Size of Rose Gums in and near the Tumoulin Forest Reserve in north Queensland and its implications for the Yellow-bellied Glider

Vanessa R. Hensley[A], *John W. Winter*[B] and *Donald C. Franklin*[C]

[A]SIT Study Abroad, 1 Kipling Road, Brattleboro VT 05302, United States of America

[B]Threatened Species Program, Department of Environment and Science, 83 Main St., Atherton Qld 4883, Australia

[C]Research Institute for the Environment & Livelihoods, Charles Darwin University, Darwin NT 0909, Australia, and Ecological Communications, 24 Broadway, Herberton Qld 4887, Australia. Email: eucalypt@iinet.net.au

Abstract

Rose Gum (*Eucalyptus grandis*) is a tall, fast-growing eucalypt which, in north Queensland, occurs in upland wet sclerophyll forest. The tree provides important habitat for wildlife; in particular, large specimens provide hollows which are used as dens by the vulnerable Wet Tropics Yellow-bellied Glider (*Petaurus australis* unnamed subspecies). The Tumoulin Forest Reserve near Ravenshoe is home for both Rose Gum and the glider but has a history of logging such that large hollow trees are now scarce. Triggered by concern that den trees are vulnerable to fire and storm damage and might not be readily replaced, we investigated the diameter of Rose Gums in and around the Reserve along seventeen transects each with 20 trees. Rose Gum diameter varied strongly between transects but not with geology (basalt, rhyolite) nor position (edge, roadside, forest interior). Eight known den trees in the Reserve had a mean diameter of 151 cm and a minimum of 95 cm. Very few trees along transects matched these diameters but trees in the 50 to 100 cm diameter class – potential replacements den trees in the foreseeable future – were patchily dispersed and occasionally abundant. An assessment of Rose Gums at the scale of glider territories may be needed to ascertain prospects for the future development of den trees.

Handling editor: Gabriel Crowley

Citation: Hensley VR, Winter JW, Franklin DC. 2020. Size of Rose Gums in and near the Tumoulin Forest Reserve in north Queensland and its implications for the Yellow-bellied Glider. *North Queensland Naturalist* 50: 55-64.

Introduction

As its specific name implies, Rose Gum (*Eucalyptus grandis*) (sometimes known as Flooded Gum) is a magnificent tall tree. It can grow to 60 m or more and develop a girth of many metres (Fig. 1). In north Queensland, the species occurs in moist high-elevation forests usually at or close to rainforest boundaries (Harrington *et al.* 2000). Because of the density of vegetation in which it occurs, it is dependent on disturbance, notably fire, for germination (Tng *et al.* 2012; Bradford 2018). Seedlings do not develop a lignotuber (Burgess & Bell 1983), but can grow remarkably rapidly; roots of two-year-old plantation saplings had reached the water table 12 m underground (Christina *et al*. 2017) and 15-year old trees that germinated in burnt rainforest on Mount Lewis had diameters of 43 and 48 cm (Russell & Franklin 2018). Because of its rapid growth, straight form and the quality of its timber for general construction, Rose Gum is a popular forestry tree in moist tropical and

Figure 1. Two large Rose Gums (*Eucalyptus grandis*) in the Tumoulin Forest Reserve.
Both have been used by Yellow-bellied Gliders as a den tree. Left: note hollow base and people for scaling; diameter at breast height 180 cm (Photo: Jodie Eden). Right: note small crown, suggesting tree is senescent; diameter at breast height 190 cm (Photo: John Winter). See also Kaiwi *et al.* in press for more photos of glider den trees in the Tumoulin forest.

sub-tropical climates and is now grown widely both within and beyond Australia (Wikipedia, *https://en.wikipedia.org/wiki/Eucalyptus_grandis*, viewed 11 April 2020).

In north Queensland, Rose Gum and the moist sclerophyll forests in which it occurs provide important habitat for wildlife. They support a rich assemblage of birds (Chapman & Kofron 2010), and a number of species of possum and glider. The Wet Tropics Yellow-bellied Glider (*Petaurus australis* unnamed subspecies) is confined to this habitat (Winter *et al.* 2004). The glider shelters in hollow trees, mostly Rose Gums, during the day (Goldingay & Quin 2004). Only large trees provide the large hollows needed for the species: "Den trees averaged 1.6 m diameter at breast height and 47 m in height. Most den hollows were at least 30 m above the ground" (Goldingay & Quin 2004). The glider subspecies is listed as Vulnerable under both the Queensland Nature Conservation Act 1992 and Endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (TSSC 2020).

