

MONDAY, FEBRUARY 13, 2023

# The Seattle Times

## Study details how 2021 heat damaged evergreens

By ISABELLA BREDA  
*Seattle Times staff reporter*

The tips of western red cedar, hemlock and Douglas fir limbs looked as if they had been scorched by flames just a few days after the Pacific Northwest's extreme heat wave in 2021.

On June 28 that year, Seattle reached 108 degrees and Portland topped out at 116 degrees, both records. Several days of high overnight temperatures provided little respite.

Now, new research shows the extreme heat discolored, damaged and killed some of the region's ubiquitous evergreens.

Coastal Douglas fir and western hemlock plantations in Oregon and Washington shouldered some of the most extensive, visible impacts of the so-called heat dome, which occurs when a high pressure system parks itself over a region. The trees were visibly scorched by the heat within days and some within hours, according to a paper published in

Tree Physiology last month.

The research, led by Christopher Still of the Oregon State University College of Forestry, responded to a 2022 study that concluded the trees were damaged as a result of drought and trees' inability to release water vapor to cool down.

While drought was a factor, the new research suggests the main issue was most likely direct heat damage. As summers in the Pacific Northwest trend hotter, researchers and state forestry leaders are

trying to understand how trees west of the Cascade crest will fare. Trees play a critical role in reducing erosion, improving water quality and sequestering carbon, and if they're damaged, climate change and its impacts would intensify.

The June 2021 heat dome was among the most extreme heat waves ever recorded globally and the most intense in the observational record for the region.

Maximum temperatures were

See > TREES, A15

# < Trees

FROM A1

about 30 degrees above the average of the hottest months over the past decade. The highest temperature was 61 degrees hotter than the average, according to the U.S. Department of Agriculture Northwest Climate Hub.

Extreme heat can be deadly to leaf tissue even in short bursts, according to the new study. That heat can increase water loss at the branch, tree and ecosystem levels.

Trees in areas where the sun is beating down at the hottest part of the day — on south- and west-facing slopes, and with exposed edges near roads — had the greatest visible damage post-heat dome.

Tree species from warmer climates did not experience as much discoloration, but species from cooler environments had burnt canopies. Conversations among re-

searchers, foresters and landowners revealed that even well-irrigated Christmas tree farms suffered damage.

The researchers didn't rule out drought, but said extreme heat is the best explanation for the scorching seen throughout the Pacific Northwest during and after the heat dome. They called for future research to disentangle stressors like extreme heat and drought, and look into how trees have evolved to be resilient under different conditions.

Tamir Klein, who heads the Weizmann Tree Lab in Israel, was the lead researcher on the 2022 article that concluded the trees' damage was the result of drought and failed transpiration.

Klein said he agrees with his colleagues' interpretation that the damage was the result of both heat and drought but wants to know what mechanisms lead to the observed browning. How can

trees' biological processes related to drought response be disentangled from those related to heat?

And, Klein said, he wants to know what species are better equipped for extreme heat, and how the leaf damage threshold varies by species. Now he and his colleagues are collaborating on a follow-up review on how leaves regulate heat.

"Working together," Klein said in an email, "we expect to fill some of these gaps in the coming years."

In 2021, the state Department of Natural Resources flew aerial surveys of federal, tribal, state and private lands. They mapped about 84,000 acres of heat-scorched damage — all of it in Western Washington.

Douglas fir, western hemlock and western red cedar saw the worst of it.

In Eastern Washington, trees have likely adapted to higher temperatures in June. But trees in Western Wash-

ington have never really experienced anything like it, said Glenn Kohler, a forest entomologist with DNR.

When the state flew the survey again in 2022, the trees looked mostly fine.

"They're generally green and growing," Kohler said. "But those branch tips that were heavily damaged are still dead."

There's no indication the heat wave killed the trees, but it may take time to understand the full impact.

Once a tree experiences a "stress event" like extreme temperatures, it may survive. But when that stressor is coupled with others like severe drought and more extreme heat events, the damage may build up. Western red cedar and western hemlock are not drought-tolerant, Kohler said. And research suggests much of the red cedar mortality is drought-driven.

Meanwhile, bark beetles often take advantage of

weak, stressed trees that can't defend themselves. Once a tree has been invaded, it will die.

The long-term impacts take a few years to materialize, Kohler said. But hopefully, he said, extreme heat won't be an annual occurrence.

The conditions aligned just perfectly to create the extreme heat wave of June 2021, said Reid Wolcott, warning coordination meteorologist for the National Weather Service.

The high pressure system that developed was akin to something that may be seen in the desert, he said. It blocked cooling marine air and prevented clouds from forming, allowing the sun to directly warm the air and land.

And the temperature continued to build each day. The longer the heat event, the more extreme, he said.

While the heat dome may be an isolated event, the

climatological record shows temperatures increasing over time.

In the past two decades, Washington has seen seven of its 10 hottest years since 1895. And in 2022, the state saw a record number of days at or over 90 degrees, coupled with the driest June to October on record.

The red-tipped trees are just one of the latest iterations of the visible impacts of climate change.

It's not unlikely that the conditions will align to create more extreme heat events like the heat dome, Wolcott said.

The hottest months will likely continue to get hotter, and especially in urbanized areas that lack green space.

"And that can contribute pretty significantly," Wolcott said, "to not only the impacts on vegetation, but human life."

Isabella Breda: 206-652-6536 or  
ibreda@seattletimes.com; on  
Twitter: @BredaIsabella.