PLANTING TREES FOR MAHOGANY GLIDERS









A GUIDE FOR REVEGETATING WOODLANDS
IN THE SOUTHERN WET TROPICS









This publication is intended for guidance and general information. It does not replace expert advice or legal advice where required.

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INTRODUCTION

This guideline is tailored to landholders in the Hinchinbrook and southern Cassowary Coast areas who want to plant some trees on their property to benefit woodland wildlife.

While there are many existing guidelines for revegetation, this guideline relates specifically to planting woodland trees in the southern Wet Tropics to benefit wildlife, particularly mahogany gliders. It is designed to maximise your success by highlighting what to keep in mind when planting woodland trees in this part of the world. For example, our high rainfall combined with the open structure of woodlands makes weeds a key issue.

This guideline covers planting both habitat (a patch that animals can live in) and corridors (vegetation that animals can use to move from one habitat patch to another). Of course, the best investment - even better than revegetation - may be looking after what you already have. Existing woodlands can be kept in good condition by managing weed and fire regimes on your property.

So what are woodlands? In this case, a woodland is vegetation where the main trees have hard (sclerophyll) leaves and can tolerate some dry weather and cool fires e.g. Eucalyptus/Corymbia (gum/bloodwood), Acacia (wattle), Melaleuca (paperbark), Lophostemon (swamp mahogany) etc. The understorey (below the canopy including the ground layer) may contain small trees and shrubs or be open/grassy. Woodlands are good habitat for species like the mahogany glider because these marsupials can glide long distances through the canopy without being blocked by dense vegetation. Rainforests are definitely not woodlands.

Revegetation can be achieved through various methods. These include assisted natural regeneration (e.g. removing weeds so natives grow back), direct seeding (planting seeds in the ground) and planting seedlings grown in small nursery tubes, technically called tubestock planting. This guideline focuses on tubestock planting. Even though tubestock planting is initially more expensive and labour-intensive than direct seeding and natural regeneration, the results are more reliable and immediate, and plant placement is controllable.

The mahogany glider is one of Australia's most threatened species. It inhabits a very restricted area of



Mahogany Glider photo thanks to Daryl Dickson

coastal woodland in Far North Queensland between Tully and just south of Ingham. Mahogany glider habitat is very fragmented, which is why restoring connectivity between isolated habitats is so important to its recovery. Trees spaced less than 30m apart across paddocks provide pathways for the mahogany glider, allowing safe movement between isolated areas of vegetation. This can significantly increase the amount of habitat available. Planting trees for mahogany gliders might have additional benefits: reducing erosion; improved water quality; increased nutrient cycling; improved soil condition; carbon sequestration; providing shade and shelter for livestock; providing windbreaks; attracting other wildlife; providing habitat for owls; helping control pests including rats in sugarcane; and enhancing scenic

If you are considering planting trees for mahogany gliders or would like more information about woodland revegetation, please contact Terrain NRM by emailing info@terrain.org.au or phoning (07) 4043 8000. We would be pleased to help you.

OTHER GUIDELINES

This guideline only covers aspects unique to revegetation in Wet Tropics woodlands. There are many other guidelines providing valuable advice for revegetation, which we haven't duplicated in this guideline. We recommend reading other guidelines in conjunction with this guideline.

SOME RECOMMENDATIONS ARE:

[1] Repairing the Rainforest

https://www.wettropics.gov.au/repairing-the-rainforest.html (This is for rainforest (not woodlands) in the Wet Tropics)

[2] From Seeds to Success - A Bush Generation Manual for Townsville, Thuringowa and the Burdekin Available from Coastal Dry Tropics Landcare Inc: https://www.cdtli.org.au/publications/

[3] South East Queensland Ecological Restoration Framework

https://hlw.org.au/download/segecologicalrestorationframeworkmanual/ (Section 5.9 is particularly relevant)

[4] National Standards for Ecological Restoration

http://www.seraustralasia.com/pages/standards.html



SITE SELECTION

The first thing to do is decide what you want to achieve. Do you want to provide habitat or a corridor or both? Is your property a good place for habitat or corridors? How much time and other resources do you have? If your property is a priority place for mahogany gliders, there are likely to be partners willing to help you.

