Unique tree chambers allowing scientists to bring the heat

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At the edge of Sydney's metropolitan fringe in the suburb of Richmond, Western Sydney University researchers are carefully taking measurements from the inside of several tall metal enclosures containing native trees. The 9 metre tall structures are lined in rows next to remnant bushland, and each hosts a threatened Parramatta Red Gum (Eucalyptus parramattensis). The chambers allow the scientists to control the temperature, humidity, CO2 concentration, and water availability of each tree, granting them a valuable opportunity to turn up the dials to see how they'll react to climate change. Once the experiments are finished, the researchers cut down the trees and measure their entire biomass, and even count the number of leaves on each tree.

"This facility is the first of its type in Australia and the Southern Hemisphere, and it was establish in collaboration with scientists at the Swedish University of Agricultural Science" says Dr John Drake, from the Hawkesbury Institute for the Environment at Western Sydney University.

"In each chamber there's an above canopy space, where the plastic floor seals around the stem of each tree, allowing us to measure that tree's photosynthesis and transpiration. Below this section we have the sub floor area, where we control the soil and root temperature, as well as water availability"

"This allows us to continuously measure the trees physiology to determine how much carbon it's taking up through photosynthesis, and

how much water it's losing through transpiration. It's a unique and informative way to study how the trees are responding to the environment."

For the first part of his study over the cooler months, Dr Drake had six of the trees to track the natural ambient temperatures, with the other six chambers given an additional three degrees of warming.

"The eucalypts that we've studied really love the additional 3 degrees of warming so far, as the extra heat accelerates their overall growth during winter and spring. One of the ways this particular species of tree is growing faster is by accelerating the rate of leaf development, meaning there's more photosynthesis and therefore more leaves in a positive feedback loop," says Dr Drake.

"But during the summer, when the temperature is already high and reaching 40 degrees, an additional 3 degrees of heat could have a negative impact on growth and photosynthetic rates. Global warming and increased heatwaves and extreme weather are potentially challenging to forest trees in Australia, and we need to understand how they will cope in these conditions."

To test how the trees respond to high impact heat events, the researchers are gearing up for a heatwave experiment over the summer, where they will expose the trees to a heat wave of the future: four consecutive days of 43 degree heat.

"Climate change in Australia is going to mean more extreme weather events like heat waves and droughts, and it's the combination of drought and higher temperatures that's most likely to challenge eucalypts," says Dr Drake.

Apart from helping researchers determine how Australian trees will cope

in changed weather conditions, the experiment is also shedding new light on the way trees behave.

"We often think of trees as organisms that just sit there, but they are dramatically and dynamically changing all the time, in lots of interesting ways. They're changing their photosynthetic capacity in leaves, respiration rates, and enzyme activities, all the time. They interact very dynamically with the environment in way that's hard to see- but with this infrastructure we can finally measure their response to the environment and see exactly how they grow, and why."

"Trees have an enormous impact on our climate, and tree growth and carbon sequestration is already solving a part of our climate problem for us. We need to understand whether this is going to continue into the future, and how we can help trees respond to changed conditions."

Provided by University of Western Sydney