connecting key partners, generating much needed resources and tools and creating programming that cultivates the conditions for collaboration. These networks bring people from communities, governments, and organizations together to identify wildfire needs and build capacity to take actions.

The Oregon Fire Resilience Network, or OR FRN, was initiated through federal funding supported by the USDA Forest Service and Sustainable Northwest and by staff at Bonneville Environmental Foundation. It is being shaped by a

temporary advisory team of wildfire planners, practitioners and agency representatives and most importantly by OR FRN members themselves. The network serves as a space for members to connect each other with information, lessons learned, and align resources with emerging opportunities to support each other and work together. In-person convenings, online webinars and discussion panels, and online workspaces are platforms for connecting. OR FRN recognizes that everyone has a role to play, but no one should or can play every role. The network is creating space for strategic coordination to help members focus limited capacity more efficiently and effectively. Connected, network members have the opportunity to identify coordinated actions.

Several themes and creative ideas emerged out of the March workshop that will guide future OR FRN learning exchanges, convenings and general programming. Community Wildfire Protection Plans (CWPP) surfaced as a hot topic during group discussions. CWPPs are collaborative stakeholder driven plans that can coordinate actions on community fire resilience and recovery and unlock funding to do so. CWPPs do not exist for all communities in Oregon and many are severely outdated. Many discussions revolved around existing barriers to expanding cultural burning and how to overcome them. Indigenous stewardship and cultural burning will be the central topic for a fall network exchange (details to come!). Finally, there was general recognition and appreciation from the group that workshop participants made up a highly diverse group of wildfire specialists which do not typically interact, however, it was also emphasized that greater representation from black, indigenous, people of color and vulnerable communities is needed in OR FRN and essential for creating just and equitable fire adapted communities.

BEF staff are working with the technical advisory team to process all the feedback from the workshop and will present those results at the next OR FRN learning exchange. At this exchange, participants will develop a twelve-month work plan to guide programming for OR FRN over the next year.

Working under the guidance that we can go further together, OR FRN members will work to support each other, learn from each other, and re-learn to live with fire together. Fire does not stay within jurisdictional boundaries, so collaboration is key to efficiently leverage resources and move work forward in a way that makes sense for our landscapes and communities.

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**If you are a wildfire practitioner in Oregon and are interested in being an active member in OR FRN or learning more about the network, please contact [jpzagarola@b-e-f.org](mailto:jpzagarola@b-e-f.org)**



*At the 2020 Echo Mountain burn scar (Oregon) in January 2021. Photo taken by Natalie Collar.*



# Planning for Resilience

## A Conversation with Steve Moddemeyer

By Hannah Buehler

**HB:** What are you learning about resilience doing the work that you do?

**SM:** Most of our attention in the practice of architecture and planning is very much centered around the near-term demands of today. It is difficult to look too far ahead because projects must address today's climate, today's technology, today's market, and today's financing. When technology, demand, and financing are short-term focused, innovation and resilience get short shrift. We continue to plan for, design, and build assuming that weather extremes will continue to be rare. Many of the strategies that we've relied on in the past are now misinforming us of our risks and of a safe pathway forward. When we do this, either willfully or inadvertently, we make ourselves more vulnerable. The result is that our investments don't deliver the service that we expect. This mismatch emerges during extreme events with the result that we needlessly compound the misery for folks whose

lives and livelihoods depend on that infrastructure and who live and work in the buildings that infrastructure is designed to serve.

**HB:** As you're helping people and organizations to navigate uncertainty, what attributes of resilience do you use to inform your work?

**SM:** I became interested in resilience science when the International Water Association (IWA) based in The Hague, Netherlands hired me in 2008 to help them launch a global program called "Cities of the Future." For about three years, I worked with IWA members and staff to convene meetings in regions of the world including Turkey, China, Korea, Canada, and Europe. In the meetings we'd examine what forward-looking people in infrastructure design and city planning were doing and how we can all learn from them. Seeing on-the-ground built examples where people were planning for a climate-changed

future demonstrated these ideas are not only not crazy, but already being implemented at full scale. This was more than a decade ago. The United States was an outlier—even then.

During that time, I came across the [Stockholm Resilience Center](#) founded by [Carl Folke](#). I resonated with their approach to socio-ecological resilience. They look at how ecological and social systems adapt to change and persist over time, through good times and tough times. Istanbul is a great example of a social system that adapts and persists over time.

Istanbul has been a city for 5,000 years. It is thriving and dynamic. It has endured and rebounded from multiple pandemics, major wars, name changes, regime changes, and it still persists. So what is it that makes a city grow and thrive through thousands of years? Are there special attributes or systems that enable that? The same question arises



### Steve Moddemeyer

*Principal for planning at Collinswoerman*

Steve is a principal for planning at Collinswoerman, an architecture and planning firm based in Seattle. He works at the intersection of sustainability, resilience, and land use and is the Chair of the National Academies of Sciences, Engineering, and Medicine's [Committee on Hazard Mitigation and Resilience Applied Research Topics](#).

with ecological systems. Any ecosystem or species that is with us today has managed to navigate and persist through all kinds of change: through glaciation, wildfires, disease, drought, floods, hunting, pests, pestilence... through everything. So what is it that makes them able to keep their identity and manage to navigate through those thousands and thousands of years?

