



Klamath Basin Revegetation

Interviews conducted by Kayla Seaforth, BEF

The November 2022 decision by the Federal Energy Regulatory Commission (FERC) to approve the removal of four dams on the Klamath River set a series of events in motion, which dozens of stakeholders have been preparing for over the course of the last two decades. Tribes that have stewarded the Klamath basin since time immemorial including the Yurok, Karuk, Klamath and Hoopa have led the fight for dam removal, and intend to be involved in the long term stewardship of the basin. The Yurok Tribe is the project lead for post-dam revegetation, with Joshua Chenoweth leading the project. Brook Thompson is a Yurok and Karuk tribal member and a restoration engineer for the Yurok Tribe. This interview took place in two parts, with Joshua first sharing details about the project, and Brook sharing her experience with the culturally significant species and landscape that the project seeks to restore.



Part I: Joshua Chenoweth

KAYLA: Tell me a little bit about your background and how you got involved with this project.

JOSHUA: I worked at Olympic National Park from 2001 until 2018, including my work on the Elwha dam project from 2007 to 2018, while also working on my Master of Science degree. My thesis specifically looked at revegetation of the reservoirs post-dam removal and the possibility of a seed bank germinating from the sediments. Elwha dam removal started in 2011 and our revegetation plan called for a seven year planting and seeding effort. During that project, the Klamath team came up to tour the Elwha and learn from it. The Yurok Tribe was represented by DJ Bandrowski, who approached me about coming down and doing this work, which I eventually did.

KS: How does the post dam landscape differ from other sorts of ecological restoration?

JC: Restoring a reservoir after drawdown is quite different as far as revegetation goes, compared to other kinds of



Elwha River floodplain through former Lake Aldwell lakebed. Photo Credit: Clallam Conservation District

projects. If you're restoring an old field that was left fallow, you've usually got a legacy of invasive species. There's a lot of history in the soil you have to deal with before you can convert it to something that you desire. What's nice about a dam removal project is it's a brand new landscape. It's not completely devoid of influences, though. Seeds from wetland species remain viable underwater and accumulate. Those species played an important role in the Elwha, dominating the understory vegetation for several years post-dam removal. In the case of the Klamath, any wetland species that do germinate in the uplands are unlikely to persist as long as they did on the Elwha because the summer environmental conditions are much more extreme.

Any vegetation that germinates from a seed bank will provide a boost to revegetation, even if the species are not suited to that habitat. Plants provide organic matter, the roots will begin the process of breaking up the sediments, paving the way for new species to establish.

KS: This project covers a vast and highly altered area. How do you conceptualize a revegetation project of this scale?

JC: The large scale adds complexity but the most important thing to do is to make sure you have enough materials to plant. How do you get the material? Where does it come from? How do you propagate it and get the volume you need? That's the first challenge. The second challenge is understanding the complexity of vegetation communities. Understanding the local vegetation and communities provides the basis for your plant palettes. The next step is to locate suitable seed sources for the selected vegetation and, over a period of several years, collect the seed. It is a long process. Producing material takes a minimum of five years for something of this scale. Seed collection and propagation for the Klamath started in 2018 and is expected to continue through at least 2025.

KS: Can you dig into that process of acquiring plant materials a little more?

JC: You cannot find 10s of thousands of pounds of suitable native seed commercially required to seed large

projects. Commercially available native seed can be hard to find and species diversity is limited. To meet this need, we employ seed increase or seed augmentation propagation, where seed is collected from wild sources in the watershed to ensure the genetics of the material are adapted to the project area. Since wild seed collection alone can never provide the amount needed, the seed is sent to specialized nurseries with agricultural fields designed to augment the seed. This process may be repeated over time, fields expanded as needed or new species added, until the volume needed is reached. For this project, we're looking at anywhere from 40,000 to as much as 80,000 pounds of seed, which, for the species we are producing, equates to roughly 19 billion pure live seeds. As you can imagine, no single facility could do that in a year or two, or even three. Instead, a project of this size requires multiple facilities over a period of several years to meet the need. From 2019 to 2020, this project contracted with three separate vendors in two different states to produce around 24,000 pounds of seed in harvest year 2020 alone. Production varies by year and can be adversely affected by climate and other factors. The seed produced by seed increase propagation will be used to direct sow into the reservoirs during and after reservoir drawdown.

