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FORESTS DEPARTMENT
 PRODUCTION
 PROTECTION
 RECREATION
 CONSERVATION
WESTERN AUSTRALIA

annual report 1988


 Pto
 7/8/88

*Forests Department
PERTH, W.A. 6000*

*TO THE HON. D. J. WORDSWORTH, M.L.C.
MINISTER FOR FORESTS*

In accordance with Section 42 of the Forests Act, I have the honour to submit the Annual Report of the operations of the Department for the year ended 30 June 1980.

*B. J. BEGGS,
Conservator of Forests.*

Front Cover:

A 70 mm aerial photography colour print enlarged from actual frame taken over disease risk area ("quarantine area") of State Forest. This enlarged scale is 1:1000. Photographs of this nature have other uses besides dieback disease detection, e.g. forest type mapping and monitoring effects of experimental treatments.

Common and botanical names of vegetation species mentioned in this report.

Jam	.....	.....	.....	.....	.....	Acacia acuminata
Prickly moses	.....	.....	.....	.....	.....	Acacia pulchella
Bull banksia	.....	.....	.....	.....	.....	Banksia grandis
W.A. sheoak	.....	.....	.....	.....	.....	Casuarina fraserana
Powder bark wandoo	.....	.....	.....	.....	.....	Eucalyptus accedens
Brown mallet	.....	.....	.....	.....	.....	Eucalyptus astringens
Dundas mahogany	.....	.....	.....	.....	.....	Eucalyptus brockwayi
Marri	.....	.....	.....	.....	.....	Eucalyptus calophylla
Silver gimlet	.....	.....	.....	.....	.....	Eucalyptus campaspe
Cleland's blackbutt	.....	.....	.....	.....	.....	Eucalyptus clelandii
Karri	.....	.....	.....	.....	.....	Eucalyptus diversicolor
Dundas blackbutt	.....	.....	.....	.....	.....	Eucalyptus dundasii
Tasmanian blue gum	.....	.....	.....	.....	.....	Eucalyptus globulus
Tuart	.....	.....	.....	.....	.....	Eucalyptus gomphocephala
Yellow tingle	.....	.....	.....	.....	.....	Eucalyptus guilfoylei
Red tingle	.....	.....	.....	.....	.....	Eucalyptus jacksonii
Spotted gum	.....	.....	.....	.....	.....	Eucalyptus maculata
Jarrah	.....	.....	.....	.....	.....	Eucalyptus marginata
Bullich	.....	.....	.....	.....	.....	Eucalyptus megacarpa
Yellow stringy bark	.....	.....	.....	.....	.....	Eucalyptus muellerana
Yarri or W.A. blackbutt	.....	.....	.....	.....	.....	Eucalyptus patens
Red mahogany	.....	.....	.....	.....	.....	Eucalyptus resinifera
Sydney blue gum	.....	.....	.....	.....	.....	Eucalyptus saligna
Wandoo	.....	.....	.....	.....	.....	Eucalyptus wandoo
Maritime pine	.....	.....	.....	.....	.....	Pinus pinaster
Monterey pine	.....	.....	.....	.....	.....	Pinus radiata
Pond pine	Pinus serotina
Loblolly pine	Pinus taeda
Sandalwood	Santalum spicatum

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PRINCIPAL OFFICERS*

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Deputy Conservator of Forests	P. J. McNamara, M.A. (Oxon.)
Assistant Conservator of Forests	F. J. Campbell, B.Sc. (For.), Dip. For. (Canb.)
Assistant Conservator of Forests (Acting)	.....	.....	.....	S. J. Quain, B.Sc. (For.), Dip. For. (Canb.)
Chief of Division	.....	.....	.....	J. B. Campbell, B.Sc. (For.), Dip. For. (Canb.)
Chief of Division	.....	.....	.....	E. R. Hopkins, Ph.D. (Melb.), B.Sc., Dip. For. (Canb.)
Chief of Division	.....	.....	.....	J. J. Havel, M.Sc. (For.) (Qld.), Dip. For. (Canb.), Dip. Ed.
Chief of Division (Acting)	.....	.....	.....	D. E. Grace, B.Sc. (For.), Dip. For. (Canb.)
Chief of Division (Acting)	.....	.....	.....	P. N. Hewett, B.A., B.Sc. (Adel.), Dip. For. (Canb.)
Chief of Division (Acting)	.....	.....	.....	A. C. van Noort, B.Sc. (For.), Dip. For. (Canb.)
Superintendent	.....	.....	.....	C. J. Edwards, B.Sc. (For.), Dip. For. (Canb.)
Superintendent	.....	.....	.....	J. K. Smart, B.Sc. (For.) (Aber.)
Superintendent	.....	.....	.....	F. H. McKinnell, Ph.D. (A.N.U.), B.Sc. (For.), Dip. For. (Canb.)
Superintendent	.....	.....	.....	G. B. Peet, M.Sc. (For.) (Melb.), B.Sc. (For.), Dip. For. (Canb.)
Superintendent	.....	.....	.....	A. J. Williamson, M.For. (Mich.), B.Sc. (Melb.), Dip.For. (Canb.)
Superintendent (Acting)	.....	.....	.....	R. J. Underwood, M.For. (Wash.), B.Sc. (For.), Dip. For. (Canb.)
Chief Draftsman	.....	.....	.....	D. B. Johnston, Dip.Cart., F.A.I.C., Grad. Dip. S.M.
Secretary	.....	.....	.....	K. G. Hide, B.A., Dip. Pers. Mgt.
Accountant	.....	.....	.....	V. K. Combs, A.A.S.A., A.P.A.A., A.A.I.M.

*As at 30 June, 1980

STATISTICAL SUMMARY OF MAJOR OPERATIONS

Sawn Wood Production

Total Production of Sawn Timber 352 811 m³

Trends in Production and Consumption

Year ended 30 June	Sawn Production (m ³)				Total Export	Local Avail- ability	Number of Sawmills	Monthly Average No. of Employees
	Hardwood	Softwood	Hewn Hardwood	Total				
1938	331 928	.....	72 883	404 811	213 695	191 116	134	3 112
1946	251 194	.....	398	251 592	95 524	156 068	128	2 876
1951	356 029	.....	33	356 062	66 339	289 723	256	4 047
1956	544 134	.....	150	544 284	129 367	414 917	274	5 804
1960	470 833	.....	.....	470 833	174 643	296 180	265	5 037
1965	460 246	22 667	.....	482 913	133 565	349 348	206	3 615
1966	475 642	16 499	.....	492 141	68 885	423 256	203	3 518
1967	461 176	17 085	.....	478 261	138 723	339 537	202	3 173
1968	469 818	16 531	.....	486 349	84 569	401 779	188	3 209
1969	413 666	19 643	.....	433 309	86 455	346 854	191	3 233
1970	425 295	16 893	.....	442 188	96 275	345 914	163	2 869
1971	420 777	21 595	.....	442 372	79 437	362 935	150	2 401
1972	379 006	21 733	.....	400 739	101 191	299 548	154	2 533
1973	375 135	23 283	.....	398 418	111 547	286 871	145	2 825
1974	374 899	26 534	.....	401 433	98 200	303 233	140	2 215
1975	368 844	27 086	.....	395 930	100 127	295 803	129	2 228
1976	383 010	16 258	.....	399 268	94 136	305 132	129	2 211
1977	369 151	16 685	.....	385 836	77 352	308 484	136	2 242
1978	347 111	18 669	.....	365 780	58 833	306 947	139	2 170
1979	331 135	18 145	.....	349 280	66 420	282 860	133	2 033
1980	331 411	21 400	.....	352 811	N/A	N/A	133	2 088

Log Production* (m³)

	Crown Land	Private Property
Saw Logs Hardwood	828 364	107 052
Saw Logs Softwood	55 203	4 827
Other Logs Hardwood	562 291	53 197
Other Logs Softwood	136 160	N/A

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

Forest Area

Total area of State forest	1 866 870 ha
Additions to State forest	13 537 ha
Excisions from State forest	840 ha
Land purchased for pine planting	252 ha

Pine Establishment

Areas planted with pines 1979	2 534 ha
<i>Pinus radiata</i>	1 973 ha
<i>Pinus pinaster</i> and other species	561 ha
Total area of pine plantation established at 31 December 1979	48 265 ha
<i>Pinus radiata</i>	24 257 ha
<i>Pinus pinaster</i> and other species	24 008 ha

Management

Area covered by hardwood assessment	41 000 ha
Engineering, new works—	
Roads and tracks	177 km
Houses	4

Protection

Area of prescribed burning	342 078 ha
Fire outbreaks—	
Number of fires	158
Area burnt	1 895 ha

Nurseries

Produced for private buyers (Hamel and Narrogin)	387 523 trees
Produced for Forests Department (Hamel, Narrogin and Manjimup)	3 152 355 trees

Sandalwood

Quantity exported	1 557 t
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Chiplogs (hardwood)

Quantity produced	562 291 m ³
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THE FOREST AREA

State Forests (Forests Act 1918-1976)

The area of State forest at 30 June 1980 was 1 866 870 ha, an increase of 12 697 ha compared with the area at 30 June 1979.

Timber Reserves (Forests Act 1918-1976)

The area held under Timber Reserves at 30 June 1980 was 118 648 ha, an increase of 247 ha compared with the area at 30 June 1979.

Freehold land held at 30 June 1980 in the name of the Conservator of Forests totalled 26 368 ha, an increase of 250 ha for the year.

These areas may be classified into the following forest types (to the nearest 1 000 ha).

	Type	Area (ha)
Jarrah	1 460 000
Karri	140 000
Wandoo	106 000
Mallet	10 000
Tuart	3 000
Goldfields species	30 000
<i>Pinus radiata</i>	24 000
<i>Pinus pinaster</i>	24 000
Very open areas	215 000
		2 012 000

Jarrah type includes: pure jarrah; jarrah with marri, W.A. blackbutt, wandoo, karri and sheoak as minor species; stands dominated by marri with jarrah as the minor species; stands dominated by W.A. blackbutt with jarrah or marri as the minor species; stands dominated by bullich with jarrah or marri as the minor species.

Karri type includes: pure karri; karri with marri as the major or minor species; karri with jarrah or the tingles as minor species; stands dominated by the tingles.

Wandoo type includes: pure wandoo; pure powderbark wandoo; mixtures of these with jarrah, marri and mallet as minor species.

Mallet type includes: plantation mallet (8 300 ha) mallet with wandoo as the minor species.

Tuart type includes: pure stands. These are mainly in the Ludlow area.

Goldfields species include: pure stands and mixtures of salmon gum, Dundas mahogany, Dundas blackbutt, Cleland's blackbutt, silver gimlet, sandalwood, jam and many others.

Very open areas include: swampy and rock areas; areas with sparse tree canopy; areas cleared for mining, power lines and dams.

Land Alienation and Leases

There were 45 applications for alienations involving 4 510 ha, and 20 applications for forest leases involving 764 ha.

During the year the Department agreed to the following:

(a) Alienations

	Number	Area (ha)
Timber zone—		
State forest	1	40
Crown land	9	381
Outside timber zone	1	770

(b) Leases

Timber zone—		
State forest	12	231
Crown land	1	12
Outside timber zone	....	....

LAND MANAGEMENT

System 6 Participation

Officers of the Department have been involved for some time in a land use study of that part of the State known as System 6, which is part of a series of land systems defined by the Conservation Through Reserves Committee in 1975. System 6 comprises the hinterland of the Perth metropolitan area from the Indian Ocean to the wheat belt between the Moore River in the North and the Blackwood River in the south.

The Department was involved at all levels of the study, from the provision of basic resource data through conservation proposals and the evaluation of their economic impact to the balancing of conservation needs with economic constraints. The contribution of the Forests Department to this study was covered in a recently published Forest Focus (No. 22, January 1980).

Three maps of the vegetation complexes of System 6 have been completed in co-operation with the Department of Conservation and Environment and have been published in the "Atlas of the Darling System" as Perth, Pinjarra and Collie sheets 1:250 000. Because vegetation is the integration of all the effective factors of the environment, the maps provide an ideal basis for the planning of land use priorities.

Land Use Management Plans

The draft land use management plan for the northern jarrah forest was amended following comment by other government departments and has now been published. Draft plans for the central and southern forest regions are well advanced and are scheduled for review and completion in the coming year. This planning process is of a developmental nature and it will not be possible to standardise on terminology until the priorities for the entire forest area have been reviewed.

These land use management plans form a basis for general working plan revisions and have strengthened the multiple use aspects of forest management.

The planning officer (northern region) is on loan to the Darling Range Study Group for two years. This has delayed the development to operational level of the land use management plan for the northern region.

Compilation of management plans for the delineated Management Priority Areas for conservation and recreation in State forest is well advanced.

THE ESTABLISHMENT AND TENDING OF FORESTS

Jarrah Forest

The Forest Improvement and Rehabilitation Scheme was expanded in 1979/80. The Department carried out improvement work in areas adjacent to bauxite mining, the operation being financed by Alcoa.

A total of 580 ha in the Wungong Brook and Gooralong Brook Catchments and 100 ha in Marrinup Brook Catchment were treated to favour water production, timber production and recreation where appropriate. In addition, 91 ha of dieback-affected forest were rehabilitated in areas not influenced by bauxite mining.

Karri Forest

During the winter of 1979, 2 236 ha of cut-over karri and karri-marri forest were regenerated, of which 1 818 ha were hand planted and fertilised in the largest karri planting programme ever undertaken. Assessments showed satisfactory survival rates in all coupes. In addition, 182 ha were established by natural seedfall from retained seed trees. Artificial seeding methods were used on a further 236 ha including 45 ha seeded from aircraft in a successful operational trial.

