WESTERN AUSTRALIAN FORESTS DEPARTMENT

RESEARCH BRANCH

SUMMARY OF RESEARCH

AUGUST 1983 - AUGUST 1984

Prepared for 1984 RESEARCH CONFERENCE
Como Training Centre
October 31st, November 1,2, 1984

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PREFACE

Communicating with forest managers is one of our major tasks and responsibilities. We tackle it in several ways - for example:

- in discussion at meetings and conferences;
- at field days;
- in collaborative preparation of management plans and job prescriptions;
- through publications; and
- in Research Reports, such as this one.

Part of our aim in this process is the rapid and effective transfer of research findings into practice. But we are also interested in the reverse flow - i.e., the views of those outside the Branch about research priorities and direction.

This booklet contains brief summaries of Forests Department research studies carried out over the last 12 months and indicates likely emphasis in the year ahead. Comments on any aspect will be welcome.

Please note:

1. This is not a publication and is not to be cited.
2. Reports are grouped by Research Station, not by discipline.
3. Results are not presented exhaustively. If further details about programmes are needed, please contact the Research Officer involved.

Thanks to Alan Davey who compiled this booklet, and to research staff for preparation of their reports.

R.J. UNDERWOOD
SUPERINTENDENT, RESEARCH

October, 1984.

RESEARCH BRANCH - 1984

Principal Officers

Chief of Research:	J.J. Havel
Superintendent:	R.J. Underwood
Inspector:	P.E. Christensen
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	I. Abbott
	J. McGrath
	J. Tippett
	M. Stukely
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Wanneroo:	L. de Bragança
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	A. Davey
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Busselton:	G. Siemon
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Manjimup:	N. Burrows
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	R. Breidahl
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TREE BREEDING, PINE SILVICULTURE AND HYDROLOGY

Trevor Butcher (Como Research)

Major work: August 1983 to August 1984

1. Position statements were prepared on:

   Forests and water use.
   Growing Pinus pinaster in the Wanneroo plantations.
   Dieback-resistant jarrah.

2. An intensive Pinus pinaster management model was prepared for the Northern Region and is implemented. This has as operations: TEND to maximize height growth while culturally preparing the sawlog crop, and GROW to maximize diameter growth of sawlog trees, and water throughput to the Gnangara Mound aquifer.

3. Information on Phytophthora cinnamomi tolerance of select Pinus radiata (glasshouse and field tests) and bole straightness, branching quality and vigour (field progeny tests) has been used in the final culling of the West Manjimup seed orchard (WMSO).

4. Large gains have already been reported from the P. pinaster breeding programme. Similar gains can now be reported for P. radiata. Data is illustrated from a 10 year-old P. radiata progeny trial in the Donnybrook sunklands.

Genetic Quality	Dbhob	Bole Straightness*	Branch Thickness*	Branch Angle*
Routine	12.3 cm	32%	30%	52%
Seed production area	13.0	40	41	57
Seed orchard	13.2	64	42	58
Orchard (after culling)	14.0	63	52	68

* number of trees with favourable character

5. Recent height measurement of 5 year-old trees in the P. radiata provenance trial in the Donnybrook sunklands have shown several of the native Californian populations to be taller than our WMSO source; an inland provenance collection at Monterey was 1 metre taller.

6. In our field Phytophthora cinnamomi inoculation trial (Donnybrook sunklands), 19% of seedlings from moderately-susceptible Pinus radiata families have died compared with 4% from moderately-tolerant families. Sub-lethal infections in the 4 year old trees have reduced heights of surviving mod-susceptible family trees to 3.7 m, compared with average heights of 4.1 m for mod-tolerant families.

7. Start has been made on new second generation "Specialty-Phytophthora cinnamomi tolerance" and "General" seed orchards of Pinus radiata. Scion material from selections of the best trees in the best families in W.A. progeny trials have been grafted.

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8. Evaluation and review of our P. pinaster breeding programme has commenced with information used for the second culling of the Mullaloo seed orchard, and selection of the best individuals in the best families for second generation grafting.

9. Eucalyptus resinifera family/provenance trials were planted on 10 ha at Jarrahdale and Huntley bauxite minesites. A 12 x 12 quadruple lattice design with 10 tree row plots at 3.5 x 2.5 m spacing was used at each site.

Proposed work: 1984/85

1. First planting of "Specialty" and "General" P. radiata seed orchards. Continuation with grafting and rejuvenation (cuttings of graft incompatible clones) for successive year planting of orchards.

2. Establishment of quarantine glasshouse to allow for introductions of best Australian second generation selections, and for "super family" cuttings from Canberra for an agroforestry clonal afforestation programme (restrictions imposed because of Dothistroma risk).

3. Screen elite P. radiata families from South Africa, New Zealand and South Australia for tolerance to Phytophthora cinnamomi (series VII). Screen second generation families used in the "Specialty" orchard, only where the pollen parent is unknown (series VIII).

4. Complete the tree breeding plans and strategies for the future development of Pinus radiata and P. pinaster in Western Australia. Implement the development of a broad base P. radiata population.

