Transcript of California Burning Episode 3

Managing for Fire

Matt: Welcome to California Burning a co-production of North State Public Radio made possible by generous contributions from Sierra Nevada Brewing Company. This is the third episode in a five-part series looking into the issues around wildfire that we've been experiencing in California, and the West in general. All five episodes are available as a podcast wherever you get your podcasts or at californiaburning.net. The first episodes in this series were about past management practices in our forests and how they affect wildfires. We also learned that the Native Americans that maintained these forests for thousands of years with prescribed fire. Then during the period of Western expansion, first large tracks of old growth forest were cut. Then the use of fire was eliminated from forest management with nothing in its place to maintain them. This caused the new forests to grow back with overly dense stands of small trees with accumulating brush and forest litter, like dead branches and pine needles, which burn and spread fire easily.

Matt: But the purpose of this episode is to find out what are the best practices for managing our forests now given their current conditions and our societal needs. The very topic of maintaining our forests is a difficult one. It seems to put the environment in which we live against the economy, which keeps our society functioning. Unfortunately, with the conversation framed this way, no one concedes anything and therefore nothing changes. So this conversation doesn't even happen much anymore, but it's a conversation that needs to happen because catastrophic wildfires are destroying our forests and threatening our communities around the state. Culminating with the Camp Fire that burned 90 percent of the Town of Paradise, destroying over 19,000 homes and killing at least 86 people.

Zeke Lunder: The Camp Fire is kind of this defining moment in all of our careers in that it seems like everything changes now. Lots of things that we didn't expect to happen happened.

Matt: This is Zeke Lunder.

Zeke Lunder: I'm a geographer. I'm working on wildland fire issues in Northern California, and I use mapping and the other tools of a geographer to help people understand the different ways that fire operates on our landscapes.

Matt: Zeke's going to teach us about how fire operates on a landscape level later in the episode. And we're going to talk to a variety of people who are managing forests in California. From forest rangers and firefighters to private land owners and timber companies, and that's the point of this episode: to get a better understanding of fire, and how human management of these forests affects the way fire behaves. If we don't understand this basic knowledge, we'll never solve our wildfire problems in the state. On this episode, we are going to be focusing a lot around Northern California, but the lessons around fire and fire behavior are universal. Welcome to California Burning, managing our forests for fire.

Matt: So yeah, managing forests in a state with 40 million people will be tricky. We have lots of stakeholders here, both public and private, who may have completely different goals for their land, but before we talk to those with the most at stake, I think we need to understand some basics of wildfire behavior. Let's go to Humboldt State University in Arcata, California, which has a highly regarded forestry school. It's nestled in the redwood forests of Humboldt County. They have a one of a kind Wildland Fire Lab with the mission to conduct fire research to better understand and manage fire adapted landscapes.

Jeff Kane: We're dealing with a few legacies. One is the legacy of fire suppression and the legacy of logging, right. We've altered a lot of these forests.

Matt: This is Dr. Jeff Kane. He's the Director of the Fire Lab and Associate Professor of Fire Ecology and Fuels Management at Humboldt State University.

Jeff Kane: You know, older forest tend to be more resistant to even wildfire today, but they can also be susceptible. But we have a lot of young forest, we have a lot of dense forest and that's largely reflective of our past land management choices.

Matt: Again, to state those choices bluntly, they were first: cut all the big valuable trees and get out of there, then leave it alone and let the forest get overgrown. Now we have these overgrown forests and we need to relearn how to predict fire in them.

Jeff Kane: So the, the primary factors that influence the fire behavior: how hot it is, how fast it moves, how tall the flames are, are how much surface fuels you have. So in the absence of fire, those surface fuels build up and so you have more surface fuels over time, and that contributes to greater flame lengths and greater fire behavior. The other part is how densely packed the fuels are. And so we, from the science of it, we talk about two

things. One is the crown bulk density. The younger the trees, the denser the crowns are, they're closer together. There's more fuel per unit volume area. And so that can allow for the spread of a crown fire by having young, dense forest. And then the other part with young forest is that they have, their crowns are typically lower to the ground, so that distance between the surface fuels and where the crown fuels are available, that can transition from a surface fire to a crown fire and then spread. So what we see here in the Northern California is that oftentimes where you have these young plantations, or maybe they're even denser than they would have regenerated naturally, that you could carry a fire very easily. And those areas tend to be, you know, the more severe fires where you have lots of tree mortality.

Matt: Compare this to a more biodiverse older forest.

Jeff Kane: And for older forests they tend to have more varied structure. They have larger trees that are often much higher off the forest floor.

Matt: Trees lowest branches, we often call them ladder fuel because a ground fire can use them to climb into the tree canopy, which then spreads fire fast. But old growth trees' lowest branches don't start until 10, 20, 30 feet off the ground. Way too high for flames to reach in most ground fires. Plus, huge trees have bark that are inches thick and don't burn easily. Studies of tree rings have shown that 100-plus-year-old trees have survived many fires throughout their lives.

Jeff Kane: All of this I should just couch by what the conditions are during the fire, whether it's the Camp Fire, the Carr Fire, Santa Rosa fires, these were pretty extreme weather events; high wind speeds, really dry conditions, and it's just a recipe for severe fire.