Rehabilitation Work

A large programme of rehabilitation of log landings and snig tracks was completed in co-operation with the timber industry. Some 200 landings and associated snig tracks were ripped, fertilised and planted. A total of 230 000 karri container stock was used.

Wandoo Forest

To allow the continuation of research work begun in the Helena Catchment last year to study the effect of logging on the groundwater table, a further 193 ha of wandoo forest have been prepared for regeneration.

In the Dryandra State Forest, 244 ha of selectively cut wandoo forest have been prepared for regeneration.

Mallet Forest

State forest at Dryandra contains most of the mallet forest under Forests Department control. This area is managed primarily for conservation of flora and fauna. A land management plan describing the area and outlining management strategies is being prepared.

Monitoring has continued of research implemented in 1978/79 to determine the regeneration pattern of mallet and native legumes after fire.

Thinning to produce mallet fence posts and material for tool handles was carried out on 231 ha and 202 ha respectively.

Tuart Forest

Regeneration in the tuart forest by clearing and burning the peppermint understorey and replanting tuart on the ashbeds was carried out on some 30 ha. A further 63 ha were prepared for next year's programme.

The conversion of 10 ha of mixed pine-tuart forest back to tuart was initiated with commercial removal of the pines.

Softwood Forest

Pine Planting

During the year the Department planted 2 534 ha of pines. This total includes 490 ha of replanting virtually completing the replanting of stands damaged by Cyclone Alby. State pine plantations now cover 48 172 ha. In all, 602 ha of plantation were clear felled. Of this total, 172 ha represented normal trade operations and 430 ha represented salvage from cyclone and fire damaged areas.

Tending Pine Plantations

During the year the following plantation tending was carried out.

	ha
Scrub control	3 885
Fertilising with superphosphate and/or "Agras"	2 875
Fertilising with minor elements	1 741
High pruning	2 820
Low pruning	3 715
Culling	5 366
Non-commercial thinning	8

Departmental Plantation Areas

The areas of plantation (by Divisions) as at December 1979 were as follows:

AREAS OF PLANTATIONS (ha)

Division	<i>P. radiata</i>	<i>P. pinaster</i> and other species	Total
Wanneroo	722.0	18 369.3	19 091.3
Mundaring	849.5	738.0	1 587.5
Jarrahdale	324.2	1 009.6	1 333.8
Dwellingup	536.1	71.5	607.6
Harvey	3 592.0	2 319.6	5 911.6
Collie	2 734.4	83.5	2 817.9
Kirup	6 624.7	70.4	6 695.1
Nannup	6 378.4	109.2	6 487.6
Busselton	2 061.4	1 152.4	3 213.8
Manjimup	207.9	.....	207.9
Pemberton	186.8	31.5	218.3
Total	24 217.4	23 955.0	48 172.4
Experimental Planting	226.1	238.6	464.7
Grand Total	24 443.5	24 193.6	48 637.1

Areas planted in 1979, totalling 2 533.9 ha, are detailed below:

1979 PLANTING (ha)

Division	<i>P. radiata</i>	<i>P. pinaster</i> and other species	Total
Wanneroo .....	.....	516.7	516.7
Harvey	200.1	.....	200.1
Collie	222.8	.....	222.8
Kirup	532.6	.....	532.6
Nannup	407.1	.....	407.1
Busselton	610.1	44.5	654.6
Total	1 972.7	561.2	2 533.9

Tree Nurseries

Forests Department nurseries at Hamel and Narrogin sold 387 523 trees for shelter and amenity planting during 1979. A further 3 152 355 hardwood seedlings, including 2.3 million open-rooted karri at Manjimup, were produced for regeneration and rehabilitation of State forest areas.

NUMBER OF TREES SUPPLIED

Nursery	For Sale				Departmental Use	Total
	Pots	Trays	Open rooted	Total	Eucalypts	
Narrogin	135 288	4 680	30 700	170 668	13 521	184 189
Hamel	77 734	62 440	76 681	216 855	415 834	632 689
Manjimup .....	.....	.....	.....	.....	2 723 000	2 723 000
Total	213 022	67 120	107 381	387 523	3 152 355	3 539 878

In addition, Departmental pine nurseries at Gnangara and Nannup raised some 3 061 000 pine seedlings for pine plantation projects. Approximately 360 000 pine trees were sold to private interests.

Seed Collection

Seed was collected from Departmental seed orchards, high-quality plantations, State forests and timber reserves.

Returns from sales from the seed store were \$5 450 for the year.

RESOURCE MANAGEMENT

Water

Because most managed water supplies in the south-west of Western Australia arise on catchments within State forests, catchment protection is of high priority in Departmental planning. Protection is carried out in close co-operation with the Public Works Department and the Metropolitan Water Supply, Sewerage and Drainage Board. The co-operation involves not only integrated research, but also modification of forest utilisation and regeneration techniques, for instance heavy thinning of young pine stands on the coastal plain is designed to maximise the replenishment of shallow aquifers used to supply the metropolitan area with water. Rehabilitation strategies in former bauxite mines are an attempt to maximise runoff while at the same time avoid surface erosion and ensure potable water. Currently the possibility of thinning jarrah regeneration areas to increase runoff is under investigation. The Department is also attempting to improve the quality of water from certain salinity-prone streams by means of the reforestation of catchments previously cleared for agriculture.

The Department participated in meetings of the Water Resources Council.

Wood Production

Timber Production

During the year, 29 195 ha of hardwood forests were cut over for sawlogs.

	ha
Jarrah forest	25 149
Karri forest—	
clear felled or cut to seed trees	2 108
removal of seed trees	587
thinnings	60
Wandoo forest	858
Mallet forest	433

The production of 352 811 m³ of sawn timber, including both hardwood and softwood, was an increase of 3 531 m³ compared with the previous year's figure. The majority of this increase was softwood. Of the total output, 39 656 m³ came from private property, a decrease of 1 208 m³ compared with the 1978/79 figure.

Details of the annual intake of mill logs and production of sawn timber are given in the accompanying tables. The summary of log production for the period 1968-1980 is given in Appendix 5.

In accordance with the provisions of Working Plan No. 86 of 1977 for reduction of the hardwood cut, licenses for the supply of Crown land timber to two sawmills were cancelled during the year.

Local plywood factories obtained the following quantities of peeler logs:

	m ³
Karri	2 211
Jarrah	....
Pine	3 976
Total	6 187

Timber Inspection

The total quantity of timber inspected during the year was 56 523 m³ as follows:

	m ³
Railway sleepers—	
Ex Crown land	30 559
Ex private property	5 661
Re-inspected	67
	<hr/>
	36 287
Other sawn timber	20 236

QUANTITY (m³) OF SAWN TIMBER PRODUCED FROM CROWN LAND
AND PRIVATE PROPERTY FOR THE PAST TWO YEARS

Year Ended 30 June	From Crown land		From Private property		Total Quantity
	Sawn Timber other than Sleepers	Sawn Sleepers	Sawn Timber other than Sleepers	Sawn Sleepers	
1979	262 511	45 905	33 109	7 755	349 280
1980	282 596	30 559	33 995	5 661	352 811

PRODUCTION OF LOG TIMBER FOR YEAR ENDED 30 JUNE 1980
EXCLUSIVE OF MINING TIMBER, FIREWOOD, POLES AND PILES

Tenure	Sawlog volume by species (1) (m ³)								Total (m ³)	Other log material (2) (m ³)		Total (m ³)	Grand Total (m ³)
	Jarrah	Karri	Wandoo	Yarri	Sheoak	Marri	Pine	Other		Hard-wood	Pine		
Crown land	550 437	259 476	2 382	3 451	839	10 961	55 203	818	883 567	562 291	136 160	698 451	1 582 018
Private property	66 655	23 597	8 678	7 082	21	301	4 827	718	111 879	53 197	.....	53 197	165 076
Total	617 092	283 073	11 060	10 533	860	11 262	60 030	1 536	995 446	615 488	136 160	751 648	1 747 094

(1) Includes sawlogs and logs used in the production of plywood veneer.

(2) Includes Chipwood.

Woodchip Operations

A total of 562 291 m³ of marri, karri and jarrah chip logs was supplied to the W.A. Chip and Pulp Company's mill at Diamond for the production of woodchips. This intake consisted of 78.2% marri and 21.5% karri plus a small trial parcel of jarrah (0.3%).

This woodchip material, unsuitable for sawmilling, came from a total area of 4 478 ha (2 668 ha karri-marri forest and 1 810 ha from jarrah-marri forest).

In addition, some 53 197 m³ of chip logs were obtained from private property.

Sawmills supplied 137 503 t of chips prepared from offcuts.

Sandalwood

Exports for the year amounted to 1 557 t. Sandalwood received at the Spearwood depot of the Australian Sandalwood Co. Ltd during the 1979/80 year totalled 1 646 t, compared with 1 364 t for the previous year. A large proportion of this increase consisted of dead sandalwood pieces.

These totals may be broken down as follows:

	1978/79	1979/80
	(t)	(t)
Sandalwood from Crown land—		
Green sandalwood—		
Logwood (including roots and butts)	781	862
Dead sandalwood—		
Burnt wood	99	85
Cleaned wood	26	30
Pieces	431	605
Sandalwood from private property	27	64
Total	1 364	1 646

Some pastoralists again produced sandalwood from their leases as the drought conditions continued.

There was an increase in the amount of sandalwood obtained from private property.

Twenty six sandalwood licenses are currently held and there are approximately 90 people employed in the industry.

Firewood Production

	Crown land (t)	Private property (t)	Total (t)
General purpose and sleeper sawmills—			
For sale	40 616	...	40 616
Own use	2 101	...	2 101
Private property sawmills—			
For sale	...	7 547	7 547
Own use	...	320	320
Domestic—			
Local Firewood Permit	3 560	...	3 560
Forest Produce License	9 589	...	9 589
Industry—			
Wundowie	98 642	...	98 642
Kalgoorlie	1 292	...	1 292
Total	155 800	7 867	163 667

Other Forest Produce

Poles and piles obtained from Crown land during the year amounted to 291 581 m, compared with 282 681 m for the previous year. Supplies of piles and poles from private property are dwindling but accurate production figures are not available.

The number of fence posts and strainers cut from Crown lands totalled 391 683. Records received show that 72 790 posts and strainers were obtained from private property, but this was probably only a small percentage of the total production from this source.

The following table gives details of the amounts and sources of other forest produce obtained during the year.

Description of forest produce	South-west Division and Agricultural Areas		Goldfields Area Crown land	Total
	Crown land	Private property		
Mining Timber South-west	397	...	...	397
Mining Timber Goldfields Area	...	...	16 532	16 532
Piles, Poles and Bridge Timber	291 581	...	...	291 581
Fence Posts and Rails	291 585	72 790	57 552	421 927
Strainers	38 254	...	4 292	42 546
Boronia	3 282	200	...	3 482
Gravel and Stone	310 610	...	...	310 610
Sand	79 781	...	...	79 781
Sawdust as fuel	44 020	...	...	44 020
Bean Sticks	8 420	...	10 000	18 420

Softwood Production

Pine log production from Departmental plantations, mainly in the form of thinnings, amounted to 191 363 m³, which was an increase of 14 419 m³ (8·15%) on production during 1978/79. The following figures show the trend in pine log removals in recent years.

Year ended 30 June	m ³ (under bark)
1950	8 440
1955	20 131
1960	28 394
1965	48 766
1970	81 281
1971	86 245
1972	90 761
1973	100 420
1974	123 393
1975	129 086
1976	105 567
1977	120 859
1978	125 548
1979	176 944
1980	191 363

Removals by category were as follows:

	Total (m ³) (under bark)
Sawlogs and peeler logs	55 203
Other log material	136 160
Total	191 363

Production from the various plantations was as follows:

	Total (m ³) (under bark)
Wanneroo	39 560
Manjimup	195
Harvey	25 431
Collie	25
Kirup (Grimwade)	44 842
Nannup	46 708
Busselton	29 750
Pemberton	4 677
Miscellaneous	175
Total	191 363

Sawn production from all sources was 21 400 m³, which is an increase of 3 255 m³ on 1978/79 production.

Softwood Utilisation

During the year the Department, through contractors, delivered to industry the total State forest supply of 191 363 m³ of pine logs. These logs, including peelers, mill logs, case logs, fence posts and rails and particle board logs, were delivered to the various users of the product.

A logging technique for steep country, previously introduced by the Department, has now been adopted commercially by logging contractors.

The construction of a small spray storage facility at the Harvey mill was completed.

The experimental programme of high temperature seasoning has continued with satisfactory results. The construction of a steaming chamber recommended by CSIRO to facilitate high temperature seasoning was completed. The Department's kiln at Harvey is the only high temperature seasoning facility in Western Australia.

The Forests Department has continued to promote quality control in the softwood industry in association with the W.A. Producers Sub-Committee of the Radiata Pine Association of Australia. Close liaison is also maintained with the Forest Products Association, especially in connection with the many enquiries about timber uses which the Department answers.

Hardwood Utilisation

The Department began commercial thinning of the regenerated karri forest and delivered the log products to sawmills and the Diamond chip plant. The Forests Department mill at Dwellingup continued to operate throughout the year. Trials were undertaken, in association with a commercial firm, to produce sliced veneer from regrowth jarrah logs.

Towards the end of the year the Department terminated its contract to supply sawlogs to Bunnings' Dwellingup mill.

Timber Industry Regulation Act, 1926-1969

The number of mills registered under the provisions of the Act at 31 December 1979 totalled 133 (75 on Crown land and 58 on private property).

The average number of persons employed in the timber mills each month throughout the year was 2 088, an increase of 55 compared with the 1978/79 figure of 2 033.

The District and Workmen's Inspectors made 1 188 mill inspections and 747 bush inspections.

There were 112 notifiable accidents during the year. Two of these were fatal.

