

A Forest Service report examines the widespread die-off of true fir trees in parts of Oregon and Washington.

Trees

Continued from A5

Extreme heat, including last year's record-breaking "heat dome," is also being investigated as a possible cause.

"When a drought event comes around it basically weakens the entire forest to a point where the insects and the diseases start to work in tandem, and this pushes a tree over the edge and it succumbs to mortality," DePinte said.

What's noteworthy about Firmageddon isn't just the total area impacted. It's the number of dead trees within that space. In some areas as much as 50% or more of fir trees are estimated to have died.

These "severe" die-offs occurred in Central Oregon in forests running from the Oregon/California border northward, according to survey data.

Survey method

Surveys of forests were conducted using a combination of fixed-wing aircraft, helicopters, drones and satellite imagery. The surveys were primarily conducted, as they have been for decades, using an airplane flying 1,000 feet over forested land.

DePinte and his team surveyed forests on federal, state and private lands, adding up to a total of roughly 69 million acres (over 100,000 square miles) in Oregon and Washington. Small sections of California and Idaho, where national forests spill over the state borders, were also surveved.

The Oregon Department of Forestry and Washington Department of Natural Resources also participated in the effort.

Although fir die-offs have been recorded as far back as 1952, when surveys began, this year's Firmageddon dwarfs all

isn't considered "severe." The USFS defines "severe" as 50% or more of the trees within an area having died.

However, the extent of the die-off in terms of total area is concerning, according to DePinte.

"It (the Douglas-fir die-off) is on the lighter side," he said. "The problem is the extent. When you're up in a plane flying over and you see that it goes on for the entire mountainside, then it's like, 'Whoa, that's a huge amount of dead trees."

What's really unusual, according to DePinte, is the insects that are believed to be causing the Douglas-fir dieoff are considered to be "secondary agendas." The insects have the ability to kill trees that are already weakened by drought or extreme heat events, but generally can't kill the trees on their own.

"They can kill trees, but they're not 'tree killers," De-Pinte said.

The USFS will continue monitoring the Douglas-fir die-off and will study the issue further with Oregon State University researchers.

Although more analysis is required, drought appears to be weakening Douglas-fir trees, making them susceptible to insect and possibly also fungal attack. This also appears to be the mechanism affecting true firs.

Insects and fungi compound problems

"I think it's sort of a 'death by a thousand cuts' kind of thing," said Robbie Flowers, a USFS etymologist, about the likely cause of the fir die-off. Firmageddon has not one

cause but multiple compounding causes, according to Flowers.

Flowers, who conducted on-the-ground surveys of



Mauna Loa eruption as viewed from Waikoloa. The world's largest active volcano erupted in Hawaii erupted at 11:30 p.m. local time Sunday, Nov. 27, for the first time in nearly four decades, the U.S. Geological Survey said.

Lava from Hawaii volcano lights night sky amid precautions

BY CALEB JONES Associated Press

KAILUA-KONA, Hawaii -Waves of orange, glowing lava and ash blasted and billowed from the world's largest active volcano in its first eruption in 38 years, and officials told people living on Hawaii's Big Island to be ready in the event of a worst-case scenario.

The eruption of Mauna Loa wasn't immediately endangering towns, but the U.S. Geological Survey warned the roughly 200,000 people on the Big Island that an eruption "can be very dynamic, and the location and advance of lava flows can change rapidly."

Officials told residents to be ready to evacuate if lava flows start heading toward populated areas. Monday night, Nov. 28, hundreds of people lined a road as lava flowed down the side of Mauna Loa and fountained into the air.

The eruption migrated northeast throughout Monday and spread out over the side of the volcano, with several distinct streams of lava running down the hillside. The eruption began late Sunday night, Nov. 27, following a series of fairly large earthquakes, said Ken Hon, scientist-in-charge at the Hawaiian Volcano Observatory. The areas where lava was emerging — the volcano's summit crater and vents along the volcano's northeast flank — are both far from homes and communities. Officials urged the public to stay away from them, given the dangers posed by lava, which is shooting 100 to 200 feet into the air out of three separate fissures roughly estimated to be 1 to 2 miles long. Volcanic gases wafting out of the vents, primarily sulfur dioxide, are also harmful. Air quality on the Big Island more generally is good right now, but officials are monitoring it carefully, said Dr. Libby Char, the director of the state Department of Health.

Hon said air quality could deteriorate while the eruption lasts, which scientists expect will be about one or two weeks if the volcano follows historical patterns.

Lifelong Big Island resident Bobby Camara, who lives in Volcano Village, said everyone across the island should keep track of the eruption. He said he's seen three Mauna Loa eruptions in his lifetime and stressed the need for vigilance.

"I think everybody should be a little bit concerned," he said. "We don't

know where the flow is going, we don't know how long it's going to last.

Gunner Mench, who owns an art gallery in Kamuela, said he awoke shortly after midnight and saw an alert on his phone about the eruption.

Mench and his

A time-lapse video of the eruption from overnight showed lava lighting up one area, moving across it like

waves on the ocean. The U.S. Geological Survey said the eruption had migrated to a rift zone on the volcano's northeast flank. Rift zones are where the mountain rock is cracked and relatively weak — making it easier for magma to emerge.

Lava could move toward the county seat of Hilo, but that could take about a week, Hon said at a news conference.