Back in the late 1960s and early '70s, Canadian ecologist C.S. "Buzz" Holling had a great insight. He realized that it is not the ability to grow and prosper that makes a species or an ecosystem persist through time, rather it is their ability to keep their identity through times of loss and change. Resilience is not simply the ability to resist change, but to recover from it with your identity intact. In 2015, I drafted a paper *Applying Elements of Resilience to Prioritization and Decision Making* and asked Mike Jones of the [Swedish Biodiversity Institute](#) to be a co-author. It hasn't been published, but it outlines eight key attributes of resilience of particular importance to planners.

### Eight Attributes of Resilience:

1. Diversity
2. Modularity
3. Connectivity
4. Storage
5. Feedback
6. Story
7. Trust
8. Self-organizing

The first principle is **diversity**. Diversity of species, food sources, ecological niches, even diversity of methods, systems, and cultures are all essential attributes of resilient systems. The broader the range of diversity, the more likely the system has the capacity to adapt to change. For planners, this means that if we only take one point of view, or one person's life experience into account, then we're not hearing all the other perspectives that can

cast clarifying light or open up new perspectives on the challenges we face. It is often that the ideas that are on the edge are most relevant for survival when conditions change. Diversity is not just a good idea culturally, or as a nation. It is a fundamental attribute of the capacity for a system to be resilient.

The second attribute of resilient systems is **modularity**. When we find a pattern that works, it makes sense to find ways to replicate that pattern in a smart way. Systems and species that survive through change have modular approaches that can work in various settings and can be repeated when the conditions are right. Modularity is closely tied to a distributed systems approach in infrastructure, where multiple modules offer services (or ecosystem services) that can dot the landscape. If one module winks out because of some disturbance, the others continue to function and can provide capacity to reestablish the affected areas.

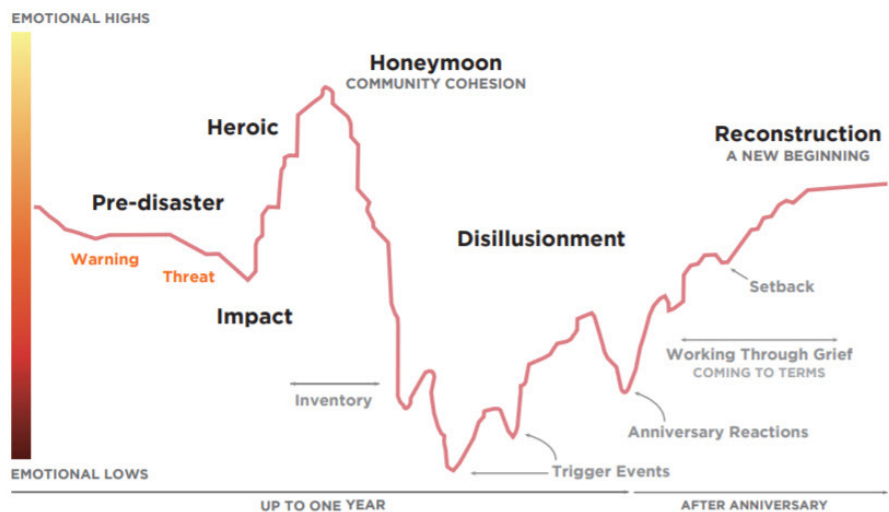
**Connectivity** is the third attribute. If we're under-connected, then we risk being isolated and vulnerable. If we are over-connected, then we are vulnerable to contagion and exhaustion. It's when we maintain a balance of strong and weak links of connectivity then we can acquire resources from across distances and share insights. For example, the internet helps us to connect and we can

learn more about what's going on in the world, but that's just one mode of connection. Connecting with where we are—right here in this place experiencing it with our senses—is another essential pathway for connectivity.

**Storage** is fourth. Storage that is distributed throughout a system allows for a resilient system to maintain viability when disaster strikes. The importance of storage became obvious during the pandemic when our just-in-time supply chains collapsed. Personal protective equipment (PPE) was not in adequate supply and the United States did not even have the capacity to make our own PPE as the pandemic impacts unfolded. We valued efficiency (and profitability) for the good times, but failed to recognize that it's the tough times that demonstrate if we have the capacity to be resilient. For individual families and businesses, storage can refer to financial savings and access to credit. Over and over it has been shown that minimal savings and limited access to credit can cripple the recovery of an impacted community.

Systems that have storage have better odds of survival and can speed recovery. Some communities are creating "resilience hubs" by retrofitting community halls, schools, or even building new facilities within walking distance of neighborhoods to store energy, water, food, tools,

### Phases of Disaster



Source: Zunin/Meyers, as cited in Training Manual for Mental Health and Human Service Workers in Major Disasters, U.S. Department of Health and Human Services (2000).



and communication equipment. Communities need to be able to store enough that they can continue essential community functions on their own for some length of time, get information when mobile phone grids are down, and share resources with friends and neighbors when things get dicey.

The fifth aspect of resilience is **feedback**. Systems with resilient capacity are able to sense, hear, and incorporate new information when it comes their way. Failing to be sensitive to and responsive to feedback is a surefire way to become vulnerable to change.

