FORESTS DEPARTMENT – RESEARCH BRANCH

SUMMARY OF RESEARCH

JULY 1982 – OCTOBER 1983

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PREPARED FOR: 1983 RESEARCH CONFERENCE

VENUE: COMO TRAINING CENTRE

DATE: OCTOBER 18, 19, 1983

Appendix 3.

October 18, 1983 9.30 - 12.30

Symposium 1 — Dieback - where are we at?

Chair: J. Bartle

Speakers: (30 min each followed by 15 min discussion)

- B. Shearer - Site-factors affecting impact by *Phytophthora cinnamomi*.
- J. Tippett - Factors affecting the resistance of jarrah to *P.c.*
- M. Stukely - *Phytophthora* and pines.
- J. Havel - Future research direction (15 mins).

Discussion (30 mins).

October 18, 1983 1.30 - 4.30

Symposium 2 — Pine Nutrition - Growing pine on tricky sites.

Chair: G. Siemon

Speakers: (30 min each followed by 15 min discussion)

- T. Butcher - Establishment of *Pinus pinaster* on coastal plain.
- J. McGrath - Can tissue analysis predict nutrient deficiencies in *Pinus radiata*?
- R. Moore - The combination of trees, pasture, fertilizers and animals.
- J. Havel - Future research direction (15 mins).

Discussion (30 mins).

October 19, 1983 9.30 - 12.30

Symposium 3 — Priorities, problems and publications

Chair: T. Butcher

Speakers: (30 min each followed by 15 min discussion)

- J. Havel - Priorities and their derivation.
- R. Underwood - Transfer of research findings to operations.
- M. Lewis - Publishing your research - what does it involve?

Discussion and general forum for grizzles (30 min).

October 19, 1983 1.30 - 4.30

Symposium 4 — Fire regimes - Where does research go from here?

Chair: P. Christensen

Speakers: (30 min each followed by 15 min discussion)

- N. Burrows - Integrating fire management and land use planning.
- L. McCaw - Prescribed burning under dry conditions - implications of the Hakea fire.
- K. Low - Mild fuel reduction burns in karri regrowth - now and the future.
- R. Underwood - Future research direction (15 mins).

Discussion (30 mins).

CONTENTS

REPORT TO RESEARCH CONFERENCE, OCTOBER 1983

Ian Abbott, Como Research
Jarrah forest ecology

I spent the period July 1982 - August 1983 writing the following:

1. Influence of fire on growth rate, mortality, and butt damage in Mediterranean forest of Western Australia (with O. Loneragan).
2. Growth rate of jarrah (Eucalyptus marginata) coppice (with O.L.).
3. Growth rate of jarrah (Eucalyptus marginata) in relation to site quality in cut-over forest, Western Australia (with O.L.).
4. Growth rate of jarrah (Eucalyptus marginata) in relation to intraspecific competition (with O.L.).
5. Growth rate and long term population dynamics of jarrah (Eucalyptus marginata) regeneration in the northern jarrah forest of Western Australia (with O.L.).
6. Big trees of the northern jarrah forest (with O.L.).
7. Jarrahdale jarrah journey (O.L. as first author).
8. Ecological features of an outlying stand of jarrah (Eucalyptus marginata) at Jilakin Rock, Western Australia.
9. Aboriginal names for plant species in South-western Australia.
10. Review of "Resource Use by Chaparral and Matorall. A comparison of vegetation formation in two Mediterranean type ecosystems."
11. Seed dispersal and seedling establishment and growth of Banksia grandis in the northern jarrah forest of Western Australia.
12. Ecological characteristics of growth of Banksia grandis (Proteaceae) in the northern jarrah forest of Western Australia.
13. Reproductive ecology of Banksia grandis (Proteaceae).
14. Population dynamics of Banksia grandis in the northern jarrah forest of Western Australia.
15. Emergence, early survival, and growth of seedlings of six tree species in Mediterranean forest of Western Australia.
16. Pattern, structure, and tree composition in old growth and regrowth jarrah forest, Western Australia.
17. Effect of a moderate intensity fire on soil properties in the jarrah forest of Western Australia (with L. Wong).
18. Changes in the abundance and activity of certain soil and litter fauna in the jarrah forest of Western Australia after a moderate intensity fire.

Next year

This brings a major change in research direction, as I am to be responsible for forest entomology research. I intend to review what has been done in this field in W.A., liaise with the current entomologist before his retirement, and familiarize myself with the problems.

I also have a few other projects to write-up. These are mainly on the autecology of jarrah (with O.L.) and earthworms.

