Revegetation of construction sites at Mount McCutcheon in south-western Tasmania

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Abstract

Several sites near Mount McCutcheon in south-western Tasmania were rehabilitated after road construction was halted in 1983. To augment natural revegetation, a seed-mix was broadcast with fertiliser on the disturbed areas in 1984. Three assessments of the revegetation have been made in the following 10-year period. There have been changes in species composition but pioneer species still dominate the site in year 10. Data on early growth rates and density are presented for selected species.

Introduction

The proposed Gordon-below-Franklin Power Scheme in south-western Tasmania required the construction of an access road from Queenstown to the dam site. In 1983, this road had reached the vicinity of Mount McCutcheon when a High Court decision halted the project. A programme to rehabilitate the areas disturbed by roadworks was initiated following cessation of the project.

Cartwright (1988) assessed the revegetation at Mount McCutcheon in 1986 and 1988. The aims of his study were to decide whether the sites had revegetated satisfactorily, whether treatments were effective and whether further treatment was required.

This paper reports on the growth rates and patterns of growth of the wet sclerophyll and rainforest species used for revegetating the sites and is based on data gathered by Cartwright (1988) and on a further assessment conducted in 1994.

Methods

Terminology

For convenience, all erect woody species including tree species have been referred to as 'shrubs' (see Appendix). 'Ground' species include all species which do not fit the shrub category (e.g. sedges, grasses, creepers, moss). Nomenclature of plant species follows that of Buchanan *et al.* (1995).

Study site and treatment

Mount McCutcheon stands in south-western Tasmania about 35 km south of Queenstown between the Gordon River, 8 km to the south, and the Franklin River, 8 km to the east. The altitude is 300–400 m. Before it was disturbed by roadworks, much of the area was covered by thamnic rainforest (nomenclature after Jarman *et al.* 1984). Wet scrub species occurred where fires had burnt some of the rainforest.

Vegetation and soil were stripped from the construction sites early in 1983, stock-piled and returned to the sites later that year. In 1984, fertiliser was applied to the sites at 250 kg / ha and a seedmix comprising seven native species was sown at 2 kg / ha. Species

Table 1. Rehabilitation sites and number of plots sampled in the Mount McCutcheon area.

Site	Area (ha)	No. of plots
Quarry	0.4	4
Tipsite	0.3	2
Helipad 200 m north	0.3	2
Works area	0.5	4
Campsite	0.5	4
Spence Road front	1.0	4
Total	**3.0**	**20**

represented in the seed-mix were *Acacia melanoxylon, A. mucronata, Atherosperma moschatum, Cenarrhenes nitida, Gahnia grandis, Leptospermum glaucescens* and *Nothofagus cunninghamii.*

Assessments

Except for some minor changes, the methods used for assessing the success of revegetation in 1994 were the same as those developed by Cartwright for the assessments in 1986 and 1988. The methods described below closely follow Cartwright (1988).

Revegetation treatments were established in the autumn of 1984 and assessments of the revegetation were conducted in winter 1986 (year 2), spring 1988 (year 4) and winter 1994 (year 10). Plots were located using random sampling (Chambers *et al.* 1983), with 20 plots being examined. Table 1 summarises the site and plot information within the study area.

Twenty new plots were located each time the area was assessed. The size of the plots was 1 m x 1 m for the studies in 1986 and 1988, but 2 m x 2 m in 1994 (except at the tipsite where it was 1 m x 1 m). A list was made of all species found within each sampling plot. The number of seedlings and the height of individual seedlings for each shrub species were recorded.

Cover data were obtained from ten transects 10 m long which were randomly located within the area. The position of the line transects was different each time the area was assessed. The line-intercept method (Chambers *et al.* 1983) was used to estimate the cover of shrub species, which was recorded as the per cent intercept of each species along the whole transect length. Total cover of shrubs was obtained by adding together the cover values for all recorded shrub species.

