Rose Gum (*Eucalyptus grandis*) seedlings arising in burned rainforest: a small case study

Rupert A.W. Russell[A] and *Donald C. Franklin*[B]

[A]PO Box 63, Mount Molloy Qld 4871, Australia. Email: rj.russell@bigpond.com

[B]Ecological Communications, 24 Broadway, Herberton Qld 4887, Australia *and* Research Institute for Environment & Livelihoods, Charles Darwin University, Darwin NT 0909, Australia

Abstract

Boundaries between upland rainforest and wet sclerophyll forest dominated by Rose Gum (*Eucalyptus grandis*) are dynamic, being influenced by climate and fire, with recent expansion of rainforest attributed by some to the exclusion of fire from eucalypt forest. We document a case in which an intense fire burnt an area of rainforest in 2002, a year of severe drought; subsequently at least two Rose Gum seedlings germinated within it, 90 m from the nearest potential mother tree. These seedlings were revisited in 2012 and 2017. Fifteen years after the fire they are trees with diameters of 43 and 48 cm at 1.3 m above ground. This small case study shows that the occurrence of Rose Gums within rainforest is not necessarily evidence of rainforest expansion, so offering an important caution in interpreting the dynamics of these vegetation boundaries.

Handling editor: Gabriel Crowley

Citation: Russell RAW, Franklin DC. 2018. Rose Gum (*Eucalyptus grandis*) seedlings arising in burned rainforest: a small case study. *North Queensland Naturalist* 48: 26-29.

Introduction

In upland areas of north Queensland's Wet Tropics bioregion, rainforests have expanded in recent decades at the expense of wet sclerophyll forest (Unwin 1989; Harrington & Sanderson 1994; Tng *et al.* 2012; Stanton *et al.* 2014a). This has been attributed to the cessation of regular burning of wet sclerophyll forest with the demise of Aboriginal hunter-gatherer land management (Harrington & Sanderson 1994; Stanton *et al.* 2014b) but might also be driven by elevation of levels of carbon dioxide in the atmosphere (Murphy & Bowman 2012; Tng *et al.* 2012); these two potential drivers might well interact.

Cessation of Aboriginal burning and its replacement with European management has almost certainly changed fire regimes close to rainforest boundaries, though we note a scarcity of direct evidence that upland wet sclerophyll forest was burnt – and burnt regularly – by Aboriginal people, as also noted by Tng *et al.* (2014a). The consequences of European management for fire regimes in these forests might be more complex than a simple reduction in fire frequency, as this is in part contingent on grazing reducing fuel loads and many of these forests are not grazed. An alternative scenario is that fires have become less frequent but more severe, with the intensity driven by the accumulation of fuels in the absence of both grazing and frequent low-intensity fires. It is possible that infrequent fires of high-intensity prevailed before Aboriginal settlement of the region at least 8,000 years ago (Cosgrove *et al.* 2007) and thus for very much longer than verifiable human existence in the region.

This small study follows from one such high-intensity fire that burned into rainforest in 2002. Here, we report on the fate of two Rose Gum seedlings that germinated within the rainforest

following the fire, the nature of the surrounding forest, and the distance to possible mother trees. We also discuss the implications of this occurrence of Rose Gums within rainforest.

Study site

The Rose Gum seedlings are at 900 m above sea level on a gentle WSW-facing slope of Mount Lewis, 20 m from the Mount Lewis Road and near a tributary of Windmill Creek, on the Mount Carbine Tablelands (16°35'S, 145°16'E). They are close to the boundary between Brooklyn Wildlife Sanctuary and Mount Lewis National Park. The area has a history of logging, though the practice is now discontinued. The forest is mapped as Regional Ecosystem (RE) 7.12.16a, "Simple notophyll vine forest on wet and moist uplands, granite and rhyolite. Uplands of the cloudy wet to moist rainfall zones" (DEHP 2016), though 7.12.16b might be more accurate (at least since the fire) as it includes "... recovering from disturbance, with *Acacia celsa* canopy or emergents". Boulders nearby confirm the area as granitic, though none were exposed near the seedlings. Downslope to the WSW and 110 to 150 m distant, the vegetation is mapped as RE 7.12.21b, "Eucalyptus grandis tall open forest and woodland with a well-developed vine forest understorey. Granites and rhyolites."

