An economic evaluation of harvesting, scrub-rolling and fencing options in blackwood swamps

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Abstract

The economics of treating blackwood swamp coupes that include a mosaic of stocked and understocked areas were examined using two recent coupes as case studies. The treatment options were to log and leave; clearfell and fence the best patch; or use scrub-rolling of understocked areas to maximise the area of fenced regeneration.

At discount rates less than 3%, the additional benefits of future harvest revenues far exceeded the costs of scrub-rolling or fencing. At rates between 3% and 5%, the investment picture was less clear, and coupes need to be evaluated on a case by case basis, examining the relationship between establishment costs and future revenues gained. At rates greater than 5%, future revenues are virtually insignificant. On a purely commercial basis, fencing or scrub-rolling would only proceed where the additional revenue from the scrub-rolled area is expected to be greater than the establishment costs.

Introduction

About 6500 ha of blackwood swamps on State forest in north-western Tasmania are being managed for sustainable blackwood sawlog production under the Swamp Working Circle (Forestry Tasmania 2000). Since the 1970s, various silvicultural treatments have been applied to the swamps, ranging from selective logging with no regeneration treatment to clear-felling, burning and fencing (Jennings *et al.* 2000). All treatments rely on regeneration from ground-stored blackwood seed germinated by logging disturbance or fire (Forestry Commission 1991; Wilkinson and Jennings 1994).

Jennings *et al.* (2000) found that browsing control was critical for regeneration success, and that the burnt and fenced treatments were among the most successful. However, adequate disturbance for regeneration can be provided by the harvesting operation alone (Wilkinson and Jennings 1994) and it is not essential to burn a blackwood coupe for regeneration purposes. Slash burning in swamps was largely discontinued as a disturbance treatment in the mid 1990s as a result of biodiversity issues, particularly the retention of rainforest plant species, raised by Pannell (1992) and Duncan *et al.* (1994). The current silvicultural systems usually applied to swamps are to clearfell and fence blackwood wet sclerophyll forest or to partially log and fence blackwood mixed forest, with retention of most of the non-commercial rainforest overstorey.

Blackwood stocking in the swamps is extremely variable, ranging from almost nothing to more than 250 mature stems per hectare. In coupes where blackwood stocking is low and the resulting harvest disturbance is light, non-commercial scrub-rolling may be required to produce suitable regeneration conditions. Scrub-rolling can also be used to improve fencing boundaries. An economic comparison of

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combinations of harvesting, scrub-rolling and fencing options is presented in this paper to help forest managers determine optimum treatments for swamp areas being regenerated to blackwood.

Methods

In order to assess the effects of economics on silvicultural options, case studies were based on two recent swamp coupes (logged during 1999 and 2000) where costs and revenue figures are available. Future volumes and revenues were estimated. A spreadsheet-based economic model was developed to calculate the net present value (NPV) of the different scenarios applied to each coupe.

A key assumption was that blackwood sawlog volumes less than 20 m^3/ha could not be commercially harvested under present conditions. Current stumpage rates were used and a rotation length of 70 years was assumed for each scenario. Scrub-rolling costs of $300/ha and fencing costs of $5500/km were used. Other assumptions upon which this model is based are shown in Appendix 1. A range of real (net of inflation) discount rates, from 2% to 10%, was used.

The two coupes were at either end of the range of blackwood volumes expected from swamp coupes. SR 107B was a 16 ha coupe with high volumes of even-aged blackwood. Harvesting of this area resulted in a clearfelled coupe with a poor shape for fencing due to the exclusion of a 3 ha patch of unstocked blackwood forest from within the coupe. This coupe produced 175 m^3/ha of blackwood sawlog and 140 m^3/ha of pulpwood from the harvested area.

