

## Transcript of California Burning Episode 5

### Our Future With Fire

Matt: You're listening to California Burning a five-part series, taking a deep look into the causes and potential solutions for the catastrophic wildfires that have been plaguing the West. I'm Matt Fidler. On this last installment we're going to focus on solutions because catastrophic wildfires are just a symptom of us ignoring the delicate systems that take care of us.

John D. Liu: And now you have a situation where you have a decade of drought, then you have massive wildfires, then you have terrible floods and then you end up with the toxicity from, from the leaking stuff.

Matt: This is California Burning. Stay with us.

Matt: You're listening to California Burning, a co-production of North State Public Radio made possible with generous support from Sierra Nevada Brewing Company. I'm Matt Fidler. This is the final episode of a five-part series, exploring the issues around the catastrophic wildfires that we've been experiencing in the West. All episodes are available as a podcast wherever you get your podcasts or at [californiaburning.net](http://californiaburning.net).

Matt: July, 2018 it was one of those extremely hot days in Redding, hitting nearly 110 degrees, when 15 miles west into the Shasta-Trinity National Forest a trailer being towed by a car, makes contact with the road, causing a spark, which then lights the grass on fire near the Judge Francis Carr Powerhouse at Whiskeytown Lake.

Randall Hauser: On the edge of Whiskeytown, and many miles away, really, it didn't occur to me that I would, that our house would be threatened at all.

Matt: This is Randall Hauser, architect and owner of a fire mapping service called ENPLAN. We're on a six-acre lot in the foothills, just west of Redding, California. At the time the Carr Fire started, Randall didn't think his house was in any danger. He was pretty far south of Whiskeytown Lake.

Randall Hauser: Then surprisingly about two days later, thee, or we had a knock on the door by the sheriff deputy saying we had to evacuate.

Matt: The Carr Fire was quickly becoming one of the more destructive fires in California's history.

Randall Hauser: I did what I could, before leaving. Gathered up all of the burnables on the edges of the house, mats, that kind of thing. Shoes, you know, anything that I could imagine embers igniting. I went up and I did a last blow out of the gutters.

Matt: After a few hours, he then gets in his car and leaves.

Randall Hauser:C ause, there very, there were very few vehicles out on the roads when I left. And it looked like the fire was going to be contained on the, on the north side of 299.

Matt: Randall was sitting at his office looking at fire maps on his computer and it looked bad. The satellite data showed fire starts all throughout his neighborhood. Much later, a fire investigator described how the Carr Fire moved through his property.

Randall Hauser: Came over that hill right there, across the road. And there's another subdivision, an older subdivision, up there, Victoria Heights, that probably 95 percent of the houses burned. And when that took off, all those houses were all very woody, woody. And they produced a tremendous volume of, of embers. And those embers just came over the hill like, like ocean waves,

Matt: Like ocean waves. Randall says, this is how home fires in the Wildland-Urban Interface often spread.

Randall Hauser: Picture an ocean wave crashing and exploding, right? And we're talking on rocks kind of thing and water shoots up into the air, in globules, in drops and so forth, spinning and turning. That's the way embers move as they're being driven up into the air and the fire is, is involved, it's not flames so much that we're concerned with in building fire resistance. It's resistance to penetration by embers.

Matt: And this is why Randall met me in Redding to talk about his experience with the Carr Fire and to show me his fire resistant home. We wind through the foothills and then into his neighborhood, which seems to be only burnt trees now, oak and a variety of pines. The burnt houses have all been cleaned up by now.

Randall Hauser: And here, this is the house, my house here you can see these we're in the process of clearing down the vegetation that was killed, the oaks and the and the pines.

Matt: Beautiful home.

Matt: Thank You. Not intended to be beautiful, intended to be fire resistant. We get out to take a look and the first thing you notice is that the house is built into the slope of the property.

Randall Hauser: Yeah, we're on a 30 percent slope. It was just where I sunk the house into the, into the earth.

Matt: It's a two-story house, but you enter on the high side of the slope on the second floor. So about 40 percent of the house is actually in contact with the ground.

Randall Hauser: There's that much less exposure to the heat of Redding as well as, as, as fire as potential. Combustibility.

Matt: Less exposed house to catch the ocean wave of embers flying over the hill. But the parts of the house that might catch an ember won't burn easily.

Randall Hauser: Stucco, exterior, fascia and the soffits are all metal clad. We have a, a band of either concrete or gravel all the way around the house, 360 degrees that extends out about five to 10 feet. That's non-flammable.

Matt: So nothing under or around the house will burn that might catch a spark or ember that can then spread to the rest of the house. Another common way that homes catch fire is when embers fly through vents and attics. But that can't happen in this house.

