Native Regrowth

A farmer's guide to maintaining biodiversity when thinning regrowth forest

A report for the Rural Industries Research and Development Corporation

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Foreword

Many properties in northern New South Wales have areas of dense regrowth forest that has arisen from previous clearing or logging.

This report describes methods for managing regrowth to improve productivity while minimising the effect on, or even enhancing, biodiversity. The methods outlined in this booklet should be used as a general guideline only, as forest types will vary from farm to farm.

The booklet's focus is on dense regrowth that may present a problem to the landholder. It is important to see these areas in the context of a whole farm plan. Within the farm certain areas may be devoted exclusively to grazing, to timber production or to conservation. Here we will be discussing areas that might successfully combine elements of all three.

This report, a new addition to RIRDC's diverse range of over 450 research publications, forms part of our Agroforestry and Farm Forestry R&D program, which aims to integrate sustainable and productive agroforestry within Australian farming systems. This project was funded by three R&D Corporations — RIRDC, LWRRDC and FWPRDC. These Corporations are funded principally by the Federal Government.

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Peter Core
Managing Director
Rural Industries Research and Development Corporation

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Photographs: Except where otherwise indicated, all photographs are by Greening Australia, Northwest New South Wales

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Executive Summary

Many properties in northern New South Wales have areas of dense regrowth forest that has arisen from previous clearing or logging. Such areas often have low value for agricultural or forestry production. Due to lack of ground cover they can have erosion problems and due to a limited range of habitats can have low value for native conservation. Such areas are often left unmanaged or are completely cleared, neither option giving the best result for timber or agricultural productivity, or in some cases nature conservation.

This project set out to identify appropriate silvicultural strategies that could enhance the productivity of certain regrowth areas whilst maintaining or enhancing habitat and conservation benefits. It recognised that certain areas of the farm might be devoted exclusively to grazing, timber production or to conservation. Thus the project focussed on areas of the farm where all three components might be successfully combined.

The thinning regime chosen will vary depending on the end product required. This project concluded that the "selection method" of thinning offered the most flexibility to the landholder. It is especially suited to uneven aged stands of native forest and can create conditions for growth and regeneration which improves the yield of a range of forest products. It also maintains natural patterns of species and communities resulting in improved biodiversity.

The project found that thinning a stand so that the average distance between trees after thinning was 15-20 times the diameter of the trees was a good rule of thumb. The report describes pruning and thinning regimes to produce different final outputs (e.g. sawlogs, poles, etc.).

The economics of thinning native timber was examined on the Northern Tablelands of NSW. This work was based on the only data available, being standard forestry studies. The results were tempered by the lack of developed markets for thinnings.

The preferred timber species in this region were *Eucalyptus laevopinea* (silvertop stringybark), *E. andrewsii* (New England blackbutt), *E. caliginosa* (white stringybark), *E. viminalis* (manna gum), and *Callitris glaucophylla* (white cypress pine). Sawmills preferred hardwoods with a 51-60 cm centre diameter and 4.5-6.0 m long, and cypress pine with a 14-24 cm centre diameter (thinnings) and over 24 cm centre diameter for final logs.

One tangible economic value of thinning trees was to improve livestock stocking rates (possibly from 1-1.5 dry sheep equivalents (DSE) without pasture improvement and up to 2.7 DSE where pasture was improved. The study concluded that thinning and marketing native timbers in the region could be economical and return an annual net return/ha of $113.

To maintain biodiversity it is important to maintain a diversity of habitats within the forest stand. This can be best achieved by maintaining a diversity of native tree and shrub species, maintaining a range of tree ages from regenerating seedlings through to hollow trees and maintaining other habitats such as logs, mistletoes, water, nectar and seeding grasses.

Introduction

Many properties in northern New South Wales have areas of dense regrowth forest that has arisen from previous clearing or logging.

Such areas frequently have low value for agricultural production because of the dense tree growth. In their unmanaged state they also have low value for timber production. Often ground cover is reduced resulting in erosion problems, and the dense regrowth often has low value for nature conservation because it contains a limited range of habitats and species.

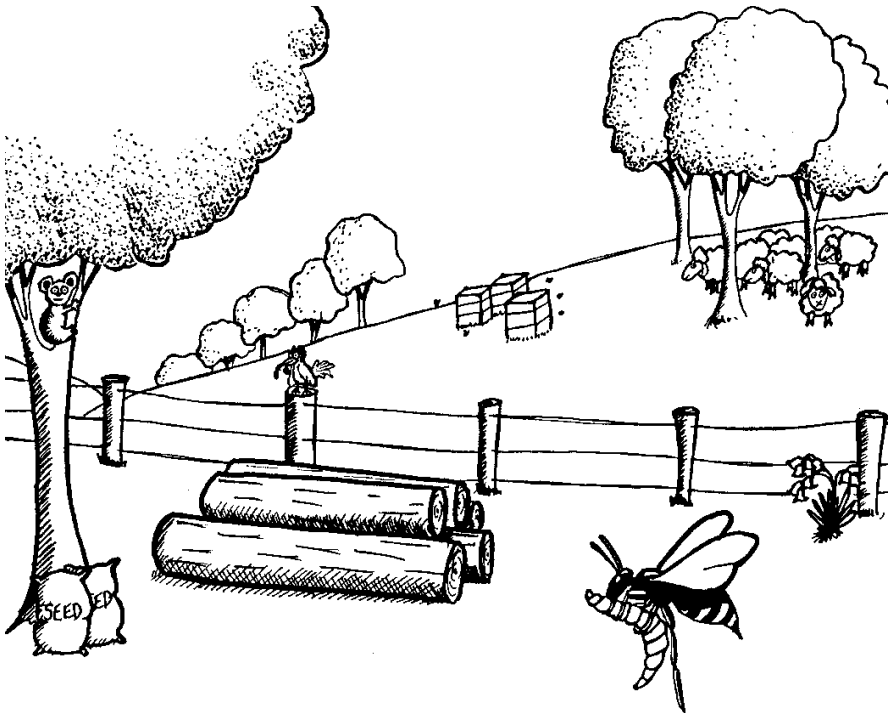
Landholders have often managed such areas in the past by either doing nothing or by clearing them completely. Neither option gives the best result for timber and agricultural production or for nature conservation.

With careful management landholders can increase the productivity of such regrowth forests while also increasing biodiversity and habitat values.

This booklet describes methods for managing regrowth to improve productivity while minimising the effect on, or even enhancing, biodiversity. The methods outlined in this booklet should be used as a general guideline only, as forest types will vary from farm to farm.

The booklet's focus is on dense regrowth that may present a problem to the landholder. It is important to see these areas in the context of a whole farm plan. Within the farm certain areas may be devoted exclusively to grazing, to timber production or to conservation. Here we will be discussing areas that might successfully combine elements of all three.

Whilst the booklet has been written for northern NSW it will be applicable to other areas also.



Biodiversity

What is biodiversity?

Biodiversity (biological diversity) is the total diversity of life on earth. It includes the diversity of ecosystems, plants and animals. Ecosystems vary greatly in complexity and in the species present.

Why conserve biodiversity?

A diverse range of native plants and animals can be a valuable asset on a property. Native forest areas can provide shade and shelter for stock, fodder in times of drought, and natural pest controlling agents, can improve land values and can reduce rehabilitation costs. In addition they can provide a diversification of income through firewood, timber, honey production, or even cut flowers. Apart from these uses, natural areas on a farm can provide homes for a range of wildlife, from insects to mammals, and can enrich the experience of those living on the land.