SR 004D was a 35 ha coupe with lower volumes of blackwood distributed through myrtle/sassafras forest with patches of tea-tree. Harvesting of this area resulted in a series of small, linked, clearfelled patches. The harvested area had poorly defined boundaries, with a very poor shape for fencing. This coupe produced 95 m^3/ha of blackwood sawlog and 60 m^3 pulpwood/ha from the harvested area.

The scenarios examined for SR 107B were:

Log and leave (Figure 1a): The coupe area was 16 ha, but only 13 ha were harvested, leaving a 3 ha patch intact. No regeneration treatment was carried out. The future crop on this area will not meet stocking standards because of browsing by mammals, and future revenue will be compromised.

Best-patch fencing (Figure 1b): The coupe area was 16 ha, but only 13 ha were harvested, leaving a 3 ha patch intact. Due to a perimeter shape poorly suited to fencing, it was only considered feasible to fence 9 ha of the harvested area. The fenced area will become fully stocked at time of harvest and future revenue maximised, but an area of 4 ha remains unfenced and future revenue from this area will be compromised.

Maximum-area fencing (Figure 1c): The coupe area was 16 ha but only 13 ha were harvested. The remaining 3 ha were scrub-rolled. The coupe shape was improved with the full 16 ha now suitable for fencing. The whole coupe will be fully stocked and future revenue maximised.

These scenarios were analysed with and without an additional blackwood volume salvaged from the scrub-rolled area, to reflect different operational conditions that may exist. Harvest volumes were assumed as 20 m^3/ha blackwood sawlog and 60 m^3/ha pulpwood.

The scenarios examined for SR004D were:

Log and leave (Figure 2a): The coupe area was 35 ha, but only 16 ha were actually harvested, leaving 19 ha intact. No regeneration treatment was carried out. The future crop on this area will not meet stocking standards because of browsing pressure and future revenue will be compromised.

Best-patch fencing (Figure 2b): The coupe area was 35 ha, but only 16 ha were harvested. The harvested area was 'squared

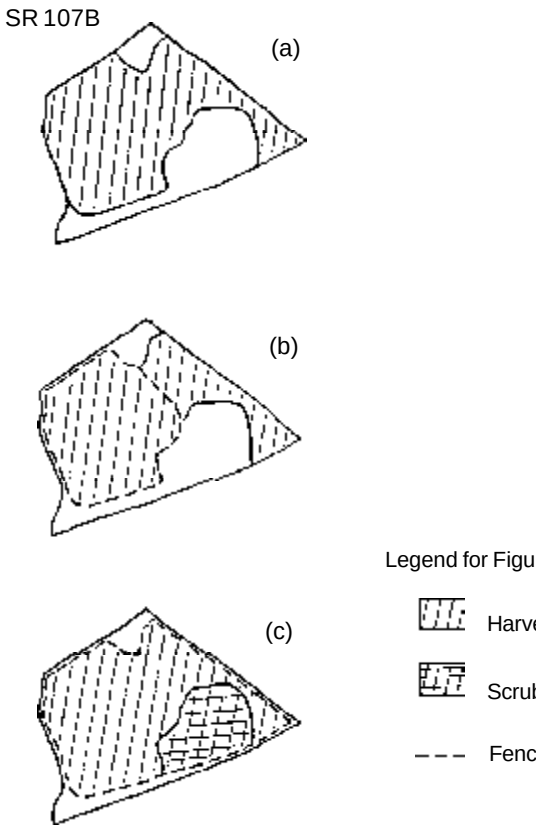

Figure 1. (a) Log and leave, (b) best-patch, and (c) maximum-area scenarios for SR 107B.