SANDALWOOD AND JARRAH SILVICS RESEARCH

Owen Loneragan
Como Research

Current Year (1982-83)

Earlier field work is being documented, the findings published and the current program maintained. The objective is to preserve the original data source, for further development of the long-term policy-objectives and strategies. Implementation of the most important and most valualbe work in State Forests cannot be validated should these records be lost.

Earlier field work

Treatments in the Jarrah Forest from 50 to 100 years old in Mundaring and Jarrahdale Divisions have been documented. Distinctive bench-marks in virgin and regrowth jarrah from 1875 to 1937 have been established in the northern region south to Collie. Permanent field plots and assessment lines from 1928 into the 1950s have been salvaged with considerable difficulty from discarded records.

Sandalwood regeneration plots of the 1920s in Karramindie State Forest and the 1898 Salmon Gum regeneration plot, established at Coolgardie in 1917 have been documented.

Publications

Several papers on jarrah silvics (ecology and silviculture) are in press through Dr. Ian Abbott as senior author, plus a bulletin in hand. Also in hand with friends and associates is a bulletin on Sandalwood in W.A. and educational publicity, through the extension service on the 100-year forest at Jarrahdale.

Sandalwood propagation, Narrogin and Kalgoorlie Divisions

Techniques established recently for sowing 4-pregerminated-seeds per spot in field operations are being validated. Current objective is to determine the desirable numbers per spot (1 to 4) for appropriate sites. Observations include seed production and collection. Testing would extend in the future to sowing in the first eight months of the year, with various host species of different ages in the field.

Liaison

Monitoring of the long-term processes in forest treatments would be possible only for as long as the distinctive benchmarks are retained undisturbed. Requirements for this purpose include permanent field markers, registered surveys and safe archives to hold the original records. Implementation is required for all the valuable earlier field plots in State Forests.

More thorough search and preservation of other outstanding original plots also are required. Those which have been disturbed require re-appraisal for other purposes - either as new scientific benchmarks or as demonstration stands for publicity for example.

Every Division needs areas readily accessible to the public and tourists, with the appropriate message about what foresters do in growing trees - and the longer the history, the more genuine e.g. 1943 sapling assessment line through the Dwellingup golf course shows growth displayed by coppice from the 1933 treatment of regeneration and from trade cutting about 1905 by the Marrinup Mill.

Proposals

Continue work, while planning for retirement.

PINE NUTRITION

J. McGrath, Como Research

August-December 1982: Finished writing a PhD thesis, titled "Some aspects of the zinc nutrition of Pinus radiata D. Don.

This project was undertaken to try and understand the occurrence of zinc deficiency in young P. radiata in the Donnybrook Sunkland. The principle findings were:

1. Applying N and P fertilisers induced zinc deficiency in P. radiata seedlings by promoting growth and hence diluting the zinc in the plants. There was no evidence that N or P depressed zinc absorption.
2. Tissue analysis can be used to determine the zinc status of P. radiata seedlings a concentration of 12 ppm zinc/g. dry wt separated zinc deficient plants from plants with an adequate supply of zinc.
3. Zinc appeared to be immobile in young non-senescing tissue, irrespective of the zinc status of the seedlings.
4. The movement of tracer zinc (^{65}Zn) through seedlings of P. radiata was slow, the rate of movement depended on the zinc supply to the seedlings.

Publications:

1. Some aspects of the zinc nutrition of Pinus radiata D. Don (J.F. McGrath). PhD Thesis University of W.A.
2. Effect of the nitrogen and phosphorus supply on the response of seedlings of Pinus radiata D. Don to applied zinc (J.F. McGrath and A.D. Robson). Submitted to Australian Forest Research.
3. The distribution of zinc and the diagnosis of zinc deficiency in seedlings of Pinus radiata D. Don (J.F. McGrath and A.D. Robson). Submitted to Australian Forest Research.
4. The influence of the supply of zinc to seedlings of Pinus radiata D. Don on the transport within the plant of recently absorbed zinc (J.F. McGrath and A.D. Robson). Submitted to: Aust J. Plant Physiology.
5. The movement of zinc through excised stems of seedlings of Pinus radiata D. Don. (J.F. McGrath and A.D. Robson). Submitted to: Annals of Botany.

Current and Future Work:

1. Determine if foliar analysis can be used to diagnose nutrient deficiencies in P. radiata: This involves examining the distribution and redistribution of nutrients within the wood, bark and needles, and examining the annual cycle of nutrient absorption and dry matter production.
2. Quantify the nitrogen inputs in the clover/pine silvicultural system at present advocated for the Donnybrook Sunkland by: (a) comparing tree growth where nitrogen is supplied by clover with inorganic nitrogen fertilisation;
   (b) examining the effect of clover on soil nitrogen concentrations.

