Aerial mapping and modelling of forest flowering and fire

Using satellite data, the CRC for Honey Bee Products used geographical information system and cloud-processing tools to investigate changes in forest flowering and the impacts of fire. This data allows beekeepers to evaluate their observations as part of their operations in south-west Western Australia and helps to inform forest and fire management.

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Flowering events are environmental indicators of forest health. They are a critical part of ecosystem reproduction and healthy forests and are core to the sustainability of the honey bee industry.

Methods for monitoring variability in forest flowering are often highly localised or are applied over short periods. They focus on small plots and individual trees, or coarsely cover large areas with many trees, with flowering difficult to determine.

novel tools

environmental stewardship

fire impacts

In a world first, CRC researchers developed a tool to systematically map flowering across a season and for a whole forest, using a dominant forest tree Marri (*Corymbia calophylla*).

Aerial image of Marri tree in flower

Researchers used drone images of flowering to calibrate new-generation daily nano-satellite data at the scale of individual Marri tree canopies (6 x 6 m). Cloud computing and machine learning algorithms were used to distinguish changes in green vegetation and the production of cream-coloured Marri flowers from January to April.

This technique allows satellite images to help track forest ecosystem conditions and support investigations into environmental drivers of eucalypt forest phenology. This is the first work globally that accurately measures forest flowering of individual trees and works in Marri-Jarrah woodlands with sparse canopy and different (exposed) soils.

Fire is a powerful environmental driver, with many beekeepers observing a relationship between fire and flowering. As the fire regime is manipulated by prescribed burning, questions have arisen about the exact relationship. To date, there has been little empirical information.

CRC researchers used aerial images of 64 fires to teach and apply machine learning to create a system based on Landsat.

Fire severity was mapped from 2005 to 2020. Severity was categorised into five classes, ranging from unburnt, through three levels of canopy scorch, to total canopy consumption, with wildfires and prescribed burns differentiated. Results from this work are freely available on Google Earth Engine.

Combined, these geographical data reveal the effect of fire on forest flowering. This research provides new insight for beekeepers, forest managers and other stakeholders on flowering of Eucalypt woodlands and forests, and the impact of fire and other environmental drivers.

New tools and open-access methods developed through research by the CRC can help monitor climate change, environmental impacts and management decisions on a landscape scale.

CRC remote sensing PhD student Daniel Dixon with a drone used for measuring flowering extent

Associate Professor Nik Callow
School of Agriculture and Environment
University of Western Australia
Email: nik.callow@uwa.edu.au
www.crchoneybeeproducts.com

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