FORESTS DEPARTMENT
WESTERN AUSTRALIA

ANNUAL REPORT 1973

Forests Department,
PERTH,
30th September, 1973

TO THE HONOURABLE THE MINISTER FOR FORESTS

Sir,

I have the honour to transmit herewith my report on the operations of the Department for the year ended 30th June, 1973.

Yours faithfully,
B. J. BEGGS,
Conservator of Forests.

Cover :

The photograph on the cover illustrates the section titled Land Use Planning at page 13

(1)—23110

MR. D. W. R. STEWART

Mr. D. W. R. Stewart attained the Office of Conservator of Forests on January 12th, 1972 in fitting recognition of his outstanding service in the Forests Department. He retired from the position on July 14th, 1972.

Mr. Stewart matriculated at Perth Modern School and attended the University of Western Australia and the Australian Forestry School in Canberra, from which he was one of the first to graduate in 1928. He joined the Forests Department in January, 1929, and served with distinction in various capacities over a period of 43 years.

In 1933 Mr. Stewart was appointed Divisional Forest Officer at Manjimup. From that centre for nearly 20 years and later from a senior posting in Perth he played a leading role in the development of the southern forests. This period saw the introduction of orderly cutting in the forest, and development of fire protection, roading and communication; the adoption of sound silvicultural and regeneration techniques; and the provision of accurate maps and cutting records based firstly on cadastral and topographic surveys and later on aerial photogrammetry.

Mr Stewart took a special interest in developing the use of forest fire detection from karri tree lookouts and the now famous Gloucester and Diamond Tree lookouts were introduced under his direction. Long before radio became feasible for forest communication Mr. Stewart introduced the Canadian type single wire earth return telephone system to southern forests. The network of bush telephone lines served the Department admirably for 40 years.

In 1950 Mr. Stewart was awarded the Russell Grimwade Prize and after a year of post graduate studies at Oxford, he obtained the degree of Diploma in Forestry (Oxon.).

After his transfer to Perth in 1954 Mr. Stewart remained the Department's first reference on all matters affecting the southern forests particularly land tenure, acquisition of land for plantation establishment and pine conversion and sales. He ably served the Department as its representative on a number of continuing committees.

In 1969 Mr. Stewart was appointed Deputy Conservator of Forests and served in that position until his appointment as Conservator.

Best wishes are extended to him for a long and pleasant retirement.

PRINCIPAL OFFICERS *

Conservator of Forests	B. J. BEGGS, B.Sc. (For.), Dip.For. (Canb.)
Deputy Conservator of Forests	W. H. EASTMAN, B.Sc. (For.), Dip.For (Canb.), Dip. For. (Oxon.)
Chief of Division	J. C. MEACHEM, D.F.C., B.Sc. (For.), Dip.For. (Canb.)
Chief of Division	P. J. McNAMARA, M.A. (Oxon.)
Chief of Division	J. B. CAMPBELL, B.Sc. (For.), Dip.For. (Canb.)
Chief of Division	E. R. HOPKINS, B.Sc. (W.A.), Dip.For. (Canb.), Ph.D. (Melb.)
Utilisation Officer	H. C. WICKETT, M.Sc. (Adel.), B.For.Sc. (N.Z.), M.I.E. (Aust.), Dip.For. (Canb.)
Superintendent	D. E. GRACE, B.SC. (For.), Dip.For. (Canb.)
Superintendent (Fire Control)	F. J. CAMPBELL, B.Sc. (For.), Dip.For. (Canb.)
Superintendent	S. J. QUAIN, B.Sc. (For.) Dip.For. (Canb.)
Superintendent (Research)	J. J. HAVEL, M.Sc. (W.A.), Dip.Ed., Dip.For (Canb.)
Superintendent (Extension Services)	P. N. HEWETT, B.A. (W.A.), B.Sc. (Adel.), Dip.For. (Canb.)
Superintendent (Plantations)	A. C. van NOORT, B.Sc. (For.), Dip.For. (Canb.)
Chief Draftsman	R. M. DAVIS, E.D.
Secretary	R. K. REID,
Accountant	R. H. WILSON, B.A. (Econ.), A.A.S.A.
Registrar	B. M. SMITH, B.A.

* At June 30th, 1973.

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APPENDICES

STATISTICAL SUMMARY OF MAJOR OPERATIONS

For the first time this report uses statistics solely in S.I. Metric units although Appendix 2 remains in Imperial this year. An abbreviated conversion table to Imperial units is incorporated as Appendix 6.

Sawnwood Production

Trends in Production and Consumption.

Sawnwood Production

Trends in Production and Consumption.

Year Ended June 30	Production (cubic metres)				Number of Sawmills	Monthly Average No. of Employees
	Hardwood	Conifer	Hewn Hardwood	Total		
1926	411 283	....	177 792	589 075	....	....
1938	331 928	....	12 883	404 811	138	3 112
1946	251 194	....	398	251 592	128	2 876
1951	356 029	....	33	356 062	256	4 047
1956	544 134	....	150	544 284	274	5 804
1960	470 833	....	....	470 833	265	5 037
1965	460 246	22 667	....	482 913	206	3 615
1966	475 642	16 499	....	492 141	203	3 518
1967	461 176	17 085	....	478 261	202	3 173
1968	469 818	16 531	....	486 349	188	3 209
1969	413 666	19 643	....	433 309	191	3 233
1970	425 295	16 393	....	442 188	163	2 869
1971	420 777	21 595	....	442 372	150	2 401
1972	379 006	21 733	....	400 739	154	2 533
1973	375 135	23 283	....	398 418	145	2 825

Log Production* (m^3)

	1973	1972
Jarrah	732 968	802 438
Karri	276 823	245 830
Wandoo	28 577	30 727
Pine	101 434	92 067
Other	23 548	32 167
	1 163 350	1 203 229

* Includes sawlogs and logs for plywood, veneer and reconstituted wood (particle board, etc.).

Forest Area

	hectares
Additions to State Forest	2 038
Excision from State Forest	68
Land purchased for pine planting	99
Total Area of State Forest	1 825 838

Reforestation

Cut-over areas treated for regeneration	74 344

Afforestation

Area planted with pines 1972		2 532
Pinus radiata	1 361 hectares	
Pinus pinaster	1 168 hectares	
Other species	3 hectares	
Total area of pine plantation established		31 879
Pinus radiata	13,407 hectares	
Pinus pinaster	18,233 hectares	
Other species	239 hectares	
Total experimental areas (additional)		1 043

Management

Survey—	
Topographical mapping	160 014
Assessment—	
Area covered	219 000
Engineering, new works—	
Roads and tracks	357 km
Houses	Nil

Protection—

Prescribed burning	313 781
Fire outbreaks—	
Number	272 (No.)
Area burnt	7 705 ha

Nurseries (Hamel and Narrogin)—

Trees produced for—	
Private buyers	235 400 (No.)
Forests Department	4 578 500 (No.)

Sandalwood

Quantity exported	1 452 tonnes

Source and Application of Funds

	1972/73 $	1971/72 $
Source—		
Royalties on timber, etc.	2 816 154	3 025 684
Departmental fees, sale of logs, etc.	2 223 550	2 007 282
Sub Total	5 039 704	5 032 966
General Loan Fund	1 900 000	1 100 000
Commonwealth Aid Road Grant	270 244	176 006
Rents	127 270	70 982
Commonwealth Softwood Forestry Agreement	558 000	56 241
Increase or decrease in unexpended balance	—682 747	—137 197
Aboriginal Training Scheme Advance	14 000	462 000
Mining Compensations Grant	7 899	....
	7 234 370	6 760 998
Application—		
1. Expended from Consolidated Revenue Fund—		
Pine and Hardwood conversion	1 340 356	995 731
Administration and general expenses	1 130 267	992 785
Transfer to Treasury	321 556	286 738
2. Expenditure under Reforestation Fund—		
Division—Direct Operating costs	2 018 204	1 720 326
Head Office and general expenses	2 423 987	2 765 418
	7 234 370	6 760 998

REVENUE AND EXPENDITURE

Revenue for the year from all sources amounted to $5 039 704 compared with $5 032 966 in the previous year.

After deduction of specified expenses, the nett revenue transferred to the Reforestation Fund was $2 239 636 ($2 757 712)—figures in brackets refer to the previous year. During the year this fund also received $1 900 000 ($1 100 000) from the General Loan Fund, advances totalling $558 000 ($56 241 and Treasurer's advance $462 000 since reimbursed by Commonwealth on the signing of the second 5 year agreement) under the Commonwealth Softwood Forestry Agreement, and Commonwealth Aid Road Grants of $270 244 ($176 006.)

Expenditure from the Reforestation Fund for the year amounted to $4 643 257 ($4 485 744) and the balance held in the Fund at the 30th June was $1 598 757 ($916 010).

FOREST AREA

State Forests (Forests Act, 1918–1969)

The total area of State Forest at 30th June, 1973, was 1 825 838 hectares which is an increase of 1 970 hectares compared with the total area at 30th June, 1972.

	June, 1972 hectares	June, 1973 hectares
Jarrah	1 308 541	1 309 761
Karri	74 404	75 120
Jarrah and Karri (mixed)	265 679	267 164
Jarrah and Wandoo (mixed)	66 300	66 297
Tuart	2 604	2 880
Tingle Tingle	4 424	4 424
Karri and Tingle (mixed)	5 619	4 229
Sandalwood	781	781
Pine Planting	73 254	72 921
Mallet	22 201	22 200
Miscellaneous	61	61
	1 823 868	1 825 838

Timber Reserves (Forests Act, 1918–1969)

The total area held under Timber Reserves at 30th June, 1973, was 71 295 hectares which is an increase of 2 201 hectares compared with the total area at 30th June, 1972.

	June, 1972 hectares	June, 1973 hectares
Jarrah	37 739	38 809
Wandoo and Jarrah (mixed)	29 053	29 052
Jarrah and Karri (mixed)	443	1 748
Pine Planting	1 855	1 682
Mallet	4	4
	69 094	71 295

Land Alienations, etc.

During the year ended 30th June, 1973, 122 applications for land and road provisions and closures were received covering a total of 57 674 hectares.

The Department agreed to release as follows :

Alienations			Leases (Pastoral—Grazing, etc.)		
Timber Zone		Outside Timber Zone	Timber Zone		Outside Timber Zone
State Forest	Crown Land		State Forest	Crown Land	
hectares	hectares	hectares	hectares	hectares	hectares
68	5 409	....	460	49	....

No. of alienations approved 30
No. of leases approved 21

The total freehold land held at 30th June, 1973, in the name of the Conservator of Forests was 24 091 hectares.

SAWMILLING, TIMBER INSPECTION AND FOREST PRODUCE

Timber Production

The production of 398 418 m³ of sawn timber was a decrease of 2 321 m³ on last year's figure. Of the total output 35 858 m³ came from private property, an increase of 192 m³ on the 1971/72 figure.

At December 31, 1972, there were 145 sawmills registered of which 80 operated on Crown Land and 65 on private property. This represents a decrease of nine on last year's registration. Details of the annual intake of mill logs and production of sawn timber are given in accompanying tables.

The annual intake of logs (1829–1973) is given in Appendix 5.

Roundwood production from Departmental pine plantations totalled 100 419 m³ an increase of 9 658 m³ on the figure for 1971/72 (see Afforestation.)

Local plywood factories obtained the following quantities of peeler logs—

	m³
Karri	3 773
Jarrah	1 055
Pine	3 632
	8 460

Timber Inspection

The total quantity of timber inspected during the year was 84 814 m³ made up as follows—

	m³
Railway Sleepers	62 971
Ex Crown Land	44 910
Ex Private Property	16 879
Re-inspected	1 183
Other Sawn Timber	21 843

All railway sleepers produced were inspected.

TIMBER PRODUCTION

PRODUCTION OF TIMBER FOR YEAR ENDED JUNE 30, 1973
EXCLUSIVE OF HARDWOOD, MINING TIMBER, FIREWOOD, POLES AND PILES

Tenure	Log Volumes by Species (1)								Totals	
	Jarrah	Karri	Wandoo	Yarri	Sheoak	Marri	Pine (2)	Other	In Log	Recovery of Sawn Timber
Crown Land m³	668 634	256 426	11 960	1 950	169	19 985	100 419	818	1 060 359	362 560
Private Property— m³	64 335	20 398	16 617	253	....	374	1 015	....	102 992	35 858
Total—m³	732 969	276 824	28 577	2 203	169	20 359	101 434	818	1 163 351	398 418

(1) Includes sawlogs and logs used in the production of plywood veneer and reconstituted wood (particle board, etc.).
(2) For log categories see Afforestation.

QUANTITY OF SAWN TIMBER PRODUCED FROM CROWN LANDS AND PRIVATE PROPERTY FOR THE PAST TWO YEARS

Year Ended June 30	From Crown Lands		From Private Property		Total Quantity
	Sawn Timber other than Sleepers	Sawn Sleepers	Sawn Timber other than Sleepers	Sawn Sleepers	
1972— m³	307 895	57 178	16 890	18 776	400 739
1973— m³	317 651	44 910	18 979	16 879	398 418

Sandalwood

The demand for Sandalwood increased by 50 per cent. and 1 452 tonnes were exported during the year 1972/73 as compared with 968 tonnes for the previous year.

Sandalwood received at Fremantle during the year totalled 1 166 tonnes compared with 1 091 tonnes for the year 1971/72.

Crown Land	Tonnes
Logwood (including Roots and Butts)	932
Pieces	233
Private Property	1
	1 166

No orders for logwood or roots and butts were placed by distillers for oil distillation purposes.

Firewood Production

	Crown Land Tonnes	Private Property Tonnes	Total Tonnes
Sawmills			
G.P. and Sleeper			
For sale	63 885	....	63 885
Own use	29 773	....	29 773
P.P. Annual			
For sale	....	8 315	8 315
Own use	....	72	72
Domestic			
L.F.	16 119	....	16 119
F.P. Licence	18 240	....	18 240
Bartons	212	....	212
Kalgoorlie	6 004	....	6 004
Industry			
Wundowie	100 186	....	100 186
Kalgoorlie			
Mines	1 029	....	1 029
Pumps	....	....	....
Industrial	....	....	....
	235 448	8 387	243 835

Other Forest Produce

Poles and piles obtained from Crown land during the year amounted to 304 433 metres compared with 317 132 metres for the previous year. Returns from private property showed 21 538 metres as compared with 19 487 metres for the year 1971/72.

Fence posts and strainers cut from Crown lands totalled 246 945. Records received show that 7 621 posts and strainers were obtained from private property, but this was only a small percentage of the total production from this source.

Apart from sawn timber supplied by sawmills, 9 531 tonnes of mining timber were used. All of this was obtained from Crown lands, 6 199 tonnes being from inland forests.

FOREST PRODUCE NOT ELSEWHERE INCLUDED IN PRODUCTION TABLES

Description	South West Division and Agricultural Areas			Goldfields Areas	Total
	Supplied by Department	Other Crown Land	Private Property		
Mining Timber .... m³	....	2 787	....	5 184	7 971
Piles, Poles and Bridge Timber .... m	....	304 433	21 538	2 288	382 259
Fence Posts and Rails .... No.	10	183 189	7 621	41 357	232 177
Strainers .... No.	....	18 694	....	3 705	22 399
Beansticks .... No.	....	9 900	....	....	9 900
Boronia .... kg	....	1 875	389	....	2 264
Gravel and Stone .... m³	....	2 830	....	....	2 830
Sand .... m³	....	1 038	....	....	1 038
Sawdust as fuel .... tonnes	....	66 925	....	....	66 925
Scout staves .... No.	200	....	....	....	200

FOREST MANAGEMENT AND CONSERVATION

Unemployment Relief

The Department continued to participate in the Commonwealth Non Metropolitan Unemployment Relief Scheme throughout the year. During the year the sum of $338 500 was made available from the Commonwealth Government through the State Treasury and this was spent on much needed silvicultural work which, because of insufficient reforestation finance, would not have otherwise been done.

Although some Divisions had extremely stable gangs, vacancies occurred in all gangs as men left of their own accord to take up more permanent positions or were transferred into the Forests Department workforce. A total of 134 men were given the opportunity of work at a time when jobs were difficult to acquire.