Seed is also collected in the wild to produce trees and shrubs for planting into the reservoirs once they are drained. Trees and shrubs can be produced as container stock, like you find at your local nursery or as bare root plants, which is the most common plant material used for fruiting trees. Most of the production for the Klamath will be bare root because they tend to be more affordable and are light and easy to move around the landscape. Bare root production requires many years depending on the fruiting habits of each species. If seed is consistently available annually, it takes at least two years to produce a bare root plant. Some species do not produce significant seed in the wild every year. These are called masting species, which produce seed in cycles every two to three years. Sometimes species don't produce seed due to drought and heat or poor pollinator conditions. All of these factors complicate seed collection and for large projects that



*Plot surveys allow managers to quantify vegetation cover and other metrics.
Photo Credit: Joshua Chenoweth*

require large volumes of seed several years of collection is needed.

Plant propagation is more an art than a science and requires an adaptive management approach. A lot of important native species are not commonly propagated and require experimentation by nurseries. As a result, some species have failed to germinate or germination was spotty, and other situations where germination exceeded expectations, resulting in more plants than ordered! As you can imagine this can change our planting plans considerably.

KS: Does the revegetation plan take climate change into account with considerations for reduced snowpack/summer flow, species range expansion, assisted migration, or other adaptation strategies?

JC: There has been some discussion around assisted migration, but we are not going to do any of that. My answer to that question of "how do you deal with the fact that it's going to be basically hotter and drier?" is; introduce as many suitable native species as possible since climate change impacts are hard to predict for every species. Planting a wide diversity of species improves the odds that at least some of our planted species

will thrive in the changing conditions caused by climate change. For a dam removal project, climate change is not the only environmental challenge. Fine sediments that have accumulated in the reservoir over the last 80 years are a novel substrate for local flora, they are not well-developed soils typical to regional plant communities. In the Klamath, the reservoir sediments are predominantly silt and clay that are as deep as five feet in some locations. The substrate and the changing climate are both important considerations.

KS: On the soil side, are you doing any sort of amendments or mulching to increase nutrient availability?

JC: That's a tricky one, when you're talking about 2,000 acres. We have looked at whether we could cover the landscape in straw or mulch, and we are not taking any of that off the table, but it's not going to happen on the scale of 2,000 acres. Any soil manipulations, amendments, top dressings, will happen at a smaller scale in specific locations. Our approach to planting is going to be a high species diversity planted in what we're calling 'facilitation patches'. Facilitation is the idea that plants clustered close together facilitate survival in hot, dry environments. Humidity is higher in high density patches of plants, reducing water loss due to evapotranspiration which is greater in dry, windy, open areas. Clustering plants together increases humidity within the patch and minimizes wind effects.

Facilitation patches are going to vary in size; between a quarter of an acre and an acre. We are producing 300,000 plants, which is not a lot for 2,000 acres. By clustering our plantings in patches we not only increase survival rates but focus our resources in discrete locations that can be irrigated, intensively controlled for invasive species or provided soil amendments that could not be accomplished on the entire 2,000 acres. Patches will be positioned in high priority riparian habitats and tributary areas as well as upland areas, particularly oak woodlands. The entire 2,000 acres will be seeded at least once, but only facilitation patches will be planted with trees and shrubs.

As far as trying to determine species suited to the silt and clay substrate,

again, that's where introducing diversity is the best approach. Plant trials in the sediments often cannot accurately mimic the conditions in the field. On the Elwha dam removal project, several species that failed to grow in the sediment trials thrived in the sediments after dam removal. Sediments in containers or raised beds behave differently compared to landscape-scale substrates. Substrates confined to containers or raised beds heat and dry out at different rates and connectivity to water tables and soil biota, including fungal communities that are crucial to some species survival, are limited. Instead of plant trials, introducing diversity of species and monitoring plant performance after planting will provide us with information to adaptively manage the restoration project during the five year maintenance and monitoring period. This may include planting new species or re-focusing our plantings to species that are proven to thrive in the sediments.

KS: What are your strategies for invasive species control and project monitoring?

JC: Before the site is exposed by dam removal, the goal is to treat invasive exotic species close to the project area to minimize the abundance and potential seed dispersal after dam removal. Invasive species are abundant in the area and cannot be managed in the entire watershed; instead, we are creating a buffer along the shoreline. The buffer is 50-100 ft wide and located in grasslands and along riparian corridors that harbor the most abundant populations of high-priority invasive species. We started creating these buffers in 2021 by mowing invasive grasses. Mowing for 2-3 years will exhaust the seed bank and result in a decline in abundance for these species. We have found a reduction after only 1 year of over 70%. However, other invasive species in the grasslands, including yellow starthistle, are not controlled well by mowing, and in those cases we use a combination of grubbing the roots and targeted herbicide application. Once dam removal starts, we'll continue work within the buffers to prevent passive seed from invasive species entering the reservoirs. However, prevention is the best control and seeding native species has proven to minimize non-native

species abundance after dam removal. Our control efforts will shift over time from buffer areas to removing invasive species from the reservoirs.