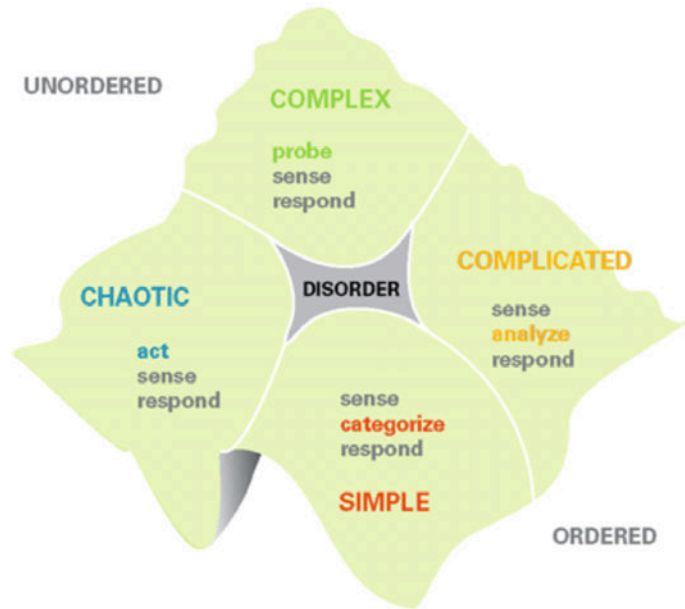
The sixth attribute is **story**. What does the story have to do with ecological systems and species? If we know the stories of salmon, we begin to know salmon: their life history, their will to survive, their ability to shift their bodies to salt water and then return home again to spawn in freshwater is how we know who they are. They are salmon and they bring wonderful gifts to us and the entire ecosystem.

We humans have our stories, too. The stories we tell ourselves about ourselves are a key element of how we maintain our identities. The cultures we grow in and the ceremonies we learn keep our stories alive through the generations. We share ceremonies and origin stories to remind ourselves of who we are and the breadth and depth of how we got here.

Community leaders are encouraged to remind impacted communities of “who we are.” They retell our own story to us. They say we are going to work together to respond and recover. They say we will not stop until everyone that can be saved is saved. They say we are all in this together. And they mean it.

**Trust** is the seventh attribute. Trust is more than an element of social systems; it is also an attribute useful for species survival. For us humans, we know that when trust is broken, our ability to recover from setbacks can take longer or maybe forever.

So how can we repair trust when it is broken? Whole books have been written about that. A shorter answer is that trust is the result of three things: 1) demonstrating consistent behaviors of trustworthiness over time; 2) providing



The Cynefin framework

clear and unbiased communication; and, 3) respecting others, which means to respect i.e., relook at the outcomes of our actions on others and use that feedback to take responsibility, and when needed, begin to repair those outcomes.

An aphorism we hear from emergency managers is, “During a disaster event is not the time we want to be exchanging business cards.” They know local people need to know each other before disaster strikes so they know who they can trust *after* the disaster. That is important because disasters attract lots of help: some altruistic and effective, some incompetent, and some opportunistically malevolent. A pre-disaster strategy is to create opportunities for all different strata of a community to meet and work together, preferably when the stakes are low. This enables the local community with the ability to know who to trust so that they can safely leverage their diversity when they need it the most.

**Self-organization** is the last attribute in our list. Systems that self organize are more capable of being resilient and adaptable to changes in conditions. This distributes decision-making up and down the system and creates the opportunity for creative solutions to emerge. A resilient system has people that feel empowered to act and make decisions at every level.

Managing these kinds of self-organized impulses is not easy in the aftermath of a disaster, as initial response methods are command and control based. Command and control responses make sense when things are under extreme stress because someone in charge creates a sense of order despite the chaos of the disaster. Yet command and control has a relatively short shelf-life in many communities because most individuals, families, and businesses prefer to make their own decisions. The transition from command and control during response to distributed decision-making during recovery can often be uneven or awkward. The skills required to respond to a disaster in real time tends to be different than the skills needed to work with survivors and community members who must make their own recovery choices about their own future.

Taken together, these eight attributes of resilient systems can be thought of as a checklist for pre and post-disaster planning. We can evaluate our everyday spending on capital, operations, and investments against these attributes. Perhaps we can even use them to reduce our vulnerability, reduce future suffering and loss, and build stronger and more equitable communities.

# Northwest Reforestation Workshop

## Focus on Assisted Migration

The USDA's [Northwest Climate Hub](#) hosted a spring convening of reforestation professionals, researchers, and landowners this May in Olympia, Wash. The workshop focused on a hot topic in reforestation: assisted migration. Presentations included an overview of climate impacts at large, and on the Pacific Northwest specifically, overviews of several assisted migration trials that are currently in progress, a panel discussion, and small and large group discussions about the barriers, gaps, and next steps surrounding assisted migration.

Most of the discussion throughout the workshop, as well as the focus of the trials that were highlighted,

focused on assisted population migration. This climate adaptation strategy calls for moving plants from one area to another, within a species' current range, with the goal of matching a particular population's historic climate to areas that will be climatically similar in the future. This often involves moving populations northward, or up in elevation. One example would be collecting seeds from Douglas fir in Southern Oregon, and planting them in Southern Washington. Some elements of range expansion were addressed in individual trials, but wholesale species migration was not discussed in detail.