Priority areas to replant for mahogany gliders (if landholders are willing) have been identified in "Landscape Management of the Mahogany Glider (Petaurus Gracilis) Across its Distribution: Subpopulations and Corridor Priorities". Available here:

https://www.publish.csiro.au/AM/AM19010

All of the identified priority areas are corridors that connect existing habitat blocks. Corridors that connect habitat blocks are really important for mahogany gliders as the corridors greatly increase the area and diversity (different vegetation types) of habitat available for gliders. Rather than planting a corridor, you might want to plant an area of habitat. If so, the area would need to be adjacent to existing habitat or along an existing corridor. Mahogany gliders can generally only glide 30 metres, so any site more than 30 metres from existing habitat won't be accessible to them.

Mahogany glider habitat mapping is available here:

www.wettropicsplan.org.au/mapping/storymaps/#action=story_maps&keywords=mahogany&local_ landscape%5B%5D=southern_cassowary

(Click on the heading to visit the 'Fast Facts' tab and scroll down to 'Habitat Types' for identified habitat, or to visit the 'Projects' tab and scroll down to 'Biodiversity

Bright Spots Woodlands' for corridor information. NB: The content of this story map is subject to change. For specific guidance and mapping, please contact Terrain NRM.)

Planting trees adjoining existing habitat not only increases the area of habitat - it can also reduce the impacts of weeds and cyclones on existing habitat, especially if you plant in locations to minimise exposed

Avoid planting near fence lines and other infrastructure/ services or make the appropriate allowances. This may include altering fencing to have a plain top wire to prevent wildlife entanglement and complying with any relevant guidelines e.g. the Department of Transport and Main Roads on-line guideline for planting near roads and infrastructure:

https://www.tmr.qld.gov.au/-/media/busind/techstdpubs/ Environment-management/Road-Landscape-Manual/ Current-files/APPENDIX4VegetationSetbacksClearances.

Once you have decided on your site, start a map showing your proposed revegetation in relation to local mahogany glider habitat and corridors. And start a works schedule with a chronology of the major tasks. Terrain NRM may be able to help.



PLANTING CONFIGURATION

Mahogany gliders need to be able to travel efficiently through habitat and corridors to access food and nesting resources whilst avoiding predators. They rarely come to the ground so trees are essential for their travel. A Mahogany glider's average glide between two tall trees is 20-30 metres. They drop one metre for every two metres travelled. These figures can be used to approximate distances for planting. The maximum gap between tall trees in a mature woodland should be no greater than 30 metres.

These distances will also determine the species you select. For example, in an existing corridor it may be useful to plant species that are going to grow much higher than existing trees.

The main objective is to get woodland plants established to a point where they are relatively resilient to weeds and fire. Your planting configuration/layout will differ depending on whether it is for habitat or a corridor.

OVERSTOREY +/- UNDERSTOREY

Whether planting habitat or a corridor, consider if you want a native understorey or your habitat or corridor will mainly be trees/overstorey.

Your overstorey is more important for glider movement than your understorey. The understorey can provide important habitat resources e.g. grass tree nectar. Ideally, you would have both. But there is little point having an understorey without trees above, so overall the tree layer is more important.

You might be able to establish an understorey once you've established the trees. Or you might want to keep the understorey slashed as pasture.



PLANTING IN ROWS

Planting in lines/rows is recommended.

Plants in rows are easier to find when you are doing maintenance, especially in the early days when plants are small. Two slasher widths between rows will allow for vehicle access, including in the future when trees have grown wider. Rows can be straight or curved like waves and responding to site contours to create a more natural feel.

Within rows, plant every 2 - 3 metres.

DENSITY

Recommended planting density is approximately 500 - 1200 plants per hectare.

Planting density is higher than the spacings desired at mature woodland stage. Tight density encourages quick establishment of a woodland environment. Plants help each other to establish and shade out weed competition.

As plants grow, some die out and decompose and this material helps to reintroduce the natural processes in a typical woodland system (fungi etc.).

If you are incorporating understorey species (shrubs etc.) in your plantings, make sure at least every second plant is a tree species so gliders can glide between them when the trees are still young and short.