5. Grafting of second generation selections of P. pinaster for Manjimup orchard, as replacement to the Mullaloo orchard.

6. Initial assessment of Eucalyptus wandoo family/provenance trials on Wellington catchment and bauxite minesites. Check strategy of family/provenance tests as the initial screening method.

7. Review of silvicultural and hydrological work on the coastal plain.

8. Complete the Eucalyptus accedens family/provenance seed collections for provenance study on bauxite minesite.

REPORT TO RESEARCH CONFERENCE, OCT/NOV 1984

IAN ABBOTT, COMO RESEARCH (JARRAH FOREST ECOLOGY)

Major work, July 1983 - August 1984

Most effort was put into preparing two reports:

1. Ecology of jarrah (*Eucalyptus marginata*) in the northern jarrah forest of Western Australia (with Owen Loneragan), 221pp + 61 Tables + 33 Figs. To be published as a Departmental Bulletin.
2. Forest entomology research in Western Australia - a review. 48pp + maps. To be published as a Technical Paper.

Both reports review and summarize the results of research extending back 50 - 60 years.

Minor work

Six papers were prepared for external publication. These deal with fire, soil properties and soil fauna; *Persoonia elliptica*; seed and fruit removal by ants and mammals; and megascolecid and lumbricid earthworms. Analysis of data collected in the study (1981-3) of logging in relation to bird-populations in Yarragil block was nearly completed.

Major research proposals for the coming year

As announced in last year's report, I am to be responsible for forest entomology research. Following a panel discussion of my review (above), C.O.D. Havel has decided that priority is to be given to studying jarrah leaf miner. Accordingly, the following RWPs have been prepared.

1. Height growth of jarrah incipient ground coppice in relation to (simulated) grazing intensity (18/84).
2. Comparison of two methods (sweeping of foliage; removal of branchlets) of sampling insects from the crowns of jarrah poles (19/84).
3. Leaf dynamics of jarrah in relation to impact of jarrah leaf miner (20/84).

Also, the history of the spread of infestation of jarrah forest by leaf miner is being documented in relation to logging, fire and clearing of forest for agriculture. Valuable archival material has been received from Zan Mazanec (CSIRO) and Pat Collins (I & P, COMO).

TREE NUTRITION/PHYSIOLOGY

JOHN McGRATH - COMO RESEARCH

RESEARCH SUMMARY 1983-84

Pinus radiata Nutrition (I) Predicting nutrient deficiencies by foliar analysis. An examination of the seasonal pattern of growth and nutrient concentrations in needles of P. radiata on the Sunkland commenced in spring 1983. Preliminary results suggest

(a) Young P. radiata grow throughout the year, with maximum growth occurring in spring and early summer.

(b) Nutrient concentrations in needles produced in either the previous or current spring growth flush decline from early in spring through summer, to extremely low values.

(c) There appears to be an annual cycle of nutrient import and export in needles to cope with the continual growth cycle.

(II) Refertilization of P. radiata following thinning. Remeasurement of P. radiata 5 years after thinning and fertilization showed a linear response between basal area increment and Agras No. 1 applications.

Physiology of E. marginata/P. cinnamomi interaction. The effect of both season and ecological site type on mineral nutrient, sugar, starch, total phenol concentrations in jarrah bark are being investigated in an attempt to determine if these factors affect the interaction between jarrah and P.c. (collaborative with Dr J. Tippett).

PAPERS

All four papers on zinc nutrition of P. radiata (see 82-83 research summary) have been accepted; 2 published, 2 pending.

RESEARCH PROPOSALS

1. Continue with foliar analysis project as fertilizer treatments on this experiment have begun to influence growth and nutrient concentrations in needles.
2. Perform stem analysis on refertilization experiment to determine the longevity of the fertilizer response, and estimate the increase in volume attributable to fertilization.
3. (a) Continue monitoring the physiological parameters in jarrah bark.
   (b) Investigate if calcium has a role in jarrah's resistance to P. cinnamomi (with Dr J. Tippett).

DIEBACK: HOST STUDIES 1983-1984

JOANNA TIPPETT RESEARCH COMO

PROGRESS

1. The susceptibility of 21 eucalypt species was tested by stem inoculation, Del Park arboretum. Jarrah was by far the most susceptible. E.muellerana warrants further testing as lesions were confined.
2. Site work. The susceptibility of jarrah on four sites (Z, H, P, T) was rated during last summer. (Susceptibility of trees on 16 other sites were also compared). Nutrition and water availability affect tree susceptibility. The physiological status of secondary phloem in mid to late summer can critically influence the growth rate of the fungus within trees.

PAPERS

Tippett J T & Hill T C 1984. Role of periderm in resistance of Eucalyptus marginata roots against Phytopthora cinnamomi European J. For. Pathol. (in press).

Tippett J T, T C Hill & B L Shearer 1984. Resistance of Eucalyptus spp. to invasion by Phytopthora cinnamomi (Aust. J. Botany submitted).

