



TREE RINGS

THE JOURNAL OF THE YUBA WATERSHED INSTITUTE

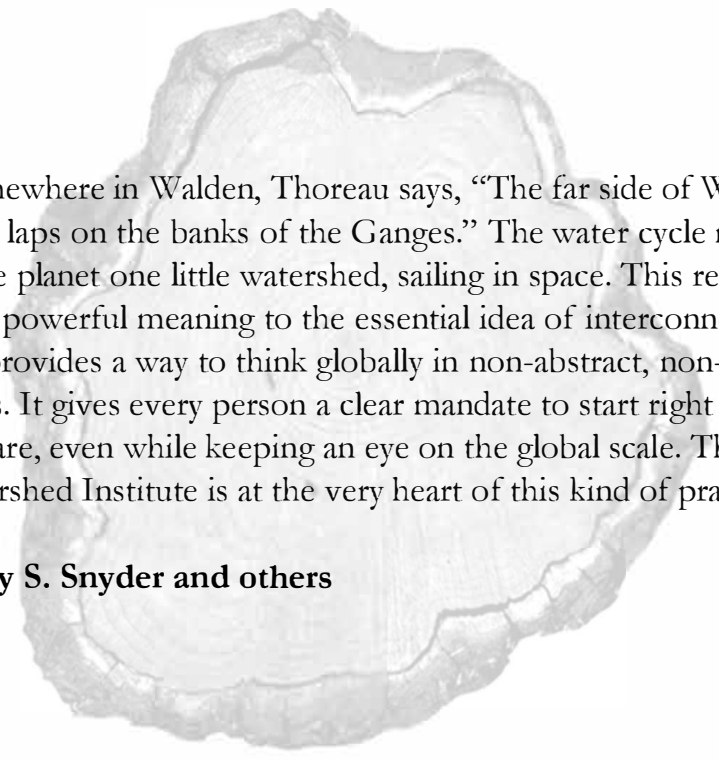


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YUBA WATERSHED INSTITUTE



Somewhere in Walden, Thoreau says, “The far side of Walden Pond laps on the banks of the Ganges.” The water cycle makes our whole planet one little watershed, sailing in space. This realization gives powerful meaning to the essential idea of interconnectedness, and provides a way to think globally in non-abstract, non-vague terms. It gives every person a clear mandate to start right where they are, even while keeping an eye on the global scale. The Yuba Watershed Institute is at the very heart of this kind of practice.

—Gary S. Snyder and others

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IN THIS ISSUE

**Listening to the Trees: Learning from the past to inform the future
of forest management** *by Jeffrey Lauder ... 3*

Restoring Fire and Building Community through the Yuba-Bear Burn Cooperative
by Jamie Ervin ... 5

The Re-Generation *by Debra Weistar ... 7*

Internship *by Amber Cone ... 9*

Prayer to a God I Don't Believe In *by Jacquie Bellon ... 10*

The Phoebe Named "It" *by Kurt Lorenz ... 11*

Fuels Reduction for Now, Forest Restoration for the Future *by Cameron Musser ... 12*

Book Review - *Trees In Trouble: Wildfires, Infestations, and Climate Change*
by Bob Erickson ... 15

Now That it's Clear *by Jacquie Bellon ... 16*

The Lone Bobcat Woods Prescribed Burn That Wasn't *by Janaia Donaldson ... 17*

**Wildfire Preparedness and Evacuation Planning in a Pandemic: Experiences from
Nevada County, California** *by Shefali Juneja Lakhina and Susie Kocher ... 21*

Front cover art - "Good Fire" *by Janaia Donaldson*

Back cover art - "We All Love the Yuba" *by Wendy van Wagner (Free download available at www.extrapro.org)*

Photo: Lisa Haden

As we begin to emerge from the COVID-19 pandemic, the Yuba Watershed Institute is doubling down on its commitment to help build a more resilient future. The theme of this *Tree Rings* issue is "Sheltering in Place," and we hope that the articles, artwork, and poems that follow offer some inspiration for what we might collectively focus on next: a renewed sense of place, strengthened community, forest management guided by emerging science, and a determination to restore the "good fire" upon which our land depends. We are listening, experimenting, and learning together as we navigate new challenges and work to become better stewards of this place.

YWI is working on fuels reduction and forest restoration projects in the Animim Forest and helping to plan new collaborative forest management projects in the Round Mountain and Little Deer Creek watershed areas. Working with community partners south of the San Juan Ridge is a big step for us, as we've historically been "hyperlocal" in our focus. However, as our neighbors have become increasingly concerned about wildfire risk arising from nearby public lands, we've been invited to build on the success of our partnership with the Bureau of Land Management and replicate our model in other communities. We are grateful for the support of our members, funders, and project partners, and look forward to more collaborative stewardship ahead.

- Cynthia King, Editor

Listening to the Trees: Learning from the past to inform the future of forest management

by Jeffrey Lauder, PhD, Ecologist,
Sierra Streams Institute and Board
Member, San Juan Ridge Taxpayers
Association

Forests are interconnected groups of organisms representing a system beyond the sum of their parts. They are more than just the trees, but trees do form the foundation. Life in the forest isn't easy; drought, pests, fire, wind, and competition with surrounding plants all conspire against young trees, selecting only the most robust seedlings to make it to adulthood. And this battle against the elements is recorded in the tree itself. Dendrochronology—the science of tree rings—allows us to look at trees as living (or sometimes dead) records of their own lives. The name of this journal—Tree Rings—is as apt as it is significant. Much like this issue contains the story of ourselves and our life within the forest, so too do the rings of a tree. But as is typically the case, there are multiple sides to this story. The 2020 fire year only amplified already renewed investment in forest restoration work. If there is one major lesson we can learn from the mistakes of prior failed forest management practices, it is that we must stop viewing forests strictly through the lens of human-forest interactions, and instead learn from the trees themselves how to go about restoring a vibrant, dynamic forest landscape.

While the fires of 2020 were more severe than many in the last century, the total acreage burned across the state was on par with pre-settlement fire seasons. This was a stark reminder that the

forests of the west burn. These forests were forged in fire, and will continue to be maintained by it. We know this through study of multiple kinds of records, including tree rings. Fire scars—formed within an annual tree ring when fire damages the thick bark but does not kill the tree—provide a readily identifiable (and dateable) indication of fire timing and severity. It is through studying these patterns that we have become aware of the severe *lack* of fire in our local forests that is the primary culprit in the firestorms we all have come to fear. This story is now a familiar one to most forest dwellers: combinations of Native American cultural burns and natural fires smoldered across our forests every few years prior to mass settlement of the region. As “civilization” began to tame the wilds, the fires were put out as soon as they were spotted, viewed as a threat to our safety. This removed a natural self-regulation mechanism from the landscape, and forests became increasingly choked by larger populations

of smaller and smaller trees. Coupled with decreased winter moisture and increased warming under climate change, this has led to most western forests being just one spark away from complete ecosystem reset.