The number of accidents per 100 persons employed was 5.36, an increase compared with the 1978/79 figure of 4.97.

The cost of administering the Timber Industry Regulation Act for the year was as follows:

	\$
Salaries	49 906
Travel allowances, office rent, plant cost and sundries	18 399

Recreation and Landscape Management

Extension branch staff continued their close liaison with operations staff in recreation planning and landscape management.

Plans were prepared and guidance given in the field for the construction of seventeen picnic sites and six walking trails.

Landscape rehabilitation was initiated along the South Dandalup water pipeline and an adjacent State Energy Commission transmission line, and in various mining rehabilitation projects.

Landscaping of the Bunbury Office was completed and plans were prepared for landscaping the new Head Office buildings under construction at Como.

Plans for low-water consumption gardens were prepared for two homes in Karratha townsite.

The collection of basic information for Regional recreation planning continued. Interpretation and reporting of the 1978/79 forest-wide visitor survey is nearing completion. The next stage, the preparation of recreation land-use capability plans, has been initiated in the Northern Region, and will shortly be extended to the Central and Southern Regions.

Pending the preparation of Regional recreation plans, most of the year's work was concentrated on upgrading existing facilities.

Work continued on a number of self-guiding tours in forest areas of particular interest and the Donnybrook Sunkland tour guide was published.

Flora and Fauna

The amended Wildlife Conservation Act was proclaimed during the year and control of flora conservation passed to the Department of Fisheries and Wildlife. Although this brings to a close the Forests Department's responsibilities for the Native Flora Protection Act, it remains committed to the conservation of flora and has established close liaison with the Department of Fisheries and Wildlife.

The Road Verge Conservation Committee remained under the chairmanship of the Conservator of Forests. This committee continued its role in protecting flora along road verges throughout the State.

The collection and identification of tree species in the Kimberley Region was commenced as part of the works programme for the new Kimberley Division, based at Kununurra.

Mining Rehabilitation

Bauxite Mining Rehabilitation

Bauxite pits and access roads totalling 258 ha were hand planted with selected species. This included 122 ha planted by the Forests Department at Jarrahdale and 136 ha by Alcoa of Australia at the Del Park and Huntly mine sites.

Species planted include *Eucalyptus wandoo*, *E. maculata*, *E. resinifera*, *E. saligna*, *E. patens* and *E. accedens*. These species were selected because of their resistance to dieback disease and their potential, in their natural environment, to produce trees of commercial size and quality. In selected areas *E. marginata*, *E. muellerana* and *E. diversicolor* were planted to investigate their potential to survive in the new environment.

Following intensive site preparation, trees are planted in mixtures of two or three species and fertilised with a nitrogen and phosphate fertiliser. Seeds of native understorey species are sown at the rate of 1 kg per hectare.

Gravel Pit Rehabilitation

Twenty disused gravel pits within State Forests were rehabilitated by the Forests Department using funds supplied by the Main Roads Department.

Mineral Sands Mining Rehabilitation

In State Forest east of Capel, 20 ha of land where mining was completed were seeded with rye grass and lupins by the mining company.

Trials to test the effect of different site preparation techniques on future pastures and tree growth were initiated in association with the mining companies involved.

Coal Mining Rehabilitation

Further tree planting and scrub seeding took place at the "old" Stockton mine workings. This rehabilitated area has proved to be a popular recreation site, and is a good example of what could be achieved in other future open-cut coal mines, provided the aims of rehabilitation are clearly laid down before mining commences.

Catchment Rehabilitation

On behalf of the Public Works Department preparation for planting of 462 ha took place at two locations, one 25 km north-east of Collie and the other 50 km south-east of Collie. Work consisted of subsoil ripping, fencing of planting areas and herbicide application to remove pasture competition.

Survival and general health of earlier plantings at location 3170 (Stene's location, 35 km north-east of Collie) are excellent for all species.



Strip planting at Stene's

Monitoring the Effects of Agricultural Clearing

Research projects at Collie, undertaken jointly with CSIRO and the Public Works Department continued the monitoring of five small research catchments, three of which have been cleared and sown to pasture.

Protection: Fire

The area of land under control of the Department and protected from fire was 2 011 886 ha. Assistance was provided to shires and other government organisations in the protection of private property and public lands adjacent to State forest. The fire season was generally of below-average severity. Rainfall was higher than average in spring and autumn and maximum temperatures were below average in the southern forest region.

Weather data recorded at Dwellingup and Pemberton are shown in the table below.

	Dwellingup (Jarrah)		Pemberton (Karri)	
	Average	1979-80	Average	1979-80
Rainfall—				
Annual (mm)	1 289	1 160	1 245	1 071
October to April inclusive (mm)	278	391	355	452
Number of Wet Days—				
Annual	131	152	169	177
October to April inclusive	46	62	70	74
Temperature—				
Mean Maximum October to April °C	25.6	25.7	22.7	23.1
Number of days 30°C and over	62	66	27.4	29
Number of days 40°C and over	0.7	2	0.2	0
Relative Humidity—				
Number of Days of 15% minimum or less	7	2	1.5	0
Number of Days between 16% and 25%	32.6	36	8.3	8

Prescribed Burning

Areas of prescribed burning (ha) for the past five fire seasons are shown below:

	Fire Season				
	1975-76 (ha)	1976-77 (ha)	1977-78 (ha)	1978-79 (ha)	1979-80 (ha)
State forest—					
Hand burning	64 497	49 405	36 567	57 801	53 137
Aircraft burning	215 513	185 236	233 931	311 733	282 965
Total	280 010	234 641	270 498	369 534	336 102
Advance, Top Disposal and Regeneration Burns	4 532	3 563	3 674	3 861	3 051
Plantations—					
Clearing burns	2 872	2 752	2 530	2 008	987
Burning under pine canopy	1 958	2 284	1 779	1 932	1 938
Total	4 830	5 036	4 309	3 940	2 925

The area of prescribed burning in State forest was greater than the average for the previous four seasons. Sufficient mild weather was experienced in spring and autumn to complete the programme. The Department assisted local shires and the Bush Fires Board with the prescribed burning of public lands at Denbarker, Pemberton, Busselton, Manjimup, Collie and Mundaring. Similar assistance was provided for the Metropolitan Water Board and South Perth City Council in burning land under their control.

Detection

The main fire detection service was provided by using light aircraft which flew in excess of 7 000 hours during the fire season. A new airstrip was built at Dwellingup and hangars are being erected at Dwellingup and Manjimup.



Piper Super Cub spotter aircraft owned by the Forests Department

Five fire towers were manned regularly and 22 others were kept in full readiness for fire emergencies. A new fire tower was constructed in the Blackwood Valley to provide additional cover for an area of pine plantation that has expanded considerably in recent years.

The dates of the first and last watch for fires were:

	Pine plantations	Jarrah forest	Karri forest
First watch	26 October	24 October	28 October
Last watch	4 May	3 May	11 April

Wildfires

The table below shows the number of fires attended and the area burnt during the past five fire seasons.

	Fire Season				
	1975-76	1976-77	1977-78	1978-79	1979-80
Number of fires attended—					
Indigenous State forest	99	120	221	121	81
Private property and Crown land adjacent to State forest	64	86	150	101	72
Pine plantation	20	21	11	13	5
Total Number	183	227	382	235	158
Area of State forest fires (ha)—					
Indigenous	3 883	5 553	8 211	2 960	1 885
Pine plantation	8	17	364	32	10
Total Area	3 891	5 570	8 575	2 992	1 895

Both the number of fires and the area burnt were below the average for the previous four fire seasons. This was only partly attributable to a milder season; considerable improvements have been achieved in fire detection and suppression, particularly communication and liaison with bush fire brigades. The number of fires attended was the lowest since the 1942/43 fire season.

General

Work has been initiated to improve planning for fire control by integrating the Department's computer facilities into decision-making processes for prescribed burning and fire suppression.

Two four-day training courses in fire management were conducted for 52 senior field staff including representatives from Bush Fires Board and the Victorian Forests Commission. Additional practical training was given to 380 of the Department's employees. Staff participated in several fire courses conducted by the Bush Fires Board.

Five slip-on pumpers with a capacity for 3 000 litres were built in the Department's workshops, including two for the Bush Fires Board for allocation to shires. Twelve smaller pumpers and a new fireline plough of American design were also built. Tests indicate that the new plough is of considerable value for fire suppression in certain forest types.

Improved facilities for the testing and storage of canvas hose were installed at the Collie fire store. Assistance has been sought from WAIT-Aid Ltd in the development of a new incendiary machine for aerial prescribed burning.

Protection: Disease

Jarrah dieback disease, caused by *Phytophthora cinnamomi*, is the major disease threatening State forest.

Proclaimed disease risk areas extend from Mundaring to Walpole and total 719 561 ha (38.5 per cent of all State forest).

There were 993 ground patrols to control entry into disease risk areas. These were supplemented by air patrols with spotter aircraft in areas where illegal entries were most common.

Since the introduction of dieback legislation in 1975, a total of 1 463 permits have been issued to maintain essential services in the disease risk areas. Included in this total were 190 new permits issued during the past year.

Research by the Department's officers has shown that resistance to dieback disease can be improved by promoting the development of acacias and reducing banksias in the jarrah forest understorey. Fire was used successfully on a small scale on some sites to achieve this more favourable balance of species. In March this research was expanded to a full-scale operational trial aerial burn covering 2 200 ha in Hakea Block, near Dwellingup. The area was burnt under dry conditions, the resulting higher fire intensities favouring the regeneration of acacias.

Two courses for senior field officers and representatives of the Bush Fires Board were held, with emphasis on planning for dieback control. Improved planning facilities have been provided through the aerial photography and mapping project for locating dieback occurrence. Other training courses in dieback hygiene were held for members of the timber industry.

Following the production of new maps showing locations of dieback, a trial roading and logging project was introduced in proclaimed disease risk forest near Dwellingup. The trial, which is one of a series of proposed trials in co-operation with the timber industry, involves the stringent application of hygiene measures to avoid spread of the disease. In conjunction with this trial, staff have written a booklet called "Dieback Hygiene Guide" a planning aid for all forest operations.

Forest Offences

Forest Diseases Regulations: Twenty-nine persons were reported for offences against the Forest Diseases Regulations. Eleven persons were prosecuted during the year for offences against these regulations. Action to prosecute two offenders for contravention of the Forest Diseases Regulations is currently pending. In all other cases warning letters were sent to the offenders.

General: Sixteen offenders were reported during the year for other offences against the Forests Act and Regulations. Three offenders were prosecuted for offences against the Forest Regulations. Two cases were settled without prosecution. Warnings were issued in all other cases.

SUPPORT SERVICES AND RESEARCH PROGRAMMES

Research

Como

Soils and Nutrition

The analysis of soil and plant samples associated with the *Pinus radiata* plantations in the Busselton and Harvey Divisions was again the major analytical programme handled by the Como laboratory. Data emphasised the very low copper status of these areas and showed that careful monitoring of foliar copper levels is necessary. Both boron and sulphur levels were adequate in all samples tested.

In a second rotation trial at Myalup, lupins were grown in conjunction with *P. radiata* in an attempt to improve the soil organic matter status. After the fourth year of legumes there was a very significant increase in the surface soil (0–10 cm) organic matter levels:

		Treatment			Organic Carbon (%)	Nitrogen (%)
Site 1	....	Lupins	....	....	1.23	0.064
		No Lupins	....	....	0.87	0.037
Site 2	....	Lupins	....	....	1.86	0.093
		No Lupins	....	....	1.38	0.058

Analysis of soil cores associated with projects directed by the Kelsall Committee was carried out on samples from the Crowea, Iffley and Poole coupes in the Woodchip License Area. The soil nitrogen studies continued during the year, further samples being collected from virgin forest stands in the Harvey Division.

Pinus radiata—Mycorrhiza—Phytophthora cinnamomi Project

Glasshouse experiments have shown that *P. cinnamomi* is capable of infecting the collar region of radiata pine. This observation has subsequently been confirmed in older trees growing in the Donnybrook Sunkland. However, there appears to be some genetic variation in susceptibility to the disease (see Wanneroo, Tree Improvement). A high level of mineral nitrogen fertiliser appears to promote the susceptibility of radiata pine to *P. cinnamomi* on Sunkland sites. It has been demonstrated that some cultivars of subterranean clover, but not those used in field practice, are potential hosts for *P. cinnamomi*.

Over 40 mycorrhizal or potentially mycorrhizal fungi have been collected in a field sampling programme. These fungi are being tested for their ability to form mycorrhizae and/or their effect on the infection of host plants by *P. cinnamomi*. In addition, a number of mycorrhizal fungi have been imported from the USA for testing against *P. cinnamomi*.

Data Analysis

Apart from routine data analysis and biometric advice this section is concerned with increasing efficiency in all three phases of data processing. In the capture phase, investigation is under way into means of bypassing the present method of recording data on field sheets, transcribing to coding sheets punching and cataloguing. The most promising solution is an electronic device similar to a pocket calculator for recording field data, which are then transferred by telephone to a mainframe computer. To improve the analysis phase, a computer terminal and line printer, linked to the W.A. Computer Centre CYBER, have been purchased. For the archiving phase, a microfiche data storage system is needed.

Editorial Section

The editorial section continued production at a high level. One Bulletin (No. 90) was published and two more are at the printer. In addition, eight Research Papers were published and nine articles, prepared by Departmental officers and published in outside journals or conference proceedings, were reprinted. The section was also involved in editing the new Foresters' Manual. Details of publications are given in Appendix (6).

Ecology

A long-term experiment to measure the impact of moderate-intensity fires on soil and litter invertebrates was begun in December 1979. Spiders and earwigs were adversely affected by the fire, whereas ants and beetles were captured in greater numbers after the fire. It is planned to continue this experiment to establish how long it takes for these invertebrates to return to their pre-burn levels of abundance.

