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ECOSYSTEM SERVICES

# Sumac rainforest harvesting trial remeasurement age 40 years

A report to the Department of State Growth

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# Executive Summary


The Sumac rainforest logging and regeneration trial was established in north-west Tasmania in the late 1970s to compare and contrast a range of different harvesting methods for potential application in rainforest.

Prior to harvesting the forest was uneven-aged, with over-mature, mature and regrowth trees of mostly myrtle, sassafras and leatherwood, over a diverse understorey which also included younger plants of those three species.

The different systems applied were selective sawlogging, strip-felling, shelterwood, clearfelling with cull retention and clearfelling with cull removal. Burning after harvesting was applied in some instances. Regeneration was from natural seedfall, ground-stored seed and coppicing. A control area was established in which there was no disturbance.

All of the treatments have regenerated, but the structure of the forest at age 40 varies between treatments. The selectively sawlogged area is perhaps closest in structure to that of the control area, with over-mature and mature trees still present, over a variable understorey of tall shrubs, ferns, and younger plants of the three dominant tree species.

Mature and over-mature trees of predominantly myrtle but also leatherwood and sassafras have persisted in the more heavily disturbed areas, but these are interspersed with dense groves of regrowth dominated by pole-sized myrtles. Leatherwood is the next most common species, and sassafras and celery-top pine are scattered throughout but never common.

The early colonising species such as cutting grass (*Gahnia grandis*) and fireweed (*Senecio* spp.) have almost disappeared from the site. Curiously, *Polystichum proliferum* (Cat head fern) and *Blechnum wattsii* (hard water fern), which are both ground ferns that reach about a metre high, were both widespread and abundant at the time of establishment of the trial, and both species are now effectively absent from the site, including from the control area.

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# 1. INTRODUCTION

The Sumac rainforest logging and regeneration trial was established in the late 1970s (Blakesley 1980). The key report on the results of the trial to date is that of Hickey and Wilkinson (1999). The trial was remeasured in 2009 by a Masters student from the University of Tasmania (Bryn Daniel), but apart from the thesis that work has not been published. This report documents remeasurement of the trial in 2019, about 40 years after establishment.

The trial was sub-divided into seven separate areas, and different logging and regeneration treatments were applied in each area. The treatments applied were:

Area 1. Selective sawlogging, no scarification, no burning.

Area 2. Strip logging of various widths, scarification, some cull felling, light burning.

Area 3. Shelterwood, scarification to create additional seedbed, no burning.

Area 4. Clearfell, culls retained, low intensity burning.

Area 5. Clearfell, culls felled, high intensity burning.

Area 6. Shelterwood, no scarification, no burning.

Area 9. Control. No disturbance, no burning.

Scarification is deliberate mechanical disturbance of the ground in order to create receptive seedbed.

There were some minor variations applied, particularly in Area 2. Culls were retained in part, and felled in part, and the burning was uneven. The strips were of nominal width, but there was some overlap, and some breaches of the retained sections (see Figure 1). Fences were established in some areas in order to assess the response of the vegetation in the absence of mammal browsing, some small areas were sown, and seedlings were planted in other areas. Full details of the harvesting and regeneration treatments are given in Hickey and Wilkinson 1999. The details are summarised in Table 1, below, and an aerial photograph of the trial site at the completion of harvesting is shown in Figure 1.

Table 1. Logging treatment details for the Sumac trial (after Hickey and Wilkinson 1999).

| | | | | Timber production | | | |
|---|---|---|---|---|---|---|---|
| Treatment (Area) | Coupe area (ha) | Canopy retained (%) | Harvest date | sawlog ($m^3$/ha) | pulpwood ($m^3$/ha) | Site prepar-ation | Burn date |
| Selective sawlogging (1) | 21 | 80 | Nov-1976 | 11 | -[3] | nil | - |
| Stripfelling (2) | 10 | from 0 to 60[1] | Nov-1976 | 4 | 56 | partial burn, low intensity | Mar-1977 |
| Shelterwood (3) | 10 | 60[2] | Feb-1978 | 8 | 54 | scarific-ation | - |
| Clearfell, culls retained (4) | 7 | 0 | Dec-1978 | 21 | 93 | low intensity burn | Mar-1977 |
| Clearfell, culls removed (5) | 8 | 0 | Dec-1978 | 21 | 93 | high intensity burn | Mar-1977 |
| Shelterwood (6) | 8 | 60 | Feb-1978 | 8 | 36 | nil | - |
| Control (9) | - | 100 | Unlogged | - | - | nil | - |

Notes.

1. In different places within the stripfelling treatment, culls were retained, or felled.

2. Most of the remaining canopy was removed [felled to waste] in July 1981, about three years after the original harvesting.

