bcf watersheds program

# treeline

## partnering for climate adapted forests

February 2021

## Collaborative Grow is Growing

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

## Join Us

With support from regional "node" leads and a Research and Extension Team, we are planning outreach activities. We want to hear from you.

Please complete **this survey** to inform next steps and help us learn about the actions that nurseries, practitioners and researchers are taking to support healthy forests in the face of climate change and other stressors.

### Want to "get on the map"?

Email **Kira** and let her know. More information coming soon on webinars and conversations.

*Treeline node leads:*

LOMAKATSI RESTORATION PROJECT

Northwest Natural Resource Group

**Nesika Wilamut**
(Willamette River Network)

# What is Assisted Migration?

**The following working definitions adapted from Williams & Dumroese (2014) describe three forms of assisted migration:**

1. Seed migration: seed sources are moved climatically or geographically within their current ranges. (Example: collecting seed from droughty or flood-prone sites for propagation and out-planting at different site, but within the same seed zone)

2. Range Expansion: seed sources or plant materials are moved to suitable areas just outside of ranges. (Example: planting California black oak north of Lane County, and still within Oregon's Willamette Valley)

3. Assisted species migration: species are moved far outside current ranges to prevent extinction, or to serve as a surrogate for another species in decline due to climate change (Example: planting incense cedar from central Oregon in the Washington Cascades)

*California black oak seedings at Scholls Valley Native nursery in Forest Grove, OR*

**Reflections on Assisted Species Migration from a Project Partner:**

"I do believe this definition and concept have a place in our deliberations and discussions, but I advise caution when considering this a viable path to "adapt" to a changing climate...

Mother nature has dealt with climate change for millions of years and will for millions more. The fact that the currently changing climate is occurring at an unprecedented rate is surely one that raises the level of concern, but we should look for solutions that mimic natural processes as opposed to completely rewriting them. Concepts like seed migration and range expansion are more in line with the way that nature adjusts through time. Unfortunately, humans have come to believe they are smart enough to bypass natural migration and create a brand-new reality. It recalls examples of scotch broom and cane toads where humans thought they had the best solution to a human-caused problem. I for one would like to learn from our past mistakes and look to mother nature for the solutions."

**—MARC GAUTHIER, WILDLIFE PROGRAM MANAGER, UPPER COLUMBIA UNITED TRIBES**

**Stay Tuned:**

Treeline partner Lisa Watt is conducting interviews with tribal and indigenous leaders in different parts of the Pacific Northwest about climate change, woody plants and adaptation. We will share in future newsletters and are grateful to learn from these leaders.

*Lisa Watt is the Director of Indigenous Affairs at Ecotrust, a Portland-based nonprofit that seeks innovative solutions at the intersection of economic prosperity, racial equity, and environmental well-being. She works closely with staff to identify areas where Ecotrust can be most helpful to Indigenous communities throughout the region on a wide range of initiatives. Prior to Ecotrust, Lisa worked in the museum field for over 30 years. She is a citizen of the Seneca Nation, from the Allegany Reservation in western New York State.*

# Making Connections: Assisted Migration, *Phytophthora* and Forest Health

## An interview with:


**Dan Stark**
*Forestry and Natural Resources Assistant Professor of Practice at Oregon State Extension*

**Norma Kline**
*Assistant Professor of Practice and Forestry Extension Agent at Oregon State Extension*

**Marianne Elliott**
*Plant Pathologist at Washington State University*


*Best management practices in a nursery – gravel bed, limited contact of pots with substrate prevents infection by* Phytophthora, *good air circulation reduces foliar diseases.*

As movement of plant materials across regions becomes more commonplace, risk of spreading pathogens like *Phytophthora* increases. Partners at Oregon and Washington Extension are collaborating on: **"Preventing *Phytophthora* infestations in restoration nurseries and wildland plant communities"**, with Jennifer Parke (OSU, College of Agricultural Sciences), Dave Shaw, (OSU, College of Forestry) and Alicia Christiansen, (OSU, Extension Agent).