Thankfully, in our region in particular, there is a revival of interest in and support for cultural burning,

prescribed burns, and mechanical or hand-based forest treatment that *embraces* low and mixed-severity fire in order to *prevent* uniformly high-severity fire. We are slowly refilling the blank pages in the story of the trees that once contained fire scars. But we must also dig deeper and read between the lines of that story. Make no doubt about it—our forests are in dire need of our stewardship. But we must also be wary of going too far in the name of fire prevention. Through studying tree rings we have learned that trees respond well to fires that clear the surrounding

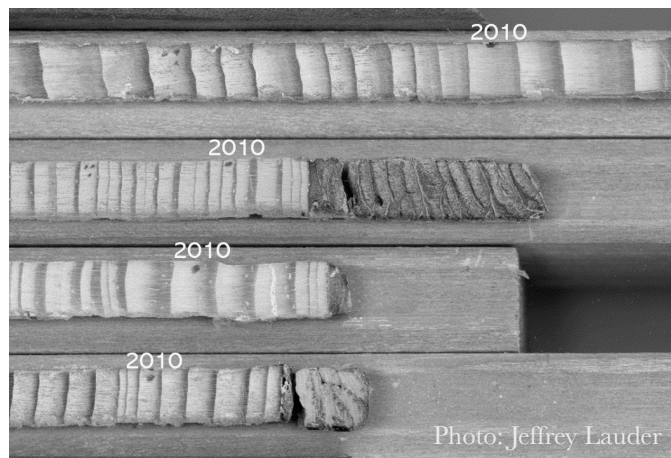




Illustration: Hal Fritz 1976

landscape, opening new patches of soil to be colonized by the next generation of seedlings, increasing access to water and other resources, and decreasing likelihood of pest infestation from nearby “brood trees.” But we also see evidence that forests thrive on dynamic changes through time and space; that a forest with many generations of trees found in clumps with gaps between them are resilient to a natural disturbance regime. “Heterogeneous,” or structurally diverse forests, both prevent uniform high severity disturbance damage (including fire, drought, and pest outbreak) and are more able to recover from it. Tree rings also tell us that some trees are much more resilient to drought, pests, and fire than even their immediate neighbors, and that this resilience may come from more conservative growth strategies (i.e., the slow-and-steady tree may be more resilient than the fast growing one). And finally, we see in tree rings that forests historically experienced particular disturbances during specific seasons, and have since adapted to that seasonality. So how do we listen to these stories the trees tell us, and allow them to help guide our actions?

We can view forests through the lens of our place in the landscape, or we can view forests through the lens of trees themselves. Neither is “right” or “wrong.” But we must be humble in our approach to forest management, and

acknowledge that most of what we “know” comes from snapshots in (modern) time—snapshots that form only the outermost rings in our largest trees. If we look further back in time, into the early pages of a tree’s story, we can learn what kinds of conditions allowed these trees to thrive, and how we can modify our strategies to mimic or support them. So the next time you perform fuel reduction on your property, try to imagine yourself as a fire; carve a large swath through some low shrubby vegetation, maybe even remove a few large trees if they are connected to that swath through their branches. Then leave an adjacent clump untouched. Plan these locations in a way that acknowledges the path a fire would take were it to burn on your land. You should place these treatments in ways that allow you egress, and to reduce the likelihood of the fire climbing into the canopy or spreading rapidly. But be wary of trying to simply “prevent fire.” Instead, embrace fire, embrace heterogeneity, and embrace this opportunity to help our forests write the next chapter in the story held in their tree rings.



Photo: Bob Erickson

Restoring Fire and Building Community through the Yuba-Bear Burn Cooperative

by Jamie Ervin, Yuba-Bear Burn Cooperative Coordinator

A strong community might be the ultimate local tool for overcoming our modern ecological crises. Over the past several years I have been fortunate to see this manifest locally while working alongside a group of landowners, organizations, and community members to help build the Yuba watershed's first prescribed burn association: the Yuba-Bear Burn Cooperative (YBBC). As it begins to gain steam, the YBBC holds great promise for empowering landowners to restore beneficial fire to their lands while strengthening our community ties along the way.

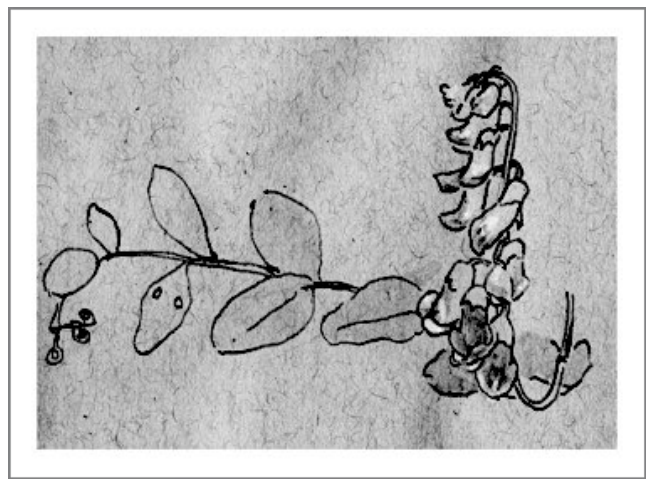
I am a relative newcomer to the Yuba watershed, having relocated here from the southeast in 2017. Despite being a forest ecologist by training, upon moving here I felt disoriented by how different the forests were from the temperate rainforests in southern Appalachia where I had cut my teeth.

The distinction, I quickly learned, is that if those are technically “rain” forests, our Sierra Nevada forests are certainly “fire” forests. Fire is *the* driver of ecosystem structure in Sierra forests, influencing everything from the size and configuration of trees, to wildlife habitat, to carbon stability, to water quality, to community safety, and so on. Without fire, the forest ecosystem as we know it collapses.

Thousands of years of indigenous knowledge, and decades of western science tell us that frequent low to moderate-intensity fires are a natural and essential part of the Sierra landscape. Restoration of beneficial fire through intentional prescribed burns is one of the most effective ways to reverse the impacts that more than a century of fire suppression, mining, logging, development, and climate change have wrought on our forests. Scientists, land managers, and policymakers agree that we need to greatly increase the pace and scale of prescribed fire in

order to make inevitable future wildfires less severe, less smoky, and less destructive.

Prescribed fire is not without its challenges though. The barriers to burning, including air quality concerns, favorable weather windows, liability, workforce capacity, social pushback, education, and more, are well-documented in scientific research and have eluded land managers in California for decades. Burning is uniquely challenging on private lands due in part to a lack of resources and professional capacity to help private landowners learn to use fire safely and effectively.



Lathyrus sulphureus, by Sunny Kahl

In recent years, prescribed burn associations (PBAs) have emerged as a promising model to help private landowners navigate these challenges and get more “good” fire on the ground. PBAs, which are modeled off of rangeland improvement associations in the Midwest, are community-based support networks where landowners work together to burn each other's lands. The PBA model, which promotes a “neighbors helping neighbors” type mentality, helps make prescribed fire a safe, cost-effective, and accessible tool for landowners by providing the volunteers, equipment, and coordination necessary to implement a burn.

In 2019—inspired by burgeoning efforts in other parts of California—Sierra Forest Legacy (my employer) expanded our work to include coordinating a PBA in the Yuba watershed. This

effort gained traction almost instantly. Within a week of taking on the project, I connected with a group of landowners and local fire practitioners at Blodgett Research Forest whom quickly helped us build an email list of over 100 interested landowners and community members. Several weeks later, nearly forty people crammed into the back of a noisy brewery in Nevada City for our first public meeting to share their prescribed fire goals and to learn how they could host a burn on their land.

After that first meeting, it became apparent that an active PBA is a greatly-needed resource in our area. I would estimate based on inquiries that I have received since then that there are many thousands of acres of private lands prescribed fire projects that are already pre-treated and ready to burn if the burn windows, volunteers, and other resources can all come together simultaneously. The YBBC can provide support in the form of education, on-the-ground training, equipment, and coordination needed to translate landowner enthusiasm into actual acres burned.

As an example, one issue is that there isn't a lot of clarity about how to go about getting a permit for a prescribed burn. California's process for permitting broadcast burns, which is shared between local air quality regulators and CAL FIRE units, is murky at best and is inconsistently applied throughout different areas of the state. One goal of the YBBC is to help de-mystify this process by creating a community hub for prescribed fire information that can improve coordination between burners and regulatory agencies. Because of these permitting challenges,

many landowners choose to burn smaller units (generally less than 10 acres) during the winter months when permits are not required. As winter dry spells become more common in our changing climate, I believe that these small winter burns will become more and more critical for increasing the pace and scale of restoration.

