Forestry Tasmania

Native Forest Silviculture

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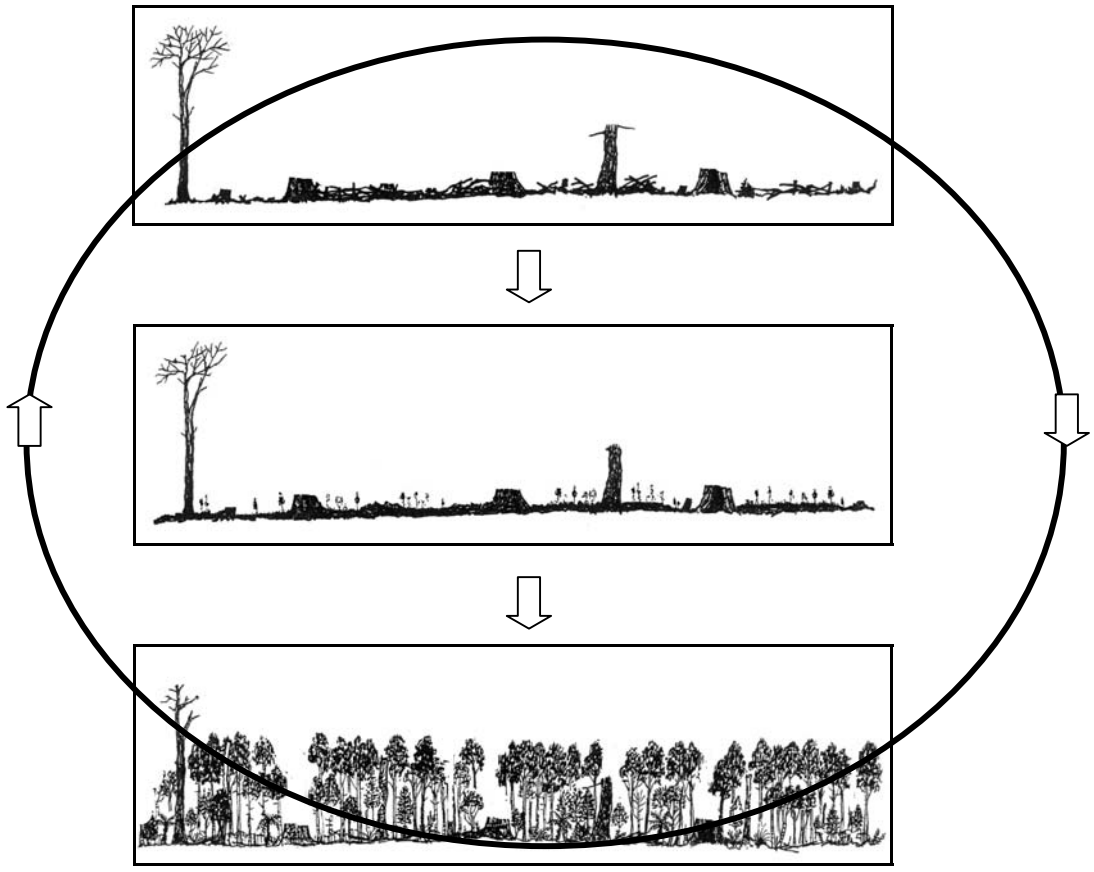
2009



Remedial Treatments

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Remedial Treatments

CONTENTS

Part A Prescriptions for the selection of appropriate remedial treatments for understocked native forest eucalypt coupes

1. Introduction

Remedial treatments are additional silvicultural operations applied to understocked coupes to significantly increase the stocking of eucalypt regeneration.

Remedial treatments should only be undertaken where:

- **the causes of the understocking have been identified;**
- **the problems are not expected to recur or are likely to be overcome by the remedial treatment;**
- **significantly higher stocking levels can be achieved cost-effectively; and**
- **the remedial crop will be healthy and form part of a vigorous regenerating stand.**

All these factors are rarely met, especially on older understocked coupes. Often, for example in very understocked coupes at age 2 years, effective browsing control is not possible and/or the creation of receptive seedbed cannot be achieved cost-effectively. Eucalypt seedlings established at age 2 may never be able to out-compete the established scrub. Retaining early germinants by prompt and intensive browsing control is a more effective approach to achieving satisfactory regeneration than later remedial treatments. Chronically understocked older coupes rarely achieve significantly better eucalypt regeneration stocking levels.

2. Monitoring and Detection

Early detection is the key to the successful treatment of potential understocking. Prompt action to remedy problems such as browsing damage can obviate the later need for much more expensive and difficult treatments. It is crucial that understocking is recognised in the first twelve months after sowing.

Regeneration stocking and early development should be monitored by checking the indicator plots and browsing transects, and through regular informal inspections of the coupe. Regeneration surveys should be conducted after the seedlings are sufficiently established and their future growth is reasonably assured, but before the opportunities for low cost remedial treatments are lost. For clearfelled coupes, this is usually in late February and/or early March.

