

## Tree Mortality From A Birds Eye View: Transcript

Jamie Hinrichs [00:00:12] Welcome to episode 41 of Forest Focus, brought to you by the USDA Forest Service Pacific Southwest Region. We're continuing in our explorations of forest health: what it means, why it matters, and how it is secured. And this time, our learning takes us up into the air.

[Airplane takeoff heard in background]

Nick Stevens [00:00:30] Trying to get the most accurate representation of the ground from our aerial observations. Flying at 100 miles an hour, 1000ft up, can be challenging, but it's very unique perspective on the state of California.

[Quiet ambient music plays]

Jamie Hinrichs [00:00:44] When it comes to getting perspective on forest health, sky-high observations are a big help in California. With over 30 million acres of forested land throughout the state, there is a lot of ground to cover. So, each summer, Forest Service aerial tree survey specialists spend several weeks in the aircraft gathering observations on tree mortality in lands of all ownerships. From above, they read the color of the forest below to determine where trees are recently dead and dying. The surveys are documenting tree mortality caused by several interconnected factors. First, many areas have too many trees on the landscape, competing for vital resources like water, sunlight, and space to grow. These crowded trees are further stressed and drained of resilience by rising temperatures, drought, disease, and insect infestation. Trees killed by wildfire are not included in these surveys. This is to give focus to the impacts of the other environmental stressors just mentioned. However, the dead, injured and dying trees within forests are prime fuel for burning. So, knowing where large patches of dead and dying trees are located helps land managers identify areas that need to have trees removed. The team develops flight schedules and routes, but the flight plans are always up in the air. Stormy skies, high winds or wildfires could derail the best laid plans. Hoping for the best and adapting to obstacles is key for their work. Fortunately, we're all systems go and we're ready to meet our first aerial guide on an airstrip in Visalia, California, on a sunny day in July.

[Music ends]

Jeff Moore [00:02:24] Hi, I'm Jeff Moore on the aerial survey program manager for Region five of the USDA Forest Service. I've been doing this work since '97. First up in Washington state with the state of Washington and I started out on paper maps up there, 13 years' worth. And now I've been in California ever since that.

Jamie Hinrichs [00:02:40] When Jeff started doing aerial surveys, he used paper maps as a documentation tool, but today he uses tablets with digital maps that move in sync with the airplane's flight over the landscape.

Jeff Moore [00:02:51] Now we have a digital sketch mapping system that is georeferenced with the integrated GPS unit. So, I know right where the airplane is, and I can look out the window a lot more and really capture the more subtle things that I see as I fly along.

Jamie Hinrichs [00:03:06] Speaking of flying along, where are we going?

Jeff Moore [00:03:08] We're flying over the lower elevation, westernmost portions of the Sierra Nevadas, working our way to the far southern tip and beyond the main part of the Sequoia, into the Scodies, into the Tehachapi and then reversing back direction.

Jamie Hinrichs [00:03:23] After this review of the flight plan and also a safety brief on the runway, we climb inside.

[Seats squeak, seat belt clicks, door shuts, wing flap whines as it extends]

With the size and architecture of this aircraft, a Cessna Turbo 182, the whirl of the propeller and thrum of engine are quite loud within the cockpit. So, we put on our headset for inflight communication, buckle in, and it's time for takeoff.

[Engine starts and continues to thrum]

This altitude provides a view of the forest that is rarely seen by most of us. With a commercial flight, we ascend rather quickly to a cruising altitude over 30,000ft and generally stay there for most of the journey. You may be able to make out vague patches of color on the ground for a bit, hinting at trees or desert, but anything more detailed than that is beyond the reach of an unaided human eye. But at 1000ft above ground level, as we are on this flight, we're close to, but still safely above the ridgeline. And this "not-too-high" altitude is just what the aerial survey specialists need to read the shape and color signatures of trees. When they spot a patch of forest, or even individual trees that seem to have a color indicating they are dead or injured, they document this observation on the tablets we heard about earlier. These tablets have digital maps moving with the flight path of the aircraft. The aerial survey specialists digitally draw on the map outlining the approximate extent of the area where they saw recently killed trees on the ground. They also add notes on what species of trees have been affected and indicate the severity of mortality they are seeing. The severity rating is the percent of the forested area with recent tree mortality or injury, which ranges from very light to very heavy. Symptoms of injury include loss of leaves, browning of leaves, or wilting branches. They take photographs too, which gives context to the map data. It is quite a lot to do at five acres per second. As our flight continues, their trained eyes rove over the ground below, dancing between tablet screen and window view. They discuss what they are seeing through the headsets. We'll tune in to their conversation for a bit.

[following dialogue is muffled, heard through a headset]

Jeff Moore [00:05:38] So I'm looking at that ridge that's about two miles up that ridge out there. That's how much area I'm trying to cover as I go along is that 2-mile swath. I'm not seeing any color; I think we're good.

Nick Stevens [00:05:51] We saw a lot of oaks dying out here, right?

Jeff Moore [00:05:53] Yes, we did last year. We're looking for fresh stuff. But I'm just seeing older mortality right now. Oh, there's a couple there. I've got a couple of live oaks, maybe a dozen. Horrible drought situation here.

Jeff Moore [00:06:06] Little pocket of ponderosa pine. At least 30 trees in there. I think I'll take a picture of it. Some white fir mortality scattered in through there, kind of moderate density on the riparian and light otherwise.

Nick Stevens [00:06:20] I am starting to see sugar pines popping up. No mortality, I'm just seeing them.

Jeff Moore [00:06:26] Gotcha. I think it's just as important to know where mortality is not occurring as it is to know where it is.

