California's Redwoods Face Climate Change

After more than a century of logging, California's old-growth redwood forests are only a fraction of what they once were. Today, they remain in a narrow coastal band that extends from Monterey Bay to the Oregon border. Most ancient redwoods are protected in parks. But now they are facing a new threat — climate change.

Coast redwoods are among the largest living organisms on the planet. Their trunks can grow to 25 feet in diameter. Much of the tree is hidden from our view.

"From down here, you can tell that they're tall but you can't tell too much about each tree," says Steve Sillett, a botany professor at Humboldt State University who has researched these trees for two decades.

To really study them, Sillett says, you have to go up.

*Listen to the QUEST radio story **California's Redwoods Face Climate Change**.*

Climbing a 360-foot redwood isn't for the faint of heart. Today, Sillett and his team are climbing one of the tallest trees in Montgomery Woods State Reserve in Mendocino County. It's taller than a 35-story building.

"We don't use spikes or spurs. We don't injure the tree in any way when we're climbing it." Sillett and his research partner, Marie Antoine, clip their climbing harnesses onto long ropes that are fixed high in the tree. They pull themselves up with an ascender — a metal clamp that slides up the rope and provides traction.

Sillett was one of the first scientists to explore the old-growth redwood canopy. Their treetops are home to an entire ecosystem of animals, fern thickets as big as a bus and even other trees that grow among the redwood branches.

"The most freaked out I have ever been was when we found the first salamander up there. And I am 3-hundred feet up in a tree and there is a salamander cruising around," says Sillett.

Climbing Giants

Watch a larger version of this video. QUEST on KQED Public Media. Today, Sillett and Antoine are measuring the tree in an unprecedented way by doing complete structural inventory.

They start by measuring the trunk. Dangling gracefully from ropes, they stretch a tape measure around the tree. "Let's do our first wrap at 40, so I'll go to 40," Sillett yells.

They continue down, measuring at different intervals. "Three twenty-one point seven. So that's over 10 feet diameter," says Sillett.

They'll also measure every branch. "We did have one tree that had 472 branches and 206 segments in it, which took about four days."

Sillett and his team are measuring hundreds of redwoods like this as part of a $2.5 million dollar study funded by the Save the Redwoods League. With the data, he generates a 3D model of each tree. Once they measure the trees again in three years, the models will tell him how much the redwoods are growing.

"Some years, there's a lot of growth, and some years there's almost no growth. And sometimes there's dieback and recovery," says Sillett. "We suspect that the really tall trees, the tallest trees in the world, are among the most sensitive things to climate change."

Tall trees, Sillett says, are already under a great deal of stress. Simply lifting water hundreds of feet from the roots to the tree tops is difficult. And with the temperature and precipitation changes predicted by climate change models, these tall trees may show climate impacts first.

But scientists aren't just looking into future. They're also looking at the past.

Fog Key to Redwoods

Todd Dawson, a scientist at UC Berkeley, holds a skinny tool that drills into a redwood tree and pulls out a thin core sample. The core shows the tree's growth rings.

"You can see there's some very large rings here, so it was clear that when this tree was young, it was putting on a lot of growth every single year," says Dawson.

The rings further from the tree's center – the newer rings – look much smaller, though Dawson isn't sure why. "They respond to changes in rainfall in a wetter year or a dryer year in how much wood they put on. But not only the rainfall or the temperature is important. For the coastal redwoods, it's also the fog."

Redwoods get their water from two places: rain and California's notorious coastal fog. Dawson says the trees are giant fog collectors. They actually absorb it through their leaves.

"The fog is a very important water subsidy for these trees, and it's been declining over the last 50, 60, 100 years," says Dawson.

Dawson and others are looking into whether there's a link between a warming climate and the decline in fog. "We're quite concerned about what those declines in fog actually mean for the future growth of the redwoods that grow along the coast."

Here's where the tree rings come in. By analyzing oxygen isotopes in the wood, Dawson can tell how much of the tree's water came from fog vs. rain in any given year. That gives him a forensic record of how the climate has affected the tree's growth. Given that some of these trees are thousands of years old, it's a long record.

"We can then put that into models and predict: what are these trees going to respond to in the future? We may lose redwoods permanently at the drier, warmer ends of their range."

Dawson says if that happens, what they're learning in this soggy forest will help them protect redwoods. That could mean preserving more forests or even planting trees in new locations that one day may become a better environment for redwood trees.