A Revegetation Guide for Sub-Tropical Forest

Australian Government
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Greening Australia

Landcare Australia

A REVEGETATION GUIDE FOR SUB-TROPICAL FOREST

Who this guide is for?

This introductory guide is for people wishing to learn, or be reminded about the basic principles and practices of planting trees, shrubs and forbes for repairing or restoring patches of sub-tropical rainforest. This guide describes six key steps that need to be followed to help ensure a successful revegetation project.

The importance of sub-tropical rainforest

This rainforest type is distributed from Queensland to northern New South Wales and is the most common rainforest type within south east Queensland and northern New South Wales. Sub-tropical rainforest is regarded as 'complex', both in terms of structure and plant species diversity. It generally occupies sites below 300 m elevation and is found growing on nutrient rich soils derived from alluvium and basalt derived deep red earths. The required rainfall is generally in excess of 1300 mm per year. This rainforest type is tall (30 m to 45 m+) and multilayered with a dense canopy and occasional emergent trees. Features such as strangling figs, plank buttresses, large epiphytes and woody vines are characteristics with a ground layer of ferns and herbs (See Photo 1).

Over the past 100 years or so large tracts of sub-tropical rainforest have been cleared to provide agricultural land. These once extensive forests have been reduced to small and isolated fragments scattered around a landscape of grassland and cropland (Photo 2). 'The Big Scrub' of northern New South Wales is a well-known example. Seventy five thousand hectares has been reduced to less than 750 hectares; that is less than 1% of its former cover. However, an increasing awareness of the rich species diversity that a rainforest supports has led to an interest in protecting existing remnants and restoring rainforest on cleared land.

This introductory guide provides basic information on sub-tropical rainforest and outlines the steps required to restore it through revegetation.

Photo 1. A typical example of a patch of rainforest growing in a gully with a dense canopy and understory features including strangling figs, plank buttresses, large epiphytes and woody vines.

Photo 2. Patches of rainforest (dark green) are often found growing in gullies surrounded by drier eucalypt forests (grey-green) and grassy pastures.

STEP 1.

Assess site conditions

It is important to ensure that the site earmarked for restoration did in fact once support rainforest vegetation and still has the characteristics required to successfully restore it. Sub-tropical rainforests often naturally occur as patches within drier forest types, so it can be difficult to determine if your site is suitable for rainforest revegetation, or some other forest type often dominated by Eucalypts.

Restoring a rainforest – is this right for the site?

This fundamental question needs to be addressed; is revegetation using rainforest species appropriate for your site? Address these sub-questions during your site assessement:

- Is there historical evidence that rainforests were present in the past?
- Are the right landforms present to support rainforest (e.g. sheltered gullies or nearby cliffs to protect the site from fire and desiccation)?
- Do rainforest stands still exist on similar landforms but within 5 km of your site?
- Are there rainforest stands still present in the same landscape under similar climate regimes within the same or adjacent bioregions?
- Are rainforest species still present on site?

If the answer is 'yes' to this last question, these species should be assessed for their ability to live outside a rainforest situation. If the remnant species on your site are only found within a rainforest, it is likely to be a rainforest remnant that has survived land clearing. However, if it is a generalist species that can also grow in drier eucalypt forests, then its presence may not prove that a rainforest was present in the past.

Refer to the *Rainforest Restoration Manual for South-Eastern Australia* (details below) to follow a decision tree for further help to determine whether the site is able to support a rainforest.

Things to be recorded during a site assessment include; the overall condition of the rainforest, remnant rainforest species, weed species and their levels of infestation, site features such as cliffs or presence of water, detrimental impacts and potential threats such as livestock grazing, erosion or altered water flows, any threatened species and potential habitat for fauna. Many of the characteristics of the site are best recorded by mapping.

Is revegetation really needed?

Revegetation intervention is only needed if nature can't do it herself, or you wish to accelerate regenerative processes. Depending on the level of disturbance, many species of rainforest plants, particularly tough pioneering plants (Text Box 1), can re-colonise a cleared site. Assess your site carefully to determine what is preventing natural regeneration of rainforest.