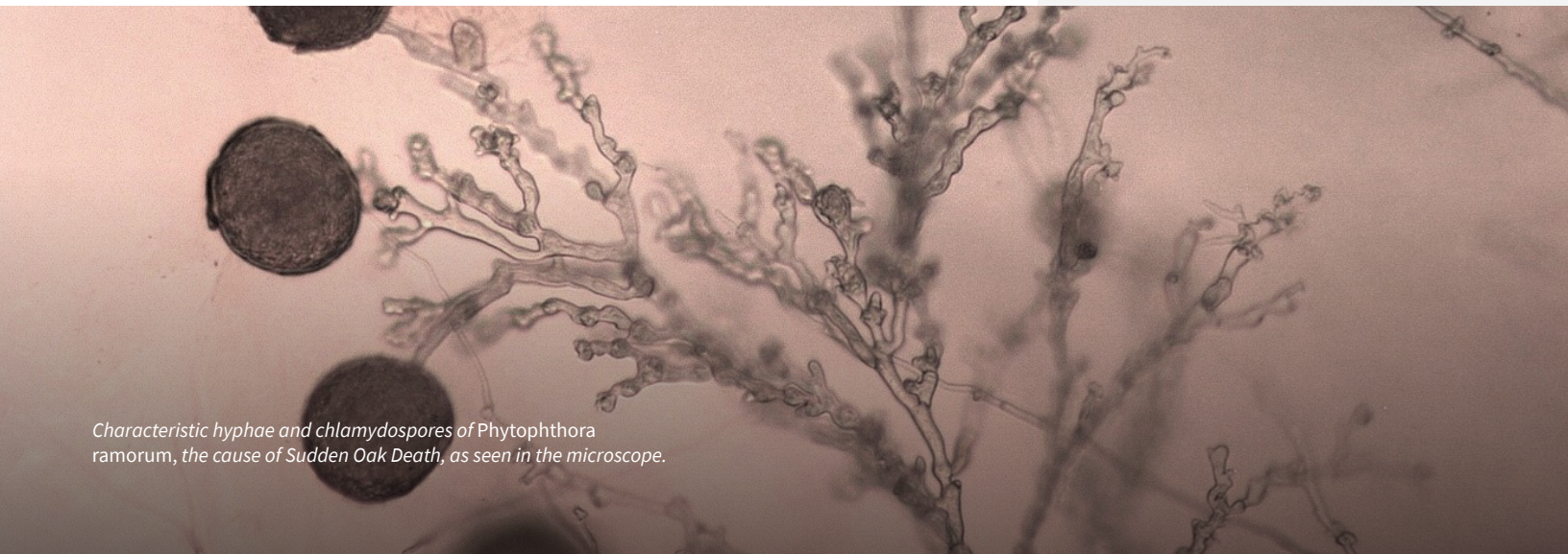
### How does *Phytophthora* relate to habitat/wildlands restoration?

**NORMA:** In the West we have invasive *Phytophthora,* a pathogen that is inadvertently introduced to wildlands that has had significant effects on ecosystems in the northwest. Recently California discovered that invasive *Phytophthora* has moved into restoration plantings on nursery stock. Essentially, areas that were trying to be restored and are already suffering were then inadvertently introduced to this deadly pathogen. As these issues came to light, there have been tremendous efforts in California to develop best management practices for *Phytophthora.* In Oregon, Jennifer Parke had a body of work on this subject that has been trying to get the message across to restoration professionals and nurseries to be extremely cautious about introducing these pathogens into their plant stock. The intent of this entire publication is to promote best management practices and make the issue clearer to folks as to why these practices are extremely important to use when planning for restoration and planting.

**DAN:** Our goal is also to provide colleagues and partners with the tools and information to disseminate out into local groups and restoration efforts. In California many of the affected restoration nurseries were "mom and pop" operations that may not have had access to the preventative measures and best management practices available to larger nurseries - and were therefore growing and spreading infected plants. This project aims to meet the

### Audience for this project:

1. Nurseries, especially smaller-scale restoration nurseries
2. Restoration professionals
3. Master Gardeners and other volunteers who are working within the restoration community. The more people that know about it, the better.



*Characteristic hyphae and chlamydospores of* Phytophthora ramorum, *the cause of Sudden Oak Death, as seen in the microscope.*

needs of the nurseries most affected by pathogens and provide them with the resources they need to do practical tasks like how to monitor for *Phytophthora.*

## How does this work complement your role as Extension Agents?

**DAN:** We really want to hear from those that work in restoration nurseries. As extension agents, effectively communicating science is ingrained in what we do, and that is something I am always working on. The goal is to make sure that what is being communicated is also being understood.

**MARIANNE:** It is really important to talk to nurseries about what they are seeing, what the issues are, where the problems lie, etc. We can't ask them to enact practices without knowing the needs and thoughts of practitioners.

## What are the unique threats of *P. ramorum* to restoration nurseries and planting sites?

**DAN AND MARIANNE :** The impacts to restoration nurseries can be enormous. A lot of people do this work because of a love of what they do and a desire to contribute meaningfully to land stewardship.

*Unique threats or considerations include:*

- Smaller nurseries can lack access to resources like monitoring protocols that support containment and Early Detection and Rapid Response (EDRR)
- Local restoration nurseries may propagate diverse native species. These nurseries play a critical role and each new procedure can increase costs and make their businesses less viable. We want to support them so they can continue to serve the groups who rely on them.
- Some small restoration nurseries work differently than large wholesale nurseries because of their size. For example, they might do things like reuse potting media which can build up disease. Recycling is usually great but can also be the cause of more problems.
- The fragility of many restoration sites makes them vulnerable to introduced pathogens, which can further strain or endanger native plants. Some endemic manzanita species in California are really important ecologically, so the potential impact of introducing a *Phytophthora* or other pathogen is exacerbated as it can spread to other manzanitas and other susceptible host plants.

**DAN:** Once they are aware, restoration nurseries are so on board with how to make these quick fixes. Practical phytosanitation practices or best management practices are effective and can have a large impact. In California, the lifting of plants a foot or two off the ground and not keeping in contact with puddles or soil immediately helped with disease prevention.

## What are the benefits of collaboration?

**NORMA:** Since we are focused on outreach and education there is a level of trust that folks have with communicating with us. This allows us to evolve interesting and impactful relationships with folks from all over (landowners, nurseries, etc).

**DAN:** Building relationships across regions is so important to show unity between agencies and players involved. We need more alignment for fire, pest management, and forest management. Things move across borders all the time, the more we can get management and regulatory agencies on board, the better. All of the players are key to potential spread pathways of disease. As Extension, we are trusted partners in our communities. People are coming to us for information.