Tasks performed by the unemployment gangs were additional to normal Departmental programmes which have had to be restricted over the years due to lack of finance. They included stand improvement work in the hardwood forest, softwood plantation pruning, raising of nursery stock for hardwood enrichment, roadside improvement and the development of tourist facilities. Gangs operated from the Divisions of Wanneroo, Mundaring Weir, Dwellingup, Narrogin, Collie, Kirup, Nannup, Manjimup, Pemberton and Kalgoorlie.

Hardwood Inventory

Assessment cover was extended to Narrogin division during the year, where 65 plots representing 21 000 hectares were measured. 254 plots representing 50 000 hectares were also measured in Walpole and Pemberton divisions. 191 plots were measured to relate the assessor's estimates to actual volumes present. With broad scale resource surveys virtually completed, emphasis has turned to more detailed management surveys of I.M.U. (Intensive Management Unit) areas. 1 202 " subsequential sample " plots representing 148 000 hectares were measured in Mundaring, Kelmscott, Dwellingup, Harvey, Collie, Kirup, and Manjimup divisions. From these plots, maps were drawn indicating which areas are suitable for different management activities such as pole thinning, cull removal, dieback rehabilitation.

Softwood Inventory

208 temporary and 502 permanent plots were measured or remeasured in Harvey, Collie, Busselton, Kirup, Nannup, Manjimup and Pemberton divisions. 946 plots were assessed to determine the stand condition after thinning operations in Harvey and Collie divisions.

Projects

Air photos were used to search for dieback in 23 700 hectares of Mundaring and Collie divisions.

A high quality virgin jarrah forest area in the northern region was assessed in order to judge its suitability for reservation for scenic and scientific purposes.

The yield of chipwood from karri regrowth thinnings was measured on an area in Pemberton division.

Data and reports were prepared for the resources panel of the FORWOOD conference to be held in Canberra in 1974.

Air photos of the heaviest marri flowering for many years were used to interpret marri and karri stands in several karri sawmill permits.

Automatic Data Processing

Metrication : Many of the projects undertaken by the A.D.P. Section have been directly concerned with metric conversion problems : the conversion of computer programmes, the preparation of metric tables and the formulation of rules of estimation for hardwood and pine log royalty purposes.

Regional Computing Centre: Improved computing facilities have been made available at the Regional Computing Centre, University of Western Australia. Some computer programmes have been converted directly to operate at this installation, others have been completely redesigned to take advantage of the improved operating system.

Thinning Operations Scheduling: Some preliminary planning has been carried out towards the development of a scheduling system for pine thinning operations. In this system, computer programmes which simulate forest growth and implement thinning prescriptions will interact with a linear programming model to produce five year thinning schedules.

Mapping

A major activity of the year has been the progressive conversion of Departmental mapping to metric measure. Plantation maps have been converted to the scale 1 : 12 500 and a commencement made in republishing the A.P.I. map series at the scale 1 : 25 000. A total of 35 type and topographical maps have been converted.

The remapping of the forest areas at the standard scale of 1 : 50 000 has been delayed through lack of basic control. A commencement has been made in the Denmark area where four map sheets are in progress.

The 1 : 63 360 scale map Kirup 80 was published in full colour and preparation is in the final stages for the printing of Augusta 80. This will complete the coverage of the forest areas with modern multi-coloured maps. The revision of this series will continue until metric coverage is available and seven maps are currently being revised. Map sheets Dwellingup 80, Wanneroo 80 and Moore River 80 were amended and two new temporary map sheets Brunswick 80 and Ludlow 80 prepared.

Special purpose mapping included the publishing of a 1 : 500 000 multi-coloured map Forest Areas of the South West and a 1 : 50 000 map of Avon Valley.

Large scale aerial photographs were used to revise plantation mapping by plotting new clearing, roading and planting and the remapping of older planting years.

Field surveys were conducted to obtain control for the remapping of Gleneagle and Harvey Weir plantations and Grimwade settlements.

Forest Engineering

During the year 357 kilometres of roads, tracks and firelines were constructed and 6 124 kilometres of existing roads were regraded.

Plant and Equipment

All items of vehicles and field equipment were maintained at a constant standard of condition with a total of 63 workshop wages employees.

Fourteen major items of fabrication were completed including three flame throwers, one pusher bar, one gang truck canopy, three boom spray units, one pine planting machine, one fork lift for a wheel tractor, one timber transfer trolley, one two wheel trailer, one fire line plough, one cultivator and other small items for field and research use.

Departmental Buildings

No new houses were built during the year although new single officers quarters at Yanchep and extensions to the Nannup Office were completed.

Kelsal tower was shifted to a new site in the Blackwood Valley and re-named Stewart tower.

A drying shed was extended at Kirup and extensions made at Ludlow to provide working space for the grading of sawn pine.

Five older houses and several other small buildings were sold during the year.

Communications

Radio-Telephones: Radio telephones were installed at Burnside, Beard, Frankland, Walpole and Wanneroo fire lookout towers and at Nannup Office. This makes a total of 30 stations.

A repeater station was developed and manufactured for Stewart tower. This installation represents a radical departute from the standard repeater installation in that the complete station in a miniaturised form will be installed in the lookout cabin with the aerials on the cabin roof. This design eliminates the need for a V.H.F. hut at ground level and the usual interconnecting cables which reduce efficiency. It also results in considerable savings in installation costs and time.

Vehicle Wiring: Twenty-three vehicles were wired for V.H.F. radio. One vehicle was wired for S.S.B. radio for use in Kalgoorlie Division.

Aircraft and Aircraft Control Beacons: Radios were installed in two aircraft during the prescribed-burning season. A radio was loaned and installed in a CSIRO aircraft for liaison while carrying out smoke analysis research in early December.

Major modifications and improvements were made to the beacon vehicle radio equipment.

General: A modern telecommunications hut was built in the Kalgoorlie arboretum. Remote control telephone cables and A.C. power lines were placed underground, thus achieving much better protection against dust and temperature extremes.

Land Use Studies

In recent years, Land Use planning has gained renewed emphasis and foresters, as managers of considerable resources are inevitably involved in serious and far reaching Land Use decisions. Sound planning must consider both the policies of other Government Departments and Private Organisations, and the opinions of members of the public.

A quadratic programming model, previously used by CSIRO in city planning problems, has been adapted to develop optimal land use plans for the catchment of the Murray River, an area of 708 400 ha, located some 100 km south of Perth, W.A. Land Use activities considered include indigenous and plantation forestry, agriculture (beef, orchards and mixed farming), bauxite mining (followed by production forestry or agriculture), national parks and water storage. Benefits evaluated include the primary products, water and its salt and sediment load, recreation and conservation values.

The study team is chaired by a forester and includes members from CSIRO's Divisions of Building Research and Land Resources Management, the University of W.A., the Department of Agriculture and the Forests Department. Members of other Government and Private organisations have assisted as advisers in their specialist field. Some 25 participants, representing 10 organisations, took part in a bus tour of the catchment, and public opinion on some aspects of the study is being obtained via the medium of questionnaires.

To date, this study has promoted inter-disciplinary discussions on the problems arising from conflicts in land use activities and is influencing current research programmes by the redirection of emphasis.

Other areas which have been under study include—

(a) The Swan coastal plain north of Perth where the needs for both *P. pinaster* plantations and the original ecosystem are being provided for.

(b) A report on the Pemberton region is being published jointly with CSIRO.

(c) Within the Wungong catchment, the relationship between soils and resource use has been described (jointly with CSIRO).

(d) A detailed ecological survey of the Nannup Sunklands is well advanced and will be used as a basis for planning.

(e) A report has been prepared on a 113 000 ha portion of the South Coast between Walpole and Cape Beaufort. This report calls for dedication of this important area primarily for recreational purposes, and requests that it be managed by a responsible authority.

All of these projects aim to provide a sounder knowledge of the technological, sociological and economic basis for sound Land Use divisions within the forest areas of this State.

Forest Recreation

A special grant of $10 000 for tourist projects enabled the Department to maintain existing recreation facilities, extend some of these and complete work in hand at the commencement of the financial year. Areas affected ranged from Wilbinga Grove, 72 km north of Perth to Dombakup Crossing, 7 km from Northcliffe.

Construction of major new works was limited to Harvey and Pemberton Divisions. At the Logue Brook Dam a nature walk including footbridges was constructed and picnic seats and tables provided. Routed signs depicting flora on the walk were erected and a brochure compiled outlining major features of interest. A similar nature walk was constructed at the Waroona Dam. Both these projects are being developed in conjunction with the Local Authority.

Picnic sites with seats and tables were developed in Pemberton Division at Rooney's Bridge, Dombakup Crossing and Moons Crossing. Provision was also made for manning Gloucester Tree out of season on behalf of tourists.

The situation has been reached, as a result of the Department's continued efforts, where the greater portion of the present $10 000 grant is required for the maintenance of existing facilities which is absolutely essential if these are to retain their attraction for the general public. In view of this, a request to increase the annual grant is receiving serious consideration by the Government.

Kalgoorlie Dust Abatement

During the year a Technical Committee to prepare a report on dust problems of Kalgoorlie and Boulder was formed at a meeting convened by the Minister for Environmental Protection. The report was adopted early in 1973 and a permanent Eastern Goldfields Dust Abatement Committee was formed, with the technical committee retained as an advisory group. The report was prepared under the direction of an officer of the Department and the first planting of a 2 kilometre wide green belt around the area with 2 000 trees was completed in early winter, 1973.

Native Flora Protection Act

During the period August to November a series of wildflower patrols by departmental officers were conducted to sample a wide range of ecotypes in the South-west land division.

Officers were briefed to investigate areas of State Forest, Timber Reserves and specific portions of Crown Land to look for signs of picking or damage of wildflowers and to make enquiries about commercial picking from settlers and local authorities. In addition patrols in the Manjimup-Walpole-Mt. Barker area concentrated on the operations of licence holders for picking of Brown Boronia, *Boronia megastigma* for seed, sprays of flowers, and petals for perfume extraction.

Although valuable data was added to records of flowering and abundance of particular species, no serious breaches of the Native Flora Protection Act were observed.

Patrols of this kind will be continued in future seasons.

REFORESTATION

Hardwood Logging

During the year 74 344 hectares of hardwood forest were logged and treated for regeneration. This was made up as follows—

Forest Type	Maiden Bush	Cut-over Bush	Total Area
	hectares	hectares	hectares
Jarrah	19 277	44 642	63 919
Karri	1 309	2 152	3 461
Marri	1 467	237	1 704
Wandoo	589	4 671	5 260
Total	22 642	51 702	74 344

Jarrah Forest

Intensive Management Units: The creation of two units in the Manjimup Division and a small addition to an existing unit in the Collie Division increased the total area selected for intensive management to 377 500 hectares. Work is continuing with investigation of further areas with potential for intensive management, and for other special purposes such as recreation reserves, fauna priority areas and species reserves.

Preparation of working plans for intensive management areas is proceeding.

Dieback Hygiene: The severe drought stress of the summer of 1972/73 showed limitations in some of the species under trial on replanted dieback sites, and accentuated areas where the disease had previously affected root systems.

Refresher courses for forest use industries have been held to maintain an optimum level of hygiene practice in the forest.

Small areas of thinning and cutting were carried out by temporary unemployment relief workers.

Karri Forest

As a result of substantial work done in immediate past years, virtually all arrears of karri regeneration have been successfully completed. However, a small amount of regeneration work was carried out in Manjimup, Pemberton and Walpole Divisions.

Regeneration burning covered 219 hectares, 282 hectares of preparatory scrub rolling was completed and some 28 hectares were hand planted mainly in areas where regeneration by natural means would have proven unsuccessful.

Limited trials of early cleaning in regenerated stands were conducted and non commercial thinning continued in selected areas for amenity purposes.

Reforestation After Mining Bauxite

This year saw the first replanting of areas mined for bauxite at Alcoa's Pinjarra operation. Alcoa of Australia is responsible for the replanting of this area and rehabilitation methods are the same as those used at Jarrahdale.

In May, 1973, 10 ha of the 63 ha originally cleared were replanted using seedlings raised at Alcoa's nursery at Jarrahdale.

At the Jarrahdale mine site where the Forests Department is responsible for replanting, 85 ha were replanted in winter 1972, and a further 39 ha have been planted so far in the winter of 1973, bringing the total area replanted at Jarrahdale to 356 ha.

Arboreta have been established at both Pinjarra and Jarrahdale to compare the performance of 20 different species on these sites.

Research to determine the optimum fertiliser requirements for early establishments of eucalypts has given promising results and work in this field is continuing.

Erosion within the mine site is a matter of concern and a group comprising representatives from the Forests Department, Soil Conservation Service and the Metropolitan Water Supply has been formed to make recommendations concerning measures necessary to control erosion on these sites.

Reforestation After Mining Gravel

Present Main Roads Department policy is to rehabilitate gravel pits currently in use and those which will be opened up in the future.

Since 1971, the Main Roads Department has made an annual grant to the Forests Department for the rehabilitation of old disused M.R.D. gravel pits in State Forest which are visible from well used public roads or tourist vantage points. To complete the project it is hoped that these grants can continue for several more years.

This year rehabilitation was carried out on 23 pits (approx. 20 ha) in the Collie, Kirup and Nannup Divisions. Since the scheme commenced in 1971 a total of 55 pits have been rehabilitated.

Rehabilitation practice varies from pit to pit but covers aspects such as removal of dangerous trees on islands, heaping and burning of debris, battering of banks to a 1 in 3 slope, spreading of topsoil, improving drainage to prevent severe ponding, deep ripping of the pit floor, planting with Phytophthora resistant eucalypts and subsequent fertilizing.

Some rehabilitated pits close to roads have obvious potential for roadside stopping places and once the planted trees become established, installation of minor recreational facilities is proposed for some pits.

AFFORESTATION

The Need for Pine Plantations

The urgent need for a continued and expanded pine planting programme to supply the timber requirements of future populations in this State was reported on in last year's Annual Report. Development during the year of serious difficulties in importing joinery timber and a sharp rise in the price of such imports confirms the opinion that imported timber will not be available in the quantities required in the future. It therefore behoves the State to make every effort to ensure self sufficiency in timber supplies.

Land for Pine Planting

The availability of land naturally suitable for *P. radiata* has reached a critical level during the year, due to difficulties in purchasing suitable land from farmers. An upturn in the economics of agriculture has resulted in the withdrawal from sale of several properties in the Blackwood Valley. The Department negotiated for purchase of a number of properties during the year but because of the extremely high prices asked, only one small property of 154·6 hectares was purchased.

The continuation of the *P. radiata* planting programme beyond 1977 depends on the purchase of some 1 200 hectares each year, which, at current prices could cost as much as $300 000 per annum. Apart from the cost, the amount of land coming on the market for sale appears to be decreasing.

The Department's aim is to establish new forests through such purchases rather than convert existing natural high forest to pine plantations. However, there are certain sandy areas in State Forest carrying poor jarrah, affected by dieback which offer a possible alternative source of land for pine planting. This would result in " islands " of pine within large areas of natural forest. These soils are extremely infertile and, on current knowledge, are seriously deficient in nutrients for the successful growth of *P. radiata*. The possibility of improving the growth of pine with fertilisers on these soils is being vigorously investigated.

Seed Supplies

It is pleasing to report that all pine seed for the planting programme is now collected locally. *P. pinaster* seed orchards are providing improved seed for the entire pinaster programme whilst *P. radiata* seed requirements are obtained from specially treated seed production areas in mature plantations. Apart from producing better formed, more vigorous trees, the use of seedlings raised from this seed permits the planting of fewer trees per hectare and thus reduces establishment and subsequent tending costs.