Constraints and threats to natural regeneration include:

- Fragmentation and isolation – past land clearing may mean that your site is too far away for existing rainforest blocks to naturally provide seed to your site. Many species of wildlife disperse rainforest seeds, but if your site is too far away, or has no roosting trees left, these natural dispersers can't assist in the regeneration of your site (Photo 3);

Photo 3. Fruits of the blue quandong (*Elaeocarpus grandis)* that are dispersed by wildlife including some rainforest pigeons. These seeds will only be naturally dispersed into your site if a rainforest remnant is nearby and there are roosting trees on your site.

- Weed invasion can prevent regeneration by competing with native plants for water, sunlight and nutrients. For example, Camphor Laurel is a serious weed threat to sub-tropical rainforests in northern NSW and SE Queensland;
- Grazing by livestock, rabbits, deer, native mammals such as wallabies and insects;
- Hostile soil conditions caused by erosion, changed water table level, soil compaction caused by vehicles, livestock and cultivation can prevent natural regeneration (Photo 4);

Photo 4. Erosion along this stream bank will need to be controlled to ensure successful rainforest restoration. Fast growing pioneer species may be best for such eroded conditions.

- Change in natural water flows and runoff and particularly the lack of flood events can prevent regeneration;
- Increased exposure to wind, sun, salt spray and frost is a problem; and
- Changed climate resulting in greater temperature extremes, more frequent droughts, and increased frequency and intensity of fires will also reduce the chances of natural regeneration.

In situations where natural regeneration cannot occur the replanting of rainforest species will be required. However, these threats and constraints need to be dealt with adequately and monitored and managed on an ongoing basis for successful restoration.

Hence a detailed site assessment is essential before restoration or revegetation works commence.

STEP 2.

Set clear revegetation objectives

Restoration or simpler revegetation? There are many very good reasons to plant native vegetation. They provide shade and shelter for livestock, can be harvested for valuable timber, sequester carbon, reduce erosion, and improve water quality in creeks, rivers and wetlands. This guide assumes your objectives include aiming for as much restoration of rainforests species and processes as possible. However, your Site Assessment (Step 1 above) will help you determine if full restoration is realistic and feasible.

If full restoration is not possible, re-planting some rainforest species can:

- Increase the size and improve the shape of a rainforest remnant;
- Improve the structure of the remnant (e.g. greater diversity of understory species);
- Increase the minimum viable population of important flora and fauna species;
- Reduce weeds, particularly understory weeds;
- Foster and accelerate the natural restorative process, by providing framework trees and shrubs that attract dispersers (e.g. birds) of other plant species; and
- Enhance wildlife habitat.

Across a landscape re-planting even a few tough rainforest species can provide connectivity between rainforest remnants by creating corridors or rainforest 'stepping stones' to allow seed and pollen dispersers to move between remnants. This will assist in gene flow across the landscape and improve the chances of natural regeneration.

STEP 3.

Carefully select and source your plants

Planting models

Kooyman's *Growing Rainforest* book (details below) provides a useful set of 'models' or concepts for the successful restoration of sub-tropical rainforest. These models provide species selection guides for sites ranging from cleared agricultural land to land adjacent to large rainforest remnants where natural recruitment can most easily be encouraged. Plant species are selected based on where they fit into the successional stages (Text Box 1). Following is a summary of each of the models and where they fit in the landscape.

Late succession planting for isolated sites

This approach uses a diversity of mature and secondary phase tree species to rapidly develop a canopy and mid-storey within 12-24 months of planting.

This kind of planting quickly creates low-light conditions in the understorey. This quickly reduces the growth of weed species and minimises on-going maintenance requirements. Shade dependent understorey species can be planted once the canopy has closed.

This planting is ideal for sites on long cleared land that are many kilometres away from a rainforest remnant that could provide seed for natural regeneration. However, make sure your site is

suitable for the establishment of late successional species. If your site is too exposed and frosty; the Pioneering Planting model described below may be better.

This option is a model for short-term and high investment in a site. It requires good site preparation and post planting care for 24 months to maximise diversity and minimise the risk of late successional species not recruiting to the site naturally.

Early successional planting for sites adjacent to rainforest patches

This model uses a mixture of predominantly tall and fast growing (shade intolerant) species from pioneer and secondary species groups with just a few mature phase tree species.