PHYTOPHTHORA AND PINES

Research Officer - Mike Stukely, Como.

Principal Research Field - Pathology (*Phytophthora*)

Research July 1982 - August 1983:

(1) Screening *Pinus radiata* families for tolerance to *Phytophthora cinnamomi*:

This program was begun in 1979 by T. Butcher, with the aim of selecting *P.c.*-tolerant families of *P. radiata* for use in the Donnybrook Sunkland and other jarrah dieback-affected areas. The fourth series of glasshouse screening trials, including 137 new families, was conducted during 1982-3. Again there was a clear separation of the new families into tolerant and susceptible groups. Monitoring of the two field trials in the Sunkland continued - deaths there were again consistently from the susceptible families. The high correlation of field with glasshouse data has been maintained.

(2) Monitoring and sampling pine mortalities in plantations:

This is now a secondary operation, with attention only being given to cases of particular importance, for example:

- *Phytophthora*-associated *P. radiata* deaths have again occurred in the Agroforestry trial at No. 6 Road, Jarrahwood (now 8 years old).
- Extensive mortalities have occurred in 20-25 year old *P. radiata* stands at Grimwade. *Phytophthora* was found in both stands sampled. The activity of *Phytophthora* in these older stands is of particular interest.

Publications:

(1) Chevis, H.W. and Stukely, M.J.C. (1982) - Mortalities of young established radiata pine associated with *Phytophthora* spp. in the Donnybrook Sunkland plantations in Western Australia. *Australian Forestry* 45(3): 193-200.

(2) Butcher, T.B., Stukely, M.J.C. and Chester, G.W. - Breeding of *Pinus radiata* for resistance to *Phytophthora cinnamomi*. (Accepted by *Forest Ecology and Management*).

Proposed research 1983-4:

(1) The major effort will be directed towards the next series of *P. radiata*/*P.c.* screening trials.

(2) Field inoculation of older trees, to examine the effect of tree age on tolerance to *P.c.*

(3) Sampling of the Nannup Nursery, and in the older stands at Grimwade.

JARRAH DIEBACK

Joanna Tippett (with Bryan Shearer)
Como

Main projects

1. Invasion of jarrah by *P. cinnamomi* - studies on the behaviour of the fungus within the tree and the tree's resistance mechanisms.
2. Determination of factors affecting the rate of fungal growth within jarrah.
3. The comparative susceptibility of *Eucalyptus* spp. to *P. cinnamomi*.

Findings

A. Jarrah can express resistance to *P. cinnamomi*
   - not all infections result in tree mortality
   - most fine root lesions resulting from inoculations were walled-off by periderm regardless of season
   - growth of *P. cinnamomi* in jarrah is often intermittent. The fungus can break-out of confined lesions to invade new areas of inner bark when conditions are favourable
   - a relationship was found between moisture content of the secondary phloem (inner bark) and rate of fungal growith within jarrah.

B. Jarrah was the most susceptible of 20 eucalypt species inoculated during last summer.

Objectives for summer 1983-84

1. Complete fine root studies. The route of fungal establishment, from time of infection to invasion of largest roots is still unclear.
2. Define factors affecting rate of fungal growth in jarrah and determine on which sites jarrah's resistance is likely to hold. A current hypothesis is that the fungus requires both high moisture and warm conditions to grow at rates which overwhelm jarrah's resistance.
3. Determine critical levels of osmotic potential in the secondary phloem, which limit fungal growth.

Static dieback boundaries in certain areas and differences in disease expression between western, eastern and southern regions of the jarrah forest

may be explained on the basis of the work outlined in (2) and (3).

References

Joanna T. Tippet, S.R. Shea, T.C. Hill and B.L. Shearer, 1983. Development of lesions caused by *Phytophthora cinnamomi* in the secondary phloem of *Eucalyptus marginata*. Australian J. Bot. 31, 197-210.

J.T. Tippet and T.C. Hill, 1984. Junction complexes between sieve tubes in the secondary phloem of Myrtaceae. Annals of Botany. In press.

J.T. Tippet and T.C. Hill, 1983. The relationship between bark moisture and invasion of *Eucalyptus marginata* by *Phytophthora cinnamomi*. Australasian Plant Pathology. In press.

1983 Research Conference

Luisa de Braganca, A.D.F.O. Wanneroo Research

Current studies, July 1982 - August 1983

Pinus pinaster

W.P. 29/71 - Investigation of decline in productivity with the 2R; although no loss was detected at age 6, an establishment problem was evident.

