PLANT COMMUNITIES OF GREENSTONE HILLS OF THE
EASTERN GOLDFIELDS OF WESTERN AUSTRALIA AS
ANALOGUES FOR THE REHABILITATION OF ROCKY WASTE
DUMPS

This thesis is presented for the degree of
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Submitted by
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Frontispiece: Mt. Burges rising above the plain to the northwest of Coolgardie, Western Australia.
I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

........................................

Shane Thomas Samuel Chalwell
Abstract

The vegetation of greenstone hills in the Kalgoorlie area of the Eastern Goldfields region of Western Australia was studied to identify the key environmental influences on community and species distribution. This information was needed to determine if plant communities of the hills could provide analogues for the rehabilitation of waste rock dumps that are produced as a consequence of open cut mining.

The ridges, slopes and flats adjacent to the main slope were examined and the floristic data sorted into communities. Two structurally and floristically distinct alliances were identified, one dominated by eucalypt species and the other by *Acacia quadrimarginea*. The eucalypt woodland displayed a taller upper stratum and few groundlayer species and was the dominant vegetation of the flats at the base of the hills. The acacia community was a low woodland and is the dominant vegetation of the hill slopes. Both communities were dominant at an equal number of sites on the ridges of the hills.

An investigation of the environmental variables found that edaphic, rather than topographic, factors were responsible for the community distribution on the hills. The eucalypt woodland showed a strong affinity to soils derived from calcrete, which had higher levels of electrical conductivity and lower exchangeable sodium percentages than the soils of the acacia low woodland. Under such conditions, the clay fraction of the soil remains in a more flocculated state allowing higher rates of water infiltration and hydraulic conductivity compared to the acacia soils. Soil nutrients were found to have a secondary influence on community distribution and had a greater effect on species distribution within alliances.
A study of the seasonal variation in water content of the soils showed that more moisture is retained in the upper soil horizons in the acacia community than in the eucalypt community during the wetter part of the year, indicating the acacia soils had poorer infiltration properties than the eucalypt soils. The distribution of drought tolerant species such as *A. quadrimarginea* and *Prostanthera incurvata* was found to be correlated to soil moisture content of the dry season whilst no correlation was found for the eucalypts at any time of the year.

Seasonal comparisons of leaf moisture content and xylem pressure potential showed that the eucalypts maintained their total leaf moisture content throughout the year whereas species such as *A. quadrimarginea* and *Allocasuarina campestris* recorded high levels of desiccation of their leaf tissue over the summer. The eucalypts also maintained a more consistent pre-dawn xylem pressure potential throughout the year than either *A. quadrimarginea* or the shrub species *Dodonaea microzyga*, indicating a greater degree of stomatal control and access to a more consistent soil water supply. The eucalypts require access to a greater soil volume than the acacias or shrubs in order to ensure sufficient water supplies for the maintenance of tissue moisture levels throughout the year. In this way, the eucalypts are able to effectively avoid the summer drought, whereas the acacias and shrubs are able to tolerate desiccation of their leaf tissues over this period.

Investigations of the germination requirements and early seedling survival of prominent species from the greenstone hills indicated that fire may be a factor in the regeneration of most hills species. All studied species were either tolerant of or responded positively to the application of dry heat. In relation to seedling establishment on waste dumps,
increasing the soil moisture content of waste dump soils increased the germination rate of most species but did not result in greater seedling survival at the end of the first summer. The provision of microsites which encouraged root development and provided protection for the young seedlings was found to be more important in reducing mortality rates in the first year than increasing the total germination.

The study emphasized the importance of physical soil factors and the soil moisture regime in the distribution of eucalypt and acacia communities on the greenstone hills. A species’ response to drought stress strongly influences its ability to compete for soil water on different soil types. The eucalypts studied in this project dominated on soils where there is better recharge of subsoil water reserves which can be accessed over the summer period to maintain tissue water levels. Acacias are tolerant of tissue desiccation and will compete successfully on shallower soils and where hydraulic conductivity is poor.