A study of the population ecology of *Banksia grandis* was begun in October 1979. This species may reach densities of 4 000 plants per hectare in the northern jarrah forest. Over 1 800 plants have been tagged so that growth rates and mortality can be measured. About 7 per cent of tagged plants, including 25 per cent of the seedlings died over the summer. In spring 1979 an average of 5.8 cones per tree were produced; the bulk of these failed to set any seed. It is estimated that, on average, only about 20 seeds per tree are set each year.

Requirements for the successful regeneration of sandalwood (*Santalum spicatum*) have been examined since 1974 with financial assistance from the Australian Sandalwood Company. The results of this research are being prepared for publication.

Wanneroo

Tree Improvement

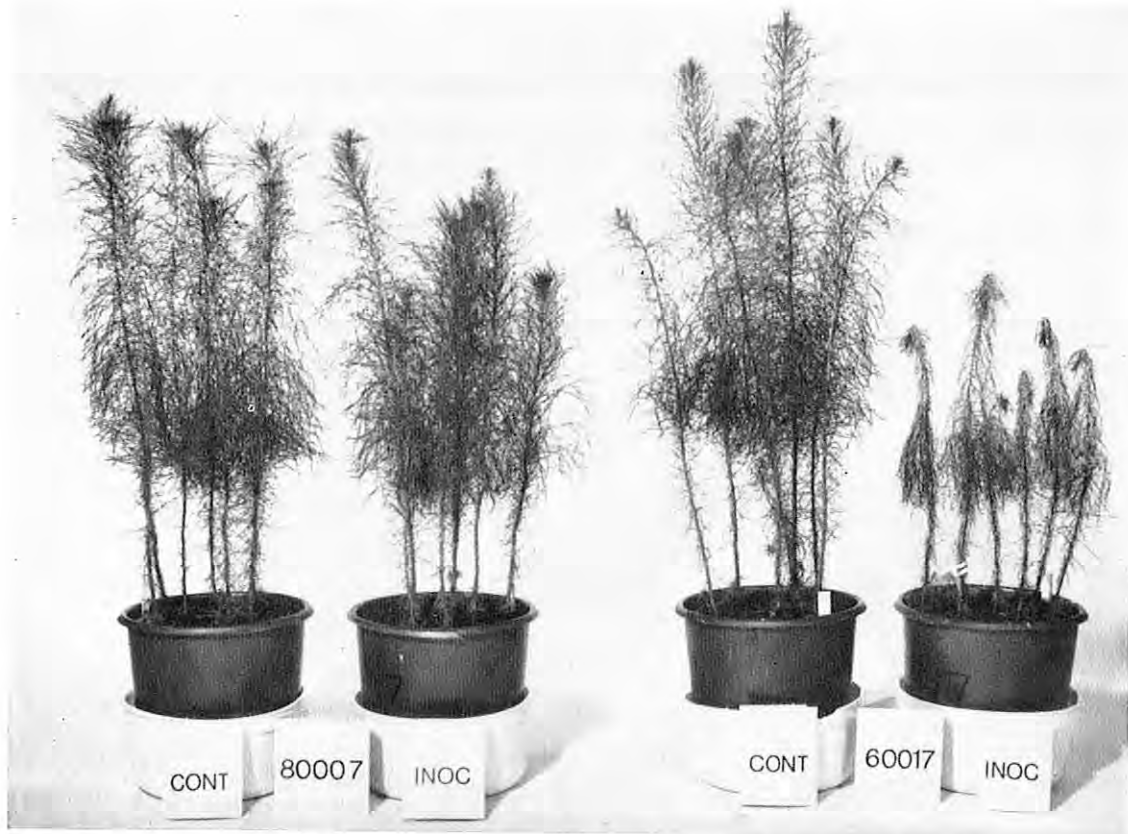
Measurements were carried out on progeny trials of *P. pinaster* on the northern Coastal Plain and in the Sunkland. Data from Yanchep plantation confirmed previous estimates of volume production gains from pedigree seed. On Sunkland sites there is a remarkable improvement in tree form, branching habit and vigour of pedigree *P. pinaster* compared with progeny of the previously used seed source.



Thirteen-year-old pedigree *Pinus pinaster* at Yanchep plantation

Extensive provenance tests were established in the Sunland in 1980. For one test, provenances of *P. taeda* and *P. serotina* collected from wet sites in the south-east of the U.S.A. were planted. In another test, seeds of the Tasmanian blue gum (*Eucalyptus globulus*) from various sources and supplied by the Tasmanian Forestry Commission were planted. This species was also planted at Manjimup and on the Wellington Catchment.

Preliminary results from a pot study showed genetic control of resistance to *P. cinnamomi* in seedlings of *P. radiata*. This variation can be exploited to create a seed source that is more tolerant of the disease.



Pinus radiata family 80007 is resistant to *Phytophthora cinnamomi*; family 60017 is susceptible

Dwellingup

Diseased individuals of the understorey tree *Banksia grandis* were found to be major a source of inoculum of *P. cinnamomi* and a refuge for the fungus during adverse soil conditions in summer. The fungus could invade all the large roots, the collar, and the stump up to 20 cm above ground level. There was total invasion of the collar, except for the central inner core.

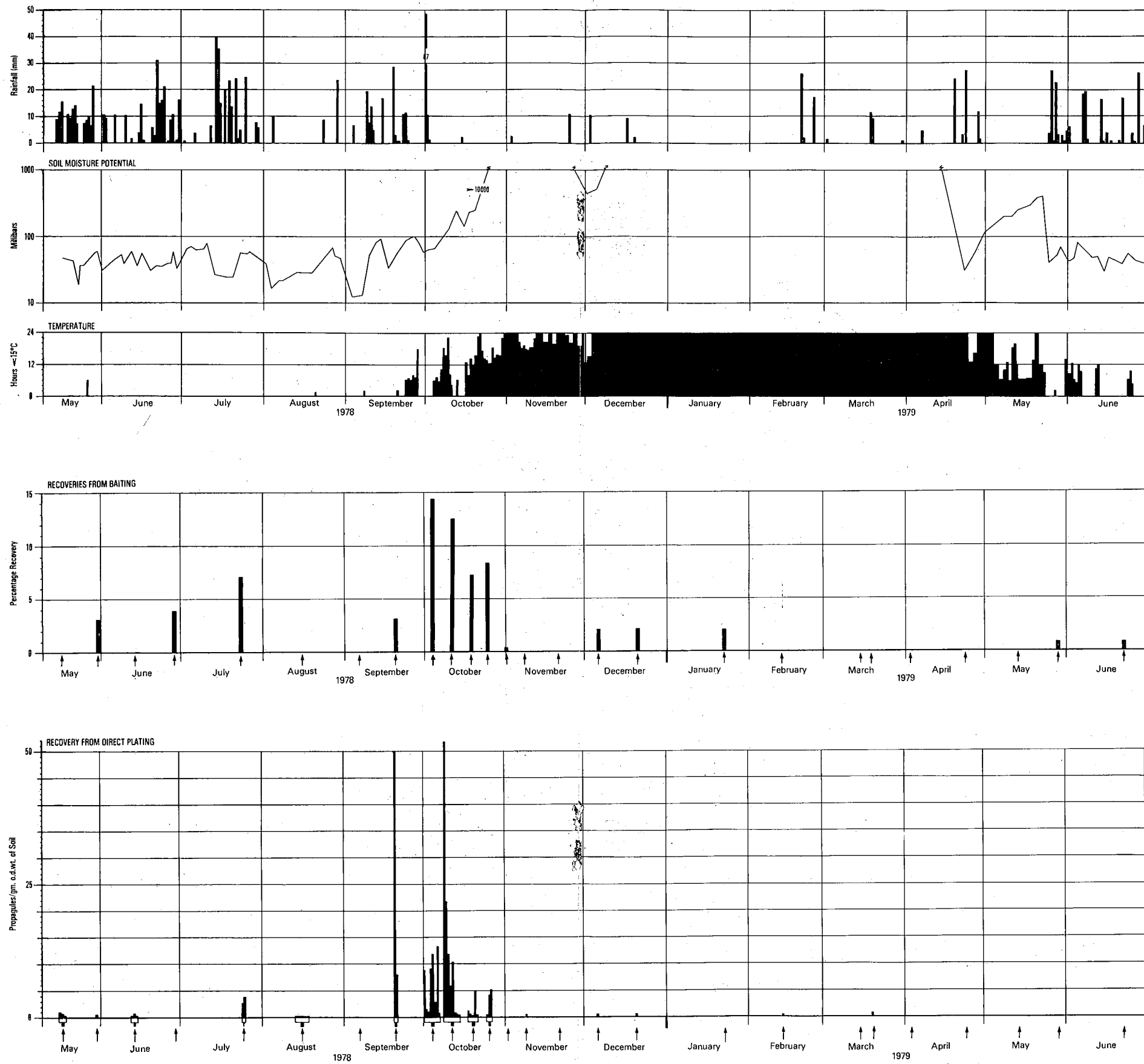
Movement of *P. cinnamomi* from the collar into the soil occurred mainly in spring.

On freely drained sites, the development of *P. cinnamomi* was found to be seasonal, the fungus being present in the soil at high density for only a short period in spring. Sporulation of the fungus occurred for brief periods in autumn and spring when there was a coincidence of high soil temperature and moisture, and corresponded to recovery of the fungus in soil at high density. However, it was shown that in autumn the fungus occurred at a high density only in the soil around recently killed banksias. Apparently the fungus does not emerge from banksia that has been subjected to drying until the following spring.

On moisture-gaining sites, the fungus could be recovered at high density from soil throughout the year, even in summer. This suggests that the disease will reach epidemic proportions only on freely drained sites in above-average rainfall years. It is possible that the apparently low rate of jarrah deaths observed in recent years is a consequence of below-average rainfall.

The morphology and structure of the surface root system of jarrah was examined, and the distribution and spread of *P. cinnamomi* in this root system was determined following inoculation with zoospores. At all sites examined, the surface root system consisted of specialised pads composed of short lateral feeder roots connected to a main framework of perennial roots. The short lateral root system fluctuated during the year, new roots being formed rapidly following rain in spring and summer. *Phytophthora cinnamomi* can have a destructive effect on the surface feeder root system by attacking the framework to which the short feeder roots are attached.

DETAILED SAMPLING OF A SEVERELY DISEASED DIEBACK SITE



Effect of moisture and temperature variation on the occurrence of *P. cinnamomi* on a freely drained site showing severe symptoms of dieback disease.

Research into the ability of a legume understorey to suppress the development of *P. cinnamomi* was continued. Pieces of *Banksia grandis* root or stem artificially inoculated with the fungus were used to infect plots containing an *Acacia pulchella* or *B. grandis* canopy or plots in forest openings. Development of the fungus in soil around the inoculum pieces and survival in the pieces were less under *A. pulchella* or in the open than under *B. grandis*.

Hydrology

Regular stream salinity sampling and stream gauging were restricted to sub-catchments of the Little Dandalup, South Dandalup and Yarragil Catchments. These are being calibrated prior to the application of experimental silvicultural treatments. Monitoring of water levels and salinity in bores established under the Hunt Steering Committee's Project 4 Dwellingup were restricted to a few key bores.

Reforestation in Areas Mined for Bauxite

The establishment phase of five large arboreta was completed. These arboreta provide a base for the systematic evaluation of performance of more than 70 prospective rehabilitation species. The arboreta are replicated on all major site types in the northern jarrah forest so that the performance of any species at any location can be determined.

In forest with saline subsoil the success of revegetation after disturbance is determined by its ability to re-establish the pre-disturbance transpiration rates. A major project to measure transpiration by the ventilated chamber method has commenced in co-operation with the CSIRO Division of Land Resources Management and Alcoa of Australia.

Busselton

Pine Nutrition

Further work on a number of field fertiliser trials showed that, although the best growth responses result from the application of nitrogen-phosphate fertiliser, the responses are short-lived. This evidence supports the change in research emphasis in 1978/79 towards the use of clover to improve overall site productivity in the Sunkland.

Several new trials were established to investigate aspects of growing pine on clover. Seven clover cultivars were grown under four shade intensities: no cultivar was any more shade-tolerant than any other. The selection of clover cultivars for planting in the Sunkland should therefore continue to be based on such factors as suitability to the site and resistance to clover scorch disease.

Agroforestry

A major agroforestry trial is currently being established in the Jarrahwood plantation. The site, 40 ha in area, is to be managed jointly by the Forests Department and the Department of Agriculture.

The objective of the trial is to obtain data on the effects of stand density and pasture fertilisation on tree and pasture growth. Clover pasture has been established amongst two-year-old pine and it is intended to introduce some stock into the area in the spring of 1980.

Weed Control

Following deregistration of the herbicide Tok-E-25, trials were carried out in the Nannup *P. radiata* nursery to screen possible replacement herbicides for use against weeds, especially barnyard millet (*Echinochloa crus-galli*). Of the herbicides tested, Caragard (25% terbuthylazine, 25% terbutometon) and Enide 50W (50% diphenamid) proved the most effective. However, timing of the application in relation to the emergence of barnyard millet was critical for total control.

Trials to test Velpar as a means of controlling eucalypt coppice in pine plantations are under way. Early results are promising.

P. radiata mortalities

Investigation of deaths in the *P. radiata* plantations in the Sunkland commenced in mid-1979 in response to concern reported over the number of deaths and the possible role of *Phytophthora cinnamomi* in causing mortality.