Wetherell Block - A priori analysis shows no decline.

W.P. 7/82 - High mortality in the young pines confirms the establishment problem.

In order to ascertain the causes of poor 2R survival in P. pinaster seedlings the following experiments are currently being held:

W.P.10/83 - Effect of incorporation of water absorbent gels and other soil amendments on the survival of pine seedlings.

W.P. 11/83 - Effect of furrowlining and nonfurrowlining crushed debris on the establishment of P. pinaster seedlings.

Regrettably this experiment has been destroyed by a fire on the 21.9.83.

Pinus radiata 2R studies at Grimwade, Harvey Coast and Margaret River to determine whether a decline in productivity is occurring.

Future studies 1983-84

Pinus pinaster pilot plots - To establish whether there is a long term decline by direct comparison between 1R plots (clearing native vegetation) and 2R plots (pine pilot plots), growing simultaneously.

Pinus pinaster nutrition trials - Investigation of the nutritional requirements of P. pinaster on marginal sites, specifically the role of nitrogen fixing crops (lupins) on these yellow sands.

L. F. S. de Braganca

Luisa de Braganca
A.D.F.O.

29 September 1983.

DWELLINGUP RESEARCH STATION.

REHABILITATION RESEARCH - John Bartle.

VENTILATED CHAMBER PROJECT.

This project aims to establish a technique to measure transpiration as part of the hydrologic evaluation of forest treatments and rehabilitation. Development and construction of one fully operational whole tree chamber (30m high) was completed in autumn 1983. Collection of data relating to the stomatal control of transpiration in this jarrah tree was carried out in April-June, before being discontinued for winter. A data processing system has been completed and analysis is proceeding.

Preliminary results indicate that jarrah does maintain quite high leaf conductance, and therefore high transpiration, through the summer drought period. However, it does exercise some degree of control contrary to previous reports. Data collection will proceed through spring and summer to contrast early and late summer transpiration control.

Reports: Evaluation of the hydrologic impact of rehabilitation - a review of Forests Department work in the Northern Jarrah Forest. Internal distribution only.

FUTURE WORK.

A trial to test the interaction of the three major rehabilitation operations (i.e. ripping, drainage fertilization) is planned for summer 1983-84. This will be done in a factorial design (3 x 2 x 3) on operational scale plots. The objective will be to allow the site potential, as established by the rehabilitation treatments to be expressed in vegetation response.

Unpublished reports:

Wood Residues from Thinning in the Northern Jarrah Forest. by G.L. Stoneman.

Potential to Increase Water Yield in the Western Zone of the Northern Jarrah Forest. by G.L. Stoneman.

The Next 12 Months:

Identify those factors that are important in determining the water and salt yields in the intermediate rainfall zone.

Relate seasonal soil moisture availability in thinned and unthinned regrowth stands to the seasonal growth pattern of jarrah in these stands.

Quantify the effect of a range of intensities of thinning on the growth and production of a 40-year-old regrowth jarrah stand.

Quantify the effect of initial stand composition, and the type and method of thinning, on the growth of residual trees, costs of the operation, economic return, fire, safety, access and tops disposal problems.

INTEGRATION OF TREES AND FARMING

Richard Moore
Bunnerton Research

Reason for work

To develop methods of integrating trees with farming to control wind erosion, to help reduce salination of land and streams, to provide shelter for stock and to improve productivity of forestry plantations.

Major projects

(i) The combination of widely-spaced *Pinus radiata* with grazing in both high and low rainfall areas.

(ii) The growth of trees in strips with areas for cropping in between.

(iii) The testing of a range of pine, eucalypt and poplar species in agroforestry systems.

The majority of projects are co-operative ventures with either the C.S.I.R.O. or the Department of Agriculture.

Future direction

These projects are continuing studies for the coming year.

Ecology field course

Participation of outside institutions is encouraged in fauna ecological work within the forest areas. Emphasis has been placed on the establishment of field ecology teaching courses at the field station within the Perup M.P.A. The Perup Forest Ecology Study Centre is now operational and is now handled through Extensions.

FOREST MANAGEMENT - ECOLOGY

P. Christensen
o G. Wardell-Johnson

(1) BIOLOGICAL SURVEYS AND EFFECTS OF FOREST OPERATIONS ON SPECIES AND COMMUNITIES

Biological surveys are conducted to establish, fauna/habitat relations and serve as benchmarks for changes in land use. Emphasis is currently placed on distribution and abundance of vertebrates within the northern forest areas.