PLANS

1. To further assess the effect of nutrition on jarrah's resistance to P.cinnamomi (joint with Dr J McGrath).
2. To determine whether jarrah's periods of cambial activity (wood production) correspond with the periods of greatest susceptibility to P.cinnamomi.
3. Monitor fungal growth within trees and relate fungal growth rate to changes in tree physiology (phloem water status included).

PHYTOPHTHORA AND PINES

Mike Stukely, Como Research

MAJOR RESEARCH JULY 1983-AUGUST 1984:

Screening Pinus radiata families for tolerance to Phytophthora cinnamomi (P.C.).

The fifth and sixth series of glasshouse trials (using elite families from Victoria (APM), NSW, South Australia, New Zealand and South Africa) were completed in 1983-4, with T. Butcher. A total of 136 elite families have now been classified as tolerant or moderately tolerant to P.C.. 42 clones (1½ generation and 2nd generation) are now being grafted at Wanneroo in preparation for the first planting of the new P.C. - tolerant seed orchard. This orchard will be established progressively from 1985, at Manjimup.

P.C. - tolerance classes were maintained when tolerant and susceptible radiata families were inoculated with a range of P.C. isolates (from several host species). One of these isolates was of the A1 mating type.

One hundred familes from the Año Nuevo, Monterey Inland, Monterey Coast, Cambria, Guadalupe Island and Cedros Island provenances were also screened in a glasshouse trial. The Año Nuevo and Guadalupe Island groups were generally highly susceptible to P.C., while Cambria was much more tolerant. Useable variation does exist in each population, however.

Monitoring of the two field screening trials in the Sunkland (planted 1980, 1981) continued: deaths were again consistently from susceptible families. It is now clear from these trials that P.C. infection has little effect on the growth of tolerant families, but severely depresses the growth of those susceptible trees which survive.

Publications:

Butcher, T.B., Stukely, M.J.C. and Chester, G.W. (1984). Genetic variation in resistance of Pinus radiata to Phytophthora cinnamomi. Forest Ecology and Management 8: 197-220.

PROPOSED RESEARCH 1984-85:

1. P. radiata screening: The final glasshouse trial in the current programme will be completed by August 1985. This will include the remaining elite South African, New Zealand and South Australian families for which growth data are available. Monitoring of the field trials will continue. Divisional officers will be monitoring the Sunkland plantations as they mature, and we will investigate any major outbreaks of mortalities.
2. Manjimup plantations: Sampling of the new radiata plantation areas for Phytophthora will be done in spring-summer 1984.

3. Nannup nursery: Sampling for Phytophthora will be done in summer-autumn.
4. Phytophthora identification: Identification of our expanding collection of Phytophthora cultures, from both pines and native hosts, will be done as soon as possible.
5. National Parks: After the Department of Conservation and Land Management comes into operation, we expect to be involved in the processing and identification of dieback samples from national parks.
6. Jarrah Screening: It is hoped that preliminary work for a new programme of screening jarrah for P.C. tolerance/resistance will be done in 1984-85.

SECOND ROTATION STUDIES

Luisa de Bragança (Wanneroo Research)

Major work: August 1983 to August 1984

1. Investigation of the second rotation (2R) establishment problem.

   * Effect of soil amendments and wetting agents on the survival of 2R *Pinus pinaster* seedlings.
   No differences in mortality rates in the control and in the treatments were evident at year one.

   * Effect of furrowlining versus non furrowlining crushed debris on the survival of 2R *P. pinaster* seedlings.
   Regrettably this experiment was destroyed by a fire. It has been repeated in July 1984.

2. Investigation of 2R decline in productivity.

   * Simultaneous growth of 1R and 2R *P. pinaster* stands side by side at the Yanchep pine plantation. This experiment was possible through the use of old pine pilot plots as 2R sites and the adjacent native bush was cleared to provide the 1R areas. Eight paired-plots were planted in 1984 covering a range of sites (marginal to good yellow sand).

3. Prescription for preparation of 2R sites was drawn up according to the best available knowledge on the 2R problem.

Proposed work:

* W.P. 29/71 - This experiment was initiated to anticipate the 2R problem and find the means of correcting it. The treatments implemented were aimed at favourably changing the microenvironment of a stand in the last 5 years of the rotation to benefit the next crop. The treatments consisted of thinning the stand, crushing or burning the debris, establishing a nitrogen fixing crop and fertilising, monitoring the growth response of the mature crop and then clearfelling the stand.
  Due to a delay in clearfelling the stand (the effect of the treatments was dissipated by then), it was decided to reapply the treatments (1984) and monitor the growth response for another 5 years, then clearfell.

* Wetting agents study - Based on selected treatments from the 1983 wetting agents experiment.

* Mt Cooke study and other experiments - writing and publication.

1984 Forests Department Research Conference

Rehabilitation Research

John Bartle, Research Station, Dwellingup

Transpiration

The objective of this work is to identify species suitable for salinity control in disturbed forest or farmland. In addition to being generally adapted and productive, suitable species must have a capacity to exploit soil water storage from a deep and apparently harsh root environment. Study of transpiration shows promise as a means of evaluating this aspect of tree performance.