The distribution of plantation areas by Divisions as at December, 1972, was as follows :—

Table

AREA OF PLANTATION (HECTARES)

Division	*P. radiata*	*P. pinaster*	Other species	Total
Wanneroo	120·9	12 540·0	82·7	12 743·6
Metropolitan	12·5	813·4	16·4	842·3
Mundaring	682·5	466·1	26·7	1 175·3
Kelmscott	313·2	1 017·5	9·5	1 340·2
Dwellingup	561·1	6·9	4·9	572·9
Harvey Coast	468·0	1 911·1	9·4	2 388·5
Harvey Hills	1 731·2	19·9	1·8	1 752·9
Collie	1 890·5	76·8	8·9	1 976·2
Kirup	3 205·4	74·7	5·1	3 285·2
Nannup	3 285·2	99·7	12·2	3 397·1
Busselton	665·0	1 182·9	33·3	1 881·2
Manjimup	212·7	....	....	212·7
Pemberton	259·2	23·8	27·9	310·9
Totals	13 407·4	18 232·8	238·8	31 879·0
Experimental Planting	219·3	753·0	70·5	1 042·8
Grand Totals	13 626·7	18 985·8	309·3	32 921·8

The 1972 plantings totalling 2531·9 hectares were spread over eight Divisions as follows :—

Table

1972 PLANTING (HECTARES)

Division	*P. radiata*	*P. pinaster*	Other Species	Total
Wanneroo	97·5	916·1	....	1 013·6
Kelmscott	75·2	114·5	0·7	190·4
Dwellingup	177·8	....	2·5	180·3
Harvey Hills	133·8	....	....	133·8
Harvey Coast	52·2	105·4	....	157·6
Collie	105·9	15·5	....	121·4
Kirup	341·2	....	....	341·2
Nannup	337·5	12·3	....	349·8
Busselton	39·3	4·5	....	43·8
Totals	1 360·4	1 168·3	3·2	2 531·9
Experimental Planting	20·7	0·6	4·9	26·2
Grand Total	1 381·1	1 168·9	8·1	2 558·1

Approximately 137 hectares of mature pine were clear felled during the year.

Roundwood Production

Roundwood production from Departmental plantations, mainly in the form of thinnings, amounted to 100 420 m³ which was an increase of 9 658 m³ or 10·6 per cent, on last year's figure. The following figures show the trend in pine log removals in recent years :—

Year Ended June 30	m³ (U.B.)
1950	8 440
1955	20 131
1960	28 394
1965	48 766
1970	81 281
1971	86 245
1972	90 761
1973	100 420

Removals by category and by species were as follows :—

Category	*P. radiata* m³	*P. pinaster* m³	Total m³
Sawlogs	36 274	11 120	47 394
Chipwood	12 923	32 917	45 840
Peeler logs	3 281	351	3 632
Fence Posts and Rails	2 055	1 058	3 113
Miscellaneous	99	340	439
Total	54 632	45 786	100 418

Roundwood removals from the various plantations were as follows :—

	m³
Wanneroo (Gnangara)	23 059
Metropolitan—	
Collier	2 863
Somerville	5 785
Mundaring	16 703
Gleneagle	639
Harvey	9 376
Collie	3 072
Kirup (Grimwade)	14 953
Nannup	4 264
Busselton—	
Ludlow	9 305
Keenan	5 816
Pemberton	4 486
Miscellaneous	99
	100 420

Sawn production from all sources was 23 283 m³ which is an increase of 1 549 m³ on 1971/72 production.

Private Forestry

Approximately 673 hectares of pine was planted by private interests in Western Australia in 1972, increasing the area of privately owned pine forest in the State to approximately 4 660 ha.

The area of private pine forests now represents nearly 12 per cent of the State's total pine forests, and private firms are offering services, ranging from purely consultant to fully serviced investments in short term pine projects on a range of proven and unproven site types.

The Forests Department provides an information service for private planters. In the financial year 1972/73, 129 enquiries were dealt with and 20 site inspections made.

Tree Nurseries

The supply of trees at cost to rural areas continued from the Hamel and Narrogin tree nurseries

Reduced demand from private sources was a result of the agricultural recession while an increase in the level of dieback rehabilitation and Bauxite mine plantings increased the demand for Departmental use.

Nursery	No. of Plants Sold				Departmental Use			Total Plants	
	Pots	Trays	Open Rooted	Total	Pines	Other	Total	No. Species	Total
Hamel	32 056	7 912	40 702	80 670	878 674	280 497	1 159 171	200	1 239 841
Narrogin	46 383	3 048	....	49 431	....	....	....	84	49 431
Total	78 439	10 960	40 702	130 101	878 674	280 497	1 159 171	284	1 289 272

The most popular species were:—

Pinus radiata	monterey pine
Pinus pinaster	maritime pine
Eucalyptus camaldulensis	River gum
Eucalyptus globulus	Tasmanian blue gum
Eucalyptus bicostata	Eurabbie
Eucalyptus gomphocephala	Tuart
Eucalyptus cladocalyx	Sugar gum
Eucalyptus cladocalyx var. *Nana*	Dwarf Sugar gum
Eucalyptus lehmannii	Bald Island Marlock
Eucalyptus ficifolia	Red Flowering gum

Departmental nurseries raised a total of 4 298 000 pine seedlings in 1972, mainly for the Department's afforestation programme. Some 146 000 seedlings were sold for private planting projects.

Mallet Plantations at Dryandra

The 8 000 ha of plantations were initially established to meet the requirements of a tan bark industry. Since this market has been largely replaced by synthetic products alternative markets for mallet are now being actively investigated, and a small factory is making tool handles from the timber. Silvicultural and Management techniques to suit a changed end product are under test.

Esperance Roadside Planting

In October, 1971, following a request from the Shire of Esperance, a scheme to plant shelterbelts along road surveys in the Esperance Shire was re-introduced. An additional proviso to the conditions applying previously is that future planting will not proceed on inadequately prepared sites or on sites considered unsuitable by the reconstituted Management Committee.

The Committee which comprises representatives of the Shire and Departments of Agriculture, Lands and Surveys, and Forests, inspected and approved of planting by 8 landholders. Subsequently 7 landholders proceeded with the planting of 12 250 pines in the 1972 winter. Results varied from a very good 98 per cent survival rate to a not really acceptable 40 per cent.

Results of the 1972 planting demonstrated that it is futile to consider planting *Pinus pinaster* on anything but deep sands. Participants in the 1973 scheme will be given the option of sowing pines or eucalypts, the former being for planting only on soils having a minimum of two feet of sand topsoil. There is considerable extra cost in raising Eucalypt seedlings as compared with *Pinus pinaster* and landholders who plan to sow eucalypts in 1973 have agreed to pay a levy of 10 cents per tree by way of subsidising the greater costs.

A total of 12 farmers will be planting 5 900 eucalypts and 4 900 pines in the 1973 winter over 24 km and 7 km respectively. Preparation for planting during the past year has progressed steadily under the guidance of the local Management Committee. The Committee, in conjunction with its planting activities, also took an active interest in the preservation of general road verge vegetation in the Esperance area.

Inland Arboreta

Maintenance of the 56 arboreta established throughout the farming areas was continued and extensions were completed at the Kalgoorlie Arboretum.

New plantings were carried out at Coolgardie and Esperance as part of a three year programme. The Esperance planting was named Helms Arboretum in honour of the late Andy Helms who was associated with a private forestry project at Esperance in the 1930s.

Two trial plots were established in the West Kimberley region, one at Kalumburu and the other at Drysdale Station. Planting was done in early January, the peak of the wet season, and was accomplished with the assistance of the Forestry Section, Northern Territory Administration, who raised the plants, and the project was supervised by the tree adviser for the North-West. Rapidly changing land use practice in the Kimberleys is expected to necessitate advice on shade and amenity plantings at an increasing level in the future, and these plots will be an initial guide to tree performance in this difficult environment.

PROTECTION

Fire Protection

	hectares
State Forest Under Protection	1 825 838
Indigenous Forest	1 784 916
Pine Plantations	32 922
Mallet Plantations	8 000

A further 809 400 ha of crown land and private property were indirectly protected due to their strategic importance relative to state forest or their forest value.

The Fire Season

The first seven months of the 1972 calendar year were amongst the driest on record. Abnormally dry fuels in spring restricted prescribed burning operations.

Dry conditions continued through summer and autumn until the first soaking rains fell in April. The season was notable for a higher than average number of fires.

The data below was recorded at forest weather stations at Dwellingup (jarrah) and Pemberton (karri).

	Jarrah		Karri	
	Average	1972/73	Average	1972/73
Rainfall—				
Annual (mm)	1 283	1 230	1 297	1 082
October to April inclusive (mm)	273·5	240·0	379·0	283·4
Number of Wet Days—				
Annual	127	142	194	173
October to April inclusive	44	43	83	60
Temperature—				
Mean maximum October to April inc. °C	25·1	26·1	22·8	23·4
Days of 38°C or over (No.)	4	5	2	1
Days of 32°C or over (No.)	27	32	14	14
Relative Humidity—				
Days of 10% or less (No.)	3	1	1	Nil
Days between 11% and 15% (No.)	7	11	3	1
Days between 16% and 25% (No.)	35	23	8	6
Fire Hazard—				
No. of dangerous days	12	8	2	2
No. of severe days	23	15	5	5
Mean hazard	5·4	6·3	4·4	5·7

Prescribed Burning

Indigenous forest		305 260 ha
Hand burning	114 822 ha	
Aircraft burning	190 438 ha	
Advance, Top Disposal and regeneration burning		5 314 ha
Plantations		3 207 ha
Clearing burns	2 520 ha	
Burning under pine canopy	687 ha	
Total Prescribed Burning		313 781 ha

Although dry conditions curtailed prescribed burning earlier than usual large areas were covered by both hand and aerial techniques early in spring. Burning within indigenous forest covered 79 000 ha more than in 1971.

Aircraft burns were completed over 18 000 ha of crown land and state forest north of Denmark. This burning was a co-operative effort with local Shires and the Bushfires Board.

Fire behaviour studies were commenced in Dryandra state forest and preparations were made for similar studies in the Stirling National Park, on behalf of the National Parks Board. The objective is to define the range of suitable weather conditions for mild prescribed burning of the particular fuel types in these areas.

Two sophisticated fire behaviour guides were successfully introduced into fire operations, one for karri forest the other for *Pinus pinaster* plantations.

For the past three decades daily estimates of fire hazard have been based on the moisture content of pine hazard rods. Last fire season saw the successful introduction of a new system for estimating hazard, based on overnight changes in relative humidity as well as daily fluctuations in both temperature and relative humidity. Fire hazard is an expression of day to day fluctuations in the moisture content of fire fuel.

New quality control techniques were tried for prescribed burning, involving aerial photography with infra-red film. Unfortunately faults in the film delayed a large scale programme until spring 1973.

Detection

Thirty-five fire towers were manned during the fire season. The period of fire watch for jarrah forest was as usual, longer than for karri.

	Karri	Jarrah	Pine
First Watch	10/11/72	6/10/72	13/9/72
Last Watch	12/4/73	28/4/73	27/4/73

Trials were conducted testing light aircraft on fire detection. The aircraft advantage of direct view over the whole search area enabled it to spot more smokes than towers, which had only indirect view over parts of the area. In a number of cases the aircraft was slower than towers spotting a fire because of the limited area under surveillance at one time.

A 35 m high wooden fire tower was dismantled and moved to a new site overlooking pine plantations in the Blackwood Valley. It has been named Stewart tower.

Fires and Fire Damage

Departmental forces attended 377 fires of which 105 were burning in private property or crown land adjacent to state forest.

Indigenous forest	211 fires burnt	7 684 ha
Pines	61 fires burnt	21 ha

Exceptionally dry summer conditions were reflected in 128 fires more than in 1971/72 burning a greater area of indigenous forest (4 500 ha) and pines (19 ha).

The detection system assisted shires by locating and reporting fires burning in private property.

Bushfire brigades were supported by Departmental forces where fires in private property threatened state forest. Fire suppression in reserves near the metropolitan area was undertaken on behalf of the Fisheries and Fauna Department.

The 1972/73 fire season was notable for the number of fires started from lightning strikes, 21 more than in 1971/72 including three strikes in pine plantations. Fire escapes from prescribed burning in both state forest and private property vied with those deliberately lit as major causes of fires in state forest. There was however an encouraging decrease in the number of fire escapes from private property.

General

There was an increasing demand by other organisations for the Department's assistance on fire control matters.

A two-week training course in forest fire control was conducted at the Dwellingup training centre for liaison officers from the Bushfires Board. Valuable assistance with the course was rendered by members of the Bushfires Brigade organisation.

Preparation of a number of aircraft and hand burns have been undertaken on behalf of the Bushfires Board, National Parks Board and Fisheries and Fauna Department.

Fire staff assisted with fire seminars held by the Armadale, Kelmscott and Cockburn Shires and with training employees from Mundaring and Kalamunda Shires in forest fire fighting.

Trials were undertaken to develop specifications for fire retardant chemicals in local fuels.

The conversion of fire operations to metric measurements was completed last summer except for some minor equipment modifications.

RESEARCH : SOFTWOOD SILVICULTURE

Pinus pinaster

Tree Breeding

The primary purpose of the tree breeding programme for *Pinus pinaster* is improvement in form. Qualitative assessment of form has indicated marked improvement, and has led to reduction in stems per acre planted from 2 240/ha for routine seed source to 1 120/ha for seed orchard seed. An additional unscheduled benefit has been increased height growth, which exceeds the routine by 10 per cent for orchard seed as a whole, and by 20 per cent for seed from the top twenty-five crosses.

PINUS PINASTER—SUMMARY OF HEIGHT GROWTH (METRES) AT AGE 3½ YEARS

Location	Mun-daring	Gnangara I	Gnangara II	Pember-ton	Collie	Yanchep I	Yanchep II	Hamel
Mean Height (cm)—								
Progeny	1·61	2·26	2·15	2·36	2·76	2·93	2·81	3·38
Routine	1·64	1·92	1·75	2·12	2·45	2·60	2·48	....
No. Families	16	30	30	13	10	30	30	24
Per cent Height Increase—								
Top 25%	13%	23	33	25	20	21	22	....
Top 50% progeny	6	21	28	17	18	18	18	....
Progeny	—2	18	23	11	13	13	13	....

The field sites on which the progeny tests were carried out differ markedly in soils and climate, yet the relative performance of genotypes was virtually unaffected by this. The lack of genotype-environment interaction means that a single breeding programme will be adequate for the full range of sites encountered in the south west of Western Australia.

Thinning

The main area in which *Pinus pinaster* is grown has experienced four consecutive years of below-average rainfall. The effect of this has been a significant reduction of increment in heavily stocked, lightly thinned stands. Despite the drought, there has been no reduction in heavily thinned stands of 7·1 m^2/ha basal area. At this level of stocking, there is adequate recharge of soil moisture in winter, and gradual withdrawal during summer, resulting in extended growing period, and markedly higher diameter increment of individual trees. Slightly denser pine stands of 10·8 m^2/ha of basal area have moisture patterns virtually identical with native woodland of banksias and eucalypts. Dense stands of 23·6 m^2/ha basal area intercept 30 per cent of rainfall, and take up soil moisture at markedly higher rates. This results in only partial wetting of the soil profile, early exhaustion of soil moisture and early cessation of growth. The diameter increment is reduced correspondingly (see graph of Mean Diameter Increment).

Whereas in years of normal rainfall heavily thinned stands have lower volume increment than lightly thinned stands, in years of below-average rainfall this difference virtually disappears. See graph of Stand Volume Increment.

In view of the fact that the aquifers under *Pinus pinaster* plantations are being tapped for Metropolitan water supply, the above findings become particularly important.

