# New harvesting and site preparation treatments in dry eucalypt forests in Tasmania

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**Abstract**

*Two new harvesting treatments, strip-felling and clump retention, and one new site preparation treatment, excavator heaping, have been trialled by District staff in response to particular problems encountered in dry forest management. All the treatments are designed for use in dry E-3 (27–34 m tall) forests.*

*Strip-felling, when combined with good seedbed preparation and good seed crops, successfully established new regeneration, and the system could be applied to any of the lowland dry forests in northern and eastern Tasmania. Aesthetic considerations will be important—from the wrong viewpoint, the system may not deliver acceptable visual management outcomes. Clump retention is not recommended. Whilst moderately successful in terms of establishing regeneration, marking costs were excessive and the system is not considered to have any advantages over standard advance growth retention plus seed-tree systems.*

*Excavator heaping and winter burning is comparable to firebreak construction followed by low intensity burning in terms of costs, is successful in terms of establishing regeneration, and could be particularly useful where harvested coupes adjoin private land, as the risk of escapes is minimised and the need for 1080 to control browsing is reduced.*

*The three treatments are described here in detail, and the problems and benefits of each are discussed.*

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## Introduction

Dry eucalypt forests occur throughout northern and eastern Tasmania (Duncan and Brown 1985). The overstorey can include any of a large number of eucalypts and the understorey can be grass, heath, shrub or sedge dominated. Dry forests are typically very variable in structure and species composition, in response to site factors, including history (Forestry Commission 1991a). The dominant eucalypts, the understoreys, and geologies underlying each of the coupes discussed here vary and are described in more detail below.

*Harvesting and regeneration treatments in dry forests*

Traditional methods for harvesting dry forests are clearfelling and partial-logging systems, which include seed-tree retention, potential sawlog retention, advance growth retention and selective logging (Forestry Commission 1991a). Currently, clearfelling of dry forests is rarely recommended due to the wastage of pre-existing advance growth, problems with establishing regeneration, maintenance and protection of non-wood values and aesthetics (McCormick and Cunningham 1989). Partial-logging systems are applied to forests with particular structures; for example, stands with significant components of potential sawlogs or advance growth. The harvesting systems most commonly applied to dry forests in the past decade have been seed-tree retention and advance growth retention, which often occur as a mosaic within the one operation.


*Photo 1. Aerial view of the strip-felled coupe, Payanna 118. (Scale 1:23 000)*

The major problems with seed-tree retention systems are that, left to contractor management and without financial incentives, the retained seed trees are almost invariably of poor quality and the spacing is often erratic. In mixed-species forests, the ash group trees are usually taken and those retained are often peppermints. Where the timber quality is low, too many trees are left behind. Too high a stocking of retained cull quality trees results in subsequent suppression of regeneration and the remaining wood volumes are too low to sustain an economic second cut. Damage levels to retained seed trees have not been formally assessed but are often perceived to be unacceptably high. In response to these problems, two alternative harvesting systems have been developed.

Bass District (north-eastern Tasmania) trialled a *strip-felling system*, after it was noticed that eucalypt regeneration often established very successfully in the cleared strip beneath powerlines (hence the colloquial term for the system 'hydro-lining') (Photo 1). Strip-felling is not entirely 'new'. It has been practiced in Europe for many years (e.g. Troup 1928) and has more recently been applied experimentally in Victoria (Squire and Edgar 1975). In the Bass trial, harvested strips about two tree heights wide were alternated with retained strips of similar width. This system has been applied to two coupes, Moorina 102 and Payanna 118. The system was perceived as being cheap to supervise. The contractor was not required to judge which trees to retain and hence the problem of retention of poor quality trees would be resolved. Directional felling


*Photo 2. Aerial view of clump retention at Swanport 049. (Scale 1:17 500)*

resulted in the majority of fuels (heads) being in the centre of the strip and away from any patches of advance growth (which were few). Seedfall would come from trees in the retained strips and the harvesting disturbance and subsequent top-disposal burning would provide the necessary seedbed preparation.