## What is next?

**MARIANNE:** I see some important things to come, like an easy way to test for *P. ramorum* on a small scale. It is really important that people get correct information and don't jump to conclusions as it is easy to get alarmed with the threat of this pathogen. We are going to try and get them the right information so people can put it into practice.

*The brown seedlings in this greenhouse bed are infected with Phytophthora cinnamomi. The pathogen can easily move in soil water to other seedlings.*

## Selected common restoration species that can host and/or are susceptible to *Phytophthora:*

**California Black Oak**
*(Quercus kelloggii)*

**Pacific Madrone/Madrona**
*(Arbutus menziesii)*

**Alder, Red, White**
*(Alnus rubra, Alnus rhombifolia)*

**Coyote Brush**
*(Baccharis pilularis)*

**Manzanita Spp.**
*(Arctostaphylos)*

**Douglas Fir**
*(Pseudotsuga menziesii)*

**Tall and Low/Dull Oregon Grape**
*(Mahonia or Berberis)*

**Salal**
*(Gaultheria spp.)*

# Community Science and the Dieback of Western Redcedar

Joey Hulbert, Postdoctoral Researcher,
WSU Puyallup Research and Extension Center

Western redcedars *(Thuja plicata)* **are dying throughout the PNW region** and people are faced with difficult decisions. While removing Western redcedar from restoration palettes would be a tragedy considering its cultural and ecological importance, restoration practitioners and forest managers are grappling with difficult questions:

- Should we continue to plant Western redcedar?
- Should we plant seed from southern sources?
- Should we use tools like the **Seedlot Selection Tool** to inform our planning? [See article in this newsletter by Dominique Bachelet for more reflections] If so, how?

More data are needed to understand the current patterns of dieback and determine the best climatic parameters for making today's decisions for tomorrow's forests. Fortunately, many community scientists are eager to help.

We chose to focus on the dieback of Western redcedar as the pilot project for the **Forest Health Watch** program because Western redcedar health was identified as a primary concern of many partners. The role of this iconic species in the cultural legacy of the Pacific Northwest may be unmatched by any other plant species. Its loss from our landscapes would be a tragedy. The urgency for more information led us to create a project on iNaturalist.org called the **Western redcedar Dieback Map**.

## Why community science?

Community science engages volunteers in "crowd-sourced information gathering", in our case through the **Forest Health Watch** program. Although community science is not appropriate for all research endeavors, it is great for ecological studies like **mapping the dieback of Western redcedar**. Engaging community scientists has many benefits for research outcomes, such as collecting wide scale data at relatively low costs. However, there are also many challenges, especially in terms of data quality and rigor. For example, how do you avoid data fragmentation or bias while asking participants to respect park policies and stay on trails? In general, the simpler the research methods, the more suitable the project is for a community science approach.

Community science provides opportunities for informal education and outreach. Is Western redcedar a 'canary in the coalmine' or an early indicator of the effects of climate change in the Pacific Northwest? By engaging people directly in a collective effort, our hope is to be a vehicle for recruiting and training critical observers, thereby achieving educational outcomes simultaneously.

## Some community science benefits:

- Can provide information about a large geography
- Can engage people in issues in a direct, meaningful way and help depoliticize issues like climate change
- Encourages collaboration and co-learning among community members and researchers

*Dead fronds on a western redcedar branch.*

# Using iNaturalist to collect community science observations

**iNaturalist.org** is a platform that lets individuals share observations, identify organisms, and join collective projects. For example, a simple search for **western redcedar**, shares more than 8,500 observations from nearly 4,000 observers. In general, users can share an observation of any organism and **iNat's AI** and the community will help identify that organism. Then, once two or more people have agreed on the identification, iNat considers it 'research grade', accounting for nearly 7,000 of the **redcedar observations**. However, none of those observations have information about the health of the trees so we created a project to add more questions.

## How Can You Get Involved

1. Join iNaturalist/encourage your team or community to sign up and find our project: **Western redcedar Dieback Map**.
2. Head outside, whether rural or urban, wildlands or parklands - wherever there are Western redcedar. If you see signs of poor health or mortality, take a photo, upload it from your phone, add additional info and answer a few short questions.
3. Follow our progress and that of your fellow community scientists by signing up for communications at **foresthealth.org**

Anyone is welcome to contact Joey for more information about the program, western redcedar research, community science in general, or instruction in using iNaturalist. We welcome any feedback and would love to connect with more communities and partners **hulbe@wsu.edu**