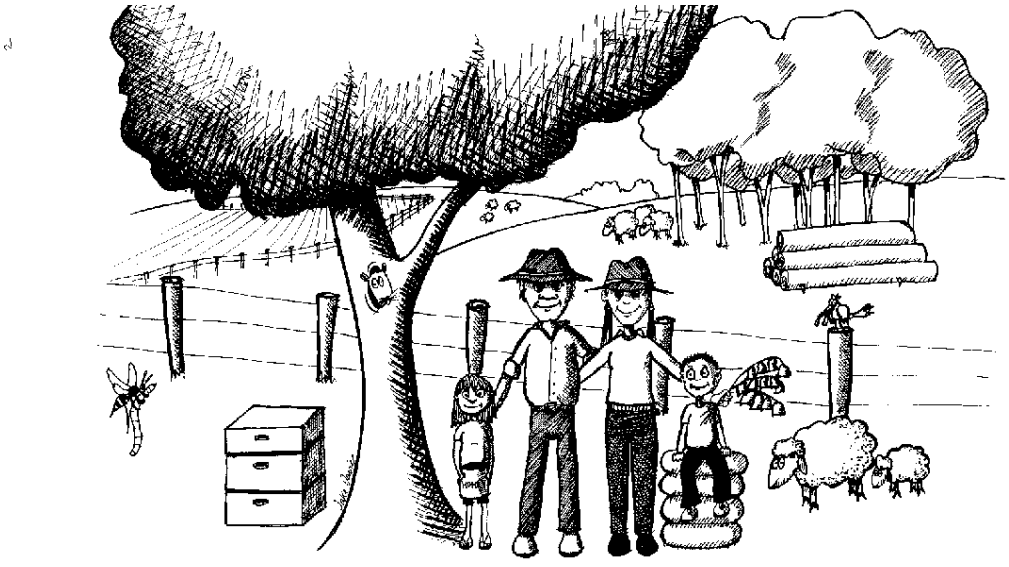
How to conserve biodiversity

Forestry operations such as thinning will damage a forest and, in the short term, both plants and animals will be injured or killed. However operations can be planned to minimise impacts on wildlife and maximise long-term benefits.

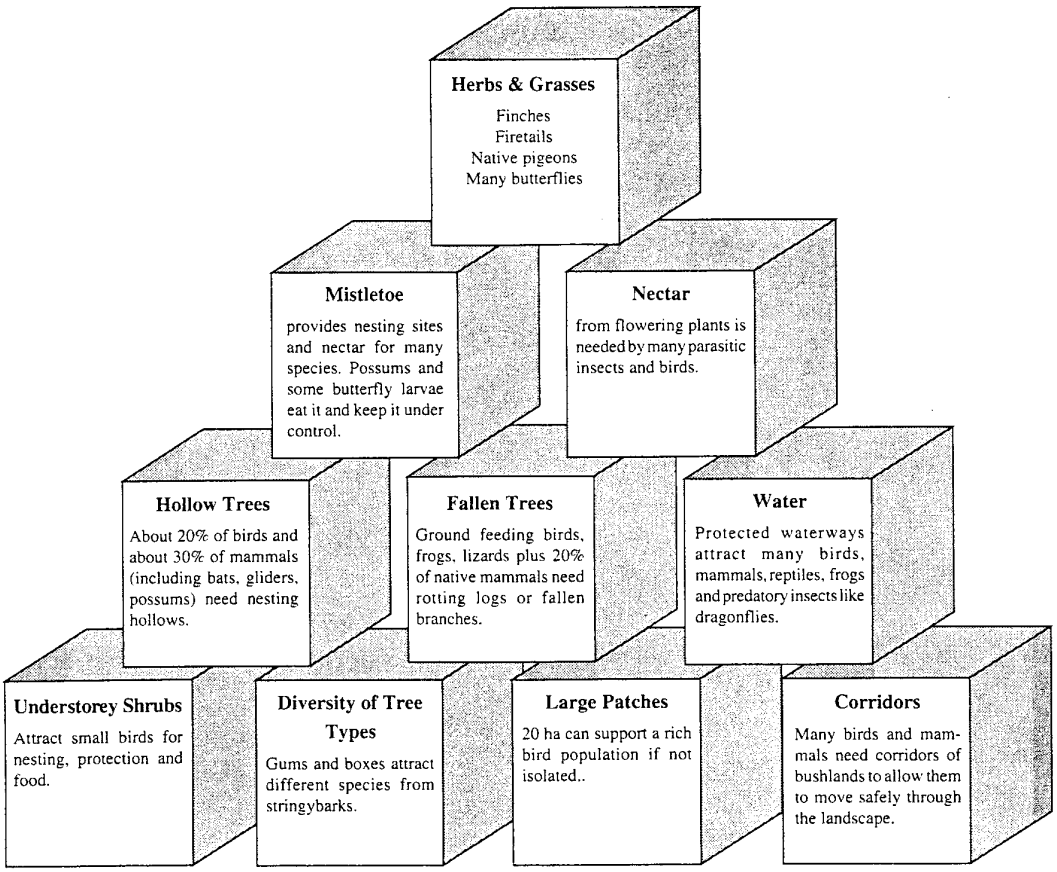
All animals need habitat (a place to live), and there are many habitat com-ponents within a forest, each of which attracts different animals. Each habitat component in a forest can be thought of as a 'building block' (see page 4). The main building blocks of habitat are: understorey shrubs, diversity of tree types, large patches of woodland forest, corridors, hollow trees, fallen trees, water, mistletoe, nectar and herbs and grasses.

Dense regrowth contains some habitats, but its nature conservation value can be increased by ensuring that a range of habitats is available like:

- A range of tree size-classes from young saplings to mature trees;
- Living old trees with hollows and standing dead trees with hollows;
- Different types of trees within a forest stand;
- Logs and fallen timbers plus ground litter (e.g. leaves, bark and twigs);



Ten Building Blocks of Habitat for Native Animals



(from a concept by Geoff Barrett)

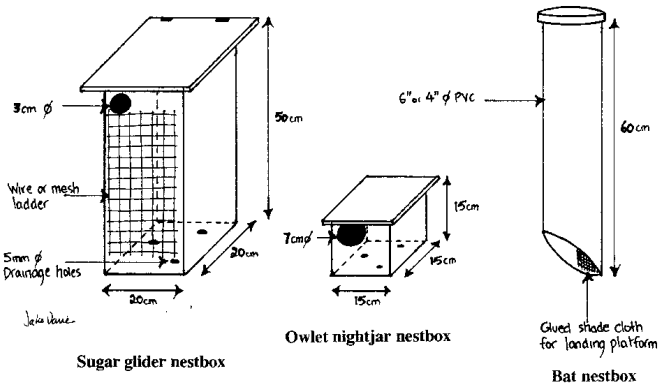
Managing native regrowth forest for wildlife

Wildlife includes land and tree- dwelling mammals, birds, bats, amphibians and reptiles. When thinning native regrowth, aim to leave different size classes of trees and open areas. Increased light will help certain understorey species to develop. Understorey species provide nesting sites for a variety of birds. Try to retain trees with hollows in their branches and trunks. These trees have little commercial value, but provide ideal nests for many types of mammals and birds.

If there is an insufficient number of hollows for birds and aboreal (tree dwelling) mammals, artificial tree hollows in the form of nest boxes can be supplied.

Many animals use insects as their food source, so the maintenance of habitats for a variety of insect species is important.

In general, the greater the diversity of plant species that is maintained in your forest, the larger the number of animals it will support, as habitat and food requirements increase.

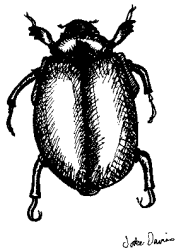


Sugar glider nestbox **Owlet nightjar nestbox** **Bat nestbox**

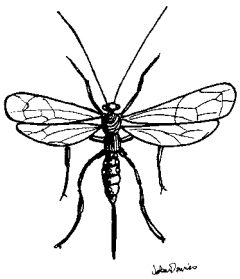
Birds are important in a forest or woodland as pollinators of many plants, such as eucalypts, melaleucas, banksias, grevilleas etc. They can benefit surrounding farm and pasture-land by reducing pests and pollinating crop and pasture plants, and they have aesthetic and sentimental values. There are many types of birds and their basic requirements are dependent upon differing habitats and foods which range from insects and small animals, to seeds and nectar. They require adequate cover such as trees, shrubs and dense low cover and some require access to water.

The value of habitat for predators and parasites

Natural vegetation provides habitat for predators and parasites of agricultural insect pests. This is evident on the Northern Tablelands region in regard to scarab beetles whose numbers can be partially controlled by retaining habitat for their predators and parasites.



One of the essential needs of all predators and parasites is a supply of food at times when they are most active. Trees such as eucalypts are valuable because they are a habitat for many insects which provide birds with a food supply. Nectar is needed for parasitic wasps and flies as well as for some birds. By having a wide variety of trees and shrubs that flower at different times of the year sources of nectar can be maintained. Maintaining a variety of different vegetation communities (e.g. on slopes, gullies, ridges) is likely to enhance the diversity of plants and the range of flowering periods.



It is also important when thinning regrowth forests to also leave logs, bark and litter which provide shelter for predatory and parasitic insects.

Why preserve understorey plants?