The small and large group discussions revealed a great deal of support for the general idea behind assisted migration, and lots of questions about how to implement it.

There was general agreement that the risk of not doing anything to account for the rapid changes that are already affecting forests was too great for most participants' comfort levels. There is much work to be done, but convenings like this one are important for furthering these conversations and gaining ground toward functional landscapes that provide the ecosystem services humans and wildlife have come to rely on.

Williams & Dumroese (2014)

### ASSISTED MIGRATION:



#### Seed Migration

Seed sources are moved climatically or geographically within their current ranges



#### Range Expansion

Seed sources or plant materials are moved to suitable areas just outside of ranges



#### Species Migration

Species moved outside current ranges to prevent extinction or to be a surrogate for another species in decline



### Some questions that emerged:

- How does assisted migration happen on a practical level? Where do you source plant materials?
- What kind of barriers exist between different large landowners that may hamper efforts?
- Does the political will exist to break down administrative barriers? How will seed zones be addressed?
- How will wildlife respond to ecosystems altered by assisted migration?
- How do you quantify the risk of the no-action alternative?
- Where does “improved” stock used by industrial timber companies fit into this conversation?
- What kind of network can be tapped into or created to coordinate around assisted migration and share knowledge?

To read more about the workshop and for additional resources, please visit the [Northwest Climate Hub](#).

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**We will continue to highlight stories about assisted migration in Treeline, so if you are working on a project that you'd like to share, please reach out to [kseafoth@b-e-f.org](mailto:kseafoth@b-e-f.org).**



*Photo Credit: Friends of Tualatin River National Wildlife Refuge*

# Unlocking the Potential of Chatbots in Environmental Restoration

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By ChatGPT

*Accessible interfaces for AI-assisted chatbots like Bing, Bard and ChatGPT are being made available to the general public. These Chatbots, also called Large Language Models (LLMs), are trained on massive amounts of text data so that they are able to understand natural language and can generate complex responses to text-based inputs. These new technologies have the potential to dramatically change the way we work and are already being integrated into many sectors. The pace of AI development may already be exceeding the ability of organizations and collaboratives to understand and develop processes to govern their use. This brief, written with assistance from ChatGPT, one of the most advanced and accessible of the current chatbots, will focus on the potential applications of ChatGPT to floodplain management.*

**Prompt:** Write me a 300 word blurb about how ChatGPT can be used by environmental restoration practitioners. Provide some other applications of the tool to restoration work in addition to writing grants, data integration to support environmental planning, and improved early warning systems for flood hazards.

**ChatGPT:** ChatGPT, a large language model, can be a valuable tool for environmental restoration practitioners who work to improve and rehabilitate degraded ecosystems. With its advanced natural language processing capabilities, ChatGPT can be used in a variety of ways to support restoration work.

One of the key ways ChatGPT can be used by environmental restoration practitioners is through its ability to generate high-quality grant proposals. By providing key information about project goals, timelines, budgets, and outcomes, ChatGPT can help practitioners streamline the grant writing process, freeing up more time and resources for actual restoration work. Additionally, ChatGPT's ability to analyze large data sets can help practitioners integrate complex ecological data into their restoration plans, facilitating evidence-based decision-making and improving project outcomes.

In addition to grant writing and data analysis, ChatGPT can also be used to improve early warning systems for natural disasters like floods and fires. By analyzing real-time data from sensors and other sources, ChatGPT can quickly identify areas at risk and generate warnings that can be shared with local communities. This can help reduce the risk of property damage and loss of life, while also supporting broader restoration efforts by minimizing the impact of natural disasters on already-stressed ecosystems.

Beyond these key applications, ChatGPT can also be used to support a range of other restoration activities. For example, its ability to generate accurate translations can help practitioners communicate with communities and stakeholders in other languages, facilitating greater collaboration and engagement. Additionally, ChatGPT can be used to develop training materials and resources for restoration practitioners, helping to build capacity and support ongoing learning and development.

Overall, ChatGPT is a powerful tool that can support environmental restoration practitioners in a variety of ways. By streamlining key processes, improving data integration and analysis, and supporting early warning systems for

natural disasters, ChatGPT can help practitioners achieve their restoration goals more effectively and efficiently, while also supporting broader efforts to protect and preserve our planet's valuable ecosystems.

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**Our team is looking into how emerging technologies can benefit the important work of restoration practitioners and we want to hear from you about what ways you're already using chatbots or other emerging AI technologies, and questions you have related to its application.**

Feel free to reach out to [hbuehler@b-e-f.org](mailto:hbuehler@b-e-f.org) with any thoughts or ideas.



