Explaining the history of Australia's vegetation

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C4 dominated Australian landscape: Triodia pungens dominated hummock grassland with scattered Acacia and Eucalyptus, on Mittebah Station in the Northern Territory. Credit: Terrestrial Ecosystem Research Network (TERN)

University of Adelaide-led research has uncovered the history of when

and why the native vegetation that today dominates much of Australia first expanded across the continent.

The new understanding will help researchers better predict the likely impact of climate change and rising CO2 levels on these critically important plants. Called 'C_4 plants' after their alternative photosynthetic pathway, these plants include a wide variety of native tropical, subtropical and arid grasses as well as saltbushes. C_4 crops include sugarcane and corn.

"C_4 plants evolved to be able to photosynthesise under warm, dry, and low CO2 conditions, with a special ability to take advantage of summer rainfall," says lead author Jake Andrae, Ph.D. candidate in the University's School of Physical Sciences and Sprigg Geobiology Centre. "As a result, they dominate the vegetation of Australian tropical, subtropical, and arid regions today.

"But despite being the most C_4 dominated continent today, little is known about the initial C_4 expansion in Australia."

The researchers analysed fossilised leaf waxes and pollen preserved in marine sediments. They measured the chemical signatures from these remnants, to reconstruct how and when C_4-dominated ecosystems first rose to prominence in Australia.

"In many regions around the globe, C_4 plants became prevalent between six and eight million years ago, which is thought by some to be the result of falling global atmospheric CO2 concentrations during this time," says project leader Dr. Francesca McInerney, Australian Research Council Future Fellow at the University of Adelaide.

"Surprisingly, in north-west Australia C_4 plants did not expand at this time in spite of regionally arid conditions and falling atmospheric CO2,

both of which should have promoted C_4 vegetation. Instead, C_4 vegetation expanded across the landscape only 3.5 million years ago, several million years later."

The authors say that the rise of C_4 plants in Australia was likely the result of a strong summer monsoon that developed around that time.

"The difference in the timing of the expansion of C_4 plants in Australia from other parts of the globe demonstrates that regional climate changes are important in driving vegetation change," Dr. McInerney says.

"In the future, the interaction between global atmospheric CO2 and regional changes in seasonality of rainfall is likely to play an important role in the distribution of C_4-dominated ecosystems. Rising CO2 will place C_4 plants at a disadvantage, while rising temperatures, and changes in the season and amount of rainfall, could favour them.

"In Australia, C_4 plants are critical to grazing, soil carbon storage and biodiversity. We need to understand the factors that are likely to influence their survival in the future, to provide a basis for future conservation of these important plants."

The research, in collaboration with Columbia University and University of Melbourne, has been published online in *Geophysical Research Letters*.

More information: J. W. Andrae et al. Initial Expansion of C4 Vegetation in Australia During the Late Pliocene, *Geophysical Research Letters* (2018). DOI: 10.1029/2018GL077833

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