Australian trees 'sweat' to survive extreme heatwaves, researchers reveal

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Calla Wahlquist January 31, 2018

Australian researchers growing trees in climate change conditions have found the leaves "sweat" to survive extreme heatwaves.

The year-long experiment showed that trees continue to release water through their leaves as an evaporative cooling system during periods of extreme heat, despite the carbon-fixing process of photosynthesis grinding to a halt.

Previously, scientists believed that photosynthesis and transpiration – the process of releasing water – were linked, meaning one would not occur without the other.

Prof Mark Tjoelker from the University of Western Sydney's Hawkesbury Institute for the Environment is one of the authors of the study, which was published in Global Change Biology this month.

Tjoelker said the findings had significant implications for climate change because they showed that trees stopped capturing carbon during extreme heatwaves, which are predicted to become more frequent and severe in the future.

"If heatwaves occur over a large surface area … clearly the trees and native forests in that area would take up less carbon," he said. "And if there is an increased frequency of heatwaves that obviously impacts their ability to serve as carbon sinks."

New South Wales and Queensland had their hottest year on record in 2017, while Australia as a whole recorded its third-hottest. Seven of the 10 hottest years recorded in Australia have occurred since 2005.

The study also showed that trees grown in conditions that mimic a predicted 3C average warming were not better able to cope with extreme heat.

The experiment was conducted at the Hawkesbury forest experiment and Yarramundi site at Richmond, near Sydney.

It involved the use of 12 “whole-tree capsules”. The nine-metre capsules are temperature and climate-controlled pods that look like a cross between a greenhouse and a spaceship, and are referred to by locals as “the Coke bottles”.

Each capsule was planted with a 60cm *Eucalyptus parramattensis* or Parramatta red gum seedling in December 2015. The species is endemic to the area and listed as vulnerable.

Six of the capsules were set to reflect the ambient temperature, while the other six were set to reflect a predicted 3C increase in mean annual temperatures, which is the modelled climate change outcome for Australia before the end of the century.

The trees in the warmer pods grew 30% faster and reached a height of six metres in two years.

Twelve months in, researchers began inflicting artificially induced four-day heatwaves across all 12 capsules, bringing the afternoon temperature up to 43C. The trees were starved of water for a month leading up to each heatwave to mimic natural heatwave conditions.

“It didn’t matter whether the trees were grown under current climate conditions or the 3C increase of the future, they responded equally well,” Tjoelker said.

"On each of those days when peak afternoon heatwave temperatures were high, we noticed the photosynthesis went to zero, so they weren't taking up any carbon any more but they maintained their water loss."

The effect was a cooling system "akin to humans sweating", he said.

A third of the world now faces deadly heatwaves as result of climate change

Tjoelker said the results would be fed back to the Intergovernmental Panel on Climate Change (IPCC) to help provide more accurate modelling.

"We can just provide the nuts and bolts, the biology, that helps improve the reliability of these simulations," he said.

Further studies will be conducted to see if the response is consistent across tree types, whether trees are able to use this cooling method to survive longer heatwaves and what happens if they run out of water.

That could result in some deaths among the pod trees.

"Trees will be sacrificed for science, in some cases," Tjoelker said.

The test centre was designed to be replanted every few years. This crop of *parramattensis* is due to be pulled up and replaced with a new species for a new round of experiments.

The project is partly funded by a $315,000 ARC discovery project grant.