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WORK EXPERIENCE REPORT

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SCHOOL OF ENVIRONMENTAL BIOLOGY

<u>WORK EXPERIENCE 301 REPORT</u>

"Research Assistant For CALM Tree Research"

Student : Helen Abbott

Employer : Patrick Pigott

Duration : January 20 - February 15 1992

CONTENTS

INTRODUCTION

This report is for the third year unit, Work Experience 301, which forms an optional component of the Bachelor of Applied Science (Biology) degree at Curtin University.

My work experience was undertaken at the Department of Conservation and Land Management (CALM) research station at Narrogin in the wheatbelt. CALM has three major roles in the wheatbelt region:

1) to conserve the flora, fauna and natural landscapes of the region. CALM manages a million hectares of land within the region, mainly for nature conservation, and is also responsible for protecting native flora and fauna throughout the state.

2) to regulate timber production in State forests and encourage tree planting for conservation and production on private land. The timber industry is based on brown mallet in State forests near Narrogin. Tree planting on private land is encouraged by:
   (a) providing trees for sale through the nursery at Narrogin.
   (b) advising on tree planting, especially through the advisory officer at Narrogin; and
   (c) researching the establishment, protection and

utilization of trees in the Wheatbelt.

3) to improve the recreational and educational experiences of people in the region. This includes establishing and maintaining picnic sites, nature trails and other facilities, and assisting educational groups.

I worked as a research assistant for tree scientist Patrick Pigott in assistance with his research programme on the ecology and management of salmon gum woodlands, for approximately four weeks. During my work experience I also interacted with other staff of both the Department of Agriculture and CALM.

The main task of my work experience was to prepare for and carry out a small project on the water relations of the dominant species within a salmon gum woodland. An experimental write up of this project forms a major part of this report.

DIARY OF ACTIVITIES

Week One (Mon Jan 20 - Fri Jan 24)

Patrick showed me around the other Narrogin offices, which consisted of the District Office, Tree Nursery and Regional Headquarters and introduced me to all the CALM staff.

I was introduced to different areas of current and proposed study in the Tooliban and Taarblin Lake catchments. The different projects were discussed by Patrick and forester, Greg Durell, from the CALM nursery as we drove around. We looked at the methods of controlling waterlogging and salinity being carried out in the area.

Shallow surface drains have been constructed which are effective in removing perched water from seasonally waterlogged areas. This also decreases the likelihood of groundwater recharge which is what brings dissolved salts to the surface and results in salinity.

Groundwater is presently being pumped away from a critical part of Tooliban Lake which is at risk of becoming saline due to increasing water table levels from the extensive clearing of native vegetation in the area. The rate of water being pumped is determined by a meter established at the site which is checked every few weeks to make sure the rate is kept constant. Bores are established throughout the area to monitor the variation in the water table. Water table measurements since 1977 have shown that at the north end of the Tooliban Lake Reserve the saline watertable is rising at about 10 cm per year.

Direct seeding of native trees on old farmland have been operating since 1985, with much success. Eight farmers with salt affected land adjoining Tooliban Lake have co-operated with the WA Dept. of Agriculture in planting rows of trees 25 metres apart across all their saltland. The trees are five metres apart along the rows. The main trees used have been flat-topped yate (Eucalyptus occidentalis) and salt sheoak (Casuarina glanca), both highly salt-tolerant WA species. In the three years since the project started 47,000 trees have been planted over 400 hectares of land. In addition saltbush has been seeded on 400 hectares between the tree rows to provide a surface mulch which will reduce salt accumulation on the soil surface and provide useful grazing for the farmers' sheep. To enable the salt-affected area to be control grazed, 30 cm of fencing has been erected by the farmers.

Greg was interested in the possibility of fire regeneration projects in different parts of forest around Tooliban Lake for regeneration of understorey. We looked at areas which had been burnt recently (in the last twenty years or so) and discussed the success of understorey regeneration.

The rest of the first week I spent reading different articles about the problems of the wheatbelt and the different projects being carried out by CALM.