A forest understorey includes shrubs, tree seedlings, small trees, grasses and herbs, vines, ferns and mosses that exist under a canopy of taller trees and taller shrubs. The understorey is important as it

provides a number of benefits such as pest control, nesting and feeding sites for birds and protection for small animals. It provides emergency feed for stock and helps stabilise the soil surface from erosion. Leguminous understorey plants add nitrogen to the soil. The understorey contributes greatly to the biodiversity of a forest and removing it results in the loss of many plant and animal species from the forest.

In dense regrowth forests the understorey is often suppressed by competition for light and water with the closely spaced trees.

Managing eucalypt regeneration and understorey species

The first process in any management regime is thinning out the even-age stands of dense trees to provide areas for other trees, shrubs and groundcovers. Different management practices will be needed for different types of regrowth forests. Some regrowth forests consist of similar-aged trees, while older regrowth forests may consist of a variety of different sized trees, sometimes with the presence of older trees dispersed throughout the stand.

A sustainably managed forest needs a crop of new seedlings to replace trees taken for logs or other products. Thinning allows the young seedlings to establish.

To achieve good regeneration of understorey species, the area needs to be protected from grazing by fencing. Once an area has been protected from grazing regeneration will occur in most types of forests as a matter of course, although it can sometimes be assisted by strategic crash grazing by stock, herbicide application or fire.

Some management of regrowth may be necessary to encourage a diversity and balance of understorey and groundcover species. This management may include the prevention of any particular species becoming dominant, as different understorey species will have different growth rates, allowing some to out-compete others. For example acacia species are legumes which fix nitrogen and are a good component of forests. However sometimes shrubs can become a problem by competing with other beneficial understorey plants. Specialist advice should be sought in the case of prolific understorey regeneration.

The use of fire to promote understorey species

Fire can be used to encourage the germination of certain plant species and to reduce fuel loads within a regrowth forest. However, fires will also burn the forest litter and fallen limbs that provide habitat for some animal species. Some fallen limbs and litter should be protected from fire and allowed to accumulate.

Different species and forest communities require different fire regimes and it is advisable to seek advice on this before buring. Studies show that the more frequent the burnings, the lower the diversity of shrubs and other plant communities.
Whilst fire can encourage certain understorey plants it can also increase the number of weeds, particularly in agricultural areas, as weeds are sometimes the first plants to colonise a bare area, so care is needed regarding the use of fire. Fires can also affect birds by reducing the accumulation of litter, shrubs and grasses needed by birds for food and habitat.

Rather than burning large areas, a patch burning approach should be used. To achieve this, only burn sections at a time, leaving unburnt areas as a refuge for plants and animals. Observe the effect that burning has before repeating it elsewhere.

Weeds

Weed control is an important consideration when thinning is done. Any soil disturbance associated with thinning can encourage the germination of weeds, so care needs to be taken to avoid excessive soil disturbance.

The key to successful weed control is to implement an ongoing weed eradication program, through integrated weed control. Herbicides might play an important role, however care should be taken not to damage desirable species, or interfere with long term regeneration. Strategic grazing can also be used to control weeds and alternative methods such as hand removal, mulching etc. may be effective on small areas. Maintaining a closed canopy will suppress certain weeds.

Regardless of the type of weed control methods adopted by landholders, reducing competition from pasture and weeds is vital for understorey and groundcover species to develop. By controlling weeds in a regrowth forest after a thinning regime has been implemented, more light can penetrate to the ground layer. Once groundcover plants establish, weed control will usually become less.

TIP:.

When thinning native regrowth forests the following rule should be used as a guide.

Aim to leave the forest stand in a diversified and healthy condition after thinning. Retain a diverse range of ages and sizes of different species of trees, shrubs and groundcovers. Include a

Silviculture: Management of Forests

Silviculture is the term used to describe the manipulation of forests to give a desired result, for example timber production and increased biodiversity. Silviculture can be thought of as improving a stand of trees and their growth by selective thinning, pruning or other management methods.

What is a native regrowth forest?

Forests differ from one another not only in the species they contain, but also in their age, size and density. Native regrowth forests are forests that have generally been logged, burnt or cleared in the past. Regrowth forests likely to respond to thinning may range in diameter from 5 to 50 cm. Some regrowth forests do however contain a few older trees which were not removed in logging or clearing. Forests which possess both larger and smaller trees are called uneven-aged stands. Both even-aged and uneven-aged age regrowth stands can benefit from thinning practices by reducing the competitive effect these trees have on each other. Having a large number of trees competing for a limited light, water and nutrient resource results in smaller trees with poor growth and a limited understorey.

Why thin native regrowth forests?

Self-thinning of most types of regrowth forests will occur slowly, resulting in the initial development of saplings and poles, then mature trees. The rate of self-thinning is usually greater in the younger stages and slows as the stand develops. Species vary in their ability to self-thin. Most eucalypts and acacias self-thin better than native pine *(Callitris)*. Artificial thinning will hasten the process of stand development to improve timber production. Thinning dense regrowth can also increase the species richness of plant communities in the understorey.

The harvesting of thinnings will also recover trees that would otherwise die if the stand is left to self-thin.

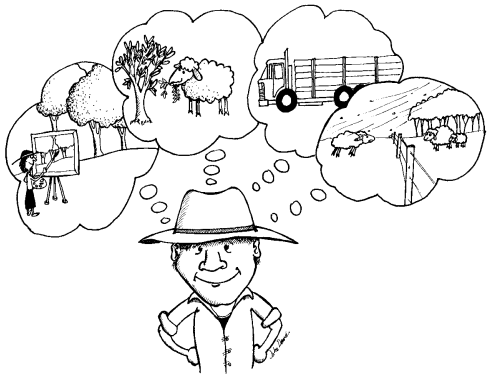
The aims of thinning might be to increase biodiversity of the site, to add to farm income by harvesting thinnings, to accelerate the growth and value of the remaining trees or to provide shelter and grazing of stock.

Depending on priorities identified different thinning regimes or intensities may need to be adopted. A landholder may wish to manage different sections of their forest for different objectives. Even aged stands might be weighted towards wood production while uneven aged stands and mixed species might favour biodiversity. The methods we outline here will lead to a mixed age forest that is selectively logged. While such a model may not achieve the optimal level of timber production or biodiversity conservation it will achieve a reasonable level of each and will be suitable for particular parts of the farm plan.

I've got some native regrowth forest. Can I manage it to add to my income and enhance environmental values?

Thinning

Before any thinning is carried out, a landholder needs to determine what end-products are wanted from the forest. There are a spectrum of uses for native forests, however trade-offs will be required with regard to the volume of timber removed and the amount of biological diversity which can be maintained.



There are several methods used to thin regrowth forest. Methods include: **selection thinning** where individual trees are removed; **strip thinning** where trees are removed in a continuous strip; and **gap thinning** where several trees are removed in patches, generally to facilitate regeneration as well as growth of remaining trees.

To achieve multiple benefits, the **selection method** offers the most flexibility for landholders. The selection method involves removing selected trees from a forest stand. The benefits of this method is that light cuttings can be carried out which do not affect biodiversity greatly, or can even increase biodiversity by providing conditions for a range of habitats for birds and animals.

The advantages of selection thinning are:

- It is especially suited to uneven aged stands of native forest and can create conditions for growth and regeneration which improves the yield of a range of forest products;
- It maintains natural patterns of species and communities resulting in improved biodiversity and aesthetics;
- Trees of good timber quality can be maintained;
- It allows cutting to be adjusted to fit market conditions;
- Wind damage is kept to a minimum, there is good site protection and fire hazard is kept low;
- Biodiversity can benefit by the retention of specific trees, which might be considered inferior for timber production and might otherwise be removed.

When implementing a thinning regime, it is essential to assess which trees are to be retained and which ones are to be removed. Canopy closure may occur at a very early age (3-5 years). These stands can be non-commercially thinned or left to thin themselves until the trees to be removed can be harvested for on-farm use or sold. If the stands are non-commercially thinned the first commercial thinnings are easier to harvest and the produce is more valuable. A rule of thumb is to thin these dense stands so that trees are left with crowns clearly separated. This will allow those trees remaining to grow more efficiently by reducing competition for moisture and soil nutrients.

