

## ClimateBrief: Redwood Forests at the Center of California's Climate Change Policy

*Rich Blaustein* May 16, 2024



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This spring, California climate change science and policy have linked prominently with a grand icon of California nature: the state's redwood forests. At the annual European Geosciences Union (EGU) Assembly in April, "An Integrated Observatory for Redwood Forest Health and California Carbon Neutrality" was presented to an international audience by UC Davis assistant professor of cooperative extension Kosana Suvočarev, who co-leads the project with Lawrence Berkeley National Laboratory scientist Housen Chu. The California Natural Resources Agency also provides agency leadership, and CAL FIRE, the California Air Resources Board, UC Davis, Lawrence Berkeley National Lab and UC Agriculture and Natural Resources (UCANR) are also involved with the observatory project.

The redwood observatory will launch this summer with initial two-year funding. The observatory features the installation of two state-of-the-art eddy covariance flux towers that track carbon forest-atmosphere exchanges and different hydrological conditions of the redwood forest. The two eddy covariance flux towers will operate from different locales within California's Jackson Demonstration State Forest.

Around the same time, on April 22, Governor Gavin Newsom further clarified the state's natural solutions program by issuing "California Nature-Based Climate Solutions Targets" that was called for by [AB 1757](#), which Governor Newsom signed in 2022. AB 1757 bolsters climate change natural solutions – for example, managing for resilient forests, carbon-enriched soil, and carbon-sequestering agriculture practices – and directs the California Natural Resources Agency, in collaboration with the other state entities, to lead and "determine an ambitious range of targets for natural carbon sequestration, and for nature-based climate solutions, that reduce greenhouse gas emissions for 2030, 2038, and 2045 to support state goals to achieve carbon neutrality and foster climate adaptation and resilience".

The 2024 California Nature-Based Climate Solutions Climate Targets has a robust forest agenda that [includes](#) directives to: regularly update California's carbon inventory on natural and working lands; "(c)onserve old growth forests to preserve the oldest trees"; and "[i]dentify key strategies to expand 30x30 conservation to contribute to NBS climate targets" (with "30 x30" signifying percentages for terrestrial and marine conservation).

Governor Newsom's office highlights that the newly released targets seek to have "11.9 million acres of forest managed for biodiversity protection, carbon storage, and water supply protection" by 2045.

Loretta Moreno -- program manager for Timber Regulation & Forest Restoration Program of the California Natural Resources Agency (CNRA) -- is involved with the eddy flow covariance flux towers project. She explains that this observatory project is funded by the Budget Act of 2021 money denoted for remote sensing for CNRA to respond to wildfires and the climate crisis. Moreno says the project will help address a serious data gap for redwoods.

"For such an iconic system like this, this is a problematic gap in terms of our broader carbon neutrality objective and broader climate and wildfire objective," Moreno says. "Across the board there is an upgrade of level of action for natural solutions, and with that old growth and the role of redwoods is paramount. We know the redwoods are storing tremendous amounts of carbon. Really understanding how redwoods are contributing to what degree will help us update our inventory information that California Air Resources Board keeps, and really quantify impact and effectiveness through time."

According to Suvočarev, the area of the project has 90 percent redwood trees at early and mid-term age stages, which reflects California's current redwood distribution, which includes much privately owned acreage. The old-growth redwoods stands are found primarily in state and public parks and preserves.

Suvočarev explains that the covariance flux towers will measure carbon and water exchanges with the atmosphere, and that redwoods, which are highly productive ecological systems, are expected to have carbon uptake. However, the towers will enable precise carbon sequestration measurements.

The project will also shed light on fog, a major feature of the coastal redwood ecosystem, which appears to be altering and diminishing, possibly as a result of climate change.

Fog significantly impacts redwood carbon uptake and water release and uptake. Redwoods have stomata that generously release water and the trees find stability in foggy settings. Previously, fog variability and impact has been studied at the individual tree level with sensors placed in trunks measuring tree sap -- which,

Suvočarev explains, moves faster due to lack of fog, corresponding with the redwoods' increased water release. The data collected at the two towers will encompass monitoring at the acreage level, with over a hundred variables measured throughout the day.