3. Investigation of Problems

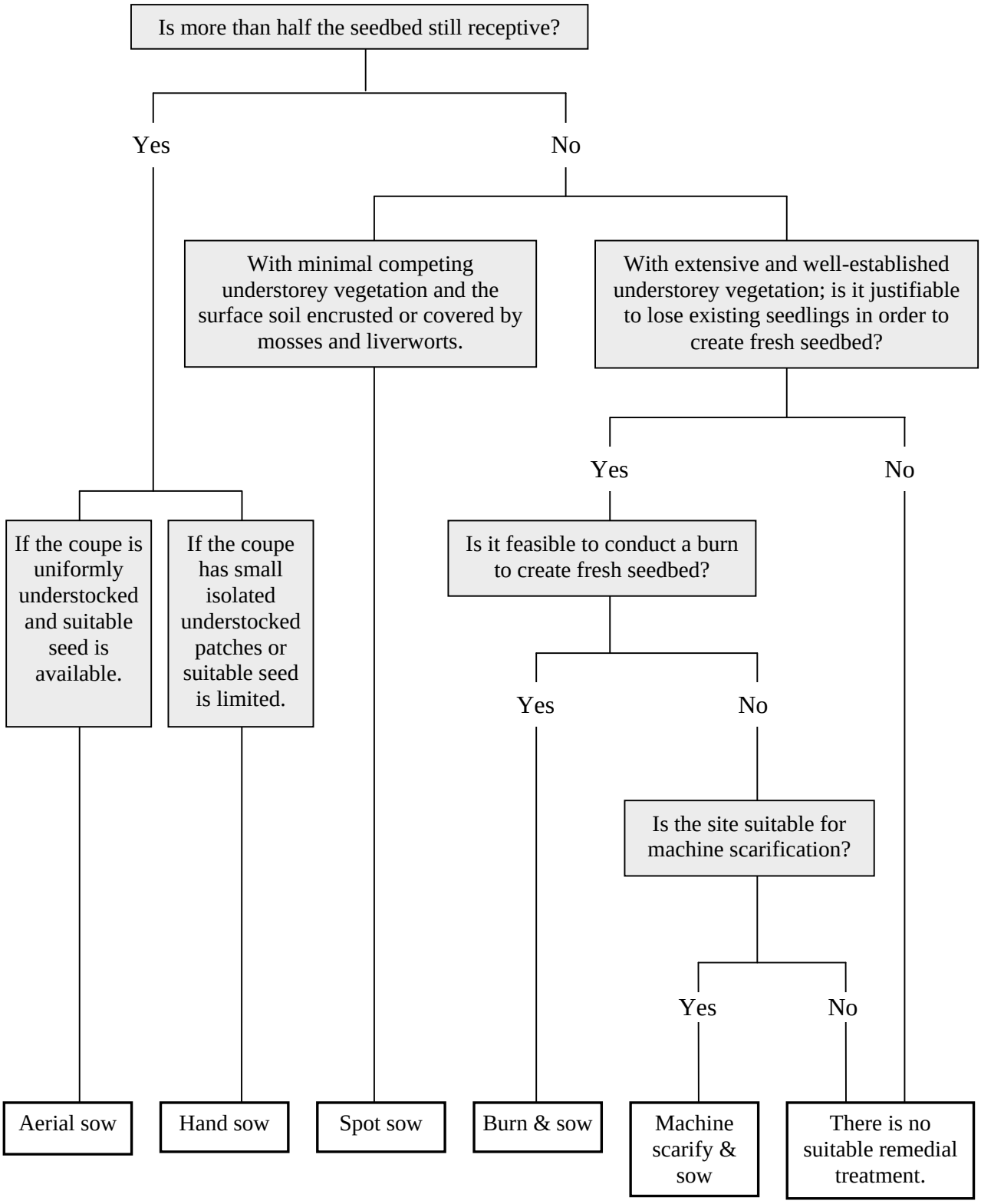
Problems should be identified so that future silvicultural systems can be modified to improve their reliability. The major causes of understocking are usually one of the following:

- Access restrictions
- Adverse soil disturbance
- Mammal browsing
- Climatic extremes (frost, etc)
- Disease/insect attack
- Extended sowing delay
- Grass invasion
- Inappropriate silviculture
- Insufficient seed sown
- Loss of advance growth
- Poor burn
- Poor natural seedfall
- Sowing problems
- Unsuitable seed provenance
- Wildfire

More detail on each of these causes is provided in Part B of this Bulletin.

4. Selection of Appropriate Remedial Treatments

Figure 1. Guidelines for the selection of the appropriate remedial treatment for understocked coupes.



All remedial treatments must include effective browsing control.