Using the ventilated chamber method on a single dominant jarrah the mechanism of stomatal regulation of transpiration was examined. Jarrah was shown to have only moderate inhibition of stomatal opening by vapour pressure deficit (the 'feed forward' response) and no inhibition due to soil water deficit (the 'feed back' response). Along with jarrah's known proneness to drought death on shallow soil sites these observations indicate a heavy dependence on an efficient root system and stored soil water. The performance of jarrah gives insight into appropriate mechanisms in replacement species.

Using porometers the late summer draw on a saline water table by seven species in the Bingham River Arboretum was inferred. The potential importance of the wide species screening programme planned was revealed when two previously untested species, Eucalyptus mannifera and E. woolsiana were found to compare with E. wandoo, the most promising local species.

This work will proceed with future accent being placed on species screening in arboreta and on improving the resolution of measurements, particularly leaf area.

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Pit Rehabilitation

A trial to test the interaction between ripping (3 levels) and nutrition (2 levels) in bauxite pits was established in winter 1984. The objective is to explore the relative contribution and interaction of these factors in restoration of site potential.

Forest Improvement and Rehabilitation Scheme (F.I.R.S.)

Recent dieback research suggests that a relatively impermeable caprock layer on some jarrah forest sites is responsible for high disease impact. A high impact site on Deer Road was blasted to improve caprock permeability to test this theory. Evaluation will focus on direct measurement of impedence to drainage and growth of replanted jarrah, using adjacent unblasted area as the control.

PHYTOPHTHORA CINNAMOMI, SITE INTERACTIONS

B.L. Shearer, Research Station, Dwellingup (Plant Pathology)

1. PROGRESS

Previous work has shown that on some sites impact of Phytophthora cinnamomi was associated with specific site characteristics that favoured sporulation and transmission of the fungus at depth in the soil profile and the infection on the root system of jarrah. This association of site characteristics with disease expression indicated the possibility of predicting impact of P.cinnamomi on a range of site types if key site indicators could be identified. The dieback programme at Dwellingup is organised into the following areas:

1.1 Site Evaluation (M. Dillon, R. Buehrig and A. Byrne).

To date over 300 northern and central jarrah forest sites, covering the range from subtle to high impact, have been evaluated for geology, soil, landscape and vegetation characteristics.

1.2 Processes Within Sites (J. Kinal and R. Fairman)

Preliminary analysis of 67 high impact sites indicates that 1/3 of the sites have plant associations indicating impeded drainage. However, in the remaining 2/3 of the sites no strong indicators are yet apparent.

As an aid to the identification of key indicators the processes within sites work aims at determining the effect of site characteristics on sporulation, survival and transmission of P.cinnamomi at depth in the soil profile and the changes that may occur over time.

During 1983 techniques were tried at the Deer Rd site to determine the best way to monitor, in situ, the within site characteristics that may affect fungal behaviour. These techniques have been transferred to our Dawn Creek site where we are using through-flow trenches, and networks of tensiometers and piezometers to determine the relationship between the hydrological response of a site and disease activity.

1.3 Disease Assessment

1.3.1 Damage to the root system of jarrah (P. Somerford, L. Vickery and G. Noske).

We know very little of the damage to jarrah roots following infection of moderate sites where P.cinnamomi has killed the susceptible understorey but there are few or no deaths of jarrah. The moderate site types constitute a major part of the jarrah forest and observations indicate that in a number of sites there has been a slow but cumulative death of jarrah over time.

To date we have excavated eight apparently healthy trees, seven in infected areas and one in an uninfected 'control' area. Phytophthora cinnamomi has been isolated from the roots of four of the seven trees in infected areas. At each excavation site a site evaluation is carried out so that we have a linking of surface indicators with below surface characteristics and tree root growth and infection. The presence of extensive recementation on the underlying laterite layer exposed during excavation suggests that this layer is dynamically

changing with time.

1.3.2 Long term monitoring

A long term monitoring research programme has been set up in collaboration with the dieback mapping group of the department, to follow the changes in disease impact in Lang (relatively undisturbed), and Balmoral (disturbed) blocks over the next 10 years.

In addition 8 high impact areas will be monitored for the next 10 years.

1.4 Operations Research (A. Byrne)

In 1983 visits were made to divisions in order to update their knowledge of current dieback research information and to determine operations research needs. A report has been prepared.

2. FUTURE PLANS

2.1 Determine the changes of impact with time and relationship to climatic events.

2.2 Use two study areas to test the development of a predictive system of site impact.

2.3 Determine significance of layers below the laterite layer.

2.4 Determine relationship between hydrological response of a site to site characteristics and rainfall event.

2.5 Continue tree excavation work to relate root damage following infection to site characteristics.

2.6 Evaluate factors affecting susceptibility of a site to pathogen establishment.

REHABILITATION ECOLOGY AND MANAGEMENT A.S. DAVEY, DWELLINGUP RESEARCH.