In this study, we appraise the size (diameter) of Rose Gums in and around Tumoulin Forest Reserve, the environmental factors that may influence diameter and the relationship between available size classes and the tree sizes used by Yellow-bellied Gliders for dens. All known Yellow-bellied Glider den trees in and around the Reserve are Rose Gums (Kaiwi *et al.* in press), and the Tumoulin area has a long and intense history of logging (Toohey 1991). In areas with a history of logging (Fig. 2), trees large enough to provide dens for Yellow-bellied Gliders may be scarce (Eyre & Smith 1997). Further, since den trees are relatively old and necessarily at least partly hollow, they may be vulnerable to destruction by strong wind and fire. We therefore examine the availability of both den trees and the cohort of younger trees that could potentially provide replacement den trees in the foreseeable future.

Figure 2. Regenerating forest with Rose Gum at front (est. 40 cm diameter) in the Sawmill Gully area of Tumoulin Forest Reserve.
Photograph: Don Franklin

Methods

Study area

The study was conducted in the Tumoulin Forest Reserve (total area 1877 ha; 17°33'30"S, 145°29'30"E, 2.5-8 km north of Ravenshoe) and immediately adjacent areas (Millstream Conservation Park [30 ha] and the Smith Road road reserve) at locations where Rose Gum occurred in sufficient numbers to sample – patchily and mainly in the higher eastern part of the forest block. The relevant parts comprise moist to wet, tall sclerophyll forest 940 to 1,100 m above sea level. In these areas, Rose Gum mostly occurs in admixture with other trees including Pink Bloodwood (*Corymbia intermedia*), Small-fruited Red Mahogany (*E. resinifera*) and Turpentine (*Syncarpia glomulifera*), in places as a co-dominant, but also as small stands, scattered individuals, or the dominant tall tree in narrow gallery forests along creeklines.

Forestry practices in Queensland, and north Queensland rainforests in particular, evolved over the 20th century, with onsite departmental control of logging and retention of habitat trees being relatively recent developments (Vanclay 1993a,b). However, no studies of logging in eucalypt forests in north Queensland appear to have been published. In the Tumoulin area, a variety of tree species including Rose Gum have been logged commercially, heavily so from 1912 following the opening of a railway line to Tumoulin in the previous year (Toohey 1991). Logging continued in the Reserve until the early 1990s, with a sawmill (in Sawmill Gully) within what is now the Reserve operating during the later years. In those later years, trees to be logged were selected and individually marked by Queensland Department of Agriculture Fisheries and Forestry rangers in accordance with *The Forestry Act 1959*; this was selective logging (i.e. not in coupes). Large ‘habitat’ trees were excluded from logging and a 100-m radius around trees known to be used by Yellow-bellied Gliders was also excluded. Jane Blackwood (personal communication) marked more than 300 such trees for exclusion after 1993, mainly in the Sawmill Gully area. Subsequently, an unofficial ban on logging was put in place for Sawmill Gully. The sawmill closed in or about 2000. Logging was formally precluded from the entire Forest Reserve when it was declared in 2010. No specific information is available on the logging history of sites assessed in this study.

Field methods

The size profile of Rose Gums was determined in April 2012 by measuring the diameter at breast height (DBH) of 340 live trees (including saplings) arranged in 17 zig-zag transects (McDonald *et al.* 1998) of 20 trees each in areas where *E. grandis* occurred in sufficient abundance to sample (Fig. 3). Starting points for transects were spread widely through the study area (14 in Tumoulin Forest Reserve, two along Smith Road just outside the Reserve, one in the Millstream Conservation Park adjacent to the Reserve). For each transect, a compass bearing corresponding with abundant *E. grandis* was selected to establish a centre line for the transect. The nearest *E. grandis* on or on either side of the transect line was first chosen for measurement, then the next nearest was chosen that was on or on the opposite side of the line and measured, the process being repeated until 20 trees had been measured. For each tree, a waypoint was taken using a GPS. Diameters were measured with a DBH tape to the nearest 1 cm, sometimes to the nearest 0.5 cm.

Den trees used by Yellow-bellied Gliders in and around Tumoulin have been identified by stag-watching at dusk for glider emergence from hollows as described by Kaiwi *et al.* (in press). The diameter of trees confirmed as containing dens was measured with a DBH tape.

Data analysis

Tree waypoints and a kml file of roads in Tumoulin forest were imported into Queensland Globe (*https://qldglobe.information.qld.gov.au/*; accessed March 2020). Each tree was scored for position and geological substrate (Fig. 3). Positions were:

- *edge*: within 30 m of cleared land;
- *road*: not within 30 m of cleared land but within 30 m of a graded road
- *forest*: neither *edge* nor *road*.

Geological substrate was scored using the 1:100,000 surface geology layer in Qld Globe. The options available at tree locations were:

- *basalt*: colluvium of Atherton basalt
- *rhyolite* of the Glen Gordon volcanics

Though both of volcanic origin, these substrates derive from eruptions of immensely different ages and yield soils of markedly different fertility. Colluvium from Atherton basalt is the fertile red soil strongly associated with agriculture on the Atherton Tablelands whereas rhyolite yields pale clays of much lower fertility (Malcolm *et al.* 1999).