Week Two (Tues Jan 28 - Fri Jan 31)

I spent the second week reading about my water potential project and planning the methods. I read some of Patrick's previous Research Project Plans which must be written and approved before any project work commences. I then attempted to write a research project plan, which is included in this report.

Stuart Crombie from CALM, Dwellingup, brought a pressure bomb along for us to use in our project, and instructed us how to use it. Stuart, Patrick and I then went out to the study site so we could discuss our procedure with Stuart. We also looked at other projects around the Tooliban and Taarblin catchments which interested Stuart, and so by this time I was becoming quite familiar with the area.

Week Three (Mon Feb 3 - Fri Feb 7)

Once a month Patrick has to weigh and calculate moisture content of samples of wood of different south-west species.

For example karri _(Eucalyptus diversicolor)_, jarrah _(E. marginata)_ and marri _(E. calophylla)_. I did this for January. Each block of wood is simply weighed and the weight recorded, then a formula is used which determines moisture content, using a given constant for each different species. When the experiment concludes the relative rates of drying for each species will be determined.

I spent a day with Peter White from Narrogin District Office who had some photography to be done on private land about 200 kilometres south of Narrogin. Early in 1991 it was reported by a property owner, that the canopies of randomly distributed eucalypts on his farmland were turning brown. Peter photographed the trees in February 1991 and the photographs clearly showed that the trees looked unhealthy. It was expected by Peter and the landowner that some of the younger trees would definitely die within the year. However, when we returned exactly twelve months later, all of the trees had completely recovered.

We also visited the property of the Vaux's, near Pingrup. This property has had a salt problem for a number of years and in recent years the owner's have begun to carefully plan their farming strategies. Accompanying Peter and I were valuable saltland advisers including a saltland agronomist, revegetation adviser and hydrologist. Between them, future revegetation strategies for the property were discussed and planned. Also discussed were the reasons why previous revegetation techniques had not been so successful.

Week 4 (Mon Feb 10 - Fri Feb 15)

On Monday February 10 we identified and tagged the trees we were to use in our project. I also spent some of the day practising with the pressure bomb, with leaf samples from trees around the office so I would be more accurate with measuring pressure potential.

On Tuesday February 11, Greg, Patrick and I arrived at the study site at about 4.15 am to take the samples. We arrived back at the office to measure the pressure potentials at about 6.30 am. Detail of these methods is provided in the report itself.

During the last few days of my work experience I photocopied material which I thought I may need to write up my report and material of value to my third year project. I experimented with the stereo microscope which allows aerial photographs to be viewed in three dimensions, so I could look at the study area. A photocopy of the aerial photograph of reserve 10521 is provided in Appendix 4. A map highlighting this reserve is provided in Appendix 5. I also looked through the herbarium Patrick has made of species of the nature reserve so I could get a closer look at the understorey species of the woodland and attempt to learn some of them.

Throughout my work experience I also carried out everyday office duties such as answering the telephone, photocopying and filing.

Department of Conservation and Land Management

Research Division, Narrogin Branch

Research Project Plan

SOHQ File No.

RPP No.

1. Title of Investigation:

Water Relations of Salmon Gum (Eucalyptus salmonophloia) Woodland species, south of Lake Tooliban, Western Australia.

Keywords:

salmon gum woodland, water potential

2. Aim:

The aim of this study is to determine a relationship between the water relations of the dominant trees of a salmon gum woodland.

3. Background/Justification:

Salmon gum (Eucalyptus salmonophloia) is widely spread across the Western Australian Wheatbelt in low to moderate rainfall zones (300-600 mm) and occurs on low lying flats suitable for agriculture. The use of salmon gum in agriculture is primarily to provide shelter for stock. (Pigott 1989)

This dryland forest type has been extensively cleared in the Western Australian Wheatbelt because originally farmers believed salmon gum was located on the 'better' soils, most appropriate for successful cropping. The widespread removal of vegetation has resulted in rising water table and salinity levels (Pigott 1989). As a consequence, remnant salmon gum woodland on private land is now an important area in nature conservation (Pigott 1989).