Randall Hauser: No penetration points. We have no vents in the house. Just happens to be the way it's constructed. We have SIP panels, structural insulated panels, instead of an attic, there's no attic.

Matt: He used metal structural insulated panels for the roof, which being metal won't catch fire. And the venting system is built into the panels and those vents they face down instead of in the path of a flying ember. Now the downside is that with these panels, he has to actually wash his roof regularly.

Randall Hauser: It takes a couple of hours with the same kind of brush you use on a car. But the reward is that it looks beautiful once it's washed and that it's even going to be more resistant to the sun, and to a fire because it makes it slippery, right? So then the embers washing over the house would be more likely to flow off.

Matt: Randall built this house 25 years ago, he said the roof has at least another 25 years left. Let's go back to the summer of 2018 when Randall and his wife were first allowed to return to their neighborhood after the Carr Fire had passed. Before they arrived home, they didn't have any clues about what had just happened. Just that the fire had burned through their neighborhood. They drove together over the bumpy roads through patches of still smoldering forest.

Randall Hauser: Well, I remember when I got on our subdivision street, every house as I approached ours left and right was down, down, boom, boom, flat ashes, still smoldering. And I got to ours and I could see through the smoke was still quite a bit of smoke on them hanging on the ground and my God, the thing still standing.

Matt: Randall did everything right from maintaining his land and his defensible space to designing the perfect house to survive a fire. And because of that, his house did survive. So yes, with knowledge preparation and a little bit of luck, you can greatly increase your chances to save your home from a wildfire. On this episode we're going to talk about how to keep your home from burning in a fire and onto solutions to prevent these kinds of catastrophic wildfires in the first place. This is California Burning.

Matt: If the natural disasters happening all over our country are making you feel helpless or anxious about the future, then this episode is for you. Living in Chico, just a few miles from where California's most deadly wildfire is still affecting everyday life, one could get fatalistic, but I'm here to tell you that there are things that we can do to counter all the problems causing this.

Matt: Now, of course the most difficult part about all of this is the political aspect. Can we get past our own prejudices about this problem and the people involved? The debate often goes like this: one side points out a problem on the other side and refuses to look at their own problems. Then nothing really changes and the problem continues or gets worse. Well, if you're tired of this nonproductive approach, then this episode is also for you because the solutions to this wildfire problem are not about right or left. Reactionary, even when they are well-meaning positions on both ideological sides are a major cause of this wildfire problem.

Brittany Dyer: The way I see it is there is this social pendulum and we've seen it before. Let's say it went arguably too far to the right with logging and then we can argue that it potentially went too far to the left with some of the environmental compliances.

Matt: This is Brittany Dyer. She's the California State Director of American Forests, America's oldest national conservation organization. She says that the problems around forest fires are demanding new levels of consensus and cooperation across parties and ideologies,

Brittany Dyer: Tree mortality, drought, the challenges in and around pests; the last five years of California, have really encouraged people from the left and the right to sit down and being able to think about different solutions on the ground. There may be things that we don't agree on, but there's a lot of things that we do agree on. And so I think it's really important as we move to a conversation about solutions that we keep that pendulum grounded in the middle and just avoid that, maybe that, natural tendency to take it back to the left, back to the right. Instead, let's look at the values across the board and what that looks like for not only future generations, but this generation.

Matt: Brittany has extensive experience working on fire-related forest projects around drought, tree mortality, pest disturbance and climate change. She says that we need to take an active approach to return our forests to good health, which will in turn help with the wildfire issues that we've been experiencing.

Brittany Dyer: We've always, we Homo sapiens, have always been managing these forests and we moved from healthy forest conditions to really where we're at today after fire suppression and other decision making tactics near out the decades, where now we might not have the diversity that we need, or we may not have the forest structure composition that's truly desirable in order to mitigate climate impacts.

Matt: Variety in structure of a forest helps biodiversity. Brittany thinks of it like a patchwork quilt and with that diversity of plants and trees, the forest is more resilient to pests, disease and fire.

Brittany Dyer: So for quilt-like forest structure and composition are really key, right? We want to improve the ecosystem function and the ability for us and all living things to, to really benefit from all the services provided So being able to have diversity among wildlife plants, et cetera, but, but also just be able to have different ages in different stand structures, to really have the best public good for the biggest portion of people and wildlife.

Matt: But Brittany can't express strongly enough how there is no one-size-fits-all solution for wildfires. Part of the solution could mean some forest thinning or prescribed low-level fires like we've talked about in past

episodes. But California is an extremely diverse place. Its forest vary wildly and the communities that live around them are just as varied.