5. Planting Eucalypt Seedlings

Planting of eucalypt seedlings is not recommended as a remedial treatment for routine use in native forest coupes. Planted eucalypt seedlings of the ash group have done very poorly in plantations, and the establishment and growth of planted seedlings in native forest situations has generally been poor. Planting is much more expensive than sowing. Seedlings must be grown from on-site or in-zone seed. It is usually more efficient to prepare additional receptive seedbed and sow, than to raise seedlings and then plant trees into older scrub 6 to 12 months after the understocking issue has been identified.

6. Comparative Costs of Remedial Treatments

Figure 2. Comparative costs for remedial treatments and mammal browsing control (per hectare, 2009).

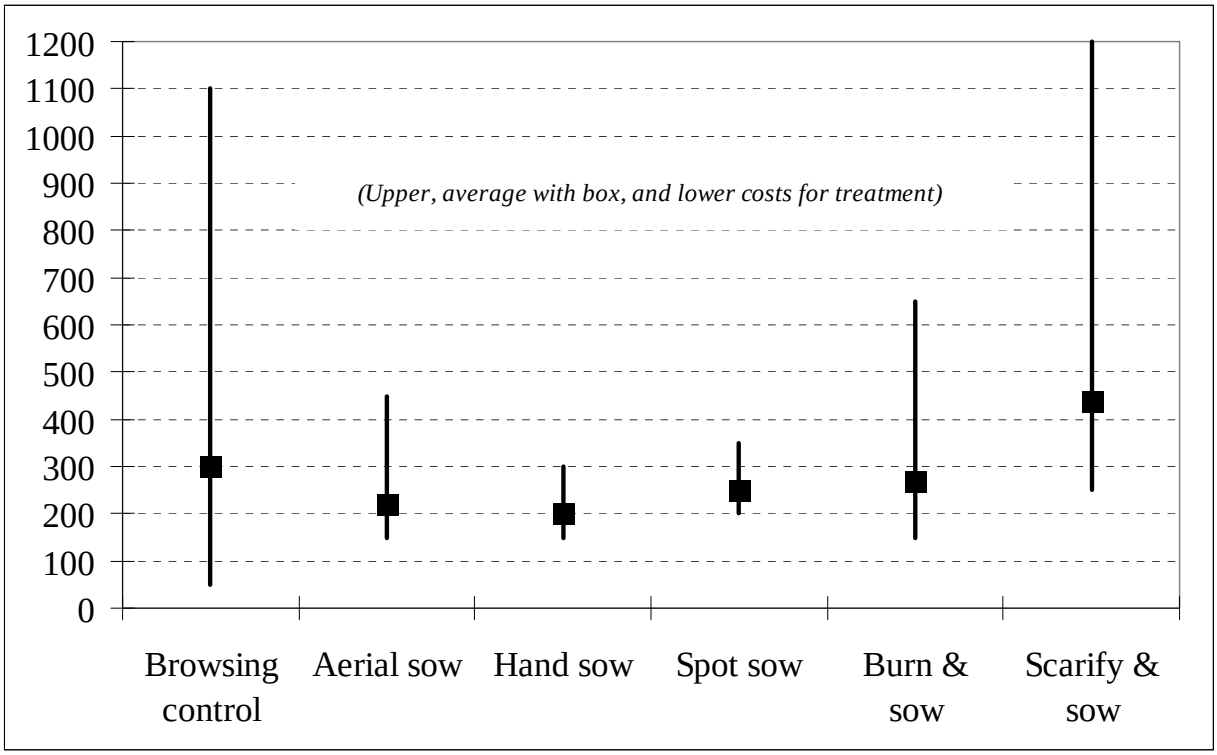


Figure 3. Identify and plan remedial treatments from the regeneration survey information

This plan is prepared following the regeneration survey in late February/early March.

Understocked patch I
16 m^2 stocking = 0/8; 0%
area = 1.6 ha

Rocky patch with much fern, poor burn, with a few eucalypts.

ACTION: Do nothing; little chance of significantly increasing stocking.

Understocked patch II
16 m^2 stocking = 1/16; 6%
area = 3.2 ha

Essentially an unburnt patch, with a few eucalypts.

ACTION: Incorporate the patch into the adjoining coupe due for harvest next summer.

Understocked patch III
16 m^2 stocking = 1/21; 5%
area = 4.2 ha

Very heavy browsing on good seedbed with moss/ liverworts.

ACTION: Control browsing and spot sow this month, or wait till spring.

Stocked patches
16 m^2 stocking = 83/99; 84%
area = 19.8 ha

About half the coupe is well stocked where the browsing damage was controlled.

ACTION: Continue monitoring and browsing control to protect the crop.

Whole coupe
16 m^2 stocking = 110/184; 60%
area = 36.8 ha

Average burn and some browsing have caused mild understocking.

ACTION: Control browsing and some spot sowing should improve stocking.

FUTURE COUPES: Aim for more consistent fuel preparation & burning, use pre-emptive browsing control with slightly heavier site weighting for the sowing.