## Critical Questions for Ensuring Riparian Forest Function post EAB

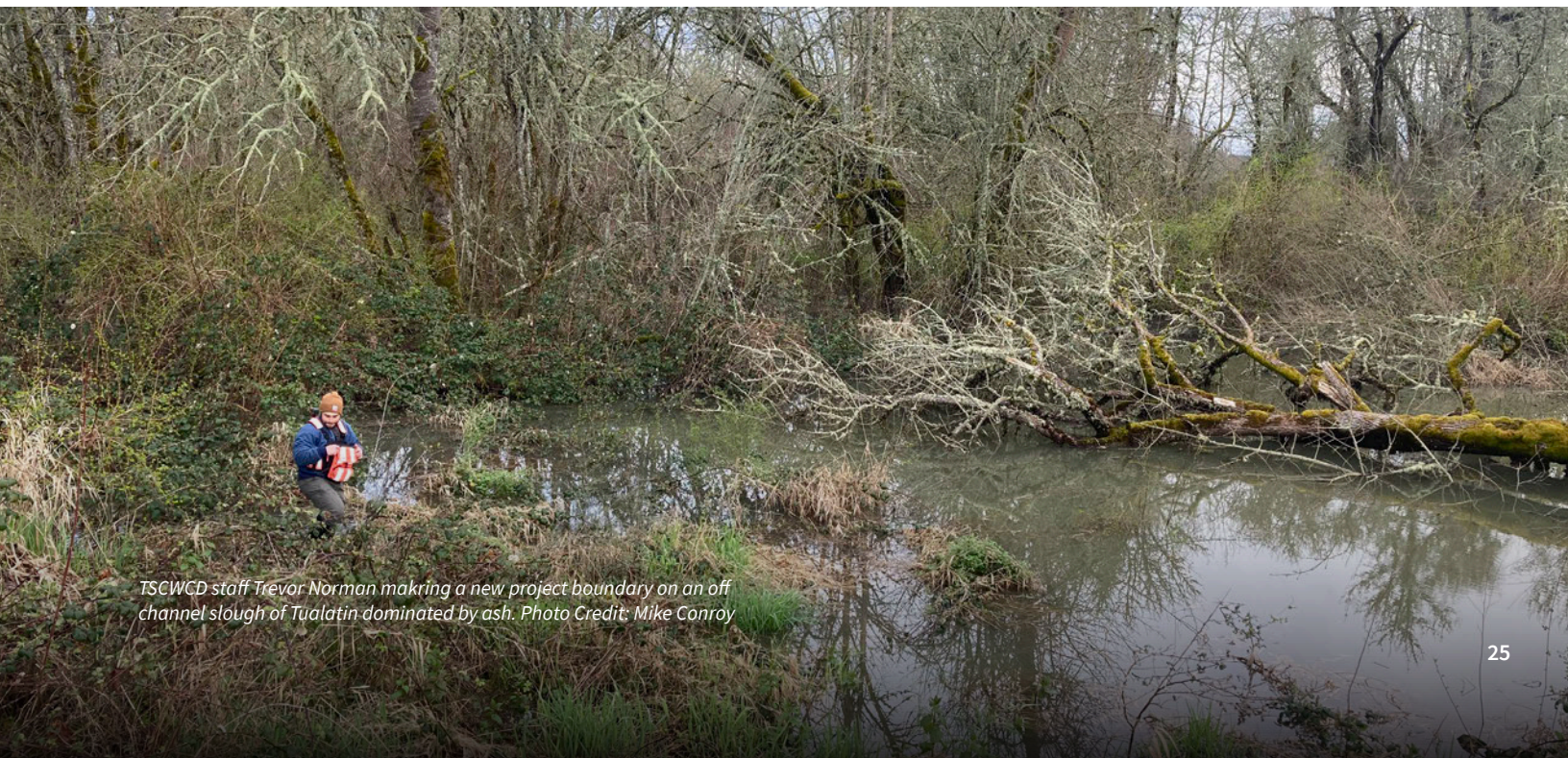
By Mike Conroy, Tualatin Soil and Water Conservation District

Emerald Ash Borer will have wide ranging impacts on forest cover throughout the lower elevations of the Tualatin Valley and the entire range of Oregon ash. Greater than 95% mortality of mature Oregon ash is anticipated, with a less certain but still bleak future for seedling ash. Oregon ash is the most dominant overstory component along perennial streams in the Tualatin River valley and negative impacts on water quality temperature from loss of shade are anticipated. While impacts on ash forested wetlands will likely lead to a future altered successional state or reversion to historical savannah like conditions, the impacts to riparian forests will have a greater impact on water quality as riparian forests are more commonly found along perennial streams and provide shade during the

summer months. Fortunately, most riparian forests can support a wider diversity of native species than forested wetlands, and may be more responsive to managed adaptation to this rapid change.

With the arrival of Emerald Ash Borer, we find ourselves in a highly industrialized and environmentally regulated Tualatin basin dependent on a sliver of a remnant riparian forest to maintain shade over perennial waters, comply with regulatory benchmarks, and provide rudimentary ecological function in a rapidly warming climate. The conditions that led us here are complex and the degree to which ash provides shade in riparian zones is currently outsized. Fortunately, most of the riparian zone of the Tualatin basin can support a wide diversity of species, and

reliance on ash isn't a necessity, but will require active management to convert these forests to more diverse and resilient floodplain communities. Many near channel riparian stands are lacking in non-ash tree diversity and the likelihood of passive conversion to a diverse and adapted forest overstory is unlikely. Many stands lack a local source of viable non-ash tree replacements due to the dominance of ash, and high cover of competitive native and non-native shrubs and herbaceous species means natural regeneration of non-ash trees is unlikely for many stands. The scope of the threat in the Tualatin valley is daunting, but by focusing efforts to convert ash dominated riparian forest stands I believe we can best address the anticipated impacts to water quality in the Tualatin valley and through most of Oregon ash's range.



