Yellow Box genetics

Our Yellow Box citizen science project explored genetic diversity and population genetic structure in this iconic species across its range. We found that the sampled populations should be producing seed with good genetic diversity suitable for restoration projects. However, moving seed to very different climates or environments is not recommended. Natural colonisation by Yellow Box over the coming decades will be limited and needs to be supported by carefully managed restoration projects.

The Yellow Box Citizen Science Project

This factsheets outlines key findings of our Yellow Box citizen science project that explored genetic diversity and population genetic structure in this iconic species across its range. The full details of this research are now published in the journal "Forest Ecology and Management" (Broadhurst *et al.* 2018).

Yellow Box (*Eucalyptus melliodora*) is broadly distributed (24-38°S) in woodlands and forests from western Victoria, through New South Wales and into south-eastern Queensland (Brooker and Kleinig 1983). This species predominantly occurs on the lower-western slopes of the Great Dividing Range (GDR), primarily at 150-600 m above sea level with occasional occurrences to 1200 m (Boland *et al.* 1984). It also co-occurs with several other eucalypts including *E. microcarpa* (Inland Grey Box), *E. pilligaensis* (Pilliga Grey Box), *E. conica* (Fuzzy Box), *E. crebra* (Narrow-leaved Ironbark) and *E. sideroxylon* (Red Ironbark). Little is known of the life history of Yellow Box, but as with other eucalypts it is relatively long-lived, likely to be mixed mating (Pryor 1976) and flowers approximately every two years (Birtchnell and Gibson 2006).

Sampling and genotyping

A citizen science project was initiated to collect from across the species range with 32 populations being used for this study (Figure 1). Leaves were collected from up to 30 trees in each populations and mailed by Express Post to CSIRO in Canberra for DNA extraction and genotyping. Each sample was amplified with seven molecular markers called microsatellites. The data produced were analysed to determine how much genetic diversity occurred across the sampled populations and to look for population genetic structure that might suggest we should limit how far seed is moved during restoration projects.

Genetic diversity

Levels of genetic diversity were relatively uniform across the sampled populations and consistent with that found in other widespread eucalypts such as *E. camaldulensis and E. gomphocephala* (Dillon *et al.* 2015; Nevill *et al.* 2014). We also found very little inbreeding and no genetic bottlenecks.

This indicates that the sampled populations should be producing seed with good genetic diversity for restoration projects.

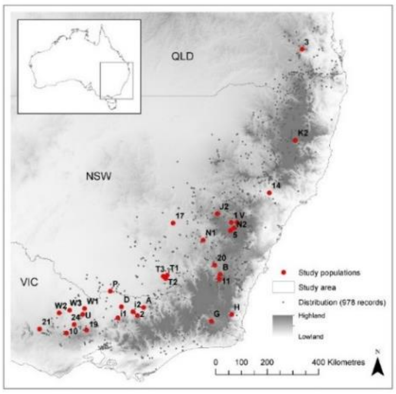

Figure 1 – sample sites used for analysis

Population genetic structure

A analysis package called STRUCTURE (Pritchard *et al.* 2000) determined that while there were four genetic groups in the sampled populations (Figure 2) there was no evidence of strong population genetic structure as the four genetic groups were found in all of the populations.

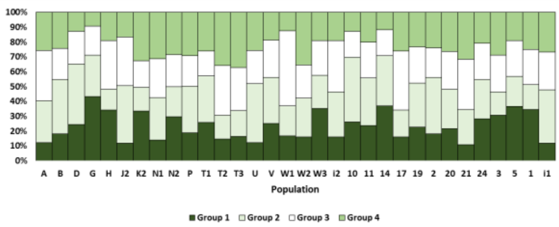

Figure 2 – example of how the four genetic groups are distributed in each population

Similarities in the genetic profiles of these Yellow Box populations suggest that these were once part of a much larger interbreeding population. The lack of obvious population genetic structure among these sites suggests that seed can be used more broadly for restoration projects. However, moving seed across large climatic (e.g. between high and low rainfall regions) or ecological distances (e.g. between different soil types or between high and low altitudes) is not recommended unless part of an experiment designed to test the long term effects of seed transfer.