Although the project was valuable in identifying water relations as the main control on community distribution on the hills, waste dumps are not strictly analogues of intact greenstone hills due to the differences in rock type and profile formation. Electrical conductivity levels are also higher due to extraction processes. However, the environmental relationships of the different species show that the more drought tolerant species such as *Allocasuarina campestris*, *Acacia quadrimarginea* and understorey species associated with them, may be suitable species to form the basis of vegetation re-instatement on waste dumps in the Kalgoorlie region.
# Table of contents

Abstract ........................................................................................................................................ iii

List of figures ................................................................................................................................ xi

List of tables ................................................................................................................................... xv

Acknowledgements .................................................................................................................... xvii

Chapter 1: INTRODUCTION ......................................................................................................... 1

1.1 STUDY CONTEXT .................................................................................................................. 1

1.2 THESIS OBJECTIVES ......................................................................................................... 6

1.3 DESIGN CONSIDERATIONS ............................................................................................... 7

1.4 STRUCTURE OF THE THESIS ............................................................................................ 9

Chapter 2: ENVIRONMENTAL SETTING .................................................................................... 10

2.1 CLIMATE ............................................................................................................................. 10

2.2 GEOLOGY ............................................................................................................................ 11

2.3 LANDFORM ........................................................................................................................ 12

2.4 VEGETATION ...................................................................................................................... 13

Chapter 3: VEGETATION ............................................................................................................. 16

3.1 INTRODUCTION .................................................................................................................. 16

3.2 METHODS .......................................................................................................................... 18

3.2.1 Site Selection ................................................................................................................ 18

3.2.2 Vegetation ..................................................................................................................... 19
3.2.3 Data Analysis .................................................................................................. 21

3.3 RESULTS .............................................................................................................. 22

  3.3.1 Vegetation Alliances ....................................................................................... 22
  3.3.2 Description of Associations ............................................................................ 28
  3.3.3 Ordination of Sites .......................................................................................... 30
  3.3.4 Similarity of Associations ............................................................................... 32

3.4 DISCUSSION ........................................................................................................ 35

3.5 CONCLUSION ...................................................................................................... 40

Chapter 4: SOILS .......................................................................................................... 41

  4.1 INTRODUCTION .................................................................................................... 41
  4.2 METHODS ............................................................................................................. 45
    4.2.1 Field Methods ............................................................................................... 45
    4.2.2 Laboratory Analysis Methods ....................................................................... 46
  4.3 RESULTS ................................................................................................................. 50
    4.3.1 Soil Profiles of Slopes .................................................................................. 50
    4.3.2 Statistical Analyses of Soil Variables ........................................................... 53
    4.3.3 Principal Components Analysis ................................................................... 57
  4.4 DISCUSSION .......................................................................................................... 61
  4.5 CONCLUSION ...................................................................................................... 68

Chapter 5: SOIL MOISTURE CONTENT AND SPECIES DISTRIBUTION ...... 70

  5.1 INTRODUCTION .................................................................................................... 70
  5.2 METHODS ............................................................................................................. 72
5.3 RESULTS .................................................................................................................73
  5.3.1 Canopy Cover .................................................................................................73
  5.3.2 Soil Depth and Soil Moisture .........................................................................74
  5.3.3 Topographic Comparisons .............................................................................74
  5.3.4 Species distribution and soil moisture content ...............................................84

5.4 DISCUSSION ............................................................................................................86
  5.4.1 Soil Moisture Content .....................................................................................86
  5.4.2 Distribution .....................................................................................................88

5.5 CONCLUSION ..........................................................................................................90

Chapter 6: WATER RELATIONS OF SELECTED TREE AND SHRUB SPECIES

6.1 INTRODUCTION .....................................................................................................91

6.2 METHODS ..............................................................................................................93

6.3 RESULTS ...............................................................................................................97
  6.3.1 Total Leaf Moisture Content ........................................................................97
  6.3.2 Seasonal Patterns of Xylem Pressure Potential ..........................................100
  6.3.3 Daily Patterns of Xylem Pressure Potential ...............................................102

6.4 DISCUSSION .........................................................................................................108
  6.4.1 Total Leaf Moisture Content .......................................................................108
  6.4.2 Pre-Dawn Xylem Pressure Potential ($\psi_{pd}$) ...........................................109
  6.4.3 Diurnal Xylem Pressure Potentials .............................................................112

6.5 CONCLUSION .......................................................................................................113
Chapter 7: CONTROLS ON THE GERMINATION OF SELECTED GOLDFIELDS SPECIES

7.1 INTRODUCTION

7.2 METHODS

7.2.1 Species Selection

7.2.2 Glasshouse Trials

7.2.3 Thermal Shock Treatment

7.2.4 Field Trials

7.2.5 Statistical Analyses

7.3 RESULTS

7.3.1 Glasshouse Germination

7.3.2 Thermal Shock Treatment

7.3.3 Field Trials

7.3.4 Summer Seedling Mortality

7.4 DISCUSSION

7.4.1 Glasshouse Germination

7.4.2 Thermal Shock Treatment

7.4.3 Field Trials

7.5 CONCLUSION

Chapter 8: GENERAL DISCUSSION

8.1 ENVIRONMENTAL CONTROLS ON THE PLANT COMMUNITIES

8.2 IMPLICATIONS FOR MINESITE REHABILITATION
REFERENCES ........................................................................Error! Bookmark not defined.