3. Pulpwood was not recovered.

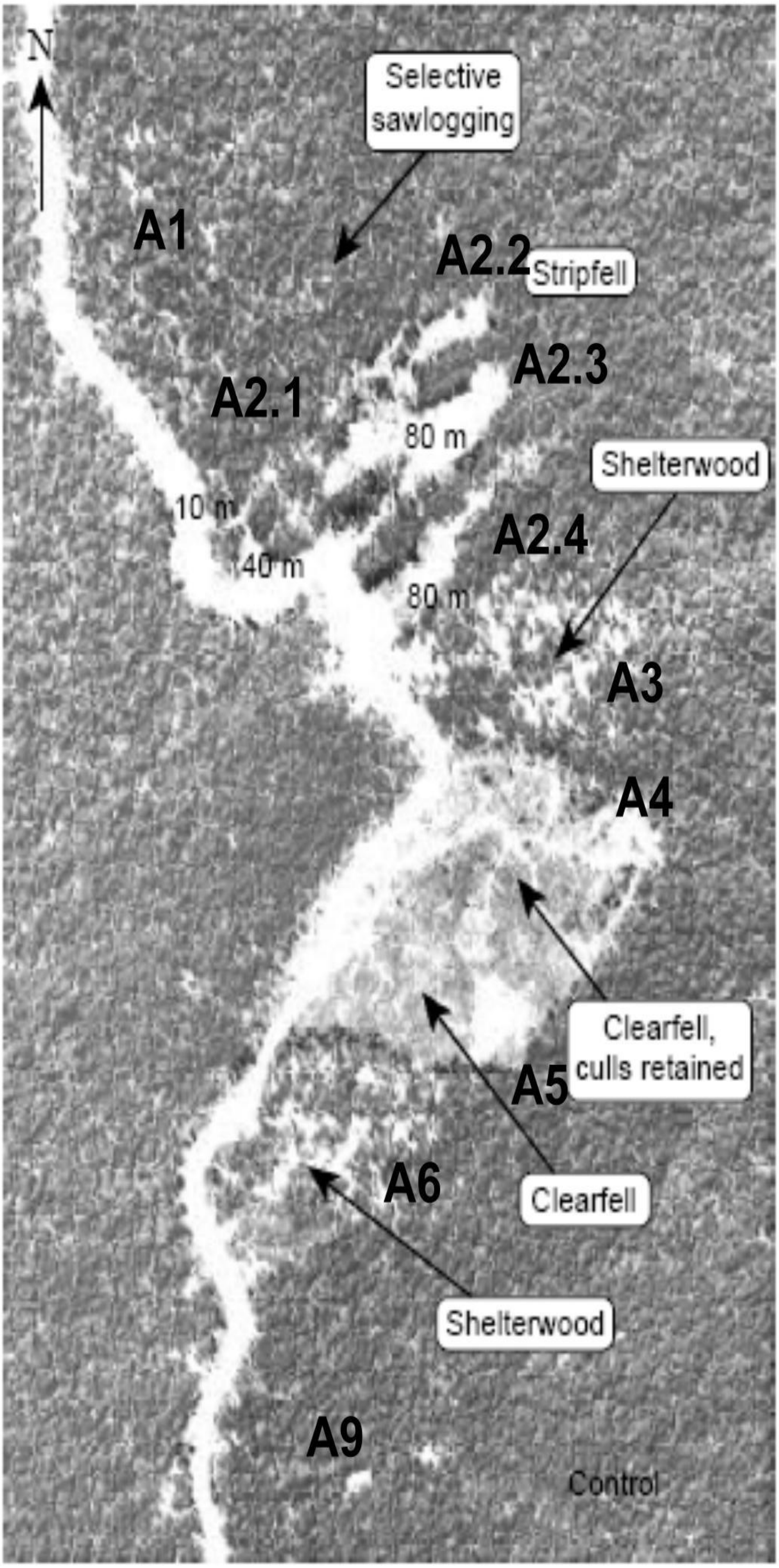


Figure 1. Aerial view of the Sumac trial at the completion of harvesting and regeneration treatments, circa 1980.

# 2. METHODS

## STAND STRUCTURE

Four sample points were randomly located within each of the different areas within the trial (see figures below), except in Area 5 where an additional (fifth) sample plot was located in order to deliberately sample an unusual patch of forest. The fenced and planted areas were avoided. At each sample point all stems less than 10 cm diameter at breast height (dbh) were counted and the species of each stem recorded, on a circular plot of 100 $m^2$ centred on the sample point. If the count was less than 10 the plot was expanded to 200 $m^2$ in order to ensure a more representative sample. At all except 4 of the sample points the larger plot was used. At each sample point the dbh of all stems greater than 10 cm dbh, and the species of each stem, was recorded on a circular plot of 200 $m^2$. This data was then used to calculate the average number of stems per hectare by size class, by species and by treatment.

For myrtle only, as it was the only species for which the stem count was sufficiently high, the ratio of regrowth stems (stems 10 to 30 cm dbh) to larger stems (stems greater than 30 cm dbh) was calculated. The cut-off point of 30 cm dbh is arbitrary, but was based on examination of the data and an understanding of myrtle growth rates. Higher and lower cut-offs were explored, and made little difference to the results. The aim was simply to look at the ratio of smaller to larger stems, across the different treatments.