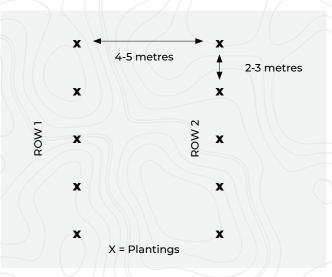


Figure 1: Recommended distance between rows and within rows

PLANTING A CORRIDOR

A single row of trees is okay for a corridor.

Narrow corridors have many edges compared to big blocks of habitat, so corridors may be more vulnerable to weeds and cyclones. Wider corridors (2 or more rows) would be less vulnerable. Mahogany gliders may be less vulnerable to predators (e.g. owls) in wider corridors compared to single rows.

Single rows require more maintenance to ensure there are no gaps.

Your corridor location could be designed to integrate any existing suitable trees, thereby reducing the number of trees to plant.

06 | Planting trees for Mahogany Gliders



SPECIES SELECTION

Carefully selecting the species to plant will greatly improve your chances of success. It generally would be unwise to plant just one species. On the other hand, it may be unnecessary to plant all the original species. A mix of species is best.

Certain species may be more tolerant of fire, weeds, grazing, cyclone, flood etc. For example, blue gum, pink bloodwood and Moreton Bay ash have some resistance to weeds and fire. Some species are more important for mahogany gliders, e.g. species that form hollows for dens, food species, and species that provide resources at a critical time of year or in a particular part of the landscape. For example, forest siris may be a particularly important food source in the drier Hinchinbrook areas.

Appendix 1 lists recommended species for planting.

WHAT NATIVE PLANTS ORIGINALLY **GREW ON YOUR SITE?**

In general, the best species to plant are those that originally grew on your site.

Here is one way to find out what plant species originally grew on your site:

· First find out what the 'pre-clear' regional ecosystem was on your site. You can either contact the State Government Veg Hub for a pre-clear regional ecosystem map or look on Queensland Globe and add the Regional Ecosystem layer:

https://gldglobe.information.gld.gov.au/#

· Then check the description for that regional ecosystem using its numbered code. The description will identify key plant species:

https://apps.des.gld.gov.au/regional-ecosystems/

A more general way to find out about native plant species in your area is through the Mahogany Glider Recovery Plan Story Map:

https://www.wettropicsplan.org.au/mapping/storymaps/#action=story_maps&keywords=mahogany&local_ landscape%5B%5D=southern_cassowary

The story map shows mixed open forest (e.g. with grass tree understorey), mixed woodlands (e.g. with some rainforest species), and monotypic stands (e.g. tea tree swamp). Check if you are in one of these mapped areas. It might help you choose which species to plant.

If the chemical and physical properties of the soil on your site have been changed significantly (e.g. by significant earthworks or fertiliser application), the original species may not prosper and a 'nursery' planting may be required to improve conditions before revegetation. A soil analysis could help determine the most suitable native woodland species to plant in such cases.

You may also consider simply observing the habitat that remains on or near the area you are rehabilitating, and identifying the native species that are thriving there. It is one thing to know what species originally grew on your site and another thing to identify species that you can get from a nursery and that will do well on your property now

In any case, plants grown from material collected in your local area (local provenance) will likely do better as they are suited to the local climate etc. When sourcing plants, ask your nursery about where they collect their seeds.

TREES +/- SHRUBS, GRASSES & OTHERS

Tree species are essential in your revegetation. It wouldn't be a woodland without trees, and gilders couldn't glide without them. The trees need to be species that grow tall enough for gliders and ultimately have a relatively open structure (rather than a dense canopy) so that gliders can launch from and land on the trunk or main branches. Trees in corridors need to be species resilient to weeds and cyclones.

But what about including native shrubs, grasses etc?

Revegetation standards do not generally require the planting of native ground covers and grasses, due largely to weeds outcompeting them. Native grasses generally like poor soil. If your site has been fertilised, especially with phosphate, native grasses may struggle.

If you want a biodiverse planting, one third could be trees and the remainder native shrubs and other understorey species.

Certain types of tough, short-lived, woodland shrubs can be planted to help exclude weeds. Certain wattles/acacias can be allelopathic and suppress other species. This can be manipulated to your advantage by carefully planting and managing wattle shrubs to suppress weeds but still allowing the interspersed tree species plantings to grow up. A dense shrub-layer planting of Acacia holosericea and/or Acacia simsii (but probably not other wattle species) can help exclude weeds such as guinea grass.