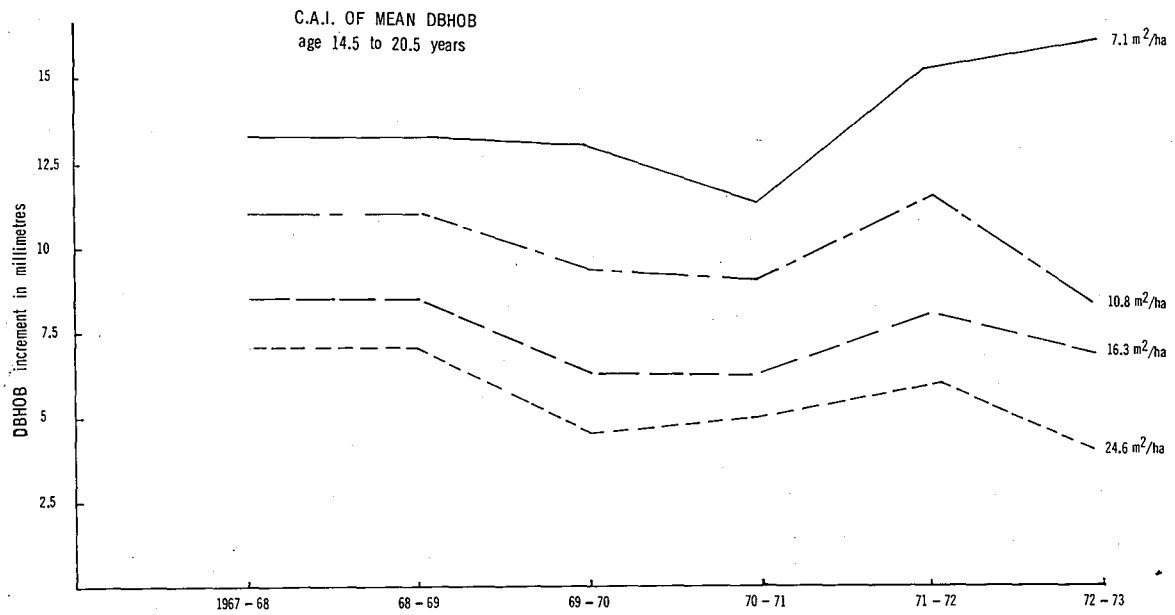
Fertiliser

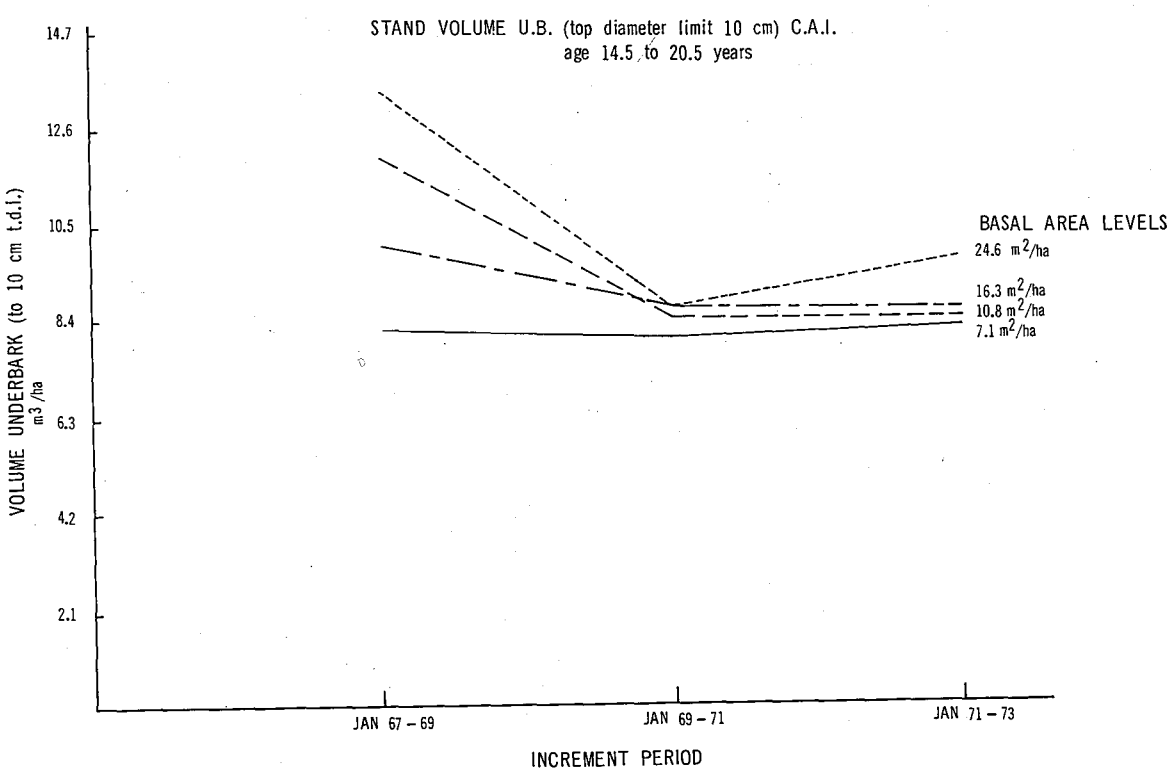
Fertiliser was applied to one half of the Yanchep thinning plots in Spring 1971. The 19 year old pines received broadcast application of 0·5 tonne Super Cu. Zn. plus 0·25 tonne Ammonium sulphate per hectare. One year increment values for diameter and basal area are shown in the table titled response to fertiliser.

RESPONSE TO FERTILISATION BY STANDS OF VARYING BA LEVELS

Prescribed Basal Area	Basal Area—m^2/ha				Mean Fert.
Fertiliser	7·1	10·8	16·3	24·6	....
Stand D.B.H.O.B. C.A.I. cm —					
Nil Fertiliser	1·40	0·99	0·64	0·38	0·86
Fertiliser	1·85	1·07	0·76	0·46	1·04
Mean Basal Area Class	1·63	1·02	0·71	0·43	0·95
Stand B.H.O.B. C.A.I. m^2/ha—					
Nil Fertiliser	1·02	1·16	1·21	1·33	1·18
Fertiliser	1·34	1·23	1·56	1·22	1·34
Mean Basal Area Class	1·18	1·19	1·38	1·27	1·26

Diameter C.A.I. has increased by 20 per cent, and Basal Area C.A.I. by 14 per cent with application of fertiliser. The response diminishes with increasing stand density. Basal area increment has not been appreciably reduced by the heavy thinning indicating that it is a function of the moisture availability.





Tree Breeding—General

Two trials, dealing with *Pinus radiata* and *Pinus pinaster* respectively were established in June 1973, to evaluate the potential of improved seed in the establishment, and management of plantations.

Bulk collections of seed from orchard, seed production, crop tree and general sources have been seedling planted at Kirup, Grimwade, and Yanchep for *P. radiata*, and Gnangara and Yanchep for *P. pinaster*. Spacings of 3·5 x 2·5 metres and 2·0 x 2·5 metres have been used to allow expression of form and branching characters.

Pinus radiata

Site Preparation Methods

An investigation on heavy pasture in the Blackwood Valley has shown that the optimum site preparation technique on these sites requires complete weed control and ploughing.

EFFECT OF PLOUGHING AND WEED CONTROL WITH VOROX AA ON *P. RADIATA* AT 11 MONTHS

	No Vorox		Vorox	
	Ht. (cm)	% Survival	Ht. (cm)	% Survival
No Ploughing	57·0	37	59·8	70
Ploughing	59·8	44	78·6	85

In the absence of weed control with Vorox, ploughing has only a minor effect on height growth and a small effect on survival, but in the presence of Vorox, it has a large effect on height growth and a moderate effect on survival. The main action of Vorox is to improve survival in year one but there are growth benefits which are not apparent from the table. Plants in Vorox-treated areas have a healthier, denser crown and much greater branch development.

Timing of Vorox spraying is also important, although the optimum spraying period will vary with seasonal conditions. In 1972–73 the optimum period was July-September (see Table), but in other years effective spraying has been possible in late October. Since the length of the spring season cannot be predicted, July is the safest time to spray.

EFFECT OF TIME OF SPRAYING (2·2 kg/ha) ON PINE SURVIVAL AND GROWTH 11 MONTHS AFTER PLANTING

Month	Mean Height (cm)	Percentage Survival
May	54·6	29
July	63·0	83
August	59·8	70
September	57·8	70
October	51·4	22

The poor survival for the May and October treatments is due to those treatments being ineffective, May spraying being too early and October too late.

The better height growth from the July spraying may be due to increased soil nitrate availability in the spring growing period. Soil samples collected early in October indicated Vorox treatment has a marked effect on inorganic nitrogen content.

EFFECT OF TIME OF VOROX SPRAYING ON SOIL INORGANIC NITROGEN LEVELS IN OCTOBER

Spraying Month	Inorganic N (ppm) as nitrate	as ammonium
May	0·7	8·1
July	11·1	4·5
September	1·8	4·7
Not Sprayed	<0·1	4·5

Use of Sheep Grazing for Plantation Weed Control

A promising pilot trial was conducted to asess the value of sheep grazing for control of weed competition in a two-year old *P. radiata* plantation. The weed competition consisted mainly of netic scrub (*Bossiaea aquifolia*), reed creeper (*Kennedya*) and coppice regrowth of marri and jarrah. The netic, creeper and herbaceous plants were quite palatable to the sheep. Marri was not touched but jarrah was browsed. Very good control of the weeds was obatined and no damage to pines incurred until other feed became scarce. Older sheep were better able to cope with the vegetation than the younger sheep. The former gained several kilograms in weight whereas the latter gained little or no weight.

Wood Density Studies Blackwood Valley

The wood density and moisture content study referred to in the previous annual report has yielded useful information. Wood density in the study area is not influenced by site quality. Average basic density is close to the accepted mean for the species, but moisture content appears low for the species, with marked seasonal variation.

AVERAGE WEIGHTED WHOLE TREE BASIC DENSITY (kg/m³)

Sample	Stratum I	Stratum II	Stratum III
1	492	474	460
2	400	427	419
3	418	404	419
4	411	420	413
Means	430	431	428

AVERAGE WEIGHTED WHOLE TREE MOISTURE CONTENT (% OF O.D.W.)

Sample Date	Stratum I	Stratum II	Stratum III	Mean
October	112	122	119	118
January	108	101	107	105
April	109	128	127	121
July	118	122	119	120

Site Amelioration

Work continues on the problems of radiata pine establishment and nutrition in the " Sunkland " area south to Busselton. A large number of field trials has now been established and early growth of the pine is generally very good. On all soil types superphoshpate at the time of planting is mandatory. Rock phosphate has given uniformly poor results. Foliar symptoms indicate pines on all sandy soils require foliar zinc application before the end of year 2, even if zinc solids had been applied at planting. Annual logging of foliar nutrient levels in the 1971 series of fertiliser field trials has commenced.

Three large plots, each of 20 hectares, were planted in 1972 to provide adequate area for future fertiliser and soil moisture studies, etc. One plot has been used, in part, to investigate the value of deep ripping as a site preparation measure on shallow gravelly soils.

Site Survey

The site survey of the large Sunkland area is continuing. Ecological analysis of the north eastern sector has been completed, and similar analysis of the south western sector is in progress. In the meantime, the knowledge on site-vegetation relationship of two test areas surveyed in detail is being extended to the whole of the Sunkland by combination of ground transects and photo interpretation.

Seed Testing

Standard seed testing by weight, germination, energy, capacity and vigour (energy/capacity) covered 153 eucalypt, 51 pine and 16 miscellaneous species. Improved experimental procedures resulted in a reduction of the confidence limits from ± 30 per cent to ± 12 per cent.

RESEARCH : HARDWOOD SILVICULTURE

Jarrah

Fertilisation with Urea

The first field trial of fertiliser application to the jarrah forest from the air was conducted in September, 1972. Seventy-three hectares were treated with urea at the rate of 237 kg/ha. The total cost of the operation was $23.90 per ha. The fertilised area was predominantly second-growth jarrah up to 27 m high. Residual veterans up to 40 m high enforced a high altitude of application, in the region of 75 m, and the spread of fertiliser was correspondingly uneven with a distribution quotient of 4·7, which exceeds the generally accepted level of 3. The flight track separation of 10 m was found to be far too narrow at this altitude.

Two hundred points within the test area were monitored for fertiliser distribution using simple catchers. Data from the monitoring was used to demarcate zones of different fertiliser application rates and trees within these zones were selected for measurement of their response to the fertiliser. Periodic water samples were taken from streams draining the test area, and from streams draining adjacent, unfertilised forest blocks. No difference was found in the nitrogen content of the water in either nitrate or ammonium form. It was concluded that urea applied at this level has no effect on water purity.

Regeneration

Investigations have been started into the possibility of regenerating badly under-stocked high quality sites by direct seeding with jarrah. Five and a half kilograms pure seed was collected at a cost of $19 per kg. Further seed collection trials are planned to reduce this cost. Preliminary seeding trials have shown that sowing rates of around 0·75 kg/ha are likely to result in an adequate stocking of seedlings and field trials are well advanced to test this on a large scale.

Karri

Seed Production Assessment

During autumn the annual karri seed sampling was carried out in six sawmill permit areas in order to forecast future seedcrops. The results indicate two possibilities :

(i) One good seed year in 1975/76 followed by a mediocre seed year in 1976/77 or

(ii) One bumper seed year in 1975/76 followed by a good seed year in 1976/77.

Which of these two possibilities will eventuate depends on whether this year's pin bud crop undergoes accelerated development to unite with last year's buds, or whether they continue to develop separately. This cannot be determined till next season. At present it appears likely that regeneration burning will be possible as early as autumn 1975.

The technique for estimation of karri seed supplies prior to regeneration burning has been improved. The new method is based on that used in Tasmania for estimating *Eucalyptus regnans* seed, but incorporates a local seed/twig system and features a different technique for the measurement of crown area. Results of trials indicate that it may prove a more accurate and simpler technique than that currently in use.

Inland Forest Reserves

Work has commenced on an ecological study of inland forest types. The purpose of the study is to determine which portion of the former Temporary Timber Reserves, totalling 685 283 hectares, which were revoked in 1971, should be rededicated as State Forest for the protection of flora and/or fauna. The ultimate aim is to preserve a representative sample of all major vegetation types, both for scientific study and as a future source of seed.

Broad reconnaissance of the Yilgarn-Kalgoorlie districts and more detailed surveys of some specific areas have been carried out. In the process of these studies problems of severe erosion of the inland areas have been noted, caused by a combination of drought and mismanagement by overgrazing. Repair and maintenance of the natural environment as well as conservation of gene sources can only occur with the preservation and proper management of the flora in designated reserves.

Inland Eucalyptus and Acacia species have difficult taxonomy which will require further clarification.

RESEARCH : PROTECTION

Fire Behaviour

Pinus pinaster burning tables

Analysis of both kiln and field experimental fires resulted in the production of fire behaviour guide in nomograph form. The guide is currently being tested.

Testing of litter drying tables produced earlier has indicated a need for re-examination of the tables.

Karri Tables

Testing of the new Karri fire danger tables indicated that they are not sufficiently accurate for general use. Additional experimental fires were carried out, but due to the severity of the summer drought this activity was severely curtailed and failed to provide data on fires of medium to high intensity which are needed to improve the tables. As a result preliminary modifications of the tables have not greatly improved their precision.

The fuel moisture prediction phase of the tables has been found to be reliable, particularly in the critical range of 25 per cent or less moisture.

Growth Plots—P. radiata burning

The scorch trial at Grimwade was concluded after continuing deaths made it meaningless. The trial showed that severe crown scorch drastically reduces increment for 15 months and can cause up to 50 per cent deaths when associated with *Ips grandicolis* infection.