Understocked patch IV
16 m^2 stocking = 25/40; 63%
area = 8.0 ha

South facing damp slope with moderate browsing, not quite enough eucalypts.

ACTION: Control browsing and natural edge sowing should increase stocking.

7. Description of Remedial Treatments

7.1 Aerial sow

Where:

On coupes where receptive seedbed is uniformly available over most of the understocked area. Areas for treatment should be in large patches with suitable boundaries for aerial sowing. The coupe should be about one year old (not two) and suitable seed must be available.

When:

In February or March for autumn sowings or from late July to mid September for spring sowings.

How:

Sowing rates generally should be increased to compensate for the reduced seedbed receptivity. Procedures for aerial sowing and selection of sowing mixtures are detailed in the Aerial Sowing Manual and Technical Bulletin No. 1 (Eucalypt Seed and Sowing) respectively.

Advantages:

No additional site preparation is necessary and existing regeneration is retained. Relatively low cost and likely to be successful if the original problems do not recur.

Disadvantages:

Sufficient quantities of suitable seed must be available. Seedling percent may be quite low.

Costs:

Average cost $220/ha with a range $150 to $450/ha (as at 2009). Unit costs may be higher than routine aerial sowing for small isolated patches. Costs are highly variable depending on the proportion of each hectare that is treated, the terrain, proximity to other coupes, sowing rates, etc. Comparative costs for remedial treatments are provided in Figure 3.

7.2 Burn and sow

Where:

On severely understocked patches where good fuels are still available. Burning and sowing is most suited to large patches that can be included with an adjoining coupe, where suitable boundaries for safe burning and sowing can be established.

When:

Burning should be carried out in optimum conditions in early autumn. The treated area should be sown as soon as possible after the burn and preferably before significant rainfall.

How:

Refer to the Prescribed Burning – High Intensity Manual (Forestry Tasmania 2005), Aerial Sowing Manual (Forestry Tasmania 2002) and Technical Bulletin No. 1 (Eucalypt seed and sowing).

Advantages:

Likely to give a successful result where the failure to burn or create receptive seedbed was the original cause of the understocking.

Disadvantages:

Additional scrub rolling or stag felling may be necessary as the harvesting debris will be at least a year old, so there will be significant greening of the coupe which can result in a poor burn. Most of the existing regeneration within the treatment area is likely to be destroyed. Sufficient quantities of suitable seed must be available. Seedling percent may be quite low.

Cost:

Average cost $270/ha with a range $150 to $650/ha. Costs will be variable depending on boundary and fuel preparation works.

7.3 Hand sow

Where:

The understocked patches with receptive seedbed are relatively small or patchy such that aerial sowing would waste seed on unreceptive seedbed. Generally applied to coupes that are about one year old.

When:

In late February and March for autumn sowings or from late July to mid September for spring sowings.

How:

Seed can either be bulked-up and thrown by hand, or spread with hand-operated sowers.

Hand-operated sowers:

Various commercially available sowers are suitable for sowing eucalypt seed. They need to be individually calibrated for each operator for walking speed, aperture and handle rotation speed. They are easily adjusted to deliver sowing rates from 0.3 to 1.0 kg per ha.

Throwing by hand:

Seed should be bulked up with, for example, dry sawdust to enable uniform spreading. The weight of an average handful of sawdust is about 14 g and an average handful covers about 8 m^2 but should be checked for each operator. About 1200 handfuls or 17.5 kg of seed and sawdust mixture are required to treat each hectare of receptive seedbed. The seed should be mixed very well.

Advantages:

No additional site preparation is necessary and existing regeneration is retained. Seed is sown only on receptive seedbed, ensuring the efficient use of seed. Changes in seed mixes can be made in response to variations across the coupe. Not reliant on aircraft availability.

Disadvantages:

Success is highly dependent upon the operator locating the individual patches requiring treatment. Subject to the availability of suitable operators coincident with good sowing days.

Cost:

Average cost $200/ha with a range $150 to $300/ha. Variable depending upon the proportion of area requiring treatment, difficulty of ground conditions etc.

7.4 Spot sow

The aim of spot sowing is to establish one seedling on the majority of spots by age one. Experience has shown that multiple seedlings on spots often compete poorly and fungal disease and poor form can result. Bigger spots are time consuming and exacerbate competition problems. Some species like *E. regnans* may be prone to stem twisting. Small spots are quick to create and sow and have resulted in good regeneration over recent years.

Where:

A high proportion of the seedbed is unreceptive due to the surface soils being encrusted or covered by light litter, mosses and/or liverworts. Any competing scrub must be short and sparse and unlikely to hinder the germination and growth of eucalypt seedlings. Can be applied on coupes up to about two years old. Dry sites or areas covered by scrub or grass are not suitable.

When:

In late February and March for autumn sowings or from late July to mid September for spring sowings.