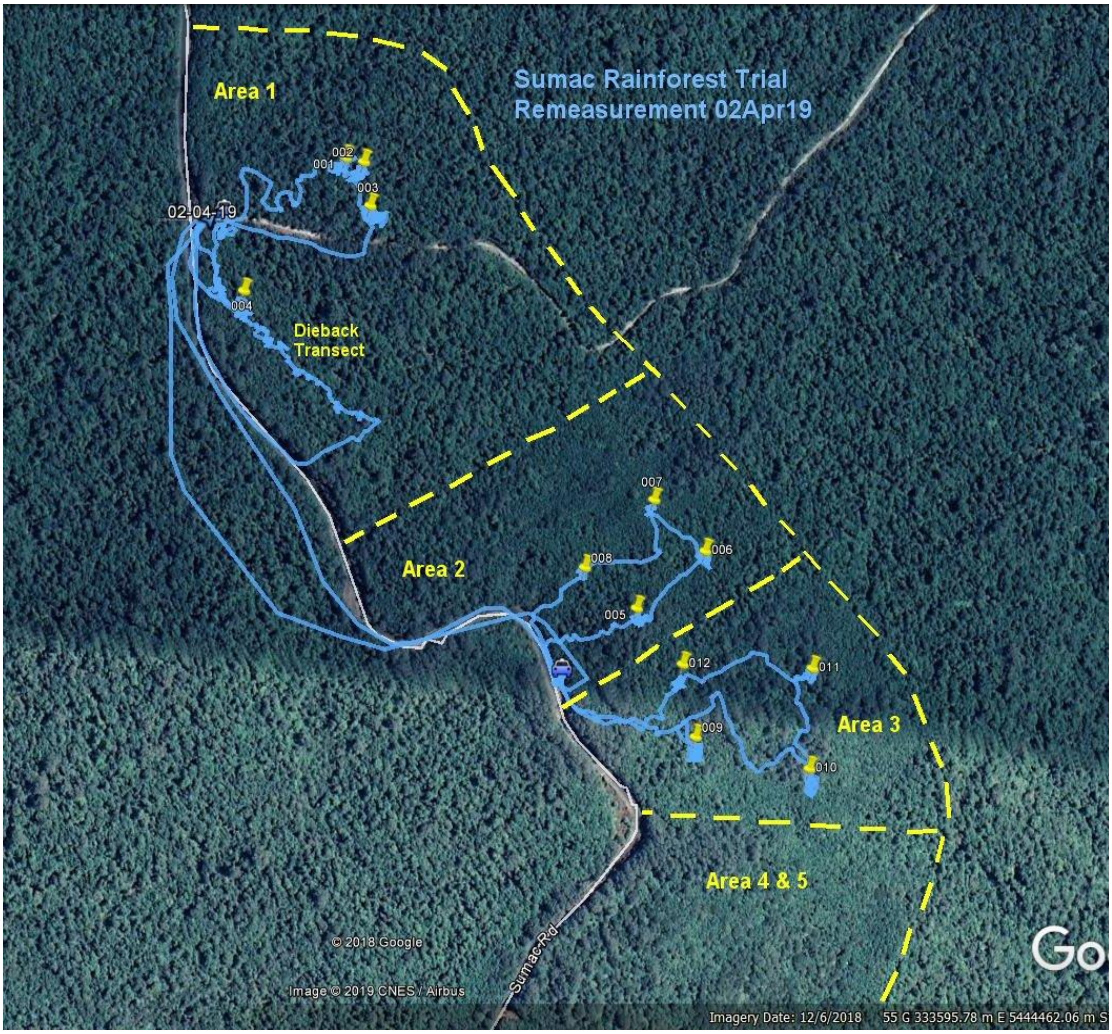


Figure 2. Day 1 of sampling at the Sumac trial, showing the location of the sampling points. The location of the Myrtle wilt ('Dieback') transect is also shown.