Cover of ground species was estimated by locating a total of 100 point-quadrats at 1 m intervals along the line transects. Cover (%) for each species was measured as the number of hits at ground level obtained for that species as a proportion of the 100 total point-quadrats (Chambers *et al.* 1983). Total cover of ground species was obtained by adding together the cover values for all species which recorded hits at ground level.

Each site was inspected after sampling for any additional species which had not been recorded in sample plots. Total species number was calculated from the enlarged list. Because the original data from 1986 and 1988 were not available, no measures of statistical significance were made in this study. Whilst no untreated area was included as a control, it has still been possible to separate some effects due to the treatment from other changes due to natural revegetation.

Results

General views of the revegetation at the campsite area at years 2, 4 and 10 are shown in Photos 1–3. Species present at year 10 are listed in the Appendix.

Table 2 shows there was little change in species richness between year 2 and year 10. Table 3 shows the general tendency for shrub density to increase for a period, and then to decrease. By year 10, the density of total shrubs had decreased to below their density at year 2.

Table 4 shows that, overall, the species chosen for the seed-mix made a relatively greater contribution to the height of revegetation

Table 2. Number of species at year 2 and year 10.

Plant stratum	No. of species	
	Year 2	Year 10
Shrub species	24	25
Ground species	17	15
Total	**41**	**40**

Table 3. Density of shrubs at each assessment date.

Regeneration source	Density of shrubs (no./m^2)		
	Year 2	Year 4	Year 10
Sown species	3.8	4.2	3.0
Unsown species	5.1	12.4	5.4
Total	**8.9**	**16.6**	**8.4**

than species which were not in the seed-mix. Seed from the seed-mix would no doubt have been complemented by seed of the same species dispersed naturally, but this study cannot separate the contribution made by each.

Table 5 shows the mean height and density of 10 selected species at each assessment. After year 4, there was an increase in height of all these species except *Phyllocladus aspleniifolius.* Growth of *Phyllocladus* and *Atherosperma* was poor throughout. Growth rates for *Phebalium* were initially high but then slowed whilst those for *Eucryphia* and *Nothofagus* were initially poor but then improved. Growth of *Acacia mucronata, Leptospermum glaucescens* and *L. scoparium* was strong throughout the period.

Table 4. Shrub height at each assessment date.

Regeneration source	Mean shrub height (cm)		
	Year 2	Year 4	Year 10
Sown species	13	34	116
Unsown species	4	18	73
Total	**7**	**22**	**88**

Photo 1. Revegetation of the Mount McCutcheon campsite at year 2.

Photo 2. The Mount McCutcheon campsite at year 4.

Photo 3. The Mount McCutcheon campsite at year 10.