Derwent District (south-eastern Tasmania) has trialled a *clump retention plus seed-tree system*, variations of which have been applied to three coupes, Swanport 049A and Tooms 033C and 033D (Photos 2, 3). Again, the system was perceived as being cheap to supervise. The contractor was not required to judge which trees to retain. Seed trees and trees in the retained clumps would provide seed and the harvesting disturbance and subsequent top-disposal burning would provide the necessary seedbed preparation.

*Post-harvesting fuel management*

In partially harvested dry forests, the most commonly applied post-harvesting fuel management tool is top-disposal burning. When successfully applied, top-disposal burning is an effective means of reducing the flashy fuels which arise during harvesting, and creating receptive seedbed. When unsuccessfully applied, top-disposal burning can result in inadequate seedbed preparation where the fire is too cool. Alternatively, where the fire is too hot, it may result in escapes and / or excessive levels of damage to retained trees, including advance growth. Top-disposal burning can also result in loss of existing

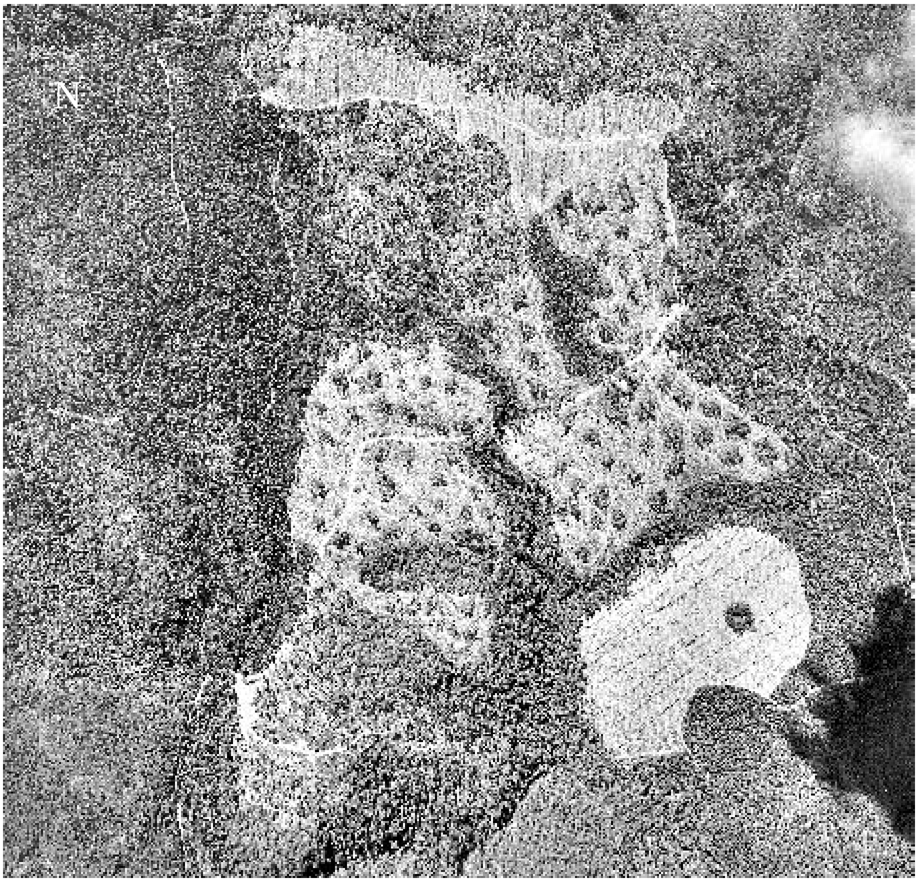


*Photo 3. Aerial view of clump retention at Tooms 033C and 033D. (Scale 1:22 000)*

regeneration, and seed stored in or under heads may be destroyed.

Mersey District (northern Tasmania) manages large areas of State forest in close proximity to private land where escapes from regeneration burns are particularly problematic. The District has developed an alternative post-harvesting fuel management system known as *excavator heaping*. A small (12–15 tonne) excavator is used to pile heads and other fine fuels into heaps which subsequently can be burnt under very mild conditions and which are often burnt in winter (Photo 4).

**CASE STUDY 1. Strip-felling—Payanna 118 and Moorina 102**

The strip-felled coupes occur on Tertiary outwash gravel derived from Devonian granite and the soils are mostly well-drained gravelly loams. The overstorey is dominated by *Eucalyptus obliqua, E. viminalis* and *E. amygdalina*. The understorey is dominated by saggs (*Lomandra longifolia*) and bracken but also includes a range of shrubs, heath species and grasses. Gentle slopes predominate.