Brittany Dyer: So we have to be able to use place-based knowledge. I'm only saying that not all trees are good and not all fire's bad, but how do we actually get that on the ground? How do we implement that on a day to day basis? Well, there's a very specific role for local government, for state government, federal government, but there's also a very, very clear role for nonprofit organizations for incorporating, your tribes in the area. And then finally private industry. This has to be able to sustain itself in the long term and being able to incentivize different products are able to actually improve forest health. So it really comes full circle.

Matt: Brittany Dyer, California State Director of American Forests.

Matt: I do understand the reluctance that some have about these partnerships. Forest management by the government 100 years ago was uninformed at best, giving huge lands up for clear-cutting and suppressing all fires. Natural or not. And later political compromises didn't do much better, clear-cutting and making tree farms out of some land, but leaving other lands alone with no management at all. So they can be quote "natural." Well, neither of those choices were natural at all. And both of those kinds of forest ended up more flammable than before.

Mike Mitzel: Yeah, pretty much in my office right here.

Matt: But now in 2019 forest managers have much more knowledge and as it turns out, both producers of lumber and forest conservationist, want at least one common thing, fire resilience.

Mike Mitzel: So we're up on Coutolenc Road on a Sierra Pacific property and here we're in a fuelbreak area that we built back in May of 2018.

Matt: Sierra Pacific Industries owns about 1.7 million acres of timberlands, making them the largest private landowner in the state. Wanting to know more about how they manage their forest for fire resiliency, I met up with Mike Mitzel in Paradise to tour the timberlands that he manages for Sierra Pacific Industries right above Paradise. I hopped in his truck and the first place he brought me was the project on Coutolenc Road near the Paradise Lake recreation area.

Mike Mitzel: Yeah. You know, we are concerned about, you know, a fire starts from activities down there, you know, illegal campgrounds, smoking, that sort of thing. So we wanted to protect all our lands to the east here. And the

idea was to build this fuel break around, you know, this highly used area by the public.

Matt: Without the forest litter, a ground fire will just burn itself out. And the Camp Fire never made it all the way to Paradise Lake, the town's water supply. But to pay for this firebreak they did have to get rid of some larger trees as well as the more flammable chaparral and brush.

Mike Mitzel: You know, we took out, you know, merchantable trees there, you know, all age classes and that helps with the economics of getting that project done, that allows you to go back and treat those fuels that are on the ground, the sub-merchantable material that may not be economically feasible to do, but you have enough revenue there so that you can get complete the whole project. To go in and just remove unmerchantable material in a timber stand, number one, in Tahoe, a good example, it's not going to get the results that you want. It's not gonna make it fire safe.

Matt: Wait, why not?

Mike Mitzel: Because you wouldn't be taking enough material out. You got to take some of the, the timber out and space it out so that you know, it's not susceptible to drought.

Matt: A forest canopy generally helps conserve water, blocking the sun and slowing evaporation. But when the understory is so dense with vegetation, there's just too much competition for the water that's available. And trees can become weak and sick leading to pest infestations like the bark beetle. And in long droughts and a warming climate, the results are even worse. Dense dying forests ready to go up like a tinderbox.

Matt: Partnerships with companies and cogeneration plants can help get rid of some of the excess fire fuel in the forest, but the economics only work in some locations of California, and cogeneration plants are a rather dirty source of power, when more clean sources are becoming available.

Matt: We're going to take a short break and when we return we're going to hear from a company with an entirely new attitude about what to do with this excess burnable material in our forests.

Valerie Navarro: What we're doing with our company, Clever By Nature, is actually turning it into consumer grade products. We have the ability to put it into textiles.

Matt: You're listening to California Burning, stay with us.

Matt: Welcome back to California Burning, exploring solutions to the wildfire problems that seem to be getting worse here in California and the West Coast in general. California Burning has been made possible with generous funding from Sierra Nevada Brewing Company.

Matt: Fires have always been an issue here in California, but for many of us, including CEO of Clever By Nature, Valerie Navarro, the Camp Fire fundamentally changed everything.

Valerie Navarro: For us. This is, and for me personally, this is the line in the sand and this is a defining event where, you know, this is where we need to make a stand.

Matt: Her company is removing excess, woody, burnable material from the forests. So when a fire hits next, it won't burn so severely. We've talked about this on past episodes. Many organizations are doing this on small scales, partnerships with timber companies, grants to clean up important areas near neighborhoods, but thinning requires the removal of small material. Timber companies want the big material they can sell, but Valerie is taking the material timber companies don't want to make biochar.

