FIRES AND HYDROLOGY OF SOUTH-EAST AUSTRALIAN MIXED SPECIES FORESTS

Mana Gharun, Tarryn Turnbull and Mark Adams
Faculty of Agriculture and Environment, University of Sydney, NSW

Introduction

Most of the research investigating relationships between catchment water yield and water use by trees in eastern Australia is located in mono-specific Ash-type forests, where fire kills the overstorey trees and the forest regenerates via seedlings. However, the Black Saturday bushfires in 2009 in Victoria predominantly burnt mixed-species foothill forests – a forest type that occupies much of the watersheds for Victoria's and New South Wales' water catchments. The majority of eucalypts that comprise mixed-species forests regenerate from fire via epicormic sprouts; sprouts that bear foliage of juvenile form akin to that found on seedlings of Ash-type species that regenerate after fire.

Research aims

We aimed to develop our existing methods of quantifying overstorey water-use so they can be applied to resprouting mixed-species forests. In addition, we have characterised the physiology of resprouting eucalypts for a range of species, soils, topographies and climates.

With this information we will quantify tree water-use in mixed-species forests as they regenerate from a crown-removing fire.

Site description

Our "Stanley" site is located on a ridge (~800 m ASL) in a native forest comprised of mixed eucalypt species; *Eucalyptus radiata* (Narrow-leaved Peppermint), *E. dives* (Broad-leaved Peppermint), and *E. mannifera* (Brittlegum), 5 km from Stanley, NE Victoria. Mean annual rainfall (1971–2000) is 1014 mm with 90 days rainfall >1 mm (Australian Bureau of Meteorology). The geological landscape consists of Ordovician aged sediments with horizons of sandstone, shale and mudstone in the bedrock.

Crown fires passed through the region in February 2009 and shortly thereafter trees sprouted from epicormic shoots. We have six plots, one burnt and unburnt pair for each of the dominant eucalypt species. Measurements correspond to three years after the crown-removing fire.

Methods

Soils and micrometeorology – Soil water content was measured every 6 h at 5, 20 and 50 cm using standing wave soil moisture sensors (MP406, ICT International Pty Ltd., Armidale, Australia). Air temperature and relative humidity were measured every 30 min for calculation of vapour pressure deficit (VPD). A nearby weather station captured rainfall data.

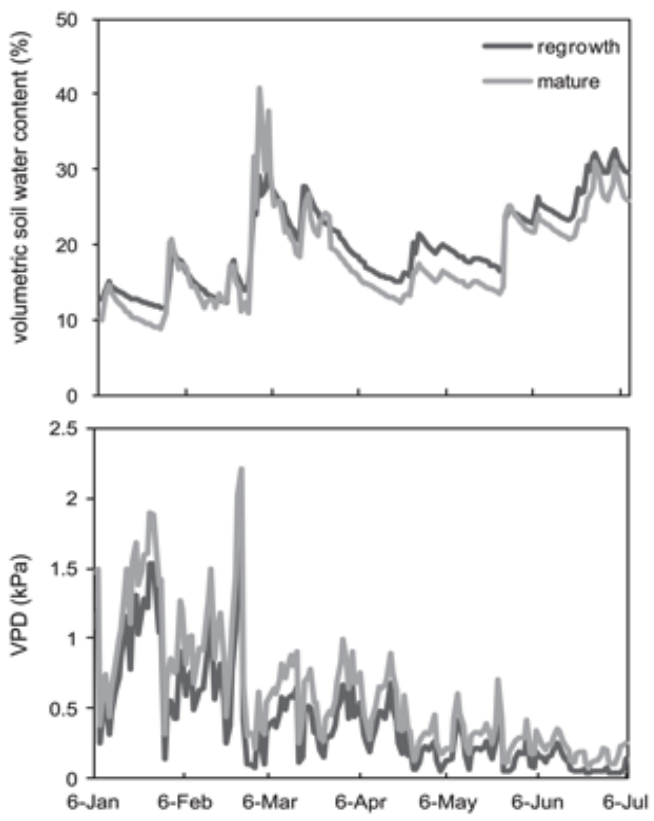

Figure 1. Soil moisture content and air vapour pressure deficit (VPD) in burnt (regrowth) and unburnt (mature) mixed species forest between January and July 2012. Reproduced from Gharun *et al*. 2013.

Tree water use – We measured sap flow using HRM sensors in three trees (smallest tree, mid-size and largest tree) from each of the dominant species (*E. radiata, E. dives* and *E. mannifera*) in the burnt and unburnt plots. We converted sap velocity to sap flow using measurements of sapwood area for the study trees. Plot level water use was calculated using species-specific relationships between sapwood area and diameter at breast height and knowledge of the diameter of all trees in the plot. For 187 days between January and July 2012 we have a continuous data set for all sites, enabling us to compare stand water use between mature and regrowth mixed species forests.

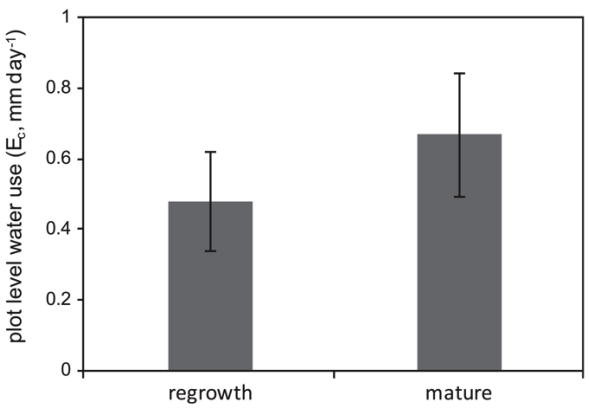

Figure 2. Plot level water use in burnt (regrowth) and unburnt (mature) mixed species forest between January and July 2012, averaged for the three dominant eucalypt species. Error bars are 95% confidence intervals. Reproduced from Gharun *et al*. 2013.

Results

We found that soils tended to be wetter under regrowth forests, as was the atmosphere within the canopy (Figure 1). As trees regenerate from a crown-removing fire, mixed-species eucalypt forests do not use more water than their unburnt counterparts (Figure 2). This is in stark contrast to the water use of regenerating Ash-type forests and can be explained by: slower sap flow in resprouting trees, a relatively small increase in sapwood area index (22%), and a 20% decrease in total leaf area index after the fire (Gharun *et al.* 2013). After three years, the canopy in the regrowth forest closely resembled those of mature forests, as such stand water use in the regenerating forest should not increase substantially after this time. Our results provides valuable information about the effects of fires on the water use of mixed-species forests in south-east Australia. This information can be used in forest water use models and be used to inform management decisions for the south-east Australian mixed-species forests.

Project Outcomes

We have already published three manuscripts and one Firenote on the topic of tree water use in mixed species forests. We have an additional two manuscripts in preparation.

References

Gharun M, Turnbull TL, Adams MA. 2013. Stand water use status in relation to fire in a mixed species eucalypt forest. *Forest Ecology and Management* 304: 162–170.

CRC

THE UNIVERSITY OF SYDNEY