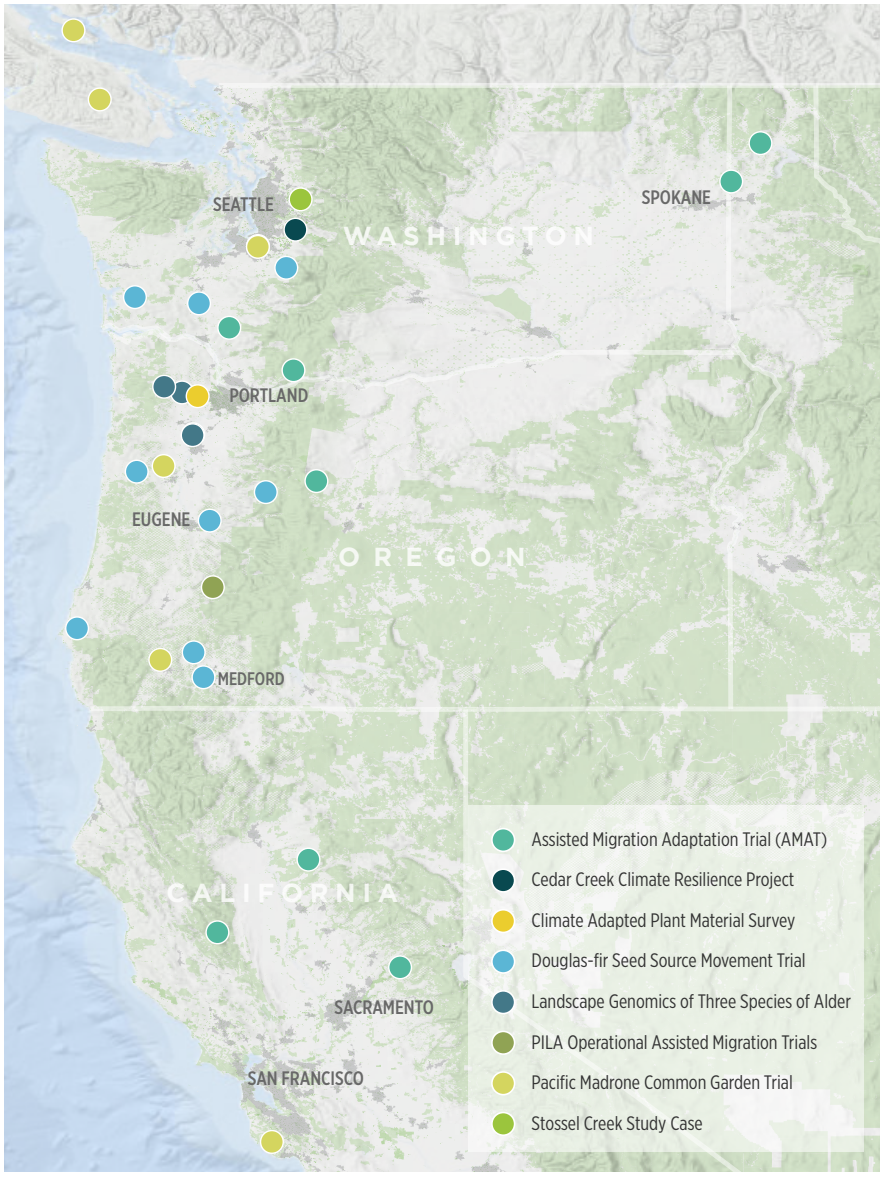
*Western redcedar with recent top dieback at Kukutali Preserve State Park and Heritage Site.*

# Who is Doing What?

**Mapping trials underway**

## To advance our goal of knowledge sharing in support of climate adaptation, we are gathering information about PNW assisted migration studies that inform restoration efforts.

The map shows locations for the studies we identified to date. You can learn more **here**.




Are you aware of any other studies we can add to this compilation?

**Please reach out to Tori: tyoder@b-e-f.org**

# The Seedlot Selection Tool (SST): The Story Behind it, Limitations, and Next Steps

Dominique Bachelet, Associate Professor, Oregon State University

Five years ago, driving to Bachelor for a day of skiing, Brad StClair (USFS, PNW) and I discussed the problems his colleague Glenn Howe (OSU, College of Forestry) was having with the (in) stability of an online website on the Oregon State University server. As a climate change impacts scientist, I wanted to learn about this tool, designed by the two forest geneticists to provide guidance for forest managers, helping them find appropriate seedling stock or helping nursery managers decide where to send their seedlings to ensure good tree growth in the next 50 years, a practice that could be labeled as **assisted migration.**

**The issue of assisted migration is controversial. Ecologists like me worry that bringing new individuals to a community might trigger a cascade of problems.**

- Will movement of plant materials bring new diseases?
- Might plant materials adapted to other places succumb to diseases and pests present in the "host" community?
- If the "host" community is weathering the climatic changes to which it has been subjected, why interfere with the fragile balance of existing ecosystem interactions and risk increased competition for resources?

These are just a few concerns, but Brad convinced me that the goal of this webtool was mostly to increase awareness of the magnitude of the changes projected by climate models and that assisted migration needed to be carefully planned mostly within a species' current range.

I suggested that Glenn and Brad come to the Conservation Biology Institute (CBI) where I led the Global Change Team (GCT). A team of talented programmers and web developers were putting together powerful web tools to help solve a wide variety of climate change related issues. Talk became action and three web sites emerged from their visits: **seedlotselectiontool.org/sst** (SST), **climaterestorationtool.org/csrt/** (CSRT) focused on sagebrush, and **specieshabitattool.org/spht/** (SPHT) mapping current and expected future ranges of a handful of tree species.