Both coupes were marked with flagging tape into parallel strips of approximately 50 m width (roughly twice tree height), separated by retained strips of similar width. Initially both sides of each strip were marked but as the contractor became more confident with the method, the centre line only was marked and the contractor worked to approximately one tree height either side of the marked line. Within each strip, all mature trees were felled. Where possible, existing clumps of advance growth were

*Photo 4. Heaps built by the excavator, ready for winter burning.*

retained undisturbed. The retained strips can be harvested in a second cut, once the regrowth is carrying sufficient seed to act as a seed source for the regeneration. Wherever possible, the major snig track was placed to one side of the harvested strip, so that in the future when the retained strip was being harvested the original snig track could be re-used, thus minimising the amount of soil compaction on the coupe and the amount of damage to established regeneration.

Top-disposal burning and natural seedfall from the retained trees were used as the regeneration treatment in both coupes. At Moorina 102, the bark heaps and landings were all well burnt and there was little evidence of head material in the strips so it is assumed that the burning was effective. At Payanna, the burning was undertaken in two stages. The first areas harvested were burnt in October/November 1993 under quite dry conditions, with some scorch, producing a reasonable seedbed (referred to hereafter as the first section). The areas harvested later were all burnt in May 1997 under quite moist conditions (referred to as the second section). In the first section, the fire 'ran' to some degree (i.e. ground layer vegetation and litter burnt freely and helped spread the fire) whilst, in the second, only a patchy burn was achieved (Sean Blake, pers. comm.).

Regeneration surveys of both coupes were conducted on the 10th and 11th of September 1998, 16 months after completion of burning on the site. In order to achieve a more comprehensive assessment of the distribution and stocking of the regeneration than would have been achieved using straight line surveys, each strip was surveyed on a zig-zag system, at ± 45° to the centreline of the strip, with survey points at 20 m intervals (Figure 1). This equates to about 9 plots/ha compared with standard regeneration surveys at 5 plots/ha. Approximately one third of the coupe was surveyed. In future strip-felling regeneration surveys, every second strip should be surveyed; in this instance, the aim was to sample each section of the coupe and this was achieved.

During the regeneration surveys, at each turning point (i.e at each side of the felled

*Table 1. Regeneration survey results from the strip-felling and clump retention coupes.*

| Coupe | Harvesting system | Percentage of coupe mapped as stocked | Tasmanian stocking standard achieved?[1] | 16 m$^2$ stocking in whole coupe (%) | Victorian stocking standard achieved?[2] |
|---|---|---|---|---|---|
| Moorina 102 | Strip-felling | 100 | yes | 83 | yes |
| Payanna 118 (1st section) | Strip-felling | 88 | yes | 73 | yes |
| Payanna 118 (2nd section) | Strip-felling | 14 | no | 10 | no |
| Tooms 033C | Clump retention | 92 | yes | 60 | no |
| Tooms 033D | Clump retention | 85 | yes | 55 | no |
| Swanport 049A | Clump retention | 92 | yes | 65 | yes |

[1] The Tasmanian standard is 80% of the coupe mapped as stocked, assessed on a 100 m x 20 m grid.

[2] The Victorian standard is 65% of 16 m$^2$ plots stocked, assessed on a 80 m x 20 m grid or 55% of 16 m$^2$ plots stocked, assessed on a 40 m x 20 m grid.