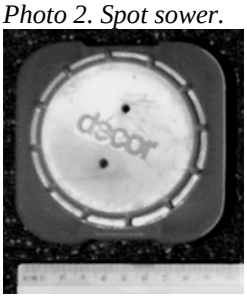
How:

Seedbed should be created by lightly cultivating spots about 10 cm in diameter at 2 m intervals along lines 3 m apart (i.e. approximately 1700 spots per hectare). Good seedbed and position are preferred over rigid uniformity of spacing. Any competing scrub should be cleared back a distance equal to their height. Spot sowing is not required within 1.5 m of an established healthy vigorous eucalypt seedling.

Photo 1. Spot sowing.

A 10 cm diameter spot has created receptive seedbed for some fresh germinants.

Photo 2. Spot sower.



Simple 'pepper shaker' style seed dispensers are light, easy to use and dispense seed quickly.

The surface of the spot should be rough, the topsoil retained and ponds not created in wet areas. Plumpton spot sowing tools or mattocks are suitable for preparing the seedbed spots, the type and style of existing ground cover and soil will inform the choice of tool.

Spots should be sown at a rate that will achieve one established seedling per spot. This is generally about 0.03 g per spot for a seedlot of about 60 000 laboratory germinants per kilogram of seed, and will need to be adjusted according to species and quality of each seedlot.

'Pepper-shaker' type dispensers are accurate enough and are light, fast and easy to use. The lid should have two holes of 3.5 mm diameter and one shake delivers about 0.03 g of eucalypt seed. Two shakes will deliver too much seed. Resist the temptation.

Advantages:

This is the lowest cost option for creating receptive seedbed and establishing additional regeneration. It is a very efficient use of seed. Any pre-existing regeneration is retained.

Disadvantages:

Poor operators may not locate spots in the best locations for germination, establishment and growth. Spot sowing of excess seed, resulting in too many seedlings per spot, may lead to growth defects, competition and interference with normal development.

Cost:

Average cost $250/ha with a range $200 to $350/ha. Costs will vary depending on the proportion of area requiring treatment, difficulty of terrain and ground cover etc.

7.5 Machine scarify and sow

The most expensive remedial treatment with the least likelihood of significant improvement in stocking.

Where:

On severely understocked areas, less than about two years old, where receptive seedbed can be created by machine clearing, and where understocked patches can be delineated for treatment without damage to adjoining stocked areas. Machine scarification is not appropriate for low quality forests or for higher quality forests that are only moderately understocked.

Photo 3. Before machine scarification.

This patch was not burnt, with scrub and only 3 eucalypts. There is minor browsing pressure.

Photo 4. After machine scarification.

The patch has been well scarified with an excavator with a crab-grab style attachment. Broadcast hand sowing and regular shooting should improve the stocking on the coupe.

When:

Scarification should be undertaken when soils are relatively dry and close to the optimum sowing time in autumn (late February/March).

How:

Appropriate machinery will depend upon the type of vegetation, soil and ground conditions. Dozer blades tend to scalp or displace the soil and are not really suitable for scarification. Dozers fitted with root-rakes are marginally better. Excavators fitted with crab-grabs are ideal for removing scrub and light debris. Material should rarely be picked up and moved. A slewing action 'wipes' the scrub and branches away with the uprooting exposing bare mineral soil and creating receptive seedbed. Large mounds of debris and topsoil should be avoided. Small piles may create natural caging opportunities for new seedlings and create less interference for control operations. Disc-ploughs can also be effective in short open scrub and light ground debris. In grassy areas root-rakes may be modified with tynes to improve grass removal and surface cultivation.

Following seedbed preparation the patches should be sown. This is often best completed by hand immediately following the machine, onto the most receptive seedbed.

Photo 5. Pushed up topsoil heaps.

Topsoil in heaps degrades the seedbed in which the new seedlings establish.

Advantages:

Creates receptive seedbed.

Disadvantages:

Most of the existing regeneration will be destroyed during the operation. Inappropriate for sites which are steep, highly erodible, rocky or that have heavy harvesting debris or dense tall scrub. Not reliable in dense grassy areas where rapid re-colonisation of grass is likely.

Cost:

Average cost $440/ha, with a range $250 to $1200/ha. Variable depending upon proportion of area requiring treatment, difficulty of terrain and ground cover etc.

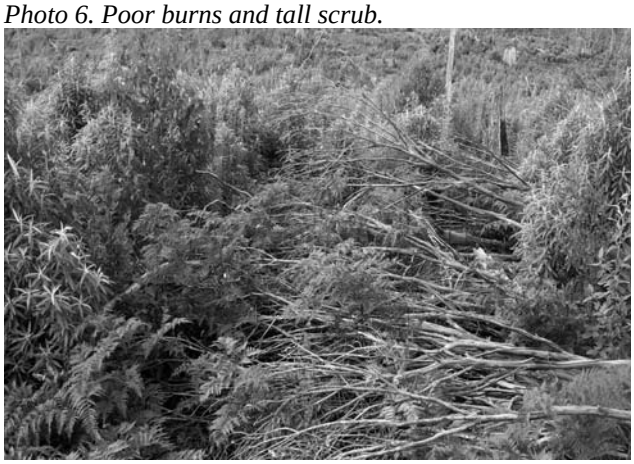
7.6 No suitable remedial treatment

Where:

On coupes that are only just understocked, that have extensive and well established understorey vegetation and where attempts to create additional receptive seedbed are likely to result in the loss of established seedlings, remedial treatments cannot be justified.