In our first analysis, we appraised whether Rose Gum diameters differed with position or geology (fixed effects), including transect in the model as a random effect because of the grouping of trees within transects. In our second analysis, we appraised whether Rose Gum diameters with position = forest (188 trees distributed across 10 transects) differed with geology, with transect included as a random effect. Both analyses were performed as a permutational Anovas in Primer v6 with the Permanova add-on (Clarke & Gorley 2006; Anderson *et al.* 2008). The similarity of diameters was described by Euclidean distance, the model was Type III (partial) with fixed effects summing to zero for mixed terms, and the 9999 permutations of residuals were calculated under a reduced model. These models are neither parametric nor fully non-parametric, but in-between (Anderson *et al.* 2008); they do not require that data be normally-distributed nor homoscedastic because probabilities are calculated by permutation. They are, however, sensitive to values (in our case, diameters) and thus to the presence of a few large trees. However, we elected to retain these values as is (i.e. not to apply a data transformation) because large trees are of particular significance to the ecological story on which we seek to shed light. In the first analysis, we also conducted pair-wise *post hoc* tests of the effect identified as significant in the main test.

Results

Among all measured Rose Gums, diameter was not significantly related to position (edge, road, forest; $P = 0.79$) nor to geology (basalt colluvium, rhyolite; $P = 0.35$). However, diameter varied strongly between transects ($P < 0.0001$), mean diameter ranging from 11.4 to 81.4 cm (Fig. 4). Of 136 pair-wise post-hoc tests, 85 were significantly different at $P < 0.05$ and 45 of these at $P < 0.001$. Four clusters of transects are suggested by the distribution of significant pair-wise tests and also by the distribution of means in Fig. 4:

1. the two with the largest means (75.3 and 81.4 cm), G01 and G02. These were the only two transects outside the forest along Smith Road. Both are on basalt colluvium;