Yellow Box – past and future

To better understand how Yellow Box might respond under climate change we modelled past and future distributions. At the last glacial maximum (LGM) some 21 thousand years ago Yellow Box probably existed across a much larger range (Figure 3 left) than where it is currently found (Figure 3 right).

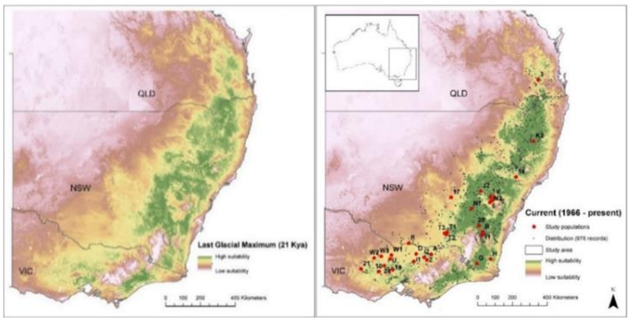

Figure 3 –modelled distribution at the LGM (left) and in 2017 (right).

The current distribution is predicted to contract to the southeast by 2050 (Figure 4 left) and 2090 (Figure 4 right) as the climate across this region becomes hotter and drier.

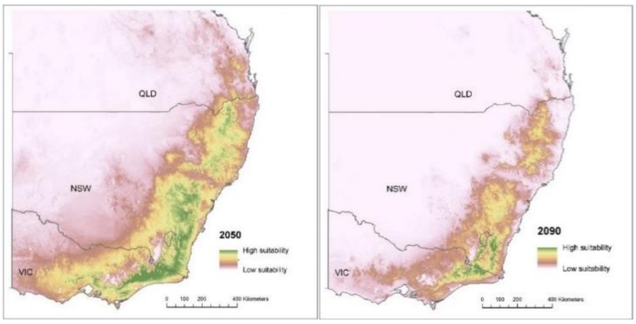

Figure 4 – modelled distribution in 2050 (left) and 2090 (right).

A major challenge associated with species moving to new areas is that land needs to be available for colonization. The southeast region where Yellow Box is predicted to move is already heavily used for agriculture and includes several major urban areas. Consequently, we modelled how land availability will influence the redistribtuion of Yellow Box in 2050 (Figure 5 left) and 2090 (Figure 5 right). These predictions indicate that opportunties for Yellow Box to colonise over the coming decades will be extremely limited.

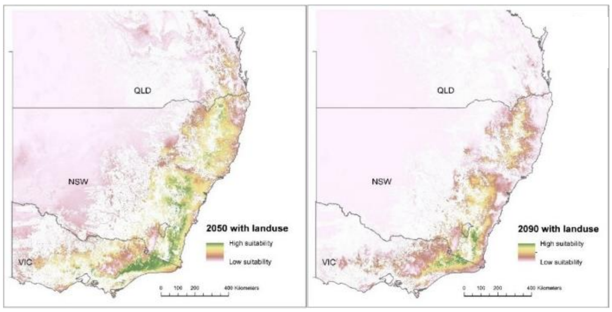

Figure 5 – modelled Yellow Box distribution including land availability at 2050 (left) and 2090 (right).

This suggests that natural colonization by Yellow Box and other species over the coming decades will be limited and will need careful planning and monitoring. Restoration projects that include experiments designed to test the effects of seed and species movement are likely to play an important role in this process (Broadhurst et al. 2017).

Acknowledgements

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CONTACT US

t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

FOR FURTHER INFORMATION

National Research Collections Australia
Dr Linda Broadhurst
t +61 2 6246 4988
e linda.broadhurst@csiro.au
w https://www.csiro.au/en/Research/Collections