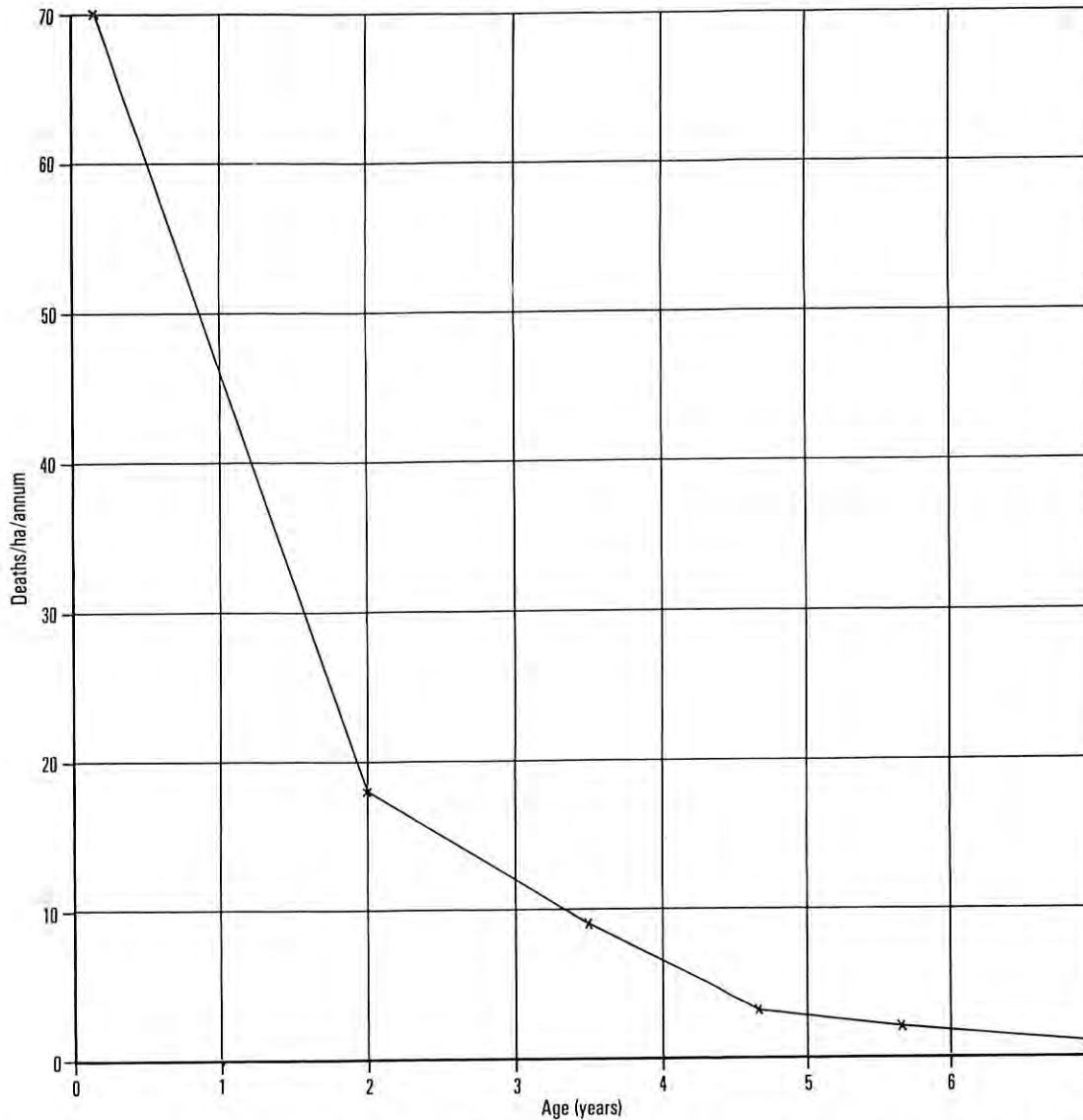
From surveys of the incidence of pine deaths several trends became evident. Data from the trial plots of *P. radiata* established in 1971 on "grave-yard" sites in the Sunkland show a high number of mortalities in the first year, declining rapidly to a very low number by age 6 to 7 years (see Fig. 2).

Surveys of 4- to 5-year-old plantation *P. radiata* showed from one to ten standing dead trees per hectare (approximately 0.5 to 5 deaths per hectare per annum) depending on soil type and presence of dieback disease in the jarrah forest that previously occupied the site.

The individual dead *P. radiata* are scattered among live trees. This may reflect either variable tolerance levels within the *P. radiata* planted or the distribution of inoculum. Studies are under way to investigate this.

Studies are continuing of soil moisture and temperature regimes in relation to sporulation and growth of *P. cinnamomi* under *P. radiata* stands of different densities.

Fig. 2
P. radiata deaths in the Sunkland



Pinus radiata deaths in the Sunkland (N.B. Data obtained from six different trial plots planted on dieback sites in 1971.)

Manjimup

Ecology

A draft management plan for conservation Management Priority Areas (M.P.A.) was compiled, outlining the general management principles which will give priority to flora, fauna and landscape values. In addition, each M.P.A. was identified according to one of seven forest and site-vegetation types, and a set of guideline management principles was prepared for each type, covering silviculture, fire management and habitat protection. These guideline principles are based on current available knowledge.

Routine trapping continued in a number of areas where long-term fauna ecology trials are established. Trapping frequency was increased at Warren Block so that change in mardo (*Antechinus flavipes*) numbers can be more closely monitored. Previous studies by the Research Branch and Murdoch University indicated that the mardo prefers dense vegetation and a deep litter layer. Trials have now been initiated using radio telemetry to study movements of the mardo in different forest types. Preliminary radio tracking results support the conclusions of the previous studies. At Warren Block and Big Brook transmitters were fitted to four mardos, and remained active for up to a week before being cast. During this limited transmitting time, the mardos ranged over an area of 1 to 3 ha and were active throughout the night, showing two-hour periods of high activity followed by two hours of rest. Although they rested throughout most of the daylight hours they had an active period of between two and four hours each day, commencing at about 10 a.m.

Trapping at Perup Fauna Priority Area showed a dramatic increase during the last 12 months in the number of woylies (*Bettongia penicillata*) captured in the south and a substantial increase in the north. At North Perup, where woylies were re-introduced in 1977, they have re-established themselves

over a greater area during the past year. Trappings and sightings also indicate an increase in the number of brush-tailed possums (*Trichosurus vulpecula*) and numbats (*Myrmecobius fasciatus*). Although baiting of the introduced fox has been carried out by the Agriculture Protection Board, no decrease in the fox population has so far been observed. The observed increases in fauna are unexplained.

A survey of vertebrate fauna was carried out at Hakea Block, Dwellingup, during spring. This block was burnt in autumn with a moderate intensity fire.

A biological survey of an area of forested vacant Crown land east of the Denmark River Catchment was carried out during autumn. A report has been prepared. The exceptional richness of the fauna and flora is apparently due largely to the area's location near the junction of the Darling, Warren and Stirling botanical districts.

The survey of the mud minnow (*Lepidogalaxias salamandroides*), a small fish formerly believed to be almost entirely confined to the Chipwood License Area, has been completed. During the survey much information was also gathered on the occurrence of other species of small fish within the area. Studies of understorey vegetation in the Woodchip License Area continued. Since the programme includes monitoring of the recovery of vegetation on the recently logged catchments at Iffley, Crowea, Poole and Moorilup, each of these areas was assessed.

Hydrology

Routine measurements continued in the four areas (Iffley, Crowea, Poole and Moorilup) being studied under the auspices of the Kelsall Committee. In November 1979, Iffley and Moorilup were burnt for regeneration on completion of the logging.

Eucalypt Silviculture

Research into karri regeneration, particularly on podsolic soil types, was continued. The main points under study were techniques for spot-sowing karri seed, rates of broadcast seeding and methods of fertiliser application at establishment. Seed production remains a major factor requiring research with karri. During the year approximately 50 ha were prepared for the establishment of karri seed orchards. Seed was collected from trees of outstanding form and vigour in the Warren, Donnelly and Shannon River valleys. The effects of tree spacing, level of nutrition and irrigation on seed tree development and seed production are being monitored at West Manjimup.

A long-term marri provenance trial was established using 96 families selected from high-quality individual trees over a wide geographical range. The aim of the trial is to determine whether it is feasible to make a significant improvement in marri wood quality, particularly with respect to sawlog production.

Investigations into soil damage associated with wet-weather logging continued. A new trial was established in karri regrowth to determine soil damage from different types of logging equipment.



Thinning karri at Treen Brook

Fire

Fire research was directed at increasing the understanding of jarrah forest fire behaviour during the drier summer and autumn months when fire hazard ratings are in excess of moderate. Studies were designed to collect information to aid in the prescription of controlled fires designed to reduce the *Banksia grandis* component of the forest and enhance legume regeneration. Such measures may inhibit jarrah dieback disease.

The following conclusions are drawn from the monitoring of some 40 experimental fires.

- (a) Under very dry fuel conditions, the current forest fire behaviour tables under-estimate head fire rates of spread when winds at 1 m above the ground are in excess of 6.5 km per hour. For winds less than 6.5 km per hour, the tables tend to over-estimate rates of spread.
- (b) Very low winds (3.5 km per hour at 1 m above the ground) could neither break nor bend the strong convection developed by the intense burning of very dry fuels. As a result the rates of spread up to this threshold were very low. Beyond this, rate of spread increased exponentially with wind speed. Moderate fire intensities were sufficient to kill a high proportion (>60% by numbers) of *Banksia* taller than 3 m. *Banksia* smaller than 3 m in height proved to be extremely resilient, surviving very hot fires. The nett *Banksia* kill from moderate fires was between 10 and 20 per cent, but these fires also caused considerable bole damage to jarrah trees of less than 20 cm diameter breast height over bark.

Inventory and Planning

Hardwood Inventory

Management-level inventory was carried out in the marri Chipwood License Area (183 ha), the Donnybrook Sunkland (594 ha), Kirup division (161 ha), and Jarrahdale division (38 ha). The inventory of these 976 ha provided management information for 33 000 ha of hardwood forest.

In Narrogin division, resource-level inventory of 33 ha provided information on 8 000 ha of the mallet forest. Thirty-three permanent growth plots were established and two plots were re-measured. Thirty-eight permanent inventory plots were established and 103 plots were re-measured.

Softwood Inventory

During the year, 1 008 permanent plots were re-measured and a further 447 were established to update information on the plantation resource.

Sixty-two agroforestry plots were re-measured in the Helena Catchment.

Forty-eight plots were re-measured and 12 additional plots established to monitor the response of stands to current silvicultural practice.

Other Projects

Kimberley Resources: A reconnaissance survey was carried out in the Kimberleys to determine species occurrence and timber volumes, especially in the Mitchell Plateau area. Timber in commercial quantities was not found and is unlikely to be found in the Kimberleys. Through the survey, considerable appreciation was gained of the range of forest and woodland types in the region.

Sandalwood: A pilot survey was carried out in the eastern goldfields to decide sampling design and intensity as part of a sandalwood resource study.

Pine logging plan: A detailed one-year logging plan was produced for all central region plantations. The plan incorporates inventory data, thinning records and estimates of demand. It also makes allowance for winter and summer logging and steep and flat country. This level of planning is essential to meet the expanding requirements of the softwood industry.

Photography: Inventory and Planning staff produced approximately 1 400 photographs, mostly aerial obliques, to monitor cutting and regeneration within coupes. The photographs were used for the maintenance of hardwood operations control records in Manjimup, Pemberton and Walpole divisions.

Chipwood Weight/Volume Ratio: Since February 1972, staff from the section have measured 12 009 logs delivered to the Diamond Chip mill site to continually update information on log density. The weight/volume ratio obtained is used to determine the royalty charged.

Karri Seed Forecast: Seed supplies from 48 forest coupes were forecast and the results were tabled for preparation of the four-year logging plan. Wherever possible, logging is scheduled to take maximum advantage of natural seeding.

Residue Assessment: An assessment of residue after felling and chipwood operations was completed for six selected coupes covering 668 ha.

70 mm Dieback Photography

Suitable weather early in the flying season meant that 81 000 ha of quarantined forest could be photographed to detect dieback occurrence. The project involved 5 949 km of flight line and 138 rolls of film. The total photo coverage of the proclaimed disease risk area is now 155 000 ha.

An additional 5 400 ha of 70 mm photography projects were undertaken. These included rehabilitation at the Del Park mine site, an *Acacia* regeneration burn, suspect dieback in a small area of pines, and a possible conveyor belt route for the Worsley Alumina project.

Camera and navigation system performance was virtually trouble-free throughout the programme. Weather conditions proved to be the most unpredictable element of the operation. One hundred and eighty-four aircraft hours were logged.

Film coverage of 50 000 ha of forest was interpreted for dieback occurrence. A laboratory assistant is working full-time processing soil samples to substantiate interpretation. A map of parts of Amphion and Taree Blocks has been prepared for divisional operations staff.

Economics

A departmental submission was prepared for the review of "State Relativities" undertaken by the Commonwealth Grants Commission. Further work was carried out on the cost-benefit study of the Donnybrook Sunkland afforestation project. Another study emphasised the need to make special allowance for inflation in long-term forestry financial calculations.

Automatic Data Processing—Scientific Applications

Forest Management Information System (F.M.I.S.): A pilot project was initiated with the objectives of:

- (a) investigating the feasibility and likely cost of creating a large-scale map data base covering the forested areas of the south-west of Western Australia, and
- (b) preparing design specifications for the development of an on-line forest management information system for implementation on the Department's Interdata 7/32 computer.

The project made use of the Map Display System, a software package developed in 1972 and previously used in several research projects. Initially, the pilot project area covered 260 000 ha in the Southern Region but has since been extended to include the whole region.

Mensuration: Volume tables incorporating a taper factor were produced for mature karri. Similar tables are being developed for re-growth karri.