This planting model provides rapid development of a pioneer to late secondary canopy that will help provide suitable conditions (i.e. low light conditions) for mature phase species to grow (photo 5). The bird and bat attractant species interspersed within the planting will

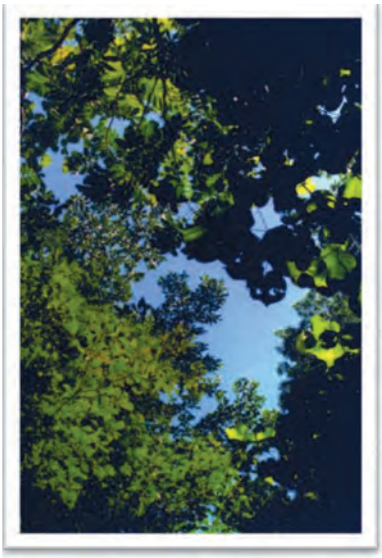

Photo 5. A diverse canopy with occasional gaps is required to promote a full diversity of rainforest plants and animals.

Stages of Sub-Tropical Rainforest Succession

A rainforest develops and regenerates through various stages as species grow, die and are replaced by others. In a mature phase of a rainforest canopy large trees form a dense canopy which regulates the microclimate under the canopy and provides resources required by the various life forms (i.e. fauna) that depend on a dense high canopy. In the event of disturbance to the mature phase canopy, the rainforest needs to be able to repair itself so it can continue to function. This process of natural regeneration in sub-tropical rainforest is referred to as succession. An understanding of successional stages can help design plantings for specific site conditions. There are a number of stages of rainforest succession that lead to the mature phase rainforest that are outlined below.

Pioneer to early secondary species

These plant species require sun to germinate and survive, are generally quick growing, and have a relatively short life span. They help to condition a site for later successional shade tolerant species by improving soil nutrition and through forming a temporary canopy that creates a suitable microclimate for germination and establishment of later successional species. In a healthy rainforest, pioneer and early secondary species are usually the first to germinate when a significant disturbance (e.g. cyclone) has created large gaps in the canopy allowing light to reach the forest floor. Early successional species predominantly make up the soil seed reserves of a rainforest.

Late secondary

Late secondary species are more shade tolerant, are slower growing and generally longer lived than pioneer and early secondary species. They are able to withstand lower light conditions and can therefore germinate and grow under the canopy formed by the pioneer and early secondary stage species. They will eventually replace the shorter lived early successional species and may become part of the mature phase canopy.

Mature phase

These species form the canopy of a mature rainforest. They are generally long lived and are more shade tolerant during the seedling and sapling stage. In the absence of disturbance they generally replace the shorter lived earlier successional species. Seed of mature phase species are usually very short lived but can germinate and live in a suppressed state in the understorey until provided with the chance to grow into the canopy. Small gaps in the rainforest canopy formed after a minor disturbance are often filled by mature phase tree species as their seedlings previously suppressed in the understorey now have the increased but still low light conditions to grow into the canopy.

Text Box 1.

assist in the recruitment of these mature phase species from nearby rainforest remnants that are at least 200 ha in size. This is a cost-effective and relatively low-risk approach for enhancing the extent of existing remnant rainforest patches.

Pioneer plantings for exposed sites

This model uses a single species or a simple mixture of pioneering rainforest tree species. Pioneering species rapidly provide a protective canopy for the establishment of later successional species (Photo 6). Many pioneering plants help stabilise the site and some fix Nitrogen (e.g. Acacias) which improves the soil for later plantings or regeneration (Photo 7).

A planting dominated by pioneering species will likely be needed on sites that experience heavy frosts and drying winds. After just 12-24 months, pioneer trees and shrubs will provide a short lived but protective canopy so frost sensitive later succession species can then be planted. If necessary the pioneer species can then be culled or pruned once these later succession species have established.

Caution, pioneer species generally have sparse canopies and the higher light conditions can allow weeds to flourish. Therefore, more maintenance is usually required to control weeds until later successional plantings create a dense canopy and deep shade. This option, is usually cheaper in the short-term, but requires longer-term maintenance to ensure the site remains on a trajectory towards a diverse rainforest community.

Photo 6. These seedlings of Homalanthus grow quickly to outcompete weeds and provide shade for a later succession of plants that are often spread by birds roosting in this pioneering shrubby tree.