“Now we are taking that to the landscape scale, and providing the data for those who can upscale that onto the narrow belt of coastal redwood natural range,” Suvočarev says. The project's findings by design would be matched up with modelling and remote sensing data, enabling regional understandings for the broader California coastal redwood region. Suvočarev says the collaborators hope that the project will ultimately be funded for 15 to 20 years “in order to get the most meaningful insights into redwood forest health.”

Kevin Conway is program manager of CAL FIRE's Demonstration State Forests Program. The program has 14 forests, with Jackson Demonstration State Forest as the largest. Conway explains that the Demonstration State Forests Program began in the 1940s when reforestation was not common to demonstrate economical management of second growth harvests and ensure sustainable timber supply. Conway says that today the forests are still used for demonstrating sustainable forest management and how the practice fits with recreation, soil management, wildlife, and fisheries. Conway also points out that Jackson Demonstration State Forest has a tribal advisory committee comprised of 19 tribes, and that the committee has been consulted about the observatory project, with more outreach and involvement possibilities ahead.

“Carbon sequestration is something the public is very concerned about,” Conway says. He adds that the covariance flux towers project will have synergies with other research in California's Demonstration Forests program. An example: the long-running and nearby Caspar Creek Experimental Watershed, which also involves the U.S. Forest Service, and which has observed fog and its effects on the redwood ecosystem since 1960.

“The research we are doing here with Kosana's group that sets the gold standard for carbon measurement in the redwood forest tags on with some of the standard silviculture demonstrations we have in the forest – how are we growing trees, accelerating the development of trees, and what are those impacts long-term on the forest,” Conway says. “We think there will be enhanced findings because we can tie it to existing research that we have going on.”

John Ramaley, staff chief for forest practice at CAL FIRE, explains that under California's Forest Practice Act, the Board of Forestry and Fire sets regulations for timber harvesting on state and private lands and meets regularly to review and improve regulations, taking into account new scientific evidence. The findings of the eddy covariance project could influence the Board's regulations.

"The Board is who will develop and may modify the rules based on research that comes out of the demonstration forests," Ramaley says.

Moreno explains that the contributions of the covariance tower project can be understood in terms of an "adaptive management loop", with science documenting the dynamics of the redwoods and their response to management, enabling management "to shift in some ways to improve conditions in the Redwoods."

Moreno adds that "there are things out of our direct control, like climate change, that if we see the trees are under stress, we can maybe modify what is happening around our management within the forests."

Certainly, climate change is the big uncertainty for redwoods, not just for science and natural resources management but also for law, says John Leshy, professor emeritus at UC College of the Law San Francisco, who was the Solicitor of the U.S. Department of the Interior during the Clinton administration. Leshy has been professionally involved with redwoods legal issues since the 1970s -- when, as a Natural Resources Defense Council attorney in the 1970s, he litigated to stop logging surrounding Redwood National Park's protruding worm-shaped extension, which NRDC and other environmental groups claimed caused erosion and other impacts that threatened old grove strands within the park. Redwood National Forest was established in 1968 and expanded in 1978, which included the area around the worm-shaped area. Later, while at the Department of Interior in the 1990s, Leshy worked on the federal government's acquisition of land for another contested redwoods area, which became the Headwaters Forest Reserve.

With decades of legal experience related to redwoods preservation, Leshy highlights the unique legal challenge posed by climate change. "The old growth is preserved from logging, that was the biggest threat. Now, how much of a threat is climate change to redwoods? The jury is out on that scientifically, although everyone expects some impacts, probably adverse, as climate is more unstable and redwoods need stability and studies point to altered fog," Leshy says.

Leshy offers an interesting thought experiment to illustrate the legal issues.

“If I were teaching a law class on this, I would ask the students: OK, the Park Service has a mandate from Congress to preserve the parks in their natural condition – how should they interpret and apply that mandate if the climate is changing and changing what is happening to the park resources that were preserved? How much flexibility should be incorporated into the law governing management of these areas set aside for preservation? Do you have to artificially manage to make up for a human-caused climate impact?” Leshy reflects. “The law is just beginning to grapple with such questions.”

He adds that the because of the expected alteration in redwoods’ relatively stable climate, “that makes the redwoods not only a harbinger -- the redwoods are kind of an understandable example of a much larger issue that we all have to face.”

And the fact that the redwoods have historically been so beloved -- and so struggled over -- gives even more force to the issue.

“Anyone who has ever been in a redwood forest is in awe,” Leshy says. “The trees really affect you.”

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