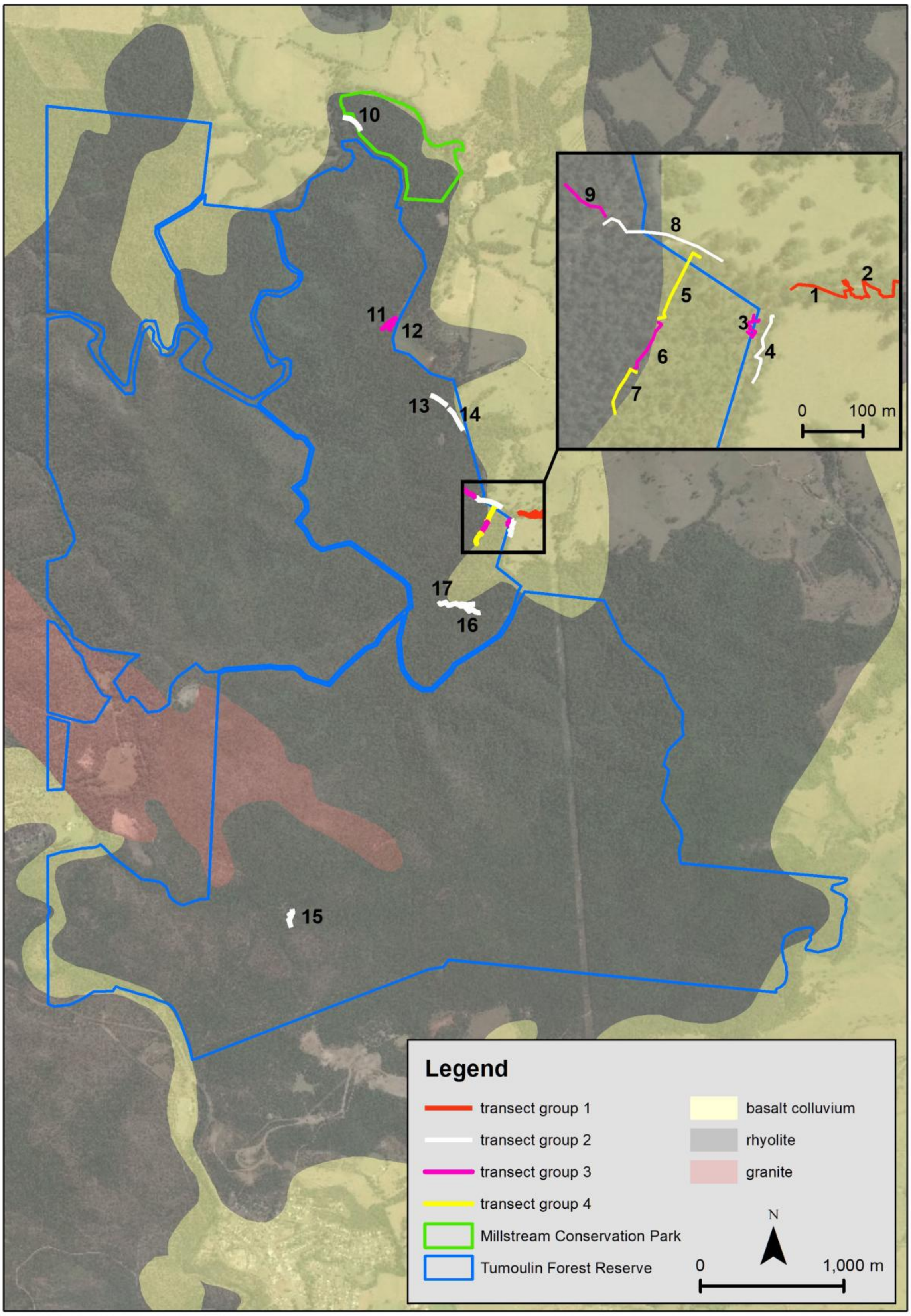

Figure 3. Tumoulin Forest Reserve and adjacent areas showing the location of transect groups. Transect numbers correspond to those in subsequent graphs. The base background layer is an air photo with darker patches being forest, whilst the layer above indicates the underlying geology as indicated in the legend. Map prepared by Steve Murphy. The logging, cyclone and fire history of individual transects is not known.

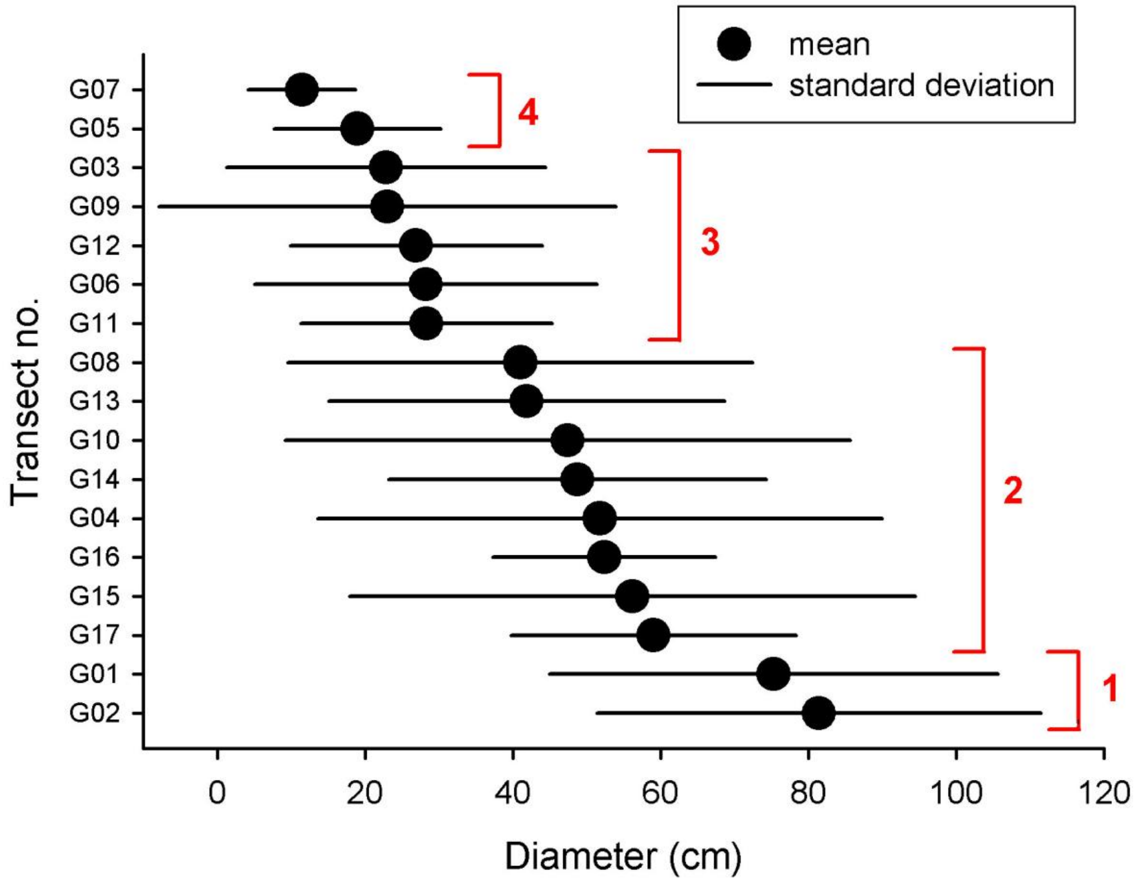

Figure 4. Mean ± standard deviation in diameter at breast height of Rose Gums (*Eucalyptus grandis*) in seventeen transects in and around Tumoulin Forest Reserve.
Clusters 1 to 4 in red are as explained in text.