Jamie Hinrichs [00:06:30] We'll avoid distracting their concentration while they fly. Instead, we will get more explanation about the survey process when we're back on the ground, about two hours later.

[subtle sound of plane landing, propeller slows]

Jeff Moore [00:06:43] Nicely done.

Jamie Hinrichs [00:06:45] Now, on the ground, we can take off our headsets and talk to our second aerial survey guide while the airplane is refueled.

Nick Stevens [00:06:51] I'm Nicholas Stevens, aerial survey specialist. I've been on the job for three years, but have had two years flying experience, and this is my third. We flew a aerial survey mission from Visalia down to Tehachapi, looking for signatures of trees that are dying. Signature is basically how the tree looks when it's freshly

dead. It's color, crown shape. For example, ponderosa pines tend to look more of a yellow color, and white firs, which you saw today, tend to turn more of a reddish color. We kind of know what signatures we're looking for based on ground observations, and we get a lot of input from other staff members. So, it's something to keep in mind as we're flying. And then once we see that signature, we record it on the tablet.

Jamie Hinrichs [00:07:38] Nick was also taking photographs during the flight, which will give illustration and context to the data he documented on the digital map.

Nick Stevens [00:07:46] We try to take as many pictures as we can that are useful. It kind of just helps get what we see to people on the ground, and add some context to some of the polygons and points that we make in our database.

[soft ambient music plays in background]

Jamie Hinrichs [00:07:59] As his mention of the database suggests, collecting observations from the sky is just the first step in this forest health monitoring effort. The ultimate goal is to make the observations available to homeowners, utility companies, researchers and land management agencies so that each can be aware of the trends in tree mortality and develop plans to respond to the associated risks. So, the survey information is evaluated and organized by a variety of specialists for a few months. Mapping experts use computer systems to analyze and display the data on maps are especially important to this process. Together, the team creates an annual report that gives details on the number of acres with tree mortality, the severity of mortality within those acres, and the types of trees being impacted. Results are tabulated for the state as a whole, but also broken down by county and by national forest.

[Music stops]

Jeff Moore [00:08:53] We share that with anybody who's interested, free of charge. I hear from a lot of people that I never even knew who used our data to tell us how much they appreciate being able to put our data up at the planning stage of a timber sale, or any kind of other habitat improvement project, or anything else going on in the forest. Just a tremendous clientele that includes researchers, landowners, private, state, other federal agencies, and also, it's a part of the national data set.

Jamie Hinrichs [00:09:20] This national data set includes aerial survey observations gathered by the Forest Service and partners throughout the country. In Hawai'i, for example, the surveys have a slightly different form and focus. Multiple times each year, the Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife is the lead on helicopter surveys that monitor the spread of rapid ohia death. This fungal disease attacks the native ohia tree, a keystone species that has great cultural significance and provides habitat for many native species. But back to the case in California, Jeff reflects a bit on the changes he's seen over time since 2009, when he started doing aerial tree surveys for the Forest Service.

Jeff Moore [00:10:03] When I first got here, total statewide mortality calculations would come in somewhere around a half a million trees. It was very normal, what we call it background levels. More recent years with drought after drought coming in a short sequence. We have been looking at tens of millions of trees dying in a given year, instead of that half a million. The health of the forest in California is fundamentally different from what it was when I got here.

Jamie Hinrichs [00:10:28] Drought is a key cause of this change in forest health, along with a few other intertwined environmental stressors.

Jeff Moore [00:10:35] Underlying causes, for sure, is drought and overcrowded conditions and fire exclusion. And all three of those kind of come together to make the perfect storm, if you will, for a mass tree mortality event here in California. And that's because we have been keeping fire out of forest areas that typically would burn about every 10, 20 years. And when a fire used to do that, it would kill the small trees, leaving the big pines with nice thick bark to

have a lot more space and a lot more water because there's no competition. But once you take fire out of the equation and those little trees continue to grow up, most of them are fir, very fire susceptible and very thirsty. So, all of a sudden you have a bunch of big trees that are all competing for very limited water. So, they're all stressed, even in a normal year. And then you put a drought situation on top of that, and it super stresses the trees and makes them very susceptible to other mortality events like bark beetles or root diseases. I think knowing the current status of the health of our forests is very important concept to try to get ahold of every year. And we do this every year, which is a really nice thing for trend analysis because you can compare, say, drought conditions to mortality, how they correlate.

Jamie Hinrichs [00:11:51] Indeed, these aerial detection surveys provide timely updates on forest health that have several benefits. The information contributes to research on climate change, efforts to track the spread of insects or diseases that are damaging forests, and responses to the wildfire crisis. The surveys help land managers to prioritize areas for forest health treatments like vegetation removal and prescribed fire, which can reduce wildfire risk associated with having a collection of dead or dying trees on the landscape. These treatments can also help to increase the availability of water and space for the still living trees. Jeff points us to the connections between aerial observations and the broader benefits healthy forests give to us all.

Jeff Moore [00:12:34] I really believe in the mission itself. The data we gather about the health of forests is important to a lot of people and should be important to all of us. The services of our forests are monumental in that clean water, clean air are the two most basic things that we need as human beings.

Jamie Hinrichs [00:12:53] Thanks for listening. For those who are curious to learn more, go over to the show description page and click on the links. To find more episodes, search for "Forest Focus Podcast" wherever you get your podcasts and if you have questions or suggestions for the show. Email us at [sm.fs.r5ffpodcast@usda.gov](mailto:sm.fs.r5ffpodcast@usda.gov). Until next time, enjoy your public lands. Please remember to recreate responsibly. know before you go and learn what you can do to prevent wildfires. Take care. This podcast is sponsored by the U.S. Department of Agriculture, Forest Service, and the USDA is an equal opportunity provider, employer, and lender.