If you don't include understorey species in your plantings at first, you could possibly add them in later, either through planting or direct seeding, or they might come in naturally over time as the native canopy develops, especially if there is healthy remnant woodland nearby.

At least one third of your plantings should be tree species. 100% tree species is acceptable. An advantage of planting only tree species is that weed control could be simpler.

If you want to play it safe, plant 100% tree species consisting of three woodland species that are easy to source from a nursery, proven in revegetation, and can cope with some weeds, fire and cyclones, e.g. blue gum, pink bloodwood and Moreton Bay ash.



SOURCING PLANTS

Plan your plant supply well in advance. Try to place your order with a nursey 9-12 months before planting. However, certain species may take two or more years to grow in a nursery. Ordering in advance will enable the nursery to ensure your plants are the right age for planting, i.e. not too young and fragile and not too old and pot-bound.

Purchase tubestock rather than big plants in standard pots. Small plants suffer less transplant shock and rapidly establish a healthy root system which encourages rapid growth. Note that watering is particularly important with tubestock as the small root ball means it's vulnerable to drying out until the roots have grown down into deeper

Nurseries that might be able to supply local native woodland species include councils and the Girringun Aboriginal Corporation.

WEED CONTROL BEFORE PLANTING

Young seedlings need time to develop a root system that can tap into reliable sources of soil moisture and nutrients. Grasses and weeds in your planting site will outcompete your seedlings for moisture and nutrients and are a major cause of failure in revegetation. Weed control is essential (and much easier) before you plant your trees. Control weeds on your planting site for at least a year before planting.

Key weed species may include guinea grass, calopo, siratro, sickle pod, lantana and Singapore daisy. In wetter areas, they may be hymenachne and para grass. Tools to help identify weeds include the How To Identify Weeds webpage: https://www.business.gld.gov.au/industries/ farms-fishing-forestry/agriculture/land-management/ health-pests-weeds-diseases/weeds-diseases/ controlling-weeds/identify

There is also the Weed Pocket Guide: Agricultural and Environmental Weeds FNQ: https://www.wettropics.gov. au/site/user-assets/docs/FNQWeedBook.PDF

Before treating weeds, check for any native plants that can be retained. A valuable seed bank of natives may still exist in the ground, depending on the time since clearing and subsequent land use or earthworks.

There are a range of chemical and non-chemical weed control methods detailed in other guidelines. If using herbicides, follow the manufacturer's instructions. If your site is predominantly grasses, site preparation could consist of grazing with cattle for a few weeks (taking care not to cause compaction), followed by herbicide application (not during rain) about 4 weeks prior to planting to allow sufficient time for the herbicide to act. Herbicide application could be confined to strips or spots where the trees will be planted, leaving the grass in the inter-rows unsprayed. Take care not to create a bare site where soil moisture is depleted.

Consider depleting soil nutrients, particularly nitrogen and phosphorus, before planting to prevent re-invasion by weeds. In other regions, this has been achieved through weed harvest, scalping, sugar (or organic carbon) applicatio, 'mining' of nutrients using unfertilised crops, and subsequent establishment of dense native grasses to continue 'locking up' nutrients.

Terrain NRM can provide contacts for a range of extension programs focused on soil health, best grazing practices, and up-to-date experimentation in companion cropping and fallow soil treatment to enhance yield as well as surrounding natural habitat.



Ant plants are found in broad-leafed tea tree ecological communities

TIMING OF PLANTING

The timing of planting has a big impact on success and the amount of maintenance needed. Plant when soil is moist. This is usually from February (once there have been significant rains) through to June (after which the ground becomes increasingly dry). After Easter may even be too late in drier areas. Late in the year is the worst time as it is hot and dry.

PLANTING

In the week leading up to planting, measure and mark out your rows (see our Planting in Rows section). Holes should be slightly larger and deeper than the tubestock tubes. And they should be at the density described in the Density section. Your digging method depends on the scale of revegetation. Small areas can be prepared with a shovel or auger. For large areas, use machinery to rip lines for planting. Deep ripping may be necessary for successful tree growth if your site has been compacted by intensive agriculture. A pick or mattock can be used in tight spots.