Stirling Range Fire Study

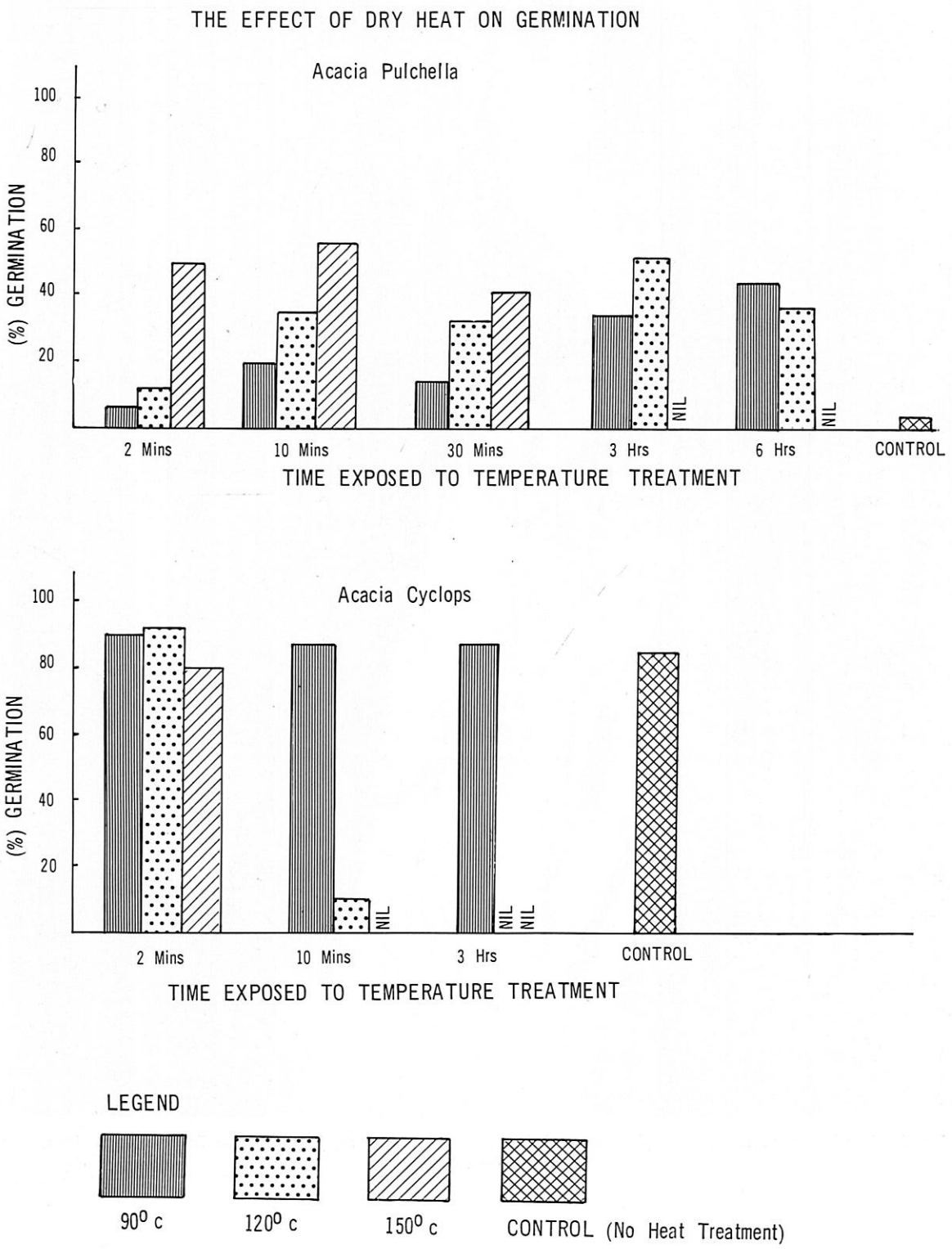
Work has commenced on a fire behaviour study in the Stirling Range National Park. Forty-eight plots have been established incorporating both northern and southern aspects and two topographic situations at each site. The fuel sampling on the plots has been completed and the burning will be carried out during the late winter and early spring.

Fire Ecology

Flora

The results of detailed quadrat sampling on many plots burned at varying intensities during different seasons indicate that fire intensity as normally recorded in terms kilowatt/metre is an ineffective indicator of how species will regenerate after a fire. Trial plot results indicate that litter depth and litter and soil moisture at the time of burning may be the main factors influencing seed germination after burning. In general the deeper the litter layer, the greater the heat penetration of the soil. This is greatly influenced by the moisture content of both litter and soil at the time of burning.

Native legume seeds, unlike the seed of many legumes elsewhere, respond to dry as contrasted with moist heat in germination trials. Response varies with the species, and is often indicative of the habitat in which they grow. For example, the seed of *Acacia pulchella*, a typical dry sclerophyll forest species, will tolerate considerable temperature treatment, whereas *A. cyclops*, a pioneer species of the coastal sand dunes is very sensitive to heat damage.



Female ringtail possum and young, photographed during a spotlight survey in the Perup Fauna Priority Area, east of Manjimup.

The season of burning affects the regeneration of scrub species indirectly through moisture, since moisture content of the litter and soil falls drastically during summer.

There is further evidence that the frequency of burning greatly affects plant regeneration. Trials in scrub communities with a high density of the well-known wildflower *Crowea dentata* indicate that a short burning cycle of 3 to 4 years may benefit this species. This is an indication of its place in the successional series. *Crowea dentata* is a species of the early seral stages which flowers and seeds at an early age and will increase in frequency if burning is frequent. Species of later seral stages which flower and seed at a later age tend to be favoured by slightly less frequent burning, e.g., *Bossiaea laidlawiana* appears to decrease in numbers when burnt very frequently.

Fauna in Southern Region

The concept of Fauna Priority areas within State Forest has now been firmly established. The Perup Fauna Priority area of approximately 40 000 hectares has been fully surveyed. The present fauna list stands at 28 mammal species, including 14 marsupials, 7 bats, 2 rodents and 5 introduced species. Over 100 species of birds, as well as a variety of reptiles and amphibia, have also been listed for the area.

It is the major stronghold of the rat kangaroo or woylie (*Bettongia penicillata*), and the banded anteater or numbat (*Myrmecobius fasciatus*) is common in the area.

Research into the fire ecology of the area is under way. Mark-trap and release experiments and radio telemetry programmes have commenced on the woylie, the tamar, and both the brush and the ringtail possum.

Fauna surveys were also carried out in the Ludlow tuart forest and the Boranup karri forest. Fauna lists have been drawn up for the areas and plans to integrate fauna protection with the recreational development in these areas have been made. An area particularly rich in bird life was located at the mouth of the Abba River and this will receive special consideration within the overall Tuart Working Plan.

Detailed studies on the southern bush rat, *Rattus fuscipes* indicate that this species disappears after fire and its place is taken by the house mouse, *Mus musculus*. However within one year, immediately following the appearance of the young in summer, the rats start to recolonize the area where ground cover is sufficiently dense, and there is a reduction in the mouse population.

Observations on birds in the same area of karri forest indicated that immediately following burning there is a reduction in bird numbers and species. Soon thereafter numbers and species start to increase and records one year after the burn show about 400 birds compared with only 120 prior to burning. The number of species has increased from 15 to 20 prior to burning, to between 20 to 30 one year later.

These increases can be largely attributed to the effects of the fire. There has been tremendous growth of epicormic shoots on the stems of young karri saplings, which in turn appears to have increased insect population and provided a favourable habitat for a number of species, particularly the white-naped honeyeater.

Effect of fire on fauna in the Northern Jarrah Forests

Studies have continued in the field of the effects of fire on mardo (*Antechinus flavipes*) and quokka (*Setonix brachyurus*). Various exploratory surveys have also been conducted in forest areas where the fauna populations are unknown. Both study species are found mainly in dense swamps within the jarrah forest, the quokka exclusively so.

Mardo

Results to date indicate that patchy burns consuming only part of the vegetation (15 to 85 per cent of test area) have no effect on mardo populations. Evidence was found of mardos surviving a very severe burn covering the whole swamp. The survivors subsequently disappeared and repopulation had not commenced 7 months after the fire. A further mardo study was initiated in an upland forest block protected from fire for 42 years. Mardo populations were found to be high when compared with an adjacent block regularly burnt under prescription.

Quokka

Patchy burns (up to 60 per cent of the test area burnt) resulted in large increases in quokka populations. The catch rate (the number of animals caught per 100 trap-nights) prior ro burning was 3·8 per cent and after the burn, 11·3 per cent (including 10 new individuals, not previously trapped). A completely burnt swamp was deserted by quokkas ; no evidence of mortality could be found. Seven months after the burn repopulation of the swamp had started and a catch rate of 1·8 per cent was recorded. Intensive trapping is continuing to follow the course of repopulation.

Jarrah Dieback

Rate of Spread

Data from plots installed during 1968–69 to measure the rate of spread of the disease upslope from existing infections has provided the first objective and precise measurement of disease intensity on upland jarrah forest sites. On a majority of the sites sampled spread rates were slow indicating that if hygiene prescriptions are strictly implemented the disease will pose little threat to healthy forest in the short and medium term. A minority of the sites exhibited excessive spread rates. The difference in disease intensity between upland sites was not related to drainage, soil temperature and the density of susceptible understorey species. There is some evidence that the age of the landscape affects susceptibility and that some unknown factors, probably of chemical and/or microbiological origin are affecting the activity of the pathogen. A number of experiments have been initiated with the aim of isolating these factors.

Root distribution of affected species

Extensive excavation of Jarrah and *Banksia grandis* root systems have revealed two root characteristics which appear to partially explain why the fungus can cause significant mortality on upland jarrah forest sites : The fine root system of jarrah includes a very dense fibrous component which is probably an adaption to extremely infertile soil conditions. Removal of this fine root component by *Phytophthora cinnamomi* would markedly reduce growth and thus survival of jarrah. A special root (proteoid) formed by *Banksia grandis*, a highly susceptible species which occurs in dense thickets in most areas of the jarrah forest is believed to be a major factor responsible for the passive spread of *P. cinnamomi*. This root occurs in dense mats immediately below the soil surface, providing a massive food base for the fungus and a mechanism by which it can move through the soil in a favourable environment.

Manipulation of understorey as control measure

Continuing measurements of the soil environment indicate that it may be possible to manipulate the understorey component to create conditions which are unfavourable for the fungus. Field inoculation trials have been established to determine directly if this hypothesis is correct. Parallel silviculture and fire research trials have been initiated to determine the most economic and practical techniques to bring about changes in structure and composition of the forest.

RESEARCH : LAND USE

Evaluation of Sites

The ecological studies and detailed surveys of test areas carried out in previous years have been utilized in assessing the suitability of the various site and vegetation types for several forms of land use practised in the northern jarrah region. These include silviculture of native hardwoods, plantation establishment of exotic pines, orchards and pastures, water supply, recreation, bauxite mining and fauna and flora conservation.

System analysis

A further stage has been reached in co-operation with Commonwealth Scientific and Industrial Research Organisation and some local instrumentalities. It consists of placing economic values on the various combinations of land use and site type, and analysing these by means of system analysis to arrive at optimum allocation of areas to land use forms. Lack of economic data has proved the most difficult task, particularly with respect to fauna and flora conservation.

Recreation Surveys and Planning

Periodic weekly surveys of people using the forest in the Dwellingup Division have been conducted over a period of 10 months. In addition to the questionnaire surveys, road counters have been installed at key recreation sites. The data has been collated and it is estimated that current recreation use of the forest in the Dwellingup Division is in excess of 35 000 visitor days per year. In contrast to previous recreation surveys in the northernmost divisions, the results from this study indicate that the season of highest use is summer. The results of this survey were used to evaluate recreation requirements for the division and detailed plans for recreation development have been drawn up for a number of locations within it.

RESEARCH : SOILS AND NUTRITION

Nutrition-Genotype Interaction

A series of *P. pinaster* families were sampled over a wide range of soil types to study this relationship. The soil types were characterised by weakly leached yellow sands at Yanchep, strongly leached grey sands at Gnangara and a colluvial gravelly sandy loan at Mundaring.

Significant differences occurred in the N, P, K, Ca, Mg, Cu, Mn and Zn foliar levels of the different families. The nitrogen levels were least affected by the genotype.

In addition a locality (soil) x genotype interaction was observed in the elements P, K, Mg, Cu, Mn and Zn.

In the three areas the most common nutrient stresses are caused by N, P, Mn and Zn deficiencies (and the chemical and statistical data for these elements are shown in Tables).

P. PINASTER PROGENY TRIALS YANCHEP, GNANGARA AND MUNDARING MEAN FOLIAR LEVELS

Family	Per cent						ppm					
	N			P			Mn			Zn		
	Y	G	M	Y	G	M	Y	G	M	Y	G	M
S 1	·96	·66	1·25	·070	·038	·104	10·1	28·4	35·3	29·2	15·5	25·8
S 2	·83	·61	1·30	·070	·037	·108	8·5	26·6	32·8	29·8	14·7	23·6
S 5	·88	·65	1·27	·075	·042	·101	9·9	25·2	25·7	27·3	13·3	18·8
S19	·89	·64	1·24	·069	·040	·096	13·3	31·8	34·8	28·5	16·1	23·3
S20	·93	·65	1·22	·071	·040	·103	11·1	35·8	34·9	28·7	16·0	20·6
S21	·91	·64	1·26	·070	·040	·100	9·2	24·0	28·1	23·9	12·9	19·7
S22	·92	·63	1·26	·075	·037	·100	12·7	32·3	33·3	33·3	16·8	21·7
S25	·91	·64	1·28	·083	·036	·119	14·2	28·8	34·5	34·4	16·8	27·9
S26	·85	·55	1·21	·072	·036	·095	11·7	29·6	30·8	27·5	13·4	18·7

Y—Yanchep. G—Gnangara. M—Mundaring.

PINUS PINASTER PROGENY TRIALS YANCHEP, GNANGARA AMD MUNDARING
SIGNIFICANCE OF VARIANCE RATIOS

Source	df	N	P	Mn	Zn
Localities (1)	2	***	***	***	***
Families (2)	8	*	***	***	***
Plots (3)	7	N.S.	**	***	*
Replicates (4)	2	N.S.	N.S.	N.S.	N.S.
1 x 2	16	N.S.	**	**	**
1 x 3	14	*	***	**	**
1 x 4	4	N.S.	N.S.	N.S.	N.S.
2 x 3	56	N.S.	*	*	N.S.
2 x 4	16	N.S.	N.S.	N.S.	N.S.
3 x 4	14	N.S.	N.S.	N.S.	N.S.
1 x 2 x 3	112	N.S.	*	***	*
1 x 2 x 4	32	N.S.	N.S.	N.S.	N.S.
1 x 3 x 4	28	N.S.	N.S.	N.S.	N.S.
2 x 3 x 4	112	N.S.	N.S.	N.S.	N.S.

Soil Organic Matter Studies under Pine Crops

An attempt was made to fractionate the soil organic matter under a 43 year old *P. radiata* plantation, and to compare this with the organic matter under adjacent indigenous forest. Preliminary evidence indicated that only slight changes had occurred in the distribution of the carbon in the various fractions.

The Role of Native Legumes in the Nitrogen Economy of The Jarrah Forest

Soil samples were collected from the Dwellingup Division to study the influence of native legumes on the organic matter levels of jarrah forest soils.

Soil variation tended to mask any differences due to vegetation, but over a range of sites the following mean values were recorded :—

Vegetation	Per cent	
	Organic Carbon	Nitrogen
No legumes	4·49	0·153
Legumes	5·04	0·190

UTILISATION

Departmental Sawmills

The only major addition to sawmill machinery was the installation of a Wadkin multi-rip saw at Harvey to produce small section stock more economically. This objective has been achieved.

Other additions to improve efficiency and safety were a sizing gauge on the Pemberton headrig and a steel Christensen type transfer truck in Ludlow stacking shed.

The disused twin-edged sawmill at Busselton belonging to Consolidated Pine Industries has been under trial with a view to lease to gain increase in production to service a rapidly growing market.

Investigations are in hand with respect to high temperature kiln drying to control seasoning degrade in the twist prone core material of small pine logs.

A dry timber storage shed of 300 square metres was built at Margaret River and an extension of 300 m^2 was added at Grimwade.

Engineering

Attention was given to numerous enquiries from other Departments, local authorities, the timber industry and the public. Many of these enquiries entailed design and data preparation.

Sleepers in the Pilbara

Weathering

A visit was arranged for the engineers of the Pilbara iron ore railways to inspect the eighteen years old test of preservative treated sleepers near Merredin. The superior condition of the oil and creosote treated jarrah and karri sleepers compared with that of the untreated control gave conclusive proof of the need to impregnate sleepers against mechanical breakdown. Termiticidal and fungicidal components can be readily included in the impregnating mixture.

In its commonest form mechanical breakdown starts off as surface and end checking which develops into a steadily deepening disintegration of the surface wood into separate bundles of fibres or slivers combined with splitting and slivering running in from the ends with a consequent loosening of the spikes until the sleeper becomes shattered and useless.

The most satisfactory term to describe this process is probably the word " weathering " but it has become obvious that at least three factors must be contributing to this condition ; high temperature, moisture and fatigue from frequent and heavy loading.

Rail temperatures of 70°C have been recorded. Correspondingly high wood temperatures are believed to cause a reduction in bending strength of the order of 25 per cent to 30 per cent in the surface layers of sleepers. The effect on shear strength and on the strength of inter fibre bonds is also believed to be considerable.

While rainfall is not high, heavy dew followed by high daily temperatures, is common and the consequent swelling and shrinkage of the cells to some small depth below the surface must be a disruptive and steadily degrading process.