The fire burnt up the slope of Mount Lewis from the vicinity of the Mulligan Hwy 6 km south-west of Mary Farms in October 2002, the fire being documented on the North Australia Fire Information (NAFI) web-site (*www.firenorth.org.au*, accessed 5 Dec. 2017). The fire burnt into rainforest for 100 to 200 m, stopping at the Mount Lewis Road (RR; David Armbrust pers. comm.), though the NAFI web-site shows it stopping several hundred metres short – it is believed that the images analysed for NAFI don't adequately show fire in rainforest. 2002 was an exceptionally dry year – the driest on record from 70 years of complete records at nearby Julatten (16°36'S, 145°22'E) (*www.bom.gov.au*, accessed 11 Dec. 2017). For the 10 months prior to Oct. 2002, rainfall at Julatten was 49.5% of the long-term average (Nov. 2011 data are missing), and none fell during Oct. 2002.

Observations

In the year following the fire, the senior author (RR) found two Rose Gum seedlings c. 2 m tall and 13.5 m apart in burnt rainforest, and marked them with galvanised star pickets close by. These seedlings were unscarred by fire and had clearly germinated following it. At the time of first sighting in 2003 the pair of saplings stood several metres tall and perhaps 4 or 5 cm diameter in fire-blackened surrounds littered with debris from fire-killed stems. The forest canopy had been severely scorched and was mostly open at the time of viewing. There were numerous sapling *Acacia celsa* (Brown Salwood) trees.

When next visited almost ten years after the fire on 8 June 2012 (RR, Juliana Russell, David Armbrust), the Rose Gum saplings were still vigorous and had grown into trees. One (hereafter Tree 1) was undamaged, had a diameter at breast height (dbh) of 39 cm, and flower buds on the ground beneath showed it had reached reproductive age. The other (Tree 2) had lost its main shoot but sent up strong branches below the break.

On 2 Dec. 2017, both trees appeared healthy (RR, DCF and Juliana Russell). Tree 1 was estimated to be 20 m tall with dbh measured at 48 cm (Fig. 1). Tree 2 was estimated to be 15 m tall with dbh measured at 43 cm. The following observations were also made on this occasion.

The canopy surrounding the two Rose Gums was dominated in places by *A. celsa* and in places by rainforest species, but the Rose Gums held their place in the canopy and overtopped it by a few metres. Some other species present included *Flindersia bourjotiana*, *Placospermum coriaceum*, *Franciscodendron laurifolium*, *Davidsonia pruriens*, *Tarenna* sp., *Alphitonia petrei*, *Litsea bindoniana*, *Elaeocarpus* sp., *Macaranga* sp. and *Polyscias* sp., many of which are rainforest pioneers. Most rainforest trees in the stand were less than 20 cm diameter, whilst *A. celsa* trees were up to about 30 cm diameter, which suggests these had germinated in response to or since the fire. However, several large live rainforest trees (dbh 0.6 to 0.7 m) close by – one was a *Flindersia* sp. (Fig. 2) – shows that some trees survived the fire.

Some charred trunks were still evident on the ground, the smaller ones concealed beneath leaf litter, the larger ones (to c. 0.8 m diameter) somewhat more obvious. Several charred stumps were located. It was also noted that several of the old, live rainforest trees had basal scars which we interpret as fire scars, but no charcoal (Fig. 2), which we think indicates that they were burnt by an earlier fire and not scarred by the 2002 one.

Figure 1. Rose Gum (*Eucalyptus grandis*) – Tree 1 – with Juliana Russell and star picket marker, 2 Dec. 2017.
The tree is no more than 15 years and two months old. All photos are by Don Franklin.

Viewed from the two subject Rose Gums, no other Rose Gums could be seen and none were located nearby on earlier visits. We found one large Rose Gum (Fig. 3) 94 m north of Tree 1 (about 85 m from Tree 2) that could feasibly have been a mother tree. The intervening forest was occupied entirely by rainforest trees (including *A. celsa*) apart from some more, smaller Rose Gum saplings (10 to 30 cm dbh) close to the possible mother tree.

Discussion

It is a necessary caveat that this is a limited documentation of events at one site with the fate of just two Rose Gum seedlings monitored for 15 years. Nevertheless, some useful conclusions can be drawn: that fire can burn into rainforest,

Figure 2. Possible older fire scar (pre-2002) on *Flindersia* sp., Mt Lewis, 2 Dec. 2017.
The tree had a dbh of 0.68 m and was 16 m from Tree 1.

that Rose Gum can colonise rainforest from nearby mother trees following such a fire, and that Rose Gum seedlings can grow rapidly and well for at least fifteen years in these circumstances. An ash-bed effect for the germination of Rose Gum has been postulated (Tng *et al.* 2012), and Tng *et al.* (2014b) demonstrated that the phosphorous released by fire enhances the survival and growth of Rose Gum seedlings especially in rainforest soils. The rapid growth rates recorded in this study are not exceptional for Rose Gum; in a Brazilian plantation, some Rose Gums reached more than 30 m height with stem diameters more than 20 cm within seven years of being planted out (Campoe *et al.* 2013).