Matt: And of course, the species that make up these forests also make a difference in how frequently these forests want to burn. And this is where a lot of Jeff's research goes. He burns different tree litter: dried pine needles, twigs and branches of different species. And he's found that species that tended to exist in more fire-prone forests have litter that burns easier.

Jeff Kane: A classic ponderosa pine or Jeffrey pine, they have these really long needles that builds a nice fluffy fuel bed that, you know, the idea is that, you know, it facilitates the spread of fire. So yeah, you get higher flame lengths, but it's more rapid combustion. So the idea is that yes, it's gonna get hot if you're a tree, but it's not going to be hot for very long. And these species often tend to have really thick bark and so they can

withstand. Other species, like an example would be like lodgepole pine, which tends to have shorter needles, more compacted fuel beds, doesn't burn very well as a surface fire, and they tend to historically had lower frequency, less common fire, maybe every 30 to 100 years. And they have really thin bark. And so it's showing us the ecology of California and, and more broadly the western U.S. conifer forest. And it seems to correlate with what we know about the fire history for these species.

Matt: Fire history varies considerably from place to place with some forested areas regularly burning every five to 10 years, while other areas traditionally maybe only saw fire once or twice a century. We leave Jeff's office and head over to the fire lab.

Jeff Kane: This is the Wildland Fire Lab. Basically we have a large fume hood, so, yeah, I dunno, it's about what is that?

Matt:Twelve by 12 or something like that?

Jeff Kane: Yeah, 12 by 12, and then we have a stainless steel table where we can put fuels on and then the fume has a draw so we can burn things and have the smoke be removed to the air.

Matt: I mean you like just literally put some material on there right next to it?

Jeff Kane: Yeah, you want to see it?

Matt: Yeah, yeah. What are these huge refrigerator looking things?

Jeff Kane: Yeah, so these are drying ovens. So often, you know, we want to remove some of the moisture before burning. So that dries fuels. It also can tell us how much fuels is out in the woods. So typically you'll collect it out in the field, bring it back, dry it and then weigh it, and then that's the amount of fuels you have in a given area. Something we call fuel loading.

Jeff Kane: So right here I have ponderosa pine needles.

Matt: I'm gonna hold a grocery bag full of them here.

Jeff Kane: Basically what we see is the really long needles allow the needles to kind of get hung up on each other, and then that promotes greater air flow through the fuel bed. And so that's what's going to contribute to pretty high flame lengths. And the other part of that is a lot of conifer species, pine species have turpines. These are chemical compounds that are highly volatile adding to the flammability of these fields. And then let me grab a, we'll be taking different measurements so here I've just put a, a

really large meter stick that's on the stand and that'll allow us to get how high the flames, you know, tell us how tall the flames get. So what's the flame length? We'll also look at things like: flaming time, how long does it take the flames to combust the material, how long will it smolder for? So flaming are the visible flames. Smoldering is the glowing combustion; those embers that you see following a fire.

Matt: So that can apply like how long hot spots are going to happen maybe? That kind of thing?

Jeff Kane: Yeah, I mean, generally what we see is that when we understand the flammability of all these different species, they kind of bear out into different maybe strategies or consistent groups where you have these species that are really, really flammable but not for a long duration. Then you have other species that are very flammable. They put a lot of energy out, but they're slower to combust. And then there's some species that just don't burn very well at all. Not so many of those in California. But there are some.

Matt: Let's burn this puppy.

Jeff Kane: Alright. So yeah, I'm gonna burn this. So I'm just igniting one little spot here.

Matt: Immediately you got like six-inch flames.

Jeff Kane: Yeah. And so once it gets into the heart of that fuel bed, we'll see much taller flames. Another thing we'll measure after the combustion is gone through is how much mass is left. So how much consumption of that fuel did we get?

Matt: But research in a controlled study cannot prepare you for the day when you face a wildfire head on.

"Sam": Once I got home and I got out of my car and parked, I could hear propane tanks in the Paradise and Magalia area just exploding. And it just sounded, what I would envision a war would sound like. It was just, you would just hear "Boom!" And then a few minutes later, "Boom!" And you could hear that coming over the ridge line.

Matt: We're going to take a quick break and we'll return to learn more about fire behavior outside of the classroom.

Matt: Welcome back to California Burning. I'm Matt Fidler. On this episode we're talking forest and wildfire management. When you think of who's

tending our forests, if anyone, maybe you think of timber companies, forest rangers or the Bureau of Land Management, but much of our forested lands are owned by individuals and families living on that land, and I'm not talking about dense towns with subdivisions like the Town of Paradise that burnt in the Camp Fire. But sparsely populated communities with houses nestled into the mountains and canyons surrounded by acres of wilderness, like the old Gold Rush era community, just a dozen miles up Butte Creek Canyon towards Paradise from Chico with the unfortunate name of Helltown. It once had thousands of people living in shanties throughout this area mining for gold, but now the community has no more than 90 people living in it. Down the road, just a couple of miles is Centerville, which is little more than an old historic schoolhouse and museum, which contains its pioneer history.