My team had been working with a variety of climate projections at scales varying from 1km nationally to 50km globally. But because of their close relationship with Sally Aitken, the Director of the Center for Forest Conservation Genetics (CFCG), and previous faculty member at OSU before joining the University of British Columbia, Brad and Glenn wanted to use climate projections provided by Tongli Wang, codirector of the CFCG. Tongli's site **ClimateNA** provides climate data at 4km resolution from the past, starting in 1901, as well as for the future in the 2020s (2010-2039), 2050s (2040-69) and 2080s (2070-2100), averaged across 15 climate models from the 5th Assessment Report for the Intergovernmental Panel for Climate Change. There are many ways to downscale the raw results from global climate models and render them more usable at the local level. That subject could be the topic for another newsletter article, and I won't get into it here, simply know that Tongli's method is robust and the data used in the tools have been published and peer reviewed (**https://bit.ly/3qTCxl4**), and they include many variables of importance to forest management.

*Skiing at Mt. Bachelor.*

Much can be said about the uncertainty of climate projections (and certainly much has been written about it), especially about rainfall (another topic for a future newsletter!). **But observations to date have shown that, if anything, climate models have been conservative.** Changes are occurring faster, especially melting of glaciers and ice caps, than models ever projected. Importantly, all climate models have agreed, for more than 30 years now, that the planet is warming. **In the Pacific Northwest we observed that annual average temperatures have been increasing at 0.2°F per decade since 1895** which matches well **climate projections**.

It is also important to remember that climate models do not predict the exact location or timing of extreme events (a topic for yet another discussion!) despite the fact that these events can exacerbate the effects of chronic warming that has been observed around the world, often driving large mortality events. The world's forests are becoming increasingly more vulnerable to climate variability as extreme events exceed their capacity to withstand them because of the underlying warming trend which causes heat waves to be hotter and the air drier than in the past.

The 2003 European heat wave, the 2010 Russian heat wave, and the hot and dry last two decades in the western US have already caused widespread forest mortality. Insects and disease agents have also responded to the warming and caused deadly outbreaks in stressed forest leading to further forest declines. The 21st century's wake-up call: "climate change is here" was the background driving the creation of the SST. Forests are becoming increasingly more vulnerable to both direct (warming, droughts, heat waves, floods, windthrow) and indirect (pests and diseases, invasives, herbivory, fires) effects of climate change and these interact in unpredictable ways.

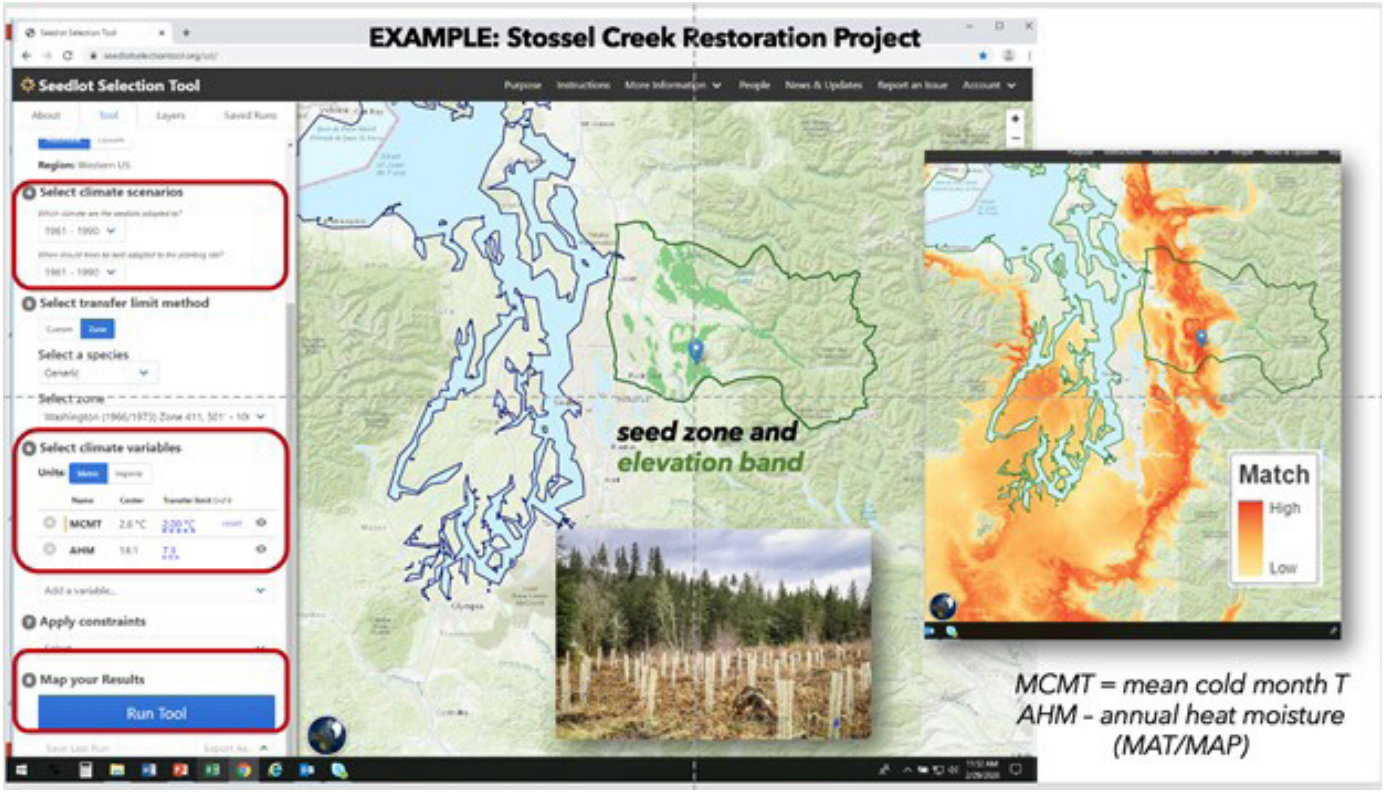
## What the SST does:

- The SST provides an estimate of the **exposure** at a particular site to the average change projected by climate models
- Lets you visualize places that currently have climates identical or similar to your site today, and see places that currently have the climate that is projected for your site either 30 or 60 years into the future. The latter are the places where you can collect seeds or get seed provenances that are likely to grow into trees well adapted to your site's future conditions.