1. TREE IMPROVEMENT PROGRAMME : Arboreta are being surveyed in conjunction with Alcoa to identify promising species. Reports covering background, introduction, and phases 1 and 2 of the T.I.P. have been completed.

Future work : It is planned that 2 provenance trials will be established per year from 1985 onwards. In the near future, arboreta are planned for Willowdale Mt. Cooke and Saddleback.

2. STRESS SCREENING OF REHABILITATION TREE SPECIES: An ultrasensitive (to .007mm diam.) dendrometer band has been developed (by Davey and Mason, Dwellingup). Over Spring-Autumn 1983/4 exceptionally distinct "healthy" (stress-free) and "unhealthy" (stress-full) patterns of diurnal diameter fluctuation were identified for 7 species. This method represents a major breakthrough in the monitoring of tree reaction to water stress for the prediction of future species survival and performance.

Future work: This method shall be used for the evaluation of species in eastern arboreta as soon as possible as it is of great significance to Trial Mining, both for predicting the suitability of species to the environment, and as an early-warning system for monitoring the health of established vegetation in ecologically/socially sensitive areas.

3. SITE ANALYSIS OF REHABILITATION AREAS: Physical studies have been completed on three more pits (22 excavations) over the past year. Soil and foliar nutrients have yet to be analysed.

Future work: Future studies shall be confined to the analysis of areas of particular interest (especially trials comparing rehab. treatments or areas exhibiting variable tree performance). There may be some scope to extend this analysis to FIRS problem areas in the future.

4. MECHANICAL FUEL-HAZARD REDUCTION OF UNDERSTOREY: Evaluation of the hydroaxe (rotary slasher) is continuing. Nutrition, slash decomposition, understorey regeneration and crop tree damage and performance are being monitored. The biggest worry with this system (apart from its expense) is the large number of vertical spikes which remain for some time after slashing.

Future work: A factorial comparison of slashing with and without burning is currently under way in areas slashed in Winter 1984. A trial comparing scrub rolling and burning with slashing is also planned.

REPORTS.

Procedure for the Assessment of Rehabilitation Forest Stands.

Rehabilitation Site Analysis - Report on Pilot Study.

Tree Improvement Programme - Discussion Paper
- Introduction and Background
- Phase 1. Immediate operations
- Phase 2. Species and Provenance Evaluation/Selection

JARRAH FOREST HYDROLOGY AND SILVICULTURE.

G. L. Stoneman, Dwellingup Research Station.

1. PRINCIPAL FINDINGS.

The Yarragil 4L catchment was thinned in early 1983 from 55% to 20% canopy cover (basal areas of 35m^2Ha to 11m^2Ha). The primary objective of the project is to test the hypothesis that thinning will increase the production of both high quality water and timber. No increase was seen in streamflow in 1983, however it is hypothesized that there has been a significant change in the water balance, with a substantial increase in soil moisture storage and a corresponding reduction in evapotranspiration. There has been no change in stream salinity, turbidity or groundwater salinity. Groundwater in the midslope borehole at 4L rose 0.9m compared to control bores, however there was no response in the valley borehole.

2. FUTURE WORK.

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

Determine the seasonal growth patterns of jarrah in a range of thinning intensities and time since thinning.

Using tree ring analysis determine the response to thinning of jarrah at various heights up the bole of the tree.

Develop methods and determine herbicide doses for killing unwanted trees in thinning operations.

Quantify the effect of a range of thinning intensities on the growth and production of both a 40 year old and a 12 year old regrowth jarrah stand.

JARRAH UTILIZATION / SILVICULTURE

GARY BRENNAN, DWELLINGUP RESEARCH

1. MAJOR AREA OF RESEARCH

The utilization of thinning from the jarrah forest.

2. WORK SINCE JANUARY 1984

Since joining the Research Branch in January 1984, a literature review titled "The Economic Utilization of Thinnings from the Jarrah Forest" has been started and is near completion. Some of the uses include sawn timber, charcoal, chemicals and energy, reconstituted wood products, and domestic firewood. However, some of these products can be produced more economically from other resources , e.g. coal and oil, therefore the products that yield the highest economic return to the W.A. community and the greatest silvicultural benefit to the forest must be chosen.

Assistance has been given in seasoning trials at the Harvey Mill. Trials using a low temperature tunnel kiln to season mature jarrah and a microwave oven to measure wood moisture content are in progress. The mature jarrah (100 x 25 mm) in the tunnel kiln is drying in winter from green to fibre saturation point in 5 to 6 weeks with minimum degrade. At this stage no conclusions have been made to the accuracy of the microwave oven to measure moisture content.

3. FUTURE WORK

1. Complete literature review for internal publication.

2. The work in sawmilling and seasoning of regrowth jarrah will intensify following the completion of the re-designed Harvey Mill, and the experimental high temperature kiln. This work will extend to include marri and karri.