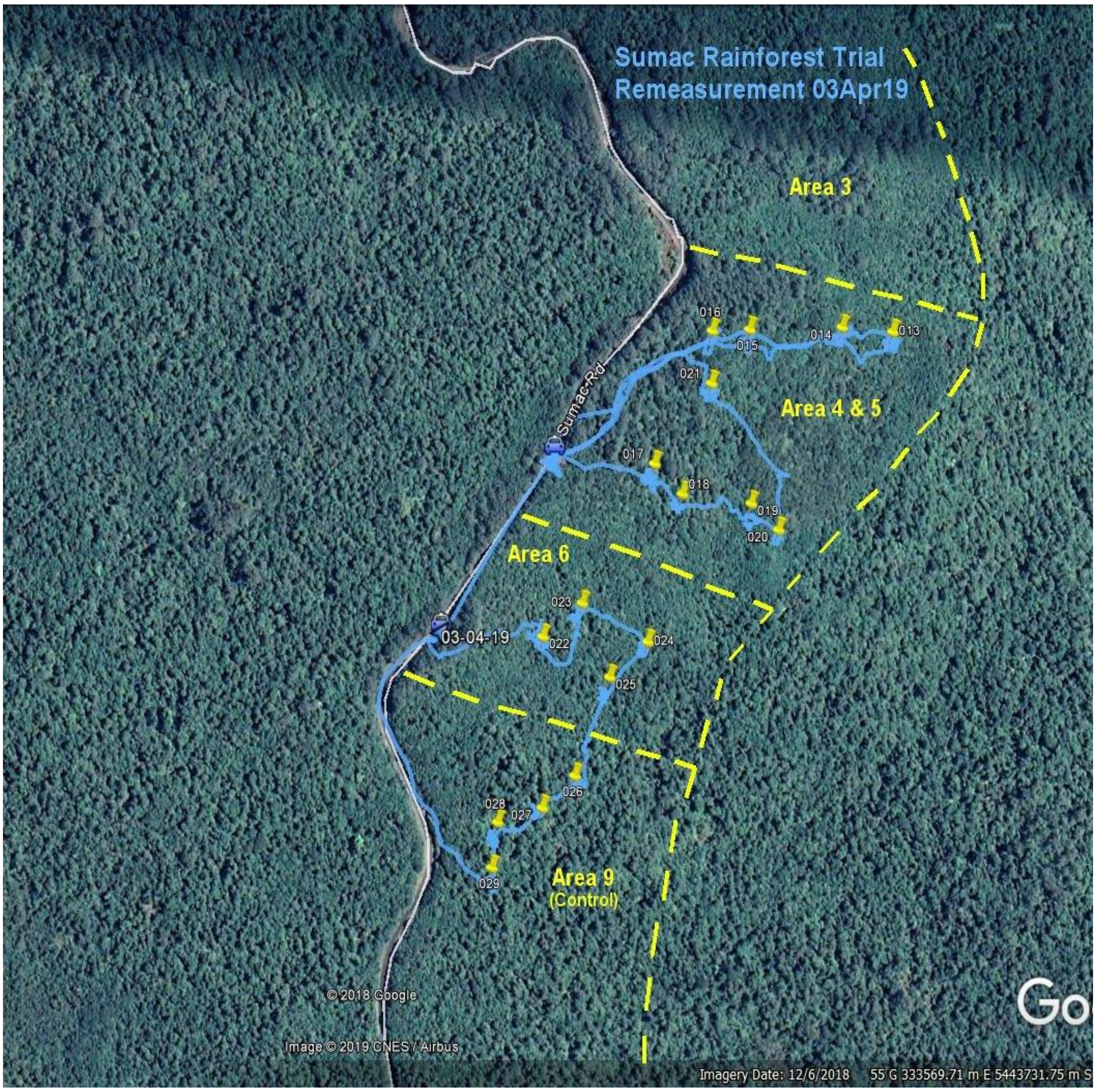


Figure 3. Day 2 of sampling at the Sumac trial, showing the location of the sampling points.

## Myrtle wilt transect.

Myrtle wilt is a disease which causes the death of mature myrtles. The incidence of the disease is known to be exacerbated by disturbances such as road construction or harvesting (Kile *et al.* 1989). To monitor the incidence of myrtle wilt within the Sumac trial, two transects were established some years ago: one in Area 1 in 1978 and a second in Area 9 in 1980 (Elliott *et al.* 2005).

The myrtle wilt transect in Area 1 was relocated. The transect was first established as noted above in 1978, and had been remeasured most recently in 2004. Most of the trees assessed during the 2004 remeasurement of the transect had numbers spray-painted on, and these were still reasonably clear, which enabled accurate relocation of a length of the transect, although it was never entirely clear where the centreline of the transect actually ran. The transect was confidently relocated from tree no. 1 to tree 113, after which it became too difficult to follow. Examination of the myrtle wilt transect in Area 9 indicated that it may not have been remeasured in 2004, or numbers were not sprayed on the trees, and it could not be located with confidence.

The health of each tree which had been assessed in the 2004 remeasurement was assessed again at this remeasurement.

## FLORISTICS

A plot with a radius of 20 m was located centred on the same sample points as used for the structural assessment. A thorough search was made of the plot, and notes recorded of the approximate projected foliage cover of each layer of the vegetation and the relative dominance of each species in each layer.

# 3. RESULTS

## STAND STRUCTURE

It is important to note that throughout the following tables that relate to the stand structure, no standard deviations are offered. This is because much of the information presented here is derived from other sources, such as published or unpublished reports in which no standard deviations were offered, and the work required to establish standard deviations would be very time consuming, and indeed not always possible if the original data cannot be located. It is clear from the data gathered during the field component of this project, that standard deviations can be as high as ± 50% of the figure provided, particularly in cases such as Area 1 where the counts of smaller stems on the 200 $m^2$ plots ranged from 7 to 342 (see Tables 6 and 9). This was the most extreme instance, and generally the standard deviations will be less, but the import is clear, and the numbers reported here must be read with this in mind.

It is also important to note that the approach to assessment of the trial has varied from measurement to measurement. In the first ten years after the harvesting most of the assessment was based on permanently located 4 $m^2$ plots. This was satisfactory for the early measurements but by the time that Daniel (2010) remeasured the trial in 2009/10, the trees had grown so much and self-thinned to the point that larger plots were required. For the current remeasurement 200 $m^2$ plots were used for most of the assessment, but time permitted only a relatively small number of plots to be located within each Area. So again, there are errors in the data, and whilst trends can be clearly seen, the numbers are not precise.

For similar reasons all the numbers reported below have been rounded following these rules: numbers less than 100 are rounded to the nearest 10, from 100 to 1000 to the nearest 50, from 1000 upwards to the nearest 100.

The following tables present seedling and/or stand density by species, by treatment and by age, from age 10 years to age 40 years.

Table 2. Seedling density (stems per hectare) at age 10 years (after Hickey and Wilkinson 1999).

| Area | Myrtle | Leatherwd | Sassafras | Celery-top | Blackwood |
|---|---|---|---|---|---|
| Area 1 (Select sawlog) | 35 000 | 800 | 200 | 200 | 0 |
| Area 2 (Strips) | 13 100 | 1200 | 100 | 200 | 0 |
| Area 3 and 6 (Shelter) | 28 200 | 820 | 500 | 0 | 0 |
| Area 4 (C'fell + culls) | 2 500 | 600 | 500 | 0 | 0 |
| Area 5 (C'fell no culls)* | 0 | 0 | 0 | 0 | 0 |
| Area 9 (Control) | 5300 | 200 | 0 | 100 | 100 |

*Hickey and Wilkinson (1999) restricted their sampling to the central area of the clearfells, in order to 'avoid the effect of seed and shelter from the surrounding forest.' Later sampling (see tables below) assessed the whole area.

Table 3. Seedling density (stems per hectare) at age 18 years. (recalculated from Sustainable Timber Tasmania data).

| Area | Myrtle | Leatherwood |
|---|---|---|
| Area 1 (Select sawlog) | 50 700 | 5 200 |
| Area 2 (Strips) | 23 900 | 2 700 |
| Area 3 and 6 (Shelter) | 36 600 | 9 400 |
| Area 4 (C'fell + culls) | 6 500 | 1 200 |
| Area 5 (C'fell no culls) | 1 050 | 50 |
| Area 9 (Control) | 3 750 | 420 |