Forest operations effects are studied to demonstrate any areas of concern and so if necessary ameliorate any undesirable or enhance any desirable effects. A long term community bird study (W.P. 22/82) has been established within the karri forest of the Donnelly system to determine the effects of four forestry operations. Fixed point census procedures and mist netting have shown that the avian communities have strong similarities between the four sites prior to the implementation of four forestry operations (clear felling, selection cutting, control burning and control). Additional aspects are studied to determine the reasons for the favouring or displacement of particular species at each stage of the succession following these operations.

Artificial nest boxes (W.P. 21/82) are being used within the karri forest to examine the effects of various forest operations on hollow nesting species. The use of boxes by mardos *(Antechinus flavipes)* was examined in the first year of the study. Boxes erected within four sites within the karri forest of different management history showed differential use by mardos. A more detailed study (likely a post graduate research project) is now required to determine the factors governing the timing of successful general colonization by mardos in regenerating karri forest. Work has begun on a detailed study of the phascogale in the Perup M.P.A. using nest boxes in conjunction with radio-tracking.

A long term study of the effects of a single summer fire on small mammal populations in the karri forest has been terminated. Eleven years data demonstrates a succession of small mammals within the karri forest and shows that the fire does not affect long term population changes in the bush rat.

Field work begun in 1981 will conclude this summer on the determination of factors affecting the distribution of abundance of three species of *Geocrinia* (W.P. 1/83). Taxonomic and morphometric analysis of these species is being completed at the University of Western Australia and Macquarie University.

(YOUNG) KARRI FIRE RESEARCH

Keith Low
Manjimup

The last year has seen the continuation of work on fuel reduction burning in young karri, and commencement of research into tree damage caused by wood-boring insect larvae.

Three sets of plots were established in 10 year old karri regrowth. Following establishment, stand and fuel characteristics were measured. This included the use of a new method (Brown's Planar Intersect) of fuel measurement which, in addition to providing an estimate of fuel weight, also gives information on the physical structure and spacial distribution of the fuel array. Computer analysis of this data is underway.

Two plots at each site were burnt in March 1983. Of the six burns, three were regarded as successful, two as marginally successful and one as a failure in terms of fuel reduction. The latter was in *Acacia pentadenia* fuels which have proved difficult to burn in the past. It will obviously be 2-4 years before fuel at this site will burn readily due to an increased component of eucalypt litter.

Since the trees were still only 10 years old it was felt damage to the crop could become a problem, especially after burning treatment so late in the season. Damage assessment six months after treatment was inconclusive. At one site scorch was greater than expected but recovery is good. There were few signs of butt damage to crop trees but since this can take two years to show up more may appear in later assessments.

Following the discovery of wood-boring insect larvae in significant numbers work has started in this area. Occurrence covers the karri range but heavy infestations appear isolated at this stage. A study has begun in an attempt to discover the cause(s) of infestation. Initially the effects of fire, site, drought stress and large monocultural populations are being investigated.

The coming year will see the continuation of the above projects. As part of the work on fuel reduction burns in karri regrowth a detailed study will be undertaken this summer into the response of moisture contents of litter fuels in young karri stands to ambient weather conditions.

JARRAH SILVICULTURE

Greg Strelein
Forests Dept.
MANJIMUP WA 6258

During the first part of 1983 time was devoted to familiarisation and literature review of the Jarrah Silviculture portfolio.

Also in this period there was much concern regarding outbreaks of the Gum Leaf Skeletoniser, *Uraba lugens*, on which some time was spent in monitoring and mapping. The insect showed a preference for jarrah but also attacked marri and was found on karri, *rudis* and *patens*. There was some association between the older burn ages and severe attacks. The insect extended far beyond the areas of obvious attack. The winter generation numbers have declined dramatically and a decision on further work is waiting to see the impact of this summers attack.

Basic silviculture trials were also initiated for establishment, seeding, fertilising, spacing and leaf miner control.

In the ensuing period of autumn and early winter concentration was on the main project of Site Classification. This was initially an evaluation of what work had been done already in the south and comparison with the northern jarrah classification.

This initial work gave some good indications and evaluation of the method of site analysis. However it was found to be restricted in the sample base and too tightly defined into classes to be applied in the field and used for mapping. A more subjective use of indicators was required rather than classes, and the sampling had to be extended to consider only relevant management categories.

A new site survey strategy was prepared and sampling commenced mid winter and is progressing. This is designed to cover regeneration, dieback and silviculture etc. At the completion of each stage, indicator species will be evaluated and management guidelines defined for the various site characteristics identified.