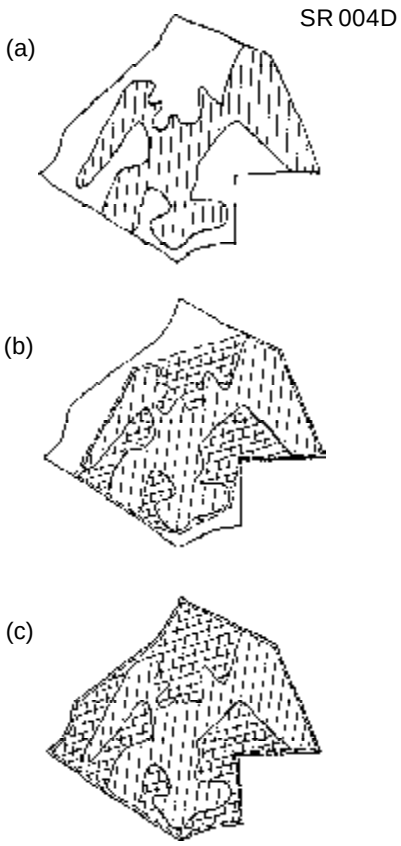

Figure 2. (a) Log and leave, (b) best-patch, and (c) maximum-area scenarios for SR 004D.

off' by scrub-rolling an additional 10 ha, producing an area of 26 ha which was considered feasible to fence. The fenced area will be fully stocked and future revenue maximised, but an area of 9 ha remains undisturbed and unfenced. The future revenue from this area will be minimal.

Maximum-area fencing (Figure 2c): The coupe area was 35 ha but only 16 ha were harvested. The remaining 19 ha were scrub-rolled. The coupe shape was improved with the full 35 ha now suitable for fencing. The whole coupe will be fully stocked and future revenue maximised.

These scenarios were run with and without an additional volume salvaged from the scrub-rolled area of 10 m^3/ha blackwood sawlog and 30 m^3/ha pulpwood.

Results

The NPV arising from the three treatment options, with and without additional revenue from recovery of timber from scrub-rolled areas, is presented for each coupe.

Coupe SR 107B

A. *No revenue from scrub-rolling (Figure 3)*

For discount rates up to 3.5%, the dominant economic influence is the revenue expected from the future blackwood crop, so the best option is 'maximum-area fencing'. At higher discount rates, the effect of discounting on the future revenue results in the 'log and leave' treatment becoming the best economic decision. However, 'log and leave' is not an acceptable option because Forestry

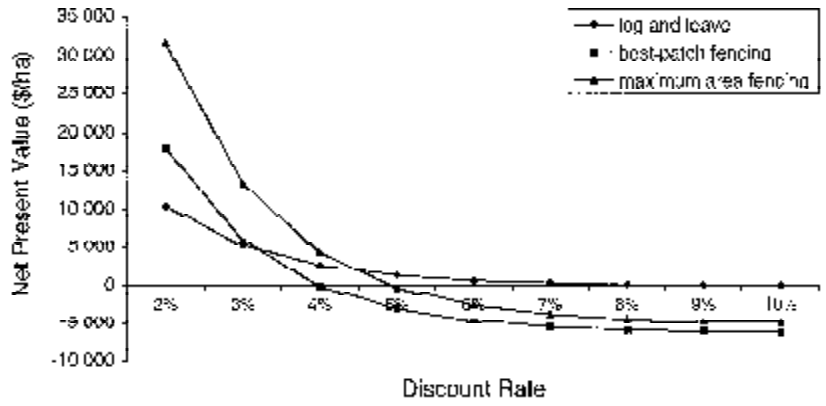

Figure 3. Net present value scenarios for SR 107B – no additional revenue from scrub-rolling.

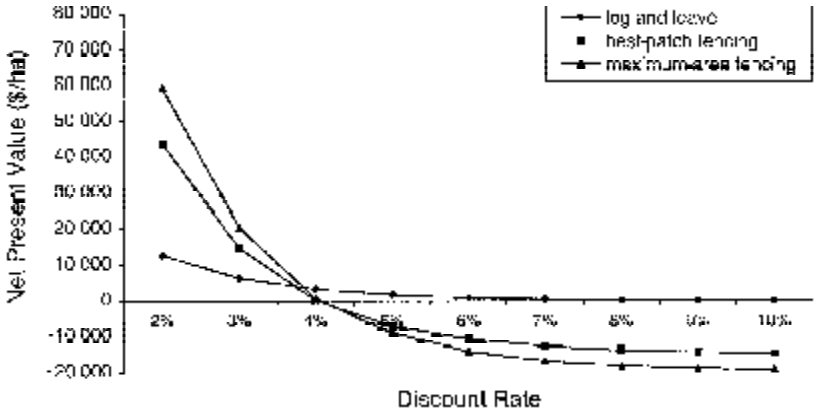

Figure 4. Net present value scenarios for SR 107B – additional revenue from scrub-rolling.