Table 4. Seedling density (stems less than 10 cm dbh, number of stems per hectare) at age 30 years (after Daniels 2010) (2009 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 4 000 | 450 | 2 200 | 150 | 0 | 0 |
| 2 (Strips) | 11 000 | 2 500 | 0 | 100 | 0 | 0 |
| 3 (Shelter) | 26 400 | 2 300 | 0 | 100 | 0 | 0 |
| 4 (C'fell + culls) | 3 100 | 600 | 0 | 0 | 0 | 0 |
| 5 (C'fell no culls) | 950 | 2 500 | 0 | 0 | 0 | 0 |
| 6 (Shelter) | 17 900 | 900 | 0 | 0 | 0 | 0 |
| 9 (Control) | 600 | 0 | 0 | 0 | 0 | 0 |

Table 5. Stem density (stems greater than 10 cm dbh, number of stems per hectare) at age 30 years (after Daniels 2010) (2009 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 200 | 20 | 160 | 0 | 0 | 0 |
| 2 (Strips) | 1 500 | 0 | 0 | 0 | 20 | 80 |
| 3 (Shelter) | 950 | 20 | 50 | 0 | 20 | 150 |
| 4 (C'fell + culls) | 1 450 | 150 | 0 | 0 | 50 | 20 |
| 5 (C'fell no culls) | 1 050 | 20 | 0 | 0 | 80 | 140 |
| 6 (Shelter) | 1 000 | 40 | 20 | 0 | 0 | 0 |
| 9 (Control) | 200 | 80 | 120 | 0 | 0 | 0 |

Table 6. Seedling density (stems less than 10 cm dbh, number of stems per hectare) at age 40 years (2019 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 6 800* | 600 | 300 | 50 | 0 | 0 |
| 2 (Strips) | 1 600 | 100 | 0 | 20 | 0 | 0 |
| 3 (Shelter) | 2 200 | 200 | 40 | 0 | 0 | 0 |
| 4 (C'fell + culls) | 200 | 200 | 0 | 0 | 0 | 0 |
| 5 (C'fell no culls) | 300 | 100 | 0 | 20 | 0 | 0 |
| 6 (Shelter) | 2 600 | 300 | 20 | 0 | 0 | 0 |
| 9 (Control) | 1 200 | 100 | 80 | 0 | 0 | 0 |

* Note. The stand density for myrtle in Area 1 falls to c. 3 400 stems per ha if an extraordinarily high count from one plot is excluded from the calculations.

Table 7. Stem density (stems greater than 10 cm dbh, number of stems per hectare) at age 40 years (2019 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 300 | 100 | 100 | 10 | 0 | 0 |
| 2 (Strips) | 1 100 | 0 | 0 | 0 | 10 | 100 |
| 3 (Shelter) | 1 200 | 50 | 50 | 0 | 10 | 150 |
| 4 (C'fell + culls) | 1 300 | 0 | 0 | 0 | 150 | 0 |
| 5 (C'fell no culls) | 100 | 0 | 0 | 10 | 90 | 0 |
| 6 (Shelter) | 1 200 | 20 | 20 | 0 | 0 | 0 |
| 9 (Control) | 400 | 90 | 120 | 0 | 0 | 0 |

Table 8. Stand density (stems per hectare, all stems) at age 30 years (after Daniels 2010, 2009 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 4 300 | 500 | 2 300 | 150 | 0 | 0 |
| 2 (Strips) | 12 600 | 2 500 | 0 | 90 | 20 | 80 |
| 3 (Shelter) | 27 300 | 2 400 | 50 | 100 | 20 | 150 |
| 4 (C'fell + culls) | 4 600 | 800 | 0 | 0 | 50 | 20 |
| 5 (C'fell no culls) | 200 | 2 500 | 0 | 0 | 80 | 150 |
| 6 (Shelter) | 18 900 | 900 | 20 | 0 | 0 | 0 |
| 9 (Control) | 850 | 80 | 950 | 0 | 0 | 0 |

Table 9. Stand density (stems per hectare, all stems) at age 40 years (2019 data).

| Area | Myrtle | Leathrwd | Sassafras | Celery | Blackwd | Obliqua |
|---|---|---|---|---|---|---|
| 1 (Select sawlog) | 7 200* | 650 | 400 | 550 | 0 | 0 |
| 2 (Strips) | 2 700 | 100 | 0 | 20 | 10 | 100 |
| 3 (Shelter) | 3 400 | 250 | 90 | 0 | 10 | 150 |
| 4 (C'fell + culls) | 1 500 | 200 | 0 | 0 | 150 | 0 |
| 5 (C'fell no culls) | 1 300 | 150 | 0 | 30 | 90 | 0 |
| 6 (Shelter) | 3 800 | 400 | 50 | 0 | 0 | 0 |
| 9 (Control) | 16 00 | 250 | 150 | 0 | 0 | 0 |

* Note The stand density for Myrtle in Area 1 falls to 3 800 stems per ha if an extraordinarily high count from one plot is excluded from the calculations.

Table 10. Ratio of myrtle regrowth stems to larger stems by area (numbers have been rounded, ratios have been retained from the calculations based on the raw data).

| Area | Count of regrowth stems (10 to 30 cm) (stems per ha) | Count of larger stems (greater than 30 cm dbh) (stems per ha) | Ratio of regrowth to larger |
|---|---|---|---|
| Area 1 (Select sawlog) | 250 | 90 | 0.37 |
| Area 2 (Strips) | 1100 | 10 | 0.01 |
| Area 3 (Shelter) | 1200 | 25 | 0.02 |
| Area 4 (C'fell + culls) | 1300 | 25 | 0.02 |
| Area 5 (C'fell no culls) | 900 | 50 | 0.05 |
| Area 6 (Shelter) | 1100 | 90 | 0.08 |
| Area 9 (Control) | 200 | 180 | 0.82 |

Most of the stems less than 10 cm dbh are dead or dying in most areas – perhaps less so in Areas 1 and 9 as they are getting a bit more light.