This study is to take place in a block of remnant salmon gum woodland which forms a part of nature reserve 10521, south of Tooliban Lake, Western Australia. The aim of the study is to determine a relationship between the water relations of the dominant trees of the woodland. No information on water relations of salmon gum has previously been recorded. The water use of these salmon gum woodland species may be useful at indicating which trees are the more effective in lowering the water table.

4. Target Users:

Interested Scientists

5. Supervising Scientist:

J.Patrick Pigott, Narrogin Research

6. Associated Staff:

Helen Abbott, student, Curtin University

Greg Durell, Forestry Department, Narrogin

7. Associated Institutions:

none

8. Locations:

Nature Reserve 10521, south of Tooliban Lake, near Narrogin.

9. Study Design:

Random trees within an approximately 20 m^2 site chosen such that at least one tree of each species (and relative age in the case of eucalypts) is widely spaced from the others.

10. Statistical Analysis:

Analysis of variance (ANOVA) and comparison of means.

11. Proposed date of commencement and expected duration of study:

10-11 Feb 1992

12. Method:

Tag trees with bright tape day prior to sampling (10 Feb)
Take two samples from each of three trees of each species, including both young and old in the case of eucalypts. To be sampled with pruner and ladder, and if necessary a shot gun. Wrap samples in plastic film and transfer to an insulated ice box. Take all samples back to laboratory to measure water potentials with Scholander type pressure chamber.

species to be sampled

salmon gum _(Eucalyptus salmonophloia)_ young and old

wandoo _(Eucalptus wandoo)_ young and old

jam _(Acacia acuminata)_

Acacia microbotrya

13. Reports:

Final report 3/4/1992, as Work Experience 301 report for Dr Jonathon D Majer, Curtin University.

14. Costs:

Transport (sites are 40 km from Narrogin) and material costs will be met from the existing budget for the research centre.

15. Other File numbers:

none

16. Signature of Supervising Scientist:

Date-

Attachments- none

17. Comments:

This project is not of large enough scale to form a C.A.L.M. project, so a research project plan is not formally required, but was carried out as part of my work experience.

WATER RELATIONS OF SALMON GUM (*Eucalyptus salmonophloia*) WOODLAND SPECIES, SOUTH OF LAKE TOOLIBAN, WESTERN AUSSTRALIA.

By HELEN ABBOTT

ABSTRACT

The pre-dawn water potentials of the dominant trees of a salmon gum woodland, in the Wheatbelt of Western Australia were determined for mid-February. Differences lied at genera level in that _Acacia_ species had lower mean water potentials than those of _Eucalyptus_ species. As there was no significant difference within the _Eucalyptus_ genera, between young and old species, it was concluded that age has no value in identifying differences in water potential, unless height can be significantly related to age. There were limitations to our experiment associated with the equipment and techniques.

INTRODUCTION

Salmon gum _(Eucalyptus salmonophloia)_ is widely spread across the Western Australian Wheatbelt in low to moderate rainfall zones (300 - 600 mm) and occurs on low lying flats suitable for agriculture. The use of salmon gum in agriculture is primarily to provide shelter for stock. (Pigott 1989)

This dryland forest type has been extensively cleared in the Western Australian Wheatbelt because originally farmers believed salmon gum was located on the 'better' soils, most appropriate for successful cropping. The widespread removal of vegetation has resulted in rising water table and salinity levels (Pigott 1989). As a consequence, remnant salmon gum on private land is now an important area in nature conservation (Pigott 1989).

This study took place on a block of remnant salmon gum woodland which forms a part of nature reserve 10521, south of Tooliban Lake. The aim of this study was to determine a relationship between the water relations of the dominant trees of the woodland. No information on water relations of salmon gum has previously been recorded. The water use of these salmon gum woodland species may be useful at indicating which species are the more effective in lowering the water table.

MATERIALS AND METHODS

Site Characteristics

The study area is part of the salmon gum woodland at nature reserve 10521, which is approximately forty kilometres due east of Narrogin (32°56'S, 117°11'E) in Western Australia.

The climate of this area is semi-arid and lies in the 400 mm /year rainfall zone. Rain fell two days prior to sampling.