Another area where the YBBC hopes to support our community's prescribed fire capacity is by providing opportunities for community members to get experience and practical training using "good" fire. There are currently very few educational pathways into becoming a prescribed fire practitioner that are distinct from the existing fire suppression training system. Most landowners do not have the time and resources to gain qualifications through the cumbersome National Wildfire Coordinating Group's training system, and most are not interested in working on a fire suppression crew.

By helping landowners overcome these challenges and others, we hope that the YBBC will spur a wave of projects throughout our watershed that will complement and connect to the work already occurring on federal lands. Building a successful PBA will not be an easy lift, but my experience coordinating the YBBC so far has convinced me that we have the creative thinkers, community ties, and work ethic to make it happen.

After all, there is no "no-fire" option in the Sierra. Our forests and our communities depend on us working together to bring good fire back to the land, otherwise we lose the forest resource that we all care about. Making this happen is up to us all.

For more information about the Yuba-Bear Burn Cooperative, contact Jamie Ervin at jamie@sierraforestlegacy.org

For more information about prescribed burn associations, visit calpba.org.



***Neighbors Helping Neighbors
Burn for Safe and
Healthy Forests***

The Re-Generation

by Debra Weistar

Walking in the woods this morning

I broke the news to the trees,

No children this spring

Climbing on their trunks,

Laughing in their branches.

They sighed.

May 2020

The forest is silent. Not a dreaded “Silent Spring” kind of silence, but an “absence of humans” silence. Many would treasure such quiet; alone, deep in the forest, in stillness and tranquility. And normally I would, too, but this is not a normal time.

Missing from the forest is the sound of young humans. Loud, mostly. Exuberant, high pitched and free, their voices and footsteps penetrating the calm and reverberating from tree to tree. They would be working together on ropes course elements: balancing one another on a cable, throwing a rope to a friend to get across a divide, offering a hand to scale the 12’ wall. And the high ropes tree climbing—higher and higher, facing oneself in non-ordinary time/space. Afterward, sitting on the earth in a circle, reflecting on what they just accomplished together, speaking aloud of insights gained. Dialog, connection, integration.

I walked alone in the forest last spring, and I spoke to the trees. I thanked them for being here, for all they provide. And I promised them that the children would return one day.

Few people, even on the Ridge, know about Synergia Learning Center. Tucked away a mile from the North Columbia Diggins, we first built

the ropes course, an experiential learning environment, in 1991. As we tramped around our land when we first moved here in 1985, Tom and I stepped into the open space that would one day become the “Games Circle.” We looked at each other and said, “This feels like a gathering place.” We both felt it. At the time we assumed we were tuning into the past, an energetic remnant of pre-invasion indigenous presence. We didn’t suspect that the feeling we shared was prescient, or that we had stumbled upon a nexus of past and future.

I know more about humans than I know about trees, which isn’t saying much. But in working with humans for over thirty years, I have learned a few things. One of the things I have learned is that young humans learn best in Nature.

The Ridge community has a long history of commitment to education and to providing for the needs of its children. The Oak Tree School story is legendary. So is the one-room North Columbia Schoolhouse, now Cultural Center, that operated as a school until 1979. In the mid-80s and into the 90s, a group of us chose to homeschool our children, but we did it together. We offered classes throughout the community—Herb Class with Robyn Martin at Olala Farms, fiber arts at Gail Shere’s sheep farm, Nature Class with me.

So when the pandemic hit, taking all of Synergia’s outdoor education programs with it, we reached back to that humble beginning, gathered the experience and knowledge gained since, took a deep breath, and started Nature School.



The pandemic didn't just shut down our programs, it shut down nearly everything. Schools shifted to distance learning, meaning that children were now isolated and spending more time than ever on screens. Parents who never intended to homeschool their children now had no choice; many without the necessary skill, time, or patience. But then we had reason to hope: As the science on the virus became known, we learned that we were safest outdoors. An all-outdoors school was the perfect solution. With adherence to Covid-safe protocols, we designed Nature School so that children could be together, not virtually but physically *together*. Here they could develop essential life skills, such as how to resolve conflict, how to think critically and respond empathically while problem-solving, or how to engage a complex project as a group. They got to be kids again, and play, and learn—together.



And who are these kids? They are the children of parents who came to this place to do something different, and to make a difference. They are the next generation of problem-solvers and learners. They are children of this place—this forest, these meadows, the severely altered yet still-beautiful Diggins. They are the children of Synergia staff, and they are the children of children we taught years ago. This morning as I greeted them when they arrived, the temperature was 35 degrees and there was snow on the ground. They carried on outside all day—joyfully. They are resilient, and adaptable, and they are learning to be friends, and what it means to befriend another. They are a cohort, in the best sense of the word.

SUMMER 2021

One day, on a particularly challenging tree climb, a 10-year-old student looked down on me far below and asked, “When your head tells you to do one thing, and your heart tells you something else, how do you know which one to listen to?”



I am listening to the land,

and to the children. I can't tell if the trees are happier now that the children have returned, but I like to think they are. I like to think that when the kids pick a tree to sit by, observe, draw, write about, name and connect with, that the trees stand taller. I like to think that when the kids rush up the hill after a long break to check on Piney and Little Oak and Bob the Madrone that the trees spread their branches wider. I like to think that the trees know that we think of them as teachers. And I like knowing that at least I've kept my promise.

Nature School can outlast this pandemic. The Ridge community was built, over decades, on bold action and defiance of norms. Big ideas and projects have started here before (we have a bit of a reputation). Cultural evolution depends on large gestures, and brave souls.

I leave you with a statement I heard on the radio just yesterday (I'm paraphrasing): Hope is not necessarily something you feel. Hope is something you do. We can engage life, and build a practice of hope.

Nature School is a practice of hope.

Debra Weistar co-directs Synergia Learning Center with her husband, Tom Weistar. Nature School is taught by Sara Dykman, Melanya Gonshorowski, and Alex Nopola. To learn more visit www.synergia.org/programs

Internship

by Amber Cone, YWI's newest
Board member

I came to the San Juan Ridge as a cocky little punk rock hippy kid who had never yet known what “place” meant. As a “townie,” I had been camping a few times out of the area and had been to the river to swim in the summer. We went to the river like it was a municipal pool. A really nice one, but just a way to get out of the heat. I had no idea that the water came from somewhere, lots and lots of somewheres, and went somewhere else, connecting all the places in between. Of course, I had remedial understanding of the water cycle, but no real idea that it somehow related to the place we splashed and played.

Teenagers in my cohort were bored, hanging out in town trying to figure out how to get as high as possible all the time. We were conceptually bound by the confines of the town limits, and people's houses in subdivisions.

When I befriended some ridge kids, and they said “see that big tree (or hill, or rock), let's go find it!” my mind was completely blown. You could just walk right out of town and there were animal trails to follow and bushes to crawl through and rocks to climb, scree fields to run, jump and slide down. None of my punk rock cohort ever looked outside the bounds of civilization for fun or entertainment or discovery. I don't blame punk rock—we were activists trying to resist the harm our culture was doing to people and the environment—but what even was the “environment.” I knew the difference between deciduous and evergreen trees but that was about it. I was in honors classes in school but lacked anything above a fundamental understanding about ecology, even less about local ecology. I was what Wendell Berry might have called a displaced person. I had no idea where I was.

A couple of my friends, Li Ezzell and Forest Hill, were applying to this YWI internship program for the summer and suggested I do the same. Since I was really enjoying this bashing around in

the wilds thing, I thought I may as well. Plus it was a paid job and my family was well below the poverty level and needed the money. I took the application very seriously, going into the computer lab at school to type it out. (Later I saw the rest of the applications, some scrawled in barely legible pencil. Another way I didn't know where I was.)