Appendix 1. Species list for the greenstone hills.........................CD (back cover)

Appendix 2. Soil data for each study site.................................CD (back cover)

Appendix 3. Species foliage projective cover data for each study site...CD (back cover)
List of Figures

FIGURE 3.1: LOCATION MAP OF GREENSTONE HILLS SELECTED FOR STUDY ................................................ 20

FIGURE 3.2: TYPICAL VEGETATION PATTERN OF THE GREENSTONE HILLS IN THE KALGOORLIE REGION ... 23

FIGURE 3.3: EUCALYPTUS GRIFFITHSII AND E. OLEOSA WOODLAND ON THE RIDGE OF COMET HILL .......... 24

FIGURE 3.4: ACACIA QUADRIMARGINEA LOW WOODLAND OVER PROSTANTHERA INCURVATA AT COMET HILL. ........................................................................................................................................... 25

FIGURE 3.5: THE FIRST TWO AXES OF A THREE DIMENSIONAL NON-METRIC MULTI-DIMENSIONAL SCALING
ORDERING OF THE COVER DATA OF THE FOUR PLANT ASSOCIATIONS IDENTIFIED ON THE
GREENSTONE HILLS (STRESS = 0.12). ................................................................................................................. 31

FIGURE 4.1: SOIL PROFILE FROM BENEATH A EUCALYPTUS GRIFFITHSII CANOPY ON THE RIDGE OF Mt.
CARNAGE. NOTE THE HIGHLY WEATHERED ROCKS WITH CARBONATE COATINGS.............................. 51

FIGURE 4.2: SOIL PROFILE FROM BENEATH A EUCALYPTUS TORQUATA CANOPY AT THE BASE OF Mt. Eaton.
......................................................................................................................................................................... 51

FIGURE 4.3: SOIL PROFILE FROM BENEATH AN ACACIA QUADRIMARGINEA CANOPY ON THE SLOPE OF EMU
HILL........................................................................................................................................................................ 52

FIGURE 4.4A: BIPLOT OF AXIS 1 VERSUS AXIS 2 OF THE PRINCIPAL COMPONENTS ANALYSIS OF THE SOIL
VARIABLES FROM THE GREENSTONE HILLS. ARROWS REPRESENT THE SOIL VARIABLES; ♦ A.
QUADRIMARGINEA SHRUBLAND; ▲ ALLOCASUARINA CAMPESTRIS THICKET SITES; □ E. GRIFFITHSII
WOODLAND SITES AND ○ E. TORQUATA WOODLAND SITES........................................................................... 59

FIGURE 4.4B: BIPLOT OF AXIS 1 VERSUS AXIS 3 OF THE PRINCIPAL COMPONENTS ANALYSIS OF THE SOIL
VARIABLES FROM THE GREENSTONE HILLS. ARROWS REPRESENT THE SOIL VARIABLES; ♦ A.
QUADRIMARGINEA SHRUBLAND; ▲ ALLOCASUARINA CAMPESTRIS THICKET SITES; □ E. GRIFFITHSII
WOODLAND SITES AND ○ E. TORQUATA WOODLAND SITES. PRINCIPAL COMPONENTS ANALYSIS OF
ENVIRONMENTAL VARIABLES OF THE GREENSTONE HILLS ....................................................................... 60

FIGURE 5.1: EXAMPLE OF THE EUCALYPT CANOPY COVER AT COMET HILL. PERCENTAGE CANOPY COVER IS
56.3% IN THIS PHOTOGRAPH ......................................................................................................................... 76
FIGURE 5.2: Example of the Acacia canopy cover at Comet Hill. Percentage canopy cover is 45.1% in this photograph. ............................................................................................................. 76

FIGURE 5.3: Mean soil moisture content of eucalypt (n=39) and Acacia (n=111) communities across dry and wet seasons at Mt. Burges, Mt. Eaton and Comet Hill at a depth of 15cm. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 79