The vegetation consists of a tall woodland dominated by salmon gum (*Eucalyptus salmonophloia*) and wandoo (*Eucalyptus wandoo*). Smaller trees include jam (*Acacia acuminata*) and *Acacia microbotrya*. A more extensive list of major tree and understorey species is provided in appendix 1.

The soils occur on flat valley floors. The gradients vary from 1 to 750 in 1,000. The profile is a very shallow sand over a dense, darkly mottled sandy clay subsoil. The deeper subsoil is mainly yellow clay with a few calcium carbonate segregations between 60 and 90 cm depth. A very shallow surface horizon produces an admixture of subsoil clay and results in a very hardsetting surface. (WA Dept Ag Report, 1991) A more detailed profile description is provided in appendix 2.

The top sandy soil has been reduced by degradation and grazing. The abundance of clay in the soil reduces deep root penetration and as a result, even the large trees are probably only shallow to medium rooted. (Piggot, pers. comm.)

Salinity, due to shallow surface groundwater may be a problem affecting the soils of this site. The groundwater level at this site would be about 170 cm.

<u>Plant Water Potentials</u>

Trees were identified and tagged with bright marking tape, the day prior to sampling so trees were easily recognised in predawn conditions.

Two samples were collected from each of three widely spaced trees of each species, including both young and old individuals for the eucalypts. Samples were representatives of recent growth which were from the outer edges of the canopy. Samples were collected with a pruner if practical and for those canopies out of reach a shot gun was used. Samples consisted of about five to six leaves and their associated twigs.

Sampling took place before dawn when changes were least expected as conditions were less desicating and stomata were closed (Crombie et al. 1988). Sampling took approximately 90 minutes and finished just before sunrise.

Samples were wrapped in plastic film to minimize desication, immediately after cutting, and then labelled accordingly. Samples were stored over ice in an insulated box and transferred to a fridge upon returning to the laboratory. Changes occuring during storage were considered acceptable as storage enabled the required number of samples to be collected in a reasonably short time (Crombie et al, 1988).

Plant water potentials were measured using a pressure chamber (Scholander et al. 1965). Instructions for operating the pressure chamber are provided in Appendix 3. The measurement of pressure potentials took about four hours for 36 samples.

Data Analysis

Data were analysed by analysis of variance using the minitab statistical package, a part of the VAX cluster at Curtin University.

RESULTS

Table 1. Predawn water potentials (-MPa) of trees of salmon gum woodland, February 1992

Values are the raw data of which replicates represent the second sample taken from each tree.
* Denotes not sampled

SPECIES	TREE NUMBER 1	2	3
E. salmonophloia	2.5	2.7	2.2
(old)	2.7	2.7	2.1
E. salmonophloia	2.3	2.5	2.5
(young)	2.7	2.5	2.3
E. wandoo	2.5	2.8	2.7
(old)	2.5	2.3	2.2
E. wandoo	2.6	2.0	1.8
(young)	2.5	2.3	2.7
A. acuminata	1.6	1.8	1.5
	1.7	*	1.4
A. microbotrya	1.7	1.7	1.8
	1.3	*	1.7