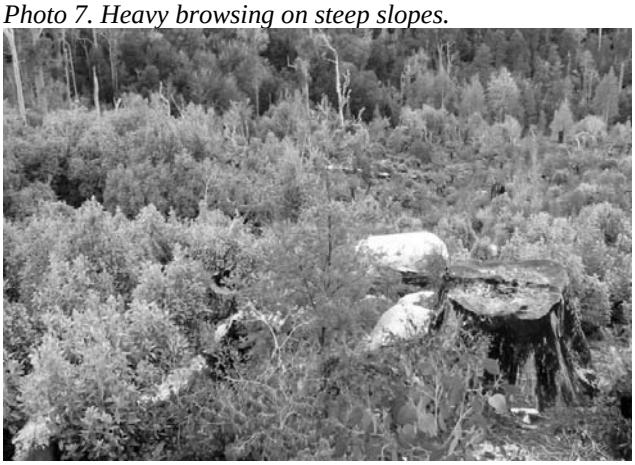
Remedial treatments on the patches shown below would be expensive and unlikely to significantly increase stocking.

Photo 6. Poor burns and tall scrub.



Extensive unburnt harvesting debris spread through 2 m tall dense broad leaved scrub.

Photo 7. Heavy browsing on steep slopes.

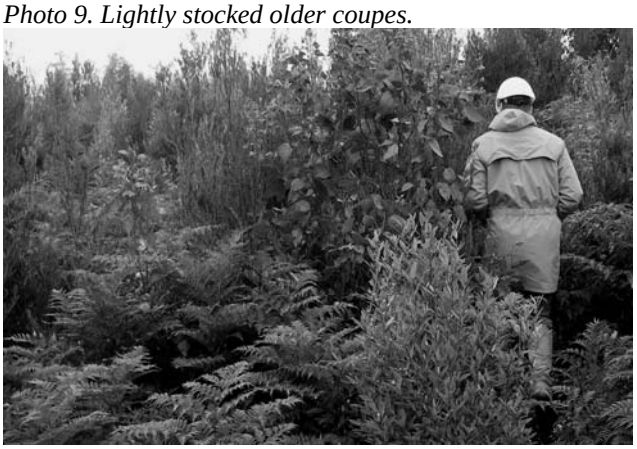


Dense tall scrub on steep slopes on erodible soils.

Photo 8. Poor burns leaving heavy debris.

Very heavy harvesting debris with scrub on steeper slopes in high rainfall areas.

Photo 9. Lightly stocked older coupes.



Tall, dense scrub with a light stocking of established eucalypts is rarely worth disturbing.

The best treatment for understocking is to make sure it doesn't happen again.

Part B Causes of understocking

1. Access restrictions

The presence of wedge-tailed eagle nests in or adjacent to coupes limits access during the breeding season (from August 1 to January 31) and has led in the past to poor browsing monitoring and control. Access to areas within 1 km line of sight of eagle nests may be affected during the breeding season. Forestry Tasmania's 'interim procedure for browsing management in proximity of eagle nests during the breeding season' is available through the Forest Management System and should be consulted in July each year to ensure appropriate approaches to browsing management are used in eagle-nest affected coupes. The procedure needs to be checked each year because ongoing negotiations mean that there are often changes.

2. Adverse soil disturbance

Understocking is common on highly modified sites such as snig tracks and landings due to the loss of top-soil, displacement, inversion and compaction. Measures to reduce losses associated with snig tracks and landings are detailed in the Forest Practices Code (2000). Rehabilitation and restoration of major snig tracks and landings is best achieved by ripping, aeration and burning of the harvesting debris on a raft of larger timber. These sites are not expected to carry the normal standard of regeneration. Additional remedial treatments to increase the stocking of eucalypts on such areas are rarely justified.

3. Browsing

Browsing kills cotyledons and very small seedlings. Early control of browsing and checks of the indicator plots will have a significant effect on the abundance of cotyledons. Even seedlings one to two years old can be killed by repeated defoliation. In addition to mortality, browsing causes growth losses which can result in seedlings being suppressed by competing scrub. Suppressed seedlings may not be seen during regeneration surveys.

Browsing damage is variable and complex. Local experience will provide a basis for planning monitoring and control measures. Grazing by domestic stock such as sheep causes serious regeneration problems in forests that adjoin grazing properties (Orr 1991). Domestic stock must be excluded from regeneration areas until seedling heights are taller than 1.5 m.