Valerie Navarro: Biochar is a, very simply, organic material like wood, that is placed in a vessel, what we call a retort, that is run at about 1,300 degrees Fahrenheit (650 C) and that is, in the absolute absence of oxygen. So what you're doing is, you're changing the characterization of that biomass, that wood or agricultural product like, it could, be a rice hulls, could be walnut hulls and you are turning it into an end use that's viable. So if you take for example, 3,500 pounds of shredded bark beetle pine, like we're doing right now up in Colorado and about to do here in Oroville, and you put it into that vessel it will give you 700 pounds of very high porosity product, which has a ton of different uses.

Matt: Basically turning an old wood into a very usable manufacturing material. And by doing it in the absence of oxygen, that makes it more porous and much cleaner to produce than that homemade backyard biochar that you may have seen on the internet.

Valerie Navarro: And that does set it apart from other biochars in terms of how it's made and something else happens there and it gets an actual ionic structure so it can pull nutrients to it, it can pull bottled chemicals to it. It also pulls liquids like water to it.



Matt: So this is a porous product and well, what do you make out of it?

Valerie Navarro: So one of the most obvious uses that you likely hear about biochars of, you know, different scopes is a soil amendment. So yes, it's great for that. And part of the reason is it's a fantastic host because you have all of those little nooks and crannies in that porosity. It gives way to repopulate it with nutrients. So it's a great soil amendment because if you put it into clays, for example, it can help remodel those clays and open up that otherwise adobe type clay, that's an issue for a lot of farmers. If you have a loamy soil, it actually can add more structure to that where maybe your soil drains too quickly, It can actually hold some water back.

Matt: As we've heard in past episodes, soil is a major issue for forest health, which then directly impacts fire. You need healthy soils to create healthy fire-resistant forest ecosystems. Valerie has used this biochar to help with erosion issues on the ridge after the fire. And biochar isn't a new thing. It can work wonderfully to help repair soils to avoid erosion, stabilize the ground or even agricultural uses.

Valerie Navarro: But what we're doing with our company, Clever By Nature is I'm actually turning it into consumer-grade products. We have the ability to put it into textiles. And the way we do that is we actually masterbatch it that's what it's called, with a polymer and, or a bio rubber, a bioplastic so it can then be integrated and pelletized and turned into fibers, and or, rubbers and or plastics. So then what you have is something that is fully compostable. For example, we did a phone case that's made out of, the first one was made of, ABS plastic with 20 percent biochar. Now we've been able to make one that's made out of bioplastic and 90 percent biochar. So we're systematically moving in our material science and getting better with that. So that phone case can now be fully composted in your yard. You don't have to take...

Matt: Wait, Your phone case can be composted.

Valerie Navarro: You can.

Matt: In your home compost, not like the industrial heavy high heat compost,

Valerie Navarro: Right, you could do it because it's a PHA bioplastic, which is compostable in the ground, and 100 percent biodegradable in the ocean as well.

Matt: They've set up their first operation in Colorado, converting pine trees that have been killed by bark beetle infestations into this material. Valerie is here in California, working on opening a new site in Oroville, just south of Paradise, to do basically the same thing in the force of this area. Turning forest fuel and burnt trees into products people want to buy like a new case for a smartphone.

Valerie Navarro: The first thing we did is phone because we wanted to do consumer product that was, you know, had utility and something that literally everybody has in their pocket. Because we're also telling the story here through product that needs to be understood. But we are able to make just about anything you could think of out of a plastics that we're playing with different manufacturers are doing different things.

Matt: Valerie Navarro of Clever By Nature.

Matt: Not all solutions to this problem are going to be modern technological advances. Some new ways of thinking around fire protection can actually come from very old ideas. I'm going to return to the fire response weekend that I attended in the Los Altos Hills where I learned a lot about how to make your home more fire resistant or even better, how to build your home out of materials that won't burn in the first place.

Brennan Byrd: I'm gonna pass that around. So this is cobb , Cobb is an old , its' a little dirty . So you don't want to, you know, it's okay, but we can get our hands dirty a little bit.

Matt: Going beyond just defensible space to save your home is important because most of the fires that get so catastrophic are windblown ember fires with flaming embers traveling up to a mile ahead of the fireline. This is why I'm here learning about alternative building materials that won't burn in a fire. Like this thing I just heard of, cobb

Brennan Byrd: Cobb is an old English word that means "lungs" and cobb structures are built lump by lump. Today about half of the world's population, around 3 billion, people still live in buildings made of earth. And is this going to be high thermal mass? High fire resistance? Yeah. So, cobb houses effectively are not going to burn. I mean the earth is not going to burn.