So, I got the gig. I showed up to the first day and realized I was the only girl among 14 boys. Wow. Ok. That never occurred to me. Where were all the girls? But never mind, this would look good on my college applications.

We started to learn the names of the trees, how to use a compass, read maps, use clinometers and loggers' tape to go out and make plots inside which we would observe and note everything that was inside that circle. That meant learning the Latin names of the trees in order to notate them. Again, I didn't know a Douglas fir from a dogwood. But somehow, moving through the woods, looking up into the canopy and crouching down to measure the depth of the duff, touching, smelling, feeling and tasting the world around me, something was awakened. Looking at something and noticing it, really observing it felt like a light turning on. Suddenly I was IN THE WORLD. Doug fir has a taste, a texture, a growth pattern, a certain kind of duff underneath, a name. *Pseudotsuga menziesii*. It has preferences. It likes to live in certain places and not in others. It can get really big. It's not really even a fir.



South Yuba River Canyon, by Janaia Donaldson



Snag, by Janaia Donaldson

Every single living thing we looked at had just as many specific qualities, things you could learn the language to observe. It made me feel wonderfully small, beautifully connected to something huge, powerful and indifferent to my existence. What a relief. I could look as long as I wanted and the forest wouldn't look away. I could zoom in or out and it was infinitely fascinating. I was in a swale, just above the scour. I was on an aspect, a slope. I was under the drip line of a *Cornus nuttallii*, where when a drop of water fell here, it would go down this little draw, into Spring Creek, down to the South Yuba, where I swam as a child. I was found.

It was also heartbreaking to learn how damaged and mismanaged this forest is. Learning what old growth was, what a climax forest looked and felt like, made me realize how much we are missing. I began to feel like maybe me observing and studying this place could actually begin to repair it. As indifferent as the forest was to my existence,

maybe what I was doing mattered. Maybe finally I wasn't just going through the motions, doing worksheets for science class. What I was doing was real. No matter what came of it, what I recorded of this plot was a description of an observed reality.

In her book *Tending the Wild*, M. Kat Anderson repeatedly describes the "intimacy" native peoples had with the land. Something about learning how to bite between the spikes of the gooseberry to access that explosion of seedy sweetness and learning its name, *Ribes*, gave me a small sense of that intimacy. I was claimed by this land. Its well-being and our well-being are linked. I can't help caring about how it is treated.

This is what the "environment" is: places where plants and animals and people live, where life is burgeoning despite all its mistreatment, hopefully moving toward some kind of glorious potential. It is the places we love. For many of us, the hope we have for a more rich, verdant, diverse and healthy landscape is an inescapable drive. We can't not think about it.



Prayer to a God I Don't Believe In

Release me from
the command to refresh,
the latest from Colossal,
today's world view,
jewelry with literary quotes,
South Indian comfort food,
death of the lost cause,
what autopsies reveal,
Facebook and the Boogaloos.
Spring me from this chair,
send me tumbling outside
into the fresh morning.
It's summertime and
the livin' is...different.

by Jacquie Bellon

The Phoebe Named “It”

by Kurt Lorenz

For several weeks now a Black Phoebe of indeterminate sex has been providing free entertainment. It is here, right around the house at 4,000 feet, on all days except for rain and storm, and flits about from one perch low down to another, fly catching with consummate skill.

We first saw it perching on steel fence posts below the house, but although it frequently can be found there, it ranges over a territory of several hundred feet in both directions at roughly the same elevation on the hill below the house. East and then West, back and forth goes the insect grim reaper. The weird thing is that although we sometimes see the crunched bits of hapless prey adorning the sides of its bill, I still don't see the small creatures it sees as it finds these quick meals with super sharp vision.

Sometimes it will drop to the ground to grab something, but most are caught in mid air just a foot or so above the ground. I know because of the wild antic shows it puts on to catch tiny meals. When the victim is good at dodging the bird can tumble and explode in aerial bursts of impossible flying, more like pouncing with flashing feathers. Then it is usually right back to the same perch, tail flicking upward like a silent snap, over and over, head rotating as it looks for the next bite. The bird is apparently solitary, and also incredibly good at an intense form of hunting, often with only seconds between one kill and the next.

I can watch and admire this small skilled creature, but lately I have been wondering what is it thinking? Jane Goodall, the primate scientist,

said that what makes humans different from animals is our power of speech. I have a hard time imagining a “thought” which is not somehow couched in mental words. Of course I also “see” mental images, and sometimes react to a stimulus by instinct, but even those split seconds have words attached, and I for sure will think in words to try to make sense of anything.

What I have realized is that this mental slant, if you will, leads to me anthropomorphizing all other living things that I encounter, including inanimate objects like trees and running water. I literally “put words in their mouth,” or perhaps more likely “in their minds.”

I do that because it fits, in my brain processing, but it gets in the way of knowing the phoebe, and everything else. There is not the slightest chance that the phoebe is thinking in human words, and therefore what and how it is processing information is just a wild guess. I know it is thinking, based on its actions, but I have no idea what is going on in that brain.

And for all of us who value and want to protect the environment around us, I challenge you to try this. For a split second, let the words and names and labels and our normal thoughts just fall away, and let the phoebe just BE. I find this incredibly hard to do, but I think it is super important.

I think this may be what happened to Aldo Leopold as he looked into the eyes of the dying wolf he had just shot in New Mexico in 1909. For me, that small flash, infinitely small and timeless, is what keeps me caring. If we multiply that nanosecond millions of times by millions of people, we might actually save something worthwhile, before it is all gone.



Eriophyllum sp., by Sunny Kahl

Fuels Reduction for Now, Forest Restoration for the Future

by Cameron Musser, YWI Forest Health Project Manager

For the past 20 years, forest management in the western US has been predominantly reactionary—focusing on the reduction of hazardous fuels that have accumulated throughout years of fire suppression (Stephens et al., 2021). Forest fuels are typically characterized as small-diameter trees, brush, and woody debris accumulated on the forest floor. The primary fuel reduction methods available are mastication, hand thinning and chipping or piling, and prescribed fire. The resulting park-like forests can instill peace and confidence in the fire-weary public. These highly visible and increasingly common fuel reduction projects within the wildland urban interface (WUI) often feel so proactive and good that they are being marketed as forest restoration projects—restoring the forest to a healthier, resilient status.

It seems counterintuitive that there is a choice between reducing hazard fuels and restoring forest health, since the latter depends so heavily on the former. However, we're beginning to understand that park-like forests are just as artificial as fuel-heavy forests (Stephens et al., 2021). Whereas fire suppression initially homogenized these forests, allowing gaps to fill in with high densities of pine and shade-tolerant firs (Stevens & Gill, 2005), thinning the understory alone promotes further homogenization. Excluding the removal of large diameter trees (>10 inches) from forest restoration projects perpetuates the cycle of hazard fuel accumulation. Without creating gaps, shade-tolerant species will continue to grow beneath overstocked closed canopies that are stressed by resource competition, pests and pathogens (Bigelow et al., 2011, Johnston et al., 2021). Furthermore, if a wind-driven fire was to enter a forest treated by fuels reduction alone, there would be no separation between the larger trees' canopies to stymie the rolling flames.

To better restore fire-resiliency and heterogeneity in Sierra forests, many areas require a reduction in overstory canopy density through the removal of mid-diameter trees, potentially through timber harvest (aka logging). For many, the word "logging" represents the opposite of forest restoration. However, when completed with environmental sensitivity, the use of logging to thin overly-dense stands of trees can be a useful regenerative tool.

