



## Original article

# Designing food and habitat trees for urban koalas: Tree height, foliage palatability and clonal propagation of *Eucalyptus kabiana*



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## ARTICLE INFO

## Keywords:

Adventitious roots  
Cuttings  
*Eucalyptus tereticornis*  
*Phascolarctos cinereus*  
Street trees  
Urban fauna

## ABSTRACT

Koalas are iconic Australian tree-dwelling marsupials that are classified as vulnerable because of threatening processes that include urban development, habitat fragmentation and inbreeding. Koalas eat the leaves of specific eucalypt trees but urban planners and landowners often prefer to plant smaller trees that pose less risk from falling limbs. We have conducted a long-term project to develop shorter koala-food trees for planting in parklands, schools, streets and gardens. We identified a little-known and geographically-confined species, *Eucalyptus kabiana*, that had potential for urban plantings. We assessed the height of *E. kabiana* trees in cultivation, determined whether their foliage was palatable to koalas, and compared the amenability to vegetative propagation of *E. kabiana* with that of an extensively-propagated related species, *E. tereticornis*. Cultivated *E. kabiana* trees were short, reaching around 3–5 m height after 6 years. Their foliage was highly palatable to koalas, and their cuttings proved to be amenable to propagation. Average rooting percentages for *E. kabiana* cuttings were 31–46%, similar to values obtained with *E. tereticornis* cuttings. Over 600 *E. kabiana* trees have thus far been distributed for planting in wildlife corridors, parklands, schools and gardens. The planting of more koala-food trees will help to alleviate the risks of inbreeding faced by koala populations in fragmented urban landscapes. School plantings also provide opportunities for students to learn about and interact with organisms such as koalas that inhabit the *Eucalyptus* trees.

## 1. Introduction

Urban trees provide a wide range of economic, social and environmental benefits such as boosting property values, reducing energy costs, lowering crime, absorbing ultraviolet radiation, reducing heatstroke, sequestering carbon, removing air pollutants and decreasing storm-water runoff (Berland and Hopton, 2014; Livesley et al., 2014; Na et al., 2014; Mullaney et al., 2015a,b,c; Graham et al., 2016; Gratani et al., 2016; McPherson et al., 2016; Thom et al., 2016; Donovan, 2017; Nowak et al., 2017; Tan et al., 2017). Trees also provide habitat and movement corridors for fauna (Munshi-South, 2012; de Oliveira et al., 2014; Zhang and Jim, 2014; Huang et al., 2015; Matsuba et al., 2016; Shimazaki et al., 2016) and they offer opportunities for residents to interact with other organisms (Pearce et al., 2015; Askerlund and Almers, 2016). However, tree clearing for urban development can reduce fauna populations, especially for herbivores that rely on tree species for both food and habitat. One example of a declining species in urban environments is the iconic Australian arboreal marsupial, the

koala (*Phascolarctos cinereus* Goldfuss), which is now listed as Vulnerable across most of its range in eastern Australia because of threatening processes that include urban development, habitat fragmentation, fire, drought, disease and inbreeding (Lee et al., 2010; Seabrook et al., 2014; McAlpine et al., 2015; Adams-Hosking et al., 2016).

Koalas feed almost exclusively on the leaves of some *Eucalyptus* and *Corymbia* species (Moore et al., 2010; Wu et al., 2012; Melzer et al., 2014). Large tracts of prime koala habitat have been cleared for urban development along the outskirts of cities and towns in eastern Australia. Most of the eucalypt species eaten by koalas in this region are tall trees, reaching between 12 m and 40 m height in cultivation (Nicolle, 2016b). Many local governments and urban landowners prefer to plant small trees that pose less risk of branches falling from a great height or becoming entangled with overhead power lines during storms (Kendall et al., 2012; Kirkpatrick et al., 2012; Nicolle, 2016a; Plant and Sipe, 2016; Roy et al., 2017). Local governments have, therefore, recognised a need to develop shorter koala-food trees for planting in urban parklands, schools and gardens. Koalas prefer to roost in tall forest trees,

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**Fig. 1.** (a) *Eucalyptus kabiana* trees planted in two rows at Chancellor State College (CSC) alongside an existing windbreak of *Melaleuca quinquenervia* trees; (b) *E. kabiana* trees at CSC at 6 years after planting; (c) *E. kabiana* foliage placed in an enclosure with a koala (*Phascolarctos cinereus*); (d) *E. kabiana* foliage being consumed by a koala; (e) *E. kabiana* branches after a koala had consumed foliage during an 18-h period; and (f) rooted cuttings of *E. kabiana* for planting in wildlife corridors, parklands, schools and gardens.

particularly on hot days (Moore et al., 2010; Crowther et al., 2013; Marsh et al., 2013), although they frequently inhabit small forest remnants, rehabilitated sites, juvenile forest trees, isolated farm trees, and trees in urban streets and gardens (White, 1999; Sullivan et al., 2004; Cristescu et al., 2013; de Oliveira et al., 2014; Melzer et al., 2014).

We have conducted a long-term project to develop shorter eucalypt trees for planting in urban areas. In this study, we identified a poorly known and geographically confined species, *Eucalyptus kabiana* L.A.S.Johnson & K.D.Hill, that has potential as a short tree for urban plantings. *Eucalyptus kabiana* (Mount Beerwah mallee) is only found in two populations on rocky outcrops of the Glasshouse Mountains National Park, Queensland, Australia (Brooker and Kleinig, 1994). It is listed as Vulnerable under the Commonwealth of Australia *Environment Protection and Biodiversity Conservation Act (1999)*. The palatability of *E. kabiana* foliage to koalas was previously unknown although *E. kabiana* is closely related to two prime koala-food species, *E. tereticornis* Sm. and *E. camaldulensis* Dehnh. We assessed the height of *E. kabiana* trees in

cultivation, determined whether the foliage of cultivated *E. kabiana* trees was palatable to koalas, and compared the amenability to clonal propagation of *E. kabiana* with that of an extensively-propagated related species, *E. tereticornis*.

## 2. Materials and methods

### 2.1. Seed collection

We collected seeds from *E. kabiana* trees in the Mount Beerwah section (26°53'S, 152°52'E) of Glasshouse Mountains National Park, Queensland, Australia, in April 2009. Seeds were collected under Permit No. WITK05599808 (Environmental Protection Agency, Queensland). We obtained seeds of *E. tereticornis* (seedlot 20357) from the Australian Tree Seed Centre, Canberra, Australia.

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