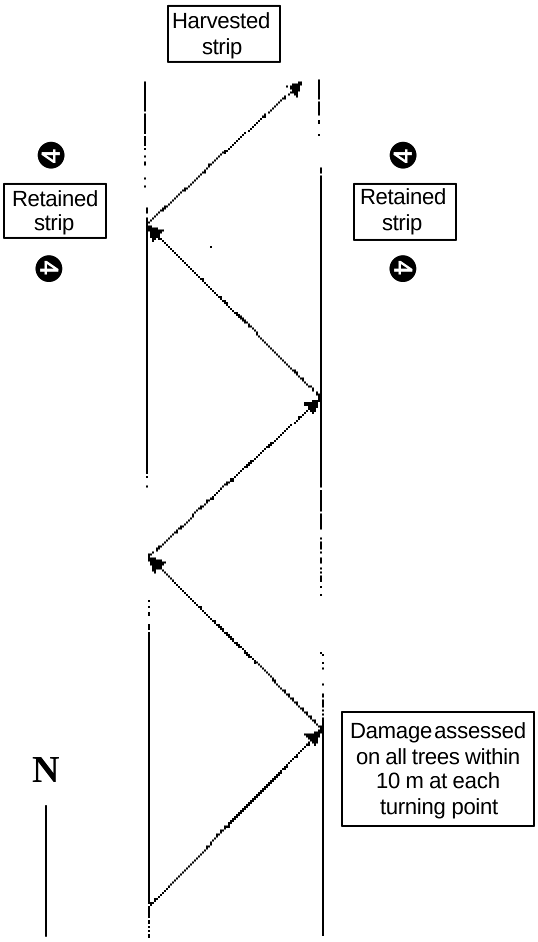


*Figure 1. Zig-zag method used for regeneration surveys at Payanna 118.*

strips) all trees greater than 10 cm DBHob within 10 m were assessed for crown and bark damage arising from the harvesting; assessed trees were therefore predominantly edge trees, on which damage would be more likely than on trees in the centre of the retained strips. Over the two coupes, 733 trees were assessed for harvesting damage.

## Results

The regeneration survey results (Table 1) clearly demonstrate the importance of good seedbed preparation. Moorina 102 and the first section of Payanna 118 were both burnt successfully and have both regenerated successfully (Photo 5), whereas the second section of Payanna 118 has failed. The failure may have been due to a lack of receptive seedbed, a lack of seed, mammal browsing or a combination of these factors. The first section of Payanna 118 and the Moorina coupe both regenerated successfully, which suggests that seed was available and that browsing was not a problem. It seems that the lack of receptive seedbed in the second section, arising from the poor top-disposal burning, is the most likely cause of the failure.

Damage levels to the retained trees were very low. Crown damage was recorded from

*Photo 5. Advanced growth, seedling regeneration and fenced indicator plot at Payanna 118. Retained strips are at the left and at the far right background of the photo.*

less than 5% of the retained trees and stem damage (usually in the form of bark scrapes) from less than 4% of the retained trees.

### CASE STUDY 2. Clump retention plus seed tree—Swanport 049A, Tooms 033C and Tooms 033D

Swanport 049A is on sandstone and light sandy soils occur throughout. The overstorey is a mix of *Eucalyptus obliqua, E. amygdalina* and *E. viminalis,* with occasional *E. ovata* in poorly drained areas. The understorey is dominated by bracken and saggs but also includes a range of heath species and occasional wattles. Rushes and cutting grass dominate in poorly drained areas. The coupe had been heavily cut-over in the past for sawlogs, posts and firewood. The coupe was adjacent to a major road and the harvesting prescription was designed to minimise the visual impact whilst returning the forest to a more productive condition.

Tooms 033C and 033D are on dolerite. The eucalypt overstorey comprises *E. delegatensis, E. obliqua, E. pulchella,* occasional *E. globulus,* and *E. ovata* in poorly drained areas. The understorey was dominated by 'short pricklies' (Epacridaceae), bracken, blanket bush, wattles and banksias.

At Swanport, the coupe was divided into three sections and a slightly different prescription applied to each section. Clumps of varying sizes and at varying spacings were retained. At the wider spacing of clumps, seed trees were retained about two tree heights apart. At Tooms, clumps of 30 m diameter were marked at a maximum of two tree lengths apart. At Swanport, after initial close supervision, the faller marked the clumps as he went. The costs of marking the clumps are not known.

The regeneration treatment in both coupes comprised top-disposal burning, with reliance on natural seedfall. A seed-crop assessment was undertaken at Tooms, which showed that seed crops before harvesting were small. No seed-crop assessment was undertaken at Swanport.

Regeneration surveys (stocking standard D) were undertaken in all three coupes. Tooms 033C and 033D were surveyed as described in Technical Bulletin 6 (Forestry Commission 1991b), with survey points at 100 m by 20 m. Swanport 049A was surveyed at half the prescribed density of strips. A subsequent part survey of Swanport 049A was undertaken which confirmed the results of the first survey.