*TSCWCD staff Trevor Norman making a new project boundary on an off channel slough of Tualatin dominated by ash. Photo Credit: Mike Conroy*



There are many potential effects from the spread of EAB in Oregon ash's range, and there are several uncertainties as to how quickly it will spread. While these uncertainties exist, based on experiences in more than 30 states it is important for individual land managers to start preparing forest stands to be resilient to a likely catastrophic outcome for mature ash over the next ten years. Given the proximity and urgency of EAB to the Tualatin valley there is a need to rapidly strengthen the toolbox for natural resource managers to begin conversion of ash dominated riparian forests. Many natural resource managers in the Tualatin valley have over a decade of experience in large scale riparian forest establishment and management, including access to a high diversity and quantity of planting stock and budgets that allow for management beyond initial establishment. While there is much to build upon there is a need to learn and adopt new best management practices quickly.

Table 1. Uncertainties Regarding EAB Invasion

Is the current extent of EAB really confined to Forest Grove?
How fast will EAB spread throughout Oregon ash's range?
If an approach to slow the spread of EAB (SLAM) is attempted, how might this impact the rate of spread?
Since biological control is being introduced comparatively early in the establishment of EAB will this greatly affect dynamics of invasion?
Oregon ash can produce seed in less than 20 years, how might this early maturation time facilitate selection over time?
How much ash is there in the Willamette Valley and how will its distribution along riparian corridors affect invasion dynamics?
Of the ash in the Willamette Valley how much is growing on sites suitable for replacement species?

### Strategies to inform ash stand management post EAB

#### REFINING METHODS TO IDENTIFY AN ENVIRONMENTAL GRADIENT FOCUSED ON REPLACEMENT SPECIES FOR ASH

When planning out restoration projects natural resource managers utilize multiple sources of information to inform their thinking, including soil maps and observations of onsite vegetation. Plants are often the best indicator of environmental gradients because they are generally readily identified year-round in the mild climate of the PNW. To identify suitability more precisely on a narrow environmental gradient where less than 1 foot in

elevation change can mean a site is suitable for non-ash tree species it is important to identify the indicators more precisely for these thresholds. Efforts should be focused on identifying common indicator species that are easily identifiable year-round and help delineate the narrow band in floodplain and riparian communities where replacement species are being considered. Paring these on site observations with the diagram of species moisture and soil type tolerances detailed in "[Alternatives to Ash in Western Oregon](#)" will allow managers and planting crews to make informed decisions that yield better outcomes.



Ash stand in riparian area off Tualatin flooded mid April due to heavy rains. Photo Credit: Mike Conroy



**IMPLEMENTING MANAGEMENT TRIALS TO CONVERT ASH DOMINATED RIPARIAN FORESTS COST EFFECTIVELY**

The impact of EAB on the PNW will be different than the majority of North America, especially the mid-latitude eastern deciduous forests which possess a greater diversity of non-ash tree species capable of filling in the vacancy left by ash. However, the black ash (*Fraxinus nigra*) forested wetlands of the northern latitudes may provide the best analog to conditions in the PNW. In these forests, black ash provides most of the

cover and site conditions preclude the colonization of other species adapted to the adjacent upland forest. Several field trials have been conducted to evaluate silvicultural and replanting management options in black ash stands, notably the work from Upper Midwest discussed in several articles stands out as a potential template to adapt for PNW ash dominated riparian forests (Palik et al 2021, Looney et al 2015, D’Amato et al 2018). These trials evaluate multiple replacement species and silvicultural strategies for 1-2- and 8-year success,

and the environmental impacts from different methods. Adapting these or similar methods with local practitioner knowledge of species tolerances shown below in figure 1 seems an essential step. Of special interest is evaluating more closely the ability of planted species to tolerate shade given that the arrival of EAB to a given site is unknown. By evaluating species in or ex situ for shade tolerance it would inform land managers of varying degrees of proximity to the current known infestation.