Wood has good fatigue resistance, usually better than metals, but in the Pilbara there are many applications of heavy load. The superior condition of the sleepers in the relatively unloaded loops compared with those in the adjacent loaded main line highlights the devastating effect of continued heavy loading. On the Mt. Newman line surface disintegration is starting to become apparent, particularly towards the southern end. It is more apparent on the Mt. Goldsworthy line, whilst on the Hamersley line the surface condition of the sleepers on curves appears worse than on adjacent tangents.

A comparison of the product million gross tonnes x years for the three systems shows :

Hamersley about 1 300
Goldsworthy about 500
Newman about 450

and these give an indication of the relative conditions of the sleepers on the three lines.

It is noticeable on all lines that wandoo sleepers are always in better condition than neighbouring jarrah and look certain to give an appreciably better life.

Committees and Conferences

The Standards Association grading rules (metric) for W.A. Structural Hardwoods were published during the year; also the Light Timber Framing Code and the Timber Engineering Design Code in imperial form ; Metric versions of the two latter are in course of preparation.

An S.A.A. meeting on scaffold planks was attended in Adelaide at which the State's right to have its long established size of plank retained as a standard was successfully maintained.

Termites in the Pilbara

In October, 1972, a team comprising a biologist from the Commonwealth Forest Research Institute, Darwin Branch, an expert private consultant, and an officer of the Forests Department, travelled to the Pilbara to observe and assess the known attacks by the termite *Mastotermes darwiniensis* on sleepers in iron ore railways.

What was till then considered to be a worrisome minor problem was found on arrival to have assumed major proportions, particularly in the Mt. Newman line. Thirteen infestations have been discovered, involving a collective total of some eight kilometres of track. Replacement of 15,000 sleepers had become a matter of urgency. The Goldsworthy line had been under attack for an even longer period, and within the year the first attack on the Hamersley line to Mt. Tom Price was found. So far no attack has been reported on the more recently constructed Robe River line.

Mastotermes darwiniensis, one of the largest and most ancient of termites, is confined to that area of Australia north of the tropic of Capricorn (Lat. 23° 26′ 30″). Under natural conditions its colonies are neither large nor frequent, and can withstand the harshest and most exposed conditions. Given a temporary improvement in habitat (e.g. good summer rains) and an unlimited food supply (e.g. sleepers at 530 mm centres) colony growth is so rapid that their voracious appetite matches the supply available. Most species of timber are prone to attack, even those such as Jarrah (*E. marginata* Donn ex Sm.) and Wandoo (E. *wandoo*, Blakeley) which are normally considered termite resistant.

The problem has two aspects, that of dealing with attacks in existing track, and that of protecting any new construction proposed. In either case a termite resistant sleeper is required. The more urgent problem, that of safeguarding existing track, is compounded by the difficulty of detecting attack at an early stage. Attack usually initiates centrally underneath the sleeper, and progresses rapidly towards the ends. The last place to show activity is the top surface facing the sun. Sleepers have therefore to be on the verge of collapse before detection is likely. Fear of expensive derailment is very real in Mastotermes prone areas.

Action suggested by the group includes :

(1) Development of a device to detect early attack. Use of electronic back scatter density devices was suggested, and the assistance from the Atomic Energy Commission was recommended.

(2) Development of a Mastotermes resistant sleeper, preferably from local hardwood.

The current replacement programme uses imported treated Malaysia Kempas and Keruing sleepers, which, though unproven as such, are the most likely available termite resistant alternative. All untreated sleepers are replaced either side of a detected attack to the distance of 100 metres, which is the estimated foraging range of Mastotermes.

Forests Department, C.S.I.R.O., sawmillers and treatment firms are all involved in the development of impregnated jarrah and karri sleepers. Incising to improve penetration, incorporation of termiticide, use of varying heavy oil to creasote ration to improve weathering and physical breakdown, and varying boltonizing schedules, are all aspects under consideration. A site at the 16 kilometre peg of the Mt. Newman line has been selected as the primary location of a graveyard trial for the testing of alternatives under conditions of intense attack. Mt. Newman have a preliminary trial already installed. A comprehensive trial organized by the Forests Department will follow.

(3) Intensive study of the Life Habits and Ecology of Mastotermes, to be undertaken by the F.R.I. in the Pilbara. Radioactive tracers (scandium) will be used to locate nests, to map colony extent, and to record termite movements. The long-term use of wood in the Pilbara will depend on a better understanding of the ecology of Mastotermes.

(4) Study of the use of termiticides in soil barriers (e.g. on the upper surface of new rail formation) and to control populations by spraying into existing ballast and formation.

LIBRARY

As statistics indicate, library operations continued at much the same level as that of preceding years. This year a figure is given for the number of items borrowed from other libraries to show our dependence on inter-library co-operation.

	1972/73
Journal circulation	12 955
Accession list requests	3 166
Loans	3 257
Queries	780
Publications received	888
Loans from other libraries	435

EDUCATION AND PUBLICITY

Education

State Forestry Cadetships : There were no Forestry Cadetships awarded in 1973 for studies at the University of Western Australia. However, two cadets graduated from the Australian National University in 1972 and a further two are expected to graduate in 1973.

Several officers attended a number of Managerial and other courses during the year. One officer attended the Rescue Service Course at Mt. Macedon and one attended a course on Automatic Data Processing Appreciation.

Field Cadet Training : Again there were no Forest Field Cadetships granted this year.

In Service Training : Twelve cadets from the 1971 intake graduated in a special ceremony held in the Como auditorium. They will now undergo two years in service training.

Publicity

One meeting of the Australian Forestry Council was held in Brisbane and was attended by the Conservator. The Conservator also attended the two meetings of the Standing Committee of the Australian Forestry Council held in Perth (August, 1972) and Canberra (March, 1973). The Department was represented at the Sirex Committee meeting in Tasmania and the AUSTIS Council meeting in Melbourne.

TIMBER INDUSTRY REGULATION ACT, 1926-1969

The number of mills registered under the provisions of the Act as at December 31, 1972 totalled 145 (80 Crown Land and 65 Private Property).

The average number of persons employed in the timber mills each month throughout the year was 2,825, an increase of 292 on last year's figure.

The District and Workmen's Inspectors made 1 161 inspections of timber holdings.

There were 148 notifiable accidents for the year ending June 30, 1973, four being fatal.

The number of accidents per 100 persons employed was 5·24, a slight increase on last year's figure.

The cost of administering the Timber Industry Regulation Act for the year ending June 30, 1973, was as follows :—

	$
Salaries	12 994
Mileage, Travelling Allowances, Office Rent, Plant Cost and Sundries	6 047
	$19 041

FOREST OFFENCES

Thirty-five breaches of the Forests Act and Regulations were reported during the year. Legal proceedings were instituted in one case and eleven cases were dealt with by charging royalty, forfeiture of deposits, collection of damages or confiscation and sale of timber illegally cut. The amount received by the Department in this way totalled $385.99. Warnings were issued in all other cases.

EMPLOYMENT IN FORESTRY AND THE TIMBER INDUSTRY

The number of wage earners directly employed in Forestry and the Timber Industry was estimated 4 100 made up as follows :—

Forestry—		
Professional officers	57	
General field staff	264	
Clerical and drafting	82	
Wages employees	508	
Contractors and employees (estimated)	20	
		931
Timber Industry—		
Sawmill employees including bush workers	2 825*	
Firewood cutters and pole getters working under permits	161	
Sandalwood workers	75	
Apiarists, estimated (1 178 sites registered)	108	
		3 169
		4 100

* Includes employees of registered sawmills only and excludes persons employed in associated yards in the Metropolitan area.

ACCIDENT PREVENTION (SAFETY)

During the year 1972/73 an average of 925 employees and staff working a total of 1 728 577 manhours suffered 45 disabling injury accidents involving a loss of 414 mandays for the year.

Besides these disabling injury accidents there were a further 112 serious injury accidents which necessitated medical attention but did not result in lost time.

The frequency rate, or number of disabling injury accidents per one million manhours worked was 26 and each accident averaged a loss of 9·2 days.

The severity rate which is a measure of the disabilities suffered by the employees in relation to manhours exposure in terms of million manhour unit was 256 for the year.

Althought there has been an increase in the number of Disabling Injury accidents sustained and the total time lost compared with last year's figures, the following summary of accident experience covering the six year period 1967/68–1972/73 reveals that success in reducing the total number of injury accidents necessitating medical attention continues.

Year	M.H.W.	D.I.A.	S.I.A.	Total Accidents	F.R.			Manhours Lost	Duration Rate	Severity Rate
					D.I.A.	S.I.A.	D.I.A. + S.I.A.			
1967/68	1 895 600	124	312	436	65	164	230	1 701	14	900
1968/60	2 019 568	96	155	251	48	76	124	1 738	18	860
1969/70	1,901 020	70	129	199	37	67	104	721	10	379
1970/71	1 808 406	48	158	206	27	87	110	458	9	253
1971/72	1 759 888	40	128	168	23	72	95	275	6	156
1972/73	1 728 577	45	112	157	26	64	90	414	9	239

M.H.W.—Manhours Worked.
D.I.A. —Disabling Injury Accident (resulting in lost time).
S.I.A. —Serious Injury Accident (resulting in medical expenses).
F.R. —Frequency Rate.

These figures illustrate benefits which in humanitarian terms are immeasurable. The scale of productivity improvement is reflected partially by the statistics of man days lost but in addition to the obvious savings in manpower there are many and substantial indirect economic benefits.

STAFF MATTERS

Public Service Act

Mr. D. W. R. Stewart retired from the position of Conservator of Forests on 15th July, 1972 and was succeeded by Mr. B. J. Beggs.

Mr. W. H. Eastman was appointed Deputy Conservator in place of Mr. Beggs.

Dr. E. R. Hopkins was promoted to replace Mr. Eastman as Chief of Division.

Mr. J. J. Havel was appointed Superintendent Research vice Dr. Hopkins.

On 14th November, 1972, Messrs. A. C. Van Noort and P. N. Hewett were reclassified to Superintendents.

Mr. C. J. Edwards was promoted to the position of Inspector on 26th July, 1972.

Mr. J. A. W. Robley was seconded to the Bush Fires Board on 2nd October, 1972.

The following officers were promoted to Senior Divisional Forest Officers :

J. B. Sclater, F. H. McKinnell, P. C. Kimber, J. K. Smart, P. N. Shedley, E. A. Jenkins, D. Spriggins and G. B. Peet.

The following officers were promoted to Divisional Forest Officers :

N. G. Ashcroft, G. S. McCutcheon, S. R. Shea, T. B. Butcher, G. Malajczuk and P. E. S. Christensen.

Mr. A. R. Gobby rejoined the Department as an Assistant Divisional Forest Officer after studying overseas.

The following were appointed as Assistant Divisional Forest Officers :

C. P. Meehan, J. H. Murch, D. A. Haswell and M. E. Sanderson.

Mr. J. C. Adams was appointed to the position of Administrative Assistant.

Mr. D. T. Connor was appointed Assistant Registrar vice Mr. Adams.

Mrs. J. A. O'Neill was appointed Librarian following the resignation of Mr. E. Willis.

Forests Act

Mr. R. Meldrum retired as Senior Timber Inspector and was replaced by Mr. L. Nicol.

Mr. H. G. Styles was promoted to the position of Senior Timber Inspector.

Appointments to the permanent staff included 9 Technical Assistants, 1 Forest Assistant and 8 Forest Guards.

Assistant Forester D. J. Richardson retired.

The following resignations were received during the year—2 Forest Guards, 6 Technical Assistants and 2 Forest Assistants.

APPENDIX 1A

Statement of Revenue and Expenditure of the Consolidated Revenue Fund for the year ended 30th June, 1973

1971/72	Revenue	1972/73	1971/72	Expenditure	1972/73
$	*Royalties*		$		
2,726,924	Logs	2,545,107	701,957	Salaries	769,509
82,611	Sleepers	54,037	107,812	Incidentals	120,571
1,770	Sawn Timber	2 167	5 350	Timber Industry Regulations Act	6 047
134 120	Poles and Piles	136 996	177 448	Hardwood Conversion	197 581
8 675	Mining Timber	5 894	818 283	Pine Conversion	1 142 775
23 050	Firewood	19 959	118 364	Recoupable Projects	150 258
15 225	Posts	22 948	44 859	Tree Nurseries	16 601
19 669	Sandalwood	20 642	8 242	Arboreta	9 974
13 640	Miscellaneous	8 404	6 201	Printing and Stationery	8 000
3 025 684		2 816 154		*Excess of Revenue over Expenditure distributed as follows*	
			2 757 712	9/10 to Reforestation Fund	2 239 626
	Pine Conversion		286 738	Transferred to Treasury	321 556
544 974	Pine Logs	548 834	....	Metric Conversion	4 307
577 162	Sawn Pine	657 402	....	Transfer of Mining Compensation	7 899
1 122 136		1 206 236			
	Hardwood Conversion				
128 143	Sawn Hardwood	101 935			
113 062	Logs	133 036			
533	Posts, Poles and Piles	862			
241 738		235 833			
	Other Sales and Fees				
36 748	Seeds and Trees	43 245			
87 171	Inspection Fees	57 102			
53 047	Rents and Leases	23 490			
281 172	Miscellaneous	398 248			
59 193	Compensation—Mining and Other	78 988			
517 331		601 073			
	Recoupable Projects				
83 730	Specific Roads	83 409			
42 347	Other	96 999			
126 077		180 408			
5 032 966		5 039 704	5 032 966		5 039 704

APPENDIX 1B

Forest Improvement and Reforestation Fund Account and General Loan Funds for the year ended 30th June, 1973

1971/72	Source of Funds	1972/73	1971/72	Expenditure	1972/73
$			$	*Divisional*	
778 813	Balance as at 1st July	916 010	1 720 326	Wages, materials, etc.	2 018 204
2 757 712	9/10 Revenue	2 239 626		*Head office*	
70 982	Rents	127 270	1 469 493	Salaries and Allowances	1 570 347
176 006	Federal Aid Road Grant	270 244	183 322	Incidentals	84 419
			136 893	Plant and Vehicles	221 652
....	Commonwealth Government Soft-		683 247	Plant Operations	636 711
56 241	wood Forestry Agreement	558 000	219 930	Purchase of Land	132 544
1 100 000	General Loan Fund	1 900 000	66 770	Fire Equipment	80 016
462 000	Treasurer's Advance	....	35 896	Head Office Housing and Building	25 447
....	Aboriginal Training Scheme Advance	14 000	33 539	Como Headquarters	34 586
....	Mining Compensation Grant	7 899	36 770	Communications	29 646
			42 684	Research	39 431
			12 399	Drafting	12 868
			16 776	Surveys	10 029
			2 198	Training of Staff	3 695
			127 380	Insurances	146 387
			110 033	Pay Roll Tax	131 910
			....	Utilisation	11 625
			4 266	Special Projects	8 880
			3 181 596		3 180 193
			4 901 922	TOTAL	5 198 397
			416 178	Less Recoups	764 105
			4 485 744		4 434 292
			916 010	Balance working account	1 598 757
5 401 754		6 033 049	5 401 754		6 033 049

APPENDIX

Statement showing distribution of Forests Department Expenditure

	$
Consolidated Revenue Fund	2 470 623
Reforestation Fund	2 743 257
General Loan Fund	1 900 000
	$7 113 880

Distribution of Expenditure

1	Busselton	518 889
2	Mundaring	363 756
3	Dwellingup	615 236
4	Collie	372 501
5	Kirup	652 113
6	Manjimup	523 944
7	Narrogin	63 218
8	Kelmscott	215 704
9	Collier	40 237
10	Harvey	735 362
11	Pemberton	391 717
12	Nannup	411 792
13	Walpole	210 949
14	Kalgoorlie, Esperance	39,381
15	Wanneroo	585 767
16	Somerville	182 638
	Head Office	1 190 622
		$7 113 880

This statement excludes a nett balance of $25 065 in respect of Commonwealth Non Metropolitan Unemployment Relief Fund.