2. eight transects with means ranging from 41.0 to 59.0 cm. These were widely dispersed geographically and include all available positions and geologies;
3. five transects with means ranging from 22.8 to 28.3 cm and, relative to cluster 4, large variation in diameters. These were fairly widely dispersed geographically and include all available positions and geologies;
4. two transects with the smallest mean diameters (11.4 and 19.0 cm) and small variation in diameters. These were both in forest (i.e. not on road or edge), and both near the Smith Road entrance to the Forest Reserve, with one on basalt colluvium and one on rhyolite.

Among forest (interior) Rose Gums, diameter was not significantly related to geology ($P = 0.90$) but varied strongly among transects ($P < 0.0001$). Trees less than 20 cm diameter were frequent and often dominant within transects but absent from G16 and G17 (Fig. 5). Trees 40 to 80 cm diameter were present in all but two transects (G03, G07) and predominant in two (G16, G17; both in Sawmill Gully area). Trees greater than 1.0 m diameter were infrequent but present in five transects.

The eight known Yellow-bellied Glider den trees within the Tumoulin forest, all being Rose Gums (seven live, one dead), ranged in diameter at breast height from 95 to 190 cm (Fig. 5) with a mean diameter of 151.4 cm.

Discussion

Two issues arise with the size of Rose Gum stands in and around the Tumoulin Forest Reserve: why is there such a scarcity of large Rose Gums within the forest, and why do (smaller) tree sizes vary so markedly in diameter between transects?

Despite the rock types at Tumoulin Forest Reserve producing soils with markedly different nutrient status, size structure of Rose Gum was not related to geology; such an effect may have been

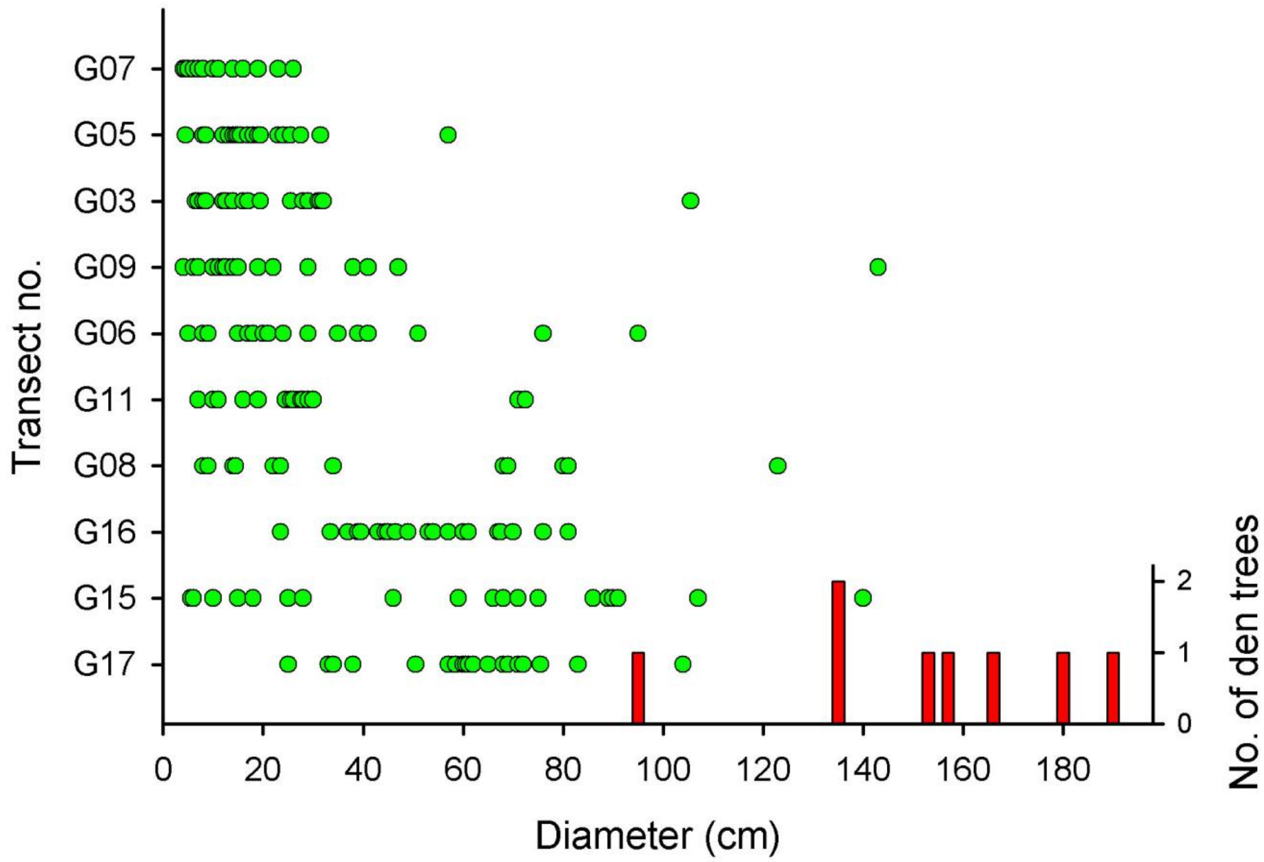

Figure 5. Diameter at breast height of individual Rose Gums (*Eucalyptus grandis*) in transects (green dots) and known den trees of the Yellow-bellied Glider (*Petaurus australis*) (red bars) within Tumoulin Forest Reserve. Sample sizes are 20 trees per transect except G08 (12 trees) and G11 (16 trees).