Trees/Arboles		Shade Tolerance			Hydrology			Soils			Palatability		Height (feet)
		Tolerancia de Sombra			Hidrologia			Suelo			Palatabilidad		Altura (pies)
Name / Nombre	Scientific Name / Nombre científico	Shade / Sombra	Partial Shade / Sombre Parcial	Sun / Sol	Dry / Seco	Moist / Humedo	Wet / Mojado	Coarse / Aspero	Mixed / Veriado	Fine / Fino	Deer / Venado	Beaver / Castor	At 20 Years / En 20 Anos
Bigleaf maple	<i>Acer macrophyllum</i>		x	x	x	x		x	x		H	H	50
Black cottonwood	<i>Populus trichocarpa</i>			x		x	x	x	x	x	H	H	80
Black hawthorn	<i>Crataegus douglasii</i>		x	x	x	x			x	x	M	L	20
Cascara	<i>Rhamnus purshiana</i>	x	x	x	x	x		x	x	x	M	L	20
Douglas fir	<i>Pseudotsuga menziesii</i>			x	x	x		x	x		L	L	40
Grand fir	<i>Abies grandis</i>		x	x	x	x			x	x	L	L	40
Oregon ash	<i>Fraxinus latifolia</i>		x	x		x	x		x	x	H	M	35
Oregon white oak	<i>Quercus garryana</i>			x	x	x		x	x	x	M	M	25
Pacific willow	<i>Salix lasiandra</i>			x			x		x	x	M	H	50
Red alder	<i>Alnus rubra</i>			x	x	x	x	x	x	x	M	M	50
Scouler willow	<i>Salix scouleriana</i>			x	x	x			x	x	H	H	30
Valley ponderosa pine	<i>Pinus ponderosa (W.v.)</i>			x	x	x		x	x	x	L	L	35
Vine maple	<i>Acer circinatum</i>	x	x		x	x		x	x		H	M	15
Western crabapple	<i>Malus fusca</i>		x	x		x	x	x	x	x	H	M	20
Western red cedar	<i>Thuja plicata</i>	x	x		x	x	x	x	x		L	M	30
White Alder	<i>Alnus rhombifolia</i>	x	x			x		x	x	x	M	M	50

Figure 1. Pocket reference for tree tolerances for species present in Tualatin riparian zones.

# Understanding Landowner Perspectives on Beavers and Their Behaviors in the Willamette Basin

By Jean-Paul Zagarola and Suzanne Teller

The Mid-Willamette Beaver Partnership (MWBP) has made significant strides on beaver habitat assessments and stakeholder engagement since the [June 2021 article](#) in Treeline. A few examples include partnering with an [Oregon State University program](#) that supports career and education pathways for college students who identify as Native American who surveyed sixteen stream kilometers for beaver habitat and dam building conditions; securing funding to test pilot a cutting edge community science based mobile app for collecting and inventorying beaver dam and stream characteristics data; working with a social research firm to conduct a series of interviews, focus groups and surveys to understand landowners and stakeholders' perceptions and values of beavers and beaver habitats. For this Treeline issue, we are going to take a deeper dive into the last example—the progress the MWBP is making in understanding the social dimensions of beaver based conservation and restoration.



Photo Credit: Jean-Paul Zagarola



**NORTH SANTIAM**  
WATERSHED COUNCIL



watersheds  
program





At its formation, the MWBP knew without authentically engaging landowners and stakeholders there was very little room to promote beaver based restoration at a scale that would make any significant impact. Much like other types of restoration, beaver based restoration is driven by social factors as much as ecological ones. This is especially true when it involves a rodent that is at once both controversial and beloved. As we begin to approach landowners, land managers, and the general public with the goal of expanding beaver populations and promoting their dam building where appropriate, we feel it is critical that we equip ourselves with the tools to address the concerns that might come up in that endeavor. Therefore, knowing what concerns stakeholders have ahead of time and how to most effectively deliver our message is key.

Once funding was secured to conduct social research and engage stakeholders, the MWBP was serendipitously introduced to a social science based approach that supports sustainable and positive behavior change called Community Based Social Marketing (CBSM). At its core, CBSM relies on collecting information about a target population through surveys, focus groups and interviews to understand the barriers and benefits that prohibit or encourage the population to adopt the beneficial behaviors, such as co-existence with beavers. That information is used to tailor messaging and outreach campaigns to address barriers and promote benefits. Different types of community members or stakeholders may view the barriers and benefits differently, so it's necessary to tailor the messaging accordingly. This approach has proven to be much more effective at fostering positive social behavior change than more traditional methods such as information-only campaigns. Members of the MWBP received training from the founder of this approach, Doug McKenzie-Mohr and contracted with the social research firm Action Research to facilitate and guide the efforts through implementation.

By early 2023, the MWBP in conjunction with Action Research, mailed out 1600 surveys to riparian landowners, held four focus groups with agriculture, timber and public works department participants and conducted 13 one-on-one interviews with a variety of critical stakeholders. The results from this effort will be used to develop and test a series of messaging strategies to support co-existing with beaver and promote dam building. In order to avoid the risk of interfering with the test-pilot, the MWBP can not release detailed results at this time but plans to in the near future. However, there are several high-level takeaways that we can report on.