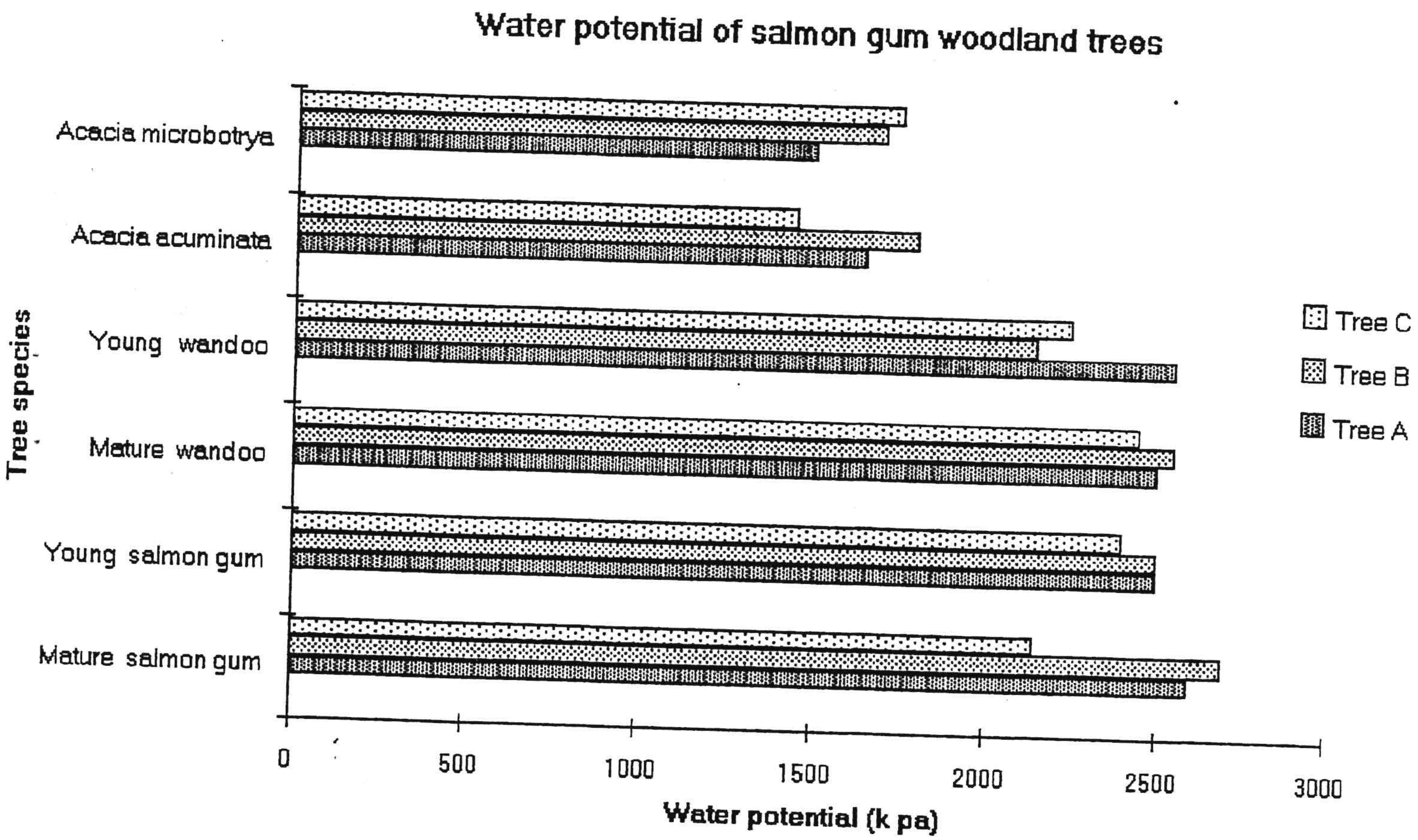
The water potential of *Acacia* trees measured were in the range of 1.3 - 1.8 -MPa. The water potential of *Eucalyptus* trees measured were in the range of 1.8 - 2.8 -MPa. Analysis of variance showed a significant difference ($p < 0.05$) between water potential of *Acacia* and *Eucalyptus* genera. That is, the mean Acacia water potential (1.62) was lower than the mean Eucalyptus water potential. (2.44)

Analysis of variance showed no significant difference ($p < 0.05$) between mean water potential of the different *Eucalyptus* species measured. Analysis of variance showed no significant difference ($p < 0.05$) between mean water potential of the different *Acacia* species measured.

Analysis of variance showed no significant difference ($p < 0.05$) between mean water potential of different trees of *Eucalyptus* measured. No statistical test was performed comparing mean water potential of different *Acacia* trees as repetitions were lacking, so insufficient data was available for a useful comparison.

Analysis of variance showed no significant difference ($p < 0.05$) between water potential of young and old *Eucalyptus* species.

Information on the water potential of E.wandoo has been recorded before. (Colquhoun et al, 1984) They found that in late summer the pre-dawn water potential of E.wandoo was 2.4. We found the mean pre-dawn water potential to be 2.41.