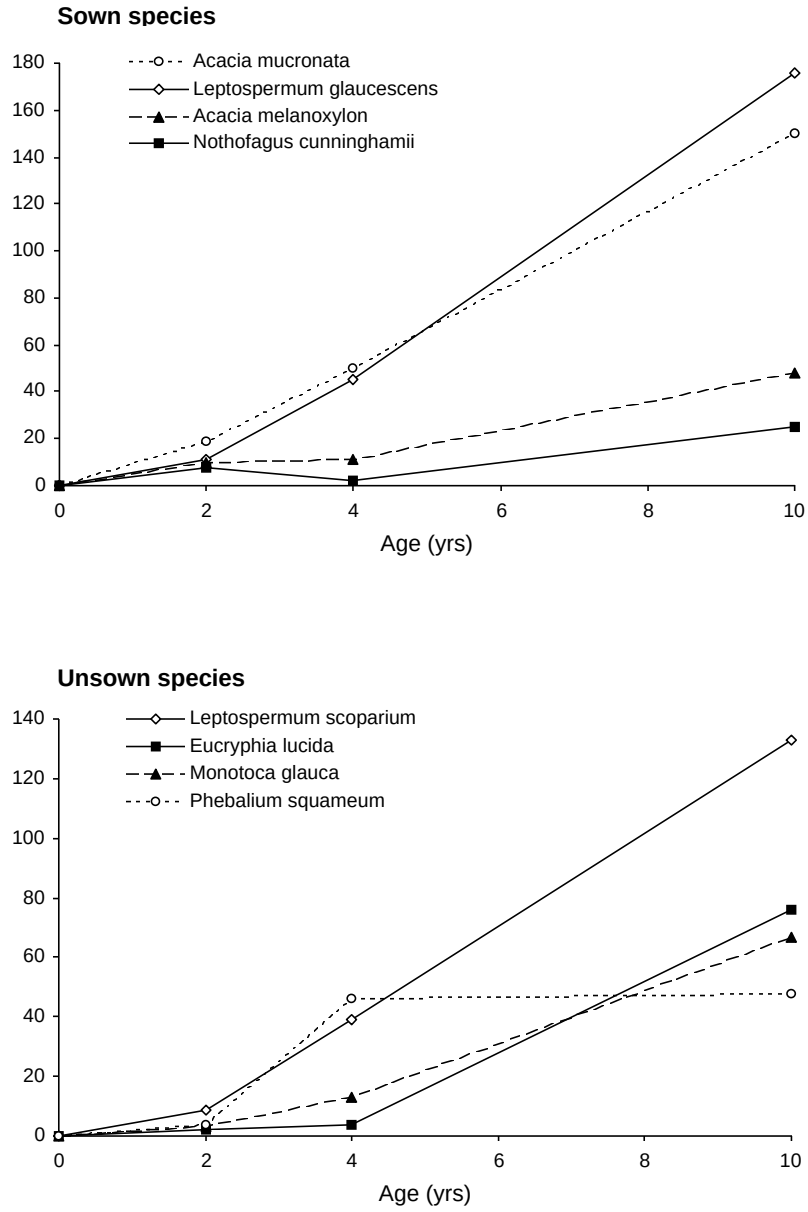

Figure 1. The increase in height across a 10-year period for selected species.

Figure 1 shows the change in height of selected shrub species. Figure 2 shows the height distribution for all plants and for selected species in year 10. All histograms show an abundance of small seedlings. These skewed distributions complicate the interpretation of average heights.

Figure 3 presents the data in Table 5 for five selected species. The area of each rectangle represents a biomass index for the selected species. The diagonal lines show the initial increase and subsequent decrease in density of plants and the increase in average height—the same pattern for the five species. There were

Table 5. Mean height (cm) and density (no./m²) of selected species at each assessment.

Species	Year 2		Year 4		Year 10	
	Height	Density	Height	Density	Height	Density
Acacia melanoxylon	9.5	0.8	11	0.2	48	0.12
Acacia mucronata	18.8	1.55	50	2.05	150	1.95
Atherosperma moschatum	1.0	0.4	2	1.0	3	0.2
Eucryphia lucida	2.0	0.1	4	0.75	76	0.41
Leptospermum glaucescens	11.4	0.7	45	0.75	176	0.19
Leptospermum scoparium	8.9	0.45	39	1.9	133	1.23
Monotoca glauca	3.2	2.2	13	5.3	67	2.28
Nothofagus cunninghamii	7.6	0.35	2	0.15	25	0.22
Phebalium squameum	3.8	1.0	46	1.05	48	0.41
Phyllocladus aspleniifolius			3	0.4	2	