APPENDIX 2A

Exports *from Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended June* 30, 1972

	Item and Destination	Quantity	Value
		Cub. ft.	$
	TIMBER		
1	Saw logs and Veneer Logs, in the rough or roughly squared—Conifer	....	....
2	Sawlogs and Veneer Logs, in the rough or roughly squared—Non-Conifer (including poles, posts, piling and other wood in the rough—		
	Overseas—		
	France	188	151
	Germany, Federal Republic of	167	150
	Japan	171	147
		526	448
3	Sleepers—		
	Overseas—		
	Algeria	168 793	349 320
	Hong Kong	88 928	155 956
	Kenya	95 393	157 385
	South Africa	8 437	13 842
	United Kingdom	946 464	1 976 523
		1 308 015	2 653 026
	Australian States—		
	New South Wales	130	311
	South Australia	332 009	563 178
	Northern Territory	1 040	1 774
		333 179	565 263
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—		
4	Non-conifer—		
	Jarrah (*a*)—		
	Overseas—		
	Bahrain	775	2 202
	Cyprus	4 330	8 319
	Germany, Federal Republic	34	50
	Greece	1 015	2 415
	Mauritius	2 425	4 532
	New Zealand	14 331	26 184
	Qatar	1 966	3 583
	Saudi Arabia	58	198
	South Africa	13 548	27 532
	United Kingdom	99 165	427 813
		137 647	502 828
	Australian States—		
	New South Wales	7 595	16 175
	Victoria	119 327	166 718
	South Australia	561 466	639 894
	Northern Territory	17 348	38 212
		705 736	860 999
5	Karri (*a*)—		
	Overseas—		
	Germany, Federal Republic	17 438	37 792
	Greece	2 458	6 361
	Mozambique	1 250	2 704
	Netherlands	10 379	23 787
	New Zealand	119 439	211 958
	Qatar	4 066	8 745
	Saudi Arabia	1 331	4 121
	South Africa	39 551	80 927
	South West Africa	1 042	2 217
	United Kingdom	6 671	15 333
		203 625	393 945
	Australian States—		
	New South Wales	84 644	129 832
	Victoria	8 603	14 868
	South Australia	519 764	677 013
	Northern Territory	67 215	132 249
		680 226	953 962
6	Other—		
	Overseas—		
	Malaysia	18	100
	Australian States—		
	South Australia	62	168
	Northern Territory	490	1 990
		552	2 158

	Item and Destination	Quantity	Value
		Cub. ft.	$
	Timber (including blocks, strips and friezes for parquet or wood block flooring, not assembled), planed, tongued, grooved, rebated, chamfered, v-jointed, centre v-jointed, beaded, centre beaded or the like, but not further manufactured—		
	Flooring—		
7	Overseas (*b*)—		
	Christmas Island	141	489
	Australian States (*c*)—		
	New South Wales	95 132	212 237
	Victoria	35 722	112 643
	South Australia	51 959	107 222
	Northern Territory	9 381	47 081
		192 194	479 183
8	Other (*d*)—		
	Overseas—		
	Austria	2	40
	Belgium-Luxemburg	295	832
	Canada	2	40
	France	2	40
	Germany, Federal Republic	35	90
	India	2	40
	Indonesia	2	40
	Iran	2	40
	Italy	3	80
	Kenya	2	40
	Malta	2	40
	New Zealand	358	1 594
	Pakistan	2	40
	Philippines	2	40
	South Africa	3	80
	Sweden	2	40
	Switzerland	2	40
	United Kingdom	9 370	21 571
	United States of America	5	120
		10 093	24 847
	Australian States—		
	New South Wales	862	1,724
	South Australia	27	110
	Northern Territory	216	650
		1 105	2 484
	Total of Timber Items 1-8	3 573 057	6 439 732
9	Wood sawn lengthwise, sliced or peeled, but not further prepared, veneer, sheets and sheets for plywood, of a thickness not exceeding 5 mm ; plywood, blockboard, laminboard and the like ; inlaid wood, cellular wood panels, whether or not faced with base metal.	sq. ft.	
	Overseas—		
	Hong Kong	224	401
	Japan	57,600	876
	Malta	640	1 152
	United Kingdom	620	779
	United States of America	64 020	10 020
		123 104	13 228
10	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Overseas—		
	Hong Kong	73 427	8 768
	Singapore	404 880	52 638
	United Kingdom	108	20
		478 415	61 426
	Total Timber Exports on this return	....	6 514 386
11	Casks, vats, barrels, etc., empty (*e*)—		
	Overseas—		
	United Kingdom	....	10 054
12	Manufactures of Wood, except furniture, n.e.i.—		
	Overseas—		
	Christmas Island	....	439
	Indonesia	....	23 180
	Singapore	....	97
	South Africa	....	5 557
	Switzerland	....	100
	Tanzania	....	3 600
		....	32 973

APPENDIX 2A—*continued*

Exports *from Western Australia of Timber, Tanning Substances and Essential Oils for the year ended June 30, 1972*

	Item and Destination	Quantity	Value
		Cub. ft.	$
	Australian States—		
	New South Wales	....	517 763
	Victoria	....	799 161
	Queensland	....	15 917
	South Australia	....	816 578
	Tasmania	....	41 801
	Northern Territory	....	60 640
		....	2 251 860
13	Tanning substances of natural origin	n.r.s.	n.r.s.
14	Essential Oils ; concretes and absolutes ; resinoids—	lb.	$
	Overseas—		
	Ceylon	....	44
	France	5 415	30 288
	Germany, Federal Republic	15 223	10 718
	Hong Kong	392	1 436
	Italy	18 769	38 093
	Japan	8	4 020
	Malaysia	1 851	2 006
	Singapore	6 761	7 490
	Switzerland	5 006	2 983
	Thailand	90	1 048
	United Kingdom	57 822	82 013
	United States of America	29 363	66 761
		140 744	248 386
	Australian States—		
	New South Wales	17 846	22 100
	Victoria	22 157	62 502
	South Australia	7 916	15 784
		47 919	100 386
	Total value of all Exports on this Return	....	**9 158 035**

(*a*) Excludes timber cut to size for making boxes or staves (included in Item 6).
(*b*) Relates to overseas exports of conifer flooring only. Overseas exports of non-conifer flooring included in Item 8.
(*c*) Relates to interstate exports of non-conifer flooring only. Interstate exports of conifer flooring included in Item 8.
(*d*) See footnotes (*b*) and (*c*). Item also includes conifer timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm.
(*e*) Interstate exports included in Item 12.

" N.E.I. " means " not elsewhere included ".
" N.R.S." means " not recorded separately ".
Basis of Value—F.O.B. at the point of final shipment.
nformation Supplied by the Commonwealth Bureau of Census and Statistics).

APPENDIX 2B

Imports *into Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended June* 30, 1972

	Item and Origin	Quantity	Value
		Cu. ft.	$
1	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer, (including poles, piling, posts, and other woods in the rough)—		
	Overseas—	(*b*)	(*b*)
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—		
	Conifer (overseas imports exclude shooks and staves—see Item 6)—		
2	Douglas Fir (*c*)—		
	Overseas—		
	New Zealand	5 155	6 369
	United States of America	34 166	81 458
		39 321	87 827
4	Other—		
	Overseas—		
	Malaysia	2 479	3 446
	New Zealand	1 904	2 909
	United States of America	1 641	5 741
		6 024	12 096
	Australian States (*d*)—		
	New South Wales	111	372
	Victoria	7	24
	South Australia	8 739	19 269
		8 857	19 665
5	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—		
	Non-conifer (overseas imports exclude shooks and staves—see Item 6)—		
	Overseas—		
	Ghana	2 642	6 933
	Indonesia	25 155	38 583
	Malaysia	641 169	1 014 595
	New Zealand	1 044	2 719
	Philippines	550	1 188
	Singapore	1 973	2 975
	Thailand	5 279	25 866
	United Kingdom	154	1 584
	Yugoslavia	339	925
		678 305	1 095 368
	Australian States—		
	New South Wales	217	678
	Victoria	2 792	3 685
	South Australia	36	130
	Tasmania	1 885	5 708
		4 930	10 201
6	Shooks and staves, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm (*e*)—		
	Overseas		
7	Wooden Beadings and Mouldings (including moulded skirting and other moulded boards)—(*f*)—		
	Overseas—		
	Austria	....	266
	China, Taiwan	....	1 058
	Lebanon	....	5 057
	Malaysia	....	2 431
	Norway	....	620
	Singapore	....	568
	Sweden	....	790
	United Kingdom	....	9 289
		....	20 079
	Timber (including blocks, strips and friezes for parquet or wood block flooring not assembled), planed, tongued, grooved, rebated, chamfered, V-jointed, beaded, centre beaded or the like, but not further manufactured—		
8	Flooring (*g*)—		
	Overseas—		
	Sweden	2 185	3 813
9	Other—		
	Overseas—		
	Germany, Federal Republic	2	479
	Malaysia	23 741	78 234
	New Zealand	308	2 332
	Singapore	1 103	3 077
	United States of America	....	206
		25 154	84 328

	Item and Origin	Quantity	Value
		Cu. Ft.	$
	Australian States(*l*)—		
	New South Wales	1 618	6 171
	Tasmania	92	684
	Northern Territory	867	2 810
		2 577	9 665
	Total, Timber Items 2-9	....	**1 343 042**
		Squ. Ft.	
10	Wood sawn lengthwise, sliced or peeled but not further prepared, veneer sheets and sheets for plywood, of a thickness not exceeding 5 mm ; plywood, blockwood, laminboard and the like, inlaid wood, cellular wood panels, whether or not faced with base metal—		
	Overseas—		
	China Mainland	305 656	15 008
	China, Republic of Taiwan	1 738 279	78 814
	Fiji	5 666 965	112 570
	Germany, Federated Republic of	6	18
	Japan	316 679	35 284
	Malaysia	2 612 745	65 341
	Netherlands	41 000	808
	New Zealand	86 40	13 050
	Philippines	41 600	1 965
	Singapore	808 368	42 037
	South Africa	550 098	9 645
	United Kingdom	164 184	11 229
	United States of America	25 492	5 016
		12 357 472	390 785
	Australian States—		
	New South Wales	727 539	311 128
	Victoria	785 075	203 906
	Queensland	2 642 905	580 272
	South Australia	42 163	9 266
	Tasmania	6 348	1 648
		4 204 030	1 106 220
11	Reconditioned Wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board—		
	Overseas—		
	Australian States	5 101 498	1 144 427
	Total of Timber Items 10, 11	**21 663 000**	**2 641 432**
	Total Timber Imports on this Return	....	**3 984 474**
12	Match Splints (*f*)—		
	Overseas—		
	Finland	....	67 540
		No.	
13	Rulers, wooden (*a*)—		
	Overseas—		
	China (Mainland)	139 140	4 385
	Japan	912	69
	Netherlands	2 304	794
	New Zealand	272	153
	Sweden	4 800	782
	United Kingdom	10 591	8 970
		158 019	15 153
14	Table Mats, wooden	N.R.S.	N.R.S.
15	Wood Flour (*c*)	....	....
16	Manufactures of wood (except furniture N.E.I. (*j*)—		
	Overseas—		
	Bulgaria	....	3 130
	Canada	....	415
	China (Mainland)	....	2 641
	China, Republic of Taiwan	....	95 113
	Czechoslovakia	....	552
	Denmark	....	1 715
	Finland	....	4 144
	France	....	942
	Germany (East)	....	2 084
	Germany, Federal Republic	....	1 627
	Greece	....	69
	Hong Kong	....	7 485
	India	....	17 287
	Indonesia	....	1 125
	Iran	....	71
	Italy	....	22 360
	Japan	....	10 722
	Kenya	....	183
	Malaysia	....	1 148
	Netherlands	....	3 613
	New Zealand	....	6 934
	Norway	....	637
	Pakistan	....	26
	Papua and New Guinea	....	420
	Philippines	....	27 729
	Portugal	....	114

APPENDIX 2B—*continued*

Imports *into Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended June* 30, 1972

	Item and Origin	Quantity	Value
		Cub. ft	$
	Singapore	....	3 893
	Spain	....	3 664
	Sweden	....	40 865
	Switzerland	....	95
	Thailand	....	25 746
	United Kingdom	....	9 828
	United States of America	....	323
	Yulgoslavia	....	110
	Origin Unknown	....	35
		....	297 345
	Australian States—		
	New South Wales	....	625 952
	Victoria	....	381 479
	Queensland	....	23 043
	South Australia	....	99 772
	Tasmania	....	6 654
		....	1 136 900
17	Clothes Pegs, wooden	N.R.S.	N.R.S.
18	Tool Handles, wooden—	doz.	
	Overseas—		
	Germany, Federal Republic	2	4
	Japan	26	141
	Netherlands	1	1
	Switzerland	12	9
	United Kingdom	4	33
	United States of America	1 003	7 458
		1 048	7 646
	Australian States (k)—		
	New South Wales	....	42 251
	Victoria	....	10 579
	Queensland	....	14 787
	South Australia	....	135
	Tasmania	....	2 009
		....	69 761
19	Tanning Extracts of Vegetable Origin—		
	wattle bark extracts (*l*)—	Cwt.	
	Overseas—		
	Brazil	1 545	15 091
	Kenya	118	1 120
	South Africa	6 688	67 617
		8 351	83 828
20	Other—		
	Overseas—		
	Norway	196	379
21	Synthetic tanning substances, artificial bates for pre-tanning ; tanning (tannic acids) and and their salts, ethers, esters and other derivatives—		
	Overseas—		
	France	11	1 773
	Germany, Federated Republic of	1 267	14 819
	Japan	....	5
	United Kingdom	884	28 221
		2 162	44 818
	Australian States—		
	New South Wales	36	726
	Victoria	660	11 860
	Queensland	32	475
	South Australia	7	2 133
		735	15 194
22	Essential Oils ; Concretes and Absolutes—	Lb.	
	Overseas—		
	Brazil	15 344	23 749
	China (Mainland)	29 243	20 930
	China, Republic of (Taiwan)	800	2 940
	Germany, Federated Republic of	992	992
	Indonesia	25 913	38 388
	Italy	4	90
	Portugal	2 194	1 739
	South Africa	19 269	11 323
	Swaziland	137 185	76 306
	Switzerland	25 812	14 763
	United Kingdom	....	3
	United States of America	3 740	15 805
		260 496	207 027
	Australian States—		
	New South Wales	253	768
	Victoria	5 987	19 735
		6 240	20 503
	Total Value of all imports on this Return	....	**5 950 568**

(*a*) Interstate imports are not recorded separately.
(*b*) Not available for publication.
(*c*) Interstate imports included in Item 4.
(*d*) See footnote (c). Item also includes imports of conifer timber, planed, tongued, grooved or the like.
(*e*) Interstate imports included in Items 4 (Conifer) and 5 (Non-conifer).
(*f*) Interstate imports included in Item 16.
(*g*) Figures relate to overseas imports of conifer flooring only. Interstate imports of flooring included in Item 4 (Conifer) and Item 9 (Non-conifer).
(*h*) Relates to Non-conifer timber only. All conifer timber, planed, tongued, grooved, etc., included in Item 4.
(*i*) Interstate imports included in Item 11.
(*j*) Includes imports of wooden packing cases, casks, domestic articles of wood and similar products.
(*k*) Includes brush and broom handles and the like.
(*l*) Interstate imports included in Item 21.

" N.E.I." means " not elsewhere included ".
" N.R.S." means " not recorded separately ".
Basis of Value : Overseas—F.O.B. at the point of final shipment.
Interstate—Landed cost in Western Australia.