Table 10 shows clearly that the proportion of larger stems is highest in the control area (Area 9). There are still significant numbers of larger stems in the selectively sawlogged area (Area 1), but throughout the rest of the trial numbers of larger (and hence presumably older) trees are low.

## Myrtle wilt transect

Table 11. Counts of healthy trees on the Myrtle wilt transect in Area 1.

| | Myrtle | Leatherwood | Sassafras | Total |
|---|---|---|---|---|
| All trees in 1978* | 50 | 23 | 41 | 114** |
| 1978 | 32 | 22 | 32 | 86 |
| 1982 | 18 | 22 | 27 | 67 |
| 2004 | 24 | 16 | 17 | 57 |
| 2019 | 24 | 14 | 14 | 52 |

* 'All trees' includes trees that were unhealthy at establishment of the transect.

** There was a tree labelled 77A, which is why this is 114, not 113 as noted in the methods.

## FLORISTICS

Table 12. Mean cover-abundance by species and treatments= (1 = <1%, 2 = 1 to 5%, 3 = 5 to 25%, 4 = 25 to 50%, 5 = >50%)

| Area | 1 | 2 | 3 | 4 | 5 | 6 | 9 |
|---|---|---|---|---|---|---|---|
| Trees | | | | | | | |
| Myrtle | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Sassafras | 2 | 0 | 2 | 0 | 1 | 1 | 2 |
| Celery-top pine | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| Leatherwood | 2 | 1 | 2 | 1 | 1 | 2 | 2 |
| Blackwood | 0 | 1 | 0 | 2 | 2 | 0 | 0 |
| *E. obliqua* | 2 | 1 | 2 | 0 | 1 | 0 | 0 |
| Shrubs | | | | | | | |
| *Anopterus glandulosus* | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Aristotelia peduncularis* | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| *Cenarrhenes nitida* | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| *Correa lawrenciana* | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Coprosma quadrifida* | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| *Leptecophylla juniperina* | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| *Gahnia grandis* | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| *Leptospermum lanigerum* | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| *Monotoca glauca* | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| *Nematolepis squamea* | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Notelea ligustrina* | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| *Olearia argophylla* | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| *Pimelea drupacea* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Pimelea cinerea* | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Pittosporum bicolor* | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| *Pomaderris apetala* | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| *Tasmannia lanceolata* | 0 | 1 | 1 | 1 | 2 | 1 | 0 |
| *Trochocarpa cunninghamii* | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Ferns | | | | | | | |
| *Asplenium flaccidum* | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| *Blechnum wattsii* | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Crepidomanes venosum* | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Dicksonia antarctica* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Grammitis billardieri* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Histiopteris incisa* | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| *Hypolepis rugosula* | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| *Hymenophyllum cupressiforme* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *H. flabellatum* | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| *H. peltatum* | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *H. rarum* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Microsorum pustulatum* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Polystichum proliferum* | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Rumohra adiantiformis* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Tmesipteris obliqua* | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

Table 13. Species richness by area and by life form.

| Area | 1 | 2 | 3 | 4 | 5 | 6 | 9 |
|---|---|---|---|---|---|---|---|
| Trees | 5 | 5 | 5 | 3 | 6 | 4 | 3 |
| Shrubs | 10 | 7 | 6 | 7 | 12 | 4 | 5 |
| Ferns | 10 | 6 | 7 | 9 | 6 | 8 | 14 |

# 4. DISCUSSION

## STRUCTURE

Prior to establishment of the trial, the forest within the Sumac trial area was described as 'very much uneven-aged in structure, with the oldest trees probably over 500 years old…, there are many patches of young to pole-sized regeneration of tree species, especially in gaps created by death or windthrow of mature trees' (Blakesley 1980). This uneven-aged structure and gap recruitment is typical of myrtle-dominated rainforest (Read and Hill 1985). The canopy was dominated by myrtle, with sassfras and leatherwood also common. Celery-top pine and blackwood were both present but occasional (Blakesley 1980).

Post-harvesting there has been massive recruitment in those areas (Area 1, selective sawlogging, 2, strips, and 3 and 6 shelterwood), where there was a significant amount of disturbance and plenty of trees left to provide seed. There was less recruitment in Area 4 (clearfell, culls retained), although the retained culls and trees adjacent to the harvested area provided some seed, and there was less recruitment again in Area 5, which was clearfelled and the culls also felled, so the only source of seed was trees in the adjacent forest. Regeneration from coppice was widespread in Area 5. Coppice regeneration probably also occurred in the other areas but was less obvious due to the abundant seedling regeneration.

Myrtle dominates the regenerating forest and has done so throughout the last 40 years. Sassafras regenerates easily but is very susceptible to browsing as is blackwood. Leatherwood has been present in good numbers but always significantly fewer than the myrtle. Scattered old eucalypts were located in the western part of the trial area, on ridges near to the road, and eucalypt regrowth is now well established, notably in areas 1, 2, 3, 4 and 5, although it generally occurs close to the road. There is a surprising amount of blackwood in Areas 4 and 5 (the clearfells), and it is surmised that despite the heavy browsing pressure which was presumed at the time to have removed most of the blackwood seedlings, that some seedlings survived within the heavy cover of cutting grass that was also a feature of the young regeneration.

The regeneration had established a closed canopy by the time of the 2009 remeasurement, if not earlier, and at the time of the 2019 remeasurement the canopy was fully closed, such that the ground layer that at one time was dominated by cutting grass, is now almost non-existent.