A commercial thinning should then be carried out when the crowns of trees again touch each other (canopy closure). This may take several years. The trees should be thinned so that the crowns are clearly separated. The products of the commercial thinning can be sold as poles, treated posts or firewood depending on their size and the remaining trees can then be left to reach maturity for future sawn timber or posts. Mature trees can be harvested some years later. Not all mature trees should be removed, as some should be left for the habitat values they provide (State Forests of NSW recommend at least 5 habitat trees per hectare). Allow some trees to grow to their full mature size. An indication of this size can be gained by looking at old stumps or tree-heads on the forest floor.

TIP:
Retain a diversity of different sized trees to ensure that you have a future supply of trees which can be harvested for wood production over a number of years, while also leaving trees for the maintenance of biodiversity.

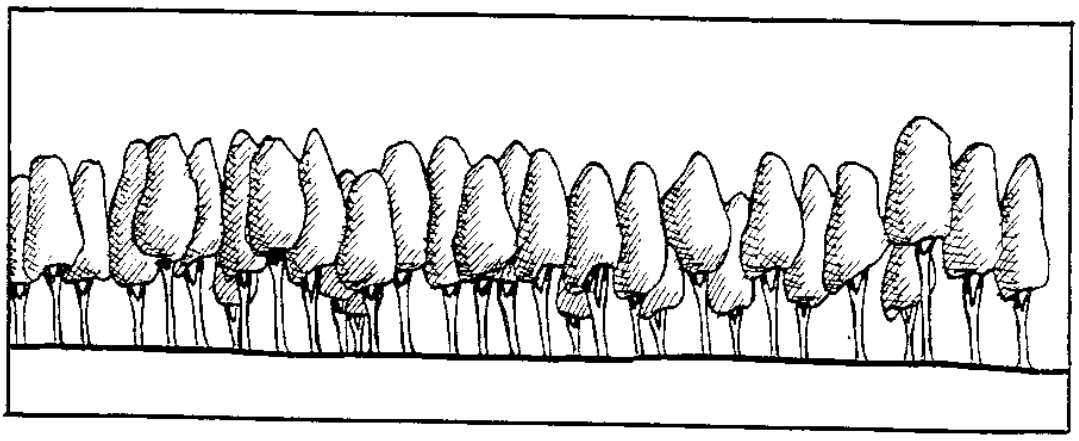


Figure 1
Even aged regrowth forest

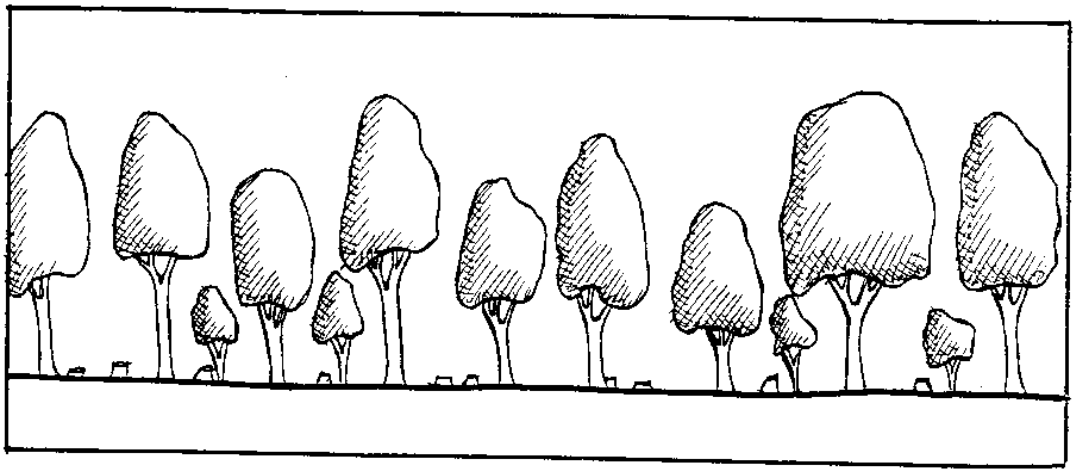


Figure 2
First thinning

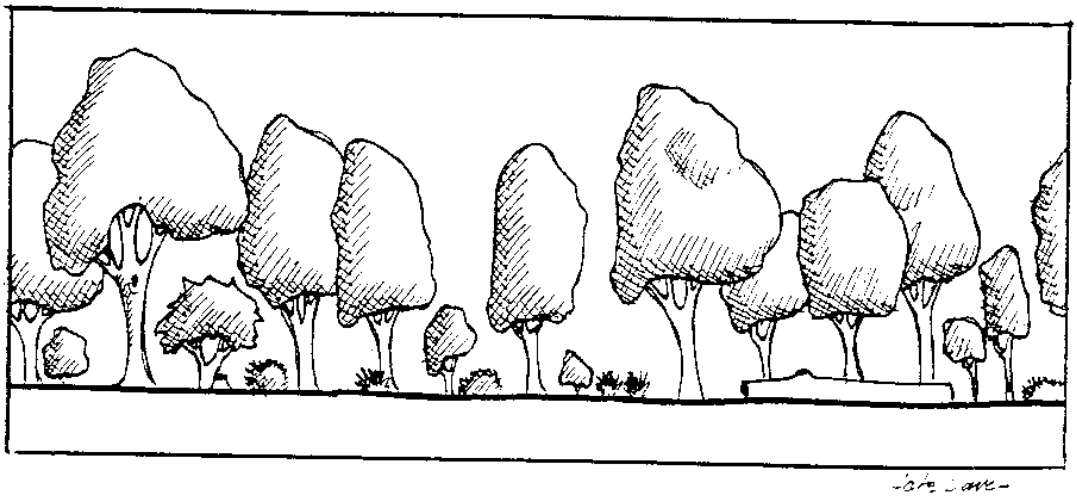


Figure 3
Mixed aged forest after a number of years of providing a timber resource for sawlogs, poles and firewood while still maintaining biodiversity with mature trees, shrubs and groundcovers providing a range of habitats.

How to maintain and improve what timber resources already exist

In order to maintain timber supply for future on and off-farm requirements, keeping growing trees for later cutting is essential. A careful examination of the condition of the forest and which end-products are required is the first step in determining which trees are retained and which need to be removed.

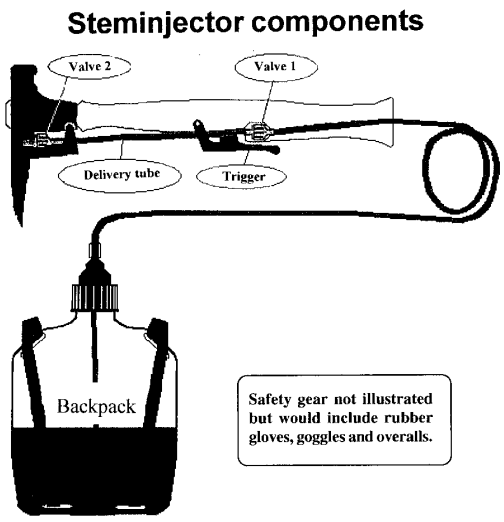
The landholder should aim to thin regrowth forest by maintaining a whole range of different trees sizes including older trees if they are present, future sawlog trees which generally have good form and are relatively straight, and saplings and smaller trees which will provide the growing stock for future needs. By thinning to leave a number of different ages and sizes of trees, landholders can also reap the benefits of increased biodiversity by providing a number of different habitats for fauna.

Tree thinning methods

When thinning regrowth forest a landholder has a number of methods from which to choose.Thinning can be achieved either via mechanical removal or treatment with herbicides such as glyphosate.

A brief description of the different options, both mechanical and chemical, are as follows:

- •Clearing saw - (brushcutter type equipment) this saw is an effective tool for one to five year old stands where the diameter is less than 7 cm;
- Basal bark spraying - this methods is used to remove trees with diameters of between 8 and 10 cm;
- Tordon axe;
- Chainsaws - chainsaws are used on larger trees;
- Stem injection of herbicide (eg. glyphosate).



The stem injection system is used for a wide range of forest stands between the ages of 5 to 30 years of age and tree sizes of 5 to 50 cm DBH (diameter at breast height).