On the day before planting, ensure all plants are well watered. Only use healthy seedlings.

Evenly distribute the plant species across the site, ensuring at least every second plant is a tree species (not understorey). Plant one plant per hole, with the surface of the potting mix just below the soil surface and ensuring you get firm contact between the root-ball and the soil to eliminate air pockets and prevent the roots from drying out. Leave a slight depression around the tree in order to catch and hold moisture.

Water each plant in well and place a circle of mulch (e.g. bagasse) at least 60cm in diameter around the tree, ensuring that it is about 10-15cm deep around the outside and 5cm deep towards the centre so that it acts as a funnel for capturing rain. Make sure there is a gap between the stem of the plant and the mulch so moisture can permeate to the roots and so the mulch doesn't rot the plant stem.

"South East Queensland Ecological Restoration Framework: Manual". Section 5.9 is particularly relevant:

https://hlw.org.au/download/ segecologicalrestorationframeworkmanual/

PROTECTION FROM GRAZING

Your young plants may be vulnerable to browsing, grazing, trampling and/or rubbing by livestock, feral animals and/or wildlife. Plants are most vulnerable to damage when less than 1 metre in height as they can be completely eaten or severely damaged. Plants taller than one metre are still vulnerable to large animals such as horses and cattle.

Your trees should be protected for at least the first year or two, or until trees are 2 metres tall. Methods to exclude animals and protect your revegetation include fencing, tree guards, deterrents and feral animal control. A drum and star picket can protect individual small trees. The method used will depend on the animals that threaten your trees. For fencing out cattle, a five-strand plain wire (non-electric) fence with galvanised pickets at five-metre spacings is recommended, with vehicle-access gates for watering and weeding. However, such a fence would be ineffective if wallabies or pigs were the main threat. If barbwire fencing must be used, make sure you have a plain top-wire to reduce fatalities to gliders and other wildlife.



Mahogany Glider photo thanks to Daryl Dickson

MAINTENANCE

Maintenance in the first few years following planting is essential to success. The more maintenance you do in the first few years, the quicker your woodland will become self-sustaining, the less work you will need to do overall, and the quicker your revegetation will support wildlife.

WATERING

The roots of the new plants need to remain moist for several months after planting. Weekly watering is recommended unless there is adequate rainfall. After six months, watering can be gradually reduced over several months. For up to three years, plants should be checked monthly and watered as required, especially from August to December and during long periods without rain.

As well as weeds, you may need to remove germinating native plant species that cause woodlands to thicken, e.g.

Control Before Planting section).

rainforest wattles (Acacia mangium and flavescens) and other rainforest species. This is probably not necessary until after the first year. Such plants can be removed by

Weed Pocket Guide: Agricultural and Environmental

Weeds FNO". (See the website address in our Weed

WEED CONTROL

Some weed species can grow over the top of your plants and deprive them of sunlight, outcompete them for nutrients and water, and promote fire that kills young woodland plants. Certain species are worse than others, e.g. guinea grass, calopo, siratro, sickle pod, lantana and Singapore daisy, and in wetter areas, hymenachne and

Weeds should be controlled when they are actively growing, before they set seed and before they begin to compete with your newly established plants. If you treat weeds before they set seed, you can break their reproduction cycle e.g. guinea grass seed is short-lived.

Weeds within rows are a higher priority than weeds between rows because they are closer to your good plants. Within rows, herbicides are possibly easiest. Herbicides should be applied in such a way as to avoid any contact with your new plant, e.g. with shielded sprayers, wick-wipers or backpack sprayers. If your main weeds species are grasses, consider using a grass-specific herbicide that won't affect your trees. Between rows, slashing is the recommended weed control method. Ultimately, you might want a native understorey between your rows but initially you need to keep the grasses (and any other weeds) down.

Weed control should be continued for at least 2 years, and longer for narrow corridors because they are more exposed to weeds. Monitor for weeds regularly. Tools to help identify weeds include "How To Identify Weeds and

REPLACEMENT PLANTING

A plant survival survey is recommended one month after planting and every six months for the first year to determine how many of each species survived, and whether in-fill plantings are required. Walk through the site and count the total number of each species of surviving plant. Compare this with the original list of plants planted. If less than 80% of any species remains, infill plantings are recommended. If a particular species has done poorly, a different replacement species could be considered. Any gaps of five metres or more should be replanted.