Dharma LaRocca: My mom and dad live in Helltown where I was raised. My sister lives by the steel bridge, which is on Centerville, and my other sister lives about halfway down.

Matt: This is Dharma LaRocca. When the Camp Fire started on November 8th and the entire area was evacuated including Helltown. Many of the people Dharma knew, who lived up the canyon, gathered at his house in Chico.

Dharma LaRocca: Now we're talking about 4 or 5 o'clock. Everyone's there. I've got, my block is full, the smoke is thick.

Matt: And they're getting rumors about what might be happening up the canyon. So Dharma, his brother-in-law Jason, and a good friend Jeb.

Jeb Sisk: My name name's Jeb Sisk.

Matt: They decide they're going to drive up the other of the canyon from where the fire is burning and look down to see if they can see if their houses are on fire.

Dharma LaRocca: We jump into, into my brother-in-law Jason's truck. We're like, we're going to go investigate.

Matt: The city streets in Chico, near Paradise, are chaotic.

Dharma LaRocca: It's just, mayhem. There's sirens, lights everywhere, thick smoke. We're going to go shoot up the Highway 32.

Jeb Sisk: We took a bunch of back roads, but we started with Old 32 to avoid the CHP roadblocks.

Dharma LaRocca: And we go all the way down to where you hit, it's called Center Gap Road, we turn the truck off. It's something that I'll never forget in my entire life. It's, the canyon's on fire. You're looking across the canyon, we're on top of the canyon, and we're looking down at Butte Creek Canyon and across the wall, you know where it's coming off Paradise, and you just see red shooting down. It looks like a lava flow.

Jeb Sisk: It was also on the same ridge. We are on that further down canyon, so it's burning up towards us.

Dharma LaRocca: As we look down, we see some tail lights. Wow. There's someone down there. I thought it was our Uncle Billy and then Jason goes, no, no, that's, that's our buddy.

Matt: Who would rather be called "Sam" for this story. He's an off-duty firefighter who also grew up in the canyon with Jeb, Dharma and Jason.

"Sam": Grew up in the canyon with them, so kind of guys I looked up to and I known 'em for as long as I can remember.

Matt: Sam returned to his home in the early afternoon right after he heard the fire was spreading so he could check on his home, and maybe protect it.

"Sam": Kind of when I came into Butte Creek Canyon, it was like a ghost town in there. And once I got home and I got out of my car and parked, I could hear propane tanks in the Paradise and Magalia area just exploding. And it just sounded, what I would envision a war would sound like. It was just, you would just hear "Boom!" And then a few minutes later, "Boom!" And you could hear that coming over the ridge line into Butte Creek Canyon. And that's, that was the echoing. And I went up to my house and made sure that we had everything, you know, things off of the porch. Then at that point was when I kind of started looking around and I made the decision obviously that I was going to do everything I could for my house and my loved ones and the people that I grew up with.

Matt: It was a bit later that evening when he gets a phone call from his buddy Jason, who says he's up Center Gap Road and can see him at the bottom of the canyon.

"Sam": And he's like, "Yeah, I see your headlights." Jason asked me, he said, he said, "Should we come down?" And I was like, "Yeah, if you want to I could use some help." But I remember looking up to Center Gap and he was like, "Yeah, I think we can make it down Center Gap." And I

remember looking up and I was like, "Center Gap's on fire. I don't think you can."

Dharma LaRocca: Center Gap Road is like, it's on the side of a cliff. Visually, it skirts right down the canyon wall.

Jeb Sisk: Myself. I was reluctant at first, but we realized it could be done.

Dharma LaRocca: Jason goes, "Jump in the truck." Jeb and I are like, "Oh, is that what we're doing?" And we all looked at each other and at this point Center Gap Road is on fire. Roll the windows up.

Jeb Sisk: So we drove through a couple flames to get down in there.

Matt: And Sam was relieved that they not only made it down Center Gap Road, but that they were there to help.

"Sam": And yeah, I mean just having some boys that, you know, know the area. I mean it made me feel real confident, real, you know, and just made me feel we're in this together and we're going to do what we can.

Matt: Sam gave them some basic fire safety instructions and they immediately started working on saving a home that was in the fire's path.

Dharma LaRocca: And Jason's like, I'm going to go to my house; my brother-in-law lives, he's right there. He's all, "I'll be right back with some shovels and my excavator."

Matt: An excavator has that big mechanical shovel arm that can dig ditches and knock things over, and it can travel on all sorts of terrain on its heavy duty tracks. Meanwhile, Dharma, Jeb and Sam are knocking down fences trying to save his neighbors' homes.

Dharma LaRocca: At that point we save those three homes, by cutting the fence down. We drive across the steel bridge and the fire's blazing on the other side. Here comes my brother-in-law with the excavator and across the bridge is another home.

Matt: At this point they have Jason's ATV as well, and they're going to save their community of Helltown.

Dharma LaRocca: There's four of us. Break up in a couple groups and we had this line we, the Centerville Road, up to the cemetery and we, we, we figure we can hold and keep an eye on about two miles.