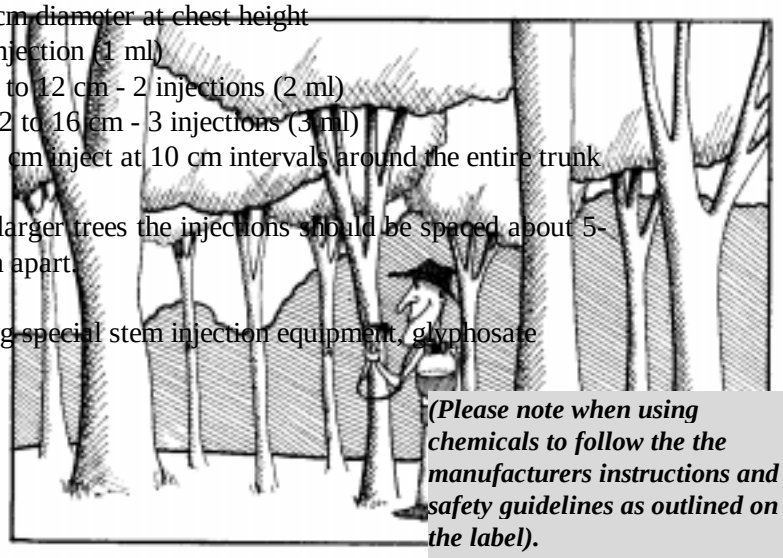
The number of injections required for different sized trees are:

< 8 cm diameter at chest height
- 1 injection (1 ml)
  8 to 12 cm - 2 injections (2 ml)
  12 to 16 cm - 3 injections (3 ml)

> 16 cm inject at 10 cm intervals around the entire trunk

For larger trees the injections should be spaced about 5-8 cm apart.

Using special stem injection equipment, glyphosate



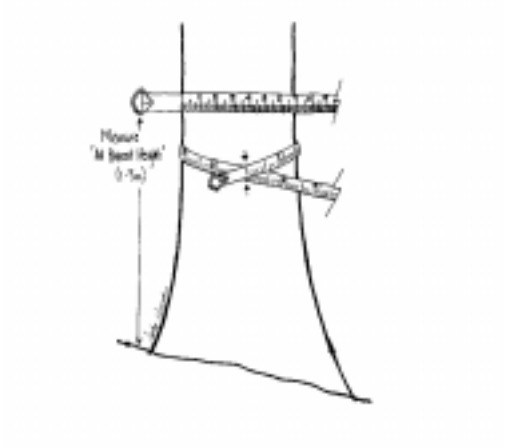
(Please note when using chemicals to follow the the manufacturers instructions and safety guidelines as outlined on the label).

(marketed as “Glyphosate” or “Roundup”) is injected directly into the sap of the tree. It is immediately translocated into the tree as the sap moves up and down the stem ensuring efficient use of the chemical and subsequent death of the tree. The stem injector method has the advantage of being easier, quicker, safer and cheaper and leads to the best growth response when compared with the removal of entire trees by mechanical means, which tend to be labour intensive. Leaving the dead trees standing overcomes the problem of windthrow, where trees are blown down due to a lack of protection from other trees. As most eucalypts coppice vigorously, mechanical removal will soon see a coppice shoot replace the removed tree. (This can be an advantage for some species which regenerate and produce a straighter stem if they are growing in a light well in the forest).

Measuring the diameter of a tree

The diameter of a tree is measured using a diameter at breast height (DBH) tape or calipers. DBH tape is placed around the circumference of the tree at breast height (1.3 m). If you don’t have a DBH tape, an ordinary tape can be used, however you need to convert your measurement from your ordinary tape so that is represents the same diameter on a DBH tape. This can be done by dividing your measurement by 3.14. If you are on a slope, take the uphill measurement from the ground.

All future reference to diameters in this booklet will refer to DBH diameter measurements.

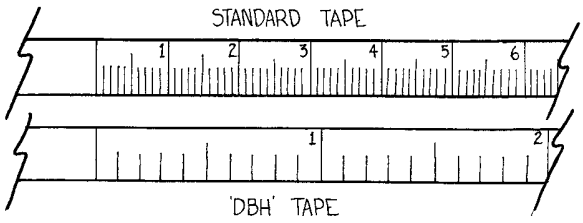


Example:

Joe has used an ordinary tape and has a circumference measurement of 45 cm. This equates to 14.3 cm DBH measurement.

Ordinary tape measurement = 45 cm
DBH diameter measurement =
45 cm / (3.14) = 14.3 cm (DBH)

A measure of how much wood is in a forest and how it is distributed is the **basal area** of the trees. Knowing the basal area of a stand of trees helps you to manage it better, will give you a tool to assist with thinning, and will help you communicate with foresters and other advisors on how best to manage your forest. For details on estimating basal area and stand volume refer to Greening Australia or your relevant forestry service.



TIP:
As a general guide when thinning a stand, the average distance between trees after thinning should be about 15 to 20 times the diameter of the trees. This allows a few more years of unrestricted growth. If you have several trees of good form you can leave those trees close together rather than leaving trees with poorer form.

Pruning trees to increase their timber value

If a stand is heavily thinned it may be beneficial to prune selected trees. Where wood production is a priority thinning is usually of moderate intensity so that branch size is limited and self pruning continues. The benefits of pruning trees in woodlots or regrowth forests are well recognised and include the following:

- higher quality and higher value timber;
- pasture growth can be promoted by reducing shade;
- access and visibility throughout the stand can be improved.

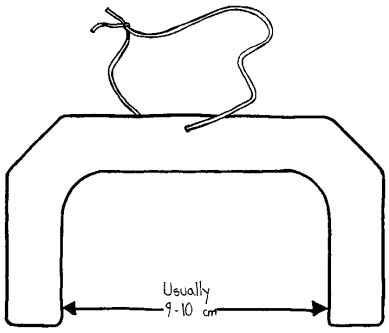
Many species are self-pruning and so pruning only becomes economic in regrowth forest where a species has a high sawlog value.

There are two stages to pruning – form pruning (to get an upright form with a single straight trunk free from branches) and clear bole pruning (to remove all side branches).

Form pruning is carried out in the early years to ensure that the tree develops with the correct shape. Form pruning is the selective removal of branches or stems from a tree to ensure that the tree grows with a single, straight trunk. Form pruning, which mainly involves the removal of double leaders and ramicorms (a vigorous branch that is steeply angled), can begin when seedlings are young and should continue until the straight trunk is the height of the desired log (usually 6m or more).

Clearbole pruning involves the removal of branches to control the development of knots. This technique is used to remove all branches up to where the trunk is about 10 cm in diameter and any higher branches that could alter the straight form of the tree. When pruning, each tree should be treated individually to an appropriate formula relating to the size of the tree rather than all of the tree being pruned to the same height, which disadvantages smaller trees by removing a greater proportion of their growing material. Pruning to the final clearwood height (usually 6 m) will generally be done in a number of “lifts”. Most commonly the lifts go from 0-2 m to 2-4 m and 4-6 m at the appropriate times.

Pruning tools such as secateurs, pruning saws and long handled pruning shears can be used. Secateurs or pruning shears are generally used to remove small branches and pruning saws are used when pruning larger branches. To decide where to prune up to, a pair of homemade callipers with a gap of 10 cm in diameter can be effective. Simply prune the branches off the stem up to a point where the trunk diameter is 10 cm.



Branches on the trunk of the tree produce knots in the timber, with the knot size related to the branch size. Knots are branches that become incorporated into the wood of the tree trunk as it grows. Knots reduce the timber strength, pulping quality and appearance values of the tree and high value timber contains either very small knots or no knots at all. If the branches are removed the timber formed thereafter will be knot free or "clearwood". The objective of pruning trees is to produce the maximum amount of "clearwood".

To maximize clearwood production, all branch stubs must be contained within a pre-determined minimum "defect core" in the centre of the trunk. The size of the defect core determines the log quality. The smaller the defect core the more valuable the timber; usually aim for 10 cm diameter.

Example:

Joe has a mixed species native regrowth forest. He uses the Quick Guide to Thinning (overleaf) to help him make decisions about thinning his forest. He has a dense stand where the crowns of the trees are touching. Joe has decided to thin his native regrowth forest as he has numerous trees in the same DBH size class and therefore wishes to thin his regrowth forest for both timber production and to increase biodiversity. Most of the trees in the stand have a DBH of greater than 200 mm which are predominantly even aged. There are a few smaller trees and larger trees in the stand and Joe will leave these trees to ensure that the forest has a diversity of species and ages.

The next step for Joe is to thin his trees leaving an average distance between them of 15 to 20 cm times the average DBH measurement eg.