FIRE PLANNING

Fire is one of the most important issues affecting whether your revegetation eventually becomes a self-sustaining woodland. It will take time for your plantings to develop some fire tolerance. Protection from fire is essential while plantings are young. Once established, planned burns can be undertaken within your revegetation to assist your woodland.

Both the frequency and timing of any fires will be critical. The desired fire frequency and timing in each revegetation area will be different, depending on the species you have planted, the weeds that are present and the age of your planting. Sites with established trees, few weeds and fire tolerant species will fare better. If you have modelled your revegetation on a particular regional ecosystem, check the Fire Management Guidelines for that regional ecosystem in the description at: https:// apps.des.gld.gov.au/regional-ecosystems/

Management of weeds after a fire is critical so they don't take over and promote hotter fires.

Appropriate fire not only promotes the health of a woodland but also reduces thickening by discouraging vines and invasive rainforest species, leaving the habitat open and healthy for the movement of gliders. The appropriate fire regime (for example cool burns only every two or three years in particular woodland habitat) is also important to discourage weeds and other invasive native species. For example, Acacia mangium is a food plant for gliders that thrives after a fire but can be invasive and will easily crowd out other species and in the long run inhibit glider movement.

MONITORING & EVALUATION

At the beginning of this guideline, we recommended that the first thing to do is to decide what you want to achieve. Do you want to provide habitat or a corridor or both? What was your site like at the start? What will it look like when you've finished?

How are you going to measure your trajectory along that pathway, e.g. photo points, plant survival surveys and/or wildlife observations? How will you know whether things are going well or whether your management needs to be adjusted?

How will you know when you have succeeded? Hopefully you will see mahogany gliders in your revegetation one

Terrain NRM is happy to provide advice on monitoring and evaluating, or any other aspect of planting woodland habitat or corridors for mahogany gliders. Please talk to us at the start of your project.

For further information contact Terrain NRM by emailing info@terrain.org.au or phoning (07) 4043 8000.



Mahogany Glider photo thanks to Daryl Dickson

APPENDIX 1

/	SPECIES	COMMON NAME	Tall tree	Food plant	Den tree	Riparian /Wetter sites	Weed tolerant	Fire tolerant	Cyclone tolerant	Notes	
	Acacia crassicarpa	Wattle		Yes							
	Acacia holosericea	Silver leaf wattle									
	Acacia mangium	Wattle	Yes	Yes							
	Albizia procera	Forest siris	Yes	Yes		Yes					
	Banksia aquilonia	Banksia		Yes							
	Corymbia clarksoniana	Bloodwood	Yes	Yes	Yes						
	Corymbia intermedia	Pink bloodwood	Yes	Yes	Yes	Yes	Yes	Yes			
	Corymbia tessellaris	Moreton Bay ash	Yes	Yes	Yes	Yes	Yes	Yes			
	Corymbia torelliana	Cadaghi	Yes	Yes		Yes					
	Deplanchea tetraphylla	Golden bouquet		Yes		Yes					
	Eucalyptus drepanophylla	Narrow-leaved ironbark	Yes								
	Eucalyptus pellita	Red mahogany	Yes	Yes	Yes	Yes					
	Eucalyptus platyphylla	Poplar gum	Yes	Yes	Yes						
	Eucalyptus tereticornis	Blue gum	Yes	Yes	Yes	Yes	Yes	Yes			
	Grevillia paralella	Beefwood		Yes							
	Grevillia pteridifolia	Golden grevillea		Yes							
	Lophostemon suaveolens	Swamp mahogany or box		Yes	Yes						
	Melaleuca dealbata	Paperbark/Tea-tree	Yes	Yes	Yes	Yes					
	Melaleuca leucadendra	Long-leaved paperbark	Yes	Yes		Yes					
	Melaleuca viridiflora	Broad-leafed tea-tree		Yes	Yes						
	Melicope elleryana	Pink euodia	Yes	Yes							
	Xanthorrhoea johnsonii	Grass tree		Yes				Yes			