Matt: They felt safe doing this not just because of the knowledge from Sam, but they grew up there. They knew this place.

Dharma LaRocca: If anything ever happened to us, we were going to run down. We're all going to meet at the, at the steel bridge, and jump in the water if we have to.

Matt: Meanwhile, the fire was coming down the canyon walls from the south from Paradise, closing in on the Centerville historic schoolhouse and museum.

Dharma LaRocca: It was flying down. You could just hear it cracking and burning. Coming down in the Centerville school and my brother-in-law Jason goes, "Watch my back." I'm like, "What are you doing?" And he, he drove around this little dirt road and he went around the schoolhouse and the museum and started taking the excavator and digging a trench, and kinda cutting a path as the flames are coming down the hill, like, you know, maybe four, four-feet wide. He's taken the excavator and he's kind of like golfing and just knocking things out of its way, and I'm yelling at him, "You got to get out of there. You're done man." And he turns around and right as he turns around, he blows a track on the excavator. He blows a track on the excavator. The fire hits the track. Burnt rubber's blown. He's limping out of there, you know, like the machine was shipwrecked at the Centerville schoolhouse for about a month and a half after this fire.

Matt: But the fireline worked.

Dharma LaRocca: The trench or the swath that he cut was enough to divert it around both sides of the school. So what burnt around the museum all the way to the road and then came around the other side and burnt. And my brother-in-law saved the schoolhouse and then he blew a track and the excavator was done for the night.

Matt: They kept putting out spot fires, digging up vegetation and creating fuel breaks throughout most of the night. Taking refuge in one of their homes for a quick rest, and were relieved when firefighters finally made it up to them the next morning. But the work they did saved the homes in Helltown, including the historic museum and schoolhouse. Dharma Jeb, Jason and Sam are now known as the "Helltown Hotshots," an honorary title given to them by the community that they helped save.

Matt: Maybe it was reckless to do what these guys did, go back into the fire, but the more I learned about how fire works, and considering Sam was a

trained firefighter, it didn't seem as crazy. Because fire is physics and it can often be predicted, if you consider all the factors involved. But most of us don't really understand those factors. This is why I met up with Hugh Scanlon who recently retired as a battalion chief for Cal Fire, California's wildland fire department. He drove me through a dense redwood forest on the northern coast of California, and suddenly the forest clears and there's a large opening.

Hugh Scanlon: So this area is Prairie Creek State Park and we've just entered Boyes Prairie. And this is an area that was prescribed burned just this last year, and we'll get out and take a look.

Matt: Hugh and I walk to Boyes Prairie, which is regularly maintained with fire.

Hugh Scanlon: This area gets burned about every three, three to four years. That's one of the main ways that this prairie gets maintained.

Matt: A highway cuts through the prairie, a campground on the far side of it backs right up to the edge of the redwood forest that surrounds us. But burning this prairie, if done correctly, doesn't threaten these things that we want to survive the burn.

Hugh Scanlon: Redwood is extremely resilient and resistant to fire. It survives fire quite well. A Douglas fir, older Douglas firs survives fire quite well. There are some species that do not do very well in fire, white fir, we've got a western hemlock, a number of species which are very susceptible to fire, especially in their younger age classes. Those species are now doing pretty well. And what we've got is we've got forests that are just thick with a young material that's basically ready to burn.

Matt: We walked through a wide variety of flowers and grasses. Little streams are hidden by an abundance of freshly growing plant life, but without regular fire, this prairie wouldn't exist at all.

Hugh Scanlon: So prescribed burning an area like this, this is about 100 acres in this block. In order to burn this site, basically they have to put together their burn plan, figure out all of the resources they're gonna need to be able to burn it. What kind of conditions they want to have to burn it so that they get the right effects. In this area, we actually have a, a number of, threatened/endangered species that they are concerned about here. This is very close to an area that has a marbled murrelet nesting sites. So when you can do the burn is constrained at some level to make sure that when you're burning, you're not going to adversely affect any nesting marbled murrelets. Marbled murrelets are done nesting generally by

September 15th. So that becomes like the magic day. Starting September 15th, you can actually go out and do a burn in this area.

Matt: So when you finally have all these things lined up and the weather cooperates, you can schedule your burn day.

Hugh Scanlon: What will happen is they will bring everybody together onsite and they'll do a briefing.

Matt: And they will assess the plan with all the control lines and figure out which way the wind is coming from.

Hugh Scanlon: So if in this case, if we have a north wind, something's coming from the north and blowing to the south. If you were to light this at the north end, the fire would catch the wind and then start burning across this very quickly. And then you would go, "Oh my gosh, what am I going to do to stop this fire from crossing my control line down here and going and running off into the woods?" So what you do is you say, well, maybe we don't want to light it at that end. Maybe we want to light it at the south end, with the north wind, and have the fire slowly work its way back off of that control line to build a burned area. And that burned area will get larger and larger as the fire backs off of that line. What will then happen is you've created a much bigger area of a burned material and cleared material that won't burn anymore.

Matt: Which brings us to one of the first guidelines you'll learn in "Firefighting 101," whether it's a controlled burn or a wildfire that you're fighting.