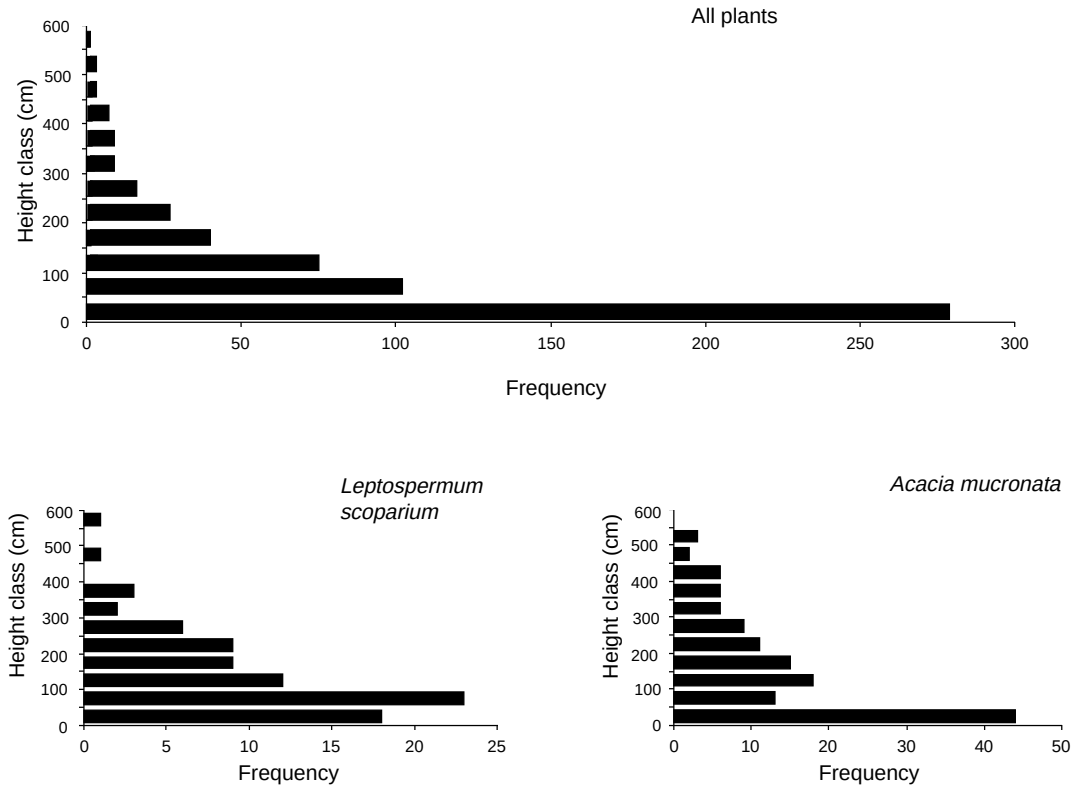

Figure 2. Frequency of all plants, and selected species at year 10.

departures from this pattern in two species not illustrated in Figure 3. For *Acacia melanoxylon*, the density steadily declined and for *Phebalium squameum* the height increase was very small between years 4 and 10.

Using sown seed has the effect of increasing the width of the rectangles (density of plants) in Figure 3 compared to what it would be if the species regenerated from unsown seed.