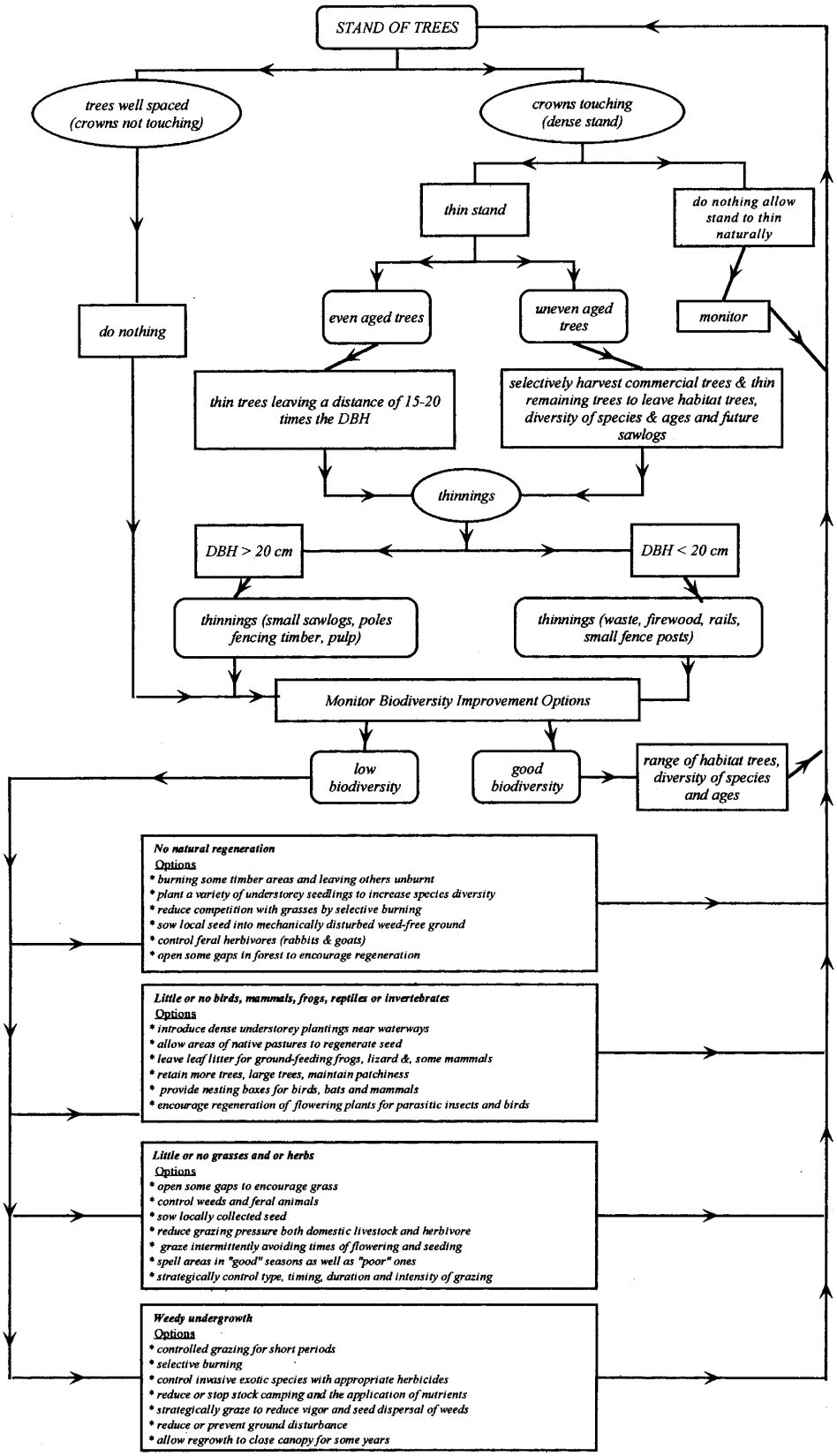
DBH	Average distance between trees
100 mm	1.5 – 2.0 m
200 mm	3.0 – 4.0 m
250 mm	4.0 – 5.0 m
300 mm	4.5 – 6.0 m

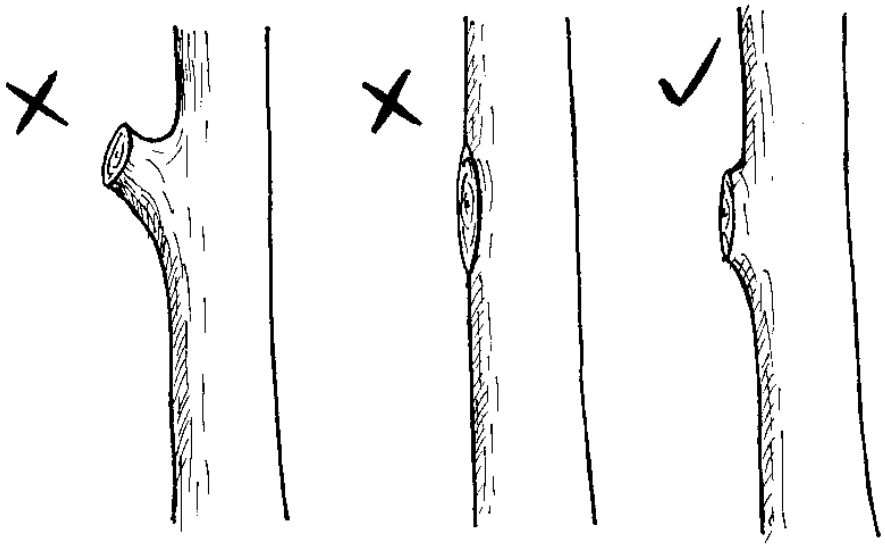
Blue wrens need shrubs for nesting

Joe thins his trees leaving a distance of 4.5 to 6.0 metres between trees. Joe decides to sell some eucalypt thinnings as yard rails and fence posts while a few logs can be sawn up for his new shed. Joe prunes and thins one species for which he has a market for higher value sawlogs. He concentrates on pruning these to ensure better form and timber quality and uses his homemade 10 cm diameter callipers as a guide*. If Joe has some regeneration (say of a high quality species) 2 to 3 metres high, he might also do a quick form prune if some trees are branching. Once Joe has thinned and pruned his forest his next step is to monitor the biodiversity. Numerous options are available to Joe dependent upon the condition of the regrowth forest. Good biodiversity includes a good range of habitat trees, and a diversity of species and ages. Joe doesn't have a good range of trees and species (low biodiversity) therefore Joe can elect to follow a number of biodiversity improvement options which are outlined in the "Quick Guide to Thinning" overleaf.

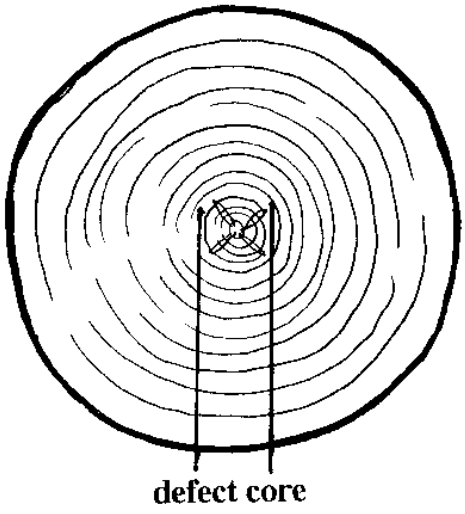
*** Note:** The pruning scar in some species (e.g. some acacias) can offer entry to borers and advice should be sought before pruning.

Quick Guide to Thinning

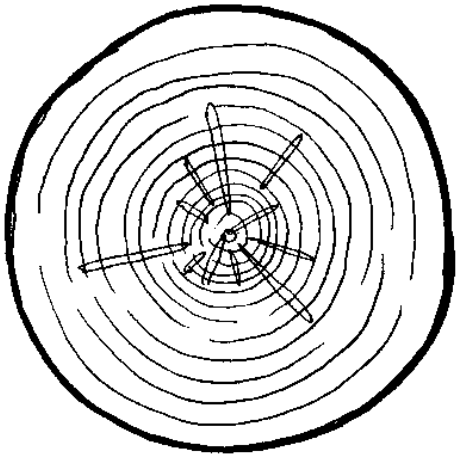




The Correct way to prune branches



Cross Section: Pruned log knot free, high quality and high value, with clearwood



Cross Section: Unpruned log knotty, low quality and low value, no clearwood

Legislative Requirements

Thinning of native regrowth forests will be subject to legislative controls in each state. Landholders undertaking thinning need to be aware of their legislative obligations by referring to the relevant state government department before undertaking work. For New South Wales the legislative requirements that apply to thinning native regrowth forests include the Native Vegetation Conservation Act (1997). Currently there are no approved codes of practice developed for the clearing of native vegetation for a specified purpose. The following are exempt from the need to obtain Development consent under the Act:

- minimal clearing – the clearing of up to two hectares per annum for any contiguous landholding in the same ownership;
- minimal tree cutting – the cutting of no more than seven trees per hectare in any period of one year for on-farm uses, including posts and firewood;
- regrowth – the removal of native vegetation, whether seedlings or regrowth less than 10 years of age if the land has been previously cleared for cultivation, pastures, or forestry plantation purposes
- private native forestry – the clearing of native vegetation in a native forest in the course of its being selectively logged on a sustainable basis, or managed for forestry purposes (timber production).