Hugh Scanlon: When you're working in a fire area, if the flames are less than four-feet in height, we usually consider that to be okay to be able to be there, say with a hand crew and tools, and be able to work on that. You know, so that, so you're okay. So you're digging up fuel at that point and you can work pretty close to where the fire is. It's really important a lot of times to be able to be actually as close to that fire as you can because one of the advantages we get with a lot of these fires, and you can see it here with this prescribed burn example, if we go over here onto the ground, and if I'm working here and say the fire jumps across line and starts burning over here and starts burning real hot and flares up, all I have to do is step over here and I'm in something that has already been burned.

Matt: You're safe.

Hugh Scanlon: So I'm safe. Firefighters refer to this as keeping one foot in the black. If you keep a foot in the black, it gives you the ability to move into an area that's already burned, and therefore you increase your margin of safety.

Matt: So what would you be doing to this line that's unburnt fuel and potentially is catching, and you have one foot in the black, what do you do?

Hugh Scanlon: What we would do in this kind of situation is you would start digging at the fire and scraping the fire back into the burned area. So we're going to try to separate the fire and the vegetation that is burning from vegetation that's not burning. So we keep, you're basically scraping the burning vegetation back into the black and trying to make sure you don't have any burning vegetation on the other side of the line you're making. And you can either do that using tools or you can do that using fire hoses, basically going in cooling and in removing the heat from that line.

Matt: The results from an ideal prescribed burn, like what happens in Boyes Praire, is similar to what happened in much of Butte Creek Canyon during the Camp Fire. Butte Creek Canyon is right next to Paradise, which sits on a ridge. On a ridge, you're subjected to strong winds, but in a canyon the winds vary a lot because of the canyon walls. Back in the winter of 2019, just a month or so after the Camp Fire, Zeke Lunder and I took a drive up the canyon to observe the burn patterns in that area.

Zeke Lunder: What's interesting to me about the patterns we see in these burns is you'll see these patches of black of high severity, and ecologists think a lot about patch size. We like to have a mosaic of burning effects because we get lots of edge on these patches and edges are interesting places cause that's, you know, there's a lot of habitat in the edges. There's places the birds can perch and see wide open areas and hunt.

Matt: We saw lots of edges in this sprawling canyon. One place we'd stand, looked hardly burnt at all. Then just 40 or 50 feet around the corner. Everything was completely blackened.

Zeke Lunder: One of the reasons that this is black and see, is our position. See the winds howling on us right now?

Matt: Yeah, you can tell. I would not want to be here during a fire.

Zeke Lunder: And so these wind favored positions on the landscape tend to be places that we have hot fire behavior and then the shelter positions less severe. So the kind of arrangement of landscape, the proportion of the

landscape that's exposed to winds versus sheltered, that drives our patterns of severity. It drives what trees are gonna do well here. So all of these things about the landscape really, you know, they say pyrodiversity creates biodiversity.

Matt: This is an extremely important lesson here. Pyrodiversity creates biodiversity. What that means is that the edges between different burn types creates opportunities that attract different kinds of wildlife and encourages growth of different kinds of vegetation, which is biodiversity. And biodiversity makes the land more fire resilient. So Zeke and I are standing in the footprint of the Camp Fire and surrounded by tragically burnt homes, but ecologically, for the land, it was kind of a good burn down here, leaving fire-resilient trees alive, while clearing smaller and weaker trees and excess brush.

Zeke Lunder: Right, and even where we are here, see it burned all the grass off, but it didn't get up in the canopy at all. Just kinda crept through here.

Matt: Yeah, you can tell it looks like got up, you know, 10, 20 feet high at some points on trees.

Zeke Lunder: And I think what people forget is that fires, like the Camp Fire, burn 24 hours a day. And throughout the entire 24-hour period, there's this really wide range of environmental conditions. If you think of, you know, going out at 3 a.m. you're going to get, you know, your socks are going to get wet if you walk out on your lawn. Same thing out here, especially, you know, this late in the year, it was really cold at night. So even though the Camp Fire made this huge run, then that, that very night, you know, it was almost freezing. One thing that really determines how effective we can be in putting out fires is whether or not we get any humidity recovery at night. So the first couple of nights I think of the Camp Fire, there was less humidity recovery. But when these fires burned for weeks, they have a really wide range of ecological effects.

Matt: So let's think about how the Camp Fire progressed from where it started in the tiny community of Pulga. After a powerline malfunctioned and caused a bunch of sparks lighting the fire, the fire rushes across Concow, which hadn't recovered from previous fires and the winds amplified from Jarbo Gap at the Feather River Canyon, blew the fire directly into Paradise, which burnt house to house, tree to tree, embers flying up to a mile ahead of the firewall. Then down to the edge of Butte Creek Canyon.

Zeke Lunder: Down here in the canyon, we're sheltered from the landscape scale winds. If the winds from the fire were coming from the east, you know, the canyon wall there would pretty much blocked that flow and so the fire had to back through here without much wind on it. If you look at it behind us, the upper slopes here burned hot because they were getting pushed with that same hot east wind that pushed the fire.