The structure of the standing forest is now clearly most diverse in the control area, with large old trees, mature trees, young regrowth and small groves of seedlings. The structure in the selectively sawlogged area is similar, but the logging and the subsequent wilt has reduced the number of large old trees there, and there are groves of pole sized trees, mostly myrtle but also leatherwood. In the stripfells and the shelterwood area there are still patches of, and individual, larger trees dispersed through the groves of pole-sized trees. In the clearfells, unsurprisingly, there are few large trees.

Hickey and Wilkinson (1999) concluded that the Sumac trial showed that plentiful regeneration of myrtle could be expected where disturbed seedbed was located within 40 m of retained trees. Burning offered no advantage. Similarly Jennings and Hickey (2003) found that in a seed tree system with about 16 mature myrtles retained per hectare, that the regeneration of myrtle, at an estimated 50 000 seedlings per hectare, was more than adequate. Both findings accord with the observations presented here.

## MYRTLE WILT TRANSECT

Blakesley (1980) in the trial establishment report, noted that the 'upper canopy trees are generally overmature, with many dead or unhealthy myrtles'. The rapid decline of the myrtles as recorded by the myrtle wilt transect, with 18 of 50 trees dying in the first 4 years, may have been the consequence of an increased incidence of myrtle wilt as a consequence of the harvesting disturbance, but natural processes of decline and death of older myrtles may also have contributed. There was significant loss of myrtle due to wilt. There was also significant loss of leatherwood and sassafras, which are not susceptible to wilt, but die nonetheless. Elliott *et al.* (2005) found that myrtle wilt was responsible for the death of about half of the trees retained in Area 1, but noted that over the same period about one-third of the trees in the control area (Area 9) had also died. This accords with Blakesley's (1980) view that the forest comprised many mature and over-mature myrtles – the latter are known to be more susceptible to wilt.

The regrowth is much less susceptible. Just one tree, probably coppice, was noted to have all the signs of myrtle wilt (brown leaves, beetle exit holes), and was dying.

The low count in 1982 (Table 11) is a consequence of beauty being in the eye of the beholder. Six trees which were recorded as sick in 1982, have since recovered and in both 2004 and 2019 were recorded as healthy.

A number of sassafras and leatherwood trees have died over the 40 or so years since the transect was established. The rate of decline of these two species appears to have slowed over the last 15 years during which time just three sassafras and two leatherwood trees have died. It was noticed whilst remeasuring the transect that there were many regrowth trees (myrtle, sassafras and leatherwood) in the range of 15 to 25 cm dbh that had established since the transect was first established.

## FLORISTICS

In the first few years after the various disturbances caused by the harvesting, the trial site was colonised by a variety of colonising species: *Cassinia aculeata* (daisy bush), *Olearia lirata* (dusty miller), *Senecio* spp. (fire weeds), *Acaena nova-zelandiae* (buzzy), a number of different herbs and rushes and of course *Gahnia grandis* (cutting grass) which flourished abundantly and to the pleasure of all going by the notes in the old field books. At the same time, a variety of shrubs more typical of wet eucalypt forest established and these are still there, but generally uncommon: *Pomaderris apetala*, *Pittosporum bicolor*, *Olearia argophyll*a and so on. (see Table 12 above for a full floristics list)

The early colonisers have now all but disappeared. In some scattered locations the last few leaves of cutting grass are still green, but it is never an impediment to progress. The forest floor is now dominated by leaf litter, and the twig mulch that is typical of dense myrtle regeneration. A bryophyte layer has re-established, notably on the larger logs left behind after the harvesting, and on the stumps of the larger trees. Both sites are also being steadily colonised by filmy ferns, particularly *Hymenophyllum cupressiforme* and *H. rarum*. Hickey (1994), noted that the lack of epiphytic ferns was a distinguishing difference between post-wildfire regeneration and post-harvesting regeneration. In this instance the close proximity of large areas of unharvested forest means that there is a rich source of spores for the epiphytic ferns, and over 40 years the conditions beneath the canopy have grown to their liking.

The diversity of shrubs is highest in Area 5 (clearfell, high intensity burn), and reflects the fact that the range of shrubs which established following the disturbance, have persisted to date. The diversity of ferns is highest in the control area, but as noted above, the epiphytic ferns are establishing strongly throughout the trial in the disturbed areas.

The site is/was/always has been dominated by myrtle, but leatherwood is persisting. Sassafras is sparse, and the celery-top pine, which is also sparse appears in many places to be struggling with the extremely low light levels under the dense myrtle canopy.