Browsing control is not a separate remedial treatment but must be considered an essential part of all silvicultural systems. Further information on the control of native animal browsing is in Technical Bulletin No. 12 (Forestry Tasmania 1999), Statham (1983) and the Standard Operating Procedure for Mammal Browsing Monitoring and Control.

Where browsing damage is a cause of understocking, remedial treatments are unlikely to succeed unless browsing pressure is reduced significantly. Browsing damage often decreases one to two years after sowing with the growth of a shrubby understorey. This provides alternative food and some degree of protection to the eucalypt seedlings.

Browsing control is an essential part of any proposed remedial treatment.

Understanding the different styles and intensities of browsing is important in determining any remedial treatment.

Photo 10. A healthy vigorous seedling.
Note the balanced shape, with fresh 'soft' new leaves at the end of each branch, one main central stem and all leaves intact.

Photo 11. Insect damage tends to be 'fine' as it was done by small 'teeth', as distinct from the bite of wallabies and possums with their bigger mouths.

Photo 12. Moderate browsing pressure is indicated when the only seedlings are growing from within natural caging which provides some protection; from unburnt branchlets to the left, and between logs below.

Photo 13. Moderate browsing pressure last season is indicated when the seedlings are healthy but are growing out from under natural caging such as branches and logs.

Photo 14. This seedling is growing out from under a protecting branch. This suggests browsing on the coupe was occurring in year one, and that all the unprotected seedlings have been killed.

This seedling has been persistently browsed. The newer succulent leaves have been browsed regularly, leaving only the leathery older ones. If there were new 'soft' growing shoots it would indicate that effective browsing control is now in place.

There is also no scrub in the vicinity, only mosses and liverworts, suggesting heavy and persistent browsing pressure.

Photo 15. Browsing pressure has commenced only recently if the seedlings are architecturally well formed, but lack leaves, especially the soft new tips.

This is often the result of possums gently removing the soft succulent leaves.

This tends to occur after good control in the first season is followed in the second season by a drop in intensity of monitoring and control operations, allowing increasing animal numbers to affect the crop in the second season.

Photo 16. This seedling has been 'pruned' repeatedly, but not killed.

This indicates that the browsing pressure is light. This intensity can be hard to pick up visually, but the seedling growth can be slow.

This browsing pressure may result in a loss of vigour and suppression from neighbours and scrub.

Photo 17. This type of damage is probably caused by Bennetts wallabies. Such damage may be fatal if it wrenches the young root system.

Browsing at this intensity must be controlled before any remedial treatment is applied.

Photo 18. This indicator plot has been significantly impacted by browsing for many months. The obvious need for browsing control has not been translated into effective control operations.

The lack of any understorey species outside the fence indicates heavy browsing for most of the time since the regeneration burn.

Photo 19. The Mersey box trap is an effective method of reducing browsing pressure. However, in this case the traps have been deployed too late – the coupe is severely understocked already.

The remedial treatment would probably be spot sowing and the introduction of effective browsing control.

4. Climatic extremes

Unusually severe or unseasonal frosts and drought have been associated with regeneration problems. Appropriate silvicultural systems have been developed for harsh climatic zones. For example, shelterwoods reduce exposure to cold temperatures at higher altitudes and seedtree systems increase regeneration opportunities on drought-prone lowland grassy sites by providing shade, shelter and a continuing seed source. Extremely cold weather can result in the water in the surface soil freezing and expanding. This forces 'needle ice' to rise, often lifting new cotyledons and small seedlings. When the ice melts, the seedlings and roots fall to the surface and the exposure often kills seedlings up to about 5 cm tall. Out of season frosts are those that occur before new seedlings have 'hardened off' and become accustomed to cold regimes. Temperatures during winter down to -6°C can be tolerated by most eucalypt species. However, 0°C may be lethal during spring and summer.

5. Disease/insect attack

Seed loss due to fungal attack and harvesting by insects can be a problem on some sites, particularly if the seed is sown months before it germinates. Seed which is sown onto compacted seedbeds in early winter may be dormant and susceptible to harvest or attack in the months before germination in spring.

Understocking due to the mortality of young seedlings is rare; poor individual seedling health and growth losses are rarely significant in the new crop - further information is contained in the Pests and Diseases Management Plan (Wardlaw 1990).

6. Extended sowing delay

Seed should be applied as soon as possible after burning and preferably before the first major rainfall. Seed that is sown onto burnt ground before rain is embedded into the soil surface. This improves the take-up of water by the seed and increases germination rates. Seed that is sown onto older seedbed sits on top of the soil surface and germination rates are lower. Good regeneration normally establishes when an adequate amount of seed of matched provenance is sown within a couple of weeks of seedbed preparation. However, when there is a considerable delay between seedbed preparation and sowing, poor regeneration may result. Compacted and unreceptive seedbeds, ant predation and desiccated germinants are the main causes. The field performance of seed is best monitored by regular inspection of the indicator plots.