Photo 7. Early successional species such as this Acacia should be considered for cleared sites to quickly help 'capture' the site and may not need the added expense of tree guards.

Choose species to suit local conditions

When selecting rainforest species to use in revegetation, first determine which planting model is to be used. This will guide whether to choose pioneer, early or late secondary or mature phase species. Look also at the site conditions such as soil type, aspect, or rainfall and select species that are able to tolerate your local conditions. All selected species should occur locally and come from similar vegetation types growing in similar conditions to that which is being restored.

Consider your project timeframes, and the existing and potential availability of species within that timeframe. Seed collection and nursery propagation timetables may not align with your project timetable, and therefore limit the availability of some species. Contact your suppliers or Landcare group as soon as you start planning your project to seek advice regarding availability of species.

A diverse range of species should be selected for the planting, within the restoration model selected. For example, species that are known attractors of seeds such as some bird and bats should be included to enable natural recruitment of additional plant species from nearby remnants. However, it is not realistic to restore all species that would occur on site because of limitations such as availability of seed, ease of propagation, specific requirements for establishment and cost. The Big Scrub Rainforest Landcare Group's book *Subtropical Rainforest Restoration* (details below) has an excellent species planting guide for sub-tropical rainforest in northern NSW where specific characteristics for each species is identified such as tolerance to sun exposure or frost. Kooyman's book (details below) also has a sub-tropical rainforest species list that is categorised into successional stages.

Seed supply

Seed for the chosen species should come from healthy populations growing on similar sites within the same bioregion so they are adapted to the environment of your site. Rainfall, soil, altitude, aspect and slope position are all important environmental factors in plant adaptation.

Wherever possible, seed should be of local native origin or provenance. This is because plants growing within the same area

(provenance) and in the same landscape position are adapted to living in the local conditions. The Big Scrub Rainforest Landcare Group's book provides best practice genetic guidelines for seed selection. Ensuring the genetic integrity of the plant species used will help the planting to facilitate successful reproduction, withstand disease and to provide enough genetic diversity for adaptation to longer term climate change. Collecting seed from at least ten different individuals from different sites (same local conditions) for secondary and mature phase species is one way to help ensure this genetic integrity.

Securing a supply of seed should be considered at least a year in advance of planting. Seed of the required species may only be able to be harvested for a short period in its natural habitat (Photo 8). Sometimes more than one seed collection season is required to acquire enough seed. Therefore at least one to two years advanced notice is needed for seed collection since many local provenance seed is not routinely stocked by seed suppliers (Text Box 2).

Photo 8. Many rainforest species used in restoration are sourced from fleshy fruits and are typically unsuitable for long-term storage as seeds. Therefore, planning needs to consider timing of collection, processing, planting, and species lists need to factor unavailability of some species in some years.

Getting the most from your seed

When ordering seed from a commercial seed supplier, ask these important questions:

- What is the viability (%) of the seed?
- Where has the seed come from (its provenance)?
- What is the age of the seed and how has it been stored?
- When comparing seed prices, remember that 1 kg of 90% viable seed is worth much more than 1 kg of seed with just 10% viability.
- Old seed may be OK, if it has been stored well. The moisture content of seed is key. Each percentage point decrease in seed moisture content between 15% and 5% **doubles** the life of the seed.

Text Box 2.

If you are collecting your own seed, good record keeping is important. Record the GPS position of the collection site, date collected, number of plants collected from, and average distance between plants. This information is important for knowing where quality seed (e.g. good survivorship) came from for future collecting.

Further guidelines for sustainable and ethical native seed collecting is provided by Florabank.

Select quality plant material

Seedlings that are used in revegetation need to be healthy and vigorous, with good root growth and free from pest and diseases. The size and root structure of seedlings is critical to their survival after transplanting and to their long term survival. Poor root development in the nursery can result in early death, slow growth, instability in windy conditions and long term self-strangulation. The plants should also be hardened off before planting. This usually involves moving the seedlings from glass house conditions to the outside for a period of time before planting where they will experience similar conditions as that found in the field such as hot temperatures, frost, or aridity. Hardening off ensures that plants are tough enough to withstand planting when the time comes.