Scientists hope "Volcanic gas the flow will parallel the 1984 eruption, where the lava was more viscous and slowed Pele's hair may down. Mauna Loa has another rift zone downwind. So on its southwest flank. Lava could reach nearby comwould ask those munities in hours

to a quarter-inch of ash could accumulate in some areas.

"Volcanic gas and possibly fine ash and Pele's hair may be carried downwind," Gov. David Ige said, referring to glass fibers that form when hot lava erupts from a fissure and rapidly cools in the air. The wind stretches the fibers into long strands that look like hair. "So certainly we would ask those with respiratory sensitivities to take precautions to minimize exposure."

Mauna Loa is one of five volcanoes that together make up the Big Island of Hawaii, the southernmost island in the Hawaiian archipelago.

Mauna Loa, rising 13,679 feet above sea level, is the much larger neighbor of Kilauea, which erupted in a residential neighborhood and destroyed 700 homes in 2018. Some of Mauna Loa's slopes are much steeper than Kilauea's, so lava can flow much faster when it erupts.

During a 1950 eruption, the mountain's lava traveled 15 miles to the ocean in under three hours.

previous records.

The USFS did not conduct aerial surveys in 2020 due to social-distancing rules around COVID-19.

'True firs' impacted

Firmageddon appears to be limited to so-called "true fir" trees; trees in the genus Abies.

The Pacific Northwest's leading timber crop, Douglas-fir (Pseudotsuga menziesii), is not in the genus Abies and is not considered to be a true fir.

Die-offs were recorded for grand fir, white fir, red fir, noble fir and the hybrid Shasta red fir. The largest mortality was observed at lower elevations where grand fir and white fir are plentiful. White fir was the hardest hit species, according to survey data.

Douglas-fir die-off

Although true firs are experiencing their worst dieoff on record, Douglas-fir is having a die-off of its own, though on a comparatively smaller scale.

The USFS survey estimates that 450,000 acres (over 700 square miles) of Douglas-fir have experienced some level of mortality in Oregon, with the majority of this occurring in Southwestern Oregon.

Washington is also seeing a die-off of Douglas-fir, with roughly 230,000 acres (nearly 360 square miles) impacted.

The level of Douglas-fir dieoff within the areas affected

tree mortality to, in effect, "ground truth" the aerial survey data, says a clear relationship between drought and fir die-offs has been observed historically — droughts tend to lead to fir die-offs.

When drought occurs, says Flowers, fir trees become susceptible to pests. The pests implicated in Firmageddon are the fir engraver beetle (Scolytus ventralis), a type of bark beetle, and multiple fungal root diseases.

Various parasitic fungi can make fir roots less able to absorb water. This makes the trees more susceptible to drought conditions.

Firs with root disease are also more susceptible to insect attacks, especially from the fir engraver beetle, which gets its name because it burrows and carves up the water-rich cambium layer of a tree just under the bark. The fir tree's only defense against this attack in its cambium layer is to flush the insects out with pitch. But if drought and root diseases make water less available, the trees can't amount a defense.

As a consequence, Flowers said, a large enough fir engraver infestation can effectively "girdle" an already water-stressed fir tree.

"The trees have a limited amount of resources they can put into defense and their defenses go down then they get into these stressful situations," he said.

wife, Ellie, ventured out to film the eerie red glow cast over the island, watching as lava spilled down the volcano's side.

"You could see it spurting up into the air, over the edge of this depression," Mench said.

"Right now it's just entertainment, but the concern is" it could reach populated areas, he said.

Seeing Mauna Loa erupt is a new experience for many residents of the Big Island, where the population has more than doubled from 92,000 in 1980.

More than a third of the island's residents live either in the city of Kailua-Kona to the west of the volcano, or about 23,000 people, and Hilo to the east, with about 45,000. Officials were most worried about several subdivisions some 30 miles to the volcano's south that are home to about 5,000 people.

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this area. But Hon said historically Mauna Loa has never erupted from both rift zones simultaneously. "So we presume at this point that all

or days if the vol-

cano erupts from

of the future activity is going to be on the northeast rift zone of Mauna Loa and not on the southeast rift zone," he said. "So those residents in that area do not have to worry about lava flows."

Hawaii County Civil Defense announced it had opened shelters because it had reports of people evacuating from along the coast on their own initiative.

The USGS warned residents who could be threatened by the lava flows to review their eruption preparations. Scientists had been on alert because of a recent spike in earthquakes at the summit of the volcano, which last erupted in 1984.

Portions of the Big Island were under an ashfall advisory issued by the National Weather Service in Honolulu. It said up

Mauna Loa's volume is estimated at least 18,000 square miles, making it the world's largest volcano when measured from the ocean floor its summit.

Tourism is Hawaii's economic engine but Big Island Mayor Mitch Roth predicted few problems for those vacationing during the eruption.

"It will be spectacular where it is, but the chances of it really interrupting the visitor industry - very, very slim," he said.

Tourism officials said no one should have to change Big Island travel plans.

For some, the eruption might cut down on some travel time, even if there is more volcanic smog caused by higher sulfur-dioxide emissions.

"But the good thing is you don't have to drive from Kona over to Hawaii Volcanoes National Park to see an eruption anymore," Roth said. "You can just look out your window at night and you'll be able to see Mauna Loa erupting."



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