FIGURE 5.4: Soil moisture content at 30cm of depth for the eucalypt and Acacia communities. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 80

FIGURE 5.5: Soil moisture content at 15cm depth for the Acacia and eucalypt communities at Comet Hill. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 81

FIGURE 5.6: Soil moisture content at 15cm depth for the Acacia and eucalypt communities at Mt. Burges. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 81

FIGURE 5.7: Soil moisture content at 15cm depth for Acacia and eucalypt communities at Mt. Eaton. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 82

FIGURE 5.8: Soil moisture content of soils at 15cm and 30cm of depth in the eucalypt community for all sites throughout the year. An asterisk indicates no significant difference between the two communities for that month. .............................................................................................................................. 83

FIGURE 6.1: Monthly total rainfall for 1998 for Kalgoorlie, the nearest reporting station to Mt. Burges. ................................................................................................................................ 96

FIGURE 6.2: Total moisture content of eucalypt leaves throughout the year for all sites where found. ........................................................................................................................................... 98

FIGURE 6.3: Total moisture content of Acacia quadrifolia leaves for all hills throughout the year. ........................................................................................................................................... 98
FIGURE 6.4: TOTAL MOISTURE CONTENT OF _Allocasuarina campestris_ BRANCHLETS FOR ALL HILLS THROUGHOUT THE YEAR. .................................................................................................................... 99

FIGURE 6.5: PRE-DAWN XYLEM PRESSURE POTENTIALS FOR _E. griffithii, A. quadrilmarginera_ AND _D. microzyga_ ON THE Mt Burges ridge THROUGH THE COURSE OF THE YEAR. BETWEEN SEASONS AND WITHIN SPECIES, DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.01). WHERE NO RESULT IS GIVEN, READINGS WERE BEYOND THE RANGE OF THE APPARATUS. 101

FIGURE 6.6: PRE-DAWN XYLEM PRESSURE POTENTIALS FOR _E. griffithii, A. quadrilmarginera_ AND _D. microzyga_ ON THE Mt Burges SLOPE THROUGH THE COURSE OF THE YEAR. BETWEEN SEASONS AND WITHIN SPECIES, DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.001). WHERE NO RESULT IS GIVEN, READINGS WERE BEYOND THE RANGE OF THE APPARATUS. ............................................................................................................................... 101

FIGURE 6.7: PRE-DAWN XYLEM PRESSURE POTENTIALS FOR _E. griffithii, A. quadrilmarginera_ AND _D. microzyga_ AT THE BASE OF Mt Burges THROUGH THE COURSE OF THE YEAR. BETWEEN SEASONS AND WITHIN SPECIES, DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.05) ........................................................................................................................................ 103

FIGURE 6.9: DAILY VARIATION IN XYLEM PRESSURE POTENTIAL OF SPECIES ON THE Mt Burges SLOPE DURING WINTER. DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.05). ASTERISKS REPRESENT SIGNIFICANT DIFFERENCES (p<0.05) BETWEEN _E. griffithii_ AND THE OTHER SPECIES........................................................................................................................................ 104

FIGURE 6.10: DAILY VARIATION IN XYLEM PRESSURE POTENTIAL OF SPECIES ON THE Mt Burges BASE DURING WINTER. DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.05) BETWEEN TIMES WITHIN EACH SPECIES. ASTERISKS REPRESENT SIGNIFICANT DIFFERENCES (p<0.05) BETWEEN _E. griffithii_ AND THE OTHER SPECIES............................................................. 105

FIGURE 6.11: DAILY VARIATION IN XYLEM PRESSURE POTENTIAL OF SPECIES ON THE Mt Burges RIDGE DURING SPRING. DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (p<0.05) BETWEEN TIMES WITHIN EACH SPECIES. ASTERISKS REPRESENT SIGNIFICANT DIFFERENCES (p<0.05) BETWEEN _E. griffithii_ AND THE OTHER SPECIES.................................................................................. 106
FIGURE 6.12: DAILY VARIATION IN XYLEM PRESSURE POTENTIAL OF SPECIES ON THE Mt BURGES SLOPE DURING SPRING. DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (P<0.05) BETWEEN TIMES WITHIN EACH SPECIES. ASTERISKS REPRESENT SIGNIFICANT DIFFERENCES (P<0.05) BETWEEN E. GRIFFITHSII AND THE OTHER SPECIES............................................................. 107