Planting containers

Native plant or forestry tubes are commonly used for native plant propagation. The standard tube is 50 mm square x 120 mm high. Use fluted tubes rather than smooth ones to ensure that roots are directed downwards (Photo 9). Seedlings grown in these sorts of smaller tubes are easy to store, transport and are less expensive. Most nurseries take back the pots to be cleaned and reused, so don't leave them at your planting site!

Photo 9. Where practical, seedlings should be grown in fluted pots to avoid roots spiralling around the sides which can later cause root strangulation, poor tree growth and even premature death.

STEP 4.

Site preparation

Weed control

Good weed control is essential for the success of any restoration planting. Many weeds, particularly vigorously growing grasses such as kikuyu or paspalum found on cleared agricultural land, compete with newly established seedlings for moisture (Photo 10). They can also shade-out young seedlings. Therefore, weeds should be controlled within an area at least 0.5-1 m diameter around each seedling site. This weed control should continue for at least two years after planting to ensure the plants are vigorous enough to out-compete the weeds. In a densely planted rainforest situation a good shady canopy should have established by this stage.

Photo 10. Weed control is key to seedling survival. This one is being smothered by paspalum which is strongly competing for sunlight, soil moisture and nutrients. This seedling is also suffering from being browsed.

Weed control for random plantings should consist of spot spraying using herbicide to create a consistently bare circle approximately 0.5 -1 m diameter in the centre of which the seedling is planted. If planting in rows, spot spraying can be used, however strip spraying is also suitable and can be more efficient if using mechanical sprayers. Slashing of the planting site will help reduce the weed layer and also provide mulch for the seedlings. The whole site could also be blanket sprayed, but this is only recommended for small plantings as it can create soil erosion problems.

Two rounds of weed control should ideally take place. The first six months before spraying and the second shortly before planting to control weed regrowth and deplete the weed soil seed bank. At minimum, a single weed control spray should occur at least four weeks prior to planting. Make sure the person doing the weed control is able to distinguish native species from weeds, including different stages of the species life-cycle (e.g. seedlings to adult plants).

Browse control

A major threat to any planting is the potential for the seedlings to be eaten by browsing animals. In many situations fencing off the area to be restored will be required. Livestock can be easily kept out of the area by setting up a stock fence around the site. Rabbits, hares and wallabies can also be a problem and are usually harder to control. Fencing using rabbit proof or hinge lock wallaby fencing can be erected, but these can be very expensive and a major cost to a revegetation project. Plant guards can also be erected around the seedlings after planting to help protect the plant (Photo 11). These come in many forms including both soft and rigid plastic guards, cardboard surrounds or netting socks. Again they increase the cost of revegetation due to the materials and the extra labour required.

Photo 11. Tree guards reduce the impact of browsing animals, lessen weed competition and provide shade and shelter. However they add considerably to costs. Consider alternatives like fast growing acacias to provide similar ecosystem services.

One strategy for browse control is to stage planting across seasons. Often browsing pressure will be variable through time and greatest during 'drought' periods, and if these browse vulnerable periods can be avoided, planting success can be enhanced.

Soil preparation

Ground preparation techniques are used to soften the soil and increase water filtration, root area and soil aeration. This however is only necessary in areas of severe soil compaction. Deep ripping can be used to allow moisture and air to enter the soil. It should occur at least 6 months prior to planting to allow the soil to settle and reconsolidate.

STEP 5.

Planting

When to plant

Planting should be carried out when soil moisture levels are high. This will ensure the success of the plantings and also reduce the need for additional watering.

Most locations have a 'wet season' or a period of time each year when rainfall is likely to be at its highest. The best time to plant is just after the start of the wet season when there is sufficient moisture in the soil with more rain to follow. In northern NSW and south east QLD this is usually from late summer to autumn. In areas of frost risk, planting early in this period will mean that plants are well established before the first frost. If there is sufficient soil moisture, early spring time can also a good time to plant but before the extremes of summer temperatures.