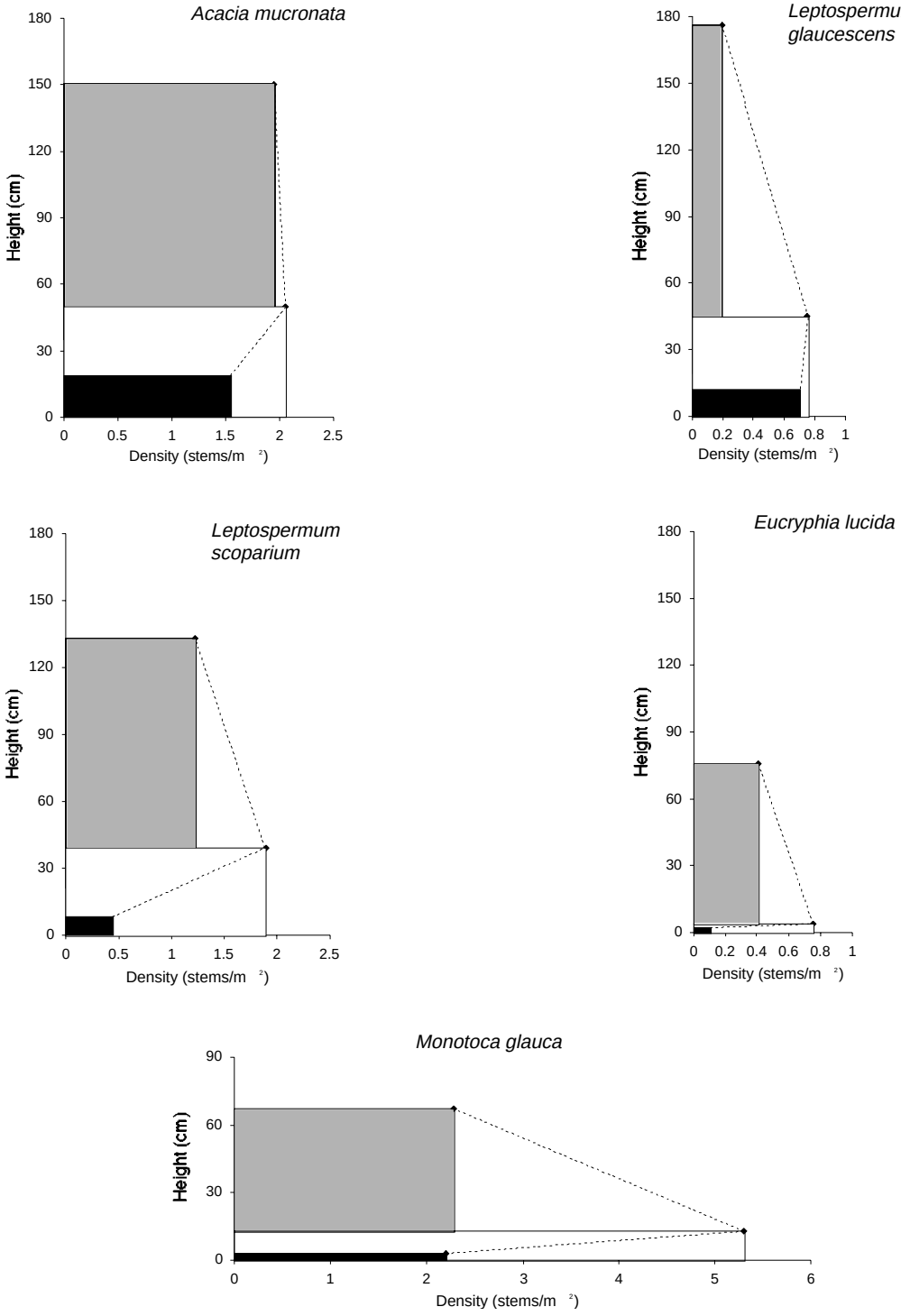

Figure 3. Diagrams showing a biomass index for five selected species. The dark rectangle represents the average height and density at year 2, the blank rectangle represents average height and density at year 4 and the shaded rectangle represents average height and density at year 10. The dotted line shows the initial increase and subsequent decrease in density as average height increases. (Caution should be used in comparing biomass areas of different species where there are different scales on the horizontal axis.)

Table 6. Shrub species making the major contribution to total cover at year 10.

Species	Cover (%)	No. of plants
Acacia mucronata	12.7	70
Leptospermum scoparium	7.8	37
Monotoca glauca	6.4	58
Leptospermum glaucescens	3.4	22
Phebalium squameum	1.4	16
Eucryphia lucida	1.2	13
Others	2.4	35
Total	**35.3**	**251**

Table 7. Ground cover at year 10.

Contributor	Cover (%)
Bare ground	19
Leaf litter	20
Moss	35
Blechnum wattsii	11
Histiopteris incisa	1
Gahnia grandis	9
Lichen	3

Shrub cover was not measured at year 2 but, at year 4, 14.7% of the ground was covered by shrubs and at year 10, 35.3% of the ground was covered. Individual species providing the greatest contribution to shrub cover at year 10 are shown in Table 6.

The species which contributed most to shrub cover at year 10 include *Phebalium squameum* along with those species that contributed most to the biomass measures shown in Figure 3. *Cyathodes juniperina* and *Phyllocladus aspleniifolius* made a greater contribution and *Sprengelia incarnata* made a poorer contribution to cover (transects) than they did to biomass (plots). However, few plants of the minor species were included in the study and such comparisons are unreliable.