Each of these exemptions are further explained in the publication *"Definitions and Exemptions, Amendment No. 2"* published by the DLWC in July 1997. Landholders are advised to read and understand the meaning of the exemptions, and satisfy themselves that any clearing they intend to carry out falls within the exemptions.

For other states landholders should refer to the specific relevant legislation below and also the relevant Threatened Species legislation:

Queensland -	South East Regional Forest Agreement 1990
Northern Territory -	Pastoral Lands Act 1998; Territory Parks and Wildlife Act 1998
Victoria -	Conservation, Forests and Lands Act 1987 - Section 55.
South Australia -	Forestry Act 1950 - Section 3
Western Australia -	Conservation and Land Management Act 1984 - Section 10
Australian Capital Territory -	Nature Conservation Act 1980 - Section 43
Tasmania -	Forestry Act 1920; Forest Practices Act 1985.

The Economics of Thinning Existing Native Timber for the Northern Tablelands of NSW

This section focusses on the economics of thinning regrowth forest specifically for wood production and is based on case study work done by CARE Pty Ltd on the Northern Tablelands of NSW. This region is a high plateau (700-1500 m) of mixed geology and rainfall (700-1200 mm pa).

The only data available on the economics of thinning is from standard forestry studies. There is no economic information available on methods which minimise loss of biodiversity.

Thinning on the Northern Tablelands of NSW

Unfortunately, for most Northern Tablelands species (with the possible exception of native cypress pine), the growth and quality response to thinning is unknown.

At present, markets for thinnings are somewhat limited in the Tablelands region with the majority of work on thinning being carried out in plantation situations. Another obstacle on the Tablelands is the lack of developed markets for thinned timber. An opportunistic market for farm timber (eg. fence-posts and rails) exists, but it has not been developed in any large or systematic way. At present, there is no pulpwood market in the region.

Because of this situation, only general statements can be made about the economics of thinning existing native timber in the Northern Tablelands region.

Thinning costs

Thinning is regularly performed in areas of Victoria where stem densities per hectare can be very high (6000-27000 stems per hectare). At these densities, the use of chemical or mechanical pre-commercial thinning have been shown to greatly increase tree growth. Stem densities are reduced to around 1200 to1800 stems/ha. Compare this to the Tablelands, where densities could be expected to be around 150-900 stems/ha. before thinning has been carried out.

The costs of thinning are determined by the following factors:

- initial stem densities;
- final target stem densities;
- accessibility of the site and site characteristics (eg. slope);
- the amount of residual timber on the ground and
- the thinning technique used.

Table 1. Indicative thinning costs for Australian Native Forests

Situation	Typical stem density (Trees/ha)	Thinning technique	Cost ($/ha)
Eucalyptus sieberi Victoria [1]	15 900	Mechanical – Hydro Ax™ used to cut 2.4-3.0 metre wide corridors	362-739 (depending on residual logs on ground)
Eucalyptus sieberi Victoria [1]	15 900	Chemical – combined Hydro-Ax™ to cut 2.4-3.0 metre wide corridors, then treat unwanted trees between corridors with Stem injector™	1354-1731 (depending on residual logs on ground)
Eucalyptus sieberi Victoria [1]	15 900	Chemical/Mechanical – Hydro-Ax™ to cut 2.4-3.0 metre wide corridors, then remove unwanted trees between corridors with clearing saw	683-1060 (depending on residual logs on ground)
Cypress pine, New England region [2]	Up to 20 000	Mechanical – brush cutter, thinning to 6m centres	100-200 (depending on density)
Blackbutt, Stringybark forest, New England [3]	Up to 500	Mechanical – chainsaw	100-200 (depending on density)

1. Kerruish et al. (1995)
2. State Forests of NSW, personal communication 1997
3. The results referenced here are from early developmental trials. Subsequent experience has greatly reduced the costs of stem injection mainly by obtaining an understanding of the types of stands that can be treated effectively and secondly, by using the stem injector without cutting access rows with the Hydro Ax, (Kerruish, personal comment).

Timber returns

In 1997, CARE Pty Ltd conducted a survey of fixed and mobile sawmills on the Northern Tablelands to gauge the current state of the timber market. Information was also gathered from several landholders who sold milled timber from their properties. This work indicated the following (see Table 2):

- Royalties paid for Tablelands species tend to be lower than for coastal species;
- Many Tablelands mills produce structural timber as opposed to dried/dressed timber, poles or veneer. This is a key reason why lower royalties are paid - the royalties are in line with the value of the end products; and
- There are fewer market outlets for farm timber on the Tablelands relative to the North Coast.

Table 2. The Markets for Northern Tablelands and Northwest Slopes and Plains Native Timber from Existing Forests

Characteristic	Values	Comments
Preferred species	Silvertop stringy (*E. laevopinea*) New England blackbutt (*E. andrewsii)* White stringy (*E. caliginosa*) Manna gum (*E. viminalis, E. nobilis)* White cypress pine (*Callitris glaucophylla)*	In coastal areas, Coastal blackbutt (*E. pilularis*), Tallowood (*E. microcorys*) and Blue gum (*E. saligna*) are preferred. In general coastal mills do not favour the highland Tablelands species and Tablelands mills have limited access to coastal species
Preferred log dimensions	Hardwoods: 51-60 cm centre diameter 4.5-6.0 m log length Cypress pine: 14-24 cm centre diameter (thinnings) 24 cm + centre diameter (final log)	Logs larger than the preferred dimensions may be reduced with a chainsaw before milling.
Minimum log volumes that mills will take	50-300 cubic metres	This depends very much on the mill demand situation. Small parcels of timber may be taken where the mill is finding it difficult to source timber. In general however, larger patches of timber are more attractive as it is economically more viable for contractors to mobilize their equipment.
Haulage distances that mills are willing to move timber	60 – 170 km	Depends on value of products which can be produced from the timber and the mill demand. Royalties offered decrease as distance increases.
Typical timber prices received by landholders	Stumpage rates (i.e. Sawmill/contractor does logging/snig/haul): Hardwoods : $18-25 per cubic metre Cypress: $18-36 per cubic metre Hardwood sawn on-farm – $320-475 per cubic metre Dried and dressed hardwood – In excess of $800 per cubic metre	Stumpage rates for Tablelands hardwoods are markedly lower than those offered by Coastal mills (which are typically $20-50 per cubic metre for sawlogs, $20-95 per cubic metre for veneer logs and $60 per cubic metre for poles).

Other benefits from native timber management

From a commercial point of view one tangible benefit to landholders from thinning is the ability to improve livestock stocking rates. On heavily timbered portions of the property this may provide the dual option of managing for timber production while increasing the carrying capacity of those areas. However, grazing will lead to biodiversity loss, and should be managed sympathetically with biodiversity values.

Studies into the benefits of thinning native Tablelands forests to improve livestock production are currently under way, however preliminary results suggest increased stocking rates in the order of 1-1.5 DSE (dry sheep equivalent) without pasture improvement, and up to 2.7 DSE where pasture is improved after thinning by two thirds. The economic value of improvements in stocking rate will vary with enterprise type and between individual farms (Table 3).

Where timber production is also increased a dual benefit may be realised in livestock and timber sales.

Table 3. Net return costs associated with three different grazing enterprises namely superfine wool (17 microns), coarse wool (21 microns) and cattle (steers) sold at 12 months of age and 450 kg in about 1996.

Enterprise	Net return ($/ha)
Superfine wool	165
Coarse wool	105
Cattle	150

NOTE: The above figures on net returns for grazing/ha are assuming a gross margin of $22 DSE for superfine and $14 for coarse wool with a carrying capacity of 7.5 DSE/ha. The above figures will vary considerably depending on market prices.