overridden by the recent history of disturbance in the forest. Other factors known to affect size structure in these types of forests are fire and logging (Tng *et al.* 2012; McLean *et al.* 2015). Although Tumoulin forest has suffered some damage from cyclones, most notably from TC Larry in March 2006, but damage was largely confined to ridge tops (Jane Blackwood, personal communication) and was evidently of limited extent even there. Tumoulin is distant from the coast (60 km) and thus less exposed to severe winds (illustrated well in Unwin *et al.* 1988), and eucalypt forest is relatively robust compared to rainforest given equivalent exposure (Unwin *et al.* 1988; Turton 2008). Within the span of recent records fire has, by attrition, adversely affected large Rose Gums in Tumoulin forest by burning out their bases, and at least one fire in about 1990 destroyed many Rose Gum seedlings in part of the forest (Jane Blackwood, personal communication). However, there is no evidence of severe fires in Tumoulin such as could kill Rose Gums outright. Fire-weather in these forests doesn't reach the extremes associated with such fires in the tall forests of south-eastern and south-western Australia (Fig. 8 in Tng *et al.* 2012), its regeneration strategy is unclear (Nicolle 2006) and Rose Gum has at least some capacity to resprout epicormically after fire (Paul Williams, personal communication).

The scarcity of large Rose Gums in the forest at Tumoulin is, we propose, because most large trees were logged over the last *c.* 110 years, with only a few very large trees that were already hollow – and thus useless to loggers – remaining. Management in Queensland forests to retain habitat trees occurred only very late in the history of logging at Tumoulin (e.g. Lamb *et al.* 1998). It is possible that the transects with the biggest trees (Group 1, Smith Road Reserve outside the forest) were never logged or logged early. Whilst Rose Gum is quick-growing, the large trees were exceptionally large (130–200 cm DBH). Nevertheless, their age is guesswork (Williams & Brooker 1997).

Because it has no lignotuber (Burgess & Bell 1983), Rose Gum does not re-shoot following logging and regeneration from seed is dependant on disturbance (Tng *et al.* 2012; Bradford 2018). Variation in tree size between transects might reflect variable times since logging, but could also reflect local fire histories including management burns. The cessation of logging in 2000 suggests a mininum age for saplings in transects with small trees (Group 4). Rose Gum seedlings are generally quick growing such that trees up to 80 cm DBH could all conceivably have arisen since logging commenced (heavily so in 1912). As a qualification, most Rose Gums in the study area grow interspersed with other eucalypts all of which persist as resprouters (Franklin 2013), so Rose Gum saplings likely encounter intense competition and may grow slower than is generally the case. Markedly slower growth rates have been reported at one site in New South Wales (Turner & Lambert 1983) though these are unusual. We are unable to provide more specific evidence about the age of particular cohorts of Rose Gums at Tumoulin.

Den trees occupied by Yellow-bellied Gliders in the Tumoulin Forest are of similar diameter (mean 151 cm) to those at Nitchaga 32 km to the SSE (mean 1.6 m; Goldingay & Quin 2004). They are at the large end, and mostly larger than any Rose Gums encountered along forest transects in this study (Fig. 5), demonstrating their rarity. One of them (153 cm diameter) along with two other large Rose Gums that were monitored in the Tumoulin Forest (175 and 190 cm diameter respectively), have fallen and died through natural causes since 2000 (JWW, personal observations).

The size range of trees observed within the Tumoulin Forest suggests that, in places at least, a new generation of Rose Gums may be approaching the age when they might support glider dens. In general, eucalypts take 120 to 220 years from germination to form useful hollows for vertebrate wildlife (Gibbons & Lindenmayer 2002). In Rose Gum, this period might be abbreviated by its rapid growth, low wood density relative to other eucalypts (DAFF 2020), and soft heartwood which is prone to rotting (Mark Heaton, Bernie Hyland, personal communications). On the other hand, Yellow-bellied Gliders use only large hollows in very large trees. Further, the spatial patchiness of medium-sized trees could be problematic, and an assessment at the scale of glider territories rather than transects may be needed to clarify the implications of the observed size profiles of Rose Gums for the future of the Yellow-bellied Glider in the Tumoulin Forest Reserve.