Early burns (February-March) followed by late sowings (April-May) result in some loss of seedbed receptivity and may give the scrub a head start. The practice of spring burns or summer wildfires followed by autumn sowings has produced some particularly poor results. Seed sown late in the season may not germinate promptly and is subject to insect and fungal losses over winter prior to the onset of suitable germination conditions in spring.

7. Grass invasion

Grassy understoreys are associated with the rapid loss of receptive seedbed. Growth losses or mortality of young eucalypt seedlings is caused by competition for moisture, light and nutrients. Grassy understoreys may also lead to the development of a soil environment that is adverse to the growth of eucalypt seedlings (Ellis 1985). This problem is more pronounced on high, dry or cold sites.

Low altitude grassy understorey forests require broad scale soil disturbance and locally intense burning, as discussed in Technical Bulletin No. 3 (Lowland dry eucalypt forests). High altitude grassy understorey forests require a shelterwood system to maintain a forest environment, as discussed in Technical Bulletin No. 2 (*Eucalyptus delegatensis* forests).

8. Inappropriate silviculture

The application of the clearfell, burn and sow (CBS) technique to forests at high altitude or on harsh, dry sites may result in understocked forests. Appropriate silvicultural systems for such forests are discussed in Technical Bulletins 2 and 3.

9. Insufficient seed sown (see 12 for naturally sown coupes)

For aerially sown coupes, insufficient seed is generally the cause of understocking only when there is an operational problem. This may be the case when:

- the actual coupe area is larger than planned,
- there is a partial blockage in the sowing auger or slinger,
- all the allocated seed is not loaded into the hopper, or
- the laboratory germination rate was provisional at the time of seed allocation and the eventual test result was less than expected.

The fenced indicator plot is the best place to monitor germination and the establishment of seedlings. The plot should be sown at 50 times the aerial sowing rate and should have about 25 seedlings on each 2 m² plot. It would be reasonable to assume insufficient seed had been sown if there were significantly less than 25 seedlings and all other factors had been taken into account.

10. Loss of advance growth

Most advance growth should be retained undisturbed during second-stage harvesting operations such as seed tree or shelterwood removals. Some damage to the advanced growth is to be expected but should be minimised.

When the shelterwood is removed some seedbed will be created through machine movement. Where there is no natural seed source available, hand sowing of tracks in any understocked patches should improve the stocking. The loss of existing regeneration rarely warrants any other treatment.

11. Poor burn

Failure to achieve high proportions of receptive seedbed following high intensity burns on wet forest sites is a major cause of understocking and depressed growth. The 'ash bed' effect is considerable and favourable to eucalypt seedling regeneration. Eucalypt seed germinates and grows only on receptive seedbeds. Unburnt harvesting debris or established scrub is not receptive seedbed.

Alternative treatments such as mechanical clearing to create seedbed are very expensive.

12. Poor natural seedfall

Understocking may occur in partially harvested stands where receptive seedbed does not coincide with adequate natural seedfall. This problem can be minimised by careful assessment of seed crops (see Technical Bulletin No. 1, Eucalypt Seed and Sowing) and the use of supplementary artificial sowing where necessary to ensure that germination opportunities are maximised whilst the seedbed remains receptive.

13. Sowing problems

Operational difficulties may prevent the achievement of a uniform cover of seed at the correct rate. This may result in patchy establishment and poor regeneration survey outcomes. Current GPS technology should minimise the risk of operational problems but discretion must be used if sowing in windy conditions.

Seed may germinate but fail to develop to a stage hardy enough to survive the stresses of cold exposure and frost heave in winter. Prescriptions for sowing are detailed in Technical Bulletin No. 1 (Eucalypt Seed and Sowing). Problems with the timing of sowing and germination are best detected by careful monitoring of the indicator plots. Early detection of understocking will enable re-sowing options to be considered while sufficient receptive seedbed is available.

14. Unsuitable seed provenance

The use of off-site seed can result in poor regeneration stocking and longer-term problems of poor health and slow growth. This seed may be unable to cope with the localised climate at the new site and may not germinate, establish and grow at the same rate as genetically adapted local seed.

'Poor' seed is occasionally suspected as a cause of understocking. Current seed testing and storage procedures minimise the risk of problems due to low germination capacity. The field performance of seed is best monitored by regular inspection of the indicator plots.

15. Wildfire

Young eucalypt seedlings are killed by fires of even low intensity, although advance growth may recover from lignotuber, epicormic or coppice shoots. The survival of regeneration is related to age, height, species and the intensity of wildfire. Further information on the effects of fire and recommendations for the treatment of forests damaged by wildfire are contained in Technical Bulletin No. 11 (Silvicultural Use and Effects of Fire). It is recommended that seed be sown onto affected areas as soon as possible after the fire.

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