Planting methods
Manual

For small plantings or where some form of cultivation has occurred that has loosened the soil, manual planting can be used. Manual planting involves hand digging holes using a mattock, shovel, motor driven tree auger, or a Pottiputki®. This is a steel tube with a trigger release at the bottom which is pushed into the ground, the bottom of the tube is opened and a plant dropped down the tube so the root ball is below the soil surface. The ground is compacted using the feet. Unless the soil is very soft, some form of cultivation (e.g. ripping) is required to enable the Pottiputki to be easily pushed into the ground. Pottiputkis can be ordered through various companies in Australia, just Google it.

In established sites consider supplementary hand planting (Photo 12). Once the planting is established other structural and floristic elements (e.g. Ephiphytes, vines) can be introduced to promote complexity and diversity. Supplementary plantings are also a good way to keep community volunteers involved in your site.

Photo 12. Consider supplementary hand planting including epiphytes.

Planting methods
Mechanical

Mechanical planting is often the preferred method for large scale plantings as they save time and effort. A number of different types of mechanical planters have been developed. For row plantings a mechanical planter such as the Treeliner® can be used. With this type of planter a tractor pulls a trailer which has a ripping blade attachment. The planter creates a rip approximately 300 mm deep as the trailer is pulled along. A planter sitting in the trailer then drops a seedling into the hole and wheels attached to the planter push the soil back around the seedling and into the rip line leaving minimal soil exposed. Small seedlings in Hikos or forestry tubes can be used with this planter. Tractor mounted hole diggers that use a tree auger attachment can also be used and are ideal if a 'random' planting pattern is required.

Plant spacings and densities

As the rapid development of a closed canopy is the main aim of rainforest restoration, seedlings should be planted densely to ensure that this is achieved quickly. Planting spaces greater than 2 m^2 lead to poor performance in restoration plantings. Spacings of 1.8 m, which is equal to 2.9 m^2 per tree, was found by the Big Scrub Rainforest Landcare Group to be more cost effective and had similar aesthetic and habitat values as that of a 1.5 m spacing. Such high density plantings have a greater initial establishment cost, however, this is partly offset by lower long-term maintenance costs such as less weed control.

Plant nutrition

Sub-tropical rainforests grow on fertile soils. In intact stands large amounts of organic matter has built up over time and with the help of microorganisms this organic matter breaks down to provide nutrients for the plants. The clearing of the rainforest and subsequent grazing has meant that most sites earmarked for rainforest restoration have lost the majority of their organic matter and have significantly depleted fertility. It may be necessary to use a fertiliser when planting. Suggested fertilisers include:

- High analysis compound fertiliser, often containing trace elements, e.g. Rustica®, Nitrophoska®;
- Organic fertilisers based on chicken manure which are low analysis, provide organic matter to the soil, release their nutrients relatively quickly and contain several trace elements, e.g. Dynamic Lifter®; and
- Slow release fertiliser tablets, e.g. Agriform® and slow release granular fertiliser, e.g. Osmocote® and Nutircote®.

The Big Scrub Rainforest Landcare Group recommends a fertiliser with an N:P:K ratio in the order of 1:1:1 to provide a balance of key nutrients to promote good initial root growth while avoiding too much above ground growth before the seedling is well established. The fertiliser should be incorporated into the planting hole just prior to planting. Follow up fertilising can take place annually to help the rapid development of the canopy.

Mulching

Mulch helps ensure a successful rainforest planting. Mulching reduces weed competition, conserves soil moist and improves seedling growth and survival. Mulches include:

Straw

Baled straw is the most cost effective mulch for large scale plantings because it is cheap to purchase and is easily moved around. It should be laid at least 100 mm thick. One small square bale of straw will mulch approximately 6-10 individual plants. If blanket mulching the whole site, such a bale will cover 5-7 m^2.

Woodwchips

Woodchips are very durable and highly effective at suppressing weeds when laid at a thickness of 50 -100 mm. Either hardwood or softwood chips can be used, but they should be composted prior to use to prevent nitrogen drawdown in the soil. They can however be expensive to purchase particularly when the mulch thickness is increased. Ensure any recycled material that is of uncertain parent material (e.g. not solely eucalypt mulch) has been stockpiled for a sufficient time to allow weed seeds to decompose.

In situ sprayed grass

This can be a cost effective method of mulching if the site has a dense covering of grass such as kikuyu or buffalo. Spraying with herbicide or slashing the grass a few months prior to planting will produce effective mulch.