Further logging of Rose Gum in the Reserve risks interrupting the replacement of ageing den trees and could thus pose a serious threat to Yellow-bellied Gliders. In eucalypt forestry areas in south-eastern Australia, two recruitment trees for each hollow tree need to be preserved at each logging cycle to maintain the abundance of hollow trees in the longer term (Gibbons *et al.* 2010). Although the gliders are tolerant of logging *per se* at least at lower intensity (e.g. Kavanagh *et al.* 1995), their absolute dependence on the presence of large hollow trees generates management issues that must be – and often have not been – adequately addressed. Negative effects of logging on the glider have been reported in a number of studies (Milledge *et al.* 1991; Eyre & Smith 1997; Lindenmayer *et al.* 1999; Wormington *et al.* 2002; Eyre 2004). We raise the issue here because the Tumoulin Forest Reserve is a temporary tenure due to expire in 2025, and thus does not provide long-term protection from logging. Further, in the Tumoulin Forest Reserve, issues with size and regrowth of Small-fruited Red Mahogany (*Eucalyptus resinifera*), a species providing a key food resource for the gliders, also present a strong argument against renewal of logging (Jessup *et al.* 2020). The Wet Tropics Yellow-bellied Glider also occurs in at least one other forest reserve (Baldy Mountain; Bradford & Harrington 1999) and the same issue may arise there.

Acknowledgements

For assistance with the measurement of *E. grandis* along transects, or otherwise in supporting the project, we are grateful to Katharine Jessup, Priscilla Clare, Alan Winlaw, Jodie Eden, Tony Cummings and John Grant. Den trees have been found and measured by volunteers over many years. Jack Coppinger and Jane Blackwood kindly provided information about the status and history of Tumoulin Forest Reserve, and Steve Murphy prepared the map. Richard Loyn and Gay Crowley provided many helpful suggestions to improve the manuscript.

References

Anderson MJ, Gorley RN, Clarke KR. 2008. *PERMANOVA+ for PRIMER: Guide to Software and Statistical Methods*. PRIMER-E: Plymouth, UK.

Bradford M. 2018. *Eucalyptus grandis* (Rose Gum) in northern Queensland: a species under fire. *North Queensland Naturalist* 48: 30-38.

Bradford MG, Harrington GN. 1999. Aerial and ground survey of sap trees of the yellow-bellied glider (*Petaurus australis reginae*) near Atherton, North Queensland. *Wildlife Research* 26: 723-729.

Burgess IP, Bell JC. 1983. Comparative morphology and allozyme frequencies of *Eucalyptus grandis* Hill ex Maiden and *E. saligna* Sm. *Australian Forest Research* 13: 133-149.

Chapman A, Kofron CP. 2010. Tropical wet sclerophyll forest and bird diversity in north-east Queensland, Australia. *Pacific Conservation Biology* 16: 20-26.

Christina M, Nouvellon Y, Laclau J-P, Stape JL, Bouillet J-P, Lambais GR, le Maire G. 2017. Importance of deep water uptake in tropical eucalypt forest. *Functional Ecology* 31: 509-519.

Clarke KR, Gorley RN. 2006. *PRIMER v6: User manual/ Tutorial*. PRIMER-E: Plymouth, UK.

Department of Agriculture and Fisheries (DAFF). 2020. *Construction Timbers in Queensland. Book 2: Properties and Specifications*. State of Queensland.

Eyre TJ. 2004. Distribution and conservation status of the possums and gliders of southern Queensland. In *The Biology of Australian Possums and Gliders*, ed. RL Goldingay, SM Jackson, pp. 1-25. Surrey Beatty & Sons: Chipping Norton, NSW.

Eyre TJ, Smith AP. 1997. Floristic and structural habitat preferences of yellow-bellied gliders (*Petaurus australis*) and selective logging impacts in southeast Queensland, Australia. *Forest Ecology and Management* 98: 281-295.

Franklin DC. 2013. *Towards an Appropriate Fire Regime for Threatened Regional Ecosystem 7.12.22 in the Tumoulin Forest Reserve*. Unpublished report to Tablelands National Park Volunteers Inc.

Gibbons P, Lindermayer DB. 2002. *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing: Melbourne.

Gibbons P, McElhinny C, Lindenmayer DB. 2010. What strategies are effective for perpetuating structures provided by old trees in harvested forests? A case study on trees with hollows in south-eastern Australia. *Forest Ecology and Management* 260: 975-982.

Goldingay RL, Quin D. 2004. Components of the habitat of the Yellow-bellied Glider in north Queensland. In *The Biology of Australian Possums and Gliders*, ed. RL Goldingay, SM Jackson, pp. 369-375. Surrey Beatty & Sons: Chipping Norton, NSW.

Harrington GN, Thomas MR, Bradford MG, Sanderson KDI, A K. 2000. Structure and plant species dominance in North Queensland wet sclerophyll forests. *Proceedings of the Royal Society of Queensland* 109: 59–74.