Unfortunately, the use of timber harvests as a tool to reduce canopy density has become increasingly uneconomical due the monopoly held by large timber companies on the state's few remaining sawmills and biomass facilities. The timber companies that own the mills also own the timberlands, and therefore prioritize processing the logs off of their own land before buying from federal or small private lands. They also control the log prices. Currently this market is flooded with salvaged pine from the recent fires. The sawmills are not buying anyone else's timber and have set the prices such that administrative, operational, and trucking costs prohibit many landowners from harvesting at all. The lack of both sawmills and a competitive market for timber are major bottlenecks between the vast supply of California timber and the high demand for lumber. Hopefully, bringing awareness to this issue can help initiate the steps needed to make timber harvests a tool in the forest restoration toolkit.

Choosing a combination of tools from the forest management toolkit—fuel reduction and timber harvest—has proven to decrease the risk of high-severity fire as well as restore forest health and resiliency (Collins et al., 2019, North et al., 2009). Choosing *one* method, however, is often the only choice. Luckily, managers can buy time with state funding to reduce fuels. Often funding limits fuels treatments to long and narrow, strategically placed fuel breaks to serve as fire lines for firefighters or to change fire behavior. In these situations, intensively clearing the forest understory can be crucial. Since returning all forests to their historically fire resilient state may be a task for tomorrow, I'll review how land managers can promote forest health and more

diverse understories while implementing the fuel reduction treatments available today.

Of the available fuel reduction methods, mastication is often seen as the quick and dirty solution. A masticator can treat the most amount of land for the least cost and consequently is becoming the treatment of choice for many land managers. With enough planning and operator collaboration, mastication can be a longer-lasting solution as well. According to many CAL FIRE firefighters and land managers, the ideal treatment for many fuel breaks and understory thinning projects would be mastication followed years later by broadcast, prescribed burning; this way all fuels are brought to the surface-level and regrowth is maintained by fire. Burning is the only fuel reduction treatment, besides chipping and hauling, that removes the fuel from the landscape; chipping, masticating, and piling don't change the volume of fuels, just the form.

Should post-mastication burning be a tool in your toolkit, consider the fire effects within the project area. Masticators shred material, producing irregularly-sized pieces that ignite at variable rates with coarser materials burning hotter and longer (Kreye et al., 2014). Burning these fuel beds may cause smoldering, or lingering fires, and latent heat on living vegetation within the topsoil. One study found that heat generated from masticated fuel beds greater than 7.5 cm could cause sterilize the soils (Busse et al., 2005).

Some measures can mitigate these effects. Operators can integrate materials into the topsoil to promote decomposition, and managers can allow the material to decay for multiple years prior to burning. Selecting vegetation to not treat, controlling the level of compaction, and monitoring fuel moistures carefully may also help to mitigate undesirable fire effects.

If follow-up burning is not available, consider this: before masticating, learn what kind of invasive species are nearby and their regeneration strategies. Scotch broom seeds, for instance, experience higher germination rates after topsoil disturbance during mastication. If you have to masticate in areas proximal to invasive plant species, ensure the equipment is thoroughly

cleaned before site entry, prioritize areas of high vegetation density that will leave a greater depth of materials to suppress regrowth, and consider budgeting for herbicide or grazing as a secondary treatment (Jain et al., 2018). In addition to leaving beds of material on top of the soil you can also use shade to suppress regrowth and help maintain the treatment by retaining higher densities of brush, with plants spaced at three to five times the height of each individual (CAL FIRE, 2020).

Mastication arguably has the most homogenizing effects on forests, due to the limited view from within the machine's cab, the masticator's size, and the need to grind material close to the ground. To create multi-layered, denser patches of vegetation, one option is to integrate hand thinning treatments throughout the mastication unit. This may leave more habitat for wildlife, reduce soil disturbance, and increase understory heterogeneity. Pre-mastication flagging of desirable plant species, small snags and logs, and vegetation screens for dens and cavities will also leave a more diverse understory.

If you are limited in the amount of pre-project planning resources (such as resource flagging), or cannot afford to incorporate hand treatments, working closely with the masticator operator and selecting specific equipment can also ensure more diverse, natural-looking results. One way to avoid creating a homogenous forest floor is by preventing the operator from grinding all the material into the top layers of the soil—to avoid creating the park-like aesthetic. Instead, instruct the operator to drive around down woody material and islands of herbaceous layers where fuel loading is minimal. As with all heavy machinery, minimizing soil disturbance should be a priority. Depending on size and weight, the pounds per square inch (psi) of a tracked masticator can range from 2-8 psi (the psi of a human foot is 6). Turning the machine and making multiple passes to masticate material, however, can disturb the litter layer and topsoil. You can minimize these effects by choosing machines with boom-mounted rather than drum cutting heads; these machines don't have to drive

to each tree and can sometimes grind much of the material while it's still standing.

Another mechanical alternative to mastication is chipping. Tracked or tow-behind chippers working in tandem with a hand cutting crew provide on-site disposal of fuels with the level of selection that you cannot get from inside the cab of a masticator. Where mild slopes permit the use of a tracked chipper, managers often use this method to avoid creating burn piles. The chips are more uniform in size compared to masticated particles and, with a smaller surface area to volume ratio, chips can hold on to moisture longer (Anderson, 1990). Though less flashy than masticated fuel beds, chipped fuel beds can also smolder and damage the biological components of the soil. With that in mind, managers should consider where continuous, even-layered fuel beds are appropriate versus where small piles of chips that can burn hotter could create discontinuous layers of fuel. The benefits of chipping come with increased time and cost and should prompt land managers to consider their objective; is it to treat as many acres as possible or to preserve certain forest components?

Regardless of the management objective, with ample planning it's possible to reduce fuels to safer levels and to conserve valuable ecological characteristics of the land. Consider these guidelines when planning fuel reduction treatments. To create mid-story and understory heterogeneity, incorporate hand work into areas designated for machine treatment. In all treatment types, commit a significant portion of time to marking vegetation for retention and areas for no treatment. This will allow you to control for variable densities of regenerating groups of trees as well as forest floor structural diversity—e.g., logs for critters, native grass seed banks, and brush for grazers. Your preexisting conditions should determine what treatment you use. Are invasive species present? What is the density and type of your vegetation? Do you have funds for maintaining your treatments? And finally, if you are lucky enough to manage land in the Sierras, thank you for your hard work and don't give up.

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Book Review

Trees In Trouble: Wildfires, Infestations, and Climate Change

by Daniel Mathews
Counterpoint Press, 2020

Reviewed by Bob Erickson

In 2017 we noticed pine trees on the south border of our property on the San Juan Ridge beginning to turn brown and die. Over the next two years four acres of 100-150 year old ponderosa pine died from western pine beetle. Now their trunks lie like piles of fallen soldiers scattered over the ground. The approximately 100 trees were in the 25"-45" diameter size range, many at the larger end. This die-off is the most significant event to our forest since we bought the property in 1970.

Daniel Mathews's 2020 book, *Trees in Trouble*, tells us the back story for this local event and other recent afflictions of forest trees in the American West. He has chosen to focus on the pine trees of western forests.

Mathews tells his stories in a style familiar to readers of John McPhee. He does this by visiting researchers and forest ecologists around the West, goes out in the field with them, reads everything he can on the subject and then writes about it for those of us who are not scientists. Some of the characters he visits are names familiar to us here, people whom the YWI has hosted for field trips and presentations at the library: Jerry Franklin, Hugh Safford, Malcolm North and Craig Thomas.

The question he is asking is "what is the interplay of insect infestation, disease, wildfire and climate change in the forests of pine trees?"

His journeys take him all over the West from British Columbia to New Mexico, from California to Montana. I read the book with curiosity about the broad subject but his references to our local mixed conifer forest is where my attention focused.