Ground cover was not measured at year 2 but the composition of the ground layer at year 10 is summarised in Table 7. Litter cover remained steady at 20% at year 4 and year 10 while total plant ground cover rose from 48% at year 4 to 60% at year 10. Moss has always been the most frequently occurring ground plant. At year 4, *Gahnia grandis* provided the second greatest contribution to cover among the plants but at year 10 its contribution was exceeded by that of *Blechnum wattsii*. *Juncus planifolius* was very common at year 2, but has apparently disappeared. Other species of *Juncus* are now present with a higher frequency than that shown previously by *J. planifolius*.

Conclusions

There are several indications that vegetation succession is still at an early stage in the study area. Measures of density, height and cover all show that the original shrub pioneers still dominate the site at year 10. Also at year 10, there are large numbers of pioneers among the smaller plants. Shrub density reached a maximum at about year 4, from which it declined by year 10, but shrub cover steadily increased and has the potential to increase further. Ground cover increased between year 4 and year 10, and also may have potential to increase further.

Although species richness was much the same between years 2 and 10, and pioneer species are still dominant, species composition has changed. This is most noticeable at ground level where *Juncus planifolius* has disappeared and *Blechnum wattsii* has increased in cover at the expense of *Gahnia grandis*.

It can be seen from the results that the most successful sown species to establish at the site after 10 years are *Acacia mucronata*, *Leptospermum glaucescens* and *Monotoca glauca*. *Leptospermum scoparium*, an unsown species, also performed well, suggesting that it is a good coloniser of disturbed sites. Potential rainforest trees are present in the recolonising vegetation, but their establishment is much poorer than that of the fast-growing sclerophyll species. *Eucryphia lucida* (unsown) performed well. It is likely that the

Nothofagus plants developing in recent years have grown from seed which dispersed naturally rather than from the seed sown originally. There is little evidence of establishment of either *Atherosperma moschatum* or *Phyllocladus aspleniifolius* at this stage.

Sowing seed probably assisted the establishment of several species including *Cenarrhenes nitida, Leptospermum glaucescens* and the species of *Acacia.* On the other hand, it probably had little effect on *Atherosperma* and *Nothofagus.*

It may be interesting to repeat this study of revegetation at Mount McCutcheon in 2004, for example. The embankments and cuttings of the nearby Kelly Basin Railway have been allowed to revegetate for 80 years, and it may be possible to extend the present study area to include such sites along the track to the Bird River.

Acknowledgements

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Appendix. Species recorded at year 10 from the study sites. (W = works area, R = road front, C = campsite, T = tipsite, Q = quarry)

	W	R	C	T	Q
Shrubs					
Acacia dealbata		+			
Acacia melanoxylon	+	+	+		+
Acacia mucronata	+	+	+	+	+
Anodopetalum biglandulosum	+		+		
Anopterus glandulosus	+	+	+		
Atherosperma moschatum	+	+			
Cenarrhenes nitida		+	+		+
Cyathodes juniperina	+	+	+	+	+
Eucalyptus nitida		+			+
Eucryphia lucida	+	+	+		+
Gaultheria hispida			+		+
Leptospermum glaucescens	+	+	+	+	+
Leptospermum scoparium	+	+	+	+	+
Melaleuca squarrosa	+				
Monotoca glauca	+	+	+	+	+
Monotoca submutica				+	
Nothofagus cunninghamii	+	+			+
Persoonia gunnii				+	+
Phebalium squameum	+	+		+	
Phyllocladus aspleniifolius	+	+			+
Prostanthera lasianthos					+
Richea pandanifolia	+	+	+		
Sprengelia incarnata		+	+		+
Tasmannia lanceolata					+
Trochocarpa cunninghamii		+	+		
Ground species					
Algae					+
Blechnum nudum					+
Blechnum wattsii	+	+	+	+	+
Dianella tasmanica		+			
Dicksonia antarctica	+	+			
Gahnia grandis	+	+		+	+
Histiopteris incisa					+
Juncus astreptus	+	+	+		+
Juncus australis			+		
Juncus pauciflorus	+		+		
Lichen	+	+	+	+	
Moss	+	+	+	+	+
Prionotes cerinthoides					+
Restio tetraphyllus	+				+
Rubus fruticosus			+		