### Results

The regeneration survey results (Table 1) show that the clump retention system has worked satisfactorily, although the 16 $m^2$ stocking in all coupes is at the low end of the scale. The *Forest Practices Code* (Forest Practices Board 2000) has included the Victorian stocking standard of 65% of 16 $m^2$ plots stocked as an alternative to the Tasmanian standard of 80% of the coupe mapped as stocked, as the Tasmanian mapping rules can cause confusion to inexperienced users. By the Victorian standard, the Tooms coupes are under-stocked and the Swanport coupe just meets the standard. The stocking at Tooms has almost certainly been influenced by the lack of seed, identified in the seed-crop assessment undertaken prior to harvesting. Lignotuberous seedlings, which were established prior to harvesting, were a significant part of the regeneration in all coupes. There was no noticeable difference in the regeneration between the three sections of the Swanport coupe—all were moderately well stocked.

## CASE STUDY 3. Excavator heaping

In Mersey District, fuels in partially harvested dry forests are being managed after harvesting using excavator heaping. A small (15 tonne) excavator, with a log-grab head, is brought into the coupe after harvesting is completed and fuels are collected into heaps, the spacing and placement of which is determined by the reach of the excavator. No other fire management activity, such as the preparation of fire-lines around the coupe, is required. The heaps can be lit at most times of the year—typically they are lit during winter, when District resources are least stretched with other work. Where possible, firewood logs are placed beside existing tracks because this reduces the impact of woodcutters on existing and developing regeneration.

Excavator heaping is being used in a range of forest types, from high altitude *E. delegatensis* forests to low altitude, mixed-species dry forests. The coupes examined for this study were all mixed-species lowland forests comprising an overstorey of *E. obliqua, E. amygdalina, E. viminalis,* occasional *E. globulus* and with *E. ovata* commonly present in poorly drained areas. The understoreys throughout were dominated by bracken and saggs with occasional shrubs. Soils are generally shallow loams over sedimentary parent materials.

### Results

The average cost of excavator heaping of $215/ha is based on recent experience from 16 coupes, using a 15-tonne excavator requiring approximately 4 hrs/ha. This cost compares favourably with costs for low intensity burning (Table 2). As discussed below, reducing the thoroughness of the current operator (i.e. spending less time per hectare) will further reduce costs.

Early regeneration surveys of three coupes were undertaken in order to gauge the success of excavator heaping as a regeneration tool. The surveys were undertaken at age 18 months whereas regulation regeneration surveys in partially harvested dry forests are undertaken at age two years; therefore, these results are preliminary and can be expected

*Table 2. Comparative costs for post-harvesting treatments.*

| | Excavator heaping ($/ha) | Top-disposal burning($/ha) |
|---|---|---|
| Fire-line construction | 0 | 60–160 |
| Excavator heaping | 215 | – |
| Burning | 15 | 60 |
| Seed and sowing | 0 | 0 |
| **Total** | **230** | **120–220** |

to improve. Two of the three coupes were mapped as greater than 80% stocked, which satisfies the current stocking standard (Forestry Commission 1991b). The third coupe was mapped as only 64% stocked. However, the surveyor noted that the bulk of the coupe was in fact well stocked, but that a lower, flatter and (at the time of survey) waterlogged section was very poorly stocked. It is expected that, following another summer, the stocking of this area will improve and this will be verified by resurveying the area. The results of the surveys confirm the visual impression that the coupes are in general well stocked, even at 18 months after treatment.

## Discussion

*Strip-felling*

The perceived benefits of strip felling over seed-tree retention are that strip felling requires less supervision, there is less damage to the retained trees, the contractor does not need to continually decide which trees to retain, and the retained strips provide a diversity of seed and a degree of protection for the regeneration from wind. In the event of a wildfire in subsequent years, the retained trees may provide seed to regenerate the coupe following the fire. As 50% of the wood volume has been retained on the coupe, a second cut will be economic. The second cut can take place any time after the regrowth in the harvested strip is carrying sufficient seed.