Mapping

About three quarters of the programme to convert departmental maps to the metric system has now been completed. Eleven new maps were published during the year and a further twelve are in the course of preparation. One map, Denmark, was revised and printed showing contours at 10 m intervals.

An evaluation was completed to ascertain the need for contours on the Department's 1:50 000 maps. It was agreed that the addition of contours improves the usefulness. As revision of each sheet is undertaken the contours will be added.

The working series of Aerial Photographic Interpretation, Topographic and planimetric maps at the scale of 1:25 000 is to be replaced by a new black and white topographical series at the same scale based on the Australian Map Grid (A.M.G.) Cadastral and topographical information is already available on the A.M.G. so no duplication of compilation work is necessary. This new series, which will show contours, will be of specific use in mapping dieback and predicting its spread. It will also be a major tool in the maintenance of the Forest Management Information System.

The Department's Vegetation Map of Western Australia is being revised. The map is being produced in collaboration with Dr. J. S. Beard, who is responsible for the vegetation information. It will be published at a scale of 1:3 000 000.

The year has shown a steady increase in the number of base maps prepared with special coloured overlays. These are proving ideal in the development of land-use management plans. The map of Forest Areas of the South West is being revised prior to reprinting. This very useful 1:500 000 scale map is used extensively for indices, to illustrate reports and for other general purposes.

Clearing for bauxite mining at Jarrahdale, Dwellingup and Harvey was mapped from aerial photos and area figures were extracted for compensation payments.

The branch prepared six tower, five co-ordinating and about 250 aerial surveillance plans for fire protection use. In addition, 127 aerial burning plans were prepared.

A relief model was constructed at a scale of 1:25 000 over the Amphion and Taree forest blocks to assist in the planning of trial logging in quarantine.

An evaluation of Landsat imagery was made in connection with the revision of aerial surveillance plans.

Cartographic

Project mapping comprised a large part of the work in this section and ranged from multicoloured maps and graphs for illustrating departmental publications to overlays on transparent material for land-use planning proposals.

Mapping from Aerial Photos

Plantation plans were amended to show new clearing. Four-year-old *Pinus radiata* and five-year-old *P. pinaster* were plotted to provide accurate maps of areas planted.

A plan was prepared from aerial photos to cover a proposed *Eucalyptus kruseana* reserve near Karonie Siding on the Trans-Australian Railway. Mallet areas at Dryandra were mapped from interpreted photos.

General Drafting

The conversion of tenure plans to a transparent plastic base and metric scale is now well under way. Fourteen plans covering Collie division were prepared for use in Head Office and divisional offices.

The provision of plans and prints required for the Hardwood Operations Control System is almost complete and those for Walpole and Narrogin divisions are now in course of preparation.

Extension

The long-planned Bibbulmun Track Walk, part of the Department's contribution to the WAY '79 celebrations, was successfully completed in October-November 1979. Eleven walkers completed the 700 kilometre trek from Albany to Kalamunda in 29 days. The Hon. D. J. Wordsworth, M.L.C., Minister for Forests, officially opened the track at a ceremony at Boorara Tree on 28 October 1979.

Public enquiries relating to tree planting, weedicide damage, insect and fungal attack, and the inspection of dangerous trees, continued to increase. Over 5 000 enquiries were dealt with during the year, leading to 250 advisory visits in the metropolitan area and 50 to country areas. A further large but unrecorded advisory service was provided by Extensions and Operations staff stationed in country areas.

Displays illustrating subjects of forestry interest were set up at thirteen agricultural shows or similar public gatherings. The subjects promoted by displays included forests as a source of honey, catchment management and the recreational and environmental use of water, tree planting techniques and the history of forest management.

A number of permanent but demountable displays is being prepared by Extensions staff for use in the Department's display caravan. These will facilitate a rapid change of subject matter, reduce the number of staff at present necessary for many displays, and permit representation at a wider range of locations throughout the south-west of the State.

Departmental officers continued to give talks to many organisations and schools on request.

A movie film "Forests Forever" was completed, its production being a joint project with the Forest Products Association of Western Australia.

Private Plantations

Private interests advised that they planted 295 ha of new plantation in 1979. The total area of private pine forest is now recorded as 11 402 ha.

The Forests Department was represented in an advisory capacity at nine meetings of The Australian Forest Development Institute, and its biennial conference in Tasmania, and at a field day arranged by the Institute.

Education

There was a steady demand for speakers to educational and other groups during the year. A close liaison was established with the Outdoor Education Branch of the Education Department.

Arboreta

A comprehensive review of the results of species trials in 54 arboreta throughout the agricultural areas from Geraldton to Esperance and Kalgoorlie was completed. This is expected to improve knowledge of the suitability of 168 different species in various localities. Establishment of two new arboreta was attempted at the Chapman Agricultural Research Station. Success was achieved in only one of these owing to adverse climatic conditions.

Further species suitability trials are being established in the Kalgoorlie-Esperance area. A total of 68 *Eucalyptus* species, nine *Pinus* species and 18 other genera are now under trial at Esperance.

Kimberley and Pilbara Regions

The Department's Kimberley Divisional Office at Kununurra was officially opened by the Hon. Minister for Forests on 13 July 1979.

Field work has been directed towards the collection of information on the forests and woodlands of the Kimberley region.

In the Pilbara the Department was involved, along with the Office of Regional Administration in the North West, in the technical running of the Karratha nursery and in the establishment of trees in the town's green belt.

Library

The following statistics for library activities were recorded:

	1978/79	1979/80
Periodicals circulated	4 048	7 726
Items accessioned	831	566
Loans:		
From the library to staff	4 501	3 477
From other libraries	323	316
To other libraries	118	160
Enquiries	1 979	2 329
Photocopies (pages)	6 333	4 647

Periodicals: The number of periodicals circulated increased this year because of the increased number of staff using this service and the addition of several new titles for circulation.

Books and other Items: Although there was an increase in the number of enquiries received, there was a decline in the number of loans and photocopies made.

In preparation for the move to Como, the library holdings have been reorganized to make the collection easier to manage and search.

Microfilm reader/printer: A microfilm reader/printer was delivered to the library.

Forest Engineering

Roading

During the year, 177 km of roads, tracks and firelines were constructed and 4 622 km of roads were maintained.

Plant and Workshops

Fourteen workshops staffed by 45 tradesmen and 21 apprentices maintained the departmental fleet of 701 units of automotive and industrial plant.

A number of fabrication projects were completed. They included the following:

Two heavy-duty Holden/Stalker pumping units with 3 000-litre tanks and ten light-duty pumping units with 900-litre tanks, all for fire fighting purposes.

Two fireline ploughs.

Two hose-drying towers for Wanneroo division.

Three new 3-point linkage planting machines for the Sunkland project. These, together with the eight existing machines were modified to dispense fertiliser at the time of planting.

A TC860 Volvo logging forwarder was acquired and placed in service in the Wanneroo Division.

Housing and Building

Work commenced on the new Forests Department State Headquarters. The general programme of housing, building and settlement maintenance included the relocation and renovation of four houses in the southern divisions. Specific projects included the construction of new houses at Jarrahdale, Mundaring, Kununurra and Karratha.

Communications

Assistance was given to the dieback photography group with the establishment and maintenance of sophisticated navigation equipment for accurate aircraft guidance, and with the installation of radar transponder stations using solar power.

The first of a series of automatic weather stations was established at Mt. William using the Very High Frequency (V.H.F.) radio system to convey information between the data-collecting station at Mt. William and a terminal at the Harvey Office, where this information is decoded.

Repeater Stations

Further improvements to radio equipment, monitoring devices and installations were carried out at Stewart, Mornington and Mt. Frankland lookouts.

Ten of the twenty radio repeater stations were provided with an improved antennae.

Greater capacity from solar arrays was obtained by the installation of additional panels at Dickson, Alco and Mowen lookouts.

A temporary repeater was set up at George tower in Dwellingup division to cover the Hakea Block experimental burn.

Aircraft

The Department's four Piper Cub spotter aircraft were fitted with locally manufactured radios, as were the five hired aircraft.

General

Two extra channels were introduced into the Department's V.H.F. radio system to cope with the increase in radio traffic. This involved the return of over 400 items of radio equipment to the branch headquarters at Como, where channel modules and crystals were fitted.

An annual maintenance check of aerial and wiring installations for radio-equipped vehicles at all divisions was carried out and 80 additional vehicles were equipped with aeriels and wiring harness. Training in radio communications was provided for field staff at Mundaring, Jarrahdale and Harvey.

ADMINISTRATION

Finance

All territorial and departmental revenue is paid into the Consolidated Revenue Fund. Allocations are made from this Fund for Forest Maintenance Activities and from the General Loan Fund for Forest development.

Source and Application of Funds

Source—	1979-80 \$
Consolidated Revenue Fund	16 612 373
General Loan Fund	2 870 000
Commonwealth Aid Road Grant	309 424
Commonwealth Softwood Forestry Agreement	909 596
Mining Compensation	641 528
Sundry Revenue	63 923
Conservator's Borrowings	1 200 000
	<hr/>
	22 606 844
	<hr/>
Application—	
Forest Development	5 776 653
Forest Maintenance	16 618 313
Increase in unexpended balance	211 878
	<hr/>
	22 606 844
	<hr/>

Grants Commission Review

Throughout the year the Department was heavily committed to participation in the preparation of the State's submission on personal income tax sharing arrangements being considered by the Commonwealth Grants Commission.

An initial briefing was given to the Commissioners in July 1979, and a written submission was produced on problems and disabilities suffered by the Department in comparison with forest services in the other States. This was supported by senior departmental officers who presented evidence at formal public hearings in March 1980.

Initial problems included the determination of areas subject to consideration by the Commission, the incompatibility of statistical information between States, and differing areas of responsibility exercised by other forest services.

Disability factors presented for consideration by the Commission were scale (need to provide a full range of services for a limited population), eligible population (units of service), dispersion (differences in population distribution) and physical and economic environment including jarrah dieback disease, soil salinity, adverse fire weather and remoteness of alternative sources of timber supplies.

Accounting Computer

A computer programme for processing pine log information was implemented during 1979/80. This system produces financial and management information from daily inputs from plantation centres. Reports are printed fortnightly and provide information for paying contractors and pieceworkers for timber produced and for billing customers.

The Sundry Debtor System, implemented in July 1979, now provides a much faster and more accurate production of invoices and statements.

Departmental Staff

Public Service Act

Mr. D. B. Johnston was appointed to the position of Chief Draftsman.
Mr. G. J. Coffey was promoted to Operations Manager, Computer Services Section.
Messrs. F. E. Batini and J. B. Sclater are on loan to the Darling Range Study Group and the Asian Development Bank respectively.
Messrs. W. G. Schmidt, J. A. Skillen and C. C. Done were reclassified as Senior Divisional Forest Officers.
Mr. J. C. Meacham and Mr. W. H. Eastman retired from the Public Service during the year.
Mr. M. E. McKiggan, Engineer, resigned.

Forests Act

Mr. P. J. Nolan was reclassified as Technical Officer.
Messrs. A. J. Brandis and T. R. K. Brittain were promoted to Technical Officers.
Mr. A. J. Ashcroft retired from his position with the Department.
It is with regret that we record the death of Forester J. E. McAlpine in December 1979.

Training Programmes

Eighteen cadets commenced the first year of their training programme at Bunbury Technical College. Twelve students successfully completed their first year and are now entering the second year of the course. One of these twelve was awarded the prize as top student at Bunbury Technical College for 1979. Two mature-age students have joined the course in the second year at Dwellingup.

In December, twelve field cadets graduated and they received individual safety awards in recognition of two years free of accidents.

Nineteen candidates were successful at the staff promotional exams held in August.

Courses were conducted during the year in the fields of fire management, dieback disease, and accident prevention. An induction course for junior professional officers was also completed.

Officers attended training courses in managerial development, secretarial skills and public relations conducted by the R. H. Doig Development Centre, the Australian Institute of Management and the Trainer Training Centre.

Conference and Study Tours

During the year, 30 departmental officers attended a total of 26 interstate conferences, courses and study tours covering a wide range of subjects.

Forest Officer Mr. P. Richmond visited India for three weeks in February-March to study various aspects of the Indian sandalwood industry.

Senior Timber Inspector L. Nicol visited Hong Kong in April with a member of the W.A. Sleeper Export Association to investigate the quality of jarrah sleepers supplied to buyers in Hong Kong.

Inspector G. B. Peet completed a three-month assignment in Kenya for the Food and Agricultural Organisation of the United Nations.

Employment in Forestry and the Timber Industry

The number of wage earners directly employed in forestry and the timber industry was estimated at 3 600, as follows:

Forestry—		
Professional officers	78	
General field staff	298	
Clerical and drafting	91	
Cadets—		
Professional	8	
Field	31	
Full-time wage employees	534	
*Contract personnel	150	
		1 190
Timber Industry—		
†Sawmill employees including bush workers	2 088	
Firewood and mining timber cutters and pole getters working under permits	76	
Sandalwood workers	87	
Apiarists estimated (2 379 sites registered)	159	
		2 410
		3 600

* Contractors are employed periodically for clearing, road building, pine logging and hardwood logging. It is not feasible to calculate an annual number that is meaningful, but it is estimated that at the year's end there were some 150 contract personnel at work in the forest.

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

ACCIDENT PREVENTION

The number of work related accidents causing injury to Forests Department employees decreased compared with the previous year, and the all-injury accident rate was one of the best results in the Department's safety history.

During the year, 1 054 full-time and 49 part-time personnel worked 1 826 542 man-hours and suffered 32 lost time accidents, with a further 125 medical treatment accidents not involving loss of working time.

Compared with the previous year's figures, these represent a decrease in both categories. The combined frequency rate for both is 86, one of the lowest ever recorded.