3. Sheoak (Allocasuarina fraserana) utilization/seasoning trial will be started and completed by Autumn 1985. The material seasoned will be backsawn and quartersawn and will be from both mature and regrowth trees. Different seasoning methods will be used to season the timber.

4. The use of a tunnel kiln as a method of seasoning mature jarrah timber, using different schedules and timber sizes will continue. The seasoning of regrowth jarrah, karri and marri timbers, using the tunnel kiln will be assessed and seasoning schedules will be developed.

5. Assessment of timber degrade from past F.D./Bunning Bros. seasoning trials will continue.

6. A round jarrah preservation treatment trial will be completed.

7. Develop schedules for seasoning timber suitable for turning, using a microwave oven.

8. Design a jarrah productivity trial.

SILVICULTURE / UTILIZATION

S.D.F.O. Graeme Siemon Busselton

1. Major areas of research
   i) Relationship between silvicultural practices and wood quality.
   ii) General timber utilization.

2. Main aspects being studied
   i) Monitoring of wood quality in pines grown under different silvicultural regimes.
   ii) Specific uses of pine eg. structural timber, poles, dowelled preservative treated sleepers.
   iii) Seasoning of mature jarrah.
   iv) Sawmilling and seasoning of regrowth jarrah, karri and marri.

3. Principal findings

Monitoring wood quality is an on-going programme. The emphasis in the past year has been on seasoning of mature jarrah, to increase the volume of furniture and joinery grade timber produced. The major advantage of improving the efficiency of timber utilization is to reduce the area of forest which must be harvested each year. Increasing utilization of both forest and sawmill residues is an important aspect. The research on sawmilling and seasoning of regrowth eucalypts will lead to decreased demands on mature forests.

4. Future proposals

The research into regrowth eucalypts will intensify. The Department should soon be involved in a co-operative study with the Radiata Pine Research Institute in seasoning pine using dehumidifiers. Organization of a timber technology course for in-service training will be finalized.

Richard Moore

Reports or papers prepared in the year include:

Siemon, G.R. (1983). Proofgrading in Western Australia. Australian Forest Industries Journal 49(8): 22-3.

Campbell, J.B. and Siemon, G.R. (1984). Future timber utilization in Western Australia. Paper for 34th Appita Conference, Surfers Paradise, Qld., 14 - 18 May, 1984.

Siemon, G.R. and Donnelly, D.J. (1984). The effects of exposure on the stability of heart-in studs of Pinus pinaster. Forests Department of Western Australia. Research Paper 78. 7pp.

AGROFORESTRY

Richard Moore — Busselton

1. Major areas of research

   i) Agroforestry in areas receiving 750mm + rainfall/year

   The prime objective is to improve productivity. The main type of agroforestry being researched is widely-spaced pine with pasture and grazing. This combination is seen as having the potential to improve the profitability of both pine plantations and farms.

   ii) Agroforestry in areas receiving 550-750mm rainfall/year

   The prime objective is to determine whether agroforestry is a viable form of land management for salinity control.

   iii) South Coast Region

   The objectives of integrating trees and farming along the South Coast are, in order of importance, to control wind erosion, to provide shelter and to produce timber.

2. Main aspects being studied

   Studies are to determine biological production (timber, pasture, crops), suitable species of trees, management techniques (pruning, thinning, debris disposal) and economics.

3. Principal findings

   i) The results of "An Economic Study of Agroforestry on Farmland in the Manjimup Region of W.A." by Malajczuk *et al*. (in press 1984) indicate that the combination of *P. radiata*, pasture and livestock is at least as profitable as plantation forestry.

   ii) Prescriptions have been developed for managing widely-spaced pine with grazing.

4. Future Proposals

   i) Complete a review of all agroforestry trials and prepare an "Update of Agroforestry" (half complete).

   ii) Plan future research based on this review.

PINE SILVICULTURE

For. (Tech.) Ray Fremlin — Busselton

1. Major areas of research
   - i) Establishment
   - ii) Post-establishment weed control
   - iii) Pruning and thinning
   - iv) Coniferous arboreta

2. Main aspects and findings
   - i) Development of techniques for establishing P. pinaster on pastured sites in medium rainfall areas eg. Esperance, including effects of site preparation and nursery treatments.
   - ii) Interaction of herbicides and soil preparation methods for establishing P. radiata and eucalypts.
   - iii) Trials on controlling eucalypt regrowth in pine plantations have shown spraying with glyphosate soon after pines are planted is effective and economic. This method, and cut-stump and stem injection techniques, have become routine practice.
   - iv) Thinning trials in the Sunkland.
   - v) Continuing management of coniferous arboreta provides comparative data on species performance.

3. Future proposals
   - i) Studies on improvement of productivity in existing plantations.
   - ii) Completion of weed control trials.
   - iii) Feasibility of chemical thinning of P. pinaster.

