



THE IMPACT

Research into how methane moves through wetland trees has evolved into a discovery, reshaping our understanding of the role of forests in combating climate change



Dr Luke Jeffrey

Qualifications:

Bachelor of Science (Honours) and PhD from Southern Cross University

Australian Research Council DECRA Fellow and Senior Researcher

Institution:

Southern Cross University, Faculty of Science and Engineering

Research Field:

Research helps explain how microbes living on tree bark remove methane and other greenhouse gases from the atmosphere, improving understanding of how forests help regulate climate and informing future climate mitigation and reforestation strategies



IN THEIR WORDS

What motivates me most about my research is uncovering hidden processes that shape our environment and atmosphere – processes that, in many cases, are entirely new to science.

I am driven by understanding tree methane exchange – or “treethane” – and the role of cryptic microbial communities within bark in processing climate-relevant gases.

My work reframes tree stems and bark not as inert protective surfaces, but as living interfaces where carbon, gases, microbes, and biogeochemical cycles intersect. Bark represents an enormous cumulative global surface area, rivalling that of the Earth’s terrestrial surface, and a single square metre of tree bark can host trillions of bacteria. Taken together, this suggests bark may play a more substantial role in moderating atmospheric composition than previously recognised, boosting the ecological value of trees and opening an exciting new research frontier.

My research is inherently multidisciplinary and collaborative, connecting me with many inspiring and talented colleagues. It also takes me into remote environments few would otherwise experience – climbing trees in flooded forests, sampling mangroves inhabited by saltwater crocodiles, navigating reservoir ghost forests, and conducting night-time measurements in wetland swamps. The fieldwork is challenging, but that challenge is part of what makes the discoveries meaningful. Equally important to me is mentoring and inspiring the next generation of scientists, fostering curiosity, independence, and confidence in the students I supervise. Ultimately, I hope my work will help refine greenhouse gas accounting, inform forest management and conservation, and contribute to practical ecological climate-mitigation strategies.

THE TREES OF LIFE

For a decade, Dr Luke Jeffrey has been uncovering secrets hidden in plain sight. As an Australian Research Council Discovery Early Career Researcher Award Fellow and Senior Researcher at Southern Cross University’s Faculty of Science and Engineering, Dr Jeffrey has discovered the bark of Australian trees harbours entire ecosystems of bacteria that actively clean our air – a finding that could reshape how the understanding of forests’ role in combating climate change.

What began as research into how methane moves through wetland trees has evolved into a groundbreaking discovery – that living microbiomes in tree bark are consuming not just methane, but hydrogen and carbon monoxide too.

“Up until now, bark was viewed as just a protective layer for trees,” Dr Jeffrey said.

“But we’ve discovered it’s actually an active surface that helps filter the air. Our latest research published earlier this year has sort of gone even deeper into the bark microbiome of trees, and we’ve discovered that living

in the bark, there’s a whole ecosystem of bacteria that actually help mitigate a variety of different gases too. So these do include methane, but other gases of interest were hydrogen and carbon monoxide.”

The research journey started in northeastern New South Wales wetlands, where Dr Jeffrey’s team first discovered methanotrophs – methane-consuming bacteria – living in the bark of paperbark trees.

This initial finding, published five years ago, was just the beginning.

In collaboration with microbiologists at Monash University, the team now has expanded their research to eight iconic Australian tree species, including casuarinas, banksias, eucalypts and acacias.

Using DNA sequencing, laboratory incubations and field measurements, they’ve proven these bark microbiomes don’t just exist – they actively consume greenhouse gases and toxic pollutants.

“We estimate that methanotrophs living in bark mitigate about a third of the methane coming from wetlands that would otherwise reach the atmosphere,” Dr Jeffrey said. “They

essentially act as a filter as methane moves through the trees.” The implications are staggering. Recent estimates suggest the global surface area of tree bark rivals the total surface area of Earth’s continents.

With approximately three trillion trees on the planet and 73,000 unique tree species, each with its own bark adaptations and microbiomes, the potential impact is enormous.

“A single paperbark tree has about six trillion bacteria in just one square metre of bark,” Dr Jeffrey said.

“When you consider the scale globally, we think this is going to be a pretty significant process that, until recently, no one’s really quantified.”

The research exemplifies interdisciplinary collaboration between biogeochemists and microbiologists at Southern Cross and Monash universities. Despite Covid-19 travel restrictions initially limiting fieldwork to northeastern New South Wales, the team has now expanded across Australia.

“I now have five students looking at different angles of this research,” Dr Jeffrey said. “We’re sampling across Australia, from tropical Darwin to temperate Victorian forests.”

While the current research represents world-first blue sky science, he saw clear pathways to practical applications.

“This discovery will have management implications,” Dr Jeffrey said. “Which trees are most effective? Can we plant more in the right places? Which should we protect to help our atmosphere?”

The next phase involves building datasets across different tree species and forest types to support global-scale modelling.

For Dr Jeffrey, being the first to measure these phenomena is matched by the excitement of training the next generation.

“Being involved in something so new is a privilege,” he said. “Getting students excited, showing them what I’ve learned, and giving them tools to make the next big discovery – that’s what I love.”

As climate change intensifies focus on nature-based solutions, Southern Cross University’s research reveals trees are even more valuable than generally thought – not just for oxygen and carbon capture, but for invisible work happening in the living skin of every tree.