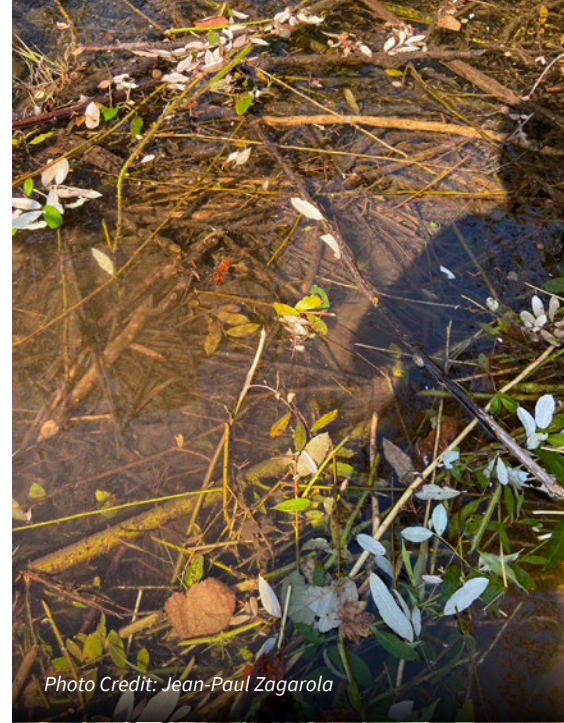
Photo Credit: Kathleen Westly

## Initial Takeaways from CBSM Stakeholder Engagement Process

- 1** Language matters! The MWBP uses the term co-existence to mean alternatives to lethal trapping or relocation that allow us to take advantage of their beneficial behaviors on-site while minimizing their impact. However, co-existence from the perspective of some of our participants means something different such as not proactively trapping beavers but trapping only when they cause problems. Trapping in this case typically meant lethal trapping. Therefore, future communications will need to be clearer in what co-existence means.
- 2** There is a fairly broad appreciation for beavers and the benefits they provide across stakeholders and riparian landowners even if they do cause problems in some areas. This presents a potential opportunity for practitioners to lean into what people appreciate and expand that support. Perhaps one of the region's favorite college team mascots is partially to thank for this.
- 3** There are generally few interactions with beavers occurring. We can speculate that beaver population numbers are still relatively low and the research also appears to point in this direction. Also, if our actions lead to healthier beaver populations it is critical that we have the tools in place to ensure increasing beaver interactions lead to positive outcomes both for landowners/managers and ecosystems.
- 4** In general, wildfire and drought that could potentially affect their property are the two biggest issues that riparian landowners are concerned about.
- 5** Finally, we have found that most people would prefer to have a “one-stop-shop” to get information about beavers—how to promote beavers and how to mitigate their impacts. We have since set up a new website which is currently under construction. We will be working with a design firm to add content and make significant stylistic improvements, so please stay tuned!



The results of our stakeholder engagement process have been eye opening. We feel strongly that lessons learned here will be applicable across the region and we are looking forward to sharing our work as it unfolds. The next step for stakeholder engagement is to develop and implement the test-pilot of our messaging strategies. We are also moving into our second year of habitat surveys that will inform our beaver dam capacity model. That model is also piloting a newly developed community science based data collection tool. Next year, we plan to work with our partners to develop beaver management plans for each of the MWBP Willamette sub-basins that integrate the results of the stakeholder engagement process and the beaver dam habitat assessments in order to prioritize areas for conservation that have the highest potential for success. Until then, don't forget to root for your favorite rodent—Go Beavs!



*Photo Credit: Jean-Paul Zagarola*



*Photo Credit: Jean-Paul Zagarola*



*Photo Credit: Jean-Paul Zagarola*



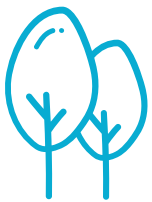
*Photo Credit: Jean-Paul Zagarola*



# The Collaborative Grow Program

## By the Numbers

BEF's Collaborative Grow Program was established in 2011 to streamline native plant procurement for groups advancing reforestation and plant establishment as part of ecological restoration, soil and water conservation, and habitat initiatives in Oregon's Willamette Basin. The collaborative includes watershed councils, land trusts, Tribes, agencies and NGOs.



**From an initial order of 66,000 plants over a decade ago, the program distributed:**

**+879,000 plants in 2023**

Of nearly **50 different species**

Grown by **5 different nurseries**

to **14 tree planting partners**

**Over 495,000 of those plants supporting wildfire recovery efforts throughout the Willamette**

Please contact Hannah Buehler at [hbuehler@b-e-f.org](mailto:hbuehler@b-e-f.org) if you are working in the Willamette Valley and coordinated plant procurement could benefit you! We are currently accepting orders for pick up in spring 2025 and have some plant availability for 2024.

With limited staff capacity and significant demands placed upon groups, the program offers a means to leverage economies of scale to:

- Reduce staff time within individual organizations and nurseries directed towards plant ordering and distribution.
- Centralize quality control and plant specification development and adaptation (i.e. minimum and maximum size specifications, target root:shoot ratios, seed source ranges).
- Increase the diversity of species grown at scale by local nurseries (the Collaborative Grow program currently offers 52 tree and shrub species) by building a clear and more reliable demand.
- Provide access to plant stock with greater genetic diversity because partners receive plant stock from numerous nurseries.
- Soften the impact of species failures in a given year due to factors such as flooded nursery fields, seed issues, etc. by facilitating species substitutions, spreading the impact of shortages across groups and supporting partners in offering plants to each other.
- Support use of bare root planting stock to reduce plant, transportation and labor costs.
- Offer financial benefits to groups that often rely on reimbursement-style grant funding and for whom carrying large balances for 5-8 months in the form of plant deposits can be difficult or untenable.



Photo Credit: Luckiamute Watershed Council





Photo Credit: Hood Canal Salmon Enhancement Group



watersheds  
program

Do you have an idea for a future newsletter article or interview, or a suggestion for how we might improve? Please reach out to Kas Guillozet at [kguillozet@b-e-f.org](mailto:kguillozet@b-e-f.org).

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