DISCUSSION

Height difference in trees, and the corresponding difference in height of water column in conductive tissues, has been shown to account for differences in leaf water potential. (Scholander et al. 1965)

The only difference of significance we found amongst our data was that the mean Acacia water potentials were lower than the mean Eucalyptus water potentials. This is due to the size differences of the trees. Whilst the eucalypts we measured were of very tall woodland stature, the acacias were only of medium height.

We found no significant difference between young and old eucalypts which is because the size difference was not large enough to result in variation in water potential. Age is therefore of little value in comparing water potential, unless age causes a significant differences in height.

No differences were found between water potentials of trees of the same genus which were located in different random positions throughout the site. This may suggest that the access to soil water of different trees does not vary much within this site.

In the study by Colquhoun et. al., in a jarrah (Eucalyptus marginata) forest, near Jarrahdale, Western Australia, the water potential of Eucalyptus wandoo was found to be in the range of our findings. It was suggested by Crombie (pers. com.), however, that the more eastern location of our study area should have resulted in lower water potentials (-MPa). This is because rainfall declines progressively to the east, so water potential is lower as the trees of the more arid areas are adapted to the availability of less water.

Limitations to our experiment lied in our inexperience with the equipment and techniques. Crombie (pers. com.) suggested that our sampling procedure may have resulted in higher water potentials than what would normally be expected. This is because some of the twigs we recut to reduce the sample size. This is not the most accurate technique as the initial cut causes the twig to be stressed and water moves away from the cut toward the leaves. Hence, if another cut is made closer to the leaves then the additional water which has moved into the leaves will result in a higher water potential for that sample.

My bombing technique should also have been done with more care as when unsuccessful on first attempt at measuring the water potential, rebombing had to be done. This takes time and meanwhile the leaf is heating up.

ACKNOWLEDGEMENTS

I would like to extend my sincere gratitude to my work experience supervisor, Patrick Pigott, for his time and patience. Special thanks are due also to Stuart Crombie for his invaluable advice and to Greg Durell for his assistance with the sampling procedures.

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APPENDIX 1

SPECIES LIST OF STUDY AREA, ORDERED ALPHABETICALLY BY SPECIES

(* Denote introduced species)

SPECIES NAME	FAMILY NAME
Acacia acuminata	Mimosaceae
Acacia erinacea	Mimosaceae
Acacia microbotrya	Mimosaceae
Aira caryophyllea *	Poaceae
Allocasuarina huegeliana	Casuarinaceae
Astroloma drummondii	Epacridaceae
Avena futua *	Poaceae
Brachycome iberidifolia	Asteraceae
Bromus rubens *	Poaceae
Conostylis prolifera	Haemodoraceae
Conostylis pauciflora	Haemodoraceae
Crassula colorata	Crassulaceae
Dampiera lavandulacea	Goodeniaceae
Danthonia caespitosa	Poaceae
Dianella revoluta	Phormiaceae
Eucalptus salmonophloia	Myrtaceae
Eucalyptus wandoo	Myrtaceae
Hibbertia rupicola	Dilleniaceae
Lepidosperma brunonianum	Cyperaceae
Lomandra micrantha	Dasypogonaceae
Lomandra sp.	Dasypogonaceae