## What the SST does not do:

- The SST does not consider extreme events or the role of refugia on the landscape
- It does not consider the sensitivity of your species of interest and its adaptive capacity.

*Figure 1. Locations with the same (dark orange) or similar (lighter orange) climatic conditions as the Stossel Creek restoration site (near Carnation, WA) in the 1980s based on mean cold month temperature and annual heat moisture.*



Seed sources for future conditions will typically be either in more southern locations or at lower elevation – sites that are warmer and often drier. Conversely if you want to see where the conditions at your site today might be found in the future, you can choose the option "find planting sites" in the SST and visualize the areas where, in the future, the climate will be similar to what it is today at your site. Those sites will usually be further north or at higher elevations.

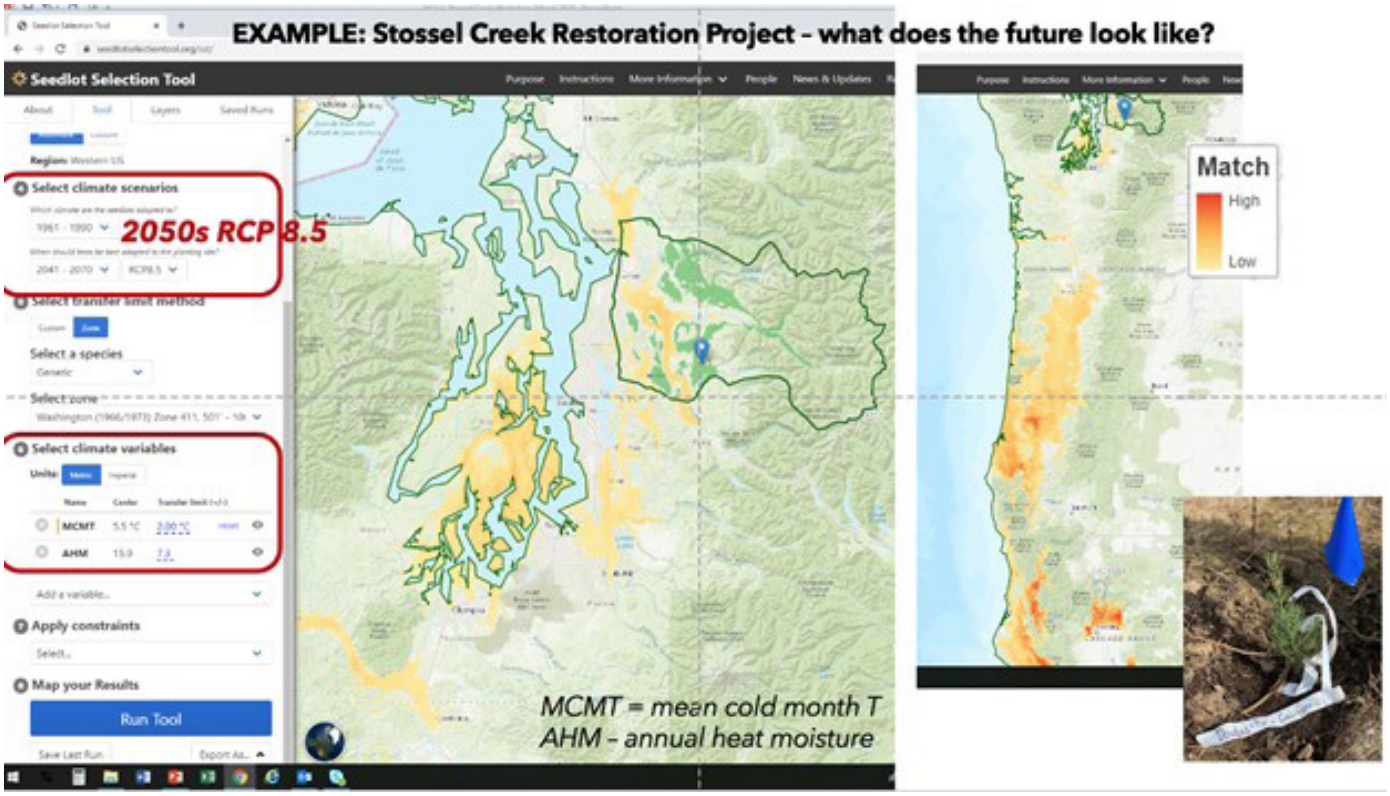
Keep in mind, however, that your site could also be a climate refugium. A site's microclimate might buffer it from regional conditions – a north-facing hillslope in a deep mountain valley, for example. Such climate refugium can be identified by instrumenting a site and collecting weather data that can be compared with records from nearby meteorological stations. If differences exist, they can tell you how much of a buffer you might expect at your site as long as extreme events such as a fire or the introduction of an exotic disease for example do not compromise the integrity of the refugium.