Timber networks

It can be difficult for individual timber producers to attract serious interest from processor/buyers because they cannot supply regular commercial quantities of timber. Timber supply networks are one way of over-coming this problem. The advantages of networks include:

- the ability to stagger silvicultural and logging operations to ensure consistent supply and quality;
- scope for combining parcels of timber to meet volume requirements and reduce transport costs;
- cost and information sharing opportunities;
- increased marketing and bargaining power.

The bottom line

For the Northern Tablelands region, until markets for thinnings become available, it is difficult to recommend spending money on thinning unless significant other benefits can be captured, or substantial increases in growth rates can be achieved. At stumpage prices of $25 per cubic metre, and with typical sawlog volumes of around 5 cubic metres per hectare, spending $200/ha on thinning is not a realistic option unless growth can be significantly increased. However, anecdotal evidence suggests that spending $200/ha on thinning may not be necessary to generate a growth response in the relatively sparse Tablelands forests. This figure may realistically come down to $100/ha or less. Table 4 shows the net return per hectare under several different sawlog yield and thinning cost assumptions. No discounting of returns has been applied.

Table 4. The effect of timber yield and thinning costs on net returns ($/ha) from managing existing timber. Assumes that timber is sold at a stumpage price of $25 per cubic metre.

Thinning cost ($/ha)	Net Return ($/ha)			
	Northern Tablelands		*Coast*	
	Growth of 5m^3/ha/yr	Growth of 10m^3/ha/yr	Growth of 15m^3/ha/yr	Growth of 20m^3/ha/yr
0	125	250	375	500
50	75	200	325	450
100	25	150	275	400
150	-25	100	225	350
200	-75	50	175	300

An alternative to selling at stumpage prices is for landholders to log and mill their own timber (either with their own sawmill, or enlisting the services of a portable mill). costs and returns from a recent study (CARE 1998) and subsequent research are provided in Table 5.

While the costs and returns in Table 5 are indicative only, they suggest that where thinning costs of $200/ha are incurred, selling sawn timber is a more attractive economic proposition than selling at stumpage prices, providing timber yields can be substantially increased.

However, there are a number of factors to be considered including:

- The ability of individual landholders to market their sawn or dressed timber. No marketing costs have been included in the above figures:
- The costs of holding stock. Often timber must be stored for extended periods prior to sale;
- The skills and labour required to log, saw and dress timber may not be available (nor may contractors to provide these services) and;
- The suitability of Tablelands species to drying/dressing.
- Strict size and defect guidelines are usually required to meet the needs of buyers who are drying/dressing sawn boards.

Milling and drying/dressing timber is a specialised operation and in many cases, will be beyond the skills base of individual landholders. Again, landholder networks can provide a mechanism for addressing this issue.

Table 5. Value adding your own native farm timber

Item	Unmanaged Forests	Managed Forests
Revenue:		
Cutting Cycle	10 years	7 years
Merchantable Timber Yield	5m^3/ha*(100% sawlog)	35m^3/ha*(60% sawlog, 40% pulp)
Gross returns with board sales @ $475/ m^3	**$ 950**	**$ 3990**
Costs:		
Harvest costs/ha	$ 125	$ 700
Milling costs @ $100/ m^3	$ 500	$ 2100
Transport costs @ $0.14/ m^3/km	$ 70	$ 294
Thinning costs/ha		$ 100
Total costs	**$ 695**	**$ 3194**
Net Return/ha	**$ 255**	**$ 796**
Annual net return/ha**	**$ 25**	**$ 113**

* Assumes an Mean Annual Increment of 0.5m^3/ha/year for unmanaged and 5m^3/ha/year for managed forests. This increase in growth is probably only feasible on the best Northern Tablelands sites.
** Takes into account the length of the cutting cycle.

Management Recommendations

The following factors need to be taken into consideration when considering improving timber production while limiting the impact on biodiversity:

- Any thinning regime should firstly prioritise the end-product required and the thinning practice adopted should then link into this end-product use, whether it be for on-farm (eg. firewood, fence posts) or off-farm use (eg. supply to mills);

- Different end-product uses of the forest/woodland will dictate different thinning needs eg. future timber production for sawlogs will require a larger spacing requirement between trees than timber production for firewood;

- Implement thinning with a plan which retains diversity of both flora and fauna species:

  - Try and retain a diversity of native tree species;
  - Maintain and enhance the shrub layer;
  - Maintain a diverse range of habitats including hollow trees, logs mistletoes, nectar, water, seeding grasses;
- Ensure adequate regeneration (this may require use of low intensity fires, direct seeding or even plantings);
-
- Management of weeds - this is very important as weeds can quickly colonise areas that have been thinned, especially where soil disturbance has occurred;
-
- Ensure any thinning regime complies with legislation.

TIP:

There is no one universal thinning practice which can be adopted for all regrowth native forests. It is up to individual landholders to set goals and then manage regrowth accordingly.

Glossary

Biodiversity
Diversity of living things. It includes the diversity of ecosystems, habitats, plants and animals.

Bole
The main trunk of a tree.

Branch stubs
Branch remaining after pruning.

Callipers
Pruning gauge to check diameter of the stem.

Canopy
The more or less continuous cover of branches and foliage formed collectively by the crown of trees in a forest stand.

Clearfelling
Method of harvesting forests or plantations whereby all trees in a coupe, apart from those retained for seed or wildlife habitat are removed.

Clearwood pruning
Pruning branches to ensure knot-free timber

Collar
Ring of wound tissue which will grow over the branch stub.

Coppice
Stems which grow from shoots arising from the stump of felled trees.

Coupe
A small forest management area from which trees are logged/harvested.

Crown
The upper part of a tree carrying the branches and leaves.

DBH – (diameter at breast height)
Measurement of the diameter of a tree at 1.3 metres above the ground.

DSE – (dry sheep equivalent)
One DSE is the amount of feed required by a 45 kg wether or non-pregnant, non-lactating ewe to maintain its weight.

Ecosystem
All the plants and animals that live in a particular area together with the complex relationships that exist between them and their environment.

Groundcover
Plants less than 0.5 metres in height eg. grasses, climbers.

Habitat
A place where animals live.
Harvesting
The process of removing timber from a forest coupe, also known as logging.

Logging
Refers to the removal of timber from a forest coupe.

Nutrient cycle
Movement of nutrients through an ecosystem via plants, animals and micro-organisms.

Parasite
An organism that lives on another organism (the host) for its own benefit while the host is harmed (although not usually killed directly).

Pole
A young straight tree from which a length of round timber suitable for a telephone pole or power-line pole could be cut.

Predator
An organism that lives by preying on others.

Prescribed burning
Burning grass and groundcover in a planned way to reduce the risk and impact of bush fires.

Pruning

The removal of selected shoots or branches from a tree to improve tree form or wood quality. Done with secateurs, pruning shears, or hand or power saws, depending on branch size, conditions and to a certain extent preferences.

Pulpwood
The wood from which fibres are extracted to make paper.

Ramicorn
A vigorous branch that is steeply angled (usually less than 30° to the trunk). Such branches should be removed as early as possible because they are hard to prune later and can threaten the integrity of the single, straight trunk.

Regeneration
Replanting of trees (or other plants) through naturally established seedlings.

Regrowth forest
Stands of naturally regenerated trees which are not yet mature.

Sapling
A young tree less than about 10 cm in diameter.

Sawlogs
Logs which are processed into sawn timber for housing, furniture, construction, veneer, poles and sleepers.

Selection method
Involves removing only selected trees from a forest stand and not clearing the whole forest.

Selective logging
Practice where only certain trees are removed from a forest stand.

Shrub
Woody plant of less size than a tree and usually divided into separate stems from near the ground.

Silviculture
The term to describe the management of forests for timber production.

Terrestrial
Land dwelling.

Thinning
The removal of trees from a forest to improve the growth, rate and health of the remaining trees. Thinning to waste is a thinning operation in which the trees that are cut are not removed or left on the forest floor. Production thinning is a thinning operation in which the trees removed are used commercially.

Tree form
The taper and general shape of a tree particularly its trunk. Includes straightness and branching pattern.

Understorey
A portion of the trees and shrubs in a stand which are below the main trees.

Woodland
Areas of trees whose tops (canopy) collectively shade less than 30 per cent of the ground.

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