Matt: Cobb lumps are made from soil, sand and straw in a very specific mixture. You stack those lumps on top of each other while it's still moist to build walls and a structure that can be almost any shape or design you want. It's very flexible. Do an internet search for creative or amazing

cobb homes and you'll see a bunch of different inspiring designs. But more importantly, cobb is fire resistant.

Brennan Byrd: Currently cobb is not actually in the international building code. There's some amazing folks with the Cobb Research Institute. John Fordice, Michael Smith, other folks that are working currently to get this into the international building code. So, power to them and the folks that are pretty hard work into that,

Matt: But in many places in the U.S. including California, straw bale home construction is legal.

Brennan Byrd: So you can build a straw bale home in California, but it's a non-structural use of straw bale, meaning that has a post and beam structure that's supporting the roof. And then the straw is the infill. And when covered with an earth and plaster, this is very fire resistant.

Matt: You may be thinking, really straw bale construction is fire resistant? Well, yes. First straw bales are very densely packed. If you've ever tried lighting a tightly packed bale of hay with a match or a lighter, it's pretty much impossible. It's like lighting a closed phone book on fire. But straw bale walls are also protected by an inch or two of stucco, which makes it very fire resistant.

Brennan Byrd: So stucco, this is a mixture of cement, lime and sand. One inch of stucco has the, the one-hour fire rating that we want, right? That can withstand these fire conditions for an hour. And then the straw bale in and of itself, if failed, It's covered. There's no oxygen, so it's not going to burn.

Matt: Brennan says you don't need new construction to get these benefits. You can do an energy retrofit using these more renewable and less toxic materials like earth and straw to make your home more fireproof.

Brennan Byrd: And so this is exciting. You can rip out the fiberglass of your otherwise conventionally designed home, use a molding, mix the straw and the clay sifted together, tamp it in, do an earth and plaster. Do, you know, wire mesh or burlap to help you create a bond and do, you know, cobb or stucco over your eaves. And now you're on your way to create an, a more, fire resistant earthen home, even with a traditional stick frame home.

Matt: Thank you Brennan Byrd from the fire response weekend at Hidden Villa in Los Altos, California. There's some great examples of both cobb and straw bale home design on our website, [californiaburning.net](http://californiaburning.net).

Matt: Before we head into this break, I want to return to Valerie Navarro because she's not just a business owner trying to manufacture products from forest litter. As a community member, she's involved with those trying to improve our emergency response. Because during many of these fires, communications failed, cell towers went down, the Emergency Alert System wasn't triggered. Most people found out from neighbors or even relatives calling from outside of the town that there was a fire. There was basically a communications blackout, but Valerie wants us to know that there's a new system called MOSES.

Valerie Navarro: And that is an acronym which is the Mobil Operations Satellite Expeditionary System. So what MOSES does is it creates a 35-mile radius communications bubble. It's a trailable mobile unit that is military grade and even EMP proof,

Matt: Which means it will survive electromagnetic pulses that sometimes knock radio stations off the air during heavy sunspot activity. Basically, this device will extend cell service, radio service, TV service, internet service, wherever this mobile unit travels to. Even if the towers and transmitters aren't working.

Valerie Navarro: And it would create a 35-mile bubble where 100,000 people within that bubble could go to communicate on any apparatus they have where the cell phone, whether it's radio, whether it's TV, internet, and that would keep things moving regardless of impacts to cell towers. The cell towers could all go away and it would still operate. So Santa Clara County is getting two of those and they are deployable when they're called. We are right now working on the next two for Butte County. We believe if there's anywhere we should get those next two, they would be here in Butte County.

Matt: Valerie Navarro, owner of Clever By Nature, talking about their efforts to secure a MOSES system for Butte county.

Matt: We're going to take one more short break and return to learn how regular people can help be involved, restoring land and returning ecosystem functions, including fire resilience back to the land.

John D. Liu: That's what we need to do. So who can do that? Well, the homeless people can do that. Young people who want to do that, can do that. Retired people who want to do that, everybody can do that.

Matt: You're listening to California Burning. I'm Matt Fidler. Stay with us.

Matt: Welcome back to California Burning made possible with funding from Sierra Nevada Brewing Company. My name is Matt Fidler.

Matt: I've spent most of the last 18 months studying fires and fire's place in our ecosystem. There are many reasons why fires have been causing us so many problems recently and it boils down to one overarching theme, how we have lived on and taken care of this land. Fire is a naturally occurring thing and as we've shown in previous episodes. Fire needs to happen on these landscapes, but it should be on our terms, when the fire will provide the services that we need, like reducing the forest fuel load on the ground and keeping tick and pest populations under control. When we know how these ecosystems work, we can make them work for us. The big things that we value in the world are all provided by these ecosystems from life, food, water, natural resources, shelter, beauty, recreation.