The vegetation at this site remains as rainforest even after being severely burnt, albeit one with a high frequency of *A. celsa* and two Rose Gums. Our observations provide additional evidence that the relationship between Rose Gum and rainforest is dynamic and driven at least partly by fire. We agree with Tng *et al.* (2014b) that it is appropriate to take a long-term perspective on the relationship

Figure 3. The nearest larger Rose Gum (dbh 1.16 m) to the two saplings marked in this study – with Rupert Russell, 2 Dec. 2017.

between rainforest and wet sclerophyll forest – that it is dynamic and not one-directional. However, we acknowledge that specific biodiversity considerations, such as conservation of the endangered Northern Bettong (*Bettongia tropica*), might warrant specific management in some locations aimed at maintaining open forest (Bateman & Johnson 2011; DNPRSR 2012).

The occurrence of Rose Gum within rainforest has often been interpreted as evidence of expansion of rainforest (e.g. Unwin 1989). Our observations indicate that this is not necessarily the case but can also be a consequence of fire burning into rainforest from nearby wet sclerophyll forest.

Acknowledgements

David Armbrust and Juliana Russell shared field visits, and David shared photographs from an earlier visit to the site. We thank Noel Preece for his thoughtful comments on a draft of this paper.

References

Bateman BL, Johnson CN. 2011. The influences of climate, habitat and fire on the distribution of cockatoo grass (*Alloteropsis semialata*) (Poaceae) in the Wet Tropics of northern Australia. *Australian Journal of Botany* 59: 315-323.

Campoe OC, Stape JL, Nouvellon Y, Laclau J-P, Bauerle WL, Binkley D, Le Maire G. 2013. Stem production, light absorption and light use efficiency between dominant and non-dominant trees of *Eucalyptus grandis* across a productivity gradient in Brazil. *Forest Ecology and Management* 288: 14-20.

Cosgrove R, Field J, Ferrier Å. 2007. The archaeology of Australia's tropical rainforests. *Palaeogeography, Palaeoclimatology, Palaeoecology* 251: 150-173.

Department of Environment and Heritage Protection. 2016. *Qld REDD V10.0 December 2016*. *https://www.qld.gov.au/environment/plants-animals/plants/ecosystems*, downloaded 29 Sept. 2017.

DNPRSR (Department of National Parks Recreation Sport and Racing). 2012. *Planned Burn Guidelines. Wet Tropics Bioregion of Queensland*. Queensland Government: Brisbane.

Harrington GN, Sanderson KD. 1994. Recent contraction of wet sclerophyll forest in the wet tropics of Queensland due to invasion by rainforest. *Pacific Conservation Biology* 1: 319-327.

Murphy BP, Bowman DMJS. 2012. What controls the distribution of tropical forest and savanna? *Ecology Letters* 15: 748-758.

Stanton P, Stanton D, Stott M, Parsons M. 2014a. Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 1. The extent and pattern of transition. *Australian Forestry* 77: 51-57.

Stanton P, Parsons M, Stanton D, Stott M. 2014b. Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 2. The dynamics of transition forests and implications for management. *Australian Forestry* 77: 58-68.

Tng DYP, Murphy BP, Weber E, Sanders G, Williamson GJ, Kemp J, Bowman DMJS. 2012. Humid tropical rain forest has expanded into eucalypt forest and savanna over the last 50 years. *Ecology & Evolution* 2: 34-45.

Tng DYP, Goosem S, Jordan GJ, Bowman DMJS. 2014a. Letting giants be - rethinking active fire management of old-growth eucalypt forest in the Australian tropics. *Journal of Applied Ecology* 51: 555-559.

Tng DYP, Janos DP, Jordan GJ, Weber E, Bowman DMJS. 2014b. Phosphorus limits *Eucalyptus grandis* seedling growth in an unburnt rain forest soil. *Frontiers in Plant Science* 5: Art. No. 527.

Unwin GL. 1989. Structure and composition of the abrupt rain-forest boundary in the Herberton Highland, North Queensland. *Australian Journal of Botany* 37: 413-428.