Matt: But it's not just wind exposure that affects fire severity. Exposure to the sunlight also makes a difference because of the effects on vegetation.

Zeke Lunder: In these canyons where you've got these steep kind of side canyons, there's real distinct changes in vegetation from a north slope to a south facing slope. The north slopes don't get as much light, so the trees grow upward, they put more energy into being tall, they chase the kind of less available light. And on the south facing slopes, the trees have plenty of light so they can put more energy into kind of growing bushy and low. And so when you have a fire, the north slopes are less likely to burn with a crown fire because your canopy's really tall and it's shady underneath and it's cooler and moister.

Matt: Fire severity is also affected by the time of the year that the fire happens. Fires traditionally started from lightning strikes in the summer, not late fall like the Camp Fire did.

Zeke Lunder: Our typical summer weather is that we'll have a low pressure weather system move through, and then there'll be hot and dry for weeks, two or three weeks. Maybe there's no weather at all, you know? And that's when it gets to be, you know, 110 degrees. And just this kind of continental scale, high pressure parks over California and everything stays really stable. So what happens when we have a lightning storm that comes through and starts a bunch of fires, is stable air causes smoke conversions, especially in our canyons. So big lightning storm will come through, it'll start thousands of fires. Within a couple of days the whole valley's smoked in. The canyons are smoked in, and then this high pressure just parks and these fires just smolder under that heavy smoke. And because the smoke layer gets thicker and thicker, our daytime average temperatures can come down, you know, 10 degrees, just all the smoke blocking the sun. So when we look at kind of the big picture of how fires had behaved in California in the past, we've had a lot of this low-intensity fire that's largely in part because our lightening fires happen at a time of year that lends itself to smoke inversions. And that's another reason that these fires had happened in the fall, under these extreme conditions, are so destructive

Matt: As we drive down the canyon towards Chico, I think about Paradise, Concow and Pulga. The forests in these communities may never fully recover from this fire. This is Concow's third major fire in three decades. And through those fires, all of which were severe, few trees survived and the soil was so roasted that nothing much more than grasses are coming back, which spread fire extremely fast compared to a biodiverse forest. I asked Zeke why this actually hasn't happened to more towns in the foothills of California.

Zeke Lunder: Historically the towns are still there because, maybe we've got like one day per decade, where you've got the weather conditions that could support a large destructive fire. You can have hazardous conditions, but unless you have the ignitions to start a fire, then nothing happens. But with these longer and longer fire seasons and these longer and longer dry periods, it just suddenly you go from, maybe you had the conditions one day a decade, to maybe now you have the conditions one day a year or two days a year. And so you've got, you know, suddenly, you're like 10 or 20 times more likely to have that bad combination of weather, dryness and ignition. That's going to cause the next Camp Fire. Things are changing and a lot of it has to do with that. The length of window that we're kind of exposed to that risk.

Matt: Zeke Lunder, pyrogeographer and friend of Butte Creek Canyon. Basically what Zeke is saying is that yes, we can predict fire behavior from geography and weather conditions, but when fires happen later and later in the year, closer to those windiest times of the year in the late fall, early winter, this increases the likelihood of a fire being severe. Before our next break, I want to bring in science educator and communicator Dave Schlom. He's also the host of NSPR's science program, Blue Dot. I asked him on the program so he could explain why our fire season seems to be getting longer without going into all the nuances of climate change, you can find that info anywhere, but I do want him to talk about the direct impact that climate change is having on these catastrophic wildfires. Dave Schlom. Thanks for coming onto the show.

Dave Schlom: Sure, Matt. Great to join you.

Matt: So how does climate change affect these catastrophic wildfires that we're been seen so often now?

Dave Schlom: Well, it's, it's basically some, some very simple things. Because the climate is warming, you are getting a much longer fire season. In other words it's getting warmer and drier earlier in the spring and later in the fall. So that fire season is lengthening. The real key thing to look at to me

is the overnight low temperatures, which most people don't focus on. They look at the high temperatures. But if you look at the overnight lows, you can see that there has been a steady trend of those going up. And that's really the signature of climate change in California. And coupled with that, of course the high temperatures during the day, those dry out vegetation, stress the plants. And then coupled with the drought we had there for several years, you know, created the catastrophic situation we've had since basically from 2012 to 2018.

Matt: So Dave, is there a relationship between climate change and the bark beetle that's been causing so much tree mortality lately?

Dave Schlom: Yeah, there certainly is. And you know, you can definitely see it if you fly over the forests and like, you know, from say Denver to California, you can see the devastation of the brown trees killed by the bark beetles. And what's happening is because the temperatures in winter are warming, those overnight lows are not cold enough to cause the, you know, long periods of freezing that would kill off a lot of these beetle larvae in the wintertime. They're able to survive and then, you know, breed and in infest more and more forest. So it's the overnight lows in the wintertime, especially that's not controlling the bark beetle like it used to. You know, they're a natural part of the ecosystem or they used to be. But now that ecosystem is changing because of the warming temperatures and the bark beetles are starting to kill more and more trees.