Considering climate velocity, or the rate at which a species must migrate to maintain constant climate conditions and, in this case, evaluating the urgency for you to find seedlings adapted to different climatic conditions, can help determine when some sort of "assisted migration" should occur. Many species will not be able to disperse fast enough to track suitable climates. In the case of trees, it is unlikely their life cycle will enable them to keep up with the changes projected for the rest of this century and the question is: will they survive? While the SST is a great way to map locations with similar climatic conditions it does not indicate the **sensitivity** of the species of interest. To explore this, another web tool was created. The SHT includes simulation results for 7 species of conifers illustrating their current range and their expected shifts in the future using the same climate projections as the SST. It pinpoints areas where tree ranges will either expand or contract, given landscape conditions. These results can help practitioners determine if their site will remain within the expected future range of their species of interest. If not, it might be a good idea to consider planting another species. The influence of increasing atmospheric $CO_2$ on the trees' water use efficiency might also confer them increased capacity to withstand hot dry air but more observations are needed to confirm that effect.

### Finally, a quick word about the adaptive capacity of trees. The level of stress caused by warming depends upon:

1. The magnitude of temperature increase
2. The magnitude of the concurrent evaporative demand
3. The duration of the exposure to heat (days/weeks), the season (warmer winters) or time of day (warmer nights), and the soil water availability (soil properties, groundwater depth)

*Figure 2. Locations with the same (dark orange) or similar (lighter orange) climatic conditions that the Stossel Creek restoration site will have in the 2050s based on mean cold month temperature and annual heat moisture.*



Few of these characteristics are included in the web tools mentioned above. **Trees are adapted to survive episodic heat waves.** For example, a common response to drought is to close stomata to reduce water loss and the possibility of hydraulic failure (embolism), but heat stress can be much more severe when cooling through transpiration is reduced by stomatal closure. Moreover, stomatal closure can cause carbon starvation when heat waves become recurrent and lead to reduced ability by stressed trees to fight insect infestations and ultimately cause their death.

Another example of adaptive capacity is the timing of budburst that has been studied by PNW researchers documenting adaptation to shorter winters with earlier budburst dates. Further research with common garden experiments are ongoing to determine the tolerance of various species to projected climate conditions and the amount of genetic variation within species with different physiological thresholds.

### What is Next:

Our rapidly changing climate is causing increased vulnerability of forests around the world. To quote Brancusi "to see far is one thing, going there is another" and the challenges to be addressed are many.

Because it is a widespread, national and even global problem, collaboration and information sharing will be key to find creative solutions and avoid pitfalls while adapting management practices. Web tools such as those described here help managers but are just one example of how scientists are trying to provide practitioners the tools they need to prepare for the future. Other sites like **climatetoolbox.org** explore applications to other sectors while **drought.gov** provides information on past and current climate trends. Much is available yet the dissemination of applicable knowledge is critical but difficult.

Scientists need to hear from practitioners to learn what they know and what they see so those scientists can improve their models, focus on relevant issues, and deliver complementary information. The 1st North Sound Riparian Conference was a giant step in that direction. Projects like Forest Heath Watch Western Redcedar Dieback **[link to Joey's article]** are another example.

*Dr. Dominique Bachelet is an Associate Professor at Oregon State University in Biological & Ecological Engineering. She is an ecologist with 40 years of combined education and work experience in the USA. Her research has focused on global climate change impacts since 1989 and she has been involved in several IPCC reports since 1995.*

## Questions to the author:

### Dominique, if you could hear your dream input from practitioners, what would that look like?

**DOMINIQUE:** A dream input: detailed, site-scale climate observations. For example, a few years ago we were talking to a small vineyard owner about climate futures and the difficulty of using coarse scale projections to simulate the future of a small place like a vineyard, a field, a forest stand. That person had installed solar panels on his roof and downloaded all the climatic info for his place. It was a dream. You could see fluctuations in daytime temps, night-time temps. He had a precip gauge so also had rainfall amounts. Suddenly we had a baseline. In a few years, we'll be able to see if there are trends in the data. Rather than rely on interpolated climate data from met stations miles away from the property we can look at what really happens at his place.

### What questions would you like practitioners to weigh in on?

**DOMINIQUE:** The question practitioners should always ask is: **how are model projections relevant to my place?** What have I observed? Practitioners should take notes, keep track of budbreak or their favorite flowers blooming dates to keep track of climate variations at their place. Models do the best they can but models are based on a lot of data. Without reliable relevant data models are weak. Climate models are run at coarse scale but if you have your own baseline you can compare with the simulated regional trend and customize the forecast to your site.

Also a dream question is: **May I have your email address?** Practitioners should feel they can email or call scientists any time they have a question. Reporters focus on the sensational, and sometimes they get it wrong. If a question arises, the public should always feel comfortable asking an expert. Asking a scientist does not mean he or she will know the answer but he or she will likely be able to refer you to someone else who will. Scientists can and do change the focus of their research when they hear questions and realize what is really important for practitioners.