Where the top-disposal burning was conducted successfully, the system has worked very well and has produced a good result with minimal supervision. Where the top-disposal burning was poor, the regeneration is also poor, and remedial treatments to improve the stocking in these areas will be required. One possibility for remedial treatment would be to mechanically scarify the unregenerated strips and either sow artificially or use natural seedfall if a good seed crop is known to be present.

Damage levels to the trees in the retained strips were very low. Because each strip is completely felled, the need to snig logs past retained trees, as is the case in seed-tree operations, is greatly reduced. The low levels of damage to the retained trees are another positive outcome of the system. Occasional stems were windthrown, particularly on shallow soils on ridges; this is to be expected in partial-harvesting operations and the number lost was not large.

Future harvesting of the retained strips will be problematic because, in the second harvest, there will need to be habitat clumps retained in the coupe, and the harvesting will have to work around these clumps. If the habitat clumps had been planned before the first harvest, this problem would have been reduced. This is not seen as insurmountable and the strip-felling technique is a potentially useful method for working in these forest types. (Note: When the coupe was first planned, habitat clumps were not part of the *Forest Practices Code*).

If strip-felling is undertaken in the future, the strips should be at least two tree heights wide (because most seed falls within two tree heights of the parent tree (Cremer 1966)), and roughly at right angles to the direction of the prevailing wind. Suppression of eucalypt regrowth by retained trees has been documented for a number of eucalypt species (e.g. *E. sieberi,* Incoll 1979; *E. diversicolor* (karri), Rotheram 1983; *E. delegatensis*, Ellis 1994), and the large edge effects in strip-felled coupes means that there will be some suppression of the regeneration. Strips of at least two tree heights in width will still receive sufficient natural seedfall, given that there are retained trees on both sides of the felled strip, and will minimise the suppressive effect of the retained trees. Narrower strips are likely to result in heavy suppression of the regeneration.

*Clump retention with seed trees*

Clump retention was developed in response to the same problems that resulted in the development of strip-felling, and the perceived benefits are similar; the contractor does not need to continually decide which trees to retain and the retained clumps and seed trees provide a diversity of seed and maintain the aesthetics of the site. However, the need for extensive marking or close supervision of the faller does not support the stated intention of reducing the costs of supervision. Individual seed trees could be marked at an appropriate spacing across a coupe in less time than it would take to mark out each clump. In the Swanport coupe, the contractor marked out the clumps, but if this could be achieved satisfactorily then so could the marking and retention of seed trees. The wood that has been retained in the clumps represents lost revenue because there is not sufficient volume for an economic second cut and it could not be recovered without significant damage to the regeneration. That the coupe is adequately regenerated, including those areas where seed trees were retained between widely spaced clumps, indicates that the faller was able to select seed trees satisfactorily and contradicts the stated problem that the contractor was unable to decide which trees to retain.

*Excavator heaping*

The costs of excavator heaping compare very favourably with those for top-disposal burning (Table 2). When the other advantages of the system are taken into account, the system obviously has good potential for general use. The heaps can be burnt in winter, which minimises the risk of escape and is the time of year when the District resources are least stretched. There is rarely a need to build firebreaks around the coupe, which has ecological as well as financial benefits because there is less soil disturbance and hence less opportunity for weed invasion or soil erosion, especially as the firebreaks are often around streamside reserves. Advance growth is protected from the fire, slash seed is conserved, browsing pressure is reduced because there is plenty of other feed (the coupe not having been burnt), wildlife habitat strips and streamside reserves require no additional protection and are in no danger of being burnt, and the local woodcutters have ready access to firewood. Once the operators have been trained in undertaking the work, supervision costs are minimal. It would be very difficult at current production levels to top-disposal or broadcast burn all the advance growth retention coupes, in which excavator heaping is currently being applied, given the limited number of suitable days each autumn and the demands that are placed on helicopters at that time, when aerial sowing is also a priority.