Jessup K, Winter JW, Franklin DC. 2020. Size of *Eucalyptus resinifera* trees, and sap-trees used by Yellow-bellied Gliders, in the Tumoulin Forest Reserve in north Queensland. *North Queensland Naturalist* 50: 1-7.

Kaiwi A, Russell RAW, Winter JW, Franklin DC. in press. Dusk emergence from den trees by the Wet Tropics Yellow-bellied Glider. *North Queensland Naturalist*

Kavanagh RP, Debus S, Tweedie T, Webster R. 1995. Distribution of nocturnal forest birds and mammals in north-eastern New South Wales: Relationships with environmental variables and management history. *Wildlife Research* 22: 359-377.

Lamb D, Loyn R, Smith A, Wilkinson G. 1998. *Managing Habitat Trees in Queensland Forests*. Queensland Department of Natural Resources.

Lindenmayer DB, Cunningham RB, McCarthy MA. 1999. The conservation of arboreal marsupials in the montane ash forests of the central highlands of Victoria, south-eastern Australia. VIII. Landscape analysis of the occurrence of arboreal marsupials. *Biological Conservation* 89: 83-92.

Malcolm DT, Nagel BKA, Sinclair I, Heiner IJ. 1999. *Soils and Agricultural Land Suitability of the Atherton Tablelands North Queensland*. Department of Natural Resources: Brisbane.

McDonald RC, Isbell RF, Speight JG. 1998. Australian Soil and Land Survey, Field Handbook. Goanna Print: Canberra.

McLean CM, Bradstock R, Price O, Kavanagh RP. 2015. Tree hollows and forest stand structure in Australian warm temperate *Eucalyptus* forests are adversely affected by logging more than wildfire. *Forest Ecology and Management* 341: 37-44.

Milledge DR, Palmer CL, Nelson JL. 1991. 'Barometers of change': the distribution of large owls and gliders in mountain ash forests of the Victorian Central Highlands and their potential as management indicators. In *Conservation of Australia's Forest Fauna (First Edition)*, ed. D Lunney, pp. 53-65. Royal Zoological Society of New South Wales: Mosman.

Nicolle D. 2006. A classification and census of regenerative strategies in the eucalypts (*Angophora*, *Corymbia* and *Eucalyptus*—Myrtaceae), with special reference to the obligate seeders. *Australian Journal of Botany* 54: 391–407.

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

Threatened Species Scientific Committee (TSSC). 2020. *Conservation Advice.* Petaurus australis *(Wet Tropics subspecies). Yellow-bellied Glider (Wet Tropics)*. Canberra: Department of Agriculture, Water and the Environment.

Tng DYP, Williamson GJ, Jordan GJ, Bowman DMJS. 2012. Giant eucalypts - globally unique fire-adapted rainforest trees? *New Phytologist* 196: 1001-1014.

Toohey E. 1991. *Tumbling Waters*. Edwina Toohey: Tumoulin.

Turner J, Lambert MJ. 1983. Nutrient cycling within a 27-year-old *Eucalyptus grandis* plantation in New South Wales. *Forest Ecology and Management* 6: 155-168.

Turton SM. 2008. Landscape-scale impacts of Cyclone Larry on the forests of northeast Australia, including comparisons with previous cyclones impacting the region between 1858 and 2006. *Austral Ecology* 33: 409-416.

Unwin GL, Applegate GB, Stocker GC, Nicholson DI. 1988. Initial effect of tropical cyclone 'Winifred' on forests in north Queensland. *Proceedings of the Ecological Society of Australia* 15: 283-296.

Vanclay JK. 1993a. Tropical rainforest logging in north Queensland: was it sustainable? *Annals of Forestry* 1: 54-60.

Vanclay JK. 1993b. Lessons from the Queensland rainforests: A century of striving for sustainability. In *The Quest for Sustainability: 100 Years of Silviculture and Management in the Tropics. Proceedings of Tropical Silviculture Workshop, IUFRO Centennial conference. 1–3 September, 1992, Berlin*, ed. PJ Wood, JK Vanclay, WRW Mohd, pp. 69–89. Forest Research Institute, Malaysia: Kepong.

Williams JE, Brooker IH. 1997. Eucalypts: an introduction. In *Eucalypt Ecology: Individuals to Ecosystems*, ed. JE Williams, JCZ Woinarski, pp. 1-15. Cambridge University Press: Cambridge.

Winter JW, Dillewaard HA, Williams SE, Bolitho EE. 2004. Possums and gliders of North Queensland: Distribution and conservation status. In *The Biology of Australian Possums and Gliders*, ed. RL Goldingay, SM Jackson, pp. 26-50. Surrey Beatty & Sons: Chipping Norton, NSW.

Wormington KR, Lamb D, McCallum HI, Moloney DJ. 2002. Habitat requirements for the conservation of arboreal marsupials in dry sclerophyll forests of Southeast Queensland, Australia. *Forest Science* 48: 217-227.