Tasmania is committed to regenerating native forests after harvesting. Therefore, at discount rates above 4%, the best option becomes 'best-patch fencing' with no additional scrub-rolling. Beyond 4%, both alternatives are producing a negative return.

B. *Additional revenue from scrub-rolling (Figure 4)*

The ability to market timber from scrub-rolling does not affect the 'log and leave' and 'best-patch fencing' options because they do not involve scrub-rolling. However, 'maximum-area fencing' produces additional revenue and now remains the preferred option for discount rates up to 4.5%. This is because revenue from additional volume salvaged from the scrub-rolled area reduces the net cost at establishment and therefore favours this option. Under the assumed volumes produced from the scrub-rolled area, this option remains a marginally better option than 'best-patch fencing' at higher interest rates, even though both strategies produce a negative NPV beyond the 5% rate.

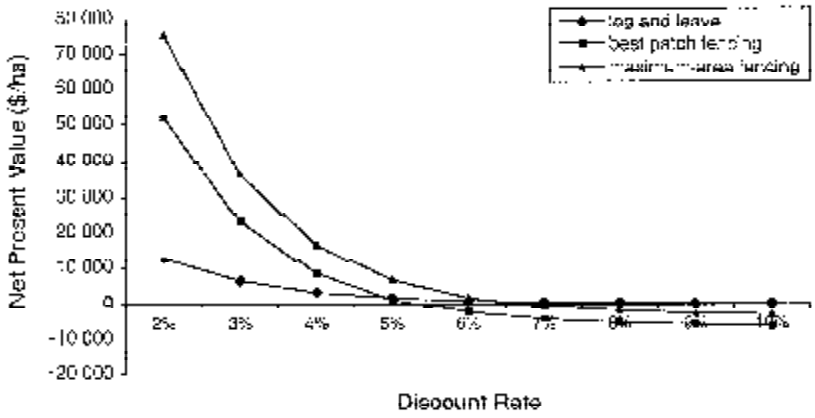

Figure 5. Net present value scenarios for SR 004D – no additional revenue from scrub-rolling.

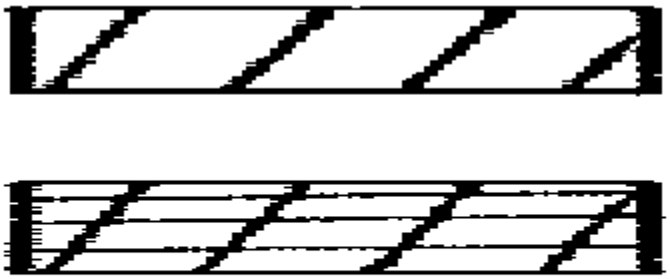

Figure 6. Net present value scenarios for SR 004D – additional revenue from scrub-rolling.

Coupe SR 004D

A. *No revenue from scrub-rolling (Figure 5)*

'Maximum-area fencing' is the best option up to a discount rate of 4%. At higher rates the 'log and leave' treatment becomes the best economic option. However, as with the previous coupe, a 'do-nothing' approach is not considered a viable silvicultural option. Therefore, at higher discount rates (> 4.25%), the preferred option becomes 'best-patch fencing' with minimal additional scrub-rolling. However, beyond 4%, both alternatives are producing a negative return.