Matt: That's why you may hear some of my guests say things like ecosystem services. A functional ecosystem helps with groundwater retention, wind regulation and local rainfall and those all directly impact fire severity. And a big part of this is the health of the soil and its ability to hold water and nutrients. To get a better understanding of how this all works. I met up with Wendell Gilgert, he's the Director of the Working Landscapes division of Point Blue Science where he assists ranchers, farmers and others making the best use of their land. I wanted him to tell me how you improve a landscape to provide better ecosystem services such as fire resilience.

Wendell Gilgert: I tell all the young people that I work with, it's not rocket science. It's more complex than that. It's tremendously complex. You know, cause you've got all these systems that are moving in different ways and all these processes and then you lay on top of that politics and economics and culture and sociology. So how the world works through all these different lenses that we all have to filter them through, then becomes incredibly complex. You know, putting a man on the moon is a trajectory. You know, we can figure that out with math and engineering. But the most difficult thing for humans to do is to live on an acre of land without spoiling it. And we have not figured out a way to do that yet.

Matt: Wendell told me early on in our talk that now in California we have five seasons.

Wendell Gilgert: The new joke is we have five seasons now in California, winter, spring, summer, fall and fire. Okay. So you know, and that's, that's our new reality.

Matt: Basically, Wendell is saying, we can't look at fire as an isolated problem anymore. Fires are becoming more severe as we change the nature of our land. And this problem can't be understood with reductionist science that ignores the systems that these fires existed.

Wendell Gilgert: Or we can look at a fire and we can say, okay, here's the problem, without looking at the system. So do we look at the water cycle? Are we looking at nutrient cycles? Are we looking at how succession is occurring or not occurring? Are we looking at pollination? How effective is photosynthesis? Are the trophic levels of different kinds of food available for wildlife available or not available. So you kind of look through this lens of the land doctor. So how's the patient doing? How's Mother Earth doing here and what's the prescription to get her better? You know, maybe it's some rest, maybe it's some brush management. Maybe it's planting, maybe it's prescribed grazing, so whatever it is, the land, like people can get better with conservation prescriptions

Matt: To solve the underlying problem of catastrophic wildfires, you need to improve the function of local ecosystems. Treating only the symptoms of the problem, the excess fire fuel, the overly dense forest is a good start, but it's not enough.

Wendell Gilgert: The upshot is that we're putting a lot more carbon dioxide and water vapor in the atmosphere.

Matt: When talking climate science, we often talk about the carbon cycle, burning fossil fuels from the ground and putting that carbon right into the atmosphere via smoke, which then traps warm air. But water vapor traps warm air as well. Just like with carbon, we need more of our water in the ground to hydrate the soil rather than the upper atmosphere where it traps heat. Both of these systems are out of balance, but both can be improved with the help of healthy vegetation.

Wendell Gilgert: Go back in time to when you were a sophomore in high school and you were learning about photosynthesis and recall the equation. Okay, it's  $\text{CO}_2$  plus  $\text{H}_2\text{O}$ . So water vapor and carbon dioxide in the presence of sunlight, the plant produces sugar,  $\text{C}_6\text{H}_{12}\text{O}_6$  with oxygen given off. So what is that, it's sugar. It's carbon. And so that plant to the extent that that plant can really grow and be robust is building sugar in, you know, anybody that drinks wine knows that sugar is referred to as bricks. So bricks as a measure of sugar in the plant. And, the higher the bricks, the more productive the plant. So we can, I've got a spectrometer in here. We could take a look at these plants and see how much bricks this plant is producing. Right now, if it's struggling, if it doesn't have the right

amount of nutrients, water, sunlight, and, and soil conditions where the soils compacted as soil has, you know, things in it that, that keep the plant from growing, well then it's going to struggle and the bricks are going to be like 2 or 3 or 4 percent, but if the plant has everything it needs and is growing robustly, you know, you could have bricks north of 25 percent, okay.

Wendell Gilgert: That's a big difference when you think about all these plants here. Filtering and taking carbon dioxide and water vapor out of the atmosphere, it is our least expensive, most hopeful way to, you know, turn around climate change,

Matt: Repairing local ecosystem function can happen with willpower. I've seen many examples all over the world. Yes, it seems daunting to reverse global climate change, but local ecosystems can be greatly improved by community members, improving the lives of the people who live there too. And it starts by just understanding what those systems need to thrive.

Wendell Gilgert: And, and one of the main things is building soil. Let me show you a real quick, please.