The monitoring piece is also of critical importance. The monitoring plan is designed to provide managers with data to adaptively manage the project and monitor our successes or failures. Part of the permitting for this project required establishing 'success criteria'; metrics with quantifiable targets that must be met for the project to be considered successful.

The success criteria are going to measure four things; species richness, vegetation cover, invasive species abundance and woody stem densities in planted areas. These metrics will be surveyed in all vegetation types within the former reservoir footprints and will be compared to data from reference plots established in communities found in the surrounding area. A critical element in our monitoring will be areas left unplanted and unseeded. These control areas, up to 10% of the dewatered reservoirs, will also be monitored and compared to the seeded and planted areas. This will give us a chance to see how unmanaged areas respond, which will give us a true sense of how effective revegetation actions are. Control areas will be treated for invasive species.

KS: Can you speak to the various partnerships in place that are making this project possible?

JC: The Klamath dam removal is a complex partnership between many entities. The project owner is KRRC, which is Klamath River Renewal Corporation (KRRC). They are a nonprofit created exclusively for this project, run by a board with representatives from the state governments of California and Oregon, the Yurok Tribe, the Karuk Tribe, commercial fisheries organizations, and conservation organizations such as Trout Unlimited, a primary advocate for this project. The contract for dam removal is held by Kiewit Construction responsible for all the civil engineering, facility removal work, roads, etc. All restoration work including revegetation is a contract held by Resource Environmental Solutions (RES). RES has subcontracted revegetation work to the Yurok Tribe.



Part II: Brook Thompson

Brook's reflections in this interview are her own, they do not represent the views of her tribe, other members of her tribe or native people as a whole.

KAYLA: Dam removal represents a huge shift in the landscape of the river basin, from land underwater to a return of riparian and upland plant communities. What does that shift mean to you?

BROOK: When it comes to native plants and restoration, some of the things I care about as an Indigenous person are gathering and collecting to do traditional crafts and medicine, but a lot of times, there are also restrictions on where we're allowed to gather. Having these native plants in the area may be beneficial, but also a lot of native plants have evolved to have interaction with people and

Indigenous parties that actually helps them grow a certain way that becomes beneficial to us and them. A lot of basket gathering materials are that way. Over generations we helped train them to be ideal basket materials, but that also helps out the plant along the way. When it comes to native species, I also think of restoring our pollinators and helping with supporting the bee populations in the area. I think of the interconnectedness of restoring wildlife, like birds and smaller critters like moles and skunks and porcupines, and providing more food for them to forage. Restoring the landscape and encouraging native plant growth following dam removal is about giving not only the plants an extra chance, but all the animals that are connected to the plants an extra chance too, which will then help build a better ecosystem. It creates a positive feedback loop, in which all parts, including the Indigenous people, help each other.

We have what we call the "Yurok mindset" in our language, it gives plants the sense of being in personhood. That inherently comes with importance and respect. You're not just going to treat a plant like an object, which I feel has been the case for a lot of time in Western history, but as a being that deserves respect and communication, like you would with anyone else. It's like the golden rule, treat other people how you want to be treated, just applied the same to plants and animals.

Where I'm from, at the mouth of the Klamath River, there are theories around the salmon and the redwood trees where the large salmon that used to be there laid the groundwork for redwood trees to be able to grow in Northern California, they acted as a fertilizer. The water and the land are definitely connected to one another, they affect one another in the ecosystem. There are a lot of animals that interact in between the water and land that help make that connection. For example, when bears pull salmon out of the water, they leave the carcasses on land, which also helps build soil nutrients.

KS: Are there any plants that you're working with that you're excited about putting back on the landscape?

BT: We are replanting 103 species in this project, and a lot of these native plants aren't well studied because they don't have a lot of benefit commercially or maybe they're not fun to plant in the garden at home. Because of that, they're not as well studied as some other plants, even though traditionally, a lot of the tribal people would know these plants very well. Things like when they bloom, where they grow best, when they like to be picked, how much you can pick, etc. Having Indigenous people work on this project helps to reestablish that connection.