Special mention must again be made of Walpole division, which completed its ninth consecutive accident-free year. Other divisions which worked for one or more consecutive years without a lost time accident are: Narrogin (three years), Manjimup (one year), Nannup (one year), Cadet Training School (seven years). Wanneroo division showed a marked improvement during the year by halving their lost time accident rate.

A number of accident prevention schools were conducted during the year, including a three-day accident control course for professional and field staff officers, a series of shorter schools for divisional personnel and several schools for hardwood and softwood fellers. Nominated personnel attended specialist safety courses on shot-firing, welding, fork-lift driving, abrasives and lectures on road safety, heart attacks, back injuries and legal aspects in accident prevention.

The Conservator of Forests delivered a paper at the "Safety '79" seminar as part of the WAY '79 anniversary celebrations and was invited as a guest speaker on safety subjects at several other functions during the year.

The Safety Officer attended the second annual meeting of State Government Safety Officers in Hobart.

A pine harvesting overseer from the Wanneroo division attended a three-week supervisors' school conducted by the Logging Industry Training Team at Mount Gambier, South Australia.

The Department participated in a safety exhibition, "Industrial Safety Goes to Town", with the presentation of a visual display exhibit. On 17 October 1979, the Department was the runner up for the C.M.L. Trophy for industrial safety in Western Australia.

Several safety films were shown to timber industry personnel at Manjimup in January 1980. The table below sets out in more detail the Department's safety record over the last 14 years.

Year	M.H.W.	L.T.A.	M.T.A.	Total Accidents	Frequency Rate			Man Days Lost	Duration Rate
					L.T.A.	M.T.A.	L.T.A.+ M.T.A.		
1966-67	....	185	....	....	100+	....	100+	2 896	....
1967-68	1 895 600	124	312	436	65	164	230	1 701	14
1968-69	2 019 568	96	155	251	48	76	124	1 738	18
1969-70	1 901 020	70	129	199	37	67	104	721	10
1970-71	1 808 406	48	158	206	27	76	110	458	9
1971-72	1 759 888	40	128	168	23	72	95	275	6
1972-73	1 728 577	45	112	157	26	64	90	414	9
1973-74	1 651 621	45	119	164	27	72	99	359	8
1974-75	1 748 219	55	127	182	31	72	104	634	11
1975-76	1 762 693	31	113	144	17.5	64	82	383	12
1976-77	1 707 635	32	157	189	19	92	111	620	19
1977-78	1 764 519	26	151	177	15	86	100	731	28
1978-79	1 835 917	44	143	187	24	76	100	810	18
1979-80	1 826 452	32	125	157	17.5	68	86	938*	14

M.H.W.—Man Hours Worked. L.T.A.—Lost Time Accidents. M.T.A.—Medical Treatment Accidents.

* Of the 938 days lost, 483 were carried over from accidents sustained during the previous year.

APPENDIX 1A

Statement of Revenue Paid into Consolidated Revenue Fund for the year ended 30 June 1980

1978-79		1979/80
S	<i>Royalties</i>	S
5 387 161	Logs	5 870 795
398 397	Chip Logs	324 956
16 475	Sleepers	35 897
248 638	Poles and Piles	356 197
14 407	Mining Timber .....	.....
11 196	Firewood	33 660
41 566	Posts	50 880
31 693	Sandalwood	44 134
61 927	Miscellaneous	56 795
<hr/>		<hr/>
6 211 460		6 773 314
	<i>Pine Conversion</i>	
2 052 120	Pine Logs	2 698 173
328 098	Sawn Pine	388 057
<hr/>		<hr/>
2 380 218		3 086 230
	<i>Hardwood Conversion</i>	
162 521	Sawn Hardwood	206 773
251 622	Logs	273 928
3 456	Posts and Other	5 854
<hr/>		<hr/>
417 599		486 555
	<i>Other Sales and Fees</i>	
161 452	Seeds and Trees	196 271
89 782	Inspection Fees	80 684
58 588	Rents and Leases	68 204
982 209	Miscellaneous	1 122 120
<hr/>		<hr/>
1 292 031		1 467 279
	<i>Recoupable Projects</i>	
238 131	Miscellaneous	394 543
<hr/>		<hr/>
238 131		394 543
<hr/>		<hr/>
10 539 439		12 207 921
140 702	<i>Less</i> Transfer of Departmental Revenue in part repayment of Treasurers Advance against cost of Pine Log Salvage Operations associated with Cyclone Alby .....	.....
<hr/>		<hr/>
10 398 737		12 207 921

APPENDIX 1B

Forestry Fund Account for year ended 30 June 1980

1978-79		Expenditure		1979-80	
\$	\$			\$	\$
1 350 660		Hardwood Forests—Establishment and Tending	....		1 215 971
2 755 136		Softwood Forests—Establishment and Tending	....		3 382 454
373 141		Access Roads Construction	....		339 811
5 608		Land Purchases	....		58 982
231 308		Plant and Equipment	....		273 425
316 927		Housing and Buildings	....		411 925
....		Sawmilling and Seasoning Plant	....		94 085
1 880 625		Forest Protection	....		2 025 637
533 245		Access Roads Maintenance	....		482 523
1 413 498		Research and Other Services	....		1 596 408
2 278 531		Commercial Operations	....		2 850 984
140 507		Trade Operations	....		185 933
273 171		Recoupable Projects	....		479 434
	6 008 507	Salaries	....	7 002 629	
4 708 507	1 300 000	Less Charged to Development	....	1 255 000	5 747 629
	3 522 286	Administration Expenses	....	3 943 825	
2 900 286	622 000	Less Charged to Development	....	700 000	3 243 825
		Cash Order Balance	....		5 940
78 967					
19 240 117					22 394 966
		<i>Source of Revenue</i>			
392 404		Balance Brought Forward	....		274 844
313 876		Commonwealth Aid Road Grants	....		309 424
828 000		Commonwealth Softwood Agreement	....		909 596
196 205		Mining Compensation	....		641 528
14 128 370		C.R.F. Contribution	....		16 612 373
2 603 000		General Loan Fund	....		2 870 000
1 000 000		Conservator's Borrowings	....		1 200 000
53 106		Sundry Revenue	....		63 923
19 514 961					22 881 688
274 844		Less Balance Carried Forward	....		486 722
19 240 117					22 394 966

APPENDIX 2A

Exports of Timber, Tanning Substances and Essential Oils from Western Australia for the Year ended 30 June 1979

	Item and Destination	Quantity	Value		Item and Destination	Quantity	Value
1	Wood, in the rough or roughly squared— Conifer—	m ³	\$	7	Flooring—	m ³	\$
	Interstate (a)	N.R.S.	N.R.S.		Interstate (b)—		
	Overseas				New South Wales	2 066	320 222
					Victoria	813	177 946
					South Australia	537	104 622
					Northern Territory	79	25 023
					Total	3 495	627 813
2	Wood, in the rough or roughly squared, non-conifer (including poles, piling, posts and other wood in the rough)—				Overseas (c)—		
	Interstate (a)				Singapore, Republic of	1	500
	Victoria	620	51 616		Total	1	500
	South Australia	16	661	8	Other (d)—		
	Total	636	52 277		Interstate—		
	Overseas				Victoria	10	4 149
					South Australia	4	2 096
					Northern Territory	53	15 517
					Total	67	21 762
3	Sleepers—				Overseas—		
	Interstate—				Greece	515	129 417
	South Australia	1 527	261 482		United Kingdom	85	22 085
	Total	1 527	261 482		U.S.A.		89
	Overseas—				Total	600	151 591
	Belgium-Luxembourg	7 102	1 016 502		Total Timber Items 1-8	66 420	10 560 052
	Kenya	990	158 190	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—	m ²	
	South Africa, Rep. of	130	19 906		Interstate	N.R.S.	N.R.S.
	United Kingdom	22 801	3 943 138		Overseas—		
	Total	31 023	5 137 736		Hong Kong	820	3 662
	Timber sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-conifer.				Singapore, Rep. of	106 430	504 441
4	Jarrah—				Total	107 250	508 103
	Interstate—			10	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	New South Wales	21	3 418		Interstate	N.R.S.	N.R.S.
	Victoria	1 588	262 395		Overseas	(e)	(e)
	South Australia	5 992	808 388	11	Casks, vats, barrels, etc., Empty—	N.R.S.	N.R.S.
	Northern Territory	73	11 118		Interstate		
	Total	7 674	1 085 319		Overseas—		
	Overseas—				United Kingdom		9 950
	Christmas Island	3	1 627		Total		9 950
	Greece	4	799	12	Manufactures of wood (except furniture), N.E.S. (f)—		
	Mauritius	37	6 872		Interstate—		
	New Zealand	34	10 676		New South Wales		4 296 011
	South Africa, Rep. of	100	19 379		Victoria		2 107 539
	United Arab Emirates	23	5 184		Queensland		266 880
	United Kingdom	299	59 754		South Australia		647 156
	U.S.A.	163	46 234		Tasmania		38 298
	Total	663	150 525		Northern Territory		143 597
					Total		7 499 481
5	Karri—				Overseas—		
	Interstate—				Kuwait		1 120
	New South Wales	4 909	675 519		New Zealand		7 326
	Victoria	172	26 571		Saudi Arabia		20
	South Australia	10 785	1 439 316		Singapore, Republic of		59
	Northern Territory	1 770	263 267		South Africa, Rep. of		35 000
	Total	17 636	2 404 673		Total		43 525
	Overseas—			13	Tanning substances of natural origin—	N.R.S.	N.R.S.
	Belgium-Luxembourg	208	35 933	14	Essential oils; concretes and absolutes; resinoids—		
	Germany, Fed. Rep. of	55	9 647		Interstate (g)—		
	Greece	20	3 638		Victoria		61 439
	Italy	45	6 597		Northern Territory		86
	New Zealand	509	100 691		Total		61 525
	South Africa, Rep. of	442	72 944		Overseas—		
	United Kingdom	423	84 204				
	U.S.A.	1 396	352 720		Total value of exports on this return		18 682 636
	Total	3 098	666 374				
6	Other—						
	Interstate						
	Overseas						
	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—						

(a) Interstate exports of conifer wood in the rough or roughly squared included in Item 2.

(b) Relates to interstate exports of non-conifer flooring only.

(c) Relates to overseas exports of conifer flooring only.

(d) See footnotes (b) and (c).

(e) Details are not available for publication.

(f) Includes cork manufactures.

(g) Includes details of perfume and flavour materials.

N.E.S. Denotes "Not Elsewhere Specified".

N.R.S. Denotes "Not Recorded Separately".

Basis of Value—F.O.B. at point of final shipment.

(Information supplied by the Australian Bureau of Statistics)

APPENDIX 2B

Imports of Timber, Timber Products, Tanning Substances and Essential Oils to Western Australia for the Year ended 30 June 1979

Item and Origin		Quantity	Value	Item and Origin		Quantity	Value
1	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer, (including poles, piling, posts and other wood in the rough)— Interstate Overseas (a)	m ³ N.R.S.	\$ N.R.S.	13	Wooden beading and mouldings (including moulded skirting and other moulded boards)— Interstate (c) Overseas— Canada China—Taiwan Prov. only Germany, Fed. Rep. of Italy Japan Malaysia New Zealand United Kingdom	m ³ N.R.S.	\$ N.R.S. 8 829 11 789 79 953 5 698 24 761 1 258 35 665
2	Railway Sleepers— Interstate Overseas— Singapore, Rep. of	N.R.S. 7 019	N.R.S. 1 539 436		Total .....	.....	89 032
	Total	7 019	1 539 436		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—		
3	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Conifer (b)— Douglas Fir— Interstate Overseas— U.S.A.	N.R.S. 1 067	N.R.S. 292 425	14	Flooring— Interstate Overseas (d)	N.R.S.	N.R.S.
	Total	1 067	292 425	15	Other— Interstate Overseas— Canada Ecuador Germany, Fed. Rep. of Malaysia Singapore, Rep. of U.S.A.	N.R.S. 8 2 2 2 094 112 392	N.R.S. 7 968 3 641 3 074 464 261 18 370 67 476
4	Other— Interstate Overseas	N.R.S. 118	N.R.S. 53 903		Total	2 610	564 790
	Total	118	53 903		Total Timber Items 2-15 (e)		5 492 010
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-Conifer (b)—			16	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— Interstate (f)— New South Wales Victoria Queensland South Australia		
5	Meranti— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. 2 334 761	N.R.S. 296 378 97 535		Total		1 212 341
	Total	3 095	393 913		Overseas— Austria Canada China—Taiwan Prov. only Germany, Fed. Rep. of Italy Malaysia New Zealand Singapore, Rep. of South Africa, Rep. of Thailand United Kingdom	2 891 20 6 620 911 21 491 148 841 24 105 305 444 996 28 416 3 914	3 312 503 33 527 2 894 21 751 52 295 287 84 292 297 756 50 072 3 323
6	Ramin— Interstate Overseas— Indonesia Malaysia Singapore, Rep. of	N.R.S. 134 163 272	N.R.S. 21 032 36 201 59 487		Total	763 429	550 012
	Total	569	116 720	17	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)— Interstate (g)		
7	Teak— Interstate Overseas— Burma, Soc. Rep. of the Union of Malaysia Singapore, Rep. of	N.R.S. 93 42 52	N.R.S. 68 651 4 339 50 501		Total	1 598 518	4 276 242
	Total	187	123 491		Overseas— Canada United Kingdom .....	..... 15	51 12 347
8	Kapur— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. 3 850 105	N.R.S. 497 445 11 718		Total	15	12 398
	Total	3 955	509 163		Total Timber Items 16-17		6 050 993
9	Keruing— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. 3 585 35	N.R.S. 385 776 2 943		Total Timber Items 2-17 (e)		11 543 003
	Total	3 620	388 719	18	Match Splints— Interstate (c) Overseas	N.R.S.	N.R.S.
10	Nyatoh— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. 5 938 331	N.R.S. 874 004 47 817	19	Rulers, Wooden— Interstate (c) Overseas— Japan United Kingdom	Number N.R.S. 50 985	\$ N.R.S. 21 2 685
	Total	6 269	921 821		Total	1 035	2 706
11	Other— Interstate Overseas— Malaysia Philippines	N.R.S. 564 681	N.R.S. 60 572 116 975				
	Total	1 245	177 547				
12	Shooks and staves, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm— Interstate Overseas	N.R.S.	N.R.S.				