Matt: Wendell goes to his truck and picks up a little trowel and brings me to a patch of grass growing back in an area that was lightly burnt by the Camp Fire several months earlier.

Matt: So what are you doing here?

Wendell Gilgert: I am getting into the soil and looking at the roots of these plants. And if these plants are healthy and if the soil is healthy, there we start to see it. You see how the soil adheres to the root. So that means that this plant is pulling carbon dioxide, pulling water vapor out of the atmosphere. It's building sugar. It's producing foliar matter on top, but it's also exudating that sugar down into the soil. And what's happening right here.

Matt: You can tell that with the little bit..

Wendell Gilgert: So yeah, you see how the, how the soil is adhering to the root. If I pull, if I pulled up a plant where the soil wasn't adhering to the root, then it's not building, you know,

Matt: Is that stickiness from sugar, is that literally what it is?

Wendell Gilgert: It is literally the exudates of the sugar that the root is putting into the soil so that all what we call soil and edaphic are like, you know, soil plants

and animals. So we call them edaphic flora and fauna. So all that edaphic flora and fauna, see that root? That is beautiful. See all that, all of this soil that's adhering to it. If we put that in a microscope, you'd see fungus and bacteria and literally hundreds of soil microbes that are feeding on that sugar that's being exuded by that root.

Matt: Because soil is a living thing. There is some mineral rock, but soil is mainly living microbes and decomposing organic material and without water, these reactions passing of energy from life form to life form, plants can't grow in that soil. Healthy forest won't be able to live in that soil and healthy soil absorbs and stores water for all life, including us to use when it's not raining. Something is especially important for us in the West with our long dry summers. If you're skeptical about the importance of soil health, Wendell has one argument to make for you. Just think about the Dust Bowl in the 1930s, the federal government under Franklin Roosevelt started a soil conservation service and hired a soil scientist named Lowdermilk.

Wendell Gilgert: And he tasked Lowdermilk to go around the world to where there are great civilizations and see if he could ascertain what role the soils had to do with those civilizations flourishing and ultimately not being there anymore. You know, so he went to Egypt, he went to China, he went to the Middle East. And what he found was the same thing over and over and over again. So where the Gardens of Babylon, where were the cedar forests of Lebanon, where the Garden of Eden was, where the Nile and the Nile Valley were, were all deserts. Now these are not stupid people. These are people that invented the clock. They invented the wheel. They invented math. These were intelligent people. If they're in the room with us right now, they're more intelligent than we were, maybe, but they didn't have the same technology. So now we've got the technology and we're really accelerating what they already did. And that was to certify, you know, this world and you know, people to keep talking about whether the sustainable, this sustainable that. And you know, I and others would argue that we have no idea what sustainability is, cause we've never done it. There's no history of any human doing anything that's sustainable. And that means for centuries. So China's been doing what they'd been doing for centuries and look what's going on there. You know, the destruction of the, of the Yellow River, you know, Valley.

Matt: Wendell Gilgert of Point Blue Science.

Matt: And since Wendell mentioned China's Yellow River valley and how traditional agriculture has turned it into a desert, I thought we could end



the series with someone who has documented people restoring that same valley to a fertile, productive ecosystem once again.

John D. Liu: Hi, I'm John D. Liu and I'm the Ecosystem Ambassador for the Commonland Foundation. And I'm a visiting fellow at the Netherlands Institute of Ecology. I study function and dysfunction in terrestrial ecosystems on a planetary scale.

Matt: John has made films documenting the restoration of ecosystems all over the world, including the film Green Gold that can be viewed on YouTube. He says the key to such projects is the soil.

John D. Liu: Over a very long period of time, the soil forms, each generation of life dies and gives up its body and builds up an organic layer on top of the geologic materials. And that layer is the microbiological habitat, aerobic bacteria. You have fungi, you have insects and all these microscopic organisms and they're not something to be afraid of. They're not something to not understand. They are something to be rather fascinated about because they're the basis of creating the systems which are feeding the plant materials which in turn feed the animal materials. And so you know without them and without the photosynthesis of the plant materials, we wouldn't be here

Matt: In this process contributed to soil buildups for millions of years. Then at one point, maybe tens of thousands of years ago, human beings first started to clear plant cover for agriculture, which started the soil degradation process and as the human population and our technology grew at a faster and faster rate, we cleared more and more vegetation with mining, large scale deforestation, huge tracks of industrial scale farming.

John D. Liu: Then as the organic layer is reduced, the temperatures rise.

Matt: Remember, plants convert the sunlight, the solar radiation into energy to grow, without a plant canopy blocking that sun it just hits the soil directly drying out any moisture and life in those soils. Life cannot survive without water.