Mathews helps explain the beetle kill dieback on our south boundary and the huge loss of ponderosa at Shields Camp by telling the detailed story of the interplay of temperature, beetles, pheromones, terpenes and drought.

As temperatures rise, stress on trees is accentuated and this opens opportunities for bark beetles and disease. Drought is accentuated by the rising temperatures. Beetles and disease find stressed trees easy targets. It's as if the trees suffer from a compromised immune system. (As a wood worker I appreciated his description of the role that blue-stain fungi play in making the wood more edible to the beetle larvae.) The beetles inoculate the trees with this blue-stain fungus through special pockets in their head called mycangia.

After the pine beetle epidemic killed our trees the needles dried out, the needles dropped and now wind has mostly blown the snags down.

Our south-facing slope of dead pine trees has now passed through the first two stages of fire hazard that Mathews describes. Stage 1, or the 'red phase,' was the dead standing trees with their reddish-brown needles intact. This stage is more fire prone than a green forest. Stage 2 is the gray stage and is less of a fire hazard than the red and even the live forest. The trees on our property are now mostly on the ground and this is Stage 3 of a beetle attack and this stage is thought to be the most dangerous 11 years out from the dieback.



The dead trees lie close to the ground and if a fire comes through all of that fuel cooks and sterilizes the soil leaving an area unable to grow trees or much of anything for decades to come, maybe never able to be a forest again. We found the cost of dealing with the dead timber to be excessive and so we are in the waiting game of hoping the slow oxidation—i.e., rot—of the wood will beat the next fire.

What can we do for our forests in response to these various crises, including a global changing climate? Mathews answers with a series of potential solutions. At the center of them is “thin and burn.” Thin the forest of brush and trees and prepare for and perform prescribed burns. He suggests removing much of the excessive fuels in the present forests via pre-commercial thinning, mastication, prescribed fire and logging. He quotes Malcolm North, forest ecologist with the research branch of the Forest Service: “the future forests need to be far more sparse, clumpy, patchy and diverse.” He also makes the case that prescribed fire is less toxic than summer wildfires citing a 2017 study done by Liu, et al. “Airborne measurements of Western U.S. wildfire emissions.” A flyover of the Rim Fire in 2013 with sophisticated measuring devices showed the wildfire smoke to be much more toxic than that of the cooler, prescribed burns done out of fire season. The extra small particulates resulting from blazes like the Rim Fire are much more dangerous to our lungs.

But not all of Mathews’s recommendations are about burning forests. He also describes an opportunity for us land owners who have a large patch of beetle kill to respond by planting new trees. This strategy works by taking seedlings from a lower, drier elevation or a more southerly seed stock and planting those trees of the same species in your forest opening, adding another genetic opportunity for natural selection 50 years down the road, in response to a warmer earth.

The author’s discussions are also inclusive of us forest dwellers whom have chosen to live in forests adapted to frequent, low intensity fire—which have had 100 years of fire suppression. He talks of escalated fuels reduction as you get closer

to a house and “hardening the roofs and walls of structures with Hardie board and stucco or brick,” but he also suggests less expensive actions like covering all house vents with 1/8” wire mesh and scrupulous removal of all litter, debris and branches from our roofs and houses. Doing what we can and what we can afford.

Trees in Trouble ranges further afield with discussions of high elevation foxtail and limber pine forests and with western white pine and bristlecone. And up into British Columbia’s massive forest die offs of lodgepole due to mountain pine beetle. I found the book worth a second read with the level of detail and his descriptions of the delightful characters who produce the science. It’s a book for anyone interested in western forestry and forests.

As to our own four acres of dead trees I quote forest researcher Connie Millar: “Bark beetles cull the forest for better adapted trees.” A few tall pines remain with green needles amidst the dead zone along with a few incense cedar and Doug fir. These ponderosa survivors might be the pines of the future; perhaps they carry the DNA for a more resilient tree.



Now That it’s Clear

Now that it’s clear
that COVID-19 is here to stay
according to *The Economist*,
let’s really get into masks,
carve some wood, paint it,
add teeth, horns, feathers, fur,
branches with nesting birds
to keep distance.
let’s go hog-wild!

by Jacquie Bellon

The Lone Bobcat Woods Prescribed Burn That Wasn't

by Janaia Donaldson

Tuesday December 8, 2020 dawned cool and still. This was set-up day, the day before our scheduled prescribed burn, after months of planning, changes of scale and direction, and hard work. I scanned the clear windless skies above the South Yuba River canyon, and my excitement welled up: “It’s gonna happen! Tomorrow we burn!”

As it happened, we didn’t. This is a story of missed opportunities and mixed messages, of lengthy preparations and last-minute changes, of labor expended and lessons learned. It’s the story of how our effort to use fire to enhance the health of our 120 acres of forested land on the western slope of California’s Sierra Nevada was thwarted by inflexible, distant decision-making, combined with the vagaries of weather, and of how things might be handled better in the future.

Ever since moving to the Sierra foothills in the early 1990s, I’ve been learning about the historic role of fire in this landscape. We know that the Indigenous Foothill Nisenan used frequent low-intensity fires to minimize the build-up of flammable material and to achieve other stewardship objectives. We also know the result of the subsequent 150 years of fire suppression: disastrous wildfires fueled by huge accumulations of debris. Our long-term vision is to restore our black-oak and ponderosa pine woodlands as they were tended by the original inhabitants, and fire is an essential tool. It’s also a way of honoring the wisdom of the Nisenan people, while improving forest health and wildlife habitat, and providing an important defense against catastrophic fire.

This is the background to the story of the Lone Bobcat Woods Prescribed Burn That Wasn’t. I’ll pick up the thread in 2016, when a half-dozen ponderosa pines were slowly killed by an infestation of pine bark beetles. We had the dead

trees logged and removed by professionals, and left the “slash” on the ground to decompose. Three years later, we consolidated the remaining debris into a dozen piles and tarped them, with the intention of burning them at some later time.

Here the story takes a curious twist. Eager to explore the potential of prescribed fire, in 2019 I learned about Wonder Labs, where a small team led by Shefali and Anukool Lakhina was developing a technology to manage fire with acoustic waves. The idea was to see if sound could be used to establish and hold wildfire defense lines. They were scouting for a forest location to test their idea on a larger scale. Fascinated, I offered Lone Bobcat Woods. They speculated that our big slash piles would generate a fire as intense as wildfire, albeit briefly, making our land ideal for their test.

The Lakhinas brought new eyes to our project. They urged us to bring in a “burn boss,” and I recommended Phil Dye at Prometheus Fire Consulting. They graciously contacted him on our behalf, and he agreed, adding one more professional to our leadership team.

We planned an initial site visit for March 2020. We invited Jamie Ervin, coordinator of the new Yuba Bear Burn Cooperative (YBBC). The Lone Bobcat Woods burn would be YBBC’s first officially sponsored project, giving us access to an all-important pool of volunteers.

Anukool, Phil and Jamie attended the first site evaluation. We walked the perimeter of an area defined by the roads, and Phil identified a 1.5-acre “burn unit” containing the slash piles within it. He explained that it was an obvious place to begin, since the roads would provide easy access and serve as fire control lines.

As we returned to our starting point, Phil speculated about the size of the larger area of which bounds we’d just walked. “Seventeen acres,” he announced, after consulting his phone’s mapping app.

“Shaped like a slug,” my partner Robin quipped, glancing at the squiggly outline on Phil’s phone.

Phil pointed uphill across the unit. “You might want to burn five acres rather than just one-and-

a-half.” He hung a pink ribbon on a nearby tree. “Scrape a control line between here and the other side of the slug.”

I inhaled sharply. Could we prepare this five-acre portion in two months, in time for a mid-May burn? Robin and I had already spent a couple of weeks working there with chainsaws, and had barely made a dent in it. But we decided to give it our best shot.