4. Reports and papers in the past year include
   - i) Evaluation of glyphosate to control regrowth of Eucalypts spp. in pine plantation in W.A. Paper for 7th Australian Weeds Conference, 17-21 September 1984.
   - ii) Growth and potential of coniferous species in the South West of W.A. Forests Department Technical Paper (in press).
   - iii) Alternatives to amitrole for weed control in forestry. Internal report.

FIRE MANAGEMENT RESEARCH

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SUMMARY OF RESEARCH JULY 1983 - AUGUST 1984

FIRE BEHAVIOUR RESEARCH

Fuels, weather and fire data collected from experimental fires under dry summer conditions in 1983 are currently being analysed. Principal results to date are:

(i) Existing fire behaviour prediction systems can seriously underestimate the behaviour of fires under dry conditions (by as much as 10 fold).

(ii) Several fires burning near each other display remarkably different behaviour to a single fire, and rarely reach a steady state. Outputs from existing fire prediction systems are usually based on single-fire studies, and are therefore inadequate. We are currently developing a fire model which is more descriptive of fire behaviour in time and space.

(iii) The intensity of massed fires can esculate rapidly when fuels are plentiful and dry. The rate of fire coalescence is affected by fuel moisture, fuel load, wind strength and lightning method. When fire fuel moisture content was greater than about 12%, coalescence was not observed in moderate fuels (7-8 tonnes/ha).

Further Research - continued development of a fire behaviour model to cater for a wider range of burning conditions including different fuel/vegetation types and different seasons. The new model will be more sympathetic and responsive to a wider range of management needs. Outputs will not only include fire behaviour information, but biotic descriptors of fire such as damage and killing power, scorch, defoliation, residence time, heat pulse into the soil, and rate and type of structural and floristic response by vegetation with time after fire.

Other Research - a biological reference area has been established in jarrah forest near Nannup. Comparisons of vegetation structure and composition will be continually made between various fire regimes and not just burnt versus unburnt. This is long term.

REPORTS

- Describing Forest Fires in Western Australia.
- Predicting Blow-up Fires.
- Protection Pyrotechnics for Plantation Pyrologists.
- Radiata Pine Slash Burning Guides.
- The Soil Dryness Index for use in Western Australia.
- Project Narrik, Progress Reports I and II.

MAJOR RESEARCH PROPOSALS

- Collecting facts for fire management planning in Nature Reserves.
- A fuel accumulation model for the dry sclerophyll forest and non forested natural lands.

JARRAH SILVICULTURE

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SOUTHERN JARRAH SITE CLASSIFICATION

The major aim of this research is to develop a site-vegetation classification system for southern jarrah. During the past year the first stage of the project was concluded. This involved sampling many forest type and management practice combinations to evaluate regeneration techniques. Information was collected on species abundance, stand structure, regeneration, soils, hydrology, landform, geology, burning, logging and disease.

Sample points were selected in areas where stand history was known to assess the success of the management used on each forest type in achieving regeneration. This data is now being analysed.

This first stage of analysis will also provide an evaluation of the project and allow a reconsideration of directions or techniques as necessary, before subsequent sampling to look at dieback and silviculture interactions with site.

Once analysed the information will be presented for management applications as guidelines in the form of 'Regeneration Requirements for Site Type ....'. A similar presentation is also planned for each management aspect which is to be investigated. Each site type identified will also be described using 'indicators' highlighted in the analysis; such as species, soil type, landform.

Sites will be mapped to make the information digestible at management, operational and planning levels. Trial photo interpretation and mapping has been completed. This is to evaluate whether all the sites can be mapped and what level of detail will be most useful. Geomorphology mapping may carry on with site types being overlayed later as they are developed.

Photo interpretation and mapping will continue over the next year as will further sampling to investigate other management areas; firstly in dieback and then silviculture.

Other jarrah silviculture work proposed will be the analysis of data from seeding and planting trials and the assessment of planted jarrah spacing and fertilising trials.

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A survey of lignotuber size relative to shoot development is also underway. A long term trial monitoring Leaf Miner impact on crown health and diameter growth will be assessed to evaluate natural resistance and quantify the problem. (This work in liaison with Dr Abbott.)

KARRI SILVICULTURE

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The major areas of work over the last year have been;

1. WARREN THINNING TRIAL

A large thinning trial was initiated in a high quality 11 year old karri regrowth stand. The trial consists of four thinning intensities (unthinned, 600, 400, 200 s.p.h.), two fertiliser levels (nil, 300 kg/ha N) and two coppice control treatments. The trial is aimed at determining whether non-commercial thinning and fertilising can be used to reduce the rotation length of karri regrowth stands. The results will also be important in the establishment of a proposed karri growth model.

2. KARRI SEED PRODUCTION AND IMPROVEMENT PROGRAMME

Two karri seed orchards were planted this winter (1984) in the low rainfall zone (~625 mm) east of Manjimup, following last years review which indicated that seed production would be much higher on these sites than on those in the karri region. Trial Seed Production Areas were established at Huntly (Dwellingup), in the Sunklands and on a number of sites east of Manjimup to test their suitability for seed production. The importance of this work is highlighted by the scarcity of karri seed and its very high cost (~$2,000/kg).