John D. Liu: So imagine you have all this agricultural land, which was once covered either by trees or by perennial grasses. So either way you've removed the canopy. So what happens when you do that? Then the solar radiation hits, the temperatures are raised and it begins to dry everything out. So you're essentially dehydrating a once functional biome. And you know these, these areas, we're probably savannah, forest savannah's with

mixed wetlands. So now you want to have agriculture and you drain the wetlands and you remove the tree cover and then you plow up the perennial grasses. I mean, every one of those actions is a massive change. So what ecosystems do is they, they adapt to whatever is happening, but they adapt, in this case at lower and lower levels of functionality. And now you have a situation where you have a decade of drought, then you have massive wildfires, then you have terrible floods and then you end up with the toxicity from, from the leaking stuff. So if we never get this right, then this cycle is repeated and repeated and we should know this because it's already been there historically. So all of the ancient civilizations have gone in the same direction. So they took down their canopies, they dehydrated their biomes, there, If you go to these places, there are deserts.

Matt: I'm afraid this could be happening to the town of Concow right now. Concow used to be forested. Much of that forest was cut for timber over 100 years ago. It's had fire after fire one every nine or 10 years for many decades. And there have been no major attempts at restoring that soil and trees just aren't growing back anymore. When the Camp Fire started just east of Concow, there weren't many trees to slow the wind or that fire down. Just dry, invasive annual grasses and shrubs. And when you add heavy winds to that equation, you have a perfect storm for the fire to burn right across Concow and into the dense Town of Paradise, which is exactly what happened during the Camp Fire.

John D. Liu: And when you have extreme temperature differentials, because over here you have a canopy and over here you have, you have something which is exposed. Well that is what creates wind. So you can create, you create motion this way and then if the density of the air is different now because it's not carrying as much moisture, then you get this like very serious wind or you get vortex activity. So when you hit get vortex activity, this is like tornadoes or hurricanes or firestorms, then you know, what are you going to do about this? This is physics. You're not going to do anything about it, then, you know, at that, at that point it's cause and effect. You're done. You know, it's only when we understand these factors and we try to be proactive in creating a denser air, maintaining a lower surface temperature, maintaining moisture in the lower atmosphere where it can condense and precipitate.

Matt: This is the point of Ecosystem Restoration Camps. The idea is to gather people who have the time, who have the passion and know this work needs to be done to restore ecosystems so they can support us.

Humans. John has documented successful efforts to restore ecosystem functions all over the world.

John D. Liu:

You know, the things that we need to do are increased biodiversity, increase biomass, and increase organic material in the soils. So if we all joyfully come together and do that instead of like run around thinking that, well we got to get to the store, we got to do this and that and yeah, let's bring over everything from Bangladesh and Chili or something or West Africa. Let's imagine that we sit down and we eat together and we do some work and we restore the, the streams and we restore the vegetation and we restore the soil and we find out, well, you know, a lot of people say, well, how can you do that? We have to eat well, gee, you think that dysfunctional ecosystems are more productive than functional ones? That's ridiculous. The functional ecosystems are vastly more productive and vastly more valuable. And so that's what we need to do. So who can do that? Well, the homeless people can do that. Young people who want to do that can do that. Retired people who want to do that, everybody can do that and you know all the students, every single person should know about this because every civilization that didn't protect their ecological systems and those systems collapsed, those civilizations failed and the sand is blowing over the ruins of once great civilizations around the world.

Matt:

You can learn more about John Liu and his restoration efforts at [ecosystemrestorationcamps.com](http://ecosystemrestorationcamps.com). You can get links to all our guests and many more people that I interviewed for this series at [californiaburning.net](http://californiaburning.net).

Matt:

We also have videos and pictures of the people that I talked to and the places I visited. All episodes of California Burning can be found anywhere you get your podcasts and on the NPR One app, or at [californiaburning.net](http://californiaburning.net).

Matt:

In the first episode we decided that Smokey Bear let us a stray. He said that all forest fires were always bad. Well times have changed and I encourage you to visit [smokeybear.com](http://smokeybear.com) now, his message is now one that accepts the complicated nature of forest ecology and Smokey is just as concerned with the more complicated than rocket science nature of this problem. He accepts that fire might be part of the solution, so please don't give Smokey grief he's updated his message. My message from the series is simple. To solve the issues that we're having with fires, we need to accept our role in maintaining functional ecosystems, from forests to grasslands to our own neighborhoods. And by understanding our own

land and our role in taking care of it, we can make our local ecosystems more functional and more fire resilient.

Matt:

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