# 5. REFERENCES


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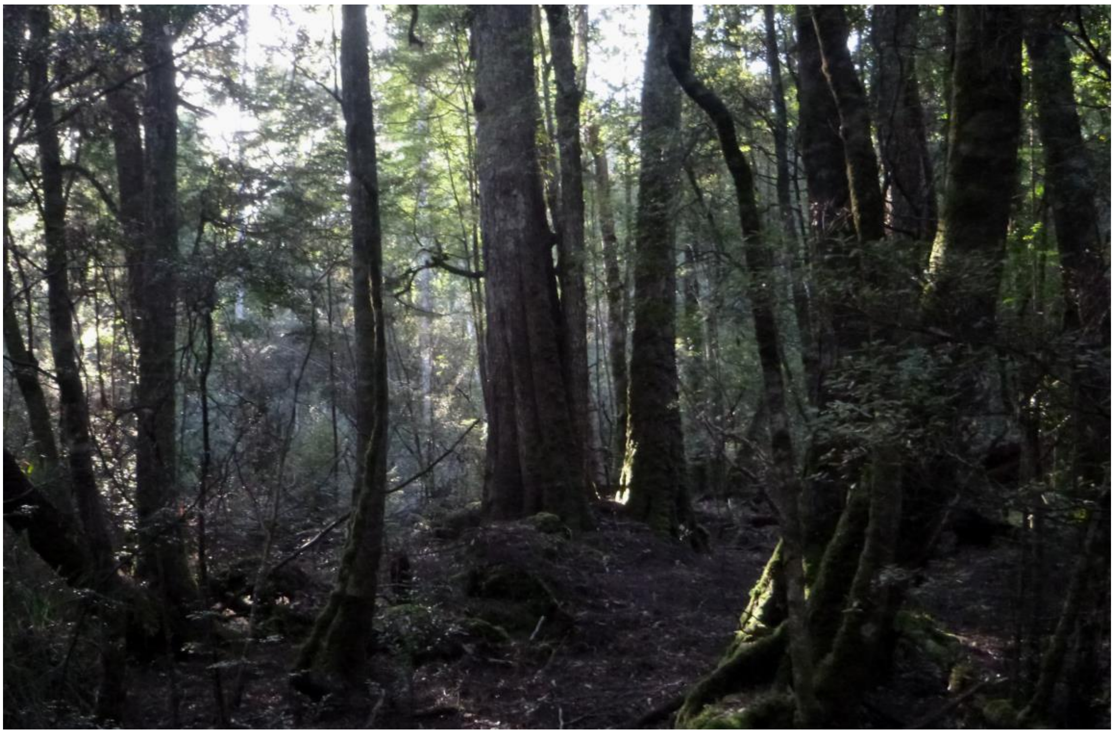
# 6. PHOTO ALBUM

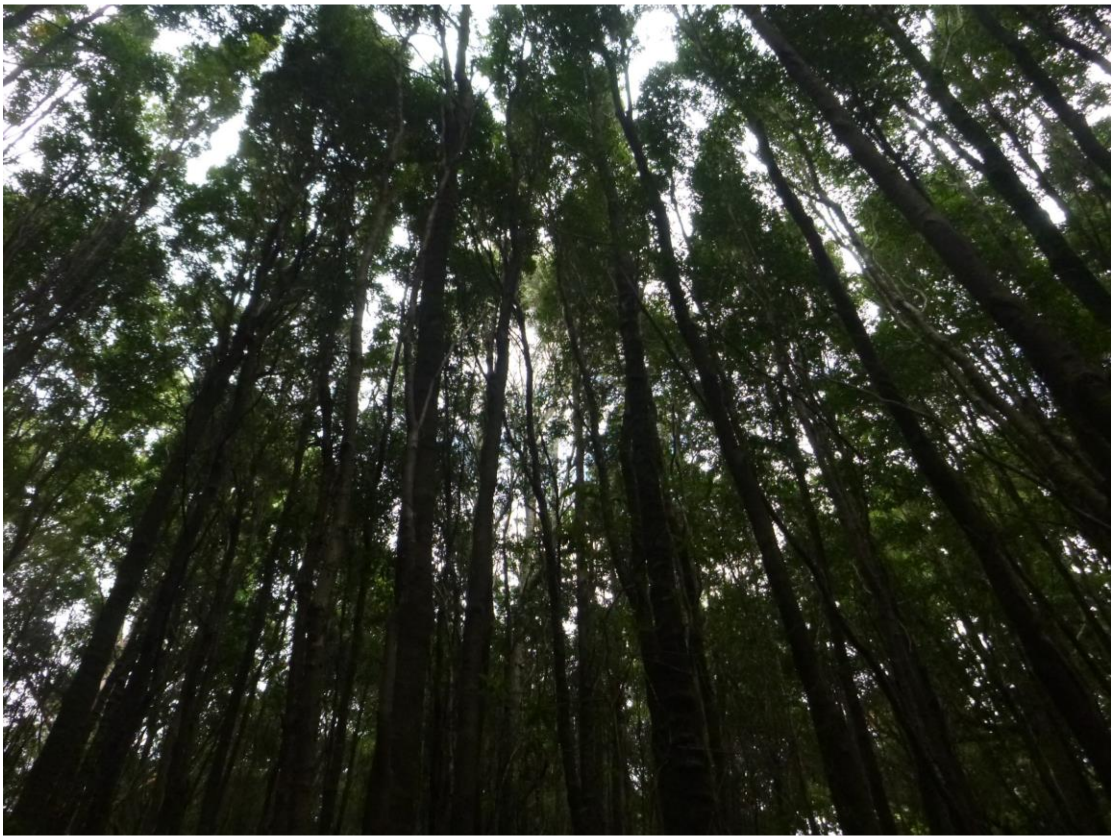


Area 1. Selectively sawlogged. An undisturbed area showing the range of stem sizes present.

Area 1. Selectively sawlogged. Probably disturbed during the harvesting, as evidenced by the abundant regrowth, and the now dead and dying bases of cutting grass.

Area 2. Strip-felling. Dense myrtle regrowth in a heavily disturbed area. The coarse woody debris left after the harvesting is now important habitat for bryophytes and filmy ferns.

Area 2. Strip-felling. Heavily disturbed area now well stocked with myrtle poles. The sticks on the forest floor are a consequence of the self-thinning process that is rapidly reducing the stand density.



Area 2. Strip-felling. Heavily disturbed. Dense myrtle pole stand such as this now occur throughout the trial wherever there was both disturbance and a seed source.

Area 3. The original snig track is still clearly evident.

Area 5. Clearfelling. Heavily disturbed and burnt in a high intensity burn. The regeneration was never as thick in the area as seed supply was limited to that coming in from adjacent unharvested forest. The larger tree to the left in the image is actually four-stemmed and is coppice.

Area 9. Control area. Myrtle, sassafras and leatherwood over ferns.