APPENDIX 3

Summary of Exports of Forest Produce since 1836

Year	Timber		Year	Timber		Wood Manufactures	Tanning Materials	Essential Oils
	m³	Value		m³	Value	Value	Value	Value
		£			£	£	£	£
1836 (a)	283	2 500	1901	202 505	572 354	....	....	....
1837	....	....	1902	177 191	500 533	....	....	....
1838	....	....	1903	219 436	619 705	....	859	....
1839	....	....	1904	229 608	654 949	....	32 876	....
1840	....	....	1905	246 653	689 943	....	154 087	....
			1906	(c) 250 085	708 993	....	140 720	....
1841	....	....	1907	(c) 181 513	511 923	....	98 773	....
1842	....	....	1908	(c) 279 504	813 591	....	79 934	....
1843	....	....	1909	(c) 306 718	867 419	....	59 633	....
1844	....	(b) 163	1910	(c) 341 939	972 698	....	93 733	....
1845	....	....						
1846	72	255	1911	(c) 352 570	986 341	....	83 470	....
1847	346	1 120	1912	(c) 319 934	903 396	....	49 004	....
1848	95	333	1913	(c) 385 714	1 089 481	....	47 377	....
1849	....	....	1914 (d)	(c) 177 843	502 152	....	18 197	777
1850	297	1 048	1915 (e)	(c) 282 308	808 392	....	6 127	381
			1916	153 837	441 991	....	10 208	1 102
1851	35	268	1917	110 183	310 893	....	18 959	2 060
1852	200	806	1918	97 315	274 141	....	16 886	3 995
1853	1 478	5 220	1919	117 124	332 584	11 535	18 875	3 987
1854	1 657	7 023	1920	143 449	465 731	21 935	22 121	3 704
1855	2 178	12 076						
1856	1 997	9 671	1921	277 996	1 137 819	24 916	23 073	10 017
1857	1 960	9 449	1922	235 332	1 041 047	22 248	13 328	6 878
1858	827	2 340	1923	224 048	997 454	12 377	21 161	20 075
1859	1 907	6 051	1924	315 113	1 367 517	11 505	29 606	39 877
1860	1 552	4 932	1925	335 431	1 477 997	13 298	40 136	42 057
			1926	339 879	1 522 958	10 072	15 056	47 819
1861	796	2 497	1927	356 273	1 651 149	8 727	15 818	26 544
1862	1 948	7 151	1928	294 097	1 265 383	7 783	27 662	39 131
1863	932	2 963	1929	216 230	960 435	6 603	35 850	63 307
1864	1 651	5 508	1930	186 338	807 425	4 687	40 628	77 510
1865	5 210	15 693						
1866	2 426	6 849	1931	116 901	507 582	26 615	35 333	56 170
1867	1 607	4 541	1932	86 735	361 700	85 488	42 016	59 301
1868	227	638	1933	63 310	262 617	80 332	33 352	26 331
1869	5 095	14 273	1934	115 003	487 248	76 107	20 904	26 720
1870	4 452	17 551	1935	150 836	636 466	65 494	15 284	35 363
			1936	158 540	697 522	50 665	12 237	27 526
1871	6 188	15 304	1937	160 685	699 684	52 338	14 491	38 185
1872	1 048	2 590	1938	213 695	932 420	47 934	13 865	35 128
1873	1 930	4 771	1939	161 544	722 310	43 518	17 842	25 550
1874	9 787	24 192	1940	143 004	634 859	62 796	19 485	47 736
1875	9 695	32 965						
1876	6 204	23 743	1941	172 502	790 876	74 935	13 686	59 867
1877	9 520	26 979	1942	148 528	700 474	64 454	6 986	74 904
1878	16 451	63 902	1943	99 589	605 327	32 426	1 598	70 523
1879	17 764	69 742	1944	103 236	613 994	25 324	1 294	72 704
1880	18 763	66 252	1945	80 754	570 028	27 307	2 795	103 055
			1946	95 524	722 061	(f) 2 618	4 872	128 050
1881	22 451	79 277	1947	97 948	865 255	13 118	12 056	151 768
1882	26 522	93 650	1948	101 510	1 099 073	6 572	9 556	116 465
1883	28 235	79 760	1949	90 573	993 152	6 639	5 112	75 395
1884	24 403	68 936	1950	80 937	974 493	13 525	8 243	78 550
1885	24 020	67 850						
1886	17 733	50 902	1951	66 339	(g) 918 485	25 101	16 581	125 833
1887	10 048	28 384	1952	67 219	1 032 909	47 689	19 120	119 109
1888	14 884	42 060	1953	112 294	2 074 421	120 095	34 136	70 852
1889	22 330	63 080	1954	109 286	2 248 320	59 360	80 248	55 273
1890	33 197	82 052	1955	98 476	1 935 019	79 893	37 338	80 882
			1956	129 367	2 818 716	119 459	554 760	90 928
1891	36 078	89 179	1957	132 651	3 256 719	78 934	588 544	58 993
1892	30 661	78 419	1958	157 818	3 875 705	39 762	337 655	101 814
1893	14 527	33 888	1959	182 991	4 373 218	41 612	259 046	52 843
1894	30 124	74 804	1960	173 693	4 160,354	20 549	366 606	63 905
1895	35 549	88 146						
1896	43 771	116 420	1961	156 719	3 838 387	25 305	201 957	95 475
1897	67 778	192 451	1962	160 318	3 993 663	194 380	281 364	81 506
1898	115 719	326 195	1963	155 314	3 966 697	255 190	254 726	70 402
1899	195 792	553 198	1964	149 142	3 686 732	272 187	322 916	88 666
1900	162 143	458 461	1965	133 566	3 545 627	523 596	326 156	76 019
					$	$	$	$
			1966	68 853	4 361 278	1 365 441	289 841	314 817
			1967	138 723	7 467 696	1 335 872	262 808	269 044
			1968	34 569	4 947 595	3 016 850	N.r.s.	280 806
			1969	86 455	4 984 098	3 802 927	N.r.s.	267 565
			1970	96 275	5 661 547	3 906 699	N.r.s.	317 553
			1971	79 362	4 803 842	2 110 802	N.r.s.	343 512
			1972 †	....	....	....	....	....
			Total	13 424 454	208 183 994	21 374 213	10 925 283	7 653 117

(a) The exports up to the year 1834 consisted only of supplies to shipping of which no record is kept.
(b) Not available.
(c) Approximate figures only.
(d) Six months ended 30th June.
(e) Year ended 30th June from 1915 onwards.
(f) Excludes casks (principally empty returns) previously recorded in this item from 1946–1966 inclusive.
(g) From 1951 onwards. Includes items for which the quantity in m³ is not available.
N.r.s.—Not recorded separately.
† See Appendix 2A.

APPENDIX 4

Summary of Imports of Timber, Furniture, Tanning Materials and Essential Oils, since 1848

Year	Timber, Woodware, etc.	Tanning Materials	Essential Oils
	£	£	£
1848	464	....	....
1849	....	....	....
1850	189	....	....
1851	3,216	....	....
1852	2,479	....	....
1853	790	....	....
1854	831	....	....
1855	1,464	....	....
1856	1,124	....	....
1857	744	....	....
1858	1,528	....	....
1859	690	....	....
1860	2,005	....	....
1861	1,459	....	....
1862	1,920	....	....
1863	1,568	....	....
1864	894	....	....
1865	548	....	....
1866	1,442	....	....
1867	1,727	....	....
1868	1,451	....	....
1869	1,408	....	....
1870	1,518	....	....
1871	736	....	....
1872	1,660	....	....
1873	1,008	....	....
1874	1,774	....	....
1875	2,707	....	....
1876	3,098	....	....
1877	2,036	....	....
1878	2,947	....	....
1879	2,340	....	....
1880	3,061	....	....
1881	3,639	....	....
1882	3,692	....	....
1883	6,667	....	....
1884	2,930	....	....
1885	11,479	....	....
1886	17,888	....	....
1887	8,136	....	....
1888	4,461	....	....
1889	7,686	....	....
1890	14,979	....	....
1891	18,406	....	....
1892	26,713	....	....
1893	14,493	....	....
1894	17,964	....	....
1895	47,128	....	....
1896	5,381	....	....
1897	164,552	....	....
1898	55,566	....	....
1899	45,689	....	....
1900	56,266	1,416	1,105
1901	80,134	1,740	1,546
1902	97,810	3,418	1,751
1903	102,383	3,556	1,348
1904	157,856	1,322	2,122
1905	98,494	582	1,592
1906	95,229	1,412	1,915
1907	122,016	2,767	1,549
1908	93,205	2,392	4,584
1909	90,502	4,129	4,033
1910	171,280	3,531	3,686
1911	152,133	2,912	4,938
1912	167,244	3,089	4,598
1913	202,640	2,651	5,392
1914	78,736	629	2,823
1914–15	107,763	2,082	4,988
1915–16	76,849	3,313	4,788
1916–17	75,681	2,848	3,848
1917–18	58,305	2,020	4,358
1918–19	62,824	1,181	4,168
1919–20	100,083	3,748	10,043
1920–21	171,654	*4,899	6,106
1921–22	92,448	5,865	6,577
1922–23	109,428	6,991	4,033
1923–24	133,983	2,790	3,301
1924–25	161,893	2,670	4,429
1925–26	144,989	5,826	4,449
1926–27	162,193	8,971	4,254
1927–28	183,196	9,648	6,955
1928–29	241,601	6,894	4,413
1929–30	197,532	10,825	3,980
1930–31	76,533	4,145	3,160
1931–32	164,496	4,705	3,505
1932–33	197,916	4,903	3,421
1933–34	183,944	4,310	3,888
1934–35	211,056	4,076	5,040
1935–36	228,451	5,401	3,921
1936–37	257,164	5,267	4,810
1937–38	270,126	4,777	6,560
1938–39	254,315	3,974	7,014
1939–40	259,399	6,802	23,027
1940–41	249,111	3,798	32,399
1941–42	283,611	15,846	33,828
1942–43	163,480	6,250	47,718
1943–44	149,928	7,883	68,871
1944–45	148,838	9,264	75,449
1945–46	†219,466	19,573	56,295
1946–47	386,465	12,395	78,091
1947–48	345,508	8,019	96,769
1948–49	470,755	8,662	42,926
1949–50	521,815	24,923	51,197
1950–51	640,059	21,147	161,358
1951–52	1,037,499	18,494	167,697
1952–53	509,667	21,493	69,804
1953–54	923,367	45,202	58,019
1954–55	816,052	27,395	76,464
1955–56	839,581	27,315	131,758
1956–57	830,700	35,403	99,863
1957–58	873,520	28,310	101,680
1958–59	815,300	9,365	62,983
1959–60	895,845	14,608	74,199
1960–61	1,203,641	12,621	60,942
1961–62	1,236,106	13,853	130,876
1962–63	1,978,937	9,868	63,739
1963–64	1,903,772	19,412	37,494
1964–65	2,289,999	21,677	69,741
	$	$	$
1965–66	4,856,090	60,963	132,862
1966–67	6,458,909	68,928	191,796
1967–68	8,135,532	75,657	143,696
1968–69	8,731,114	109,905	206,309
1969–70	10,968,170	153,169	293,845
1970–71	6,761,806	103,857	175,331
1971–72‡	....	....	....
Total	98,569,785	1,776,985	5,419,407

* This and subsequent years include tanning extracts, not previously recorded.
† This and subsequent years include values for furniture, bamboo, cane, etc., not previously included.
‡ See Appendix 2B.

APPENDIX 5

SUMMARY OF LOG VOLUMES PRODUCED IN WESTERN AUSTRALIA SINCE 1829

Year	Crown Land* m³	Private Property m³	Totals m³
1829–1916†	....	....	18 784 136
1917 (*a*)	547 513	60 732	608 245
1918 (*b*)	217 088	14 300	231 388
1919 (*c*)	566 033	96 018	662 051
1920	801 235	163 205	964 440
1921	830 029	198 763	1 028,792
1922	1 022 986	442 929	1 465 915
1923	759 183	279 435	1 038 618
1924	1 189 566	264 588	1 454 154
1925	1 241 348	513 789	1 755 137
1926	1 382 689	709 065	2 091 754
1927	1 327 857	888 005	2 215 862
1928	1 211 565	660 832	1 872 397
1929	914 446	314 322	1 228 768
1930	896 446	330 030	1 226 476
1931	533 056	344 046	877 102
1932	332 558	116 564	449 122
1933	372 851	69 572	442 423
1934	602 171	179 277	781 448
1935	777 618	324 314	1 101 932
1936	889 265	380 512	1 269 777
1937	897 853	450 350	1 348 302
1938	898 805	451 108	1 349 913
1939	828 293	313 956	1 142,249
1940	783 334	258 832	1 042 166
1941	795 486	291 384	1 036 870
1942	754 350	159 538	913 888
1943	668 491	122 426	790 917
1944	630 191	126 200	756 391
1945	622 190	122 046	744 236
1946	598 302	155 260	753 562
1947	621 583	221 801	843 384
1948	630 158	251 252	881 410
1949	573 814	277 941	851 755
1950	597 018	281,293	878 311
1951	719 086	303 394	1 022 480
1952	819 653	338 093	1 157 746
1953	969 207	368 766	1 337 973
1954	1 061 602	384 076	1 445 678
1955	1 061 084	430 335	1 491 419
1956	1 127 457	390 061	1 517 518
1957	1 116 547	328 097	1 444 644
1958	1 106 448	351 096	1 457 544
1959	1 147 908	389 576	1 537 484
1960	1 101 140	340 337	1 441 477
1961	1 069 159	306 388	1 375 547
1962	1 111 377	277 232	1 388 609
1963	1 095 183	278 430	1 373 613
1964	1 116 688	289 430	1 406 118
1965	1 173 320	277 985	1 451 305
1966	1 195 807	286 196	1 482 003
1967	1 159 464	282 291	1 441 755
1968	1 231 517	228 281	1 459 798
1969	1 143 705	160 771	1 304 476
1970	1 121 396	175 686	1 297 082
1971	1 145 161	161 990	1 307 151
1972	1 096 236	106 993	1 203 229
1973	1 060 359	102 992	1 163 351
Total	....	....	86 440 802

* Includes State Forest, Timber Reserves, Crown Land and Private Property (Timber Reserved).
† Estimated.
(*a*) Year Ended 31st December.
(*b*) Six months ended 30th June.
(*c*) Year ended 30th June—from 1919 onwards.

APPENDIX 6

METRICS

It will be noticed that this report uses only S.I. Metric units throughout. For general information the following conversions are supplied.

	Metric Unit and Symbol	Imperial to Metric	Metric to Imperial
LENGTH	millimetre (mm)	1 in. = 25·4 mm	1 mm = 0·0394 in.
	centimetre (cm)	1 ft = 305 mm	
	metre (m)	1 yd = 0·914 m	1 m = 3·28 ft
	kilometre (km)	1 mile = 1·61 km	1 km = 0·62 mile
AREA	square centimetres (cm^2)	1 in^2 = 6·45 cm^2	1 cm^2 = 0·155 in^2
	Square metre (m^2)	1 ft^2 = 929 cm^2	1 m^2 = 10·8 ft^2
	hectare (ha, 10 000 m^2)	1 yd^2 = 0·836 m^2	1 ha = 2·47 acres
		1 acre = 0·405 ha	
	Square kilometre (km^2, 10^6 m^2)	1 $mile^2$ = 2·59 km^2	1 km^2 = 0·386 $mile^2$
VOLUME	Cubic centimetre (cm^3)	1 in^3 = 16·4 cm^3	1 cm^3 = 0·061 in^3
	Cubic metre (m^3, 10^6 cm^3)	1 ft^3 = 28·300 cm^3	1 m^3 = 35·3 ft^3
		1 yd^3 = 0·765 m^3	1 m^3 = 1·31 yd^3
		1 load = 50 ft^3 = 1·416 m^3	1 m^3 = 0·706 1d.
MASS	gram (g)	1 oz = 28·3 g	1 g = 0·0353 oz
	kilogram (kg, 1 000 g)	1 lb = 454 g	1 kg = 2·2 lb
	tonne (t, 1 000 kg)	1 lb = 0·454 kg	
		1 ton = 1·02 t	1 t = 0·98 ton
DENSITY	gram per cubic centimetre (g/cm^3)	1 lb/in^3 = 27·7 g/cm^3	1 g/cm^3 = 0·036 1 lb/in^3
	= tonne per cubic metre (t/m^3)	1 lb/in^3 = 27·7 t/m^3	1 t/m^3 = 0·361 lb/in^3
DERIVED UNITS	square metres per hectare (m^2/ha)	ft^2/acre x 0·229/588 = m^2/ha	
	cubic metres per hectare (m^3/ha)	ft^3/acre x 0·069/96 = m^3/ha	
	tonne per hectare (t/ha)	ton/acre x 2·511 = t/ha	
	kilowatts per metre (kW/m)	Btu/ft/sec x 3·461 = kW/hour	
	trees per hectare (t.p.ha)	trees/acre x 2·47 = t.p.ha.	

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