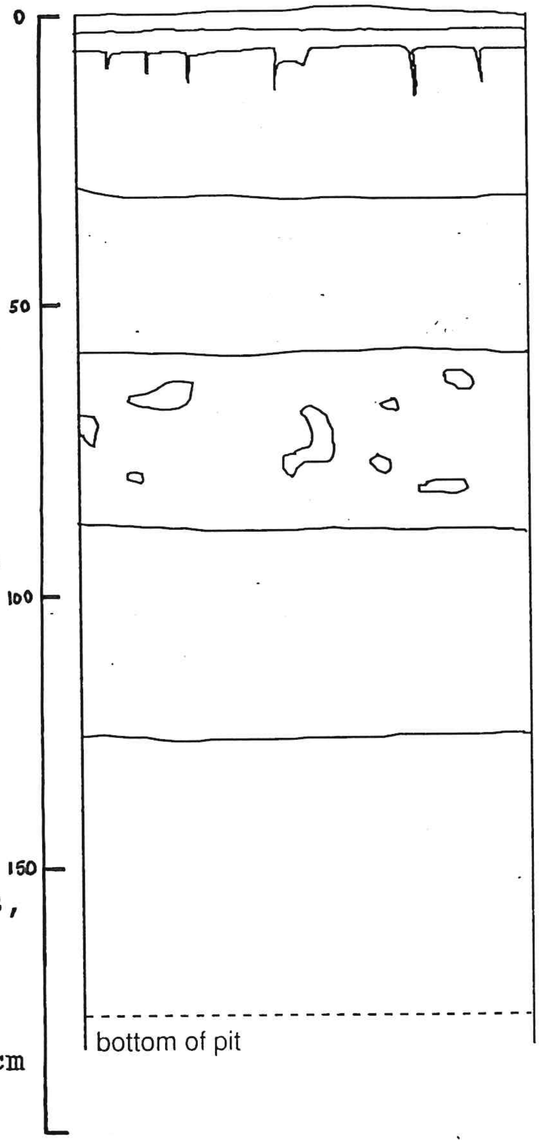
Stipa nitida	Poaceae
Stipa semibarbata	Poaceae
Templetonia sulcata	Papiliaraceae
Verticordia densiflora	Myrtaceae

APPENDIX 2

SOIL PROFILE DESCRIPTION OF SALMON GUM WOODLAND

Profile sketch (Figure 1) interprets the profiles presented in matching coloured photograph (Figure 2)

Figure 1



0-3 cm dark greyish brown sand, (pH 5.9 , $CaCl_2$ 4.6)

3-5 cm light brownish grey clayey sand (pH 6.2)

5-30 cm light brown/grey, distinct brown mottles, sandy clay, columnar structure (pH 7.4 , $CaCl_2$ 6.0)

30-60 cm light grey with few faint orange mottles, sandy clay (pH 9.3 , $CaCl_2$ 8.0)

60-90 cm yellow, distinct brown mottles, light/med clay, calcium carbonate nodules (pH 9.3 , $CaCl_2$ 8.2)

90-125 cm yellow-brown, grey mottles, clayey sand, very few quartz fragments (pH 9.1 , $CaCl_2$ 7.9)

125-175+ cm brownish yellow, grey mottles, med clay, few manganiferous segregations (pH 8.3 , $CaCl_2$ 7.6

Note: Sali ent at 170 cm

Figure 2

(taken from 'An introduction to the Soils of the Narrogin Advisory District)

APPENDIX 3

INSTRUCTIONS FOR USE OF PRESSURE BOMB

Water potential is that pressure needed to pull sap to the surface of the twig which contains the leaves, hence, the xylem tension of the leaves. The twig is held firmly in place within an insulated chamber, such that the movement of the sap can be directly viewed using a microscope which is positioned above. The instant the sap can be viewed at the cut surface of the twig the pressure is cut off and the pressure gauge is read.

(The following instructions were provided with the Bomb, by Dwellingup Research)

Air into and out of the bomb is controlled by the two quarter turn ball valves.

The rate of pressure increase is controlled by the double-sided needle valve (mounted near and to the left of the bomb) and the outlet pressure from the regulator.