Matt: Thank you Dave. Schlom of Blue Dot. You're listening to California Burning a co-production of North State Public Radio with support from Sierra Nevada Brewery. I'm Matt Fidler. We're going to take a short break and when we come back, we're going to join a group of forest rangers for a tour of a fire recovery project in the 2.2 million-acre Shasta-Trinity National Forest.

Kevin Osborne: So when you see the clearcut patches that you're looking at on the private timberland, their goal is to maximize profits by growing trees as a crop. That's not the goal of the Forest Service.

Matt: We'll be right back.

Matt: Welcome back to California Burning. I'm Matt Fidler. We've talked a lot about how fires burn across landscapes, how we can predict it and why some fires burns so severe. But what about after a catastrophic wildfire? How do you even begin to repair a forest, especially on a large scale to help prevent future severe fires? Fortunately, I found a group of folks

doing this kind of work that were more than happy to talk to me. Up in Hayfork, California, I met with a group of forest rangers who wanted to show me a wildfire recovery project that they're working on. So I jumped into a car with national forest ranger, Randi Paris.

Randi Paris: And I'm a supervisory forester on the Shasta-Trinity National Forest.

Matt: The Shasta-Trinity National Forest is California's largest forest and acts as a barrier between the Central Valley and the coast. As we continue to drive up towards the project site, the overly dense forest we were surrounded by suddenly opens up with only blackened ground and tree trunks surrounding us.

Randi Paris: So now we're really entering ...

Matt: Oh wow, the end of the forest. (Laughter)

Randi Paris: Yeah, so this is the Stafford Fire. It burned in 2012. Human-caused. So it started up and over this little ridge and at the bottom of the valley. In just a couple of hours, it jumped Hayfork Creek, burned up the slope, and then licked over the top and kinda took a run for Hayfork. And the fact is it was a really quick fire. It wasn't one of these fires that went on and on and on.

Matt: But the fire was severe in the ridge it burned over separates forested timberlands from the town of Hayfork, where people work and live. So where this fire went over, could now actually be restored to act as a strategic fire line to protect Hayfork against future fires. We walk out on the ridge and meet up with the other rangers who agreed to show me around.

Ranger Intros: My name is Dan Osterman. I am the fire management specialist for prescribed fire and fuels for the Shasta-Trinity National Forest. I'm Carol Underhill, I'm the public affairs officer for the Shasta-Trinity National Forest. I'm Kevin Osborne. I'm the fire ecologist for the Shasta-Trinity National Forest.

Matt: All five of us are standing on this strategic ridge, which because the brush was cleared by the previous fire is now acting as a natural fire break. But this break needs to be maintained, so brush and bushes don't return, which can then spread the fire fast again. They eventually want healthy, fire-resistant trees on this ridge. But what the forest service needs to do next is control soil erosion, making sure the road ridge stop is stable and that the ground will support growing trees.

Kevin Osborne: It can be mulch, could be wood straw, directional felling of trees to act as the tree itself serves as a water bar. It intercepts and disperses water along the length of the bowl if it's felled directionally across the slope. Hydroseeding with helicopters, where you put down a wet and mulch material to increase the growth and soil cover with grasses and the mulch itself. And then we also use straw wattles where you put the netting wrap straw bales along with stakes to hold it up.

Matt: After erosion is dealt with, they plant new trees from seeds collected from a similar area. Establishing a healthy new stand of trees where there is no canopy anymore, has a few phases.

Randi Paris: You know initially you're trying to get the trees above the brush.

Matt: Grass and brush grow faster and taller than baby trees do and can take up all the water and block sunlight from reaching those baby trees, effectively killing them if you don't manage the competing vegetation.

Randi Paris: And then you kind of get into a stage where you're really more worried about what's the overall fuel condition across that young stand.

Matt: Because young, small trees can catch fire easily in the drier months. And if all the trees are the same size, no older, bigger trees in between them, if one catches fire, they will likely all catch fire.

Randi Paris: And then you get to the point where maybe the trees are competing with each other, but you can kind of see across the road how these small trees are very closely spaced and they don't really have room to grow. So then we'll go in and thin out the trees.

Matt: Basically when replanting a tree stand, the Forest Service goal is to get to the point where they don't have to use their own resources to maintain it. Because their resources are limited. So they partner with a timber company who can then thin some smaller trees and harvest some larger ones and sell the wood to subsidize their work, which is a totally different strategy than how a private timber company might manage their lands. On private timberlands, some of which you can actually see from the ridge we're on, you can't help but notice the 15 to 20-acre clearcut scars scattered about.

Kevin Osborne: So when you see the clearcut patches that you're looking at on the private timberland, their goal is to maximize profits by growing trees as a crop. That's not the goal of the Forest Service on most of our landscape. So we do have goals to produce timber products because we are the

land of many uses, right? We have lots of goals. Producing timber for the American people is one of them, but preserving habitats is another one. Providing clean drinking water is another one. Providing recreation opportunities is another one. So that wide range of goals kind of pushes us out of the clearcut business and into other methods of harvesting and thinning that achieve multiple objectives.