We didn’t have a budget to hire workers, and we wanted to involve the community. So, we scheduled a volunteer work day for YBBC and members of the local Lake Vera-Round Mountain Firewise Neighborhood Association. I figured out parking, made signs, flagged project areas, prepared food, and did all the other things needed for a successful event, in a sequence that I was to repeat many times as the project grew in scope.

California moved into the pandemic lockdown in mid-March. Prescribed burns remained permissible as “essential activities,” and we considered sticking with our plan to burn in May. But with so much uncertainty, we decided to postpone until fall.

At this point, Phil upped the ante once more: “You might want to burn all 17 acres in the fall.”

Once again I inhaled sharply. If prepping five acres in two months had seemed daunting, what would it be like to prep 17 acres in six months? Impossible? We set about developing a plan. Thinking strategically, I divided the 17 acres into three sub-units. We would first prepare the sub-unit containing the test piles, then move on to sub-unit two. If we had enough time, we’d prep sub-unit three. That way we’d be able to burn either one, two, or three sub-units, as circumstances allowed. Over the next six months, Robin and I worked on the project almost every day, often with my sister alongside. I also organized seven work days, each comprised of more than two dozen volunteers, and by the end of October we’d achieved what had seemed impossible: all 17 acres were ready for burning.

With the coming of fall, we started paying close attention to the weather. Finding a good burn day is increasingly difficult: the first rains of the season are coming later due to climate change, and burns are only safe when there’s been rain, but not too much. Toward the end of November we finally saw our opportunity: a predicted 10-day dry period, after some early-season rain. The forecast was clear until Friday, December 11. We picked Tuesday, December 8 to burn, in case the rain came early. I contacted 40-plus volunteers, and the food vendor and equipment purveyors to confirm their availability.

We were superbly prepared. We’d widened three control lines, established easy access to 7,000 gallons of “stationary water,” and secured three trucks equipped for firefighting to carry an additional 900 gallons, exceeding all of the requirements of the burn plan Phil had written. Our crew was outstanding. We had volunteers with firefighter certification, researchers from Sierra Streams Institute and University of California, Davis, and volunteers from the Natural Resources Conservation Service (including the Chief Forester for California). Most of the team had some previous experience with fire, and we had twice as many volunteers as the burn plan stipulated.

All seemed well. Then, on Friday, December 4 forecasts predicted an “extreme wind event” over the weekend and through our burn day. I quickly learned that CAL FIRE had reinstated its summer burn ban, meaning that our burn wouldn’t be possible unless the ban was lifted by Tuesday. After consulting Phil, I called off the burn scheduled for Tuesday, December 8.

The wind event fizzled out prematurely on Sunday. On Monday morning I contacted CAL FIRE, which hadn’t yet lifted the burn ban. I asked if we could burn on Wednesday, December 9. I was transferred two levels up to the Unit Chief, who said with “95% confidence” that the answer would be yes. I called Phil and got his green light. Then, in a now-familiar routine, I emailed volunteers and engine drivers, ordered burritos, and attended to the other event details.

Tuesday, December 8, set-up day. A beep on my phone. It's Phil, texting to ask whether the CAL FIRE Battalion Chief had entered our new date on the permit form that I'd submitted weeks ago. I hadn't yet made the formal request, so I called and left a message asking the Battalion Chief to do so. Next I emailed the Northern Sierra Air Quality Management District and was assured they would grant permission for our burn, even if it wasn't a permissible burn day for the public. Once CAL FIRE filled in the correct burn date on the permit, we'd be ready to go.

I was busy setting up when I got a call from our CAL FIRE Battalion Chief. "You can't burn tomorrow or Thursday," he said, relaying a decision made two levels above him, by people with no knowledge of our site or level of preparedness. "CAL FIRE is keeping the burn ban in place, at least until the next rain."

I was in shock. I knew the local Battalion Chief supported our burn; couldn't his assessment of our specific conditions override the faraway ruling? Apparently not: the regional decision would stand, and there was no means of appeal.

It was a mere 18 hours before we had been scheduled to start. Devastated, I called Phil. Already 100 miles from home, he was understandably upset, noting that we hadn't engaged CAL FIRE as a partner in the burn and had our own more-than-adequate resources lined up. Warily I contacted everyone involved, including volunteers from as far away as Tahoe and Monterey, to tell them that the burn was off.

Prescribed-fire veterans told us that this is the way with planned burns. On-again, off-again. Windows of opportunity opening and closing all the time, with weather and air quality and CAL FIRE all factoring in. "You have to be nimble," one of them said. Nimble, indeed, and prepared for all eventualities.

Wednesday, December 9 dawned with perfect burn conditions, as anticipated. I felt like the Road Runner racing off the cliff, legs pumping in thin air. I was drained, disoriented, empty. How could I screech to a halt, after nine months of intense activity? We had put in nearly 1,600 hours of work. We started dismantling all the set-

up that we'd done, and tried to assimilate what had happened over the last few days.

"We could have had a good burn today," I said on Thursday, as we covered the slash piles with tarps. On Friday the rain moved in as predicted, and with it the window of opportunity was gone.



Photo: Lisa Haden

Post-fire wildflower bloom

So, what can we learn from this story? We already know that prescribed burning is an important defense against catastrophic wildfire. Indeed, CAL FIRE is planning to increase the practice dramatically, from tens of thousands of acres a year to hundreds of thousands of acres. We can't attribute our thwarted attempt to a conflict around goals and principles; instead, it was the specifics of implementation that short-circuited our effort. Here are some suggestions that could lead to more successful outcomes in the future.

First, CAL FIRE burn-day decisions would ideally factor in local or parcel-specific conditions. Our preparations had been extensive (and expensive), we had equipment lined up, and all the rest of it—so surely it would have been in CAL FIRE's interest, as well as in ours, to get an on-site assessment of the micro-environment and conditions at the specific burn site, as close to the intended burn time as possible. CAL FIRE benefits from supporting landowners' initiative in a couple of different areas: it conserves human

and economic resources (volunteers do the prep, not CAL FIRE); it improves firefighting conditions in the event of a larger fire; and it gets a bunch of acreage burned at essentially no cost to the agencies involved. If our Battalion Chief wasn't able to visit on set-up day, what if I could have texted him a test burn video? We could have provided measurable data such as flame length, rate of spread, smoke dispersion, etc. to help inform the agency's decision.

Also, it's worth considering how to optimize public and private firefighting resources in the event of a prescribed fire "escaping" to other landowners' parcels. CAL FIRE would be the responsible agency if a fire escaped from our property, and therefore requires its own staffing to meet a minimum threshold when issuing its burn permit. In our case, the burn plan specifies that we will provide fire suppression resources at or above the level of preparedness required by CAL FIRE. As landowners and communities work together to implement more prescribed fire, the additional fire suppression resources brought to the table should be factored in when CAL FIRE makes its permitting decisions.

We need to support CAL FIRE, especially by being active in our own communities. CAL FIRE can do its job best when we organize in neighborhood associations focused on fire, like Firewise communities, and do everything possible to encourage the use of prescribed burns. They're a win-win for everyone: by reducing the risk of catastrophic fires, our public services will be less over-stretched, our neighborhoods will be safer, and the forests will benefit.

I trust our burn will happen—whether as one big burn or several smaller burns. The land hungers for it. Scientists want to learn from it. Some species need it to propagate. Wildlife habitat and biodiversity will benefit. The Foothill Nisenan used low-intensity maintenance fire every two to five years, approximating the frequency of wildfire from lightning in unpopulated regions. We're a long way from that reality, and there are many complicating factors, but we need to head in that direction, for the long-term health of the forests and the safety of all.