FIGURE 6.13: DAILY VARIATION IN XYLEM PRESSURE POTENTIAL OF SPECIES AT THE BASE OF Mt BURGES DURING SPRING. MEASUREMENTS FOR E. GRIFFITHSII WERE OUTSIDE THE RANGE OF THE INSTRUMENT FROM EARLY MORNING. DATA POINTS WITH THE SAME LETTER CODE ARE SIGNIFICANTLY DIFFERENT (P<0.05) BETWEEN TIMES WITHIN EACH SPECIES. ASTERISKS REPRESENT SIGNIFICANT DIFFERENCES (P<0.05) BETWEEN E. GRIFFITHSII AND THE OTHER SPECIES............................................................. 107

FIGURE 7.1: MEAN GERMINATION PERCENTAGE OF SELECTED GOLDFIELDS WOODY PERENNIAL SPECIES GROWN UNDER OPTIMAL CONDITIONS IN A GLASSHOUSE IN WASTE DUMP SOIL. .............................. 122

FIGURE 7.2: BAR GRAPHS OF SEEDS OF GREENSTONE HILLS SPECIES SUBJECTED TO THERMAL SHOCK OF DIFFERENT TEMPERATURES AND DURATIONS (±SE). AN ASTERISK REPRESENTS A SIGNIFICANT DIFFERENCE FROM THE CONTROL (P<0.05) AND DATA POINTS WITH THE SAME LETTER CODE ARE NOT SIGNIFICANTLY DIFFERENT FROM EACH OTHER................................................................................ 124

FIGURE 7.3: SOIL MOISTURE CONTENT UNDER EACH SOIL TREATMENT ON THE Mt. PERCY WASTE DUMP GERMINATION TRIALS IN OCTOBER AND DECEMBER. ................................................................. 129

FIGURE 7.4: SEEDLING MORTALITY OF SELECTED SPECIES IN DIFFERENT SURFACE SOIL TREATMENTS OVER THE FIRST SUMMER, EXPRESSED AS THE PERCENTAGE OF SURVIVING SEEDLINGS FROM THE ORIGINAL SEED SOWN. ........................................................................................................................................ 132
List of Tables

**Table 2.1:** Climatic data for Kalgoorlie Airport ....................................................... 11

**Table 3.1:** Sorted two-way table of the Greenstone Hills sites showing Domin values of foliage projective cover.................................................................................. 26

**Table 3.2:** Pairwise R-values of dissimilarity between the different communities from the ANOSIM analysis .............................................................. 33

**Table 3.3:** The mean basal area (m²/ha±SE) of each topographic position for each species of Eucalypt found on the Greenstone Hills ........................................... 34

**Table 3.4:** Mean density (individuals/ha±SE) for selected shrub species (n≥10) on the Greenstone Hills. ............................................................... 35

**Table 4.1:** Mean values (±SE) of soil variables for each plant community..... 54

**Table 4.2:** Pearson product moment correlation (R) between selected soil variables. ............................................................... 55

**Table 4.3:** Cumulative fraction of variance (R² adj) explained by each of the first three axes in the PCA of the soil variables ........................................ 61

**Table 5.1:** Mean soil moisture % (±SE) at 15cm depth (n=15) and 30cm depth for each topographic site for each season........................................... 77

**Table 5.2:** Mean soil moisture contents (gravimetric % at a depth of 15cm) for sites where each species was present compared to sites where the species was absent ......................................................... 85

**Table 6.1:** General atmospheric conditions and time of sunrise for each day of xylem pressure potential measurement at Mt. Burges. ......................... 95
<table>
<thead>
<tr>
<th>Table 6.2: Total moisture content (%) of the leaves of several shrub species from the Greenstone Hills.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 6.3: The range of DBH and total basal area of sampled <em>E. griffithsii</em> trees at the three landscape positions on Mt. Burges.</td>
</tr>
<tr>
<td>Table 6.4: Daily variation in xylem pressure potential (MPa) for <em>E. griffithsii</em> at all sites at Mt. Burges in February.</td>
</tr>
<tr>
<td>Table 7.1: Estimated numbers of seeds of each species included in the seed mixes used for the field trials on a waste rock dump at Mt. Percy, Kalgoorlie.</td>
</tr>
<tr>
<td>Table 7.2: Germination percentages (±SE) of each species or species group in different surface treatments on the rocky waste dump at Mt. Percy, Kalgoorlie.</td>
</tr>
</tbody>
</table>
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