Dominique's email address is **dominique.bachelet@oregonstate.edu**

# Reflections from the Field: Nursery

## Georgia Mitchell - Seed & Harvest Coordinator, Fourth Corner Nurseries

### Georgia, how has Fourth Corner Nurseries used the Seedlot Selection Tool or other climate/vegetation models?

**GEORGIA:** At Fourth Corner Nurseries, we began looking at the SST in 2019, after learning about it at a 2018 Society for Ecological Restoration (SER) conference. We began exploring climate implications for our nursery site and seed collecting practices, while researching how best to utilize the tool and information it provides. As our wholesale bareroot operation provides plants for customers throughout Washington, Oregon, and beyond, tailoring production to the future climate realities of so many locations presents a steep challenge. Conversation and planning within the Propagation and Seed Collecting Departments have steadily increased since early 2020 due to vocal customer interest in climate adapted seed and new opportunities for collaboration with researchers and organizations. An in-house audit of current practices as they relate to genetic diversity and population resilience is one of the first action items on our list.

### Georgia, what questions relating to your work and climate change would you love to have researchers investigate?

**GEORGIA:** As species-specific research primarily covers conifers, climate vulnerability research into other common restoration species of the Pacific Northwest is our greatest interest. The establishment of appropriate proxies for categorizing groups of species likely to be most impacted would be another option where individual species research is deemed too limiting. A related issue is access to or development of an information database on life history traits of native species that could help guide our approach to conservation of genetic diversity.

One of the challenges we experience as practitioners is simply not being versed in the breadth of scientific research available or underway. Forging stronger communication pathways between researchers and practitioners so that we know which experts to reach out to with specific types of questions would help us all avoid duplications of effort and – on the practitioner side – hours of internet searching.

Our first interactions with the SST produced a windfall of questions: Which climate variables are most important for species survival and fitness? How do we know how to set reasonable transfer limits? Do we base limits on species tolerances or likely climatic variation within the ecoregion? While we have gradually found answers to some of our questions, there remains a degree of uncertainty that effectively slows institutional adoption. While we're obviously aware of the risk of inaction on climate adaptation, we also recognize the risk we take making preemptive changes that affect our customers and possibly the viability of the plants we grow today. Further in-depth instruction on how best to utilize the SST and other related technology may be an on-going need as both climate change and human response accelerate.

*Fourth Corner Nurseries, located in Whatcom County, Washington, is a wholesale grower of native plants with 40 acres currently under production.*

# Restoration Reflections

## Toby Query, Natural Resource Ecologist, City of Portland, Watershed Revegetation Program

### Have you used the SST?

**TOBY:** Yes, I have used it. It was the first practical tool that combined climate change modeling with forestry and restoration applications. Being from Portland and using the tool with an RCP 8.5, it shows the huge changes that are upon us and exposes the failings of our ability to adapt with current structures. Matches for Douglas Fir can show seed lots that are best adapted to conditions in 2071-2100 in Arizona and New Mexico. It also forces the conversation that the future is going to be increasingly different and dynamic and using past frameworks of managing for resilience (local reference sites for example) need to be thrown out and use scenario planning and other methods to take their place. To create new frameworks for resiliency, we need to build relationships that will help navigate these difficult decisions.

### What questions relating to your stewarding of riparian plant communities would you love to have researchers investigate?

I would like to see more transdisciplinary research whereby research questions arise from a process involving diverse subject matter experts as well as representatives of marginalized communities. Having more platforms to bring people together with an environmental justice lens can help navigate the future as well as start healing past injustices. One translation of research that may arise out of this process could be comparative studies of land management from different perspectives: having indigenous practices compared to organic methods, to western restoration practices, to rewilding practices, and mixes of all of these and others. And then researching outcomes of these approaches not just of the plant community, but of soil, water, and air quality, as well as impacts to animal and human communities. A multitude of perspectives as well as creativity are necessary to navigate the changes that are upon us.

# Contractor Partner

## R. Franco Restoration is a family owned business based in Aumsville, Oregon, that has been providing planting, site maintenance and wildfire fighting services for over 15 years.

### Rosario, what are you and crew members observing in the field relating to climate and woody plant health?

**ROSARIO:** We know climate change is happening and we see high mortality rates especially in riparian and floodplain areas where it is wet during the planting season (January-March) and now gets very dry in the early summer. We are planting some of the plants that have wet and dry tolerance, like Scouler's willow *(Salix scouleriana),* swamp rose *(Rosa pisocarpa)* and twinberry *(Lonicera involucrata)* to see how much they can tolerate.

### Rosario, what are your priorities for research and extension?

**ROSARIO:** How to leverage resources to support fire prevention through education and what actions people can take to reduce fire risk.

Finally, we know that intact, connected healthy forests that allow for natural migration of living things are key to climate change mitigation and adaptation.

With the generous support of One Tree Planted, the Arbor Day Foundation, and other donors, we are on track to support the planting of close to **2,000,000 native plants** in the PNW in 2021.

Do you need additional resources for your plantings? Reach out to **hbuehler@b-e-f.org** for more information.

## Have a listen:

"Around the Woods: How Practitioners are Adjusting for Climate Change", by Brenda Clifton, Senior Restoration Botanist for the Skagit River System Cooperative, and Michael Yadrick, Plant Ecologist for the City of Seattle.

Climate Talk: Rowan Braybrook of the Northwest Natural Resource Group talks about creating healthy forests here in Washington

bef 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 **kira@b-e-f.org**.

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