Epilogue:

Over the winter, we burned dozens of piles to reduce fuels in the burn unit. When a forecast for a multi-week dry spell appeared in early April 2021, we quickly organized a half-acre surface burn with a dozen volunteers, led by retired forester and firefighter Dario Davidson. When the dry spell extended, we did another 2.5-acre surface burn several days later. Although conditions were wetter than desired, our community gained experience and confidence.

We planned to burn the remaining unit on May 19, Phil Dye's earliest availability. I lined up the requisite 30 volunteers plus three water engines, and contacted CAL FIRE, which required permits starting May 1. The day our Battalion Chief was to visit our site, he informed me of CAL FIRE's decision to suspend permitted burns starting on May 24, with the caveat that there might be zero permissive burn days before then. I conferred with Phil, who recommended we postpone until fall, saying "It's crazy dry out there. The thousand-hour fuels, a measure of drought, are already at historical moisture minimums. If fire were to get established in some of the heavier fuels, you could be mopping up and patrolling all summer."

Although I expected to do mop-up (extinguishing) for many days, the last thing I want is for smoldering burns in the punky stump holes to become fires in August and September.

Ironically, or perhaps perversely, Wednesday May 19 turned out to be a permissive burn day, followed by light rains the following two days which would've helped douse "smokes." I don't regret the decision. Waiting until the afternoon before a scheduled burn for a go/no go decision is too tight a turnaround for a large burn with lots of moving parts.

Mother Nature has spoken. We are listening. We wait for another burn window, meanwhile knowing that the pre-treatment alone reduces the risk of catastrophic fire.

Wildfire Preparedness and Evacuation Planning in a Pandemic: Experiences from Nevada County, California

by Shefali Juneja Lakhina
and Susie Kocher

Much like the rest of California, the Sierra Nevada foothills experienced devastating wildfire impacts in 2020. The North Complex Fire features on CAL FIRE's list of California's 20 largest and most destructive fires. It burned 318,935 acres, caused 15 fatalities, and damaged 2,352 structures across Butte, Plumas, and Yuba Counties. A number of smaller fires also affected communities in the foothills, including the Jones Fire, which burned 705 acres in Nevada County, caused over 4,000 evacuations, and destroyed 21 structures. Yet, size isn't everything. It is important to also pay attention to wildfire's wide-ranging and long-term impacts on forest health and community wellbeing. Developing a broader understanding of the social, ecological, and public health dimensions of wildfire impacts is particularly important during the ongoing COVID-19 pandemic, as communities cope with compounding crises, such as smoke, public safety power shutoffs, housing instability, food insecurity, racial injustice, and social isolation.

In this article, we present initial findings from a recently concluded National Science Foundation-supported research study on *Wildfire Preparedness and Evacuation Planning in a Pandemic*. Our aim was to study the social, ecological, and public health dimensions of wildfires during the COVID-19 pandemic. The objective was to examine how communities in two locations at very high-risk from wildfires—Nevada County in California and Larimer County in Colorado—perceived and practiced safety as they prepared for wildfires and recovered from wildfires during the pandemic. The first round of interviews was conducted between June–August 2020 and a second round of interviews was conducted between November 2020–February 2021. We conducted in-depth interviews with institutional

representatives from fire management, forest management, emergency management, and key utilities such as water and electricity, and with community representatives from volunteer networks, including Firewise communities, prescribed burn associations, and other regional and community-based organizations.

Here, we present our initial findings on the social and ecological dimensions of wildfire preparedness and evacuation planning in a pandemic from Nevada County. The social dimensions can be characterized by the new methods of collaboration and modes of communication adopted by local institutions, organizations, and volunteer networks. Across the board, teams re-organized to work from home or remote locations and coordination heavily relied on phone calls, emails, and apps for virtual meetings, including Zoom, Google Meet, Whatsapp, and Facebook. Local institutions and organizations adopted a range of innovative information, communication, and outreach technologies. Notably, the timely launch of the Ready Nevada County Dashboard, just days before the Jones Fire, enabled the orderly evacuation and repopulation of over 4,000 people. However, the new reliance on technology meant that many people who were not acquainted with or could not access these modes of communication got left out of community-wide wildfire preparedness and evacuation planning efforts. In fact, the compounding crises of 2020 were most severely experienced by people with disabilities, older adults, and people from culturally and linguistically diverse backgrounds, especially in remote areas that lack connectivity, support services, and infrastructure. However, community-based organizations and services proved essential, even as their volunteer base shifted over the months, due to health and safety precautions for older volunteers. The nature of volunteer work itself changed to allow for physically distant, virtual, and telecare interactions. These innovations enabled essential care and support programs to continue delivering meals and disaster preparedness messages to older adults and to conduct outreach for people with disabilities to prepare them for Public Safety

Power Shutoffs. Yet, a general absence of personal connections and meaningful social interactions due to COVID-19 resulted in prolonged experiences of isolation and mental health challenges for many.

The ecological dimensions of implementing fuel reduction activities during the COVID-19 pandemic were characterized by an overarching trend of urgency. The state of California considered fire hazard reduction work to be so critical in 2020 that forestry and fuel crews were defined as essential workers during the pandemic. This meant that most paid workers involved in fuels reduction projects continued their work. As a result, Nevada County experienced a surge of defensible space, home hardening, fuel reduction, and restoration work. As one research participant shared, people were home, ‘had more time and not much else to do.’ Also, wildfires were generally perceived as a more significant concern than COVID-19. The perception was that COVID-19 rate of spread could be controlled by following personal hygiene and physical distancing guidelines whereas wildfire risk was perceived to be mounting at an insurmountable landscape scale. The implementation of vegetation management programs largely continued ‘as normal,’ with COVID-19 related health and safety protocols in place. Notably, as of spring 2021, work on the Ponderosa West project, a shaded fuel break, was nearing completion on the west side of Grass Valley. On private lands, landowners employed a range of methods including thinning, pruning, and pile burning. Landowners worked alone, organized work parties with neighbors in small groups, or hired crews if available. In cases where large work parties were planned prior to the spread of COVID-19, some drop-offs were seen among volunteers who self-identified as high-risk. Looking ahead, there is a felt need among Firewise communities to be engaged in larger landscape level risk reduction projects, especially where private lands sit adjacent to public lands that in many cases remain poorly managed. In addition, fuel reduction along major transportation routes and highways remains a concern for evacuation planning.

Nevada County is unique in the Sierra foothills for its robust network of Firewise communities undertaking defensible space projects. Planning ahead, the Nevada County Coalition of Firewise Communities can be empowered, through the Fire Safe Council of Nevada County, with annual resources, a shared work plan with measurable targets, and regular capacity development opportunities with local and state fire management agencies. The Coalition can be a powerful ally to achieve wildfire risk reduction goals in inclusive and just ways. For example, Firewise communities can undertake a more inclusive approach to wildfire risk reduction by reaching out to new geographies and demographics. Current Firewise boundaries often leave out people living in mobile park homes and informal housing, including migrant workers and street encampments. Even within existing Firewise boundaries, engagement with low-income older adults, people with disabilities, and culturally and linguistically diverse households is patchy or insufficient. While there has been a lack of funding for various projects due to budgetary constraints, going forward the Coalition could consider other kinds of partnerships, such as raising private and philanthropic funds to implement wildfire mitigation and prevention activities on a larger scale. Healthy forests and watersheds in the Sierra Nevada foothills contribute to clean air and water for millions living across the Sacramento Valley and San Francisco Bay Area. Restoring ecosystem infrastructure and services in the Sierra Nevada forests and watersheds is a shared goal for all of Northern California. We hope our research findings and recommendations will motivate state agencies, local institutions, community-based organizations, and volunteer networks in Nevada County to continue to work in collaborative, agile, and responsive ways as they prepare for 2021 and beyond.

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