As far as specific plants, the serviceberry has been really fun because that's one



Iron Gate Reservoir. Photo Credit: Joshua Chenoweth



Removing invasive plants like the scotch thistle pictured here is hard work, but necessary to ensure successful revegetation.

of the plants that I've been picking and have gotten to know really well, it almost feels like a friend.

If you hired a crew that wasn't Indigenous for a job like this, you wouldn't get the same quality of work because a lot of the Indigenous people here enjoy spending their time trying to understand the plants. It's not just about the job and getting the paycheck at the end of the day. They're doing it for an almost spiritual connection. They're talking to the plants and letting them know what they're going to be used for. It's based on a deeper relationship and understanding than it might be if someone is more worried about getting a paycheck.

Other plants that are important to me are Oregon grape, which has medicinal properties. Elderberries are a super important medicinal one, too. A lot of the species we are planting are less basket weaving plants but more so medicinal plants. Chokecherries are great food too. Even things like Doug fir, the spring tips can be used in teas that have vitamins and can be essential for nutrition. We can't eat them, but I also like snowberries. I don't know coyote bush well, but I love the smell of it.

KS: What are your thoughts and hopes for long term stewardship of these ecosystems?

BT: For me, a really essential part is Land Back, which a lot of people assume means getting property title transferred to tribes, which is not necessarily what Land Back means. It more refers to the management style of the land. For example, before National Forests were established, a lot of us lived in those areas, until Teddy Roosevelt and some of the Sierra Club founders helped

pioneer the National Forest System. He disliked Native Americans specifically, and thought we were hurting the environment. This idea, which comes from colonization, that wilderness is pristine and untouched is not the truth. Because of that, we were taken off the land that we had been managing, and then we got larger fires, and a lot of plants struggled because of it. So, to me, if future restoration includes letting Indigenous peoples on these lands again, understanding that when we do things like gathering, because we have these Indigenous values and understanding of management, it's not the same as the Western sense where you're going to try to get everything you can and only care about yourself and not future generations. I'd like to see that care be put back in Indigenous hands, and us being allowed sovereignty over our decisions about how we take care of these landscapes that we had a relationship with.

I think long term management needs to seriously consider things like what happens with cows and wild horses, because they can be really destructive to native plants. A lot of cows free range in Oregon and California and they really like how the native plants taste, so they'll uproot all these native plants that then leave room for invasive species to spread in. That will be something that we need to take into consideration long term.

Indigenous management is not doing this for five years, and then moving onto the next project. You want to be multigenerational. I think you can only really expect that if you have Indigenous people who are invested in this area, versus someone who sees it as just a job. Projects can really be in flux with funding from year to year, and who is elected who might not have the complex historical understanding needed. It's really about trusting Indigenous people and giving us the access to manage our traditional homelands.

KS: Anything else you'd like to share?

BT: I'd like to stress the importance of hiring Indigenous peoples, and that skills aren't always going to be a certificate on a resume. Understanding that Indigenous values, knowledge and diverse backgrounds are really

important. And statistically having diverse backgrounds is also financially and creatively beneficial to everyone. But yet, when we apply to jobs as Indigenous people, so often despite having skills that we've learned through our traditions and our lived experience in these places, they'll just get looked over as not being as valid as other education or experiences. I don't think that helps anyone. Lived experience is important when applying these restoration techniques.

One other thing I would add is that with reestablishing the connection with these plants, and having more of Indigenous plants, one thing to consider is with Indigenous health, that a lot of us don't have the access to traditional medicines, adequate health care, or good and healthy foods. Helping restore these plants also helps to restore our health as Indigenous peoples. If we can gather more traditional medicines, having access to these plants that are super rich in vitamins that help supplement our diets will create healthier people overall.

Bios

Brook Thompson is a Yurok and Karuk Native American from Northern California. She is a Ph.D. student at the University of California Santa Cruz and works as a Restoration Engineer for the Yurok Tribe. Brook earned an M.S. at Stanford University in Environmental Engineering with a focus on Water Resources and Hydrology, and a B.S. in Civil Engineering, with a minor in Political Science from Portland State University's Honors College. Brook aims to bring together water rights and Native American knowledge through engineering, public policy, and social action.

Joshua Chenoweth's career in botany began in 2001 after leaving New York City and a career in television. In the ensuing 22 years, he worked on a variety of restoration projects from coastal wilderness and degraded subalpine campgrounds for Olympic National Park in Washington State to riparian and upland restoration projects on the Klamath, Trinity and Sacramento Rivers for the Yurok Tribe. He earned a Masters in Science degree in Restoration Ecology from the University of Washington in 2007.