Matt: The problem that I saw with this idea is that both the forest and the timber company wants to keep the big healthy trees. They're more valuable to the timber company and more fire resistant to the forest. So if the Forest Service is using the timber company to clear the forest, what do you do if those trees aren't marketable? Because that's a major issue with these overgrown forests. The trees are numerous but small.

Randi Paris: It can be challenging to develop a thinning project that's also economically viable and balancing all the competing interests. We have other contracts called stewardship contracts, where in addition to the value of the timber, I'm paying the operator to do additional work.

Matt: Kevin says all the interests and goals of the Forest Service are weighed with a multitude of specialists.

Kevin Osborne: Wildlife biologists, fish biologists, watershed hydrologists, soil scientists, geologists, silviculturists, fire and fuels specialists, archeologists. Yeah. And I don't want to forget anybody. So there's just this massive range of specialties that go into and have, say and have importance when we plan our projects.

Carol Underhill: You know, we're not the only land managers out here. We're not the only stewards of the land. You know, there's private companies, there's private lands. So working with our partners. Working across our boundaries. Finding ways to work together and maximize our opportunities, you know, because our funding's limited, their funding might be limited, but together we might be able to do a project together.

Matt: Thank you Carol Underhill, Dan Osterman, Kevin Osborne and Randi Paris for the day they spent with me driving me to different sites and answering all my questions. And a big thanks to Joe Arose for coordinating everything and making this whole tour possible. The next stop is to the east to timberlands owned by Michigan-California Timber Company, attractive land on a small mountain called Black Butte, just north of Redding. Chris Chase manages these lands for both lumber production, but also fire resilience.

Chris Chase: You can't stop every fire. You can't prevent every fire. But we can certainly take steps to help mitigate the, the impact, of those fires.

Matt: He takes me to a site where they are mechanically thinning small and unhealthy trees in the stand to provide more room for others to grow bigger and healthier.

Chris Chase: And you can see how that's just that bud is not healthy and you see a lot of these tips are dead. And I can see that one's just got kind of a deformed look to it.

Matt: Is this have anything to do, why the branches are a little scraggly here or is that?

Chris Chase: Yeah. This isn't a particularly healthy tree. Pedro's gonna whack that one. (Talking/laughter)

Matt: I stare almost in awe as this tractor with a huge mechanical arm in a saw blade end, grabs a tree and cuts through it in one stroke. Then the tree gets placed in a neat little pile to minimize ground disturbance. We have pictures and a video of this on californiaburning.net. Eventually material like this will be put into a shredder and sold to a cogeneration plant where it creates a renewable form of low-emission energy. The shredder is buzzing loudly in the background.

Chris Chase: It's really low value, residual materials, small diameter, broken chunks, mostly limbs, needles, that kind of thing. So you know, we do have the option of just burning this on site, but then you're, you know, that's, that's an open burn in an uncontrolled environment. There's, you know, some risk associated with that. You know, it's putting smoke up into the atmosphere.

Chris Chase: This right here is a bear track.

Matt: Chris and I spend the better part of the day walking around MCTC timberlands talking about the severity of these problems. And I keep bringing up prescribed fires, but he doesn't think the forests are ready for fire in the areas that need maintenance the most. The fuel load is just too great, he says. So they won't be low-level fires. First they need thinning, then possibly fire can be used afterwards to help maintain them.

Chris Chase: And we've got to acknowledge that we've got to remove some of these medium and large size trees that have value to cover the costs of the operation and make it self-sustaining. And that may require some government investment, as sort of seed money to get this going. But

that's where we need to go if we're ever going to get ahead of this thing. And I'm just afraid if we rely solely on grants and different government programs to try to fund the sort of one-offs, we're just not going to get there, and we're going to wind up losing our, our forests. And this is happening on our watch and you know, we're going to be judged by what we do in the next 10 or 20 years and we just have to acknowledge that these forests cannot be maintained in a static condition. We got to get ahead of it. They need management in the absence of natural fires. So let's do what we need to do and invest in our forests for the future.

Matt: Thank you Chris Chase for showing me around Michigan-California Timber Company's, Black Butte tract. I also want to thank the director of Humboldt State's Fire Lab, Jeff Kane; Cal Fire's Hugh Scanlon; Helltown Hotshots, Dharma LaRocca, Jeb Sisk and firefighter "Sam"; geographer, Zeke Lunder; host of Blue Dot, Dave Schlom; and Shasta-Trinity National Forest rangers, Randi Paris, Dan Osterman, Kevin Osborne, and Carol Underhill. Tune into the next episode of California Burning when we explore the Wildand-Urban Interface where the forest fires meet towns and cities, and how we can all learn to live better and safer in those places.

Jim Broshears: And that we need to learn from those lessons and carry them forward so that not only Paradise when it's rebuilt will never have this happen again, but other communities are across the state and the nation can also benefit from the same experience we've had.

Matt: California Burning is a co-production of North State Public Radio and was made possible by generous contributions from Sierra Nevada Brewing Company. Music by Stephen LaRosa of Wonder Boy Audio. Thanks to our team: Sarah Bohannon, Gregg McVicar and Jill Fincher. I'm the creator and host Matt Fidler. See you next time on California Burning.