The main criticism of the excavator heaping that has been done to date is that the operator is too thorough. At some of the coupes that were inspected, virtually all the logging slash, including heavier material, had been heaped. If all the debris on the forest floor is heaped, the natural caging effect that retained slash can provide (Orr 1991) is lost, as is the micro-site protection for germinants and cover for invertebrates and small animals. Less enthusiastic heaping will also be cheaper. A rule-of-thumb aim for top-disposal burning sometimes quoted is ‘to remove three-quarters of the fuel from three quarters of the area’. This seems a sensible target for

*Table 3. Advantages and disadvantages of the range of harvesting systems used in dry forests.*

| Harvesting system | Advantages | Disadvantages |
|---|---|---|
| Clearfelling, burning and sowing | Low supervision costs | Loss of advance growth<br>Problems with regeneration on difficult sites<br>Poor aesthetics<br>Higher costs<br>Non-wood values diminished |
| Seed tree / advance growth retention | On-site seed<br>Conservation of growing stock | Seed trees of poor quality<br>Poor spacing of retained trees<br>Preferred species removed<br>Less preferred species retained<br>Culls retained<br>Suppression of regrowth<br>Damage to retained trees |
| Strip felling | Low supervision costs<br>Low damage to retained trees<br>On-site seed<br>Conservation of growing stock | Habitat clump management<br>Aesthetics<br>Suppression of regrowth<br>Damage during second harvest |
| Clump retention | Aesthetics<br>On-site seed<br>Conservation of growing stock<br>Structural diversity | Higher supervision costs<br>Uneconomic second harvest |

excavator heaping, which should aim to move fuel that is immediately adjacent to patches of advance growth and to heap mainly the fine flashy fuels—the heavier material provides natural mulch, micro-sites for germination and contributes little to the fire risk.

## Conclusions

Partial-harvesting systems that retain on-site seed and advance growth, that prepare receptive seedbed and follow-up with browsing animal monitoring and control where required, are unlikely to fail. Both the systems described above (strip-felling and clump retention) were successful in terms of reaching stocking standards, although the second section of Payanna 118 will need further attention.

Strip-felling is potentially suitable for the north-eastern lowlands, where there are extensive areas of lower quality forest on gentle topography, where the strips could easily be marked. Pre-planning of habitat clumps would simplify the need to work around the habitat clumps in the future. Retention of roadside and seen-area buffers would reduce the visual impact that could be created if strips were cleared up to roadsides (or up hillsides in significant landscapes, where it would produce unacceptable visual landscape outcomes).

Clump retention with seed trees is not considered to be a significant improvement compared to traditional seed-tree systems. Marking costs were high. Aesthetically, the clumps are pleasing and they contribute to the maintenance of structural diversity

*Table 4. Advantages and disadvantages of the range of regeneration treatments used in dry forests.*

| Regeneration treatment | Advantages | Disadvantages |
|---|---|---|
| High intensity burning and sowing | Useful in steep country (cable coupes), where mechanical disturbance is not an option | One-off opportunity for success |
| Top-disposal burning | Ongoing seedfall<br>On-site seed | Some loss of slash seed<br>Some loss of seedlings<br>Fire damage to retained trees<br>Fire damage to advance growth<br>Risk of escape |
| Excavator heaping | Low supervision costs<br>Ongoing seedfall<br>On-site seed<br>Slash seed retained<br>No seed or seedlings burnt in regeneration burn<br>No need for fireline clearing<br>Little risk of escape<br>Firewood out to tracks<br>Burning window greatly extended | Some loss of natural caging effect of retained slash<br>Loss of invertebrate habitat<br>Loss of micro-site protection for germinants |

on the coupe but the same result could be created by the judicious placement of habitat clumps and roadside screens. Significant volumes of wood have been retained on the coupe that cannot be harvested in a second cut without significant damage to the regeneration. The volume of wood retained is not sufficient for a commercial harvest. Habitat clumps are retained at a wider spacing (200 m) than the clumps retained in these coupes (100 and 160 m), and hence less commercial wood would have been retained.

Excavator heaping followed by winter burning shows promise as a management tool, particularly in those areas of State forest that are surrounded by private land and where the risk of fire escapes onto private land is unacceptable. As the cost is comparable to that of firebreak construction and top-disposal burning, excavator heaping could be used wherever top-disposal burning is currently applied.

The advantages and disadvantages of the range of available options for harvesting and regenerating dry forests are summarised in Tables 3 and 4. In most lower quality dry forests, partial harvesting, comprising a mix of advance growth and seed-tree retention, followed by excavator heaping and winter burning or top-disposal burning, is usually the best option.

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