APPENDIX 2B—continued

Imports of Timber, Timber Products, Tanning Substances and Essential Oils to Western Australia for the Year ended 30 June 1979

	Item and Origin	Quantity No.	Value \$		Item and Origin	Quantity No.	Value \$
20	Table Mats, Wooden (c)	N.R.S.	N.R.S.		Overseas—		
21	Wood Flour— Interstate (c) Overseas	N.R.S.	N.R.S.		Brazil		1 901
22	Clothes Pegs, Wooden (c)	N.R.S.	N.R.S.		China-Excl. Taiwan Prov.		11 756
23	Tool handles, Wooden Interstate (h)— New South Wales Victoria Queensland Total Overseas— Netherlands United Kingdom U.S.A. Total		35 188 8 961 124 269 168 418		Taiwan Prov. only		571 948
24	Doors not incorporating locks, hinges or similar fittings— Interstate (i)— New South Wales Victoria South Australia Total Overseas— China—Taiwan Prov. only Indonesia Singapore, Rep. of Total		985 238 137 787 630 035 1 753 060		Czechoslovakia		14 948
25	Manufactures of wood (except furniture) N.E.S. (j)— Interstate— New South Wales Victoria Queensland South Australia Total Overseas— Brazil Canada China-Excl. Taiwan Prov. Taiwan Prov. only Denmark France Germany, Fed. Rep. of Hong Kong India Indonesia Italy Japan Korea, Rep. of Malaysia New Zealand Philippines Singapore, Rep. of South Africa, Rep. of Spain Sweden Thailand United Kingdom U.S.A. Yugoslavia Total		588 436 462 402 186 704 141 121 1 378 663		Denmark		1 424
			1 313 38 890 2 398 65 503 54 277 72 5 646 662 834 261 2 387 10 015 59 14 921 27 266 20 123 13 419 40 1 621 1 682 12 628 38 727 17 813 134 330 691		Germany, Fed. Rep. of		8 733
					Hong Kong		33 383
					India		11 072
					Indonesia		2 144
					Italy		375 709
					Japan		46 937
					Korea, Rep. of		10 164
					Macao		4 661
					Malaysia		10 201
					Mexico		5
					New Zealand		48 309
					Norway		740
					Pakistan		649
					Philippines		33 629
					Singapore, Rep. of		313 264
					South Africa, Rep. of		1 221
					Spain		1 581
					Switzerland		6 371
					Thailand		4 889
					United Kingdom		446 484
					U.S.A.		185 106
					Yugoslavia		5 266
					Total		2 152 495
					Overseas—		
					China—Taiwan Prov. only	19 820	141 057
					Indonesia	2	148
					Singapore, Rep. of	5 305	29 908
					Total	25 127	171 113
					Other—		
					Interstate (l)		
					Overseas—		
					Italy	33 600	22 100
					South Africa, Rep. of	461 000	207 794
					United Kingdom	5 480	8 491
					Total	500 080	238 385
					27 Tanning Extracts of Vegetable Origin		
					Wattle Bark extract—		
					Interstate (l)	kg	N.R.S.
					Overseas—		
					South Africa, Rep. of	11 000	4 614
					Total	11 000	4 614
					28 Other—		
					Interstate (l)		
					Overseas—		
					Italy	33 600	22 100
					South Africa, Rep. of	461 000	207 794
					United Kingdom	5 480	8 491
					Total	500 080	238 385
					29 Synthetic Tanning Substances, Artificial Bases for Pre-Tanning; Tannings (Tannic Acids) and their Salts, Esters and Other Derivatives—		
					Interstate (m)—		
					New South Wales		166 938
					Victoria		108 362
					South Australia		19 719
					Total		295 019
					Overseas—		
					Belgium-Luxembourg	4 000	24 272
					Germany, Fed. Rep. of	9 020	5 788
					New Zealand	39 160	19 607
					Sweden	100	755
					United Kingdom	12 025	26 188
					Total	64 305	76 610
					30 Essential Oils; concretes and absolutes; resins—		
					Interstate—		
					Overseas—		
					Singapore, Rep. of	10	48
					Total	10	48
					Total value of imports on this return		18 815 184

- (a) Excludes overseas imports of veneer logs in the rough. Details are not available for publication.
- (b) Overseas imports exclude shooks and staves, see Item 12.
- (c) Details included in Item 25.
- (d) Relates to overseas imports of conifer flooring only.
- (e) Includes an interstate value of \$321 050 covering Items 1–12, 14 and 15.
- (f) Relates to interstate imports of plywood only.
- (g) Includes interstate details of "improved" wood. State details are not available for publication.
- (h) Includes brush and broom handles and the like.
- (i) Interstate imports include doors with locks, hinges, etc.
- (j) See footnote (c).
- (k) Excludes imports, if any, of wooden medical, dental, surgical or veterinary furniture, non-domestic chairs and furniture parts.
- (l) Details included in Item 29
- (m) Includes details of Items 27 and 28

N.E.S. denotes "not elsewhere specified".
N.R.S. denotes "not recorded separately".
Basis of value: Overseas—F.O.B. at the point of final shipment.

Interstate: landed cost in Western Australia.
(Information supplied by the Australian Bureau of Statistics.)

APPENDIX 3

SUMMARY OF EXPORTS OF FOREST PRODUCE—SINCE 1968

Year	Timber		Wood Manufacture Value	Essential Oils and Tanning Material*
	m ³	value		
Brought forward	13 081 830	\$ 177 786 912	\$ 8 536 935	\$ 17 368 964
1968	84 569	4 947 595	3 016 850	280 806
1969	86 455	4 984 098	3 802 927	267 565
1970	96 275	5 661 547	3 906 699	317 553
1971	79 362	4 803 842	2 110 802	343 512
1972	101 191	6 439 732	2 369 541	348 762
1973	111 547	7 036 637	2 604 116	377 736
1974	98 200	7 366 709	3 769 461	433 627
1975	100 127	9 080 092	132 278	479 019
1976	94 136	9 823 037	993 199	214 918
1977	77 352	10 150 025	205 173	45 767
1978	58 833	8 809 324	4 625 089	41 422
1979	66 420	10 560 052	8 122 584	61 525
1980†				

* Tanning materials not recorded separately since 1967.

† Not Available.

APPENDIX 4

SUMMARY OF IMPORTS OF FOREST PRODUCE—SINCE 1968

Year	Timber Woodware	Tanning Materials	Essential Oils
Brought Forward	\$ 63 937 163	\$ 1 344 397	\$ 4 600 226
1968	8 135 532	75 657	143 696
1969	8 731 114	109 905	206 309
1970	10 968 170	153 169	293 845
1971	6 761 806	103 857	175 331
1972	5 578 819	144 219	227 530
1973	8 326 939	225 463	366 786
1974	11 738 861	420 010	271 713
1975	14 053 751	465 884	641 859
1976	19 960 421	373 331	131 515
1977	24 857 792	603 819	39 143
1978	24 039 952	912 669	620
1979	18 200 508	614 628	48
1980†			

† Not available.

APPENDIX 5

SUMMARY OF LOG PRODUCTION—SINCE 1968

Year	Crown Land m ³	Private Property m ³	Total m ³
Brought Forward	44 466 501	15 455 468	78 705 715*
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
1974	1 084 463	91 884	1 176 347
1975	1 096 356	87 957	1 184 313
1976	1 194 667	111 761	1 306 428
1977	1 429 493	106 848	1 536 341
1978	1 445 465	119 706	1 565 171
1979	1 489 515	129 665	1 619 180
1980	1 582 018	165 076	1 747 094

* Includes 18 783 746 m³ estimated cut prior to 1917.

Note—as in previous years this total includes log material used for reconstituted wood and chipwood.

APPENDIX 6

FORESTS DEPARTMENT RESEARCH PUBLICATIONS PRODUCED DURING THE YEAR ENDED 30 JUNE 1980

Departmental Research Papers

- | | | | |
|--|------|------|--|
| 55—C. J. Schuster | .... | .... | An initial Study of Provenance Variation in Karri (<i>Eucalyptus diversicolor</i> F. Muell.) |
| 56—D. H. Perry | .... | .... | Protection of Timber in Contact with the Ground from the Termite <i>Mastotermes darwiniensis</i> in the Pilbara Region of Western Australia. |
| 57—G. S. McCutcheon | .... | .... | Field Classification of Vegetation Types as an Aid to Soil Survey. |
| 58—I. C. Richmond | .... | .... | Streamflow and Water Quality Following Pine Establishment in the Donnybrook Sunkland. |
| 59—A. R. Annels | .... | .... | Artificial Seeding of Karri (<i>Eucalyptus diversicolor</i> F. Muell.). |
| 60—N. D. Burrows | .... | .... | Quantifying <i>Pinus radiata</i> Slash Fuels. |
| 61—C. J. Schuster and R. R. A. Fremlin | .... | .... | Herbicides for Use in Western Australian Forest Nurseries. |
| 62—N. D. Burrows | .... | .... | Crushing the Thinning Slash Problem. |

Departmental Bulletins

- | | | | |
|--------------------|------|------|--|
| 90—O. W. Loneragan | | | Karri (<i>Eucalyptus diversicolor</i> F. Muell.) Phenological Studies in Relation to Reforestation. |
|--------------------|------|------|--|

External Publications

- | | | | |
|-----------------------------------|------|------|--|
| Bartle, J. R. and Shea, S. R. | .... | .... | Development of the Ecosystem after mining. Proceedings 1979 Environmental Workshop, Bunbury, September 1979. Australian Mining Industry Council. |
| Batini, F. E. | .... | .... | Managing Forested Catchments. Proceedings, Hydrology and Water Resources Symposium, Perth 1979. Institution of Engineers, Australia. |
| Batini, F. E. | .... | .... | State Forests of Western Australia: Multiple-Use and Agroforestry concepts. Social Sciences Forum Vol. 6 No. 1 June 1980. |
| Boughton, T. J. and Malajczuk, N. | .... | .... | Mechanisms of action of C6A 48988 Fungicide on <i>Phytophthora cinnamomi</i> . Fourth National Plant Pathology Conference, Perth, May 1980. Abstracts of Papers Australian Plant Pathology Society. |
| Butcher, T. B. | .... | .... | Management of <i>Pinus pinaster</i> plantations on the Swan coastal plain for timber and water yield. Australian Water Resources Council Technical Paper 42. 1979. |
| Butcher, T. B. | .... | .... | Growing sawlogs on the Gnangara Mound. Proceedings Hydrology and Water Resources Symposium, Perth, 1979. Institution of Engineers, Australia. |
| Havel, J. J. | .... | .... | Vegetation, natural factors and human activity. Ch. 5 in <i>Western Landscapes</i> . J. Gentilli, Editor, University of Western Australia Press, 1979. |
| Heddle, E. M. | .... | .... | Monitoring the effects of groundwater extraction on the native vegetation of the Northern Swan Coastal Plain, Western Australia. Proceedings, Hydrology and Water Resources Symposium, Perth, 1979. Institution of Engineers, Australia. |

- Heddle, E. M. Mapping the vegetation of the Perth Region. Ch. 6 in *Western Landscapes*.
J. Gentilli, *Editor*, University of Western Australia Press, 1979.
- Kimber, P. C. and Schuster, C. J. Fire and the Regeneration of Karri (*Eucalyptus diversicolor* F. Muell.)
Proceedings Symposium Biology of Native Australian Plants, Perth, August, 1979.
J. S. Pate, *Editor*. University of Western Australia Press (in press).
- Shea, S. R. *Phytophthora cinnamomi* (Rands)—A collar rot pathogen of *Banksia grandis* Willd.
Australasian Plant Pathology Vol. 8 No. 3, September 1979.
- Schild, D. E., Shea, S. R. and Shearer, B. L. Distribution of *Phytophthora cinnamomi* Rands in *Banksia grandis* Willd. in the jarrah forest in Western Australia.
Fourth National Plant Pathology Conference, Perth, 1980.
Abstracts of papers. Australian Plant Pathology Society.
- Shea, S. R. and Dell, B. The susceptibility of the surface root system of *Eucalyptus marginata* to *Phytophthora cinnamomi*.
Fourth National Plant Pathology Conference, Perth, 1980.
Abstracts of Papers. Australian Plant Pathology Society.
- Shea, S. R., Leppard, W. and Kitt, R. J. The Effect of *Acacia pulchella* root amendments on pathogenicity and survival of *Phytophthora cinnamomi*.
Fourth National Plant Pathology Conference, Perth, 1980.
Abstracts of Papers. Australian Plant Pathology Society.
- Shea, S. R. and Shearer, B. L. Variation in the Development of *Phytophthora cinnamomi* in soil with no canopy cover and under *Acacia pulchella* and *Banksia grandis*.
Fourth National Plant Pathology Conference, Perth, 1980.
Abstracts of Papers. Australian Plant Pathology Society.
- Shea, S. R., Shearer, B. L. and Titze, J. Seasonal development of *Phytophthora cinnamomi* Rands in the *Eucalyptus marginata* forest in relation to site and environment.
Fourth National Plant Pathology Conference, Perth, 1980.
Abstracts of Papers. Australian Plant Pathology Society.