Weed mats

Weed mat either comes in rolls or individual pieces that can be placed directly around the base of a tree. Materials used for weed mats include felt, hessian, jute, and recycled cardboard. The rolls of weed mat can suppress weeds over a large area, however, mats are not necessarily biodegradable and therefore can suppress natural regeneration of rainforest species, even after a suitable canopy has formed. Individual weed mats have the advantage that they only suppress plant regeneration directly around the planted tree.

Watering

Watering-in of seedlings not only gives them a 'drink' but also helps the soil settle in around the planted seedling, reduces air pockets and supports quicker root penetration of the surrounding soil.

Unless the soil is thoroughly moist at the time of planting, watering of the seedlings should occur at installation. Ideally, water is poured directly into the planting hole just prior to the seedling. However, in large scale mechanical plantings this is not always practical so watering on top of the soil around the seedling should occur directly after planting. If a freshwater body such as a creek or dam is in close proximity to the site, a pump with a hose attached can be used water the seedlings. Otherwise a truck or trailer mounted water tank will need to be used. Each plant should receive at least 5 liters of water.

If conditions are particularly dry, some follow up watering may be required in the weeks after planting. Mulching the seedlings will help in retaining moisture.

STEP 6.

Monitoring and maintenance

It is important when planning a revegetation project to ensure that there are enough funds for long term monitoring, evaluation and maintenance. If monitoring and maintenance is not done, then chances are that the project will be unsuccessful.

Monitoring should:

- Record basic information about the project including its location, size, cost, objectives and details of onground work;
- Provide an ongoing assessment of the condition of the vegetation This will identify any problems such as browsing or weed competition before they cause a project to fail. This sort of simple monitoring should inform your maintenance program to fix emerging problems. Keep an eye on plant survival, canopy cover (key component in rainforest restoration), problem weeds and natural recruitment (Photo 13);
- Show whether the revegetated sites are progressing towards target conditions

in terms of structure (layers of vegetation) and wildlife habitat. This usually requires baseline data to be collected prior to planting to use as a comparison. For example the rainforest structure provided by the planting and its ability to provide habitat to fauna should be tracked over time. An increase in fauna numbers post planting compared to pre planting will show that the revegetation has been successful in providing wildlife habitat;

Photo 13. Monitoring starts with a keen pair of eyes and an enquiring mind. This Grevillia growing out of a junked car shows us the importance of controlling grazing and the ability of some rainforest species to naturally regenerate if given a chance.

- Improve the design of future revegetation projects by monitoring what site preparation, planting and maintenance works best. Wherever possible, compare different techniques such as species mixes, stocking rates and planting techniques on the same site; and
- Estimate carbon sequestration which will foster participation in the carbon markets.

In new plantings,condition assessments should occur relatively frequently (e.g. at least 4 times a year) to ensure that any establishment issues are picked up and dealt with promptly. The frequency of monitoring can be reduced as the plantings become more established.

Environmental Training and Employment Inc. (EnviTE) and the Big Scrub Rainforest Landcare Group have developed a database (MERV Data Base) for monitoring and evaluating the restoration of vegetation. The MERV Data Base comprises tables for storing data and forms for entering data and assessing remnant vegetation. The data that can be recorded include a range of site and fauna habitat descriptors and relevant indicators of vegetation structure, species diversity and abundance. It covers both native and weed species and includes a comprehensive checklist of sub-tropical rainforest species. It has the capacity to record fauna observations and chemical usage. People interested in using MERV should contact EnviTE.

Alternatively, the Reef and Rainforest Research Centre published a toolkit for the Monitoring Revegetation Projects in Rainforest Landscapes (Kanowski et al 2008). The toolkit was written to assist landholders, community groups and restoration practitioners record the details of their revegetation projects, assess their condition and monitor their outcomes for biodiversity and carbon sequestration. The toolkit provides guidelines on how to carry out monitoring and templates that can be used to record data in the field. They have also designed several downloadable Microsoft Excel spreadsheeets to help store and analyse data collected using the toolkit. Click here.

Further Reading

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Further Assistance

For further assistance or advice we suggest you try contacting:

Greening Australia
ph 1300 886 589
or find us in our webpage.

Your Regional NRM (catchment) Organisation

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