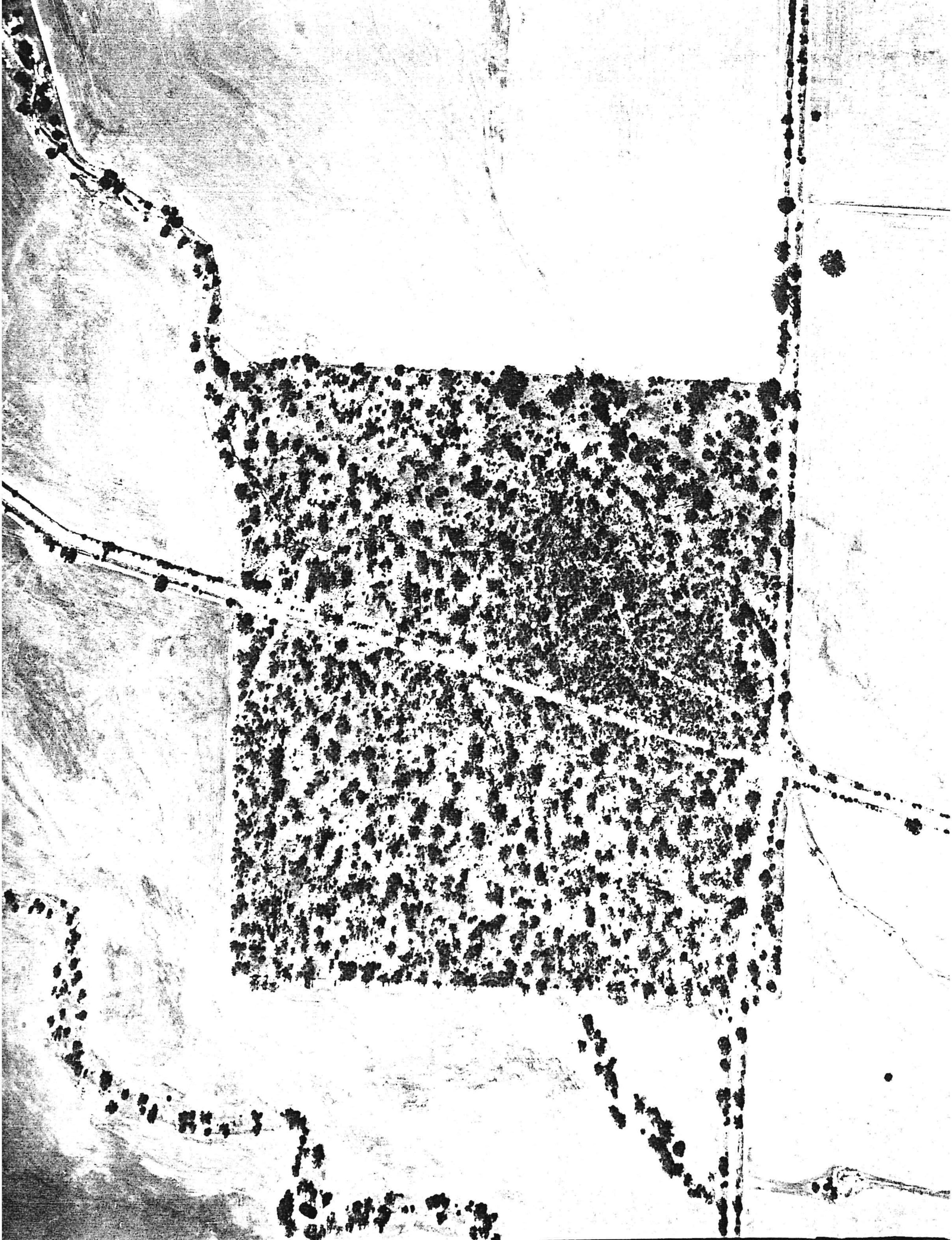
The valve functions like two needle valves in series. One needle sets the range of air flow possible and the second needle regulates flow within this range. If you screw the valves down to the bottom of their travel, don't tighten them as you may damage the needles and/or seats.

Regulator pressure should be set at about 3000 kPa and left there for the duration of the run. When putting the equipment into storage, shut the bottle valve off, release the pressure through the bomb and finally remove the regulator knob.

There is a pressure relief valve under the bomb platform. It releases at 4000 kPa, so there is no way to measure balance pressures over this limit. The only part of the system that can fail below 4000 kPa are pressure gauges which do not have ranges up to 4000 kPa. If you severely over-pressure a gauge you will risk injury from flying fragments.

Pressure gauges are only accurate between 10% and 90% of full scale. If you use a gauge beyond about two thirds of full scale you may change it's calibration and it's life will be shortened. Change gauges to operate within 10% to 70% of full scale.

APPENDIX 4 AERIAL PHOTOGRAPH OF RESERVE 10521



APPENDIX 5. Map of Narrogin Area. (Reserve 10521 is highlighted)