B. *Additional revenue from scrub-rolling (Figure 6)*

The ability to market timber from scrub-rolling does not affect the 'log and leave' option as it does not involve scrub-rolling. However, both of the alternatives produce additional revenue from scrub-rolling and become more attractive. 'Maximum-area fencing' now remains the preferred option for discount rates up to 6.5% because the

revenue from additional volume salvaged from the scrub-rolled area is almost enough to offset the costs of the scrub-rolling and fencing. Beyond 6.5%, both alternatives are producing a negative return; 'maximum-area fencing' remains a better option than 'best-patch fencing'.

Discussion

The costs of blackwood regeneration treatments in the swamps vary widely depending on the size and shape of the coupe and the level of blackwood stocking before harvest. Fencing is an expensive treatment and has a requirement for reasonably straight coupe boundaries for the fence line. The economics of fencing are also very sensitive to the area/perimeter ratio (Jennings and Dawson 1998).

Scrub-rolling is a useful method of maximising the opportunity for blackwood regeneration in understocked patches within or adjacent to areas of commercial blackwood harvesting. It can be used to 'square up' the boundaries of coupes to increase their suitability for fencing and future yield, while simultaneously reducing the unit cost per hectare of fencing. Scrub-rolling in conjunction with commercial harvesting reduces the cost per hectare, as much of the required disturbance is created during the harvesting operation.

When evaluating the economic merits of blackwood regeneration treatments for understocked areas, the relative importance of the initial establishment costs (scrub-rolling and fencing) and future revenues are extremely sensitive to the discount rate used. At discount rates less than 3% p.a. in the scenarios examined, the additional benefits of improved future harvest revenues exceed the costs of scrub-rolling or fencing. This option becomes even more attractive where some additional volume (either sawlog or pulpwood) can be salvaged from any scrub-rolled area.

If discount rates of 3–5% are used, the picture is less clear, and coupes need to be evaluated on a case by case basis, examining the relationship between establishment costs and future revenues which may be gained. If discount rates greater than 5% are used, then the decision making is dominated by the relationship between the establishment costs and current revenues, as the impact of discounting on the future harvest revenue makes this virtually insignificant. On a purely commercial basis, at discount rates of greater than 5%, fencing or scrub-rolling would only proceed where the additional revenue from the scrub-rolled area is expected to be greater than the establishment costs.

As blackwood swamps are not suitable for conversion to plantations of fast-growing tree species, the return from blackwood swamps can be compared to standard unfenced regeneration of native eucalypt forest. Blackwood swamp investment is equivalent to, or better than, long-rotation native forest investment, which generally gives internal rates of return between 2% and 4%.

In times of merchantability of less favoured pulpwood species, it will be possible to extend harvesting into areas of low sawlog volume with saleable pulpwood. Such areas may need to be assessed, prior to treatment, for ground-stored blackwood seed supply if the pre-logging density of blackwood trees is very low. Where areas suitable for scrub-rolling are within or adjacent to areas being commercially harvested, this increases the likelihood that the area will have adequate ground-stored seed.

Scrub-rolling should not be used without fencing as a treatment for blackwood regeneration. Without effective browsing control, most of the seedling regeneration will be browsed (Jennings *et al.* 2000) and despite the financial investment, the area will not meet stocking standards.

Acknowledgements

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Appendix 1. Assumptions for economic modelling of net present values of 'log and leave', 'best-patch fencing' and 'maximum-area fencing' scenarios for SR 107 B and SR 004D.

Scrub-rolling costs	\$300 / ha
Fencing costs	\$5500 / km
Blackwood sawlog stumpages	\$60 / m^3 for category 4 \$30 / m^3 for utility log \$15 / m^3 for below specification log
Blackwood sawlog proportions	60% category 4 20% utility log 20% below specification log
Pulpwood stumpage	\$7.80 / t
Rotation length	70 years
Yield at rotation length	200 m^3 / ha for fenced regeneration 70 m^3 / ha for unfenced regeneration