Significant breakthroughs have been made in the vegetative propagation of karri in the past twelve months. Success has been achieved with both grafting and cuttings although much more work is required to refine techniques.

Two papers were presented to the R.W.G. 1 meeting at Como.
"Effect of site on flowering and seed production of karri"
"Provenance variation in karri"

3. REDUCING THE COST OF REGENERATION

A fertiliser trial was established this winter (1984) testing a number of fertiliser treatments which if successful will reduce fertilising costs

by up to 67%. Trials were also established using a number of spot sowing techniques which if successful will eliminate the need for expensive planting operations.

4. REPORTS

(i) Effect of various pre-emergent herbicides on weed control and seedling growth in the karri nursery.

(ii) Response to light thinning and fertilising in a dense eleven year old karri stand.

The major research proposals for the coming year are:

1. 50 year old regrowth thinning trial - to determine the effect of a range of residual basal areas on total volume and sawlog volume.

2. Establishment of another karri seed orchard.

3. Further trials on grafting and cuttings.

4. Spot sowing trials using a new pelleting technique.

KARRI FIRE RESEARCH

Lachlan McCaw
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Principal research field -

Fuel reduction burning in young stands of karri (10-20 y.o.).

Protection of karri regrowth stands from destruction by wildfire is a vital step in the long term management of the forest for ecological and commercial uses (see Eden N.S.W., 1980). Fuel reduction burning of strategic areas of regrowth will be necessary in the near future in order to maintain an effective network of protection buffers.

Key research questions are -

- What factors govern fire behaviour in regrowth - how does this differ from mature forest?
- How do these factors vary with site and stand characteristics?
- What are the effects of prescribed burning on the stand?

Principal results -

Fuel studies in stands covering a range of ages and sites have shown that fuel accumulation relates strongly to stand development. Basal area is a better indicator of fuel development than age. Fuel weight alone is not a good index of flammability as a large proportion of the litter is in a compacted duff layer which does not readily burn, even when dry.

Studies of fuel moisture regimes over the summer demonstrated that dense regrowth dries considerably more slowly than mature forest. Fuels in the three stands examined (12, 14, 18 y.o.) were in the 10-15% moisture content range on about 25 days last season. This level of dryness is not usually reached until several days into each drying cycle.

There is little or no wind penetration into dense regrowth under normal conditions, and the role of wind in determining fire behaviour will be less important than in mature forest.

Experimental fires have confirmed that fuel type is the major determinant of fire behaviour in regrowth. Two more small plots were successfully burnt last summer. Dominant trees have recovered well from scorch both in these plots, and in the six burnt during the previous season. Butt damage is largely associated with ignition of log debris.

Work on the karri borer study has been limited due to staff absence.

The next year -

Continue the programme of plot burning, monitor tree damage and fuel reaccumulation on plots already burnt.

Use existing data to prepare guidelines for operational burns on areas up to 50 ha. Monitor fire behaviour, evaluate results and improve guidelines.

Examine the potential of air photography for distinguishing stages of stand development to allow stratification of fuel types (e.g. crown/stem relationships).

FOREST ECOLOGY RESEARCH

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SUMMARY OF RESEARCH JULY 1983 - AUGUST 1984

KARRI BIRD STUDY

Prior to felling, bird populations were monitored by census techniques and mist netting in four plots at Gray Block Karri Forest. A comparison of diversity indicies and density curves suggest that the bird communities of the four sites are similar.

Felling treatments are currently in progress. Monitoring of the effect of these treatments will be carried out in November 1984 and again prior to burning of logging slash in February 1985.

JARRAH BIRD STUDY

A study has commenced into the relationship between birds, vegetation and insects in jarrah forest at the Perup.

Mist netting and censusing has provided information on the resident bird populations prior to the influx of migrant species of summer 84/85.

WOYLIE RE-ESTABLISHMENT

Work on re-establishment of the Woylie (Bettongia penicillata) in selected areas of State Forest has met with mixed success.

The Northern Perup colony is thriving with last trapping yielding a 14% capture rate.

However the Collie and St. John's Brook colonies have not been as successful. Trapping of all areas will continue.

TAMMAR HABITAT MANAGEMENT

Past studies have established the dependence of Tammar's (Macropus eugenii) on thickets of Heartleaf Poison (Gastrolobium bilobum) or Melaleuca viminea.

Experimental burning of Heartleaf thickets shown the importance of fire in successful thicket regeneration, and the need for a fire regime designed to maintain this type of habitat.

An experiment has been established to attempt to prescribe a fire to promote the development of a Heartleaf thicket and to test the feasibility of intergrating this type of management requirement into present burning practices.

FIELD COURSES

Three field ecology courses have been conducted. February 1984 for Forests Department and National Park Personnel. May 1984 for school teachers and August 1984 for school teachers.

The courses have been well received by participants and it is anticipated that the demand for these courses will increase.

FUTURE RESEARCH

Ecological research will be designed to provide data for the management of Flora and Fauna Priority Areas.